MIC Safety Action Plan

Phase 1 Summary

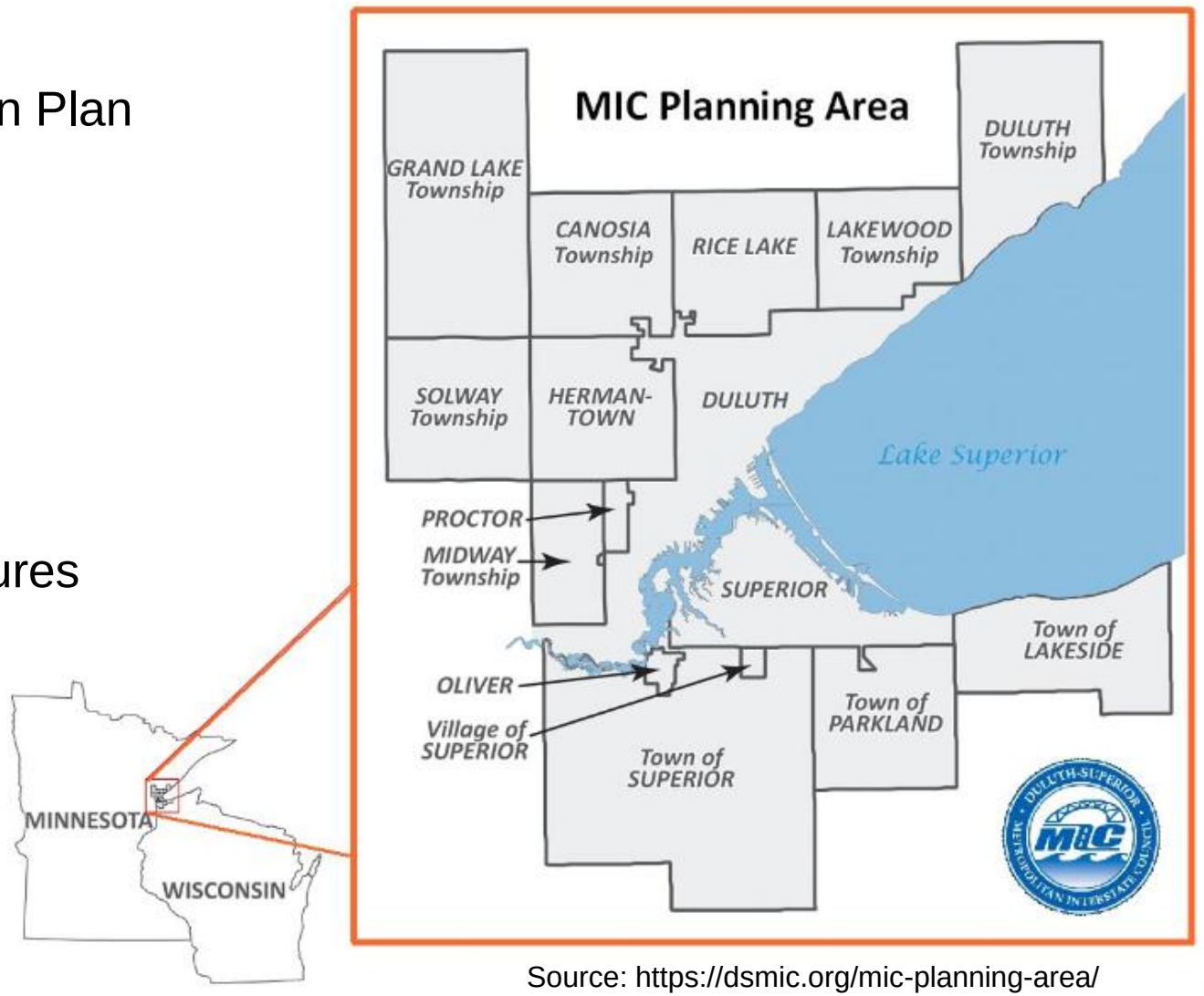
Technical Advisory Committee Meeting

December 10, 2024

Derek Salomonsen, AECOM

Agenda

- Overview of a Comprehensive Safety Action Plan
- Overview of Systemic Safety Plan Process
- Crash Tree Overview
- Safety Emphasis Areas
- Risk Factors & Risk Assessments
- Safety Countermeasures
- Decision Trees for Selecting Countermeasures
- Safety Projects
- Questions/Discussion



Source: https://dsmic.org/mic-planning-area/

US DOT's Comprehensive Safety Action Plan

Comprehensive safety plans are aimed at reducing and eliminating *serious-injury* and *fatal crashes* affecting all roadway users.

The US DOT has identified eight components of a Safety Action Plan:

1. Leadership Commitment and Goal Setting
2. Planning Structure
3. **Safety Analysis**
4. Engagement and Collaboration
5. Equity
6. Policy and Process Changes
7. **Strategy and Project Selection**
8. Progress and Transparency

https://www.transportation.gov/grants/ss4a/comprehensive-safety-action-plans

S|S
4|A

Safe Streets and Roads for A

Action Plan Component

This document is not meant to replace the NOFO. Applicants should follow the instructions in the NOFO to correctly apply for a grant. See the SS4A website for more information: https://www.transportation.gov/SS4A

Leadership Commitment and Goal Setting

An official public commitment (e.g., resolution, policy, ordinance, etc.) by a high-ranking of and/or governing body (e.g., Mayor, City Council, Tribal Council, MPO Policy Board, etc.) to eventual goal of zero roadway fatalities and serious injuries. The commitment must includ goal and timeline for eliminating roadway fatalities and serious injuries achieved through or both, of the following:

(1) the target date for achieving zero roadway fatalities and serious injuries, OR

(2) an ambitious percentage reduction of roadway fatalities and serious injuries by a spec date with an eventual goal of eliminating roadway fatalities and serious injuries.

Planning Structure

A committee, task force, implementation group, or similar body charged with oversight of t Action Plan development, implementation, and monitoring.

Safety Analysis

Analysis of existing conditions and historical trends that provides a baseline level of crash involving fatalities and serious injuries across a jurisdiction, locality, Tribe, or region. Includ an analysis of locations where there are crashes and the severity of the crashes, as well as contributing factors and crash types by relevant road users (motorists, people walking, tra users, etc.). Analysis of systemic and specific safety needs is also performed, as needed (e high-risk road features, specific safety needs of relevant road users, public health approa analysis of the built environment, demographic, and structural issues, etc.). To the extent practical, the analysis should include all roadways within the jurisdiction, without regard f ownership. Based on the analysis performed, a geospatial identification of higher-risk locations is developed (a High-Injury Network or equivalent).

Engagement and Collaboration

Robust engagement with the public and relevant stakeholders, including the private secto and community groups, that allows for both community representation and feedback. Information received from engagement and collaboration is analyzed and incorporated in the Action Plan. Overlapping jurisdictions are included in the process. Plans and processes coordinated and aligned with other governmental plans and planning processes to the ex practical.

U.S. Department of Transportation

Still have questions? Visit the SS4A w

SS4A Action Plan Components | Page

MIC Safety Action Plan – Phase 1 Technical Advisory Committee

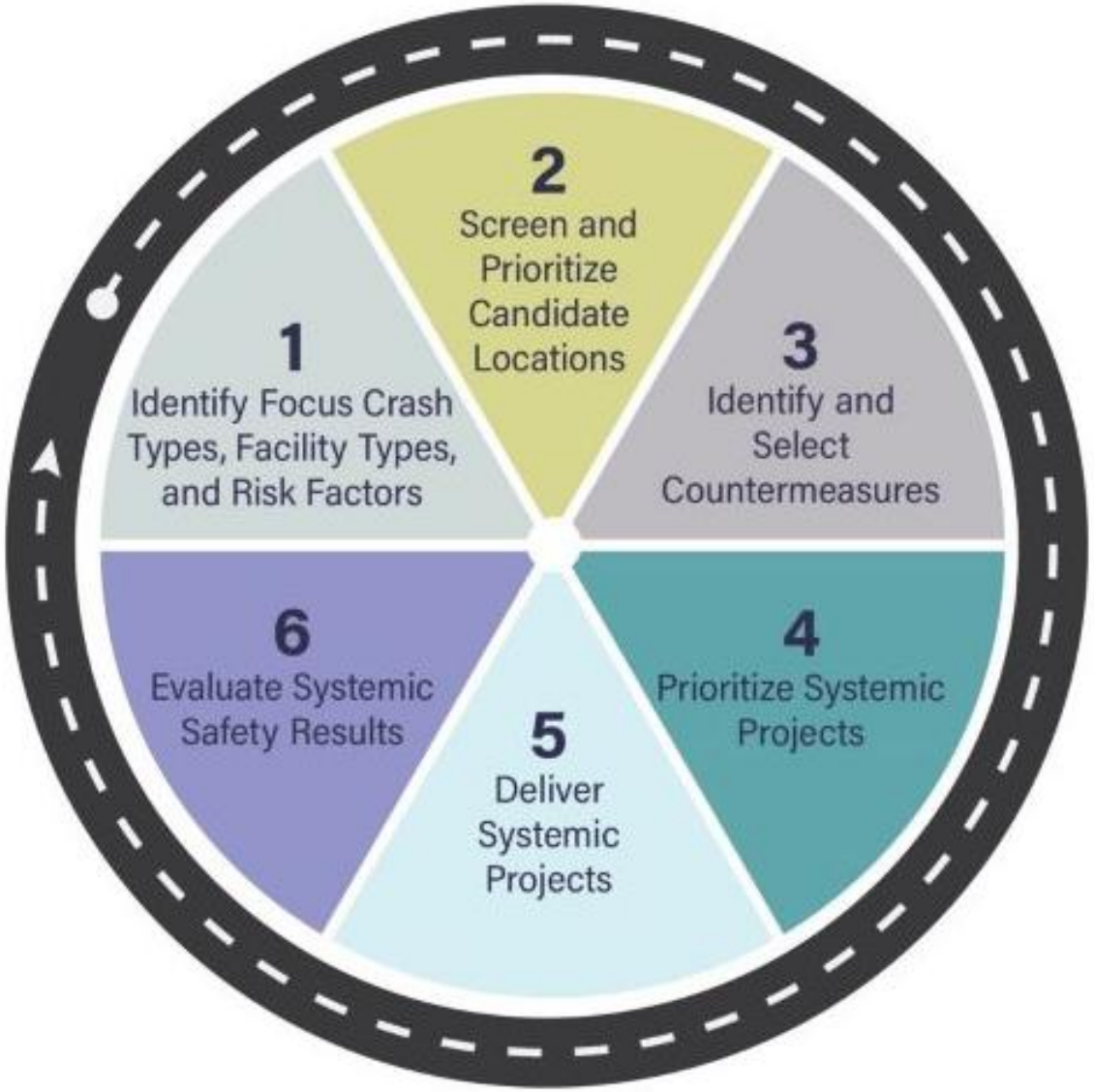
The MIC formed a technical advisory committee to assist in the completion of this phase of the Safety Action Plan.

- Members that represented all jurisdictions within the MIC study area, including municipal, state DOT, and county representatives.
- Monthly progress meetings
- Two 4-hour workshop meetings were held at critical points throughout the study to gather committee input.

Thank you to all who were a part of this committee.

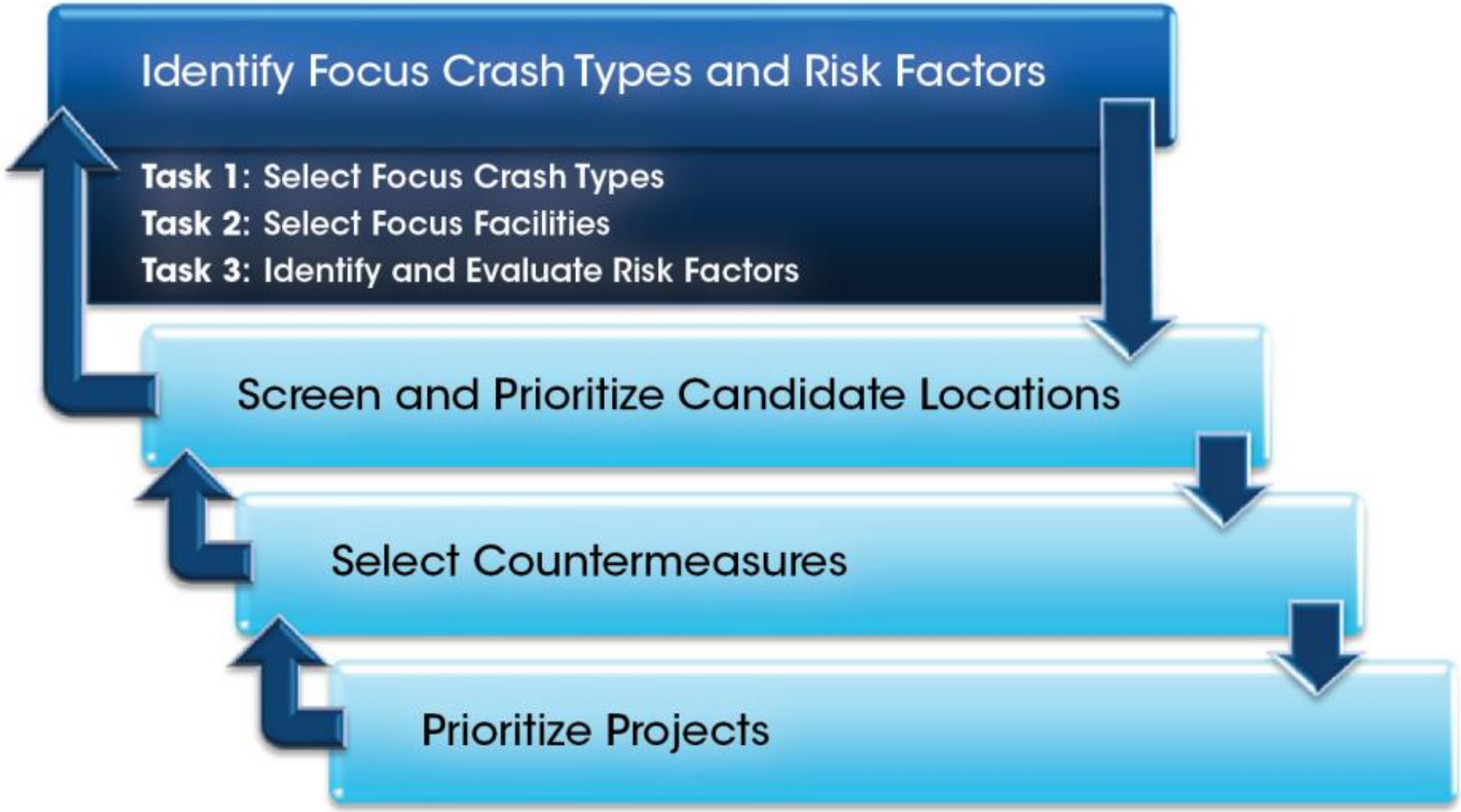
STEP 1: SAFETY ANALYSIS

FHWA's Systemic Approach to Safety



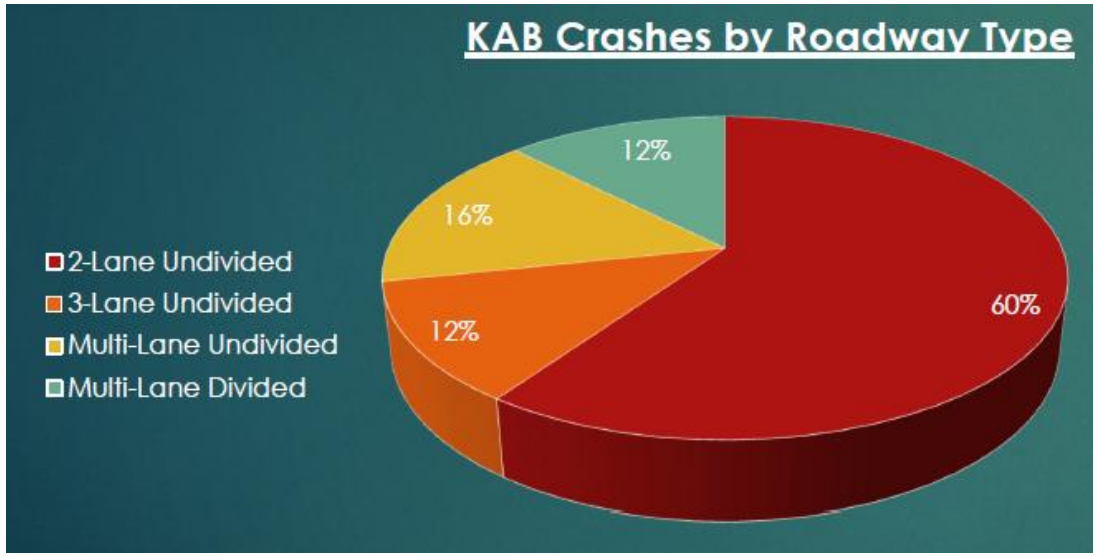
Source: https://highways.dot.gov/safety/data-analysis-tools/systemic

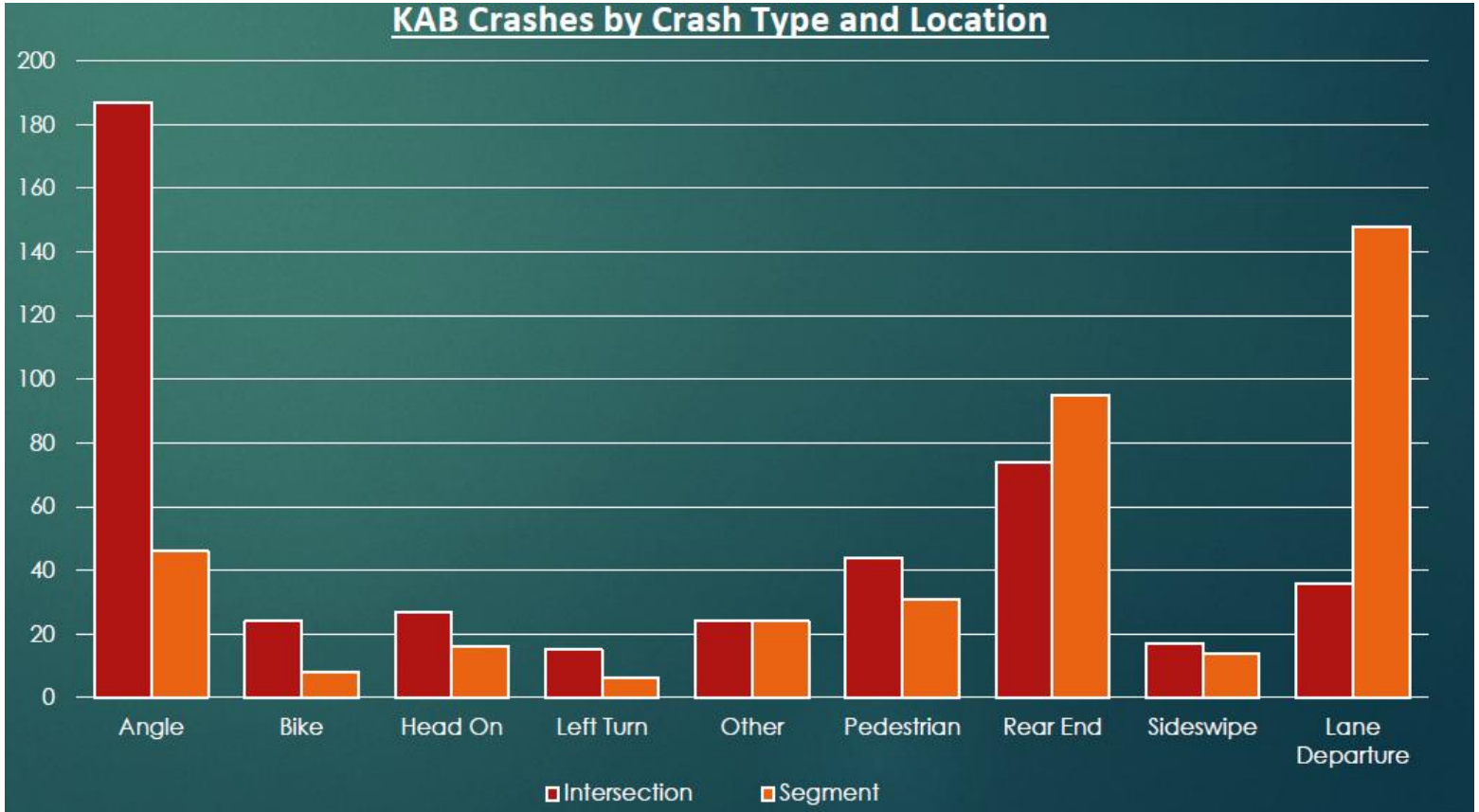
Systemic Safety Plan Process

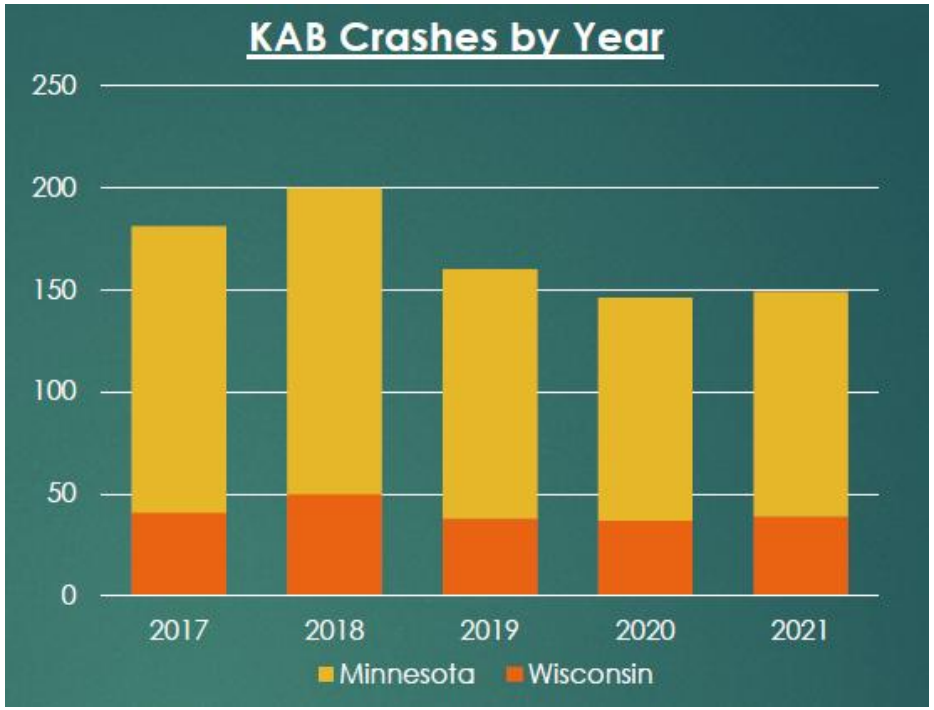


Overview – Collection/Research of Crash Data

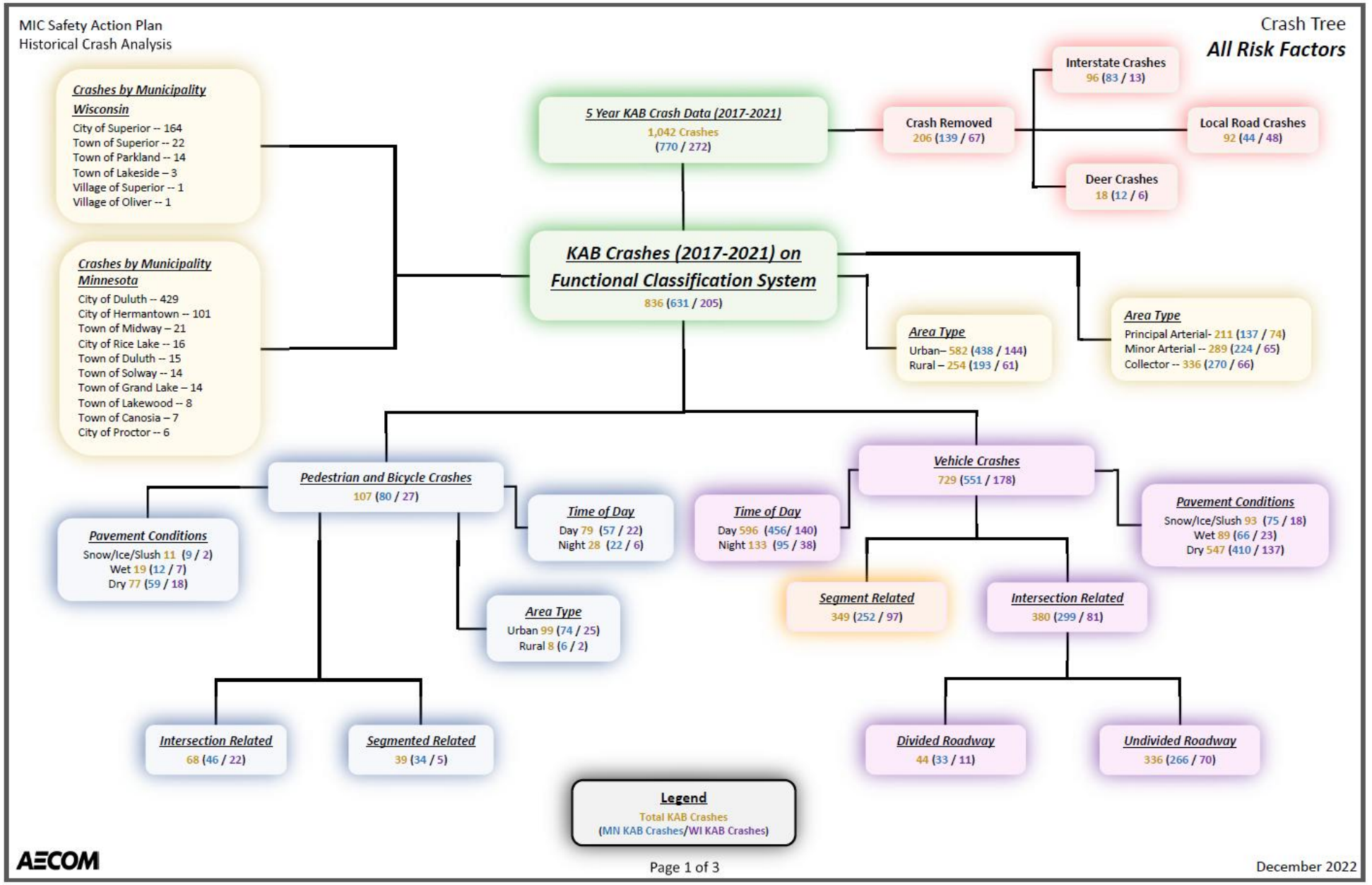
- Collected High Severity (K/A/B) Crashes
  - 5 Years (2017-2021)
  - Only Roads on Functional System (Collectors & Arterials)
  - Crashes were disaggregated by crash type, location, functional classification, roadway geometrics, traffic volume, and other roadway characteristics.



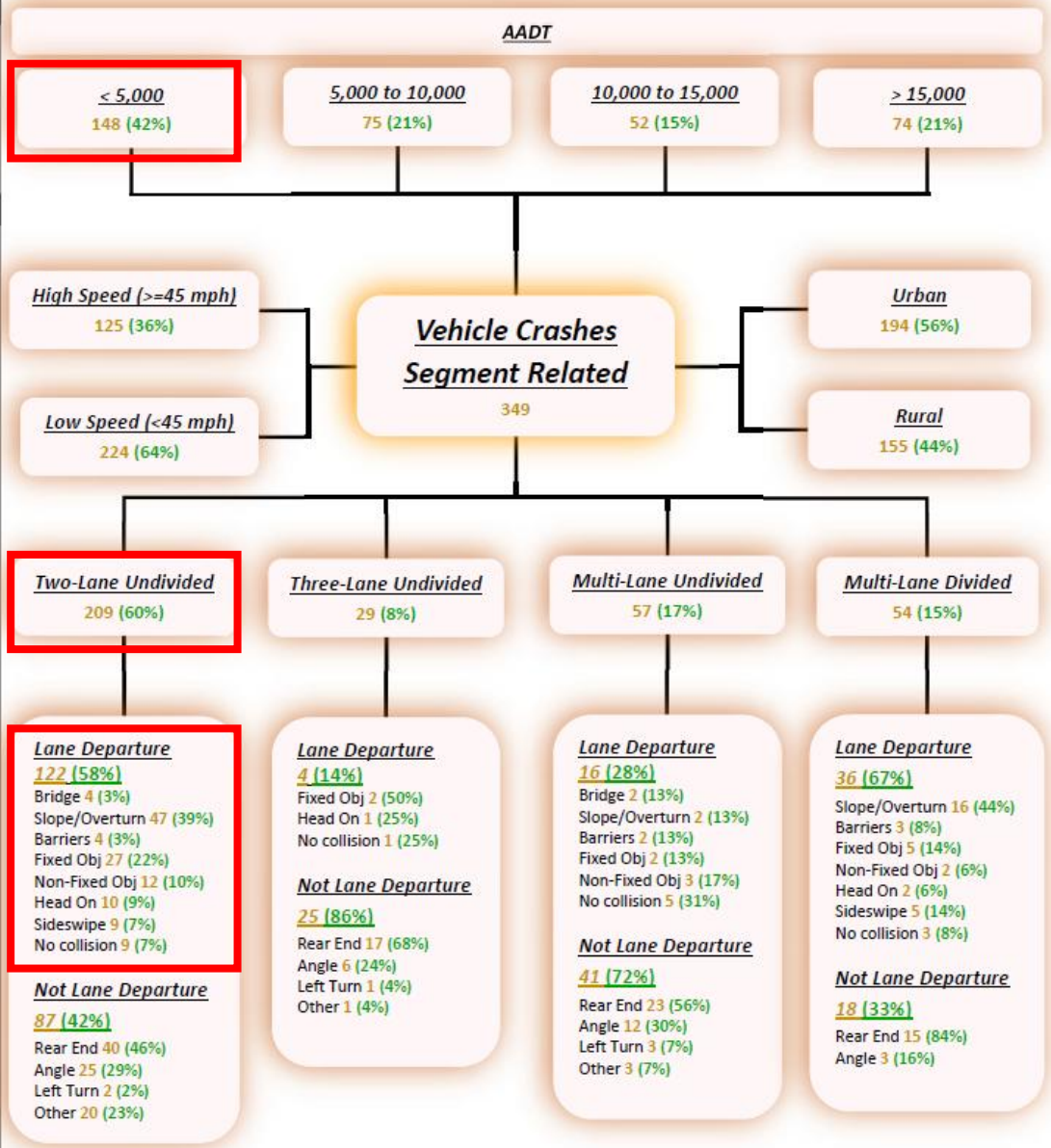


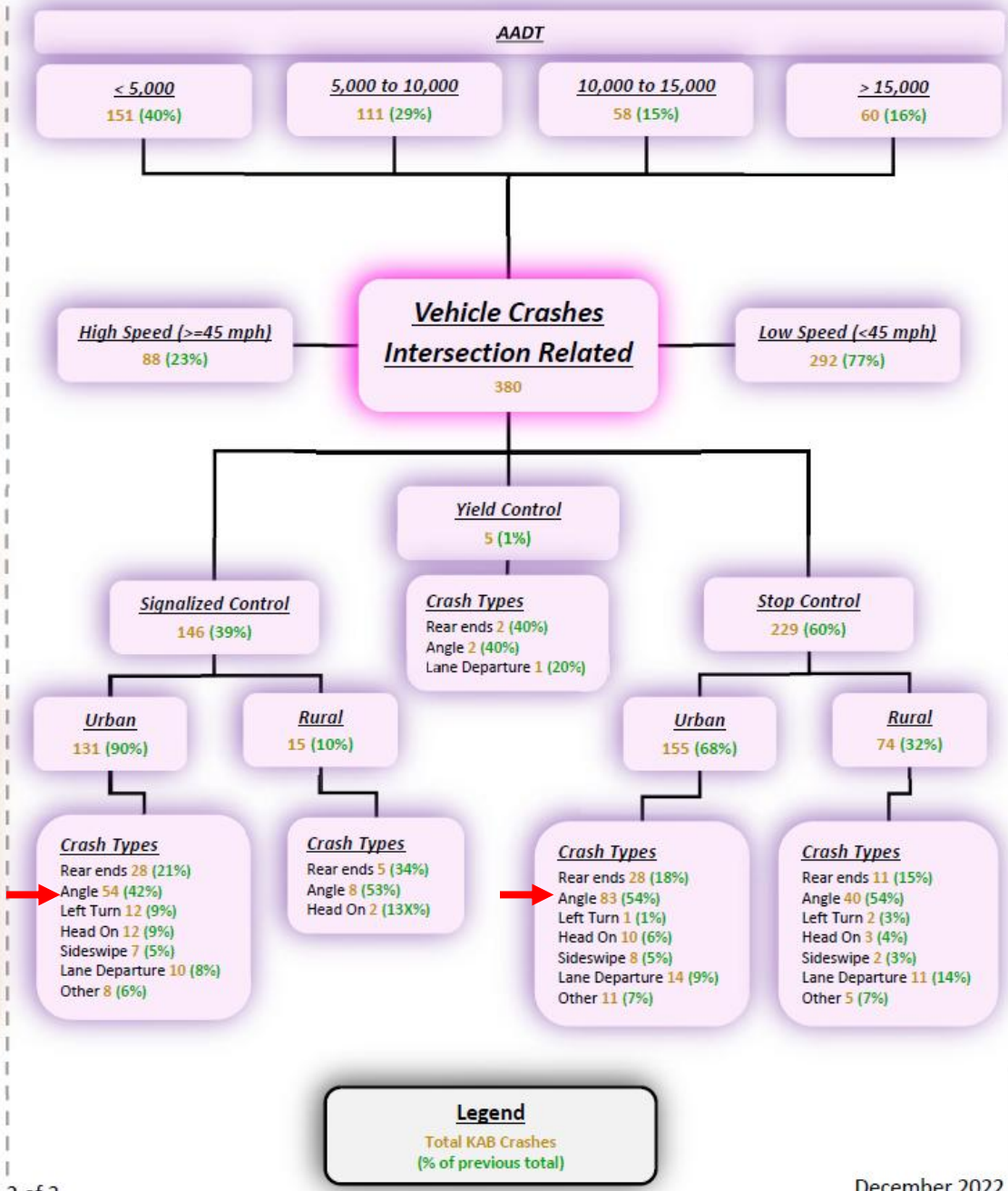


Overview – Crash Tree: Overall



Vehicle Risk Factors





Ped/Bike Risk Factors

Pedestrian Crashes

75

AADT

- < 5,000: 31 (41%)
- 5,000 to 10,000: 28 (37%)
- 10,000 to 15,000: 6 (8%)
- > 15,000: 10 (13%)

Time of Day

Day 55 (73%)
Night 20 (27%)

Facility Type

Two-Lane Undivided 50 (65%)
Three-Lane Undivided 11 (16%)
Multi-Lane Undivided 6 (8%)
Multi-Lane Divided 8 (11%)

No Accommodations

4 (5%)
(All Segment Crashes)

Accommodations Present

71 (95%)

- Sidewalk, Behind Curb: 29 (41%)
- Sidewalk, Including Terrace: 42 (59%)
- Segment Related: 28 (39%)
- Intersection Related: 43 (61%)

Fatal Crashes

All fatal pedestrian (3) crashes occurred at stop-controlled intersections with sidewalk behind the curb.

Crash Type (Segment Related)

Unmarked Mid-Block Crossing 14 (50%)

Illegally Walking in Road 5 (18%)

Driveway/Alley 3 (11%)

Other 6 (21%)

Crash Type (Intersection Related)

Ped Fail to Yield 7 (16%)

Turning Vehicle Fail to Yield 24 (56%)

Through Vehicle Fail to Yield 12 (28%)

Bicycle Crashes

32

AADT

- < 5,000: 11 (34%)
- 5,000 to 10,000: 7 (22%)
- 10,000 to 15,000: 8 (25%)
- > 15,000: 6 (19%)

Time of Day

Day 24 (75%)
Night 8 (25%)

Facility Type

Two-Lane Undivided 14 (44%)
Three-Lane Undivided 6 (19%)
Multi-Lane Undivided 5 (15%)
Multi-Lane Divided 7 (22%)

No Accommodations

26 (82%)

Accommodations Present

On-Street 2 (6%)
Shared Lane 3 (9%)
Separate Path 1 (3%)

- Segment Related: 4 (15%)
- Intersection Related: 22 (85%)
- Segment Related: 4 (67%)
- Intersection Related: 2 (33%)

Crash Type

Bike Fail to Yield 10 (45%)
(60% at signals & 40% at stop signs)

Turning Vehicle Fail to Yield 8 (56%)
(50% right turns & 50% left turns)
(70% at signals & 30% at stop signs)

Through Vehicle Fail to Yield 4 (28%)
(38% at stop signs & 62% at signals)

Fatal Crashes

All fatal bike (2) crashes occurred on segments without bike accommodations

Legend

Total KAB Crashes
(% of previous total)

Overview – Collection/Research of Crash Data

- Overrepresentation Analysis
  - Categories highlighted in yellow indicate an overrepresentation of KAB crashes for that roadway characteristic
  - Categories highlighted in red indicates an overrepresentation by a factor of two or more.

	Category	% Study Area	% of KAB Crashes
Functional Classification	Principal Arterial	12%	25%
	Minor Arterial	23%	35%
	Major Collector	42%	28%
	Minor Collector	23%	12%
Area Type	Rural	67%	30%
	Urban	33%	70%
Roadway Type	Five-Lane Undivided	1%	6%
	Four-Lane Divided	8%	12%
	Four-Lane Undivided	3%	9%
	Three-Lane Undivided	3%	12%
	Two-Lane Divided	0%	1%
	Two-Lane Undivided	84%	59%
	Single Lane	0%	0%
AADT	<5,000	74%	41%
	5,000 to 10,000	15%	26%
	10,000 to 15,000	6%	15%
	>15,000	4%	13%
State	Minnesota	74%	75%
	Wisconsin	26%	25%

Overview- Collection/Research of Crash Data

Crash Rate Analysis

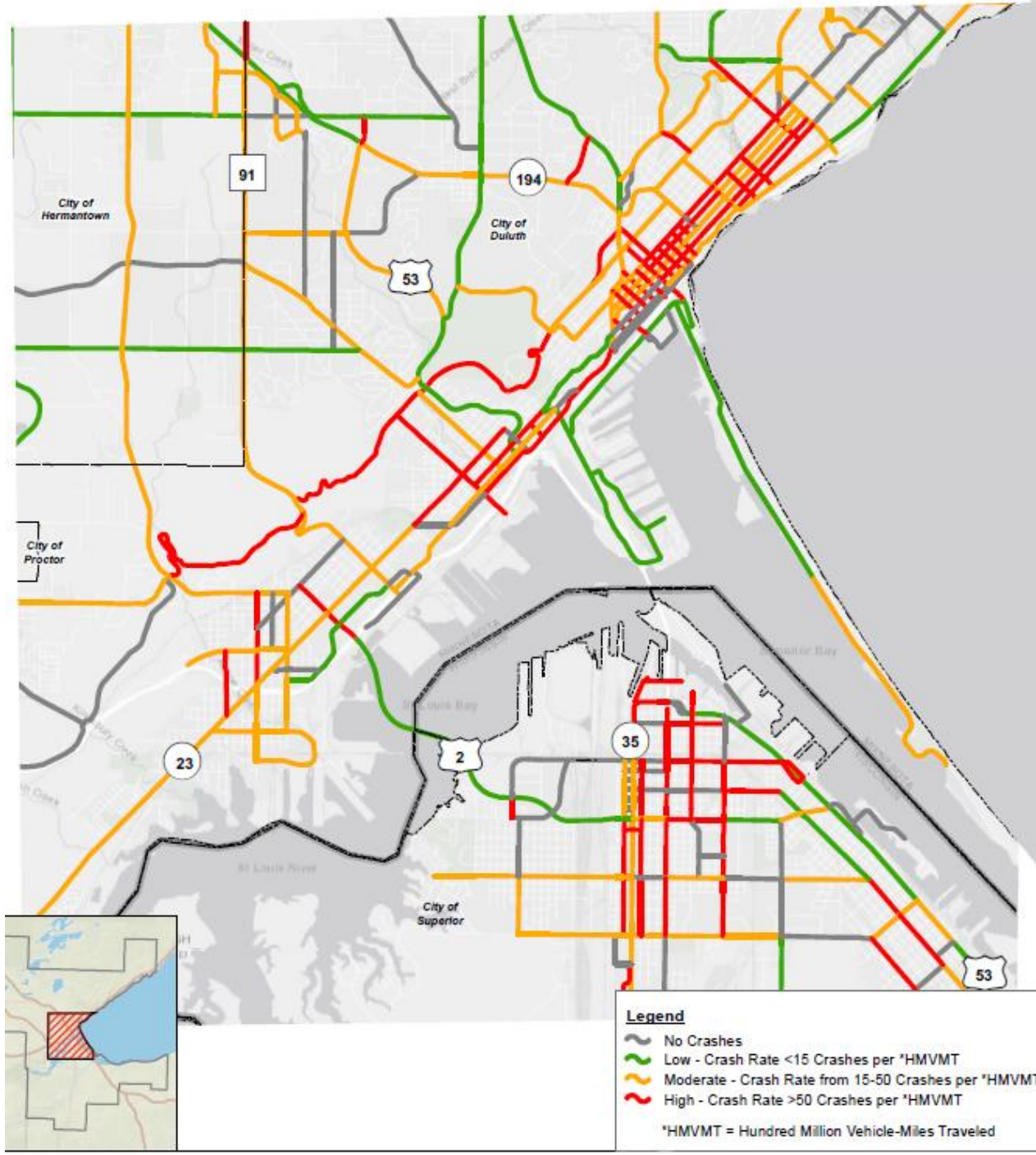
- Segmented all functionally classified roads based on substantial changes in roadway attributes, including AADT, typical section, posted speeds, functional classification, area type, and/or changes in route designation.

- Many segments had no crashes occur in past 5 years, including:
  - 8% of arterial roadway miles
  - 35% of collector roadway miles

Legend

- No Crashes
- Low - Crash Rate <15 Crashes per *HMVMT
- Moderate - Crash Rate from 15-50 Crashes per *HMVMT
- High - Crash Rate >50 Crashes per *HMVMT

*HMVMT = Hundred Million Vehicle-Miles Traveled



Overview – Collection/Research of Crash Data

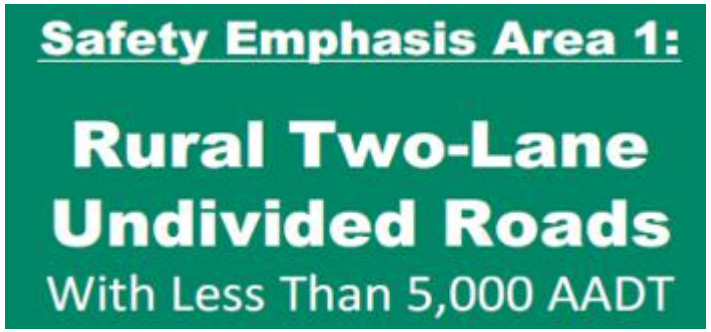
Category	KAB Crashes per HMVMT*
Low	<15
Moderate	15 to 50
High	>50

*Hundred Million Vehicle-Miles Traveled

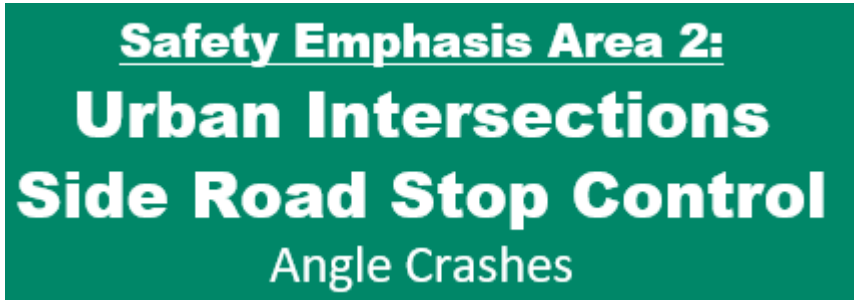
Category		Miles	KAB Crashes	KAB Crash Rate (Crashes per HMVMT*)
Functional Classification	Principal Arterial	78.67	211	13.11
	Minor Arterial	146.96	289	9.16
	Major Collector	267.71	235	6.32
	Minor Collector	147.72	101	12.13
Area Type	Rural	431.60	254	11.14
	Urban	209.46	582	22.78
Roadway Type	Five-Lane Undivided	9.17	54	21.45
	Four-Lane Divided	50.65	103	9.56
	Four-Lane Undivided	21.47	77	17.67
	Three-Lane Undivided	21.05	99	31.34
	Two-Lane Divided	1.89	8	56.27
	Two-Lane Undivided	536.00	494	18.06
	Single Lane	0.84	1	20.87
AADT	<5,000	469.27	335	21.34
	5,000 to 10,000	97.71	215	17.53
	10,000 to 15,000	38.88	136	16.24
	>15,000	35.21	150	12.48

*Hundred Million Vehicle-Miles Traveled

Safety Emphasis Areas



- 360 miles or 270 Segments
- 250 curves

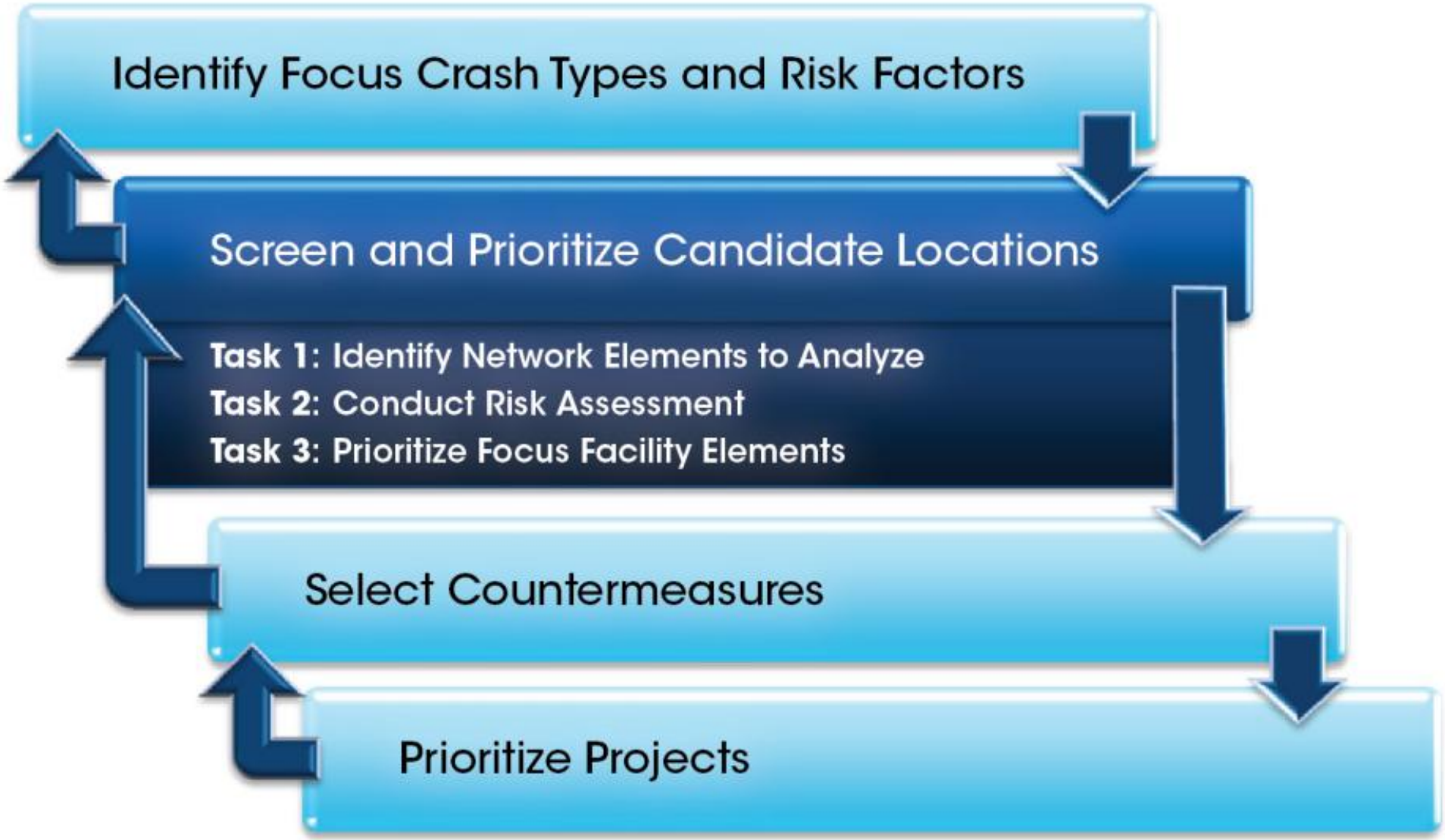


- 160 Intersections

- 93 Intersections

- 722 Intersections

Systemic Safety Plan Process



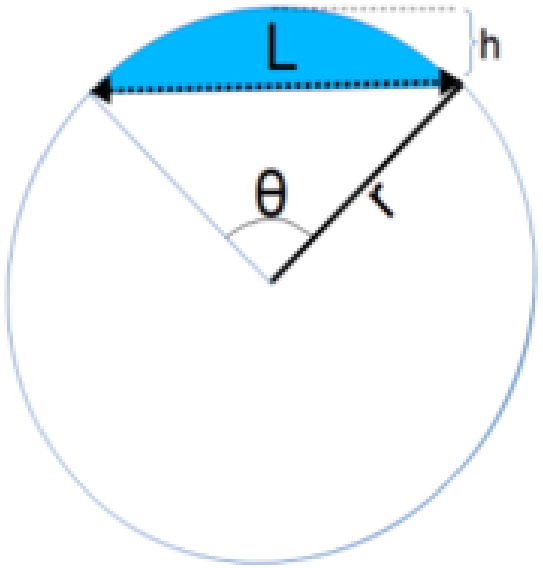
Risk Factors – Safety Emphasis Area 1
Rural Two-Lane Undivided Roads, AADT <5,000 (Lane Departure Crashes)

Risk Factor -Segments	At-Risk Criteria	Data Source	Include in Study?
Density of Lane Departure KAB Crashes	↾ >0.10 crashes per mile per 5 year period ★ >=0.50 crashes per mile per 5 year period	AECOM	Yes
Curve Density	↾ >=1 curve/s per mile ★ >=3 curves per mile	Stakeholders & AECOM	Yes
Access Density (driveways, field entrances, unsignalized public streets)	↾ >=7 & <15 ★ >=15	AECOM	Yes
Edge Risk Assessment & Shoulder/Surface Type (steep slopes, fixed objects in clear zone)	↾ No Paved Shoulder & No Deficiencies ↾ Paved Shoulder & 1 or 2 Deficiencies ★ No Paved Shoulder & 1 or 2 Deficiencies	AECOM	Yes
Speed Limit	↾ >=40 mph & <55 mph ★ >=55 mph	AECOM	Yes
Roadway Width (of thru travel lanes)	★ <24-feet	AECOM	Yes
Presence of Edgeline and/or Centerline Rumble Strips	-	-	No Use as mitigation strategy
Presence of Edgeline and/or Centerline Pavement Markings	-	-	No Use as mitigation strategy
Risk Factor - Curves	**Criteria**	**Data Source**	**Include in Study?**
Occurrence of KAB Crashes on Curves	↾ 1 crash per curve per 5 year period ★ >=2 crashes per curve per 5 per period	Stakeholders & AECOM	Yes
Presence of Intersection on Curve or Visual Trap	↾ Intersection on curve ★ Visual Trap & Int. on Curve	AECOM	Yes
Curve Radii	↾ >=500-feet to 1,000-feet ★ < 500-feet	AECOM	Yes
Horizontal Curve Speed Differential	↾ 5-10 mph (curve advisory speed sign present) ★ >10 mph (curve advisory speed sign present) ★ Curve Radius <=750', Speed Limit >=45 mph (no curve advisory speed sign present)	Stakeholders & AECOM	Yes
Shoulder/Surface Type	↾ Gravel Shoulder Only ★ No Paved shoulder	AECOM	Yes

Identification of Curves

Curve locations and curve data (radius) were estimated using aerials, with horizontal curve tangents and points of intersection estimated from aerial measurements.

- 360 curves were evaluated along the 360 miles of rural undivided two-lane roads (<5,000 AADT)
- Only curves with a radius <= 1,150-ft were included in the risk assessment (252 Total Curves)



$$r = \frac{L^2}{8h} + \frac{h}{2}$$

- r is the radius of a circle
- L is the length of the chord. Thi
- h is the height above the chord.

Risk Factors – Safety Emphasis Area 2
Urban Side Road Stop Control Intersections (Angle Crashes)

Risk Factor	At-Risk Criteria	Data Source	Include in Study?
Occurrence of Angle Crashes	★ >=1 crash per 5 year period	Stakeholders	Yes
Speed Limit on Major Road	↳ >=30 mph ★ >=40 mph	Stakeholders	Yes
Mainline Cross Section	↳ Multi-Lane, with median ★ Multi-Lane, no median	Stakeholders	Yes
Skew of Intersection	↳ > 5 degrees ★ >= 25 degrees	AECOM	Yes
Number of Entering Legs	★ 4 intersection legs	AECOM	Yes
Context Zone	★ Commercial, Retail, School, Library, Park	AECOM	Yes
Mainline AADT	↳ >= 5,000 & < 12,000 ★ >=12,000	Stakeholders	Yes
Speed Limit on Minor Road			No
Intersection Location			No
Presence of On-Street Parking			No
Presence of Turn Lanes			No, Use as mitigation strategy

Risk Factors – Safety Emphasis Area 3
Signalized Intersection, Multi-Lane Arterials

Risk Factor	At-Risk Criteria	Data Source	Include in Study?
Number of KAB Crashes	↾ 1 crashes per 5 year period ★ 2 or more crashes per 5 year period	AECOM	Yes
Speed Limit on Major Road	↾ >=35 mph ★ >=45 mph	Stakeholders	Yes
Speed Limit on Minor Road	↾ >=30 mph ★ >=40 mph	Stakeholders	Yes
Mainline AADT	↾ > 8,000 & < 12,000 ★ >=12,000	Stakeholders	Yes
Skew of Intersection	↾ > 5 degrees ★ >= 20 degrees	Stakeholders	Yes
Presence of Mainline Median	↾ Median on 1 Approach ★ No Median	Stakeholders	Yes
Presence of Mainline Left Turn Lanes	↾ None on 1 Approach ★ None on all Approaches	Stakeholders	Yes
Left Turn Signal Phasing, by Mainline Approach	↾ Permitted/Protected by Mainline Approach ★ Permitted Only by Mainline Approach	Stakeholders (AECOM Collected for City of Duluth Intersections)	Yes
Signal Heads per Number of Mainline Thru Lanes	↾ <1:1 signal heads/lanes ★ <=1:2 signal heads/lanes	Stakeholders (AECOM Collected for City of Duluth Intersections)	Yes
Access Within Influence Area	↾ 1-2 driveways ★ >=3 driveways	Stakeholders (AECOM Collected for City of Duluth Intersections)	Yes
Mainline Left Turn Lane Alignment	↾ Zero Offset ★ Negative Offset	Stakeholders	Yes
Isolated vs. Coordinated	★ Isolated Signal	Stakeholders	Yes
Presence of Signal Head Backplates			No, Use as Mitigation strategy

Risk Factors – Safety Emphasis Area 4
Urban Intersections (Bikes & Peds)

Risk Factor	At-Risk Criteria	Potential Data Source	Include in Study?
Occurrence of Ped/Bike Crashes	★ >=1 crash	Stakeholders	Yes
Mainline AADT	↳ > =5,000 & < 10,000 ★ >=10,000	Stakeholders	Yes
Type of Traffic Control	★ Signalized	Stakeholders	Yes
Speed Limit on Major Road	↳ 30 mph ★ >=35 mph	Stakeholders	Yes
Number of Thru Lane on Major Approach	★ >2-lanes	AECOM	Yes
Presence of Bicycle Facilities (mainline)	↳ Paved Shoulder ★ No Bike Facilities	Stakeholders	Yes
Exposure Length (exclude median refuge)	↳ >=40-ft & <50-ft ★ >=50-ft	AECOM	Yes
Presence of Sidewalk (mainline)	↳ Partial Sidewalk ★ No Sidewalk	Stakeholders	Yes
Presence of Lighting	↳ No Lighting on Minor Approaches ★ No Lighting	Stakeholders	Yes
Presence of On-Street Parking (mainline)	★ Parking	AECOM	Yes
Presence of Pedestrian Generators	↳ Commercial, Parks & School ↳ On DTA Route	Stakeholder	Yes
Disadvantaged Neighborhoods	★ Adjacent to Disadvantaged Community	Stakeholder	Yes
Presence of Bus Stops			No, essentially included in Presence of Pedestrian Generators
Presence of Crosswalks			No, Use as Mitigation Strategy

Selection of At-Risk Locations

- **Tier 1 Location:** Top 5% or minimum of top 20 locations.

- **Tier 2 Locations:** Evaluate next 5% (or next 20 locations) for corridor-wide projects and to see if the there is a good representation of different municipalities.

  Evaluate locations in municipalities that are not well represented in the original top 5%.

Risk Assessment
Safety Emphasis Area 1

Segments

Rural Two-Lane Undivided Roads, AADT <5,000 (Lane Departure Crashes)

Tier 1 Location: 20 or 25 miles

Tier 2 Locations: 18 or 32 miles

Road Name	State	County	Municipality	Speed Limi	Number of KAB Crashe	Length (mil	AADT	Total Stars
Lester River Rd	Minnesota	Saint Louis	Township of Lakewood	45	1	3.6	2000	★★★★★
Ryan Rd	Minnesota	Saint Louis	Township of Duluth	50	1	0.3	364	★★★★★
Becks Rd	Minnesota	Saint Louis	Township of Midway	55	1	1.1	670	★★★★½
CTH A	Wisconsin	Douglas	Township of Superior	40	1	1.3	730	★★★★½
CTH K	Wisconsin	Douglas	Township of Parkland	55	0	1.8	1200	★★★★½
CTH A	Wisconsin	Douglas	Township of Superior	55	2	0.7	970	★★★★½
S Chicago Ave	Wisconsin	Douglas	Village of Oliver	45	1	1.3	2300	★★★★½
W Skyline Pkwy	Minnesota	Saint Louis	City of Duluth	55	0	1.7	1580	★★★★
Saginaw Rd	Minnesota	Saint Louis	Township of Solway	55	0	0.4	225	★★★★
CTH 8	Minnesota	Saint Louis	Township of Grand Lake	30	0	0.8	120	★★★★
Hermantown Rd	Minnesota	Saint Louis	City of Hermantown	55	1	1.0	2800	★★★★
Seven Bridges Rd	Minnesota	Saint Louis	City of Duluth	45	1	1.4	348	★★★★
Occidental Blvd	Minnesota	Saint Louis	City of Duluth	30	0	0.4	348	★★★★
Ryan Rd	Minnesota	Saint Louis	Township of Duluth	55	0	0.2	364	★★★★
Swan Lake Rd	Minnesota	Saint Louis	City of Duluth	30	0	1.2	3000	★★★★
Observation Rd	Minnesota	Saint Louis	City of Duluth	40	0	1.1	1100	★★★★
E Skyline Pkwy	Minnesota	Saint Louis	City of Duluth	40	0	0.7	1450	★★★★
CTH U	Wisconsin	Douglas	Township of Lakeside	30	0	0.9	90	★★★★
CTH C	Wisconsin	Douglas	Township of Parkland	30	4	4.0	1000	★★★★
CTH E	Wisconsin	Douglas	Township of Parkland	55	0	1.1	1200	★★★★
W Skyline Pkwy	Minnesota	Saint Louis	City of Proctor	30	1	1.8	680	★★★½
W Skyline	Minnesota	Saint Louis	Township of Midway	30	1	0.5	680	★★★½
Oldenberg Pkwy	Minnesota	Saint Louis	City of Duluth	55	1	2.0	2000	★★★½
Lavaque Rd	Minnesota	Saint Louis	City of Hermantown	45	0	0.7	3500	★★★½
Caribou Lake Rd	Minnesota	Saint Louis	Township of Grand Lake	40	2	0.6	499	★★★½
Schultz Rd	Minnesota	Saint Louis	City of Rice Lake	55	0	2.0	170	★★★½
Schultz Rd	Minnesota	Saint Louis	City of Rice Lake	55	2	1.0	115	★★★½
Culbertson Rd	Minnesota	Saint Louis	Township of Duluth	55	0	1.0	380	★★★½
McQuade Rd	Minnesota	Saint Louis	Township of Lakewood	40	2	0.4	345	★★★½
Swan Lake Rd	Minnesota	Saint Louis	City of Hermantown	55	0	0.7	1400	★★★½
W Calvary Rd	Minnesota	Saint Louis	City of Rice Lake	55	0	2.0	1650	★★★½
CTH D	Wisconsin	Douglas	Township of Lakeside	55	1	2.5	1400	★★★½
CTH K	Wisconsin	Douglas	Township of Parkland	55	0	2.5	850	★★★½
CTH C	Wisconsin	Douglas	Township of Parkland	55	0	2.7	750	★★★½
CTH E	Wisconsin	Douglas	Township of Parkland	45	1	2.8	670	★★★½
CTH E	Wisconsin	Douglas	Township of Parkland	55	0	1.0	2000	★★★½
CTH C	Wisconsin	Douglas	Township of Superior	30	0	3.7	430	★★★½
CTH W	Wisconsin	Douglas	Township of Superior	30	0	3.7	270	★★★½

Risk Assessment
Safety Emphasis Area 1

Curves

Rural Two-Lane Undivided Roads
AADT <5,000
(Lane Departure Crashes)

Tier 1 Location: 20

Tier 2 Locations: 25

RoadName	State	Count	Municipality	Lat/Long	Speed Limit (mph)	Curve Advisory Speed (mp	Length (miles	AAD	Total Star
CTH C	Wisconsin	Douglas	Township of Superior	46°35'25.04"N, 92° 7'58.90"W	55	15	3.7	430	★★★★
W Tischer Rd	Minnesota	Saint Louis	Township of Lakewood	46°52'49.13"N, 92° 0'19.37"W	40	20	2.0	870	★★★★
E McCuen St	Minnesota	Saint Louis	City of Duluth	46°39'22.28"N, 92°12'30.51"W	35	25	0.6	2300	★★★½
CTH 8	Minnesota	Saint Louis	Township of Grand Lake	46°55'24.22"N, 92°24'46.07"W	55	No Posting	0.8	120	★★★½
Ryan Rd	Minnesota	Saint Louis	Township of Duluth	46°57'22.91"N, 91°53'59.42"W	55	30	1.3	380	★★★½
W Skyline Pkwy	Minnesota	Saint Louis	City of Duluth	46°46'43.40"N, 92° 7'15.66"W	55	No Posting	1.7	1580	★★★½
Ryan Rd	Minnesota	Saint Louis	Township of Duluth	46°54'3.49"N, 91°54'2.98"W	55	No Posting	0.2	364	★★★½
Industrial Rd	Minnesota	Saint Louis	Township of Grand Lake	46°53'37.03"N, 92°21'56.59"W	50	No Posting	0.1	1000	★★★½
Ryan Rd	Minnesota	Saint Louis	Township of Duluth	46°54'11.29"N, 91°54'12.54"W	55	15	0.3	364	★★★½
Occidental Blvd	Minnesota	Saint Louis	City of Duluth	46°50'38.96"N, 92° 0'37.28"W	30	20	0.4	348	★★★
CTH W	Wisconsin	Douglas	Township of Superior	46°33'7.90"N, 92°14'49.97"W	55	No Posting	3.7	270	★★★
N 58th St	Wisconsin	Douglas	City of Superior	46°40'11.71"N, 92° 4'37.88"W	30	15	1.0	2000	★★★
W SKyline Pkwy	Minnesota	Saint Louis	City of Proctor	46°43'30.81"N, 92°13'1.44"W	30	15	0.2	4150	★★★
Maple Grove Rd	Minnesota	Saint Louis	Township of Solway	46°48'27.56"N, 92°20'0.41"W	50	25	1.1	1466	★★★
E Shilhon Rd	Minnesota	Saint Louis	Township of Duluth	46°57'22.89"N, 91°52'43.28"W	55	25	1.0	380	★★★
W Skyline Pkwy	Minnesota	Saint Louis	City of Duluth	46°46'43.44"N, 92° 7'23.31"W	55	No Posting	1.7	1580	★★★
Becks Rd	Minnesota	Saint Louis	Township of Midway	46°42'15.72"N, 92°17'31.69"W	50	40	1.1	670	★★★
Caribou Lake Rd	Minnesota	Saint Louis	Township of Solway	46°51'38.82"N, 92°19'21.75"W	55	No Posting	1.2	265	★★★
Munger Shaw Rd	Minnesota	Saint Louis	Township of Grand Lake	46°54'46.80"N, 92°20'38.89"W	45	No Posting	3.4	1050	★★★
CTH C	Wisconsin	Douglas	Township of Superior	46°34'48.28"N, 92°12'6.64"W	55	20	3.2	430	★★★
CTH W	Wisconsin	Douglas	Township of Superior	46°33'14.72"N, 92°14'41.78"W	55	No Posting	3.7	270	★★½
Occidental Blvd	Minnesota	Saint Louis	City of Duluth	46°50'29.15"N, 92° 0'36.58"W	30	20	0.4	348	★★½
CTH W	Wisconsin	Douglas	Township of Superior	46°32'43.85"N, 92°14'38.17"W	55	25	3.7	270	★★½
N 58th St	Wisconsin	Douglas	City of Superior	46°40'9.80"N, 92° 4'40.55"W	30	15	1.0	2000	★★½
Hermantown Rd	Minnesota	Saint Louis	City of Hermantown	46°47'22.30"N, 92°10'31.24"W	40	No Posting	1.0	2800	★★½
E Skyline Pkwy	Minnesota	Saint Louis	City of Duluth	46°48'43.37"N, 92° 5'26.53"W	30	15	0.7	1450	★★½
S Chicago Ave	Wisconsin	Douglas	Village of Oliver	46°38'42.53"N, 92°11'32.99"W	55	25	1.3	2300	★★½
Becks Rd	Minnesota	Saint Louis	Township of Midway	46°41'56.24"N, 92°16'47.16"W	50	No Posting	1.1	670	★★½
Minnesota Ave	Minnesota	Saint Louis	City of Duluth	46°43'41.96"N, 92° 3'8.90"W	30	No Posting	1.0	1850	★★½
Maple Grove Rd	Minnesota	Saint Louis	Township of Solway	46°48'28.32"N, 92°20'19.68"W	50	25	1.1	1466	★★½
42nd Ave	Wisconsin	Douglas	City of Superior	46°39'29.00"N, 92° 3'59.28"W	55	35	0.5	970	★★½
Maple Grove Rd	Minnesota	Saint Louis	Township of Solway	46°48'34.09"N, 92°20'15.47"W	50	25	1.1	1466	★★½
Oldenberg Pkwy	Minnesota	Saint Louis	City of Duluth	46°40'21.35"N, 92°17'27.23"W	40	25	2.0	2000	★★½
CTH A	Wisconsin	Douglas	Township of Superior	46°29'38.66"N, 92° 4'20.00"W	55	35	3.3	930	★★½
CTH U	Wisconsin	Douglas	Township of Lakeside	46°37'56.39"N, 91°54'41.08"W	55	No Posting	0.9	90	★★½
W Skyline Pkwy	Minnesota	Saint Louis	City of Duluth	46°46'24.45"N, 92° 7'38.55"W	55	No Posting	1.7	1580	★★½
St. Louis River Rd	Minnesota	Saint Louis	City of Hermantown	46°45'50.88"N, 92°14'59.42"W	45	No Posting	1.5	531	★★½
CTH U	Wisconsin	Douglas	Township of Lakeside	46°37'40.46"N, 91°54'21.35"W	55	No Posting	0.9	90	★★½
Korkki Rd	Minnesota	Saint Louis	Township of Duluth	46°57'48.95"N, 91°52'43.39"W	55	25	2.0	380	★★½
Swan Lake Rd	Minnesota	Saint Louis	City of Hermantown	46°49'49.50"N, 92°11'2.04"W	55	30	0.7	1400	★★½
CTH A	Wisconsin	Douglas	Township of Superior	46°37'49.02"N, 92° 3'58.80"W	55	20	1.3	730	★★½
CTH W	Wisconsin	Douglas	Township of Superior	46°33'17.08"N, 92°14'27.44"W	55	No Posting	3.7	270	★★½

Risk Assessment
Safety Emphasis Area 2

Urban Side Road
Stop Control Intersections
(Angle Crashes)

Tier 1 Location: 22 Intersections

Tier 2 Locations: 33 Intersections

Road Name	Lat/Long	Maintaining Agen	Traffic Contr	TOTAL STAR
Grand Ave, S 63rd Ave W	46.733143,-92.177404	City of Duluth	2-Way Stop	★★★★★½
Highway 53, E St	46.725675,-92.073523	City of Superior	2-Way Stop	★★★★★½
E 2nd St - Hwy 53/2, E 2nd St - Hwy 53/2, E 3rd St	46.67769,-92.01047	City of Superior	2-Way Stop	★★★★★½
Midway Rd, Old Miller Trunk Hwy	46.853476,-92.280423	Township of Canosia	2-Way Stop	★★★★★
Tower Ave, Tower Ave, N 16th St	46.719309,-92.103964	City of Superior	2-Way Stop	★★★★★
Mesaba Ave, Mesaba Ave	46.785267,-92.10836	City of Duluth	2-Way Stop	★★★★★
Railroad St, Railroad St, Harbor Dr	46.783758,-92.098405	City of Duluth	2-Way Stop	★★★★½
Rice Lake Rd, Rice Lake Rd, E Skyline Pkwy	46.796809,-92.107038	City of Duluth	1-Way Stop	★★★★½
Tower Ave, N 56th St, Tower Ave	46.672224,-92.104293	City of Superior	2-Way Stop	★★★★½
Tower Ave, Henry Cohen Dr	46.684543,-92.104201	City of Superior	2-Way Stop	★★★★½
Hammond Ave, N 5th St, Hammond Ave, N 5th St	46.732539,-92.097857	City of Superior	1-Way Stop	★★★★
E 2nd St - Hwy 53/2, E 2nd St - Hwy 53/2, 23rd Ave E	46.705584,-92.046012	City of Superior	2-Way Stop	★★★★
Hammond Ave, Broadway St, Hammond Ave	46.726591,-92.097838	City of Superior	2-Way Stop	★★★★
Tower Ave, Tower Ave, N 34th St, N 34th St	46.698911,-92.104079	City of Superior	2-Way Stop	★★★★
E 2nd St - Hwy 53/2, Marina Dr, E 2nd St - Hwy 53/2	46.718679,-92.063054	City of Superior	2-Way Stop	★★★★
E 4th St, N 4th Ave E	46.793465,-92.097548	City of Duluth	2-Way Stop	★★★★
E 2nd St - Hwy 53/2, 31st Ave E, E 2nd St - Hwy 53/2	46.697325,-92.035494	City of Superior	2-Way Stop	★★★★
Belknap St, E 5th St, E 5th St, Belknap St	46.72148,-92.073535	City of Superior	2-Way Stop	★★★★
E Superior St, N 14th Ave E, S 14th Ave E, E Superior St	46.800315,-92.08077	City of Duluth	2-Way Stop	★★★★
Tower Ave, N 40th St	46.6917,-92.104146	City of Superior	2-Way Stop	★★★★
Skyline Pkwy, Mesaba Ave, E 9th St, Mesaba Ave	46.793681,-92.10707	City of Duluth	2-Way Stop	★★★★
E Superior St, 47th Ave E, 47th Ave E	46.82925,-92.029228	City of Duluth	2-Way Stop	★★★★
Highway 53, Catlin Ave	46.733377,-92.087412	City of Superior	1-Way Stop	★★★½
Tower Ave, N 58th St, Tower Ave	46.669482,-92.104311	City of Superior	2-Way Stop	★★★½
Highway 53, Grand Ave, Grand Ave	46.733759,-92.093319	City of Superior	2-Way Stop	★★★½
W Michigan St, W Superior St, W Michigan St	46.773974,-92.113991	City of Duluth	1-Way Stop	★★★½
Broadway St, Broadway St, Tower Ave, Tower Ave	46.726615,-92.103889	City of Superior	2-Way Stop	★★★½
Woodland Ave, W Redwing St	46.850022,-92.081848	City of Duluth	2-Way Stop	★★★½
Banks Ave, N 28th St, N 28th St	46.706216,-92.105571	City of Superior	2-Way Stop	★★★½
Woodland Ave, Woodland Ave	46.810829,-92.078289	City of Duluth	2-Way Stop	★★★½
N 6th Ave E, E 7th St	46.797353,-92.098371	City of Duluth	2-Way Stop	★★★½
E 1st St, N 19th Ave E	46.805754,-92.075682	City of Duluth	2-Way Stop	★★★½
N 1st Ave E, E 1st St, E 1st St	46.788585,-92.098036	City of Duluth	2-Way Stop	★★★½
N 59th Ave W, N 59th Ave W, Cody St, Cody St	46.741309,-92.171944	City of Duluth	2-Way Stop	★★★½
N 59th Ave W, N 59th Ave W, W Eighth St	46.744014,-92.171927	City of Duluth	2-Way Stop	★★★½
London Rd, 45th Ave E	46.82422,-92.032798	City of Duluth	1-Way Stop	★★★½
E 4th St, N 12th Ave E	46.801087,-92.087656	City of Duluth	2-Way Stop	★★★
Highway 2, Highway 2, N 2nd Ave	46.741341,-92.222349	City of Proctor	2-Way Stop	★★★
W 4th St, N 3rd Ave W	46.786766,-92.10627	City of Duluth	2-Way Stop	★★★
E 4th St, N 3rd Ave E, E 4th St	46.792491,-92.098828	City of Duluth	2-Way Stop	★★★
Highway 53, N 5th St	46.73254,-92.085315	City of Superior	1-Way Stop	★★★
Broadway St, Broadway St, Ogden Ave, Ogden Ave	46.726606,-92.102351	City of Superior	2-Way Stop	★★★
N 24th Ave W, S 24th Ave W, W Superior St, W Superior St	46.764095,-92.128014	City of Duluth	2-Way Stop	★★★

Risk Assessment
Safety Emphasis Area 3

Signalized Intersections
Multi-Lane Arterials

Tier 1 Location: 39 Intersections

Tier 2 Locations: 18 Intersections

Signalized Intersection Name	Maintaining Agency	Intersection Location (Lat/Long	Total Stars
MNTH 23 (Grand Ave) & MSAS 108, MUN 153 (Raleigh St)	City of Duluth	46.731269,-92.180057	★★★★★★★★★
MNTH 23 (Grand Ave) & River West Dr/Warkwick St	City of Duluth	46.714344,-92.203656	★★★★★★★½
MNTH 23 (Grand Ave) & MUN 172 (72nd Ave W)	City of Duluth	46.725327,-92.188433	★★★★★★★½
USTH 53 (Trinity Rd) & MSAS 198 (Anderson Rd)	City of Duluth	46.793185,-92.156289	★★★★★★★½
CSAH 9 (4th St) at 6th Ave E	St. Louis County/Duluth	46.795357,-92.09511	★★★★★★★
First Street and 46th Ave W	City of Duluth	46.744615,-92.1568984	★★★★★★★
18th Ave E & E 5th St	Superior	46.708897,-92.055627	★★★★★★★
MNTH 23 (Grand Ave) & MSAS 101 (88th Ave W)	MnDOT/Duluth	46.697136,-92.218051	★★★★★★★
USTH 53 (Miller Trunk Hwy) & CSAH 13 (Midway Rd)	MnDOT/County	46.852995,-92.280403	★★★★★★★
USH 2/USH 53 (E 2nd) & 22nd Ave E	Superior	46.706586,-92.047341	★★★★★★★
Arrowhead Road and Arlington Ave	City of Duluth	46.8222412,-92.1323428	★★★★★★★
USTH 53 (Trinity Rd) & CSAH 90 (Arlington Ave)	City of Duluth	46.78255,-92.138753	★★★★★★★
USTH 53 (Miller Trunk Hwy) & CSAH 91 (Haines Rd)	MnDOT/County	46.814785,-92.174789	★★★★★★★
USTH 53 (Miller Trunk Hwy) & MSAS 104, CSAH 32 (W Arrowhead Rd)	MnDOT/Hermantown	46.822112,-92.18676	★★★★★★★
Superior Street and 27th Ave W	City of Duluth	46.7613776,-92.1317979	★★★★★★½
I-35 & MSAS 191 (26th Ave E) & TH 61, MSAS 193 (London Rd)	City of Duluth	46.808919,-92.061389	★★★★★★½
College Street and Kenwood Ave	City of Duluth	46.8167053,-92.1003188	★★★★★★½
USH 53 (2nd St) & USH 2 (Belknap St)	WisDOT	46.722281,-92.068439	★★★★★★½
STH 35 (Tower Ave) & N 28th St	Superior	46.706188,-92.104047	★★★★★★½
STH 35 (Tower Ave) & N 21st St	Superior	46.713416,-92.103969	★★★★★★½
TH 194 (Central Ent) & MSAS 198, M 535 (Anderson Rd)	City of Duluth	46.800664,-92.143421	★★★★★★½
Summit Street and Woodland Ave	City of Duluth	46.817781,-92.077889	★★★★★★
Clover Street and Woodland Ave	City of Duluth	46.8157372,-92.0780403	★★★★★★
USTH 53 (Miller Trunk Hwy) & CSAH 48 (Lavaque Bypass Rd), MSAS 101 (	MnDOT/County	46.83658,-92.238403	★★★★★★
STH 35 (Tower Ave) & N 31st St	Superior	46.70253,-92.104136	★★★★★★
STH 35 (Tower Ave) & N 37th St	Superior	46.695397,-92.104127	★★★★★★
TH 194 (Mesaba Ave) & MSAS 127 (W 7th St)	MnDOT/Duluth	46.790914,-92.106795	★★★★★★
TH 194 (Mesaba Ave) & MSAS 126 (W 3rd St)	City of Duluth	46.783745,-92.108303	★★★★★★
USTH 53 (Miller Trunk Hwy) & CSAH 17, MSAS 103 (Stebner Rd)	MnDOT/Hermantown	46.827651,-92.195789	★★★★★★
TH 194 & CSAH 4 (Mesaba Ave) & MSAS 192 (Central Ent)	MnDOT/Duluth	46.795888,-92.107092	★★★★★★
TH 194 (Central Ent) & CSAH 90 (Arlington Ave)	City of Duluth	46.800452,-92.13214	★★★★★★
TH 194 (Central Ent) & MSAS 205, M 494 (Basswood Ave)	City of Duluth	46.80047,-92.135306	★★★★★★
Michigan Street and 27th Ave W	City of Duluth	46.760847,-92.131133	★★★★★½
USTH 53 & CSAH 54 (Piedmont Ave)	City of Duluth	46.775111,-92.143167	★★★★★½
Grand Ave and 46th Ave W	City of Duluth	46.7460826,-92.1592956	★★★★★½
CSAH 9 (Woodland Ave) at W Arrowhead Rd	St. Louis County/Duluth	46.825768,-92.071347	★★★★★½
TH 194 (Central Ent) & MSAS 182 (Pecan Ave)	City of Duluth	46.799477,-92.116405	★★★★★½
USH 2/USH 53 (E 2nd) & 39th Ave E	Superior	46.689033,-92.025013	★★★★★½
Arrowhead Road and Rice Lake Road (CSAH 4)	City of Duluth	46.822098,-92.12661	★★★★★½
TH 53 and Lavaque	MnDOT/Hermantown	46.836657,-92.217085	★★★★★
Arrowhead Road and Menard Drive	City of Duluth	46.8222438,-92.1843165	★★★★★
St. Marie Street and Woodland Ave	City of Duluth	46.8222306,-92.0741843	★★★★★
Ninth Street and 6th Ave E	City of Duluth	46.7987104,-92.1003168	★★★★★

Risk Assessment
Safety Emphasis Area 4

Urban Intersections (Bikes & Peds)

Tier 1 Location: 61 Intersections

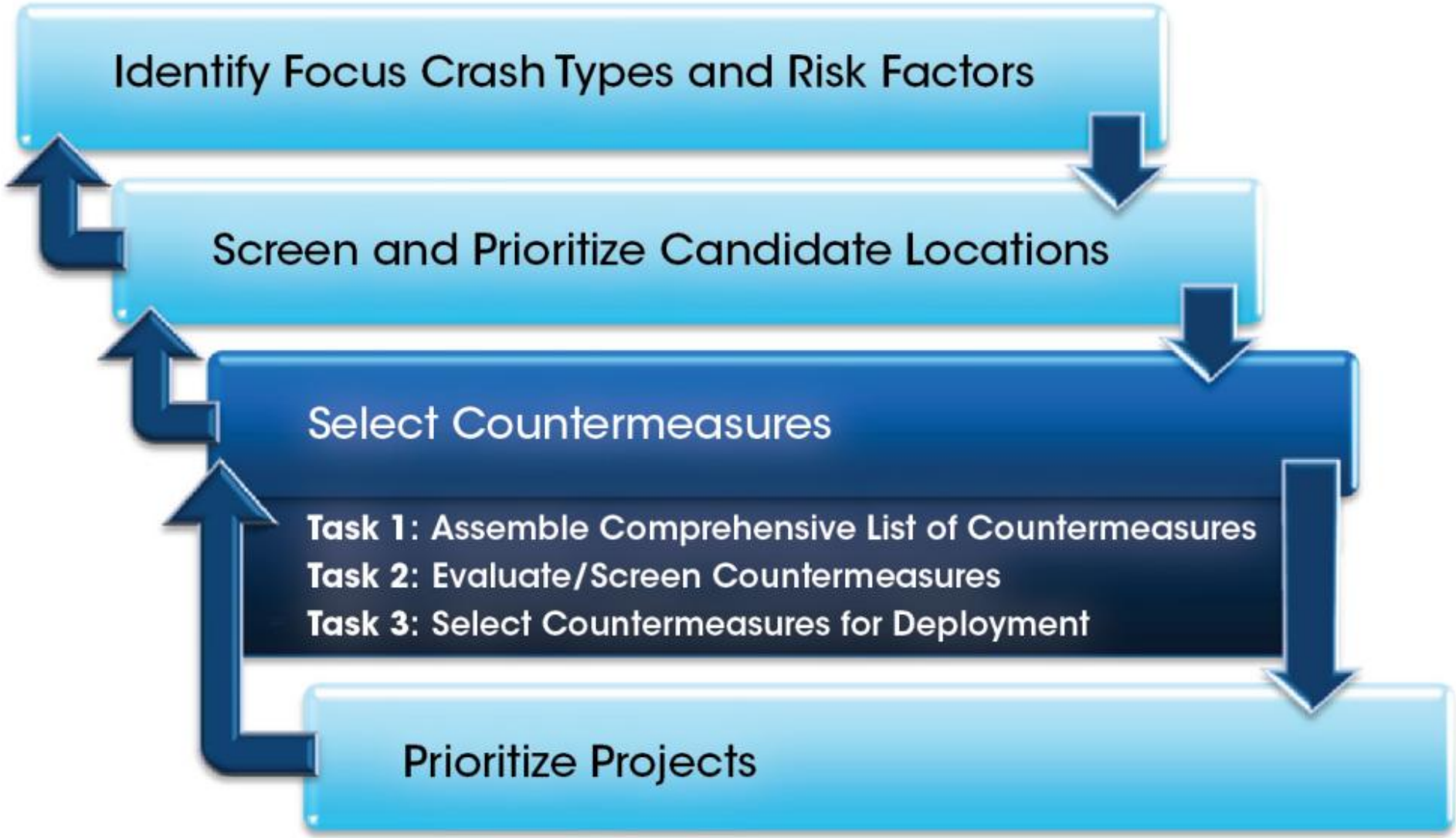
Tier 2 Locations: 32 Intersections

Road Name	Lat/Long	Maintaining Agency	TOTAL STARS
Tower Ave, N 31st St	46.702589,-92.10406	City of Superior	★★★★★★★★★
Tower Ave, N 28th Ave, N 28th St, Tower Ave	46.706202,-92.104034	City of Superior	★★★★★★★★★
S Lake Ave, W Superior St, N Lake Ave, E Superior St	46.786944,-92.098145	City of Duluth	★★★★★★★★½
Tower Ave, Tower Ave, N 37th St, N 37th St	46.695387,-92.10411	City of Superior	★★★★★★★★½
Belknap St, Hammond Ave	46.720626,-92.097883	City of Superior	★★★★★★★★½
Tower Ave, N 21st St, N 21st St, Tower Ave	46.71342,-92.104006	City of Superior	★★★★★★★★½
Tower Ave, Tower Ave, N 16th St	46.719309,-92.103964	City of Superior	★★★★★★★★½
E 2nd St, N 3rd Ave E	46.791129,-92.096598	City of Duluth	★★★★★★★★
Grand Ave, Grand Ave, N 40th Ave W, N 40th Ave W	46.751662,-92.15132	City of Duluth	★★★★★★★★
E 2nd St - Hwy 53/2, 39th Ave E	46.68907,-92.024958	City of Superior	★★★★★★★★
E 4th St, N 5th Ave E	46.794438,-92.09629	City of Duluth	★★★★★★★★
Tower Ave, N 20th St	46.714713,-92.103983	City of Superior	★★★★★★★★
Tower Ave, N 18th St	46.717022,-92.10396	City of Superior	★★★★★★★★
E 2nd St, N 1st Ave E, N 1st Ave E	46.789237,-92.099117	City of Duluth	★★★★★★★½
N 2nd Ave W, W 2nd St	46.786435,-92.102837	City of Duluth	★★★★★★★½
N Lake Ave, E 2nd St, W 2nd St, N Lake Ave	46.788296,-92.100372	City of Duluth	★★★★★★★½
E 9th St, N Central Entrance, N 6th Ave E	46.798692,-92.100577	City of Duluth	★★★★★★★½
N Lake Ave, W 1st St, E 1st St	46.787635,-92.099302	City of Duluth	★★★★★★★½
Belknap St, Lamborn Ave, Grand Ave, Belknap St	46.72062,-92.09344	City of Superior	★★★★★★★½
Ogden Ave, Belknap St, Belknap St, Ogden Ave	46.720645,-92.102379	City of Superior	★★★★★★★½
W Central Entrance, Basswood Ave	46.800474,-92.135306	City of Duluth	★★★★★★★½
E Central Entrance, S Arlington Ave	46.800418,-92.132132	City of Duluth	★★★★★★★½
Woodland Ave, Summit St	46.817772,-92.077898	City of Duluth	★★★★★★★½
N 1st Ave E, S 1st Ave E, E Superior St, E Superior St	46.787872,-92.09695	City of Duluth	★★★★★★★½
N 24th Ave W, N 24th Ave W, W 3rd St, W 3rd St	46.766138,-92.131292	City of Duluth	★★★★★★★½
S 5th Ave W, N 5th Ave W, W Superior St, W Superior St	46.782185,-92.104402	City of Duluth	★★★★★★★½
E Superior St, N 4th Ave E	46.790771,-92.093213	City of Duluth	★★★★★★★½
E 2nd St - Hwy 53/2, E 2nd St - Hwy 53/2, E 3rd St	46.67769,-92.01047	City of Superior	★★★★★★★½
Tower Ave, N 17th St	46.718164,-92.103965	City of Superior	★★★★★★★½
Tower Ave, N 19th St	46.715859,-92.103961	City of Superior	★★★★★★★½
Highway 53, Grand Ave, Grand Ave	46.733759,-92.093319	City of Superior	★★★★★★★½
W 2nd St, N 3rd Ave W	46.785453,-92.104074	City of Duluth	★★★★★★★
W 2nd St, N 4th Ave W, N 4th Ave W	46.784465,-92.105373	City of Duluth	★★★★★★★
N 1st Ave W, W 2nd St, N 1st Ave W	46.787326,-92.101633	City of Duluth	★★★★★★★
N 6th Ave E, E 4th St, N 6th Ave E	46.795355,-92.095123	City of Duluth	★★★★★★★
N 6th Ave E, E 3rd St, N 6th Ave E, N 6th Ave E, E 3rd St	46.79468,-92.094027	City of Duluth	★★★★★★★
E Central Entrance, Pecan Ave	46.799475,-92.116465	City of Duluth	★★★★★★★
W Central Entrance, Mall Dr	46.802217,-92.148685	City of Duluth	★★★★★★★
W Central Entrance, Anderson Rd/ W Myrtle St	46.800619,-92.143463	City of Duluth	★★★★★★★
E Central Entrance, Blackman Ave	46.800081,-92.121644	City of Duluth	★★★★★★★
Miller Trunk Hwy, W Central Entrance, US 53 (Trinity Rd), Joshua Ave	46.804276,-92.153697	City of Duluth	★★★★★★★
US 53, Cottonwood Ave/Loberg Ave	46.805561,-92.156889	City of Duluth	★★★★★★★

Validating At-Risk Locations

	SEA 1 Rural Two-Lane Roads, AADT <5,000	SEA 2 Urban Stop Control Intersections	SEA 3 Signalized Intersections along Multi-Lane Arterials	SEA 4 Urban Intersections (Bike/Ped)
% Locations in Tier 1	7%	12%	42%	9%
% KAB Crashes in Tier 1	15%	35%	65%	38%
% Locations in Tier 1 + Tier 2	14%	33%	62%	13%
% KAB Crashes in Tier 1 + Tier 2	27%	77%	90%	48%

Systemic Safety Plan Process



Safety Countermeasures

Sources of Safety Information

- FHWA Proven Safety Countermeasures
- WisDOT Approved Crash Modification Factors
- MnDOT District Safety Plan Updates
  “The Big Book of Ideas”
- Crash Modification Clearinghouse

Safety Countermeasures – Safety Emphasis Area 1 - Segments

Rural Two-Lane Undivided Roads, AADT <5,000 (Lane Departure Crashes)

Safety Countermeasure	In Response to Which Risk Factor?	MN* Safety Benefit (% Crash Reduction)	WI Safety Benefit (% Crash Reduction)	Source of WI Safety Data	Include in Study?
Install Shoulder Rumble Strips	N/A	35%: KA Lane Departure Crashes	8%: Injury Crashes 16%: Lane Departure Crashes	WisDOT Approved CMF CMF ID 3430 & 3442	Yes
Install Centerline Rumble Strips	N/A	36%	No WI Data CMF Clearinghouse: 4% to 11%		Yes
Provide Paved Shoulder	Edge Risk Assessment, Lane Width	17% to 31%	No WI Data CMF Clearinghouse: 12% (Run off Road)		Yes
Widen Paved Shoulder	Edge Risk Assessment, Lane Width	N/A	14%	WisDOT Approved CMF CMF ID 4078	Yes
Install Safety Edge (45 mph or Greater)	Edge Risk Assessment	24%	13%	WisDOT Approved CMF CMF ID 8658	Yes
Side Slope Improvements	Edge Risk Assessment	14% : KAB Rollover Crashes	N/A	N/A	Yes
Increase Edgeline from 4" to 6"	N/A	18%	No WI Data CMF Clearinghouse: 18% (All), 27% (Single Vehicle)		Yes
Install Barrier for Non-Recoverable Slopes	Edge Risk Assessment	35%: Injury Crashes	No WI Data CMF Clearinghouse: 9%		Yes
Clear Zone Maintenance (Clearing of Vegetation and Appropriate R/W Width)	Edge Risk Assessment	22% to 44%	N/A	N/A	Yes
Remove or Relocate Fixed Object	Edge Risk Assessment	No State Data CMF Clearinghouse: 38%		CMF ID 1024	Yes
Install Wet Reflective Pavement Markings	Edge Risk Assessment	N/A	40%: All Crashes 25%: Wet Crashes 30%: Nighttime Crashes (CMFs for multilane divided highways)	WisDOT Approved CMF CMF ID 8110, 8113, 8115	Yes
Increase Lane Width from 11-ft to 12-ft	Lane Width	No State Data CMF Clearinghouse: 5%		CMF ID 3	No

Safety Countermeasures – Safety Emphasis Area 1 - Curves

Rural Two-Lane Undivided Roads, AADT <5,000 (Lane Departure Crashes)

Safety Countermeasure	In Response to Which Risk Factor?	MN* Safety Benefit (% Crash Reduction)	WI Safety Benefit (% Crash Reduction)	Source of WI or Other Safety Data	Include in Study?
High Friction Surface Treatment	Curve Radius	62%	Up to 67%	WisDOT Approved CMFs CMF ID 10353, 10355, 10332	Yes
Install Chevron Signs	Horizontal Curve Speed Differential	25%: Injury Nighttime Crashes	16% : Injury Crashes	WisDOT Approved CMF CMF ID 2438	Yes
Upgrade or install Fluorescent Curve Signs	Horizontal Curve Speed Differential	N/A	25%	WisDOT Approved CMF CMF ID 2433	Yes
Clear Zone Maintenance (Clearing of Vegetation and Appropriate R/W Width)	N/A	22% to 44%	N/A	N/A	Yes
Reconstruct Triangle Intersections on Curve to T-Intersection	Presence of Intersection or Visual Trap on Curve	No Safety Benefit Included, but part of list	N/A	N/A	Yes
Increase Edgeline from 4" to 6"	N/A	No Safety Benefit Included, but part of list	No WI Data CMF Clearinghouse: 18% (All), 27% (Single Vehicle)		Yes
In-Lane Curve Warning Pavement Markings	Horizontal Curve Speed Differential	N/A	N/A	FHWA Proven Safety Countermeasure	Yes
Install Barrier at Non-Recoverable Slopes	N/A	51%: KABC Lane Departure Crashes	No WI Data CMF Clearinghouse: 9%		Yes
Slope Flattening	N/A	No State Data FHWA says 22% when flattening from 1:4 to 1:6 or 8% from 1:3 to 1:4		FHWA Proven Safety Countermeasure	Yes
Add or Widen Paved Shoulders	Shoulder/Surface Type	N/A	N/A	FHWA Proven Safety Countermeasure	Yes
Update Curve Advisory Speeds	Curve Speed Differential	No State Data CMF Clearinghouse: 40%; for Installing Chevron Signs and Curve Warning Signs (No CMF for Curve Advisory Signs)			Yes
Install Wet Reflective Pavement Markings	Edge Risk Assessment	N/A	40%: All Crashes 25%: Wet Crashes 30%: Nighttime Crashes (CMFs for multilane divided highways)	WisDOT Approved CMF CMF ID 8110, 8113, 8115	Yes
Install Advance Intersection Flashing Beacons at TWSC Intersection	Curve prior to Intersection	N/A	5%: All 13%: Angle Crashes 8%: Rear End Crashes	WisDOT Approved CMF CMF ID 446/448/449	Yes

com

Safety Countermeasures – Safety Emphasis Area 2

Urban Side Road Stop Control Intersections (Angle Crashes)

Safety Countermeasure	In Response to Which Risk Factor?	MN* Safety Benefit (% Crash Reduction)	WI Safety Benefit (% Crash Reduction)	Source of WI or Other Safety Data	Include in Study?
Convert TWSC to AWSC	Occurrence of KAB Angle Crashes, Context Zone	N/A	70%: All 75%: Angle Crashes 18%: Rear End 53%: Pedestrian	WisDOT Approved CMF CMF ID 3127/310/311/313	Yes
Convert TWSC Intersection to Single Lane Roundabout	Occurrence of KAB Angle Crashes, Mainline AADT	51%	58%: Injury Crashes +50% PDO Crashes	Wisconsin Study	Yes
Convert TWSC Intersection to Mini-Roundabout or Compact Roundabout	Occurrence of KAB Angle Crashes, Mainline AADT	61%: Injury Crashes (Mini-Roundabout)	N/A	CMF ID 11240, 11241 20%: All Crashes 61%: Injury Crashes	Yes
Install Advance Intersection Flashing Beacons at TWSC Intersection	N/A	N/A	5%: All 13%: Angle Crashes 8%: Rear End Crashes	WisDOT Approved CMF CMF ID 446/448/449	Yes
Convert Full Access Intersection to Minor RIRO Access	N/A	N/A	15%: All 40%: Injury Crashes 90%: Angle (All) 90%: Left Turn (All)	WisDOT Approved CMF Specific WI Study	Yes
Increase Triangle Sight Distance	N/A	N/A	56%: Injury Crashes	WisDOT Approved CMF CMF ID 1637/1638	Yes
Install or Upgrade Lighting	All	42%: Nighttime Crashes	N/A	FHWA Proven Countermeasure CMF ID 4462 shows 12%	Yes
Install Median with Marked Crosswalk (Mainline)	Mainline Cross Section, Context Zone	9%: Injury Crashes 86%: Fatal Bike & Ped Crashes	46%: Pedestrian Crashes	WisDOT Approved CMF CMF ID 175	Yes
Install Pedestrian Curb Extension (In Areas with Parking)	Context Zone	30%: All Crashes	37%: Pedestrian Crashes	WisDOT Approved CMF CMF ID 1786	Yes
Raised Crosswalk / Raised Intersection	Context Zone	45%	N/A	CMF ID 135 shows 36%	Yes
Install Retroreflective Strips on Stop Sign Posts	N/A	No Safety Benefit Included, but part of list	N/A	FHWA Proven Countermeasure	Yes
Reduce Lane Width	Speed Limit on Major/Minor Road	Up to 43%: Injury Crashes	N/A	N/A	Yes
Install Stop Bars on Side Road	N/A	N/A	N/A	FHWA Safety Countermeasure for HRRR for Unsignalized Intersections	Yes

Safety Countermeasures – Safety Emphasis Area 2

Urban Side Road Stop Control Intersections (Angle Crashes)

Safety Countermeasure	In Response to Which Risk Factor?	MN* Safety Benefit (% Crash Reduction)	WI Safety Benefit (% Crash Reduction)	Source of WI or Other Safety Data	Include in Study?
Install Left Turn Lane - Mainline (One Approach)	N/A	N/A	Urban: 10% Rural: 18%	WisDOT Approved CMF Urban CMF ID 262 Rural CMF ID 4647	Yes
Install Left Turn Lane - Mainline (One Approach @ T-Intersection	N/A	N/A	Urban: 7% Rural: 15%	WisDOT Approved CMF Urban CMF ID 4644 Rural CMF ID 4643	Yes
Install Left Turn Lane - Mainline (Both Approaches)	N/A	N/A	Urban: 19% Rural: 33%	WisDOT Approved CMF Urban CMF ID 270 Rural CMF ID 4648	Yes
Install Right Turn Lane- Mainline (One Approach)	N/A	44%	14%	WisDOT Approved CMF CMF ID 285	Yes
Install Right Turn Lane- Mainline (Both approaches)	N/A	44%	26%	WisDOT Approved CMF CMF ID 289	Yes
Road Diet (Lane Reconfiguration)	AADT, Speed	40%: Ped Crashes 47% Vehicle Crashes	N/A	FHWA Proven Safety Countermeasure: 19-47%	Yes
Continuous Green T-Intersection (Non-Signalized)	Occurrence of KAB Angle Crashes, Mainline AADT	12% (Signalized Option)	N/A	No safety information available on this non-signalized concept	Yes
Convert TWSC to Traffic Signal - 3 leg Intersection	Occurrence of KAB Angle Crashes, Mainline AADT	N/A	14%: Injury Crashes 34%: Angle Crashes (Injury) +50%: Rear End Crashes (Injury)	WisDOT Approved CMF CMF ID 316/317/318	No
Convert TWSC to Traffic Signal - 4 leg Intersection	Occurrence of KAB Angle Crashes, Mainline AADT	N/A	23% 67%: Angle Crashes (Injury) +39%: Rear End Crashes (Injury)	WisDOT Approved CMF CMF ID 319/320/321	No

Safety Countermeasures – Safety Emphasis Area 3

Signalized Intersection, Multi-Lane Arterials

Safety Countermeasure	In Response to Which Risk Factor?	MN* Safety Benefit (% Crash Reduction)	WI Safety Benefit (% Crash Reduction)	Source of WI Safety Data	Include in Study?
Install Median at Intersection	Presence of Median	9%: All Crashes 89%: Fatal Bike/Ped Crashes	46%: Pedestrian Crashes	WisDOT Approved CMF CMF ID 175	Yes
Realign Intersection	Intersection Skew	N/A	Dependent on Facility Type and Existing/Proposed Skew	WisDOT Approved CMF CMF ID 5188/5190/5189/5191	Yes
Convert Signal to AWSC	N/A	N/A	N/A	No CMF data to support this safety countermeasure	Yes
Install Left Turn Lane (One Approach)	Presence of Left Turn Lane	N/A	Urban: 10% Rural: 18%	WisDOT Approved CMF Urban CMF ID 262 Rural CMF ID 4647	Yes
Install Left Turn Lane (One Approach @ T-Intersection	Presence of Left Turn Lane	N/A	Urban: 7% Rural: 15%	WisDOT Approved CMF Urban CMF ID 4644 Rural CMF ID 4643	Yes
Install Left Turn Lane (Both Approaches)	Presence of Left Turn Lane	N/A	Urban: 19% Rural: 33%	WisDOT Approved CMF Urban CMF ID 270 Rural CMF ID 4648	Yes
Install Flashing Yellow Arrow Signal Heads (Maintain Prot/Perm Phasing)	Left Turn Signal Phasing	37%: Left Turn	8%: (All Crashe 20%: Left Turn	WisDOT Approved CMF All Crashes CMF ID 4176 Lef Turn Crashes CMF ID 4177	Yes
Install Flashing Yellow Arrow Signal Heads (Maintain Perm Phasing)	Left Turn Signal Phasing	N/A	37%	WisDOT Approved CMF CMF ID 4175	Yes
Change From Permitted to Protected/Permitted Left Turn Phasing	Left Turn Signal Phasing	N/A	14%: (Left Turn	WisDOT Approved CMF CMF ID 4270	Yes
Change From Permitted or Protected/Permitted to Protected Only Left Turn Phasing	Left Turn Signal Phasing	N/A	99%: Left Turn	WisDOT Approved CMF CMF ID 333	Yes
Improve Signal Head Visibility and Install Retroreflective Backplates	Signal Heads per Number of Thru Lanes	N/A	7%: All Crashes 23%: Angle	WisDOT Approved CMF All Crashes: CMF ID 1430 Angle Crashes: WI Data	Yes
Install Retroreflective Signal Head Backplates	Signal Heads per Number of Thru Lanes	15% 2024 Study Says No Safety Benefit	15%	WisDOT Approved CMF CMF ID 1410	Yes

Safety Countermeasures – Safety Emphasis Area 3

Signalized Intersection, Multi-Lane Arterials

Safety Countermeasure	In Response to Which Risk Factor?	MN* Safety Benefit (% Crash Reduction)	WI Safety Benefit (% Crash Reduction)	Source of WI Safety Data	Include in Study?
Close Driveway Near Intersection	Access Within Influence Area	N/A	N/A	N/A	Yes
Modify Access Near Intersection to RIRO	Access Within Influence Area	N/A	51% : Angle, Left Turn, Rear End Crashes	WisDOT Approved CMF CMF ID 8220	Yes
Improve Left Turn Lane Offset, Negative to Zero	Left Turn Lane Alignment	N/A	26%: Left Turn Crashes	WisDOT Approved CMF CMF ID 276	Yes
Provide Positive Offset to Left Turn Lanes	Left Turn Lane Alignment	N/A	34%	WisDOT Approved CMF CMF ID 6095	Yes
Corridor Signal timing to Reduce High-Speed Flow	Coordinated vs. Isolated & Speed	11%	N/A	N/A	Yes
Install Pedestrian Countdown Timer	N/A	9%: Ped Crashes	8%	WisDOT Approved CMF CMF ID 10115	Yes
Reduce Lane Width	Speed Limit on Major/Minor Road	Up to 43%: Injury Crashes	N/A	N/A	Yes
Leading Pedestrian Interval	N/A	59% : Bike & Ped Crashes	13%	WisDOT Approved CMF CMF ID 9916	Yes
Install or Upgrade Lighting	N/A	42% : Nighttime Crashes	N/A	FHWA Proven Countermeasure CMF ID 4462 shows 12%	Yes
High-Visibility Crosswalks	N/A	37% : Bike & Ped Crashes	40%: Ped Crashes	WisDOT Approve CMF CMF ID 4123	Yes
Road Diet (Lane Reconfiguration)	AADT, Left Turn Lanes, Speed	47% : All Crashes	N/A	FHWA Proven Safety Countermeasure: 19-47%	Yes
Improve Channelized Right Turn Angle	N/A	44%	60% Rear End and Sideswipe Crashes	WisDOT Approved CMF CMF ID 8431	Yes

Safety Countermeasures – Safety Emphasis Area 3

Signalized Intersection, Multi-Lane Arterials

Safety Countermeasure	In Response to Which Risk Factor?	MN* Safety Benefit (% Crash Reduction)	WI Safety Benefit (% Crash Reduction)	Source of WI Safety Data	Include in Study?
Convert Signal to Signalized RCUT/J-Turn Intersection	AADT, Intersection Skew, Presence of Median	22%	46%: Not exact match TWSC to J-turn	WisDOT Approved CMF CMF ID 4883	Yes
Convert Signal to Continuous Green T-Intersection	AADT	15%	N/A	CMF ID 8655 & 8656 shows 4% (All Crashes) and 16% (Injury Crashes)	Yes
Remove signal and convert Intersection to RIRO Intersection	AADT, Intersection Skew, Presence of Median	N/A	15%: All 40%: Injury Crashes 90%: Angle (All) 90%: Left Turn (All)	WisDOT Approved CMF Specific WI Study	Yes
Verify/Update Clearance Intervals	Speed Limit on Major/Minor Road	Up to 36% : Rear End Crashes	N/A	N/A	Yes
Add "Prepare to Stop When Flashing" Beacons for Mainline Approaches (>40 mph)	Speed Limit on Major/Minor Road	N/A	N/A	N/A	Yes
Convert Signal to Roundabout	N/A	51%	14%: Fatal & Injury Crashes +32% PDO Crashes	Wisconsin Study	Yes
Enforcement Confirmation Lights	N/A	71%: Disobeyed Signal Crashes	N/A	CMF ID 421 & 422 installation of red light cameras: 16% angle/left turn injury; +15%-24% for Rear End	Yes

Safety Countermeasures - Safety Emphasis Area 4

Urban Intersections (Bike & Ped Crashes)

Safety Countermeasure	In Response to Which Risk Factor?	MN* Safety Benefit (% Crash Reduction)	WI Safety Benefit (% Crash Reduction)	Source of WI or Other Safety Data	Include in Study?
Convert TWSC to Traffic Signal - 3 leg Intersection	Mainline AADT, Type of Traffic Control	N/A	14%: Injury Crashes 34%: Angle Crashes (Injury) +50%: Rear End Crashes (Injury)	WisDOT Approved CMF CMF ID 316/317/318	Yes
Convert TWSC to Traffic Signal - 4 leg Intersection	Mainline AADT, Type of Traffic Control	N/A	23% 67%: Angle Crashes (Injury) +39%: Rear End Crashes (Injury)	WisDOT Approved CMF CMF ID 319/320/321	Yes
Convert TWSC to AWSC	Mainline AADT, Type of Traffic Control	N/A	70%: All 75%: Angle Crashes 18%: Rear End 53%: Pedestrian	WisDOT Approved CMF CMF ID 3127/310/311/313	Yes
Convert AWSC Intersection to Roundabout	Mainline AADT, Type of Traffic Control	N/A	17%: Injury Crashes +47%: PDO Crashes	WisDOT Approved CMF Specific WI Study	Yes
Convert Signal to Roundabout	Mainline AADT, Type of Traffic Control	N/A	14%: Injury Crashes +32%: PDO Crashes	WisDOT Approved CMF Specific WI Study	Yes
Convert TWSC Intersection to Roundabout	Mainline AADT, Type of Traffic Control	51%: Injury Crashes	50% to 59%: Injury Crashes +16 to +50%: PDO Crashes	WisDOT Approved CMF Specific WI Study	Yes
Convert TWSC Intersection to Mini/Compact Roundabout	Mainline AADT, Type of Traffic Control	61%: Injury Crashes (Mini-Roundabout)	N/A	CMF ID 11240, 11241 20%: All Crashes 61%: Injury Crashes	Yes
Convert Full Access Intersection to Minor RIRO Access	Mainline AADT, Type of Traffic Control	N/A	15%: All 40%: Injury Crashes 90%: Angle (All) 90%: Left Turn (All)	WisDOT Approved CMF Specific WI Study	Yes
Convert Signal to AWSC	N/A	N/A	N/A	No CMF data to support this safety countermeasure	Yes
High-Visibility Crosswalks	Exposure Length, Speed Limit on Major Road	37%: Bike & Ped Crashes	40%: Pedestrian Crashes	WisDOT Approved CMF CMF ID 4123	Yes
Install Median (Refuge) with Marked Crosswalk (Mainline)	Exposure Length	9%: Injury Crashes 86%: Fatal Bike & Ped Crashes	46%: Pedestrian Crashes	WisDOT Approved CMF CMF ID 175	Yes
Install Pedestrian Curb Extension (In Areas with Parking)	Presence of Mainline Parking	30%: All Crashes	37%: Pedestrian Crashes	WisDOT Approved CMF CMF ID 1786	Yes

Safety Countermeasures - Safety Emphasis Area 4

Urban Intersections (Bike & Ped Crashes)

Safety Countermeasure	In Response to Which Risk Factor?	MN* Safety Benefit (% Crash Reduction)	WI Safety Benefit (% Crash Reduction)	Source of WI or Other Safety Data	Include in Study?
Rectangular Rapid Flashing Beacon (Unsignalized Intersections)	Traffic Control, Pedestrian Generators	69%: Pedestrian Crashes	48%: Pedestrian Crashes	WisDOT Approved CMF CMF ID 9024	Yes
Raised Crosswalk / Raised Intersection	Traffic Control, Occurrence of Crashes	45%	N/A	CMF ID 135 shows 36%	Yes
Enhanced Transit Stops (seating, shelter, dedicated bus lanes/pullouts)	Presence of Pedestrian Generators (MTU Stops)	45%	N/A	N/A	Yes
Leading Pedestrian Interval (Signalized Intersections)	Traffic Control, Presence of Pedestrian Generators	59% : Bike & Ped Crashes	13%: Ped Crashe	WisDOT Approved CMF CMF ID 9916	Yes
Install Pedestrian Countdown Timer (Signalized Intersections)	Traffic Control	9%: Ped Crashes	8%	WisDOT Approved CMF CMF ID 10115	Yes
Pedestrian Hybrid Beacon (Unsignalized Intersections)	Traffic Control, Presence of Pedestrian Generators	43%: Ped Crashes	55%: Ped Crashes	WisDOT Approved CMF CMF ID 10115	Yes
Install Sidewalk where No Sidewalk Exists	Presence of Sidewalk	N/A FHWA Proven Safety Countermeasure w/ 65-89% reduction in crashes involving a pedestrian walking along roadways	88%: Pedestrian	US DOT Study Only targets pedestrian crashes where the pedestrian is walking along roadways or a pedestrian crossing within 250-ft of an intersection where the intersection did not have sidewalks.	Yes
Green color pavement (Bike Facilities)	Presence of Bicycle Facilities	No Safety Benefit Included, but part of list	NACTO Safety Efficacy Guide (2018): 10% increase in vehicles which yield to pedestrians. Rate of conflicts decreased from 0.95 to 0.59 conflicts per 100 bicyclists after colored pavement was added to conflict zones.		Yes
Bike Lanes Marked through Intersection	Presence of Bicycle Facilities	No Safety Benefit Included, but part of list	N/A	FHWA Proven Safety Countermeasure w/ 49% Reduction in Bike Crashes	Yes
Provide Flexible Delineator Posts Adjacent to Bike Lane (Existing Bike Lanes)	Presence of Bicycle Facilities	N/A	N/A	FHWA Proven Safety Countermeasure w/ 53% Reduction in Bike Crashes	Yes
Bike Box (Two-Stage Turn Queue Box)	Presence of Bicycle Facilities	No Safety Benefit Included, but part of list	N/A	N/A	Yes
Left Turn Calming where No Median Present (See Image on Following Page)	Occurrence of Crashes, Presence of Pedestrian Generators, Exposure Length	No Safety Benefit Included, but part of list	City of Chicago Left Turn Traffic Calming Study indicates 24% Crash Reduction and a 20% increase in left turn vehicles yielding to peds in crosswalks.		Yes

Safety Countermeasures - Safety Emphasis Area 4

Urban Intersections (Bike & Ped Crashes)

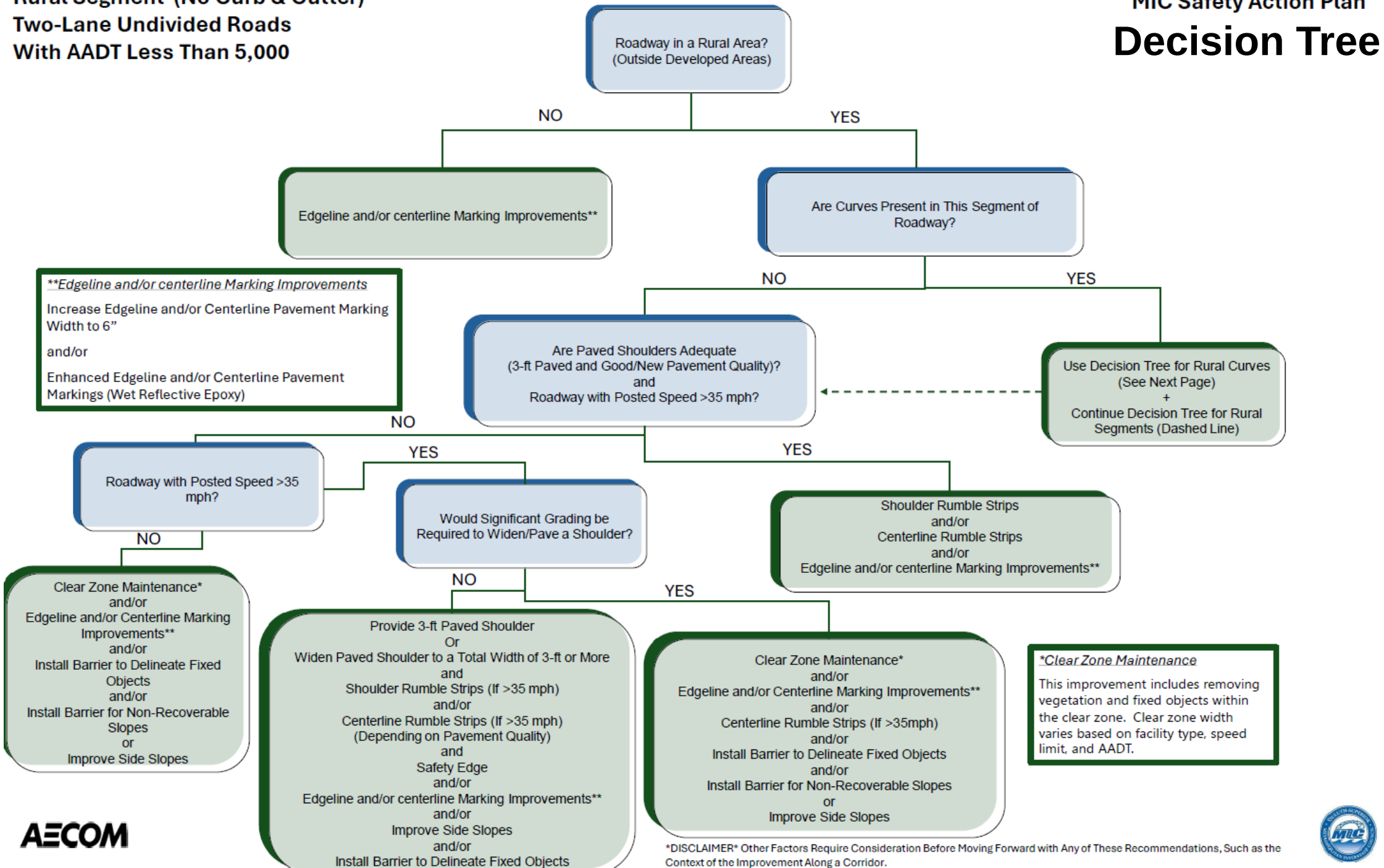
Safety Countermeasure	In Response to Which Risk Factor?	MN* Safety Benefit (% Crash Reduction)	WI Safety Benefit (% Crash Reduction)	Source of WI or Other Safety Data	Include in Study?
Install or Upgrade Lighting	Presence of Lighting	42%: Nighttime Crashes	N/A	FHWA Proven Countermeasure CMF ID 4462 shows 12%	Yes
Road Diet (Lane Reconfiguration)	AADT, Speed, Bike Accommodations	40%: Ped Crashes 47% Vehicle Crashes	N/A	FHWA Proven Safety Countermeasure: 19-47%	Yes
Verify/Update Pedestrian Clearance Intervals	Presence of Sidewalk, Type of Traffic Control	N/A	N/A	No CMF data to support this safety countermeasure	Yes
Install Bicycle Signal Heads	Presence of Bicycle Facilities, Type of Traffic Control	N/A	N/A	FHWA states bike signals can be used to make traveling through an intersection safer for bicyclists, and will minimize conflicts between bicyclists and other vehicles to clarify right-of-way.	Yes
Install Bike Lanes or Bike Path	Presence of Bicycle Facilities	57% (Lanes)	N/A	No CMF data to support this safety countermeasure. FHWA states tat the addition of bicycle lanes can reduce crashes up to 49% for total crashes on urban 4-lane undivided collectors and local roads and 30% for 2-lane undivided collectors and local roads.	Yes
Reduce Lane Width	Speed Limit on Major/Minor Road	Up to 43%: Injury Crashes	N/A	N/A	Yes

Systemic Safety Plan Process

Rural Segment (No Curb & Gutter)
Two-Lane Undivided Roads
With AADT Less Than 5,000

MIC Safety Action Plan

Decision Tree



DISCLAIMER Other Factors Require Consideration Before Moving Forward with Any of These Recommendations, Such as the Context of the Improvement Along a Corridor.

AECOM

Rural Curves (No Curb & Gutter)
Two-Lane Undivided Roads
With AADT Less Than 5,000

MIC Safety Action Plan
Decision Tree

Curve in a Rural Area?
(Outside Developed Aeas)

NO → Edgeline and/or centerline Marking Improvements**

YES → Is There a History of Lane Departure Crashes on The Curve?

NO → Are Paved Shoulders Adequate
(3-ft Paved and Good/New Pavement Quality)?
and
Roadway with Posted Speed >35 mph?
+
Continue on to curve signing requirements (dashed line)

YES → Consider High Friction Surface Treatment
(If >40 mph)
+
Continue on to paved shoulder requirements
(dashed line)

Are Paved Shoulders Adequate ... → Roadway with Posted Speed >35 mph?

NO → Shoulder Rumble Strips
and/or
Centerline Rumble Strips
and/or
Edgeline and/or centerline Marking Improvements**

YES → Would Significant Grading be Required to Widen/Pave a Shoulder?

NO → Clear Zone Maintenance*
and/or
Edgeline and/or Centerline Marking Improvements**
and/or
Install Barrier to Delineate Fixed Objects
and/or
Install Barrier for Non-Recoverable Slopes
or
Improve Side Slopes

YES → Provide 3-ft Paved Shoulder
Or
Widen Paved Shoulder to a Total Width of 3-ft or More
and
Shoulder Rumble Strips (If >35mph)
and/or
Centerline Rumble Strips (If >35 mph)
(Depending on Pavement Quality)
and
Safety Edge
and/or
Edgeline and/or centerline Marking Improvements**
and/or
Improve Side Slopes
and/or
Install Barrier to Delineate Fixed Objects

Re-evaluate the Curve Signing and Updating to Meet MUTCD and State Policy as Necessary.^

Are There Existing Chevrons or Night Arrows on The Curve?

YES → Upgrade to Fluorescent Signs
and/or
In-Lane Curve Warning Pavement Markings

NO → Install Chevrons
And/or
Install Night Arrows

Intersection Near Curve

- Install Flashing Beacons with Warning 'Stop Ahead' Signs if Curve is Adjacent to a stop control intersection.

****Edgeline and/or centerline Marking Improvements**

Increase Edgeline and/or Centerline Pavement Marking Width to 6"

and/or

Enhanced Edgeline and/or Centerline Pavement Markings (Wet Reflective Epoxy)

**Clear Zone Maintenance*

This improvement includes removing vegetation and fixed objects within the clear zone. Clear zone width varies based on facility type, speed limit, and AADT.

Triangle Intersections on Curves

Reconstruct a triangle intersection, or an intersection with a visual trap, on a curve to a T-Intersection with as close to a 90 degree approach angle as possible.

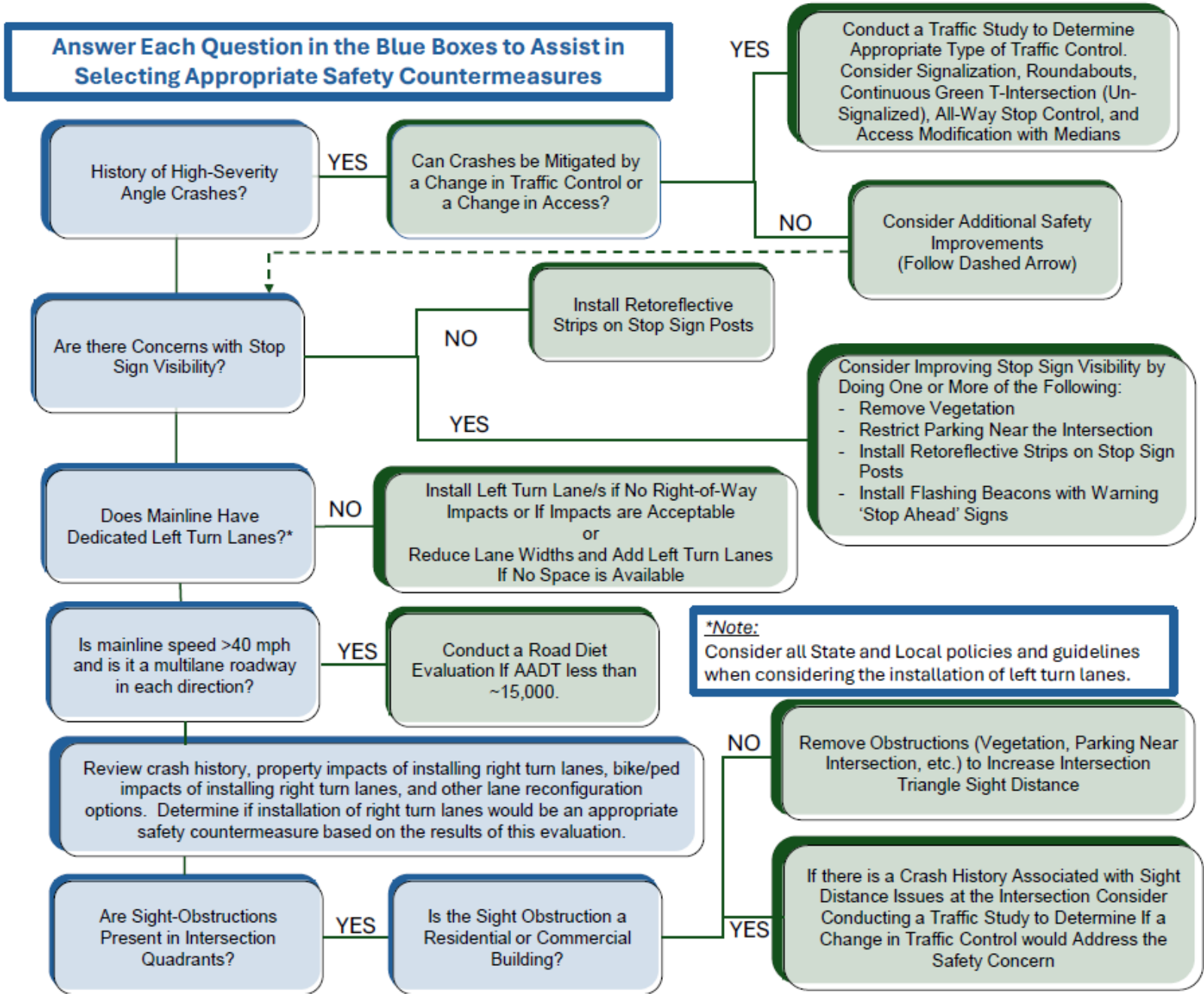
^Update Signing to Meet MUTCD and State Policy

- Curve Warning Signs
  - Required if curve is less than posted or Statutory Speeds and
  - Curve Advisory Speed is >=35 mph
- Curve Turn Sign
  - Required if curve is less than posted or statutory speeds and
  - Curve advisory speed is <=30 mph
- Advisory Plaque
  - Required if speed difference is >=15 mph (>=10 mph for WisDOT)
- Chevrons and/or Night Arrows
  - Required if speed difference is >=15 mph

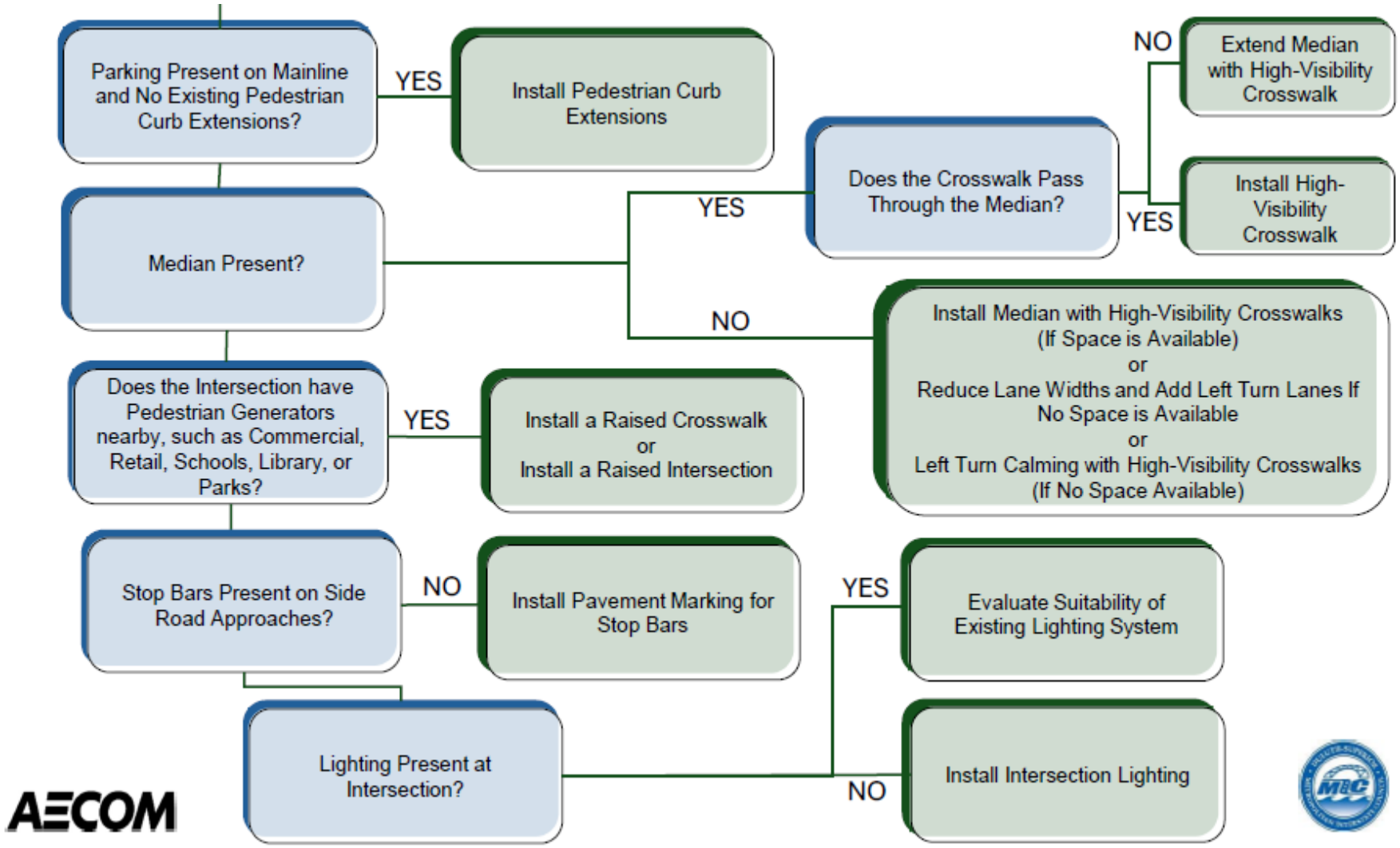
AECOM

DISCLAIMER Other Factors Require Consideration Before Moving Forward with Any of These Recommendations, Such as the Context of the Improvement Along a Corridor.

Decision Tree
Safety Emphasis Area 2
Urban Side Road Stop Control Intersections (Angle Crashes)

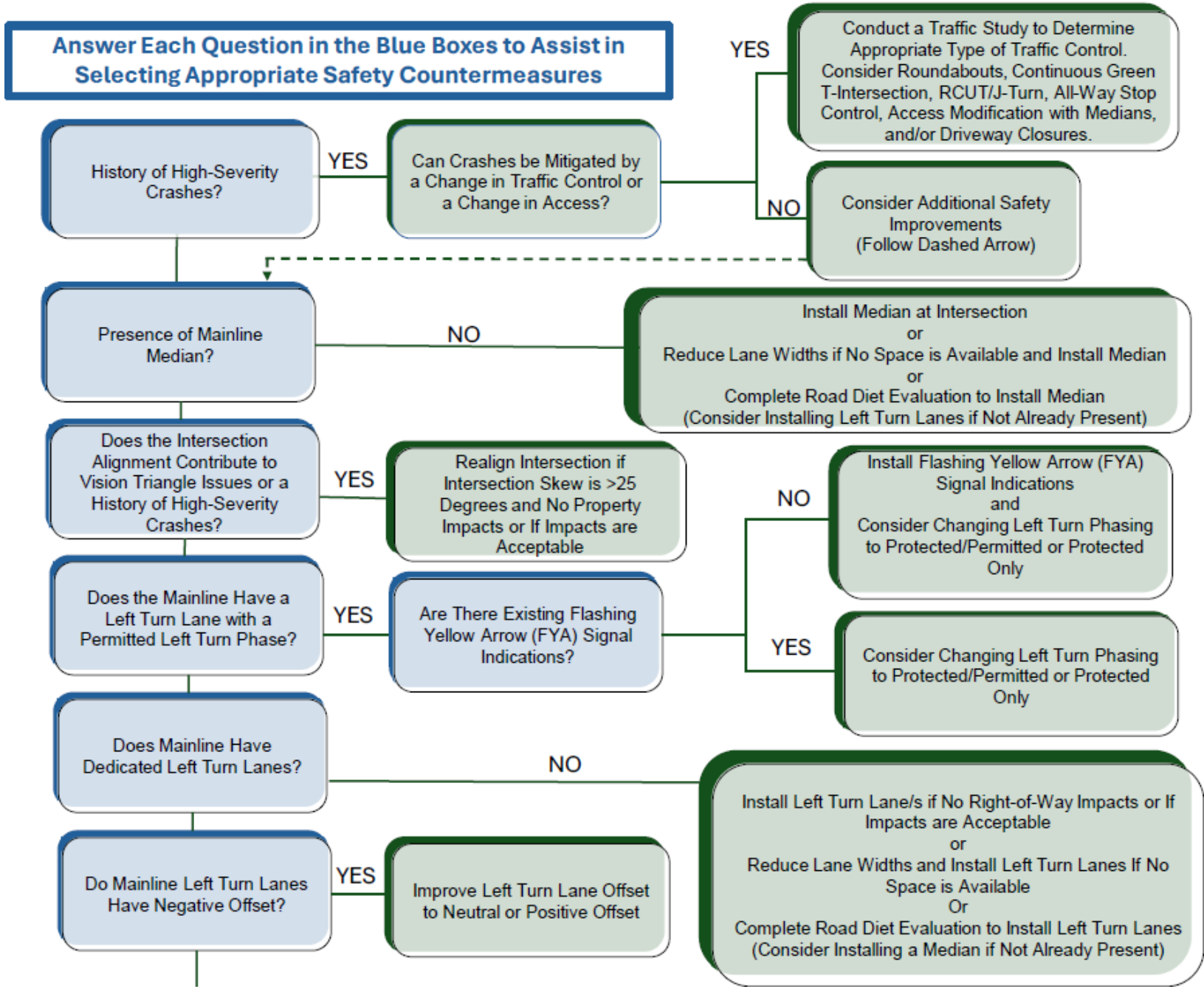


Decision Tree
Safety Emphasis Area 2
Urban Side Road Stop Control Intersections (Angle Crashes)

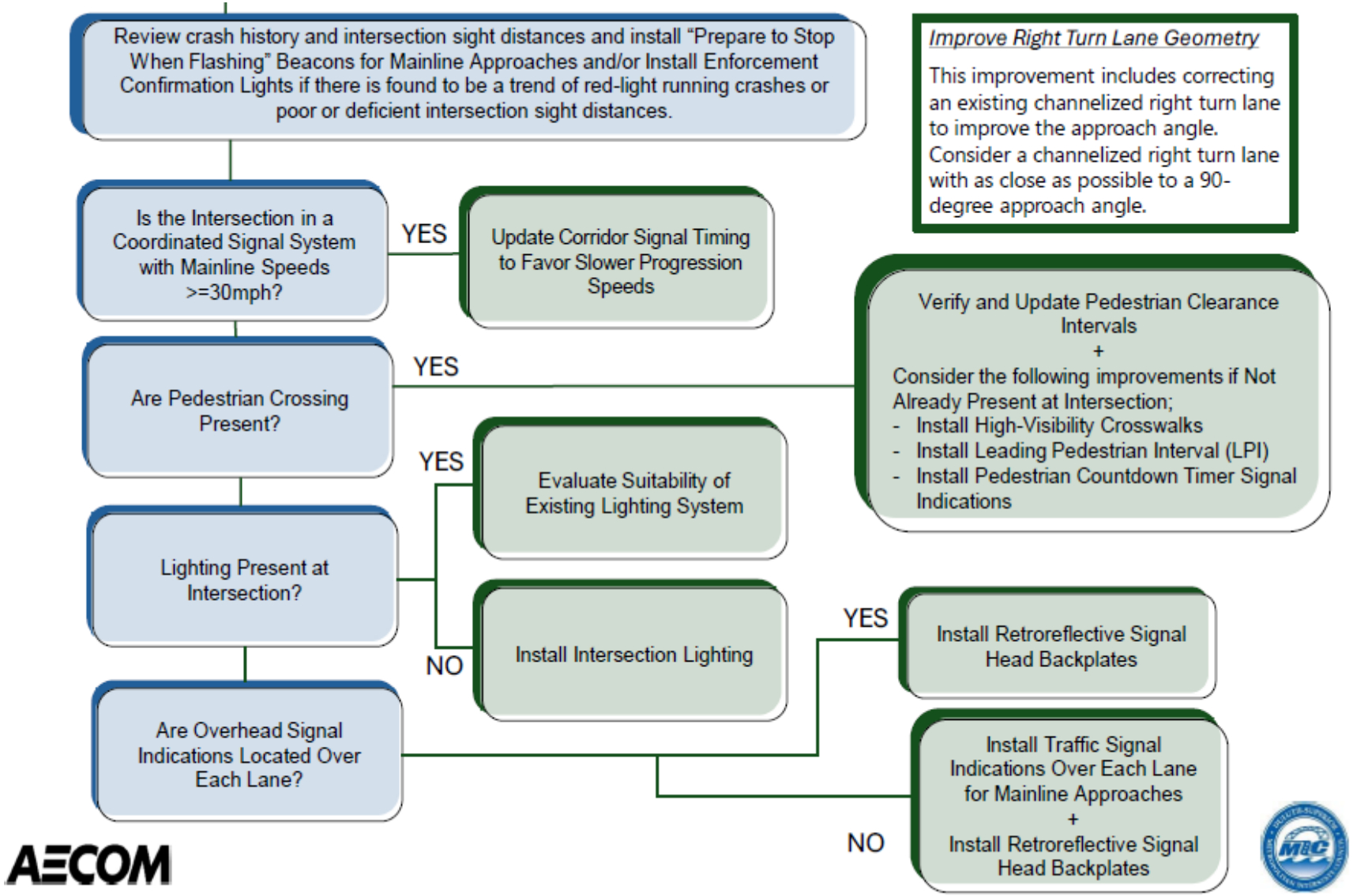


DISCLAIMER Other Factors Require Consideration Before Moving Forward with Any of These Recommendations, Such as the Context of the Improvement Along a Corridor.

Decision Tree
Safety Emphasis Area 3
Signalized Intersection, Multi-Lane Arterials

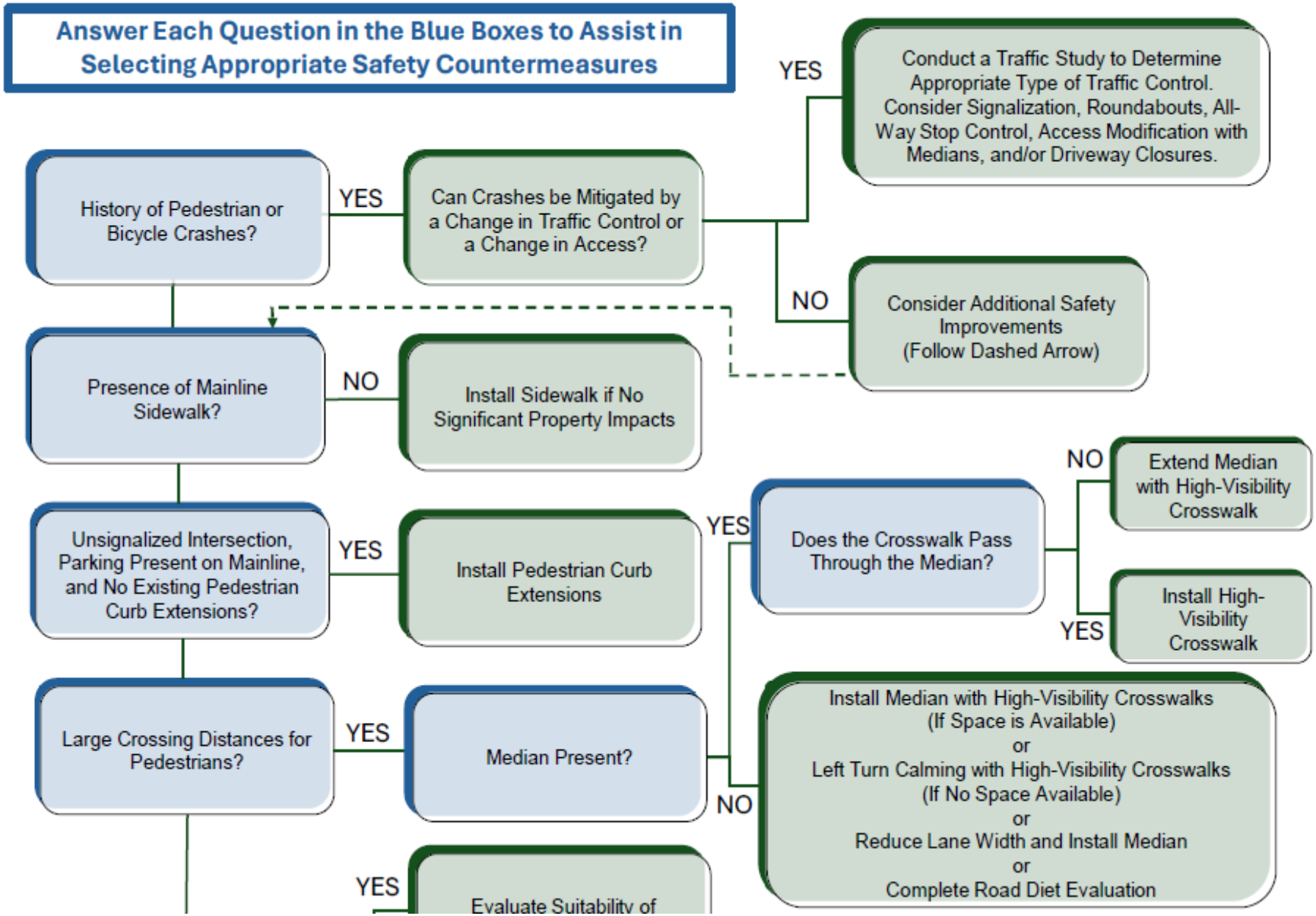


Decision Tree
Safety Emphasis Area 3
Signalized Intersection, Multi-Lane Arterials

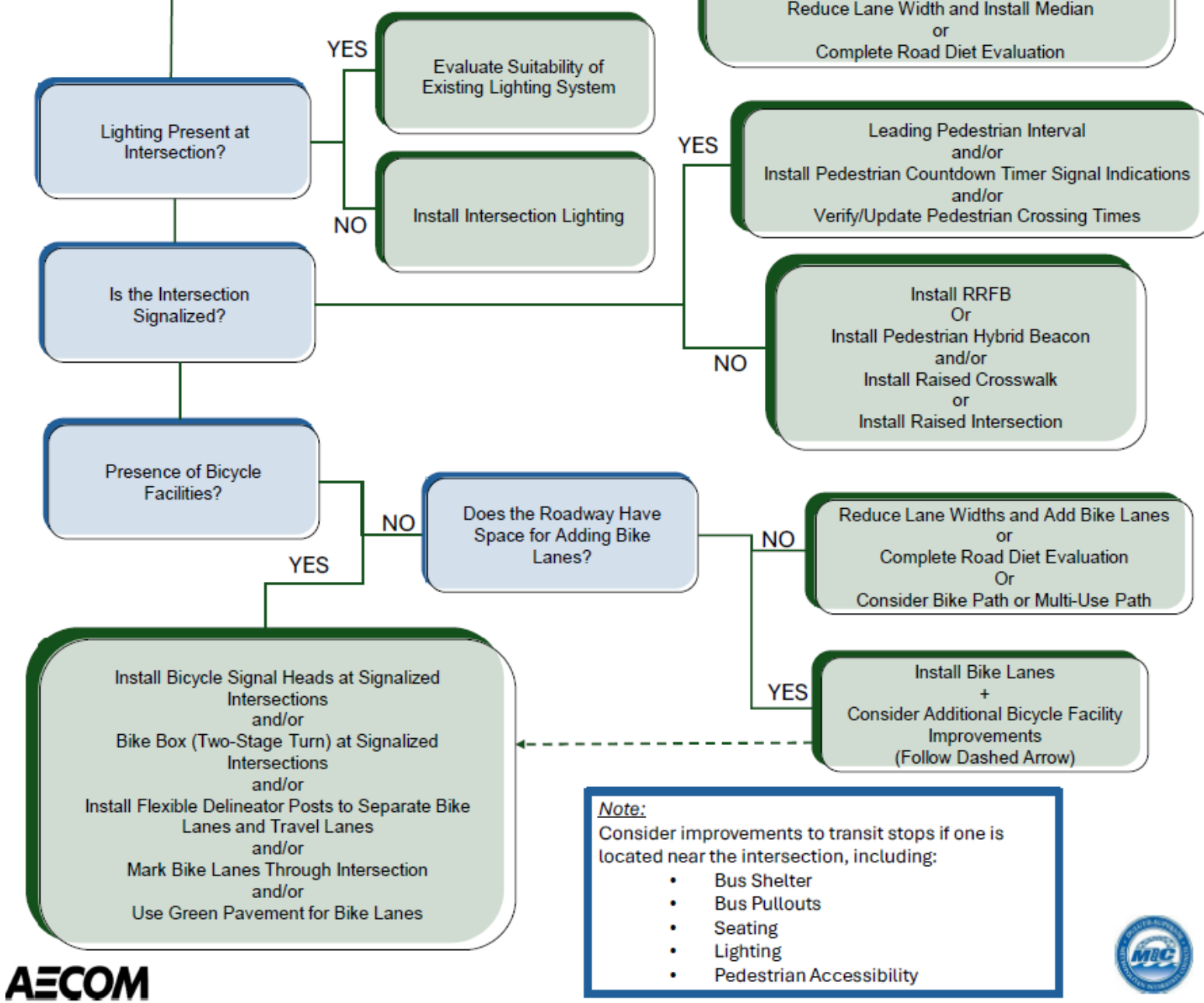


Decision Tree – Safety Emphasis Area 4

Urban Intersections (Bikes & Peds)



Decision Tree
Safety Emphasis Area 4
Urban Intersections (Bikes & Peds)



AECOM

DISCLAIMER Other Factors Require Consideration Before Moving Forward with Any of These Recommendations, Such as the Context of the Improvement Along a Corridor.

Cost Estimates – Safety Emphasis Area 1 - Segments

Rural Two-Lane Undivided Roads, AADT <5,000 (Lane Departure Crashes)

Safety Countermeasure	Unit	Unit Price
Add Paved Shoulders + Safety Edge	MI	$ 330,000
Clear Zone Maintenance	MI	$ 47,000
Increase Edgeline + Centerline from 4” to 6” (Paint)	MI	$ 19,800
Increase Edgeline + Centerline from 4” to 6” (Epoxy)	MI	$ 34,000
Increase Edgeline + Centerline from 4” to 8” (Paint)	MI	$ 34,000
Increase Edgeline + Centerline from 4” to 8” (Epoxy)	MI	$ 46,000
Install Barrier at Non-Recoverable Slopes	LF	$ 50
Install Centerline Rumble Strips	MI	$ 12,000
Repave Existing Shoulder and Install Safety Edge	MI	$ 140,000
Install Shoulder Rumble Strips	MI	$ 8,000
Remove or Relocate Fixed Object	MI	$ 41,000
Side Slope Improvements	MI	$ 190,000
Install Wet Reflective Pavement Markings	MI	$ 41,000
Widen Paved Shoulder + Safety Edge	MI	$ 240,000

Cost Estimates – Safety Emphasis Area 1 - Curves

Rural Two-Lane Undivided Roads, AADT <5,000 (Lane Departure Crashes)

Safety Countermeasure	Unit	Unit Price
Add Paved Shoulders + Safety Edge	MI	$ 330,000
Clear Zone Maintenance	MI	$ 47,000
High Friction Surface Treatment	CURVE	$ 116,600
Increase Edgeline + Centerline from 4" to 6" (Paint)	MI	$ 19,800
Increase Edgeline + Centerline from 4" to 6" (Epoxy)	MI	$ 34,000
Increase Edgeline + Centerline from 4" to 8" (Paint)	MI	$ 34,000
Increase Edgeline + Centerline from 4" to 8" (Epoxy)	MI	$ 46,000
Install Centerline Rumble Strips	MI	$ 12,000
Install Shoulder Rumble Strips	MI	$ 8,000
In-Lane Curve Warning Pavement Markings	CURVE	$ 3,000
Install Barrier at Non-Recoverable Slopes	LF	$ 50
Re-align Side Road on Curve at Intersections	INT	$ 225,000
Install Chevron Signs or Night Arrow	CURVE	$ 2,000
Reconstruct Triangle Intersections on Curve to T-Intersection	INT	$ 60,000
Side Slope Improvements	MI	$ 190,000
Update Curve Advisory Speeds	CURVE	$ 1,000
Upgrade or Install Fluorescent Curve Signs	CURVE	$ 1,000
Install Wet Reflective Pavement Markings	MI	$ 41,000
Widen Paved Shoulder + Safety Edge	MI	$ 240,000

Cost Estimates
Safety Emphasis Area 2
Urban Side Road
Stop Control Intersections (Angle Crashes)

Safety Countermeasure	Unit	Unit Price
Complete a Traffic Study to Determine Appropriate Traffic Control (in house)	INT	$ 10,000
Complete a Traffic Study to Determine Appropriate Traffic Control (by Consultant)	INT	$ 48,000
Modify Access Near Intersection to RIRO	INT	$ 68,000
Close Driveway Near Intersection	EACH	$ 4,000
Continuous Green T-Intersection (Non-Signalized)	INT	$ 220,000
Convert TWSC to traffic Signal - 3 Leg*	INT	$ 240,000
Convert TWSC to traffic Signal - 4 Leg*	INT	$ 340,000
Install Advance Intersection Flashing Becaons at TWSC Intersection	INT	$ 18,000
Upgrade Lighting LED**	INT	$ 3,000
Install Lighting - Decorative	INT	$ 58,000
Install Lighting - DOT standard	INT	$ 26,000
Convert Full Access Intersection to Minor RIRO Access	INT	$ 380,000
Convert TWSC Intersection to Mini-Roundabout or Compact Roundabout	INT	$ 1,500,000
Convert TWSC Intersection to Single Lane Roundabout	INT	$ 2,500,000
Convert TWSC to AWSC	INT	$ 2,000
Increase Triangle Sight Distance (Remove Vegetation)**	INT	$ 7,000
Install Left Turn Lane - Mainline (One Approach)	INT	$ 400,000
Install Left Turn Lane - Mainline (Both Approaches)	INT	$ 800,000
Extend Median through Marked Crosswalk (Mainline)	CROSSING	$ 69,000
Install Median with Marked Crosswalk (Mainline)	CROSSING	$ 98,000
Left Turn Calming where No Median Present**	INT	$ 8,000
Install Pedestrian Curb Extension (In Areas with Parking)	INT	$ 100,000
Restrict Parking Near Intersection**	INT	$ 4,000
Install Retroreflective Strips on Stop Sign Posts**	INT	$ 1,000
Install Right Turn Lane- Mainline (Both approaches)	INT	$ 800,000
Install Right Turn Lane- Mainline (One Approach)	INT	$ 400,000
Raised Crosswalk	CROSSING	$ 50,000
Raised Intersection	INT	$ 120,000
Install Stop Bars on Side Road Approaches**	INT	$ 2,000
Road Diet (Lane Reconfiguration) with Resurfacing	MILE	$ 870,000
Road Diet (Lane Reconfiguration) without Resurfacing	MILE	$ 120,000
Complete a Road Diet Evaluation	MILE	$ 90,000
Reduce Lane Width**	MI	$ 120,000

Cost Estimates
Safety Emphasis Area 3
Signalized Intersection, Multi-Lane Arterials

Safety Countermeasure	Unit	Unit Price
Complete a Traffic Study to Determine Appropriate Traffic Control (in house)	INT	$ 10,000
Complete a Traffic Study to Determine Appropriate Traffic Control (by Consultant)	INT	$ 48,000
Close Driveway Near Intersection	EACH	$ 4,000
Convert Signal to AWSC	INT	$ 33,000
Install Flashing Yellow Arrow Signal Heads**	INT	$ 29,000
Change Left Turn Signal Phasing - No Equipment Change*	INT	$ 4,000
Improve Signal Head Visibility and Install Retroreflective Backpaltes	INT	$ 130,000
Install Retroreflective Signal Head Backplates**	INT	$ 4,000
Corridor Signal Timing to Reduce High-Speed Flow (in house)	CORRIDOR	$ 5,000
Corridor Signal Timing to Reduce High-Speed Flow (by Consultant)	CORRIDOR	$ 26,000
Upgrade to Pedestrian Countdown Timer**	INT	$ 7,000
Install Pedestrian Counterdown Timer**	INT	$ 17,000
Upgrade Lighting LED**	INT	$ 6,000
Install Lighting - Decorative	INT	$ 116,000
Install Lighting - DOT standard	INT	$ 52,000
Leading Pedestrian Interval*	INT	$ 1,000
Verify/Update Clearance Intervals**	INT	$ 2,000
Improve Channelized Right Turn Angle	INT	$ 150,000
Add "Prepare to Stop When Flashing" Beacons for Mainline Approaches**	INT	$ 18,000
Enforecement Confirmation Lights**	INT	$ 2,000
Convert Signal to Continuous Green T-Intersection	INT	$ 250,000
Convert Signal to Roundabout	INT	$ 2,600,000
Convert Signal to Signalized RCUT/J-Turn Intersection	INT	$ 2,500,000
High-Visibility Crosswalks**	CROSSING	$ 6,000
Improve Left Turn Lane Offset, Negative to Positive or Zero	INT	$ 240,000
Install Left Turn Lane (Both Approaches)	INT	$ 800,000
Install Left Turn Lane (One Approach)	INT	$ 400,000
Install Median at Intersection	CROSSING	$ 98,000
Modify Access Near Intersection to RIRO	INT	$ 68,000
Realign Intersection	INT	$ 900,000
Reduce Lane Width**	MI	$ 25,000
Road Diet (Lane Reconfiguration) with Resurfacing	MILE	$ 870,000
Road Diet (Lane Reconfiguration) without Resurfacing	MILE	$ 120,000
Complete a Road Diet Evaluation	MI	$ 90,000
Convert Full Access Signalized Intersection to Minor RIRO Access	INT	$ 410,000

Cost Estimates
Safety Emphasis Area 4
Urban Intersections (Bikes & Peds)

Safety Countermeasure	Unit	Unit Price
Complete a Traffic Study to Determine Appropriate Traffic Control (in house)	INT	$ 10,000
Complete a Traffic Study to Determine Appropriate Traffic Control (by Consultant)	INT	$ 48,000
Bike Box (Two-Stage Turn Queue Box)**	INT	$ 1,000
Bike Lanes Marked through Intersection**	INT	$ 1,000
Close Driveway Near Intersection	EACH	$ 4,000
Convert Full Access Intersection to Minor RIRO Access	INT	$ 380,000
Convert TWSC to Traffic Signal - 3 Leg Intersection	INT	$ 240,000
Convert TWSC to Traffic Signal - 4 Leg Intersection	INT	$ 340,000
Convert Signal to Roundabout	INT	$ 2,600,000
Convert TWSC or AWSC Intersection to Mini/Compact Roundabout	INT	$ 1,500,000
Convert TWSC or AWSC Intersection to Roundabout	INT	$ 2,500,000
Convert TWSC to AWSC	INT	$ 2,000
Upgrade Lighting LED**	INT	$ 3,000
Install Lighting - Decorative**	INT	$ 58,000
Install Lighting - DOT standard**	INT	$ 26,000
Green color pavement (Bike Facilities)**	INT	$ 22,000
RRFB	CROSSING	$ 36,000
Enhanced Transit Stops (Seating,Shelter, Dedicated Pullout)	BUS STOP	$ 40,000
Leading Pedestrian Interval*	INT	$ 1,000
Upgrade to Pedestrian Countdown Timer**	INT	$ 7,000
Install Pedestrian Counterdown Timer**	INT	$ 17,000
Pedestrian Hybrid Beacon	INT.	$ 110,000
Provide Flexible Delineator Posts Adjacent to Bike Lane**	INT	$ 3,000
Left Turn Calming where No Median Present**	INT	$ 8,000
Verify/Update Pedestrian Crossing Times	INT	$ 2,000
Install Bicycle Signal Heads**	INT	$ 10,000
High-Visibility Crosswalks**	CROSSING	$ 6,000
Extend Median (Refuge) with Marked Crosswalk (Mainline)	CROSSING	$ 69,000
Install Median at Intersection	CROSSING	$ 98,000
Install Pedestrian Curb Extension (In Areas with Parking)	INT	$ 100,000
Install Sidewalk where No Sidewalk Exists	MI	$ 330,000
Raised Crosswalk	CROSSING	$ 50,000
Raised Intersection	INT	$ 120,000
Road Diet (Lane Reconfiguration) with Resurfacing	MI	$ 870,000
Road Diet (Lane Reconfiguration) without Resurfacing	MI	$ 120,000
Complete a Road Diet Evaluation	MI	$ 90,000
Bike Path or Multi-Use Path	MI	$ 850,000
Reduce Lane Width**	MI	$ 25,000
Install Bike Lanes (re-striping)**	MI	$ 25,000

STEP 2: STRATEGY & PROJECT SELECTION

Applying Cost Estimates to Safety Projects

Road Name	TOTAL STARS	Remove Vegetation or Obstructions to Improve Stop Sign Visibility	Restrict Parking Near the Intersection	Install Retroreflective Strips on Stop Sign Posts	Install Flashing Beacons with Warning 'Stop Ahead' Signs	Install Left Turn Lanes	Consider Installing Right Turn Lanes	Remove Obstructions to Increase Intersection Sight Distance	Install Pedestrian Curb Extensions	Extend Median Through Crosswalk	Install High-Visibility Crosswalk	Left Turn Calming	Reduce Lane Widths and Install Median	Install Raised Crosswalk	Install Raised Intersection	Install Stop Bar Pavement Markings on Side Road Approaches	Project Cost Estimate
Grand Ave, S 63rd Ave W	★★★★★½		X	X			X				X	X or	X or	X or	X or	X	$1,149,000
Highway 53, E St	★★★★★½					X	X									X	$1,931,000
E 2nd St - Hwy 53/2, E 2nd St - Hwy 53/2, E 3rd St	★★★★★½				X		X	X			X		X	X or	X or	X	$3,725,000
Midway Rd, Old Miller Trunk Hwy	★★★★★			X				X				X				X	$160,000
Tower Ave, Tower Ave, N 16th St	★★★★★			X					X		X		X	X or	X or		$727,000
Mesaba Ave, Mesaba Ave	★★★★★	X	X	X		X	X	X								X	$1,215,000
Railroad St, Railroad St, Harbor Dr	★★★★½			X	X		X							X			$472,000
Rice Lake Rd, Rice Lake Rd, E Skyline Pkwy	★★★★½			X										X		X	$484,000
Tower Ave, N 56th St, Tower Ave	★★★★½			X			X	X	X		X	X or	X or	X or	X		$858,000
Tower Ave, Henry Cohen Dr	★★★★½			X			X	X	X		X		X				$3,680,000
Hammond Ave, N 5th St, Hammond Ave, N 5th St	★★★★			X						X	X			X or	X or	X	$288,000
E 2nd St - Hwy 53/2, E 2nd St - Hwy 53/2, 23rd Ave E	★★★★							X		X	X		X	X or	X or		$322,000
Hammond Ave, Broadway St, Hammond Ave	★★★★		X	X					X		X	X or	X or	X or	X or		$453,000
Tower Ave, Tower Ave, N 34th St, N 34th St	★★★★			X			X		X		X			X or	X or		$648,000
E 2nd St - Hwy 53/2, Marina Dr, E 2nd St - Hwy 53/2	★★★★	X		X	X		X	X		X	X			X or	X		$693,000
E 4th St, N 4th Ave E	★★★★	X or		X	X or				X		X	X		X or	X or	X	$711,000
E 2nd St - Hwy 53/2, 31st Ave E, E 2nd St - Hwy 53/2	★★★★						X				X		X			X	$1,014,000
Belknap St, E 5th St, E 5th St, Belknap St	★★★★			X	X		X						X				$1,025,000
E Superior St, N 14th Ave E, S 14th Ave E, E Superior St	★★★★		X	X			X	X	X		X	X		X or	X or		$1,081,000
Tower Ave, N 40th St	★★★★						X		X	X	X			X or	X or		$1,185,000
Skyline Pkwy, Mesaba Ave, E 9th St, Mesaba Ave	★★★★	X		X		X	X									X	$1,213,000
E Superior St, 47th Ave E, 47th Ave E	★★★★		X	X			X					X		X or	X or		$3,482,000
Highway 53, Catlin Ave	★★★½		X	X												X	$308,000
Tower Ave, N 58th St, Tower Ave	★★★½		X	X							X	X or	X or	X or	X or		$353,000
Highway 53, Grand Ave, Grand Ave	★★★½		X	X									X			X	$413,000

Risk Assessment Prioritization

Prioritization by Risk

or

Prioritization by Cost per Weighted Risk

Road Name	TOTAL STARS	Project Cost Estimate	Weighted Risk Factor	Prioritization ($ per Weighted Risk Factor)
Grand Ave, S 63rd Ave W	★★★★★½	$1,149,000	10	$114,900
Highway 53, E St	★★★★★½	$1,931,000	10	$193,100
E 2nd St - Hwy 53/2, E 2nd St - Hwy 53/2, E 3rd St	★★★★★½	$3,725,000	10	$372,500
Midway Rd, Old Miller Trunk Hwy	★★★★★	$160,000	9.09	$17,600
Tower Ave, Tower Ave, N 16th St	★★★★★	$727,000	9.09	$79,970
Mesaba Ave, Mesaba Ave	★★★★★	$1,215,000	9.09	$133,650
Railroad St, Railroad St, Harbor Dr	★★★★½	$472,000	8.18	$57,689
Rice Lake Rd, Rice Lake Rd, E Skyline Pkwy	★★★★½	$484,000	8.18	$59,156
Tower Ave, N 56th St, Tower Ave	★★★★½	$858,000	8.18	$104,867
Tower Ave, Henry Cohen Dr	★★★★½	$3,680,000	8.18	$449,778
Hammond Ave, N 5th St, Hammond Ave, N 5th St	★★★★	$288,000	7.27	$39,600
E 2nd St - Hwy 53/2, E 2nd St - Hwy 53/2, 23rd Ave E	★★★★	$322,000	7.27	$44,275
Hammond Ave, Broadway St, Hammond Ave	★★★★	$453,000	7.27	$62,288
Tower Ave, Tower Ave, N 34th St, N 34th St	★★★★	$648,000	7.27	$89,100
E 2nd St - Hwy 53/2, Marina Dr, E 2nd St - Hwy 53/2	★★★★	$693,000	7.27	$95,288
E 4th St, N 4th Ave E	★★★★	$711,000	7.27	$97,763
E 2nd St - Hwy 53/2, 31st Ave E, E 2nd St - Hwy 53/2	★★★★	$1,014,000	7.27	$139,425
Belknap St, E 5th St, E 5th St, Belknap St	★★★★	$1,025,000	7.27	$140,938
E Superior St, N 14th Ave E, S 14th Ave E, E Superior St	★★★★	$1,081,000	7.27	$148,638
Tower Ave, N 40th St	★★★★	$1,185,000	7.27	$162,938
Skyline Pkwy, Mesaba Ave, E 9th St, Mesaba Ave	★★★★	$1,213,000	7.27	$166,788
E Superior St, 47th Ave E, 47th Ave E	★★★★	$3,482,000	7.27	$478,775
Highway 53, Catlin Ave	★★★½	$308,000	6.36	$48,400
Tower Ave, N 58th St, Tower Ave	★★★½	$353,000	6.36	$55,471
Highway 53, Grand Ave, Grand Ave	★★★½	$413,000	6.36	$64,900

Safety Projects

- Safety Emphasis Area 1 can prioritize rural segment projects based on the standalone risk assessment.
- Intersections from SEA's 2-4 were combined to evaluated corridor-wide safety projects.

Corridor Rank	Corridor	State	Limits	Length (Mi)	# of Intersections in Tier 1 or Tier 2 Locations	Total Cost	Weighted Risk Factor	Total Prioritization ($/Weight)
1	Superior St	Minnesota	6th Ave W to 4th Ave E	0.9	9	$ 927,000	71.11	$ 14,000
2	2nd St	Minnesota	4th Ave W to 3rd Ave E	0.6	8	$ 2,034,000	64.44	$ 32,000
3	Lake Ave	Minnesota	Superior St to 3rd St	0.2	3	$ 993,000	25.00	$ 40,000
4	Grand Ave	Minnesota	59th Ave to Central Ave	0.4	3	$ 939,000	23.33	$ 41,000
5	4th St	Minnesota	3rd Ave E to 5th Ave E	0.2	3	$ 1,258,000	21.62	$ 59,000
6	46th Ave	Minnesota	Mike Colalilo Dr/1st St to Grand Ave	0.2	2	$ 917,000	13.89	$ 67,000
7	Superior St - 3	Minnesota	12th Ave E to 14th Ave E	0.2	3	$ 1,540,000	21.72	$ 71,000
8	6th Ave/Central Entrance Dr	Minnesota	3rd St to 10th St	0.5	4	$ 3,648,000	49.44	$ 74,000
9	Woodland Ave	Minnesota	Kent Rd/8th St to Oxford St	1.5	6	$ 6,115,000	68.89	$ 89,000
10	US 2/Belknap St	Wisconsin	STH 35/Tower Ave to Catlin Ave	1	6	$ 4,345,000	47.78	$ 91,000
11	Tower Ave/Hwy 35	Wisconsin	58th St to 31st St	2.3	7	$ 9,240,000	84.49	$ 110,000
12	CSAH 4/Mesaba Ave	Minnesota	3rd St to Skyline Parkway	1	6	$ 5,855,000	52.32	$ 112,000
13	Hammond Ave	Wisconsin	Broadway St to 5th St	0.4	5	$ 5,394,000	44.55	$ 122,000
14	Tower Ave/Hwy 35 - 2	Wisconsin	28th St to Broadway St	1.5	9	$ 12,476,000	100.45	$ 125,000
15	MNTH 23 (Grand Ave)	Wisconsin	88th Ave to 63rd Ave	3.2	5	$ 5,784,000	44.44	$ 131,000
16	USTH 53/Miller Trunk Hwy - 2	Minnesota	Midway Rd to Stebner Rd	4.6	5	$ 4,175,000	31.67	$ 132,000
17	USH 53/2nd St - 2	Wisconsin	USH 2/Belknap St to Grand Ave	1.5	5	$ 7,046,000	50.96	$ 139,000
18	USTH 53/Trinity Rd	Minnesota	Piedmont Ave to Mall Dr	2.5	4	$ 4,168,000	27.78	$ 151,000
19	USH 53/2nd St	Wisconsin	3rd St/50th Ave to Marina Dr/9th Ave	3.8	7	$ 9,757,000	59.04	$ 166,000
20	TH 194/Central Entrance	Minnesota	USH 53/Trinity Rd to Pecan Ave	1.8	7	$ 15,808,000	87.22	$ 182,000
21	USTH 53/Miller Trunk Hwy	Minnesota	CSAH 32 (Arrowhead Rd) to Loberg Ave/Cottonwood A	1.9	6	$ 8,389,000	43.33	$ 194,000
22	Arrowhead Rd	Minnesota	CSAH 90/Arlington Ave to Rice Lake Rd	0.4	2	$ 3,179,000	13.89	$ 229,000
23	27th Ave	Minnesota	Helm St/I-35 WB Ramps to 1st St	0.2	2	$ 3,696,000	13.33	$ 278,000
24	Superior St - 2	Minnesota	43rd Ave to 47th Ave	0.4	2	$ 4,744,000	12.73	$ 373,000

Next Steps

Complete the final Comprehensive MIC-Area Safety Action Plan
(SS4A grant (2025-2026)

1. **Leadership Commitment and Goal Setting**
2. **Planning Structure**
3. Safety Analysis
4. **Engagement and Collaboration**
5. **Equity**
6. **Policy and Process Changes**
7. Strategy and Project Selection
8. **Progress and Transparency**

- It will incorporate the two technical components (#3 & #7) completed by AECOM
- The 2025-2026 planning process will address at least four of the remaining six components (Scope of Work is currently being developed; RFP release early 2025)

Thank you.

Questions?