

Appendix F – Road Safety Audit

**Downtown Kalamazoo – Stadium Drive, Michigan
Avenue, Kalamazoo Avenue and Michikal Street (I-94
BL/US-131 BR/M-43)
(Southwest Region)**

Kalamazoo County

Road Safety Audit (JN 127117)

FINAL REPORT

December 2016

Prepared for:



Downtown Kalamazoo – Stadium Drive, Michigan Avenue, Kalamazoo Avenue and Michikal Street (I-94 BL/US-131 BR/M- 43)

Kalamazoo County Road Safety Audit

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1.0 INTRODUCTION

One of the principles of The Michigan Strategic Highway Safety Plan is to integrate safety engineering improvements across the entire roadway system by coordinating efforts with all state and local agencies that have a hand in addressing public safety issues. One of the ways by which the Michigan Department of Transportation (MDOT) can greatly contribute to reducing the number of fatalities on our roadways is the collaborative effort by the different MDOT divisions, and one of the tools is the use of Road Safety Audits (RSA).

An RSA is a formal safety evaluation of planned or existing roadways by an independent, multidisciplinary audit team. The team looks for potential safety hazards that may affect any type of road user and suggests measures to mitigate those safety issues. The audit team is composed of transportation professionals and individuals with special skills in safety, law enforcement, and emergency medical services from federal, state and local transportation personnel. The RSA team leader and team member conduct field reviews (both day and night) and prepare the audit report with cost estimates. Procedures in performing an RSA are detailed in the FHWA Road Safety Audit Guidelines.

MDOT retained OHM Advisors to facilitate the RSA for Downtown Kalamazoo – Stadium Drive, Michigan Avenue, Kalamazoo Avenue and Michikal Street (I-94 BL/US-131 BR/M-43) in Kalamazoo County. This RSA followed the 8-step process as detailed in the FHWA Road Safety Audit Guidelines:

- Step 1: Identify Project
- Step 2: Select an RSA Team
- Step 3: Conduct a Pre-Audit Meeting to Review Project Information and Drawings
- Step 4: Conduct Review Analysis and Prepare Report of Findings
- Step 5: Conduct Audit Analysis and Prepare Report of Findings
- Step 6: Present Audit Findings to Project Owner/Design Team
- Step 7: Prepare Formal Response
- Step 8: Incorporate Findings into the Project when Appropriate

This document is the final report of the Downtown Kalamazoo – Stadium Drive, Michigan Avenue, Kalamazoo Avenue and Michikal Street (I-94 BL/US-131 BR/M-43) RSA. The following sections will detail the process, methodology for this analysis, and data obtained throughout the study. The report will also present all significant findings and safety issues as well as provide recommended mitigation strategies.

1.1 Project Location

This Existing Road Safety Audit of Downtown Kalamazoo – Stadium Drive, Michigan Avenue, Kalamazoo Avenue and Michikal Street (I-94 BL/US-131 BR/M-43) RSA in Kalamazoo County has been completed per the request of MDOT. The site is located in MDOT's Southwest Region in Kalamazoo County. The project location is shown in Figure 1 on the next page.

The objectives of the study are to:

- Review traffic operations and safety on the corridor
- Identify physical and operational problems that may affect traffic safety
- Suggest mitigating measures

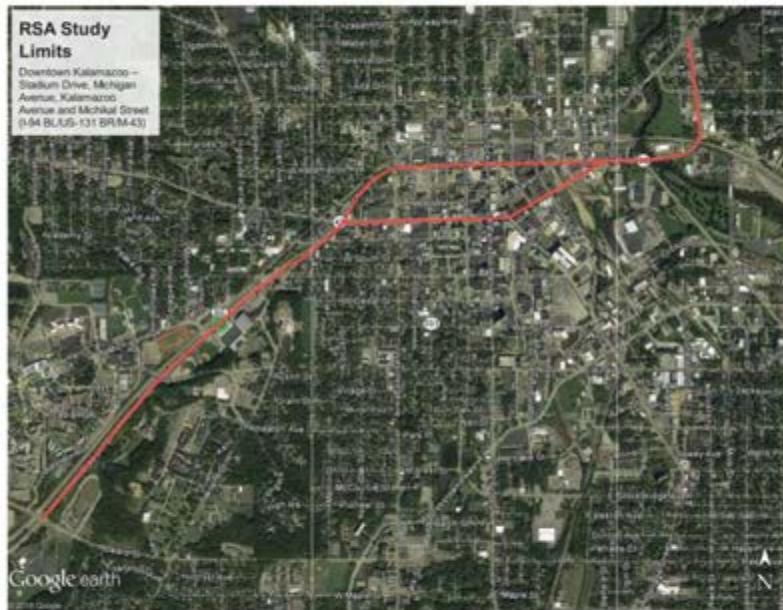


Figure 1 - Project Location

2.0 ROAD SAFETY AUDIT

2.1 Road Safety Audit Team

An RSA is a formal safety performance examination of an existing or future transportation facility or development by an independent multidisciplinary team. RSA's help promote road safety by identifying safety issues during the planning, design, and implementation stages, promoting awareness of safe design practices, integrating multimodal safety concerns, and considering human factors.

Location: Downtown Kalamazoo – Stadium Drive, Michigan Avenue, Kalamazoo Avenue and Michikal Street (I-94 BL/US-131 BR/M-43) in Kalamazoo County

Audit Team Members:	Steven Loveland	Team Leader	OHM Advisors
	Matt Clark	Assistant	OHM Advisors
	Mark Brinker	Traffic Safety & Operation	MDOT
	Rosemary Edwards	Geometrics Engineer	MDOT
	Wendy Ramirez	Traffic & Safety Engineer	MDOT
	Nathan Bouvy	Signals Engineer	MDOT

Project Owner: Michigan Department of Transportation

Review Date: October 17, 2016 - October 21, 2016

Audit Stage: Existing Road Safety Audit for coordination with the Downtown Kalamazoo Planning and Environmental Linkages (PEL) Study

Start Up Meeting: October 17, 2016 at 11:00 AM

Preliminary Findings Meeting: October 21, 2016 at 10:00 AM

Attended By: Michigan Department of Transportation – Lansing
MDOT – Kalamazoo TSC
MDOT – Southwest Region
City of Kalamazoo
Kalamazoo Area Transportation Study
Western Michigan University
Kalamazoo College
Kalamazoo County Parks
Disability Network Southwest Michigan
Central County Transportation Authority
Michigan State Police
Downtown Kalamazoo Inc.

The RSA team members conducted this audit to the best of their professional abilities within the on-site time available and by referring to provided information. While every attempt has been made to identify significant safety issues, the project owner is reminded that responsibility of the design, construction, and performance of the roadway remains with the agency with jurisdictional authority.

2.2 Road Safety Audit Materials

The RSA was based on the following data and analyses:

Site Review: Site visits were conducted on October 17, 2016 – October 19, 2016 to review the corridor geometry and adjacent land use and to observe traffic operations and conflicts.

Traffic Counts: Annual Average Daily Traffic counts were found on MDOT's website. The existing ADT's for the study roadways are:

- Stadium Drive – 27,500 with 2.3 % commercial vehicles
- Michigan Avenue – 22,100 eastbound with 2.9% commercial vehicles
- Kalamazoo Avenue – 22,800 westbound with 2.9% commercial vehicles
- East Michigan/Riverview Drive – 17,500 with 2.8% commercial vehicles

Review of Crash Data and Analysis of Crash Trends: Crash data on Kalamazoo Avenue from Harrison Street to Westnedge Avenue, on M-43 (Riverview Drive) from Harrison Street to Gull Road, on Michikal Street from Westnedge Avenue to M-43 (W Main St), on Michigan Avenue from Lovell Street to Harrison Street, and on Stadium Drive from Oliver Street to Lovell Street were collected for an almost seven-year period from January 1, 2010 through August 31, 2016.

Identification of Improvement: Countermeasures were identified to address the safety issues and collision causes.

Project Data and Documents Available for the RSA:

- Traffic Volumes
- Crash History and UD-10s
- Google Earth
- Field Observation
- Corridor Study
- Construction Plans and ROW Maps
- Signal Timing Permits

2.3 Road Safety Audit Team and Process

The Road Safety Audit started on October 17, 2016 with a pre-Audit meeting attended by the RSA team and the stakeholders listed above. During this meeting, OHM Advisors gave a presentation describing the RSA process, the goals and objectives of an RSA, the steps that have already been completed by MDOT, and the steps that would be completed by the RSA Team during the next five days. After the presentation, open discussion began about the corridor identifying known issues, concerns of the local stakeholders, any constraints that needed to be worked within and identify planned mitigations that will be implemented in the near future.

Local Stakeholder Known Issues and Concerns

- Non-motorized safety throughout the study region, with notable areas indicated below:
 - Pitcher Street at Kalamazoo Avenue
 - Porter Street at Kalamazoo Avenue
 - Pedestrian walkway underneath East Michigan Avenue near the Kalamazoo River, as well as crossing the bridge above
 - Kalamazoo Avenue at Burdick Street (high pedestrian traffic due to transit center)

- Unsignalized crosswalk at Church Street and West Michigan Avenue
- Non-motorized connectivity between WMU and Kalamazoo College campuses and Downtown, with notable areas indicated below:
 - “Spaghetti bowl” area near South Street, Lovell Street and Stadium Drive/West Michigan Avenue
- Bus shelter and bus stop improvements
- Proposed development Downtown
- Vehicle travel lanes used as parking lane and vice-versa
 - Left lane on Kalamazoo Avenue on approach to Water Street
 - Right lane on West Michigan Avenue on approach to Rose Street
- Confusing railroad crossings in conjunction with high-speed rail
- Kalamazoo River Valley Trail (KRVT) crossings and connectivity
- Prominent blind and/or deaf population
- Notable vehicle crash pattern at West Michigan Avenue and Park Street

Constraints

- Work within the project limits
- Maintain on street parking

Planned Mitigations

- Kalamazoo PEL study

After the pre-Audit meeting, the RSA team listed above conducted field visits on October 17-19, 2016. The corridor and intersections were driven by the team from end-to-end and back multiple times during the AM peak, PM peak and night periods. The team also walked up and down the entire study region. While out driving and walking the corridor and intersections, the team verified issues discussed during the pre-Audit meeting and discussed additional concerns, while taking notes and photos to document the findings.

Once the field reviews were completed, the team gathered to discuss the findings. Each team member spoke to deficiencies observed and also positives found at the site. A comprehensive list of the findings was compiled. This list was then put into groupings to arrive at a list of eleven key safety focus areas according to an analytical hierarchy process guided by the Prioritize Safety Issues: Risk Matrix (developed by the FHWA). The team also discussed potential recommendations to address each of the safety concerns.

The preliminary audit findings were then recorded and assigned levels of risk and consequence. The safety issues were ranked from highest to lowest priority using the risk matrix. Based on the findings, a presentation was developed reflecting the activities of the RSA.

3.0 ROADWAY CHARACTERISTICS

3.1 Corridor Conditions and Adjacent Land Uses

Stadium Drive is located in the City of Kalamazoo. The road is primarily a five-lane section with a two-way left turn lane (TWLTL) with a posted speed limit of 45 mph between Howard Street and Oliver Street and a speed limit of 35 mph north of Oliver Street. The roadway edge varies between paved shoulder and curb.

West Michigan Avenue and Kalamazoo Avenue are one-way pairs located in the City of Kalamazoo downtown area. West Michigan Avenue is a five-lane to three-lane, one-way eastbound street with intermittent on-street parallel parking. Kalamazoo Avenue is a three-lane, one-way westbound street with intermittent on-street parallel parking. The speed limit is 30 mph on both roadways.

East Michigan Avenue/Riverview Drive is located in the city of Kalamazoo. East Michigan Avenue is a 5-lane section with a TWLTL east of the East Michigan Avenue and Kalamazoo Avenue split. East Michigan Avenue becomes Riverview Drive at the railroad bridge and is a four-lane section within the project limits. The posted speed limit on East Michigan Avenue and Riverview Drive is 35 mph.

3.2 Traffic Control

- Signalized Intersections
 - Stadium Drive at Howard Street (pedestrian countdown signals)
 - Stadium Drive at Oliver Street (pedestrian countdown signals)
 - Stadium Drive at West Michigan Avenue (pedestrian countdown signals)
 - Stadium Drive at Lovell Street (pedestrian countdown signals)
 - Stadium Drive at South Street (pedestrian WALK/DON'T WALK signals)
 - M-43 (West Main Street)/West Michigan Avenue at Michikal St (pedestrian countdown signals)
 - West Michigan Avenue at Westnedge Avenue (pedestrian WALK/DON'T WALK signals)
 - West Michigan Avenue at Park Street (pedestrian WALK/DON'T WALK signals)
 - West Michigan Avenue at Rose Street (pedestrian countdown signals)
 - West Michigan Avenue at Kalamazoo Mall (pedestrian countdown signals)
 - East Michigan Avenue at Portage Street (no pedestrian signals)
 - East Michigan Avenue at Edwards Street (pedestrian countdown signals)
 - East Michigan Avenue at Pitcher Street (pedestrian WALK/DON'T WALK signals)
 - East Michigan Avenue at Harrison Street (pedestrian WALK/DON'T WALK signals)
 - East Michigan Avenue at King Highway (pedestrian countdown signals)
 - M-43 (Riverview Drive) at Mills Street (pedestrian countdown signals)
 - M-43 (Riverview Drive) at East Michigan Avenue (pedestrian WALK/DON'T WALK signals)
 - M-43 (Riverview Drive) at Gull Road (pedestrian WALK/DON'T WALK signals)
 - Kalamazoo Avenue at Pitcher Street (pedestrian WALK/DON'T WALK signals)
 - Kalamazoo Avenue at Edwards Street (pedestrian WALK/DON'T WALK signals)
 - Kalamazoo Avenue at Burdick Street (pedestrian countdown signals)
 - Kalamazoo Avenue at Rose Street (pedestrian countdown signals)
 - Kalamazoo Avenue at Park Street (pedestrian countdown signals)
 - Kalamazoo Avenue/Michikal Street at Westnedge Avenue (pedestrian WALK/DON'T WALK signals)

- STOP-controlled Intersections
 - West Michigan Avenue at Academy Street (STOPs on Academy Street)
 - West Michigan Avenue at Church Street (STOP on Southbound Church Street)
 - M-43 (Riverview Drive) at Sherwood Avenue (STOPs on Sherwood Avenue)
 - M-43 (Riverview Drive) at Hotop Avenue (STOPs on Hotop Avenue)
 - M-43 (Riverview Drive) at Bridge Street (STOPs on Bridge Street)
 - Kalamazoo Avenue at Walbridge Street (STOPs on Walbridge Street)
 - Kalamazoo Avenue at Porter Street (STOP on Porter Street)
 - Kalamazoo Avenue at Water Street (STOP on Water Street)
 - Kalamazoo Avenue at Church Street (STOPs on Church Street)
 - Kalamazoo Avenue at Cooley Street (STOPs on Cooley Street)
 - Michikal Street at Elm Crossover (STOP on Westbound Elm Crossover)

3.3 Road User Characteristics

The primary travel modes through the corridor are passenger and commercial vehicles. Secondary travel modes include walking and cycling.

3.4 Collision Analysis

Crash data on Kalamazoo Avenue from Harrison Street to Westnedge Avenue on PR# 7405 from MP 0.503 to MP 1.269, on M-43 (East Michigan Avenue and Riverview Drive) from Harrison Street to Gull Road on PR# 22207 from MP 10.75 to MP 11.105 (East Michigan Avenue) continuing to PR# 8403 from MP 0.000 to MP 0.339 (Riverview Drive), on Michikal Street from Westnedge Avenue to M-43 (W Main St) on PR# 7907 from MP 0.000 to MP 0.288, on West Michigan Avenue from Lovell Street to Harrison Street on PR# 22207 from MP 9.428 to MP 10.738 in the eastbound direction and PR# 3392168 from MP 0.000 to MP 0.304 in the westbound direction, and on Stadium Drive from Oliver Street to Lovell Street on PR# 22207 from MP 8.889 to MP 9.428 were collected for an almost seven-year period from January 1, 2010 through August 31, 2016.

During the analysis period, there were 1,901 crashes, with 8% of the crashes occurring during snowy/icy/slush conditions, 23% during wet conditions and 22% during dark hours. There were 3 fatalities and 343 total injury crashes (17 A type) over the five-year period. A description of the fatal crashes follows below:

05/08/2016 – Fatal Incident involving a motorcyclist

At the intersection of West Michigan Avenue and Park Street, a vehicle was traveling northbound on a green signal and was struck by a motorcyclist which ran on red at a high rate of speed. The operator of the motorcycle died on impact, while the driver of the vehicle sustained B-type injuries. None of the passengers of the vehicle suffered injuries in the incident.

04/06/2010 – Fatal Incident involving a bicyclist

At the intersection of Riverview Drive and Hotop Avenue, a vehicle was traveling southbound on Riverview Drive when a cyclist traveling westbound on Hotop Avenue failed to yield and struck the vehicle on the driver's side. The bicycle had two passengers, with one riding on the handlebars. The UD-10 report does not indicate which of the two bicycle passengers was killed. No injuries were caused to the driver or passenger of the vehicle.

04/26/2010 – Fatal Incident involving vehicles only

At the intersection of East Michigan Avenue and Kings Highway, vehicles 2 and 3 were traveling eastbound on East Michigan Avenue on a green light in the right and left thru-lanes, respectively. Vehicle 1 traveling northbound on Kings Highway ran on red while attempting to turn left onto East Michigan Avenue. During the illegal left-turn movement, vehicle 1 collided with vehicle 2 at an angle, causing vehicle 2 to spin clockwise and collide with vehicle 3. A passenger in vehicle 1 was killed, with another passenger sustaining A-type injuries. The driver of vehicle 1 suffered B-type injuries. The driver of vehicle 2 also suffered B-type injuries. No injuries were caused to the driver of vehicle 3.

The predominant crash types consisted of 654 (34%) rear-end straight, 390 (21%) side-swipe same, and 291 (15%) angle straight. The remainder were of various collision types. The primary driver violations attributed to these crashes are failure to stop in assured clear distance, running red lights, failure to yield and improper lane use.

4.0 POSITIVES

During the field visit the RSA team looked for positive aspects of safety along the corridor. During the post field review discussions, the team documented these positives. The team agreed that the following items should continue to be implemented and incorporated into future designs.

- Bus Shelter at Howard Street



- Pavement Markings (Special Emphasis Crosswalks and Turning Guide Markings)



- Advance Railroad Signals



- Signals (Box Span, Countdown, Disappearing Legend, Low Levels, Progression)



- Curb Extensions



- Overhead Lane Use Signs



- West Michigan Avenue at Kalamazoo Mall Intersection



- Reflective Stripping for Warning Signs



- Lighting



5.0 AUDIT FINDINGS AND SUGGESTIONS

The issues identified by the RSA team were prioritized using the Prioritize Safety Issues: Risk Matrix provided by FHWA. For each of the safety issues the team developed potential mitigation measures for review by MDOT. The safety issues were prioritized based on observed and perceived crash frequency and the anticipated and observed severity of crashes resulting from each safety issue. As a result, each safety issue was prioritized on the basis of ranking between A (lowest risk and lowest priority) to F (highest risk and highest priority). A table identifying the ranking system is shown in Figure 2 below.



Figure 2: Prioritize Safety Issues: Risk Matrix

The safety deficiencies discovered during the RSA were categorized into eleven primary categories. A discussion of each of the sub-components which comprise these groups follows.

5.1A Crash Potential #1 (Risk Category E) – Pedestrian Safety
Bus Stop on Riverview Drive (near Hotop Avenue)

Observations

- The bus stop on Riverview Drive near Hotop Avenue suffers from a wide variety of safety deficiencies, as represented in the image below taken on foot during the field review. Immediately apparent is the poor condition of the sidewalk. Additionally, missing entirely is a marked crosswalk, there are no ADA-compliant ramps in the vicinity of the area, and most of the area is unlighted.



Suggested Improvements

- Install a high visibility crossing fit with special emphasis “ladder-style” pavement markings at a location that best matches with the present desired pedestrian crossing locations.
- Perform a comprehensive traffic and safety analysis to determine the viability of a mid-block crossing and determine the proper treatment.
- Improve the sidewalk along the west side of street to improve access to the bus stop.
- At the very least, install a bus landing at the bus stop location. Consider more evolved solutions, up to and including a bus shelter.

5.1B Crash Potential #1 (Risk Category E) – Pedestrian Safety
West Michigan Avenue at Church Street Pedestrian Crossing

Observations

- At the intersection of West Michigan Avenue and Church Street, a number of issues were observed which were detrimental to pedestrian safety. The sidewalk was in very poor condition, the sidewalk ramps were not ADA compliant, and there were no pedestrian crossing signs. These issues are exacerbated by the nature of the location of the unsignalized intersection on a high-speed multi-lane corridor.



Suggested Improvements

- Install curb extensions as seen in the image below to reduce the current crossing distance from approximately 73' to 50' or less. The less time pedestrians spend in uncontrolled vehicle travel lanes greatly improves the probability of a safe crossing maneuver.
- Create a high visibility crossing fit with special emphasis "ladder-style" pavement markings and W11-2 "Pedestrian Traffic" signs to increase driver awareness that pedestrians may attempt to cross at the location.



5.1C Crash Potential #1 (Risk Category E) – Pedestrian Safety
West Michigan Avenue at Lovell Street Pedestrian Crossing

Observations

- Due to the geometric configuration and traffic operation of the intersection, pedestrians crossing east-west on the south leg of the intersection may find it difficult to find a gap to cross against westbound left-turning vehicle traffic.



Suggested Improvements

- To provide an adequate opportunity for pedestrians to cross the street, consider implementing a leading pedestrian interval at the signal to allow pedestrians to get out into the road prior to conflicting left-turning traffic. To further enhance the leading pedestrian interval, investigate the possibility of adding a R10-5L "Left Turning Vehicles Yield to Pedestrians" sign on the westbound approach.
- To reduce the speed of left-turning traffic, reorient the curb line to achieve a desirable 90-degree angle which will slow down traffic making the left-turn movement.
- Increase the visibility of all crosswalks at the intersection by converting the markings to high-emphasis crosswalk markings.
- Remove the abandoned utility pole in the southeast quadrant, as it poses an unnecessary visual and physical obstruction.

5.1D Crash Potential #1 (Risk Category E) – Pedestrian Safety
Lack of Enhanced Crosswalks Near Schools

Observations

- At intersections and midblock crossing locations in the vicinity of the campuses of Western Michigan University and Kalamazoo College, as well as other schools, the crossing locations are either completely unmarked or striped with only the standard 6"-width longitudinal lines.



Suggested Improvements

- Retrofit crosswalk locations with special emphasis "ladder-style" crossings near schools and universities.

5.1E Crash Potential #1 (Risk Category E) – Pedestrian Safety
Lack of Pedestrian Facilities

Observations

- Throughout the study region, the RSA team observed and noted numerous instances of missing, substandard, disconnected or deteriorated pedestrian facilities, with some notable examples shown below.



Suggested Improvements

- Create an asset management program to take inventory of all pedestrian facilities and assess the condition of such features. Maintain compliant existing pedestrian facilities, upgrade those which don't meet ADA standards and install missing components.
- Ensure that existing or planned pedestrian facilities are connected in a safe and consistent manner.

**5.1F Crash Potential #1 (Risk Category E) – Pedestrian Safety
Jaywalking**

Observations

- The RSA team observed a number of occurrences of jaywalking. Particularly on Riverview Drive near Hotop Avenue and in the “Spaghetti Bowl” area near Oliver Street, South Street and Stadium Drive/West Michigan Avenue (which was an area pinpointed during the pre-RSA meeting by a member in attendance).



Suggested Improvements

- Improve the connectivity of pathways, sidewalks and crossings to provide a safe and navigable route for pedestrians to travel the corridor. Where deemed safe and appropriate, attempt to install new pedestrian features that coincide with current travel paths according to a comprehensive non-motorized origin-destination analysis.

5.1G Crash Potential #1 (Risk Category E) – Pedestrian Safety
Pavement Condition at Kalamazoo Avenue at Parks Street

Observations

- The RSA team observed pronounced pavement rutting on the northeast corner of the intersection of Kalamazoo Avenue at Park Street. This is an undesirable situation as it makes navigating the crossing difficult for pedestrians with physical disabilities. Even those without a physical impairment may find the road difficult to traverse if the rutted pavement holds water and/or ice during inclement weather.



Suggested Improvements

- Reconstruct the northeast corner of the intersection with a pavement that can withstand high volumes of turning heavy vehicles.

5.1H Crash Potential #1 (Risk Category E) – Pedestrian Safety
East Michigan Avenue at Portage Street - Crossing of Portage Street - Planters Block View of Motorists

Observations

- At the intersection of East Michigan Avenue at Portage Street, the planter seen in the very right of the image below blocks the view of motorists to pedestrians attempting to cross Portage Street heading eastbound.



Suggested Improvements

- Move the planter to provide better visibility of pedestrians.
- Add a R1-5R "Yield to Pedestrians" sign on the Portage Street leg. This would face traffic turning onto Portage Street, immediately after the STOP sign, but before the marked crosswalk.



5.2A Crash Potential #2 (Risk Category E) – Bikes
Lack of Bicycle Facilities

Observations

- There does not exist a dedicated non-motorized path that connects Howard Street to Riverview Drive. The current non-motorized features are sporadic with variations between pathways, sidewalk or no features.



Suggested Improvements

- Create a Non-Motorized Master Plan which performs a thorough origin-destination study and ultimately produces a recommendation for a fully-connected, non-motorized path from Howard Street, through Downtown, and across to the neighborhoods near Riverview Drive.

5.2B Crash Potential #2 (Risk Category E) – Bikes
Pedestrian Bridge Underneath East Michigan Avenue on Kalamazoo River

Observations

- Low clearance underneath the bridge over the Kalamazoo River on East Michigan Avenue creates an unsafe situation for cyclists utilizing the pedestrian bridge, especially considering the lack of lighting and inadequate advance warning.



Suggested Improvements

- Install advance warning signs on approach to the bridge, especially catered towards cyclists. Potential message to include, "WALK BIKES LOW CLEARANCE AHEAD".

5.3A Crash Potential #3 (Risk Category E) – Signal Modernization
Outdated Diagonal Span Signals and Lack of Countdown Pedestrian Signals

Observations

- Numerous signalized intersections were constructed as diagonal span and/or lacked countdown pedestrian signals.



Suggested Improvements

- Modernize all signals which are deficient to a box span design with countdown pedestrian signals, ADA ramps, and pushbuttons. The box span design has been shown to reduce the frequency of red-light running by making the signals easier to see. The box span design also improves the safety of maintenance workers by moving the maintenance operation out of the middle of the intersection.
- Consult with a Mobility Specialist to determine if audible pushbuttons are needed.
- If the funding is available, consider incorporating mast arms with lighted street names in the box span design. The mast arms are an aesthetic improvement, while the lighted street names will enhance navigation of the study region.

5.3B Crash Potential #3 (Risk Category E) – Signal Modernization Pushbuttons Locations

Observations

- At many signalized intersections, pedestrian pushbuttons are not ADA compliant, either due to lateral distance from ramps or vertical distance from grade.



Suggested Improvements

- If existing ramps meet ADA requirements, relocate the pushbuttons. If existing ramps do not meet ADA requirements, modernize the signals. Given Kalamazoo's high population of blind citizens, it is imperative that pushbuttons are located according to ADA requirements to meet the user's expectations.

5.4A Crash Potential #4 (Risk Category D) – Geometrics
Stadium Drive Shoulder/Curb Inconsistency

Observations

- Along Stadium Drive, the edge of pavement varies between paved shoulder and curb, and guardrail or no guardrail. This creates a situation where cyclists riding on the shoulder may run out of space to ride on the shoulder, which may cause them to ride on the wrong side of the road.



Suggested Improvements

- Provide a consistent shoulder treatment along Stadium Drive to accommodate travel expectations of cyclists utilizing the road. This recommendation coincides with an earlier suggestion to produce a city-wide Non-Motorized Master Plan.

5.4B Crash Potential #4 (Risk Category D) – Geometrics West Michigan Avenue at Park Street

Observations

- According to city officials as noted at the pre-RSA meeting, there is a crash pattern regarding vehicles striking the building at the northeast quadrant of the intersection of West Michigan Avenue at Park Street. As seen in the images below, this crash pattern may be attributed to the lane alignment on Park Street heading northbound. The northbound rightmost lane is marked as "RIGHT ONLY"; however, looking ahead, the rightmost lane is striped as a through travel lane. Vehicles are likely attempting to travel through from the right turn lane and conflicting with vehicles attempting to change lanes from the adjacent through lane, causing them to swerve and hit the building.



Suggested Improvements

- Construct curb extensions (bump-outs) on all corners of the intersection, which will shorten the crossing distance for pedestrians. The curb extension on the northeast quadrant in particular will serve to delineate the travel and parking lane (which should receive parking space striping) on the north leg, while maintaining the right-turn lane on the south leg.

5.4C Crash Potential #4 (Risk Category D) – Geometrics Lane Width and Delineation

Observations

- At many locations, particularly along Kalamazoo Avenue between Walbridge Street and Pitcher Street, along East Michigan Avenue between Pitcher Street and Walbridge Street, and along West Michigan Avenue between Westnedge Avenue and Kalamazoo Mall, extra wide lane widths and lack of delineation between travel lanes and parking spaces creates a confusing situation for motorists as to the desired travel path. This is likely a major contributing factor to the high frequency of sideswipe crashes in the study region.



Suggested Improvements

- Install curb extensions to provide a clear indication of where parking spaces begin and travel lanes end.
- Delineate parking stalls and/or edge lines to reinforce where parking is, or is not, permitted.

5.4D Crash Potential #4 (Risk Category D) – Geometrics

Excess Pavement East of Pitcher Street and Past Both Sets of Tracks on East Michigan Avenue

Observations

- An excessive amount of pavement on East Michigan Avenue east of Pitcher Street and past both sets of railroad crossings creates a situation where motorists may drift out of position and sideswipe adjacent vehicles.



Suggested Improvements

- Add edge pavement marking lines to both sides of the roadway to delineate travel lanes at a consistent width.
- Delineate the parking spaces, turn lane, and shoulder on the north side of road.

5.4E Crash Potential #4 (Risk Category D) – Geometrics

Intersection of Kalamazoo Avenue and Westnedge Avenue and Michikal Street

Observations

- At the intersection of Kalamazoo Avenue and Westnedge Avenue and Michikal Street, the geometric configuration and overhead lane assignment signs create a situation where it is unclear to the motorist which is the desired travel lane. Lane assignment confusion can result in sideswipe and/or fixed object collisions.
- The geometry of the intersection on the west leg is such that a pedestrian must traverse approximately 90' of pavement to cross the road. As noted earlier in the report, long crossing distances increase the likelihood of a potentially severe vehicle-pedestrian collision.



Suggested Improvements

- Add a curb extension to the southwest quadrant as depicted in the image above which will shorten the pedestrian crossing length, as well as alleviate driver confusion.
- In addition to the above suggestion, construct a second curb extension on the departure side of Kalamazoo Avenue, which would eliminate the option lane. The west median could be extended to further trim the pedestrian crossing length and accommodate a pedestrian refuge.

5.4F Crash Potential #4 (Risk Category D) – Geometrics
Riverview Drive Cross Section

Observations

- Riverview Drive is presently a four-lane, undivided urban roadway. These types of roads commonly exhibit higher than expected crash rates due to the high number of conflict points and poor sight distances for turning and crossing vehicles along the street.



Suggested Improvements

- Perform a traffic study to investigate if Riverview Drive could be converted to a three-lane roadway, potentially using a center two-way left-turn lane, without significantly hampering the operational performance of the corridor. The conversion from four lanes to three lanes has been shown to reduce rear-end crashes due to minimizing the variability in vehicle speeds, reduce sideswipe crashes due to vehicle separation, and reduce left-turning crashes by providing the center lane for a vehicle to wait for an adequate gap to complete the turn. Three lanes are also more manageable for pedestrians to cross compared to four lanes.

5.4G Crash Potential #4 (Risk Category D) – Geometrics

Weaving Traffic on West Michigan Avenue After Intersection with Michikal Street and West Main Street

Observations

- The current geometric configuration of the intersection of West Michigan Avenue/West Main Street and Michikal Street promotes the weaving of vehicles as motorists heading westbound from West Main Street attempt to position themselves to turn right onto Westnedge Avenue (the next major intersection and M-route) conflict with motorists heading west from the south leg who try to leave the right turn lanes. Weaving vehicles are symptomatic of sideswipe collisions.



Suggested Improvements

- Construct a curb extension on the south side of West Michigan Avenue just past the intersection to separate the parking spaces from the travel lane and stripe the parking spaces.
- Study traffic patterns to modify the geometry and striping of the intersection such that vehicles turning right from the south leg of the intersection are routed to the middle through lanes rather than the option lane and right turn lane.



**5.5A Crash Potential #5 (Risk Category D) – Railroad and Fencing
Howard Street Bus Stop**

Observations

- Near the intersection of Stadium Drive and Howard Street, the fencing protecting pedestrians from crossing the railroad tracks is located too far west of the tracks, so as to be ineffective.



Suggested Improvements

- Place additional fencing on the east side of the tracks to guide pedestrians coming to and from the bus stop away from the railroad tracks.

5.5B Crash Potential #5 (Risk Category D) – Railroad and Fencing Sidewalk Crossings

Observations

- None of the railroad crossing on West Michigan Avenue and Kalamazoo Avenue are protected by pedestrian crossing arms. This is especially concerning as these rails carry high-speed passenger trains.



Suggested Improvements

- Add pedestrian crossing arms similar to those on Rose Street near Kalamazoo Avenue, as shown in the image below:



**5.5C Crash Potential #5 (Risk Category D) – Railroad and Fencing
Vehicles Stopping on Tracks**

Observations

- The RSA team observed a number of vehicles stopping on the railroad tracks crossing Kalamazoo Avenue just adjacent to Porter Street. Vehicles stopping on the tracks is a potentially dangerous situation in the case of a signal or vehicle malfunction.



Suggested Improvements

- Add R8-8 "DO NOT STOP ON TRACKS" signs in front of the railroad crossing.

5.6A Crash Potential #6 (Risk Category D) – Pavement Markings
Lack of Parking Space Delineation and Edge Lines

Observations

- Throughout the study region, the RSA team observed a widespread lack of parking space delineation and edge lines, which can induce sideswipe collisions as motorists are unaware of the proper travel path.



Suggested Improvements

- For a short term solution, add pavement markings to delineate parking spaces and edge lines.
- In the long term, construct curb extensions (bump-outs) throughout parking areas (as depicted below) with marked parking stalls, for reasons described earlier in the report.



5.6B Crash Potential #6 (Risk Category D) – Pavement Markings
Unaligned Pavement Joints and Lane Lines

Observations

- At various locations along West Michigan Avenue, the pavement joints do not align with the lane lines, which can contribute to sideswipe collisions as motorists tend to follow the pavement joints, especially on wet or snow-covered pavement.



Suggested Improvements

- With the next scheduled mill and resurface, align lane lines with the pavement joints according to MDOT Pavement Marking Standard PAVE-905-C.

**5.6C Crash Potential #6 (Risk Category D) – Pavement Markings
West Michigan Avenue at Stadium Drive (Across from Waldo Stadium)**

Observations

- On the West Michigan Avenue approach to the intersection, the turn symbol pavement markings are only located west of the railroad crossing, as shown in the image below. This could lead to lane assignment confusion and thus a sideswipe collision if the markings went unnoticed and the motorist made an incorrect turn at the intersection.



Suggested Improvements

- Add a second set of turn symbol pavement markings just east of tracks to provide redundancy in case of driver inattentiveness.
- Given that either lane may turn left, add turning guide pavement markings to keep vehicles in lane and further reduce the likelihood of a sideswipe collision.

5.6D Crash Potential #6 (Risk Category D) – Pavement Markings
Intersections with Dual-left and Dual-right Turns without Turning Guide Markings

Observations

- Some of the study intersections have dual-left and dual-right turns without turning guide markings. Without these markings, motorists may have a tendency to drift into the adjacent lane, causing a sideswipe collision.



Suggested Improvements

- Lay down turning guide markings in accordance with MDOT Pavement Marking Standard PAVE-945-C.

5.6E Crash Potential #6 (Risk Category D) – Pavement Markings
West Michigan Avenue at Academy Street

Observations

- At the intersection of West Michigan Avenue at Academy Street, the inside West Michigan Avenue approach lanes are unmarked and undivided and it is unclear where a motorist should position his or her vehicle to perform a left-turn to Academy Street from either direction. This situation likely increases the likelihood of both sideswipe and head-on collisions.



Suggested Improvements

- Evaluate the feasibility of side-by-side left turn lanes.

5.6F Crash Potential #6 (Risk Category D) – Pavement Markings
Intersection of West Michigan Avenue/West Main Street at Michikal Street

Observations

- At the intersection of West Michigan Avenue/West Main Street and Michikal Street, the correct travel path for northbound vehicles is unclear, which may lead to sideswipe or fixed object collisions. The lack of pavement markings may exacerbate the weaving traffic issue described in Section 5.4G.



Suggested Improvements

- Add pavement markings on the northbound approach, starting at the gore and continuing along the splitter island to help delineate vehicle paths.

**5.6G Crash Potential #6 (Risk Category D) – Pavement Markings
Driver Expectancy for Lane Assignments**

Observations

- Along West Michigan Avenue, the arrow symbol pavement markings are not consistent throughout the corridor. Some intersections have the arrow symbols, while others do not. This variation violates driver expectancy which can cause rear-end collisions due to speed variability, sideswipe collisions due to abrupt lane changes, or head-on collisions due to wrong-way travel.



Suggested Improvements

- Review whether arrow symbols are needed at the intersections, and if so, keep the pavement markings consistent and constant through the corridor to maintain driver expectation.

**5.6H Crash Potential #6 (Risk Category D) – Pavement Markings
Riverview Drive between Mills Street and East Michigan Avenue**

Observations

- A number of issues were observed on Riverview Drive between Mills Street and East Michigan Avenue, which include the following:
 - No turning guide markings for southbound Riverview Drive left turns at East Michigan Avenue, for westbound East Michigan Avenue left turns at Riverview Drive, and for westbound Mills Street right turns at Riverview Drive
 - Missing center skip lines on northbound Riverview Drive just north of Mills Street and below the railroad bridge
 - Lack of channelizing striping for the northbound Riverview Drive right turn to East Michigan Avenue
 - Narrow lanes around the curve underneath the railroad bridge



Suggested Improvements

- Add turning guide pavement markings to keep vehicles in lane and further reduce the likelihood of a sideswipe collision.
- Restripe missing center skip lines with resilient pavement marking material to prolong the life of the markings against high heavy vehicle traffic volumes.
- Add channelizing striping for the northbound right turn movement onto East Michigan Avenue to improve lane decisions.
- Narrow the hatched median on the northbound approach to provide wider lanes through the curve and enhance driver comfort.

5.61 Crash Potential #6 (Risk Category D) – Pavement Markings

Lack of Pavement Markings on Walbridge Street between East Michigan Avenue and Kalamazoo Avenue

Observations

- The short roadway segment of Walbridge Street between East Michigan Avenue and Kalamazoo Avenue allows two-way traffic, however the center double-yellow centerline is missing. This is problematic given that both East Michigan Avenue and Kalamazoo Avenue are one-way, which might lead a motorist to incorrectly believe that Walbridge Street is also one-way, possibly resulting in head-on collisions.



Suggested Improvements

- Stripe a double-yellow centerline pavement marking down the middle of the segment to indicate that the road permits two-way travel.

5.7A Crash Potential #7 (Risk Category D) – Signs (Pedestrian)
West Michigan Avenue at Church Street

Observations

- At the intersection of West Michigan Avenue at Church Street, there are unsignalized pedestrian crossings of Michigan Avenue which are lacking pedestrian warning signs. This is an intersection that was highlighted as potentially detrimental to pedestrian safety by local stakeholders at the pre-RSA meeting.



Suggested Improvements

- Install W11-2 "Pedestrian Traffic" and W16-7P "Angled-Down Arrow" signs at the crossings and emphasize the crosswalks with special emphasis "ladder-style" pavement markings.

5.7B Crash Potential #7 (Risk Category D) – Signs (Pedestrian)
Mid-block Crossing on Riverview Drive near Hotop Avenue

Observations

- In the vicinity of the bus stop on Riverview Drive near Hotop Avenue, there are no marked crosswalks despite the high pedestrian demand as a result of the bus stop.



Suggested Improvements

- Install a high visibility crossing, fit with special emphasis "ladder-style" pavement markings at a location that suits present pedestrian travel patterns.
- Conduct a traffic study to determine what, if any, type of mid-block crossing would be appropriate.

5.8A Crash Potential #8 (Risk Category C) – Signs (Specific)
Missing Signs at Various Locations

Observations

- Other locations that the RSA team noted missing or incorrect signs:
 - The “Spaghetti Bowl” area near Oakland Drive, South Street, and West Michigan Avenue had missing R5-1 “Do Not Enter” signs on the northeast approach
 - The median on West Michigan Avenue near Academy Street was missing an R4-7 “Narrow Keep Right” sign for southbound vehicles on West Michigan Avenue
 - The access point to West Michigan Avenue for the Walgreens on the southwest quadrant of the intersection was missing a R3-2 “Left Turn Prohibition” sign
 - The overhead guide signs on eastbound West Michigan Avenue on approach to Park Street was missing a M-16 “Michigan Route Sign” for M-43
 - Various locations had missing R6-1 “One Way” and R3-1 “Right Turn Prohibition” signs (i.e. East Michigan Avenue at Edwards Street)
 - The intersection of West Michigan Avenue at Stadium Drive had a missing W1-7 “Two Direction Large Arrow” sign. Additionally, the signal span wire case sign does not accurately reflect the lane assignments

Suggested Improvements

- Consider installing the above missing signs and replacing the case sign with the correct symbol panel.

5.8B Crash Potential #8 (Risk Category C) – Signs (Specific)
Michigan at Portage

Observations

- At the intersection of West Michigan Avenue and Portage Street, the right turn movement conflicts with pedestrians crossing Portage Street without notice, placing pedestrians at risk of being struck by an unsuspecting vehicle turning right onto Portage Street
- The W4-2R “Lane Ends” sign is missing, thus vehicles may perform a late lane switch and sideswipe a vehicle in the adjacent through lane.



Suggested Improvements

- Install a R1-5 “Yield to Pedestrian” sign on the Portage Street leg. This would face traffic turning onto Portage, immediately after the STOP sign, but before the marked crosswalk.
- Install an advance W4-2R sign just west of Kalamazoo Mall, warning motorists of the impending lane drop.

5.8C Crash Potential #8 (Risk Category C) – Signs (Specific)
East Michigan Avenue at Harrison Street

Observations

- The RSA team noticed a number of signing issues near the intersection of East Michigan Avenue at Harrison Street, which include:
 - Missing W4-2R “Lane Ends” sign on East Michigan Avenue for the right turn lane to Kings Highway
 - The eastbound I-94 and eastbound M-43 Junction sign cluster assembly has the route signs in the wrong order
 - The cantilever structure for the overhead guide signs is located in the sidewalk



Suggested Improvements

- Install the W4-2R signs on East Michigan Avenue on approach to King’s Highway, warning motorists of the impending lane drop.
- Review the junction and route marker assembly to ensure signs are arranged in the correct order, minimizing motorist confusion.
- Improve the sidewalk alignment to avoid the cantilever structure with construction of the proposed development. Currently, the cantilever is obstructing the clear path of pedestrians walking on the sidewalk.

5.8D Crash Potential #8 (Risk Category C) – Signs (Specific)
East Michigan Avenue at Riverview Drive

Observations

- On southbound Riverview Drive on approach to East Michigan Avenue, the advance lane assignment signs are representative of a right turn lane, when the outside lane is actually a through lane. Motorists may incorrectly prepare for a right turn or change lanes unnecessarily, creating a situation prone to sideswipe collisions.



Suggested Improvements

- Remove the R3-7b "Left Only, Right Only" sign and the R10-11b "NO TURN ON RED" signs, as the right lane does not turn at the intersection.
- Install R3-7e "Left Only, Thru Only" signs to match revised pavement markings that correctly denote the lane assignments for the approach.

5.8E Crash Potential #8 (Risk Category C) – Signs (Specific)
Blocked Signs

Observations

- At various locations, the RSA team noticed signs which were blocked by other signs, signal heads or vegetation. Signs which are not visible cannot serve their intended purpose, possibly leading to unsafe driver behavior.



Suggested Improvements

- Review visibility of all signs in the study region and relocate the signs or remove obstructions/vegetation, as necessary.

5.8F Crash Potential #8 (Risk Category C) – Signs (Specific)
Missing “DO NOT STOP ON TRACKS” Signs

Observations

- The RSA team noticed missing R8-8 “DO NOT STOP ON TRACKS” signs on westbound Kalamazoo Avenue on approach to the railroad crossing adjacent to Porter Street. Vehicles stopping on the tracks is a potentially dangerous situation in the case of a signal or vehicle malfunction.



Suggested Improvements

- Add R8-8 “DO NOT STOP ON TRACKS” signs in front of the railroad crossing.

5.8G Crash Potential #8 (Risk Category C) – Signs (Specific)
Michikal Street at Elm Crossover

Observations

- At the Michikal Street at Elm Crossover intersection, the R5-1 “DO NOT ENTER” signs on Elm Crossover southeast of the intersection are set too far back away from the intersection. An unfamiliar motorist could potentially drive the wrong way on Elm Crossover before noticing the signs, which may result in a head-on collision.



Suggested Improvements

- Relocate the R5-1 signs closer to Michikal Street in a manner that provides adequate and safe forewarning that Elm Crossover is a one-way, westbound street.

5.8H Crash Potential #8 (Risk Category C) – Signs (Specific)
West Michigan Avenue/M-43 (West Main Street) at Michikal Street

Observations

- The current sign, which warns “COMPLETE LEFT TURN WHEN TRAFFIC CLEARS” is too ambiguous and may confuse motorists. The sign does not convey which direction of traffic must clear, leaving an unfamiliar driver to ignore the sign and potentially enter the intersection against oncoming traffic, resulting in a head-on or angle collision.



Suggested Improvements

- Create and install a new sign with a revised message, possibly as shown below:



5.9A Crash Potential #9 (Risk Category C) – Signs (Upgrade)
General Sign Deficiencies

Observations

- Throughout the study regions, the RSA team observed signs which were outdated, don't meet current standard, have poor or no reflectivity, incorrect bottom height, and with conflicting messages on the same sign assembly.



Suggested Improvements

- The information relayed to motorists on signs is imperative to traffic safety. It is recommended that a sign upgrade project is performed on all stretches of road under investigation in the RSA to ensure that signs are readable, consistent and correct.

**5.9B Crash Potential #9 (Risk Category C) – Signs (Upgrade)
Street Name Signs**

Observations

- Throughout the RSA study limits, the D3-1 street name signs are not clearly identified. Street name signs which are difficult to read can create driver confusion, which could potentially result in wrong way driving or late lane decisions.



Suggested Improvements

- Coordinate with future signal projects or find other means to increase the size and visibility of D3-1 street name signs. The image below depicts a possible approach:



5.9C Crash Potential #9 (Risk Category C) – Signs (Upgrade)
Cantilever – West Michigan Avenue to Westnedge Avenue

Observations

- The overhead guide sign on eastbound West Michigan Avenue on approach to Westnedge Avenue does not meet current design guidelines. The sign message is unclear, which may influence undesirable weaving and merging behavior, facilitating sideswipe collisions.



Suggested Improvements

- Upgrade the sign to meet current specifications using an arrow per lane with the option lane treatment. An example is shown below:



5.9D Crash Potential #9 (Risk Category C) – Signs (Upgrade)
Signs on the Truss on Kalamazoo Avenue before Michikal Street

Observations

- The guide signs on the truss on Kalamazoo Avenue before Michikal Street do not effectively convey the lane assignment at this location. For example, there is no indication that the middle lane is an option lane. Lane assignment confusion could result in sideswipe collisions.



Suggested Improvements

- Upgrade the signs to meet current specifications with arrows per lane, indicate the option lane, and clearly identify route numbers. An example is shown below:



**5.10A Crash Potential #10 (Risk Category C) – Access Management
Excessive Number of Driveways & Unusable Driveways**

Observations

- The RSA team observed many locations where a property had in excess of two access points to West Michigan Avenue, particularly between Michikal Street and Westnedge Avenue. Every additional access point increases the number of conflict points which raises the probability of an accident occurring.



Suggested Improvements

- Perform an access management study to consolidate or eliminate driveways where possible.

5.11A Crash Potential #11 (Risk Category C) – Signals (General)
East Michigan Avenue and Portage Street

Observations

- At the intersection of East Michigan Avenue and Portage Street, there are two flashing yellow bulbs over three lanes and one flashing red over the right turn lane.



Suggested Improvements

- Consider adding a third yellow flasher and center each over its respective lane. The current configuration may be confusing for motorists.
- Potentially change the solid balls to diagonal arrows to warn motorists of the approaching bend in the road.

**5.11B Crash Potential #11 (Risk Category C) – Signals (General)
Kalamazoo Avenue at Edwards Street**

Observations

- At the intersection of Edwards Street and Kalamazoo Avenue, it appears that Edwards Street was converted from a two-way street to a one-way street without removing the unnecessary signal heads. A motorist may look right from the driveway north of the intersection to see the signal heads downstream, travel the wrong way on Edwards Street, and collide with an oncoming vehicle head-on.



Suggested Improvements

- Remove the signal heads as needed and provide a "DO NOT ENTER" symbol for the case sign facing north.

5.11C Crash Potential #11 (Risk Category C) – Signals (General)
Southbound Riverview Drive at East Michigan Avenue

Observations

- At the intersection of Riverview Drive and East Michigan Avenue, the signal heads on the southbound approach are not aligned with the lanes. This issue in conjunction with the incorrect lane assignment pavement markings and signs creates a confusing situation for motorists.



Suggested Improvements

- Consider shifting the signal heads to better align with the lanes and replace the solid green and yellow balls with angled arrows to warn motorists of the approaching bend in the road.

5.11D Crash Potential #11 (Risk Category C) – Signals (General)
Pedestrian Signals Blocked by Street Name Signs

Observations

- On the southwest quadrant at the intersection of Kalamazoo Avenue, Westnedge Avenue and Michikal Street, the pedestrian signals are obscured by the street name signs. Given that this is already a difficult location for pedestrians to cross with long crossing distances and high speed vehicles, the pedestrian signals must be visible.



Suggested Improvements

- Relocate the street name signs.

6.0 Other Items Considered

There were some other items discussed following the field reviews which did not neatly fit into any of the eleven highlighted crash potentials. These items are summarized next.

New Signal at the intersection of East Michigan Avenue at Harrison Street

Observations

- Given that a new signal is planned to be constructed at the intersection of East Michigan Avenue and Harrison Street, the RSA team believed it to be an opportune time to ensure all potential safety issues were mitigated. The location of the intersection is such that a signal may not be expected by unfamiliar drivers on eastbound East Michigan Avenue.
- The proposed pedestrian path crossing on the west leg of the intersection is offset from the north leg against a heavy southbound left turn. The RSA team was concerned that southbound right-turn traffic may not notice pedestrians attempting to cross East Michigan Avenue.



Suggested Improvements

- Install advance W3-3 "Signal Ahead" warning signs on eastbound East Michigan Avenue with flashing beacons.
- Include supplemental low-level signal heads.
- Revisit the design of the south leg of the intersection to keep the pedestrian crossing as close to the intersection as possible. This will increase the visibility of pedestrians and reduce the potential for southbound right-turning vehicles to collide with a crossing pedestrian.

USPS Mailboxes Kalamazoo Avenue near Westnedge Avenue

Observations

- On Kalamazoo Avenue just prior to Westnedge Avenue, there are two USPS mailboxes located next to the curb on the south side of the road. Vehicles must stop in the left turn lane to deposit mail among vehicles traveling at high speeds. The location of these mailboxes is conducive to sideswipe collisions as vehicles merge in and out of traffic to drop off mail, as well as rear-end crashes when vehicles stop in a travel lane.



Suggested Improvements

- Relocate the mailboxes off of MDOT routes.

Lighting Levels

Observations

- During one of the nighttime field reviews, the RSA team observed low lighting conditions on the west side of the intersection on Riverview Drive at East Michigan Avenue. Poor lighting conditions can increase the likelihood of a vehicle striking a pedestrian wishing to cross East Michigan Avenue at night.



Suggested Improvements

- Review the lighting needs at the intersection.

Guardrail Upgrades

Observations

- The guardrail approach terminal is missing on Riverview Drive, just north of Mills Street. The guardrail at this location is intended to protect vehicles from striking the bridge columns.



Suggested Improvements

- Replace the guardrail approach terminal.

Two Way Left Turn Lane (TWLTL)

Observations

- Stadium Drive from Howard Street to Oliver Street has an extraneous TWLTL without places to turn. This space could be better utilized.



Suggested Improvements

- Investigate the feasibility of removing/reducing the TWLTL reduce to incorporate bike lanes and/or green space in the median.

6.0 ESTIMATED COSTS OF IMPROVEMENTS

Individual suggested improvements are listed below with estimated costs for each item.

Crash Potential #1 – Pedestrian Safety

- Install high visibility crossings throughout the study region
Cost: \$1,000 to \$3,000 per location depending on need for ramps, signs and markings
- Install a mid-block crossing on Riverview Drive near Hotop Avenue
Cost: \$3,000
- Improve the sidewalk along the west side of the street on Riverview Drive near Hotop Avenue
Cost: \$10,000
- Install a bus landing at the bus stop location on Riverview Drive near Hotop Avenue
Cost: \$1,500
- Install curb extensions throughout the study region
Cost: \$15,000 per corner (varies based on needs)
- Add leading pedestrian walk signs, install a R10-5L sign, reorient curb line and remove abandoned utility pole on West Michigan Avenue at Lovell Street
Cost: \$1,000 for signs and pole removal, realigning the intersection is a long term fix that could be in the \$100,000's range
- Create city-wide Non-Motorized Master Plan and Asset Management program that ensures pedestrian facilities are connected and meet ADA standards
Cost: \$40,000 study
- Reconstruct the northeast corner of the intersection of Kalamazoo Avenue at Parks Street
Cost: \$15,000 per corner (varies based on needs)
- Move the planter, add a R5-1R sign at intersection of East Michigan Avenue at Portage Street
Cost: \$500

Crash Potential #2 – Bikes

- Install advance warning signs on approach to pedestrian bridge underneath East Michigan Avenue
Cost: \$250

Crash Potential #3 – Signal Modernization

- Modernize all deficient signals to a box span design with countdown pedestrian signals, ADA ramps, and pushbuttons (potentially with audible pushbuttons)
Cost: \$150,000 per signal
- Incorporate mast arms with lighted street names in the box span designs
Cost: \$3,500 per lighted sign

Crash Potential #4 – Geometrics

- Provide consistent shoulder treatment along Stadium Drive
Cost: Long term fix involving reconstruction of Stadium Drive. This could get into the \$1,000,000+ range.
- Convert Riverview Drive to a three-lane roadway with a center TWLTL
Cost: \$20,000 Study
- Realign intersection of West Michigan Avenue/West Main Street and Michikal Street
Cost: \$15,000 per corner (varies based on needs)
- Realign sidewalk on East Michigan Avenue near Harrison Street
Cost: \$5,000

Crash Potential #5 – Railroad and Fencing

- Place additional protective fencing on east side of tracks on Stadium Drive near Howard Street
Cost: \$10,000
- Add pedestrian crossing arms to all pedestrian railroad crossings
Cost: \$50,000
- Install R8-8 signs in front of railroad crossing on Kalamazoo Avenue near Porter Street
Cost: \$500

Crash Potential #6 – Pavement Markings

- Add pavement markings to delineate parking spaces and edge lines throughout study region
Cost: \$0.15 to \$2 per foot of pavement marking depending on material used
- Add a second set of turn symbol pavement markings at intersection of Stadium Drive at West Michigan Avenue
Cost: \$500
- Lay down turning guide markings at various locations
Cost: \$1,000 per location (varies by need)
- Incorporate side-by-side left turn lanes on West Michigan Avenue near Academy Street
Cost: \$500
- Add pavement markings to delineate vehicle paths on northbound approach at intersection of West Michigan Avenue/West Main Street at Michikal Street
Cost: \$500
- On Riverview Drive between Mills Street and East Michigan Avenue, restripe missing center skip lines, add channelizing striping for northbound right turn to East Michigan Avenue, and narrow the hatched median
Cost: \$500
- Stripe a double-yellow centerline on Walbridge Street
Cost: \$100

Crash Potential #7 – Signs (Pedestrians)

- Install W11-2 and W16-7P signs at various crossings
Cost: \$500 per location

Crash Potential #8 – Signs (Specific)

- Install various missing signs, remove unnecessary signs, relocate signs at wrong location and fix incorrect signs throughout study region
Cost: \$250 per location (varies)
- Remove obstructions/vegetation blocking signs
Cost: \$250

Crash Potential #9 – Signs (Upgrade)

- Complete signing upgrade project throughout study region
Cost: \$1,000,000+
- Increase size and visibility of street name signs throughout study region
Cost: \$20,000
- Upgrade overhead guide sign on eastbound West Michigan Avenue to Westnedge Avenue
Cost: \$15,000
- Upgrade overhead guide signs on the truss on Kalamazoo Avenue before Michikal Street
Cost: \$15,000

Crash Potential #10 – Access Management

- Perform access management study within study region
Cost: \$40,000 study

Crash Potential #11 – Signals (General)

- At intersection of East Michigan Avenue and Portage Street, add a third yellow flasher and realign all flashers
Cost: \$1,000
- At intersection of East Michigan Avenue and Portage Street, change solid balls to angled arrows
Cost: \$500
- At intersection of Kalamazoo Avenue at Edwards Street, remove the unnecessary signal heads and install a "DO NOT ENTER" symbol for the case sign
Cost: \$2,500
- At intersection of Riverview Drive at East Michigan Avenue, shift the signal heads and replace solid green and yellow balls with angled arrows
Cost: \$500

7.0 CONCLUSION

This audit has been prepared to assist the responsible road authorities in the identification and actualization of opportunities to improve safety within the study area. The audit is based on observations to improve safety within the study area through observations made between October 17-19, 2016 and information available at the time of the safety review. This RSA has been performed in accordance with the FHWA guidelines and policies. The suggestions it contains are for consideration only, and are in no way intended to serve as design or operational recommendations.

This report does not preclude the identification of additional issues pertaining to safety by the responsible road authorities, or the emergence of new issues over time.

It is recommended that the responsible agencies review this report; document their responses to the issues identified in a formal response report; and track their progress towards the implementation of safety improvements prompted by this audit.