SECTION 4
TRAFFIC DATA SUMMARY

4.01 INTRODUCTION

The Beltline PEL Study team prepared traffic-related technical memoranda and reports to summarize the evaluation of motor vehicle operations on the Beltline mainline and interchanges. The memoranda and reports are summarized in the following report sections (Sections 4.02 through 4.05). Refer to the specific memorandum or report referenced in the following for additional details and supporting documentation. The traffic memoranda and reports prepared for the Beltline PEL Study included the following:

- *HOV Demand Model* technical memorandum dated August 2021, provides traffic volume usage estimates for the addition of a single high-occupancy vehicle (HOV) lane in each direction on the Beltline (Section 4.02).
- *Base Year Traffic Data Review Memorandum,* prepared in October 2021, summarizes a data driven review of the base year traffic data for the Beltline PEL Study base conditions traffic analysis (Section 4.03).
- The *2050 Traffic Volume Development Memorandum*, dated November 2021, provides a summary of the process used to develop the Beltline PEL Study traffic forecasts. The memorandum also describes how the Beltline PEL Study team used the forecasts to develop hourly volumes for the 2050 Highway Capacity Software (HCS) operations analysis (Section 4.04).
- The *Mainline and Interchanges Improvements Refinement Report* (MIIRR), dated January 2025, builds on analyses completed in the BIIM and the IIIM that were finalized in September 2021 and April 2024, respectively. Concepts were carried forward from the BIIM and the IIIM memoranda and summarized in the MIIRR after they were vetted further to determine which Components should be considered for one or more Strategy Packages. As part of further evaluation in the MIIRR, committed and planned projects that were completed or developed since the completion of the BIIM and IIIM were included or reviewed during the traffic analysis for the Beltline PEL Study. Section 4.05 describes the updates to the traffic analysis for the Beltline PEL Study.

4.02 BELTLINE HOV DEMAND VOLUMES MEMORANDUM

This memorandum discusses methodology and volume estimates for the addition of a single HOV lane on the Beltline in each direction between Parmenter Street and County N using a TransCAD corridor-based HOV choice model. A base demand model was developed in TransCAD using the Paramics simulation model and Dane County Travel Demand Model (TDM). The base model represents 2012 traffic volumes and conditions. An HOV Choice Model was developed in TransCAD to estimate the potential shift from single-occupancy vehicle (SOV) to HOV mode for the 2012 roadway demand in the Beltline corridor.

The HOV demand analysis was originally drafted in 2017. Since then, a dynamic part-time shoulder use lane (Beltline Flex Lane), was approved and opened to traffic in July 2022. No updates were made to the 2017 HOV demand analysis, but some additional context was needed. The HOV volume estimates in this memorandum assumed the HOV lane would replace the Beltline Flex Lane. The speed improvements and travel time savings presented were compared to the pre-Beltline Flex Lane conditions on the Beltline.

A. TDM Software

At the time of the 2017 analysis, the Dane County TDM could not be used directly to estimate changes in HOV volumes because of the way the Dane County TDM calculates HOV volumes. The Dane County TDM estimates mode share (SOV, HOV, transit, pedestrians, bicyclists) as a daily estimate. Since the HOV lanes would only operate during peak periods, changes in HOV lane usage could not be evaluated directly without making significant changes to the Dane County TDM.

TransCAD was chosen to model a potential HOV lane on the Beltline. TransCAD used information from the Paramics model and Dane County TDM to develop a subarea model that focused on the study area. The benefit of TransCAD was that it considered travel time savings and value of time when identifying mode choice.

The term “model” in this section refers to the TransCAD HOV choice model, unless specified otherwise. The base scenario in this section represents 2012 conditions without the HOV lane or the Flex Lane on the Beltline. The HOV lane scenario in this section represents 2012 volumes with an HOV lane on the Beltline.

B. Base Dane County TDM

The methodology to develop the TransCAD Base Dane County TDM was as follows:

1. The Paramics roadway network and vehicle demand were used to develop a corridor-based HOV choice model for the study area in TransCAD.

2. Roadway link attributes such as capacity, free flow speed, and volume-delay functions were obtained from the Dane County TDM.

3. Base HOV mode shares for AM and PM periods were obtained from the Dane County TDM.

4. The base HOV mode share was adjusted to match model HOV volumes with observed HOV demand at High Point Road, Cannonball Path, and South Towne Drive locations from the Madison Beltline HOV study.[1]

5. The roadway link volume-delay function parameters were adjusted to match zone-to-zone travel times from the Paramics model to the extent possible.

C. HOV Choice Model

A HOV Choice Model was developed to estimate the number of SOV vehicles that would likely shift to HOV mode to take advantage of the travel time savings provided by the HOV lane. The HOV lane was coded in the TransCAD model network on the Madison Beltline with the option to activate sections of the HOV lane for testing different HOV configurations.

[1]AECOM Technical Memorandum dated August 20, 2021: *Madison Beltline HOV Demand Volumes*, available upon request from the WisDOT Southwest Region Office

SOV and truck vehicle classes were prohibited from using the HOV lane. The HOV lane was coded with 15 percent lower capacity per lane than the general purpose (GP) lane. The capacity of the HOV lane was reduced to reflect the inability to pass a slower vehicle in the HOV lane and the tendency of vehicles in the HOV lane to drive slower when the GP lanes are moving slowly. The free-flow speed for the HOV lane was coded as similar to the GP lane since the HOV lane drivers probably expect to travel as fast as in the GP lane. This is the free-flow speed and not operating speed. The HOV drivers would expect the operating speed in the HOV lane to be better than the GP lane operating speed. If a policy is developed to operate HOV lanes with lower speed limits, the analysis will need to be revised accordingly.

The volume-delay function (vdf) selected for the HOV lane resulted in slower speeds for the HOV lane than in the adjacent GP lane for the same level of congestion (or volume-to-capacity [v/c] ratio). In that sense, the travel speeds reported for the HOV lane could be considered a conservative estimate of expected LOS in the lane. A lower capacity and steeper vdf for an HOV lane in the model reflect the inability to pass a slower vehicle in the HOV lane and the propensity of vehicles in the HOV lane to drive at a lower speed when the vehicles in the GP lanes are moving slowly. Despite this, the zone-to-zone travel times using the HOV lane were faster than those using the GP lanes. The faster travel times using the HOV lane were a result of a lower number of vehicles per lane in the HOV lane compared to the GP lane, and hence less congestion. The HOV Mainline Component is documented in Section 6.

D. Summary of HOV Model Results

1. In locations with existing (pre-Beltline Flex Lane) speeds less than 40 miles per hour (mph), the HOV percentage increases from 7 to 10 percent to 15 to 20 percent when an HOV lane is added. In locations with low congestion levels, the mode shift from SOV to HOV is marginal.

2. Short trips on the Beltline are not able to capture the travel time saving benefit from the HOV lane, and therefore do not contribute to the SOV to HOV shift.

3. There are adequate HOV volumes expected along the Beltline to warrant an HOV lane that would be well used and operate at speeds greater than the GP lanes. Speeds in the GP lanes would also benefit from the HOV lane. By adding a GP lane instead, the existing GP lanes will see a larger increase in speeds compared to adding an HOV lane (up to 5 mph faster if comparing to the 5-minute value of travel time threshold) because a larger overall share of traffic would use a new GP lane compared to a new HOV lane, resulting in better distribution of traffic across all lanes and therefore improved speeds across all lanes.

4. The addition of an HOV lane to pre-Beltline Flex Lane conditions provides travel time benefits for both HOV vehicles and SOV vehicles. During the AM peak hour, speeds in the GP lanes would increase by as much as 12 mph and speeds in the HOV lane would be 4 to 15 mph faster than the GP lane with a value of travel time threshold of 5 minutes. During the PM peak hour, speeds in the GP lanes would increase by as much as 23 mph and speeds in the HOV lane would be 1 to 11 mph faster than the GP lane with a value of travel time threshold of 5 minutes.

5. The conversion of the Beltline Flex Lane to an HOV lane would likely improve the travel time in the new Flex Lane/HOV lane, but is anticipated to have a negative effect on the travel time in the GP lanes.

6. The addition of an HOV lane increases the percentage of HOV vehicles on the Beltline. The HOV percentage for the corridor would increase from 9.5 to 14.3 percent in the AM peak hour and from 12.2 to 17.2 percent in the PM peak with a value of travel time threshold of 5 minutes.

7. The most promising section for adding a HOV lane based on AM peak demand (in the westbound direction) is between I-90 in the east and Mineral Point Road in the west.

8. The most promising section for adding a HOV lane based on PM peak demand (in the eastbound direction) is between South Whitney Way in the west and I-90 in the east.

9. The HOV lane will attract users who travel long distances along the Beltline. Using a conservative assumption that a user would need to observe a travel time reduction of at least 5 minutes in order to switch from SOV to HOV (represented in this evaluation by the 5 minute value of travel time threshold), they would need to travel in the HOV lane for several miles in order to see the benefit in making the mode change. HOV lanes are not attractive for short trips because they require several lane shifts to enter and exit the lane, and also because the short usage and corresponding small reduction in travel time does not warrant a change of mode from SOV to HOV.

10. After incorporating the mode shift from SOV to HOV, the speeds in the GP and HOV lanes were found to be similar at several locations. This suggests that the HOV lane is well used and has a similar usage as the GP lanes. In the most congested sections, such as eastbound at West Broadway in the PM and westbound Rimrock Road to South Park Street in the PM, the HOV lane is expected to have speeds greater than 10 mph faster than the GP lanes.

11. The travel time savings for the HOV vehicles with the additional HOV lane are equal to or greater than those provided by an additional GP lane. The GP travel speeds improve more with an additional GP lane than with an HOV lane. However, the GP lanes see a travel time savings of 2 to 5 minutes along the Beltline (North Star Road to Parmenter Street or vice-versa) with the addition of an HOV lane compared to pre-Beltline Flex Lane conditions.

12. The analysis in this memorandum does not consider shifts in trip patterns or changes in trip levels on the Beltline with the introduction of an HOV or additional GP lane. The analysis also does not consider other factors such as land use and activity location changes required to more precisely determine potential demand for the additional lanes. Although these aspects are not included in the analysis, the analysis results provide a conservative baseline that can be used to determine if a HOV lane is a justifiable investment. This analysis primarily looks at travel time savings to estimate HOV lane usage, which is the biggest driving factor on encouraging users to switch from SOV to

HOV. If these other aspects were included, the estimated HOV lane usage would be the same or better.

13. For this analysis, the potential HOV lane demand is restricted to existing auto demand in the corridor. If HOV improvements are made outside of the Beltline corridor, more users would likely switch to HOV because of even more travel time savings. Future analysis to evaluate a potentially larger HOV network should use a regional model to better understand the demand for the new lanes in the regional context.

4.03 BASE YEAR TRAFFIC DATA REVIEW MEMORANDUM

This section summarizes a review of the base year traffic data for the Beltline PEL Study base conditions traffic analysis. The goal of the traffic data review was to compare the 2012 traffic data used in the base conditions developed as part of previous Beltline PEL Study efforts to newer base year (2019) conditions, and to continue to use the substantial data collection and modeling investment WisDOT made with previous Beltline PEL Study efforts.

The Beltline PEL Study team did not make adjustments to the base year 2012 Paramics models developed as part of the Beltline PEL Study. The goals of the Beltline PEL Study traffic analysis were:

- Identify where additional capacity may be needed in 2050 along the mainline and at interchanges.
- Identify the most promising 2050 mainline and interchange Components to carry forward into future studies or NEPA documents.

It was anticipated that the basic conclusions of where capacity may be needed and what type of improvements may address the capacity concerns would be similar with microsimulation modeling and Highway Capacity Manual (HCM)-based modeling. Proceeding with HCM-based modeling for the current Beltline PEL Study efforts provided the most efficient process knowing that further microsimulation modeling was anticipated to occur, with smaller models, in future studies or NEPA documents after the conclusion of the Beltline PEL Study. The Beltline PEL Study team coordinated with WisDOT Southwest Region (SWR) Traffic and WisDOT Bureau of Traffic Operations (BTO) staff on this approach.

The Beltline Origin-Destination (OD) Study in 2012 involved an extensive data collection and analysis effort to collect travel times, travel speeds, densities, traffic volumes, and vehicular OD. This effort included the use of time-lapse aerial photography (TLAP), Bluetooth and microwave detector deployment, field counts, and other available resources.

The data-driven review of the base year traffic data included gathering historic traffic and OD data from 2016 through 2019 and comparing it with the 2012 traffic data used in previous Beltline PEL Study efforts.

A. <u>Comparison Methodology</u>

1. Travel Times

Beltline mainline travel times were primarily used to help validate base condition Paramics models during previous Beltline PEL Study efforts. The validation criteria used for the 2012 base condition models were based on the 2014 WisDOT Draft Microsimulation Guidelines. Updated microsimulation validation guidance was reviewed in WisDOT's *Traffic Engineering, Operations, and Safety (TEOpS) Manual*, which was first published in January 2018. The Beltline PEL Study team reviewed and documented how the TEOpS guidance might impact the validation of the base year 2012 Paramics models (for travel times, speeds, and mainline volumes); however, adjustments to the base year 2012 Paramics models were not made as part of this study. Further microsimulation modeling is anticipated to occur in future NEPA study efforts.

Travel times were also an operational metric reported in alternatives analysis as part of the Beltline Flex Lane project, which used the Beltline PEL Study base conditions Paramics models as a starting point for the alternatives analysis.

2. Travel Speeds

Similar to travel times, Beltline mainline travel speeds were important in validating the base conditions Paramics models developed as part of previous Beltline PEL Study efforts. Travel speeds were commonly referenced in various study documents as well because they are a relatable metric for all audiences. Travel speeds were also an operational metric reported in the alternatives analysis as part of the Beltline Flex Lane project, which used the Beltline PEL Study base conditions Paramics models as a starting point for the analysis.

3. Traffic Volumes

Peak hour traffic volumes were used for a wide variety of purposes in previous Beltline PEL Study efforts. Balanced 2012 AM and PM peak hour volume sets were developed for the corridor from County K through County N, which included all mainline, ramps, and intersections within the modeling limits. These balanced 2012 peak hour volumes were used as the base year for HCM-based operations analysis along the Beltline mainline and at intersections, the target volumes for the base year 2012 Paramics models, and the baseline for developing 2050 peak hour volumes for the HCM-based operations analysis. The volumes and operations from these analyses were documented in multiple reports for the study.

4. <u>OD Volumes</u>

The 2012 bluetooth OD analysis included 36 interchange origins and 35 interchange destinations along the approximately 20-mile Beltline study corridor from US 14/University Avenue to County N. The bluetooth data collection period spanned a full month in late summer and early fall 2012. Major OD pairs and trends were summarized in the *Beltline PEL Existing Conditions Report* for the AM and PM peak hours.

B. <u>Summary</u>

1. In general, the congestion periods in 2019 were slower, started earlier, and lasted longer than in previous years. Slower travel times (and longer durations of congestion) were apparent in the 2019 AM peak traveling westbound. Longer durations of congestion, with

a similar magnitude of congestion to 2012, were apparent in the 2019 PM peak traveling eastbound.

2. The previously developed base year 2012 Paramics models remained validated for speeds and travel times as outlined in WisDOT's TEOpS guidance.

3. The modeling effort for the Beltline Flex Lane project, which approximated a base year of 2017, appeared to be a better representation of 2019 observed PM peak period congestion as opposed to AM peak period congestion. This means results from those models were likely stronger and more reliable for the PM peak period.

4. Peak hour traffic volumes generally rose throughout the corridor between 2012 and 2019. However, the trend of peak spreading was apparent within the more congested stretch between Verona Road and I-39/90. The Beltline PEL Study's current HCS analysis efforts adequately account for increases in volume between 2012 and 2019. In the locations with peak spreading, the adjustment to K250[2] lessened the difference seen between the 2019 and 2012 volumes and supported the validation of the previous Beltline PEL Study HCS modeling results.

5. Intersection volume comparisons were performed and some locations had variations for a variety of different reasons. Further review on how these comparisons may influence previous analyses and study recommendations are included in the MIIRR.

6. OD patterns were generally consistent between 2019 and 2012. The most noticeable difference was in the westbound direction of travel where more traffic appeared to be exiting at Stoughton Road or Monona Drive (in both AM and PM peaks) than exiting at interchanges between West Broadway and Todd Drive.

C. COVID-19 Impacts

The COVID-19 pandemic generally affected weekday commuting patterns across the state and nation and the Beltline PEL Study team has been monitoring traffic data trends along the Beltline corridor since the start of the pandemic. At the Automated Traffic Recorder (ATR) site between West Broadway and Monona Drive, 2021 daily volumes were on average approximately 8 percent less than pre-COVID 2019 daily volumes. At this ATR location, the eastbound PM peak period and the westbound AM peak period were the controlling (i.e., highest volume and most congested) directions of travel during commuting hours. Eastbound PM peak flow rates in 2021 were within approximately 3 percent of 2019 and westbound AM peak flow rates in 2021 were about 10 percent less than 2019.

In May 2022, the latest month of ATR data available at the writing of the *Base Year Traffic Data Review Memorandum*, daily volumes were within 4 percent of 2019 daily volumes at this location and peak period trends were consistent with the 2021 versus 2019 trends noted previously.

[2]K250 is the 250th highest traffic volume within a specified timeframe in a given year. Some studies use K100 (the 100th highest annual traffic volume) to evaluate potential improvements. In urban areas, like the Beltline PEL Study corridor, K250 can be used because traffic volumes are more consistent and vary less from day to day. This avoids being too conservative (using volumes that are too high) when developing and testing improvement options. WisDOT received approval from FHWA to use K250 for the Beltline PEL Study.

Corridor travel times and speeds were reviewed for a 10-mile stretch between Whitney Way and I-39/90, which has typically been the most congested portion of the Beltline. May to November 2019 was compared to May to November 2021 for this review to capture the period of time in 2021 where COVID-19 vaccines were becoming more widespread and traffic volumes began to return to 2019 levels. The analysis showed the following between Whitney Way and I-39/90:

- Corridor travel times in 2021 were 10 to 35 percent less than corridor travel times in 2019.
- Corridor speeds during the PM peak (4 to 5 P.M.) in the eastbound direction were 26 mph in 2019 and were 36 mph in 2021. In May 2022, eastbound speeds were 30 mph.
- Corridor speeds during the AM peak in the westbound direction were 30 mph in 2019 from 7 to 8 A.M. and were 39 mph in 2021 and occurred later (7:30 to 8:30 A.M.). In May 2022, westbound speeds were 30 mph.
- In general, the duration of congestion was 30 to 60 minutes longer in 2019 than in 2021 during the peak periods. May 2022 travel speed data shows that the duration of congestion for the eastbound PM peak was nearly the same as 2019 (at approximately 3 hours under 50 mph) and that the duration of westbound AM peak congestion remained 30 to 60 minutes less than 2019.

Considering the largely similar traffic volumes and low-end corridor speeds in 2021 and May 2022, the Beltline PEL Study team believed the conclusions from the 2019 base year traffic data review analysis remained valid.

In July 2022, the Beltline Flex Lane became active on the Beltline after this memorandum was finalized. This change was documented as part of the MIIRR.

4.04 2050 TRAFFIC VOLUME DEVELOPMENT MEMORANDUM

The Beltline PEL Study team created 2019 and 2050 AM and PM peak hour balanced volume sets for use in the study’s HCS operations analysis. The methodology to develop the balanced volumes was coordinated with WisDOT SWR, WisDOT Traffic Forecasting Section (TFS), WisDOT BTO, and WisDOT Bureau of State Highway Programs (BSHP) in fall 2020. Results were reviewed and approved in December 2020 and February 2021.

In conjunction with the HCS operations modeling efforts, traffic forecasts were prepared by WisDOT TFS for the Future, Existing, and Committed (FEC) conditions and two build alternatives. Chapter 9 of the *Transportation Planning Manual* (TPM) provides a detailed explanation of traffic forecasting process and planning data.[3] The *2050 Traffic Volume Development Memorandum* provides a brief summary of the process used to develop the Beltline PEL Study forecasts and how the Beltline PEL Study team is using the traffic forecasts to develop hourly volumes for the 2050 HCS operations analysis.

Previous HCS traffic modeling efforts for the Beltline PEL Study, which began in 2015, involved separating the Beltline into seven sections for planning-level operations analysis. This previous HCS analysis was completed by direction (eastbound and westbound) for weekday AM and PM peak hours. This analysis used a 2012 base year and a 2050 design year. At the time, it was anticipated that microsimulation models would be used to evaluate 2050 improvement Strategies along the Beltline.

[3]WisDOT Transportation Planning Manual: https://wisconsindot.gov/Documents/projects/data-plan/plan-res/tpm/9.pdf. Accessed October 27, 2020.

The current traffic modeling efforts for the Beltline PEL Study, conducted from 2020 through 2022, do not include additional microsimulation. Rather, microsimulation is anticipated to occur during future studies or NEPA documents. For the current Beltline PEL Study traffic modeling efforts, HCS is being used to reevaluate previously prepared traffic operations analysis with the following notable updates:

- Updated base year traffic count data
- Updated traffic forecast data
- An updated set of committed projects
- New capabilities within the HCS analysis modules

More detail on the previous HCS traffic modeling efforts can be found in the BIIM. The *2050 Traffic Volume Development Memorandum* focuses on the current Beltline PEL Study traffic forecasting and volume balancing processes that support the current HCS traffic modeling efforts.

A. Daily Traffic Forecast Development

Traffic forecasting is a dynamic process that considers numerous factors. WisDOT TFS provided the roadway forecasts for the Beltline PEL Study. The daily Dane County TDM and Traffic Analysis Forecasting and Information System (TAFIS) were the tools used to estimate traffic volumes that reasonably represent how the Beltline could be expected to be used in the future under various conditions. The following paragraphs summarize these tools. More detail on how travel demand models and TAFIS may be used to conduct a traffic forecast can be found in Chapter 9 of the TPM.

1. Dane County TDM

WisDOT TFS used the Dane County TDM to forecast future travel patterns and volumes. Travel demand models are complex and integrated tools. Key inputs include current and future households, employment, and special traffic generators. Roadway network inputs include speed, roadway classification, and number of lanes. Local municipalities throughout Dane County develop land use plans that describe their long-term expectations regarding how agricultural, urban, and rural areas will change in the future. These land use plans are incorporated into the Dane County TDM, which models how new development and changes in redeveloped areas impact the transportation system.

The Dane County TDM considers data including trip generation (the number of trips to be made); trip distribution (where those trips go); mode choice (how the trips will be divided among the available modes of travel); and trip assignment (assigning the route trips will take). The Dane County TDM is validated against existing travel patterns and traffic volumes, and then used to project future travel patterns and traffic volumes.

For the Beltline PEL Study, version 6.7.1.0 of the Dane County TDM was used in the forecasting process. Committed projects along the Beltline included in the Dane County TDM, which have committed funds to be constructed before the 2050 design year, are the following:

- Beltline Flex Lane (implementation from Whitney Way to I-39/90)
- Beltline interchange with I-39/90 reconstruction project
- US 12 and County AB interchange

When the *2050 Traffic Volume Development Memorandum* was prepared in April 2021, the Beltline Flex Lane and the Beltline interchange with I-39/90 projects were both under construction and the US 12 and County AB interchange project was under design. A projected design year of 2050 was based on an assumed construction year of 2030 plus the standard 20 years after construction to reach the study horizon.[4] Two methods are documented to account for the demand of the Beltline Flex Lane. The project team agreed to use Method 1 in the forecasts for the 2050 FEC and 2050 Build Alternative 2 described in the following sections. The *2050 Traffic Volume Development Memorandum* was approved by WisDOT TFS in November 2020.

Planned projects, or those currently without committed funds, are projects that were considered for inclusion but were ultimately not included in the Dane County TDM because of unknowns with project schedules and funding. Two examples of planned projects considered were an interchange at US 12 and County K and improvements along US 51/Stoughton Road; both of which were in the study phase.

2. TAFIS

WisDOT TFS used the TAFIS as a supplemental tool to develop the forecast. TAFIS is a computer program operating on the principle of forecasting future Wisconsin State Highway (WIS) traffic volumes using historic traffic counts to create a best-fit, statistically significant forecast. WisDOT uses a combination of TAFIS and the Dane County TDM output to conduct roadway traffic forecasts in areas where travel demand models exist, such as the Beltline corridor. Travel demand model growth rates and TAFIS growth rates are generated with different information. The travel demand model growth rate can account for anticipated changes in population and employment in specific locations. Regression-based TAFIS growth rates are based on formulas that are applied to the past and current counts for specific locations, and do not normally include or consider assumptions as to why those volume changes occur. WisDOT TFS documents the difference in growth rates before choosing which to use in traffic forecasts and uses engineering judgement to choose growth rates based on the level of confidence in forecasting tools, including travel demand models and TAFIS.

3. Final Traffic Forecasts

WisDOT TFS finalized the traffic forecasts for the Beltline PEL Study in October 2020. The roadway traffic forecast existing (or base) year volumes were determined by the most recent traffic

[4]FDM 11-10-1.1 (Accessed October 2020): The design years for projects are normally 20 years from the date projects are proposed to be opened to traffic. Shorter design periods may be used when highways are to be constructed in stages or designed for shorter pavement improvement lifespans. The traffic forecasts for the Beltline PEL Study were developed assuming an estimated construction year of 2030.

count data available through WisDOT's traffic count program at the time of the forecasting effort. All roadway traffic counts along the Beltline used in the forecasting effort were completed in 2018 or 2019. The traffic forecast results prepared by WisDOT TFS are discussed in more detail in Section B, Daily Traffic Forecasts.

B. Daily Traffic Forecasts

1. Forecast Locations

The Beltline PEL Study team requested mainline forecasts at seven locations throughout the corridor, which is consistent with previous study efforts. The locations provide a representation of the different geometrics (i.e., basic number of lanes) and volume characteristics along the Beltline within the study's traffic modeling limits, which are from County K to County N.

Figure 4.04-1 shows the locations where mainline forecasts were prepared.

Figure 4.04-1 Beltline Mainline Forecast Request Locations

2. Forecast Alternatives

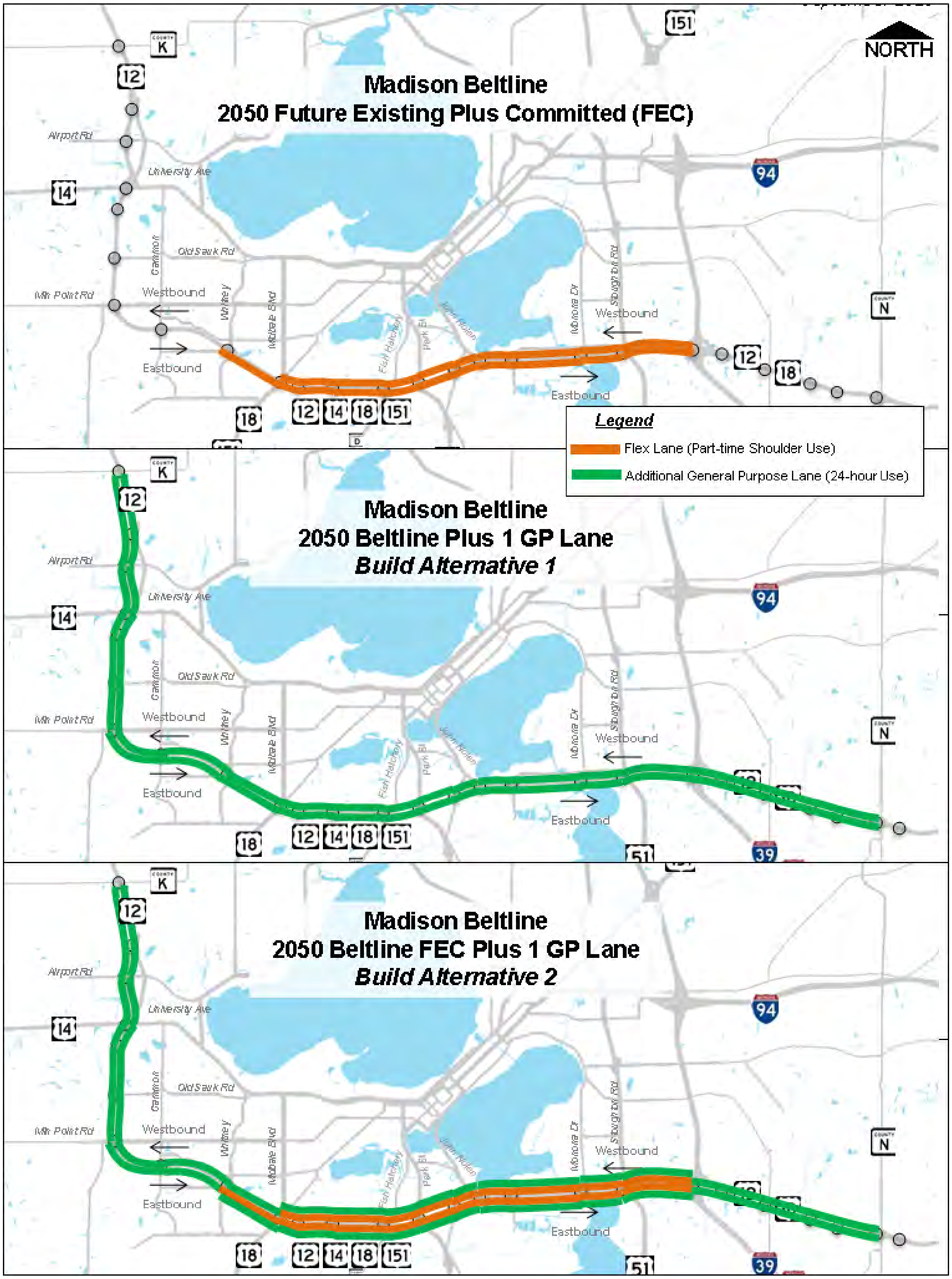
Traffic forecasts were prepared for the following three alternatives:

- 2050 FEC–This alternative is similar to a “No-Build” condition except that it includes projects with committed funding. The committed projects along the corridor include the Beltline Flex Lane from Whitney Way to I-39/90, the Beltline interchange with I-39/90 reconstruction, and the US 12 and County AB interchange.
- 2050 Build Alternative 1–This alternative includes an additional GP lane along the Beltline from County K to County N. The Beltline interchange with I-39/90 reconstruction and the US 12 and County AB interchange are included as committed projects. The Beltline Flex Lane from Whitney Way to I-39/90 is removed with this alternative and is replaced with the additional GP lane.
- 2050 Build Alternative 2–This alternative includes an additional GP lane along the Beltline from County K to County N and keeps the Beltline Flex Lane from Whitney Way to I-39/90. The Beltline interchange with I-39/90 reconstruction and the US 12 and County AB interchange are included as committed projects with this alternative.

These traffic forecast alternatives provide a basis for a range of potential cross sections to consider for future studies or NEPA documents; however, future studies or NEPA documents will not necessarily include all three of these alternatives. Many factors outside of vehicular mobility (such as safety, infrastructure condition and deficiencies, system mobility for all modes, environmental impacts, etc.) will be considered when deciding what to include for future studies or NEPA documents.

Schematics of the alternatives described are shown in Figure 4.04-2.

Figure 4.04-2 Beltline Traffic Forecast Alternatives



3. Daily Forecast Results

Generally, the highest growth rates are seen at the four-lane endpoints of the corridor, which have the lowest base year volumes and the most capacity (or room for growth) available. Growth is more moderate from Old Sauk Road to Verona Road and is the lowest between Verona Road and the Beltline interchange with I-39/90, where base year volumes are the highest. Table 4.04-1 shows the Beltline mainline 2050 daily traffic forecast results compared to the base year conditions and Table 4.04-2 shows the annual growth rates for each alternative.

Beltline Mainline Location	AADT Volumes (vpd)			
	Base Year (Year)	**2050 FEC (+Beltline Flex Lane)**	**2050 Build Alternative 1 (+1 GP)**	**2050 Build Alternative 2 (+1 GP, +Beltline Flex Lane)**
County K to Parmenter Street	31,500 (2018)	41,400 *+31%*	42,400 *+35%*	42,400 *+35%*
Old Sauk Road to Mineral Point Road	75,900 (2018)	87,600 *+15%*	97,700 *+29%*	98,500 *+30%*
Whitney Way to Verona Road	107,000 (2018)	133,400 *+25%*	145,700 *+36%*	148,700 *+39%*
Fish Hatchery Road to Park Street	137,300 (2018)	160,800 *+17%*	177,900 *+30%*	183,200 *+33%*
John Nolen Drive to West Broadway	138,300 (2018)	164,900 *+19%*	180,000 *+30%*	184,400 *+33%*
Stoughton Road to I-39/90	90,700 (2018)	115,900 *+28%*	122,300 *+35%*	124,300 *+37%*
I-39/90 to County AB	18,200 (2018)	26,300 *+45%*	27,400 *+51%*	27,900 *+53%*

Notes: Rounded Percent Growth from Base Year in *italics*.
AADT=annual average daily traffic

Table 4.04-1 Beltline Mainline Daily Traffic Forecast Results

Beltline Mainline Location	Annual Growth Rates (Percent Growth/Year)		
	2050 FEC (+Beltline Flex Lane)	2050 Build Alternative 1 (+1 GP)	2050 Build Alternative 2 (+1 GP, +Beltline Flex Lane)
County K to Parmenter Street	+1.01%	+1.12%	+1.12%
Old Sauk Road to Mineral Point Road	+0.48%	+0.90%	+0.93%
Whitney Way to Verona Road	+0.77%	+1.13%	+1.22%
Fish Hatchery Road to Park Street	+0.53%	+0.92%	+1.04%
John Nolen Drive to West Broadway	+0.60%	+0.94%	+1.04%
Stoughton Road to I-39/90	+0.87%	+1.09%	+1.16%
I-39/90 to County AB	+1.39%	+1.58%	+1.67%

Table 4.04-2 Beltline Mainline Annual Growth Rates

The annual growth rates shown in Table 4.04-2 were the most critical pieces of forecast data used in the development of 2050 hourly volumes for the current Beltline PEL Study efforts. The hourly volume development process is described in the following paragraphs.

C. Hourly Volume Development

Earlier in the Beltline PEL Study there was a large data collection effort that took place in September 2012. TLAP data that was used for traffic analysis was mostly collected on September 11, 2012. On that day, the peak directions of travel represented traffic between K150 and K250. Balanced 2012 AM and PM peak hour volumes were developed based off of the TLAP data set from County K through County N and were used for a variety of reasons in previous efforts, ranging from HCS analysis to volume validation targets for microsimulation modeling. The use of these volumes for traffic operations analysis was documented in a design hour vehicle (DHV) memorandum prepared in 2014.

The previous HCS analysis was performed for the seven sections of the Beltline shown in Figure 4.04-3.

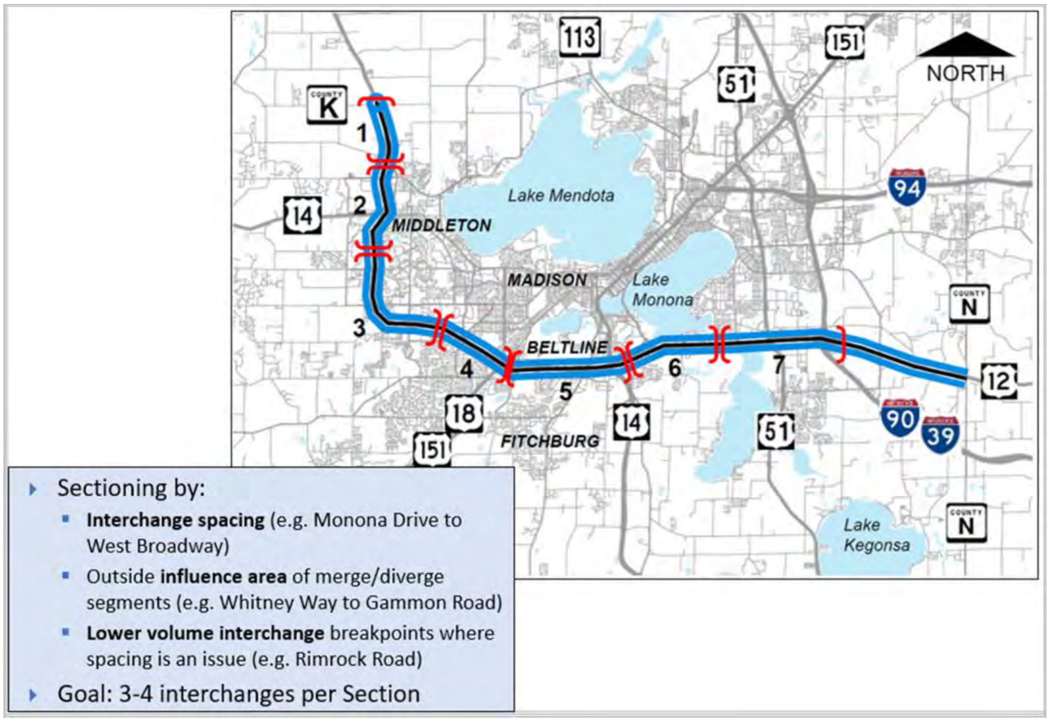


Figure 4.04-3 Sections of Beltline for HCS Modeling (Previous Efforts)

The BIIM provides more detail on the analysis methodology and results of the previous HCS analysis; however, there are some differences in how the previous analysis was performed compared to how the current analysis is performed. A few notable differences are outlined in the remainder of this section.

1. Base Year Determination

Through WisDOT's coverage count program, short-term counts were performed at all US 12 mainline and ramp locations in spring 2018 within the traffic modeling limits of the Beltline PEL Study. There are also five ATR locations along the US 12 mainline within the traffic modeling limits. These ATRs continuously collect data and, therefore, were not included in the coverage count program. The Beltline PEL Study team reviewed 2018 and 2019 data at each ATR.

The Beltline PEL Study team coordinated with WisDOT SWR Traffic to determine the most appropriate base year for the current Beltline PEL Study analysis. The options included the following:

- 2018–Year the coverage counts were taken. Minimal overnight construction activity along the Beltline.
- 2019–No coverage counts available. Moderate overnight construction activity along the Beltline from April through November.
- 2020–No coverage counts available. Effects of the COVID-19 pandemic experienced from mid-March onwards.

WisDOT SWR Traffic recommended 2019 as a base year for the analysis based on daily volumes in 2019 being the most current full year of traffic data available and based on higher daily volumes in 2019 compared to 2018. The Beltline PEL Study team reviewed whether the construction activities in 2019, (although most overnight construction included lane shifts), would have affected travel patterns during peak periods. To evaluate if 2019 (with construction) and 2018 (without construction) were similar, the Beltline PEL Study team compared 2018 and 2019 bluetooth OD data during the AM and PM peak periods between Verona Road and I-39/90. The Beltline PEL Study team found that patterns between the 2 years were reasonably similar and supported the use of 2019 as a base year for the current Beltline PEL Study efforts.

2. 2019 DHVs

The FDM defines the Directional Design Hour Volume (DDHV) as follows:[5]

$$DDHV = AADT * K_{(both\ directions)} * D$$

Where:
DDHV=directional design hour volume (vehicles per hour)
AADT=annual average daily traffic in both directions (vpd)
$K_{(both\ directions)}$=proportion of AADT occurring in the design hour for both directions combined
D=proportion of traffic in the highest direction during the design hour

The five ATRs within the traffic modeling limits were each used to develop target DHV values for the 2019 hourly volume development process. To develop the target DHV at each ATR location, the Beltline PEL Study team used 2019 traffic volumes, a 2019 total roadway (i.e., two-way) K250 factor, and a D factor (i.e., Directional Split) based on 2019 annual average Tuesday to Thursday data. See the *2050 Traffic Volume Development Memorandum* for more detail on the DDHV development for this study.

3. Peak Hour Volumes

The Beltline PEL Study team used WisDOT's Freeway Volume Balancing Tool to balance the 2019 AM and PM peak hour mainline and ramp volumes throughout the corridor.[6] The limits of the volume balancing effort focused on the freeway portions of US 12 from north of Parmenter Street to just east of I-39/90.

Raw 2050 AM and PM hourly traffic volumes were developed by applying a 2019 to 2050 growth factor from the traffic forecasts to the base year 2019 balanced hourly volume. After growth was applied to develop the raw volumes, the Beltline PEL Study team balanced the raw 2050 AM and PM peak hour volumes for the FEC and build alternatives.

[5] WisDOT FDM 11-5-3.5.1.1 Design Hour Volume for Freeways, Multilane Highways, and Two-Lane Highways: Updated August 17, 2020. Accessed September 2020.
[6] The WisDOT freeway volume balancing tool is found at this link: https://wisconsindot.gov/Pages/doing-bus/local-gov/traffic-ops/programs/analysis/default.aspx. The Beltline PEL Study team used v3.9.1 of the tool, which was the most current as of July 2020 when the base year data review began.

D. Summary

The traffic forecasting process and traffic forecasts were developed by WisDOT TFS and the Beltline PEL Study team concurrently. The process to develop the hourly balanced volumes was reviewed and approved by several parties within WisDOT and the results have been approved by SWR Traffic. The *2050 Traffic Volume Development Memorandum* was approved by WisDOT SWR in September 2021 and by WisDOT TFS in November 2021.

The Beltline PEL Study team has used the balanced hourly volumes for HCS analysis efforts and has used the traffic forecast information for study documentation and meeting presentations.

WisDOT traffic forecasts account for many factors, as described in Section 4.04B–Daily Traffic Forecast Development. However, there are several factors that may influence future travel characteristics that are unknown and/or cannot be accounted for in the Dane County TDM or are not explicitly covered in WisDOT's TPM.

See the *2050 Traffic Volume Development Memorandum* for more detail on the volume balancing and future volume development processes used in this study along with discussion on traffic forecast uncertainties.

4.05 MIIRR

The MIIRR builds on the analyses of Beltline Mainline Component Concepts in the BIIM and Interchange Component Concepts in the IIIM. Concepts were carried forward in the MIIRR after further evaluation to determine which Components should be considered for potential inclusion in Strategy Packages. As part of further evaluation in the MIIRR, committed and planned projects that were completed or developed since the completion of the BIIM and IIIM were included in the traffic analysis for the Beltline PEL Study. The following paragraphs describe the progression of traffic analysis in the Beltline PEL Study and the committed and planned projects included or reviewed in the MIIRR.

1. Traffic Analysis Methodology

Beltline Mainline

The traffic operations analysis included in the BIIM used a base year of 2012 and a design year of 2050 for the HCM-based traffic modeling. The traffic modeling effort used HCS 2010, which is a software based on the HCM 2010, to evaluate the existing and future operations of the Beltline. The HCS analysis for this study was initiated in 2015 and was performed for each direction of travel (eastbound and westbound) for weekday AM and PM peak hours. At the time it was anticipated that microsimulation models would be used to evaluate 2050 improvement Strategies along the Beltline. More information on the traffic analysis methodology and traffic forecasts used in the previous analysis is included in the BIIM.

The current traffic modeling efforts for the Beltline PEL Study, conducted in 2020 and 2021, do not include additional microsimulation. Rather, microsimulation is anticipated to occur during future studies or NEPA phases. For the current Beltline PEL Study traffic modeling efforts, HCS is being used to reevaluate previously prepared traffic operations analysis with the following notable updates:

- Updated base year traffic count data
- Updated traffic forecast data
- An updated set of committed projects
- New capabilities within the HCS analysis modules

Since the completion of the BIIM, the Beltline PEL Study team created 2019 and 2050 AM and PM peak hour balanced volume sets for use in the study's current HCS operations analysis. Documentation regarding the development of the 2019 and 2050 balanced peak hour volumes can be found in the study's *2050 Traffic Volume Development Memorandum.*

Additionally, the current HCS analysis uses HCS Version 7 (HCS7), which implements the methodologies of the HCM 6th Edition (HCM6). The guidance in the HCM6 and the capabilities of HCS7 allow for the traffic operations of managed lanes to be assessed. More detail on inputs and assumptions for the traffic modeling is included in Section 1.02-C of the MIIRR.

Beltline Interchanges

The traffic operations analysis included in the IIIM used a base year of 2012 and a design year of 2050 for the traffic modeling. The traffic modeling effort used a variety of tools, including Synchro/SimTraffic, Sidra, Paramics, and Capacity Analysis for Planning of Junctions (CAP-X) to evaluate existing and future operations of interchanges and intersections.

The current Beltline PEL Study efforts do not include a reevaluation of intersection operations at or near interchanges or updates to intersection traffic forecasts.

Base Year Data Review

The Beltline PEL Study team reviewed how the 2012 traffic data used in the base conditions developed as part of previous Beltline PEL Study efforts compare to more recent base year (2019) conditions. By performing this comparison, assessments could be made regarding the applicability of the HCM-based operations analysis and microsimulation operations analysis that was performed using 2012 traffic data for previous Beltline PEL Study efforts.

The *Beltline PEL Base Year Traffic Data Review Memorandum* (described in Section 4.03) documents the methodology and results of the base year data review effort.

2. Future Existing Plus Committed and Planned Projects

The Beltline Mainline Component Concepts were evaluated for 2050 conditions assuming that projects currently under construction as well as those for which funding has been committed, will be complete. The two largest projects at the time of BIIM evaluation were the US 18/151/Verona Road project and the Beltline interchange with I-39/90 project. Each of these projects have been completed. Since the completion of the BIIM, two new committed projects have been completed. These are the Beltline Flex Lane project that implemented dynamic part-time shoulder use from Verona Road to I-39/90 and the US 12 and County AB interchange project.

To help differentiate between the No-Build Component Concepts discussed in the BIIM, the naming convention for the current Beltline PEL Study operations analysis is identified as the FEC. The FEC is similar to a no-build condition except that it includes projects with committed funding. As of the writing of this document, the US 18/151/Verona Road, Beltline interchange project, the Beltline Flex Lane, and the US 12 and County AB interchange project have been completed.

Each of these four projects are included as committed projects in the FEC alternative and are discussed in detail in the following:

US 18/151/Verona Road Project

Stage 1 of the US 18/151/Verona Road project at the Beltline was completed in 2016, and Stage 2 was completed in 2020. The Verona Road project Stage 1 improvements included one additional mainline travel lane on the Beltline from Verona Road to Gammon Road, a Single Point Urban Interchange (SPUI) at the Beltline and US 151/Verona Road, and a grade-separated jug-handle on Verona Road at Summit Road/Atticus Way. Stage 2 included construction of interchanges for Verona Road and Williamsburg Way, and Verona Road and County PD.

This committed project was included in both the previous BIIM traffic analysis and the current Beltline PEL Study traffic analysis.

Beltline Interchange with I-39/90 Project

The Beltline interchange with I-39/90 project was in the NEPA study stage in fall 2017 when a substantial amount of the Component analysis was completed for the BIIM document. In fall 2017, the Beltline interchange with I-39/90 project included conversion of the existing system interchange at the Beltline and I-39/90 to a turbine interchange. In spring 2016, WisDOT began investigating other configurations for the Beltline interchange with I-39/90; however, for the purposes of report completion in 2017, the original turbine proposal was assumed for the analysis included in the BIIM document.

While the Beltline PEL Study was on hold in winter 2017, FHWA and WisDOT chose to rescind the Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) for the Beltline interchange with I-39/90 project and revise the project scope, and purpose and need. The turbine interchange concept was dismissed from further consideration. In December 2018, an Environmental Assessment was completed for the project with a preferred alternative that included two lanes on northbound I-39/90 and three lanes on southbound I-39/90 and used existing infrastructure to reduce impacts and construction costs. Construction started in 2020 and was completed in spring 2022.

The findings of the BIIM were reevaluated in light of the changes in scope and preferred alternative for the Beltline interchange with I-39/90 project. Key Beltline interchange with I-39/90 modifications that were assumed for the Beltline PEL Study analysis in the BIIM and were not included in the Beltline interchange with I-39/90 improvements include the provision of a new Collector-Distributor (CD) road to the Stoughton Road interchange in the westbound direction and converting the existing left-hand US 12 eastbound to I-39/90 northbound exit to a right-hand exit.

The current Beltline PEL Study traffic analysis accounts for the change in scope and preferred alternative with the Beltline interchange with I-39/90. The traffic operation results from this evaluation are summarized in Section 2 of the MIIRR.

Beltline Flex Lane Project

Construction of the Beltline Flex Lane project was completed in June 2022 and included the following improvements between Verona Road and I-39/90:

- Resurface to address deteriorating pavement
- Improve existing drainage deficiencies
- Replace the existing median barrier wall
- Upgrade Beltline median shoulders to be used as part-time travel lanes.

Upgrading the shoulders for through travel is a practice known as part-time shoulder use, which is branded on the Beltline as the Flex Lane. The shoulder travel lanes would typically be open during peak periods to safely and efficiently improve travel reliability between Verona Road and the Beltline interchange with I-39/90.

The Beltline Flex Lane was included as a committed project in the current Beltline PEL Study traffic analysis. During the previous BIIM traffic analysis efforts, the Beltline Flex Lane was not considered as a committed project as the concept was only in the planning stage at the time (i.e., no committed funds were associated with the project).

US 12 and County AB interchange

Construction of a diamond interchange at the intersection of US 12/18 and County AB was completed in 2023. This US 12/18 and County AB interchange project:

- Constructed a diamond interchange just east of the existing County AB intersection with roundabouts at the ramp terminals.
- Removed all access along US 12/18 including at Millpond Road and Long Drive except for the right-turn movement going from eastbound US 12/18 to Millpond Road which is still allowed.
- Constructed frontage roads that connect Millpond Road and Long Drive to the realigned County AB roadway.
- Added a roundabout at the new County AB and Millpond Road intersection.

Planned projects, or those currently without committed funds, are projects that were considered for inclusion but were ultimately not included in the traffic forecasts because of unknowns with project schedules and funding. Examples of planned projects considered were an interchange at US 12 and County K, improvements along US 51/Stoughton Road (currently in the study phase), the I-39/90/94 corridor (currently transitioning from the study phase to the design phase), and the *US 12/18 Freeway Conversion Study* from I-39/90 to County N.

For the US 12/18 corridor east of County AB, the *US 12/18 Freeway Conversion Study* from I-39/90 to County N is an example of one of the planned projects within the Beltline PEL Study limits. The *US 12/18 Freeway Conversion Study* prepared the following recommendations[7]:

- US 12/18–The recommended alternative includes improvements to the US 12/18 median and shoulders while maintaining the existing travel lanes. Direct access to US 12/18 at Siggelkow Road, Femrite Drive, and Vilas Road would be eliminated.
- Siggelkow Road–A new bridge over US 12/18 would be constructed between Siggelkow Road and Femrite Drive approximately 400 feet west of the existing intersection with US 12/18. A portion of Siggelkow Road would be reconstructed to remove several sharp curves in the existing roadway.
- Femrite Drive–A portion of Femrite Drive would be reconstructed north of the new bridge crossing. A new frontage road would be constructed along the north side of US 12/18 between Femrite Drive and Vilas Road to provide access to the properties on the north side of US 12/18.
- Vilas Road–Vilas Road would be shifted approximately 150 feet to the east of the current location where it intersects US 12/18. A new bridge would be constructed over US 12/18.
- This alternative is recommended because the general consensus of the public and design staff indicated that crossings of US 12/18 should be provided for the East Section at the side road locations where access is being removed.

The section of the Beltline from I-39/90 to County N was not reviewed in detail by the Beltline PEL Study team as it is expected to be addressed as part of other ongoing WisDOT studies and projects. The potential improvements identified as part of the *US 12/18 Freeway Conversion Study* from I-39/90 to County N should be considered when traffic or safety issues arise.

Details on the traffic forecasting effort for the study, including discussion of committed and planned projects, can be found in the study's *2050 Traffic Volume Development Memorandum*, which is summarized in Section 4.04.

I-39/90/94 Corridor Study and Implications for the Beltline Interchange with I-39/90

The I-39/90/94 Corridor Study began in summer 2022 and WisDOT and FHWA released the approved Final Environmental Impact Statement (FEIS) and Record of Decision on

[7]US 12/18 Freeway Conversion Study project page:
https://wisconsindot.gov/Pages/projects/by-region/sw/1218conv/public.aspx

December 5, 2024. While the southern study limits are north of the Beltline interchange with I-39/90, the Beltline interchange with I-39/90 is included in the study's traffic analysis limits. As of spring 2024, traffic modeling completed for the I-39/90/94 Corridor Study identified capacity constraints for the eastbound to northbound Beltline interchange with I-39/90 system ramp and the southbound to westbound Beltline interchange with I-39/90 system ramp. The current Beltline PEL Study traffic analysis was completed before the I-39/90/94 Corridor Study's starting point, and therefore, does not account for the I-39/90/94 Corridor Study's differences in traffic volumes. The Components considered to address capacity constraints for these system ramps as part of the I-39/90/94 Corridor Study are discussed further in the MIIRR report.