IH-94 Willow Glen Rd - Zoo IC Corridor Needs Report

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I-94 Willow Glen to Zoo Interchange Needs Study
Corridor Needs Report

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I-94

Jefferson, Waukesha and Milwaukee Counties, Wisconsin

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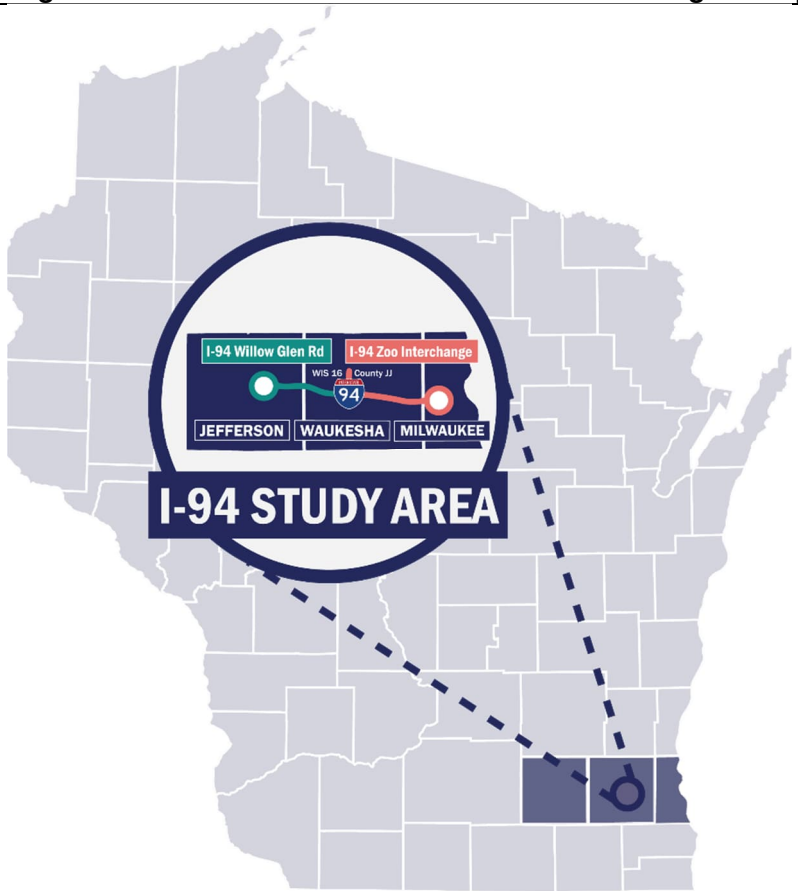
EXECUTIVE SUMMARY

The I-94 Waukesha County Needs Study evaluated the existing and future conditions along I-94 corridor from just west of Willow Glen Road in Jefferson County through Waukesha County to the western I-41 ramps of the Zoo Interchange in Milwaukee County as well as a portion of WIS 16 from County J south to the system interchange with I-94. The study area is shown in Figure 1.

Evaluations of the corridor included analyses of safety, pavement, structures, geometrics, and traffic. Existing conditions data was gathered in 2022 and utilized for this report released in 2025. Future year analysis forecasted conditions through the year 2050. The purpose of this study was to inform decision makers regarding future safety, pavement, bridge, or other improvement projects. This Corridor Needs Report summarizes information from two technical reports generated during this study: the Existing Conditions Report and the 2050 Future No Build Traffic and Safety Report. These reports are provided in the appendix for detailed information about the analyses conducted during I-94 Waukesha County Needs Study.

- **Existing Conditions Report** contains details of the current needs in the corridor for safety, pavement, bridge, geometrics, and traffic operations.
- **2050 Future No Build Traffic and Safety Report** analyzes the future safety and traffic operational needs to the year 2050 assuming no improvement projects occur.

Figure 1: I-94 Willow Glen Road to Zoo Interchange Study Area



Needs by Category

The following summarizes the main findings of the I-94 Waukesha County Needs Study organized by category (safety, pavement, structures, geometrics, and traffic).

Safety issues were found throughout the corridor in high crash rate areas. Forty crash 'hot spots' with high crash rates were found throughout the corridor. The main engineering factors contributing to crashes were congestion, deficient horizontal geometry and drainage issues.

Crashes are expected to increase as traffic volumes increase and existing contributing factors are further exacerbated. The predictive safety analysis showed strong potential safety improvement in the crash hot spot locations. The predictive safety analysis also identified ramps and ramp terminal intersections with safety concerns.

There are many pavement projects planned for the coming years, including pavement replacement for most of the corridor within the next 35 years. The entire corridor requires a major maintenance project by 2030. As the pavement ages, replacement and maintenance needs will become more frequent.

Safely managing traffic during pavement maintenance and replacement projects will be difficult as traffic volumes increase in the corridor. These construction projects cause congestion and backups for vehicles using the corridor, likely requiring restrictions to be placed on the contractor such as time of day work, number of workdays, and temporary pavement and/or bridges which can all increase project costs.

As structures continue to age across the corridor, more maintenance will be required over time. There are already 33 projects programmed for bridges within the corridor. All of these projects are anticipated to be completed before 2031 with projects planned in 6 of the 7 years between 2024 and 2031.

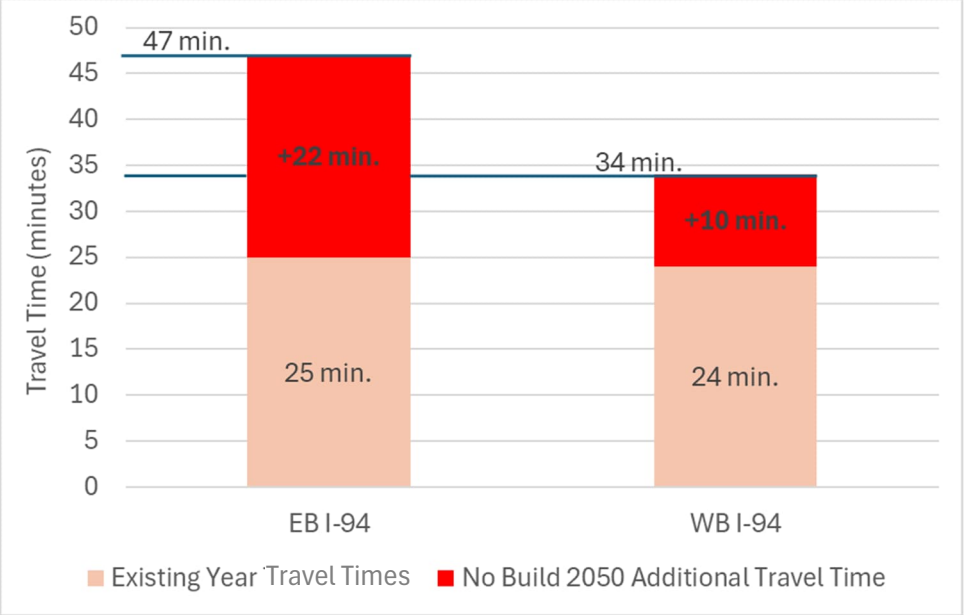
Many of the bridges will reach the end of their assumed life, 75 years old, before 2040. The average age of the bridges in this corridor is 50 years old in 2022 with many bridges well over 60 years old. These bridges will require more frequent and extensive maintenance projects as they age. Combining these structure maintenance projects with the pavement maintenance projects could benefit from shared traffic control.

There are many geometric deficiencies throughout the corridor that contribute to crashes and safety issues. Almost the entire corridor has an element that is geometrically substandard. There are substandard curves and hills that contribute to crashes as well as grade and slope deficiencies that lead to drainage issues.

I-94 does, and will continue to, experience undesirable congestion. The I-94 corridor experienced undesirable congestion in the peak travel hours in 2022. At the time of this study, the worst congestion occurred between WIS 16 to County F on weekdays during commuter peaks (AM/PM) and near County SS on Fridays. By 2050, the entire corridor is expected to get worse, with most of the corridor experiencing undesirable congestion or failing conditions. Bottlenecks will create long backups and delay on the mainline.

Peak Travel times will increase as much as 20 minutes. Figure 2 shows the expected travel time increase from 2022 to 2050 on I-94 during the Friday evening peak travel time.

Figure 2. I-94 Friday Travel Time

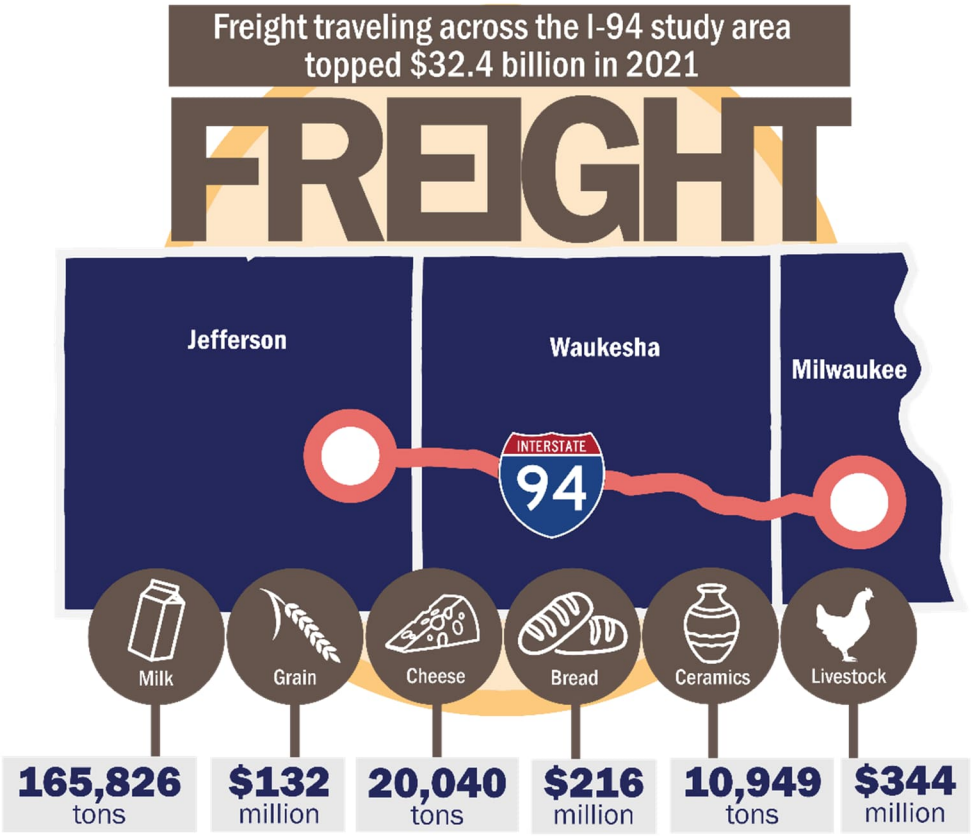


Travel times are anticipated to increase at least 40% with eastbound travel times increasing by over 20 minutes. The increased travel time adds frustration for commuters trying to traverse the corridor and increased cost for the freight operations present.

Other Considerations

Interstate 94 is also an important corridor for freight and shipping. Trucking carries more goods both in tonnage and value than any other mode of transportation in Wisconsin. Thirty-two billion dollars of freight travel through this corridor annually and it is the primary freight corridor between Madison and Milwaukee. Figure 3 illustrates some of the major goods moving along the I-94 study area.

Figure 3. I-94 Freight Economics

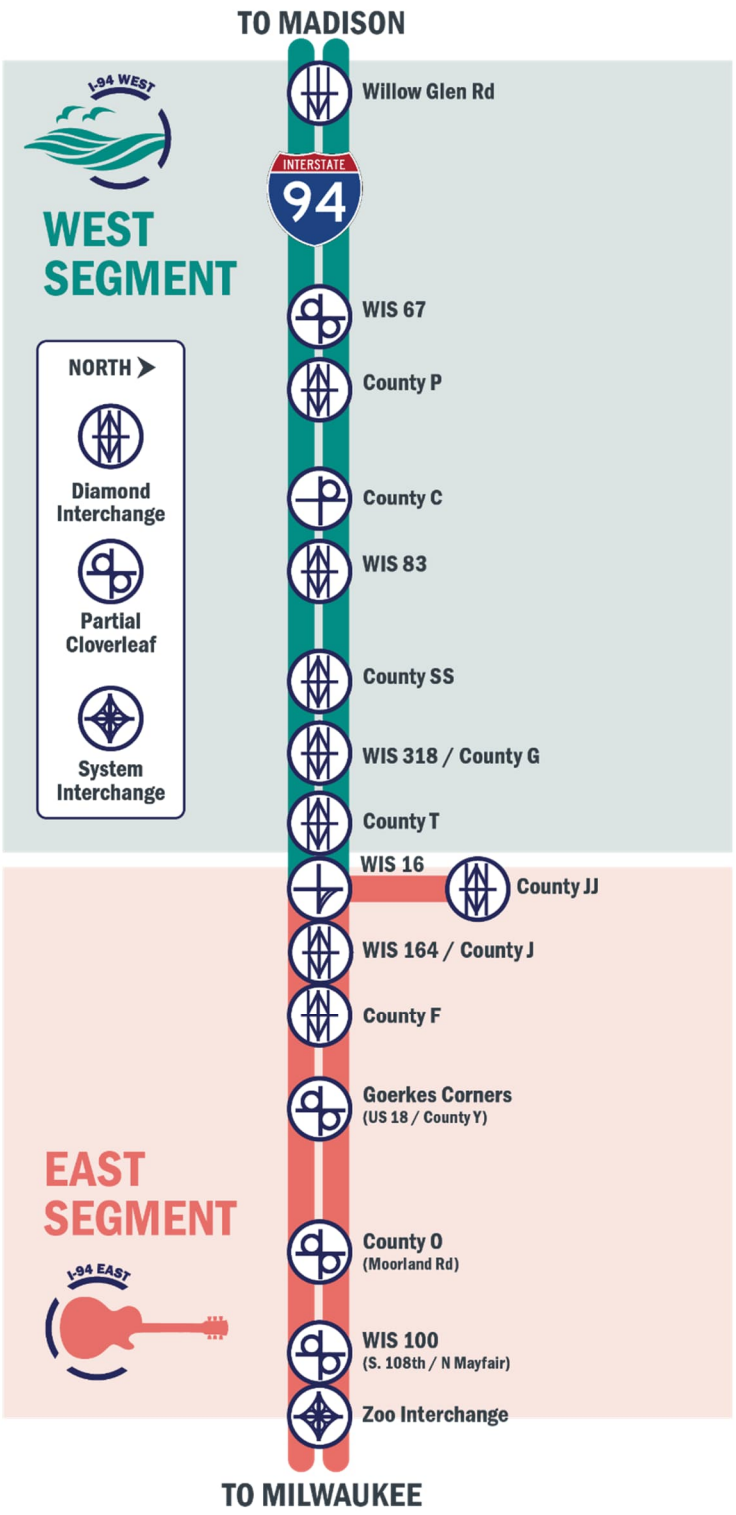


Interstate 94 also serves as an important recreational corridor. It serves as a route to northern recreational areas for travelers in southeastern Wisconsin and northern Illinois. Tourism is a big part of the Wisconsin economy, comprising $23.7 billion in total business sales for the entire state in 2022. The counties included in the I-94 study account for almost 20% of total state tourism, and I-94 is the primary corridor through these counties connecting Milwaukee to Madison and the western side of the state.

Needs by Geographic Location

I-94 was divided into two sections geographically to simplify the communication of study results. Section limits and descriptions are shown in Figure 4.

Figure 4. Project Location



West Section

The West Section stretches between Willow Glen Road and the WIS 16 interchange. This section has four lanes for most of the length and is characterized as rural as it is bordered by beautiful lakes and farmland allowing room for future growth.

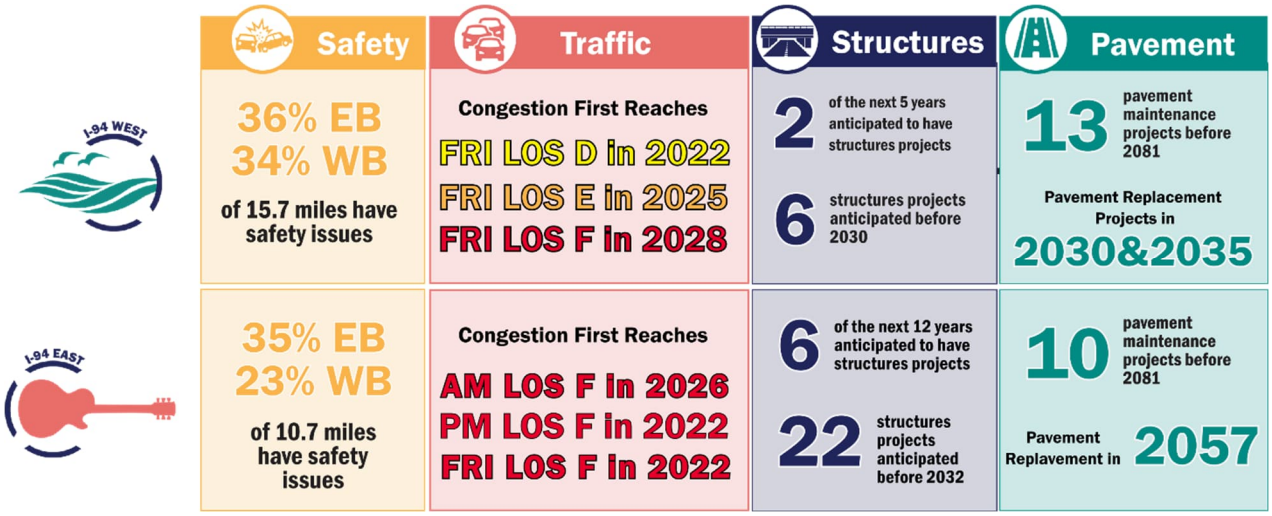
East Section

The East Section stretches between the WIS 16 interchange and the Zoo Interchange including a portion of WIS 16 up to the CTH JJ intersection. This section has six lanes and is characterized as urban as it goes through the City of Waukesha birthplace of Les Paul.

For both sections, the main safety, traffic, structures and pavement findings are summarized in Figure 5. These findings were derived from the detailed "summary of needs" maps shown in Exhibits 1-3. The summary of needs exhibits show the year and location of potential future pavement and structures projects needed to maintain the current infrastructure. The exhibits also highlight current safety issues and how traffic congestion increases over time. While both sections of the corridor have traffic, safety, pavement, and structures needs, the main needs for each include the following:

- **West Section – Safety and Pavement** are pronounced needs in the West Section. Over a third of the section had safety issues, many related to geometric deficiencies which cover most of the section including multiple curves that are too tight for the posted speed. Additionally, pavement replacement projects are planned in this section for 2030 and 2035. These large projects could be opportunities to improve geometric conditions.
- **East Section – Traffic and Structures** are prominent needs in the East Section. Traffic operations in parts of the corridor were already considered failing due to congestion and delay. In 2050, the entire East Section is anticipated to experience failing conditions at some point in the day with severe bottlenecks and backups that can lead to safety issues. Additionally, there are 29 bridge and large culvert projects anticipated before 2035, placing a lot of construction stress on an already congested stretch of interstate. The bridges in this section are aging and will continue to need major maintenance efforts to keep them structurally sound.

Figure 5: I-94 Safety, Congestion and Infrastructure Summary by Section



Next Steps

The purpose of I-94 Waukesha County Needs Study was to inform decisionmakers regarding future safety, pavement, bridge, or other improvement studies and projects. Next steps beyond this study may include prioritizing, scoping, and detailed study of future projects. The "summary of needs" maps in Exhibits 1-3 can serve as a tool for identifying and packaging potential future projects to gain cost and time efficiencies. I-94 was divided into two sections to communicate information for this study; however, actual project boundaries may vary as improvement alternatives are developed.

INTRODUCTION

The purpose of the I-94 Waukesha County Study was to inform decisionmakers regarding potential future safety, pavement, structures, or other improvement projects. This report summarizes existing and future needs throughout the I-94 corridor in the following categories:

Safety issues were found throughout the corridor in high crash rate areas. Forty crash hot spots with high crash rates were found throughout the corridor in the existing conditions and the future expected conditions. The main contributing factors were congestion, deficient horizontal geometry and possible drainage issues.

There are many pavement projects planned for the coming years including pavement replacement for most of the corridor within the next 35 years. These pavement maintenance and replacement projects will require difficult traffic control as volumes increase in the corridor.

As structures continue to age across the corridor more maintenance will be required over time. There are already thirty-three projects programmed for bridges within the corridor and the average age of bridges in the corridor is fifty years old.

There are many geometric deficiencies throughout the corridor that contribute to crashes and safety issues. There are substandard horizontal and vertical curves as well as grade and cross slope deficiencies that lead to drainage issues along the corridor.

Traffic congestion causes delays during peak hours throughout the corridor. The traffic analysis evaluated traffic operations and Level of Service (LOS) for the existing year 2022 through the forecasted year 2050 traffic. Congestion and significant travel delay were found through most of the corridor. The worst congestion occurs from WIS 16 to County F on weekdays, and near County SS on Fridays.

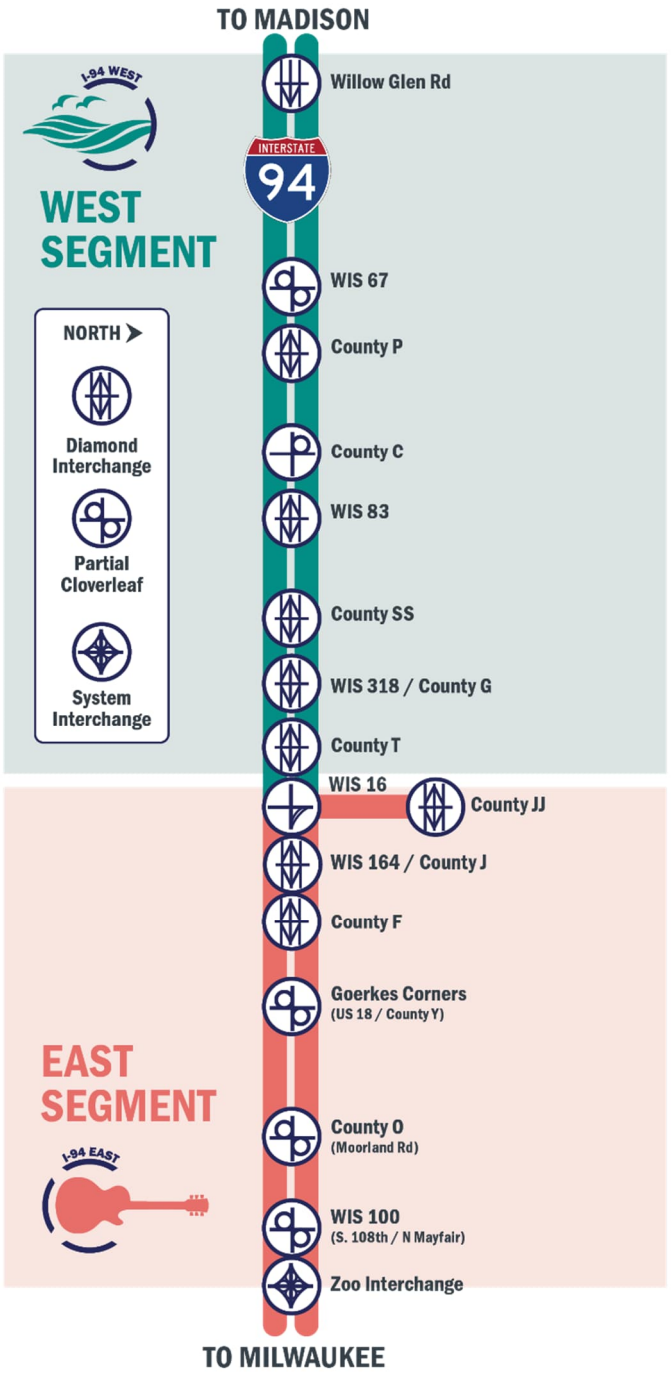
The appendices of this report include the two supporting reports generated during the I-94 Willow Glen Road to Zoo Interchange Needs Study. These reports contain more detailed information on each of the needs:

- **Existing Conditions Report** (Appendix I & II) – contains details regarding traffic, safety, pavement, bridge and geometric conditions in the corridor as of 2022.
- **2050 Future No Build Traffic and Safety Report** (Appendix III & IV) – contains analysis of future year 2050 traffic congestion and safety issues in the corridor.

Corridor Section Definition

For the purposes of this report, the corridor was split into two: the east and the west sections. These are shown in Figure 6.

Figure 6. Project Location



West Section

The West Section stretches between Willow Glen Road and the WIS 16 interchange. This section has four lanes for most of the length and is characterized as rural as it is bordered by beautiful lakes and farmland allowing room for future growth.

East Section

The East Section stretches between the WIS 16 interchange and the Zoo Interchange including a portion of WIS 16 up to the CTH JJ intersection. This section has six lanes and is characterized as urban as it goes through the City of Waukesha birthplace of Les Paul.

SAFETY

The existing safety conditions throughout the corridor were evaluated to find general trends and identify high crash locations potentially needing correction. Historical crash data for the mainline ramps and ramp terminals along the corridor were obtained from the University of Wisconsin-Madison Traffic Operations and Safety Laboratory for the years of 2017 – 2021.

An Interactive Highway Safety Design Model (IHSDM) was created for this study. It evaluated the future predicted and expected crashes throughout the corridor for the year 2050. This analysis supported the findings in the existing conditions safety analysis and highlighted additional locations with safety issues.

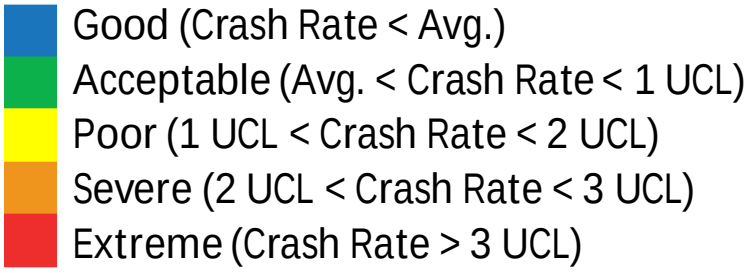
The safety analysis performed for the I-94 corridor study truncated its eastern study limits from the Zoo Interchange to the Waukesha / Milwaukee County Line due to recent reconstruction and capacity improvements along I-94 in Milwaukee County.

Mainline Safety

Collected crash data were converted into crash rates using the method detailed in Appendix I. KAB (injury and fatal crashes) crash rates and KABCO (all crashes) crash rates were both calculated for every location. Crash rates were then compared to the statewide average using Upper Control Limits (UCL). The UCL was determined by the statewide average for a roadway plus one standard deviation from that average. WisDOT provided UCL's for different Meta-Manager Peer Groups which are grouped based on the function, design and volume of traffic on each roadway.

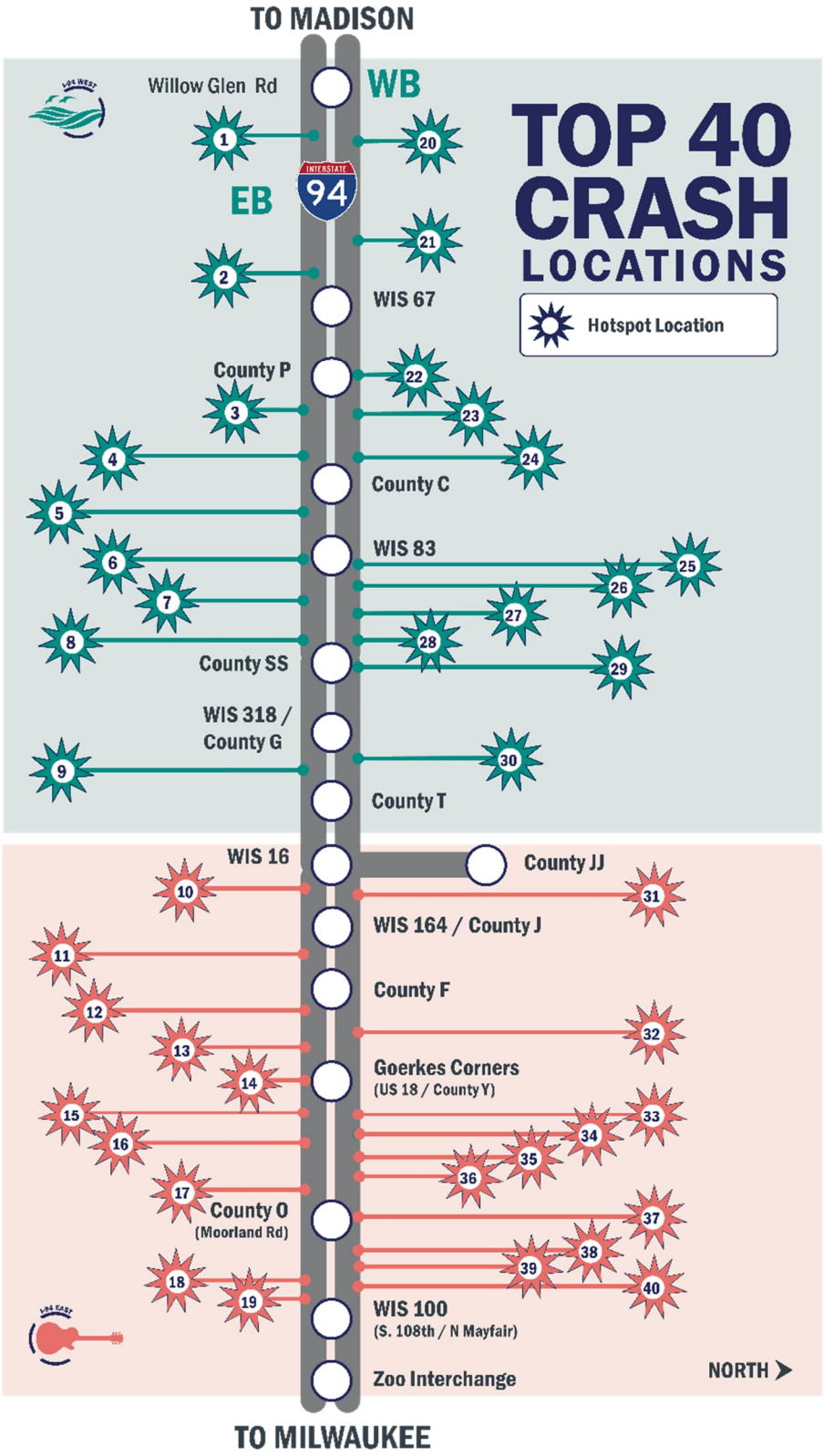
Using these peer group UCL's and the crash rates each data point was given a rating. The ratings ranged from good to extreme as shown in Figure 7.

Figure 7. Crash Condition Ratings



Forty existing mainline hot spots were identified along the corridor for having extended sections of poor, severe or extreme crash rates (Figure 8). Of these forty hot spot locations, 15 had discernable crash trends related to possible engineering factors - seven occurring in the west section and eight in the east.

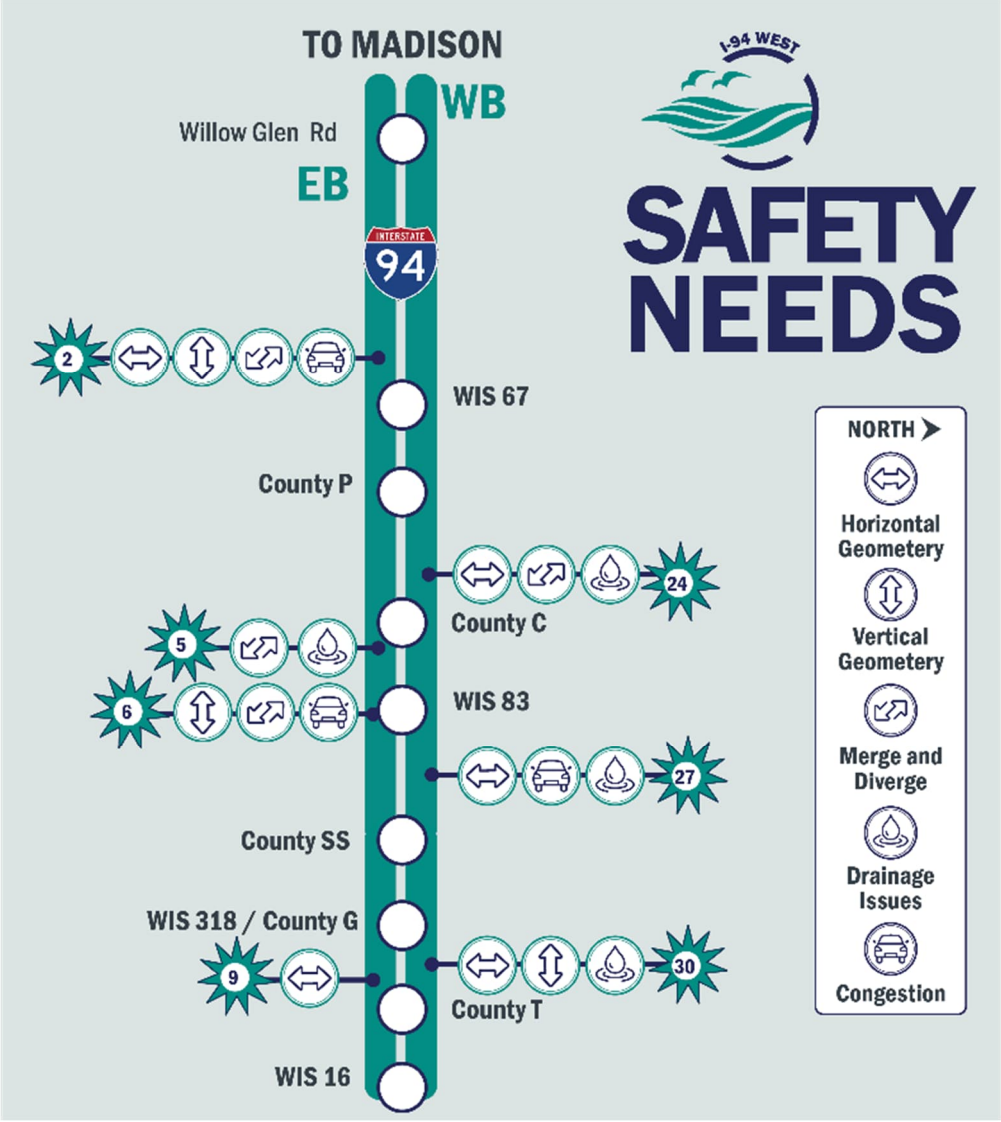
Figure 8. Crash Hot Spot Locations



West Section Select Mainline Hot Spots

The West Section has seven existing hot spots with discernable crash trends with contributing factors to the crashes. Possible contributing factors most commonly found were substandard horizontal curves, drainage issues, and congestion. Horizontal curves rated for lower speeds than the speed limit can lead to congestion as vehicles slow down to navigate the curve and can contribute to crashes when the pavement is wet or snowy as vehicles attempt to take the slippery curve too quickly. The curve between County P and County C (Hot Spot #24) showed a safety issue at the deficient horizontal curve in both the eastbound and westbound directions. Figure 9 shows the seven hot spot locations with contributing factor patterns.

Figure 9. West Section Hot Spot Contributing Factors



More details about the location, crash severity and contributing factors can be found in the following sections. For more details on each crash hot spot please see Appendix II.

I-94 EB; 0.52 mile segment just west of the WIS 67 interchange

This hot spot experiences crash rates three times higher than the UCL for both KABCO and KAB crashes. Eleven (11) of 26 recorded crashes had congestion as the primary contributing factor. Four (4) crashes had merging/diverging geometry as the primary contributing factor.

The exit geometry at this location does not meet the minimum deceleration length or the minimum taper rate and the horizontal curve through the interchange is rated to 60 mph which may contribute to slowing and congestion.

I-94 EB between the County C (Genesee Street) Interchange and the WIS 83 Interchange

This 1.14 mile segment experiences crash rates three times higher than the UCL for both KABCO and KAB crashes. The main contributing factors were identified to be drainage issues (7 crashes), congestion (9 crashes) and merging/diverging geometry (3 crashes).

The County C on-ramp geometry has a substandard acceleration length and taper rate.

I-94 EB; 1.24 mile segment at the WIS 83 Interchange

This hot spot experiences crash rates three times higher than the UCL for both KABCO and KAB crashes. Twenty-five (25) crashes named congestion as a contributing factor and six crashes were attributed to merging geometry at the WIS 83 Interchange. Five crashes occurred on the WIS 83 overpass with slippery conditions. Slippery conditions can be caused by poor drainage.

I-94 EB; 0.53 mile segment along the horizontal curve between WIS 318 and County T

This hot spot experiences crash rates three times higher than the UCL for both KABCO and KAB crashes. This location has the highest crash rates of all crash spots within the study area.

Of 94 crashes, 80 were determined to have the contributing factor of substandard horizontal geometry. Seventy-two of the crashes were “no collision” type, meaning the vehicles ran off the road without hitting another vehicle. Sixty-three of the no collision crashes occurred with wet or snowy road conditions. The substandard horizontal curve can contribute to crashes in the following ways:

1. Difficulty negotiating the curve especially in wet or snow conditions.
2. Reduced rear and side vision through a horizontal curve increasing difficulty changing lanes.
3. Reducing sight distance to possible congestion and other hazardous conditions up ahead.

I-94 EB; 0.79 mile segment at the County C (Genesee Street) Interchange

This hot spot experiences crash rates three times higher than the UCL for KABCO and exceeds the UCL for KAB crashes. Contributing factors include drainage issues (7crashes) and merging geometry of the County C westbound on ramp (7crashes).

The on-ramp geometry has substandard acceleration length and taper rate.

I-94 WB; 0.42 mile segment at the Maple Avenue underpass

This hot spot experiences crash rates three times higher than the UCL for both KABCO and KAB crashes. Contributing factors include horizontal curve geometry, drainage issues and congestion.

The horizontal curve radius and superelevation are substandard and result in a 65 mph rating. These geometric deficiencies could contribute to drainage and congestion issues.

I-94 WB; 0.16 mile segment between the STH 318 and County T interchanges

This hot spot is rated severe for injury crashes. The main contributing factors are substandard geometry, both vertical and horizontal, leading to poor drainage issues and congestion.

East Section Select Mainline Hot Spots

The east section has eight hot spots with discernable crash trends and identified contributing factors to crashes. The most common factors in this section are congestion and horizontal geometry. This coincides with the findings of the geometric review and the traffic analysis finding that congestion is common and will only increase in this part of the study area, likely leading to more crashes in the future. The crash hot spot locations and contributing factors can be seen in Figure 10.

More details about each crash hot spot including size and rating can be seen in the following sections and even more details can be found in Appendix II.

I-94 EB; 0.56 mile segment between WIS 16 and WIS 164

This hot spot experiences crash rates three times higher than the UCL for KABCO and 2x UCL for KAB crashes. The largest contributing factor to this location is congestion, contributing to 59% of crashes. Five of the crashes were possibly affected by the substandard vertical curve in this area which limits the sight distance.

I-94 EB; 0.36 mile segment between WIS 164 and County F Interchanges

This hot spot experiences crash rates three times higher than the UCL for KABCO and 2x UCL for KAB crashes. The major contributing factors at this location are congestion (57 crashes) and merging/diverging geometry (3 crashes).

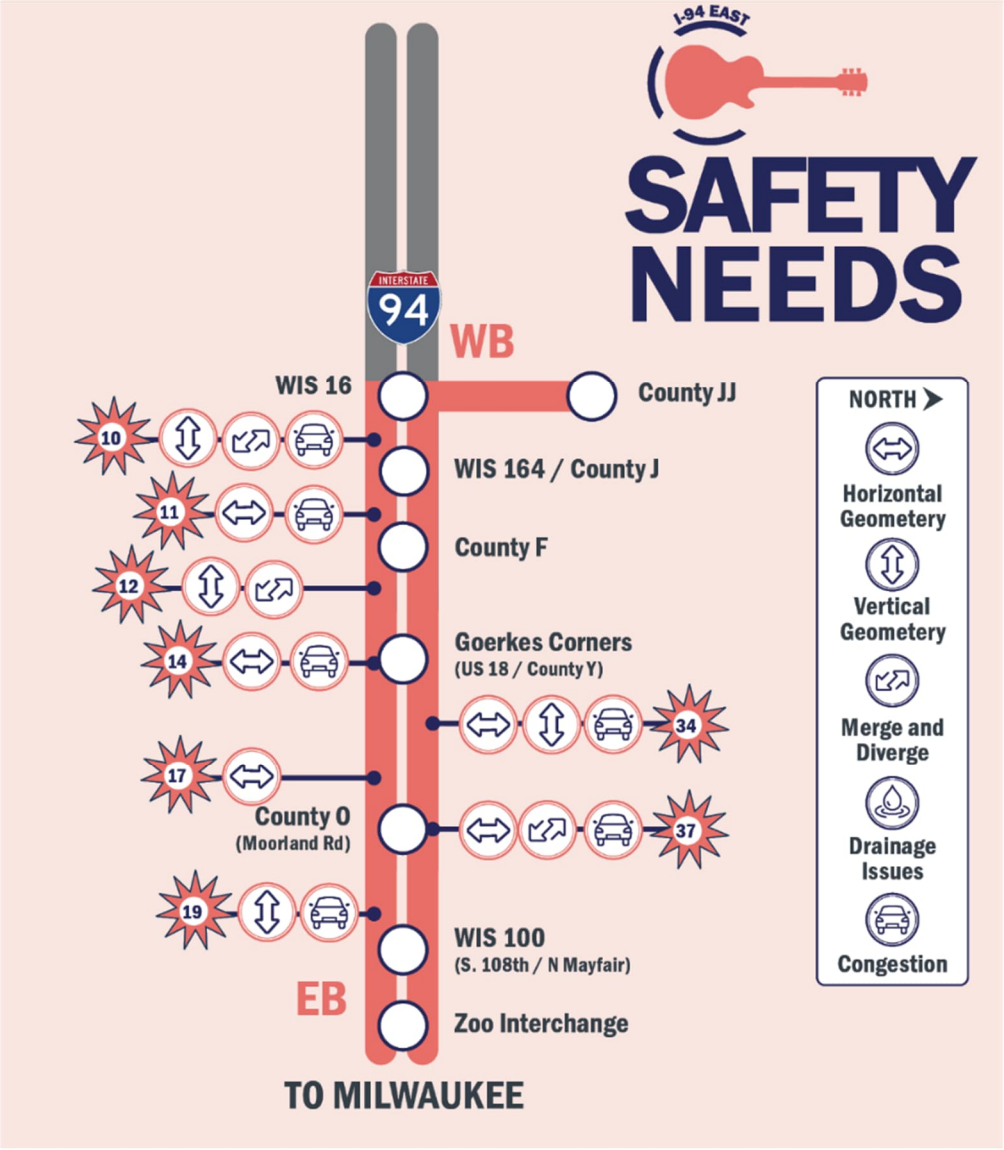
I-94 EB; 0.41 mile segment over CN Railroad and Fox River, just east of County F

This hot spot experiences crash rates two times higher than the UCL for both KABCO and KAB crashes. Contributing factors include substandard vertical crest curve and on-ramp geometry at County F.

I-94 EB; 0.56 mile segment at Goerke's Corners Interchange

This hot spot experiences crash rates two times higher than the UCL for both KABCO and KAB crashes. Contributing factors include substandard horizontal curve radius (27 crashes) and congestion (24 rear end crashes). Twenty-four of the twenty-seven crashes associated with the horizontal curve were run off the road crashes showing the difficulty vehicles have in navigating the substandard curve. The horizontal curve can also contribute to the congestion rear end crashes as vehicles slow down to navigate the substandard curve.

Figure 10. East Section Hot Spot Contributing Factors



I-94 EB; 0.15 mile segment between Calhoun Rd and County O

This hot spot experiences greater than 1x UCL for KAB crashes. Nine of 12 recorded crashes attributed substandard horizontal curve as a contributing factor.

I-94 EB; 0.98 mile segment between Elm Grove Road and the Waukesha/Milwaukee county line

This hot spot experiences crash rates three times higher than the UCL for both KABCO and KAB crashes. This location includes the 1 ¼-mile advanced warning signage for the Zoo Interchange which could cause high levels of weaving as drivers make lane choices. Increased weaving could contribute to congestion at this location which also includes a substandard vertical curve (-3.68% grade exceeds the -3% standard). Speed differentials could also be a contributing factor to crashes. This area has a lower speed limit of 55 mph compared to most of the corridor. This combined with the vertical curve and vehicles driving downhill can lead to more greater speeds as well.

I-94 WB; 0.17 mile segment at Brookfield Road

This hot spot experiences crash rates two times higher than the UCL for KABCO and >1x UCL for KAB crashes. Two geometric deficiencies that contribute to crashes include substandard horizontal and vertical curves.

I-94 WB; 0.35 mile segment at the County O Interchange

This hot spot experiences crash rates three times higher than the UCL for both KABCO and KAB crashes. The primary contributing factor at this location is congestion which may be exacerbated by merging/diverging geometry and horizontal curve deficiencies. The on-ramp at Moorland Road (County O) has inadequate acceleration length.

Ramp Safety

For the ramp safety analysis Federal Highway Administration's (FHWA) Interactive Highway Safety Design Model (IHSDM) was used for two analyses:

- **Predicted Number of Crashes**: The predicted number of crashes (PNC) was calculated by the model using equations derived from nationwide studies of similar roadway types and calibrated based on state-wide studies of similar roadway types.
- **Expected Number of Crashes**: The expected number of crashes (ENC) provided a more "realistic" result by accounting for crash history of the project roadways. The ENC is a modification to the PNC using crash history and an empirical Bayes approach.
- **Potential Safety Improvement**: The potential safety improvement (PSI) is the difference between the ENC and PNC. A positive PSI represents higher than average crashes, and a negative PSI represents lower than average crashes.

Both an ENC and PNC analysis were performed for the entire study area for the future year of 2050 and the results were compared with one another. An ENC that is greater than the PNC means that the ramp or intersection has higher historical crashes than the average road or intersection (nationally) with similar characteristics. Intersections and ramps are ranked based on PSI to determine which locations have the greatest safety concerns based on historical crash trends compared to facilities with similar characteristics.

The top five ramps with the largest PSI are shown in Table 1.

Table 1. I-94 Top Five Ramps (2041-2050) – IHSDM Results

Ramp	ENC (# crashes)			PNC (# crashes)			PSI (# crashes)		
	KABC	PDO	Total	KABC	PDO	Total	KABC	PDO	Total
US 18 EB Off-Ramp	4	9	13	3	4	7	1	5	6
US 18 WB Off-Ramp (Loop)	9	13	22	7	10	17	2	3	5
US 18 EB On-Ramp	8	16	24	8	13	21	0	3	3
County C WB Off-Ramp (Loop)	4	15	19	7	9	16	-3	6	3
County O EB On-Ramp (Loop)	11	34	45	15	27	42	-4	7	3

Red text indicates the ENC is larger than the PNC meaning historically higher than average crashes
Green text indicated PNC is larger than or equal to ENC meaning historically lower than average crashes

Four of the top five ramps are in the East Section and the top three are all part of the Goerke's Corners (US 18 / Bluemound Rd) Interchange. The Goerke's Corners Interchange has many different ramp alignments and tight loop ramps that can cause confusion and difficulty navigating the interchange.

The fourth ranked location is in the western section. The County C WB off-ramp has a series of curves with small radii that could contribute to crashes here though the curves are currently meeting standard for the posted speed. All nine observed crashes at this location were run off the road crashes.

For more details on the Ramp safety results, please see Appendix IV.

Ramp Terminal Intersection Results

The top five ramp terminal intersections with the largest PSI are shown in Table 2.

Table 2. I-94 Top Five Ramp Terminal Intersections (2041-2050) – IHSDM Results

Intersection	ENC (# crashes)			PNC (# crashes)			PSI (# crashes)		
	KABC	PDO	Total	KABC	PDO	Total	KABC	PDO	Total
US 18 & County Y	64	270	334	121	106	227	-57	164	107
County O & I-94 EB Off-Ramp	75	131	206	61	67	128	14	64	78
County Y & I-94 WB Ramps*	27	70	97	26	31	57	1	39	40
County JJ North & County T North*	14	54	68	11	21	32	3	33	36
County T North & WIS 16 Off-Ramp*	21	35	56	20	19	39	1	16	17

***Intersection was evaluated using HSM calibration factors. WisDOT calibration factors were unable to model these intersections.**

Red text indicates the ENC is larger than the PNC meaning historically higher than average crashes

Green text indicated PNC is larger than or equal to ENC meaning historically lower than average crashes

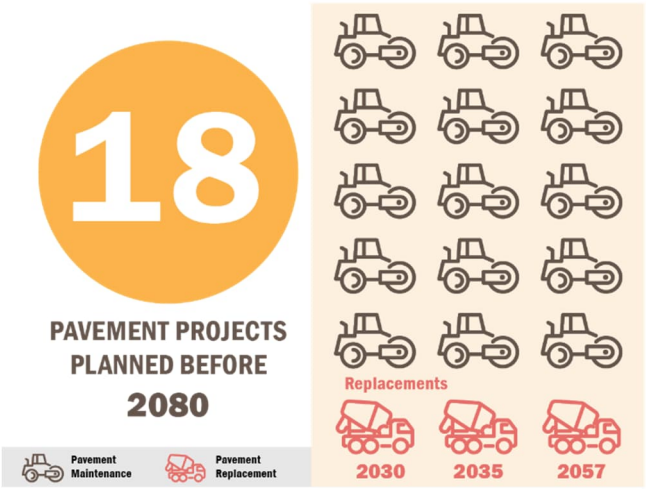
All five of these intersections are in the East Section, with two of them along WIS 16. The WIS 16 & County JJ Interchange experiences congestion from the large Waukesha County Technical College campus drawing a lot of traffic and causing delay and unbalanced volumes on the ramps. The US 18 & County Y and County Y & I-94 EB Off-Ramp intersections are both part of the Goerke's Corners Interchange which is a large and complex interchange that can be difficult to navigate.

PAVEMENT

The existing pavement history and future planned maintenance projects were provided by the WisDOT SE Region Programming Section. Please see Appendix II for the provided information. These projects represent the pavement condition and age as well as the effort needed to keep the pavement in working order. Pavement maintenance projects include concrete overlays, concrete base repairs, pavement patch replacements, and full pavement replacements.

Because of the importance of the I-94 corridor for the commuter, freight and tourism economy in Wisconsin, it is important to keep the pavement in good driving condition. Much of the pavement in the study section is over 20 years old and has reached the point in the pavement life cycle where it will need more frequent maintenance and eventually a major pavement replacement project. Eight of the next thirty-five years have anticipated pavement maintenance projects (Figure 11) including multiple highly impactful pavement replacements in 2030, 2035 and 2057 and ten significant pavement resurfacing projects.

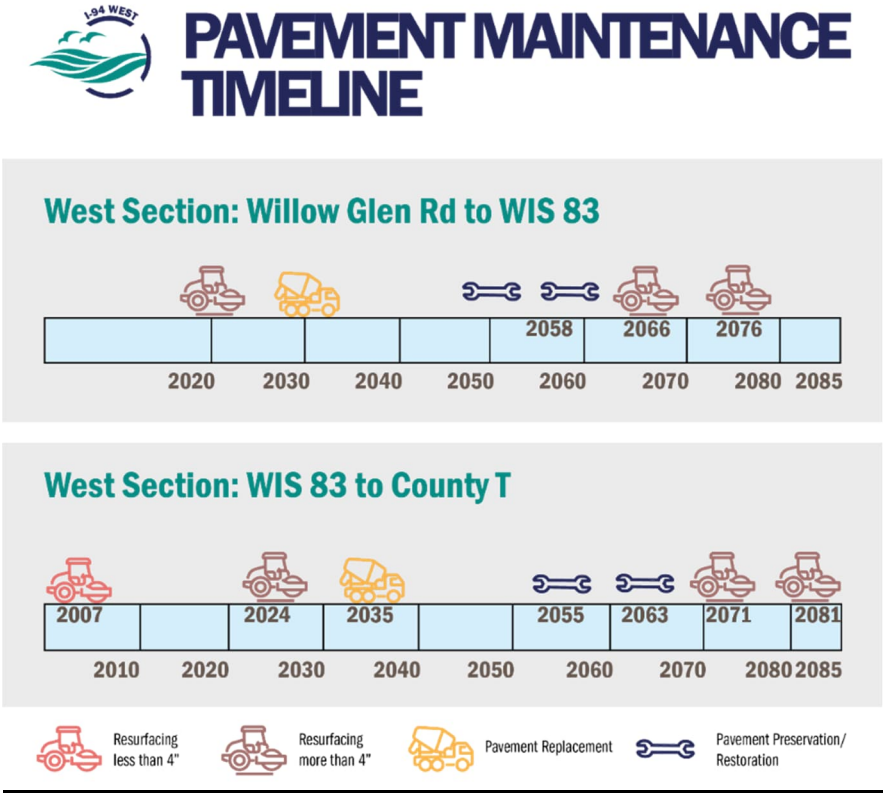
Figure 11. Pavement Project Summary



West Section

The West Section has planned pavement replacement throughout the next ten years. Willow Glen Road to WIS 83 is anticipated to need replacement around 2030, and WIS 83 to County T is anticipated to need replacement around 2035. Besides these two major pavement replacement projects, the West Section has ten additional pavement maintenance projects scheduled before 2080. Figure 12 shows the pavement maintenance timelines for the West Section.

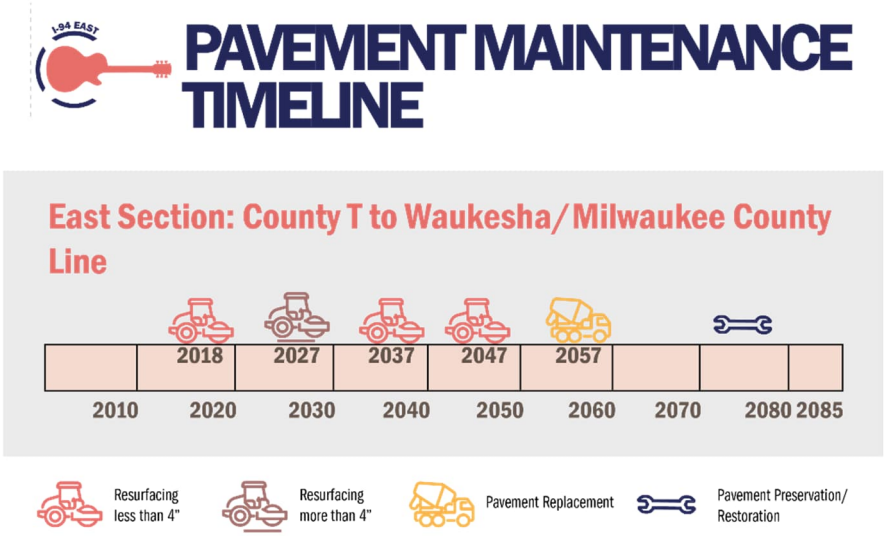
Figure 12. West Section Pavement Timelines



East Section

The portion of the East Section from County T to the Waukesha/Milwaukee County Line has ten pavement maintenance projects scheduled before 2080. These projects include a large-scale pavement replacement in 2057. The scheduled project timeline is shown on Figure 13.

Figure 13. East Section Pavement Timelines



STRUCTURES

Structural data for 47 bridges and five large (multi-cell with ≥ 20' span) box culverts were collected from:

- WisDOT Highway Structures Information System (HSIS) – location, construction year, superstructure type, and clear width – and,
- Wisconsin Structures Asset Management System (WiSAMS) – location, construction history, bridge type, size, condition data, and anticipated rehabilitation schedule.

Vertical and lateral clearances were compared to current standards in the WisDOT Facilities Development Manual (FDM) and the Wisconsin Bridge Manual. Structural condition was evaluated using the structure age, National Bridge Inventory (NBI) ratings, and load ratings. For detailed information on the methodology used to evaluate structures see Appendix I – Existing Conditions Report. For tables containing the various information collected, please see Appendix II – Existing Conditions Appendix.

The structures in this corridor are aging with 33 structures over the age of 60 as of 2024. In addition, many of the structures are deficient in clearance either vertically or horizontally. A summary of these ages and deficiencies can be seen in Table 3 and Table 5.

West Section

In the West Section there are 12 structures that are more than 60 years old as of 2024 and 50% are deficient in lateral clearance. As these structures age, more maintenance will be needed.

Table 3: Deficient Structures in West Section

					Deficiency			
Structure Number	Type	Facility On	Facility Under	Age in 2024	Vertical Clearance	Lateral Clearance	Clear Width	Condition
B280051	Bridge	IH 94 EB	Willow Glen Rd	61				
B280052	Bridge	IH 94 WB	Willow Glen Rd	61				
B670060	Bridge	IH 94 WB	Maple Ave	62		x		
B670061	Bridge	IH 94 EB	Maple Ave	62		x		
B670062	Bridge	IH 94 WB	STH 83	62		x		
B670063	Bridge	IH 94 EB	STH 83	62		x		
B670065	Bridge	IH 94 EB	Cushing Park Rd	62				
B670066	Bridge	IH 94 WB	Cushing Park Rd	61				
B670067	Bridge	IH 94 EB	Waterville Rd	62		x		
B670068	Bridge	IH 94 WB	Waterville Rd	61		x		
B670069	Bridge	IH 94 EB	Nemahbin Lake	62				
B670083	Culvert	IH 94	Battle Creek	60				

There are five bridge projects planned in the West Section. Four concrete overlay projects were identified in WisDOT's Financial Integrated Improvement Programming System (FIIPS) which is a database for funded projects. One bridge replacement was identified in the Wisconsin Structures Asset Management System (WiSAMS) which recommends bridge maintenance and replacement projects, but the projects do not currently have committed funding and are generally more than five years into the future. The details can be seen in Table 4.

Table 4: West Segment FIIPS and WiSAMS Structures Programmed Projects

	Structure Number	Facility On	Facility Below	Year	Work Action
	B-67-060/061	I-94	Maple Ave	2024	Concrete Overlay
	B-67-267	WIS 318	I-94	2024	Concrete Overlay
	B-67-266	County Rd SS	I-94	2024	Concrete Overlay
	B-67-245	County Rd T	I-94	2024	Concrete Overlay
	B-67-064	County Rd C (Genesee St)	I-94	2030	Bridge Replacement

Gray shade represents completed projects.

There will be significant work on these structures within the next five years, and more work is anticipated in the following years as the structures continue to age. This is true for the west section, but it is also true for the east section.

East Section

In the East Section there are 22 structures that are either aging or are deficient geometrically. Twenty of those 22 structures are over the age of 60 as of 2024 and will continue to need more frequent and extensive maintenance as they age. Fourteen of the structures are deficient in clearance in some way.

Table 5: Deficient Structures in East Section

					Deficiency			
Structure Number	Type	Facility On	Facility Under	Age in 2024	Vertical Clearance	Lateral Clearance	Clear Width	Condition
B670012	Culvert	IH 94	Pewaukee River	67				
B670014	Bridge	CTH F SB	IH 94	68				
B670140	Bridge	CTH F NB	IH 94	47	x			x
B670016	Bridge	IH 94 WB	CN RR	67		x		
B670017	Bridge	IH 94 EB	CN RR	67		x		
B670018	Bridge	IH 94 WB	Fox River	67			x	
B670019	Bridge	IH 94 EB	Fox River	67			x	
B670040	Bridge	IH 94 WB	CTH SR (Springdale Rd)	66			x	
B670041	Bridge	IH 94 EB	CTH SR (Springdale Rd)	66			x	
B670042	Bridge	CTH JJ WB	IH 94	62		x	x	
B670043	Bridge	CTH JJ EB	IH 94	62		x	x	
B670044	Bridge	USH 18 WB	IH 94	62				
B670045	Bridge	USH 18 EB	IH 94	62				
B670046	Bridge	CTH Y/Barker Rd	IH 94	62				
B670047	Culvert	IH 94	Poplar Creek	63				
B670072	Culvert	IH 94	BR Poplar Creek	63				
B670048	Bridge	IH 94 WB	Brookfield Rd	62			x	
B670049	Bridge	IH 94 EB	Brookfield Rd	62			x	
B670052	Bridge	IH 94 WB	CTH O (Moorland Rd)	64		x		
B670053	Bridge	IH 94 EB	CTH O (Moorland Rd)	64		x		
B670102	Bridge	Ramp, CTH O SB to IH 94 EB	CTH O (Moorland Rd)	58			x	
B670058	Culvert	IH 94	BR Poplar Creek	64				

There are 23 bridge projects planned in the East Section before 2031. Four are identified in WiSAMS as requiring projects in 2030 and 2031. The others are funded projects between 2024 and 2028 identified in FIIPS. The details can be seen in Table 6.

Table 6: East Segment FIIPS and WiSAMS Structures Programmed Projects

	Structure Number	Facility On	Facility Below	Year	Work Action
	B-67-240	County Rd JJ	I-94	2024	Concrete Overlay
	B-67-140	County Rd F NB	I-94	2026	Deck Replacement
	B-67-014	County Rd F SB	I-94	2026	Minor Rehabilitation
	B-67-307/308	I-94	Calhoun Rd	2026	Concrete Overlay
	B-67-244	WIS 16 EB	I-94	2027	Concrete Overlay
	B-67-234/235	WIS 164 – County Rd J	I-94	2027	Concrete Overlay
	B-67-012	I-94	Pewaukee River	2027	Minor Rehabilitation
	B-67-016/017	I-94	CN RR	2027	Concrete Overlay
	B-67-018/019	I-94	Fox River	2027	Concrete Overlay
	B-67-040/041	I-94	County Rd SR (Springdale Rd)	2027	Concrete Overlay
	B-67-042/043	County Rd JJ WB	I-94	2027	Concrete Overlay
	B-67-044/045	US 18 WB	I-94	2027	Concrete Overlay
	B-67-046	County Rd Y/Barker Rd	I-94	2027	Concrete Overlay
	B-67-047	I-94	Poplar Creek	2027	Minor Rehabilitation
	B-67-048/049	I-94	Brookfield Rd	2027	Concrete Overlay
	B-67-052/053	I-94	County Rd O (Moorland Rd)	2027	Concrete Overlay
	B-67-058/072	I-94	BR Poplar Creek	2027	Minor Rehabilitation
	B-67-018/019	I-94	Fox River	2028	Painting
	B-67-012	I-94	Pewaukee River	2030	Culvert Replacement
	B-67-017	I-94	CN RR	2031	Painting
	B-67-017	I-94	CN RR	2031	Painting
	B-67-058	I-94	BR Poplar Creek	2031	Culvert Replacement

Gray shade represents completed projects.

There are 13 bridge projects along approximately 8 miles of the study area planned for the year 2027 which could cause a lot of disruption to the already congested East Section. Careful planning of work actions is needed to maximize efficiency and minimize driver frustration, delay, and increase freight costs.

GEOMETRICS

The geometric deficiency analysis showed majority of the corridor has at least one substandard geometric feature compared to current design standards. Most of the corridor has substandard cross slope or vertical grade deficiencies leading to potential drainage issues, and every ramp in the corridor has a deficiency in vertical sight distance; many have other deficiencies as well. These deficiencies are discussed below and additional details are found in Appendix II – D.

Cross Sectional Deficiencies

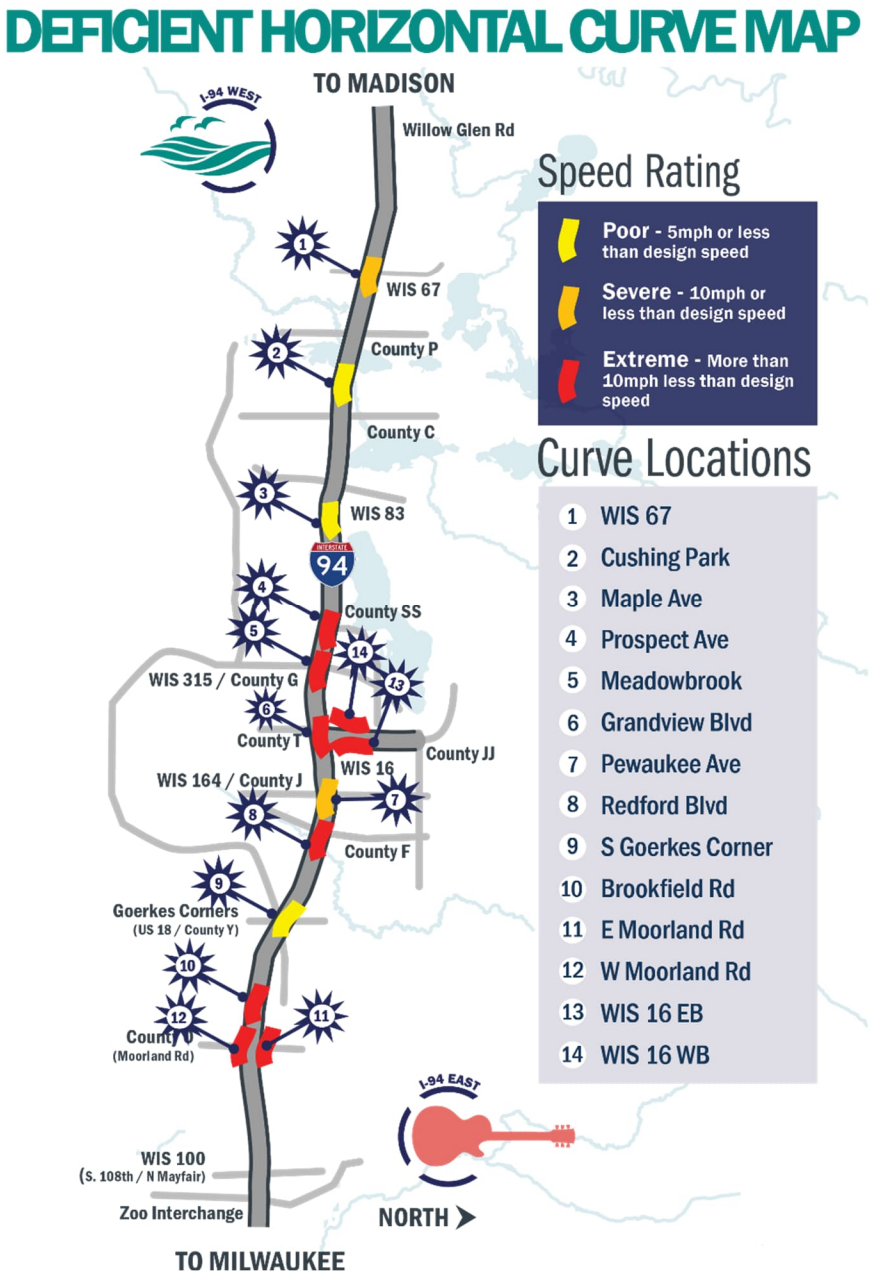
Cross Slope Deficiencies

Most of I-94 was originally constructed with a 1% cross slope through tangent areas. Since this original construction, the cross slope standard for WisDOT projects was raised to 2% so that water drains efficiently across the pavement. Roads with substandard cross slopes are more prone to black ice, hydroplaning, and slippery conditions leading to safety issues. Some subsequent resurfacing projects along the corridor raised the cross slope to 1.5%, but the vast majority of the corridor remains below the current cross slope 2% standard. The specific areas of the corridor with substandard cross slopes are shown in Appendix II - D.2.1 on Table 2.4.

Horizontal Alignment Deficiencies

Horizontal alignment elements include tangent sections and horizontal curves evaluated for alignment deflection, radii and superelevation. There are no existing alignment deflection deficiencies, but there are 14 mainline curves (12 on I-94 and 2 on WIS 16) that are rated deficient for minimum radii and/or deficient for superelevation. Of these 14 curves, 9 are classified as Extreme with speed ratings 10 mph or more below the posted speed. The locations of these deficient mainline curves can be seen in Figure 14.

Figure 14. Deficient Horizontal Curves



Vertical Profile

The vertical profile of a roadway section is the series of curves, tangents, and deflections that describe the vertical movement of the roadway. Along with cross slope, the vertical grade contributes to the efficient drainage of a roadway. Roads that are too “flat” are more prone to black ice, hydroplaning, and slippery conditions leading to safety issues. Table 7 shows the locations within the corridor have substandard vertical grades.

Table 7. Minimum Vertical Grade Deficiencies

Alignment	Grade	Required	
		MINIMUM	DESIRABLE
IH 94 EB Just west of the WIS 67 intersection	0.28%	0.30%	0.50%
IH 94 EB through the middle of the WIS 67 intersection	0.28%	0.30%	0.50%
IH 94 EB East of WIS 67	0.00%	0.30%	0.50%
IH 94 EB between WIS 83 & County C	0.00%	0.30%	0.50%
IH 94 EB on Ramp from STH 67 LOOP RAMP	0.23%	0.30%	0.50%
Meadowbrook Ave on ramp to IH 94 WB	0.12%	0.30%	0.50%
IH 94 WB off ramp to Meadowbrook Ave	0.13%	0.30%	0.50%
Meadowbrook Ave on ramp to IH 94 EB	-0.15%	0.30%	0.50%
IH 94 WB off ramp to Pewaukee Road	0.28%	0.30%	0.50%
IH 94 WB off ramp to Pewaukee Road	0.02%	0.30%	0.50%
IH 94 WB on ramp from USH 18 LOOP RAMP	0.00%	0.30%	0.50%
IH 94 WB on ramp from Moorland Rd	0.00%	0.30%	0.50%
IH 94 EB on ramp from SB Moorland Rd LOOP RAMP	0.00%	0.30%	0.50%
IH 94 EB off ramp to Moorland Rd	0.00%	0.30%	0.50%

Red represents locations that are rated extreme.

Table 7 isolates the areas that are below the minimum standard for vertical grade. Many additional locations, not shown in Table 7, have below desirable grades (0.5%); details for these locations can be found in Appendix II - C.2.3 in Table 2.8. Substandard cross slopes that cover most of the corridor compound the drainage issues at these deficient grade locations.

In addition to the minimum grade standards to facilitate appropriate drainage, there are maximum tangent grade requirements to prevent safety issues caused by the slowing of large vehicles to navigate steep hills. The grades were given speed ratings and the poor and extreme rated locations can be seen in Table 8.

Table 8. Maximum Vertical Grade Deficiencies

Location	Grade	Design Speed	Max Grade (+/-)	Speed Rating
IH 94 Between County P and County C interchanges	3.14%	70	3.00%	55
IH 94 Between County O and the Zoo Interchange	-3.68%	60	3.00%	55
IH 94 WB just east of County C	-3.19%	70	3.00%	55
IH 94 EB on ramp from Grandview Blvd	-5.15%	60	5.00%	45

Red represents locations that are rated extreme.
Yellow represents locations are rated severe.

For more information and details on the vertical grade deficiencies see Appendix II - D.2.3 on Table 2.9.

Sight Distance

Vertical alignment has sight distance requirements for its design. When the vertical curve is too short or is too sharp, it restricts the sight distance of the drivers. There are two categories of sight distance: stopping site distance (SSD) and decision sight distance (DSD). These were both investigated and given a speed rating. The mainline locations where the stopping sight distance was deficient can be seen in Table 9.

Table 9. Mainline Vertical Sight Distance Deficiencies

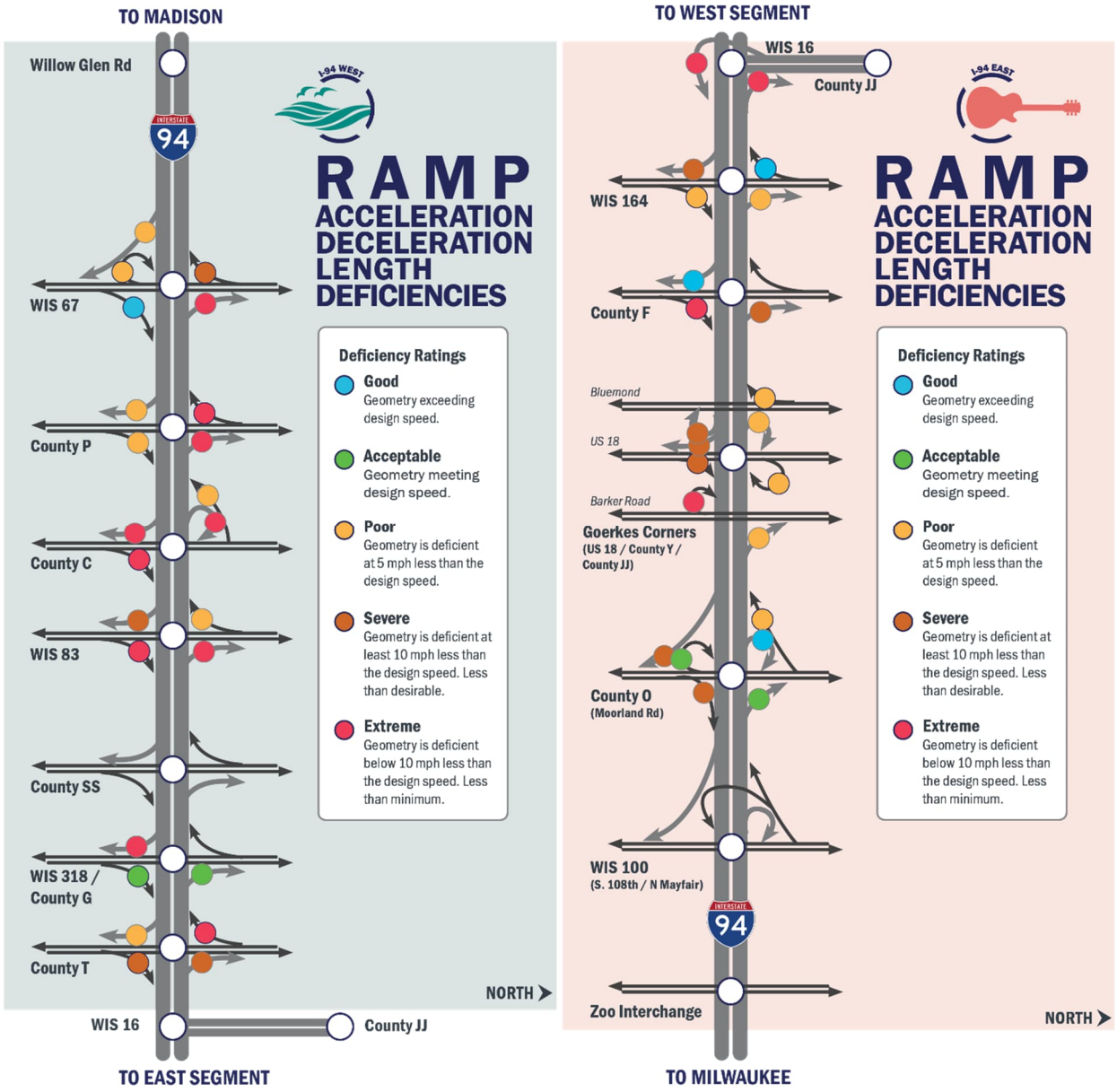
Alignment	Location	Curve Type	Curve Length	Grade Delta	SD	Design Speed	Required SD		Speed Rating
							SSD	DSD (CAT 2)	
IH 94 EB	East of County F	Crest	360	4.08%	444	70	730	1445	<30
IH 94 EB	West of Goerke's Corners	Sag	670	5.50%	545	70	730	1445	55
IH 94 WB	East of County F	Crest	360	4.08%	444	70	730	1445	<30
IH 94 WB	West of Goerke's Corners	Sag	670	5.50%	545	70	730	1445	<30

Many of the ramps in the corridor have deficient vertical curves in terms of sight distance speed ratings as well. For all of the ramp details as well as the ratings for other sections of the mainline, see Appendix II - C.2.4.

Ramp Acceleration/Deceleration

The ramp acceleration and deceleration lengths were calculated based on the speed differential between the mainline and the ramp. The greater the speed differential, the greater the distance necessary for the vehicle to achieve the proper speed. Thirty-three of the 75 ramps within the study area are deficient based on the current speed of the ramp compared to the speed of the mainline. For locations of deficient ramps, see Appendix II - D.2.6. The ramps' speed ratings for the acceleration/deceleration lengths can be seen in Figure 15.

Figure 15. Ramp Acceleration and Deceleration Length Deficiencies[1]



[1] Note: Ramps without ratings do not have data and were not included in the as-builts.

TRAFFIC

Potential congestions issues were identified by analyzing traffic volumes from existing year (2022) through forecasted year (2050) assuming no improvements are made beyond those that are already committed (funded). A variety of data sources and tools were used in the analysis, including: traffic counts, lane utilization and third-party data sources such as travel time from National Performance Management Research Data Set (NPMRDS) and StreetLight origin-destination data. Analysis produced detailed information regarding:

- Traffic level of service (LOS)
- Traffic speeds
- Travel times
- Origin-destination travel patterns
- Ramp terminal intersection LOS

This report summarizes the overall traffic congestion issues and operational status of the corridor. Details regarding the traffic analysis can be found in Appendix I and Appendix III.

Traffic Trends

There are two main types of travel patterns in the I-94 corridor: commuter traffic and recreational traffic. Commuting traffic typically makes up the majority of the total volume observed during the weekday AM and PM peak hours. Recreational traffic typically occurs during the afternoon hours on summer Fridays. In some parts of the study area, the recreational traffic represents the highest traffic volumes; in others, the commuter traffic represents the highest traffic volumes.

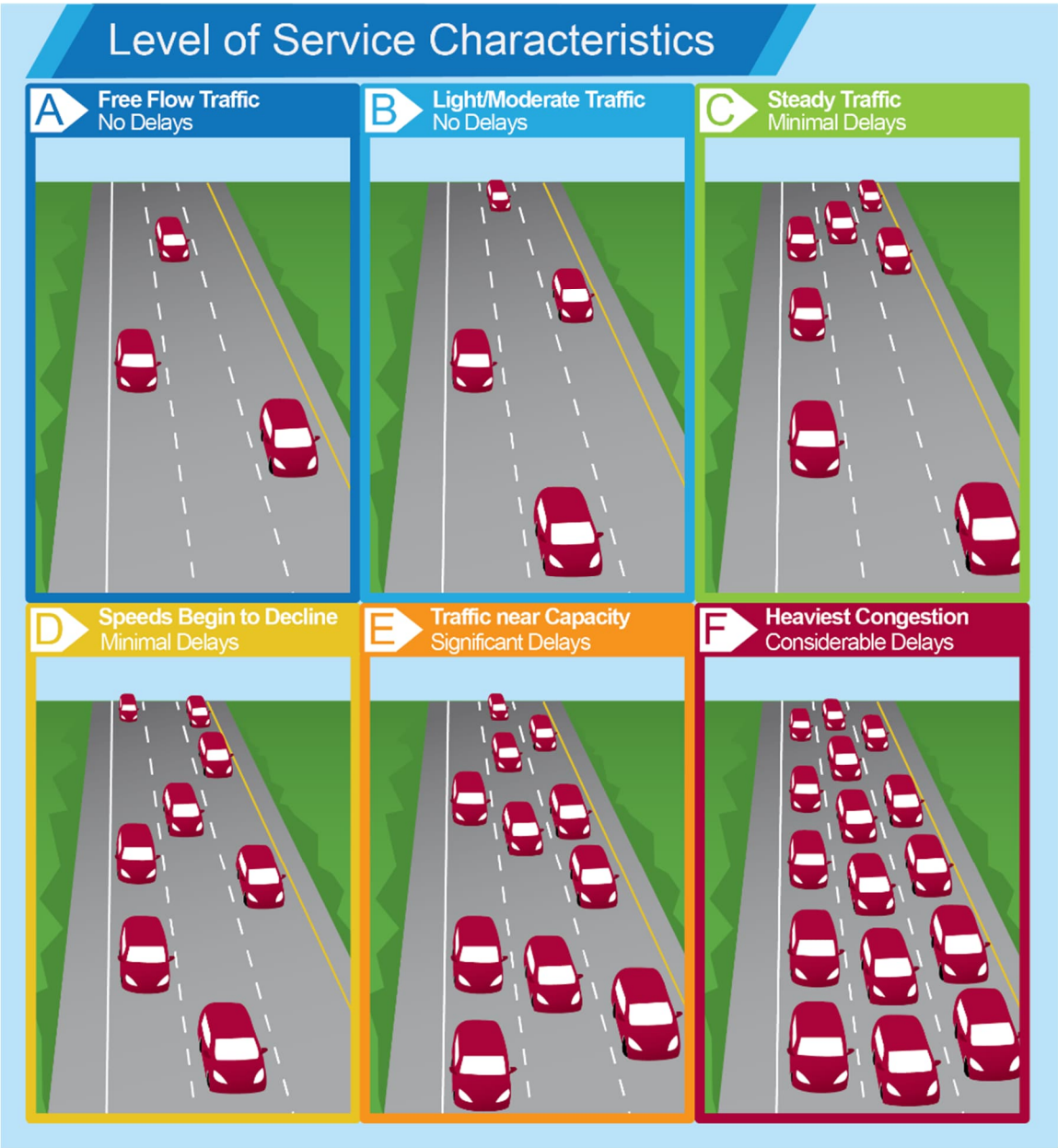
Generally, commuter traffic volumes are higher for I-94 segments east of County T while recreational traffic volumes are higher for segments west of County T. This also follows a change in land type along the corridor as the western segments are more rural in nature, while the eastern segments exhibit more urban features; however, all I-94 segments in the study area except for Willow Glen Road are classified by WisDOT as urban. The truck percentages along the corridor follow this same pattern with the western portion having higher truck percentages (greater than 10%) while the eastern portion has lower truck percentages (less than 10%).

Traffic Level of Service

Freeway Level of Service (LOS)

Traffic operational analysis primarily focused on level of service (LOS) as a planning-level indicator of congestion, driver discomfort, frustration, and increased travel time. Figure 16 shows the differences between levels of service.

Figure 16: Freeway Level of Service



Section 11-5-3.2.1 of WisDOT's Facilities Development Manual (FDM)[2] defines desirable LOS thresholds. For C2030 Backbone Routes, like I-94, a LOS D for urban areas and LOS C for rural areas is desired as shown in Table 10.

[2] FDM 11-5 General Design Considerations

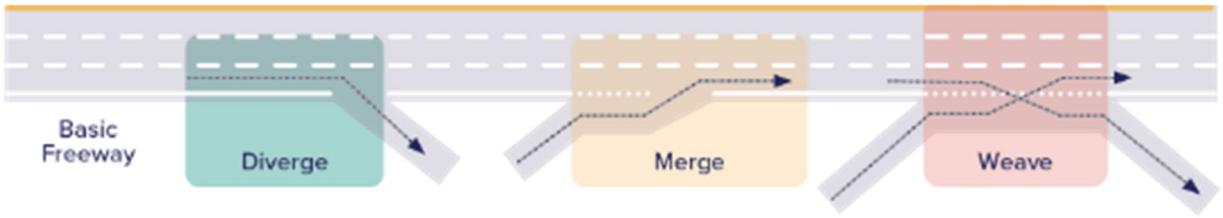
Table 10: Desirable Levels of Service

STH Sub-System	Rural and Small Urban Areas	Urbanized Areas with Population > 50,000
Corridor 2030 Backbone and Connector Routes	LOS C	LOS D
National Highway System (NHS) Routes (Non-NHS Backbone and Connector Routes)	LOS D	LOS D
Non-NHS Routes (Other Principal Arterials, Minor Arterials, Collectors and Local Functionally Classified Roads)	LOS D	Mid LOS E

Adapted from Wisconsin Facilities Development Manual, *FDM 11-5 General Design Considerations*, Section 3.2.1, Page 4.

Freeway level of service analysis was completed using methodologies published in the Highway Capacity Manual (HCM) 6th Edition. PTV Vissim microsimulation software was used to develop a traffic operations model of the I-94 freeway corridor. The freeway was segmented into basic, merge, diverge, and weave influence areas (Figure 17), per HCM guidelines, resulting in 50 influence areas for the eastbound mainline and 52 influence areas for westbound. Additionally, five northbound and five southbound influence areas along WIS 16 were included in the analysis. Vissim analysis was used to determine the LOS along the whole study area.

Figure 17: Mainline Segmentation Example



Data inputs for the LOS analysis were obtained from existing year 2022 traffic counts through year 2050 traffic forecasts. The following report sections discuss freeway and intersection LOS and traffic congestion on I-94.

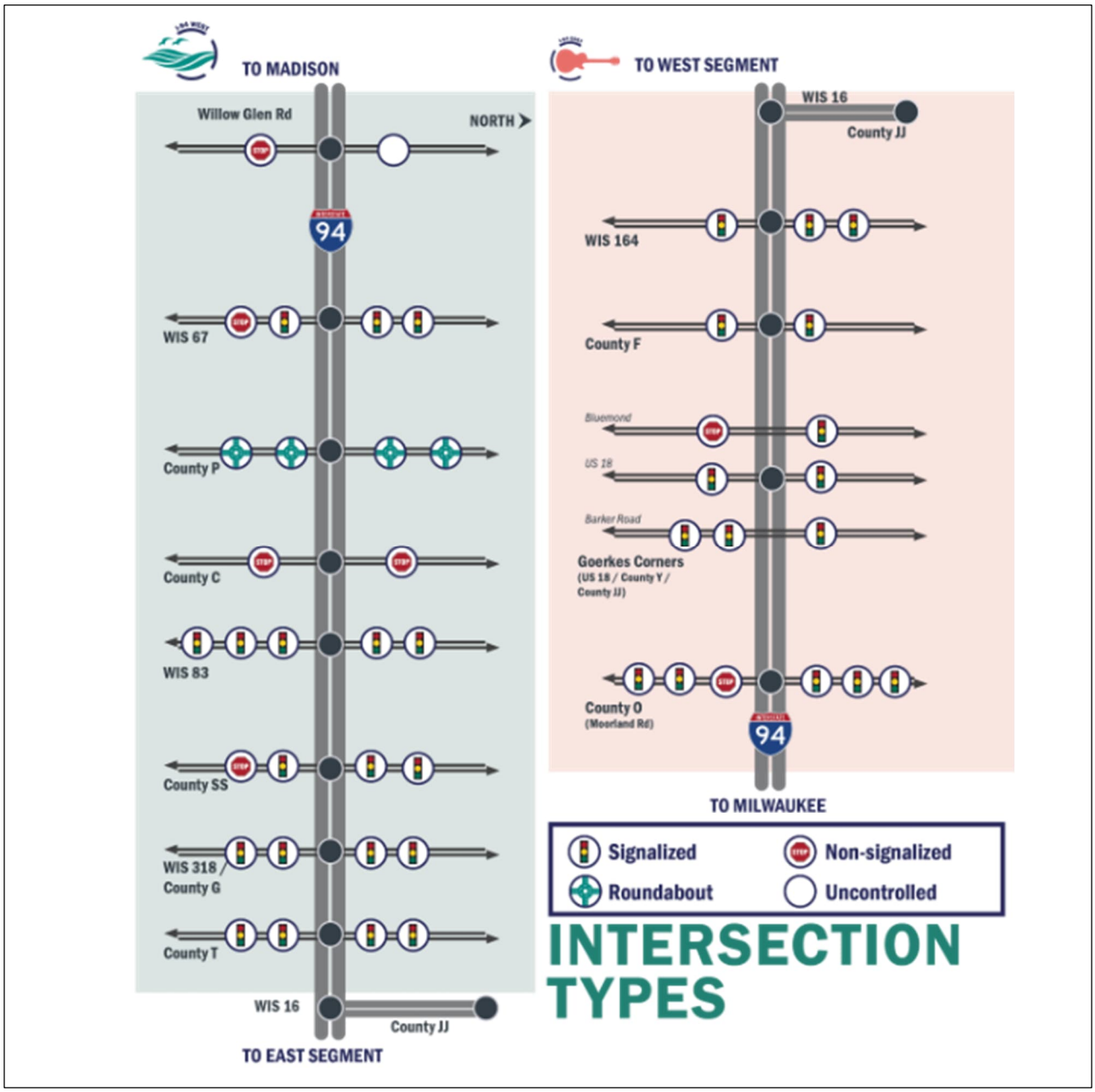
Intersection LOS

Intersection LOS was determined using control delay per vehicle per lane group. Weighted averages of the control delay for lane groups can provide an LOS for an approach or for an entire intersection. Section 11-5-3.2.2 of WisDOT's FDM provides guidance regarding the desired LOS on WisDOT-controlled roadways, "Where practical, on C2030 and NHS routes, strive to provide LOS D or better operations for all movements at the intersection (left, through, and right turning movements for each approach) during the peak hours of travel."[3] Therefore, LOS D was identified as the minimum desired LOS condition for intersection analysis.

[3] FDM 11-5 General Design Considerations

Synchro 11 modeling software was used to analyze LOS at 41 intersections along the corridor, 33 signalized intersections and 8 stop-controlled intersections, and one diverging diamond interchange. The HCM 6th Edition methodology was followed when possible; however, some locations were unable to be modeled using HCM 6 due to limitations in the software for unique lane configurations or signal phasing. In these situations, WisDOT approved the use of HCM 2000 as an alternate method. Additionally, four roundabouts were analyzed using Sidra 9.1 modeling software following HCM 6th Edition methodology. Intersection locations with LOS analysis are shown in Figure 18.

Figure 18: Analyzed Intersection Location Map



Traffic Level of Service Results

The level of service analysis showed that there are many portions of the corridor operating below desirable levels, especially in the east section. This can be seen in the mainline and interchange results.

Freeway Congestion Results

The West Section is operating at LOS D in the existing conditions around the County C and WIS 83 interchanges. In the future conditions, the corridor deteriorates with greater traffic and experiences LOS F from WIS 67 to WIS 16 in the Friday and PM peaks. The interchange results mirror the mainline results showing the worst existing conditions around County C and County SS, and then the failing conditions expand to all interchanges except Willow Glen Road in the future. The west section LOS results can be seen in

Table 11.

Table 11: West Section Mainline Interchange Congestion Results

Location	Segment Type	Existing 2022						Future Year 2050					
		AM		PM		FRI		AM		PM		FRI	
		EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
West Section (desirable LOS D)													
West of Willow Glen Road	Basic	B	B	B	B	C	C	B	B	C	C	C	C
Willow Glen Rd	Diverge	B	-	B	-	C	-	B	-	C	-	C	-
	Merge	-	B	-	B	-	C	-	B	-	B	-	C
Willow Glen Road to WIS 67	Basic	B	B	B	B	C	C	B	B	C	C	C	C
WIS 67	Diverge	B	C	B	C	C	C	B	C	B	C	D	C
	Basic	B	B	B	B	C	C	B	B	B	B	F	B
	Merge	B	B	C	B	C	C	B	B	E	B	F	C
WIS 67 to County P	Basic	C	C	C	C	C	C	C	C	F	C	F	C
County P	Diverge	B	B	C	C	C	C	C	C	F	C	F	F
	Basic	C	C	C	C	C	C	C	C	F	C	F	C
	Merge	C	B	D	C	E	C	D	C	F	C	F	C
County P to County C	Basic	C	C	D	C	D	D	D	C	F	D	F	F
County C	Diverge	C	C	C	C	D	C	C	C	F	F	F	F
	Basic	C	C	D	C	E	C	D	C	F	C	F	F
	Merge	C	C	E	C	F	C	E	C	F	C	F	F
County C to WIS 83	Basic	C	C	D	D	D	D	D	C	F	F	F	F
WIS 83	Diverge	C	C	D	D	D	D	D	D	F	F	F	F
	Basic	C	C	C	C	C	C	F	C	F	F	F	F
	Merge	C	C	D	C	D	D	F	C	F	F	F	F
WIS 83 to County SS	Basic	D	D	D	D	D	D	F	D	F	F	F	F
County SS	Diverge	C	-	D	-	D	-	F	-	F	-	F	F
	Basic	C	C	D	F	D	F	D	E	F	F	F	F
	Merge	C	D	C	D	C	E	C	D	F	F	F	F
WIS 318	Diverge	B	B	B	B	C	B	C	B	F	F	F	F
	Basic	C	B	C	B	C	C	C	B	F	F	F	F
	Merge	C	-	C	-	C	-	C	-	F	-	F	F
WIS 318 to County T	Basic	C	B	C	C	C	C	C	B	F	C	F	F
County T	Diverge	C	B	C	C	C	C	E	C	F	C	F	F
	Basic	C	B	C	B	C	C	F	B	F	C	F	F
	Merge	C	B	C	C	C	C	F	B	F	C	F	F
County T to WIS 16	Basic	C	B	C	C	C	C	F	C	F	C	F	F

The east section is already experiencing LOS F between Goerke's Corners and County O for all peaks and both directions. There are other failing sections as well between County F and Goerke's Corners. This expands to the whole section in the Future 2050 No Build condition. The east section experiences a great deal of congestion both now and it will only get worse in the future conditions. The existing interchange LOS results show a great deal of failing conditions in the east section. Every interchange experiences LOS F in at least one direction and peak for multiple segments in the existing conditions and it only gets worse in the future conditions, where nearly all segments, peaks, and directions experience failing LOS. Please see east section LOS results in Table 12.

Table 12: East Section Congestion Results

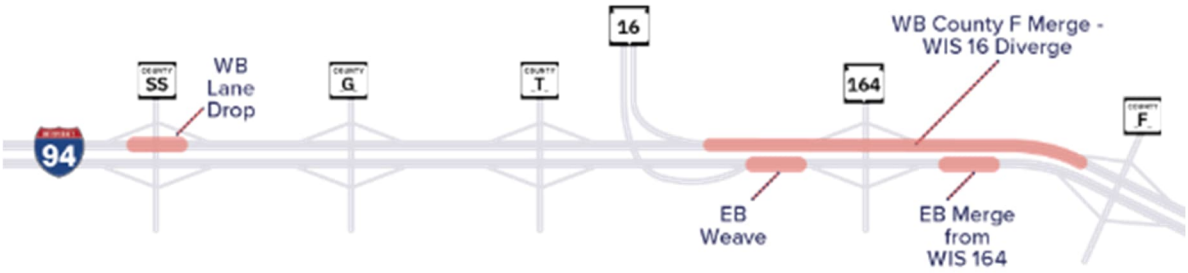
Location	Segment Type	Existing 2022						Future Year 2050					
		AM		PM		FRI		AM		PM		FRI	
		EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
East Section (desirable LOS D)													
WIS 16 to WIS 164 Weave	Basic	E	B	C	C	C	C	F	B	F	F	F	F
WIS 164	Diverge	-	D	-	F	-	D	-	D	-	F	-	F
	Basic	F	C	F	C	E	C	F	C	F	F	F	F
	Merge	F	-	F	-	F	-	F	-	F	-	F	-
County F	Diverge	E	C	E	F	E	C	F	F	F	F	F	F
	Basic	F	C	F	F	F	C	F	C	F	F	F	F
	Merge	F	C	F	F	F	D	F	D	F	F	F	F
County F to Goerke's Corners	Basic	F	D	D	F	E	D	F	F	F	F	F	F
Goerke's Corners	Diverge	F	F	E	F	E	F	F	F	F	F	F	F
	Basic	F	C	F	F	F	C	F	F	F	F	F	F
	Merge	F	D	F	F	F	E	F	F	F	F	F	F
Goerke's Corners to County O	Basic	F	F	F	F	F	F	F	F	F	F	F	F
County O	Diverge	F	F	F	D	F	D	F	F	F	F	F	F
	Basic	D	F	D	F	D	F	F	F	D	F	D	F
	Merge	D	F	D	F	D	F	D	F	D	F	D	F
County O to WIS 100	Basic	D	E	D	D	D	D	D	F	D	E	D	E

The most significant congestion occurs east of WIS 16 due to merging and weaving traffic to and from closely-spaced, high-volume ramps (Figure 19) as described below:

- Eastbound AM peak weave between WIS 16 and WIS 164: The on-ramp from WIS 16 is over-capacity with 2,100 vehicles per hour (vph) in future no build conditions and has a short, one-quarter mile, distance to change lanes to continue on EB I-94.

- Eastbound AM peak merge from WIS 164 toward County F: Closely spaced ramps between WIS 164 and County F can cause congestion to spill back towards WIS 16.
- Westbound PM peak merge from County F through diverge to WIS 16: The high-volume exit to WIS 16 (about 2,000 vph in future no build conditions) and high volume on-ramps from County F and WIS 164 overload the right lanes of I-94.
- Westbound FRI peak lane drop between County SS ramps: About 3,700 vph go through in future no build conditions the 3-to-2 lane drop at County SS on Fridays, the amount of congestion can vary, but typically more occurs due to recreational traffic on summer Fridays.

Figure 19. Major Areas of Congestion



Intersection Congestion Results

Forty-seven intersections were analyzed for weekday AM and weekday PM peak hours. The complete results of the analysis of these intersections can be found in Appendix III including interchange result diagrams. Friday PM peak hours were not evaluated for intersections. Seventeen intersections were identified as having movements that experienced LOS E or F in the existing conditions and 19 intersections in the future no build conditions. These intersections are identified in Table 13. Movements that have become LOS E or F or have worsened from LOS E to LOS F since 2022 are noted with an asterisk (*).

Four intersections were improved by scheduled projects. At County F, the existing diamond interchange was modeled as a diverging diamond interchange to represent the committed rehabilitation project. This project improved the multiple LOS E and F movements in the existing condition to LOS C or better. At County C, the committed bridge replacement project over I-94 was modeled to provide left turn lanes at the existing County C ramp terminals.

Intersections within the Goerke's Corners interchange have the most failing movements and have long queues associated with the high delay. This is also a confusing interchange with many different ramps that cause drivers to move more hesitantly, also creating congestion. For full results please see Appendix II and Appendix IV and the intersection exhibits contained within.

Table 13. LOS E and LOS F Intersection Lane Movements

Location	Existing Conditions Movements		2050 Future No Build Movement(s)	
	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
WIS 67 & Aurora Drive			EBL*, WBL/T*	
I-94 EB Ramp & County C	EBL/T	EBL/T	EBL/T*	EBL/T
I-94 WB Ramp/Poplar Path & County C		EBL/T/R	EBL/T/R*	EBL/T/R
WIS 83 & Hillside Dr		WBR		WBR
WIS 83 & Heritage Dr				WBR***
WIS 83 & Golf Rd	EBL	EBL, EBT, EBR, WBL	EBL, WBL*	EBL, EBT, EBR, WBL
WIS 318 & Silvernail Rd				WBT/R*
I-94 EB Ramp & WIS 318			NBR*	
County T & Silvernail Rd	WBL	EBL, WBL	EBL*, WBL	EBL, WBL
I-94 EB Ramp & WIS 164	EBL		EBL	
I-94 EB Ramp & County F**	EBL, EBL/T, SBL	EBL, EBL/T, NBR, SBL		
I-94 WB Ramp & County F**	WBL, WBL/T, SBT			
I-94 EB Ramp & Bluemound Road	NBR		NBR*	NBR*
Bluemound Road & Barker Road	WBT, NBL, SBL, SBT	WBT, WBL, NBL, NBT, SBT	WBL*, NBL, NBT*, SBL, SBT	WBL, WBT, SBT*, NBL, NBT, SBL*
Moreland Blvd & Kossow Rd	EBT		EBT	
Swenson Dr & Barker Rd		NBL		NBL
I-94 EB Ramp/Park and Ride & Barker Road		WBL, WBR		WBL, WBR
County O & Brookfield Square Drive		NBL		NBL
I-94 WB Off ramp & County O	WBR		WBR*	
County O & Carpenter Road		SBL		SBL
I-94 EB Ramps & County O	EBL, EBR	EBL, EBR	EBL, EBR	EBL, EBR

Red text indicates LOS F

*Location with new LOS E or F movement compared to existing

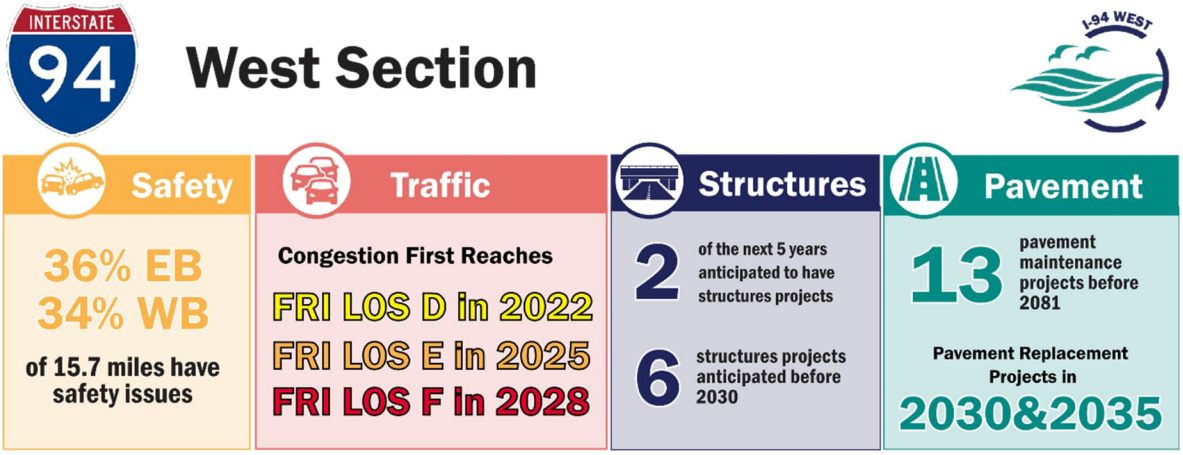
**County F has a planned DDI conversion project which resolved congestion issues in the future conditions based on this study's higher level analysis. Further analysis in other studies will be completed.

***Since data collection and analysis was completed a WBRT overlap has been added to this intersection.

CONCLUSION

The I-94 Willow Glen Road to the Zoo Interchange corridor was evaluated to determine existing and future needs associated with traffic operations, safety, pavement, geometrics, and structures as well as other key considerations.

West Section



Traffic

- The highest traffic volumes in the West section are from recreational traffic coinciding with the more rural land use around the section and the beautiful lakes.
- Part of the corridor currently functions at LOS D, especially around the County C, County P and WIS 83 interchanges. At least part of the section is expected to operate at LOS E by 2025, and LOS F in 2028 all in the Friday Peak.
- By 2050 there is LOS F in all peaks and there is a great amount of congestion stretching from WIS 67 to WIS 16 taking up most of the section in the PM and FRI peaks.
- The County C interchange has both ramps experiencing LOS F on the exit ramps in the future no build condition. In the PM peak at the County C & WB Ramp, the WB Off-ramp has a queue of 800 ft up the ramp towards the freeway.

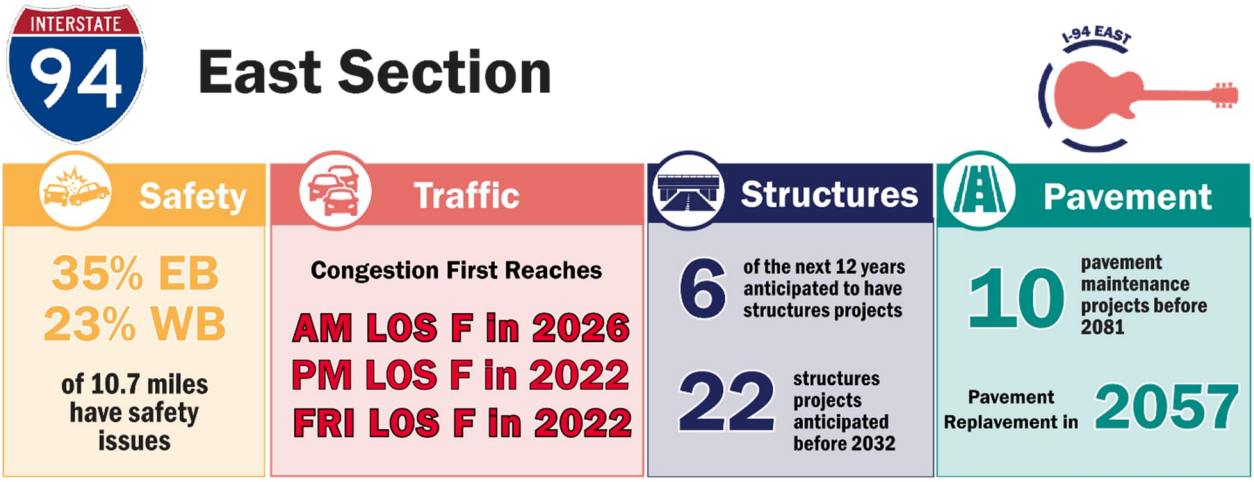
Safety and Geometrics

- Approximately 36% of eastbound and 34% of westbound miles for the west section were identified as having a crash rate more than 1 UCL above the statewide average.
- Twenty Hot Spot locations were identified within the west section, and of those seven had clear contributing factors that included substandard horizontal curves, poor drainage and congestion.
- The majority of the section has substandard cross slopes that can contribute to poor drainage.
- There are several horizontal curves that are substandard and all of them have a crash hot spots associated with them.
- The County C WB Off-Ramp and WIS 67 EB Off-Ramp both were flagged for safety issues as well as having substandard acceleration/deceleration lengths and taper rates.

Structures and Pavement

- There are 17 bridges in this section that are over 50 years old and will require increasing maintenance in the coming years.
- All pavement along the corridor is planned to be replaced between 2030 and 2036. Many bridges will reach the end of their expected age (75 years old) in 2037.

East Section



Traffic

- Parts of the section are experiencing LOS F in the existing conditions. The mainline section between Goerke's Corners and County O experiences LOS F in AM, PM and Friday peaks and both directions.
- The entire section experiences LOS F in multiple peaks for at least one direction in 2050. This represents large amounts of delay and congestion occurring on a regular basis throughout the section.
- One of the worst congestion areas coincides with the WIS 16 system interchange and weaving section. The WIS 16, WIS 164 and County F interchanges are all high volume and closely spaced. As vehicles enter and exit the mainline, extra congestion occurs as cars attempt to change lanes within a crowded area.
- There are multiple intersections at the Goerke's Corners interchange that have failing movements. At the Bluemound Rd & Barker Road intersection, the westbound and southbound through movements both have LOS F and long queues.

Safety and Geometrics

- Approximately 35% of eastbound and 23% of westbound miles for the east section experience crash rates that are more than one UCL above the statewide average.
- Twenty crash hot spots were identified in the east section with eight of them having clear contributing factors including substandard horizontal curves, congestion, and merge/diverge areas.
- Two vertical curves in the east section cause substandard sight distances. One is east of County F and the other West of Goerke's Corners. These correspond with safety hot spots #12, #13, #32, #15, #16, and #33.

Structures and Pavement

- There are currently 22 bridges over 50 years old in the existing conditions.
- Pavement replacement is planned for 2057.
- There is a large pavement resurfacing project planned for 2027 and many maintenance projects in the same year. These projects will require a great deal of traffic control and maintenance.
- Many bridges will reach the end of their expected life (75 years old) in 2037 which coincides with a large, planned pavement resurfacing project.