APPENDIX LS-B
PURPOSE AND NEED SCREENING TECHNICAL MEMO

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Project ID 1440-13/15-00

Wisconsin State Highway 23

Fond du Lac to Plymouth

Fond du Lac and Sheboygan Counties, Wisconsin

Purpose and Need Screening Evaluation

Technical Memo

August 21, 2012

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Introduction

Background

A Draft Environmental Impact Statement (DEIS) was released for WIS 23 from Fond du Lac to Plymouth in November 2004. Figure 0-1 shows the approximately 19.5-mile corridor limits. The DEIS evaluated alternatives that addressed system, capacity, and safety needs on this corridor. Because of changes and additions to the project, a Supplemental Draft EIS (SDEIS) was released in December 2009, followed by a Final EIS (FEIS) released in June 2010. The Federal Highway Administration (FHWA) issued a Record of Decision (ROD) on September 27, 2010. The ROD provided for the 4-lane expansion of WIS 23 from Fond du Lac to Sheboygan as well as the construction of several interchanges and the extension of a multiuse trail.

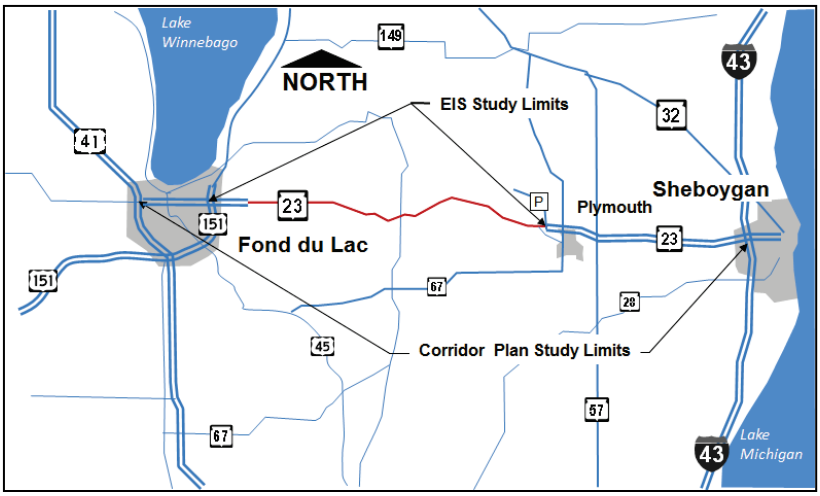


Figure 0-1 Project Location

Since the time of approval, Wisconsin Department of Transportation (WisDOT) has been purchasing right of way along the corridor. Some right of way was previously purchased before the ROD through the hardship acquisition process.[1]

WisDOT, in partnership with the FHWA, seeks to prepare a Limited Scope Supplemental Environmental Impact Statement for the study according to Title 23, Part 771.130 (f) of the Code of Federal Regulations (23 CFR 771.130). The applicable text states:

> *§ 771.130 Supplemental environmental impact statements.*
>
> *(f) In some cases, a supplemental EIS may be required to address issues of limited scope, such as the extent of proposed mitigation or the evaluation of location or design variations for a limited portion of the overall project. Where this is the case, the preparation of a supplemental EIS shall not necessarily:*
>
> *(1) Prevent the granting of new approvals;*
>
> *(2) Require the withdrawal of previous approvals; or*
>
> *(3) Require the suspension of project activities; for any activity not directly affected by the supplement. If the changes in question are of such magnitude to require a reassessment of the entire action, or more than a limited portion of the overall action, the Administration shall suspend any activities which would have an adverse environmental impact or limit the choice of reasonable alternatives, until the supplemental EIS is completed.*

The Supplemental EIS (SEIS) will be used to address issues of Limited Scope associated with the overall project. These issues include:

- Updating data that is no longer valid in the original project purpose and need.
- Enhancing and clarifying the discussion of alternatives that do not include capacity expansion.

[1] On prolonged studies, property owners may be eligible for hardship acquisition. Affected property owners may make a formal request to WisDOT to purchase their property as a "hardship." The owner must show that the marketability of the property has been adversely affected by the proposed plan and that a prolonged delay in the acquisition will cause them undue economic hardship. Once WisDOT receives such a request, WisDOT considers the request and follows the procedures for Early and Advanced Acquisitions in accordance with the WisDOT Real Estate Program Manual (WisDOT, August 2012, https://trust.dot.state.wi.us/extntgtwy/dtid_real_estate/repm/repm.htm) .

- Enhancing and clarifying the discussion of impacts to Section 4f resources.
- Updating and clarifying the Indirect and Cumulative Effects (ICE) analysis.

Purpose of this Memo

The 2010 FEIS had several paragraphs describing existing and projected traffic volumes as well as the resulting traffic operation from those volumes. Since the completion of the 2010 FEIS, a Travel Demand Model was developed for the Northeast Region that expands the ability of WisDOT to model network changes. The model results were used along with current traffic data and linear regression techniques to develop revised 2035 forecasts for the SEIS. Lower traffic volumes on roadways throughout the state influence future traffic forecasts and in most cases have made them lower. In March 2012, WisDOT prepared traffic forecasts for WIS 23 for the year 2035 using traffic counts performed in 2011 and 2012. They were lower than those presented in the 2010 FEIS and those used in the initial alternatives screening.[2] Additional traffic counts were performed in June of 2012 to address some equipment malfunctions that occurred with the 2011 and 2012 traffic counts. The June traffic counts were also performed to determine if lower traffic volume trends were continuing as economic conditions were improving throughout the state. Traffic forecasts performed in July of 2012 using these counts are similar to those presented in the 2010 FEIS though still lower. These lower forecast volumes may make alternatives that were initially screened from consideration appear viable today.

Screening criteria are used to determine whether alternatives satisfy the project purpose and need. The screening criteria are directly linked to the project purpose and need stated in the 2010 FEIS.

This technical memo evaluates whether the alternatives that were eliminated from detailed study in the initial EIS process because they did not satisfy the project purpose and need could now be viable as a result of changed conditions. If these alternatives continue to <u>not satisfy</u> the project purpose and need, WisDOT and FHWA will continue to move forward with the Limited Scope SEIS. If the previously eliminated alternatives, as a result of current conditions, are now determined to <u>satisfy</u> the project purpose and need, WisDOT and FHWA will prepare a full SEIS and activities on the project will be suspended until the SEIS is completed.

Current Alternatives Under Consideration

The DEIS, SDEIS, and FEIS evaluated various alignments for WIS 23, many of which included an off-alignment 4-lane expansion of the WIS 23 corridor. These options are described more fully in the DEIS, SDEIS, and FEIS for the project. The off-alignment alternatives[3] were dismissed from consideration as the preferred alternative because of their high environmental and socioeconomic impacts. The reasons for their elimination remain and do not require reevaluation. The on-alignment alternatives are influenced by reduced traffic volumes and traffic forecasts. Less traffic may increase the ability of previously dismissed on-alignment improvement alternatives to satisfy the project purpose and need. An example would be the provision of passing lanes instead of 4-lane expansion. With lower 2035 traffic forecasts, passing lane alternatives may be able to provide acceptable operation levels, which would help those alternatives satisfy the project purpose and need.

The following paragraphs <u>briefly describe</u> the alternatives being evaluated in this technical memo on their ability to satisfy the project purpose and need.

[2] Appendix A contains a technical memo that describes how the WIS 23 corridor traffic forecasts have been affected by reduced traffic volumes.

[3] Referred to as Segments A through E and Alternatives 2, 3, 4, 5 and 6 in the FEIS.

A. No-Build

The No-Build alternative involves the continued use of the existing WIS 23 without reconstruction or enhancements of the existing roadway. By definition, the No-Build alternative may include minor restoration types of activities that maintain the same typical section and alignment of the highway. WIS 23 would remain a 4-lane roadway for the western 1.3 miles from US 151 to 0.4 miles east of County K. It would be a 2-lane roadway for the remaining 18 miles to the end of the study limits. In the June 2010 FEIS, the No-Build alternative included a mill and overlay pavement maintenance project. The No-Build alternative serves as the basis for comparison of other alternatives. If the No-Build alternative were selected, other smaller WIS 23 projects could be evaluated in subsequent National Environmental Policy Act (NEPA) documents and implemented if appropriate.

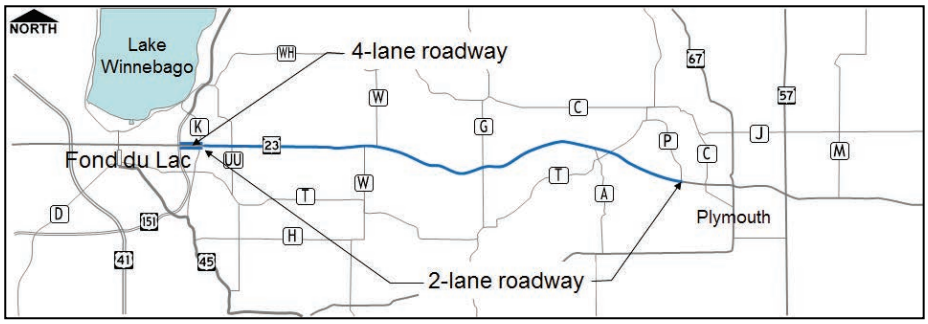


Figure 0-2 No-Build Alternative

B. Passing Lane Without Left-Turn Lanes

Passing lane alternatives were evaluated by WisDOT in a report prepared in May 2006. While WIS 23 is not currently part of the state plan for corridors with passing lanes, current traffic forecasts indicate design-hour volumes fall within the thresholds where passing lanes could be considered. WisDOT has criteria for locating passing lanes to provide optimal operational benefits as found in WisDOT's Facilities Development Manual (FDM) 11-15-10. A corridor that is being considered for passing lanes should be approximately 15 to 50 miles in length. The roadway must be a 2-lane rural highway; the passing lane must be placed where passing opportunities are limited because of traffic volumes, roadway alignment, or high proportion of slower vehicles. Passing lane placement should also acknowledge guidelines found in FDM 11-15-10.1.2.[4]

The Passing Lane Without Left-Turn Lanes alternative adds 4 passing lanes, 2 for eastbound travel and 2 for westbound travel in addition to the existing two climbing lanes west of County P in Sheboygan County. The distance between the successive westbound passing lanes is 4.3 miles; the distance between the successive eastbound passing lanes is 6.6 miles. Each passing lane is 12 feet wide with an 8-foot shoulder, of which 6 feet is paved.

The Passing Lane Without Left-Turn Lanes alternative would upgrade side-road intersections with the appropriate intersection type in WisDOT's FDM. These intersection improvements, however, would not provide left-turn lanes on the WIS 23 highway. By not installing left-turn lanes, the amount of roadway available for passing is increased. A new jug-handle intersection would be provided at County K to address the higher crash frequency and traffic volumes at this intersection. The jug-handle has a grade separation with bridges to carry WIS 23 over County K. West of County K, traffic would have on and off access to WIS 23 using dedicated lanes. The access would be right-in/right-out, which eliminates dangerous crossing and left-turning maneuvers. Figure 0-3 schematically illustrates passing lane placement and the location of the County K jug-handle while Figure 0-4 illustrates the typical section through a passing lane segment.

[4] Facilities Development Manual 11-15-10 (WisDOT, December 30, 2002; http://roadwaystandards.dot.wi.gov/standards/fdm/11-15.pdf)

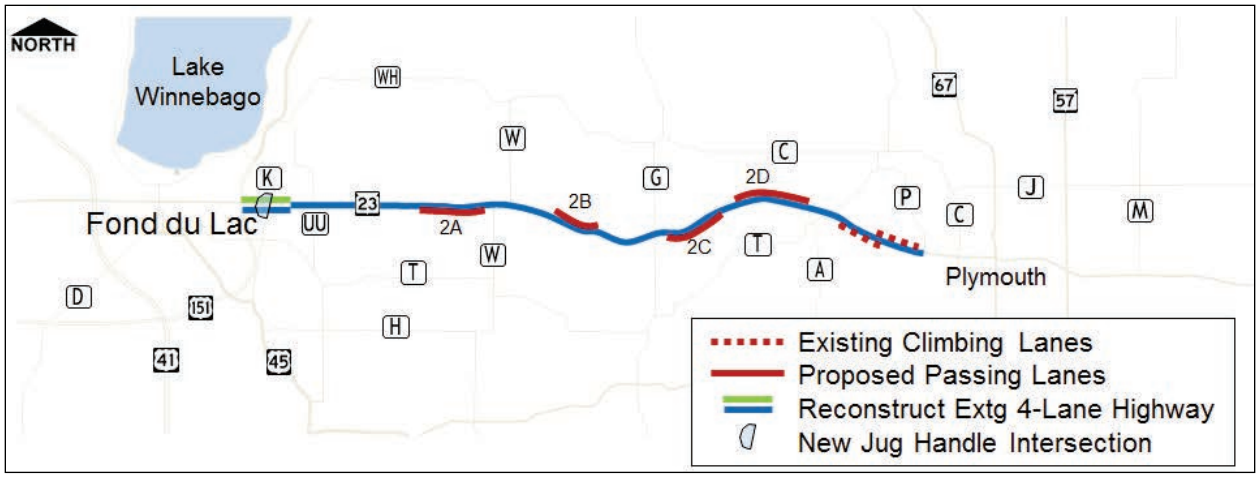


Figure 0-3 Passing Lane Without Left-Turn Lanes Alternative

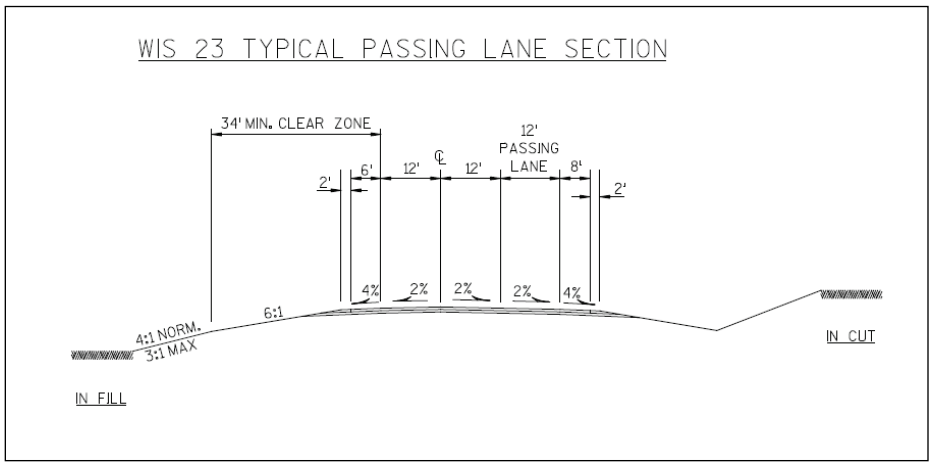


Figure 0-4 Passing Lane Typical Section

C. Passing Lane With Left-Turn Lanes

The Passing Lane With Left–Turn Lanes alternative has all the characteristics as the previously described alternative except that it adds a left-turn lane for WIS 23 traffic at higher volume intersections. FDM 11-25-5 [5] provides warrants for the installation of left-turn lanes on rural highways based on the traffic volumes of the mainline and the side road. Even though most WIS 23 side road intersections do not have traffic volumes that warrant the installation of left-turn lanes, this alternative includes left-

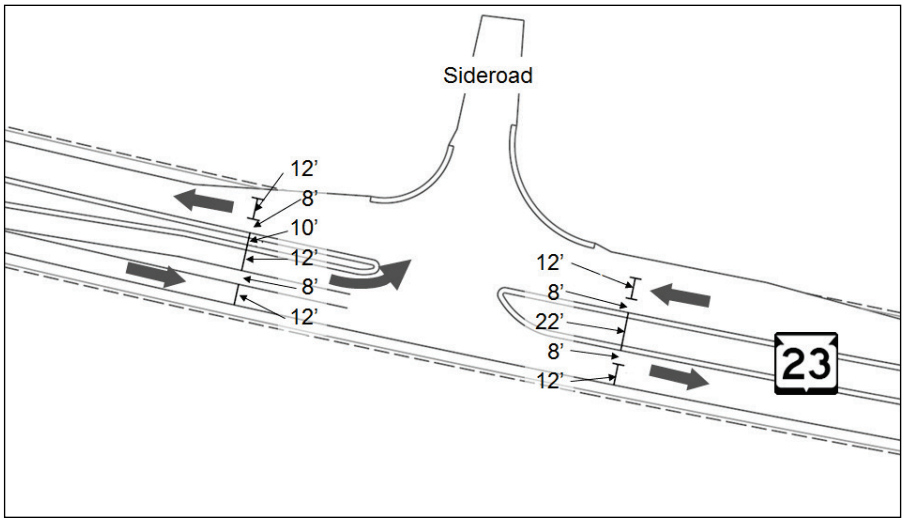


Figure 0-5 Typical Left-Turn Layout

[5] Facilities Development Manual 11-25-5 (WisDOT, February 25, 2011; http://roadwaystandards.dot.wi.gov/standards/fdm/11-25.pdf#fd11-25

turn lanes because they provide a safety feature. The left-turn lane provides a refuge for left-turning vehicles removing them from exposure to the through travel stream. Adding the left-turn refuge requires the development of a median for 0.2 miles on both sides of the side-road intersection, which decreases the amount of roadway that is available for passing. Figure 0-5 illustrates a typical configuration of a WIS 23 T-intersection with a left-turn lane and associated median; the median associated with the left-turn lane also provides a median refuge for side-road vehicles crossing or making a left onto WIS 23.

D. Hybrid 4-Lane to County G, Passing Lane County G to County P

The Hybrid alternative was developed during the formation of alternatives for the Limited Scope SEIS to assess the potential to satisfy the project purpose and need with the revised and lower traffic volume forecasts. It provides a 4-lane divided highway for 11.5 miles from US 151 in Fond du Lac to County G. A jug-handle intersection would be provided at County K. Diamond interchanges would be provided at County UU and County G. East of County G, WIS 23 would be a 2-lane roadway with passing lanes for the remaining 8 miles. Figure 0-6 schematically illustrates this alternative.

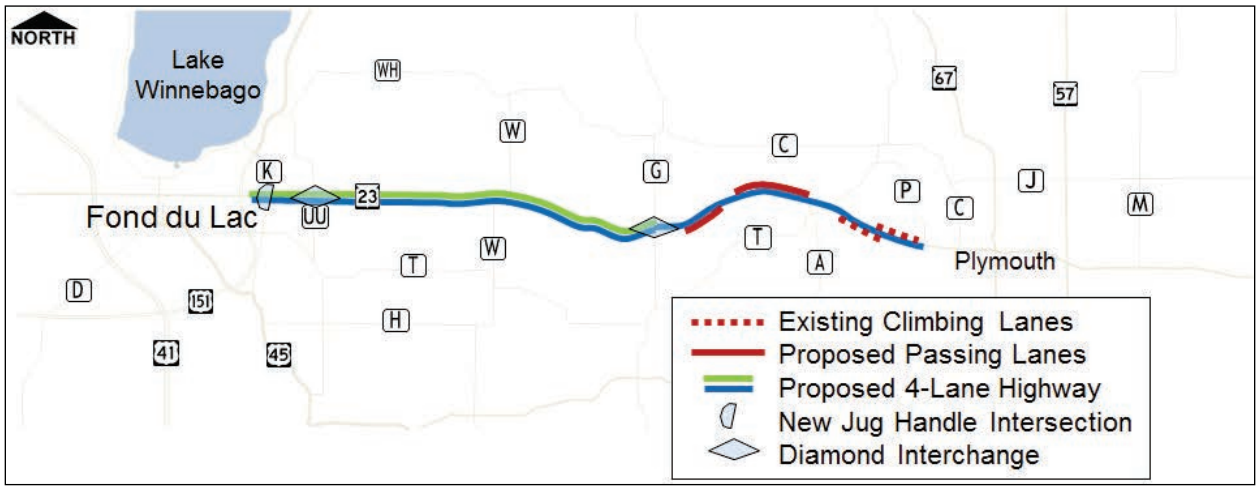


Figure 0-6 Hybrid 4-Lane to County G, 2-Lane County G to County P Alternative

E. 4-Lane Build On-Alignment

The 4-Lane Build On-Alignment Alternative evaluated in this technical memo was the Preferred Alternative described in the 2010 FEIS and ROD. This alternative would provide a 4-lane divided highway on the existing alignment for the full length of the project. For the 2-mile section from US 151 to County UU, WIS 23 would have a high-speed urban cross section. This includes four 12-foot lanes, 6-foot inside shoulders, 10-foot outside shoulders, and an 18-foot median with mountable curb. The outside edges use either a rural section with a ditch or a suburban section with mountable curb and gutter.

From County UU east to County P in Sheboygan County, WIS 23 would have a typical expressway cross section with a design speed of 70 mph. This includes four 12-foot lanes, 6-foot inside shoulders, 10-foot outside shoulders, and a 60-foot median.

A jug-handle intersection would be provided at County K; diamond interchanges would be provided at County UU, County G, and County P. Of the 40 intersections, J-Turns are proposed at 6 high volume intersections. J-Turns are being proposed at 7 Hills Road, County W, County U, Sugarbush Road, County A, and County S. This intersection concept only allows right-in/right-out/left-in movements and removes the most hazardous left-out and through movements from the intersection. Drivers from the side road that want to turn left onto WIS 23 or travel through on the side road must take a right and then make a U-turn at an appropriate distance from the intersection. This type of intersection has been successfully used in several states to improve intersection safety and was a recommended measure for this project based on a road safety audit. A J-Turn can only be installed on 4-lane divided highways because the

radius needed for a large truck to make a U-turn is too great to install on a 2-lane roadway that does not have a median. This concept is shown in Figure 0-7.

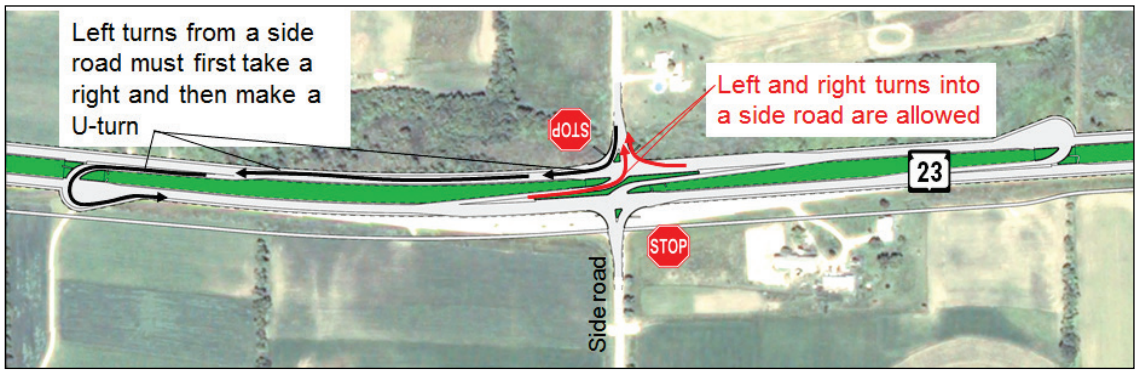


Figure 0-7 J-Turn Concept

F. Other Features

All the alternatives, except for the No-Build alternative, would officially map lands needed for future transportation improvements, such as overpasses and interchanges. The official mapping would be implemented through the freeway designation and corridor preservation provisions of Wisconsin State Statute 84.295. Improvements that would be officially mapped include interchanges at County W north and County A as well as overpasses at Tower Road, 7 Hills Road, Scenic View Drive, and Sugarbush Road. The Passing Lane alternatives would also preserve right of way for the future 4-lane expansion as well as interchange at County UU, G, and P. Local road improvements/reroutings would be officially mapped.

All the build alternatives have the opportunity to provide bicycle accommodations either through a wide paved shoulder or through the extension of the Old Plank Road Trail, a multiuse path. WisDOT incorporated this extension in the 2010 FEIS Preferred Alternative in response to existing bicycle plans and actions made by local governments. About 2.5 miles of the existing Old Plank Trail already exists within the project limits.

The Passing Lane alternatives as well as Hybrid alternative could include the extension of the Old Plank Road Trail by constructing a trail from where it currently ends near Greenbush. It would be extended 17 miles west to the Prairie Trail in Fond du Lac. Figure 0-8 schematically illustrates the location of the proposed Old Plank Trail extension. In order for the Passing Lane alternatives to include the trail extension, they would need to purchase additional right of way. Also, the trail would either be built in its ultimate location (based on future 4-lane design) or would need to be relocated if future 4-lane expansion occurs. The trail would cross WIS 23 using an at-grade intersection when switching from the south side to the north side at County UU.

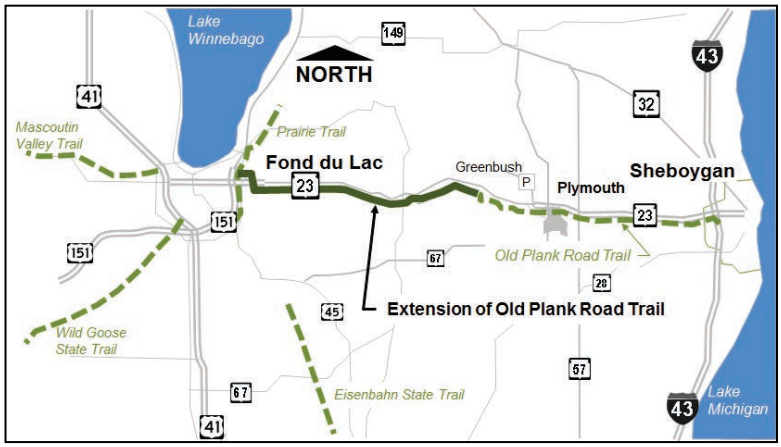


Figure 0-8 Old Plank Road Trail Extension

The 4-Lane Build On-Alignment would include the extension of the Old Plank Road Trail in the location described in the Passing Lane alternatives. Because this alternative is a full 4-Lane alternative, the trail would be built in its ultimate location. Also, because the 4-lane Build On-Alignment includes an interchange at County UU, it provides a grade-separated crossing of WIS 23 where the trail switches from the south side of WIS 23 to the north side of WIS 23 for bicyclists using the trail.

The remainder of this technical memo provides a discussion of the factors within the purpose and need and develops screening criteria for the evaluation of alternatives. If the alternatives satisfy the screening criteria, they satisfy that component of the project purpose and need.

Purpose and Need Criteria Discussion

1. System Linkage and Route Importance

The 2010 FEIS project purpose objectives for the proposed action that pertain to purpose and need criterion 1 include the following:

- *Provide a safe and dependable highway connection to and from regional communities…*
- *Provide system continuity between the City of Sheboygan and the City of Fond du Lac. WIS 23 is a major east-west connecting highway between these population centers of east central Wisconsin.*

The 2010 FEIS project need expressed the following needs regarding system linkage and route importance.

> *"WIS 23 is part of the National Highway System (NHS) as designated under the 1998 Transportation Equity Act for the 21st Century (TEA21). NHS routes serve major population centers, intermodal transportation facilities, and major travel destinations and provide connections to the national defense highway network. WIS 23 provides an NHS east-west link between Milwaukee (to the south) and Appleton (to the north).*
>
> *WIS 23 is a state-designated long truck route. This designation further demonstrates its importance to commercial and economic development interests within the state. Trucks account for approximately 14 percent of the average daily traffic (ADT) using the highway.*
>
> *WIS 23 is identified in the Corridors 2020/Connections 2030 State Highway Plan as a Connector route. Connector routes are two- and four-lane highways that connect key communities and regional economic centers to the Corridor 2020/Connections 2030 Backbone routes. Backbone routes are a network of key multilane routes that connect major population and economic centers and provide economic links to national and international markets. While making up just 3 percent of the state highway transportation system, these routes carry 37 percent of all auto travel and 53 percent of all truck travel within the state.*
>
> *As a Connector route within this network, WIS 23 is a major link between Sheboygan and Fond du Lac and connects the Backbone routes of I-43 and US 41. When combined, these highways connect Sheboygan and Fond du Lac to other population, manufacturing, and trade centers, such as Green Bay, Oshkosh, Madison, Milwaukee, and Chicago."*

Note that while the FEIS references Corridors 2020, Wisconsin's new Highway Plan is called Corridors 2030. A Summary Plan is available at: http://www.dot.wi.gov/projects/state/docs/2030-fact-corridors.pdf. Connections 2030 is WisDOT's Long Range Transportation Plan. Additional information is available at: http://www.dot.wisconsin.gov/projects/state/connections2030.htm. Also note that while the FEIS states that truck traffic accounts for 14 percent of the ADT using the highway, traffic forecasts performed in March 2012 indicate that the truck percentage on WIS 23 is now 11.2 percent.

National Highway System

WIS 23 is designated as part of the National Highway System (NHS), and because of its importance in the NHS it is designated as a Connector in the Corridors 2030 state highway plan. Both designations recognize WIS 23 as being integral to safe and efficient regional and statewide travel, thus serving a key role in promoting economic development. Corridors 2030 Connectors design standards meet and exceed NHS design standards. WIS 23 is a critical route connecting metropolitan areas in the state, such as Milwaukee and Appleton.

The importance of the NHS designation, large truck travel, and associated expectations of efficient travel influence various design elements. Design elements considered for this WIS 23 corridor include passing opportunities, intersection layout, turning movements, and specific geometric design standards. These

considerations are based primarily on policies, standards, and specifications adopted by the American Association of State Highway and Transportation Officials (AASHTO). Safety is a prime consideration in the design of all highways.

Corridors 2030 Connector Route

WIS 23 is a Connector Route in the Corridors 2030 and Connections 2030 plans. One of the main design requirements of a Corridors 2030 route has to do with traffic operations. The FDM is WisDOT's highway design manual. FDM 11-5-3, Table 3.1[6], provides the operational goals for Corridors 2030 (formerly Corridors 2020) routes. They are defined by Level of Service (LOS).[7] LOS C indicates the LOS on this route must be kept above the operational threshold between LOS C and LOS D (the numeric LOS <=4.0).

FDM 11-5-3.2 states "The highest LOS thresholds are applied to the Corridors 2020 system in recognition of its importance from a mobility and economic development perspective. On Corridors 2020 routes, "minimal to moderate" congestion is allowed. Some "severe" congestion is allowed on non-Corridors 2020 routes in highly urbanized areas." WIS 23 is a Connector Route in the Corridors 2030 plan.

FDM 11-15 Attachment 1.1[8] shows the cross section components of a rural highway. The Design Annual Average Daily Traffic (AADT) is the projected traffic volume forecast for the design year of the roadway, typically the construction year plus 20 years.[9]

WIS 23 current and projected 2035 AADT volumes fall within the category of Design Classes A2–a 2-lane roadway, and A3–a 4-lane roadway. Design class A2 has a 60 mph design speed whereas design class A3 has a 70 mph design speed.

State Designated Long Truck Route[10]

WIS 23 is designated as a primary Oversize Overweight (OSOW) route in the August 2011 state OSOW Freight Network. This designation means very large truck loads, such as those carrying windmill turbines, are directed to use primary routes such as WIS 23. Because WIS 23 is designated as a long truck route and is in the OSOW Freight Network, the roadway and intersections must accommodate truck movements.

The long truck route designation does not add additional design requirements to the WIS 23 roadway. The designation as a long truck route does direct trucks through the WIS 23 corridor, and roadway/intersection design should consider trucks to the extent possible. With any WisDOT improvement, trucks are considered in the geometric design of intersections and medians. However, not all WisDOT projects, because of scope and other factors, are able to address the effect trucks have on traffic operations. Slower moving vehicles, such as trucks, farm equipment, and recreational vehicles create platoons of traffic on 2-lane roadways such as WIS 23. Nontruck traffic is unable to travel the free-flow speed because of the impediment slow-moving vehicles create. This operational problem is exacerbated when passing opportunities are few and opposing traffic volumes are high. While not a requirement of being a long truck route, it is desirable to reduce the negative effects truck traffic has on corridor traffic operations in order to meet driver expectations for this type of facility.

[6] Facilities Development Manual, 11-5-3 (WisDOT, March 27, 2008; http://roadwaystandards.dot.wi.gov/standards/fdm/11-05.pdf#fd11-5)

[7] LOS describes the operation, or congestion levels, of a roadway. It ranges from LOS A (good) to LOS F (very poor). The Highway Capacity Manual (Transportation Research Board, 5th Edition, 2010) provides more detail on this rating system. It is also discussed to greater extent in criterion 4 of the Purpose and Need evaluation.

[8] Facilities Development Manual 11-15, Attachment 1.1 (WisDOT, March 27, 2008, http://roadwaystandards.dot.wi.gov/standards/fdm/11-15-001att.pdf#fd11-15a1.1)

[9] Facilities Development Manual (FDM) 11-10-1.1 (WisDOT, December 30, 2002, http://roadwaystandards.dot.wi.gov/standards/fdm/11-10.pdf)

[10] Wisconsin State Statute 348.07(4) discusses long truck routes and their designation. State Administrative Rule Trans 276 further expounds on this designation.

Traffic Volume		Roadway Width Dimensions			
Design Class	Design AADT	Design Speed (mph)	Traveled Way Width (feet)	Shoulder Width (feet)	Roadway Width (feet)
A1	Under 3500	**60**	**24**	**6**	**36**
A2 [1] (2 lanes)	3,500–8,700[A] 3,500–15,000[C]	**60**	**24**	**10** (8)	**44** (40)
A3[1] (4 lane divided)	8,700[A] - 44,000[A] 8,700[B] - 53,500[B] 15,000[C] - 60,000[C]	**70** [4]	**2 @ 24**	**6LT** (4) **10RT**[5]	**2 @ 40** (38)
A3[1] (6 lane divided)	44,000[A] - 69,000[A] 53,500[B] - 85,000[B] 60,000[C] - 90,000[C]	**70** [4]	**2 @ 36**	**10 LT & RT**[5]	**2 @ 56**

[A] For non-freeway Corridors 2020 backbone and connector route, LOS threshold is C/D or 4.0.
[B] For freeway Corridors 2020 backbone route, LOS threshold is C/D or 4.0.
[C] For other principal and minor arterials, LOS threshold is D/E or 5.0.

Desirable values are shown in bold and minimum values are shown in parentheses.

Table 1-1 FDM 11-15 Attachment 1.1

The table gives AADT thresholds for the different design classes, but these thresholds were based on a typical operations analysis and are for guidance purposes. A footnote on Attachment 1.1 states the following:

> [1] *The top of the traffic volume range for design class A2 is 8,700 AADT for a Corridors 2020 route and 15,000 AADT for a non-corridors 2020 route. These volumes are based on the 2000 Highway Capacity Manual assuming level terrain, 12-foot lanes, ≥ 6-foot shoulders, 80% passing, 10% trucks, K30 design factor, and 60/40 directional split. In cases where a reduced level of service is determined to be acceptable and the use of passing lanes is found to be adequate treatment for the facility, the 8,700 AADT value for C2020 Connector routes may be increased to 12,000 AADT. Design class A3 assumptions: level terrain, 12-foot lanes ≥ 6-foot shoulders, 10% trucks, K30 design factor, 61/39 directional split, 2 access points per mile, except freeway. See FDM 11-5-3 for additional information on level of service thresholds for different facility types and the respective numerical value.*

This footnote indicates that the Design Classification is based on LOS, and the thresholds provided for Design Classification are based on a generic highway segment. For WIS 23, the Design Classification, and corresponding number of lanes, is based on what is necessary to maintain LOS C in the design year for WIS 23's specific roadway and traffic volume characteristics that factor into LOS calculations. Discussion in criterion 4 of this technical memo provides greater description of the factors used in determining LOS. Individual roadway characteristics, such as peak-hour volume, directional distribution of traffic, lane and shoulder width, percent passing zone availability, and truck percentage, all contribute to the LOS calculation for the individual roadway. Operations analysis for WIS 23 indicates that it currently (2012) and in 2015 does not meet the LOS C operational goals for a Connector in the Corridors 2030 plan. Table 1-2 summarizes the operational analysis for the corridor for a construction year of 2015 and the design year 2035. More information regarding the operations analysis is discussed under criterion 4.

System Continuity

WIS 23 provides a National Highway link between Milwaukee (to the south) and Appleton (to the north) as well as between Madison (to the southwest) and Sheboygan. Most of the highways connecting these metropolitan areas are 4-lane divided expressways and freeways. On the 32.5-mile section of WIS 23 from US 151 to I-43, 14 miles is a 4-lane divided highway, and the remaining 18 miles between County K in Fond du Lac County and County P in Sheboygan County is a 2-lane highway. It is desirable, though not required by FDM or AASHTO standards, to have a consistent facility type along WIS 23 linking the US 41, US 151 and

I-43 4-lane arterials. In November 2011, WisDOT informed FHWA of interim guidance it was using to determine the purpose and need for capacity expansion (attached as Appendix B). The guidance references LOS analysis and thresholds and also listed other factors that would support capacity expansion and help satisfy the purpose and need. Those factors included the following.

> *"Small highway segments that provide lane continuity and logical connections to major facilities or areas."*

This interim guidance factor could support the provision of a 4-lane corridor for the full distance between Fond du Lac and Sheboygan.

WIS 23 Mainline Operation Levels		
2-Lane No Build LOS		
	County UU to County G	
	Eastbound	Westbound
LOS 2015	D	D
LOS 2025	D	D
LOS 2035	D	D
Year LOS passes from C to D	2012	2012
First Year C to D both directions	2012	
	County G to County P	
	Eastbound	Westbound
LOS 2015	D	D
LOS 2025	D	D
LOS 2035	D	D
Year LOS passes from C to D	2012	2012
First Year C to D both directions	2012	

Table 1-2 WIS 23 Operations Analysis

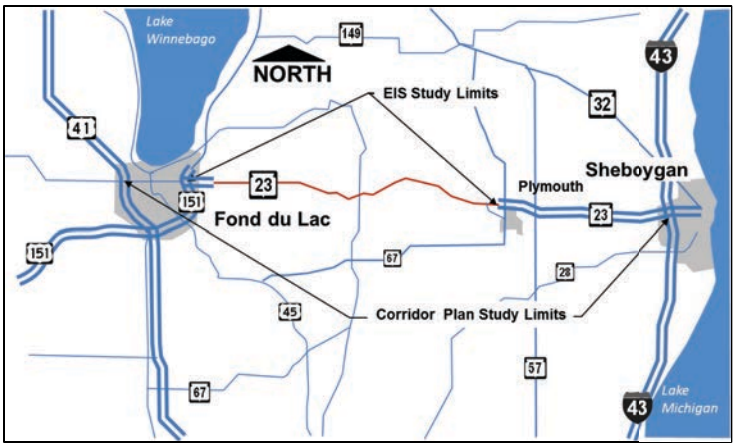


Figure 1-1 WIS 23 System Continuity Between US 41 and I-43

Purpose and Need Screening

All alternatives meet NHS expectations and needs if they are designed to meet Corridors 2030 Connector design criteria. All alternatives will provide a safe and dependable connection between Fond du Lac and Sheboygan. Not all alternatives are able to address the effects of trucks and other slow-moving vehicles on WIS 23 operations.

The following questions are used to determine how well an alternative satisfies the **System Linkage and Route Importance** purpose and need criterion.

a) Does the alternative adequately address truck traffic needs resulting from WIS 23's designation as a long truck route?

To meet this criterion, the alternative must address the operational challenges resulting from trucks and provide geometry that accommodates trucks. Measures such as passing lanes partially address this criterion by providing opportunities for platoons caused by trucks to disperse. A 4-lane expansion would address this criterion by preventing the formation of platoons by allowing through traffic the opportunity to travel around truck traffic. Also, intersection improvements that provide deceleration lanes, left-turn lanes, and adequate turn radii address this criterion by providing intersection geometry that accommodates truck movements.

The No-Build alternative does not meet this purpose and need criterion. No measures are incorporated to address platoons caused by truck traffic and intersection geometry is not improved.

The Passing Lane without Left-Turn Lanes partially meets this criterion. It provides 4 additional passing lanes along the corridor that help disperse platoons caused by truck and heavy vehicle traffic. It does not prevent the formation of platoons.

The Passing Lane with Left-Turn Lanes partially meets this criterion. It provides 4 additional passing lanes along the corridor that help disperse platoons caused by truck and heavy vehicle traffic. It does not prevent the formation of platoons.

The Hybrid 4-Lane to County G, Passing Lane County G to County P partially meets this criterion. From County K to County G, a full 4-lane divided highway is provided that prevents the formation of platoons caused by truck traffic and heavy vehicles. East of County G, it provides two passing lanes for the dispersal of platoons caused by truck traffic.

The 4-Lane Build On-Alignment meets this criterion. It provides a full 4-lane facility for the full length of the corridor that prevents the formation of platoons caused by truck traffic.

b) Does the alternative provide system continuity?

As mentioned it is desirable, though not required, to have a consistent facility type on WIS 23 between the US 151 4-lane expressway and the I-43 4-lane Interstate. To satisfy this criterion, the alternative should provide a reasonable level of consistency. Because this WIS 23 corridor is a 4-lane divided expressway at both ends of the corridor, alternatives that provide a full 4-lane facility satisfy this desire. Alternatives that provide a facility that is less than 4 lanes are considered to partially meet this criterion if there is a significant drop in traffic volume where the 2- or 3-lane facility begins.

The No-Build alternative does not satisfy this criterion because it does not provide a consistent facility type throughout the WIS 23 corridor.

The Passing Lane Without Left-Turn Lanes alternative does not satisfy this criterion. It does not provide a consistent facility type throughout the corridor. The reduction to a 2-lane facility occurs in a portion of the corridor that has only a modest traffic volume reduction.

The Passing Lane With Left-Turn Lanes alternative does not satisfy this criterion. It does not provide a consistent facility type throughout the corridor. The reduction to a 2-lane facility occurs in a portion of the corridor that has only a modest traffic volume reduction.

The Hybrid 4-Lane to County G, Passing Lane County G to County P does not meet this criterion. It does not provide a consistent facility type throughout the corridor and provides an even shorter span of 2-lane highway on the corridor from US 151 to I-43. The reduction to a 2-lane facility occurs in a portion of the corridor that has only a modest traffic volume reduction.

The 4-Lane Build On-Alignment meets this criterion because it provides a full 4-lane facility from US 151 to I-43.

2. Transportation Demand/Regional Economic Development

The 2010 FEIS project purpose objectives for the proposed action pertaining to purpose and need criterion 2 include the following:

- *Improve the operational efficiency of the WIS 23 corridor, appropriate for the highway's function as a Connector route in the Corridors 2020/Connections 2030 State Highway Plan, promoting regional and statewide economic development.*

The 2010 FEIS project need expressed the following needs regarding transportation demand and regional economic development.

> *"WIS 23 provides a connection to many economic sectors within the eastern Wisconsin region, such as manufacturing, tourism, recreation, agriculture, and trade. As a two lane highway facility, WIS 23 will not meet the operational and safety needs to serve these economic sectors as traffic increases.*
>
> *Increasing travel time and traffic hazards contribute to higher transportation costs for commuters and truck traffic. Increased travel and shipping costs result in higher product costs. This makes existing local businesses less competitive and less likely to expand and makes it more difficult for communities in the region to attract new business and industry. The consumer may also see higher product prices. Increased travel times may prevent extension of local business customer service and supply areas.*
>
> *Highway improvements that lower transportation costs and increase accessibility create a positive perception of the region, increase its competitiveness, and enhance economic development opportunities. Certain industries may be attracted to corridor communities because of improved access to population centers, suppliers, or buyers. Conversely, failing to improve the existing deficient access conditions may prevent new business and employment opportunities.*
>
> *Improved travel routes to recreational facilities benefit tourism in east central Wisconsin recreational areas through reduced travel time, increased safety, and more relaxed and predictable travel. Recreational destinations such as Elkhart Lake, the golf courses of Kohler, and state parks and forests have been successful in drawing local, state, national, and international visitors. Future international events at these venues will draw even more travelers that will use WIS 23."*

The WIS 23 corridor was incorporated as a Connector into the Corridors 2030 state highway plan because of its multifaceted role. WIS 23 connects producers with markets, people to jobs, and is an important link to recreational facilities in east central Wisconsin. Economics is a key factor in the designation of both Backbone and Connector Routes in Corridors 2030. Reducing travel times and providing predictable travel times decrease transportation costs for businesses and increase the attractiveness of the corridor and adjacent communities for business development. Providing easy and intuitive access also helps businesses that rely on tourists and recreational patrons.

Reducing traffic hazards decreases industry costs on vehicles, lost shipments, travel time, and employee value. Because traffic hazards are directly related to safety, this purpose and need component is discussed under criterion 7, Safety.

Travel Time and Predictability

Providing a satisfactory LOS affects travel time and travel time predictability. FDM 11-5-3.2 states "The highest LOS thresholds are applied to the Corridors 2020 system in recognition of its importance from a mobility and economic development perspective. On Corridors 2020 routes, "minimal to moderate"

congestion is allowed."[11] WIS 23 is a Connector Route in the Corridors 2030 plan. On 2-lane roadways such as WIS 23, platoons of vehicles prevent travelers from moving the free-flow speed and increase the percent time spent following another vehicle. Operational analyses show that in 2015 the average traveling speed on WIS 23 is 46 to 47 mph during peak hours, even with a posted speed limit of 55 mph.

Reducing travel time is a function of the highway facility's free-flow speed and providing satisfactory LOS. According to FDM 11-15 Attachment 1.1,[12] 4-lane expressways have a design speed of 70 mph and a posted speed of 65 mph.[13] Sixty-five mph is the posted speed of the 4-lane WIS 23 roadway east of this study corridor. Two-lane state trunk highways have a design speed of 60 mph and a posted speed of 55 mph. Fifty-five mph is the posted speed on WIS 23 within the study corridor. The difference in just the free-flow speeds amounts to about 3 minutes in travel time per corridor trip, which equates to over 150,000 travel hours per year.

Passing lanes help relieve platooning on 2-lane roadways, but they typically are not able to remove all platooning. Operational analyses on WIS 23 indicate passing lanes improve travel speeds by about 1 to 2 mph in the 2015 peak hour. This amounts to a 10- to 20-second travel time reduction for the 2-lane portion of the corridor over the No-Build alternative in the 2015 peak hour.

Four-lane roadways that operate above LOS C allow most vehicles to travel the free-flow speed of the roadway. The additional lane provides opportunity for vehicles to travel around slower vehicles. Operational analyses on WIS 23 indicate a 4-lane facility would provide 65 mph travel speeds on WIS 23 during the 2015 peak hour. The travel time difference between the No-Build 2-lane facility and 4-lane Build On-Alignment for the 18-mile 2-lane portion of the corridor would be almost 6 minutes 20 seconds during the 2015 peak hour. WIS 23 operational analysis is discussed in greater detail under criterion 4, Existing and Future Traffic Volumes and Resulting Operations.

Travel time predictability, or reliability, is a function of the LOS and other events that can affect travel time for a smaller portion of traffic. Examples could include crashes that block through streams of traffic or other traffic flow disruptions that can randomly and significantly affect travel time. Travel time predictability is growing as a service measure in urbanized environments where travel times can vary widely because of unstable traffic flow, incidents, and other disruptions. In 2010 FHWA highlighted reliability in its *Urban Congestion Trends* series titled *Enhancing System Reliability with Operations.* For WIS 23, travel time predictability, or reliability, is a function of the LOS as well as through traffic interaction with slower vehicles. Agricultural machinery uses WIS 23 and can encroach upon the travel lanes. This combined with the difficulty in passing because of opposing traffic can substantially decrease travel speeds. Providing reliable and predictable travel on WIS 23 aids the flow of goods and people through the corridor and between metropolitan areas and helps in promoting regional and statewide economic development.

Purpose and Need Screening

All build alternatives improve WIS 23. Reduced travel times and traffic hazards can lower transportation costs and create a positive perception of the region, enhance its competitiveness for attracting and retaining business, and enhance economic development opportunities. Predictable travel time can also benefit WIS 23 as a recreation route and benefit area tourism.

The following questions are used to determine how well an alternative satisfies the **Transportation Demand and Regional Economic Development** purpose and need criterion.

a) Does the alternative reduce travel time?

This criterion is accomplished by providing effective passing opportunities and allowing vehicles to travel at the free-flow speed of the highway, both of which contribute to providing a satisfactory LOS.

[11] Facilities Development Manual 11-5-3.2 (WisDOT, March 27, 2008; http://roadwaystandards.dot.wi.gov/standards/fdm/11-05.pdf)

[12] Facilities Development Manual 11-15 Attachment 1.1 (WisDOT, March 27, 2008; http://roadwaystandards.dot.wi.gov/standards/fdm/11-05.pdf)

[13] Typically the posted speed is 5 mph below the design speed.

The No-Build alternative does not satisfy this criterion. Average travel speeds during peak hours in 2015 remain at 46 mph.

The Passing Lane Without Left-Turn Lanes alternative does not satisfy this criterion. While providing opportunities to pass and relieve platoons, the passing lanes only increase the average travel speed during peak periods in 2015 by 1 to 2 mph, to almost 48 mph, which reduces the travel time through the 2-lane portion of the corridor by a little more than 20 seconds when compared to the No-Build alternative.

The Passing Lane With Left-Turn Lanes alternative does not satisfy this criterion. While providing opportunities to pass and relieve platoons, the passing lanes only increase the average travel speed during peak periods in 2015 by almost 1 mph, to 47 mph, which reduces the travel time through the 2-lane portion of the corridor by about 10 seconds when compared to the No-Build alternative.

The Hybrid 4-Lane to County G, Passing Lane County G to County P partially meets this criterion because for half the corridor it provides a facility with higher travel speeds and prevents the formation of platoons. The other half of the corridor from County G east will continue to have travel speeds around 48 mph during peak periods. This alternative reduces travel time through the 2-lane portion of the corridor in 2015 peak periods by about 3 minutes and 40 seconds when compared to the No-Build alternative.

The 4-Lane Build On-Alignment fully meets this purpose and need criterion because it provides a full 4-lane facility with high free-flow speeds and high LOS. This alternative reduces travel time through the 2-lane portion of the corridor in 2015 peak periods by about 6 minutes and 20 seconds when compared to the No-Build alternative.

b) Does the alternative provide for more predictable travel?

This criterion is satisfied by maintaining satisfactory LOS consistently throughout the corridor and reducing the negative effect of slow-moving agricultural, truck, and recreational vehicle traffic on the WIS 23 through travel stream. WIS 23's current lack of passing opportunities and available gaps in the opposing travel stream make passing slow-moving vehicles difficult. Reducing the negative effect of slow-moving traffic can be accomplished by providing opportunities to pass through passing lanes or capacity expansion.

Crashes also affect travel predictability. Because traffic hazards are directly related to roadway safety, this purpose and need component is discussed under criterion 7, Safety.

The No-Build alternative does not satisfy this criterion because the negative effect of slow-moving agricultural, truck, and recreational vehicles is not mitigated.

The Passing Lane Without Left-Turn Lanes alternative does not satisfy this criterion. For 4 lane miles of the 36 lane miles (2 directions x 18 miles) of the 2-lane corridor, there are opportunities to pass slow-moving agricultural, truck, and recreational vehicles. For the remaining 32 miles, vehicles must look for gaps in the opposing travel stream to travel around slow-moving traffic.

The Passing Lane With Left-Turn Lanes alternative does not satisfy this criterion. For 4 lane miles of the 36 lane miles (2 directions x 18 miles) of the 2-lane corridor, there are opportunities to pass slow-moving agricultural, truck, and recreational vehicles. For the remaining 32 miles, vehicles must look for gaps in the opposing travel stream to travel around slow-moving traffic.

The Hybrid 4-Lane to County G, Passing Lane County G to County P partially satisfies this criterion. For approximately 24 lane miles of the 36 lane-mile corridor (4 lanes for 11 miles, plus 2 miles of passing lanes), there is opportunity to pass slow-moving agricultural, truck, and recreational vehicles. For the remaining 12 lane miles, vehicles must look for gaps in the opposing travel stream to travel around slow-moving traffic.

The 4-Lane Build On-Alignment satisfies this criterion. With the provision of 4 lanes, high speed traffic is able to travel around slow-moving agricultural, truck, and recreational traffic.

3. Legislative and Transportation Planning History

The 2010 FEIS project purpose objectives for the proposed action that pertain to purpose and need criterion 3 include the following:

- *Preserve the corridor for future transportation needs by coordinating local governmental land use plans with transportation improvement plans….Proper planning will help alleviate development pressures on WIS 23 while addressing environmental issues for the future highway project.*
- *Maintain a rural highway-type facility while addressing the increased traffic needs of the expanding urban areas.*

The 2010 FEIS project need expressed the following needs regarding legislative and transportation planning history.

> *"In March 1989, WisDOT submitted its Corridors 2020 Report to the Governor that described proposed Backbone and Connector components of the state's highway system. The purpose of Corridors 2020 is to create a network of superior quality highways to foster economic development and meet intercity mobility needs into the 21st century. As mentioned in Section 1.3 A., WIS 23 is identified in the Corridors 2020 Plan as a Connector route. WIS 23 is functionally classified as a rural principal arterial. The Corridors 2020 Plan has since been incorporated in the Connections 2030 State Highway Plan.*
>
> *As a Connector route, WIS 23 should be upgraded to meet current standards for roadway width, level of service (LOS), and alignment. An improved WIS 23 that meets these standards will meet the transportation needs of east central Wisconsin and integrate its economy and communities with the rest of Wisconsin and the nation.*
>
> *In August 1989, WisDOT adopted a statewide plan for mapping access on the state highway system. The purpose of the access plan is to provide a high LOS for through traffic while providing reasonable access to abutting properties. The plan identifies Corridor 2020 Connector routes, like WIS 23, as highways for which managed access is essential for maintaining high levels of service.*
>
> *In April 1991, the Mobility 2000 report was developed as a legislative amendment to the 1991 to 1993 transportation budget. The report incorporates the recommendations made in the Corridors 2020 Plan. WIS 23 is identified in the Corridors 2020 Plan as a Connector route. In general, Mobility 2000 goes into more detail than the Corridors 2020 Plan on funding and other strategies for implementing the state's transportation program.*
>
> *The Wisconsin State Legislature in the 1999 Biennial Budget enumerated WIS 23 as a major project. Authorization for expanding highway capacity along the portion of WIS 23 from WIS 67 to US 41 in Sheboygan and Fond du Lac Counties is found in Wis. Stats 84.013(3)(ra)."*

Coordination with Local Land Use and Transportation Plans

Local Government:
WisDOT considers local land use and transportation plans whenever corridor improvements are being considered. WisDOT plans corridors that are compatible with local plans to the extent possible while still fulfilling the highway's role in the state transportation system.

Wisconsin State Statute 84.295 Preservation:
WisDOT uses Wisconsin State Statute 84.295 to alert communities of future transportation improvements along a highway. Wisconsin State Statute 84.295 is a long-term planning tool that allows WisDOT to officially designate and preserve highway corridors as expressways/freeways. One principal benefit of this tool is that it identifies to both property owners and local communities the location and future right of way

needed for expressway/freeway conversion improvements. Identifying right of way and access helps minimize costly relocations and/or disruptions to property owners. With this knowledge local government can acknowledge improvements in the local land use plans and approve development in light of future transportation improvements. Future land uses then would not preclude or be incompatible with expressway/freeway conversion improvements. Without active preservation, local development may occur on lands needed for the long-term highway improvements forcing the evaluation of corridors less suitable for transportation improvements. This could result in greater environmental impacts as "best-fit" alignments are precluded by development. Identifying suitable lands for transportation improvements that minimize environmental impacts, and then preserving these lands, helps ensure future transportation improvements have fewer impacts to the environment. Wisconsin State Statute 84.295 is discussed in more detail under criterion 6, Access.

Metropolitan Planning Organizations:
WisDOT coordinates with local Metropolitan Planning Organizations (MPO) for urban centers with a population over 50,000. They are federally mandated policy-making organizations made up of representatives from local government and transportation authorities.[14] An MPO maintains a fiscally constrained Long-Range Transportation Plan (LRTP) for the urban area that fosters mobility and access for people and goods and efficient transportation system performance.

Portions of the WIS 23 corridor are within two separate MPOs. The west end of the corridor is in the Fond du Lac Metropolitan Planning Organization that includes the city of Fond du Lac, Fond du Lac County, the village of North Fond du Lac, and the towns of Fond du Lac, Byron, Empire, Taycheedah and Friendship. The East Central Wisconsin Regional Planning Commission supports and staffs this MPO. The east end of the corridor is near the Sheboygan Metropolitan Planning Organization that includes the cities of Sheboygan and Sheboygan Falls, the villages of Kohler and Howards Grove, the town of Sheboygan, and portions of the towns of Herman, Lima, Mosel, Sheboygan Falls, and Wilson. The Bay-Lake Regional Planning Commission supports and staffs this MPO. Note that this portion of WIS 23 is outside the metropolitan planning area but is included in its air quality conformity analysis of Sheboygan County.

Wisconsin State Statutes

Wisconsin State Statute 13.489 lays out the procedure for the approval of major projects as well as the authorization of new projects to move through the NEPA process. A major project is defined in Wisconsin State Statute 84.013(1)(a) by the two categories as follows:

84.013(1)(a), (Definition of a Major Project)

> *Category 1–A project that has a total cost of more than $30,000,000 and satisfies any of the following:*
> *(1) Constructing a new highway 2.5 miles or more in length.*
> *(2) Reconstructing or reconditioning an existing highway by either:*
> *(a) Relocating 2.5 miles or more of the existing highway, or*
> *(b) Adding one or more lanes 5 miles or more in length to the existing highway.*
> *(3) Improving to freeway standards 10 miles or more of an existing divided highway having 2 or more lanes in either direction.*
>
> *Category 2–A project that has a total cost of more than $75,000,000 and is not described in Category 1 above.*

[14] The United States Congress passed the Federal-Aid Highway Act of 1962, which required the formation of an MPO for any urbanized area with a population greater than 50,000. Congress created MPOs to ensure that existing and future expenditures of governmental funds for transportation projects and programs are based on a continuing, cooperative, and comprehensive ("3-C") planning process. Statewide and metropolitan transportation planning processes are governed by federal law (23 U.S.C. §§ 134–135).

The procedure outlined in Wisconsin State Statute 13.489 includes the use of a Transportation Projects Commission, which consists of the governor, 3 citizen members appointed by the governor, and 5 state senators and 5 representatives to the assembly. The statute directs the commission to meet biyearly on even-numbered years to approve the preparation of environmental impact statements or environmental assessments for transportation projects that could potentially become major projects. The statute also directs the commission to meet biyearly, on odd-numbered years, to enumerate funding for projects where a NEPA document has been completed and the project merits construction.

In 1999, the Wisconsin State Legislature enumerated WIS 23 as a major project and authorized WisDOT to begin construction. The authorization is found in Wisconsin State Statute 84.013(3)(ra) and is as follows:

> *84.013*
> *(3) The department may proceed with construction of the following major highway projects:*
> *(ra) STH 23 between STH 67 and USH 41 in Sheboygan and Fond du Lac counties.*

With this authorization, the Wisconsin State Legislature avoided the use of the Transportation Projects Commission Process described in State Statute 13.489 and directly enumerated the WIS 23 project. This action by the legislature illustrates WIS 23's regional and economic importance to the state. To qualify as a major project according to the previously referenced 84.013(1)(a), and comply with this enumeration, WIS 23 must add 5 or more lane miles to the corridor.

This enumeration process does not supersede the NEPA/WEPA process. Through the NEPA/WEPA process, lesser alternatives may be selected. If they are selected, the project would no longer qualify as a major project and would no longer be eligible for funding under this program. However, the relevance of the enumeration of this project as a major project by the State Legislature illustrates the statewide recognition of the importance of the corridor for economic development and regional mobility.

Purpose and Need Screening

Coordination with local governments and MPOs will ensure WIS 23 improvements inclusion in local land use and transportation plans. Official mapping of future interchange and overpass right of way needs will alert communities and property owners to future improvements and access modification.

The following questions are used to determine how well an alternative satisfies the **Legislative and Transportations Planning History** purpose and need criterion.

a) Is the alternative consistent with and/or reflected in local land use and transportation plans?

To be consistent, the alternative should be reflected in or not contradict the local land use and transportation plans. Specific MPO plans referencing WIS 23 include the Fond du Lac Area MPO Long Range Transportation Plan (Exhibit 72, Item 11) and the 2035 Update to the Sheboygan Area Plan (page 6-17).

The No-Build alternative does not satisfy this criterion because it contradicts what is incorporated in the MPO long-range plans.

The Passing Lane Without Left-Turn Lane alternative partially satisfies this criterion. This alternative improves the mobility of WIS 23, yet does not provide the 4-lane expansion mentioned in the MPO plans.

The Passing Lane With Left-Turn Lane alternative partially satisfies this criterion. This alternative improves the mobility of WIS 23, yet does not provide the 4-lane expansion mentioned in the MPO plans.

The Hybrid 4-Lane to County G, Passing Lane County G to County P partially satisfies this criterion. This alternative improves the mobility of WIS 23 and provides the 4-lane expansion discussed in the Fond du Lac Area MPO plan. It does not contain the 4-lane expansion discussed in the 2035 update to the Sheboygan Area Plan.

The 4-Lane Build On-Alignment satisfies this purpose and need criterion. The improvement is consistent with that mentioned in both the Fond du Lac Area MPO and Sheboygan Area MPO plans.

b) Is the alternative consistent with the intent of Wisconsin State Statute 84.013(3)(ra)?

To be fully consistent the alternative must add "*one or more lanes 5 miles or more in length to the existing highway*."

The No-Build alternative does not satisfy this purpose and need criterion. It does not add any lanes to the WIS 23 corridor nor does it improve the mobility of the corridor.

The Passing Lane Without Left-Turn Lanes alternative, while not adding 5 miles of new roadway, does recognize the importance of WIS 23 and acknowledges the intent of the Legislators who passed this Statute and therefore partially satisfies this criterion.

The Passing Lane With Left-Turn Lanes alternative, while not adding 5 miles of new roadway, does recognize the importance of WIS 23 and acknowledges the intent of the Legislators who passed this Statute and therefore partially satisfies this criterion.

The Hybrid 4-Lane to County G, Passing Lane County G to County P satisfies this criterion because it adds more than 5 lane miles to the WIS 23 corridor.

The 4-lane Build On-Alignment satisfies this criterion because it adds more than 5 lane miles to the WIS 23 corridor.

4. Existing and Future Traffic Volumes and Resulting Operations

The 2010 FEIS had several paragraphs describing existing and projected traffic volumes as well as the resulting traffic operation from those volumes. Since the completion of the 2010 FEIS, a Travel Demand Model was developed for the Northeast Region that expands the ability of WisDOT to model network changes. To ensure that the Limited Scope Supplemental EIS reflected up-to-date traffic data, a revised forecast was performed using current traffic data and new forecasting tools. The model results were used with existing traffic data and linear regression techniques to develop revised 2035 forecasts for the WIS 23 corridor.[15]

The revised traffic forecasts from July 2012 are similar yet lower than those used for the 2010 FEIS.[16] This has caused some of the text of the 2010 FEIS Purpose and Need dealing with traffic volumes and operations to be outdated in that it either references traffic forecasts that are no longer current or traffic operations analysis that is no longer relevant in light of the revised traffic forecasts. The underlying purpose and need components that involve traffic volumes and operations generally continue to apply to the project. But as mentioned, alternatives that do not involve traditional capacity expansion and were eliminated from detailed analysis in the 2010 FEIS may now have more opportunity to satisfy the Existing and Future Traffic Volumes and Resulting Operation component of the project purpose and need. Therefore, these lesser alternatives are being evaluated to determine if they could now potentially meet the purpose and need.

To avoid confusion, only relevant portions of the Existing and Future Traffic Volumes and Resulting Operation portion of the Project Purpose and Need in the 2010 FEIS are shown below.

The 2010 FEIS project purpose objectives for the proposed action pertaining to purpose and need criterion 4 include the following.

- *Increase the mobility by adding capacity…*
- *Improve the operational efficiency of the WIS 23 corridor, appropriate for the highway's function as a Connector route in the Corridors 2020/Connections 2030 State Highway Plan, …*
- *Maintain a rural highway-type facility while addressing the increased traffic needs of the expanding urban areas.*

The 2010 FEIS project need expressed the following needs regarding existing and future traffic volumes and the resulting operation.

1. Traffic Volumes and Composition

. . . . . Current volumes from 2003 and 2005 show that WIS 23 is approaching the levels where highway capacity expansion improvements are investigated. As traffic volumes increase to those forecasted for the design year 2035, the volumes will be well within the range where four-lane capacity improvements are investigated and implemented.

Truck volumes on WIS 23 are very high. The average daily truck traffic comprises almost 14 percent of the total traffic volume on WIS 23, which on two-lane roadways is particularly detrimental to roadway operational characteristics because passing requires use of the opposing traffic lane. The high numbers of trucks create "platoons" of traffic where vehicles are not able to travel the free-flow speed and have difficulty passing. The truck traffic imposes a direct limitation on the overall capacity of the existing road with the inability to pass, creating conflicts with slower local traffic, recreational vehicles, vehicles towing

[15] The travel demand model, current traffic data and linear regression techniques were reconciled in accordance with National Cooperative Highway Research Program (NCHRP) Report No. 255 Highway Traffic Data for Urbanized Area Project Planning and Design (1982) http://teachamerica.com/tih/PDF/nchrp255.pdf. More discussion is provided in a technical memo prepared by WisDOT Northeast Region in Appendix A of this document.

[16] Since 2009 traffic volumes on highways throughout the state of Wisconsin including WIS 23 have decreased. These lower actual traffic volumes have influenced future traffic forecasts. For WIS 23, the result is traffic forecasts are now slightly lower than those shown in the 2010 FEIS.

trailers, and farm machinery. This mixture of traffic impedes traffic flow creating unsafe situations and lowers the efficiency of the roadway.

Traffic along the existing route is comprised of local and through traffic. Local traffic has origins and/or destinations within the municipalities of Plymouth and Fond du Lac, as well as along the corridor. The through traffic does not have origins or destinations within these municipalities.

In 1997, WisDOT conducted origin/destination (OD) surveys in the Fond du Lac area. Approximately 43 percent of all the vehicles were through trips (beyond the City of Fond du Lac or Plymouth) and 58 percent of the truck traffic comprised of through trips.

2. Operation Levels

. . . . . As a Corridors 2020/Connections 2030 Connector route, the numeric LOS threshold for mobility improvements on WIS 23 is 4.0, which is the boundary between LOS C and LOS D. These thresholds are based on a balance of social, environmental, and dollar costs and may not match with every traveler's perception of when congestion warrants roadway improvements.

As a Corridors 2020/Connections 2030 Connector route, portions of WIS 23 do not meet the operational standards for a Connector route. Steadily increasing traffic volumes and numerous access points will decrease the mobility and efficiency of the existing highway so that all of the highway will not meet the operational objectives of a Connector route by the year 2035. The combination of high traffic volumes, truck composition, and numerous access points makes it difficult for the WIS 23 to satisfy the operational objectives of a Connector route as a two-lane roadway. . . . . "

Note that the text above references 14 percent truck traffic, whereas the July 2012 traffic forecasts revise the truck percentage to 11.2 percent.

The requirements associated with a Corridors 2020/2030 Connector Route were described in criterion 1, System Linkage and Route Importance. This criterion provides more detail on the operational analyses and how they apply to potential WIS 23 alternatives.

While this 2010 FEIS excerpt mentions the effect of agricultural traffic on highway operations, this is related more to the availability of lanes to bypass the slow-moving traffic. Therefore the effect of farm machinery on WIS 23 operations and the effect of WIS 23 alternatives on farm machinery are discussed in criterion 2b, Predictable Travel Time of this technical memo.

Current WIS 23 Traffic Projections (July 2012)

The most current July 2012 traffic forecasts provide 2035 traffic volume projections for the following scenarios:

- No-Build
- Passing Lane Without Left Turns
- Passing Lane With Left Turns
- Hybrid Facility-4 Lanes to County G and 2 Lanes with Passing Lanes County G to County P[17]
- 4-Lane Build On-Alignment

[17] This alternative was not discussed in the 2010 FEIS but was looked at as part of the Limited Scope Supplemental EIS because the July 2012 traffic forecasts show slightly lower volumes in the design year (2035).

Table 4-1 shows the difference between the 2010 FEIS traffic volume forecasts and the July 2012 traffic forecasts for various segments of WIS 23.

Segment	June 2012 Counts	From 2010 FEIS	From July 2012 Forecasts				
		2035 Volumes (No Longer Valid)	2035 No-Build[1]	2035 Passing Lane Without Left-turns[1]	2035 Passing Lane with Left-turn Lanes and Median Refuge[1]	2035 Hybrid 4-Lane to County G Passing Lane County G to County P[1]	2035 4-Lane Build On Alignment[1]
US 151 – County K	12,200	Not Given	17,400	16,000	16,000	16,300	17,000
County K – County UU	11,100	18,400	12,300	13,100	13,100	13,600	14,200
County UU – Hinn Rd	8,800	12,400-13,700[2]	10,800	11,000	11,000	11,500	11,900
Hinn Rd – County W	8,800	15,800	9,500	11,000	11,000	11,500	11,900
County W – County G	8,100	12,200-13,400[2]	9,100	9,700	9,700	10,400	11,000
County G – County T	7,600	11,200-14,700[2]	8,500	9,100	9,100	9,400	10,200
County T – County A	9,500	Not Shown	8,800	9,300	9,300	9,700	10,500
County A – County P	8,000	14,600	10,400	10,700	10,700	11,200	12,000

Table 4-1 2010 FEIS and July 2012 Traffic Forecasts for Year 2035

Operations Analysis Methods

The operation of a highway facility is typically expressed as Level of Service (LOS) and ranges from LOS A (good) to LOS F (poor), which are defined in the 2010 Highway Capacity Manual (HCM) Chapter 5.[18] There are different defining characteristics for each type of highway facility. For example, the LOS definitions are different for an intersection than they are for a 2-lane highway. The LOS definitions are also different for a 4-lane highway. Similarly, there are different service measures for different types of facilities.

2-Lane Roads

The WIS 23 existing and passing lane operational analysis used the methodology for 2-lane highways as described in Chapter 15 of the 2010 HCM.[19] The LOS is determined by the percent time-spent-following. Chapter 5 of the manual states the following:

> *"Percent time-spent-following represents the freedom to maneuver and the comfort and convenience of travel. It is the average percentage of travel time that vehicles must travel in platoons behind slower vehicles because of the inability to pass."*

Chapter 15 of the HCM provides three analysis classes for the 2-lane capacity analysis. Class 1 highways are highways where motorists expect to travel at relatively high speeds. Because of WIS 23's classification as a Connector in the Corridors 2030 state highway plan, it is a Class 1 highway. Two-lane highways that are major intercity routes, primary connectors of major traffic generators, daily commuter routes, or major links in state or national highway networks are generally assigned to Class 1. These facilities serve mostly long-distance trips or provide the connections between facilities that serve long-distance trips. As a 2-lane Class 1 highway, WIS 23 must

[18] 2010 Highway Capacity Manual (Transportation Research Board, 5th Edition, 2010)

[19] The 2-lane analysis used in the 2010 FEIS used a microscopic traffic simulation program from the Interactive Highway Safety Design Model (FHWA) because the 2000 HCM did not have a good analysis model for passing lanes. The 2010 Highway Capacity Manual (Transportation Research Board, 5th Edition, 2010) provides a better 2-lane and passing lane analysis tool and therefore is used in this analysis.

maintain an LOS C. LOS C means that the percent time-spent-following is greater than 50 percent and less than 65 percent, according to 2-Lane Roadway LOS[20] from 2010 HCM, pages 15-7 and 15-8. LOS C also means that most vehicles are traveling in platoons and speeds are noticeably curtailed.

2-Lane Roads with Passing Lanes

Two-lane roadways with passing lanes are analyzed as 2-lane roadways as described in Chapter 15 of the HCM. The length and location of passing lanes are a required input into the standard analysis and are described on pages 15-28 to 15-33 of the HCM.

4-Lane Roads

The WIS 23 4-Lane Build On-Alignment alternative uses the operations analysis procedures described in Chapters 10-14 of the 2010 HCM, which includes freeways, basic freeway segments, weaving segments, merge and diverge segments, and multilane highways. Figure 4-1 is taken from Figure 3 (a) of HCM Chapter 2 and schematically illustrates the different freeway analysis components. Multilane highways that are not freeways (e.g., they contain intersections) are often called expressways and have similar analysis components. Chapter 14 of the HCM states:

> *"Uninterrupted flow on multilane highways is in most ways similar to that on basic freeway segments (Chapter 11 HCM). Several factors are different, however. Because side frictions are present in varying degrees from uncontrolled driveways and intersections as well as from opposing flows on undivided cross sections, speeds on multilane highway tend to be lower than those on similar basic freeway segments."*

When expressways use interchanges instead of intersections, the freeway analysis components of the freeway merge segment, diverge segment, and basic segment apply. The LOS density characteristics for multilane highways are the same as those for a Freeway Basic Segment LOS except that free-flow speed factors into the density thresholds for LOS E and F. This is described in more detail in the 2010 HCM page 14-4.

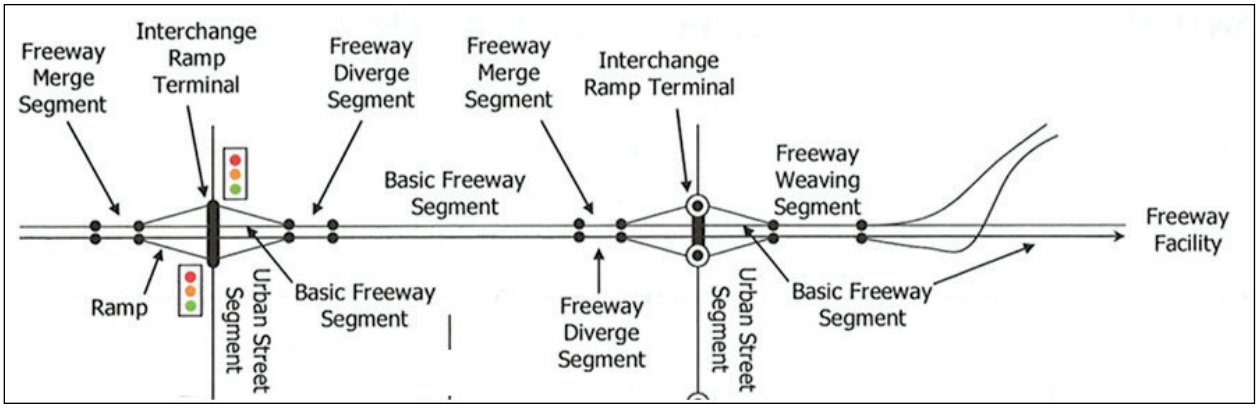


Figure 4-1 Freeway Operational System Elements

For 4-lane roadways, the LOS is determined by the density of traffic per lane per mile. The denser the freeway segment, the more difficult it is to maneuver. Unlike speed, density increases as flow increases up to capacity, resulting in a service measure that is both perceivable by motorists and is sensitive to a broad range of flows. Chapters 11 and 13 of the 2010 HCM describe Freeway Basic Segment LOS[21] C as providing *"for flow with speeds near the free-flow speed of the freeway. Freedom to maneuver within the traffic stream is noticeably restricted, and lane changes require more care and vigilance on the part of the driver."* The Level of Service Characteristic for

[20] Physical roadway inputs into the HCM operations analysis include lane widths, shoulder widths, access point density, terrain, percent no-passing zones, speed limit, base design speed, passing lane lengths, and pavement conditions. Traffic inputs include hourly automobile traffic, analysis period, peak-hour factor (determines how much of the peak-hour traffic occurs in the peak 15 minutes), directional split, heavy vehicle percentage, and the presence of occupied parking.

[21] Roadway inputs into the operations analysis include free-flow speed, number of mainline lanes, lane width, lateral clearance, ramp density, and terrain. Traffic inputs include traffic demand during the analysis period, heavy vehicle presence, peak-hour factor, and driver population factor. These paragraphs only briefly summarize how LOS is calculated on freeway segments.

Freeways[22] and for Merging and Diverging Freeway Segments for LOS C are 18[23] to 26 passenger cars/mile/lane and 20[24] to 28 passenger cars/mile/lane, respectively. For multilane highways (expressways), the LOS C threshold densities are the same.

Intersections

There are no direct LOS requirements for intersections associated with a Corridors 2030 route. FDM 11-5-3.2 Table 3.1[25] lists the acceptable LOS for highways, yet the accompanying text states

> *Table 3.1 is not intended for use to determine appropriate LOS at controlled intersections. Intersection LOS will be determined on a case-by-case basis dependent on the local land use, economic, social and environmental impacts.*

Because WIS 23 is a high mobility corridor and a Corridors 2030 Connector Route, signals are not desired. Signals introduce substantial delay for WIS 23 vehicles, they reduce the mobility of the corridor, and they are contrary to driver expectations on a high speed corridor. Because of this, access to WIS 23 will either be through interchanges (with the previously described merges and diverges) or at two-way stop-controlled intersections where the side-road vehicle is required to stop and wait for a gap in traffic before crossing or entering WIS 23 traffic. The operations analysis for Two-Way Stop-Controlled intersections is described in Chapter 19 of the HCM and uses gap acceptance models. The LOS is calculated by how long a side-road vehicle has to wait before making its maneuver. Table 4-2 summarizes the side-road LOS as defined in Exhibit 19-1 from the HCM.

Control Delay (s/vehicle)	LOS by Volume to Capacity Ratio V/C<=1.0
0-10	A
>10-15	B
>15-25	C
>25-35	D
>35-50	E
>50	F

Table 4-2 Exhibit 19-1 from HCM LOS for Two-Way Stop-Controlled Intersections

Delay thresholds for Two-Way Stop-Controlled intersections are lower than those for signalized intersections because the uncertainty on the part of side-road users and need for vigilance reduces the travelers' delay tolerance.

While not required to establish an LOS threshold for side-road intersections on WIS 23, WisDOT seeks to provide reasonable operation levels at all intersections and WisDOT defines this as LOS D.[26] Operation levels tend to deteriorate at more highly used intersections because there is a higher demand for access which leads to queuing. Higher volume intersections along WIS 23 include county trunk highways that are classified either as minor arterials or rural collectors. This becomes more critical and more difficult to achieve at the highly used intersections of County G, County UU, and County W. Table 4-2 provides the side-road LOS for two-way stop-controlled intersections on major intersections along the corridor.

[22] The LOS density characteristics for multilane highways that are not freeways (e.g., they contain intersections) are the same as those for a Freeway Basic Segment LOS except that free-flow speed factors into the density thresholds for LOS E and F. This is described in more detail in the 2010 Highway Capacity Manual page 14-4 (Transportation Research Board, 5th Edition, 2010).
[23] The range spans from *just greater than* 18 pc/m/l to 26 pc/m/l.
[24] The range spans from *just greater than* 20 pc/m/l to 28 pc/m/l.
[25] Facilities Development Manual 11-5-3, (WisDOT; March 27, 2008; http://roadwaystandards.dot.wi.gov/standards/fdm/11-05.pdf#fd11-5)
[26] Most municipalities, county, and state governments establish LOS D as an acceptable intersection operation level. As such, this LOS would be expected at higher use intersections along WIS 23 to ensure effective access.

Intersection	Forecast Year	No Build Side Street LOS							
		NBL/TH		NBR		SBL/TH		SBR	
		Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
County G	2015	32.2	D	11.8	B	29.6	D	10.1	B
	2025	50.2	F	12.6	B	42.8	E	10.4	B
	2035	77.7	F	13.4	B	68.4	F	10.7	B
County UU	2015	24.7	C	11.0	B	21.4	C	11.5	B
	2025	31.3	D	11.4	B	25.1	D	12.1	B
	2035	42.8	E	11.9	B	30.7	D	12.8	B
County W/Loehr	2015	46.2	E	12.5	B	82.9	F	11.1	B
	2025	54.0	F	12.7	B	112.3	F	11.2	B
	2035	67.2	F	12.9	B	211.9	F	11.3	B
General Intersection (2035 Mainline Traffic approx 10,000 ADT)	20 Turns Out	27.8	D	27.8	D	26.8	D	26.8	D
	40 Turns Out	32.2	D	32.2	D	31.1	D	31.1	D
	60 Turns Out	39.8	E	39.8	E	38.2	E	38.2	E
	80 Turns Out	52.8	F	52.8	F	50.4	F	50.4	F
	100 Turns Out	79.6	F	79.6	F	76.9	F	76.9	F

NBL = Northbound Left NBR = Northbound Right
SBL = Southbound Left SBR = Southbound Right
TH = Through

Table 4-3 WIS 23 Intersection LOS

Table 4-3 illustrates the left-turn and through movements at major intersections are, or soon will be, experiencing substantial delays.

Facility changes on WIS 23 will change the way some at-grade intersections are analyzed between the alternatives. For example, a left-turn maneuver onto an undivided highway must identify gaps in both eastbound and westbound traffic. If a median refuge is provided with sufficient storage for one vehicle, the left-turn movement can be made in two movements. The vehicle first identifies a gap in one traffic direction, crosses to the median, and then waits for an acceptable gap in the opposing travel direction. This operational change to side-road operations would be implemented for any alternative that introduces a median onto WIS 23. Similarly, side-road intersection operations change when an intersection is converted to an interchange. The left turn from a side-road LOS is calculated in seconds of control delay. If the intersection is converted to an interchange, the LOS is calculated by the control delay at the ramp terminal and the density at the merge segment of the freeway. For WIS 23 projected volumes, the ramp terminal LOS and merging densities would operate at LOS A whereas a two-way-stop-controlled intersection would operate very poorly. Similarly, the installation of a J-turn at an intersection changes the left-turn delay to the combined delay of a right-turn movement and the delay associated with a U-turn from the mainline. (Note: The installation of J-turns is not possible on the 2-lane Passing Lane alternatives because it requires a large divided median to allow trucks to make a U-turn. Providing such a large median would eliminate passing opportunities for much of the corridor.) Figure 4-2 illustrates these transitions and how the operation of the movements changes.

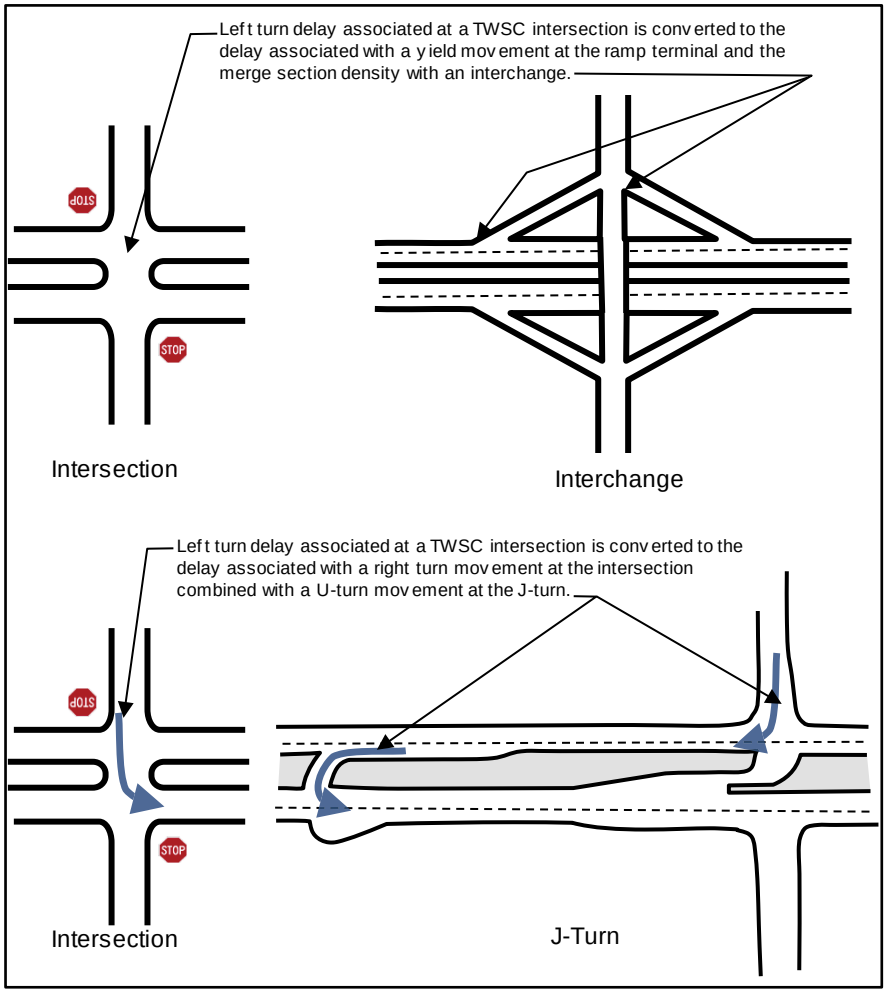


Figure 4-2 LOS Transition from Intersection to Interchange and J-Turn

WIS 23 Mobility

As mentioned, one factor that plays heavily into mainline operations is the absence of traffic control that would stop or delay WIS 23 traffic. High mobility highways, such as Corridors 2030 routes, place a premium on maintaining through traffic movement. Yet in urban areas, side-road access demand often leads to local requests for traffic signals. Increasing traffic volumes on the mainline make it more difficult to enter and cross it from a side road. These delays can increase crash frequencies. Yet traffic signals would increase WIS 23 delay and introduce crashes associated with signals. Signals do not meet expectations on a rural highway. Multiple signals on urbanizing corridors substantially reduce mobility and are contrary to the objectives of a Corridors 2030 Route. For this reason, maintaining a rural highway-type facility while addressing increased traffic needs is a component of the project purpose and need. Outside the Fond du Lac urban area, WisDOT seeks to prevent the degradation of mobility on WIS 23 by avoiding signal installation but still provide reasonable access to and across WIS 23.[27]

Purpose and Need Screening

All alternatives will maintain a rural highway-type facility outside the Fond du Lac urban area. All build alternatives will improve operational efficiency over the baseline existing two-lane facility operation but to varying degrees.

[27] Note: Inside Fond du Lac, a roundabout will be installed at Wisconsin American Drive to slow traffic prior to entering the signalized US 151 interchange and to provide access out of the Wisconsin American Business Park.

The following question indicates how well an alternative satisfies the **Existing and Future Traffic Volumes and Resulting Operations** project purpose and need criteria.

a) Does the alternative improve WIS 23 mainline operational efficiency and mobility by meeting LOS requirements of a Corridors 2030 Connector Route? (LOS C or below numeric LOS 4.0)

WIS 23 Mainline Alternative Comparison

The operational goals for a Corridors 2030 route, such as WIS 23, are to maintain an LOS C in the 2035 design year. Table 4-4 summarizes the mainline operations for the alternatives being considered. The analyses was broken into two sections, from County UU to County G and from County G to County P, to more accurately account for the traffic variations along the corridor in the analysis. Breaking the analysis into sections also allows each section to be evaluated individually to see if lower build alternatives have the potential to meet the operational component of the project purpose and need.

	CTY UU to CTY G									
			Passing Lane Alternatives							
	2-Lane No Build		Passing Lanes Without Left Turn Lanes		Passing Lanes With Left Turn Lanes		Hybrid 4-Lane to CTY G, Passing Lane CTY G to CTY P		4-Lane Build On-Alignment	
	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound	Eastbound*	Westbound*	Eastbound*	Westbound*
% Following 2015	76.4%	76.6%	64.1%	63.7%	65.4%	65.1%	---	---	---	---
LOS 2015 (Numeric)	4.76	4.77	3.94	3.91	4.03	4.01	---	---	---	---
LOS 2015	D	D	C	C	D	D	A	A	A	A
% Following 2025	78.2%	78.4%	67.4%	67.1%	68.7%	68.3%	---	---	---	---
LOS 2025 (Numeric)	4.88	4.89	4.16	4.14	4.25	4.22	---	---	---	---
LOS 2025	D	D	D	D	D	D	A	A	A	A
% Following 2035	78.4%	78.6%	68.8%	68.3%	69.9%	69.5%	---	---	---	---
LOS 2035 (Numeric)	4.89	4.91	4.25	4.22	4.33	4.30	---	---	---	---
LOS 2035	D	D	D	D	D	D	A	A	A	A
Year LOS passes from C to D	2012	2012	2017	2018	2013	2013	---	---	---	---
First Year C to D both directions	2012		2017		2013		---		---	

*4-Lane Freeway Analysis

	CTY G to CTY P									
			Passing Lane Alternatives							
	2-Lane No Build		Passing Lanes Without Left Turn Lanes		Passing Lanes With Left Turn Lanes		Hybrid 4-Lane to CTY G, Passing Lane CTY G to CTY P		4-Lane Build On-Alignment	
	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound	Eastbound*	Westbound*
% Following 2015	73.1%	73.8%	64.7%	64.1%	67.1%	66.9%	64.8%	64.0%	---	---
LOS 2015 (Numeric)	4.54	4.59	3.98	3.94	4.14	4.13	3.99	3.93	---	---
LOS 2015	D	D	C	C	D	D	C	C	A	A
% Following 2025	74.2%	74.9%	67.0%	66.3%	69.4%	69.0%	68.1%	67.3%	---	---
LOS 2025 (Numeric)	4.61	4.66	4.13	4.09	4.29	4.27	4.21	4.15	---	---
LOS 2025	D	D	D	D	D	D	D	D	A	A
% Following 2035	76.4%	77.1%	69.0%	68.5%	71.2%	71.1%	69.7%	69.2%	---	---
LOS 2035 (Numeric)	4.76	4.81	4.27	4.23	4.41	4.41	4.31	4.28	---	---
LOS 2035	D	D	D	D	D	D	D	D	A	A
Year LOS passes from C to D	2012	2012	2017	2017	2012	2012	2016	2016	---	---
First Year C to D both directions	2012		2017		2012		2016		---	

Table 4-4 WIS 23 Mainline LOS by Alternative

The No-Build alternative does not satisfy the operational component of the purpose and need. Mainline WIS 23 operates at LOS D in all directions through the year 2035.

The Passing Lane Without Left-Turn Lanes does not satisfy the operational component of the project purpose and need. WIS 23 operates at LOS D (or above the numeric LOS of 4.0) in both directions by 2025 and continues at this LOS through the 2035 design year.

The Passing Lane With Left-Turn Lanes does not satisfy the operational component of the project purpose and need. The eastbound direction on both the west and east sections operates at LOS D (or above the numeric LOS of 4.0) by 2015 and continues at this LOS through the 2035 design year. The Passing Lane With Left-Turn Lanes operates poorer than the same alternative without left-turn lanes because the installation of the left-turn lanes reduces the percent passing availability by 16 percent, decreasing the LOS of the alternative.

The Hybrid 4-Lane to County G, Passing Lane County G to County P alternative was developed during the formation of alternatives for the Limited Scope SEIS to see if it had the potential to satisfy the project purpose and need with the revised and lower traffic volume forecasts. It incorporates a 4-lane facility on the west portion of the corridor and a 2-lane highway, with passing lanes, on the east portion of the corridor. Even with lower traffic forecasts, this alternative does not satisfy the project purpose and need for this criterion. The 4-lane section from County UU to County G operates at LOS A in 2035. The increased traffic volumes associated with this alternative cause the east end of the corridor (the end with passing lanes) to fall to LOS D (or above the numeric LOS of 4.0) by 2025 and continue at this LOS through the 2035 design year. The passing lane portion of this alternative (east section) performs worse than the east section of the regular passing lane alternative because the 4-lane expansion portion of the alternative causes higher forecast traffic volumes, which in turn decrease the LOS on the east end of the corridor.

The 4-Lane Build On-Alignment alternative satisfies the project purpose and need. WIS 23 will operate at LOS A in both directions in the 2035 design year.

b) Does the alternative provide a reasonable LOS for vehicles trying to access WIS 23?

Intersection Side-Road Alternative Comparison

Table 4-5 summarizes the side-road operation levels associated with each of the build alternatives, and Table 4-3 summarizes the operations for the No-Build alternative.

Intersection	Forecast Year	Side Road LOS - Passing Lane Without Left Turn Lanes								Side Road LOS - Passing Lane With Left Turn Lanes							
		NBL/TH		NBR		SBL/TH		SBR		NBL/TH		NBR		SBL/TH		SBR	
		Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
County G	2015	33.1	D	11.8	B	30.7	D	10.1	B	20.3	C	11.8	B	20.3	C	10.1	B
	2025	59.5	F	12.8	B	48.2	E	10.5	B	26.0	D	12.8	B	26.0	D	10.5	B
	2035	128.3	F	14.1	B	100.9	F	10.9	B	33.3	D	14.1	B	35.7	E	10.9	B
County UU	2015	24.9	C	11.0	B	21.7	C	11.5	B	16.2	C	11.0	B	15.7	C	11.5	B
	2025	34.0	D	11.6	B	26.8	D	12.3	B	19.5	C	11.6	B	17.5	C	12.3	B
	2035	54.0	F	12.3	B	35.2	E	13.3	B	23.3	C	12.3	B	19.8	C	13.3	B
County W/Loehr	2015	49.2	E	12.7	B	93.6	F	11.2	B	23.5	C	12.7	B	31.2	D	11.2	B
	2025	82.9	F	13.4	B	328.5	F	11.6	B	28.5	D	13.4	B	46.3	E	11.6	B
	2035	236.3	F	14.3	B	>600	F	12.1	B	37.3	E	14.3	B	101.8	F	12.1	B
General Intersection (2035 Mainline Traffic approx 10,000 ADT)	20 Turns Out	27.8	D	27.8	D	26.8	D	26.8	D	17.9	C	17.9	C	17.1	C	17.1	C
	40 Turns Out	32.2	D	32.2	D	31.1	D	31.1	D	19.2	C	19.2	C	18.4	C	18.4	C
	60 Turns Out	39.8	E	39.8	E	38.2	E	38.2	E	20.8	C	20.8	C	20.3	C	20.3	C
	80 Turns Out	52.8	F	52.8	F	50.4	F	50.4	F	23.1	C	23.1	C	23.0	C	23.0	C
	100 Turns Out	79.6	F	79.6	F	76.9	F	76.9	F	26.2	D	26.2	D	26.9	D	26.9	D

NBL = Northbound Left NBR = Northbound Right
SBL = Southbound Left SBR = Southbound Right
TH = Through

Intersection	Forecast Year	Side Road LOS - Hybrid 4-Lane to Cty G, Passing Lane Cty G to Cty P								Side Road LOS - 4-Lane Build On-Alignment							
		NBL/TH		NBR		SBL/TH		SBR		NBL/TH		NBR		SBL/TH		SBR	
		Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
County G	2015	Interchange ramp terminals: LOS A-LOS B								Interchange ramp terminals: LOS A-LOS B							
	2025	Interchange merge and diverge: LOS A								Interchange merge and diverge: LOS A							
	2035																
County UU	2015	Interchange ramp terminals: LOS A								Interchange ramp terminals: LOS A							
	2025	Interchange merge and diverge: LOS A								Interchange merge and diverge: LOS A							
	2035																
County W/Loehr J-Turn	Forecast Year	J-Turn Middle Intersection				West Intersection		East Intersection		Middle Intersection				West Intersection		East Intersection	
		NBR		SBR		WBU		EBU		NBR		SBR		WBU		EBU	
		Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
	2015	10.9	B	10.6	B	12.0	B	10.3	B	10.9	B	10.7	B	12.1	B	10.3	B
	2025	11.5	B	11.2	B	12.9	B	10.6	B	11.6	B	11.2	B	13.1	B	10.6	B
	2035	12.1	B	11.8	B	14.1	B	10.9	B	12.3	B	11.9	B	14.4	B	11.0	B
Intersection	2035 Side-street turns	NBL/TH		NBR		SBL/TH		SBR		NBL/TH		NBR		SBL/TH		SBR	
		Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
General Intersection (2035 Mainline Traffic approx 10,000 ADT)	20 Turns Out	17.9	C	17.9	C	17.1	C	17.1	C	15.8	C	15.8	C	14.6	B	14.6	B
	40 Turns Out	19.2	C	19.2	C	18.4	C	18.4	C	16.3	C	16.3	C	14.9	B	14.9	B
	60 Turns Out	20.8	C	20.8	C	20.3	C	20.3	C	17.2	C	17.2	C	15.6	C	15.6	C
	80 Turns Out	23.1	C	23.1	C	23.0	C	23.0	C	18.4	C	18.4	C	16.5	C	16.5	C
	100 Turns Out	26.2	D	26.2	D	26.9	D	26.9	D	20.0	C	20.0	C	17.8	C	17.8	C

Table 4-5 Side-Road Operations by Build Alternative[28]

[28] Note: J-turns cannot be installed on the 2-lane passing lane alternatives because a wide median is required to allow trucks to make a U-turn.

Table 4-3 shows that the No-Build alternative does not satisfy this purpose and need criterion. WIS 23 operates at LOS D in the 2035 design year.

The Passing Lane Without Left-Turn Lane alternative does not satisfy this purpose and need criterion because multiple side-road movements from the higher-use intersections operate at LOS E or F in the 2035 design year.

The Passing Lane With Left-Turn Lane alternative performs measurably better because of the median refuge that is provided at a major intersection when left-turn lanes are provided along the mainline (19 of the 47 locations available for left-turn lanes). This refuge allows vehicles to complete a left turn as a two-stage maneuver. Even with this operational improvement, the Passing Lane With Left-Turn Lane alternative does not satisfy this purpose and need criterion because several movements at two intersections still operate at LOS E and F in the 2035 design year.

The Hybrid 4-Lane to County G, Passing Lane County G to County P alternative places an interchange at the highly used intersections of WIS 23 with County UU and County G and a J-turn at County W.[29] That combined with the median refuge provided at minor intersections substantially helps service levels at side-road intersections. Movements associated with the J-turn include the right turn out (LOS B) and the U-turn (LOS B). Although not analyzed, J-turns will modify the left-turn delays at 7 Hills Road, which may reduce driver frustration. This alternative satisfies the criterion for this project purpose component.

The 4-Lane Build On-Alignment alternative provides interchanges at County UU and County G and a J-turn at County W. That combined with the median refuge provided at other intersections substantially helps service levels at side-road intersections. Median refuges will be provided at all side-road intersections that have cross access on WIS 23, which includes more intersection refuges than with the other alternatives. Although not analyzed, J-turns will modify the left-turn delays at 7 Hills Road, County U, Sugarbush Road, County A, and County S, which may reduce driver frustration. This alternative satisfies the criterion for this purpose and need component.

5. Highway Geometric Characteristics

This section describes WIS 23 highway geometric characteristics including intersection geometrics, alignment, and cross section attributes such as clear zone and shoulder width. Note that the typical section portion of the 2010 FEIS text (as shown below and page 1-8 of the FEIS) incorrectly cited the shoulders as being 10 feet wide. According to the 45 percent design plans prepared by KL Engineering, west of County UU shoulders generally are 10 feet wide. In Fond du Lac County east of County UU, the shoulder varies from 3 to 8 feet in width with the majority being 8 feet wide. In Sheboygan County, the shoulder width ranges from 3 to 10 feet. Also note the 2010 FEIS text below references a weighted average traffic forecast that is no longer current; the revised forecasts discussed in criterion 4 now apply. For a discussion on updated traffic forecast methodology, see the discussion in Appendix A.

The 2010 FEIS project purpose for the proposed actions that pertain to purpose and need criterion 5 includes the following:

- *Improve the highway facility to meet current design standards for this Corridors 2020 and Connections 2030 State Highway Plan Connector route in Wisconsin.*

The 2010 FEIS project need expressed the following needs regarding highway geometric characteristics of the WIS 23 corridor. The 2010 FEIS discussion regarding highway geometry includes the following.

> *Roadway factors, such as type of facility, lane widths, shoulder widths, lateral clearances, and horizontal and vertical alignments, influence the capacity of the road. These factors are discussed here.*

[29] Note: J-Turns are not used in the Passing Lane alternatives because they require a large median to accommodate the turning radii for trucks making a U-turn.

1. Typical Sections

Existing WIS 23 is a two-lane rural roadway with bituminous pavement that has 12-foot-wide lanes and 10-foot shoulders. Generally the clear zones are about 22 feet in cuts and 45 feet in fills. While these geometric characteristics of the existing highway are adequate for a two-lane facility, traffic volumes warrant a multilane facility to meet current and future capacity needs. When the ADT exceeds 8,700, the desirable standard for a rural 2020 Connector route is a four-lane facility. The existing average weighted ADT for WIS 23 within the project limits is 8,150 and forecasted volumes are projected to exceed this threshold.

2. Horizontal and Vertical Geometrics

The overall horizontal and vertical geometrics generally fall within WisDOT standards. However, the locations of side roads and access points intersect many of the curves in less than optimal locations. These horizontal and vertical curves, in combination with the existing terrain, make approximately 22 percent (average) of the roadway being designated as no passing zones. Even when passing zones are available, traffic volumes often prevent passing opportunities on the remaining roadway because of the opposing vehicles. The inability to pass restricts speed and maneuverability for through-traffic.

3. US 151/WIS 23 Connection

The connection between the US 151 Fond du Lac bypass and WIS 23 joins two Connector routes in the State Highway Plan. Typically connections between highways with this classification have "system" interchanges with free-flowing ramps. This higher level connection emphasizes the importance of safety and mobility between the two highways. Currently, this connection is serviced by at-grade signalized intersections at the terminals of a diamond interchange. As traffic volumes grow, it will become more important for this connection to be consistent with these two roadway classifications. Because US 151 is designated a Connector route to the south of WIS 23, and WIS 23 is designated a Connector route to the east of US 151, the free-flowing ramps would serve the northbound-to-eastbound and westbound-to-southbound movements only.

Note that while the 2010 FEIS noted the US 151/WIS 23 connection and a possible future system interchange as a need, the FEIS also selected the No Corridor Preservation Option for the connection as the preferred alternative because of the adverse effects to businesses associated with mapping of a future system interchange. For this reason, this connection is not discussed in this technical memo.

Design Class

WIS 23 is a Connector Route in the Corridors 2030 plan. For a Corridors 2030 (formerly Corridors 2020) route, the design criteria for rural state trunk highways are held to a higher standard. One of the main design requirements of a Corridors 2030 route has to do with traffic operations. FDM 11-5-3.2 provides the operational goals for Corridors 2030 routes. They are defined by Level of Service (LOS).[30] The operational goal for WIS 23, a Corridors 2030 Connector, is LOS C, meaning the LOS on this route is expected to remain at LOS C or below LOS 4.0 on the numerical scale discussed in FDM 11-5-3.[31] Refer to criterion 4 for more details. The cross-sectional requirements related to a Corridors 2030 route are directly connected to their ability to satisfy the operational goals for the Design Class. Attachment 1.1 in the FDM 11-15 illustrates Design Criteria by Design Class. Information includes Design Average Annual Daily Traffic (AADT), design speed, traveled way width, shoulder width, and roadway width. The Design Classes are divided into four categories: A1, A2 (2 lanes), A3 (4-lane divided), and A4 (6-lane divided). For each Design Class, there are AADT guideline ranges[32] that are related to operational expectations for freeway Backbone routes, non-freeway Backbone and Connector Routes, and principal arterials. Table 5-1 shows FDM 11-15 Attachment 1.1.

[30] LOS describes the operation, or congestion levels, of a roadway. It ranges from LOS A (good) to LOS F (very poor). The 2010 Highway Capacity Manual (Transportation Research Board, 5th Edition, 2010) provides more detail on this rating system. It is also discussed to greater extent in criterion 4 of this technical memo.
[31] Facilities Development Manual 11-5-3.2 (WisDOT, March 27, 2008, http://roadwaystandards.dot.wi.gov/standards/fdm/11-05.pdf#fd11-5)
[32] Average Annual Daily Traffic (AADT) is a measure used in the transportation engineering field, which is the total volume of vehicle traffic of a roadway for a year divided by 365 days. AADT is a useful and simple measurement of how much traffic a roadway carries.

Design Criteria For Rural State Trunk Highways
Functionally Classified As Arterials **(Level Terrain)**

Traffic Volume		Roadway Width Dimensions				Bridges	
Design Class	Design AADT	Design Speed (mph)	Traveled Way Width (feet)	Shoulder Width (feet)	Roadway Width (feet)	Minimum Design Loading	Clear Roadway Width of Bridges (feet) [2, 3]
A1	Under 3500	**60**	**24**	**6**	**36**	**HS20**	**36**
A2 [1] (2 lanes)	3,500–8,700[A] 3,500–15,000[C]	**60**	**24**	**10** (8)	**44** (40)	**HS20**	**44** (40)
A3[1] (4 lane divided)	8,700[A] - 44,000[A] 8,700[B] - 53,500[B] 15,000[C] - 60,000[C]	**70** [4]	**2 @ 24**	**6LT** (4) **10RT**[5]	**2 @ 40** (38)	**HS20**	**2 @ 40**
A3[1] (6 lane divided)	44,000[A] - 69,000[A] 53,500[B] - 85,000[B] 60,000[C] - 90,000[C]	**70** [4]	**2 @ 36**	**10 LT & RT**[6]	**2 @ 56**	**HS20**	**2 @ 56**

[A] For non-freeway Corridors 2020 backbone and connector route, LOS threshold is C/D or 4.0.
[B] For freeway Corridors 2020 backbone route, LOS threshold is C/D or 4.0.
[C] For other principal and minor arterials, LOS threshold is D/E or 5.0.

Desirable values are shown in bold and minimum values are shown in parentheses.

[1] The top of the traffic volume range for design class A2 is 8,700 AADT for a Corridors 2020 route and 15,000 AADT for a non-corridors 2020 route. These volumes are based on the 2000 Highway Capacity Manual assuming; level terrain, 12-foot lanes, ≥ 6-foot shoulders, 80% passing, 10% trucks, K30 design factor, and 60/40 directional split. In cases where a reduced level of service is determined to be acceptable and the use of passing lanes is found to be adequate treatment for the facility, the 8,700 AADT value for C2020 Connector routes may be increased to 12,000 AADT. Design class A3 assumptions: level terrain, 12-foot lanes ≥ 6-foot shoulders, 10% trucks, K30 design factor, 61/39 directional split, 2 access points per mile, except freeway. See FDM 11-5-3 for additional information on level of service thresholds for different facility types and the respective numerical value.
[2] Normally provide full width of approach roadways across all new bridges. Exceptions may be made when the bridge is considered a major structure on which design dimensions are subject to individual economic studies because of high unit cost.
[3] Lateral clearance requirements for underpass bridges are included in FDM 11-35-1.
[4] See FDM 11-10-1.
[5] Use a 12 ft paved shoulder (right) on 4-lane freeways if truck traffic >250 DHV, or if the facility experiences a high degree of congestion and incidents. The roadway width and clear roadway width on bridges are increased accordingly.
[6] Use 12 ft paved shoulders (left & right) on 6-lane freeways if truck traffic > 250 DHV or if the facility experiences a high degree of congestion and incidents. The roadway width and clear roadway width on bridges are increased accordingly.

Table 5-1 FDM 11-15 Attachment 1.1

The Design AADT is the projected traffic volume forecast for the design year of the roadway, typically the construction year plus 20 years.[33] According to this Attachment 1.1, for an A2 (2 lanes) Design Class non-freeway Corridors 2020 Connector Route, WIS 23's current classification, the traffic volume guidance ranges from 3,500 to 8,700 AADT. For an A3 (4-lane divided highway) Design Class non-freeway Corridors 2020 Connector Route, the Design AADT guidance ranges from 8,700 to 44,000.

The Design AADT shown in Attachment 1.1 is a guideline based on LOS calculations for a generic roadway with generic characteristics. These Design AADT ranges provide guidance on the appropriate design classification. Actual classification is determined by the operational analysis for the design year. A footnote on Attachment 1.1 states the following.

> *1 "The top of the traffic volume range for design class A2 is 8,700 AADT for a Corridors 2020 route and 15,000 AADT for a non-corridors 2020 route. These volumes are based on the 2000 Highway Capacity Manual assuming; level terrain, 12-foot lanes, ≥ 6-foot shoulders, 80% passing, 10% trucks, K30 design factor, and 60/40 directional split. In cases where a reduced level of service is determined to be acceptable and the use of passing lanes is found to be adequate treatment for the facility, the 8,700 AADT value for C2020 Connector routes may be increased to 12,000 AADT. Design class A3 assumptions: level terrain, 12-foot lanes ≥ 6-foot shoulders, 10% trucks, K30 design factor, 61/39 directional split, 2 access points per mile, except freeway. See FDM 11-5-3 for additional information on level of service thresholds for different facility types and the respective numerical value."*

[33] Facilities Development Manual 11-10-1.1 (WisDOT, December 30, 2002, http://roadwaystandards.dot.wi.gov/standards/fdm/11-10.pdf#fd11-10)

This footnote indicates that the Design Classification is based on an LOS, and the thresholds provided for Design Classification are based on a generic highway segment. For WIS 23 the Design Classification, and corresponding number of lanes, is based on what is necessary to maintain LOS C (or numeric LOS below 4.0) in the design year for the specific WIS 23 roadway and traffic volume characteristics that factor into LOS calculations. This footnote also states that the threshold between Design Classifications may be increased to 12,000 AADT when passing lanes are used. Again, this is based on an operations analysis for a generic highway segment. The actual AADT threshold is based on the operations analysis for the subject highway. For WIS 23, the Design Classification, and corresponding number of lanes, is based on what is necessary to maintain LOS C (or numeric LOS below 4.0) with passing lanes and the given AADT traffic forecast. Individual roadway characteristics, such as peak-hour volume, directional distribution of traffic, lane and shoulder width, percent passing zone availability, access frequency, and truck percentage are all factors in the LOS calculation for the individual roadway. The discussion for criterion 4 provides a greater description of the factors used in determining LOS.

In the design year 2035, the traffic volumes on much of WIS 23 will create LOS that will warrant either a passing lane or a 4-lane cross section to meet the LOS C (or numeric LOS of less than 4.0) requirement for a Connector Route in the Corridors 2030 plan. If LOS C can be maintained with a 2-lane facility, Design Class A2 and a 60 mph design speed[34] apply. If a 2-lane facility cannot maintain LOS C in the design year, divided 4-lane alternatives are considered. If a divided 4-lane facility is needed to maintain LOS C, Design Class A3 and a 70 mph design speed apply. Criterion 4 discusses the operational objectives of WIS 23 in more detail.

Design Class Criteria

Horizontal and vertical alignment characteristics of a roadway are based on design speed. The design speed is used to determine the stopping sight distance, intersection sight distance, and other controlling alignment characteristics. For example, the stopping sight distance for an A2 Design Class with a 60 mph design speed is 570 feet. The stopping sight distance for an A3 Design Class with a 70 mph design speed is 730 feet. The respective stopping sight distances then control both horizontal curves as well as vertical curves on the roadway alignment.

The desirable roadway shoulder width for an A2 Design Class is 10 feet, with 8 feet being the minimum width. The desirable shoulder widths for Design Class A3 are 6 feet left and 10 feet right. The minimum shoulder widths for Design Class A3 are 4 feet left and 10 feet right. In Fond du Lac County, shoulder widths on the current 2-lane WIS 23 roadway vary from 3 feet to 8 feet with the majority of the shoulder width being 8 feet. In Sheboygan County, the shoulder varies from 3 to 10 feet wide.

A clear zone is the total roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles. Clear zones along WIS 23 vary from roughly 22 feet in cut sections to up to 45 feet in fill sections.[35] According to FDM 11-15 Attachment 1.9[36], the clear zone distance for a roadway is dictated by the Design Speed, Design AADT, and the slope of the foreslopes and backslopes. Based on the design speed of WIS 23 (A2 or A3), WIS 23 requires a 20- to 30-foot clear zone in cut sections depending on the backslope used (1:3 to 1:6 or flatter). WIS 23 also requires a 30- to 46-foot clear zone in fill sections, depending on the foreslope used (1:6 or flatter to 1:4). Attachment 1.9 states that clear zones may be limited to 30 feet for practicality and to provide a consistent roadway template. The clear zones along WIS 23 generally meet A2 and A3 design standards, and adequate clear zone distances can be provided under any of the build alternatives.

WIS 23 is frequently used by farm machinery and other slow-moving traffic which is affected by cross section. With a 2-lane highway, slow-moving traffic could impede through traffic, whereas a 4-lane highway would provide opportunities for through traffic to travel around the farm machinery. The farm machinery and other slow-moving traffic hinders through traffic since opposing traffic makes it difficult for vehicles to pass the slow-moving vehicles, even though much of the corridor is currently marked with passing zones. The effect of slow-moving vehicles such as farm machinery, recreational vehicles, and trucks is discussed under criterion 2b.

[34] The design speed is a selected speed used to determine geometric design features of a roadway such as cross section, horizontal alignment/curves, sight distance, and cross section. Desirable Design Speed is 5 mph greater than the posted speed.
[35] Based on 45 percent completion plan produced by KL Engineering for WIS 23 in Fond du Lac County.
[36] Facilities Development Manual, 11-15 Attachment 1.1 (WisDOT, March 27, 2008; http://roadwaystandards.dot.wi.gov/standards/fdm/11-15-001att.pdf#fd11-15a1.1)

Purpose and Need Screening

The following question indicates how well an alternative satisfies the **Highway Geometric Characteristics** criterion of the project purpose and need.

a) Does the alternative incorporate the appropriate design criteria for the roadway classification?

Criteria	No Build	Passing Ln w/o Lt Turns	Passing Ln w/ Lt Turns	Hybrid 4-Ln to G Passing Ln G to P	4-Lane Build On-Alignment
Design Class	A2	A2	A2	A3 and A2	A3
Design Speed	60 mph	60 mph	60 mph	70 mph to G, 60 mph east of G	70 mph
Horizontal Alignment Satisfy SSD for Design Speed?	Yes	Yes	Yes	Yes	Yes
Vertical Alignment Satisfy SSD for Design Speed?	Yes	Yes	Yes	Yes	Yes
Intersection Sight Distance Provided?	Not Evaluated	Yes	Yes	Yes	Yes
Appropriate clear zone provided?	Generally	Yes	Yes	Yes	Yes
Number of Lanes	2	2+	2+	4 to G, 2+ east of G	4
Inside Shoulder	NA	NA	NA	6 feet to G, NA east of G	6 feet
Outside Shoulder	3 to 8 feet Does not currently meet 8' minimum shoulder	8 feet	8 feet	10 feet to G 8 feet east of G	10 feet
LOS C Maintained in 2035 with Lanes Provided?	No See criterion 4	Yes See criterion 4	No See criterion 4	No See criterion 4	Yes See criterion 4
Satisfy Geometric Criterion?	No	Partially (Does not maintain LOS C in 2035)	Partially (Does not maintain LOS C in 2035)	Partially (Does not maintain LOS C in 2035)	Yes

Table 5-2 Geometric Screening

6. Access Management

The 2010 FEIS project purpose objectives for the proposed action that pertain to purpose and need criterion 6 include the following.

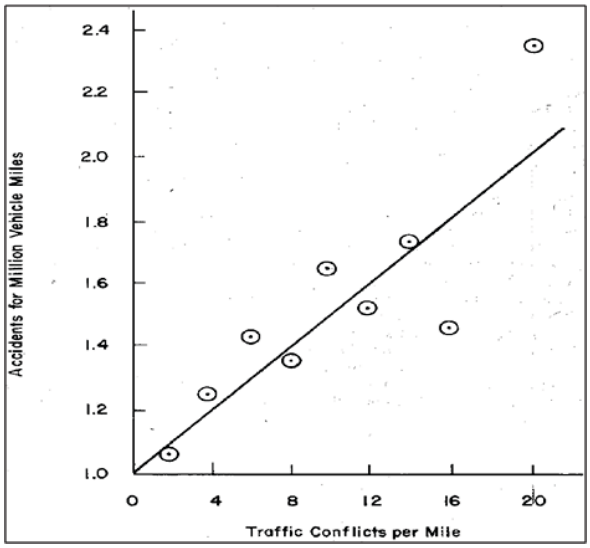
- *Increase the mobility by… minimizing public and private access.*
- *Preserve R/W needed for future grade separations and interchanges so future safety improvements are easily implemented*
- *Provide a safe and dependable highway connection… while reducing conflicts between local and through traffic.*

The 2010 FEIS project need expressed the following needs regarding access.

"F. Access

In August of 1989, WisDOT adopted a statewide access plan for managing access on the state highway system. The purpose of the access plan is to provide a high LOS for through traffic and increase safety while providing reasonable access to abutting properties. The plan seeks to balance public investments in highway improvements, land development, tax base growth, and job creation. The plan identifies Corridors 2020/Connections 2030 Backbone and Connector routes, like WIS 23, as a group of highways for which managed access is deemed essential to maintaining a required high LOS and safety.

There is a direct relationship between access points and crashes. Figure 1.3-4 shows a graph from the American Association of State Highway Officials Policy on Geometric Design[37] that shows the correlation of conflicts per mile versus the crash rate on rural highways. As access points increase, so does the crash rate. Driveways for residential and commercial properties as well as side roads are located along the entire 19-mile WIS 23 route. There are 235 access points within the project limits, which are summarized in Table 1.3-5. This amounts to approximately 12.3 access points per mile. Excluding driveways and farm entrances, WIS 23 has 67 access points, which is about 3.5 points per mile. The mean access density (without driveways) for a Connections 2030 Connector route is 2.9 access points per mile.



FEIS Figure 1.3-4 Relationship between Access Points and Crash Rates

Vehicles entering and exiting WIS 23 at the numerous access points interrupt the flow of traffic. Drivers must adjust their travel speed to accommodate entering and exiting vehicles, and each access point creates potential for conflict and subsequent crashes.

Existing WIS 23 Access Summary			
Access Type	***No. of Access Points***	***WIS 23 Access Density (per mile)***	***Mean Access Density for 2030 Connector Route***
State Trunk Highway Intersections	*0*	*0*	*--*
County Trunk Highway Intersections	*16*	*0.8*	*--*
Local Roads and Street Intersections	*51*	*2.7*	*--*
Subtotal	*(67)*	*3.5*	*2.9*
Commercial, Residential Driveways	*95*	*5*	*--*
Field Entrances	*73*	*3.8*	*--*
TOTAL	*235*	*12.3*	*--*

FEIS Table 1.3-5

[37] *A Policy on the Geometric Design of Highways and Streets, 1990,* American Association of State Highway and Transportation Officials (AASHTO)

WisDOT Access Policy

FDM 7-5-1 describes the State Access Management Plan (SAMP).[38] It was adopted as part of the Connections 2030 statewide long-range multimodal transportation plan in October of 2009 and defines the vision and policy for appropriate access on Wisconsin's state trunk highway system. Table 6-1 illustrates the first two rows of FDM 7-5-1 Table 1.1. It lays out the following goals for new access allowed on Tier 1 and Tier 2A routes. The portion of the WIS 23 corridor discussed in this document is a Tier 2A route since it is not a freeway or Corridors 2030 backbone route.

Goal for Access and Traffic Movement	Type of New Access Allowed
Tier 1 - Maximize Interstate/Statewide Traffic Movement – Generally reserved for C2020 Backbone and Connector routes. – High percentage designed/planned for expressway or freeway standards.	Safely spaced at constructed or planned grade separated locations. Locked/gated driveways for emergency vehicles. Plan in place for ultimate removal of all private access.
Tier 2A - Maximize Interregional Traffic Movement – High Volume – High percentage is C2020 Backbone and Connector routes, but also includes significant number of other routes. – Most are constructed/planned for 4-lane capacity. Expressway standards are highly desirable.	At-grade public road intersections, with interchanges at higher volume routes. Locked/gated driveways for emergency vehicles. No at-grade intersections within 1 mile of interchange entrance ramps. See FDM 11-5-5 for spacing.

Table 6-1 FDM 7-5-1 Table 1.1 Guidelines for New Access Points (First two rows)

WisDOT provides recommended access densities for various functional classifications of intersecting roads with rural principal arterials in FDM 11-5, Attachment 5.1.[39] For nonexpressway rural principal arterials, the recommended maximum density is 5.3 private access points per mile (based on a minimum spacing of 1000 feet between private access points). For expressway principal arterials, this drops to 2.6 private access points per mile. WIS 23 currently averages 8.8 private access points per mile.

FDM 7-5-1 states the following regarding guidelines for existing access points.

> *"When an existing access point does not meet the desired level of access control identified in the SAMP, it is often because no reasonable alternative access exists (a side road, for example) or no opportunity to obtain an alternative access exists. In response, decision and actions will consider the following:*
> - *Alter all existing access points to meet departmental and operational safety standards as opportunities arise.*
> - *Develop a long-term plan to remove existing hazardous access points when opportunities arise.*
> - *Restrict access with a covenant, a formal sealed contract or agreement. When a property is restricted access via covenant, its owners will not be granted further access beyond what the agreement indicated.*
>
> *The SAMP recommends that all access decisions balance current needs with safety risks and be consistent with the defined access management system. WisDOT will work with the general public and local governments to achieve a safe and efficient state trunk highway system in the public interest."*

[38] Facilities Development Manual 7-5 (WisDOT; December 22, 2011; http://roadwaystandards.dot.wi.gov/standards/fdm/07-05.pdf#fd7-5-1)
[39] Facilities Development Manual 11-5, Attachment 5.1 (WisDOT, December 30, 2002; http://roadwaystandards.dot.wi.gov/standards/fdm/11-03-005att.pdf#fd11-3a5.1)

Access Management Mechanisms

WisDOT will use the provisions of Wisconsin State Statute 84.295, along with other access management tools, to assist in managing access along WIS 23. This statute allows WisDOT to designate roadways as freeways and expressways and then preserve right of way and manage access through the publishing of an official map. An official map, which is recorded at the register of deeds, lays out future right of way needed as well as future access conditions for the proposed highway. It alerts landowners of potential highway projects that will affect their property. Also, prior to improving their property within an area that is officially mapped under 84.295, the landowner must notify WisDOT of the improvement plans. WisDOT may then choose to purchase the right of way at that time or wait until the highway improvement is actually implemented.

This law is a powerful planning and preservation tool for access management. Statute 84.295 allows a fully developed freeway/expressway concept to be approved and legally recorded without requiring it to be implemented as a project with right of way acquisition and construction at a specific time in the future.

The following paragraphs excerpted from FDM 7-40-1.4[40] discuss the authorities granted under this law that apply to the WIS 23 corridor

> *"1.4 Authorities Granted Under §84.295*
> *. . . Empowers the department to construct grade separations at intersections with other public highways and railroads and to change or adjust the lines of public highways and if necessary combine, relocate or extend the same to adjust traffic service to grade separation structures. Ref: s. 84.295(6)*
>
> *. . . . . Empowers the department by agreement to relocate, extend, or close at a point near the intersection with the freeway or expressway, any highway or make provision for carrying such highway over or under the freeway or expressway. Ref: §84.295 (7)(a). This paragraph does not limit the authority of the department under s. 84.295(6) to construct grade separations without such an agreement, as mentioned above.*
>
> *. . . .Allows the department to grant or deny access requests for public road connections to the freeway or expressway and to place terms and conditions on such connections as the department deems will best serve the public interest. Ref: s. 84.295(7)(b)"*

WisDOT would use this statute on WIS 23 to:

- Officially map future interchanges and overpasses.
- Officially map future road closures.
- Officially map local road alterations needed for above.

For private access management, including the removal of driveways, WisDOT uses the provisions of Wisconsin State Statute 84.09 to purchase access. This law allows lands or land interests, including access rights, needed for highway purposes to be purchased by WisDOT. 84.09 is typically used when:

- New or additional lands are being acquired.
- The access rights to a parcel have measurable value.
- Changes in current access or the elimination of access is necessary.

WisDOT would use this statute to eliminate or relocate private access points on WIS 23 where possible or feasible.

WisDOT uses its powers to alter access arrangements within the highway right of way to eliminate hazardous movements. Hazardous movements include movements that cross WIS 23 through traffic or impede WIS 23 through movement. Hazardous movements are typically associated with access and

[40] Facilities Development Manual 7-40-1 (WisDOT, February 25, 2011; http://roadwaystandards.dot.wi.gov/standards/fdm/07-40.pdf#fd7-40-1)

examples include left turns from side roads, left turns from the WIS 23 mainline, and crossing movements from the side road. Examples of access modifications include:

- Installation of an interchange at an intersection.
- Installation of a grade separation that allows access across, but not to, a state highway.
- Installation of a median that restricts access to right-in/right-out.
- Removal of a median opening.
- Restricting intersection access to left-in, right-in, and right-out only.
- Installation of a J-turn.
- Removing existing access points.
- Combining existing access points.

For WIS 23, all the above measures would be used to eliminate hazardous movements. Some of these measures are only able to be applied to a 4-lane facility. For example, WisDOT only constructs interchanges on 4-lane divided highways because it has had poor safety results with installing interchanges on 2-lane roadways. Interchanges on 2-lane roadways have resulted in crashes as drivers completing their merging maneuvers from the on-ramp mistakenly assumed they were on a divided 4-lane roadway and used the actual opposing lane as a travel lane. Another measure that is not feasible on 2-lane highways are J-Turns because a median is required to accommodate the turning radii needed by trucks to make a U-turn.

Private access points tend to have fewer turning and crossing movements associated with them because they serve fewer parcels. Because they typically have a tenth (or less) of the turning movements, they do not have as great a crash potential as a side-road intersection. WisDOT still seeks to reduce the number of private access points and would determine the feasibility of access point removal on a case-by-case basis. With the purchase of right of way, WisDOT often can provide alternate access to parcels or combine access points, allowing the removal of access from WIS 23. When right of way is not purchased, there are fewer opportunities to provide alternate access to parcels. Determination of private access removal will be made during design.

Purpose and Need Screening

The following questions are used to determine how well an alternative satisfies the **Access** purpose and need criterion.

a) Does the alternative reduce the number of hazardous movements (left turns or crossing from sideroads) at public access points through the installation of access restrictions or interchanges?

Table 6-2 summarizes the access treatments associated with each alternative. At-grade access has the highest number of hazardous movements. The provision of left-turn lanes on WIS 23 only marginally reduces this. The installation of cul de sacs, interchanges, or J-Turns are the most effective in reducing hazardous maneuvers.

Table 6-2 Intersection Access Treatment for Each Alternative

Intersection	Access Treatment (RI/RO = right in/right out)				
	No-Build	Passing Ln w/o Lt Turns	Passing Ln w/ Lt Turns	Hybrid 4-Ln to G Passing Ln G to P	4-Lane Build On-Alignment
Wisconsin American Drive	At-grade	Multi-Lane Roundabout	Multi-Lane Roundabout	Multi-Lane Roundabout	Multi-Lane Roundabout
County K	At-grade	Jug-handle	Jug-handle	Jug-handle	Jug-handle
Mary Hill Drive	At-grade	At-grade	At-grade	Access removed	Access removed
Whispering Springs Drive	At-grade	RI/RO	RI/RO	RI/RO	RI/RO
HillTop Drive	At-grade	Cul-de-sac	Cul-de-sac	Cul-de-sac	Cul-de-sac
Northway Road	At-grade	At-grade	At-grade	Access removed	Access removed
County UU	At-grade	At-grade	At-grade	Diamond Interchange	Diamond Interchange
Taft Road	At-grade	At-grade	At-grade	RI/RO	RI/RO
Tower Road North	At-grade	At-grade	At-grade	J-turn	J-turn

Table 6-2 Intersection Access Treatment for Each Alternative					
Intersection	**Access Treatment** (RI/RO = right in/right out)				
	No-Build	Passing Ln w/o Lt Turns	Passing Ln w/ Lt Turns	Hybrid 4-Ln to G Passing Ln G to P	4-Lane Build On-Alignment
			w/left-turn lanes		
Tower Road South	At-grade	At-grade	At-grade w/left-turn lanes	RI/RO	RI/RO
Poplar Road North	At-grade	At-grade	At-grade	RI/RO	RI/RO
Poplar Road South	At-grade	At-grade	At-grade	RI/RO	RI/RO
7 Hills Road North	At-grade	At-grade	At-grade w/left-turn lanes	J-turn	J-turn
7 Hills Road South	At-grade	At-grade	At-grade w/left-turn lanes	J-turn	J-turn
Hinn Road	At-grade	At-grade	At-grade w/left-turn lanes	RI/RO	RI/RO
County W South	At-grade	At-grade	At-grade w/left-turn lanes	J-turn	J-turn
County W North	At-grade	At-grade	At-grade w/left-turn lanes	J-turn	J-turn
Loehr Rd	At-grade	At-grade	At-grade w/left-turn lanes	RI/RO	RI/RO
Log Tavern Road North	At-grade	At-grade	At-grade	At-grade T-intersection	At-grade T-intersection
Log Tavern Road South	At-grade	At-grade	At-grade	Cul-de-sac	Cul-de-sac
Triple T	At-grade	At-grade	At-grade	Rerouted to Pit Road South	Rerouted to Pit Road South
Pit Rd North	At-grade	At-grade	At-grade	At-grade Intersection	At-grade Intersection
Pit Rd South	At-grade	At-grade	At-grade	At-grade Intersection	At-grade Intersection
Banner Rd	At-grade	At-grade	At-grade	Cul-de-sac	Cul-de-sac
Triple T Rd North	At-grade	At-grade	At-grade	At-grade T-intersection	At-grade T-intersection
Hillview Rd North	At-grade	At-grade	At-grade	RI/RO with Dedicated Left In	RI/RO with Dedicated Left In
Hillview Rd South	At-grade	At-grade	At-grade	RI/RO	RI/RO
Hickory Road	At-grade	At-grade	At-grade	Cul-de-sac	Cul-de-sac
County G	At-grade	At-grade	At-grade w/left-turn lanes	Diamond Interchange	Diamond Interchange
Division Rd North	At-grade	At-grade	At-grade	At-grade	Cul-de-sac
Division Rd South	At-grade	At-grade	At-grade	At-grade	Access Road to County G
Chickadee Dr	At-grade	At-grade	At-grade	At-grade	RI/RO
County U	At-grade	At-grade	At-grade w/left-turn lanes	At-grade or At-grade w/left-turn lanes	J-turn
Sunrise Rd	At-grade	At-grade	At-grade	At-grade	At-grade T-intersection
Spring Valley Dr	At-grade	At-grade	At-grade	At-grade	At-grade T-intersection
Scenic View Dr North	At-grade	At-grade	At-grade	At-grade	At-grade Intersection
Scenic View Dr South	At-grade	At-grade	At-grade	At-grade	At-grade Intersection
County T	At-grade	At-grade	At-grade w/left-turn lanes	At-grade or At-grade w/left-turn lanes	J-turn
Plank Rd–West	At-grade	At-grade	At-grade	At-grade	RI/RO
Sugarbush Road	At-grade	At-grade	At-grade	At-grade	RI/RO with

Table 6-2 Intersection Access Treatment for Each Alternative					
Intersection	**Access Treatment** (RI/RO = right in/right out)				
	No-Build	Passing Ln w/o Lt Turns	Passing Ln w/ Lt Turns	Hybrid 4-Ln to G Passing Ln G to P	4-Lane Build On-Alignment
North					Dedicated Left In – J-turn
Sugarbush Road South	At-grade	At-grade	At-grade	At-grade	RI/RO with Dedicated Left In – J-turn
County A North	At-grade	At-grade	At-grade w/left-turn lanes	At-grade or At-grade w/left-turn lanes	J-turn
County A South	At-grade	At-grade	At-grade w/left-turn lanes	At-grade or At-grade w/left-turn lanes	J-turn
Plank Rd–East	At-grade	At-grade	At-grade	At-grade	RI/RO
Castle Rock Court	At-grade	At-grade	At-grade	At-grade	At-grade Intersection
Julie Court West	At-grade	At-grade	At-grade	At-grade	At-grade Intersection
Julie Court East	At-grade	At-grade	At-grade	At-grade	Cul-de-sac
Ridge Rd North	At-grade	At-grade	At-grade	At-grade	Cul-de-sac
Ridge Rd South	At-grade	At-grade	At-grade	At-grade	At-grade T-intersection
County S North	At-grade	At-grade	At-grade w/left-turn lanes	At-grade or At-grade w/left-turn lanes	J-turn
County S South	At-grade	At-grade	At-grade w/left-turn lanes	At-grade or At-grade w/left-turn lanes	J-turn
Coary Lane	At-grade	At-grade	At-grade	At-grade	Removed from WIS 23–Sandstone Lane extended and cul-de-sac
Twinkle Lane	At-grade	At-grade	At-grade	At-grade	Removed from WIS 23–Valley Lane extended and cul-de-sac
County P North and South	At-grade	At-grade	At-grade w/left-turn lanes	At-grade w/left-turn lanes	At-grade intersection
Inez St	At-grade	At-grade	At-grade	At-grade	At-grade T-intersection
Branch Road	At-grade	At-grade	At-grade	At-grade	Removed from WIS 23–Extended to Inez Court
Hazardous Movement Removed from Sideroad?	No	No	No	Partially	Yes

Table 6-2 Intersection Access Treatment for Each Alternative

b) Does the alternative reduce the number of private access points through right of way acquisition?

Defining the exact number of private access points reduced is not possible until the real estate process is complete. All build alternatives will attempt to reduce the number of access points during acquisition of the needed right-of-way.

The No-Build alternative does not reduce the number of private access points.

The Passing Lane Without Left-Turn Lanes alternative partially satisfies this purpose and need criterion because it would eliminate or combine a few private access points.

The Passing Lane With Left-Turn Lanes alternative partially satisfies this purpose and need criterion because it would eliminate or combine a few private access points.

The Hybrid 4-Lane to County G, Passing Lane County G to County P alternative partially satisfies this purpose and need criterion because it would eliminate many private access points from USH 151 to County G. With this alternative right of way would be acquired from County K to County G, giving more opportunity to combine and realign access points to side roads. From County G to County P, this alternative would eliminate a few private access points.

The 4-Lane Build On-Alignment alternative would fully satisfy this purpose and need criterion because it would eliminate or combine many private access points along the length of the project. With this alternative right of way would be acquired for the full corridor length giving more opportunity to combine and realign access points to side roads.

c) Does the alternative designate and preserve land for future access modifications, such as overpasses and interchanges, through official mapping?

The No-Build alternative does not designate or preserve land for future access modifications.

All build alternatives will designate and preserve land for future access modifications.

7. Safety

The 2010 FEIS included several paragraphs describing highway safety. To ensure that the Limited Scope Supplemental EIS reflected up-to-date data, the crash information was made current with 2009 and 2010 crash data. Also, since the time the crash analysis was performed in the 2010 FEIS, WisDOT changed its method of reporting average state crash rates. The new methodology increased the number of roadway classifications used to report statewide crash rates. The new methodology also only provides 5-year rolling averages rather than the yearly averages that were previously reported. Because of these changes, it is not possible to duplicate the 2010 FEIS data for the crash update that will be presented in the Limited Scope Supplemental EIS. However, the more recent crash data is analyzed and applied to the WIS 23 corridor.

The 2010 FEIS project purpose for the proposed action that pertains to purpose and need criterion 7 includes the following:

> *"The purpose of the proposed action is to provide additional highway capacity to serve existing and projected traffic volumes and **improve** operational efficiency and **safety** for local and through traffic while avoiding or minimizing environmental effects.*
>
> - *Provide a **safe** and dependable highway connection to and from regional communities while reducing conflicts between local and through traffic.*
> - *Improve **safety** at intersections and farm crossings.*

The 2010 FEIS project need expressed the following needs regarding safety on the WIS 23 corridor

> *"G. Safety*
>
> *A crash study report prepared for WIS 23 between County K and County P analyzed crashes from 2001 to 2008. A total of 308 nondeer crashes occurred during the 8-year study period. Crash rates are compared to Statewide Average Crash Rates for rural state trunk highways. FEIS Table 1.3-6 summarizes rural crashes from County K to County P.*

Summary of Rural Highway 23 Crashes Not Including Deer						
	Fatal Crash Rate		*Injury Crash Rate*		*Total Crash Rate*	
Year	*WIS 23*	*STATE*	*WIS 23*	*STATE*	*WIS 23*	*STATE*
2001	*1.9*	*1.5*	*41*	*42*	*76*	*104*
2002	*0.0*	*1.7*	*35*	*42*	*63*	*106*
2003	*0.0*	*1.8*	*48*	*46*	*87*	*117*
2004	*0.0*	*1.7*	*43*	*47*	*91*	*121*
2005	*1.9*	*1.6*	*33*	*43*	*59*	*115*
2006	*3.7*	*1.7*	*35*	*43*	*69*	*109*
2007	*0.0*	*1.5*	*39*	*44*	*76*	*118*
2008	*0.0*	*1.3*	*15*	*43*	*50*	*130*
Average	*0.9*	*1.6*	*36*	*44*	*71*	*115*
Crash rates are expressed as the number of crashes per 100 million vehicle miles.						

FEIS Table 1.3-6

In the study corridor, deer crashes accounted for 57 percent of the total number of rural crashes (an additional 406 crashes). Common types of nondeer crashes in rural areas included run-off-the-road at 30 percent, angle crashes at 24 percent, rear-end crashes at 19 percent, and sideswipes at 13 percent.

The WIS 23 crash rate within the project limits is less than the statewide rates. While the WIS 23 crash rate is lower, increases are expected as the traffic increases. Roadways carrying similar traffic volumes to WIS 23 typically fall into a higher roadway classification that has lower crash rates.

WIS 23 Crash Data Update

Table 7-1 updates the FEIS Table 1.3-6 with the years 2009 and 2010. Statewide yearly average crash rates are not reported for the reasons previously discussed.

Summary of Rural Highway 23 Crashes Not Including Deer						
	Fatal Crash Rate		Injury Crash Rate		Total Crash Rate	
Year	WIS 23	STATE	WIS 23	STATE	WIS 23	STATE
2001	1.9	1.5	41	42	76	104
2002	0.0	1.7	35	42	63	106
2003	0.0	1.8	48	46	87	117
2004	0.0	1.7	43	47	91	121
2005	1.9	1.6	33	43	59	115
2006	3.7	1.7	35	43	69	109
2007	0.0	1.5	39	44	76	118
2008	0.0	1.3	15	43	50	130
2009	0.0	NA	18	NA	68	NA
2010	0.0	NA	27	NA	55	NA
Average	0.7	NA	33	NA	69	NA
Crash rates are expressed as the number of crashes per 100 million vehicle miles.						

Table 7-1 Summary of WIS 23 Crashes

The updated crash study report prepared for WIS 23 between County K and County P provided an analysis of crashes for five years from 2006 to 2010. A total of 172 nondeer crashes occurred during the 5-year analysis period. Overall, the corridor had a 5-year average crash rate of 60 crashes per 100 million vehicle miles traveled. Crash rates are compared to Statewide Average Crash Rates for rural state trunk highways. Table 7-2 summarizes rural crashes from County K to County P by segment. The analysis looked at individual segments so that areas where safety concerns exist can be identified and appropriate countermeasures investigated.

WIS 23 Segment	Fatal Crash Rate		Injury Crash Rate		Total Crash Rate	
	WIS 23	2006-2010 Statewide	WIS 23	2006-2010 Statewide	WIS 23	2006-2010 Statewide
County K to County UU	0	0.9	38.2	24.7	99	67
County UU to 7 Hills Road	0	1.3	25.4	28.2	51	70
7 Hills Road to County W/Hinn	0	1.3	6.2	28.2	68	70
County W/Hinn to County W/ Loehr	0	1.3	78.6	28.2	144	70
County W/Loehr to Hillview Road	2.3	1.3	9.1	28.2	18	70
Hillview Road to County G	0	1.3	25.3	28.2	88	70
County G to County T North	0	1.3	26.2	28.2	48	70
County T North to County P/ Pioneer	1.7	1.3	32.2	28.2	85	70
Corridor County K to County P	**0.7**	**1.3**	**26.0**	**28.2**	**63**	**70**
Crash rates expressed as the number of crashes per 100 million vehicle miles traveled Shaded cells indicate areas with higher crash rates than the state average.						

Table 7-2 Summary of Rural WIS 23 Crashes Not Including Deer (2006-2010 Analysis)

While the overall corridor crash rate is slightly below the statewide average for a 2-lane rural highway, there are sections at both ends and at the center of the corridor that have higher crash frequencies. Also, the area between the County W intersections shows a very high crash rate; this is likely because through movements on County W need to turn right, travel on WIS 23, and then turn left. Figure 7-1 illustrates the 5-year crash rates on sections of WIS 23 compared to the 5-year statewide average crash rate for a 2-lane rural roadway.[41]

Of the 172 reported crashes from 2006 to 2010, the most frequent types of crashes are angle (24 percent) and run-off-the-road (29 percent). Table 7-3 lists the types and percentages of crashes that occurred.

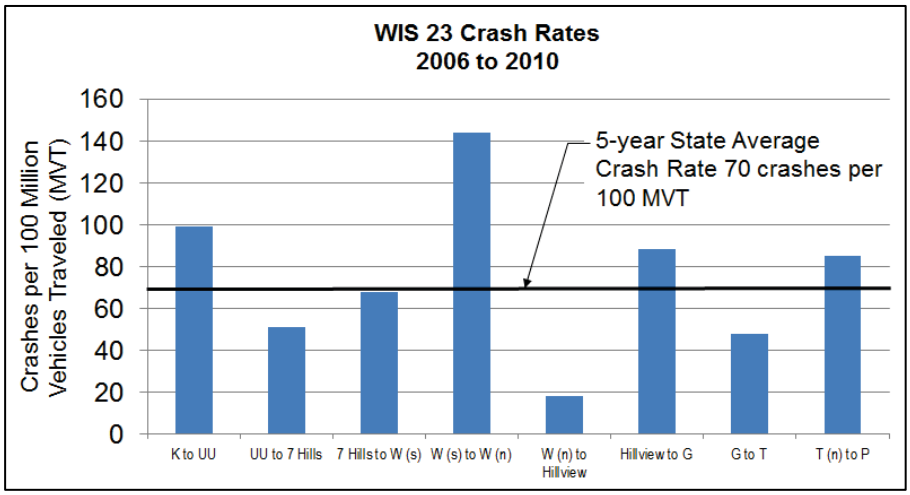


Figure 7-1 WIS 23 Total Crash Rate Compared to Statewide Average Crash Rate

[41] Note that the FEIS provided crash data for 8 years, from 2001 to 2008. In 2009, WisDOT instituted a new method of crash data comparison that changed the facility type categories and used a 5-year average. Therefore only 5-year crash comparisons are now possible.

Number	Percent of Total	Type
7	4%	Head-On
13	8%	Sideswipe Traveling Opposite Direction
10	6%	Sideswipe Travelling Same Direction
42	24%	Angle (of which 32 occurred at intersections)
33	19%	Rear End (of which 6 involved stopped left-turning vehicles and 15 involved slowing vehicles making a turn)
50	29%	Run-off-the-Road
17	10%	Other
Total = 172		

Table 7-3 Crash Type Frequency

Of the 172 nondeer crashes that occurred from 2006 to 2010, 78, or 45 percent, were associated with intersections. (Note: Intersection crashes span multiple crash types in Table 7-3, meaning many different crash types occurred at intersections.) Intersections introduce turning movements where vehicles must cross through WIS 23 traffic. Intersections also introduce left-turning vehicles waiting for a gap in traffic in the through travel lane that increase the opportunity for rear-end and sideswipe crashes. Intersections with the highest number of crashes from 2006 to 2010 correspond with intersections with the highest traffic volumes. Table 7-4 lists them.

Intersection	Number of Crashes 2006-2010
County K	4 crashes[42]
County G	12 crashes
County A	11 crashes
County UU	5 crashes
7 Hills Rd	6 crashes

Table 7-4 Intersection Crashes

On high priority Corridor 2030 Connector Routes such as WIS 23, it is desirable to reduce risk factors that contribute to crashes, particularly at intersections.

Safety Improvements (Countermeasures)

Safety improvements are often termed countermeasures because they counter specific safety deficiencies. WisDOT has always considered and incorporated countermeasures in highway improvements to address safety deficiencies. In recent years there have been studies and guides published that allow a more quantitative approach to safety evaluation. Two references that provide guidance on countermeasures to existing crash problems are the *2010 Highway Safety Manual*, published by American Association of State Highway and Transportation Officials[43]; and the *2008 Desktop Reference for Crash Reduction Factors*[44] published by FHWA and based on report FHWA-SA-08-011. Information from these texts is referenced here to provide an understanding of the potential effectiveness of the countermeasures being incorporated in the alternatives that will be addressed in the Limited Scope Supplemental EIS.

The Highway Safety Manual outlines a process that allows highway designers to predict the safety effects of different geometric modifications. The process uses Crash Modification Factors (CMF). A CMF is a multiplicative factor used when calculating the expected number of crashes after implementing a given countermeasure at a specific site.

[42] Note, prior to the US 151 bypass opening (2005-2007), County K had numerous crashes. From 2001 to 2010, the intersection experienced 25 crashes.
[43] *2010 Highway Safety Manual*, (American Association of State Highway and Transportation Officials, First Edition, 2010, http://www.highwaysafetymanual.org/Pages/default.aspx)
[44] *Desktop Reference for Crash Reduction Factors,* Report Number FHWA-SA-08-011; Bahar, Geni; Masliah, Maurice; Wolff, Rhys; Park, Pete; U.S. Department of Transportation, Federal Highway Administration (FHWA), Office of Safety; http://safety.fhwa.dot.gov/tools/crf/resources/fhwasa08011/

The 2008 Desktop Reference for Crash Reduction Factors uses Crash Reduction Factors (CRF). A CRF is the percentage crash reduction that might be expected after implementing a given countermeasure at a specific site.

The main difference between CRF and CMF is that CRF provides an estimate of the percentage reduction in crashes, while CMF is a multiplicative factor. Both terms are widely used in the field of traffic safety.[45] For the purposes of this technical memo, CMFs are converted to CRFs, for comparison sake, meaning they indicate the percent reduction of that type of crash the countermeasure may produce.

Table 7-5 shows the type of crashes experienced on WIS 23, the type of countermeasure that is being used to address that safety concern, and the associated crash reduction factor associated with that countermeasure. Note that the countermeasures are provided for comparison as an indication of the measure's effectiveness. To project crash reductions, the predictive methods discussed in the *2010 Highway Safety Manual* must be used.

Crash Type	Number	Countermeasure	AASHTO CRF[a]	FHWA CRF[c]
Head-On	7	Install median	12% injury 18% non-injury	15%
Sideswipe, Opposite Direction	13	Install median	12% injury 18% non-injury	15%
Sideswipe, Same Direction	10	Install passing lanes	25%	25%
		Expand to 4 lanes	None given	35%[46]
Angle Crashes at Intersection	32	Install interchange	42%	None given
		Install J-turn	20%	18%
		Install median refuge	None given	27%[47]
Rear-End Crashes[b]	33	Install left-turn lane	48%	48%
Run-off-the-Road	50	Expanding shoulder beyond 6 feet	13%	4% (8') 18% (10')

[a] converted from CMF
[b](of which 6 involved stopped left-turning vehicles and 15 involved slowing vehicles making a turn)
[c] Note CRF provided typically apply to all crash types at an intersection. While the countermeasures target specific safety concerns, there is not a direct correlation between the CRFs provided and the specified crash type.

Table 7-5 WIS 23 Crash Types and Countermeasures

The listing in Table 7-5 is not exhaustive. There are numerous other countermeasures that were reviewed but not incorporated into the alternatives. Examples of countermeasures reviewed but not incorporated include:

- Cable guard–Addresses head-on and sideswipe opposite direction crashes (can only be installed on alternatives with a median).
- Centerline rumble strips–Address head-on and sideswipe opposite direction crashes.
- Shoulder rumble strips– Address run-off-the-road crashes.
- Restrict access to right-in/right-out only–Helps address angle crashes. (This countermeasure is not enforceable on alternatives that do not include a median.)

The countermeasures listed above were not incorporated into the alternatives because they were difficult to implement, were not the most effective treatment, or are not yet incorporated into WisDOT design practices. Further review of these countermeasures will occur during design.

[45] Mathematically stated, CMF = 1 - (CRF/100). For example, if a particular countermeasure is expected to reduce the number of crashes by 23 percent (i.e., the CRF is 23), the CMF will be 1 - (23/100) = 0.77.
[46] Assumed passing lanes in both directions
[47] Note, the Desktop Reference for Crash Reduction Factors specifies a CRF of 27% for all crash types and severities, rather than specific angle crashes.

Purpose and Need Screening

While the WIS 23 corridor has an overall crash rate that is less than the state average, there are sections of the corridor that experience higher than normal crash rates. With any road improvement it is important to address safety deficiencies to reduce crash potential; this includes WIS 23. Appropriate safety improvements are required whenever a roadway is reconstructed.

a) Does the alternative adequately address WIS 23 mainline safety?

Table 7-6 summarizes the safety countermeasures that are included with each alternative being considered.

Crash Type	No.	Countermeasure	No-Build	Passing Ln w/o Left-turn Ln	Passing Ln w/ Left-turn Ln	Hybrid 4-Ln to Cty G, Passing Ln Cty G to Cty P	4 Lane Build On-Alignment
Head On	7	Install median	No	No	No	Yes US 151 to Cty G No Cty G to Cty P	Yes
Sideswipe, Opposite Direction	13	Install median	No	No	No	Yes US 151 to Cty G No Cty G to Cty P	Yes
Sideswipe, Same Direction	10	Install passing lanes	No	Yes	Yes	Yes Cty G to Cty P	
		Expand to 4 Lanes	No	No	No	Yes US 151 to Cty G No Cty G to Cty P	Yes
Rear End Crashes Associated with Left Turn from Mainline	33 (6 lefts, 15 slowing veh)	Install left-turn lane	No	No	Yes	Yes US 151 to Cty G Possibly Cty G to Cty P	Yes
Run off Road	50	Expanding shoulder beyond 6 feet	No	Yes	Yes	Yes	Yes
Adequately Satisfy WIS 23 Mainline Safety Component of Purpose and Need?			**No**	**Partially**	**Partially**	**Yes**	**Yes**

Table 7-6 WIS 23 Mainline Safety Purpose and Need Screening Evaluation

b) Does the alternative address intersection safety?

Intersection safety is addressed by removing the intersection access point or providing countermeasures for angle crashes. This purpose and need criterion is strongly related to the access management criterion 6, and the removal of access points was addressed in that section.

Table 7-7 summarizes the safety countermeasures to reduce angle crashes for each alternative considered.

Crash Type	No.	Counter Measure	No-Build	Passing Ln w/o Left-turn Ln	Passing Ln w/ Left-turn Ln	Hybrid 4-Ln to Cty G, Passing Ln Cty G to Cty P	4 Lane Build On-Alignment
Angle Crashes at Intersection	32	Install Interchanges	No	No	No	2 locations	2 locations
		Install J-turn	No	No	No	2 locations	6 locations
		Install Median Refuge	No	No	Yes	Partially to Cty G	Yes
Address Intersection Safety Component of Purpose and Need?			No	No	Partially	Partially	Yes

Table 7-7 WIS 23 Intersection Countermeasures for Angle Crashes

8. Accommodations for Non-Motorized Travel

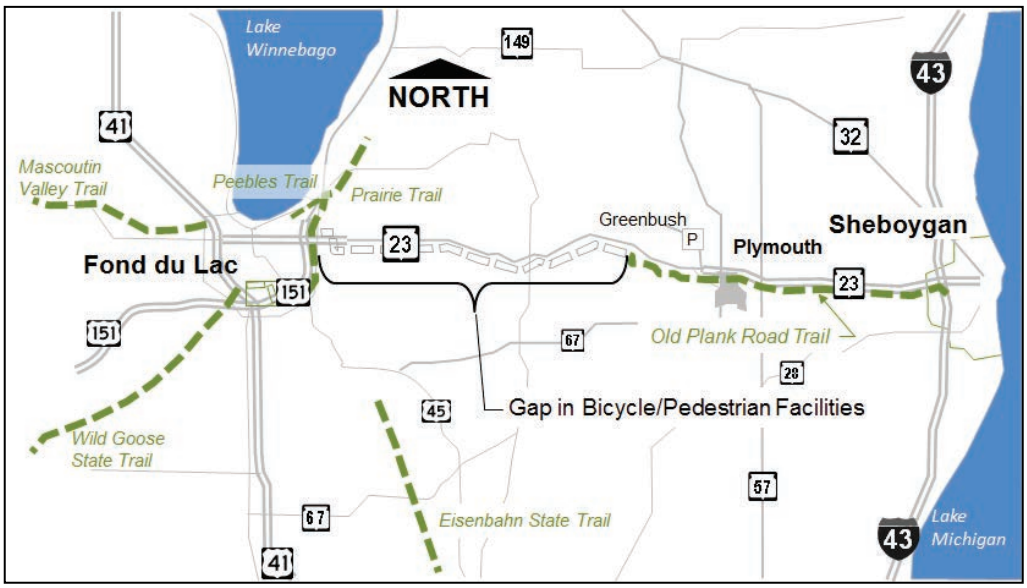
The 2010 FEIS project purpose for the proposed action that pertain to purpose and need criterion 8 include the following:

- *Preserve the corridor for future transportation needs by coordinating local governmental land use plans with transportation improvement plans. These plans include non-motorized transportation accommodations.*
- *Provide accommodations for non-motorized transportation.*

The 2010 FEIS project need expressed the following needs regarding bicycle and pedestrian accommodations on the WIS 23 corridor.

"H. <u>Accommodations for Non-Motorized Travel</u>

There are currently no adequate facilities for non-motorized transportation along WIS 23 between the Town of Greenbush and the City of Fond du Lac. Currently, the urban area of Fond du Lac is served by the multiuse Prairie Trail that travels around the perimeter of the city on the US 151 right of way. This trail connects the Wild Goose State Trail south of the city and the WIS 149 trail in Peebles. In Sheboygan County, the Old Plank Road Trail extends 17 miles from Sheboygan west to Greenbush and connects with the Kettle Moraine State Forest. This leaves a 16-mile gap along the WIS 23 corridor between Fond du Lac and Greenbush where no satisfactory facilities exist for non-motorized travel (Figure 1.3-5). Local and state bike plans do not identify any other reasonable east-west bicycle or pedestrian routes in the WIS 23 project corridor, and WIS 23 provides the only east-west route for crossing the Sheboygan River and many other geographical features (kettles). In response to this lack of accommodations, the Fond du Lac County Board passed a resolution supporting a trail connecting the Prairie Trail with the Old Plank Trail in Sheboygan County. The Town of Empire and Sheboygan County also support the trail extension. Support for a trail extension has been received by the WDNR, local municipalities, and the County. Fond du Lac and Sheboygan County have signed bicycle/pedestrian agreements for cost share and maintenance of a future trail connection.



FEIS Figure 1.3-5 Bicycle and Pedestrian Trails

Purpose and need screening:

All build alternatives have the opportunity to include the extension of the Old Plank Trail from Greenbush to Fond du Lac.

The following question indicates how well an alternative satisfies this component of the project purpose and need.

a) Does the alternative provide accommodations for non-motorized travel?

The No-Build alternative does not provide any non-motorized travel accommodations and therefore does not satisfy this purpose and need criterion.

The Passing Lane Without Left-Turn Lanes alternative satisfies this purpose and need criterion. It would include an 8- to 10-foot paved shoulder, which is a bicycle accommodation. The alternative could also include the extension of the Old Plank Trail if additional right of way is purchased. If constructed, the trail would either be built in its ultimate location (based on future 4-lane design) or would be relocated if future 4-lane expansion occurs. At County UU the trail would cross WIS 23 with an at-grade intersection when switching from the south side to the north side. A County UU interchange, which would allow a grade-separated crossing of WIS 23, is not part of this alternative.

The Passing Lane With Left-Turn Lanes alternative satisfies this purpose and need criterion. It also would include an 8- to 10-foot paved shoulder, which is a bicycle accommodation. As with the previous alternative, it could also include an extension of the Old Plank Trail if additional right of way is purchased. The trail would either be built in its ultimate location (based on future 4-lane design) or would be relocated if future 4-lane expansion occurs. At County UU the trail would cross WIS 23 with an at-grade intersection where it switches from the south side to the north side of WIS 23. A County UU interchange, which would allow a grade-separated crossing of WIS 23, is not part of this alternative.

The Hybrid 4-Lane to County G, Passing Lane County G to County P alternative satisfies this purpose and need criterion. It would include an 8- to 10-foot paved shoulder which is a bicycle accommodation. It also could include the extension of the Old Plank Trail if additional right of way is purchased from County G to Greenbush. The trail would be built in its ultimate location (based on a future 4-lane design) or would be relocated if future 4-lane expansion occurs. This alternative provides an interchange at County UU, so trail users could use a grade-separated overpass where the trail switches from the south side to the north side of WIS 23.

The 4-Lane Build On-Alignment alternative satisfies this purpose and need criterion. It includes the Old Plank Trail extension and includes a grade-separated crossing at the County UU interchange where the trail switches from the south side of WIS 23 to the north side of WIS 23.