# Local Road Safety Plan <br> <br> Marion County 

 <br> <br> Marion County}

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Kansas TraŋSystems (1) Kimey)Horn

## DRAFT PLAN

FOR

# Marion County Local Road Safety Plan 

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## Acknowledgements

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## Executive Summary

The Kansas Department of Transportation (KDOT), as part of their strategic goal to reduce fatalities and serious injuries within Kansas is conducting Phase 1 of the Local Road Safety Plan (LRSP) process for twenty counties within the state. Four counties were included in the Pilot Phase of this process, which was completed in 2018. The LRSP concept is built on the foundation established by the Strategic Highway Safety Plan (SHSP). Figure E1 shows the location of the Phase 1 LRSP counties and the Pilot Phase counties.


Figure E1 - Location of LRSP Counties

## E.1. What is a Local Road Safety Plan (LRSP)?

As defined by the Federal Highway Administration (FHWA), a LRSP provides a framework for identifying, analyzing, and prioritizing roadway safety improvements on local roads. The LRSP development process and content are tailored to local issues and needs. The process results in a prioritized list of issues, risks, actions, and improvements that can be used to reduce fatalities and serious injuries on the local road network. LRSPs are one of the FHWA's Proven Safety Countermeasures based on its proven effectiveness and benefits in reducing serious injuries and fatalities on local roadways throughout the country.

A LRSP is a resource to assist local public authorities as they select and prioritize projects that will have the biggest impact on safety based on the crash types and high-risk roadway characteristics in their jurisdiction. Because of the random nature of crashes - in particular on lower-volume local roads - these plans place an emphasis on low-cost systemic improvements; that is, the approach is proactive rather than a reactive approach based on "hot spots" where crashes are occurring. A LRSP identifies several proactive measures, based on a comprehensive systemic review, that are targeted at enhancing the overall safety for roadway users.

## E.2. Marion County's LRSP Routes

The LRSP study routes within Marion County generally included all major collectors and all paved roads under the county's jurisdiction except subdivisions with speed limits lower than 35 mph . A total of 301 miles of roadway segments ( $60 \%$ paved, $40 \%$ unpaved), 304 intersections and 56 curves were analyzed as part of the Marion County LRSP. Interstate, US and Kansas Highway routes were not included as these are not maintained by the county.

## E.3. LRSP Project Overview

This LRSP includes the following general tasks:

- Data collection - Analyze existing crash data and roadway data that can be used to identify systemic risk factors for the County's LRSP routes.
- Risk factor determination - Determine systemic risk factors associated with existing fatal or serious injury crashes that will be used in a systemic safety analysis.
- Countermeasure selection - Develop potential safety countermeasures to address the approved risk factors.
- Safety workshop - Engage County stakeholders on the LRSP process and gather feedback on potential safety countermeasures.
- Development of safety projects - Determine prioritized safety projects for the County's LRSP routes based on a systemic risk factor analysis of all LRSP segments, intersections, and curves.
- Final report - Document the LRSP process and findings in a final report.


## E.4. Marion County's Recommended Improvements

The ten recommended safety improvement project locations identified as part of this LRSP, along with an opinion of their probable cost are shown in Table E1. The segment, intersection, and curve project sheets for Marion County are provided in Appendix M of this plan.

Table E1 - Marion County LRSP Project Locations and Opinion of Probable Cost

| ID | Project Location Description | Opinion of Probable Cost |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Short Term Improvements | Longer Term Improvements | Additional Potential Improvements | Estimated Project Total * |
| $\begin{gathered} \text { Segments } \\ 51,52 \end{gathered}$ | 60th Street between Limestone Road and S Locust Street (Peabody Southwest City Limit) | \$39,635 | \$176,443 | \$90,000 | \$526,000 |
| $\begin{aligned} & \text { Segments } \\ & 83,85,89 \end{aligned}$ | Nighthawk Road between 140th Street and US-50 | \$110,794 | \$1,623,272 | \$180,000 | \$3,135,000 |
| Segment 100 | Remington Road between 290th Street and 240th Street | \$57,759 | \$379,110 | \$195,000 | \$1,085,000 |
| Segments $103,105$ | Sunflower Road between 140th Street and US-50 | \$87,538 | \$1,271,155 | \$315,000 | \$2,754,000 |
| Segments 25, 26, 32 | 290th Street between K15 and Nighthawk Road | \$88,850 | \$1,397,474 | \$180,000 | \$2,741,000 |
| Segments 12, 16 | 190th Street between Nighthawk Road and Remington Road (K-256) | \$69,695 | \$961,685 | \$90,000 | \$1,876,000 |
| $\begin{aligned} & \text { Segments } \\ & 49,50,53 \end{aligned}$ | 60th Street between S Maple Street (Peabody Southeast City Limit) and Timber Road | \$94,588 | \$450,323 | \$165,000 | \$1,218,000 |
| Segments 1, 2 | 120th Street between K15 and Indigo Road | \$126,995 | \$1,623,543 | \$165,000 | \$3,137,000 |
| Intersection 147 | Nighthawk and 190th | \$24,300 | \$0 | \$40,000 | \$111,000 |
| $\begin{gathered} \hline \text { Curves } 22, \\ 30 \end{gathered}$ | Indigo Road near 130th Road | \$10,924 | \$101,880 | \$100,000 | \$366,000 |
|  | Total | \$711,078 | \$7,984,885 | \$1,520,000 | \$16,949,000 |

* Includes estimates for mobilization, traffic control, contingency, design engineering, and construction inspection as identified on project sheet.

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## Table of Contents

1. INTRODUCTION ..... 1
1.1. What is a LRSP? ..... 1
1.2. Background and Purpose of the LRSP .....  1
1.3. Marion County's LRSP Routes. ..... 2
1.4. LRSP Project Overview .....
1.5. Document Organization ..... 2
2. Data Collection ..... 4
2.1. Crash Analysis ..... 4
2.2. Crash Data for Marion County LRSP Routes ..... 4
2.2.1. Crash Location Heat Map ..... 5
2.2.2. Crash Frequencies ..... 5
2.3. Roadway Data ..... 6
2.3.1. KDOT Maps ..... 6
2.3.2. County Data ..... 6
2.3.3. Aerial Photography ..... 7
2.3.4. Field Inspections ..... 7
3. Risk Factors ..... 8
3.1. Systemic Safety Risk Factors ..... 8
3.2. Approved Risk Factors ..... 9
4. COUNTERMEASURE SELECTION. ..... 10
4.1. County Workshop ..... 10
4.1.1. Five E's of Safety ..... 10
4.1.2. Attendee Input and Feedback ..... 10
4.2. Approved Countermeasures ..... 11
5. Safety Project Development ..... 12
5.1. Methodology ..... 12
5.1.1. GIS Database ..... 12
5.1.2. Risk Factor Ranking ..... 12
5.1.3. Countermeasure Project Selection Thresholds ..... 13
5.1.4. Project Sheets ..... 14
5.2. Segments ..... 15
5.2.1. Segment Risk Factor Ranking Criteria. ..... 15
5.2.2. Segment Project Location Recommendations ..... 16
5.2.3. Prioritized Segment Recommendations ..... 17
5.3. Intersections ..... 18
5.3.1. Intersection Risk Factor Ranking Criteria ..... 18
5.3.2. Intersection Project Location Recommendations ..... 19
5.3.3. Prioritized Intersection Recommendations ..... 19
5.4. Curves ..... 20
5.4.1. Curve Risk Factor Ranking Criteria ..... 20
5.4.2. Curve Project Location Recommendations ..... 21
5.4.3. Prioritized Curve Recommendations ..... 21
6. SUMMARY ..... 22
6.1. Recommended Improvements ..... 22
6.2. Next Steps ..... 22
LIST OF ApPENDICES
Appendix A LRSP Study Routes
Appendix B Crash Analysis Technical Memorandum
Appendix C Crash Location Heat Map and Crash Frequencies
Appendix D Data Maps
Appendix E Edge Condition and Roadside Assessment Ratings
Appendix F Countermeasures Technical Memorandum
Appendix G LRSP Safety Workshop Meeting Minutes (without exhibits)
Appendix H Safety Resources
Appendix I Risk Factor Ranking and Countermeasure Selection Technical Memorandum
Appendix J LRSP Segment Risk Factor Scores
Appendix K LRSP Intersection Risk Factor Scores
Appendix L LRSP Curve Risk Factor Scores
Appendix M LRSP Project Locations and Project Sheets
List of Figures
Figure 1 - Location of LRSP Counties ..... 1
Figure 2 - Marion County LRSP Route Crashes by Roadway Type ..... 5

## List of Tables

Table 1 - Marion County LRSP Route Crashes by Roadway Type ..... 4
Table 2 - Segment Risk Factor Ranking Criteria ..... 15
Table 3 - Opinion of Probable Cost for Segment Project Locations ..... 17
Table 4 - Intersection Risk Factor Ranking Criteria ..... 18
Table 5 - Opinion of Probable Cost for Intersection Project Locations ..... 19
Table 6 - Curve Risk Factor Ranking Criteria ..... 20
Table 7 - Opinion of Probable Cost for Curve Project Locations ..... 21
Table 8 - Opinion of Probable Cost for Marion County LRSP Project Locations ..... 23

## List of Acronyms

| A | Serious Injury Crash |
| :--- | :--- |
| AASHTO | American Association of State Highway and Transportation Officials |
| ADT | Average Daily Traffic |
| BLP | Bureau of Local Projects |
| CMF | Crash Modification Factor |
| DASC | Kansas Data Access and Support Center |
| FHWA | Federal Highway Administration |
| GIS | Geographic Information System |
| HRRR | High Risk Rural Roads |
| HSM | Highway Safety Manual |
| K | Fatal Crash |
| KDOT | Kansas Department of Transportation |
| LRSP | Local Road Safety Plan |
| mph | Miles per Hour |
| MUTCD | Manual on Uniform Traffic Control Devices |
| NG911 | Next Generation 911 |
| SHSP | Strategic Highway Safety Plan |
| TEAP | Traffic Engineering Assistance Program |

## 1. Introduction

The Kansas Department of Transportation (KDOT), as part of their strategic goal to reduce fatalities and serious injuries within Kansas is conducting Phase 1 of the Local Road Safety Plan (LRSP) process for twenty counties within the state. Four counties were included in the Pilot Phase of this process, which was completed in 2018. The LRSP concept is built on the foundation established by the Strategic Highway Safety Plan (SHSP). Figure 1 shows the location of the Phase 1 LRSP counties and the Pilot Phase counties.


Figure 1 - Location of LRSP Counties

### 1.1. What is a LRSP?

As defined by the Federal Highway Administration (FHWA), a LRSP provides a framework for identifying, analyzing, and prioritizing roadway safety improvements on local roads. The LRSP development process and content are tailored to local issues and needs. The process results in a prioritized list of issues, risks, actions, and improvements that can be used to reduce fatalities and serious injuries on the local road network. LRSPs are one of the FHWA's Proven Safety Countermeasures based on its proven effectiveness and benefits in reducing serious injuries and fatalities on local roadways throughout the country.

### 1.2. Background and Purpose of the LRSP

Traffic on local roads in Kansas accounts for approximately $43 \%$ of the total vehicle miles traveled, and according to the Kansas SHSP 2017, crash data between 2010 and 2014 shows that $46 \%$ of fatalities and $54 \%$ of disabling injuries occurred on roads owned by local public authorities. Since the overall goal of the Kansas SHSP is to halve fatalities and serious injuries over the 20-year period ending in 2029, locally owned roads must be included as a significant part of the plan. With
limited funds, a county needs a plan to make an effective impact on reducing the fatalities and serious injuries on their roadways.

An LRSP is a resource to assist local public authorities as they select and prioritize projects that will have the biggest impact on safety based on the crash types and high-risk roadway characteristics in their jurisdiction. Because of the random nature of crashes-in particular on lower-volume local roads-these plans place an emphasis on low-cost systemic improvements; that is, the approach is proactive rather than reactive. An LRSP identifies several proactive measures, based on a comprehensive systemic review, that are targeted at enhancing the overall safety for roadway users.

The final LRSP provides a prioritized list of safety improvement projects with a preliminary opinion of probable cost. The prioritization is based on the systemic review process and risk factors determined as part of the LRSP process. Each project sheet includes low-cost, short-term safety recommendations, as well as longer term improvements, and is a resource for the county to use in applying for safety funds through the KDOT Bureau of Local Projects' (BLP) High Risk Rural Roads (HRRR) Program.

### 1.3. Marion County's LRSP Routes

The LRSP study routes within Marion County generally included all major collectors and all paved roads under the county's jurisdiction except subdivisions with speed limits lower than 35 mph . The location of the LRSP study routes within Marion County are identified on the map included in Appendix A. A total of 301 miles of roadway segments ( $60 \%$ paved, $40 \%$ unpaved), 304 intersections and 56 curves were analyzed as part of the Marion County LRSP. For the purposes of the analysis, a curve was defined using the following parameters: radius less than 2,500 feet and a length greater than 100 feet. Interstate, US and Kansas Highway routes were not included as these are not maintained by the county.

### 1.4. LRSP Project Overview

This LRSP includes the following general tasks:

- Data collection
- Crash analysis
- Roadway data analysis
- Risk factor determination
- Countermeasure selection
- County input and a safety workshop
- Development of safety projects
- Final report


### 1.5. Document Organization

This LRSP is organized into the following sections:

- Section 1 presents an introduction to the LRSP, along with the background and purpose.
- Section 2 summarizes the LRSP data collection and crash analysis.
- Section 3 introduces risk factors and identifies the approved risk factors for the project.

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- Section 4 provides a list of potential safety countermeasures to address the approved risk factors for the project.
- Section 5 describes the process for selecting safety projects from the Marion County LRSP segments, intersections, and curves. It also includes the prioritized list of safety improvement projects.
- Section 6 summarizes the recommended improvements and potential next steps.
- Appendices


## 2. Data Collection

### 2.1. Crash Analysis

As part of the LRSP, a comprehensive analysis was conducted to assess whether findings from the LRSP Pilot Phase crash analysis could be applied to the LRSP Phase 1 project. A particular emphasis was a comparison of where crashes are occurring (for example, at an uncontrolled intersection versus a curved segment of road) and the crash circumstances. Details of the analysis conducted for this project are documented in the Crash Analysis Technical Memorandum included in Appendix B.

### 2.2. Crash Data for Marion County LRSP Routes

This section provides a summary of the crash data for the Marion County LRSP routes using records from the KDOT crash database for the project (2013-2017 data). Table 1 contains a tabular summary of the Marion County LRSP route crashes by roadway type and Figure 2 contains a graphical summary of these data. It is important to note that this information is exclusively for the LRSP study routes within the county rather than all county roads. For Marion County, slightly over half of the LRSP study routes are paved roads.

Table 1 - Marion County LRSP Route Crashes by Roadway Type

|  | Roadway Type | Total Crashes |  | Fatal and Serious Injury (K \& A) Crashes |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Count | Percent | Count | Percent |
| County <br> Paved | Intersection | 3 | 1\% | 1 | 7\% |
|  | Non-Intersection (on curve) | 13 | 4\% | 2 | 13\% |
|  | Non-Intersection (off curve) | 302 | 86\% | 11 | 73\% |
|  | Other/Unknown | 0 | 0\% | 0 | 0\% |
|  | Subtotal | 318 | 91\% | 14 | 93\% |
| County Unpaved | Intersection | 0 | 0\% | 0 | 0\% |
|  | Non-Intersection (on curve) | 1 | 0\% | 0 | 0\% |
|  | Non-Intersection (off curve) | 31 | 9\% | 1 | 7\% |
|  | Other/Unknown | 0 | 0\% | 0 | 0\% |
|  | Subtotal | 32 | 9\% | 1 | 7\% |
|  | Total | 350 |  | 15 |  |

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County Paved<br>318 Total, $14 \mathrm{~K} \& \mathrm{~A}$<br>(91\%Total, $93 \%$ K \& A)

County Unpaved<br>32 Total, $1 \mathrm{~K} \& \mathrm{~A}$<br>(9\%Total, $7 \%$ K \& A)


(K - Fatal Crash; A - Serious Injury Crash)
Figure 2 - Marion County LRSP Route Crashes by Roadway Type
The above findings indicate that from 2013 to 2017, there were a total of 350 crashes on the Marion County LRSP routes, including 15 fatal or serious injury crashes. Similar to the findings from the crash analysis, roadway segment crashes (non-intersection, off-curve crashes) accounted for the majority of the total crashes (95\%) for paved and unpaved roads combined, as well as $80 \%$ of the fatal or serious injury crashes. Total crashes were much less frequent at intersections or on curves and accounted for the remaining $20 \%$ of the overall fatal or serious injury crashes along the Marion County LRSP routes.

### 2.2.1. Crash Location Heat Map

Although LRSPs use a proactive approach to identifying safety improvement locations rather than a reactive approach based on "hot spots" where crashes are occurring, the crash records for the 2013 to 2017 period were used to prepare a graphical representation of the total crashes along the Marion County LRSP routes in the form of a heat map. The heat map was prepared for the County's use and is included in Appendix C. Brighter colors on the map indicate locations with a higher number of crashes.

### 2.2.2. Crash Frequencies

In addition to the heat map, a list of high crash locations for the LRSP study routes was prepared for the County's use. High crash locations were determined based on a comparison between the
actual crash frequency (crashes per year) and the predicted average crash frequency using procedures outlined in the Highway Safety Manual (HSM). Tables of the Actual vs HSM Predicted Crash Frequencies for all the Marion County LRSP segments, intersections, and curves are included in Appendix C. It should be noted that crash frequencies were only included for locations that experienced a crash in the 5-year analysis period (2013-2017).

### 2.3. Roadway Data

A comprehensive Geographic Information Systems (GIS) database that includes pertinent roadway data that can be used to identify systemic risk factor rankings for the LRSP study routes was not available for use on the project. As a result, data was obtained by the project team through a variety of sources, including existing KDOT maps, county GIS data, and maps of various existing features, readily-available aerial photography (Google, Bing, etc.), and field inspections. A GIS database was created to store the attribute data collected for the LRSP segments, intersections, and curves.

### 2.3.1. KDOT Maps

KDOT District, County, and City traffic count maps were used as the primary source to obtain Average Daily Traffic (ADT) volumes on the LRSP study routes. If applicable, an additional source for obtaining ADTs was previous Traffic Engineering Assistance Program (TEAP) studies conducted at various locations throughout the county. Where ADT data was unavailable, estimates were used based on county input or neighboring segment ADTs.

### 2.3.2. County Data

### 2.3.2.1. GIS Data

The Kansas Data Access and Support Center (DASC) provided GIS mapping of the county's current roadway centerline files and 911 address points as of May 2019. The roadway centerline files were used primarily to define segment names and length. Segments along the LRSP study routes were also identified based on attributes that generally remained similar along the segments, such as pavement or shoulder widths. Segments were also defined if there were major alignment changes in the route (i.e., a change from north/south alignment to east/west), or if the segment intersected a state highway or another LRSP route, particularly where traffic volume and characteristics changed.

The 911 address points file was developed according to the state specifications for Next Generation 911 (NG911), and in all but a few exceptions, address points were identified on the buildings and not at the driveway entrances.

### 2.3.2.2. County Maps

Maps were provided to the counties for their use in identifying the location of various existing conditions and safety features along the LRSP study routes. Maps for the following items were provided for county input, and if returned, are included in Appendix $\mathbf{D}$ (no map is included if data was unavailable or not provided):

- Intersection lighting
- Overhead/Stop Sign Flashing beacons
- Centerline rumble strips
- Edgeline and/or shoulder rumble strips
- Transverse rumble strips
- Pavement width and type (material)

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- Shoulder width and type (material)
- Edgeline pavement markings
- Centerline pavement markings
- Curve warning signs
- Curve superelevation


### 2.3.3. Aerial Photography

Readily-available aerial photography sources (Google, Bing, etc.) were used to identify various data along the LRSP study routes, including the following data elements:

- Pavement width, where county data was unavailable
- Access points (driveways and intersections)
- Intersection skew angle
- Curve length and radius


### 2.3.4. Field Inspections

Field inspections of each LRSP study route were conducted by driving each roadway in the spring of 2019 and collecting pertinent field data that can be used to determine the presence of an approved risk factor. Geospatial video data was also recorded as part of this effort. Primary data elements collected as part of the field inspections or video review included:

- Edge condition rating
- Roadside assessment rating
- Shoulder width and type (material), where county data was unavailable
- Speed limit
- Intersection control
- Intersection sight distance
- Supplemental confirmation of other data elements provided by the county (e.g., lighting, curve signs, curve superelevation, etc.)

Data collection for some of the above items was more general in nature. For example, database entries for the presence of curve warning signs and curve superelevation were a simple "yes/no" or "present/not present". An assessment of the existing curve superelevation or the appropriate Manual on Uniform Traffic Control Devices (MUTCD) curve signage could be a recommendation for a high-ranking curve, but these aspects were not reviewed in detail as part of this systemic review. For other items (e.g., intersection sight distance, edge condition and roadside assessment), general subjective ratings were identified based on our field inspections or on review of the video data. For example, ratings of "adequate" or "limited" were used for intersection sight distance based on the video review. For edge condition and roadside assessment, ratings of "good", "average", or "poor" were also identified during the field work. Some photos which illustrate examples of the general subjective ratings, along with maps which show a graphical representation of the edge condition and roadside assessment ratings for the Marion County LRSP routes are included in Appendix E.

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## 3. Risk Factors

### 3.1. Systemic Safety Risk Factors

The purpose of the LRSP project is to identify locations where systemic safety improvements can be implemented on county roads. The systemic approach focuses on risk and takes a broader view and looks at risk across an entire roadway system, rather than applying improvements to locations where crashes have previously occurred.

When developing systemic safety improvements, it is important to note risk factors associated with the crash types. The FHWA, as part of their Systemic Safety Project Selection Tool, has developed a list of potential risk factors that can be utilized to identify locations for systemic safety improvements. While all of the risk factors outlined below were not utilized for the LRSP project due to data availability and crash types to be addressed, they have been included below for reference.
"The systemic approach to safety involves widely
implemented improvements based on high-risk roadway features correlated with specific severe crash types. The
approach provides a more comprehensive method for safety planning and
implementation that
supplements and complements
traditional site analysis. It helps agencies broaden their traffic safety efforts and consider risk as well as crash history when identifying where to make low cost safety improvements."
FHWA - Office of Traffic Safety

- Presence of lighting
- Presence of on-street parking
- Intersection skew angle
- Intersection traffic control device
- Number of signal heads vs. number of lanes
- Presence of backplates
- Presence of advanced warning signs
- Intersection located in or near horizontal curve
- Presence of left-turn or right-turn lanes
- Left-turn phasing
- Allowance of right-turn-on-red
- Overhead versus pedestalmounted signal heads
- Pedestrian crosswalk presence, crossing distance, signal head type
- Traffic Volume:
- Average daily traffic volumes
- Average daily entering vehicles
- Other Features:
- Posted speed limit or operating speed
- Presence of nearby railroad crossing
- Presence of automated enforcement
- Proportion of commercial vehicles in traffic stream
- Adjacent land use type (e.g., schools, commercial, or alcoholsales establishments)
- Location and presence of bus stops


### 3.2. Approved Risk Factors

Based on the Crash Analysis Technical Memorandum for the project included in Appendix B, risk factors approved by KDOT in the LRSP Pilot Phase were reviewed and considered appropriate for use on the LRSP Phase 1 project. Each of the approved risk factors was used to analyze potential risk for the Marion County LRSP segments, intersections and curves.

## 4. Countermeasure Selection

As part of the LRSP, potential safety countermeasures were developed for the project based on the approved risk factors. Details of the safety countermeasures for this project are documented in the Countermeasures Technical Memorandum which is included in Appendix F. A workshop was held with each of the Phase 1 LRSP counties to discuss the LRSP project and these countermeasures based on the crash characteristics within the region.

### 4.1. County Workshop

The Marion County LRSP Safety Workshop was held on the morning of Wednesday, August 14, 2019. The minutes of the meeting are included in Appendix G. Invitees included a wide range of stakeholders from the "5E's" of highway safety.

### 4.1.1. Five E's of Safety

The first four "E's" refer to the Engineering, law Enforcement, Education, and Emergency response communities, while the fifth "E" refers to "everyone" and can include any stakeholders with a passion for roadway safety, such as elected officials, paratransit service providers, insurance providers, parents, or other civic groups.

This type of multidisciplinary approach is essential to enhancing overall safety of the roadway system. Studies have shown that over $90 \%$ of crashes are a result of driver factors, with the most common errors including recognition (41\%), decision (33\%) and performance (11\%). All disciplines can play a role in developing strategies to both prevent crashes as well as lessen the severity of crashes. A number of these were discussed during the workshop, including:

- Engineering measures: LRSP development, system enhancements, and "hot spot" analyses
- Enforcement measures: traffic-related enforcement, targeted enforcement using datadriven approaches to crime and traffic safety - identifying areas that have high incidences of crime and crashes to deploy law enforcement more effectively.
- Education measures: public education and outreach programs
- Emergency response measures: "golden hour" - the first hour after the occurrence of a traumatic injury, considered the most critical for successful emergency treatment

A list of Kansas and nationally available safety resources was provided to the workshop attendees and is included in Appendix H.

### 4.1.2. Attendee Input and Feedback

Participants at the workshop were encouraged to provide feedback and input throughout the meeting. Specific group feedback times were provided to discuss locations of concern along the county's LRSP routes, along with the potential safety countermeasures that were presented. For the latter, photos and descriptions of many of the potential safety countermeasures were provided to the attendees as part of the workshop discussion (see Appendix G).

### 4.1.2.1. Locations of Concern

Participant input on specific locations of concern is documented as part of the meeting minutes in Appendix G, but included the following locations on the Marion County LRSP routes:

- Nighthawk and 190th intersection
- 90th at Chisholm Trail
- Diamond at 370th
- 90th and Falcon intersection
- Kanza Road between 240th and 270th
- 1st/360th and D Streets near Quail Creek Road (in Ramona)
- Pawnee and 210th intersection
- Sunflower and 180th intersection
- Old Mill Road between 50th and 60th
- 290th between Mustang Road and Nighthawk


### 4.1.2.2. Potential Safety Countermeasures

Participant input on the potential safety countermeasures is documented as part of the meeting minutes in Appendix G, but treatments that were considered favorable or effective included:

- Clearing and grubbing along roadways, particularly any foliage/brush within the right of way
- Removing/relocating fixed objects, or delineating these with retroreflective markers
- Aggregate shoulder treatments where mild shoulder is available
- Paved shoulders with safety edge treatment, where applicable
- Use of 6-inch edge lines rather than 4-inch
- Intersection lighting
- Transverse rumble strips on paved, stop-controlled approaches
- The use of flags, beacons, LEDs or even strobe lights on signs
- Dynamic speed feedback signs in areas that typically experience higher vehicle speeds
- Warning sign upgrades and delineators for curves


### 4.2. Approved Countermeasures

The approved segment, intersection, and curve countermeasures for this project, along with the corresponding Crash Modification Factors (CMFs) and estimated costs are included in the Countermeasures Technical Memorandum in Appendix F. It should be noted that the estimated costs were generally determined using estimated quantities with typical project unit costs applied. More representative cost information was requested from each county, and if provided, was applied in the development of the final improvement project estimates.

## 5. Safety Project Development

### 5.1. Methodology

Using the GIS database that was created from the attribute data described in Section 2 of this plan, each of the LRSP segments, intersections, and curves within the county were analyzed and assigned rankings based on the KDOT approved risk factors. The rankings of the LRSP segments, intersections, and curves were provided to the county, along with recommended safety improvement project locations. Based on the county's feedback, the recommended safety improvement project locations were finalized, the risk factors for each location were compared to the countermeasure project selection thresholds, and draft project sheets were developed. After review of the draft project sheets, final project sheets were developed which incorporated comments and additional improvements from the county. The subsections that follow further describe the major steps of the methodology.

### 5.1.1. GIS Database

Data obtained in coordination with KDOT and the county were incorporated into a GIS database along with roadway data collected by the project team. Data associated with each roadway segment, intersection, and horizontal curve was used in the analysis of risk along the LRSP routes throughout the county. The database elements are described in Section 2 of this plan.

### 5.1.2. Risk Factor Ranking

Segments, intersections, and curves were analyzed throughout the county for risk factors identified in Section 3 of this plan. Risk factors were determined to identify locations that have a higher likelihood of crashes involving serious injuries and/or fatalities. For every segment, intersection, and curve along the LRSP routes, risk factors were evaluated, and each location was ranked based on these risk factors. Risk factor scoring criteria was determined during the Pilot Phase of the LRSP project and reviewed as part of the Phase 1 project. The review is documented in the Risk Factor Ranking and Countermeasure Selection Technical Memorandum which is included in Appendix I. The revised scoring criteria, which includes LRSP Phase 1 modifications, are identified in further detail in later subsections of Section 5 . Some items of note:

- The proposed risk factor scoring reflects a maximum possible score of 24 points for any segment, intersection, or curve. This was completed to address the potential for score comparison across the three categories, even though separate rankings have been prepared for segments, intersections, and curves.
- Volume is considered a significant risk factor since the probability of a crash is higher as volume (exposure) increases. The scoring has been weighted accordingly and criteria were established separately for each county based on the data that were collected as part of this project. (i.e., only volumes on Marion County Roads were compared to Marion County Roads as opposed to comparing volumes to other counties.)
- Thresholds identified for scoring of pavement and shoulder width have been determined from the data collected and are consistent for all counties.
- Scoring thresholds for several risk factors (e.g., edge condition and roadside assessment) were established separately for each county based on the data that were collected as part of this project.
- Crash experience is included in the scoring for all segments, intersections, and curves. However, this does not carry an overly significant weight since the intent is a systemic process rather than overvaluing "hot spot" locations.
- Access density scores were eliminated for intersections with ADT less than or equal to 400 vehicles per day (based on the American Association of State Highway and Transportation Officials' (AASHTO) guidelines for a very low-volume local road) and for segments where the posted speed limit is less than or equal to 30 miles per hour.
- Given the characteristics of unpaved roads, some of the segment and curve risk factor scores were eliminated since these were either not applicable (e.g., the presence of pavement markings) or poorly defined (e.g., shoulder width).

Specific risk factor scores determined for all of Marion County's LRSP segments, intersections, and curves are included in Appendix J, Appendix K, and Appendix L. Based on a review of the scores, the crash frequency lists, and locations of concern expressed during the Safety Workshops, the project team coordinated with KDOT and the counties to develop a list of recommended safety improvement project locations (10 total) for the LRSP study routes.

### 5.1.3. Countermeasure Project Selection Thresholds

Countermeasure project selection thresholds for roadway segments, intersections, and curves were developed during the Pilot Phase of the LRSP project and reviewed as part of the Phase 1 project. The review is documented in the Risk Factor Ranking and Countermeasure Selection Technical Memorandum in Appendix I. Revised threshold tables developed as part of the review are included in the Technical Memorandum and allow uniform recommendations to be provided across the counties. Establishing thresholds allows for a unique set of recommendations to meet the specific safety needs of each location. Some items of note in the development of the thresholds are summarized below:

- Clearing and grubbing is recommended for all projects. For specific roadway segment project locations, the associated cost is based review of the site videos.
- One of the initial proposed countermeasures included use of a 45-degree aggregate edge wedge along segments. The description of this countermeasure was revised since this is intended to be more of a short-term or spot treatment of edge ruts/drop-offs, rather than something applied to a long length of road.
- A general threshold of an ADT greater than 400 vehicles per day was applied for several project types based on AASHTO's guidelines for a very low-volume local road.
- Edgeline or centerline rumble strip installation is recommended to include a feasibility review, primarily in consideration of the existing pavement types and/or width.
- New pavement treatments for segments or curves is recommended to include an appropriate amount of full depth reconstruction to accommodate the treatment, whether this is just partial reconstruction (e.g., shoulder paving to accommodate use of a safety edge) or full depth reconstruction to completely repave a roadway.
- Flattening and widening foreslopes is a long-term countermeasure that typically includes the extension of existing drainage pipes/culverts. The general intent of this is to complete as much shoulder and foreslope improvements as possible within the available right-of-way. Where applicable, the extension of existing drainage pipes/culverts was added as a site-specific countermeasure for segments where there may be a delay in funding for the ultimate long-term improvements.
- The use of retroreflective strips on stop signs and curve signage (chevrons) are low-cost effective treatments that is included for all projects.
- Installation of an additional "Stop" sign and "Stop Ahead" sign for an intersection approach includes these additional signs on the left side of the approach. The threshold identified for this countermeasure (minor road ADT greater than 400) was set to include this treatment on higher volume minor approaches and avoid overuse.
- Vertical grade modifications for intersections with a sight distance concern were not included as part of the project selection thresholds but can be added as a site-specific countermeasure for selected intersections based on county input.
- Curve countermeasure thresholds are consistent whether evaluated as part of a curve or a segment project.


### 5.1.4. Project Sheets

Unique project sheets were developed for each of the recommended safety improvement project locations ( 10 total). The draft project sheets were reviewed by KDOT and the counties, and final project sheets were developed which incorporated the comments received as well as any additional improvements requested by the county. The final project locations and project sheets for Marion County are provided in Appendix M of this plan. Each project sheet includes the project location, project type, proposed improvements, and an opinion of probable cost. The project selection thresholds were applied to each location to assist in identifying which countermeasures should be applied to the location based on the attributes. Other things to note on the project sheets, include the following:

- Where multiple segments (or curves) are identified on a project sheet, the risk factor scoring information is for the highest ranked segment (or curve).
- The table on the back page of the project sheets is where additional site-specific improvements can be identified, such as culvert extensions, vertical grade adjustments, or in the case of some curves, total reconstruction.
- For projects along an LRSP segment (or group of segments) that also contain one or more LRSP curves, the project sheets include improvements for the curves. Some LRSP intersection improvements (e.g., transverse rumble strips on paved stop-controlled side roads) may be included on the corresponding segment project sheets. Where applicable, these additional project benefits are generally identified on the back side of the project sheet.
- When a curve reconstruction project impacts an adjacent intersection, costs were included on the back of the project sheet for tying in the affected intersection legs.
- The project sheets are designed to provide the county with information needed when applying for HRRR funding through KDOT. For example, a crash history table has been added to the project sheet to assist the county in preparing their HRRR funding application.
- The estimated project cost summary on the back page of the project sheets includes line items for general items (e.g., mobilization, traffic control, design engineering, and construction inspection), as determined during the Pilot Phase of the LRSP project, along with a contingency factor. It should be noted that the overall project cost summary reflects the total of the recommended safety improvements, rather than a smaller subset that the county might select for HRRR funding.

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### 5.2. Segments

The following sections summarize the risk factor ranking criteria, project locations, and recommendations for the segments analyzed along the LRSP study routes.

### 5.2.1. Segment Risk Factor Ranking Criteria

Risk factor ranking criteria for the LRSP segments, including their associated point values, are illustrated in Table 2. Specific scores for all of Marion County's LRSP segments, along with the point breakdown for each risk factor, and a graphical representation of the scores are included in Appendix J.

Table 2 - Segment Risk Factor Ranking Criteria

| Risk Factor | Measurement | Points | Max Points Available |
| :---: | :---: | :---: | :---: |
| Volume | Average roadway segment volume per county (ADT) | 0: ADT within 0\%-14.3\% percentile range | 6 |
|  |  | 1: ADT within 14.3\%-28.6\% percentile range |  |
|  |  | 2: ADT within $28.6 \%-42.9 \%$ percentile range |  |
|  |  | 3: ADT within 42.9\%-57.1\% percentile range |  |
|  |  | 4: ADT within $57.1 \%-71.4 \%$ percentile range |  |
|  |  | 5: ADT within $71.4 \%-85.7 \%$ percentile range |  |
|  |  | 6: ADT within $85.7 \%-100 \%$ percentile range |  |
| Access density | Density of intersections and driveways per mile | 0: Bottom third of the access density Crash Modification Factor (CMF)* | 2 |
|  |  | 1: Middle third of the access density CMF* |  |
|  |  | 2: Top third of the access density CMF* |  |
| Edge condition | Observed condition rating | 0 : Rating of 2.75-3 | 3 |
|  |  | 1: Top third of remaining ratings |  |
|  |  | 2: Middle third of remaining ratings |  |
|  |  | 3: Bottom third of remaining ratings |  |
| Roadside assessment | Observed condition rating | 0 : Rating of 2.75-3 | 3 |
|  |  | 1: Top third of remaining ratings |  |
|  |  | 2: Middle third of remaining ratings |  |
|  |  | 3: Bottom third of remaining ratings |  |
| Roadway width | Width in feet | 0: Roadway width greater than or equal to 22 feet | 2 |
|  |  | 2: Roadway width less than 22 feet |  |
| Shoulder width | Width in feet of recoverable area prior to a ditch or fill slope | 0: 4-foot shoulder and greater, or unpaved road | 2 |
|  |  | 1: 2-foot shoulder to 4-foot shoulder |  |
|  |  | 2: less than 2-foot shoulder |  |

Table 2 - Segment Risk Factor Ranking Criteria (Continued)

| Risk Factor | Measurement | Points | Max Points Available |
| :---: | :---: | :---: | :---: |
| Lane departure crash rate | Lane departure crashes per MVMT | 0: Bottom fourth of roadway departure crash rates along the roadway segments | 3 |
|  |  | 1: Second lowest fourth of roadway departure crash rates along the roadway segments |  |
|  |  | 2: Second highest fourth of roadway departure crash rates along the roadway segments |  |
|  |  | 3: Top fourth of roadway departure crash rates along the roadway segments |  |
| Presence of pavement markings | Observed presence of markings | 0 : Both centerline and edgeline present, or unpaved road | 2 |
|  |  | 1: Centerline or edgeline present |  |
|  |  | 2: Neither centerline or edgeline present |  |
| Surface type | Paved or unpaved | 0: Paved | 1 |
|  |  | 1: Unpaved |  |

* Access Density CMF Equation as presented in the Highway Safety Manual (Equation 13-7).


### 5.2.2. Segment Project Location Recommendations

Based on a review of the risk factor scores for all of Marion County's LRSP segments, as shown in Appendix J, the project team coordinated with KDOT and the county to develop a list of recommended safety improvement project locations (up to a maximum of 10) for their LRSP. In addition to the risk factor scoring, input from the Safety Workshops and findings from the crash frequency listings were also considered as part of the project location selection. The following segments were identified for improvements:

- Segments 51 \& 52: 60th Street between Limestone Road and S Locust Street (Peabody Southwest City Limit)
- Segments 83, 85, \& 89: Nighthawk Road between 140th Street and US-50
- Segment 100: Remington Road between 290th Street and 240th Street
- Segments 103 \& 105: Sunflower Road between 140th Street and US-50
- Segments 25, 26, \& 32: 290th Street between K-15 and Nighthawk Road
- Segments 12 \& 16: 190th Street between Nighthawk Road and Remington Road (K-256)
- Segments 49, 50, \& 53: 60th Street between S Maple Street (Peabody Southeast City Limit) and Timber Road
- Segments 1 \& 2: $120^{\text {th }}$ Street between K-15 and Indigo Road


### 5.2.3. Prioritized Segment Recommendations

The final segment project sheets for Marion County are provided in Appendix M of this plan. Costs identified on the project sheets for the recommended improvements are shown in Table 3.

Table 3 - Opinion of Probable Cost for Segment Project Locations

| ID | Segment Description | Opinion of Probable Cost |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Short Term Improvements | Longer Term Improvements | Additional Potential Improvements | Estimated Project Total * |
| $\begin{aligned} & 51, \\ & 52 \end{aligned}$ | 60th Street between Limestone Road and S Locust Street (Peabody Southwest City Limit) | \$39,635 | \$176,443 | \$90,000 | \$526,000 |
| $\begin{aligned} & 83, \\ & 85, \\ & 89 \end{aligned}$ | Nighthawk Road between 140th Street and US-50 | \$110,794 | \$1,623,272 | \$180,000 | \$3,135,000 |
| 100 | Remington Road between 290th Street and 240th Street | \$57,759 | \$379,110 | \$195,000 | \$1,085,000 |
| $\begin{aligned} & 103, \\ & 105 \end{aligned}$ | Sunflower Road between 140th Street and US-50 | \$87,538 | \$1,271,155 | \$315,000 | \$2,754,000 |
| $\begin{aligned} & 25, \\ & 26, \\ & 32 \end{aligned}$ | 290th Street between K-15 and Nighthawk Road | \$88,850 | \$1,397,474 | \$180,000 | \$2,741,000 |
| $\begin{aligned} & 12, \\ & 16 \end{aligned}$ | 190th Street between Nighthawk Road and Remington Road (K-256) | \$69,695 | \$961,685 | \$90,000 | \$1,876,000 |
| $\begin{aligned} & 49, \\ & 50, \\ & 53 \end{aligned}$ | 60th Street between S Maple Street (Peabody Southeast City Limit) and Timber Road | \$94,588 | \$450,323 | \$165,000 | \$1,218,000 |
| 1, 2 | 120th Street between K-15 and Indigo Road | \$126,995 | \$1,623,543 | \$165,000 | \$3,137,000 |
|  | Total | \$675,854 | \$7,883,005 | \$1,380,000 | \$16,472,000 |

* Includes estimates for mobilization, traffic control, contingency, design engineering, and construction inspection as identified on project sheet.

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### 5.3. Intersections

The following sections describe the intersection risk factor ranking criteria, locations for improvements, and recommended improvements.

### 5.3.1. Intersection Risk Factor Ranking Criteria

Risk factor ranking criteria for the LRSP intersections, including their associated point values, are shown in Table 4. Specific scores for all of Marion County's LRSP intersections, along with the point breakdown for each risk factor, are included in Appendix K.

Table 4 - Intersection Risk Factor Ranking Criteria

| Risk Factor | Measurement | Points | Max Points Available |
| :---: | :---: | :---: | :---: |
| Volume | Average Daily Traffic (ADT) on all approaches per intersection with a paved approach per county | 0: ADT percentile is 0\%-14.3\% | 6 |
|  |  | 1: ADT percentile is $14.3 \%-28.6 \%$ |  |
|  |  | 2: ADT percentile is $28.6 \%-42.9 \%$ |  |
|  |  | 3: ADT percentile is $42.9 \%-57.1 \%$ |  |
|  |  | 4: ADT percentile is $57.1 \%-71.4 \%$ |  |
|  |  | 5: ADT percentile is $71.4 \%-85.7 \%$ |  |
|  |  | 6: ADT percentile is $85.7 \%-100 \%$ |  |
| Access density | Number of driveways or intersections within 500 feet of the intersection | 0 : None (or ADT less than 400) | 2 |
|  |  | 1:1 or 2 Access Points |  |
|  |  | 2: More than 2 Access Points |  |
| Sight distance | Based on field observations | 0: Adequate | 3 |
|  |  | 3: Limited |  |
| Horizontal curvature | Intersection on a curve | 0: No | 3 |
|  |  | 3: Yes |  |
| Crash experience | Fatal or serious injury crashes | 0 : None | 3 |
|  |  | 3: 1 or more |  |
| Distance from previous stop sign | Based on field data collection | 0: 1.5 miles or less | 3 |
|  |  | 2: 1.5 miles to less than 5 miles |  |
|  |  | 3: 5 miles or more |  |
| Skewed approach | Degrees | 0: 75 degree to 90 -degree intersection approaches | 3 |
|  |  | 3: 75 degree or less intersection approach |  |
| Intersection control | Observed control type | 0: Yield/None | 1 |
|  |  | 1: Stop |  |

### 5.3.2. Intersection Project Location Recommendations

Based on a review of the risk factor scores for all of Marion County's LRSP intersections, as shown in Appendix K, the project team coordinated with KDOT and the county to develop a list of recommended safety improvement project locations (up to a maximum of 10) for their LRSP. In addition to the risk factor scoring, input from the Safety Workshops and findings from the crash frequency listings were also considered as part of the project location selection. Based on the analysis, the following intersection was selected:

- Intersection 147: Nighthawk and 190 ${ }^{\text {th }}$


### 5.3.3. Prioritized Intersection Recommendations

The final intersection project sheets for Marion County are provided in Appendix M of this plan. Costs identified on the project sheets for the recommended improvements are shown in Table 5.

Table 5-Opinion of Probable Cost for Intersection Project Locations

| ID | Intersection <br> Description | Opinion of Probable Cost <br> Short Term <br> Improvements | Longer Term <br> Improvements | Additional <br> Potential <br> Improvements | Estimated <br> Project Total * |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\$ 24,300$ | $\$ 0$ | $\$ 40,000$ | $\$ 111,000$ |
|  |  | $\$ 24,300$ | $\$ 0$ | $\$ 40,000$ | $\$ 111,000$ |

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### 5.4. Curves

The following sections contain the risk factor ranking criteria, locations, and recommendations for curve improvements.

### 5.4.1. Curve Risk Factor Ranking Criteria

Risk factor ranking criteria for the LRSP curves, including their associated point values, are shown in Table 6. Specific scores for all of Marion County's LRSP curves, along with the point breakdown for each risk factor, are included in Appendix L.

Table 6 - Curve Risk Factor Ranking Criteria

| Risk Factor | Measurement | Points | Max Points Available |
| :---: | :---: | :---: | :---: |
| Volume | Average curve volume per county | 0: ADT within 0\%-14.3\% percentile | 6 |
|  |  | 1: ADT within 14.3\%-28.6\% percentile |  |
|  |  | 2: ADT within $28.6 \%-42.9 \%$ percentile |  |
|  |  | 3: ADT within 42.9\%-57.1\% percentile |  |
|  |  | 4: ADT within $57.1 \%-71.4 \%$ percentile |  |
|  |  | 5: ADT within $71.4 \%-85.7 \%$ percentile |  |
|  |  | 6: ADT within $85.7 \%-100 \%$ percentile |  |
| Curve radius | Radius of curve in feet per county | 0 : Top fourth of curve radii | 3 |
|  |  | 1: Second highest fourth of curve radii |  |
|  |  | 2: Second lowest fourth of curve radii |  |
|  |  | 3: Bottom fourth of curve radii |  |
| Access density | Intersections or driveways within 500 feet of the curve | 0 : None | 2 |
|  |  | 1:1 or 2 Access Points |  |
|  |  | 2: More than 2 Access Points |  |
| Shoulder width | Width in feet of recoverable area prior to a ditch or fill slope | 0 : 4-foot shoulder and greater, or unpaved road | 2 |
|  |  | 1: 2-foot shoulder to 4-foot shoulder |  |
|  |  | 2: less than 2-foot shoulder |  |
| Edge condition | Observed condition rating | 0 : Rating of 3 | 2 |
|  |  | 1: Rating of 2 |  |
|  |  | 2: Rating of 1 |  |
| Roadside assessment | Observed condition rating | 0 : Rating of 3 | 2 |
|  |  | 1: Rating of 2 |  |
|  |  | 2: Rating of 1 |  |
| Superelevation | Presence of superelevation | 0 : Yes | 2 |
|  |  | 2: No |  |
| Crash experience | Fatal or serious injury crashes | 0 : None | 3 |
|  |  | 3: 1 or more |  |
| Presence of warning signs | Observed presence | 0: Present | 2 |
|  |  | 2: Not present |  |

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### 5.4.2. Curve Project Location Recommendations

Based on a review of the risk factor scores for all of Marion County's LRSP curves, as shown in Appendix L, the project team coordinated with KDOT and the county to develop a list of recommended safety improvement project locations (up to a maximum of 10) for their LRSP. In addition to the risk factor scoring, input from the Safety Workshops and findings from the crash frequency listings were also considered as part of the project location selection. Based on the analysis, the following curves were identified for improvements:

- Curves 22 \& 30: Indigo Road near $130^{\text {th }}$ Road


### 5.4.3. Prioritized Curve Recommendations

The final curve project sheets for Marion County are provided in Appendix M of this plan. Costs identified on the project sheets for the recommended improvements are included in Table 7.

Table 7 - Opinion of Probable Cost for Curve Project Locations

| ID | Curve <br> Description | Short Term <br> Improvements | Longer Term <br> Improvements | Additional <br> Improvements | Estimated <br> Project Total * |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\$ 10,924$ | $\$ 101,880$ | $\$ 100,000$ | $\$ 366,000$ |
| Total |  | $\$ 101,880$ | $\$ 100,000$ | $\$ 366,000$ |  |

* Includes estimates for mobilization, traffic control, contingency, design engineering, and construction inspection as identified on project sheet.


## 6. Summary

### 6.1. Recommended Improvements

The ten recommended safety improvement project locations identified as part of this LRSP, along with an opinion of their probable cost are shown in Table 8.

### 6.2. Next Steps

The process established as part of the Phase 1 LRSP project for KDOT has resulted in the identification of several recommended safety improvement projects throughout Marion County based on a systemic review of their LRSP study routes. Unique project sheets have been developed for each of these projects and have been designed to provide the county with the information needed to apply for HRRR funding through KDOT. An important and logical next step for the county would be to utilize these resources to implement safety improvements on their roadway network. Simply by completing this LRSP, the county is in a highly advantageous position to obtain some of these competitive safety funds.

Going forward, the project team recommends that the county consider designating a safety champion to lead the effort in implementing the results of this LRSP. This person could also lead, develop, or participate in a local safety coalition that takes part in the planning, implementing, evaluating, and updating of this LRSP. Stakeholders from all of the five "E's" should be included, starting with representatives who participated in this process by attending the Marion County Safety Workshop. As noted previously, this type of multidisciplinary approach is essential to enhancing overall safety of the roadway system.

Finally, an LRSP is intended to be a "living" document. As such, it would be appropriate to review, or update the plan on a regular basis (e.g., every 5 years or so) by reevaluating crash trends, changes to roadway characteristics. This review will aid in reprioritizing safety improvements for segments, intersections, and curves based on current local needs and priorities.

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Table 8 - Opinion of Probable Cost for Marion County LRSP Project Locations

| ID | Project Location Description | Opinion of Probable Cost |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Short Term Improvements | Longer Term Improvements | Additional Potential Improvements | Estimated Project Total * |
| $\begin{gathered} \text { Segments } \\ 51,52 \end{gathered}$ | 60th Street between Limestone Road and S Locust Street (Peabody Southwest City Limit) | \$39,635 | \$176,443 | \$90,000 | \$526,000 |
| $\begin{aligned} & \text { Segments } \\ & 83,85,89 \end{aligned}$ | Nighthawk Road between 140th Street and US-50 | \$110,794 | \$1,623,272 | \$180,000 | \$3,135,000 |
| Segment 100 | Remington Road between 290th Street and 240th Street | \$57,759 | \$379,110 | \$195,000 | \$1,085,000 |
| $\begin{gathered} \text { Segments } \\ 103,105 \end{gathered}$ | Sunflower Road between 140th Street and US-50 | \$87,538 | \$1,271,155 | \$315,000 | \$2,754,000 |
| Segments $25,26,32$ | 290th Street between K15 and Nighthawk Road | \$88,850 | \$1,397,474 | \$180,000 | \$2,741,000 |
| Segments 12, 16 | 190th Street between Nighthawk Road and Remington Road (K-256) | \$69,695 | \$961,685 | \$90,000 | \$1,876,000 |
| Segments 49, 50, 53 | 60th Street between S Maple Street (Peabody Southeast City Limit) and Timber Road | \$94,588 | \$450,323 | \$165,000 | \$1,218,000 |
| Segments 1, 2 | 120th Street between K15 and Indigo Road | \$126,995 | \$1,623,543 | \$165,000 | \$3,137,000 |
| Intersection 147 | Nighthawk and 190th | \$24,300 | \$0 | \$40,000 | \$111,000 |
| $\begin{gathered} \text { Curves 22, } \\ 30 \end{gathered}$ | Indigo Road near 130th Road | \$10,924 | \$101,880 | \$100,000 | \$366,000 |
|  | Total | \$711,078 | \$7,984,885 | \$1,520,000 | \$16,949,000 |

* Includes estimates for mobilization, traffic control, contingency, design engineering, and construction inspection as identified on project sheet.

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## APPENDIX A LRSP Study Routes




## Legend

Interstate/US/K Route (Not Part of Study)<br>LRSP Segment<br>LRSP Curve

Length of Segments: 301 miles
Paved: 180 miles (60\%)
Unpaved: 121 miles (40\%) Number of Curves: 56
Number of Intersections: 304

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## APPENDIX B <br> Crash Analysis Technical Memorandum

# KDOT Local Road Safety Plans <br> (LRSPs) - Phase 1 <br> KDOT PROJECT NO: 106 C-4790-02 

CLARK, COMANCHE, COWLEY, CRAWFORD, DOUGLAS, ELLIS, FORD, GRANT, GRAY, HASKELL, JEFFERSON, KIOWA, LYON, MARION, MEADE, MONTGOMERY, NESS, PAWNEE, REPUBLIC, AND RICE COUNTIES

Prepared for:
KDOT Bureau of Local Projects
Eisenhower State Office Building
700 S.W. Harrison Street, $3^{\text {rd }}$ Floor West
Topeka, Kansas 66603-3745
785-296-3861

Prepared by:

## Tran Systems

EXPERIENCE | Transportation

## Kimley»Horn

May 2019
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# KDOT Local Road Safety Plans (LRSPs) - <br> Phase 1 

KDOT PROJECT NO: 106 C-4790-02

Prepared for:<br>KDOT Bureau of Local Projects

Eisenhower State Office Building
700 S.W. Harrison Street, $3^{\text {rd }}$ Floor West
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## Statutory Notice

23 U.S.C. § 409: US Code - Section 409: Discovery and admission as evidence of certain reports and surveys

Notwithstanding any other provision of law, reports, surveys, schedules, lists, or data compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential accident sites, hazardous roadway conditions, or railway- highway crossings, pursuant to sections 130, 144, and 148 of this title or for the purpose of developing any highway safety construction improvement project which may be implemented utilizing Federal-aid highway funds shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data.

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## Table of Contents

1. INTRODUCTION ..... 1
1.1. Purpose ..... 1
1.2. Document Organization ..... 2
2. Crash Trees .....  2
2.1. LRSP Pilot Phase Crash Trees (19-County Region) .....  2
2.1.1. Crash Data ..... 2
2.1.2. Crash Tree Development ..... 3
2.1.2.1. Vehicle Action and Manner of Crash ..... 3
2.1.3. 19-County Region Crash Trees ..... 3
2.2. LRSP Phase 1 Crash Trees (KDOT District 3 and District 6) .....  8
2.2.1. Crash Data ..... 8
2.2.2. KDOT District 3 and District 6 Crash Trees ..... 9
2.3. Comparison of Crash Trees ..... 13
3. KANSAS LRSP RISk FActors ..... 15
3.1. Segment Risk Factors. ..... 15
3.2. Intersection Risk Factors ..... 16
3.3. Curve Risk Factors ..... 16
4. SUMmARY ..... 17
5. Next Steps ..... 17
List Of Figures
Figure 1 - Location of Crash Tree Analysis Regions and LRSP Counties ..... 1
Figure 2 - Crashes within the Pilot Phase Crash Tree Analysis Area (2011-2015) ..... 3
Figure 3 - LRSP Pilot Phase Crash Tree - Paved (19-County Region) ..... 5
Figure 4 - LRSP Pilot Phase Crash Tree - Unpaved (19-County Region) ..... 6
Figure 5 - Pilot Phase Crash Tree Data - Crashes by Roadway Type. ..... 7
Figure 6 - Crashes within the Phase 1 Crash Tree Analysis Area (2013-2017) ..... 8
Figure 7 - LRSP Phase 1 Crash Tree - Paved (KDOT District 3 and District 6) ..... 10
Figure 8 - LRSP Phase 1 Crash Tree - Unpaved (KDOT District 3 and District 6) ..... 11
Figure 9 - Phase 1 Crash Tree Data - Crashes by Roadway Type ..... 12
Figure 10 - All Crashes by Roadway Type (Phase 1 and Pilot Phase). ..... 14
Figure 11 - K\&A Crashes by Roadway Type (Phase 1 and Pilot Phase) ..... 14

List of Tables
Table 1 - Pilot Phase Crash Tree Data - Crashes by Roadway Type ..... 7
Table 2 - Phase 1 Crash Tree Data - Crashes by Roadway Type ..... 12
Table 3 - Segment Risk Factors ..... 15
Table 4 - Intersection Risk Factors ..... 16
Table 5 - Horizontal Curve Risk Factors ..... 16

## LIST OF ACRONYMS

| A | Serious Injury Crash |
| :--- | :--- |
| ADT | Average Daily Traffic |
| CMF | Crash Modification Factor |
| FHWA | Federal Highway Administration |
| K | Fatal Crash |
| KDOT | Kansas Department of Transportation |
| LRSP | Local Road Safety Plan |
| SHSP | Strategic Highway Safety Plan |

## 1. Introduction

The Kansas Department of Transportation (KDOT), as part of their strategic goal to reduce fatalities and serious injuries within Kansas is conducting Phase 1 of the Local Road Safety Plan (LRSP) process for twenty counties within the state. Four counties were included in the Pilot Phase of this process, which was completed in 2018. The LRSP concept is built on the foundation established by the Strategic Highway Safety Plan (SHSP). Based on discussions with KDOT, crashes within a 37 -county area, inclusive of KDOT District 3 and District 6, were analyzed as part of the LRSP Phase 1 project. As part of the Pilot Phase, the crash history within the 19-county region, included in the Kansas Department of Health and Environment's South Central Healthcare Coalition, was analyzed. Figure 1 shows the location of the Phase 1 Crash Tree Analysis Area (District 3 and District 6 counties), the Phase 1 LRSP counties, the Pilot Phase Crash Tree Analysis Area (19-county region), and the Pilot Phase counties.


Figure 1 - Location of Crash Tree Analysis Regions and LRSP Counties

### 1.1. Purpose

This document has been prepared to provide a comparison of the crash trees developed for the LRSP Phase 1 project to the crash trees that were developed during the LRSP Pilot Phase. Based on the information contained in the crash trees and other known safety research, risk factors have been identified for determining the attributes for data collection, which are summarized in this document.

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### 1.2. Document Organization

This Crash Analysis Technical Memorandum is organized into the following sections:

- Section 1 presents the project background and purpose of the Technical Memorandum.
- Section 2 summarizes the crash tree development and contains a comparison of the Phase 1 and Pilot Phase crash trees.
- Section 3 details the risk factors recommended for the LRSP project.
- Section 4 provides a summary of recommendations.
- Section 5 includes the next steps in the project.


## 2. Crash Trees

The following sections describe the process of developing the Pilot Phase Crash Trees and a comparison to the Phase 1 Crash Trees.

### 2.1. LRSP Pilot Phase Crash Trees (19-County Region)

The Pilot Phase Crash Tree Analysis Area included the following counties:
$\left.\begin{array}{llllll}\text { - } & \text { Barber } & \text { - } & \text { Edwards } & \text { - } & \text { Marion }\end{array}\right)$.

### 2.1.1. Crash Data

Crash data was provided by KDOT including five years of data from 2011 to 2015. Over 86,000 crash records were included in the crash database. The database includes data on the crash level, vehicle level, and person level. For the purposes of this analysis the crash and vehicle level information were used.

The KABCO injury severity scale (National Safety Council, 1990) is used to summarize the crash data in the following charts. The KABCO scale is used by the investigating police officer on the scene to classify injury severity for occupants with five categories:

- K, killed;
- A, disabling injury;
- B, evident injury;
- C, possible injury;

> The focus of the LRSP is to identify systemic safety improvements that target reductions in fatal (Type K)
> and serious injury (Type A) crashes.

- O, no apparent injury.

These definitions may vary slightly for different police agencies. Within this memorandum "K" signifies a fatal crash and " $A$ " represents a serious injury crash.

Figure 2 shows a summary of the crashes within the 19-county region, all crashes as well as fatal and serious injury crashes. It should be noted that while only $15 \%$ of the region's crashes occur on county roads, $24 \%$ of the fatal or serious injury crashes occur on county roads.



K \& A Crashes


Figure 2 - Crashes within the Pilot Phase Crash Tree Analysis Area (2011-2015)

### 2.1.2. Crash Tree Development

Crash trees were developed using the Kansas DOT Crash Database. Crashes were included over the period from January 1, 2011 through December 31, 2015. Crashes were grouped into three categories: State, City, and County. Any crash that occurred on an Interstate, US, or Kansas highway was counted as a State crash. Crashes that did not fall into this category but occurred outside of a city were counted as County crashes. All remaining crashes within a City were counted as City crashes. In the crash database, the attribute "Surface Type" was used to determine if the crash occurred on a paved or unpaved roadway. Then, to determine if a crash occurred at an intersection, the "Accident Location" field was used. The "Traffic Controls" attribute was used to group intersection crashes by control type. Finally, to determine if non-intersection crashes occurred on a curve, the "Road Character" attribute was used.

### 2.1.2.1. Vehicle Action and Manner of Crash

"Vehicle Action" and "Manner of Crash" statistics are provided in the crash trees and are based on total crashes. The fatal and serious injury crashes had similar characteristics as the total crashes for the counties. Due to limited space, only the top four vehicle actions and manners of crash were typically listed under each category.

### 2.1.3. 19-County Region Crash Trees

In order to define the types of roadway features associated with crashes, a crash tree was developed for the 19-county region in the south-central part of the state. The crash tree includes total crashes as well as fatal and serious injury crashes; however, the vehicle action of the crash and manner of crash are reported only for total crashes. The fatal and serious injury crashes had similar vehicle actions and manners of crash as the total crashes for 19-county region. Figure 3 shows the crash tree for paved county roads and Figure 4 shows a crash tree for the unpaved county roads. Within the 19-county region, $71.5 \%$ of all of county road crashes occurred on paved roadways, also $\mathbf{6 2 . 5 \%}$ of the county road fatal and serious injury crashes occurred on paved roads within the region. Also, 54.6\% of the county road crashes occurred on straight roadway segments along a paved county road, not at an intersection and not at a curve. These roadway crashes could be effectively mitigated with low-cost countermeasures such as clearing and
grubbing along the roadway, adding wider edgeline striping, widening the shoulder and/or installing rumble strips.

For both paved and unpaved roads, it should be noted that animal crashes were not removed from the analysis since there are some countermeasures that could be implemented to address these, primarily clearing the roadside foliage. However, these crashes generally do not result in a fatality or serious injury. Within the 19-county region, $2.5 \%$ of the county road fatal and serious injury (K\&A) crashes involved an animal collision.

During the study period, $37.5 \%$ of the K\&A crashes occurred on unpaved county roads. Just over $80 \%$ of those K\&A crashes occurred on straight roadway segments.

Figure 3 - LRSP Pilot Phase Crash Tree - Paved (19-County Region)


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$$
\begin{array}{|c}
\begin{array}{|c|c|}
\hline \begin{array}{c}
\text { City Road Crashes } \\
\text { K7,342 } \\
\text { K\&A: } 666
\end{array} \\
\hline
\end{array} \\
\begin{array}{|c}
\text { State Road Crashes } \\
\text { 26,344 } \\
\text { K\&A: } 703
\end{array} \\
\hline \\
\begin{array}{c}
\text { Unpaved } \\
3,68(28.5 \%) \\
\text { K\&A: } 159(37.5 \%)
\end{array} \\
\hline
\end{array}
$$

NOTE:

- Vehicle Action and Manner of Crash Statistics are based on Total
Crashes.
K\&A Crashes had similar Vehicle Action and Manner of Crash.
ADDITIONAL INF ORMATION:
- All percentages based on total County Road Crashes.
- "Non-Collision" - refers to a crash where the crash record did not
have the "manner of crash" coded as a collision, which could be when
a vehicle did not collide with another vehicle, such as a run off the
road crash, jackknife, fire, tire or brake failure, etc.
-Animal" - crash type refers to a crash that involved a collision with
an animal.
- "Motor Vehicle in Transport" - vehicle action refers to a crash
between two or more in-motion vehicles (as opposed to a crash with
a parked vehicle).
-Straight/following road" - refers to the vehicle action just prior to
the unstabilized situation (loss of control, etc.).
Figure 4 - LRSP Pilot Phase Crash Tree - Unpaved (19-County Region)


Table 1 contains a tabular summary of the Pilot Phase Crash Tree Analysis Area crashes by roadway type and Figure 5 contains a graphical summary of the crashes, which is the same information that is presented in the crash trees.

Table 1 - Pilot Phase Crash Tree Data - Crashes by Roadway Type


Figure 5 - Pilot Phase Crash Tree Data - Crashes by Roadway Type

### 2.2. LRSP Phase 1 Crash Trees (KDOT District 3 and District 6)

The development of the Phase 1 crash trees followed the same methodology as was described in the Section 2.1 LRSP Pilot Phase Crash Trees.

The Phase 1 Crash Tree Analysis Area included the following counties:

- Cheyenne
- Greeley
- Norton
- Smith
- Clark
- Hamilton
- Osborne
- Stanton
- Decatur
- Haskell
- Phillips
- Stevens
- Ellis
- Hodgeman
- Rawlins
- Thomas
- Finney
- Kearny
- Ford
- Lane
- Gove
- Logan
- Graham
- Meade
- Rooks
- Trego
- Russell
- Wallace
- Scott
- Seward
- Grant
- Morton
- Sheridan
- Gray
- Ness
- Sherman


### 2.2.1. Crash Data

Crash data was provided by KDOT including five years of data from 2013 to 2017. Over 25,000 crash records were included in the crash database. The database includes data on the crash level, vehicle level, and person level. For the purposes of this analysis the crash and vehicle level information were used.

Figure 6 shows a summary of the crashes within KDOT District 3 and District 6, all crashes as well as fatal and serious injury crashes. It should be noted that while only $14 \%$ of the area's crashes occur on county roads, $22 \%$ of the fatal or serious injury crashes occur on county roads. Based on data trends in other states, data analyzed during the Pilot Phase, and the nature of the county road system (design standards, etc.), it is expected that county roads in Kansas typically experience lower traffic volumes than state or city roads. It is anticipated that the fatal and serious injury crash rate on the county roads would be higher than the crash rate on state or city roads.


Figure 6 - Crashes within the Phase 1 Crash Tree Analysis Area (2013-2017)

### 2.2.2. KDOT District 3 and District 6 Crash Trees

In order to define the types of roadway features associated with crashes for Phase 1 of the LRSP project, a crash tree was developed for the KDOT District 3 and District 6 counties. Similar to the crash trees from the Pilot Phase, the crash tree includes total crashes as well as fatal and serious injury crashes; however, the vehicle action of the crash and manner of crash are reported only for total crashes. The fatal and serious injury crashes had similar vehicle actions and manners of crash as the total crashes for the KDOT District 3 and District 6 counties. Figure 7 shows the crash tree for paved county roads and Figure 8 shows a crash tree for the unpaved county roads. Within the KDOT District 3 and District 6 counties, $46.9 \%$ of all county road crashes occurred on paved roadways, and $38.4 \%$ of the county road K\&A crashes occurred on paved roads within the area. Also, $32.7 \%$ of the paved county road crashes occurred on straight roadway segments, not at an intersection and not at a curve. Similarly, as noted for the pilot phase crash analysis, these roadway crashes could be effectively mitigated with low-cost countermeasures such as clearing and grubbing along the roadway, adding wider edgeline striping, widening the shoulder and/or installing rumble strips.
Similar to the methodology in the pilot phase, for both paved and unpaved roads, animal crashes were not removed from the analysis since there are some countermeasures that could be implemented to address these, primarily clearing the roadside foliage. However, these crashes generally do not result in a fatality or serious injury. Within the KDOT District 3 and District 6 counties, $1.3 \%$ of the county road K\&A crashes involved an animal collision.

Crashes on unpaved county roads within the KDOT District 3 and District 6 counties accounted for $53.1 \%$ of the total crashes and $61.6 \%$ of the K\&A crashes. $82.7 \%$ of the K\&A crashes on county unpaved roadways occurred on straight roadway segments.
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Figure 7 - LRSP Phase 1 Crash Tree - Paved (KDOT District 3 and District 6)
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Figure 8 - LRSP Phase 1 Crash Tree - Unpaved (KDOT District 3 and District 6 )
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2019-05-30 KDOT LRSP Tech Memo Crash Analysis.docx

Table 2 contains a tabular summary of the KDOT District 3 and District 6 crashes by roadway type and Figure 9 contains a graphical summary of the crash data, which is the same information that is presented in the crash trees.

Table 2 - Phase 1 Crash Tree Data - Crashes by Roadway Type

| Roadway Type |  | Total Crashes |  | Fatal and Serious Injury (K \& A) Crashes |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Count | Percent | Count | Percent |
| County Paved | Intersection | 309 | 9\% | 14 | 9\% |
|  | Non-Intersection (on curve) | 194 | 5\% | 13 | 8\% |
|  | Non-Intersection (off curve) | 1,182 | 33\% | 32 | 20\% |
|  | Other/Unknown | 11 | 0\% | 2 | 1\% |
|  | Subtotal | 1,696 | 47\% | 61 | 38\% |
| County Unpaved | Intersection | 146 | 4\% | 12 | 8\% |
|  | Non-Intersection (on curve) | 158 | 4\% | 5 | 3\% |
|  | Non-Intersection (off curve) | 1,597 | 44\% | 81 | 51\% |
|  | Other/Unknown | 22 | 1\% | 0 | 0\% |
|  | Subtotal | 1,923 | 53\% | 98 | 62\% |
|  | Total | 3,619 |  | 159 |  |
|  County Paved <br>  1,696 Total, $61 \mathrm{~K} \& \mathrm{~A}$ <br>  $(47 \%$ Total, $38 \% \mathrm{~K} \& \mathrm{~A})$ |  |  | County Unpaved <br> 1,923 Total, $98 \mathrm{~K} \& A$ (53\% Total, $62 \%$ K \& A) |  |  |
| 50\% |  |  | 51\% |  |  |
|  |  |  |  | 44\% |  |
| $40 \%$ 33\% |  |  |  |  |  |
| $30 \% \square$ | $20 \% \square 20 \%$ |  |  |  |  |
| $\begin{array}{cc} 10 \% & 9 \% \\ 0 \% & \\ & \end{array}$ | $\begin{array}{ccc} 9 \% & 5 \% & 8 \% \\ \hline & \square & \square \\ \hline \end{array}$ | - 1\% | 8\% |  | 1\% 0\% |
|  |  |  |  |  |  |

Figure 9 - Phase 1 Crash Tree Data - Crashes by Roadway Type

| 091841008 | KDOT LRSPs - Phase 1 |
| :--- | ---: |
| 2019-05-30 KDOT LRSP Tech Memo Crash Analysis.docx | May 2019 |

### 2.3. Comparison of Crash Trees

The Phase 1 crash tree has a larger percentage of unpaved county road crashes. It is our understanding that this corresponds to the larger percentage of unpaved county roads in the western, more rural portion of the state. The total number of crashes included in the Phase 1 crash tree was over 25,000 with 1,696 occurring on paved county roadways, while the Pilot Phase crash tree included over 86,000 crashes, with 9,222 occurring on paved county roadways. While the Phase 1 crash tree analysis area includes nearly twice the number of counties, there were less than one-third the number of total crashes as compared to the Pilot Phase due to the rural nature of the counties in the Phase 1 crash tree analysis area. The Phase 1 crash tree had a higher percentage of K\&A crashes that occurred on state roadways than the Pilot Phase (61\% compared to $39 \%$ ), while the percentage of K\&A crashes on county roads was similar ( $24 \%$ in Pilot Phase, $22 \%$ in Phase 1). This likely corresponds to higher K\&A crash rates along county roads in Phase 1 and may be attributed to having fewer city roads in this area compared to the 19-county region.

The trends of the locations of crashes were similar, with the majority of crashes along straight roadway segments, fewer at intersections and the least at curves. In the Pilot Phase, 78\% of the crashes occurred on straight segments, as well as $67 \%$ of K\&A crashes. Similarly, in Phase 1, straight roadway segments accounted for $77 \%$ of the crashes and $71 \%$ of the K\&A crashes. Figure 10 shows the breakdown for all crashes for both the Pilot Phase and Phase 1 and Figure 11 shows a similar comparison of K\&A crashes.

There were a larger percentage of crashes on unpaved county roads within the KDOT District 3 and District 6 counties (Phase 1: 53.1\%) than in the 19-county region (Pilot Phase: 28.5\%). K\&A crashes on unpaved county roads also accounted for a larger percentage of the total within KDOT District 3 and District 6, $61.6 \%$ compared to $37.5 \%$ in the 19 -county region. Over $80 \%$ of the K\&A crashes on county unpaved roadways occurred on straight roadway segments for both the Phase 1 and Pilot crash trees. As noted, the higher prevalence of unpaved county roads likely corresponds to these higher percentages in the Phase 1 crash tree analysis area.

The vehicle actions and manner of crashes were similar between the two crash trees, with many of the actions and manners following the same distribution order, with "ran off road right" being followed by "ran off road left", for example.

Based on these findings, it is recommended that the risk factors developed during the Pilot Phase be used in the LRSP Phase 1 project. Using the same risk factors will also allow for more even comparison between counties and their recommended projects from the Pilot Phase, Phase 1, and future LRSP phases. The following section describes the risk factors used during the Pilot Phase.

County Paved
County Unpaved


Figure 10 - All Crashes by Roadway Type (Phase 1 and Pilot Phase)


Figure 11 - K\&A Crashes by Roadway Type (Phase 1 and Pilot Phase)

## 3. KANSAS LRSP RISK FACTORS

The purpose of the LRSP project is to identify locations where systemic safety improvements can be implemented on county roads. The systemic approach focuses on risk and takes a broader view and looks at risk across an entire roadway system, rather than applying improvements to locations where crashes have previously occurred.

While there are many risk factors that could be used in systemic safety analysis, the following sections provide the risk factors approved by KDOT in the LRSP Pilot Phase, along with the safety issue or risk that they correspond and the method for collecting the associated data.

### 3.1. $\quad$ Segment Risk Factors

Table 3 shows the risk factors, based on the crash analysis of the crash trees for segments. Each of these risk factors can be used to analyze potential risk.
> "The systemic approach to safety involves widely implemented improvements based on high-risk roadway features correlated with specific severe crash types. The approach provides a more comprehensive method for safety planning and implementation that supplements and complements traditional site analysis. It helps agencies broaden their traffic safety efforts and consider risk as well as crash history when identifying where to make low cost safety improvements."
> FHWA - Office of Traffic Safety

Table 3 - Segment Risk Factors

| Risk Factor | Issue |
| :---: | :---: |
| Average Daily Traffic (ADT) volumes | Exposure |
| Surface type (paved or unpaved) | Surface type |
| Roadway width | Staying on the roadway |
| Shoulder width | Staying on the roadway, recovery from crash |
| Access density | Conflicting movements along the segment |
| Presence of pavement markings | Staying on the roadway |
| Lane departure crash rate | History of issues staying on roadway |
| Edge condition | Ability of vehicle to recover from a roadway departure |
| Roadside assessment | Roadside collision hazard |

### 3.2. Intersection Risk Factors

For analysis of the risk factors included in Table 5, data for every intersection along the study routes will be required with relevant information pertaining to each intersection. Each of these risk factors will be used to analyze potential crash risk.

Table 4 - Intersection Risk Factors

| Risk Factor | Issue |
| :---: | :---: |
| Average Daily Traffic (ADT) on all <br> approaches | Exposure |
| Distance from previous stop sign (along the <br> LRSP routes) | Running the intersection |
| Location on a curve | Running the intersection, sight visibility |
| Skew | Running the intersection, sight visibility |
| Sight distance | Running the intersection, sight visibility |
| Proximity of driveway or another intersection | Conflicting movements near intersection |
| Fatal or serious injury crash history | History of potential safety issues |
| Intersection control | Control type |

### 3.3. Curve Risk Factors

As shown in Table 5, many of the risk factor data associated with curves can be obtained simultaneously with the segment risk factors. One important distinction in curve risk factors, is to consider the use of curve radius, as research suggests, generally, that curves with larger radii historically have seen fewer crashes. Each of these risk factors will be used to analyze potential crash risk.

Table 5 - Horizontal Curve Risk Factors

| Risk Factor | Issue |
| :---: | :---: |
| Average Daily Traffic (ADT) volumes | Exposure |
| Curve radius | Staying on roadway |
| Shoulder width | Staying on roadway, recovering from crash |
| Access density | Conflicting movements near horizontal curve, sight <br> visibility |
| Fatal or serious injury crash history | Sistory of potential safety issues |
| Presence of warning signs | Staying on roadway |
| Superelevation | Ability of vehicle to recover from a roadway departure |
| Edge condition | Roadside collision hazard |
| Roadside assessment |  |

## 4. SUMMARY

The review of the Phase 1 Crash Tree Analysis Area (KDOT District 3 and District 6) found more crashes on unpaved roads than in the LRSP Pilot Phase analysis of the 19-county region. It is expected that this is likely due to the increased percentage of the number of unpaved roadways in western Kansas. The breakdown of individual crash characteristics (vehicle action and manner of crash) were similar between the Phase 1 and Pilot Phase crash trees as associated with roadway geometry and intersection control. Based on the findings of this review, it is recommended that the same risk factors be used for analysis of the LRSP Phase 1 project as were approved by KDOT for the LRSP Pilot project. These risk factors were developed to systemically assess crash risk along roadway segments, at intersections, and at horizontal curves as part of the LRSP process.

## 5. Next Steps

The next steps include collection of data to support the risk factors. Workshops will also be conducted with each of the twenty LRSP Phase 1 counties to discuss transportation safety strategies and countermeasures.

After the workshops are conducted, a systemic analysis will be conducted for the twenty LRSP Phase 1 counties to calculate risk factor scores for each roadway segment, intersection, and curve along the LRSP study routes. Project sheets will be created for the locations with the highest risk factor scores with associated recommended safety countermeasures.

Finally, a LRSP report will be produced for each county, providing a summary of the project, risk factor information, and the project sheets.

Marion County
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## APPENDIX C Crash Location Heat Map and Crash Frequencies

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Crash Location Heat Map<br>Marion County LRSP Routes<br>Total Crashes



## Marion County

Local Road Safety Plan (LRSP)

## Segment Crash Frequencies (Actual vs. Predicted)

Five-Year Analysis Period: 2013-2017

| ID | LRSP Segment | Location | Total Crashes | Lane Departure Crashes | Animal Crashes | Crash Frequency (crashes per year) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  | Actual | Highway Safety Manual (HSM) Predicted Average | Difference (actual predicted) |
| 104 | SUNFLOWER | From 140TH to E. FOREST | 23 | 3 | 17 | 4.60 | 1.39 | 3.21 |
| 13 | 190TH | From KANZA to NIGHTHAWK | 19 | 9 | 9 | 3.80 | 1.32 | 2.48 |
| 70 | INDIGO | From 90TH to 70TH | 15 | 4 | 11 | 3.00 | 0.86 | 2.14 |
| 71 | INDIGO | From 120TH to 90TH | 18 | 6 | 11 | 3.60 | 1.91 | 1.69 |
| 84 | NIGHTHAWK | From 190TH to 150TH | 10 | 6 | 3 | 2.00 | 0.42 | 1.58 |
| 1 | 120TH | From EAGLE to INDIGO | 10 | 2 | 8 | 2.00 | 0.49 | 1.51 |
| 103 | SUNFLOWER | From 110TH to HWY 50 | 10 | 8 | 2 | 2.00 | 0.65 | 1.35 |
| 12 | 190TH | From OLD MILL to REMINGTON | 14 | 10 | 3 | 2.80 | 1.50 | 1.30 |
| 99 | REMINGTON | From 240TH to 210TH | 7 | 0 | 7 | 1.40 | 0.17 | 1.23 |
| 85 | NIGHTHAWK | From 140TH to 120TH | 7 | 5 | 2 | 1.40 | 0.21 | 1.19 |
| 2 | 120TH | From HWY 15 to EAGLE | 8 | 3 | 5 | 1.60 | 0.49 | 1.11 |
| 16 | 190TH | From NIGHTHAWK to OLD MILL | 8 | 4 | 2 | 1.60 | 0.51 | 1.09 |
| 49 | 60TH | From QUAIL CREEK to TIMBER | 7 | 3 | 3 | 1.40 | 0.33 | 1.07 |
| 80 | LIMESTONE | From 330TH to 290TH | 7 | 5 | 2 | 1.40 | 0.36 | 1.04 |
| 50 | 60TH | From OLD MILL to QUAIL CREEK | 6 | 2 | 4 | 1.20 | 0.22 | 0.98 |
| 100 | REMINGTON | From 290TH to 240TH | 8 | 5 | 3 | 1.60 | 0.66 | 0.94 |
| 26 | 290TH | From LIMESTONE to NIGHTHAWK | 7 | 4 | 3 | 1.40 | 0.48 | 0.92 |
| 74 | KANZA | From 190TH to 140TH | 7 | 4 | 3 | 1.40 | 0.52 | 0.88 |
| 9 | 150TH | From EAGLE to INDIGO | 6 | 3 | 3 | 1.20 | 0.32 | 0.88 |
| 69 | INDIGO | From 150TH to BLAIRWOOD | 14 | 1 | 12 | 2.80 | 2.03 | 0.77 |
| 3 | 120TH | From MERIDIAN to ALAMO | 4 | 1 | 1 | 0.80 | 0.10 | 0.70 |
| 118 | KANZA | From 240TH to US HWY 56 | 6 | 2 | 3 | 1.20 | 0.51 | 0.69 |
| 14 | 190TH | From GOLDENROD to WEST OF HILLSBORO | 4 | 4 | 0 | 0.80 | 0.13 | 0.67 |
| 36 | 330TH | From MERIDIAN to DIAMOND | 5 | 2 | 3 | 1.00 | 0.34 | 0.66 |
| 72 | INDIGO | From 140TH to 150TH | 6 | 2 | 3 | 1.20 | 0.60 | 0.60 |
| 10 | 150TH | From K-15 to EAGLE | 4 | 0 | 4 | 0.80 | 0.21 | 0.59 |
| 7 | 140TH | From NIGHTHAWK to PAWNEE | 3 | 3 | 0 | 0.60 | 0.05 | 0.55 |
| 52 | 60TH | From 0.25 MILE WEST OF NIGHTHAWK to S LOCUST | 3 | 2 | 1 | 0.60 | 0.07 | 0.53 |
| 90 | OLD MILL | From 60TH to 30TH | 5 | 3 | 0 | 1.00 | 0.47 | 0.53 |
| 51 | 60TH | From LIMESTONE to 0.25 MILE WEST OF NIGHTHAWK | 3 | 2 | 1 | 0.60 | 0.15 | 0.45 |
| 35 | 30TH | From OLD MILL to TIMBER | 3 | 1 | 2 | 0.60 | 0.16 | 0.44 |
| 39 | 330TH | From DIAMOND to HWY 15 | 4 | 2 | 2 | 0.80 | 0.40 | 0.40 |


| ID | LRSP Segment | Location | Total Crashes | Lane Departure Crashes | Animal Crashes | Crash Frequency (crashes per year) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  | Actual | Highway Safety Manual (HSM) Predicted Average | Difference (actual predicted) |
| 89 | NIGHTHAWK | From 90TH to HWY 50 | 4 | 3 | 1 | 0.80 | 0.41 | 0.39 |
| 109 | TIMBER | From 60TH to 40TH | 3 | 3 | 0 | 0.60 | 0.22 | 0.38 |
| 73 | INDIGO | From 140TH to 120TH | 8 | 5 | 3 | 1.60 | 1.23 | 0.37 |
| 101 | REMINGTON | From 210TH to HWY 56 | 2 | 0 | 1 | 0.40 | 0.06 | 0.34 |
| 46 | 360TH | From PAWNEE to QUAIL CREEK | 2 | 2 | 0 | 0.40 | 0.08 | 0.32 |
| 53 | 60TH | From S MAPLE to OLD MILL | 2 | 1 | 1 | 0.40 | 0.10 | 0.30 |
| 66 | DIAMOND | From 250TH to 210TH | 2 | 2 | 0 | 0.40 | 0.10 | 0.30 |
| 88 | NIGHTHAWK | From 150TH to 140TH | 2 | 1 | 1 | 0.40 | 0.10 | 0.30 |
| 105 | SUNFLOWER | From 140TH to 110TH | 5 | 4 | 1 | 1.00 | 0.72 | 0.28 |
| 45 | 360TH | From LIMESTONE to PAWNEE | 3 | 2 | 0 | 0.60 | 0.33 | 0.27 |
| 55 | 90TH | From MERIDIAN to K15 | 2 | 0 | 2 | 0.40 | 0.13 | 0.27 |
| 76 | KANZA | From 270TH to 240TH | 3 | 0 | 3 | 0.60 | 0.34 | 0.26 |
| 47 | 40TH | From TIMBER to WAGONWHEEL | 2 | 1 | 1 | 0.40 | 0.15 | 0.25 |
| 40 | 340TH | From QUAIL CREEK to N WASHINGTON | 3 | 2 | 1 | 0.60 | 0.36 | 0.24 |
| 28 | 290TH | From HWY 56 to BLUESTEM | 2 | 1 | 1 | 0.40 | 0.19 | 0.21 |
| 23 | 290TH | From REMINGTON to TIMBER | 3 | 3 | 0 | 0.60 | 0.39 | 0.21 |
| 106 | SUNRISE | From 240TH to HWY 56 | 2 | 1 | 0 | 0.40 | 0.22 | 0.18 |
| 102 | SUNFLOWER | From 370TH to 360TH | 1 | 1 | 0 | 0.20 | 0.02 | 0.18 |
| 83 | NIGHTHAWK | From 120TH to 90TH | 4 | 1 | 3 | 0.80 | 0.62 | 0.18 |
| 97 | QUAIL CREEK | From 330TH to 290TH | 2 | 1 | 1 | 0.40 | 0.23 | 0.17 |
| 113 | UPLAND | From HWY 256 to LAKESHORE | 2 | 1 | 0 | 0.40 | 0.23 | 0.17 |
| 25 | 290TH | From HWY 15 to KANZA | 4 | 1 | 3 | 0.80 | 0.64 | 0.16 |
| 8 | 140TH | From INDIGO to KANZA | 1 | 0 | 1 | 0.20 | 0.04 | 0.16 |
| 81 | LIMESTONE | From 370TH to 360TH | 1 | 1 | 0 | 0.20 | 0.05 | 0.15 |
| 61 | BLUESTEM | From 310TH to 290TH | 1 | 1 | 0 | 0.20 | 0.06 | 0.14 |
| 94 | PAWNEE | From 240TH to 230TH | 1 | 1 | 0 | 0.20 | 0.06 | 0.14 |
| 107 | TIMBER | From 30TH to 10TH | 1 | 1 | 0 | 0.20 | 0.06 | 0.14 |
| 60 | 90TH | From K15 to CHISOLM TRAIL | 1 | 0 | 1 | 0.20 | 0.07 | 0.13 |
| 41 | 340TH | From US HWY 77 to XAVIER | 1 | 0 | 1 | 0.20 | 0.07 | 0.13 |
| 108 | TIMBER | From 290TH to 240TH | 1 | 1 | 0 | 0.20 | 0.08 | 0.12 |
| 67 | FALCON | From 90TH to 70TH | 1 | 0 | 0 | 0.20 | 0.11 | 0.09 |
| 95 | PAWNEE | From 360TH to 370TH | 1 | 1 | 0 | 0.20 | 0.11 | 0.09 |
| 63 | DIAMOND | From 370TH to 330TH | 1 | 0 | 1 | 0.20 | 0.11 | 0.09 |
| 20 | 240TH | From NIGHTHAWK to PAWNEE | 1 | 1 | 0 | 0.20 | 0.12 | 0.08 |
| 48 | 40TH | From WAGONWHEEL to HWY 77 | 1 | 1 | 0 | 0.20 | 0.12 | 0.08 |
| 96 | QUAIL CREEK | From 360TH to 340TH | 1 | 1 | 0 | 0.20 | 0.12 | 0.08 |
| 77 | KANZA | From US HWY 56 to 190TH | 1 | 1 | 0 | 0.20 | 0.13 | 0.07 |
| 87 | NIGHTHAWK | From HWY 56 to 190TH | 1 | 0 | 0 | 0.20 | 0.13 | 0.07 |


| ID | LRSP Segment | Location | Total Crashes | Lane Departure Crashes | Animal Crashes | Crash Frequency (crashes per year) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  | Actual | Highway Safety Manual (HSM) Predicted Average | Difference (actual predicted) |
| 58 | 90TH | From CHISHOLM TRAIL to EAGLE | 1 | 0 | 1 | 0.20 | 0.13 | 0.07 |
| 64 | DIAMOND | From 330TH to 290TH | 1 | 0 | 1 | 0.20 | 0.13 | 0.07 |
| 79 | LIMESTONE | From 360TH to 330TH | 1 | 1 | 0 | 0.20 | 0.15 | 0.05 |
| 86 | NIGHTHAWK | From 290TH to 240TH | 1 | 1 | 0 | 0.20 | 0.16 | 0.04 |
| 37 | 330TH | From LIMESTONE to QUAIL CREEK | 3 | 0 | 3 | 0.60 | 0.57 | 0.03 |
| 30 | 290TH | From QUAIL CREEK to REMINGTON | 1 | 0 | 1 | 0.20 | 0.20 | 0.00 |
| 6 | 140TH | From SUNFLOWER to ULYSSES | 1 | 0 | 1 | 0.20 | 0.21 | -0.01 |
| 33 | 30TH | From LIMESTONE to OLD MILL | 1 | 0 | 1 | 0.20 | 0.22 | -0.02 |
| 15 | 190TH | From PRAIRIE to KANZA | 3 | 3 | 0 | 0.60 | 0.66 | -0.06 |
| 91 | OLD MILL | From 210TH to 190TH | 1 | 1 | 0 | 0.20 | 0.36 | -0.16 |
| 93 | PAWNEE | From 230TH to 210TH | 1 | 0 | 0 | 0.20 | 0.39 | -0.19 |
| 38 | 330TH | From HWY 15 to LIMESTONE | 1 | 0 | 1 | 0.20 | 0.42 | -0.22 |
| 24 | 290TH | From NIGHTHAWK to QUAIL CREEK | 2 | 1 | 0 | 0.40 | 0.64 | -0.24 |

## Marion County <br> Local Road Safety Plan (LRSP) <br> Curve Crash Frequencies (Actual vs. Predicted)

Five-Year Analysis Period: 2013-2017

| ID | LRSP Curve | Total <br> Crashes | Actual | Highway Safety <br> Manual (HSM) <br> Predicted Average | Difference <br> (actual - <br> predicted) |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | 2 | 0.40 | 0.05 |
| 20 | GOLDENROD RD \& 190TH | 2 | 0.35 |  |  |
| 47 | SUNFLOWER 1.2M N OF 120TH | 1 | 0.20 | 0.03 | 0.17 |
| 33 | NIGHTHAWK 0.02M S OF 130TH | 1 | 0.20 | 0.08 | 0.12 |
| 39 | SUNFLOWER 0.10M N OF 90TH | 1 | 0.20 | 0.09 | 0.11 |
| 45 | SUNFLOWER 0.37 M N OF 90TH | 1 | 0.20 | 0.11 | 0.09 |
| 43 | SUNFLOWER 0.09 M S OF 180TH | 1 | 0.20 | 0.18 | 0.02 |
| 22 | INDIGO 0.07M S OF 130TH | 1 | 0.20 | 0.22 | -0.02 |
| 14 | 360TH \& PAWNEE | 1 | 0.20 | 0.43 | -0.23 |
| 17 | 60TH \& S MAPLE | 1 | 0.20 | 0.44 | -0.24 |

Local Road Safety Plan (LRSP)
Intersection Crash Frequencies (Actual vs. Predicted)
Five-Year Analysis Period: 2013-2017

| ID | LRSP Intersection | Total <br> Crashes | Actual | Highway Safety <br> Manual (HSM) <br> Predicted Average | Difference <br> (actual - <br> predicted) |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | 1 | 0.20 | 0.003 |
| 137 | NEEDLE \& 60TH | 1 | 0.20 | 0.005 | 0.20 |
| 68 | INDIGO \& 120TH | 1 | 0.08 | 0.12 |  |
| 147 | NIGHTHAWK \& 190TH | 1 | 0.20 | 0.08 |  |

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## APPENDIX D <br> Data Maps

## From:

Sent:
To:
Cc:
Subject:
jjstanek@transystems.com
Wednesday, May 8, 2019 9:48 AM
Hamm, Jesse
csproberts@transystems.com; David.Church@wsp.com; jay.aber@wsp.com RE: Marion County LRSP Data Request

Good morning Jesse - just a friendly reminder that the team would like to receive the map information requested below by Friday, May 10, 2019. I recognize you may have other priorities with all the rain we've been receiving. We appreciate your efforts in providing this information as timely as possible so we can keep the project on schedule.

Thank you, Jim

From: KC-James Stanek
Sent: Thursday, April 25, 2019 11:44 AM
To: Jesse Hamm (jhamm@marioncoks.net) [jhamm@marioncoks.net](mailto:jhamm@marioncoks.net)
Cc: KC-Chris S.P. Roberts [csproberts@transystems.com](mailto:csproberts@transystems.com); David Church (David.Church@wsp.com)
[David.Church@wsp.com](mailto:David.Church@wsp.com); Jay Aber (jay.aber@wsp.com) [jay.aber@wsp.com](mailto:jay.aber@wsp.com)
Subject: Marion County LRSP Data Request
Jesse:

In order to enhance the quality of your LRSP, we would like to obtain the following sets of information regarding the LRSP routes in your County. Please indicate the following information within your County on the attached maps:

1. Intersection Lighting: Please indicate which intersections along the County LRSP routes have intersection lighting.
2. Overhead/Stop Sign Flashing Beacons: Please indicate which intersections along the County LRSP routes have overhead or stop sign flashing beacons. 2 Flashing stop sigas at $190 \pm 4$ Nighthawk intersection
3. Centerline Rumble Strips: Please provide locations of centerline rumble strips along the County LRSP routes if these are available. None
4. Edge line and/or Shoulder Rumble Strips: Please provide locations of edge line and/or shoulder rumble strips along the County LRSP routes if these are available.
5. Transverse Rumble Strips: Please provide locations of transverse rumble strips at intersections along the County LRSP routes if these are available. None
6. Pavement width and type (material): Please provide information regarding the pavement width and type along the County LRSP routes if it is available. Paved roads are asplialt 4 chip in seal roads. They range from 22 feet to 24 feet wide
7. Shoulder width and type (material): Please provide information regarding the shoulder width and type along the County LRSP routes if it is available. 1- i's mile stretch has lio" SOW the rest of the roads are $60^{\circ}$ to $64^{\circ}$ ROW
8. Edge Line pavement markings: Please provide locations of edge line pavement markings along the County LRSP routes if these are available.
9. Centerline pavement markings: Please provide locations of center line pavement markings along the County LRSP routes if these are available.
10. Curve Warning Signs: Please indicate which curves along the County LRSP routes have horizontal alignment warning signs (e.g., Turn or Curve warning signs, curve chevrons, etc.). Note - the type of warning signs do not need to be identified; only a "yes" or "no" if the curve has any horizontal alignment warning signs. Yes all heve chrve warning signs
11. Curve Superelevation: Please identify curves along the County LRSP routes that have superelevation. Note - the degree of superelevation does not need to be identified; only a "yes" or "no" if the curve has any superelevation. Yes - Suaflower Read South of 140 th Street
Some of these should be fairly simple, but others may take some time unless you already have the information in a digital format (e.g., a signing database). We have received a number of GIS files for your county, so please advise if you think we have some of this information already.

If possible, please provide this information by Friday, May 10, 2019. Thank you and please feel free to contact me with any questions you may have regarding this data request.

Jim

James J. Stanek PE, PTOE Senior Traffic Engineer


Note: The information contained in this transmission as well as all documents transmitted herewith are privileged and confidential information. This information is intended only for the use of the individual or entity to whom it was sent, and the recipient is obliged to protect this information as appropriate. If the recipient of the e-mail, and/or the documents attached is not the intended recipient, you are hereby notified that any dissemination, distribution or reproduction, copy, or storage of this communication is strictly prohibited. Thank you.


## Information regarding the LRSP maps

Question 1 - Hwy 50 and Indigo intersection, Hwy 50 and Nighthawk intersection, Hwy 50 and Sunflower intersection all have lighting

Question 2 - Two flashing stop signs at the intersection of $190^{\text {th }}$ and Nighthawk Road
Question 3 - No Centerline Rumble Strips in the county
Question 4 - No Edge Line Rumble Strips in the county
Question 5 - No Transverse Rumble Strips in the county
Question 6 - Paved roads are Asphalt and Chip \& Seal Roads they all range from $22^{\prime}$ to $24^{\prime}$ wide

Question 7 - Indigo Road has $4^{\prime}$ to $5^{\prime}$ width of shoulder the rest of the roads in the county range from 6" to one foot of shoulder

Question 8 \& 9 are the same - Indigo Road, $90^{\text {th }}$ from Meridian to Chisholm Trail, $120^{\text {th }}$ from Meridian to Indigo, $150^{\text {th }}$ from Hwy 15 to Indigo, $190^{\text {th }}$ from Goldenrod to Remingtion, Sunflower from $180^{\text {th }}$ to Hwy $50,330^{\text {th }}$ from Meridian to Limestone, Limestone from $330^{\text {th }}$ to $290^{\text {th }}$, Quail Creek from $370^{\text {th }}$ to $290^{\text {th }}$, Remington from $290^{\text {th }}$ to Hwy 56, $290^{\text {th }}$ from Diamond to Hwy 77, $60^{\text {th }}$ from Old Mill to Timber, Timber from $60^{\text {th }}$ to $10^{\text {th }}, 40^{\text {th }}$ from Timber to Hwy 77 all have edge line and center line markings.

Question 10 - Yes all have curve warning signs
Question 11 - Yes south of Sunflower and $140^{\text {th }}$ intersection I would say is the only area that has Curve


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## APPENDIX E

## Edge Condition and Roadside Assessment Ratings

Edge Condition


Use Restricted 23 U.S.C. § 409


Marion County Edge Condition Ratings

## Legend

Edge Condition Rating
$2.8-3.0$
$2.4-2.7$
$2.1-2.3$
$1.7-2.0$
$1.4-1.6$
$1.0-1.3$
1.4-1.6
1.0-1.3
Roadside Assessment



Marion County Roadside Assessment Ratings
Legend

## Roadside Assessment Rating

$2.8-3.0$
$2.4-2.7$
$2.1-2.3$
$1.7-2.0$
$1.4-1.6$
$-1.0-1.3$

Marion County
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## APPENDIX F

## Countermeasures Technical Memorandum

## TECHNICAL MEMORANDUM - COUNTERMEASURES

# KDOT Local Road Safety Plans <br> (LRSPs) - Phase 1 <br> KDOT PROJECT NO: 106 C-4790-02 

CLARK, COMANCHE, COWLEY, CRAWFORD, DOUGLAS, ELLIS, FORD, GRANT, GRAY, HASKELL, JEFFERSON, KIOWA, LYON, MARION, MEADE, MONTGOMERY, NESS, PAWNEE, REPUBLIC, AND RICE COUNTIES

Prepared for:
KDOT Bureau of Local Projects
Eisenhower State Office Building
700 S.W. Harrison Street, $3^{\text {rd }}$ Floor West
Topeka, Kansas 66603-3745
785-296-3861

Prepared by:

## IranSystems

EXPERIENCE | Transportation

## Kimley»Horn

TECHNICAL MEMORANDUM - COUNTERMEASURES
FOR

## KDOT Local Road Safety Plans (LRSPs) - <br> Phase 1

KDOT PROJECT NO: 106 C-4790-02
Prepared for:
KDOT Bureau of Local Projects
Eisenhower State Office Building
700 S.W. Harrison Street, ${ }^{\text {rd }}$ Floor West
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## Statutory Notice

23 U.S.C. § 409: US Code - Section 409: Discovery and admission as evidence of certain reports and surveys

Notwithstanding any other provision of law, reports, surveys, schedules, lists, or data compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential accident sites, hazardous roadway conditions, or railway- highway crossings, pursuant to sections 130, 144, and 148 of this title or for the purpose of developing any highway safety construction improvement project which may be implemented utilizing Federal-aid highway funds shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data.

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1. INTRODUCTION ..... 1
1.1. Purpose ..... 1
1.2. Document Organization ..... 1
2. Systemic Safety Countermeasures .....  2
2.1. Crash Modification Factors ..... 2
2.2. Segments ..... 4
2.2.1. Segment Risk Factors ..... 4
2.2.2. Approved Segment Countermeasures ..... 4
2.3. Intersections ..... 6
2.3.1. Intersection Risk Factors ..... 6
2.3.2. Approved Intersection Countermeasures ..... 6
2.4. Curves ..... 8
2.4.1. Curve Risk Factors .....  8
2.4.2. Approved Curve Countermeasures ..... 9
3. Additional Potential Countermeasures ..... 10
3.1. Segments ..... 11
3.2. Intersections ..... 11
3.3. Curves ..... 12
3.4. Unpaved Roadways ..... 12
4. Next Steps. ..... 14

## List of Figures

Figure 1 - Location of LRSP Counties ..... 1
Figure 2 - CMF Calculation ..... 2
Figure 3 - CMF Method Sample Calculation ..... 3
Figure 4 - CRF Calculation ..... 3
Figure 5 - Unpaved Roadway Proper Shape Guidance ..... 13
List of Tables
Table 1 - Approved Segment Countermeasures ..... 5
Table 2 - Approved Intersection Countermeasures ..... 7
Table 3 - Approved Curve Countermeasures ..... 9
Table 4 - Additional Segment Countermeasures ..... 11
Table 5 - Additional Intersection Countermeasures ..... 11
Table 6 - Additional Curve Countermeasures ..... 12

## List of Acronyms

| ADT | Average Daily Traffic |
| :--- | :--- |
| CMF | Crash Modification Factor |
| CRF | Crash Reduction Factor |
| FHWA | Federal Highway Administration |
| HFST | High Friction Surface Treatment |
| HSM | Highway Safety Manual |
| ICE | Intersection Control Evaluation |
| KDOT | Kansas Department of Transportation |
| LRSP | Local Road Safety Plan |
| MUTCD | Manual on Uniform Traffic Control Devices |
| RSA | Road Safety Assessment/Audit |
| SHSP | Strategic Highway Safety Plan |

## 1. Introduction

The Kansas Department of Transportation (KDOT), as part of their strategic goal to reduce fatalities and serious injuries within Kansas is conducting Phase 1 of the Local Road Safety Plan (LRSP) process for twenty counties within the state. Four counties were included in the Pilot Phase of this process, which was completed in 2018. The LRSP concept is built on the foundation established by the Strategic Highway Safety Plan (SHSP). Figure 1 shows the location of the Phase 1 LRSP counties and the Pilot Phase counties.


Figure 1 - Location of LRSP Counties

### 1.1. Purpose

This technical memorandum has been prepared to provide a list of potential safety countermeasures. The countermeasures presented in this document were selected to address the risk factors previously approved. A similar memorandum was prepared for the LRSP Pilot Phase, and this document has been updated based on a review of national resources and best practices.

### 1.2. Document Organization

This technical memorandum is organized into the following sections:

- Section 1 presents the project background and purpose of the technical memorandum.
- Section 2 provides a review of the approved risk factors from the previous technical memorandum and includes a list of the approved LRSP Pilot Phase safety countermeasures.
- Section 3 includes additional countermeasures to be considered as part of Phase 1 of the LRSP project.
- Section 4 summarizes the next steps in the project.


## 2. SYSTEMIC SafETY COUNTERMEASURES

While there are many safety countermeasures that could be used to systemically improve roadway safety, the following sections provide countermeasures approved in the LRSP Pilot Phase and additional countermeasures for consideration by KDOT and the counties based on the risk factors approved by KDOT. In addition to the systemic safety countermeasures described in this section, with additional site specific information, such as turning volumes, travel patterns, vertical alignment, and other known concerns, additional location specific safety countermeasures may be appropriate. This section also describes additional countermeasures that could be considered by the counties where segments, intersections, or curves are identified with high risk factor scores. At the request of the counties, the additional safety countermeasures can be added to the project sheets.

Along with the countermeasure list, the Crash Modification Factors (CMFs) associated with each countermeasure are provided. Section 2.1 provides a discussion of CMFs and how they are used in predictive crash analysis. The following section and CMFs in this technical memorandum are provided for reference and to show the potential positive impact to safety, if applied. The LRSP project does not include predictive crash analysis based on calculating the number of crashes that will be reduced by applying a specific countermeasure; as such, the CMFs have been provided for reference to aid the counties in understanding potential reductions from crashes by different countermeasures.

### 2.1. Crash Modification Factors

When identifying potential systemic safety improvements, it is important to look at CMFs for the proposed improvements. The CMF Method is found in Part D of the Highway Safety Manual (HSM). CMFs are defined as the ratio of effectiveness of one condition in comparison to another condition and represent the relative change in crash frequency due to a change in one specific condition. In other words, a CMF is a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site. Countermeasures with CMFs less than one are expected to reduce crashes if applied, while those countermeasures with CMFs greater than one are expected to increase crashes. Figure 2 illustrates the definition of CMFs.

$\mathrm{CMF}=1.0 \quad$ Expected to have no impact on safety
CMF < 1.0 Expected to reduce crashes
CMF > 1.0 Expected to increase crashes

Figure 2 - CMF Calculation
The CMF Method is used to calculate the expected number of crashes by taking the observed number of crashes and multiplying those crashes by the applicable CMF for the proposed countermeasure. It is recommended that CMFs be applied to a minimum of three years of crash data for urban and suburban sites and five years of crash data for a rural site. Figure 3 is a sample calculation of the CMF method with one CMF being applied to a particular site for a single year.
9.2 crashes / year:
a reduction of 0.9 total crashes per year and a CRF of $9 \%$

Figure 3 - CMF Method Sample Calculation
A Crash Reduction Factor (CRF) is similar to a CMF but stated in different terms. A CRF is defined as a percentage of crash reduction that might be expected after the implementation of a given countermeasure at a specific site. Figure 4 shows how a CRF is calculated in relationship to a CMF.

$$
\text { CRF }=\pi \cdot=\operatorname{comen} \times 10
$$

Figure 4 - CRF Calculation
Caution should be used in the selection of appropriate CMFs. The following guidance should be considered when selecting CMFs for predictive crash analysis:

- CMFs should be selected from the HSM Part D or from the Federal Highway Administration's (FHWA) CMF Clearinghouse website (http://www.cmfclearinghouse.org).
- Read the countermeasure abstract to determine if the CMF is applicable to the proposed improvement.
- Only CMFs with a four-star rating or higher should be considered for use in analysis.
- Be sure the selected CMF is applicable to the set of crash data being used for analysis. Some CMFs may only be applicable to a subset of the crash data.
- The application of multiple CMFs can overestimate the expected crash reduction. Unless each CMF addresses independent crash types, multiple CMFs should not be used. It is suggested that no more than three independent CMFs be applied to a particular site.

The countermeasures proposed in this document were chosen because of their effectiveness in reducing crashes, particularly those associated with the approved LRSP risk factors. Some safety countermeasures that are recommended do not yet have CMF ratings, due to the amount of data and peer review that is required; however, preliminary studies show safety benefits as result of these countermeasures.

### 2.2. Segments

### 2.2.1. Segment Risk Factors

The following risk factors for roadway segments were approved by KDOT for use in the LRSP project.

- Average Daily Traffic (ADT) volumes
- Surface type (paved or unpaved)
- Roadway width
- Shoulder width
- Access density
- Presence of pavement markings
- Lane departure crash rate
- Edge condition
- Roadside assessment


### 2.2.2. Approved Segment Countermeasures

Table 1 lists segment countermeasures approved in the LRSP Pilot Phase, CMFs, and planninglevel estimated costs. The countermeasures were selected based on the approved risk factors for segments. The CMFs in the table are at times provided as a range, showing the range of potential crash modification the countermeasure can have based on differing research, specific crash types, or specific volume-level roadways (i.e., CMF can vary based on the amount of traffic on the road, vary based on reducing crash severity, or vary between rear-end and run-off-road crashes). The costs included in the table are high-level estimates prepared as part of the LRSP Pilot Phase and have been based on costs from other Midwest states and national averages. These cost estimates can be adjusted per the counties or KDOT to be more specific to their area if desired.

It should be noted that some curve countermeasures are included with the segment countermeasures to address potential risk at curves within a certain segment. Also, some of the countermeasures will require additional information from the county, as the data collected as part of this project is for a more "high-level"/systemic review. For example, information on vehicle turning movements, vehicle speeds, or superelevation rates were not collected. At the request of the counties, based on their local knowledge of the roadway network, the additional safety countermeasures can be added to the project sheets.

Table 1 also has two columns indicating the applicability of each countermeasure to paved or unpaved roadways.

Table 1 - Approved Segment Countermeasures

| Safety Countermeasure | Crash Modification Factor <br> (CMF) ${ }^{* *}$ | Estimated <br> Cost | Paved | Unpaved |
| :---: | :---: | :---: | :---: | :---: |

Countermeasures where Risk Factor Data for Recommendations has been Collected

| Install/Upgrade Guardrail | $\begin{gathered} 0.53-0.56 \\ \text { New Guardrail along } \\ \text { Embankment } \\ \hline \end{gathered}$ | \$35/foot | X | X |
| :---: | :---: | :---: | :---: | :---: |
| Delineate Roadside Hazards with Retroreflective Markers | CMF not defined | \$100/each | X | X |
| Remove/Relocate Fixed Objects in Clear Zone (e.g. tree, utility pole, culvert headwall, substandard guardrail) | FHWA Proven Countermeasure | \$1,000/each | X | X |
| Centerline Rumble Strips | 0.55-0.91 | \$2,000/mile | X |  |
| Install 4" Retroreflective Centerline | 0.76 when installed in combination with edgelines | \$2,100/mile | X |  |
| Install 6" Retroreflective Edgeline | 0.64-0.88 | \$4,200/mile | X |  |
| Edgeline Rumble Strips | 0.61-0.67 | \$5,000/mile | X |  |
| Post-Mounted Delineators | 0.55 when installed in combination with edgelines and centerlines | \$5,000/mile | X | X |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations | CMF not defined | \$5,000/mile | X |  |
| Install 18-inch Aggregate Shoulder Treatment | CMF not defined | \$15,000/mile | X |  |
| Clear and Grub | 0.78 | \$30,000/mile | X | X |
| Flattening and Widening <br> Foreslopes <br> (excludes culvert extension costs) | $0.58-0.90$ | \$75,000/mile | X | X |
| 2' Paved Shoulder with Safety Edge (includes earthwork) | $\begin{gathered} 0.75-0.99 \text { "Pave } \\ \text { Shoulder" } \\ 0.77-0.96 \text { "Safety Edge" } \end{gathered}$ | \$150,000/mile | X |  |

Countermeasures for a Segment that also has Curves

| Retroreflective Strips on Curve <br> Signage | CMF not defined | $\$ 100 /$ curve | X | X |
| :--- | :---: | :---: | :---: | :---: |
| Install/Upgrade Curve Signage <br> (Warning signs, Speed Advisory <br> plaques, Chevrons) to meet the | $0.59-0.61$ for warning <br> signs/plaques; <br> Manual on Uniform Traffic Control <br> Devices (MUTCD) and KDOT <br> Standards | $\$ 1,000-$ <br> $\$ 3,500 / c u r v e$ | X | X |


| Safety Countermeasure | Crash Modification Factor (CMF) ** | Estimated Cost | Paved | Unpaved |
| :---: | :---: | :---: | :---: | :---: |
| Transverse Rumble Strips Prior to Curve | 0.66 Install Transverse Rumble Strips as Traffic Calming Device | \$3,000/curve | X |  |
| Install High Friction Surface Treatment (HFST) | 0.48-0.76 | \$20,000/curve | X |  |
| Countermeasures for Specific Locations where Additional Data/Information is Needed |  |  |  |  |
| On-Pavement Markings for Speed Control | CMF not defined | $\begin{gathered} \$ 1,000- \\ \$ 3,000 / \text { each } \end{gathered}$ | X |  |
| Speed Activated Flashers on Chevron Signs | CMF not defined | \$4,000/each | X | X |
| Superelevation Correction on Curves | CMF not defined | \$20,000/curve | X | X |
| Remove/Relocate/Combine Driveways | CMF not defined | $\begin{gathered} \$ 20,000- \\ \$ 40,000 / \text { each } \end{gathered}$ | X | X |
| Conduct Road Safety <br> Audit/Assessment (RSA) * | CMF varies based on recommendations | $\begin{gathered} \$ 20,000- \\ \$ 40,000 / \text { each } \end{gathered}$ | X | X |
| Pave Roadway | CMF not defined | \$850,000/mile |  | X |

[^1]
### 2.3. Intersections

### 2.3.1. Intersection Risk Factors

The following risk factors for intersections were approved by KDOT for use in the LRSP project.

- Average Daily Traffic (ADT) on all approaches
- Distance from previous stop sign (along the LRSP routes)
- Location on a curve
- Skew
- Sight distance
- Proximity of driveway or another intersection
- Fatal or serious injury crash history
- Intersection control


### 2.3.2. Approved Intersection Countermeasures

Table 2 lists intersection countermeasures approved in the LRSP Pilot Phase, CMFs, and estimated costs. The countermeasures were selected based on the approved risk factors for intersections. Some of the countermeasures will require additional information from the county.

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At the request of the counties, based on their local knowledge of the roadway network, the additional safety countermeasures can be added to the project sheets.
Table 2 also has two columns indicating the applicability of each countermeasure to paved or unpaved roadways.

Table 2 - Approved Intersection Countermeasures

| Safety Countermeasure | Crash Modification Factor (CMF) ** | $\begin{aligned} & \text { Estimated } \\ & \text { Cost } \end{aligned}$ | Paved | Unpaved |
| :---: | :---: | :---: | :---: | :---: |
| Countermeasures where Risk Factor Data for Recommendations has been Collected |  |  |  |  |
| Retroreflective Strips on Stop Sign Posts | CMF not defined | \$100/ intersection | X | X |
| Install Second Stop Sign and Stop Ahead Signs | CMF not defined | \$1,200/leg | X | X |
| Transverse Rumble Strips on paved, Stop-Controlled Approaches | 0.79 | \$1,500/leg | X |  |
| Upgrade Signs and Pavement Markings | $0.4-0.69$ "Stop Ahead Pavement Markings" <br> $0.75-0.91$ "New Stop Sign" <br> CMF not defined "Intersection Warning Sign with Advance Street Name Sign Plaque" <br> CMF not defined "Stop Line" CMF not defined "Stop Ahead Sign" | \$2,200/leg | X | $\begin{gathered} \text { X } \\ \text { (signs } \\ \text { only) } \end{gathered}$ |
| Install Beacon on Stop Signs | 0.42-0.87 | \$2,500/sign | X | X |
| Install Stop Signs with LED Flashing Lights | CMF not defined | \$2,500/sign | X | X |
| Install Beacon on Intersection Warning Sign | CMF not defined | \$2,500/sign | X | X |
| Clear and Grub | 0.78 | \$2,500/leg | X | X |
| Intersection Lighting (one luminaire) | 0.62 | \$5,500/each | X | X |
| Realign Intersection Approaches to Reduce or Eliminate Skew | CMF varies based on original skew angle <br> 0.57 Change from 45 degrees to 90 <br> 0.6 Change from 60 degrees to 90 <br> 0.67 Change from 75 degrees to 90 | \$300,000/ paved leg <br> \$100,000/ unpaved leg | X | X |
| 091841008 KDOT LRSPs - Phase 1 <br> 2019-08-01 KDOT LRSP Tech Memo Countermeasures.docx Page 7 |  |  |  |  |


| Safety Countermeasure | Crash Modification Factor (CMF) ** | Estimated Cost | Paved | Unpaved |
| :---: | :---: | :---: | :---: | :---: |
| Countermeasures for Specific Locations where Additional Data/Information is Needed * |  |  |  |  |
| Removal of Unwarranted Stop Signs on Major Approach | CMF not defined | \$500/leg | X | X |
| Convert Two-Way Stop to All- <br> Way Stop <br> (if MUTCD warrants are met) | $0.52-1.12$ | \$1,200/leg | X | X |
| Install Intersection Conflict Warning System | 0.52-0.91 | \$40,000/each | X | X |
| Provide Left-Turn Lanes at Intersection | $0.42-0.52$ | \$150,000/leg | X |  |
| Provide Right-Turn Lanes at Intersection | 0.74-0.92 | \$150,000/leg | X |  |
| Install Traffic Signal (if MUTCD warrants are met) | 0.56 | $\begin{gathered} \$ 250,000 / \\ \text { each } \end{gathered}$ | X |  |
| Convert Offset T-Intersection to Four-Legged Intersection | CMF not defined | ```$300,000/ each paved $50,000/each unpaved``` | X | X |
| Convert Stop-Control to Roundabout | 0.18-0.42 | $\begin{gathered} \$ 1,500,000- \\ \$ 2,000,000 / \\ \text { each } \end{gathered}$ | X |  |

* An Intersection Control Evaluation (ICE) is recommended for intersection control changes (estimated cost of \$7,500 - \$20,000/each)
** The CMFs in this table are for information only, showing the range of potential crash modification the countermeasure can have based on differing research, specific crash types, or specific volume-level roadways (i.e., CMF can vary based on the amount of traffic on the road, vary based on reducing crash severity, or vary between crash type). The CMFs in this table should not be used for crash prediction without first assuring the CMF applies to the specific location and countermeasure implementation.


### 2.4. Curves

### 2.4.1. Curve Risk Factors

The following risk factors for horizontal curves were approved by KDOT for use in the LRSP project.

- Average Daily Traffic (ADT) volumes
- Curve radius
- Shoulder width
- Access density
- Fatal or serious injury crash history
- Presence of warning signs
- Superelevation
- Edge condition
- Roadside assessment


### 2.4.2. Approved Curve Countermeasures

Table 3 lists curve countermeasures approved in the LRSP Pilot Phase, CMFs, and estimated costs. The countermeasures were selected based on approved risk factors for horizontal curves. Some of the countermeasures will require additional information from the county. At the request of the counties, based on their local knowledge of the roadway network, the additional safety countermeasures can be added to the project sheets.

Table 3 also has two columns indicating the applicability of each countermeasure to paved or unpaved roadways, or both.

Table 3 - Approved Curve Countermeasures

| Safety Countermeasure | Crash Modification Factor (CMF) * | Estimated Cost | Paved | Unpaved |
| :---: | :---: | :---: | :---: | :---: |
| Countermeasures where Risk Factor Data for Recommendations has been Collected |  |  |  |  |
| Install/Upgrade Guardrail | $0.53-0.56$ <br> New Guardrail along Embankment | \$35/foot | X | X |
| Retroreflective Strips on Curve Signage | CMF not defined | \$100/curve | X | X |
| Install/Upgrade Curve Signage (Warning signs, Speed Advisory plaques, Chevrons) to meet the Manual on Uniform Traffic Control Devices (MUTCD) and KDOT Standards | $0.59-0.61$ for warning signs/plaques; <br> $0.75-0.96$ for chevrons | $\begin{gathered} \$ 1,000- \\ \$ 3,500 / \text { curve } \end{gathered}$ | X | X |
| Centerline Rumble Strips | 0.55-0.91 | \$2,000/mile | X |  |
| Install 4" Retroreflective Centerline | 0.76 when installed in combination with edgelines | \$2,100/mile | X |  |
| Clear and Grub | 0.78 | \$2,500/curve | X | X |
| Transverse Rumble Strips Prior to Curve | 0.66 Install Transverse Rumble Strips as Traffic Calming Device | \$3,000/curve | X |  |
| Install 6" Retroreflective Edgeline | 0.64-0.88 | \$4,200/mile | X |  |
| Edgeline Rumble Strips | 0.61-0.67 | \$5,000/mile | X |  |
| Post-Mounted Delineators | 0.55 when installed in combination with edgelines and centerlines | \$5,000/mile | X | X |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations | CMF not defined | \$5,000/mile | X |  |
| Install 18-inch Aggregate Shoulder Treatment | CMF not defined | \$15,000/mile | X |  |
| 091841008 KDOT LRSPs - Phase 1 <br> $2019-08-01$ KDOT LRSP Tech Memo Countermeasures.docx Page 9 |  |  |  |  |
|  |  |  |  |  |


| Safety Countermeasure | Crash Modification <br> Factor (CMF)* | Estimated Cost | Paved | Unpaved |
| :--- | :---: | :---: | :---: | :---: |
| Install High Friction Surface <br> Treatment (HFST) | $0.48-0.76$ | $\$ 20,000 /$ curve | X |  |
| Pave 2' Outside Shoulder with <br> Safety Edge (includes <br> earthwork) | $0.75-0.99$ "Pave <br> Shoulder" <br> $0.77-0.96$ "Safety Edge" | $\$ 150,000 /$ mile | X |  |
| Countermeasures for Specific Locations where Additional Data/lnformation is Needed |  |  |  |  |
| On-Pavement Markings for <br> Speed Control | CMF not defined | $\$ 1,000-$ <br> $\$ 3,000 /$ each | X |  |
| Speed Activated Flashers on <br> Chevron Signs | CMF not defined | $\$ 4,000 /$ each | X | X |
| Superelevation Correction on <br> Curves | CMF not defined | $\$ 20,000 /$ curve | X | X |

* The CMFs in this table are for information only, showing the range of potential crash modification the countermeasure can have based on differing research, specific crash types, or specific volume-level roadways (i.e., CMF can vary based on the amount of traffic on the road, vary based on reducing crash severity, or vary between crash type). The CMFs in this table should not be used for crash prediction without first assuring the CMF applies to the specific location and countermeasure implementation.


## 3. Additional Potential Countermeasures

With continuing research in transportation safety, it is necessary to review national best practices and recommended safety countermeasures. The following sections include additional safety countermeasures for KDOT and the Phase 1 counties to consider including recommendations where site location data/information would be needed.

While some of the previously noted countermeasures can be applied to unpaved roadways, there are additional countermeasures that could be considered specific to unpaved roadways. Nationally, there are relatively low percentages of fatal and serious injury crashes that occur on unpaved roadways when compared to paved roadways. As such, safety research has focused on paved roadways. The lack of research on the unpaved system results in very few CMFs defined for safety countermeasures on unpaved roadways.

Table 4, Table 5, and Table 6 have two columns indicating the applicability of each countermeasure to paved or unpaved roadways, or both.

### 3.1. Segments

Table 4 - Additional Segment Countermeasures

| Safety Countermeasure | Crash Modification <br> Factor (CMF) * | Estimated Cost | Paved | Unpaved |
| :--- | :---: | :---: | :---: | :---: |
| Install Guardrail Reflectors | CMF not defined | $<\$ 1 / f 0 o t$ <br> (negligible) | X | X |
| Reshape/Repair Roadway <br> Surface and Apply Dust <br> Suppressants | CMF not defined | $\$ 1,000-$ <br> $\$ 5,000 / \mathrm{mile}$ | X |  |
| Install a Dynamic Speed <br> Feedback Sign | $0.93-0.95$ | $\$ 4,000 /$ sign | X | X |
| Upgrade Roadway Surface (e.g., <br> millings, well-graded rock mix <br> with adequate binder) | CMF not defined | $\$ 8,000 /$ mile | X |  |
| Improve/Increase Roadway <br> Width (to meet standards) | CMF not defined | $\$ 20,000-$ <br> $\$ 30,000 / \mathrm{mile}$ | X | X |

* The CMFs in this table are for information only, showing the range of potential crash modification the countermeasure can have based on differing research, specific crash types, or specific volume-level roadways (i.e., CMF can vary based on the amount of traffic on the road, vary based on reducing crash severity, or vary between crash type). The CMFs in this table should not be used for crash prediction without first assuring the CMF applies to the specific location and countermeasure implementation.


### 3.2. Intersections

Table 5 - Additional Intersection Countermeasures

| Safety Countermeasure | Crash Modification Factor <br> (CMF) * | Estimated Cost | Paved | Unpaved |
| :--- | :---: | :---: | :---: | :---: |
| Install Raised Pavement <br> Markers (150'-300' on <br> Intersection Approach) | 0.87 | $\$ 500 /$ leg | X |  |
| Reshape Intersection for <br> Control Type | CMF not defined | $\$ 2,500 /$ each |  | X |
| Install a Dynamic Speed <br> Feedback Sign on <br> Intersection Warning Sign | $0.93-0.95$ | $\$ 4,000 /$ sign | X | X |
| Provide Bypass Lane on <br> Shoulder at T-intersection | CMF not defined | $\$ 50,000 /$ each | X |  |
| Install a Restricted Crossing <br> U-Turn (RCUT) Intersection | $0.46-0.65$ | $\$ 250,000 /$ each | X |  |

* The CMFs in this table are for information only, showing the range of potential crash modification the countermeasure can have based on differing research, specific crash types, or specific volume-level roadways (i.e., CMF can vary based on the amount of traffic on the road, vary based on reducing crash severity, or vary between crash type). The CMFs in this table should not be used for crash prediction without first assuring the CMF applies to the specific location and countermeasure implementation.


### 3.3. Curves

Table 6 - Additional Curve Countermeasures

| Safety Countermeasure | Crash Modification <br> Factor (CMF) * | Estimated Cost | Paved | Unpaved |
| :--- | :---: | :---: | :---: | :---: |
| Install In-Lane Curve Warning <br> Pavement Markings | 0.62 | $\$ 1,000 /$ each | X |  |
| Install Guardrail Reflectors | CMF not defined | $\$ 100 /$ curve | X | X |
| Install Raised Pavement <br> Markers (150'-300' in advance of <br> and along curve) | 0.87 | $\$ 1,000 /$ curve | X |  |
| Install a Dynamic Speed <br> Feedback Sign on Curve <br> Warning Sign | $0.93-0.95$ | $\$ 4,000 /$ sign | X | X |
| Reshape/Repair Roadway <br> Surface and Apply Dust <br> Suppressants | CMF not defined | $\$ 1,000-$ <br> $\$ 5,000 /$ mile | X |  |

* The CMFs in this table are for information only, showing the range of potential crash modification the countermeasure can have based on differing research, specific crash types, or specific volume-level roadways (i.e., CMF can vary based on the amount of traffic on the road, vary based on reducing crash severity, or vary between crash type). The CMFs in this table should not be used for crash prediction without first assuring the CMF applies to the specific location and countermeasure implementation.


### 3.4. Unpaved Roadways

A thorough resource on unpaved roads is provided by the FHWA entitled: Gravel Roads Construction \& Maintenance Guide, which can be found at the following website: https://www.fhwa.dot.gov/construction/pubs/ots15002.pdf. The guide includes detailed sections on the following topics:

- Routine Maintenance and Rehabilitation
- Drainage
- Surface Gravel
- Dust Control/Stabilization
- Innovations

The summary of the guide states: "The first and most basic thing to understand in road maintenance and construction is proper shape of the cross section. The road surface must have enough crown to drain water to the shoulder, but not excessive crown which impacts roadway safety." "When proper shape is established and good surface gravel is placed, many gravel road maintenance problems simply go away, and road users are provided the best possible service from gravel roads" (Gravel Roads Construction \& Maintenance Guide, FHWA, 2015). Figure 5 shows examples of proper unpaved road shapes.


Backslope: no steeper than soil stability will support and as flat as a R-O-W width allows.


Foreslope: recommended at $1 \mathrm{~V}: 3 \mathrm{H}$ slope or flatter if R-O-W width allows, never steeper than $1 \mathrm{~V}: 2 \mathrm{H}$
A flat bottom ditch is recommended if R-O-W width allows.


Figure 5 - Unpaved Roadway Proper Shape Guidance (Gravel Roads Construction \& Maintenance Guide, FHWA, 2015)

## 4. Next Steps

The next steps include processing of data to support the analysis of risk factors. Workshops will be conducted with each of the twenty Phase 1 LRSP counties to discuss transportation safety strategies and countermeasures.

After the workshops are conducted, a systemic analysis will be conducted for the Phase 1 LRSP counties to calculate risk factor scores for each roadway segment, intersection, and curve along the LRSP study routes. The segments, intersections, and curves with the highest risk factor scores will be reviewed and 10 locations will be selected for safety improvement consideration. Project sheets will be created for the locations selected which include associated recommended safety countermeasures.

Finally, a LRSP report will be produced for the counties, providing a summary of the project, risk factor information, and the project sheets.

Marion County

## APPENDIX G

LRSP Safety Workshop Meeting Minutes (without exhibits)
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| Attendee | Brice Goebel (Marion County)  <br>  Jim Stanek (TranSystems)  <br>  David Church (WSP) <br>  Terry Coder (WSP) <br>   <br>   <br> See Attached Attendance Sheet for  <br> additional attendees  |
| :--- | :--- |



## MINUTES:

The Marion County Local Road Safety Plan (LRSP) Safety Workshop was held at the Marion City Building (208 East Santa Fe, Marion, KS) on August 14, 2019, from approximately 9:00 to 11:20 a.m. TranSystems provided a PowerPoint presentation, presentation handout and maps of the County's LRSP routes. A copy of the presentation is included with these minutes.

The primary agenda items included the LRSP Background and Purpose, 5E's of Safety, an Overview of Crash Data, Systemic Risk Factors, and Potential Safety Countermeasures. Audience participation was encouraged throughout and group feedback times were provided to discuss locations of concern along the County's LRSP routes, along with the safety countermeasures that were presented. The feedback received and discussion regarding these topics is summarized below:

## General Items

I. Jim noted that LRSPs are being championed by KDOT. KDOT contacts within the Bureau of Local Projects are Bill Legge and Nelda Buckley.
2. As part of the 5E's of Safety discussion, the S.A.F.E. Program (Seatbelts Are For Everyone) was discussed. An attendee, Matt Voth with Marion County Fire District \#2, requested that we send him information about that program. This was completed by David Church as a follow-up to the meeting.

## LRSP Routes

Participants were given approximately 15 minutes to review the supplied county map and give feedback on specific locations of concern. Below are the specific locations mentioned or discussed:
I. Nighthawk and 190th: The intersection is a major concern because drivers on Nighthawk often run through the stop signs. The county has attempted to reduce the stop sign violations by placing flashing beacons on the signs; however, the issue is still occurring. It was noted that 190th (Old 56) carries the highest traffic volumes along the county's roads.
2. 90th at Chisholm Trail: A concern was expressed about the transition between paved and unpaved surfaces along 90th at this intersection. Drivers can lose control transitioning from the paved to the unpaved surface.
3. Diamond at 370th: This has the same concern as noted for 90 th at Chisholm Trail. Diamond is paved in Dickinson County and is unpaved in Marion County.
4. 90th and Falcon: Trees and other obstructions reduce the sight lines at this intersection.
5. Nighthawk and US-50 (on west side of Peabody): The intersection was noted as a concern even though this is on KDOT's system and not part of the LRSP project. The county is working with KDOT to address sight line concerns, high vehicle speeds and a pattern of crashes involving southbound and westbound traffic.
6. Kanza Road between 240th and 270th: This segment of road goes over the Marion Reservoir and has a winding horizontal alignment. Concerns along the segment include the existing curves, guardrail and foliage which can impact driver sight lines. Obstructions associated with guardrail were considered of most concern.
7. Ist/360th and D Streets near Quail Creek Road (in Ramona): The county road crosses the railroad tracks on a winding horizontal alignment. When drivers are travelling westbound, they are immediately met with a three-leg intersection (D Street) which has a large channelizing island. The curve impacts sight lines for drivers on D Street.
8. 290th (Main Street) at US-56/77 in Lincolnville: The intersection was noted as a concern even though this is on KDOT's system and not part of the LRSP project. There are sight line concerns for east/west traffic attempting to enter or cross the highway.
9. Railroad crossing on K-I5 (in Durham): The location was noted as a concern even though this is on KDOT's system and not part of the LRSP project. Participants expressed a concern about the timing of the gate arm descent prior to the arrival of a train. A number of school bus drivers have noted having difficulty stopping in time and would like the gate arms to drop sooner.
10. Pawnee and 210th: The intersection has some unusual geometry and signage that confuses drivers. When stopping northbound, drivers have an option to turn right onto a gravel road or follow the curve left on the paved road towards the Marion Reservoir. Realignment options have been considered as a potential improvement for this intersection.
II. Sunflower and I80th: Participants noted concerns with sight distance due to crops and trees near the intersection.
12. Old Mill Road between 50th and 60th: There is a narrow box/bridge on this segment.
13. 290th between Mustang and Nighthawk: There is a narrow box/bridge on this segment.
14. Kent Becker, Marion County Commissioner, noted that farmers are growing more corn and there is a lot of agricultural encroachment onto the right of way, particularly at intersection corners, which impacts sight lines. The county would like to reclaim some of the right of way to increase sight distance for drivers. They have policies in place, but these lack "teeth". Matt Voth (also a farmer) mentioned that this can be an education issue for the farmers. Randy West mentioned that different counties are working on preserving the right of way due to similar sight distance issues.
The participants were encouraged to notify Jim Stanek (TranSystems) or Brice Goebel (Marion County) about other locations of concern, if they identified any others after the meeting.

## Crash Data

Some items noted in the discussion of the crash data:
I. Findings for Marion County are excluded to crashes along the LRSP routes rather than all county roads.
2. The Crash Location Heat map (Exhibit 3D) has been included to show the intensity of crashes along the LRSP routes during the 5 -year analysis period. It was noted that while some crash characteristics will be considered as part of the risk factors on the project, the focus of the project is a systemic review of the LRSP routes rather than just targeting existing "hot spots".
3. A list of high crash locations will be developed as part of the project and provided to Brice Goebel for the County's use.
4. There was a discussion about drivers under the influence of drugs and how that can affect their behavior. Randy West noted that he attended a safety meeting with law enforcement and they explained that drivers under the influence have trouble seeing certain colors (e.g., red and blue). This can lead to frequent stop sign violations by these drivers.
5. Kent Becker mentioned that a number of run-off-road crashes are likely due to texting; however, it is difficult to determine without a driver's statement.

## Potential Safety Countermeasures

Countermeasures for the LRSP segments, intersections and curves were identified. Participants were given approximately 15 minutes to review these and give feedback on specific countermeasures that are either of interest or concern. The feedback received and subsequent discussion is summarized below:
I. Comments on edgeline and centerline rumble strips were generally less favorable, primarily due to the potential for pavement damage. Brice noted he has heard/seen many drivers hitting these types of rumble strips for long periods of time which is surprising.
2. Overall, the county liked the idea of clearing and grubbing given the concerns expressed with agricultural and foliage encroachment onto the right of way. Marion County passed an ordinance recently to establish guidelines to address agricultural encroachment. Even so, it can be difficult to monitor and regulate the landowners cleaning up their land that borders county roads. The recent flooding and rain has worsened conditions, and the county generally doesn't have the resources to fix concerns in a timely manner.
3. Removing or relocating fixed objects was considered a positive treatment. This could include some of the larger and more decorative rock/stone mailboxes along some of their roads, although there was some uncertainty regarding who has the authority to coordinate the removal or relocation with the property owner. An alternate treatment could be the use of retroreflective markers or strips so drivers can see them better at night.
4. An aggregate shoulder treatment could be useful, but only where there is some mild shoulder available. The county generally doesn't have much useful shoulders along their roads. Even their busiest stretch of road, 190th (Old 56), doesn't have much shoulder width.
5. While the paved shoulder with safety edge treatment was considered positive, it would likely not be very practical for them since they tend to use rock patching and/or cold mix asphalt when patching the roadway. Hot mix asphalt is too expensive to use.
6. Use of 6 -inch edge lines may be beneficial for the county because there are limited locations with shoulders. This was considered a positive treatment for keeping more drivers on the road.
7. Intersection lighting was considered positive.
8. Transverse rumble strips on stop-controlled approaches was considered a positive treatment, but not likely feasible for the county given their typical pavements (chip seal or cold mix asphalt). Milled in rumble strips work best for more long-term use. Joe Palic noted that KDOT's practice is to use $3 / 8$-inch depth for these. Again, this is likely not practical for many of the county's roads.
9. There was positive feedback about adding flags, beacons, LEDs or even strobe lights to signs to potentially alert drivers. The participants also noted they liked the idea of speed monitor message boards in select areas known for higher vehicle speeds.
10. The use of warning signs and possibly delineators along curves were considered positive treatments. The county noted that they follow MUTCD standards regarding signing for their curves, even though they generally don't have that many curves.

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## Conclusion

As part of the Next Steps discussion, Jim explained how Marion County can benefit from their LRSP by using information in the report to apply for safety improvement funds (HRRR funding) through KDOT for safety improvements at their top safety project locations. Earlier in the presentation it was noted that by having a completed LRSP, a county will get extra points added to their application score. Previous KDOT guidance has indicated that the funds need to be used for a systemic improvement rather than a maintenance project.

Reports from the four LRSP Pilot counties were available for the participants to review. Jim noted that three of the four counties were able to obtain High Risk Rural Road (HRRR) funding for improvement projects by using the information provided within their report.

The participants were encouraged to contact Jim Stanek (TranSystems) or Brice Goebel (Marion County) if they have any additional comments about the information that was presented. Brice also asked the Fire Department and School District to talk with their staff about the LRSP and get their feedback to Jim Stanek.

The meeting concluded at approximately II:20 a.m.

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Agenda
$\begin{aligned} & \text { Introductions and Safety Briefing } \\ & \text { LRSP Background and Purpose } \\ & \text { 5E's of Safety } \\ & \text { Overview of Crash Data } \\ & \text { - LRSP Pilot Phase, LRSP Phase I and Your LRSP Routes } \\ & \text { Systemic Risk Factors } \\ & \text { - Segments, Intersections and Horizontal Curves } \\ & \text { Potential Safety Countermeasures } \\ & \text { - Segments, Intersections and Horizontal Curves } \\ & \text { Next Steps }\end{aligned}$


- Kansas’ Strategic Highway Safety Plan (SHSP)

- 

Five Year Average Fatalities by System (2009-2013)

plan to
crash statistics
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effectively make



Monthly Conference Calls
and
Safety Workshop

5E's of Safety
Strategies to prevent Crashes
Bang!
Golden Hour
Seatbelt Usage
"Hot Spot" Analysis


Your LRSP Routes
Where are your specific locations of concern?

- Segments
- Intersections
- Curves


19-County Region in the Kansas Department of Health and
Environment's South Central Healthcare Coalition




Marion



#### Abstract




| 2 |
| :--- |
| $\frac{1}{3}$ |
| $\frac{1}{3}$ |

Harvey
Sedgwick


Rice
,
Kingman

Barber Harper
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| $\square$ Pilot Phase Counties |
| :--- |
| $\square$ |
| 19-County Region |

Legend




$$
\begin{aligned}
& \text { Crash Data: LRSP Pilot Phase } \\
& \text { Crashes on straight roadway segments (paved or } \\
& \text { unpaved) are most common: } \\
& -78 \% \text { of all crashes, with } 67 \% \text { of the } K+A \text { crashes }
\end{aligned}
$$


Pilot Phase

$$
\begin{aligned}
& \text { Crashes on straight roadway segments: } \\
& \text { - Many involved running off road (right or left), animal } \\
& \text { collisions (hitting or swerving to avoid), or crossing } \\
& \text { centerline } \\
& \text { - Many coded as "non-collision" meaning the vehicle did not } \\
& \text { collide with another vehicle or object } \\
& \text { Crashes at intersections were primarily angle or side- } \\
& \text { impact crashes } \\
& \text { Crashes on curves were less frequent, but generally } \\
& \text { more severe }(6 \% \text { of all crashes, but } 12 \% \text { of the K+A crashes) }
\end{aligned}
$$

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County Paved
318 Total, 13 K \& A
$(91 \%$ Total, $87 \%$ K \& A)




| Risk Factor | Issue |
| :---: | :---: |
| Average Daily Traffic (ADT) volumes | Exposure |
| Surface type (paved or unpaved) | Surface type |
| Roadway width | Staying on the roadway |
| Shoulder width | Staying on the roadway, recovery from crash |
| Access density | Conflicting movements along the segment |
| Presence of pavement markings | Staying on the roadway |
| Lane departure crash rate | History of issues staying on roadway |
| Edge condition | Ability of vehicle to recover from a roadway departure |
| Roadside assessment | Roadside collision hazard |



| Risk Factor | Issue |
| :---: | :---: |
| Average Daily Traffic (ADT) on all <br> approaches | Exposure |
| Distance from previous stop sign <br> (along the LRSP routes) | Running the intersection |
| Location on a curve | Running the intersection, sight visibility |
| Skew | Running the intersection, sight visibility |
| Sight distance | Running the intersection, sight visibility |
| Proximity of driveway or another intersection | Conflicting movements near intersection |
| Fatal or serious injury crash history | History of potential safety issues |
| Intersection control | Control type |


| Risk Factor | Issue |
| :---: | :---: |
| Average Daily Traffic (ADT) volumes | Exposure |
| Curve radius | Staying on roadway |
| Shoulder width | Conflicting movements near horizontal curve, sight <br> visibility |
| Access density | History of potential safety issues |
| Fatal or serious injury crash history | Staying on roadway |
| Presence of warning signs | Staying on roadway |
| Superelevation | Ability of vehicle to recover from a roadway departure |
| Edge condition | Roadside collision hazard |
| Roadside assessment |  |




| Safety Countermeasure | Crash Modification Factor <br> (CMF) | Estimated Cost | Paved | Unpaved |
| :--- | :---: | :---: | :---: | :---: |
| Install $6^{n}$ Retroreflective Edgeline | $0.64-0.88$ | $\$ 4,200 / \mathrm{mile}$ | X |  |
| Install 4 " Retroreflective Centerline | 0.76 when installed in <br> combination with edgelines | $\$ 2,100 / \mathrm{mile}$ | X |  |
| Edgeline Rumble Strips | $0.61-0.67$ | $\$ 5,000 / \mathrm{mile}$ | X |  |
| Centerline Rumble Strips | $0.55-0.91$ | $\$ 2,000 / \mathrm{mile}$ | X |  |
| Install a Dynamic Speed Feedback Sign | $0.93-0.95$ | $\$ 4,000 / \mathrm{sign}$ | X | X |

Ranges indicate potential crash modification
results based on:

- differing research
- crash types
- volume levels

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| Potentia Segnnent counternneasures |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Safety Countermeasure | Crash Modification Factor (CMF) | Estimated Cost | Paved | Unpaved |
| Delineate Roadside Hazards with Retroreflective Markers | CMF not defined | \$100/each | X | X |
| Remove/Relocate Fixed Objects in Clear Zone (e.g. tree, utility pole, culvert headwall, substandard guardrail) | FHWA Proven Countermeasure | \$1,000/each | X | X |
| Post-Mounted Delineators | 0.55 when installed in combination with edgelines and centerlines | \$5,000/mile | X | X |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations | CMF not defined | \$5,000/mile | X |  |
| Reshape/Repair Roadway Surface and Apply Dust Suppressants | CMF not defined | $\begin{gathered} \$ 1,000- \\ \$ 5,000 / \mathrm{mile} \end{gathered}$ |  | X |
| Upgrade Roadway Surface (e.g., millings, well-graded rock mix with adequate binder) | CMF not defined | \$8,000/mile |  | X |
| Install 18-inch Aggregate Shoulder Treatment | CMF not defined | \$15,000/mile | X |  |
| Clear and Grub | 0.78 | \$30,000/mile | X | X |

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ountermeasures


| Safety Countermeasure | Crash Modification Factor (CMF) | Estimated Cost | Paved | Unpaved |
| :---: | :---: | :---: | :---: | :---: |
| Improve/Increase Roadway Width (to meet standards) | CMF not defined | $\begin{gathered} \$ 20,000- \\ \$ 30,000 / \mathrm{mile} \end{gathered}$ | X | X |
| Install/Upgrade Guardrail | $0.53-0.56$ <br> New Guardrail along Embankment | \$35/foot | X | X |
| Install Guardrail Reflectors | CMF not defined | < \$1/foot (negligible) | X | X |
| Flattening and Widening Foreslopes (excludes culvert extension costs) | 0.58-0.90 | \$75,000/mile | X | X |
| 2' Paved Shoulder with Safety Edge (includes earthwork) | $0.75-0.99$ "Pave Shoulder" $0.77-0.96$ "Safety Edge" | \$150,000/mile | X |  |
| Remove/Relocate/Combine Driveways | CMF not defined | $\begin{gathered} \$ 20,000- \\ \$ 40,000 / \text { each } \end{gathered}$ | X | X |
| Conduct Road Safety <br> Audit/Assessment (RSA) * | CMF varies based on recommendations | $\begin{gathered} \$ 20,000- \\ \$ 40,000 / \text { each } \end{gathered}$ | X | X |
| Pave Roadway | CMF not defined | \$850,000/mile |  | X |

* Countermeasure recommended on segments with high crash rates


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| Safety Countermeasure | Crash Modification Factor <br> (CMF) | Estimated <br> Cost | Paved | Unpaved |
| :--- | :---: | :---: | :---: | :---: |
| Intersection Lighting (one luminaire) | 0.62 | $\$ 5,500 /$ each | X | X |
| Upgrade Signs and <br> Pavement Markings | $0.4-0.69$ "Stop Ahead Pavement Markings" <br> $0.75-0.91$ "New Stop Sign" <br> CMF not defined "Intersection Warning Sign <br> with Advance Street Name Sign Plaque" <br> CMF not defined "Stop Line" <br> CMF not defined "Stop Ahead Sign" | $\$ 2,200 / \mathrm{leg}$ | X | X <br> (signs <br> only) |
| Retroreflective Strips on Stop Sign <br> Posts | CMF not defined | $\$ 100 /$ <br> intersection | X | X |
| Install Raised Pavement Markers <br> (150'-300' on Intersection Approach) | 0.87 | $\$ 500 / \mathrm{leg}$ | X |  |
| Install Second Stop Sign and Stop <br> Ahead Signs | CMF not defined | $\$ 1,200 / \mathrm{leg}$ | X | X |
| Transverse Rumble Strips on <br> paved, Stop-Controlled Approaches | 0.79 | $\$ 1,500 / \mathrm{leg}$ | X |  |

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| Safety Countermeasure | Crash Modification Factor (CMF) | Estimated Cost | Paved | Unpaved |
| :---: | :---: | :---: | :---: | :---: |
| Install Beacon on Stop Signs | 0.42-0.87 | \$2,500/sign | X | X |
| Install Stop Signs with LED Flashing Lights | CMF not defined | \$2,500/sign | X | X |
| Install Beacon on Intersection Warning Sign | CMF not defined | \$2,500/sign | X | X |
| Install a Dynamic Speed Feedback Sign on Intersection Warning Sign | 0.93-0.95 | \$4,000/sign | X | X |
| Clear and Grub | 0.78 | \$2,500/leg | X | X |
| Reshape Intersection for Control Type | CMF not defined | \$2,500/each |  | X |
| Realign Intersection Approaches to Reduce or Eliminate Skew | CMF varies based on original skew angle 0.57 Change from 45 degrees to 90 <br> 0.6 Change from 60 degrees to 90 <br> 0.67 Change from 75 degrees to 90 | \$300,000/ paved leg <br> \$100,000/ unpaved leg | X | X |

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Use Restricted 23 U.S.C. § 409
Countermeasures

Potential
,
Removal of Unwarranted Stop Signs on Major Approach

| Safety Countermeasure * | Crash Modification Factor (CMF) | Estimated Cost | Paved | Unpaved |
| :---: | :---: | :---: | :---: | :---: |
| Removal of Unwarranted Stop Signs on Major Approach | CMF not defined | \$500/leg | X | X |
| Convert Two-Way Stop to All-Way Stop (if MUTCD warrants are met) | 0.52-1.12 | \$1,200/leg | X | X |
| Install Intersection Conflict Warning System | $0.52-0.91$ | \$40,000/each | X | X |
| Provide Bypass Lane on Shoulder at Tintersection | CMF not defined | \$50,000/each | X |  |
| Provide Left-Turn Lanes at Intersection | 0.42-0.52 | \$150,000/leg | X |  |
| Provide Right-Turn Lanes at Intersection | 0.74-0.92 | \$150,000/leg | X |  |
| Install Traffic Signal (if MUTCD warrants are met) | 0.56 | $\begin{gathered} \$ 250,000 / \\ \text { each } \\ \hline \end{gathered}$ | X |  |
| Install a Restricted Crossing U-Turn (RCUT) Intersection | $0.46-0.65$ | $\begin{aligned} & \$ 250,000 / \\ & \text { each } \end{aligned}$ | X |  |
| Convert Offset T-Intersection to Four-Legged Intersection | CMF not defined | \$300,000/ each paved \$50,000/ each unpaved | X | X |
| Convert Stop-Control to Roundabout | 0.18-0.42 | $\begin{gathered} \$ 1,500,000- \\ \$ 2,000,000 / \\ \text { each } \end{gathered}$ | X |  |

${ }^{*}$ An Intersection Control Evaluation (ICE) is recommended for intersection control changes (estimated cost of \$7,500 - \$20,000/each)

P

| $\begin{array}{c}\text { Safety Countermeasure }\end{array}$ | $\begin{array}{c}\text { Crash Modification Factor } \\ \text { (CMF) }\end{array}$ | $\begin{array}{c}\text { Estimated } \\ \text { Cost }\end{array}$ | Paved |
| :--- | :---: | :---: | :---: |
| Unpaved |  |  |  |$)$



Use Restricted 23 U.S.C. § 409

|  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Safety Countermeasure | Crash Modification Factor (CMF) | Estimated Cost | Paved | Unpaved |
| Clear and Grub | 0.78 | \$2,500/curve | X | X |
| Transverse Rumble Strips Prior to Curve | 0.66 Install Transverse Rumble Strips as Traffic Calming Device | \$3,000/curve | X |  |
| Install/Upgrade Guardrail | $0.53-0.56$ <br> New Guardrail along Embankment | \$35/foot | X | X |
| Install Guardrail Reflectors | CMF not defined | \$100/curve | X | X |
| Install High Friction Surface Treatment (HFST) | 0.48-0.76 | \$20,000/curve | X |  |
| Pave 2' Outside Shoulder with Safety Edge (includes earthwork) | 0.75 - 0.99 "Pave Shoulder" $0.77-0.96$ "Safety Edge" | \$150,000/mile | X |  |
| Reshape/Repair Roadway Surface and Apply Dust Suppressants | CMF not defined | $\begin{gathered} \$ 1,000- \\ \$ 5,000 / \mathrm{mile} \end{gathered}$ |  | X |
| On-Pavement Markings for Speed Control | CMF not defined | $\begin{gathered} \$ 1,000- \\ \$ 3,000 / \text { each } \end{gathered}$ | X |  |
| Speed Activated Flashers on Chevron Signs | CMF not defined | \$4,000/each | X | X |
| Superelevation Correction on Curves | CMF not defined | \$20,000/curve | X | X |

Countermeasures
Potential Curve

Potential Safety Countermeasures
Workshop Feedback Opportunity:
What countermeasures interest you? Why?
What countermeasures concern you? Why?
Next Steps

$$
\begin{aligned}
& \text { Refine and Prioritize Strategies } \\
& \text { Rank Locations based on Risk Factor Scores } \\
& \text { Identify Safety Projects } \\
& \text { Develop LRSP Report with materials that can be } \\
& \text { used to apply for HRRR Funds }
\end{aligned}
$$

Marion County
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IranSystems
Kimley»)Horn

## APPENDIX H

## Safety Resources

# Safety Resources 

KDOT's Traffic Safety Section Page<br>https://www.ksdot.org/bureaus/burTrafficSaf/default.asp

KDOT's Law Enforcement Liaison Program Page https://www.ksdot.org/bureaus/burTrafficSaf/lel/lawEnL.asp

Law Enforcement Liaison Regions


```
Dave Corp
316/250-9654
Ddc394@aol.com
```

Bob Hamilton
913/558-9423
bobhlel@gmail.com


Troy Wells 316/259-8405 wellsd0537@cox.net

Kansas Traffic Safety Resource Office https://www.ktsro.org/

Vision Zero Webpage
http://visionzeronetwork.org/

National Traffic Safety Board
https://www.ntsb.gov/Pages/default.aspx
Kansas DUI Impact Center
https://ksdui.org

KDOT Crash Record Request https://kdotapp.ksdot.org/CrashRecords/AcceptTerms.aspx

ITE Vision Zero Page http://www.ite.org/visionzero/

National Highway Traffic Safety Administration
https://www.nhtsa.gov/
MADD State Statistics
https://www.madd.org/state-statistics

Marion County

# APPENDIX I <br> Risk Factor Ranking and Countermeasure Selection Technical Memorandum 

# KDOT Local Road Safety Plans <br> (LRSPs) - Phase 1 <br> KDOT PROJECT NO: 106 C-4790-02 

CLARK, COMANCHE, COWLEY, CRAWFORD, DOUGLAS, ELLIS, FORD, GRANT, GRAY, HASKELL, JEFFERSON, KIOWA, LYON, MARION, MEADE, MONTGOMERY, NESS, PAWNEE, REPUBLIC, AND RICE COUNTIES

Prepared for:
KDOT Bureau of Local Projects
Eisenhower State Office Building
700 S.W. Harrison Street, $3^{\text {rd }}$ Floor West
Topeka, Kansas 66603-3745
785-296-3861

Prepared by:

## TranSystems

EXPERIENCE | Transportation

## Kimley»Horn

# TECHNICAL MEMORANDUM - RISK FACTOR RANKING AND COUNTERMEASURE SELECTION 

FOR

# KDOT Local Road Safety Plans (LRSPs) Phase 1 

KDOT PROJECT NO: 106 C-4790-02

Prepared for:
KDOT Bureau of Local Projects
Eisenhower State Office Building
700 S.W. Harrison Street, $3^{\text {rd }}$ Floor West
Topeka, Kansas 66603-3745
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## Table of Contents

1. Introduction ..... 1
1.1. Purpose ..... 1
2. Risk Factor Scoring Criteria .....  2
2.1. LRSP Phase 1 Scoring Modifications ..... 2
2.1.1. Unpaved Roads .....
2.1.2. Intersection Control ..... 2
2.1.3. Access Density. ..... 2
2.1.4. Crash Experience ..... 3
2.1.5. Intersection Skew ..... 3
2.1.6. Edge Condition and Roadside Assessment. ..... 3
3. Project Selection Threshold Tables ..... 7
3.1. LRSP Phase 1 Threshold Modifications ..... 7
3.1.1. General Modifications ..... 7
3.1.2. Revised Countermeasures ..... 7
3.1.3. Thresholds ..... 7
4. Next Steps. ..... 10
List of Figures
Figure 1 - Location of LRSP Counties ..... 1
List of Tables
Table 1 - Crash Analysis by Intersection Control Type ..... 2
Table 2 - Segment Risk Factor Scoring Criteria. ..... 4
Table 3 - Intersection Risk Factor Scoring Criteria ..... 5
Table 4 - Curve Risk Factor Scoring Criteria ..... 6
Table 5 - Segment Countermeasure Project Selection Thresholds ..... 8
Table 6 - Intersection Countermeasure Project Selection Thresholds ..... 9
Table 7 - Curve Countermeasure Project Selection Thresholds ..... 9

## LISt OF Acronyms

| ADT | Average Daily Traffic |
| :--- | :--- |
| CMF | Crash Modification Factor |
| FHWA | Federal Highway Administration |
| HFST | High-Friction Surface Treatment |
| KDOT | Kansas Department of Transportation |
| LRSP | Local Road Safety Plan |
| MUTCD | Manual on Uniform Traffic Control Devices |
| SHSP | Strategic Highway Safety Plan |

## 1. Introduction

The Kansas Department of Transportation (KDOT), as part of their strategic goal to reduce fatalities and serious injuries within Kansas is conducting Phase 1 of the Local Road Safety Plan (LRSP) process for twenty counties within the state. Four counties were included in the Pilot Phase of this process, which was completed in 2018. The LRSP concept is built on the foundation established by the Strategic Highway Safety Plan (SHSP). Figure 1 shows the location of the Phase 1 LRSP counties and the Pilot Phase counties.


Figure 1 - Location of LRSP Counties

### 1.1. Purpose

This technical memorandum has been prepared to provide risk factor scoring criteria based on the approved risk factors as well as project selection threshold tables to be used in determining applicable countermeasures for identified safety project locations. The risk factors and countermeasures presented in this document were approved in previous technical memos. It should be noted that the purpose of this risk factor scoring analysis is to help prioritize which segments, intersections, and curves share similar attributes that could contribute to crash risk and to identify countermeasures that could reduce the potential for a fatal or serious injury crash.

## 2. Risk Factor Scoring Criteria

Risk factor scoring criteria was determined during the Pilot Phase of the LRSP project and reviewed as part of the Phase 1 project. Table 2 includes the risk factor scoring criteria for segments, Table 3 for intersections, and Table 4 for curves.

### 2.1. LRSP Phase 1 Scoring Modifications

Some minor clarifications and modifications are recommended to these tables as detailed in the following sections. The proposed modifications maintain the same maximum number of risk factor score points (24) as were included in the LRSP Pilot project.

### 2.1.1. Unpaved Roads

The tables have been revised to including the text "or unpaved road" in the scoring criteria of shoulder width that receive 0 points, and presence of pavement markings for 0 points.

### 2.1.2. Intersection Control

The intersection control risk factor scoring was reversed to include a risk factor point where the intersection control was identified as stop-controlled (as opposed to the yield/uncontrolled control), as more crashes (and fatal and serious injury crashes) are associated with stopcontrolled intersections based on the crash analysis conducted as part of this study.

Based on the crash data provided as part of the LRSP Phase 1 project, there were a total of 241 intersection crashes within the 20 counties along LRSP routes. Table 1 includes a breakdown of the intersection crashes showing a crash rate $40 \%$ higher for stop-controlled intersection, consistent with assessing risk factor points for stop-controlled intersections as opposed to yield or uncontrolled intersections. Two of the crashes occurred at a signalized intersection and are not included in the table.

Table 1 - Crash Analysis by Intersection Control Type

|  | Stop Control | Yield/Uncontrolled |
| :--- | :---: | :---: |
| Number of Intersections | 3,975 | 727 |
| Number of Intersection Crashes | 221 | 18 |
| Crashes per Intersection | 0.56 | 0.25 |
| Average Daily Entering Vehicles | 483 | 300 |
| Average Number of Crashes per million entering vehicles | 115.1 | 82.5 |

### 2.1.3. Access Density

Based on the characteristics of access points along the LRSP routes, many of which are lowvolume field access points, the access density risk factor score total was reduced from 3 to 2 , to give access density less weight in risk factor scoring for segments, intersections, and curves.

### 2.1.4. Crash Experience

To provide more weight to locations where priority crash types have occurred in the past, the risk factor scores were adjusted from 2 to 3 for the maximum number of points for segments and curves.

### 2.1.5. Intersection Skew

The maximum risk factor score for an intersection based on skew was increased from 2 to 3 points. This change was made to increase the impact to the score of having a significant skew on at least one leg of the intersection, targeting associated priority crash types.

### 2.1.6. Edge Condition and Roadside Assessment

To further help identify segments and curves with risk factors that could contribute to run-off-road crashes, the scoring criteria for edge condition and roadside assessment were modified to include a score of 0 where a rating of 2.75 to 3 was recorded. This range allows for less risk factor points to be applied where conditions are generally good with minimal apparent edge drop-offs or roadside hazards.

Table 2 - Segment Risk Factor Scoring Criteria

| Risk Factor | Measurement | Points | Max Points Available |
| :---: | :---: | :---: | :---: |
| Volume | Average roadway segment volume per county (ADT) | 0: ADT within 0\%-14.3\% percentile range | 6 |
|  |  | 1: ADT within 14.3\%-28.6\% percentile range |  |
|  |  | 2: ADT within $28.6 \%-42.9 \%$ percentile range |  |
|  |  | 3: ADT within 42.9\%-57.1\% percentile range |  |
|  |  | 4: ADT within $57.1 \%-71.4 \%$ percentile range |  |
|  |  | 5: ADT within 71.4\%-85.7\% percentile range |  |
|  |  | 6: ADT within $85.7 \%-100 \%$ percentile range |  |
| Access density | Density of intersections and driveways per mile | 0: Bottom third of the access density Crash Modification Factor (CMF)* | 2 |
|  |  | 1: Middle third of the access density CMF* |  |
|  |  | 2: Top third of the access density CMF* |  |
| Edge condition | Observed condition rating | 0 : Rating of 2.75-3 | 3 |
|  |  | 1: Top third of remaining ratings |  |
|  |  | 2: Middle third of remaining ratings |  |
|  |  | 3: Bottom third of remaining ratings |  |
| Roadside assessment | Observed condition rating | 0 : Rating of 2.75-3 | 3 |
|  |  | 1: Top third of remaining ratings |  |
|  |  | 2: Middle third of remaining ratings |  |
|  |  | 3: Bottom third of remaining ratings |  |
| Roadway width | Width in feet | 0: Roadway width greater than or equal to 22 feet | 2 |
|  |  | 2: Roadway width less than 22 feet |  |
| Shoulder width | Width in feet of recoverable area prior to a ditch or fill slope | 0: 4-foot shoulder and greater, or unpaved road | 2 |
|  |  | 1: 2-foot shoulder to 4-foot shoulder |  |
|  |  | 2: less than 2-foot shoulder |  |
| Lane departure crash rate | Lane departure crashes per MVMT | 0 : Bottom fourth of roadway departure crash rates along the roadway segments | 3 |
|  |  | 1: Second lowest fourth of roadway departure crash rates along the roadway segments |  |
|  |  | 2: Second highest fourth of roadway departure crash rates along the roadway segments |  |
|  |  | 3: Top fourth of roadway departure crash rates along the roadway segments |  |
| Presence of pavement markings | Observed presence of markings | 0 : Both centerline and edgeline present, or unpaved road | 2 |
|  |  | 1: Centerline or edgeline present |  |
|  |  | 2: Neither centerline or edgeline present |  |
| Surface type | Paved or unpaved | 0 : Paved | 1 |
|  |  | 1: Unpaved |  |

* Access Density CMF Equation as presented in the Highway Safety Manual (Equation 13-7).

Table 3 - Intersection Risk Factor Scoring Criteria

| Risk Factor | Measurement | Points | Max Points Available |
| :---: | :---: | :---: | :---: |
| Volume | Average Daily Traffic (ADT) on all approaches per intersection with a paved approach per county | 0 : ADT within 0\%-14.3\% percentile range | 6 |
|  |  | 1: ADT within $14.3 \%-28.6 \%$ percentile range |  |
|  |  | 2: ADT within $28.6 \%-42.9 \%$ percentile range |  |
|  |  | 3: ADT within 42.9\%-57.1\% percentile range |  |
|  |  | 4: ADT within $57.1 \%-71.4 \%$ percentile range |  |
|  |  | 5: ADT within $71.4 \%-85.7 \%$ percentile range |  |
|  |  | 6: ADT within $85.7 \%-100 \%$ percentile range |  |
| Access density | Number of driveways or intersections within 500 feet of the intersection | 0 : None | 2 |
|  |  | 1: 1 or 2 Access Points |  |
|  |  | 2: More than 2 Access Points |  |
| Sight distance | Based on field observations | 0 : Adequate | 3 |
|  |  | 3: Limited |  |
| Horizontal curvature | Intersection on a curve | 0: No | 3 |
|  |  | 3: Yes |  |
| Crash experience | Fatal or serious injury crashes | 0: None | 3 |
|  |  | 3: 1 or more |  |
| Distance from previous stop sign | Based on field data collection | 0: 1.5 miles or less | 3 |
|  |  | 2: 1.5 miles to less than 5 miles |  |
|  |  | 3: 5 miles or more |  |
| Skewed approach | Degrees | 0: 75 degree to 90 -degree intersection approaches | 3 |
|  |  | 3: 75 degree or less intersection approach |  |
| Intersection control | Observed control type | 0: Yield/None | 1 |
|  |  | 1: Stop |  |

Table 4 - Curve Risk Factor Scoring Criteria

| Risk Factor | Measurement | Points | Max Points Available |
| :---: | :---: | :---: | :---: |
| Volume | Average curve volume per county | 0: ADT within 0\%-14.3\% percentile range | 6 |
|  |  | 1: ADT within 14.3\%-28.6\% percentile range |  |
|  |  | 2: ADT within $28.6 \%-42.9 \%$ percentile range |  |
|  |  | 3: ADT within 42.9\%-57.1\% percentile range |  |
|  |  | 4: ADT within $57.1 \%-71.4 \%$ percentile range |  |
|  |  | 5: ADT within 71.4\%-85.7\% percentile range |  |
|  |  | 6: ADT within $85.7 \%-100 \%$ percentile range |  |
| Curve radius | Radius of curve in feet per county | 0 : Top fourth of curve radii | 3 |
|  |  | 1: Second highest fourth of curve radii |  |
|  |  | 2: Second lowest fourth of curve radii |  |
|  |  | 3: Bottom fourth of curve radii |  |
| Access density | Intersections or driveways within 500 feet of the curve | 0 : None | 2 |
|  |  | 1: 1 or 2 Access Points |  |
|  |  | 2: More than 2 Access Points |  |
| Shoulder width | Width in feet of recoverable area prior to a ditch or fill slope | 0: 4-foot shoulder and greater, or unpaved road | 2 |
|  |  | 1: 2-foot shoulder to 4-foot shoulder |  |
|  |  | 2: less than 2-foot shoulder |  |
| Edge condition | Observed condition rating | 0 : Rating of 3 | 2 |
|  |  | 1: Rating of 2 |  |
|  |  | 2: Rating of 1 |  |
| Roadside assessment | Observed condition rating | 0 : Rating of 3 | 2 |
|  |  | 1: Rating of 2 |  |
|  |  | 2: Rating of 1 |  |
| Superelevation | Presence of superelevation | 0: Yes | 2 |
|  |  | 2: No |  |
| Crash experience | Fatal or serious injury crashes | 0: None | 3 |
|  |  | 3: 1 or more |  |
| Presence of warning signs | Observed presence | 0: Present | 2 |
|  |  | 2: Not present |  |

## 3. Project Selection Threshold Tables

Countermeasure project selection threshold tables were developed during the Pilot Phase of the LRSP project and reviewed as part of the Phase 1 project. Table 5, Table 6, and Table 7 include the threshold tables for segments, intersections, and curves respectively.

### 3.1. LRSP Phase 1 Threshold Modifications

Based on the findings of the LRSP Pilot Phase and a review of appropriate countermeasures as documented in previous technical memoranda, some modifications were made to the thresholds and countermeasures included within the tables as detailed in the following sections.

### 3.1.1. General Modifications

The threshold tables from the LRSP Pilot Phase were updated to match the language, updated CMFs, and costs approved in the Phase 1 Countermeasures tech memo, which included various minor modifications.

### 3.1.2. Revised Countermeasures

The intersection countermeasure: "Review and Install/Upgrade Intersection Warning Sign" was removed, as the installation of intersection warning signs are included in the countermeasure "Upgrade Signs and Pavement Markings".

### 3.1.3. Thresholds

Where some countermeasures did not have an identified threshold in the LRSP Pilot Phase, one was added in the Phase 1 tables. These modifications included adding the thresholds "based upon video review" and "all" for various countermeasures.

The thresholds for improving edge rut conditions on segments and curves were modified from requiring an aggregate shoulder to including all "unpaved" shoulders, as the countermeasure can be effectively deployed without an existing aggregate shoulder.

| Safety Countermeasure | CMF | Cost | Short-Term | Long-Term | Threshold |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Install 6" Retroreflective Edgeline (Both Sides of Road) | 0.64-0.88 | \$4,200/mile | X |  | All |
| Install 4" Retroreflective Centerline | 0.76 | \$2,100/mile | X |  | All |
| Delineate Roadside Hazards with Retroreflective Markers | not defined | \$100/each | X |  | All (10 markers per mile) |
| Clear and Grub (Both Sides of Road) | 0.78 | \$30,000/mile | X |  | All |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations (Both Sides of Road) | not defined | \$5,000/mile | X |  | Edge Condition < 2 and unpaved shoulder |
| Review Pavement Condition/Type and Install Edgeline Rumble Strips (If Feasible on Both Sides of Road) | 0.61-0.67 | \$5,000/mile | X |  | ADT > 400 and 11' lanes |
| Review Pavement Condition/Type and Install Centerline Rumble Strips (If Feasible) | 0.55-0.91 | \$2,000/mile | X |  | ADT > 400 and 11' lanes |
| Install Post-Mounted Delineators | 0.55 | \$5,000/mile | X |  | Roadside Assessment < 2 |
| Review and Upgrade Curve Signage (Warning signs, Speed Advisory plaques, Chevrons) to meet the Manual on Uniform Traffic Control Devices (MUTCD) and KDOT Standards | 0.59-0.96 | \$1,000/curve | X |  | On all curves within the segment that currently have signage |
| Install Curve Signage (Warning signs, Speed Advisory plaques, Chevrons) to meet the Manual on Uniform Traffic Control Devices (MUTCD) and KDOT Standards | 0.59-0.96 | \$3,500/curve | X |  | On all curves within the segment that do not have signage |
| Retroreflective Strips on Curve Signage | not defined | \$100/curve | X |  | On all curve signage within the segment |
| Remove/Relocate Fixed Objects in Clear Zone (e.g. tree, utility pole, culvert headwall, substandard guardrail) | FHWA proven Countermeasure | \$1,000/each |  | X | All (based upon video review) |
| Install 18-inch Aggregate Shoulder Treatment (With Transition to Earth) | not defined | \$15,000/mile |  | X | No existing aggregate shoulder and edge condition < 2 |
| Pave 2' Shoulder with Safety Edge (Both Sides of Road - Includes Earthwork) | 0.75-0.99 | \$150,000/mile |  | X | ADT > 400 |
| Install Edgeline Rumble Strips (Both Sides of Road) | 0.61-0.67 | \$5,000/mile |  | X | ADT > 400 and 11' lanes |
| Install Centerline Rumble Strips | 0.55-0.91 | \$2,000/mile |  | X | ADT > 400 and 11' lanes |
| Install/Upgrade Guardrail | 0.53-0.56 | \$35/foot |  | X | All (based upon video review) |
| Flattening and Widening Foreslopes (Excludes Culvert Extension Costs) | 0.58-0.90 | \$75,000/mile |  | X | All |
| Install High Friction Surface Treatment (HFST) on Curves | 0.48-0.76 | \$20,000/curve |  | X | All curves with ADT > 400 and no superelevation |

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Table 6 - Intersection Countermeasure Project Selection Thresholds

Table 7 - Curve Countermeasure Project Selection Thresholds

| Safety Countermeasure | CMF | Cost | Short-Term | Long-Term | Threshold |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Review and Upgrade Curve Signage (Warning signs, Speed Advisory plaques, Chevrons) to meet the Manual on Uniform Traffic Control Devices (MUTCD) and KDOT Standards | 0.59-0.96 | \$1,000/curve | X |  | On all curves that currently have signage |
| Install Curve Signage (Warning signs, Speed Advisory plaques, Chevrons) to meet the Manual on Uniform Traffic Control Devices (MUTCD) and KDOT Standards | 0.59-0.96 | \$3,500/curve | X |  | On all curves that do not have signage |
| Retroreflective Strips on Curve Signage | not defined | \$100/curve | X |  | All |
| Install 6" Retroreflective Edgeline (Both Sides of Road) | 0.64-0.88 | \$4,200/mile | X |  | All |
| Install 4" Retroreflective Centerline | 0.76 | \$2,100/mile | X |  | All |
| Clear and Grub | 0.78 | \$2,500/curve | X |  | All |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations | not defined | \$5,000/mile | X |  | Edge Condition < 2 and unpaved shoulder |
| Review Pavement Condition/Type and Install Edgeline Rumble Strips (If Feasible on Both Sides of Road) | 0.61-0.67 | \$5,000/mile | X |  | ADT > 400 and 11' lanes |
| Review Pavement Condition/Type and Install Centerline Rumble Strips (If Feasible) | 0.55-0.91 | \$2,000/mile | X |  | ADT > 400 and 11' lanes |
| Install Post-Mounted Delineators | 0.55 | \$5,000/mile | X |  | Roadside Assessment < 2 |
| Install 18-inch Aggregate Shoulder Treatment (With Transition to Earth) | not defined | \$15,000/mile |  | X | No existing aggregate shoulder and edge condition < 2 |
| Pave 2' Outside Shoulder with Safety Edge (Both Sides of Road - Includes Earthwork) | 0.75-0.99 | \$150,000/mile |  | X | ADT $>400$ |
| Install Edgeline Rumble Strips (Both Sides of Road) | 0.61-0.67 | \$5,000/mile |  | X | ADT > 400 and 11' lanes |
| Install Centerline Rumble Strips | 0.55-0.91 | \$2,000/mile |  | X | ADT > 400 and 11' lanes |
| Install/Upgrade Guardrail | 0.53-0.56 | \$35/foot |  | X | All (based upon video review) |
| Install High Friction Surface Treatment (HFST) | 0.48-0.76 | \$20,000/curve |  | X | ADT > 400 and no superelevation |

Install High Friction Surface Treatment (HFST)
091841008
2019-10-31 KDOT LRSP Risk Factor Ranking and Countermeasure Selection.docx

## 4. Next Steps

Upon approval from KDOT of these risk factor scoring criteria and countermeasure project selection threshold tables, the next steps include a systemic analysis that will be conducted for the 20 LRSP counties to calculate risk factor scores for each roadway segment, intersection, and curve along the LRSP study routes. The segments, intersections, and curves with the highest risk factor scores will be reviewed and 10 locations will be selected for safety improvement consideration. Project sheets will be created for the locations selected which will include associated recommended safety countermeasures.

Finally, a LRSP report will be produced for the counties, providing a summary of the project, risk factor scoring information, and the project sheets.

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## APPENDIX J

 LRSP Segment Risk Factor Scores

Marion County LRSP Segment Risk Factor Scores
Total Score

- 17; 18
14; 15; 16
11; 12; 13
- 8; 9; 10
- 5; 6; 7


| TSID | Segment Name | From | To | Length (mi) | Total <br> Score | ADT Score | Access <br> Density <br> Score | Edge Condition Score | $\qquad$ | Roadway/ <br> Pavement <br> Width <br> Score | Shoulder <br> Width <br> Score | Lane Departure Crash Rate Score | Pavement <br> Markings <br> Score |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 51 | 60TH | LIMESTONE | 0.25 MILE WEST OF NIGHTHAWK | 1.80 | 18 | 3 | 2 | 3 | 3 | 0 | 2 | 3 | 2 | 0 |
| 89 | NIGHTHAWK | 90TH | HWY 50 | 1.94 | 18 | 5 | 2 | 3 | 3 | 0 | 2 | 3 | 0 | 0 |
| 100 | REMINGTON | 290TH | 240TH | 5.00 | 18 | 5 | 2 | 3 | 3 | 0 | 2 | 3 | 0 | 0 |
| 103 | SUNFLOWER | 110TH | HWY 50 | 2.29 | 18 | 6 | 1 | 3 | 3 | 0 | 2 | 3 | 0 | 0 |
| 1 | 120TH | EAGLE | INDIGO | 3.97 | 17 | 5 | 2 | 3 | 3 | 0 | 2 | 2 | 0 | 0 |
| 12 | 190TH | OLD MILL | REMINGTON (K-256) | 2.98 | 17 | 6 | 2 | 3 | 3 | 0 | 1 | 2 | 0 | 0 |
| 16 | 190TH | NIGHTHAWK | OLD MILL | 1.01 | 17 | 6 | 1 | 3 | 3 | 0 | 1 | 3 | 0 | 0 |
| 26 | 290TH | LIMESTONE | NIGHTHAWK | 1.99 | 17 | 5 | 1 | 3 | 3 | 0 | 2 | 3 | 0 | 0 |
| 49 | 60TH | QUAIL CREEK | TIMBER | 3.04 | 17 | 4 | 2 | 3 | 3 | 0 | 2 | 3 | 0 | 0 |
| 15 | 190TH | PRAIRIE | KANZA | 1.25 | 16 | 6 | 2 | 3 | 1 | 0 | 2 | 2 | 0 | 0 |
| 50 | 60TH | OLD MILL | QUAIL CREEK | 2.00 | 16 | 4 | 2 | 3 | 3 | 0 | 2 | 2 | 0 | 0 |
| 52 | 60TH | 0.25 MILE WEST OF NIGHTHAWK | S LOCUST | 0.50 | 16 | 3 | 0 | 3 | 3 | 0 | 2 | 3 | 2 | 0 |
| 46 | 360TH | PAWNEE | QUAIL CREEK | 1.04 | 16 | 3 | 2 | 3 | 3 | 0 | 2 | 3 | 0 | 0 |
| 40 | 340TH | QUAIL CREEK | N WASHINGTON | 4.84 | 15 | 3 | 2 | 3 | 3 | 0 | 2 | 2 | 0 | 0 |
| 5 | 140TH | PAWNEE | SUNFLOWER | 3.00 | 15 | 3 | 2 | 3 | 3 | 0 | 2 | 0 | 2 | 0 |
| 9 | 150TH | EAGLE | INDIGO | 4.00 | 15 | 3 | 1 | 3 | 3 | 0 | 2 | 3 | 0 | 0 |
| 13 | 190TH | KANZA | NIGHTHAWK | 3.00 | 15 | 6 | 1 | 3 | 1 | 0 | 2 | 2 | 0 | 0 |
| 14 | 190TH | GOLDENROD | WEST OF HILLSBORO | 1.49 | 15 | 4 | 2 | 3 | 1 | 0 | 2 | 3 | 0 | 0 |
| 29 | 290TH | DIAMOND | PARK AVE | 4.03 | 15 | 4 | 1 | 3 | 1 | 2 | 2 | 0 | 2 | 0 |
| 53 | 60TH | S MAPLE | OLD MILL | 0.51 | 15 | 4 | 0 | 3 | 3 | 0 | 2 | 3 | 0 | 0 |
| 73 | INDIGO | 140TH | 120TH | 1.93 | 15 | 6 | 2 | 0 | 3 | 0 | 2 | 2 | 0 | 0 |
| 80 | LIMESTONE | 330TH | 290TH | 4.01 | 15 | 4 | 2 | 3 | 1 | 0 | 2 | 3 | 0 | 0 |
| 90 | OLD MILL | 60TH | 30TH | 3.01 | 15 | 5 | 0 | 3 | 3 | 0 | 2 | 2 | 0 | 0 |
| 92 | OLD MILL | 30TH | 10TH | 2.01 | 15 | 5 | 2 | 3 | 3 | 0 | 2 | 0 | 0 | 0 |
| 95 | PAWNEE | 360TH | 370TH | 1.00 | 15 | 4 | 2 | 3 | 1 | 0 | 2 | 3 | 0 | 0 |
| 118 | KANZA | 240TH | US HWY 56 | 4.00 | 15 | 5 | 1 | 3 | 0 | 0 | 2 | 2 | 2 | 0 |
| 2 | 120TH | HWY 15 | EAGLE | 3.01 | 14 | 5 | 2 | 3 | 0 | 0 | 2 | 2 | 0 | 0 |
| 3 | 120TH | MERIDIAN | ALAMO | 1.00 | 14 | 3 | 0 | 3 | 3 | 0 | 2 | 3 | 0 | 0 |
| 75 | KANZA | 290TH | 270TH | 2.00 | 14 | 4 | 2 | 1 | 1 | 2 | 2 | 0 | 2 | 0 |
| 77 | KANZA | US HWY 56 | 190TH | 1.01 | 14 | 5 | 0 | 3 | 0 | 0 | 2 | 2 | 2 | 0 |
| 78 | LAKESHORE | TURKEY CREEK | HWY 77 | 1.72 | 14 | 2 | 2 | 3 | 3 | 0 | 2 | 0 | 2 | 0 |
| 83 | NIGHTHAWK | 120TH | 90TH | 2.99 | 14 | 5 | 1 | 3 | 3 | 0 | 2 | 0 | 0 | 0 |
| 85 | NIGHTHAWK | 140TH | 120TH | 1.99 | 14 | 4 | 1 | 3 | 1 | 0 | 2 | 3 | 0 | 0 |
| 109 | TIMBER | 60TH | 40TH | 2.01 | 14 | 4 | 0 | 3 | 3 | 0 | 1 | 3 | 0 | 0 |
| 74 | KANZA | 190TH | 140TH | 5.01 | 13 | 5 | 1 | 3 | 0 | 0 | 2 | 2 | 0 | 0 |
| 6 | 140TH | SUNFLOWER | ULYSSES | 3.26 | 13 | 2 | 1 | 3 | 3 | 0 | 2 | 0 | 2 | 0 |
| 23 | 290TH | REMINGTON | TIMBER | 1.99 | 13 | 5 | 1 | 3 | 0 | 0 | 2 | 2 | 0 | 0 |
| 25 | 290TH | HWY 15 | KANZA | 2.99 | 13 | 5 | 2 | 3 | 1 | 0 | 2 | 0 | 0 | 0 |
| 32 | 290TH | KANZA | LIMESTONE | 1.01 | 13 | 5 | 0 | 3 | 3 | 0 | 2 | 0 | 0 | 0 |
| 48 | 40TH | WAGONWHEEL | HWY 77 | 2.43 | 13 | 1 | 1 | 3 | 3 | 0 | 2 | 3 | 0 | 0 |
| 71 | INDIGO | 120TH | 90TH | 3.01 | 13 | 6 | 2 | 0 | 3 | 0 | 2 | 0 | 0 | 0 |
| 84 | NIGHTHAWK | 190TH | 150TH | 3.99 | 13 | 4 | 0 | 3 | 1 | 0 | 2 | 3 | 0 | 0 |
| 88 | NIGHTHAWK | 150TH | 140TH | 1.01 | 13 | 4 | 0 | 3 | 1 | 0 | 2 | 3 | 0 | 0 |
| 107 | TIMBER | 30TH | 10TH | 2.03 | 13 | 1 | 1 | 3 | 3 | 0 | 2 | 3 | 0 | 0 |
| 36 | 330TH | MERIDIAN | DIAMOND | 4.02 | 12 | 4 | 1 | 3 | 0 | 0 | 2 | 2 | 0 | 0 |




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## APPENDIX K LRSP Intersection Risk Factor Scores

Marion County
Local Road Safety Plan
Intersection Risk Factor Points

|  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |

Marion County
Local Road Safety Plan
Intersection Risk Factor Points

| TSID | Intersection Name | Total Score | Volume Score | Access Density Score | Sight Distance Score | Horizontal Curvature Score | Crash Experience Score | Distance from Previous STOP Score | Skewed <br> Approach Score | Intersection Control Score |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 171 | OLDMILL \& 10TH | 9 | 5 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 195 | QUAILCREEK \& 330TH | 9 | 5 | 0 | 0 | 0 | 0 | 3 | 0 | 1 |
| 196 | QUAILCREEK \& 360TH | 9 | 2 | 0 | 3 | 0 | 0 | 3 | 0 | 1 |
| 256 | UPLAND \& 180TH | 9 | 5 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 285 | ZEBULON \& 250TH | 9 | 2 | 0 | 3 | 0 | 0 | 3 | 0 | 1 |
| 300 | 190TH \& PRARIE POINT | 9 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 1 |
| 301 | NIGHTHAWK \& 194TH TER ( N ) | 9 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 1 |
| 303 | OLD HWY 77 \& FOREST | 9 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 1 |
| 305 | OLD MILL \& NORWOOD | 9 | 5 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 54 | GOLDENROD \& 120TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 74 | INDIGO \& 170TH | 8 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 75 | INDIGO \& 180TH | 8 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 108 | LIMESTONE \& 290TH | 8 | 5 | 0 | 0 | 0 | 0 | 2 | 0 | 1 |
| 132 | MUSTANG \& 330TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 134 | MUSTANG \& 60TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 143 | NIGHTHAWK \& 150TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 144 | NIGHTHAWK \& 160TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 146 | NIGHTHAWK \& 180TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 157 | NIGHTHAWK \& 60TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 160 | NORWOOD \& 60TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 187 | PAWNEE \& 60TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 197 | QUAILCREEK \& 60TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 199 | QUAILCREEK \& 340TH | 8 | 5 | 0 | 0 | 0 | 0 | 3 | 0 | 0 |
| 202 | REMINGTON \& 210TH | 8 | 2 | 0 | 3 | 0 | 0 | 2 | 0 | 1 |
| 203 | REMINGTON \& 230TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 206 | REMINGTON \& 260TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 207 | REMINGTON \& 270TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 208 | REMINGTON \& 280TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 213 | REMINGTON \& 60TH | 8 | 4 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 214 | RIDGEWAY DR \& 170TH | 8 | 5 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| 249 | TIMBER \& 60TH | 8 | 1 | 0 | 3 | 0 | 0 | 3 | 0 | 1 |
| 251 | TIMBER \& 80TH | 8 | 1 | 0 | 0 | 3 | 0 | 0 | 3 | 1 |
| 253 | TURKEY CREEK \& 80TH | 8 | 1 | 0 | 0 | 3 | 0 | 0 | 3 | 1 |
| 255 | ULYSSES \& 140TH | 8 | 2 | 0 | 3 | 0 | 0 | 2 | 0 | 1 |
| 284 | ZEBULON \& 240TH | 8 | 1 | 0 | 3 | 0 | 0 | 3 | 0 | 1 |
| 295 | PAWNEE \& 211TH | 8 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 1 |
| 296 | PAWNEE \& 213TH | 8 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 1 |
| 298 | UPLAND \& PRARIE | 8 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 302 | NIGHTHAWK \& 194TH TER (S) | 8 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 304 | INDIGO \& WILLOW GLEN | 8 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 19 | CHISHOLM TRAIL \& 330TH | 7 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 25 | DIAMOND \& 150 TH | 7 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 49 | FALCON \& 290TH | 7 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 55 | GOLDENROD \& 150TH | 7 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 57 | GOLDENROD \& 285TH | 7 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 1 |
| 58 | GOLDENROD \& 290TH | 7 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 1 |
| 67 | INDIGO \& 110TH | 7 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 104 | LIMESTONE \& 30TH | 7 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 107 | LIMESTONE \& 190TH | 7 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 116 | LIMESTONE \& 370TH | 7 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 1 |
| 118 | LIMESTONE \& E 2ND | 7 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 1 |
| 154 | NIGHTHAWK \& 30TH | 7 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 163 | OLD MILL \& 190TH | 7 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 179 | PAWNEE \& 220TH | 7 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 193 | QUAILCREEK \& 310TH | 7 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 194 | QUAILCREEK \& 320TH | 7 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 211 | REMINGTON \& 340TH | 7 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |

Marion County
Local Road Safety Plan
Intersection Risk Factor Points

| TSID | Intersection Name | Total Score | Volume Score | Access Density Score | Sight Distance Score | Horizontal Curvature Score | Crash Experience Score | Distance from Previous STOP Score | Skewed <br> Approach Score | Intersection Control Score |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 216 | SUNFLOWER \& 110TH | 7 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 221 | SUNFLOWER \& 170TH | 7 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 226 | SUNFLOWER \& 360TH (E) | 7 | 0 | 0 | 3 | 0 | 0 | 3 | 0 | 1 |
| 245 | TIMBER \& 340TH | 7 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 254 | TURKEY CREEK \& LAKESIDE DR | 7 | 1 | 0 | 3 | 0 | 0 | 0 | 3 | 0 |
| 8 | ALFALFA \& 30TH | 6 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 18 | CHISHOLM TRAIL \& 290TH | 6 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 20 | CHISHOLM TRAIL \& 90TH | 6 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 47 | FALCON \& 120TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 60 | GOLDENROD \& 90TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 86 | KANZA \& 140TH | 6 | 2 | 0 | 0 | 0 | 0 | 3 | 0 | 1 |
| 87 | KANZA \& 150TH | 6 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 93 | KANZA \& 210TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 102 | KANZA \& 330TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 113 | LIMESTONE \& 340TH | 6 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 125 | MERIDIAN \& 300TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 130 | MUSTANG \& 290TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 139 | NIGHTHAWK \& 110TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 141 | NIGHTHAWK \& 130TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 148 | NIGHTHAWK \& 240TH | 6 | 2 | 0 | 0 | 3 | 0 | 0 | 0 | 1 |
| 155 | NIGHTHAWK \& 330TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 158 | NIGHTHAWK \& 80TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 165 | OLD MILL \& 290TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 169 | OLD MILL \& 40TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 181 | PAWNEE \& 240TH | 6 | 2 | 0 | 0 | 3 | 0 | 0 | 0 | 1 |
| 182 | PAWNEE \& 290TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 223 | SUNFLOWER \& 290TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 231 | SUNRISE \& 210TH | 6 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 233 | SUNRISE \& 230TH | 6 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 257 | UPLAND \& 290TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 261 | UPLAND \& GILHAM | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 262 | UPLAND AND 140TH | 6 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 263 | VISTA \& 290TH | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 5 | ALAMO \& 90TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 14 | BLUESTEM \& 300TH | 5 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 15 | BLUESTEM \& 310TH | 5 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 32 | DIAMOND \& 290TH | 5 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 1 |
| 45 | EAGLE \& 330TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 48 | FALCON \& 150TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 50 | FALCON \& 330TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 59 | GOLDENROD \& 330TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 76 | INDIGO \& 2907H | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 77 | INDIGO \& 330TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 81 | JADE \& 140TH | 5 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 83 | JADE \& 290TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 84 | JADE \& 330TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 89 | KANZA \& 170TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 90 | KANZA \& 175TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 94 | KANZA \& 220TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 95 | KANZA \& 230TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 96 | KANZA \& 240TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 105 | LIMESTONE \& 60TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 145 | NIGHTHAWK \& 170TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 167 | OLD MILL \& 330TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 184 | PAWNEE \& 330TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 186 | PAWNEE \& 370TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 204 | REMINGTON \& 240TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

Marion County
Local Road Safety Plan
Intersection Risk Factor Points

| TSID | Intersection Name | Total Score | Volume Score | Access Density Score | Sight Distance Score | Horizontal Curvature Score | Crash Experience Score | Distance from Previous STOP Score | Skewed <br> Approach <br> Score | Intersection Control Score |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 205 | REMINGTON \& 250TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 224 | SUNFLOWER \& 30TH | 5 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 229 | SUNFLOWER \& 60TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 234 | SUNRISE \& 240TH | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 1 |
| 236 | TIMBER \& 10TH | 5 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 238 | TIMBER \& 20TH | 5 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 244 | TIMBER \& 30TH | 5 | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 1 |
| 247 | TIMBER \& 40TH | 5 | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 1 |
| 265 | VISTA \& 40TH | 5 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 267 | WAGONWHEEL \& 40TH | 5 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 269 | XAVIER \& 250TH | 5 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 278 | YARROW \& 250TH | 5 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 279 | YARROW \& 290TH | 5 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 280 | YARROW \& 40TH | 5 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 294 | REMINGTON \& 275TH | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 4 | ALAMO \& 330TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 11 | BISON \& 330TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 17 | CHISHOLM TRAIL \& 150TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 29 | DIAMOND \& 240TH | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 39 | DIAMOND \& 360TH | 4 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| 42 | DIAMOND \& E MAIN | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 |
| 52 | FALCON \& 80TH | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 64 | HOLY \& 150TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 65 | HOLY \& 190TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 88 | KANZA \& 160TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 97 | KANZA \& 250TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 98 | KANZA \& 260TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 99 | KANZA \& 270TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 100 | KANZA \& 280TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 103 | KANZA \& 90TH | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 109 | LIMESTONE \& 300TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 110 | LIMESTONE \& 310TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 111 | LIMESTONE \& 320TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 117 | LIMESTONE \& 90TH | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 119 | LIMESTONE \& E 3RD | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 121 | LIMESTONE \& E 5TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 126 | MERIDIAN \& 330TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 128 | MUSTANG \& 140TH | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 131 | MUSTANG \& 30TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 136 | N MAIN STREET \& 340TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 162 | OLD MILL \& 140TH | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 176 | PAWNEE \& 140TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 180 | PAWNEE \& 230TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 188 | QUAIL CREEK \& 140TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 200 | QUAILCREEK \& 350TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 212 | REMINGTON \& 360TH | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 225 | SUNFLOWER \& 340TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 227 | SUNFLOWER \& 360TH (W) | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 |
| 258 | UPLAND \& 340TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 259 | UPLAND \& 360TH | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 264 | VISTA \& 360TH | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 266 | WAGONWHEEL \& 340TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 271 | XAVIER \& 340TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 273 | YARROW \& 125TH | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 274 | YARROW \& 160TH | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 283 | ZEBULON \& 230 | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| 289 | PAWNEE \& 365TH | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

Marion County
Local Road Safety Plan
Intersection Risk Factor Points

| TSID | Intersection Name | Total Score | Volume Score | Access Density Score | Sight Distance Score | Horizontal Curvature Score | Crash Experience Score | Distance from Previous STOP Score | Skewed <br> Approach <br> Score | Intersection Control Score |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | ALAMO \& 150TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 2 | ALAMO \& 290TH (E) | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 3 | ALAMO \& 290TH (W) | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 9 | ARROW \& 30TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 10 | BISON \& 290TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 114 | LIMESTONE \& 350TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 120 | LIMESTONE \& E 4TH | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 124 | MERIDIAN \& 290TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 149 | NIGHTHAWK \& 250TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 172 | OLDMILL \& 240TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 174 | PALM \& 140TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 175 | PARK \& 285TH | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 183 | PAWNEE \& 30TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 201 | REMINGTON \& 140TH | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 232 | SUNRISE \& 220 TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 235 | SUNSET \& 140TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 237 | TIMBER \& 140TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 242 | TIMBER \& 270TH | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| 260 | UPLAND \& 40TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 268 | WASHINGTON \& 340TH | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 270 | XAVIER \& 290TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 275 | YARROW \& 170TH | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 290 | 330TH \& LINCOLN | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 291 | 330TH \& MAIN | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 292 | 330TH \& ROOSEVELT | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 293 | 330TH \& COLUMBUS | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 37 | DIAMOND \& 340TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 38 | DIAMOND \& 350TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 41 | DIAMOND \& 90TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 46 | EAGLE \& 90TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 63 | HOLLY \& 90TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 106 | LIMESTONE \& 140TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 115 | LIMESTONE \& 360TH | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| 150 | NIGHTHAWK \& 260TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 151 | NIGHTHAWK \& 270TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 152 | NIGHTHAWK \& 280TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 192 | QUAILCREEK \& 30TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 210 | REMINGTON \& 30TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 272 | XAVIER \& 40TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 276 | YARROW \& 180TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 286 | ZEBULON \& 290TH | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 287 | 360TH \& B ST | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 6 | ALFALFA \& 240TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 7 | ALFALFA \& 290TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 12 | BLUESTEM \& 240TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 21 | CLOVER \& 240TH | 1 | 0 | 0 | 0 | 0 |  | 0 | 0 | 1 |
| 26 | DIAMOND \& 210TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 27 | DIAMOND \& 220TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 30 | DIAMOND \& 250TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 33 | DIAMOND \& 300TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 35 | DIAMOND \& 320TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 40 | DIAMOND \& 370TH | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | EAGLE \& 150TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 51 | FALCON \& 70TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 85 | JADE \& 90TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 123 | MERIDIAN \& 150TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 129 | MUSTANG \& 190TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |


| TSID | Intersection Name | Total <br> Score | Volume Score |  | Sight <br> Distance <br> Score | Horizontal Curvature Score | Crash Experience Score | Distance from Previous STOP Score | Skewed <br> Approach Score | Intersection Control Score |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 133 | MUSTANG \& 360TH | $-1$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 135 | MUSTANG \& 90TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 156 | NIGHTHAWK \& 360TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 168 | OLD MILL \& 360TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 228 | SUNFLOWER \& 370TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 240 | TIMBER \& 250TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 241 | TIMBER \& 260TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 246 | TIMBER \& 360TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 248 | TIMBER \& 50TH | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 250 | TIMBER \& 70TH | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 277 | YARROW \& 190TH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 281 | ZEBULON \& 210 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 282 | ZEBULON \& 220 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 23 | CLOVER \& 40TH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | DIAMOND \& 230TH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31 | DIAMOND \& 280TH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | DIAMOND \& 310TH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 190 | QUAILCREEK \& 210TH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 252 | TMBER \& 280TH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



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## APPENDIX L LRSP Curve Risk Factor Scores

| TSID | Location or Intersection | Total Score | Volume <br> Score | Curve Radius Score | Access <br> Density <br> Score | Shoulder <br> Width <br> Score | Edge Condition Score | Roadside Assessment Score | Superelevation Score | Presence of Warning Signs Score | Crash Experience Score |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 22 | INDIGO 0.07M S OF 130TH | 16 | 6 | 0 | 2 | 2 | 0 | 1 | 2 | 0 | 3 |
| 45 | SUNFLOWER 0.37 M N OF 90TH | 16 | 5 | 1 | 1 | 2 | 1 | 1 | 2 | 0 | 3 |
| 17 | 60 TH \& S MAPLE | 15 | 4 | 3 | 2 | 2 | 1 | 1 | 2 | 0 | 0 |
| 14 | 360TH \& PAWNEE | 15 | 5 | 3 | 1 | 2 | 1 | 1 | 2 | 0 | 0 |
| 43 | SUNFLOWER 0.09 M S OF 180TH | 14 | 6 | 2 | 2 | 2 | 0 | 0 | 2 | 0 | 0 |
| 18 | 60TH 0.27M E OF NIGHTHAWK | 13 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 0 | 0 |
| 7 | 290TH 0.13M W OF PARK | 13 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 0 | 0 |
| 4 | 290TH 0.52 M E OF GOLDEN | 13 | 3 | 3 | 2 | 2 | 1 | 0 | 2 | 0 | 0 |
| 41 | SUNFLOWER \& 90TH | 13 | 5 | 1 | 1 | 2 | 1 | 1 | 2 | 0 | 0 |
| 31 | NIGHTHAWK 0.07M S OF HWY 56 | 13 | 4 | 2 | 2 | 2 | 1 | 0 | 2 | 0 | 0 |
| 42 | SUNFLOWER \& E HIGHLAND | 13 | 6 | 2 | 1 | 2 | 0 | 0 | 2 | 0 | 0 |
| 30 | INDIGO 0.06M N OF 130TH | 13 | 6 | 0 | 2 | 2 | 0 | 1 | 2 | 0 | 0 |
| 13 | 360 TH \& N D ST (W) | 12 | 3 | 3 | 2 | 0 | 1 | 1 | 2 | 0 | 0 |
| 16 | 40TH \& HWY 77 | 12 | 1 | 3 | 2 | 2 | 1 | 1 | 2 | 0 | 0 |
| 5 | 290TH \& GOLDEN ROD (E) | 12 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | 0 | 0 |
| 40 | SUNFLOWER \& 180TH | 12 | 6 | 0 | 2 | 2 | 0 | 0 | 2 | 0 | 0 |
| 44 | SUNFLOWER 0.21 M S OF 180TH | 12 | 6 | 0 | 2 | 2 | 0 | 0 | 2 | 0 | 0 |
| 32 | NIGHTHAWK \& 130TH | 12 | 4 | 2 | 1 | 2 | 1 | 0 | 2 | 0 | 0 |
| 33 | NIGHTHAWK 0.02M S OF 130TH | 12 | 4 | 2 | 1 | 2 | 1 | 0 | 2 | 0 | 0 |
| 39 | SUNFLOWER 0.10M N OF 90TH | 12 | 5 | 0 | 1 | 2 | 1 | 1 | 2 | 0 | 0 |
| 38 | PAWNEE 0.5 M N OF 213TH | 12 | 5 | 0 | 1 | 2 | 1 | 1 | 2 | 0 | 0 |
| 37 | PAWNEE 0.25 M N OF 213TH | 12 | 5 | 0 | 2 | 2 | 1 | 0 | 2 | 0 | 0 |
| 20 | GOLDENROD \& 190TH | 11 | 3 | 2 | 1 | 2 | 1 | 0 | 2 | 0 | 0 |
| 6 | 290TH \& GOLDEN ROD (W) | 11 | 3 | 1 | 2 | 2 | 1 | 0 | 2 | 0 | 0 |
| 24 | KANZA 0.38M N OF 260TH | 11 | 4 | 1 | 1 | 2 | 1 | 0 | 2 | 0 | 0 |
| 25 | KANZA \& 260TH | 11 | 4 | 1 | 1 | 2 | 1 | 0 | 2 | 0 | 0 |
| 29 | LAKESHORE DR 0.42 M E OF TURKEY | 11 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 0 | 0 |
| 27 | LAKESHORE DR 0.30M E OF TURKEY CREEK | 11 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 0 | 0 |
| 28 | LAKESHORE DR 0.10M W OF RIDGEWAY DR | 11 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 0 | 0 |
| 21 | GOLDEN ROD JUST S OF HWY 56 | 11 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 0 | 0 |
| 50 | TIMBER \& 80TH | 10 | 1 | 3 | 2 | 0 | 1 | 1 | 2 | 0 | 0 |
| 23 | KANZA 0.27M S OF 270TH | 10 | 4 | 0 | 1 | 2 | 1 | 0 | 2 | 0 | 0 |
| 26 | KANZA 0.58M N OF 250TH | 10 | 4 | 0 | 1 | 2 | 1 | 0 | 2 | 0 | 0 |
| 48 | SUNRISE \& 240TH | 10 | 1 | 3 | 2 | 0 | 1 | 1 | 2 | 0 | 0 |
| 49 | TIMBER \& 240TH | 10 | 1 | 3 | 2 | 0 | 1 | 1 | 2 | 0 | 0 |
| 1 | 140TH 0.30M E OF UPLAND | 10 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 0 | 0 |
| 36 | OLDMILL 0.17M N OF HWY 56 | 10 | 5 | 0 | 1 | 2 | 0 | 0 | 2 | 0 | 0 |
| 12 | 360TH \& N D ST (E) | 9 | 0 | 3 | 2 | 0 | 1 | 1 | 2 | 0 | 0 |
| 15 | 360TH 0.01M E OF N D ST | 9 | 0 | 3 | 2 | 0 | 1 | 1 | 2 | 0 | 0 |
| 11 | 340TH 0.13M W OF HWY 56 | 9 | 2 | 1 | 2 | 0 | 1 | 1 | 2 | 0 | 0 |
| 9 | 340 TH \& HWY 56 (W) | 9 | 2 | 1 | 2 | 0 | 1 | 1 | 2 | 0 | 0 |
| 8 | 30TH \& CLOVER | 9 | 1 | 3 | 1 | 0 | 1 | 1 | 2 | 0 | 0 |
| 19 | BLUESTEM \& 290TH | 9 | 0 | 3 | 2 | 0 | 1 | 1 | 2 | 0 | 0 |
| 35 | OLD MILL \& 210TH | 9 | 5 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 |
| 51 | TURKEY \& 80TH | 8 | 1 | 3 | 1 | 0 | 0 | 1 | 2 | 0 | 0 |
| 56 | ZEBULLON \& 30TH | 8 | 0 | 2 | 2 | 0 | 1 | 1 | 2 | 0 | 0 |
| 47 | SUNFLOWER 1.2M N OF 120TH | 8 | 5 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 |
| 46 | SUNFLOWER 0.43 M S OF 140TH | 8 | 5 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 |
| 10 | 340TH \& HWY 56 (E) | 8 | 2 | 0 | 2 | 0 | 1 | 1 | 2 | 0 | 0 |
| 3 | 240TH \& PAWNEE | 7 | 2 | 1 | 2 | 0 | 0 | 0 | 2 | 0 | 0 |
| 2 | 240TH \& NIGHTHAWK | 7 | 2 | 1 | 2 | 0 | 0 | 0 | 2 | 0 | 0 |
| 52 | YARROW 0.42 M N OF 125TH | 7 | 0 | 2 | 1 | 0 | 1 | 1 | 2 | 0 | 0 |
| 54 | YARROW 0.67 M S OF 160TH | 7 | 0 | 2 | 1 | 0 | 1 | 1 | 2 | 0 | 0 |
| 55 | YARROW 0.76 M S OF 160TH | 7 | 0 | 2 | 1 | 0 | 1 | 1 | 2 | 0 | 0 |
| 53 | YARROW 0.66 M N OF 125TH | 6 | 0 | 1 | 1 | 0 | 1 | 1 | 2 | 0 | 0 |
| 34 | NIGHTHAWK 0.12M N OF 280TH | 4 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 |

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## APPENDIX M <br> LRSP Project Locations and Project Sheets



## Marion County LRSP Project Locations

## Legend

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## Use Restricted 23 U.S.C. § 409

Date: 2/28/20 Prepared By: AJW Checked By: MMO

SEGMENT

Project Name: 60th Street between Limestone Road and S Locust Street (Peabody Southwest City Limit) Contact Name: Brice Goebel

E-mail: bgoebel@marioncoks.net
Location Description

Length (miles): 2.30

Project Location Maps


Segment Information and Systemic Ranking Summary

| Systemic Ranking Summary | Value | Score* $^{*}$ |
| :---: | :---: | :---: |
| Average Daily Traffic (ADT) | 185 | $\mathbf{3}$ |
| Access Points per Mile | 4.5 | 2 |
| Edge Condition | 2.0 | 3 |
| Roadside Assessment | 2.0 | 3 |
| Pavement Width (ft) | 24.0 | 0 |
| Shoulder Width (ft) | 0.0 | 2 |
| Lane Departure Crash Rate | 3.3 | 3 |
| Presence of Pavement Markings | No | 2 |
| Surface Type | PAVED | $\mathbf{0}$ |
| Total Risk Factor Score (24 max) | $\mathbf{1 8}$ |  |


| Other Information |  |
| :---: | :---: |
| Paved Shoulder | No |
| Shoulder Material | NONE |
| Speed Limit (mph) | $\mathbf{5 5}$ |
| Number of Lanes | $\mathbf{2}$ |
| Lane Width (ft) | $\mathbf{1 2}$ |
| Edgeline Rumble Strips | NOT PRESENT |
| Centerline Rumble Strips | NOT PRESENT |
| Curves | $\mathbf{1}$ |
| Curves with Warning Signs | $\mathbf{1}$ |

*Score from highest ranking segment used
Opinion of Probable Cost (Short Term Improvements)

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Install 6" Retroreflective Edgeline (Both Sides of Road) | 2.30 | MILE | \$ | 4,200 | \$ | 9,657 |
| Install 4" Retroreflective Centerline | 2.30 | MILE | \$ | 2,100 | \$ | 4,828 |
| Delineate Roadside Hazards with Retroreflective Markers | 23 | EACH | \$ | 100 | \$ | 2,300 |
| Clear and Grub (15 Feet Off Edge of Road, If Applicable) | 0.73 | MILE | \$ | 30,000 | \$ | 21,750 |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations | 0 | MILE | \$ | 5,000 | \$ | - |
| Review Pavement Condition/Type and Install Edgeline Rumble Strips (If Feasible) | 0 | MILE | \$ | 5,000 | \$ | - |
| Review Pavement Condition/Type and Install Centerline Rumble Strips (If Feasible) | 0 | MILE | \$ | 2,000 | \$ | - |
| Post-Mounted Delineators | 0 | MILE | \$ | 5,000 | \$ | - |
| Review and Upgrade Curve Signage to Meet MUTCD and KDOT Standards | 1 | CURVE | \$ | 1,000 | \$ | 1,000 |
| Install Curve Signage to Meet MUTCD and KDOT Standards (If Needed) | 0 | CURVE | \$ | 3,500 | \$ | - |
| Retroreflective Strips on Curve Signage | 1 | CURVE | \$ | 100 | \$ | 100 |
| Short Term Improvements Subtotal: |  |  |  |  | \$ | 39,635 |


| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Remove/Relocate Fixed Objects in Clear Zone | 4 | EACH | \$ | 1,000 | \$ | 4,000 |
| Install 18-inch Aggregate Shoulder Treatment (With Transition to Earth) | 0 | MILE | \$ | 25,000 | \$ | - |
| Pave 2' Shoulder with Safety Edge (Both Sides of Road - Includes Earthwork) | 0 | MILE | \$ | 150,000 | \$ | - |
| Install Edgeline Rumble Strips | 0 | MILE | \$ | 5,000 | \$ | - |
| Install Centerline Rumble Strips | 0 | MILE | \$ | 2,000 | \$ | - |
| Install/Upgrade Guardrail | 0 | FOOT | \$ | 35 | \$ | - |
| Flattening and Widening Foreslopes | 2.30 | MILE | \$ | 75,000 | \$ | 172,443 |
| Install High Friction Surface Treatment (HFST) on Curve | 0 | CURVE | \$ | 20,000 | \$ | - |
|  | Longer Term Improvements Subtotal: |  |  |  | \$ | 176,443 |

Project Location Map Sources:
Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013,
DigitalGlobe, GeoEye, i-cubed, USDA, AEX, Getmapping, Aerogrip, IGN, IGP, swisstopo, and the GIS User Community


## Use Restricted 23 U.S.C. § 409

Project Name: 60th Street between Limestone Road and S Locust Street (Peabody Southwest City Limit) Contact Name: Brice Goebel

E-mail: bgoebel@marioncoks.net

Date: 2/28/20
Prepared By: AJW
Checked By: MMO


SEGMENT

## Opinion of Probable Cost (Additional Potential Improvements)

There are a variety of other safety improvements that could be considered that were not included on the front page of the project sheet due to availability of data, the need for site-specific information, and/or the appetite for the countermeasure to be deployed throughout the county. The following countermeasures could be considered appropriate by the county and included below as additional potential improvements

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| On-Pavement Markings for Speed Control |  | EACH | \$ | 3,000 | \$ | - |
| Remove/Relocate/Combine Driveways |  | EACH | \$ | 40,000 | \$ | - |
| Pave Roadway |  | MILE | \$ | 850,000 | \$ | - |
| Conduct Road Safety Audit/Assessment (RSA) |  | EACH | \$ | 40,000 | \$ | - |
| Transverse Rumble Strips Prior to Curve |  | CURVE | \$ | 3,000 | \$ | - |
| Superelevation Correction on Curves |  | CURVE | \$ | 20,000 | \$ | - |
| Speed Activated Flashers on Chevron Signs |  | CURVE | \$ | 4,000 | \$ | - |
| Speed Feedback Sign on Curve Warning Sign |  | EACH | \$ | 4,000 | \$ | - |
| Other: Extend Culverts | 6 | EACH | \$ | 15,000 | \$ | 90,000 |
| Other: |  |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
| Additional Potential Improvements Subtotal: |  |  |  |  | \$ | 90,000 |
| *Mobilization is $10 \%+/$ - of the subtotal with a minimum of $\$ 2,500$ and a maximum of $\$ 75,000$ <br> ${ }^{* *}$ To be considered by county as they move forward with design of the recommendations | Short Term Improvements Subtotal: |  |  |  | \$ | 39,635 |
|  | Longer Term Improvements Subtotal: |  |  |  | \$ | 176,443 |
|  | Construction Subtotal: |  |  |  | \$ | 306,078 |

## Additional Project Benefits:

The improvements recommended along this segment can also have the benefit of positively impacting the following identified facility:

- Curve 18

| Mobilization: $(\%+/-)^{*}$ | $10 \%$ | $\$$ | 30,610 |
| ---: | ---: | :--- | ---: |
| Traffic Control: $(\%+/-)$ | $5 \%$ | $\$$ | 15,462 |
| Contingency: $(\%+/-)$ | $20 \%$ | $\$$ | 61,849 |
| Estimated Construction Cost | $\$ \$$ | 414,000 |  |
|  |  |  |  |

Crash History Along this 2.3 Mile Roadway Segment

|  | 2017 | 2016 | 2015 | 2014 | 2013 |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Number of Fatal Crashes | 1 | 0 | 0 | 0 | 0 |
| Number of Fatalities | 1 | 0 | 0 | 0 | 0 |
| Number of Disabling Injury Crashes | 0 | 0 | 0 | 0 | 0 |
| Number of Disabling Injuries | 0 | 0 | 0 | 0 | 0 |
| Number of Injury Crashes | 0 | 0 | 0 | 0 | 0 |
| Number of Injuries | 0 | 0 | 0 | 0 | 0 |
| Number of Property Damage Only Crashes | 0 | 0 | 0 | 5 | 0 |


| PE (Design) | 12\% | \$ | 49,680 |
| :---: | :---: | :---: | :---: |
|  |  | \$ | - |
| ROW** |  | \$ | - |
| CE (Inspection) | 15\% | \$ | 62,100 |
| Estimated Pro | Total | \$ | 526,000 |

## Opinion of Probable Construction Cost Disclaimer

Kimley-Horn, TranSystems, and WSP have no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Kimley-Horn, TranSystems, and WSP at this time and represent only our judgment as design professionals familiar with the construction industry. Kimley-Horn, TranSystems, and WSP cannot and do not guarantee that proposals, bids, or actual construction costs will not vary from these opinions of probable costs.

## Project Description Form Disclaimer:

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Marion County
ROAD © BRIDGE DEPT.

## Use Restricted 23 U.S.C. § 409

Date: 2/28/20
Prepared By: AJW Checked By: MMO

SEGMENT

Project Name: Nighthawk Road between 140th Street and US-50 Contact Name: Brice Goebel

E-mail: bgoebel@marioncoks.net
Location Description
Road: Nighthawk Road
From: 140th Street
To: US-50

GPS ID:
83, 85, 89


Segment Information and Systemic Ranking Summary

| Systemic Ranking Summary | Value | Score $^{*}$ |
| :---: | :---: | :---: |
| Average Daily Traffic (ADT) | 460 | 5 |
| Access Points per Mile | 5.2 | 2 |
| Edge Condition | 2.0 | 3 |
| Roadside Assessment | 2.0 | 3 |
| Pavement Width (ft) | 22.0 | 0 |
| Shoulder Width (ft) | 1.0 | 2 |
| Lane Departure Crash Rate | 1.8 | 3 |
| Presence of Pavement Markings | Yes | 0 |
| Surface Type | PAVED | $\mathbf{0}$ |
| Total Risk Factor Score (24 max) | $\mathbf{1 8}$ |  |


| Other Information |  |
| :---: | :---: |
| Paved Shoulder | Yes |
| Shoulder Material | ASPHALT |
| Speed Limit (mph) | $\mathbf{5 5}$ |
| Number of Lanes | $\mathbf{2}$ |
| Lane Width (ft) | $\mathbf{1 1}$ |
| Edgeline Rumble Strips | NOT PRESENT |
| Centerline Rumble Strips | NOT PRESENT |
| Curves | $\mathbf{2}$ |
| Curves with Warning Signs | $\mathbf{2}$ |
| **Edgeline and Centerline |  |

*Score from highest ranking segment used
Opinion of Probable Cost (Short Term Improvements)

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Install 6" Retroreflective Edgeline (Both Sides of Road) | 6.92 | MILE | \$ | 4,200 | \$ | 29,051 |
| Install 4" Retroreflective Centerline | 6.92 | MILE | \$ | 2,100 | \$ | 14,525 |
| Delineate Roadside Hazards with Retroreflective Markers | 70 | EACH | \$ | 100 | \$ | 7,000 |
| Clear and Grub (15 Feet Off Edge of Road, If Applicable) | 0.32 | MILE | \$ | 30,000 | \$ | 9,600 |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations | 0 | MILE | \$ | 5,000 | \$ | - |
| Review Pavement Condition/Type and Install Edgeline Rumble Strips (If Feasible) | 6.92 | MILE | \$ | 5,000 | \$ | 34,584 |
| Review Pavement Condition/Type and Install Centerline Rumble Strips (If Feasible) | 6.92 | MILE | \$ | 2,000 | \$ | 13,834 |
| Post-Mounted Delineators | 0 | MILE | \$ | 5,000 | \$ | - |
| Review and Upgrade Curve Signage to Meet MUTCD and KDOT Standards | 2 | CURVE | \$ | 1,000 | \$ | 2,000 |
| Install Curve Signage to Meet MUTCD and KDOT Standards (If Needed) | 0 | CURVE | \$ | 3,500 | \$ | - |
| Retroreflective Strips on Curve Signage | 2 | CURVE | \$ | 100 | \$ | 200 |
|  |  | hort Term |  | Subtotal: | \$ | 110,794 |

Opinion of Probable Cost (Longer Term Improvements)

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Remove/Relocate Fixed Objects in Clear Zone | 4 | EACH | \$ | 1,000 | \$ | 4,000 |
| Install 18-inch Aggregate Shoulder Treatment (With Transition to Earth) | 0 | MILE | \$ | 25,000 | \$ | - |
| Pave 2' Shoulder with Safety Edge (Both Sides of Road - Includes Earthwork) | 6.92 | MILE | \$ | 150,000 | \$ | 1,037,529 |
| Install Edgeline Rumble Strips | 6.92 | MILE | \$ | 5,000 | \$ | 34,584 |
| Install Centerline Rumble Strips | 6.92 | MILE | \$ | 2,000 | \$ | 13,834 |
| Install/Upgrade Guardrail | 182 | FOOT | \$ | 80 | \$ | 14,560 |
| Flattening and Widening Foreslopes | 6.92 | MILE | \$ | 75,000 | \$ | 518,765 |
| Install High Friction Surface Treatment (HFST) on Curve | 0 | CURVE | \$ | 20,000 | \$ | - |
|  | Longer Term Improvements Subtotal: |  |  |  | \$ | 1,623,272 |

Project Location Map Sources:
Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013,
DigitalGlobe, GeoEye, i-cubed, USDA, AEX, Getmapping, Aerogrip, IGN, IGP, swisstopo, and the GIS User Community


## Use Restricted 23 U.S.C. § 409

Project Name: Nighthawk Road between 140th Street and US-50
Contact Name: Brice Goebel
E-mail: bgoebel@marioncoks.net

Date: 2/28/20
Prepared By: AJW Checked By: MMO


SEGMENT

## Opinion of Probable Cost (Additional Potential Improvements)

GPS ID:
83, 85, 89
There are a variety of other safety improvements that could be considered that were not included on the front page of the project sheet due to availability of data, the need for site-specific information, and/or the appetite for the countermeasure to be deployed throughout the county. The following countermeasures could be considered appropriate by the county and included below as additional potential improvements

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| On-Pavement Markings for Speed Control |  | EACH | \$ | 3,000 | \$ | - |
| Remove/Relocate/Combine Driveways |  | EACH | \$ | 40,000 | \$ | - |
| Pave Roadway |  | MILE | \$ | 850,000 | \$ | - |
| Conduct Road Safety Audit/Assessment (RSA) |  | EACH | \$ | 40,000 | \$ | - |
| Transverse Rumble Strips Prior to Curve |  | CURVE | \$ | 3,000 | \$ | - |
| Superelevation Correction on Curves |  | CURVE | \$ | 20,000 | \$ | - |
| Speed Activated Flashers on Chevron Signs |  | CURVE | \$ | 4,000 | \$ | - |
| Speed Feedback Sign on Curve Warning Sign |  | EACH | \$ | 4,000 | \$ | - |
| Other: Extend Culverts | 12 | EACH | \$ | 15,000 | \$ | 180,000 |
| Other: | Other: |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
| Additional Potential Improvements Subtotal: |  |  |  |  | \$ | 180,000 |
| *Mobilization is $10 \%+/$ - of the subtotal with a minimum of \$2,500 and a maximum of \$75,000 |  | Term Imp | rov | Subtotal: | \$ | 110,794 |
| ${ }^{* *}$ To be considered by county as they move forward with design of the recommendations | Longe | Term Im | rov | Subtotal: | \$ | 1,623,272 |
|  |  |  | ns | Subtotal: | \$ | 1,914,066 |

## Additional Project Benefits:

The improvements recommended along this segment can also have the benefit of positively impacting the following identified facility:

- Curves 32, 33

| Mobilization: $(\%+/-)^{*}$ | $10 \%$ | $\$$ | 75,000 |
| ---: | ---: | :--- | ---: |
| Traffic Control: $(\%+/-)$ | $5 \%$ | $\$$ | 95,787 |
| Contingency: $(\%+/)$ | $20 \%$ | $\$$ | 383,147 |
| Estimated Construction Cost | $\$$ | $2,468,000$ |  |
|  |  |  |  |

Crash History Along this 6.92 Mile Roadway Segment

|  | 2017 | 2016 | 2015 | 2014 | 2013 |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Number of Fatal Crashes | 0 | 0 | 0 | 0 | 0 |
| Number of Fatalities | 0 | 0 | 0 | 0 | 0 |
| Number of Disabling Injury Crashes | 0 | 0 | 0 | 0 | 0 |
| Number of Disabling Injuries | 0 | 0 | 0 | 0 | 0 |
| Number of Injury Crashes | 0 | 1 | 2 | 0 | 0 |
| Number of Injuries | 0 | 1 | 3 | 0 | 0 |
| Number of Property Damage Only Crashes | 1 | 3 | 3 | 1 | 4 |


| $\begin{aligned} & \text { PE (Design) } \\ & \text { Utilities** } \\ & \text { ROW** } \end{aligned}$ | 12\% | \$ | 296,160 |
| :---: | :---: | :---: | :---: |
|  |  | \$ |  |
|  |  | \$ |  |
| CE (Inspection) | 15\% | \$ | 370,200 |
| Estimated Proj | Total | \$ | 3,135,000 |

## Opinion of Probable Construction Cost Disclaimer

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Marion County
ROAD O゙ BRIDGE DEPT.

## Use Restricted 23 U.S.C. § 409

# Marion County Local Road Safety Plan <br> Project Name: Remington Road between 290th Street and 240th Street Contact Name: Brice Goebel 

E-mail: bgoebel@marioncoks.net


Date: 2/28/20
Prepared By: AJW
Checked By: MMO
SEGMENT

## Segment Information and Systemic Ranking Summary

| Systemic Ranking Summary | Value | Score |
| :---: | :---: | :---: |
| Average Daily Traffic (ADT) | 295 | $\mathbf{5}$ |
| Access Points per Mile | $\mathbf{5 . 0}$ | $\mathbf{2}$ |
| Edge Condition | 2.0 | $\mathbf{3}$ |
| Roadside Assessment | $\mathbf{2 . 0}$ | $\mathbf{3}$ |
| Pavement Width (ft) | $\mathbf{3 0 . 0}$ | $\mathbf{0}$ |
| Shoulder Width (ft) | $\mathbf{0 . 0}$ | $\mathbf{2}$ |
| Lane Departure Crash Rate | $\mathbf{1 . 9}$ | $\mathbf{3}$ |
| Presence of Pavement Markings | Yes | $\mathbf{0}$ |
| Surface Type | PAVED | $\mathbf{0}$ |
| Total Risk Factor Score (24 max) |  | $\mathbf{1 8}$ |


| Other Information |  |
| :---: | :---: |
| Paved Shoulder | No |
| Shoulder Material | NONE |
| Speed Limit (mph) | $\mathbf{5 5}$ |
| Number of Lanes | $\mathbf{2}$ |
| Lane Width (ft) | $\mathbf{1 5}$ |
| Edgeline Rumble Strips | NOT PRESENT |
| Centerline Rumble Strips | NOT PRESENT |
| Curves | $\mathbf{0}$ |
| Curves with Warning Signs | $\mathbf{0}$ |
| **Edgeline and Centerline |  |

## Opinion of Probable Cost (Short Term Improvements)

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Install 6" Retroreflective Edgeline (Both Sides of Road) | 5.00 | MILE | \$ | 4,200 | \$ | 21,006 |
| Install 4" Retroreflective Centerline | 5.00 | MILE | \$ | 2,100 | \$ | 10,503 |
| Delineate Roadside Hazards with Retroreflective Markers | 51 | EACH | \$ | 100 | \$ | 5,100 |
| Clear and Grub (15 Feet Off Edge of Road, If Applicable) | 0.71 | MILE | \$ | 30,000 | \$ | 21,150 |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations | 0 | MILE | \$ | 5,000 | \$ | - |
| Review Pavement Condition/Type and Install Edgeline Rumble Strips (If Feasible) | 0 | MILE | \$ | 5,000 | \$ | - |
| Review Pavement Condition/Type and Install Centerline Rumble Strips (If Feasible) | 0 | MILE | \$ | 2,000 | \$ | - |
| Post-Mounted Delineators | 0 | MILE | \$ | 5,000 | \$ | - |
| Review and Upgrade Curve Signage to Meet MUTCD and KDOT Standards | 0 | CURVE | \$ | 1,000 | \$ | - |
| Install Curve Signage to Meet MUTCD and KDOT Standards (If Needed) | 0 | CURVE | \$ | 3,500 | \$ | - |
| Retroreflective Strips on Curve Signage | 0 | CURVE | \$ | 100 | \$ | - |
| Short Term Improvements Subtotal: |  |  |  |  | \$ | 57,759 |

## Opinion of Probable Cost (Longer Term Improvements)

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Remove/Relocate Fixed Objects in Clear Zone | 4 | EACH | \$ | 1,000 | \$ | 4,000 |
| Install 18-inch Aggregate Shoulder Treatment (With Transition to Earth) | 0 | MILE | \$ | 25,000 | \$ | - |
| Pave 2' Shoulder with Safety Edge (Both Sides of Road - Includes Earthwork) | 0 | MILE | \$ | 150,000 | \$ | - |
| Install Edgeline Rumble Strips | 0 | MILE | \$ | 5,000 | \$ | - |
| Install Centerline Rumble Strips | 0 | MILE | \$ | 2,000 | \$ | - |
| Install/Upgrade Guardrail | 0 | FOOT | \$ | 35 | \$ | - |
| Flattening and Widening Foreslopes | 5.00 | MILE | \$ | 75,000 | \$ | 375,110 |
| Install High Friction Surface Treatment (HFST) on Curve | 0 | CURVE | \$ | 20,000 | \$ | - |
|  | Longer Term Improvements Subtotal: |  |  |  | \$ | 379,110 |

Project Location Map Sources:
Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013,
DigitalGlobe, GeoEye, i-cubed, USDA, AEX, Getmapping, Aerogrip, IGN, IGP, swisstopo, and the GIS User Community


## Use Restricted 23 U.S.C. § 409

Project Name: Remington Road between 290th Street and 240th Street Contact Name: Brice Goebel

E-mail: bgoebel@marioncoks.net

Date: 2/28/20
Prepared By: AJW Checked By: MMO


SEGMENT

There are a variety of other safety improvements that could be considered that were not included on the front page of the project sheet due to availability of data, the need for site-specific information, and/or the appetite for the countermeasure to be deployed throughout the county. The following countermeasures could be considered appropriate by the county and included below as additional potential improvements.

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| On-Pavement Markings for Speed Control |  | EACH | \$ | 3,000 | \$ | - |
| Remove/Relocate/Combine Driveways |  | EACH | \$ | 40,000 | \$ | - |
| Pave Roadway |  | MILE | \$ | 850,000 | \$ | - |
| Conduct Road Safety Audit/Assessment (RSA) |  | EACH | \$ | 40,000 | \$ | - |
| Transverse Rumble Strips Prior to Curve |  | CURVE | \$ | 3,000 | \$ | - |
| Superelevation Correction on Curves |  | CURVE | \$ | 20,000 | \$ | - |
| Speed Activated Flashers on Chevron Signs |  | CURVE | \$ | 4,000 | \$ | - |
| Speed Feedback Sign on Curve Warning Sign |  | EACH | \$ | 4,000 | \$ | - |
| Other: Extend Culverts | 13 | EACH | \$ | 15,000 | \$ | 195,000 |
| Other: |  |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
| Additional Potential Improvements Subtotal: |  |  |  |  | \$ | 195,000 |
| *Mobilization is $10 \%+/$ - of the subtotal with a minimum of $\$ 2,500$ and a maximum of $\$ 75,000$ <br> ${ }^{* *}$ To be considered by county as they move forward with design of the recommendations | Short Term Improvements Subtotal: |  |  |  | \$ | 57,759 |
|  | Longer Term Improvements Subtotal: |  |  |  | \$ | 379,110 |
|  | Construction Subtotal: |  |  |  | \$ | 631,870 |


| Mobilization: $(\%+/-)^{*}$ | 10\% | \$ | 63,190 |
| :---: | :---: | :---: | :---: |
| Traffic Control: (\% +/-) | 5\% | \$ | 31,788 |
| Contingency: (\% +/-) | 20\% | \$ | 127,152 |
| Estimated Constru | Cost | \$ | 854,000 |

Crash History Along this 5 Mile Roadway Segment

|  | 2017 | 2016 | 2015 | 2014 | 2013 |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Number of Fatal Crashes | 0 | 0 | 0 | 0 | 0 |
| Number of Fatalities | 0 | 0 | 0 | 0 | 0 |
| Number of Disabling Injury Crashes | 0 | 0 | 1 | 0 | 0 |
| Number of Disabling Injuries | 0 | 0 | 1 | 0 | 0 |
| Number of Injury Crashes | 0 | 0 | 1 | 0 | 0 |
| Number of Injuries | 0 | 0 | 1 | 0 | 0 |
| Number of Property Damage Only Crashes | 1 | 1 | 3 | 1 | 0 |


| $\underset{\text { Utilities** }}{\text { PE }}$ | 12\% | \$ | 102,480 |
| :---: | :---: | :---: | :---: |
|  |  | \$ | - |
| ROW** |  | \$ |  |
| CE (Inspection) | 15\% | \$ | 128,100 |
| Estimated Proj | Total | \$ | 1,085,000 |

## Opinion of Probable Construction Cost Disclaimer

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## Project Description Form Disclaimer:

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Marion County
ROAD Ơ BRIDGE DEPT.

## Use Restricted 23 U.S.C. § 409

Date: 2/28/20
Prepared By: AJW
Checked By: MMO
SEGMENT

Project Name: Sunflower Road between 140th Street and US-50 Contact Name: Brice Goebel

E-mail: bgoebel@marioncoks.net
ocation Description
Road: Sunflower Road
From: 140th Street
To: US-50

Length (miles): 5.38


Segment Information and Systemic Ranking Summary

| Systemic Ranking Summary | Value | Score $^{*}$ |
| :---: | :---: | :---: |
| Average Daily Traffic (ADT) | 615 | $\mathbf{6}$ |
| Access Points per Mile | 2.2 | 1 |
| Edge Condition | 2.0 | 3 |
| Roadside Assessment | 2.0 | 3 |
| Pavement Width (ft) | 24.0 | $\mathbf{0}$ |
| Shoulder Width (ft) | $\mathbf{0 . 0}$ | $\mathbf{2}$ |
| Lane Departure Crash Rate | $\mathbf{3 . 1}$ | $\mathbf{3}$ |
| Presence of Pavement Markings | Yes | $\mathbf{0}$ |
| Surface Type | PAVED | $\mathbf{0}$ |
| Total Risk Factor Score (24 max) | $\mathbf{1 8}$ |  |


| Other Information |  |
| :---: | :---: |
| Paved Shoulder | No |
| Shoulder Material | NONE |
| Speed Limit (mph) | $\mathbf{5 5}$ |
| Number of Lanes | $\mathbf{2}$ |
| Lane Width (ft) | $\mathbf{1 2}$ |
| Edgeline Rumble Strips | NOT PRESENT |
| Centerline Rumble Strips | NOT PRESENT |
| Curves | $\mathbf{5}$ |
| Curves with Warning Signs | $\mathbf{5}$ |
| **Edgeline and Centerline |  |

*Score from highest ranking segment used
Opinion of Probable Cost (Short Term Improvements)

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Install 6" Retroreflective Edgeline (Both Sides of Road) | 5.38 | MILE | \$ | 4,200 | \$ | 22,591 |
| Install 4" Retroreflective Centerline | 5.38 | MILE | \$ | 2,100 | \$ | 11,295 |
| Delineate Roadside Hazards with Retroreflective Markers | 54 | EACH | \$ | 100 | \$ | 5,400 |
| Clear and Grub (15 Feet Off Edge of Road, If Applicable) | 0.17 | MILE | \$ | 30,000 | \$ | 5,100 |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations | 0 | MILE | \$ | 5,000 | \$ | - |
| Review Pavement Condition/Type and Install Edgeline Rumble Strips (If Feasible) | 5.38 | MILE | \$ | 5,000 | \$ | 26,894 |
| Review Pavement Condition/Type and Install Centerline Rumble Strips (If Feasible) | 5.38 | MILE | \$ | 2,000 | \$ | 10,758 |
| Post-Mounted Delineators | 0 | MILE | \$ | 5,000 | \$ | - |
| Review and Upgrade Curve Signage to Meet MUTCD and KDOT Standards | 5 | CURVE | \$ | 1,000 | \$ | 5,000 |
| Install Curve Signage to Meet MUTCD and KDOT Standards (If Needed) | 0 | CURVE | \$ | 3,500 | \$ | - |
| Retroreflective Strips on Curve Signage | 5 | CURVE | \$ | 100 | \$ | 500 |
|  |  | hort Term | over | Subtotal: | \$ | 87,538 |

Opinion of Probable Cost (Longer Term Improvements)

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Remove/Relocate Fixed Objects in Clear Zone | 4 | EACH | \$ | 1,000 | \$ | 4,000 |
| Install 18-inch Aggregate Shoulder Treatment (With Transition to Earth) | 0 | MILE | \$ | 25,000 | \$ | - |
| Pave 2' Shoulder with Safety Edge (Both Sides of Road - Includes Earthwork) | 5.38 | MILE | \$ | 150,000 | \$ | 806,816 |
| Install Edgeline Rumble Strips | 5.38 | MILE | \$ | 5,000 | \$ | 26,894 |
| Install Centerline Rumble Strips | 5.38 | MILE | \$ | 2,000 | \$ | 10,758 |
| Install/Upgrade Guardrail | 241 | FOOT | \$ | 80 | \$ | 19,280 |
| Flattening and Widening Foreslopes | 5.38 | MILE | \$ | 75,000 | \$ | 403,408 |
| Install High Friction Surface Treatment (HFST) on Curve | 0 | CURVE | \$ | 20,000 | \$ | - |
|  | Longer Term Improvements Subtotal: |  |  |  | \$ | 1,271,155 |

Project Location Map Sources:
Continued on back of this page.
Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013,
DigitalGlobe, GeoEye, i-cubed, USDA, AEX, Getmapping, Aerogrip, IGN, IGP, swisstopo, and the GIS User Community


## Use Restricted 23 U.S.C. § 409

Project Name: Sunflower Road between 140th Street and US-50
Contact Name: Brice Goebel
E-mail: bgoebel@marioncoks.net

Date: 2/28/20
Prepared By: AJW Checked By: MMO


SEGMENT

## Opinion of Probable Cost (Additional Potential Improvements)

GPS ID:
103, 105
There are a variety of other safety improvements that could be considered that were not included on the front page of the project sheet due to availability of data, the need for site-specific information, and/or the appetite for the countermeasure to be deployed throughout the county. The following countermeasures could be considered appropriate by the county and included below as additional potential improvements


## Additional Project Benefits:

The improvements recommended along this segment can also have the benefit of positively impacting the

Mobilization: $(\%+/-)^{\star}$ Traffic Control: $(\%+/-)$
Contingency: $(\%+/-)$
Estimated Construction

| $\begin{aligned} & \text { PE (Design) } \\ & \text { Utilities }{ }^{* *} \\ & \text { ROW** }^{* *} \end{aligned}$ | 12\% | \$ | 260,160 |
| :---: | :---: | :---: | :---: |
|  |  | \$ |  |
|  |  | \$ |  |
| CE (Inspection) | 15\% | \$ | 325,200 |
| Estimated Proje | Total | \$ | 2,754,000 |

following identified facility:

- Curves 39, 41, 45, 46, 47
Crash History Along this 5.38 Mile Roadway Segment

|  | 2017 | 2016 | 2015 | 2014 | 2013 |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Number of Fatal Crashes | 0 | 0 | 0 | 0 | 0 |
| Number of Fatalities | 0 | 0 | 0 | 0 | 0 |
| Number of Disabling Injury Crashes | 0 | 0 | 1 | 0 | 0 |
| Number of Disabling Injuries | 0 | 0 | 6 | 0 | 0 |
| Number of Injury Crashes | 0 | 1 | 1 | 1 | 0 |
| Number of Injuries | 0 | 1 | 1 | 1 | 0 |
| Number of Property Damage Only Crashes | 1 | 3 | 2 | 3 | 2 |

## Opinion of Probable Construction Cost Disclaimer

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Marion County
ROAD ©゚ BRIDGE DEPT

## Use Restricted 23 U.S.C. § 409

Date: 2/28/20
Prepared By: AJW
Checked By: MMO
SEGMENT

Project Name: 290th Street between K-15 and Nighthawk Road Contact Name: Brice Goebel

E-mail: bgoebel@marioncoks.net
ocation Description
Road: 290th Street
From: K-15
To: Nighthawk Road
Length (miles): 5.98


Segment Information and Systemic Ranking Summary

| Systemic Ranking Summary | Value | Score $^{*}$ |
| :---: | :---: | :---: |
| Average Daily Traffic (ADT) | 535 | $\mathbf{5}$ |
| Access Points per Mile | 2.0 | 1 |
| Edge Condition | 2.0 | 3 |
| Roadside Assessment | 2.0 | 3 |
| Pavement Width (ft) | 26.0 | $\mathbf{0}$ |
| Shoulder Width (ft) | 1.0 | 2 |
| Lane Departure Crash Rate | 2.1 | 3 |
| Presence of Pavement Markings | Yes | $\mathbf{0}$ |
| Surface Type | PAVED | $\mathbf{0}$ |
| Total Risk Factor Score (24 max) | $\mathbf{1 7}$ |  |


| Other Information |  |
| :---: | :---: |
| Paved Shoulder | Yes |
| Shoulder Material | ASPHALT |
| Speed Limit (mph) | $\mathbf{5 5}$ |
| Number of Lanes | $\mathbf{2}$ |
| Lane Width (ft) | $\mathbf{1 3}$ |
| Edgeline Rumble Strips | NOT PRESENT |
| Centerline Rumble Strips | NOT PRESENT |
| Curves | $\mathbf{0}$ |
| Curves with Warning Signs | $\mathbf{0}$ |
| **Edgeline and Centerline |  |

*Score from highest ranking segment used
Opinion of Probable Cost (Short Term Improvements)

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Install 6" Retroreflective Edgeline (Both Sides of Road) | 5.98 | MILE | \$ | 4,200 | \$ | 25,121 |
| Install 4" Retroreflective Centerline | 5.98 | MILE | \$ | 2,100 | \$ | 12,560 |
| Delineate Roadside Hazards with Retroreflective Markers | 60 | EACH | \$ | 100 | \$ | 6,000 |
| Clear and Grub (15 Feet Off Edge of Road, If Applicable) | 0.11 | MILE | \$ | 30,000 | \$ | 3,300 |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations | 0 | MILE | \$ | 5,000 | \$ | - |
| Review Pavement Condition/Type and Install Edgeline Rumble Strips (If Feasible) | 5.98 | MILE | \$ | 5,000 | \$ | 29,906 |
| Review Pavement Condition/Type and Install Centerline Rumble Strips (If Feasible) | 5.98 | MILE | \$ | 2,000 | \$ | 11,962 |
| Post-Mounted Delineators | 0 | MILE | \$ | 5,000 | \$ | - |
| Review and Upgrade Curve Signage to Meet MUTCD and KDOT Standards | 0 | CURVE | \$ | 1,000 | \$ | - |
| Install Curve Signage to Meet MUTCD and KDOT Standards (If Needed) | 0 | CURVE | \$ | 3,500 | \$ | - |
| Retroreflective Strips on Curve Signage | 0 | CURVE | \$ | 100 | \$ | - |
| Short Term Improvements Subtotal: |  |  |  |  | \$ | 88,850 |

## Opinion of Probable Cost (Longer Term Improvements)

| Item Description | Quantity | Unit | Unit Price | Item Cost |
| :--- | :---: | :---: | :---: | :---: |
| Remove/Relocate Fixed Objects in Clear Zone | 4 | 1,000 | $\$$ | 4,000 |
| Install 18-inch Aggregate Shoulder Treatment (With Transition to Earth) | 0 | EACH | $\$$ | - |
| Pave 2' Shoulder with Safety Edge (Both Sides of Road - Includes Earthwork) | MILE | $\$$ | 25,000 | $\$$ |
| Install Edgeline Rumble Strips | 5.98 | MILE | $\$$ | 150,000 |
| Install Centerline Rumble Strips | 5.98 | 897,177 |  |  |
| Install/Upgrade Guardrail | 5.98 | MILE | $\$$ | 5,000 |
| Flattening and Widening Foreslopes | $\$$ | 29,906 |  |  |
| Install High Friction Surface Treatment (HFST) on Curve | 73 | MILE | $\$$ | 2,000 |

Project Location Map Sources:
Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013,
DigitalGlobe, GeoEye, i-cubed, USDA, AEX, Getmapping, Aerogrip, IGN, IGP, swisstopo, and the GIS User Community


## Use Restricted 23 U.S.C. § 409

Project Name: 290th Street between K-15 and Nighthawk Road Contact Name: Brice Goebel

E-mail: bgoebel@marioncoks.net

Date: 2/28/20
Prepared By: AJW Checked By: MMO


SEGMENT

There are a variety of other safety improvements that could be considered that were not included on the front page of the project sheet due to availability of data, the need for site-specific information, and/or the appetite for the countermeasure to be deployed throughout the county. The following countermeasures could be considered appropriate by the county and included below as additional potential improvements

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| On-Pavement Markings for Speed Control |  | EACH | \$ | 3,000 | \$ | - |
| Remove/Relocate/Combine Driveways |  | EACH | \$ | 40,000 | \$ | - |
| Pave Roadway |  | MILE | \$ | 850,000 | \$ | - |
| Conduct Road Safety Audit/Assessment (RSA) |  | EACH | \$ | 40,000 | \$ | - |
| Transverse Rumble Strips Prior to Curve |  | CURVE | \$ | 3,000 | \$ | - |
| Superelevation Correction on Curves |  | CURVE | \$ | 20,000 | \$ | - |
| Speed Activated Flashers on Chevron Signs |  | CURVE | \$ | 4,000 | \$ | - |
| Speed Feedback Sign on Curve Warning Sign |  | EACH | \$ | 4,000 | \$ | - |
| Other: Extend Culverts | 12 | EACH | \$ | 15,000 | \$ | 180,000 |
| Other: |  |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
| Additional Potential Improvements Subtotal: |  |  |  |  | \$ | 180,000 |
| *Mobilization is $10 \%+/$ - of the subtotal with a minimum of $\$ 2,500$ and a maximum of $\$ 75,000$ <br> ${ }^{* *}$ To be considered by county as they move forward with design of the recommendations | Short Term Improvements Subtotal: |  |  |  | \$ | 88,850 |
|  | Longer Term Improvements Subtotal: |  |  |  | \$ | 1,397,474 |
|  | Construction Subtotal: |  |  |  | \$ | 1,666,323 |


| Mobilization: $(\%+/-)^{\star}$ | $10 \%$ | $\$$ | 75,000 |
| :---: | ---: | :--- | ---: |
|  | $\$ 1$ |  |  |
| Traffic Control: $(\%+/-)$ | $5 \%$ | $\$$ | 83,335 |
| Contingency: $(\%+/-)$ | $20 \%$ | $\$$ | 333,341 |
| Estimated Construction Cost | $\$$ | $2,158,000$ |  |

Crash History Along this 5.98 Mile Roadway Segment

|  | 2017 | 2016 | 2015 | 2014 | 2013 |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Number of Fatal Crashes | 0 | 0 | 0 | 1 | 0 |
| Number of Fatalities | 0 | 0 | 0 | 1 | 0 |
| Number of Disabling Injury Crashes | 0 | 0 | 0 | 0 | 0 |
| Number of Disabling Injuries | 0 | 0 | 0 | 0 | 0 |
| Number of Injury Crashes | 0 | 1 | 0 | 0 | 0 |
| Number of Injuries | 0 | 1 | 0 | 0 | 0 |
| Number of Property Damage Only Crashes | 2 | 3 | 1 | 1 | 2 |


| $\begin{aligned} & \text { PE (Design) } \\ & \text { Utilities** } \\ & \text { ROW** }^{* *} \end{aligned}$ | 12\% | \$ | 258,960 |
| :---: | :---: | :---: | :---: |
|  |  | \$ | - |
|  |  | \$ | - |
| CE (Inspection) | 15\% | \$ | 323,700 |
| Estimated Pro | Total | \$ | 2,741,000 |

## Opinion of Probable Construction Cost Disclaimer

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Marion County
ROAD ©゙ BRIDGE DEPT.

## Use Restricted 23 U.S.C. § 409

Date: 2/28/20
Prepared By: AJW
Checked By: MMO
SEGMENT

Project Name: 190th Street between Nighthawk Road and Remington Road (K-256) Contact Name: Brice Goebe

E-mail: bgoebel@marioncoks.net



Segment Information and Systemic Ranking Summary

| Systemic Ranking Summary | Value | Score $^{*}$ |
| :---: | :---: | :---: |
| Average Daily Traffic (ADT) | 1,075 | $\mathbf{6}$ |
| Access Points per Mile | 3.7 | 2 |
| Edge Condition | 2.0 | 3 |
| Roadside Assessment | 2.0 | 3 |
| Pavement Width (ft) | 26.0 | 0 |
| Shoulder Width (ft) | 2.0 | 1 |
| Lane Departure Crash Rate | 0.9 | 2 |
| Presence of Pavement Markings | Yes | $\mathbf{0}$ |
| Surface Type | PAVED | $\mathbf{0}$ |
| Total Risk Factor Score (24 max) | $\mathbf{1 7}$ |  |


| Other Information |  |
| :---: | :---: |
| Paved Shoulder | No |
| Shoulder Material | GRAVEL |
| Speed Limit (mph) | $\mathbf{5 5}$ |
| Number of Lanes | $\mathbf{2}$ |
| Lane Width (ft) | $\mathbf{1 3}$ |
| Edgeline Rumble Strips | NOT PRESENT |
| Centerline Rumble Strips | NOT PRESENT |
| Curves | $\mathbf{0}$ |
| Curves with Warning Signs | $\mathbf{0}$ |
| **Edgeline and Centerline |  |

*Score from highest ranking segment used
Opinion of Probable Cost (Short Term Improvements)

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Install 6" Retroreflective Edgeline (Both Sides of Road) | 3.98 | MILE | \$ | 4,200 | \$ | 16,720 |
| Install 4" Retroreflective Centerline | 3.98 | MILE | \$ | 2,100 | \$ | 8,360 |
| Delineate Roadside Hazards with Retroreflective Markers | 40 | EACH | \$ | 100 | \$ | 4,000 |
| Clear and Grub (15 Feet Off Edge of Road, If Applicable) | 0.43 | MILE | \$ | 30,000 | \$ | 12,750 |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations | 0 | MILE | \$ | 5,000 | \$ | - |
| Review Pavement Condition/Type and Install Edgeline Rumble Strips (If Feasible) | 3.98 | MILE | \$ | 5,000 | \$ | 19,904 |
| Review Pavement Condition/Type and Install Centerline Rumble Strips (If Feasible) | 3.98 | MILE | \$ | 2,000 | \$ | 7,962 |
| Post-Mounted Delineators | 0 | MILE | \$ | 5,000 | \$ | - |
| Review and Upgrade Curve Signage to Meet MUTCD and KDOT Standards | 0 | CURVE | \$ | 1,000 | \$ | - |
| Install Curve Signage to Meet MUTCD and KDOT Standards (If Needed) | 0 | CURVE | \$ | 3,500 | \$ | - |
| Retroreflective Strips on Curve Signage | 0 | CURVE | \$ | 100 | \$ | - |
| Short Term Improvements Subtotal: |  |  |  |  | \$ | 69,695 |

Opinion of Probable Cost (Longer Term Improvements)

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Remove/Relocate Fixed Objects in Clear Zone | 4 | EACH | \$ | 1,000 | \$ | 4,000 |
| Install 18-inch Aggregate Shoulder Treatment (With Transition to Earth) | 0 | MILE | \$ | 25,000 | \$ | - |
| Pave 2' Shoulder with Safety Edge (Both Sides of Road - Includes Earthwork) | 3.98 | MILE | \$ | 150,000 | \$ | 597,129 |
| Install Edgeline Rumble Strips | 3.98 | MILE | \$ | 5,000 | \$ | 19,904 |
| Install Centerline Rumble Strips | 3.98 | MILE | \$ | 2,000 | \$ | 7,962 |
| Install/Upgrade Guardrail | 975 | FOOT | \$ | 35 | \$ | 34,125 |
| Flattening and Widening Foreslopes | 3.98 | MILE | \$ | 75,000 | \$ | 298,565 |
| Install High Friction Surface Treatment (HFST) on Curve | 0 | CURVE | \$ | 20,000 | \$ | - |
|  | Longer Term Improvements Subtotal: |  |  |  | \$ | 961,685 |

Continued on back of this page.
Project Location Map Sources:
Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013,
DigitalGlobe, GeoEye, i-cubed, USDA, AEX, Getmapping, Aerogrip, IGN, IGP, swisstopo, and the GIS User Community


## Use Restricted 23 U.S.C. § 409

Project Name: 190th Street between Nighthawk Road and Remington Road (K-256) Contact Name: Brice Goebel

E-mail: bgoebel@marioncoks.net

Date: 2/28/20
Prepared By: AJW Checked By: MMO


SEGMENT

## Opinion of Probable Cost (Additional Potential Improvements)

There are a variety of other safety improvements that could be considered that were not included on the front page of the project sheet due to availability of data, the need for site-specific information, and/or the appetite for the countermeasure to be deployed throughout the county. The following countermeasures could be considered appropriate by the county and included below as additional potential improvements

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| On-Pavement Markings for Speed Control |  | EACH | \$ | 3,000 | \$ | - |
| Remove/Relocate/Combine Driveways |  | EACH | \$ | 40,000 | \$ | - |
| Pave Roadway |  | MILE | \$ | 850,000 | \$ | - |
| Conduct Road Safety Audit/Assessment (RSA) |  | EACH | \$ | 40,000 | \$ | - |
| Transverse Rumble Strips Prior to Curve |  | CURVE | \$ | 3,000 | \$ | - |
| Superelevation Correction on Curves |  | CURVE | \$ | 20,000 | \$ | - |
| Speed Activated Flashers on Chevron Signs |  | CURVE | \$ | 4,000 | \$ | - |
| Speed Feedback Sign on Curve Warning Sign |  | EACH | \$ | 4,000 | \$ | - |
| Other: Extend Culverts | 6 | EACH | \$ | 15,000 | \$ | 90,000 |
| Other: |  |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
| Additional Potential Improvements Subtotal: |  |  |  |  | \$ | 90,000 |
| *Mobilization is $10 \%+/$ - of the subtotal with a minimum of $\$ 2,500$ and a maximum of $\$ 75,000$ <br> ${ }^{* *}$ To be considered by county as they move forward with design of the recommendations | Short Term Improvements Subtotal: |  |  |  | \$ | 69,695 |
|  | Longer Term Improvements Subtotal: |  |  |  | \$ | 961,685 |
|  | Construction Subtotal: |  |  |  | \$ | 1,121,380 |

## Additional Project Benefits:

The improvements recommended along this segment can also have the benefit of positively impacting the following identified facility:

- Intersection 147

| Mobilization: $(\%+/-)^{*}$ | $10 \%$ | $\$$ | 75,000 |
| ---: | ---: | :--- | ---: |
| Traffic Control: $(\%+/-)$ | $5 \%$ | $\$$ | 56,124 |
| Contingency: $(\%+/-)$ | $20 \%$ | $\$$ | 224,496 |
| Estimated Construction Cost | $\$$ | $1,477,000$ |  |
|  |  |  |  |

Crash History Along this 3.98 Mile Roadway Segment

|  | 2017 | 2016 | 2015 | 2014 | 2013 |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Number of Fatal Crashes | 0 | 0 | 0 | 0 | 0 |
| Number of Fatalities | 0 | 0 | 0 | 0 | 0 |
| Number of Disabling Injury Crashes | 0 | 1 | 0 | 0 | 0 |
| Number of Disabling Injuries | 0 | 1 | 0 | 0 | 0 |
| Number of Injury Crashes | 0 | 2 | 1 | 0 | 1 |
| Number of Injuries | 0 | 2 | 1 | 0 | 4 |
| Number of Property Damage Only Crashes | 2 | 2 | 3 | 3 | 3 |


| $\underset{\text { Utilities** }}{\text { PE }}$ | 12\% | \$ | 177,240 |
| :---: | :---: | :---: | :---: |
|  |  | \$ |  |
| ROW** |  | \$ |  |
| CE (Inspection) | 15\% | \$ | 221,550 |
| Estimated Proj | Total | \$ | 1,876,000 |

## Opinion of Probable Construction Cost Disclaimer

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Marion County
ROAD © BRIDGE DEPT.

## Use Restricted 23 U.S.C. § 409

Date: 2/28/20 Prepared By: AJW Checked By: MMO

SEGMENT

Project Name: 60th Street between S Maple Street (Peabody Southeast City Limit) and Timber Road Contact Name: Brice Goebel

E-mail: bgoebel@marioncoks.net

From: S Maple Street (Peabody Southeast City Limit)
To: Timber Road (miles): 5.55


Segment Information and Systemic Ranking Summary

| Systemic Ranking Summary | Value | Score* $^{*}$ |
| :---: | :---: | :---: |
| Average Daily Traffic (ADT) | 245 | $\mathbf{4}$ |
| Access Points per Mile | 4.6 | $\mathbf{2}$ |
| Edge Condition | 2.0 | $\mathbf{3}$ |
| Roadside Assessment | 2.0 | 3 |
| Pavement Width (ft) | $\mathbf{2 4 . 0}$ | $\mathbf{0}$ |
| Shoulder Width (ft) | $\mathbf{0 . 0}$ | $\mathbf{2}$ |
| Lane Departure Crash Rate | $\mathbf{2 . 2}$ | $\mathbf{3}$ |
| Presence of Pavement Markings | Yes | $\mathbf{0}$ |
| Surface Type | PAVED | $\mathbf{0}$ |
| Total Risk Factor Score (24 max) | $\mathbf{1 7}$ |  |


| Other Information |  |
| :---: | :---: |
| Paved Shoulder | No |
| Shoulder Material | NONE |
| Speed Limit (mph) | $\mathbf{5 5}$ |
| Number of Lanes | $\mathbf{2}$ |
| Lane Width (ft) | $\mathbf{1 2}$ |
| Edgeline Rumble Strips | NOT PRESENT |
| Centerline Rumble Strips | NOT PRESENT |
| Curves | $\mathbf{1}$ |
| Curves with Warning Signs | $\mathbf{1}$ |
| **Edgeline and Centerline |  |

*Score from highest ranking segment used
Opinion of Probable Cost (Short Term Improvements)

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Install 6" Retroreflective Edgeline (Both Sides of Road) | 5.55 | MILE | \$ | 4,200 | \$ | 23,292 |
| Install 4" Retroreflective Centerline | 5.55 | MILE | \$ | 2,100 | \$ | 11,646 |
| Delineate Roadside Hazards with Retroreflective Markers | 56 | EACH | \$ | 100 | \$ | 5,600 |
| Clear and Grub (15 Feet Off Edge of Road, If Applicable) | 1.77 | MILE | \$ | 30,000 | \$ | 52,950 |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations | 0 | MILE | \$ | 5,000 | \$ | - |
| Review Pavement Condition/Type and Install Edgeline Rumble Strips (If Feasible) | 0 | MILE | \$ | 5,000 | \$ | - |
| Review Pavement Condition/Type and Install Centerline Rumble Strips (If Feasible) | 0 | MILE | \$ | 2,000 | \$ | - |
| Post-Mounted Delineators | 0 | MILE | \$ | 5,000 | \$ | - |
| Review and Upgrade Curve Signage to Meet MUTCD and KDOT Standards | 1 | CURVE | \$ | 1,000 | \$ | 1,000 |
| Install Curve Signage to Meet MUTCD and KDOT Standards (If Needed) | 0 | CURVE | \$ | 3,500 | \$ | - |
| Retroreflective Strips on Curve Signage | 1 | CURVE | \$ | 100 | \$ | 100 |
| Short Term Improvements Subtotal: |  |  |  |  | \$ | 94,588 |


| Opinion of Probable Cost (Longer Term Improvements) |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Item Description | Quantity | Unit |  | rice |  | Cost |
| Remove/Relocate Fixed Objects in Clear Zone | 4 | EACH | \$ | 1,000 | \$ | 4,000 |
| Install 18-inch Aggregate Shoulder Treatment (With Transition to Earth) | 0 | MILE | \$ | 25,000 | \$ | - |
| Pave 2' Shoulder with Safety Edge (Both Sides of Road - Includes Earthwork) | 0 | MILE | \$ | 150,000 | \$ | - |
| Install Edgeline Rumble Strips | 0 | MILE | \$ | 5,000 | \$ | - |
| Install Centerline Rumble Strips | 0 | MILE | \$ | 2,000 | \$ | - |
| Install/Upgrade Guardrail | 380 | FOOT | \$ | 80 | \$ | 30,400 |
| Flattening and Widening Foreslopes | 5.55 | MILE | \$ | 75,000 | \$ | 415,923 |
| Install High Friction Surface Treatment (HFST) on Curve | 0 | CURVE | \$ | 20,000 | \$ | - |
| Longer Term Improvements Subtotal: |  |  |  |  | \$ | 450,323 |

Project Location Map Sources:
Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013,
DigitalGlobe, GeoEye, i-cubed, USDA, AEX, Getmapping, Aerogrip, IGN, IGP, swisstopo, and the GIS User Community


Date: 2/28/20
Prepared By: AJW
Checked By: MMO


SEGMENT

## Opinion of Probable Cost (Additional Potential Improvements)

There are a variety of other safety improvements that could be considered that were not included on the front page of the project sheet due to availability of data, the need for site-specific information, and/or the appetite for the countermeasure to be deployed throughout the county. The following countermeasures could be considered appropriate by the county and included below as additional potential improvements

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| On-Pavement Markings for Speed Control |  | EACH | \$ | 3,000 | \$ | - |
| Remove/Relocate/Combine Driveways |  | EACH | \$ | 40,000 | \$ | - |
| Pave Roadway |  | MILE | \$ | 850,000 | \$ | - |
| Conduct Road Safety Audit/Assessment (RSA) |  | EACH | \$ | 40,000 | \$ | - |
| Transverse Rumble Strips Prior to Curve |  | CURVE | \$ | 3,000 | \$ | - |
| Superelevation Correction on Curves |  | CURVE | \$ | 20,000 | \$ | - |
| Speed Activated Flashers on Chevron Signs |  | CURVE | \$ | 4,000 | \$ | - |
| Speed Feedback Sign on Curve Warning Sign |  | EACH | \$ | 4,000 | \$ | - |
| Other: Extend Culverts | 11 | EACH | \$ | 15,000 | \$ | 165,000 |
| Other: |  |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
|  | Additional Po | ential Imp | rove | Subtotal: | \$ | 165,000 |
| *Mobilization is $10 \%+/$ - of the subtotal with a minimum of \$2,500 and a maximum of \$75,000 |  | Term Imp | rov | Subtotal: | \$ | 94,588 |
| **To be considered by county as they move forward with design of the recommendations | Longer | Term Imp | rov | Subtotal: | \$ | 450,323 |
|  |  |  | nst | Subtotal: | \$ | 709,910 |
|  |  | Mobilizatio | : | 10\% | \$ | 71,000 |
|  |  | affic Cont | : | 5\% | \$ | 35,618 |
| Additional Project Benefits: |  | Contingen | y: | 20\% | \$ | 142,472 |
| The improvements recommended along this segment can also have the benefit of positively impacting the |  | Estimated | d | tion Cost | \$ | 959,000 |

following identified facilities:

- Curve 17


| Crash History Along this 5.55 Mile Roadway Segment |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | 2017 | 2016 | 2015 | 2014 | 2013 |
| Number of Fatal Crashes | 0 | 0 | 0 | 0 | 0 |
| Number of Fatalities | 0 | 0 | 0 | 0 | 0 |
| Number of Disabling Injury Crashes | 0 | 0 | 0 | 0 | 0 |
| Number of Disabling Injuries | 0 | 0 | 0 | 0 | 0 |
| Number of Injury Crashes | 1 | 1 | 1 | 1 | 1 |
| Number of Injuries | 2 | 1 | 1 | 1 | 4 |
| Number of Property Damage Only Crashes | 2 | 1 | 0 | 4 | 10 |

## Opinion of Probable Construction Cost Disclaimer

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Marion County
ROAD © BRIDGE DEPT.

## Use Restricted 23 U.S.C. § 409

Date: 2/28/20
Prepared By: AJW
Checked By: MMO
SEGMENT

Project Name: 120th Street between K-15 and Indigo Road Contact Name: Brice Goebel

E-mail: bgoebel@marioncoks.net
Location Description
Road: 120th Street
From: K-15
To: Indigo Road


Segment Information and Systemic Ranking Summary

| Systemic Ranking Summary | Value | Score* $^{*}$ |
| :---: | :---: | :---: |
| Average Daily Traffic (ADT) | 275 | $\mathbf{5}$ |
| Access Points per Mile | 4.0 | 2 |
| Edge Condition | 2.0 | 3 |
| Roadside Assessment | 2.0 | 3 |
| Pavement Width (ft) | 24.0 | $\mathbf{0}$ |
| Shoulder Width (ft) | $\mathbf{0 . 0}$ | 2 |
| Lane Departure Crash Rate | 1.0 | 2 |
| Presence of Pavement Markings | Yes | $\mathbf{0}$ |
| Surface Type | PAVED | $\mathbf{0}$ |
| Total Risk Factor Score (24 max) | $\mathbf{1 7}$ |  |


| Other Information |  |
| :---: | :---: |
| Paved Shoulder | No |
| Shoulder Material | NONE |
| Speed Limit (mph) | $\mathbf{5 5}$ |
| Number of Lanes | $\mathbf{2}$ |
| Lane Width (ft) | $\mathbf{1 2}$ |
| Edgeline Rumble Strips | NOT PRESENT |
| Centerline Rumble Strips | NOT PRESENT |
| Curves | $\mathbf{0}$ |
| Curves with Warning Signs | $\mathbf{0}$ |
| **Edgeline and Centerline |  |

*Score from highest ranking segment used
Opinion of Probable Cost (Short Term Improvements)

| Item Description | Quantity | Unit |  | ice |  | Cost |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Install 6" Retroreflective Edgeline (Both Sides of Road) | 6.98 | MILE | \$ | 4,200 | \$ | 29,319 |
| Install 4" Retroreflective Centerline | 6.98 | MILE | \$ | 2,100 | \$ | 14,660 |
| Delineate Roadside Hazards with Retroreflective Markers | 70 | EACH | \$ | 100 | \$ | 7,000 |
| Clear and Grub (15 Feet Off Edge of Road, If Applicable) | 0.91 | MILE | \$ | 30,000 | \$ | 27,150 |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations | 0 | MILE | \$ | 5,000 | \$ | - |
| Review Pavement Condition/Type and Install Edgeline Rumble Strips (If Feasible) | 6.98 | MILE | \$ | 5,000 | \$ | 34,904 |
| Review Pavement Condition/Type and Install Centerline Rumble Strips (If Feasible) | 6.98 | MILE | \$ | 2,000 | \$ | 13,962 |
| Post-Mounted Delineators | 0 | MILE | \$ | 5,000 | \$ | - |
| Review and Upgrade Curve Signage to Meet MUTCD and KDOT Standards | 0 | CURVE | \$ | 1,000 | \$ | - |
| Install Curve Signage to Meet MUTCD and KDOT Standards (If Needed) | 0 | CURVE | \$ | 3,500 | \$ | - |
| Retroreflective Strips on Curve Signage | 0 | CURVE | \$ | 100 | \$ | - |
| Short Term Improvements Subtotal: |  |  |  |  | \$ | 126,995 |

Opinion of Probable Cost (Longer Term Improvements)

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Remove/Relocate Fixed Objects in Clear Zone | 4 | EACH | \$ | 1,000 | \$ | 4,000 |
| Install 18-inch Aggregate Shoulder Treatment (With Transition to Earth) | 0 | MILE | \$ | 25,000 | \$ | - |
| Pave 2' Shoulder with Safety Edge (Both Sides of Road - Includes Earthwork) | 6.98 | MILE | \$ | 150,000 | \$ | 1,047,119 |
| Install Edgeline Rumble Strips | 6.98 | MILE | \$ | 5,000 | \$ | 34,904 |
| Install Centerline Rumble Strips | 6.98 | MILE | \$ | 2,000 | \$ | 13,962 |
| Install/Upgrade Guardrail | 0 | FOOT | \$ | 35 | \$ | - |
| Flattening and Widening Foreslopes | 6.98 | MILE | \$ | 75,000 | \$ | 523,559 |
| Install High Friction Surface Treatment (HFST) on Curve | 0 | CURVE | \$ | 20,000 | \$ | - |
|  | Longer Term Improvements Subtotal: |  |  |  | \$ | 1,623,543 |

Continued on back of this page
Project Location Map Sources:
Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013,
DigitalGlobe, GeoEye, i-cubed, USDA, AEX, Getmapping, Aerogrip, IGN, IGP, swisstopo, and the GIS User Community


## Use Restricted 23 U.S.C. § 409

Project Name: 120th Street between K-15 and Indigo Road Contact Name: Brice Goebel

Date: 2/28/20
E-mail: bgoebel@marioncoks.net
Prepared By: AJW
Checked By: MMO

## Opinion of Probable Cost (Additional Potential Improvements)

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| Mobilization: $(\%+/-)^{*}$ | 10\% | \$ | 75,000 |
| :---: | :---: | :---: | :---: |
| Traffic Control: (\% +/-) | 5\% | \$ | 95,892 |
| Contingency: (\% +/-) | 20\% | \$ | 383,570 |
| Estimated Construc | Cos | \$ | 2,470,00 |

Crash History Along this 6.98 Mile Roadway Segment

|  | 2017 | 2016 | 2015 | 2014 | 2013 |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Number of Fatal Crashes | 0 | 0 | 0 | 0 | 0 |
| Number of Fatalities | 0 | 0 | 0 | 0 | 0 |
| Number of Disabling Injury Crashes | 0 | 0 | 0 | 1 | 0 |
| Number of Disabling Injuries | 0 | 0 | 0 | 2 | 0 |
| Number of Injury Crashes | 1 | 0 | 0 | 0 | 0 |
| Number of Injuries | 1 | 0 | 0 | 0 | 0 |
| Number of Property Damage Only Crashes | 4 | 3 | 2 | 3 | 4 |


| PE (Design) | 12\% | \$ | 296,400 |
| :---: | :---: | :---: | :---: |
|  |  | \$ | - |
| ROW** |  | \$ | - |
| CE (Inspection) | 15\% | \$ | 370,500 |
| Estimated Pro | Total | \$ | 3,137,000 |

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Marion County
ROAD © BRIDGE DEPT.

## Use Restricted 23 U.S.C. § 409



Intersection Information and Systemic Ranking Summary

| Systemic Ranking Summary | Value | Score |
| :---: | :---: | :---: |
| Average Daily Traffic (ADT) | $\mathbf{1 , 3 2 0}$ | 6 |
| Access Points within 500 feet | $\mathbf{2}$ | 1 |
| Sight Distance | LIMITED | 3 |
| Intersection Control | STOP | 1 |
| Fatal or Debilitating Injury Crashes | $\mathbf{1}$ | 3 |
| Dist. from Previous Stop Sign (mi) | $\mathbf{1 0 . 0}$ | 3 |
| Intersection on Curve | NO | $\mathbf{0}$ |
| Minimum Approach Angle | $\mathbf{9 0}$ | $\mathbf{0}$ |
| Total Risk Factor Score (24 max) |  | 17 |
|  |  |  |


| Other Information |  |
| :---: | :---: |
| Major Road ADT | $\mathbf{1 , 0 5 5}$ |
| Minor Road ADT | $\mathbf{2 6 5}$ |
| Intersection Crash Rate (TMEV) | $\mathbf{4 . 2}$ |
| Lighting | NOT PRESENT |
| Flashing Beacon | PRESENT |
| Transverse Rumble Strips | NOT PRESENT |
| Number of Paved Approaches | $\mathbf{4}$ |

Opinion of Probable Cost (Short Term Improvements)

| Item Description | Quantity | Unit |  |  |  | ost |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Retroreflective Strips on Stop Sign Posts | 1 | INTERSECTION | \$ | 100 | \$ | 100 |
| Clear and Grub | 4 | LEG | \$ | 2,500 | \$ | 10,000 |
| Review Pavement Condition/Type and Install Transverse Rumble Strips on Paved, Stop-Controlled Approaches | 2 | LEG | \$ | 1,500 | \$ | 3,000 |
| Upgrade Signs and Pavement Markings | 4 | LEG | \$ | 2,200 | \$ | 8,800 |
| Install Second Stop Sign and Stop Ahead Signs | 0 | LEG | \$ | 1,500 | \$ | - |
| Install Beacon on Stop Signs or Stop Sign with LED Flashing Lights | 0 | SIGN | \$ | 2,500 | \$ | - |
| Review and Install/Upgrade Intersection Warning Sign | 2 | LEG | \$ | 1,200 | \$ | 2,400 |
| Install Solar-Powered Flashing Beacon on Intersection Warning Sign | 0 | Short Term Improvements Subtotal: |  |  | \$ | - |
|  |  |  |  |  | \$ | 24,300 |

Opinion of Probable Cost (Longer Term Improvements)

| Item Description | Quantity | Unit | Unit Price | Item Cost |
| :--- | :---: | :---: | :---: | :---: |
| Intersection Lighting (One Luminaire) | 0 | EACH | $\$$ | 5,500 |
| Realign Intersection Approaches to Reduce or Eliminate Skew (Paved) | 0 | $\$$ |  |  |
| Realign Intersection Approaches to Reduce or Eliminate Skew (Unpaved) | 0 | LEG | $\$$ | 300,000 |

Marion County Local Road Safety Plan

Project Description for Intersection Improvements Risk Factor Score: | Date: 2/28/20 |
| :--- |

There are a variety of other safety improvements that could be considered that were not included on the front page of the project sheet due to availability of data, the need for site-specific information, and/or the appetite for the countermeasure to be deployed throughout the county. The following countermeasures could be considered appropriate by the county and included below as additional potential improvements.

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Convert Two-Way Stop to All-Way Stop |  | LEG | \$ | 1,200 | \$ | - |
| Removal of Unwarranted Stop Signs on Major Approach |  | LEG | \$ | 500 | \$ | - |
| Install Intersection Conflict Warning System | 1 | EACH | \$ | 40,000 | \$ | 40,000 |
| Provide Left-Turn Lanes at Intersection |  | LEG | \$ | 150,000 | \$ | - |
| Provide Right-Turn Lanes at Intersection and Remove Sweeping Right Turns |  | LEG | \$ | 150,000 | \$ | - |
| Remove Sweeping Right Turns |  | EACH | \$ | 5,000 | \$ | - |
| Install Traffic Signal (if MUTCD Warrants are Met) |  | EACH | \$ | 250,000 | \$ | - |
| Convert Offset T-Intersection to Four-Legged Intersection (Paved) |  | EACH | \$ | 300,000 | \$ | - |
| Convert Offset T-Intersection to Four-Legged Intersection (Unpaved) |  | EACH | \$ | 50,000 | \$ | - |
| Convert Stop-Control to Roundabout |  | EACH | \$ | 2,000,000 | \$ | - |
| Other: |  |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
|  | dditional Pot | ential Im | rov | nts Subtotal: | \$ | 40,000 |
|  |  | Term Im | rov | nts Subtotal: | \$ | 24,300 |
|  | Longe | Term Im | rov | nts Subtotal: | \$ | - |
|  |  |  | nstr | ion Subtotal: | \$ | 64,300 |
|  |  | obilization | : (\% | - ${ }^{*} 10 \%$ | \$ | 6,430 |
|  |  | ffic Cont | ol: | /-) 5\% | \$ | 3,254 |
|  |  | ontingen | y: | /-) 20\% | \$ | 13,016 |
| *Mobilization is 10\% +/- of the subtotal with a minimum of \$2,500 and a maximum of \$75,000 |  | Estimat | d | truction Cost | \$ | 87,000 |

**To be considered by county as they move forward with design of the recommendations

| PE (Design) | 12\% | \$ | 10,440 |
| :---: | :---: | :---: | :---: |
| Utilities** |  | \$ | 40,000 |
| ROW** |  | \$ | 40,000 |
| CE (Inspection) | 15\% | \$ | 13,050 |
| Estimated Pro | Total | \$ | 111,000 |


|  | 2017 | 2016 | 2015 | 2014 | 2013 |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Number of Fatal Crashes | 0 | 0 | 0 | 0 | 0 |
| Number of Fatalities | 0 | 0 | 0 | 0 | 0 |
| Number of Disabling Injury Crashes | 0 | 0 | 1 | 0 | 0 |
| Number of Disabling Injuries | 0 | 0 | 1 | 0 | 0 |
| Number of Injury Crashes | 0 | 0 | 0 | 0 | 0 |
| Number of Injuries | 0 | 0 | 0 | 1 | 0 |
| Number of Property Damage Only Crashes | 0 | 0 | 0 | 0 | 0 |

## Opinion of Probable Construction Cost Disclaimer:

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Marion County TranSystems

## Use Restricted 23 U.S.C. § 409

Project Name: Indigo Rd near 130th Rd
Contact Name: Brice Goebel
E-mail: bgoebel@marioncoks.net


Length (feet): $\mathbf{1 , 4 7 5}$

Date: 2/28/20
Prepared By: AJW
Checked By: MMO
CURVE

Location Description

## Project Location Maps



## Curve Information and Systemic Ranking Summary

| Systemic Ranking Summary | Value | Score $^{*}$ |
| :---: | :---: | :---: |
| Average Daily Traffic (ADT) | $\mathbf{1 , 2 7 3}$ | $\mathbf{6}$ |
| Curve Radius (ft) | $\mathbf{1 , 9 7 0}$ | $\mathbf{0}$ |
| Access Points within 500 feet | $\mathbf{4}$ | $\mathbf{2}$ |
| Shoulder Width (ft) | $\mathbf{1 . 0}$ | $\mathbf{2}$ |
| Edge Condition | $\mathbf{3 . 0}$ | $\mathbf{0}$ |
| Roadside Assessment | $\mathbf{2 . 0}$ | $\mathbf{1}$ |
| Superelevation | NO | $\mathbf{2}$ |
| Fatal or Debilitating Injury Crashes | $\mathbf{1}$ | $\mathbf{3}$ |
| Presence of Warning Signs | PRESENT | $\mathbf{0}$ |
| Total Risk Factor Score (24 max) | $\mathbf{1 6}$ |  |


| Other Information |  |
| :---: | :---: |
| Paved Shoulder | Yes |
| Shoulder Material | ASPHALT |
| Speed Limit (mph) | Not Provided |
| Number of Lanes | $\mathbf{2}$ |
| Lane Width | $\mathbf{1 1}$ |
| Edgeline Rumble Strips | NOT PRESENT |
| Centerline Rumble Strips | NOT PRESENT |

*Score from highest ranking curve used
Opinion of Probable Cost (Short Term Improvements)

| Item Description | Quantity | Unit |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Review and Upgrade Curve Signage to Meet MUTCD and KDOT Standards | 2 | CURVE | \$ | 1,000 | \$ | 2,000 |
| Install Curve Signage to Meet MUTCD and KDOT Standards (If Needed) | 0 | CURVE | \$ | 3,500 | \$ | - |
| Retroreflective Strips on Curve Signage | 2 | CURVE | \$ | 100 | \$ | 200 |
| Install 6" Retroreflective Edgeline (Both Sides of Road) | 0.28 | MILE | \$ | 4,200 | \$ | 1,176 |
| Install 4" Retroreflective Centerline | 0.28 | MILE | \$ | 2,100 | \$ | 588 |
| Clear and Grub (15 Feet Off Edge of Road, If Applicable) | 2 | CURVE | \$ | 2,500 | \$ | 5,000 |
| Improve Edge Rut Conditions with Aggregate at Edge Drop-off Locations | 0 | MILE | \$ | 5,000 | \$ | - |
| Review Pavement Condition/Type and Install Edgeline Rumble Strips (If Feasible) | 0.28 | MILE | \$ | 5,000 | \$ | 1,400 |
| Review Pavement Condition/Type and Install Centerline Rumble Strips (If Feasible) | 0.28 | MILE | \$ | 2,000 | \$ | 560 |
| Post-Mounted Delineators | 0 | MILE | \$ | 5,000 | \$ | - |
| Short Term Improvements Subtotal: |  |  |  |  | \$ | 10,924 |

Opinion of Probable Cost (Longer Term Improvements)

| Item Description | Quantity | Unit |  | Price |  | Cost |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Install 18-inch Aggregate Shoulder Treatment (With Transition to Earth) | 0 | MILE | \$ | 25,000 | \$ | - |
| Pave 2' Shoulder with Safety Edge (Both Sides of Road - Includes Earthwork) | 0.28 | MILE | \$ | 150,000 | \$ | 42,000 |
| Install Edgeline Rumble Strips | 0.28 | MILE | \$ | 5,000 | \$ | 1,400 |
| Install Centerline Rumble Strips | 0.28 | MILE | \$ | 2,000 | \$ | 560 |
| Install/Upgrade Guardrail | 224 | FOOT | \$ | 80 | \$ | 17,920 |
| Install High Friction Surface Treatment (HFST) on Curve | 2 | CURVE | \$ | 20,000 | \$ | 40,000 |
|  | Longer Term Improvements Subtotal: |  |  |  | \$ | 101,880 |

Continued on back of this page.

Project Location Map Sources:
Esri, DeLorme, NAVTEQ, USGS, Intermap, IPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013,
DigitalGlobe, GeoEye, i-cubed, USDA, AEX, Getmapping, Aerogrip, IGN, IGP, swisstopo, and the GIS User Community

Marion County
ROAD O BRIDGE DEPT.

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Date: 2/28/20
Prepared By: AJW
Checked By: MMO


CURVE

## Opinion of Probable Cost (Additional Potential Improvements)

There are a variety of other safety improvements that could be considered that were not included on the front page of the project sheet due to availability of data, the need for site-specific information, and/or the appetite for the countermeasure to be deployed throughout the county. The following countermeasures could be considered appropriate by the county and included below as additional potential improvements.

| Item Description | Quantity | Unit | Unit Price |  | Item Cost |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| On-Pavement Markings for Speed Control |  | EACH | \$ | 3,000 | \$ | - |
| Transverse Rumble Strips Prior to Curve |  | CURVE | \$ | 3,000 | \$ | - |
| Speed Activated Flashers on Chevron Signs |  | CURVE | \$ | 4,000 | \$ | - |
| Speed Feedback Sign on Curve Warning Sign |  | EACH | \$ | 4,000 | \$ | - |
| Superelevation Correction on Curves | 2 | CURVE | \$ | 50,000 | \$ | 100,000 |
| Other: Reconstruct Curves with Intersection Tie-ins |  | MILE | \$ | 1,400,000 | \$ | - |
| Other: Reconstruct Culvert |  | EACH | \$ | 50,000 | \$ | - |
| Other: |  |  |  |  |  |  |
| Other: |  |  |  |  |  |  |
| Additional Potential Improvements Subtotal: |  |  |  |  | \$ | 100,000 |
| *Mobilization is $10 \%+/$ - of the subtotal with a minimum of $\$ 2,500$ and a maximum of $\$ 75,000$ <br> ${ }^{* *}$ To be considered by county as they move forward with design of the recommendations | Short Term Improvements Subtotal: |  |  |  | \$ | 10,924 |
|  | Longer Term Improvements Subtotal: |  |  |  | \$ | 101,880 |
|  | Construction Subtotal: |  |  |  | \$ | 212,804 |

## Additional Project Benefits:

The improvements recommended along this segment can also have the benefit of positively impacting the following identified facility:

- Intersection 69

Crash History Along this 0.28 Mile Curve

| Mobilization: (\% +/-)* | 10\% | \$ | 21,290 |
| :---: | :---: | :---: | :---: |
| Traffic Control: (\% +/-) | 5\% | \$ | 10,781 |
| Contingency: (\% +/-) | 20\% | \$ | 43,125 |
| Estimated Construc | Cost | \$ | 288,000 |


| PE (Design)Utilities ${ }^{* \star}$ | 12\% | \$ | 34,560 |
| :---: | :---: | :---: | :---: |
|  |  | \$ | - |
| ROW** |  | \$ | - |
| CE (Inspection) | 15\% | \$ | 43,200 |
| Estimated Proj | Total | \$ | 366,000 |

## Opinion of Probable Construction Cost Disclaimer:

Kimley-Horn, TranSystems, and WSP have no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Kimley-Horn, TranSystems, and WSP at this time and represent only our judgment as design professionals familiar with the construction industry. Kimley-Horn, TranSystems, and WSP cannot and do not guarantee that proposals, bids, or actual construction costs will not vary from these opinions of probable costs.

## Project Description Form Disclaimer:

The recommended improvements contained in this project description form were developed through a Geographic Information System (GIS) database risk assessment and project selection threshold process, as specifically stated in our scope of services. Kimley-Horn has no control over the accuracy of the GIS databases and recommended improvements have been provided for consideration by County Staff. The County Staff may use this project description form to aid in the selection and development of projects, but this project description form should not be used as the sole basis for the County Staff's decision making process. We endeavored to research issues and constraints to the extent practical given the scope, budget, and schedule agreed to with the Client. Our assessment is based in large part on information provided to us by others (DOT, County Staff, etc.) and therefore is only as accurate and complete as the information provided to us. No detailed assessment was made for the improvement recommendations contained on this page. If a recommendation is in question, it is recommended that a study/analysis of this location be made to warrant the above indicated improvements. This project description form is based on our knowledge as of January 2020.

Marion County
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[^0]:    * Includes estimates for mobilization, traffic control, contingency, design engineering, and construction inspection as identified on project sheet.

[^1]:    * Countermeasure recommended on segments with high crash rates
    ** The CMFs in this table are for information only, showing the range of potential crash modification the countermeasure can have based on differing research, specific crash types, or specific volume-level roadways (i.e., CMF can vary based on the amount of traffic on the road, vary based on reducing crash severity, or vary between crash type). The CMFs in this table should not be used for crash prediction without first assuring the CMF applies to the specific location and countermeasure implementation.

