Corridor Study

Carmichael Road

Hudson, Wisconsin

HUDSO 142677 | September 20, 2018

SEH

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September 20, 2018

RE: Carmichael Road
Corridor Study
Hudson, Wisconsin
SEH No. HUDSO 142677 4.00

Mr. Michael Johnson, Community Development Director
City of Hudson
505 - 3rd Street
Hudson, WI 54016-1694
Dear Mr. Johnson:

Enclosed with this letter is the completed the Carmichael Road Corridor Study. The findings of the study were presented to the City Council in January 2018. Since that time, the Wisconsin Department of Transportation (WisDOT) reopened their I-94/Carmichael Road Preferred Alternate Interchange design study to consider how the findings contained in this study affect their previous findings. SEH has worked with the WisDOT consultant to revise the interchange concept to provide enough capacity to handle the Year 2040 forecasted traffic volumes. The results of the effort are part of the report.

The final steps in the study utilized a Synchro/SimTraffic simulation model which allowed modifications of the interchange design and other modifications to the corridor to be modeled to assess impacts on projected traffic patterns. The traffic forecasts used trip generation estimates from proposed developments such as St. Croix Meadows to model future traffic. Should the proposed developments change, new trip generation estimates can be made for the new site plan, compared to those used in the original forecast, and, if necessary, the model can be rerun to determine the impacts of the changed traffic forecast.

It is recommended that the results of the study be conveyed by the City to WisDOT so agreement can be reached on the final concept for the interchange. SEH can provide assistance to the City in these discussions. This study further identifies recommended improvements in other area of the Corridor to provide adequate capacity and improve safety for users.

The Carmichael Corridor contains many challenges in trying to accommodate the anticipated significant increases in traffic such as close spaced intersections, high turning traffic volumes, and limited areas for expansion. We look forward to working with the City to develop the needed improvements to the corridor as identified in this study.

Respectively Submitted,

Glen Van Wormer
Project Manager

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Corridor Study

Corridor Study
Hudson, Wisconsin

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1 Background

1.1 General

I-94 is a major element in the Hudson Transportation System and is an origin or destination for many Hudson trips. The volume of traffic on the St. Croix River Bridge in 2016 was 91,000 vehicles per day (MnDOT). East of the Highway 12 interchange (Exit 4), the traffic volume drops by 51,000 vehicles to 40,000 vehicles per day (WisDOT, 2015). This demonstrates the high demand in the Hudson area for access to I-94. The 2009 Hudson Comprehensive Plan Update showed 41 percent of Hudson workers commuted to Minnesota. Commercial and employment center parking lots in Hudson have many vehicles with Minnesota license plates, further demonstrating the heavy demand for access to I-94.

Currently, there are four I-94 interchanges in the Hudson Area, and an additional single westbound on-ramp (A companion east bound off ramp was removed when the Carmichael Road interchange was constructed).

- Exit 1 (Highway 35) directly east of the St. Croix River has access only to the north, into the downtown area. Motorists can use Coulee Road at the south end of the downtown to travel to the top of the bluff.
- Exit 2 is to Carmichael Road where there currently is a diamond interchange configuration. The eastbound off ramp has a daily volume of over 13,400 vehicles (2015), while the westbound on ramp volume is 8,700 vehicles per day. Between Exits 1 and 2 is the westbound slip ramp with a daily volume of 4,900, resulting in 13,600 westbound vehicles entering I-94 from the Carmichael Road area.
- Exit 3 is a freeway to freeway interchange with Highway 35 to the south. There is no local access except via the Hanley Road interchange to the south.
- Exit 4 is a diamond interchange with Highway 12 east of the Hudson area.

I-94 is also one of several barriers to traffic flow in Hudson. Access across I-94 is limited to two locations, Carmichael Road and Heggen Street/11th Street. Since the main access across I-94 (Carmichael Road) coincides with the largest volume interchange, there is a considerable amount of traffic and resulting congestion in the Carmichael Road corridor.

Further compounding the congestion problem is the amount of traffic generated in the southwest quadrant of the I-94 and Carmichael Road interchange. Trips are generated by the following land uses:

- This area contains almost 300 acres of industrial and manufacturing uses and is a major employment center. A rough estimate of traffic generation from these uses (based on acreage) is 13,000 trips per day.
- This area also contains a major commercial area for Hudson, including high traffic generators like fast food restaurants, convenience stores, and major retailers. A rough estimate of traffic generation based on land use is 28,000 trips per day.
- Based on aerial photos, there are about 750 dwelling units which add another 6,000 trips per day.
- This southwest area generates over 47,000 trips per day.

Additional traffic is generated along Coulee Road, in the commercial area north on Carmichael Road, from the Hospital and commercial development in the southeast quadrant, from the County Government Center, and from a large sector of the Hudson residential areas. Access to I-94 and interaction between all these developments create a large amount of traffic focused in a single corridor.

Reducing the congestion, delays, and undesirable stopping in the Carmichael Road Corridor is a major objective for the Hudson transportation system. Numerous suggestions have been made in the past and a few have been implemented. However, the congestion remains and is a major source of irritation to area motorists and business owners.

1.2 History of Past Work in the Corridor

Comprehensive Plan: The 2009 Comprehensive Plan Transportation Element discussed options for the Carmichael Road Corridor and recommended a more detailed study of the corridor. The Plan document devoted several pages to a proposed systematic review of traffic operations, primarily along Carmichael Road and in the downtown. A Planning Commission meeting in 2009 discussed implementation of the Comprehensive Plan's recommendations and had the Carmichael Corridor Study as the top transportation priority. Selected pages of the Transportation Plan are provided in the Appendix.

The City of Hudson and the Wisconsin Department of Transportation (WisDOT) held discussions in 2010 about the concerns in the I-94 corridor, especially at the Carmichael Road interchange. The city provided sketches of alternates developed with the Comprehensive Plan. The sketches included loop ramps, split diamond interchanges, additional crossings of I-94, and modified slip ramps.

Origin/Destination Study: WisDOT conducted an Origin/Destination study for the I-94 corridor in 2011 to determine the desired traffic patterns of motorists.

Corridor Study: As part of an I-94 corridor study, WisDOT later developed several interchange options for the Carmichael Road interchange based partially on the data from the origin/destination study. After review, the City and WisDOT selected a preferred option for the interchange with possible construction in the 2022 to 2025 time-frame. At the time of the WisDOT study, there were no plans to redevelop the golf course or dog racing track.

Developments: Major re-development proposals for the Hudson Golf Club (Carmichael Ridges) and the former dog racing track (St. Croix Meadows) were reviewed and approved by the City. The traffic study done for St. Croix Meadows pointed out the congestion problems anticipated without implementation of the preferred option for the I-94/Carmichael Road interchange by 2025, and several issues that will remain in 2040 even if the preferred alternate is constructed.

The City also approved a residential/commercial development for the property between Maxwell Drive and the former dog racing track (Gerard). Annexation and or development proposals for the southwest quadrant of Vine Street and Carmichael Road (Atwood) and for the area south of Mayer Road (Lee) are now being considered. A Super Walmart had been proposed for the northeast quadrant of the I-94 interchange.

1.3 Status of the Current Study

Carmichael Corridor Study: The City hired SEH Inc. in the summer of 2017 to conduct a Corridor Study for Carmichael Road. The study was to include a review of undeveloped land uses and proposed development, provide traffic forecast volumes for future years 2025 and 2040, evaluate traffic operation with and without the Preferred Alternate Interchange, recommend improvements throughout the corridor, and develop a traffic signal coordination program for the existing signal system to provide some earlier congestion relief.

The study was completed through the analysis of the 2040 traffic scenario and presented to the City Council in January 2018. The 2040 scenario with the Preferred Alternate Interchange did not have enough capacity to carry the 2040 forecasted traffic volumes.

WisDOT reviewed the study results in early 2018 and planned to restudy the interchange concepts with the additional traffic generated from the approved and potential developments. A meeting in Hudson in May 2018 provided background information and ideas for the WisDOT restudy. In late July 2018, WisDOT, their consultant, the City, and SEH met to review data developed by WisDOT's consultant. A subsequent working meeting on August 9 developed potential modifications to the preferred interchange. These were worked into the model, further refined, and tested in the Synchro/SimTraffic model until a satisfactory interchange concept was developed.

The Corridor study is essentially complete and the City could use the results of the study to evaluate other options to balance the 2040 traffic volumes and roadway capacity. It was agreed that SEH should complete the Corridor Study and provide a report to assist in the continued evaluation of the final interchange concept for the Corridor by WisDOT and the City.

The coordinated traffic signal system work (See Section 13) will continue until installation of the timing is complete in the fall of 2018.

2 Traffic Operations and Concerns

Traffic volumes on Carmichael Road vary by location, from 7,000 vehicles per day (vpd) south of Mayer Road to 34,000 vpd south of I-94. But the traffic volumes are only part of the operational concerns. Six lane streets often carry more than 50,000 vpd.

The four busiest intersections on Carmichael Road are Coulee Road, the I-94 westbound ramps, the I-94 eastbound ramps, and Crest View Drive. These four intersections are closely spaced with the average distance between them of only about 500 feet. The short distance creates significant problems for vehicle backup, turn lane storage, lane changing, and signal operations.

Traffic signal operations at the six central intersections (Coulee Road to Hanley Road) are inconsistent as shown by the comparisons of left turn phasing and control (Table 1). A study of the Hanley Road intersection showed a capacity need for "protected/permissive" left turns, but also a crash problem involving the left turning traffic. A consistent, better understood left turn

phase was recommended for the corridor, with flashing yellow arrow indications at both Hanley Road and Center Road.

Each intersection in the corridor has high turning movement volumes. There are about 13,000 vpd on the eastbound off ramp, all turning right or left. This not only requires a long green signal time for the ramp traffic, but creates vehicle storage concerns with the short distances to the adjacent intersections on Carmichael Road. Traffic entering Carmichael Road from a cross street has only a short distance to the next intersection to weave to the desired lane for their next move. The short distances also mean lots of acceleration and deceleration on Carmichael Road.

The high volume of turning traffic creates significant interruptions in the flow of traffic on Carmichael Road. Through traffic on Carmichael Road must wait for cross street traffic to enter or cross Carmichael Road as well as for opposing left turning traffic to make their turn.

Carmichael Road also has a varied number of lanes and some lane inconsistencies, such as for northbound traffic at the eastbound I-94 ramps and Coulee Road.

The City has controlled access for most of Carmichael Road allowing only few “right turn only” private connections between intersections, and no median openings except at intersections. However, some busy cross streets, such as Crest View Drive and Center Road, have intersections only 300 to 400 feet from Carmichael Road, which can interfere with the Carmichael Road intersection operation.

3 Traffic Volumes

As the work plan included no additional traffic counts, it was necessary to use as much existing traffic data as possible. Past studies by potential developers and data from WisDOT studies provided a significant number of traffic counts, although they were from several different years.

Traffic volumes in western Wisconsin have shown varied growth patterns in the past ten years. Travel throughout the Midwest was affected by the recession with many roads showing decreased traffic volumes after 2007.

Traffic counts taken on Carmichael Road south of Crestview Drive showed a daily traffic volume of 13,000 in 2004 and dropped slightly by 2006. The count recorded in 2009 was 16,400 and then dropped to 15,500 in 2010 and 15,100 in 2015. Other count locations in Hudson showed similar variation.

- The 2009 Hudson Comprehensive Transportation Plan provided information showing some inconsistences in traffic count data, which is not unusual in any area. However, some traffic volume trends enabled development of reasonable growth patterns for most streets in Hudson.
- There were several sources of existing traffic data from 2010 to 2017. With the limited traffic growth in recent years, it was felt that the existing data could be used and extrapolated to provide 2017 traffic volumes rather than undertake new counts at a dozen or more intersections and on several streets and highways.
- The WisDOT traffic count program takes counts at many of the same locations every three to five years. Data was generally available for 2015, 2012, and 2009. Hourly count data (mostly for 2015) was obtained from WisDOT, sometimes with directional information. The tabulations also provided factors to convert the raw count data to an assumed Average Annual Daily Traffic Volume for the locations.

- As part of the I-94 interchange Origin/Destination Study done in 2010, WisDOT made a series of traffic counts at many additional locations. Raw count data for locations in the study area was obtained from WisDOT. The data for several locations was collected for a 16-day duration and provided day-of-week fluctuation information and hourly volume information.
- The origin/destination study calculated the paths of some vehicles through the Hudson I-94 corridor by tracking blue tooth devices. The report was previously obtained from WisDOT and reviewed. While the data met statistical significance criteria, it was compared to volumes, turning movement data, and observations, and was used with some caution.
- As part of the review process for the proposed St. Croix Meadows development, turning movement counts were made in spring of 2017 at all intersections from I-94 south to Coulee Trail. The counts were tabulated for 6 to 8 AM and 4 to 6 PM peak periods for weekdays. This data was the base for developing the 2017 traffic volumes used in the Carmichael Road Corridor Study.
- Some traffic data was available from the Traffic Analysis Study done for the Carmichael Ridges proposed development. This study used proposed residential and commercial development and existing traffic volumes to determine the additional traffic volume impact of the development.
- Traffic count data was also obtained from a traffic study made as part of an evaluation of commercial development (Walmart) in the northeast quadrant of the I-94 interchange. Turning movement data was available for several intersections on Carmichael Road.
- SEH made additional traffic counts in August 2017 and May 2018 to clarify traffic volumes from other data.

As part of the Transportation Element for the Hudson Comprehensive Plan Update completed in 2009, SEH made a detailed study of traffic patterns, volumes and growth to evaluate the then existing count data. General information from that study was used to evaluate the collected traffic volume data for the Carmichael Road Study and make adjustments as needed. Table 2 shows traffic volume history in the I-94 corridor. It shows both the overall growth and some inconsistencies in the collected data.

Traffic counting is not an exact science. Tube counts may miss or double count vehicles. Radar or similar counts have some problems with stop and go traffic conditions. Manual counts, especially at busy intersections, will not be completely accurate. Video counts may be more accurate when they are counted in the office, but still have errors. Traffic volumes also fluctuate and counting on different days will provide different numbers.

Each traffic count used in the study was reviewed for accuracy by comparing it to other counts in the area and to previous count data at the same location. Computer traffic modeling and traffic signal coordination programs require continuity of volumes between intersections. Thus, the traffic volume data was adjusted to compensate for possible errors and to provide continuity.

After reviewing, comparing, and adjusting hundreds of traffic counts, a final assumed 2017 volume was created for each intersection in the corridor. The volumes were for the AM and PM peak hours and are balanced for continuity between intersections. The latest traffic volumes are shown in Figure 1.

4 Land Uses for the Study

For the study, the Master Land Use Plan for Hudson, which is based on the existing Comprehensive Plan and updated periodically as changes are made, was used to determine land use and the resulting trip generation. The latest Master Plan update is shown in Figure 2. Traffic volumes are directly related to land use. Knowing the land use of properties will allow projection of trips to and from a site and ultimately determine traffic patterns and volumes in the adjacent area.

Additional traffic on Carmichael Road will come from development of nearby vacant land, redevelopment of properties, and general traffic growth in the surrounding area. Land use of an existing vacant area or redevelopment of an existing parcel is assumed to conform to the city's comprehensive land use plan.

The 2009 Comprehensive Plan divided the City into eight planning districts and provided information on development and/or redevelopment. For the Carmichael Corridor Study, some assumptions needed to be made to provide an accurate traffic forecast. The following paragraphs provide background for the land uses and assumptions.

4.1 North Side District

The land use plan reflects the inplace use and ownership of properties. Grandview Park is improved and unlikely to change. The schools are inplace and enrollment might fluctuate, but not enough to significantly change traffic volumes. The YMCA can grow but not enough to influence traffic. The only variable is the large County owned vacant parcel in the northwest quadrant of the Vine Street intersection.

The St. Croix County Government Center could grow, but not enough to use the entire parcel. The location is not near the center of the county, so there may be more County facility growth in the Baldwin area. St. Croix County could use the land as a park, but they are more focused on regional parks. The county may consider selling the land for other uses, such as commercial, but the comprehensive plan land use and zoning may interfere with that.

Public land use was retained for the study and the traffic forecast considered the parcel a park in the future. A trip generation number for conversion of a portion of the vacant land to commercial could be made later.

4.2 Central District

The Central District is essentially built out except for the Carmichael Ridges Development/ former golf course site. The master plan has been completed for the development and trip generation for both the proposed residential and potential commercial uses were reflected in an Intersection Analysis prepared by the developer's engineer. It included 145 one-family residences and approximately 100-multifamily residences.

The study also included 20 acres of commercial development that assumed a large grocery store and a fuel/convenience store. With the development of the Family Fresh and Target grocery stores in front of the Carmichael Ridges commercial development, another grocery store is not likely. Similarly, a convenience store would have competition from locations with better access. The suggested commercial development in the Carmichael Ridges development was used in the

study, including the grocery store, convenience stores, 90-room hotel, two restaurants, 15,000 square feet of office space, and 57,000 square feet of retail space.

The only other changes in traffic generation in the Central District could result from some changes in land use along Coulee Road. These would result in relatively minor adjustments in trip numbers in the Carmichael Corridor.

4.3 Carmichael District

With the master plan in place for St. Croix Meadows, the largest developable land area in this district has specific land uses to which traffic generation can be assigned. The developer provided a traffic study of the development which ultimately included an accurate estimate of trip generation and distribution for the site.

The St. Croix Meadows development was divided into 4 stages, with three to be completed by 2025. The trip generation tables in this report provide details of the included development.

The second largest developable land area was the former WisDOT rest area, which has been partially developed. Trips generated from properties in this land area that were developed and opened before January 1, 2017 are included in latest traffic counts. Properties opened after that date had trip generation forecasts as part of background growth.

There are few other parcels yet to be developed (along Pearson Drive and Industrial Street) and trip generation was covered by background traffic growth Some redevelopment in the area might take place, but it would be difficult to accurately estimate feature uses, and the trip generation changes would be relatively small.

4.4 Southeast District

This area is largely residential and almost fully developed. The only remaining parcels are a large parcel (not in the city) south of County Road N west of Highway 35 and parcels on the cul-de-sac of Old Highway 35 north of County Road N. The former is likely to be zoned multi-family when annexed to the city and the latter will be general commercial. These parcels have little impact on future Carmichael Road traffic volumes.

4.5 Industrial District

This industrial area is about 90 percent developed and the remaining areas will also be industrial in nature. Trip generation and distribution would be based on general rates and measured size of the parcels, but it is likely that much of the I-94 oriented traffic will use the Hanley Road/Highway 35 interchange and have little impact on Carmichael Road.

4.6 Extraterritorial Area 1

The area north east of the Carmichael Road/I-94 interchange is in the Town of Hudson and currently consists of semi-rural/ex-urban single family residential land uses. The area closest to I-94 has been considered for redevelopment to commercial use. A traffic study for a potential Walmart super store was completed several years ago.

Development of commercial uses in this area would significantly impact the Carmichael Corridor. Since it is an existing residential area outside the City of Hudson, it would be difficult for the city to project other land uses for the Carmichael Road Corridor study. However, intense

development would be difficult without extension of City of Hudson utilities, so the city has some control.

The 2030 Comprehensive Plan Master Plan has assigned land uses to an area extending approximately 1,200 feet east of Carmichael Road from I-94 to Vine Street, and the area southwest of the Vine Street/Carmichael Road intersection not in the City. The uses include general commercial south of Deer Haven Drive, and a mix of uses north to Vine Street. These land uses were incorporated into the Carmichael Road Corridor study in three separate areas.

For the corridor study, ETA-1 was divided into three subareas as shown on Figure 3.

Area ETA -1a, west of Carmichael Road, was assumed to have 28 acres of single family homes (2.5 du/acre), 22 acres of medium density homes (10 du/acre) and 11 acres of commercial. This development was assumed to occur between 2025 and 2040.

Area ETA -1b, east of Carmichael Road and north of Deer Haven Drive, was assumed to have 34 acres of single-family homes, 10 acres of medium density homes, and 10 acres of general retail. This development was assumed to occur between 2025 and 2040.

Area ETA-1c, east of Carmichael Road and south of Deer Haven Drive, had two scenarios; residential and commercial (Walmart). The residential scenario had 18 acres of single family homes developed by 2025. The commercial scenario had the Walmart store as proposed in 2011 and was assumed to be developed after 2025.

4.7 Extraterritorial Areas 2, 3 and 5

Areas 2 and 3 are along Highway 12 in the Town of Hudson and will have minor impact on traffic in the Carmichael Corridor. Area 5 is southeast of Hudson along Highway 35 and will have little impact on Carmichael Drive.

4.8 Extraterritorial Area 4

This area is south of Hudson in the Town of Troy along County Road F and Coulee Trail. It is a mix of large lot single family residential, agricultural, and some commercial. Traffic generated in this area will have some direct impact on Carmichael Road.

For the study, it was assumed that most of the agricultural land east of County Road F, south to South Fork Road will be replaced by two-acre single family lots. The traffic from the residential development is reflected in background traffic growth.

4.9 Other Areas

There are other areas that could impact Carmichael Road traffic volumes. Residential growth in the Town of Hudson may be the origin of trips to destinations along the Carmichael Road corridor. However, many of the trips to access I-94 will have better access by using the Highway 12 interchange. Even trips from north of Hudson to Carmichael Road destinations south of I-94 may find it more convenient to use the Highway 12 interchange and then Exit I-94 at Carmichael Road or even use I-94 and Highway 35 to use the Hanley Road interchange.

Often this increase in traffic is covered by a universal annual percent growth uniformly applied to all locations and is called background traffic growth. For the Carmichael Road Corridor study, variable rates were applied at distinct locations to better reflect area growth potential.

5 Trip Generation

Trip generation from undeveloped property is generally determined by proposed land use. The primary reference source for this is the Trip Generation Manual published by the Institute of Transportation Engineers (Trip Manual). This collection and tabulation of studies of trips generated by different land uses provides daily, peak hour, and weekend trip numbers by direction for many land use types.

New trips for St. Croix Meadows, Carmichael Ridge, and Walmart were obtained from the existing studies prepared by the developers using the Trip Manual and reviewed by the city. Trips for the ETA areas, except Walmart, were calculated from data in the Trip Manual.

The calculations were adjusted for internal trips and pass-by trips consistent with the Trip Manual and local development. Internal trips are those which have both the origin and destination of the trip in the same development. For example, a resident of Carmichael Ridge may leave home, travel to the proposed on-site grocery store, stop at the gas station and return home, never reaching an arterial street. All six trip ends (home to grocery, grocery to gas station, and gas station to home) are internal trips. These trips are deducted from the trips from the development to Carmichael Road.

Pass-by trips are those which are diverted from existing traffic already on the adjacent street. A motorist normally traveling on Carmichael Road who stops at a new store as part of an existing trip is not added traffic to Carmichael Road. But that diverted movement is still part of the inbound and outbound traffic for the development. The trip is counted with the traffic generated by the site and using the access but is not added to the new traffic on Carmichael Road.

Directional distribution of the new trips was determined from several sources. Land uses have traffic patterns related to trip type. Census data helps determine employment trip distribution and was used in the 2009 Comprehensive Transportation Plan. Residential density helps determine commercial trip distribution. Recreational uses vary by type of spectators and audiences.

The WisDOT origin/destination study provided good information for both existing and new trips. Competition for commercial and entertainment land uses influences distribution of trips. The detailed study of existing traffic volumes also gave insight to travel patterns.

- Figure 4 shows AM peak hour trip generation calculations for all the development sites in the study corridor.
- Figure 5 shows PM peak hour trip generation calculations for all the development sites in the study corridor.
- Figure 6 Illustrates the directional distributions for the trips generated from the Carmichael Ridge site.
- Figure 7 Illustrates the directional distributions for the trips generated from St. Croix Meadows.
- Figure 8 Illustrates the directional distributions for the trips generated from ETA-1a.
- Figure 9 Illustrates the directional distributions for the trips generated from ETA-1b.
- Figure 10 Illustrates the directional distributions for the trips generated from ETA-1c.

6 Study Scenarios

Based on the potential and proposed land uses in the Corridor, and timetables suggested by the developers, the following scenarios were initially proposed to be analyzed in this study.

- Existing year 2017:
  - The conditions existing in 2017
- Interim Year 2025 No-Build:
  - Existing I-94/Carmichael Road interchange remains
  - Carmichael Ridges is fully developed
  - St. Croix Meadows Stage 1, 2, and 3 are completed
  - External Areas 1a and 1b are not developed
  - External Area 1c is developed with the single-family home scenario
- Interim Year 2025 Build Scenario:
  - Same land uses as the No-Build scenario
  - The existing I-94/Carmichael Road interchange is replaced by the preferred alternate from the WisDOT study.
- Design Year 2040 Scenario:
  - The existing I-94/Carmichael Road interchange is replaced by the preferred alternate from the WisDOT study.
  - Carmichael Ridges and St. Croix Meadows Stages 1-4 are fully developed
  - External Areas 1a and 1b are developed
  - External Area 1c is developed with the single-family home scenario
- Design Year 2040 Walmart Scenario:
  - Same as design Year 2040 except the Walmart scenario is substituted for the single-family homes scenario in ETA-1c.

The Interim year 2025 build scenario was run and analyzed first. The scenario had numerous problems with delays, queue lengths, and levels of service even with the preferred interchange alternate. After numerous adjustments to the interchange design and improvements to other locations, some operational concerns remained. It was determined that the 2025 no-build scenario with the anticipated development would not function and no analysis was made for the output data.

For the same reason, a 2040 no-build scenario was not included in the study.

7 Development of Traffic Forecasts

The forecasted traffic volumes for the different scenarios are the product of several sources. The assumed 2017 intersection traffic volumes are the base for the forecasts. As discussed previously, these are the product of analyses of hundreds of individual traffic counts and are balanced between intersections. These are shown for each intersection in Figure 11.

The growth in background traffic assumes some traffic increases will occur from areas outside the study area, some site redevelopment, infill of vacant sites, and changes in traffic patterns. The background growth rates for Carmichael Road and several cross streets were developed based on current and anticipated land uses in the area, use of alternate routes, local knowledge

of traffic patterns, travel time, development potential, past experience with similar areas, and engineering judgement. Figure 12 illustrates the annual growth rates on the various segments and cross streets.

The traffic forecasts were prepared by combining the existing traffic volumes (assumed 2017), the background traffic growth, and new trips from the several developments and areas. Traffic volumes were prepared for the two scenarios in the Build Year 2040 and the two scenarios in the Interim Year 2025.

- Figure 13 illustrates the 2040 peak hour turning movements assuming single family homes for the ETA-1c and the preferred alternate interchange at I-94.
- Figure 14 illustrates the 2040 peak hour turning movements assuming a Walmart store for the ETA-1c and the preferred alternate interchange at I-94.
- Figure 15 illustrates the 2025 No-Build peak hour turning movements assuming the preferred alternate interchange at I-94 is not built
- Figure 16 illustrates the 2025 Build peak hour turning movements assuming the preferred alternate interchange at I-94 is built

The daily traffic volumes on Carmichael Road were established based on the existing peak hour/daily ratios and forecasted peak hour traffic forecasts at the same location.

8 System Operations Analysis

8.1 General

Traffic volumes for 2025 and 2040 were used to determine the capacity and traffic flow in the corridor. Synchro/SimTraffic Planning and Analysis Software program (Synchro/SimTraffic) was used to both simulate the flow of traffic and provide a significant volume of data related to traffic delays, queues, backup, blocked lanes, and level of service. Both components are critical to evaluation of the system and opportunities for improvement.

8.2 Levels of Service

The simulation program is based on Level of Service (LOS) from the Highway Capacity Manual. It is a method of grading the general operation of an intersection. The range is from A to F, with F as the worst. In general terms, the grades and operation for a signalized intersection are as follows:

- LOS A: Free flow with virtually no delay. This is seldom achieved.
- LOS B: Flow with slight delays, generally less than 20 seconds.
- LOS C: Some delays, generally less than 30 seconds and very tolerable for motorists.
- LOS D: Normal delays of 35 to 55 seconds. These delays are often accepted by motorists if there is heavy traffic on the crossing street. Occasionally, some motorists may not clear the intersection on the first signal cycle. This LOS is considered acceptable during rush hour times.
- LOS E: Delays are 55 to 80 seconds and generally intolerable to motorists.
- LOS F: This is a forced flow situation. Motorists often are waiting through more than one signal cycle and are prone to force their way through the intersection, often entering after expiration of the yellow clearance phase.

A LOS grade can be given to an intersection, based on overall operation. While this can be useful in some studies comparing intersections, a LOS B intersection may have an approach with delays that would rate a LOS rating of F. Additionally, LOS ratings can be calculated for each approach to an intersection, and for each movement in the approach, such as right or left turns. For the Carmichael Road Corridor, LOS for all movements was calculated and used for evaluation and improvement.

The grades are clear for an isolated intersection. They become more complex when there are several intersections in close proximity. Motorists traveling through several intersections may find the 30 second delays giving LOS C for their direction unacceptable if they stop and wait at each signal. Developing a coordinated signal system to provide a green light to motorists on the main street will reduce delays for main street motorists and improve traffic flow in the corridor, despite generally increasing delay for cross street motorists.

Conversely, a motorist waiting 60 to 80 seconds on a cross street at a very busy highway with continual traffic may accept the delay as justified, especially if the motorist enters the main street and benefits from uninterrupted flow through other intersections. Minnesota Highway 36 from the St. Croix River to I-694 is a good example of this.

8.3 Traffic Signal Coordination

Traffic signal coordination is often used where there are several signalized intersections in a row. The concept is simple; a vehicle leaving a green light at one intersection will receive a green light upon arrival at the next intersection. This is based on the time it would take to reach that intersection traveling at a reasonable legal speed. The timing of the traffic signals is coordinated to start the green light at a specific time after the start of the green light at the previous intersection. That concept can be extended for several intersections.

- The concept is simple for a one way street, but becomes more complex trying to coordinate traffic in both directions. If the intersections are spaced so that queues of traffic in both directions pass through the several intersections at the same time, it is easy to set up. With irregularly spaced intersections, the system setup becomes more complex.
- Another complicating element is traffic entering the main street from a cross street. The queue of traffic must be accounted for, so it is not stopped at the next intersection preventing the main street queue of traffic from passing through the intersection at the proper time.
- A similar complication occurs when there is a large volume of left turning traffic at an intersection. The left turns will hold up the opposite through traffic, creating another problem for moving a queue of traffic through the intersection.
- Finally, fluctuations of traffic and changes in traffic patterns during the day will require different time settings for movements at intersections.

Carmichael Road has every complicating element present. Intersections are closely spaced. There is a significant volume of turning traffic at many intersections. Many trips on Carmichael Road are short. Fluctuations in traffic often occur.

The simulation program used in the study developed a coordinated system from Hanley Road to Hillcrest Road.

8.4 Simulation Program

The Carmichael Corridor Study used the Synchro/SimTraffic software program to analyze the traffic. The program not only provided calculations for LOS, but calculated delays and queue length of backup for each movement in each approach to an intersection. The results provided in the printout would flag (color coded) any LOS D, E, or F. The print out also flagged and provided information whenever an average or maximum queue length exceeded the available storage length for that movement, as well as when traffic queued in a lane blocked traffic from reaching another lane. Figures 17A and B are example printouts showing 2025 forecast volumes with the preferred alternate build scenario.

The visual simulation was valuable in spotting potential reasons for a poor LOS. The relationship between intersections is easier to understand with simulations. Weaving traffic between intersections can be seen in the simulations, but it is not available on a printout.

The program also provides a method to test ideas for improvements. A turn lane can be lengthened to increase storage or eliminate a blockage and the results can be seen and calculations changed. However, it does take some time to make the changes and see all the changes in the results.

8.5 The Preferred I-94/Carmichael Road interchange

WisDOT studied the I-94 Corridor in St. Croix County in 2012, with special emphasis on the Carmichael interchange. At that time, there were no plans to redevelop the golf course and no active plan for the dog racing track. Reasonable background traffic growth was anticipated and used for traffic forecasts. After considering a number of interchange concepts and conferring with the City, WisDOT selected a partial cloverleaf interchange as the Preferred Alternate (See Figure 18). This alternate provided the capacity to handle the forecasted traffic.

Eastbound traffic destined to the north at Carmichael Road was removed from the ramp and placed on a loop on the eastside of Carmichael Road. Instead of sharing the ramp with southbound destined traffic it had a separate loop with a right turn only intersection at Carmichael Road. The remaining ramp traffic (eastbound to southbound) also had a right turn only intersection on Carmichael Road across the median from the loop intersection. A loop was also provided for northbound Carmichael Road traffic destined for westbound I-94. The southbound to westbound on-ramp connection to Carmichael Road was retained. These changes eliminated two busy left turns from the interchange area.

The on ramp to eastbound I-94 was moved from its location opposite the existing eastbound off ramp to the Crest View Drive intersection. The connection to Stageline Drive, which was opposite Crest View Drive, was moved to the Center Drive intersection. The westbound off ramp, which was opposite the westbound on ramp, was moved to the Coulee Road intersection. The frontage road was moved from Coulee Road to Hillcrest Drive.

These several changes reduced the number of left turns on Carmichael Road, provided more distance between the intersections, and moved some traffic out of the present four core intersections.

9 Traffic Operations: 2025 Analysis

9.1 General

The traffic forecast for 2025 and the “Build” interchange concept were analyzed using Synchro/SimTraffic software. As previously mentioned, the 2025 “No Build” scenario was determined to have unacceptable levels of service in a previous study and was not analyzed.

The 2025 turning movement volumes (Figure 16) were the basis of this analysis. The Preferred Concept interchange at I-94 was used as the 2025 road system. Lanes, turn lane lengths, tapers, and other geometric features were taken from the interchange drawing recognizing that it was just a concept and that dimensions were generalized. Outside of the preferred interchange concept, the inplace geometrics of each intersection were used.

9.2 Results of 2025 Traffic and Preferred Interchange Build Scenario

The first run of the program with 2025 forecast PM Peak Period traffic and the preferred interchange build scenario produced several Levels of Service of E or F. The first run also showed three average and several maximum queue lengths that exceeded lane storage lengths. Each intersection was reviewed in detail and potential changes to improve LOS and storage were developed.

When the program was rerun with the several adjustments made to the intersection geometrics, the six LOS F movements had been eliminated and the number of LOS E reduced from five to three. The results of the analysis at each of the intersections follows.

The changes suggested to the preferred interchange concept are only to meet the needs of 2025 forecasted traffic. Section 9.2 makes further recommendations for changes needed to accommodate 2040 forecasted traffic.

Vine Street: Southbound Carmichael Road had a LOS F for both through and left turn traffic. The problem is the lack of a southbound left turn lane. Widening Carmichael Road north of Vine Street to provide a 280-foot left turn lane and a 250 foot right turn lane improved the southbound operation to LOS D. The widening will need to be made on both sides of Carmichael Road to maintain the northbound right turn lane to the commercial development.

The east bound right turn lane was extended to 200 feet to eliminate right turn blockage.

Hillcrest Road: The initial analysis had minimum intersection improvements of just adding northbound and southbound left turn lanes. The Carmichael Ridge Development review indicated that a larger intersection would be needed for full build out of the development. The new intersection would have two northbound and two southbound through lanes, dual northbound, southbound and eastbound left turn lanes, and single eastbound and westbound through lanes. Westbound dual left turn lanes were shown, but not needed with the residential development scenario.

Eastbound dual left turn lanes are needed primarily for storage during red light phases, but will also reduce “red light time” on Carmichael Road. The same is true for the northbound dual left turn lanes.

The length of all turn lanes is consistent with the recommendations in the review. These changes raised LOS on all approaches to LOS D or better.

When Hillcrest Road was built, the design of the westbound roadway meets future needs and the eastbound roadway only needs to be widened to the south. See the Carmichael Ridge files for more detailed information and sketches of the future planned intersection.

Walgreens: The intersection was analyzed as a right-in/right-out only intersection, with no median island opening. A review of the safety and operation was made, and a northbound left turn could be provided for access to the west side. The median opening would need to be designed to prevent eastbound left turns. There would be left turn delays on Carmichael Road as a traffic signal would be too close to Hillcrest Road and Coulee Road signalized intersections.

Coulee Road/Westbound Off-Ramp: The initial analysis had problems with southbound and eastbound right turns and westbound delays and backups.

The southbound right turn lane was extended to 325 feet to eliminate blockage of the right turns by through traffic. This was done with pavement markings as there is existing width available and some drivers are already treating the extra width as a longer turn lane.

The eastbound lanes as shown in the concept drawing for the interchange had the two lanes of Coulee Road become dual left turn lanes and a right turn lane was added close to the intersection. The concept was changed in the reanalysis to lengthen the right turn lane.

The westbound approach (ramp) had backup queues that exceeded the shown turn lane lengths. As this did not affect the operation of the intersection, only the left turn lane was lengthened to eliminate a queuing problem.

The northbound right turn was assumed to be free flow in the analysis even though the concept drawing had it as part of the intersection.

Westbound On-Ramp Intersection from Southbound Carmichael Road: A southbound right turn lane to the ramp was added to the concept design and used in both the initial and second analyses. The turn lane reduces deceleration conflicts and removes turning traffic from the through lane earlier.

Eastbound Off-Ramp: Removing the left turning traffic from the ramp by providing a loop on the east side of Carmichael Road reduced the ramp traffic by a third. However, that still left 1,360 vehicles on the ramp turning right onto southbound Carmichael Road. The loop had a 2025 volume of 650 vehicles going north.

The origin-destination study in 2011 estimated 21 percent of the eastbound ramp traffic would turn right onto Crest View Drive from Carmichael Road. This may be low depending on the location of the origin-destination detection on Crest View Drive. It is assumed to have been east of Gateway Blvd. If not at Carmichael Road, it would not include ramp traffic destined to McDonalds or Kwik Trip which generate about 6,000 to 7,000 trip ends per day.

With a PM peak hour volume of 1360 vehicles, the average queue length on the ramp is 300 feet and the maximum queue length is about 500 feet, or about 22 vehicles.

Crest View Drive: The existing intersection is congested and needs three eastbound left turn lanes to accommodate the left turn volume. The preferred interchange design moves the

eastbound I-94 on ramp to this location eliminating the need for one eastbound left turn lane. The simulation showed satisfactory operation of the intersection.

The new intersection design has two left turn lanes, one through lane, and one combined through/right turn lane on the eastbound approach. There is concern that the combined lane will not operate satisfactorily, with thru traffic blocking right turning traffic. Two options were considered: making the right lane right turn only and adding a separate right turn lane. The second option is preferred as it would provide better eastbound vehicle storage and less opportunity for blockage of either the right or left turn lanes.

A minor adjustment was to lengthen the northbound right turn lane by decreasing the taper. This will provide more right turn lane access (less blockage).

Center Drive: The character of the intersection and the traffic on Center Drive changed significantly with the connection of Stageline Drive to Center Drive. The cross street and southbound left turn signal timing have increased creating longer delays and bigger queues of traffic on Carmichael Road. The southbound left turn has two lanes in the preferred alternate to accommodate the increased volume.

The northbound right turn lane is blocked by northbound through traffic about 1/3 of the time. Lengthening the right turn lane may decrease that, but construction may be difficult with pipe lines and ponds.

The northbound left turn is also blocked by through traffic on occasion and southbound queues of traffic occasionally get long. Options are to lengthen the northbound left turn lane or to narrow the median and provide two left turn lanes, which would mirror the proposed two southbound left turn lanes. A second, westbound receiving lane on Center Drive west of Carmichael Road would be necessary and some physical reconstruction would be needed. Center Drive has two westbound lanes at Gateway Blvd and a taper from Carmichael Road, so the length of widening may be about 200 feet.

Hanley Road: The character of the intersection will change with the added traffic from St. Croix Meadows. The conflict between the heavy southbound left turn and increased northbound traffic will create delays. The only low LOSs are for Hanley Road. Currently, eastbound Hanley Road has a single thru lane and left and right turn lanes while westbound Hanley Road just has a single thru lane and a dedicated right turn lane.

The addition of a westbound left turn lane reduces westbound delays and provides a satisfactory LOS. The left turn lane will be provided by changing the pavement markings as part of the 2018 Hanley Road resurfacing project. Lane markings west of Carmichael Road should also be reviewed and modified as needed to increase capacity, safety and motorist direction.

Left turn (protected/permissive) phases for eastbound and westbound left turns should also be added to the traffic signal to make the Hanley Road phases more efficient.

Other Carmichael Road Intersections: Mayer Road is a tee intersection with few conflicts. Only the eastbound left turn has any appreciable delay but still meets LOS D. The left turn volume is small (35) and the delays are about 30 seconds.

The Riverview Drive intersection will be connected to the St. Croix Meadows development and will be adequately controlled with stop signs with anticipated 2025 traffic volumes. Delays to

westbound Riverview Drive traffic will be less with stop signs at Carmichael Road than with a traffic signal. A high LOS D is anticipated for Riverview traffic and LOS A for Carmichael Road.

The proposed new south access to St. Croix Meadows will operate at LOS B with no problems.

The intersections of the ramps with Albert St will operate at LOS A.

Intersections north of Vine Street will have some additional traffic, but the volume increase will be relatively small. The area northeast of the City of Hudson is expected to become more residential, but there will be good access to County Road A and Highway 12. With congestion along Carmichael Road, use of Exit 4 on I-94 is likely to be favored by many drivers from any new developments.

The intersection of Burr Oak Drive/School Entrance and Carmichael Road has all way stop Control, primarily needed for school traffic (vehicles and pedestrian). There are no turn lanes on Carmichael Road at the intersection. Some delays do occur. While turn lanes might reduce vehicle delays, they would introduce more conflicts especially with pedestrians. The current control and design should be retained except for crosswalk recommendations made in Section 12.

The intersection of Oak Ridge Circle/Middle School and Carmichael Road has stop signs only on the cross street and operates satisfactorily.

A comment from the public expressed concerns about the operation of parent drop off and pick up and general traffic circulation at the school. This is off Carmichael Road and under the control of the school district and therefore not part of the Corridor Study.

The St. Croix County Government Center entrances, parking lots and traffic circulation patterns were studied in detail and a revised system was constructed in 2017 creating a much safer and more efficient traffic system. It appears to be working well and should continue to do so in the future.

The recommendations for the Vine Street and Carmichael Road intersection will influence the operation of the shopping center entrance, Grandview Community Park entrance, and the two St. Croix County Government Center entrances.

Crest View Drive and Gateway Boulevard: This intersection was not in the simulation program but will be part of the final coordinated signal system and was evaluated for operation in 2025. The current signal phasing and turn lane arrangement on Gateway Boulevard does create efficiency problems for the intersection. The signal should be coordinated so westbound backup does not impact the adjacent Carmichael Road intersection.

Increasing development on Gateway Boulevard and Badger Drive has created more southbound traffic, especially left turning traffic, at the intersection with Crest View Drive. Currently, a southbound left turn lane and a combined through/right turn lane are in-place. For northbound traffic, south of Crest View Drive, the highest volume appears to be turning right and a separate right turn lane is provided for this traffic. Northbound Gateway Boulevard also has a combined left turn/through lane approaching Crest View Drive.

Southbound left turning traffic often extends past the Kwik Trip driveway. Once this southbound traffic turns left, drivers must then select the proper lane to approach Carmichael Road as there are four eastbound lanes to choose from. A southbound left turn phase in the traffic signal cycle

would allow southbound traffic to turn without having to find a gap in northbound traffic and may also reduce conflicts with northbound right turning traffic. It would also make selection of the proper eastbound lane easier.

Northbound left turning traffic shares a lane with through traffic. The separate right turn lane carries the higher volume and should be retained. Northbound right turns made on a red light after stopping also allows right turning traffic to use gaps in eastbound traffic, reducing the “green time” needed for this movement. It also reduces the volume of conflicts with the southbound left turn traffic.

There are two lanes traveling away from the intersection in both the northbound and southbound directions. The two northbound lanes are marked only as far as the Kwik Trip driveways. The two southbound lanes continue to the Menards parking lot. The main benefit of having the two through lanes is to provide room to bypass vehicles that are turning right or left. The two lanes are not needed for capacity.

To provide a separate northbound left turn signal phase, it would be possible to develop a third northbound lane approaching Curve Crest Drive by converting the left southbound through lane into a northbound left turn lane. That would provide separate northbound left turn, through and right turn lanes. This would also provide southbound left turn drivers with a better view of oncoming through traffic as the left turn lanes would then be lined up opening a clearer view to northbound through traffic, which is in their own lane.

The lane markings could be adjusted on all of Gateway Boulevard and on Badger Drive to reflect the intersection changes and turning lane needs further north and south.

10 System Operation, 2040

10.1 General

The traffic forecast for 2040 and the “Build” interchange concept were also analyzed using Synchro/SimTraffic software. Since the “No Build” scenario had unacceptable levels of service for 2025 traffic volumes, it was not used with 2040 volumes.

The 2040 turning movement volumes (Figure 13) were the basis of this analysis. The northeast quadrant “residential” scenario volumes were used. The “Walmart” scenario was tested, but the system could not provide adequate capacity. The Preferred Concept interchange at I-94 was used as part of the 2040 road system. All the changes made to the Hudson street system and Preferred Interchange for 2025 were retained for the 2040 analysis. These included turn lanes and lengths, added lanes, geometric changes, and signal operations.

10.2 Results of 2040 Traffic and Preferred Interchange Build Scenario

The first run of the program with 2040 forecast PM Peak Period and the preferred interchange produced several Levels of Service E or F. While some intersection modifications were made to improve the levels of service at specific intersections, the area at I-94 remained a bottleneck with unacceptable levels of service. While intersections such as Vine Street could be reconstructed to achieve an acceptable level of service, traffic flowing south from Vine Street would still face LOS F in the interchange.

A major problem was the high volume of traffic on the eastbound off ramps. While the loop for eastbound to northbound traffic provided a partial solution, the ramp for eastbound to southbound traffic had long delays and backup, and traffic then faced delays and backups at the Crest View Drive intersection. Even diverting 30 percent of the right turning traffic could not raise the LOS to acceptable levels.

WisDOT reviewed the preliminary numbers and chose to revisit the interchange design. The Carmichael Road Corridor Study did not include intersection redesign in the work plan. A cooperative effort between the WisDOT consultant (SRF) and SEH resulted in a final, more detailed concept that provided a generally adequate capacity model.

Each intersection was reviewed and detail and potential changes to improve LOS and storage were developed.

Vine Street: With much of the development in the 2025 to 2040 time frame occurring in the Vine Street area, significant changes are needed for the Carmichael Road and Vine Street intersection. Additional northbound and southbound through lanes are needed.

The approaches north and south of the intersection would both have two through lanes, right and left turn lanes, and a median island. The southbound left turn lane should extend north with a short taper in the median just south of the shopping center entrance. The southbound right turn lane should be 250 feet long. The northbound left turn ideally would be 350 feet long, but will need to be balanced by need with a southbound left turn lane to Faith Community Church to the south.

Single through lanes on Vine Street are adequate. Right and left turn lanes are needed. The westbound left turn lane should allow a short eastbound left turn lane to the shopping center. The eastbound right turn lane of 200 feet (from 2025 recommendations) will be adequate.

Hillcrest Road: The intersection developed for the 2025 traffic volumes will be adequate for 2040. The westbound approach will be adequate for the residential development scenario.

Walgreens: The intersection developed for the 2025 traffic volumes will be adequate for 2040. The simulation was run with a closed median creating a right-in and right-out condition at the entrance. It would be possible to provide a northbound left turn lane to permit this movement. A traffic signal at this location would not fit into the system. A street connection from the south side of Walgreens to the street serving the proposed Carmichael Ridge commercial development should be provided.

Coulee Road: Using the 2025 intersection for 2040 traffic resulted in unacceptable LOS. A third southbound lane starting at Walgreens and an added 200 foot right turn lane improved the LOS to acceptable levels. The third southbound lane was also needed south of Coulee Road.

The eastbound lanes as shown in the concept drawing for the interchange had the two lanes of Coulee Road become dual left turn lanes and a right turn lane was added close to the intersection. The concept was changed in the reanalysis to lengthen the right turn lane. For 2040, a 300-foot turn lane was used to assure the right turn traffic would not be blocked by left turning traffic. A concept of adding a left turn lane instead of a right turn lane resulted in poorer model operation.

The westbound approach (ramp) had backup queues that exceeded the shown turn lane lengths. As this did not affect the operation of the intersection, only the left turn lane was lengthened to

eliminate a queuing problem. In the final design, the length of the widening for turn lanes on the ramp will need to be developed.

The northbound right turn to the loop ramp was assumed to be free flow in the analysis even though the concept drawing had it as part of the intersection. A large radius creating a loop rather than a turn would provide better operation.

Westbound On-Ramp: While the intersection operation was satisfactory, backups occurred in the simulation. This was corrected by providing an additional southbound lane from Coulee Road to the On-Ramp that was designated as a right turn lane. This better distributed the traffic over the three southbound through lanes.

Eastbound Off-Ramp: This had been the problem intersection throughout the modeling process. The ramp and intersection must accommodate 1625 vehicles on the off ramp in the PM peak hour. A second problem involved significant weaving volumes in the southbound lanes between Coulee Road and Center Road. Numerous adjustments were reviewed before a combination of changes resulted in satisfactory operation.

The ramp currently has two left turn and two right turn lanes at the intersection. The preferred alternative retains the two right turn lanes and develops a loop ramp east of Carmichael Road to replace the current left turns. This eliminates a high volume of left turning vehicles and reduces the current ramp volume. But the growth in traffic resulted in long backups on the ramp.

The final proposed interchange has a three lane off ramp with the added right turn lane becoming an added lane on Carmichael Road and a dedicated right turn lane to Crest View Drive. To reduce lane blocking and weaving, the two southbound left turn lanes at Crest View Drive were extended north through the ramp intersection. This eliminated many weaves south of the ramp, better balanced lane use at the ramp intersection, and essentially increased available lanes and storage for ramp traffic entering Carmichael Road.

For this combination of lanes to be successful, overhead lane assignments on the ramp are needed. The right ramp lane should be for “Crest View Drive Only”. This lane will carry about 25 percent of the ramp traffic. This lane designation will also reduce weaves and merges on Carmichael Road.

The loop ramp for eastbound to northbound traffic does have some delays to ramp traffic, but backups are contained on the ramp. The eastbound to southbound ramp which had backup concerns with the preferred alternative now has an estimated maximum backup of 500 feet with ramp storage of over 1,200 feet.

Crest View Drive: The existing intersection is congested and needs three eastbound left turn lanes to accommodate the left turn volume. The preferred interchange design moves the eastbound I-94 on ramp to this location eliminating the need for one eastbound left turn lane. The 2040 simulation showed mostly satisfactory operation of the intersection.

The new intersection design for the eastbound approach has two left turn lanes, one through lane, and one combined through/right turn lane. The combined lane will not operate satisfactorily, with thru traffic (270 PM peak hour vehicles) potentially blocking right turning traffic (350 vehicles). Adding a separate right turn lane and retaining two through lanes would provide better eastbound vehicle storage, less opportunity for blockage of the right turn lane, and allow maximum use of a phase overlap and right turn on red light movements by right turning vehicles.

One remaining concern is the short distance to the entrance to McDonalds and Kwik Trip on Crest View Drive. As part of the new interchange construction, the north curb line and entrance could be revised to better define the southbound to westbound path and the beginning of a short turn lane to the entrance.

Center Drive: The suggested changes to the preferred alternative for the 2025 volumes will be needed to accommodate the 2040 volumes. The dual northbound left turn lanes will reduce time for the left turn phase and reduce potential blockage of the lane on Carmichael Road by through traffic. Extending the northbound right turn lane is less important but would reduce or eliminate lane blockage.

Hanley Road: The only low LOS approaches are on Hanley Road. Adding left turn phases for turns from Hanley Road will reduce the delays.

Left turns are the biggest concern at the intersection. The southbound left turn lane should be lengthened to 325 feet. A westbound left turn lane was just added as part of the Hanley Road construction project. Lane markings on Hanley Road from Carmichael Road to Foxglove Way should be redone to provide better lane definition, more turn lane storage, and more efficient operation. Some widening in short areas may be needed.

Crest View Drive and Gateway Boulevard: This intersection is not in the simulation program, but will be coordinated with the Carmichael Road signal system. There were a number of suggestions made for lane arrangements and turn phases in the 2025 analysis. The 2040 analysis shows the importance of making these modifications. They are:

- Revise lane markings on the northbound approach to provide a left turn lane, right turn lane and a through lane
- Add a southbound right turn lane.
- Retain the southbound left turn lane and mark the current through/right turn lane as a through lane.
- Modify the traffic signal to provide northbound and southbound left turn phases. This will require new signal heads, poles, detection, controller, and cables. The northbound and southbound left turn phases should be protected/permissive with flashing yellow arrows.
- Modify the pavement markings on Gateway Boulevard between Crest View Drive and Center Drive to have a single through lane in each direction and a center two way left turn lane, with dedicated left turn lanes at intersections.
- Extend the pavement markings north of Crest View Drive to provide a single northbound lane and develop left turn lanes where possible.

These changes will improve the efficiency of movements to and from Gateway Boulevard which is needed so maximum “green time” can be provided to westbound traffic reducing the potential for backed up traffic from Gateway Boulevard from interfering with flow of traffic on Carmichael Road.

Other Intersections: Intersections at Albert St, Mayer Road, Riverview Drive, and the south entrance to St. Croix Meadows should be adequate with the 2025 scenario comments. A revised Traffic Impact Study for changes in the St. Croix Meadows site plan and land uses may identify additional concerns if traffic volumes or distribution change. The eastbound left turn from Mayer Road to Carmichael Road had some lengthy delays in the 2040 model, but the traffic queues from the proposed traffic signal at Riverview Drive were beneficial.

Intersections north of Vine Street will continue to operate satisfactorily as described in Section 9. However, the recommended final design of the Vine Street/Carmichael Road intersection will affect the operation of entrances from Oakridge Circle to Vine Street. The southbound left turn lane at Vine Street will extend almost to the Shopping Center Entrance and the existing southbound left turn lane to the shopping center is to be retained. Between Vine Street and Oakridge Circle, the cross section of Carmichael Road must change from two lanes in each direction with left and right turn lanes at Vine Street to a single lane in each direction.

A suggested concept is to continue the two northbound lanes and raised median north past the entrance and then merge the two lanes to a single lane. The design can use the full raised median width to provide a center left turn lane to the south Government Center entrance. Because of the off-set location of the Grandview Park entrance/exit, the center turn lane would need to be a Two Way Left Turn Lane (TWLTL) for a short distance. Continue the TWLTL to the south Government Center Entrance and then create a southbound left turn lane in place of the TWLTL, transitioning to a left turn lane to the north Government Center entrance. It could then transition back to the two lane roadway. A short northbound right turn lane could be provided at the Grandview Park entrance.

In the southbound direction, the painted center island could be started south of the crosswalk south of Oak Creek Circle and continue to the north Government Center Entrance. A right turn lane to the Government Center should be provided. There would be a northbound left turn lane at the north entrance transitioning to a southbound left turn lane before the south entrance. A second southbound lane can be introduced south of the Government Center. Then a right turn lane for Vine Street can be introduced near the Shopping Center entrance.

The concept will need to be carefully studied and revised to fit all the turn lanes and transitions safely and efficiently into the final design. An option would be to align the south Government Center entrance and the Grandview Park entrance/exit which would eliminate many conflicts and the need for the short section of TWLTL.

11 Traffic Impacts on Other Roads

11.1 General

A consideration and also a concern is traffic seeking alternate routes if Carmichael Road becomes too congested. An alternate route, if capable of carrying higher volumes, could be explored to determine if it is a viable option for some Carmichael Road traffic to use. Conversely, if traffic on Carmichael Road is diverted to alternate routes not suitable for higher volumes, options to diminish the route's attractiveness need to be reviewed. Several routes were reviewed as part of the Carmichael Corridor Study

11.2 Heggen Street/11th Street

The intersections of Heggen Street and Crest View Drive on the south side of I-94 (South intersection) and 11th Street and Coulee Road on the north side of I-94 (North intersection) are already busy and often congested. In the AM peak hour, the Heggen Street Bridge carries 550 vehicles in each direction. In the PM peak hour, the bridge carries 750 vehicles southbound and 850 northbound, based on turning movement counts made in May 2018.

Based on the turning movements at the intersections on either side of the bridge and traffic volume data and observations made at other intersections, the Heggen Street Bridge already

serves as a route to and from destinations on the south side of I-94. It not only serves as a local connection across the bridge, but serves Minnesota traffic using a route of Exit 1 (Highway 35 north), 2nd Street, and Coulee Road where their south trip end is in the western portion of the industrial area.

The St. Croix Meadows Traffic Study assumed some of the traffic to and from the development would use Mayer Road, O'Keefe Road or Industrial Drive, Crest View Drive and the Heggen Street Bridge to reach the north side of I-94. The option to access westbound I-94 via the slip ramp on the north side of I-94 will be attractive to some drivers.

The Mayer Road route is not likely to either attract drivers from Carmichael Road except those headed for the downtown or the northwest section of Hudson. The delays to get across the Heggen Street Bridge and the back-tracking along Coulee Road to reach the slip ramp offset the Carmichael Road congestion delays, unless Carmichael Road improvements fail to meet expected traffic volumes. Even then, the alternate route can only carry a limited increase in traffic volume.

11.3 Hanley Road

Hanley Road provides a convenient alternate route between Carmichael Road and Highway 35, and traffic observations indicate that drivers with origins or destinations east on I--94 are using it. Those drivers have the other end of their trip south of Hanley Road, so the total number is relatively small.

The St. Croix Meadows Traffic Study estimated that 12 percent of the external trips from the development would use Hanley Road to reach eastern portions of Hudson, Highway 35 to the south, I-94 to the east, or to reach Highway 12 at Exit 4.

The use of Hanley Road to reach I-94 west will not provide any advantage to drivers. The distance between Hanley Road and the north ramp intersection is about 3,600 feet. Northbound drivers will pass through traffic signals at Hanley Road, Center Road, Crest View Drive, and the south I-94 ramp. With the Preferred I-94 interchange alternate, they will not stop to enter the loop to go west on I-94. With even basic signal coordination, there should be few stops at the signals.

Using Hanley Road, northbound Highway 35, and westbound I-94, the speeds may be higher, and delays are less likely, but the total distance to reach I-94 is about 16,000 feet and two roundabouts must be negotiated.

Assuming 20 mph average speed and 60 seconds of delay, the driver following Carmichael Road to westbound I-94 will enter Minnesota about 2 minutes sooner than a driver following Hanley Road at 40 mph and traveling the speed limit on Highway 35 and I-94. While a few drivers may choose the route for consistent times and less congestion, it is not a route that will either relieve Carmichael Road or have diverted traffic, assuming adequate improvements are made to Carmichael Road.

11.4 Highway 35

Access to Highway 35 is limited to the Hanley Road interchange and Glover Road. Hanley Road is discussed in the previous section. Glover Road crosses Highway 35 far south of Hudson and would serve as an alternate route only for those trips between the far southwest side of Hudson

and areas to the south such as River Falls. The route to Glover Road requires knowledge of the local rural road system.

It is unlikely that any traffic would divert from Carmichael Road to the road south of Hudson.

12 Pedestrian and Bicycle Facilities

12.1 General

The City of Hudson, like many other cities, has become more focused on facilities for pedestrians and bicyclists. There is increased emphasis on health and wellness, recreation, alternative transportation modes, and safety. The City has built trails and sidewalks with different projects and has plans to connect existing segments and to meet specific needs.

Trails have been provided along many streets such as Carmichael Road, Hanley Road, Crest View Drive, Wisconsin Street, and Vine Street. Trails exist in parks and subdivisions and sidewalks are in place along many streets.

One of the barriers to the Hudson Trail system is Interstate Highway 94. Only Carmichael Road and Heggen Street cross I-94. A trail is provided on the west side of Carmichael Road and a sidewalk is provided on the Heggen Street Bridge. The Carmichael Road Trail consists of either sidewalk or trail from Albert Street to Deerhaven Drive and from Vine Street to north of Dorwin Circle in the Town of Hudson.

12.2 St. Croix County Plan

The recently completed (2017) St. Croix County Bicycle and Pedestrian Plan (County Plan) suggested several improvements for facilities in the Carmichael Road area.

The top ranked corridor was the “I-94-River Crest Elementary School Connection”. This corridor is a connection between several bike and pedestrian generators including Troy Beach, River Crest Elementary School, Camp St. Croix, 2nd Street and I-94 bridge trails, and the downtown. The plan calls for a separated bike path on Coulee Road from 2nd Street to 11th Street and bike lanes along Heggen Street, Hanley Road, Industrial Road and Mayer Road. The section along Carmichael Road would consist of a bike path from Albert Street to the Elementary School and “Other Planned Bikeways or Enhancements to Existing Bikeways” south of the school. Selected pages from the County Plan are in the Appendix A.

A separate project in the County Plan is the completion of a separated trail on Carmichael Road from Vine Street to Deerhaven Drive. This would provide the missing link in the Carmichael Road Trail.

A critical concern in the County Plan is the connection of numerous trails in the Hudson Area. The Carmichael Road trail connects to trails on Hanley Road, Crest View Drive, and Coulee Road, and ultimately on Vine Street.

12.3 Background and Trail Requirements

Many of the older trails in Hudson and other communities were built to local standards or for low cost and ease of construction. The design of many aspects of sidewalks and trails are now governed by federal and state laws and design standards. The Americans with Disabilities Act

(ADA) and Wisconsin State Statutes have specific standards which must be met by any new or revised street or trail construction.

Most of the standards relate to providing facilities oriented to accommodate persons with disabilities, but many also contribute to the safety of all users. There is no requirement yet to improve existing facilities to meet current standards, but if any pedestrian ramp is altered or the street has almost any type of reconstruction, the pedestrian ramp must be updated to comply with current standards.

Most standards relate to pedestrian and trail connections to street crossings.

12.4 Carmichael Corridor Facilities and Suggestions

The current trail is primarily an 8 foot bituminous path on the west side of Carmichael Road from Albert Street to Deerhaven Drive, with a narrower section at I-94. A similar path is provided on the east side of Carmichael Road north from Vine Street past the north city limits. A trail is also in place on the west side, directly adjacent to the street, from Vine Street almost to Oak Ridge Trail. Marked crosswalks are provided at most intersections. Crosswalks are not marked across private entrances at private entrances.

The separated trail is the best type of pedestrian/bicycle facility for a street like Carmichael Road. The high volumes of traffic and significant amount of turning traffic at virtually all intersections would make any on-street bike facility unsafe. There is still concern with turning traffic at each intersection.

There are a significant variety of crosswalk markings and pedestrian ramps in use along the Carmichael Road Trail. A consistent type of pavement marking for crosswalks at all intersections and entrances would be beneficial. There are four common types of crosswalk markings which are shown and described in Figure 19.

- The Standard type are simple to install, but when the lines in the “wheel paths” are worn, little is left to see. The line widths are six inches to two feet.
- The Continental or block type are positioned to be out of the wheel paths and will provide longer and better service life. This type is the most visible with the wide bars and is preferred for higher pedestrian volumes.
- The Ladder type combines the Standard and Ladder types, but once the markings in the wheel paths wears, it resembles the Continental type. If the bars are too close together, there is little contrast area left for good visibility.
- The Zebra type uses angled lines for better visibility, but can lose some of its effectiveness once markings in the wheel path wear.

There are also a number of handicapped ramps which do not meet current standards and/or are in poor condition. Several have openings that are quite narrow creating problems for bikes, strollers, and wheelchairs.

Crosswalks are in place at several intersections controlled by a traffic signal. At each of these, the traffic signal system includes pedestrian push buttons and a single head pedestrian indication. With the exception of the two traffic signals at the I-94 ramps, which are under state control, the pedestrian indication phasing display consists of a white “walk” symbol, followed by a flashing orange “don’t walk” symbol (as a clearance period), and then a steady orange “don’t walk” symbol. The amount of time for the clearance period varies with the length of the crossing.

The pedestrian indications at the two state controlled intersections use a “countdown timer” for the clearance period. This provides the amount of time left before the clearance period ends and the crosswalk should be empty. With a long crosswalk, pedestrians facing only a flashing don’t walk symbol, may assume “we can walk fast and make it” often leaving them in the middle of an intersection when the light changes. With a countdown timer, they know how much time they have to complete the crossing.

Where there are several signalized crossings of varied distances, the countdown timers will provide additional safety for pedestrians and are recommended along Carmichael Road whenever a traffic signal is modified or rebuilt.

Each crossing was reviewed in the field and the following comments and suggestions are the result of the review. These comments do not reflect all changes necessary to make the crosswalks comply with current ADA requirements.

East Elementary School Crossing: The trail crossing of the driveway has adequate slope and domes for the crossing. There are no pavement markings or signs. A sidewalk from the school is adjacent to the curb and connects to the trail on a side slope. The crossing is about 60 feet south from the edge of Carmichael Road.

A crosswalk should be marked as the crossing is away from the stop sign for Carmichael Road. The sidewalk could be angled away from the curb to intersect the trail away from the side slope and provide better alignment for bike and pedestrian turns to the trail.

East intersection with Burl Oak Curve: The crossing connects a sidewalk to the school with the sidewalk on the west side of Burl Oak Curve. The south side of Carmichael Road is relatively flat with domes and is lined up with the sidewalk to the school. The north side has a dropped curb in the center of the radius which does not line up with the crossing or sidewalk. A Ladder type crossing marking is used, and School Crossing signs are in place. The signs have imbedded LED flashing lights.

It would be safer if the north side ramp were revised to align with the sidewalk and crossing.

South Intersection with Burl Oak Curve/School Entrance: The intersection has a four way stop control and marked crosswalks on the south and west sides. The pedestrian ramps are in the center of corner radii and afford little landing area for pedestrians or bicycles. The west crosswalk is directly next to a traveled lane of southbound Carmichael Road. The southwest corner crosswalks actually meet in the street. A Standard two-line crosswalk marking is used.

The three corners should be revised to move the crosswalks (and stop lines) further west and south to shorten the crossing distance, align the ramps with the crosswalks, provide larger landing and storage areas, and separate the two crossings.

Center School Entrance: The Carmichael Trail crosses the school entrance about 60 feet east of the Carmichael/Burl Oak Curve intersection. The crossing has adequate slopes and domes and is lined up with the trail. There are no signs or pavement markings. With the short distance to the Carmichael Road intersection, the crossing may not be expected.

Pavement markings for the crosswalk are recommended.

South School Entrance: The Carmichael Trail crosses the school entrance about 60 feet east of Carmichael Road. The crossing has adequate slopes and domes and is lined up with the trail. There are no signs or pavement markings. With the short distance to the Carmichael Road intersection, the crossing may not be expected.

Pavement markings for the crosswalk are recommended.

Midblock Crossing south of Oak Ridge Development: The trail which connects to Grandview Drive crosses Carmichael Road less than 100 feet south of the south school entrance. The crossing has School Crossing signs and Ladder type pavement markings. The west side has only a dropped curb with a downward slope on the approach. A trail next to the west curb of Carmichael Road connects to the south at this location. The crossing on the east side has a connection to the trail along the east side of Carmichael Road.

Although the crossing is near the schools and used by school children, the year-round use of the trails may make Trail Crossing signs more appropriate. The west side approach should be rebuilt to reduce the approach slope, provide a flat landing area, connect to the south trail at the landing area, add domes, and be ADA compliant.

North St. Croix County Entrance: The trail along the west side of Carmichael Road crosses the entrance. The crossing has new landing areas and domes properly aligned.

The crosswalk across the entrance is not visible and should be remarked.

South St. Croix County Entrance: The trail along the west side of Carmichael Road crosses the entrance. This crossing has new landing areas and domes properly aligned. The south landing area is small due to the fire hydrant at this location.

There is also a crossing of Carmichael Road at this location, or at least remnants of two white lines. The west side has a dome and dropped curb which could serve the crossing. The east side has no connection to this crosswalk; the remnants seem to end in the exit road from Grandview Park. The St. Croix County entrance south edge is almost lined up with the Grandview Park exit north edge, resulting in the crosswalk going through the middle of the offset intersection.

A better location for the Carmichael Road crosswalk would be from the north side of the St. Croix County entrance directly across the street to connect to the Carmichael Road east trail. This would line up the cross walk with the south sidewalk to the St. Croix County Building and provide a much better landing area on both sides of the street. A dropped curb was recently installed on the west side to accommodate a crosswalk. A similar connection on the east side is needed. Pavement markings for the crosswalk and Trail Crossing signs are recommended.

Grandview Park driveways: The trail on the east side of Carmichael Road crosses both the entrance and exit driveways to Grandview Park about 50 feet east of Carmichael Road. The crossings are flat and already have domes.

Although there is good visibility of the trail, crosswalk pavement markings are recommended to define the crossing.

Shopping Center Entrance: The east side trail crosses the shopping center entrance about 40 feet from Carmichael Road. The trail has pedestrian ramps and domes in place. There also is a gutter section with the dropped curb leaving a bump for bikes and other wheeled devices.

A warning sign on the trail for bikes, etc. would be appropriate. Crosswalk pavement markings are recommended.

Vine Street: There is a single crosswalk on the north side of the intersection marked with the Standard two lines. The ramp on the east side is in the radius and has domes for crosswalks both to the south and west. There is no south crosswalk, but the dome is well located, almost in the tangent section. The west crosswalk ramp on the east side is in the middle of the radius which is a poor location. The ramp on the west side is also in the radius. The west side trail along Carmichael Road is next to the curb and continues around the corner to the west before ending on the shoulder of Vine Street. The trail goes through the side slopes of the ramp, which creates problems for bikes, handicapped individuals, etc.

Other sections of this report recommend revising the north side of the intersection to add a southbound left turn lane. Moving the north crosswalk north to a tangent section on Carmichael Road would shorten the pedestrian crossing distance, provide better landing areas, and give more prominence to the crosswalk. The reconstruction should also consider crossings on the east and west sides of the intersection to accommodate future development and an extension of the Carmichael Road Trail to the south on the west side. The west side trail on Carmichael Road should be moved away from the curb at the intersection to provide a proper landing area at the crosswalks and keep the users off the side slopes.

The crossing of Vine Street is controlled by a traffic signal with push buttons and single head pedestrian indications. Countdown clearance pedestrian indications, which are inplace at the I-94 ramp intersections, should be installed with any changes needed at the Vine Street/Carmichael Road intersection.

Vine Street to Deerhaven Drive: This is the major missing link in the Carmichael Trail. A potential development at Vine Street may permit an extension south from Vine Street. If built, the trail should be located to be out of the construction area for future expansion of Carmichael Road to four lanes in this section.

There is a painted edge line with about one to three feet of pavement to the gravel shoulder. The edge line moves to align with the curb on the west side at Deerhaven Drive. With the narrow area, and the few missing areas, this section is not suitable for marking as a trail or bike lane.

Deerhaven Drive: The Carmichael Road Trail from the south ends at this intersection. There is a bend in the trail to allow a physical connection to the Carmichael Road pavement, which would allow access to the narrow area along Carmichael Road to the north.

With the poor conditions along Carmichael Road to the north, a crosswalk should not be installed at Deerhaven Drive.

Former Country Club Driveway: There are short sections of dropped curbs in the radii on both sides of the driveway in line with the trail. There are no domes and the openings are not ADA compliant, but will function for bikes. The channelizing island starts on the Carmichael Road side, east of the trail alignment, and is not a hazard.

When the Country Club is reopened, remodeled, or replaced, the curb openings and island should be reconstructed, and a crosswalk added. The reconstruction of the driveways should reduce the southbound right turn speed to reduce conflicts with trail users and improve the sight distance to trail users and southbound traffic for drivers turning onto Carmichael Road.

Hillcrest Drive: This new intersection has the trail connecting directly to a dropped curb in line with the trail. The connections are relatively flat and there are no domes. No crosswalk had been painted before the review was made in late May.

Crosswalk markings should be installed.

Entrance south of Walgreens: The crossing is in a very poor location with the drop curb in the radii. The south dropped curb in the radius is almost to the tangent section of Carmichael Road and the north dropped curb is almost as bad. Pedestrians and bikes entering the crossing may be out of view or unexpected by turning motorists. The crossing distance is over 110 feet.

The crossing should be moved away from Carmichael Road, preferably to reduce the crossing distance closer to 50 feet. A marked crosswalk should be installed.

Coulee Road: There are three separate crossings at this location; the southbound to westbound free-flow lane, Coulee Road, and the eastbound to southbound free-flow lane. All are in good locations and have domes properly placed. The north crosswalk has a Standard two-line crosswalk marked while the other two crosswalks have the Continental marking. They should be consistent.

The three crossings are adequate for safe operation, but will likely be replaced when a new interchange is constructed.

The crossing of Coulee Road is controlled by a traffic signal with push buttons and single head pedestrian indications. Countdown clearance pedestrian indications, which are in place at the ramp intersections, should be installed with the new interchange.

North Ramp Intersection: The crossings are just small sections of dropped curb in line with the trail on each side. The south dropped curb is in the radius, almost at the tangent section of Carmichael Road. Pedestrians are almost into a lane of traffic when leaving the curb and entering the crosswalk. The north dropped curb is further from Carmichael Road.

The pavement marking is Standard two-line crosswalk. There are no domes and the crossing is not ADA compliant. The crossing length is about 90 feet, but could be relocated to reduce it to 60 feet and move the south connection further from Carmichael Road. The crosswalk is likely to be changed when the interchange is reconstructed.

The crossing is controlled by a traffic signal with push buttons, single pedestrian indications, and a countdown clearance timer.

The crossing is adequate for safe operation, but will likely be replaced when a new interchange is constructed. If the interchange is delayed or does not affect the crossing, the south connection should be moved west, and the crosswalk relocated.

South Ramp Intersection: The crossings are just small sections of dropped curb in line with the trail on each side. The crossing is in two sections; the south section crosses the two right turn lanes and the north section crosses the two left turn lanes. They are separated by a channelizing island with dropped curb sections for the crossing. The pavement marking is Standard two-line crosswalk. There are no domes and the crossing is not ADA compliant. The pavement and curbs are in poor condition.

The crossing is controlled by a traffic signal with push buttons, single pedestrian indications, and a countdown clearance timer.

The two crossings are adequate, but will likely be replaced when a new interchange is constructed.

Crest View Drive/Stageline Road Intersection: This is a three-section crossing**.** The north section crosses the southbound to westbound free-flow lane, connecting the channelizing island with the northwest corner. The connections are short sections of dropped curb with domes installed in the sloped section at the crossing. The pavement marking is Standard two-line crosswalk.

The second section crosses the westbound lanes and the third section crosses the eastbound lanes. They are separated by a narrow median island with dropped curbs to accommodate the trail. The connections are short sections of dropped curb with domes installed in the sloped section at the crossing. The pavement markings are Standard two-line crosswalks.

The south corner has a single ramp with domes for both the crosswalk for Carmichael Road and the crosswalk for Crest View Drive. This has pedestrians being misled by the domes and the two crosswalks meeting in the street. The crosswalk on Carmichael Road has Continental markings.

The southwest corner should be reconstructed for safety. The Crest View crossing should be separate and moved west and the Carmichael crossing moved south. The intersection may be rebuilt when a new interchange is constructed.

The crosswalk on the south side does not have ramps, landing areas, or a connecting sidewalk on the east side. If the east side is realigned to become an on ramp to I-94, the value of the crosswalk diminishes and could be removed.

The crossings of Crest View Drive are controlled by a traffic signal with push buttons and single head pedestrian indications. The entire street must be crossed in a single pedestrian phase as there is no median push button and little room for a pedestrian refuge. Countdown clearance pedestrian indications, which are inplace at the ramp intersections, should be installed when the intersection is revised.

Crest View Drive and Gateway Boulevard: There is a trail along the south side of Crest View Drive from Carmichael Road west. The ramps for the trail at Gateway Boulevard are in the center of the radii and could be misleading for visually impaired walkers. A landing area and domes are provided.

There are marked Standard two-line crosswalks on the west and north sides of the intersection, but they only lead to narrow, dropped curbs with no ramps, landing areas, or connecting sidewalks. With the increased growth along Badger Drive, consideration should be given to sidewalks and ADA compliant crossings for these crosswalks.

There is a narrow sidewalk on the north side of Crest View Drive going west from Carmichael Road. However, it turns towards McDonald’s and ends at the drive through lane. There are no ramps, dropped curbs or cuts in the medians once on McDonald’s property.

The three crosswalks are controlled by a traffic signal with push buttons and single head pedestrian indications, even though there are no sidewalks on the northside. The pedestrian signal on the southwest corner is not in line with the westbound crosswalk. Countdown clearance

pedestrian indications, which are inplace at the I-94 ramp intersections, should be installed when countdown indications are installed at Crest View Drive and Carmichael Road.

Center Road: This intersection has marked crosswalks on all four sides. The west side is marked as a Standard two-line crosswalk. The north and south sides are marked as Continental crosswalks. The east side is marked as a Ladder crosswalk.

All four corners have one sloped ramp in the middle of the radius and both ramps meet at it. This has pedestrians being misled by the domes and the two crosswalks meeting in the street. This also constricts the area pedestrians have on each corner as a flat landing area.

All four approaches to the intersection have raised medians. The west Center Road crosswalk is marked in front of the beginning of the median while the other three have openings in the median for the crosswalks.

The west crosswalk should be moved west with its own sloped ramp and a cut in the median. The landing areas on both west corners should be increased in size. The north crosswalk on the east side should be moved further north to provide a better approach and landing area. The median cut for the crosswalk can remain where it is. The same should be done with the south crosswalk on the east side. Moving the east crosswalk further east would be desirable, but costly. The intersection may be revised when the new interchange is built.

All crosswalks are controlled by a traffic signal with push buttons and single head pedestrian indications. Countdown clearance pedestrian indications, which are inplace at the ramp intersections, should be installed when countdown indications are installed at Crest View Drive.

Hanley Road: The intersection has marked crosswalks on the west and south sides. Crossings on the east and north side are discouraged based on a previous study of the intersection. The west crossing is in two parts; the southbound to westbound free-flow lane and the crossing of Hanley Road. The south crossing is split by the median Island. The west Hanley Road crossings have Ladder pavement marking while the Carmichael crossings are Continental markings.

With the free-flow turn and channelizing island, the northwest corner options are limited, and the existing system is adequate. The west and south crosswalks meet at the single sloped ramp in the southwest corner. This has pedestrians being misled by the domes and the two crosswalks meeting in the street. The southwest corner should be revamped to split the connections of the two crosswalks, moving the west ramp west and the south ramp south although the signal pole may be a problem. The crosswalks may be left where they are at the medians.

All crosswalks are controlled by a traffic signal with push buttons and single head pedestrian indications. Countdown clearance pedestrian indications, which are in place at the ramp intersections, should be installed when the countdown timers are installed at Crest View Drive.

East Side of Carmichael Road: There are no sidewalks parallel to Carmichael Road on the east side. The only Carmichael Road Corridor walkway over I-94 is on the west side. There are no substantial pedestrian generators between I-94 and Vine Street. South of Crest View Drive, there are a number of commercial developments and the hospital which will generate pedestrian and bicycle travel.

The crosswalk at Crest View Drive ends with a curb cut on the east side. The north crosswalk at Center Drive has a connection to a sidewalk along Center Drive. The south crosswalk at Center

Drive has a small landing area with ramps to the west and north, but no connecting sidewalk. There is a trail along the south side of Hanley Road.

Little pedestrian or bike movements along the east side of Carmichael Road south of I-94 has been observed and the parallel streets and limited sidewalks seem to suffice. As improvements are made to the area, pedestrian and bike facilities should be considered and ramps brought up to ADA standards.

Construction of the St. Croix Meadows development will increase pedestrian and especially bicycle traffic. The ball field and sports facilities will be attractive to alternate mode travel as will the concentration of employment. While the Carmichael Trail on the west side will provide a route, an east side connection from Hanley Road to the St. Croix Meadows will connect to the Hanley Road Trail to the east and the east side residential area and trail system. A trail/sidewalk along Maxwell Drive and through the Gerrard development will provide a convenient link.

Albert Street: The Carmichael Road Trail follows the off ramp to Albert Street and ends. The approved site plan for St. Croix Meadows will modify the ramp intersections and traffic flow in the area. The plans should provide crosswalks to connect the trail on the north side of the ramp at Albert Street to the pedestrian facilities in St. Croix Meadows.

South of Albert Street: The number one corridor in the St. Croix County Bicycle and Pedestrian Plan is to complete a connection from River Crest School north including a connection to the Carmichael Trail at Albert Street.

13 Traffic Signal System Coordination, Existing System

13.1 Existing condition

The existing signal coordination system is generally out of service. The two ramp signals controlled by WisDOT are still connected and coordinated, but without coordination to the adjacent signals, not providing a lot of benefit. They do maintain “green time” for Carmichael Road and do not, as some have claimed, turn red for Carmichael Road whenever there is traffic on the ramp.

Coordinating the system, as has been mentioned in previous sections, is very difficult. The close spacing of intersections, the high volumes of turning traffic, and the different phasing and sequencing of the signals makes any system development and installation complicated. In addition, the system needs to be monitored regularly by experienced signal technicians.

It appears that the coordination system has been unintentionally disabled or modified at a few locations, either during repairs, replacements, or adjustments. With the system under two different jurisdictions, maintenance and monitoring of the entire system has not been a priority.

Setting up a coordinated system is not simple to do, especially given the existing conditions along Carmichael Road. A complex software program is needed to handle all the variables. An experienced signal technician needs to run the program to make sure the options are all addressed. Data, especially existing turning volumes, needs to be accurate and properly inputted to the program. Finally, the timing data needs to be placed into the individual signal controllers

and then monitored and adjusted. Any missteps in the process will result in unsatisfactory operation.

13.2 Carmichael Road Coordinated Signal System

All intersection controller cabinets were inventoried to obtain existing timing information, review equipment installed and operating, determine status of coordination and interconnection, and ascertain the condition of needed equipment.

The 2017 intersection turning movement volumes (Figure 1) were utilized as input into the coordinated signal system analysis. The existing geometrics, lanes, etc. were used with a few exceptions. A number of iterations for the system were run in an effort to find the most beneficial set of signal timings. Some of the options considered included the following:

- Disconnect Hanley Road from the system.
- Coordinate flow from the eastbound left turn on Crest View Drive with the northbound through movement at the south ramp.
- Change various left turns from “leading” to “lagging”.
- Install right turn overlaps

This work was coordinated with WisDOT to obtain their input into timing schemes, equipment availability, planned and possible renovations or changes, and potential installations.

Timing plans were developed for the AM peak hour, PM peak hour, Saturday, and mid-day (between AM and PM peaks). Time of day for the changes in coordinated system were also determined.

13.3 System Timing Installation

The new signal timings and coordinated system parameters were initially planned to be installed at the individual intersection controllers in late spring of 2018. This would provide time for any traffic pattern changes with the opening of the new St. Croix River Crossing near Stillwater to take place. Since traffic volumes generally increase in late spring through early fall and school traffic is not a significant factor in traffic fluctuations in the Carmichael Road corridor, this time period was also the best. Additionally, WisDOT planned to install a new cabinet with different phasing at the south ramp intersection in late spring.

However, WisDOT has a construction project on I-94 that is creating abnormal traffic patterns in the Hudson area. Exit 1 has had closures and detours. Local traffic has developed new routes to avoid both the construction area and the detoured traffic. Work on I-94 has resulted in some traffic apparently taking an alternate route. The work and traffic pattern adjustments are expected to last until mid-October 2018.

Because a major part of any coordinated signal system installation is the observation/adjustment period following the installation, it was decided to delay the installation and implementation until construction is complete in October. The final timing plans will then be provided to the City and WisDOT and placed in the appropriate controller cabinets. A short summary of the timing plan and any changes needed to the corridor will be delivered as an amendment to this report.

14 Recommendations

14.1 General

A number of recommendations have been made throughout this report. The 2025 Traffic and Preferred Interchange Scenario (Section 9) provided a number of changes to the system based on the Synchro/SimTraffic model and analysis. Many of the changes were related to modifying and refining the Preferred Alternate Interchange. The 2040 Scenario (Section 10) showed that the Preferred Alternate Interchange would need several additional changes to meet the needs of the 2040 forecasted traffic. There were also some “2040” recommendations outside of the area of the interchange.

WisDOT reopened their study of the interchange given the results of the 2040 Scenario. The 2040 final SEH model retained the basic interchange concept, but added lanes and turn lanes as described in Section 10. WisDOT will need to accept the changes to the Preferred Alternate and begin their design process.

A partial solution to the traffic concerns anticipated in 2040 is to monitor or even reduce the additional development and associated major traffic increases. While St. Croix Meadows, Gerrard, and Carmichael Ridge have been approved and are under construction, other development (Atwood, Lee, northwest quadrant) have not as of the date this report was prepared. Reduced development would reduce 2040 traffic volume forecasts and capacity needs. However, the final model with the additional lanes will generally provide adequate capacity for the 2040 forecasted traffic from the land uses assumed in Section 4. The 2040 Walmart scenario traffic volumes did result in poor LOS and backups over much of the system.

The model system shown in Figures 20 thru 28 represents what is needed and the intersection discussions in Sections 9 and 10 provide more information. Figures 20 through 28 are copies of Synchro/Sim Traffic screens that shows lanes, turn lane lengths, but do not represent a geometric design.

The Pedestrian and Bicycle Facilities Section 12 provided a number of detailed recommendations for trails, sidewalks and crossings. Some of these recommendations are dependent on the final new interchange design, but all are still needed to provide a safe and efficient trail system.

There are also a number of improvements needed for portions of Carmichael Road in the vicinity of approved developments, such as the proposed Atwood development. These are needed regardless of the interchange design or 2040 traffic volumes. However, the design and construction of these improvements should be consistent with the final corridor design. A coordinated project between the City and the developer may provide the most efficient method of reaching the final recommended corridor designs.

14.2 Recommendations

The following is a general description of the major changes and improvements needed in the Carmichael Corridor. To assist with more specific design recommendations, refer to Sections 9 and 10.

- Reconstruct the I-94 interchange. The minimum redesign is the Modified Preferred Alternate with the design adjustments, additions and changes. All modifications to the

Preferred Alternate in Sections 9 and 10 should be included. Figures 20 thru 28 show the final recommended design concept.

- Reconstruct Carmichael Road from Coulee Road to north of Vine Street to provide two through lanes and appropriate turn lanes at all intersections and major driveways. Part of this was included in the WisDOT Preferred Alternative, from north of the interchange ramps past Hillcrest Road.
- An interim Vine Street intersection concept was described in Section 9 and would be adequate for 2025 volumes, but not 2040 volumes. Completing the 2040 concept for the Vine Street intersection area without the interim step may be most economical.
- Widen and/or reconstruct Carmichael Road from Vine Street to Oakridge Circle consistent with the recommendations in Section 10.
- Coordinate any improvements needed for development along Carmichael Road with the recommendations of this report.
- Lengthen eastbound right turn lane on Vine Street at Carmichael Road.
- Revise traffic signals on Carmichael Road, to provide uniform left turn phasing and indications consistent with capacity needs. Flashing Yellow left turn arrows should be installed on Carmichael Road at Vine Street and Hanley Road and other locations with protected/permissive left turn signal phasing but only after sight distance and intersection operation are considered.
- Revise the Albert Street northbound on-ramp to a one-lane ramp and merge condition. Include a northbound right turn lane to Maxwell Drive. This was part of the St. Croix Meadows development.
- Revise Albert Street under the Carmichael Road Bridge which also was part of the St. Croix Meadows development.
- Revise the Riverview Drive Intersection and provide for future traffic signals unless the revised St. Croix Meadows development traffic study changes the volumes.
- Complete the Carmichael Road Trail between Deer Haven Drive and Vine Street as described in Section 12.3.
- Complete the Carmichael Road trail between Albert Street and Coulee Trail.
- Revise pavement markings and traffic signal phasing and detection on Hanley Road west of Carmichael Road.
- Revise the north entrance to the old golf course parking lot.
- Revise the pavement markings and traffic signal phasing and detection at Crest View Drive and Gateway Boulevard.
- Make the changes to pedestrian facilities and crosswalks as described in Section 12.
- Complete other revisions as described in the 2025 and 2040 intersection analysis.

Because the Carmichael Road Corridor 2040 forecast traffic volumes are close to the capacity of the final model of the Modified Preferred Alternate interchange, it is critical that the design process for the interchange be started as soon as possible. Coordination between WisDOT and the City will be critical in the process. Discussions of funding options for the construction of the recommendations, including the interchange, should also start as soon as possible.

The City also needs to carefully review any development proposal that could add traffic volumes to the corridor. Even several small deviations or additions could create capacity problems in the future.

Traffic management will also be desirable to prevent congestion. Regulating the starting times of ball games, adjusting starting and shift change times, etc., are examples.

Monitoring the traffic signal system and adjusting as needed will assist in maintaining optimum flow of traffic. When intersections or the interchange are reconstructed or modified, the coordinated signal system will need adjustments.

9/19/2018

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Tables

Carmichael Road Left Turn Controls

Intersection	Direction	Left Turn Lanes	Left Turn Control Carmichael	Left Turn Control Cross Street
Hanley Road	NB	1	Prot/Perm	
	SB	1	Prot/Perm	
	EB	1		Permit
	WB	0		None
Center Street	NB	1	Prot/Perm	
	SB	1	Prot/Perm	
	EB	1		Prot/Perm
	WB	1		Prot/Perm
Crestview Drive	NB	2	Protect	
	SB	1	Prot/Perm	
	EB	3		Protect
	WB	1		Protect
South I-94 Ramps	NB	Prohibited	x	
	SB	1	Prot/Perm	
	EB	2		None
North I-94 Ramps	NB	2	Protect	
	SB	Prohibited	x	
	WB	2		None
Coulee Road	NB	2*	Split P	
	SB	1	Split P	
	EB	1		None
	WB	0		None

Protected: Left turn on green arrow only
Prot/Perm: Left turn on green arrow or green ball
Permit: Left turn on green ball; no arrow indications.
Split P: Intersection has NB and SB on different (split) phases

Historical Daily Traffic Volumes - Interstate 94 from WisDOT sources

Year	St Croix River Bridge		East of STH 35		East of Carmichael		East of STH 12		East of STH 65	
	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
1976	10,940	11520	12470	12590	8670	9900	8030	7240	7480	7240
1979	17300	16340	13530	13800			8700	9760	8310	9130
1982	15580	15960	13300	13240	11450	12620	6870	7660	7470	7990
1986	14630	14570	14060	14360	12430	13810	7670	6760	7420	7090
1988	20350	20070	17460	17690	15670	15070	9440	9030	8830	8350
1990	22880	22190	19250	19140	16630	15980	10800	10520	9910	9720
1994	26800	27800	25800	25100	19300	17800	12700	12000	13600	12400
1996	27100	28100	26100	25400	19500	18000	12800	12100	13800	12500
1998	33200	33000	22300	24800	17600	19000	15500	15500	15300	14700
2000	36400	36400	31800	31800	33800	26000	19900	19800	18400	19700
2003	33900	33400	32900	32200	25800	25600	19400	19200		
2006	67300*	*	50400*	*	41100*	*	35500*	*	31800*	*
2009	77000*	*	73000*	*	60200*	*	39900*	*	35100*	*
2015			83200*	*	73000*	*	44900*	*	40000*	*
2018					73000*	*	47200*	*	43300*	*

* Volumes are for traffic in both directions

Figures

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Print Date: 9/18/2018

Map by: thastings
Projection: WCRS St, Criox County Feet
Source: St. Croix County

2015 ADT Volumes - WisDOT INTERACTIVE TRAFFIC COUNT MAP

CARMICHAEL CORRIDOR STUDY

Hudson, Wisconsin

Figure 1

Path: \\SEHNR\Projects\FJH\Hudso\142677\GIS\Mapsand Data\Figure 1 - 2015 ADT Volumes.mxd

Lake Mallalieu

Lake St. Croix

PD 1

PD 2

PD 3

PD 4

PD 5

PD 6

PD 7

PD 8

Legend

City of Hudson

Future Land Use

- Single and Two Family Residential
- Rural Residential
- Medium Density Residential
- High Density Residential
- Recreational Commercial
- Neighborhood Commercial
- Downtown Commercial
- General Commercial
- Industrial
- Public
- Institutional
- Conservancy District
- Park

Planning Districts

LABEL	PLANNING DISTRICT
PD 1	Historic Downtown
PD 2	North Central
PD 3	Central
PD 4	North Side
PD 5	Bluff
PD 6	Carmichael
PD 7	Southeast
PD 8	Industrial

0 600 1,200 2,400

FEET

Map Revisions

Ord. 07-09, 05/18/09
Ord. 01-10, 02/04/10
Ord. 03-10, 04/19/10
Ord. 08-10, 05/03/10
Ord. 10-10, 05/03/10
Ord. 01-11, 01/24/11
Ord. 11-11, 07/05/11
Ord. 16-11, 09/06/11
Ord. 20-11, 11/07/11
Ord. 08-12, 07/23/12
Ord. 10-12, 08/06/12
Ord. 13-12, 12/17/12
Ord. 05-13, 09/12/13
Ord. 10-13, 11/18/13
Ord. 11-13, 11/18/13
Ord. 07-14, 07/21/14

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Map by: jmacholl
Projection: WISCRS St. Croix County (feet)
Source: City of Hudson

Figure 2

CITY OF HUDSON 2030 MASTER PLAN

COMPREHENSIVE PLAN

Hudson, Wisconsin

N
W E
S

Path: N:\FJH\Active\131022\Zoning and Comp Plan Updates\Land Use - Future_2015-03-27_24x44P_Final.mxd

Path: \\SEHNR\Projects\FJH\Hudso\142677\GIS\MapsandData\Figure 3 - Proposed Land Uses and Locations.mxd
Date Saved: 9/17/2018 1:59:41 PM User Name: thastings

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Source:

PROPOSED LAND USES AND LOCATIONS

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 3

Figure 4 AM Peak Hour Trip Generation

Table 1.1 Trip Generation for the Site ETA-1a (AM peak hour)

Land Use	ITE Code	Land Acreage	Units	Quantity	Rate Formula	Directional		Total Trips			Internal Trips						External Trips			Pass-by Trips				Primary Trips		
						Enter	Exit	Total	Enter	Exit	Total %	Enter %	Exit %	Total	Enter Trips	Exit Trips	Total	Enter	Exit	Rate	Total	Enter	Exit	Total	Enter	Exit
Single Family Home	210	28	Dwelling Units	70	ln(T)=0.91*ln(X)+0.2	26%	74%	58	15	43															
Multi-Family Home	220	22	Dwelling Units	220	ln(T)=0.94*ln(X)-0.29	28%	72%	119	33	86															
Residential Subtotal								177	48	129	39%	46%	37%	70	22	48	107	26	81	0%	0	0	0	107	26	81
Neighborhood Commercial	820	11	k-sf GLA	120	T=2.76*X+77.28	54%	46%	408	221	188	17%	10%	19%	70	48	22	339	173	166	10%	34	17	17	305	156	149
Total								**586**	**269**	**317**	**22%**	**21%**	**23%**	**140**	**70**	**70**	**446**	**199**	**247**		**34**	**17**	**17**	**412**	**182**	**230**

** Trip rates and internal trip calculations based on ITE Trip Generation Manual 10th Edition; AM Pass-by rates is assumed to be 10% based on WsDOT TIA Guidelines updated in May 2017*

Table 1.2 Trip Generation for the Site ETA-1b (AM peak hour)

Land Use	ITE Code	Land Acreage	Units	Quantity	Rate Formula	Directional		Total Trips			Internal Trips						External Trips			Pass-by Trips				Primary Trips		
						Enter	Exit	Total	Enter	Exit	Total %	Enter %	Exit %	Total	Enter Trips	Exit Trips	Total	Enter	Exit	Rate	Total	Enter	Exit	Total	Enter	Exit
Single Family Home	210	34	Dwelling Units	85	ln(T)=0.91*ln(X)+0.2	26%	74%	91	24	68															
Multi-Family Home	220	10	Dwelling Units	100	ln(T)=0.94*ln(X)-0.29	28%	72%	67	19	49															
Residential Subtotal								159	43	117	44%	46%	43%	70	20	50	90	23	67	0%	0	0	0	90	23	67
Neighborhood Commercial	820	10	k-sf GLA	109	T=2.76*X+77.28	54%	46%	601	324	276	12%	10%	19%	70	50	20	530	274	256	10%	53	27	26	477	247	230
Total								**759**	**367**	**393**	**22%**	**21%**	**23%**	**140**	**70**	**70**	**620**	**297**	**323**		**53**	**27**	**27**	**567**	**270**	**296**

** Trip rates and internal trip calculations based on ITE Trip Generation Manual 10th Edition; AM Pass-by rates is assumed to be 10% based on WsDOT TIA Guidelines updated in May 2017*

Table 1.3 Trip Generation for the Site ETA-1c (Scenario 1, AM peak hour)

Land Use	ITE Code	Land Acreage	Units	Quantity	Rate Formula	Directional		Total Trips			Internal Trips						External Trips			Pass-by Trips				Primary Trips		
						Enter	Exit	Total	Enter	Exit	Total %	Enter %	Exit %	Total	Enter Trips	Exit Trips	Total	Enter	Exit	Rate	Total	Enter	Exit	Total	Enter	Exit
Single Family Home	**210**	**18**	**Dwelling Units**	**46**	ln(T)=0.91*ln(X)+0.2	**26%**	**74%**	**40**	**10**	**29**	**Not Applicable**						**39**	**10**	**29**	**0%**	**0**	**0**	**0**	**40**	**10**	**29**

** Trip rates based on ITE Trip Generation Manual 10th Edition*

Table 1.4 Trip Generation for the Site ETA-1c (Scenario 2, AM peak hour)

Land Use	ITE Code	Land Acreage	Units	Quantity	Rate Formula	Directional		Total Trips			Internal Trips						External Trips			Pass-by Trips				Primary Trips		
						Enter	Exit	Total	Enter	Exit	Total %	Enter %	Exit %	Total	Enter Trips	Exit Trips	Total	Enter	Exit	Rate	Total	Enter	Exit	Total	Enter	Exit
Walmart store development*																								**259**	**146**	**113**

**Trips from the study conducted By Kimley-Horn Associates Inc in 2011*

Table 1.5 Trip Generation for the Carmichael Ridge Redevelopment Site (AM peak hour)

Land Use	ITE Code	Land Acreage	Units	Quantity	Rate Formula	Directional		Total Trips			Internal Trips						External Trips			Pass-by Trips				Primary Trips		
						Enter	Exit	Total	Enter	Exit	Total %	Enter %	Exit %	Total	Enter Trips	Exit Trips	Total	Enter	Exit	Rate	Total	Enter	Exit	Total	Enter	Exit
Single Family Home	210		Dwelling Unit	145	0.75	25%	75%	109	27	82		8%	13%	13	2	11	96	25	71	0%	0	0	0	96	25	71
Apartment	220		Dwelling Unit	100	0.51	20%	80%	51	10	41		8%	13%	6	1	5	45	9	36	0%	0	0	0	45	9	36
Hotel	310		Rooms	90	0.53	59%	41%	48	28	20		4%	30%	7	1	6	41	27	14	0%	0	0	0	41	27	14
Office	710		1,000 GFA	15	1.56	88%	12%	23	21	2		29%	50%	7	6	1	16	15	1	0%	0	0	0	16	15	1
Shopping Center	820		1,000 GFA	31	0.96	62%	38%	30	18	12		4%	14%	2	1	2	28	17	10	34%	9	5	5	19	12	5
Specialty Retail	826		1,000 GFA	12	6.84	48%	52%	82	39	43		4%	14%	8	2	6	74	37	37	0%	0	0	0	74	37	37
Discount Supermarket	854		1,000 GFA	90	2.53	58%	42%	228	132	96		4%	14%	19	5	13	209	127	83	23%	48	24	24	161	103	59
Pharmacy/Drug Store	881		1,000 GFA	14	3.45	52%	48%	48	25	23		4%	14%	4	1	3	44	24	20	49%	21	11	11	23	13	9
Sit Down Restaurant	932		1,000 GFA	12	10.81	55%	45%	130	71	59		73%	24%	66	52	14	64	19	45	43%	28	14	14	36	5	31
Gas Convenience/Car Wash	946		Fuel Positions	16	11.84	51%	49%	189	97	92		4%	14%	17	4	13	172	93	79	56%	96	48	48	76	45	31
Total								**938**	**468**	**470**				**148**	**74**	**74**	**790**	**394**	**396**		**202**	**102**	**102**	**607**	**295**	**312**

**Trips from the study conducted by Spack Consulting in 2015; The internal trips were recalculated based on the ITE Trip Generation Manual (10th Edition).*

Table 1.6 Trip Generation for the St Croix Meadows Redevelopment Site (AM peak hour)

Land Use	ITE Code	Land Acreage	Units	Quantity	Rate Formula	Directional		Total Trips			Internal Trips						External Trips			Pass-by Trips				Primary Trips		
						Enter	Exit	Total	Enter	Exit	Total %	Enter %	Exit %	Total	Enter Trips	Exit Trips	Total	Enter	Exit	Rate	Total	Enter	Exit	Total	Enter	Exit
Multi-purpose (Phase I, 2018)																					10	6	5	480	396	84
Multi-purpose (Phase II, 2020)																					13	6	7	321	219	102
Multi-purpose (Phase III, 2021)																					0	0	0	259	230	29
Total by 2025																					**23**	**12**	**12**	**1,060**	**845**	**215**
Multi-purpose (Phase IV, 2040)																					0	0	0	149	140	10
Total by 2040																					**23**	**12**	**12**	**1,209**	**985**	**225**

**Trips from the study conducted by WSB in 2015*

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Project: HUDSO 142677
Date: 9/18/2018

Map by: thastings
CRS: NAD 1983 HARN WISCRS St Croix County Feet
Source:

AM PEAK HOUR TRIP GENERATION

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 4

Figure 5 PM Peak Hour Trip Generation

Table 2.1 Trip Generation for the Site ETA-1a (PM peak hour)

Land Use	ITE Code	Land Acreage	Units	Quantity	Rate Formula	Directional		Total Trips			Internal Trips					External Trips			Pass-by Trips				Primary Trips		
						Enter	Exit	Total	Enter	Exit	Enter %	Exit %	Total	Enter Trips	Exit Trips	Total	Enter	Exit	Rate	Total	Enter	Exit	Total	Enter	Exit
Single Family Home	210	28	Dwelling Units	70	ln(T)=0.94*ln(X)+0.34	64%	36%	76	49	27															
Multi-Family Home	220	22	Dwelling Units	220	T=0.66*X+1.41	59%	41%	147	86	60															
Residential Subtotal								223	135	87	46%	37%	94	62	32	128	73	55	0%	0	0	0	128	73	55
Neighborhood Commercial	820	11	k-sf GLA	120	ln(T)=0.72*ln(X)+3.02	50%	50%	644	322	322	10%	19%	94	32	62	550	290	260	34%	187	94	94	363	196	166
Total								866	457	409	21%	23%	188	94	94	678	363	315		187	94	94	491	269	221

** Trip rates and internal trip calculations based on ITE Trip Generation Manual 10th Edition; PM Pass-by rates based on WsDOT TIA Guidelines updated in May 2017*

Table 2.2 Trip Generation for the Site ETA-1b (PM peak hour)

Land Use	ITE Code	Land Acreage	Units	Quantity	Rate Formula	Directional		Total Trips			Internal Trips					External Trips			Pass-by Trips				Primary Trips		
						Enter	Exit	Total	Enter	Exit	Enter %	Exit %	Total	Enter Trips	Exit Trips	Total	Enter	Exit	Rate	Total	Enter	Exit	Total	Enter	Exit
Single Family Home	210	34	Dwelling Units	85	ln(T)=0.94*ln(X)+0.34	64%	36%	91	59	33															
Multi-Family Home	220	10	Dwelling Units	100	T=0.66*X+1.41	59%	41%	67	40	28															
Residential Subtotal								159	99	61	46%	43%	72	46	26	88	53	35	0%	0	0	0	88	53	35
Neighborhood Commercial	820	10	k-sf GLA	109	ln(T)=0.72*ln(X)+3.02	50%	50%	601	300	300	10%	19%	72	26	46	528	274	254	34%	180	90	90	348	184	164
Total								759	399	361	21%	23%	144	72	72	616	327	289		180	90	90	436	237	199

** Trip rates and internal trip calculations based on ITE Trip Generation Manual 10th Edition; PM Pass-by rates based on WsDOT TIA Guidelines updated in May 2017*

Table 2.3 Trip Generation for the Site ETA-1c (Scenario 1, PM peak hour)

Land Use	ITE Code	Land Acreage	Units	Quantity	Rate Formula	Directional		Total Trips			Internal Trips					External Trips			Pass-by Trips				Primary Trips		
						Enter	Exit	Total	Enter	Exit	Enter %	Exit %	Total	Enter Trips	Exit Trips	Total	Enter	Exit	Rate	Total	Enter	Exit	Total	Enter	Exit
Single Family Home	**210**	**18**	**Dwelling Units**	**46**	**ln(T)=0.94*ln(X)+0.34**	**64%**	**36%**	**51**	**33**	**18**	**Not Applicable**					**51**	**33**	**18**	**0%**	**0**	**0**	**0**	**51**	**33**	**18**

** Trip rates based on ITE Trip Generation Manual 10th Edition*

Table 2.4 Trip Generation for the Site ETA-1c (Scenario 2, PM peak hour)

Land Use	ITE Code	Land Acreage	Units	Quantity	Rate Formula	Directional		Total Trips			Internal Trips					External Trips			Pass-by Trips				Primary Trips		
						Enter	Exit	Total	Enter	Exit	Enter %	Exit %	Total	Enter Trips	Exit Trips	Total	Enter	Exit	Rate	Total	Enter	Exit	Total	Enter	Exit
Walmart store development*																				**190**	**95**	**95**	**549**	**271**	**278**

**Trips from the study conducted By Kimley-Horn Associates Inc in 2011*

Table 2.5 Trip Generation for the Carmichael Ridge Redevelopment Site (PM peak hour)

Land Use	ITE Code	Land Acreage	Units	Quantity	Rate Formula	Directional		Total Trips			Internal Trips					External Trips			Pass-by Trips				Primary Trips		
						Enter	Exit	Total	Enter	Exit	Enter %	Exit %	Total	Enter Trips	Exit Trips	Total	Enter	Exit	Rate	Total	Enter	Exit	Total	Enter	Exit
Single Family Home	210		Dwelling Unit	145	1	63%	37%	145	91	54	52%	59%	79	47	32	66	44	22	0%	0	0	0	66	44	22
Apartment	220		Dwelling Unit	100	0.62	65%	35%	62	40	22	52%	59%	34	21	13	28	19	9	0%	0	0	0	28	19	9
Hotel	310		Rooms	90	0.6	51%	49%	54	28	26	36%	31%	18	10	8	36	18	18	0%	0	0	0	36	18	18
Office	710		1,000 GFA	15	1.49	17%	83%	22	4	18	75%	28%	8	3	5	14	1	13	0%	0	0	0	14	1	13
Shopping Center	820		1,000 GFA	31	3.71	48%	52%	115	55	60	9%	14%	13	5	8	102	50	52	34%	35	18	18	67	32	34
Specialty Retail	826		1,000 GFA	12	5.02	56%	44%	60	34	26	9%	14%	7	3	4	53	31	22	0%	0	0	0	53	31	22
Discount Supermarket	854		1,000 GFA	90	8.34	50%	50%	751	375	376	9%	14%	86	34	53	665	341	323	23%	153	77	77	512	264	246
Pharmacy/Drug Store	881		1,000 GFA	14	9.91	50%	50%	139	69	70	9%	14%	16	6	10	123	63	60	49%	60	30	30	63	33	30
Sit Down Restaurant	932		1,000 GFA	12	9.85	60%	40%	118	71	47	51%	66%	67	36	31	51	35	16	43%	22	11	11	29	24	5
Gas Convenience/Car Wash	946		Fuel Positions	16	13.86	51%	49%	222	113	109	9%	14%	25	10	15	197	103	94	56%	110	55	55	87	48	39
Total								1,688	880	808			352	176	176	1,336	704	632		380	191	191	1,110	582	528

**Trips from the study conducted by Spack Consulting in 2015; The internal trips were recalculated based on the ITE Trip Generation Manual (10th Edition).*

Table 2.6 Trip Generation for the St Croix Meadows Redevelopment Site (AM peak hour)

Land Use	ITE Code	Land Acreage	Units	Quantity	Rate Formula	Directional		Total Trips			Internal Trips					External Trips			Pass-by Trips				Primary Trips		
						Enter	Exit	Total	Enter	Exit	Enter %	Exit %	Total	Enter Trips	Exit Trips	Total	Enter	Exit	Rate	Total	Enter	Exit	Total	Enter	Exit
Multi-purpose (Phase I, 2018)																				15	10	6	653	306	347
Multi-purpose (Phase II, 2020)																				23	10	13	528	273	256
Multi-purpose (Phase III, 2021)																				0	0	0	283	56	228
Total by 2025																				**38**	**20**	**19**	**1,464**	**635**	**831**
Multi-purpose (Phase IV, 2040)																				0	0	0	679	619	60
Total by 2040																				**38**	**20**	**19**	**2,143**	**1,254**	**891**

**Trips from the study conducted by WSB in 2015*

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Map by: thastings
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Source:

PM PEAK HOUR TRIP GENERATION

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 5

Path: \\SEHNR\Projects\FJH\Hudso\142677\GIS\MapsandData\Figure 6 - NEW TRIPS DIRECTIONAL DIST.mxd
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Source:

CARMICHAEL RIDGE TRIPS DIRECTIONAL DISTRIBUTIONS

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 6

Legend

x% New Trips Passing the Location in %

New Trip Access Location

Date: 1/8/2018

N W E S

Path: \\SEHNR\Projects\FJH\Hudso\142677\GIS\MapsandData\Figure 7 - NEW TRIPS DIRECTIONAL DIST.mxd
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Project: HUDSO 142677
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Map by: thastings
CRS: NAD 1983 HARN WISCRS St Croix County Feet
Source:

ST. CROIX MEADOWS NEW TRIPS DIRECTIONAL DISTRIBUTIONS

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 7

Path: \\SEHNR\Projects\FJH\Hudso\142677\GIS\MapsandData\Figure 8 - ET 1-A NEW TRIPS DIRECTIONAL DIST.mxd
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Print Date: 9/17/2018

Map by: thastings
CRS: NAD 1983 HARN WISCRS St Croix County Feet
Source:

ETA-1a NEW TRIPS DIRECTIONAL DISTRIBUTIONS

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 8

Legend

x% New Trips Passing the Location in %

New Trip Access Location

Date: 1/8/2018

N

W E

S

Path: \\SEHNR\Projects\FJH\Hudso\142677\GIS\MapsandData\Figure 9 - ET 1-B NEW TRIPS DIRECTIONAL DIST.mxd
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Source:

ETA-1b NEW TRIPS DIRECTIONAL DISTRIBUTIONS

CARMICHAEL CORRIDOR STUDY
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Figure 9

Path: \\SEHNR\Projects\FJH\Hudso\142677\GIS\MapsandData\Figure 10 - ET 1-c NEW TRIPS DIRECTIONAL DIST.mxd
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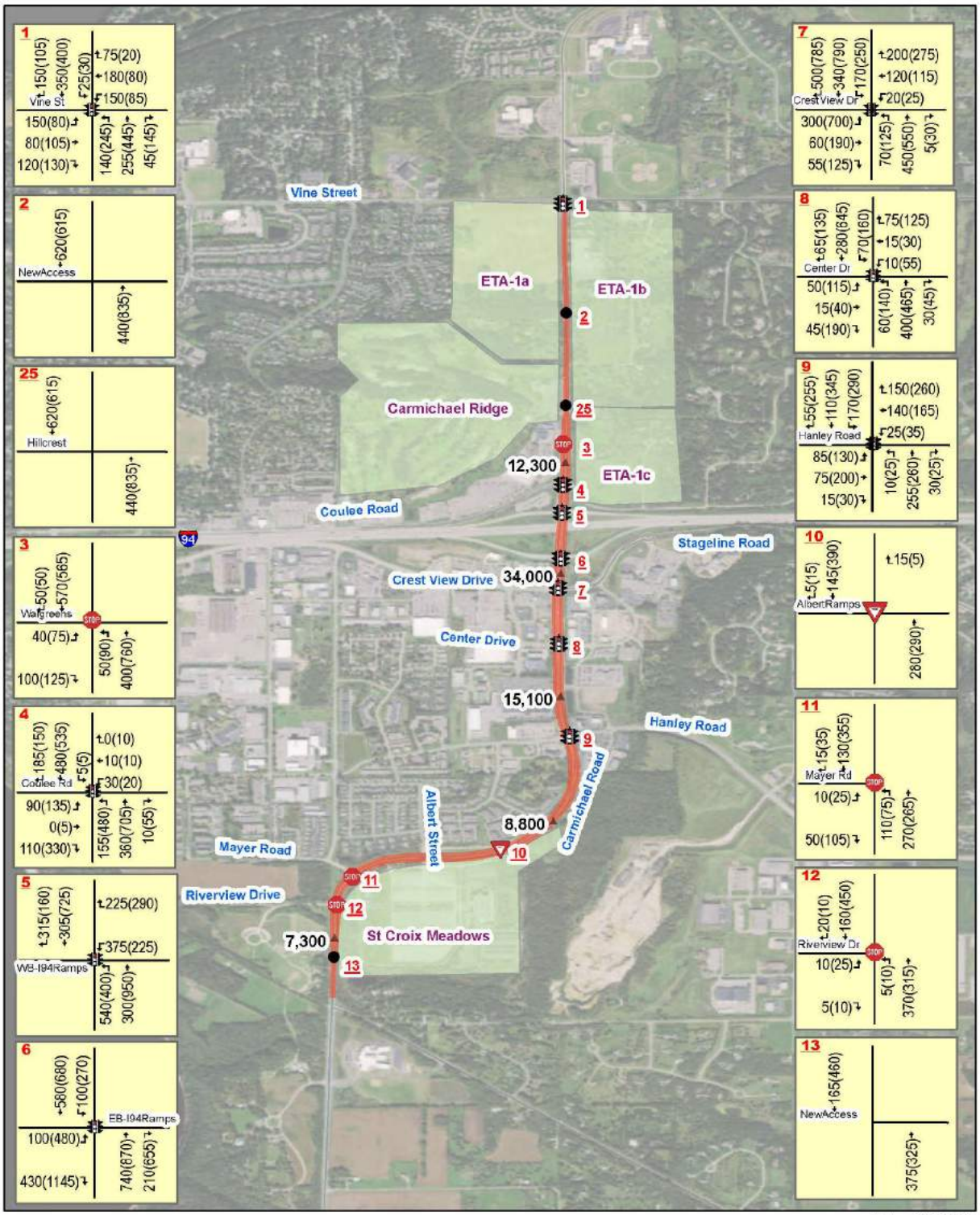
CRS: NAD 1983 HARN WISCRS St Croix County Feet
Source:

ETA-1c NEW TRIPS DIRECTIONAL DISTRIBUTIONS

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 10



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EXISTING PEAK HOUR TURNING MOVEMENTS (2017)

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 11

Legend

x% Annual Background Growth Rate

Date: 1/8/2018

N
W
E
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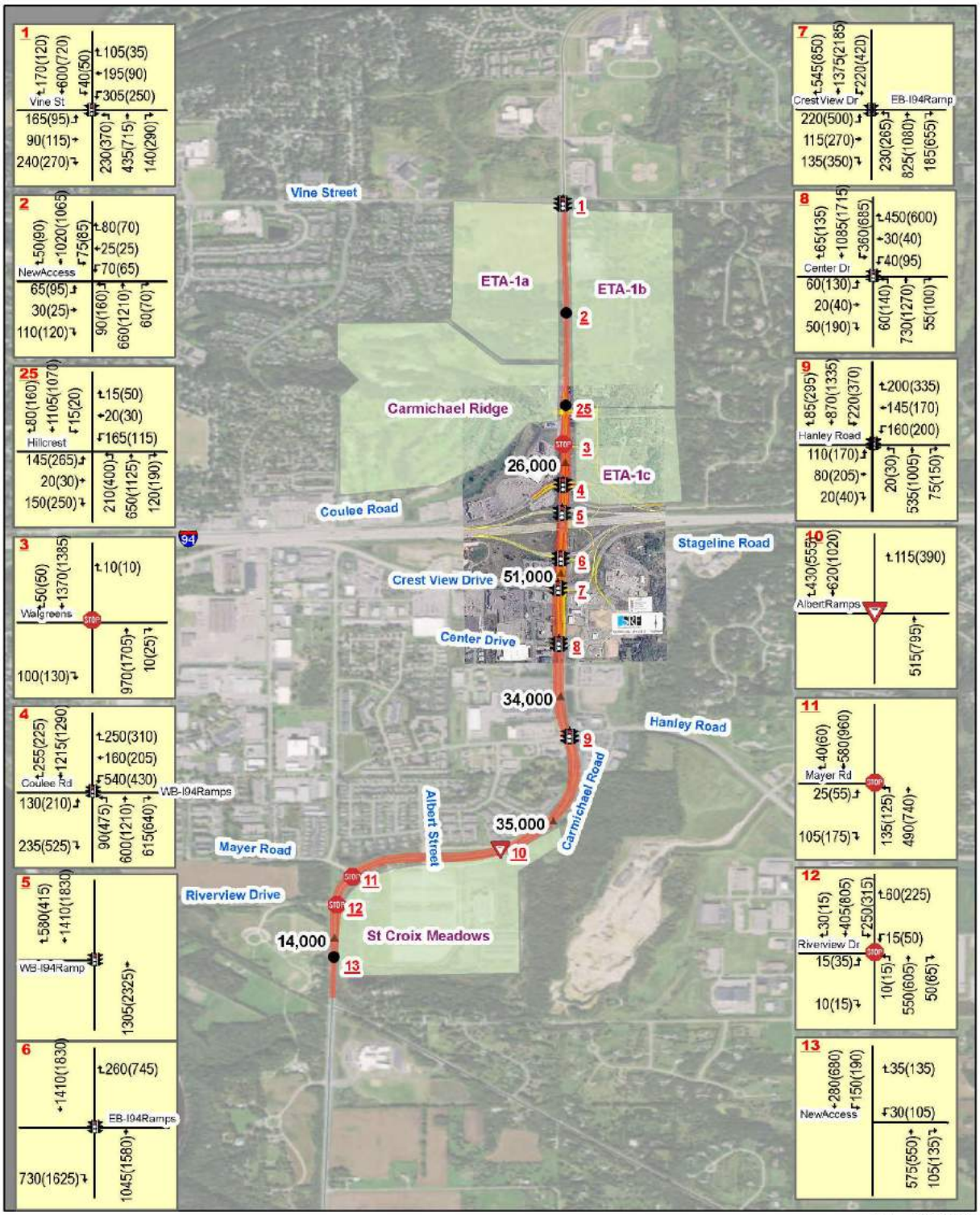
BACKGROUND ANNUAL GROWTH RATE

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 12



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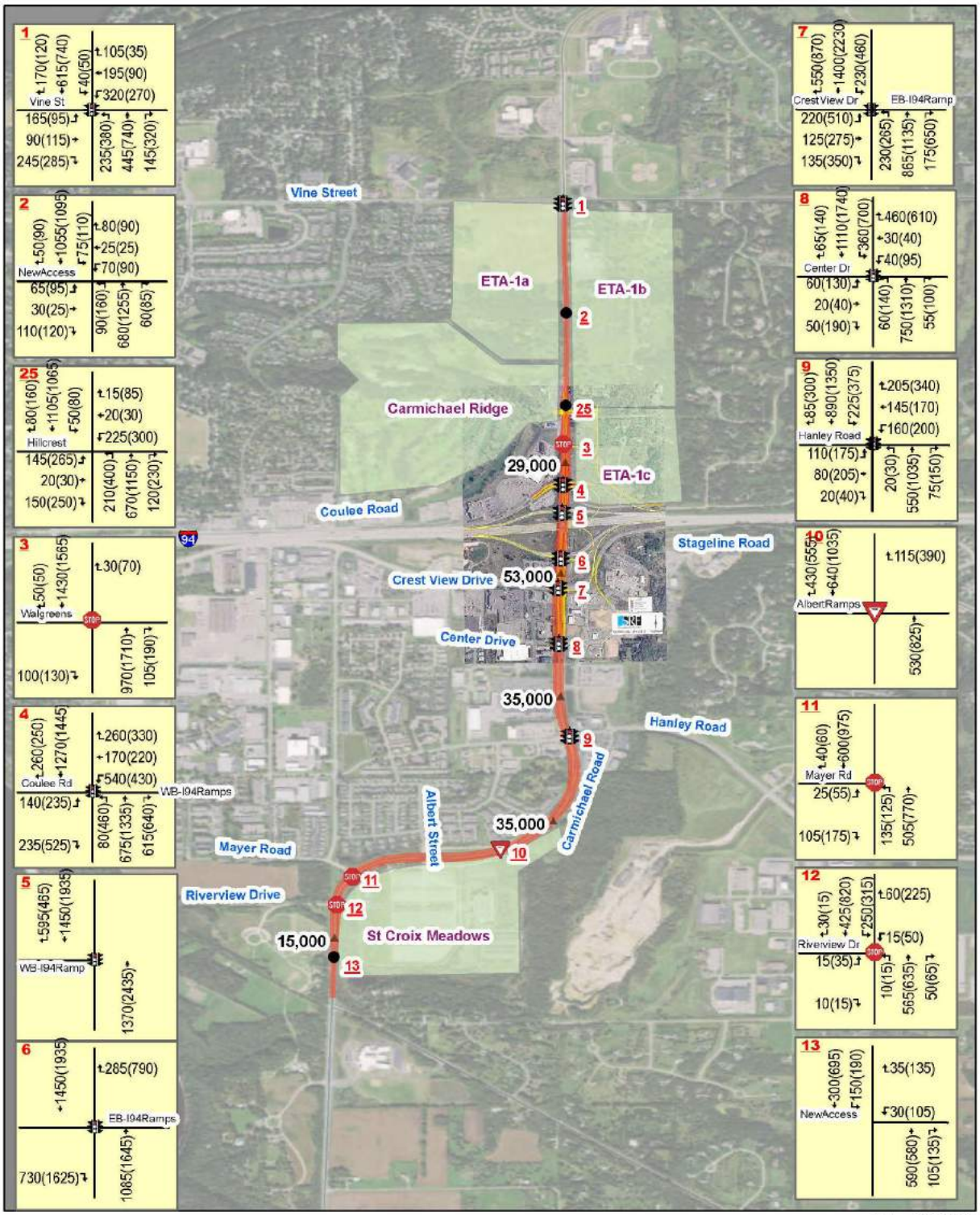
Source:

2040 PEAK HOUR TURNING MOVEMENTS (ETA-1c: SINGLE FAMILY)

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 13



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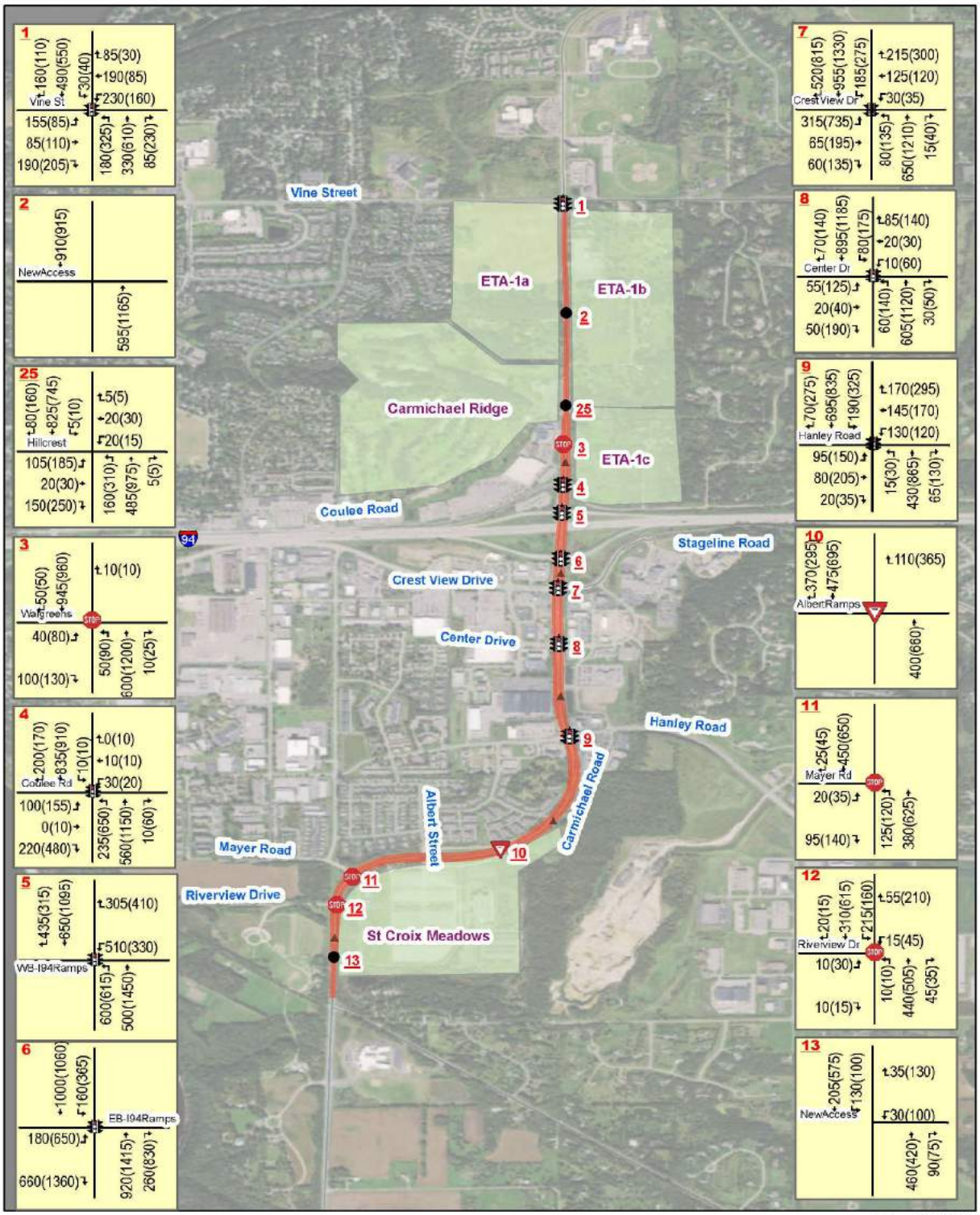
Source:

2040 PEAK HOUR TURNING MOVEMENTS (ETA-1c: WALMART)

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 14



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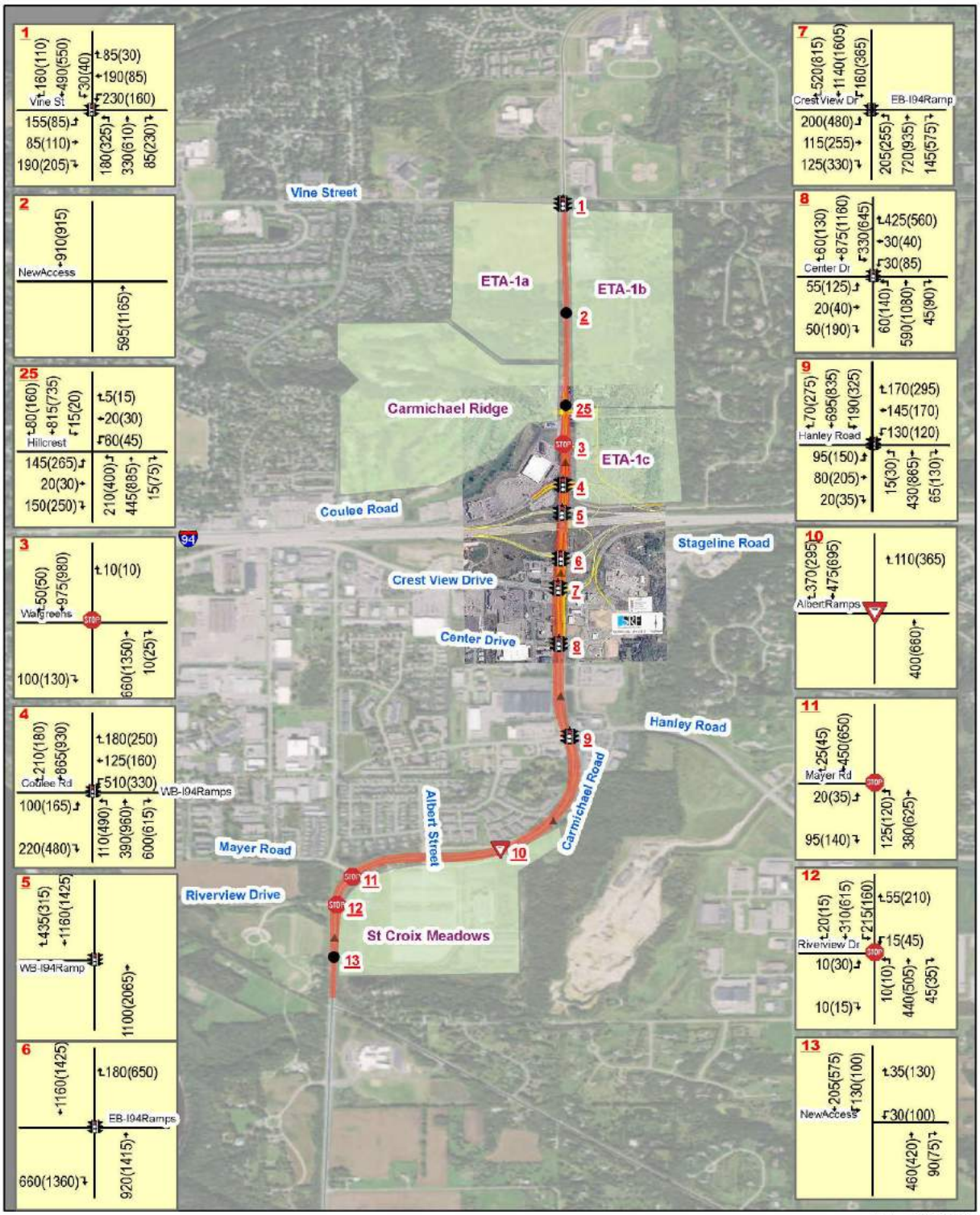
Source:

2025 INTERCHANGE NO-BUILD PEAK HOUR TURNING MOVEMENTS

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 15



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Source:

2025 INTERCHANGE BUILD PEAK HOUR TURNING MOVEMENTS

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 16

Carmichael Road Study
Hudson, WI
2025 Preferred Interchange Alternative (8:00-9:00 AM Weekdays)

TOTAL DELAY 98.3 VEH-HRS

TOTAL STOPS 9,650

Intersection	App	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queuing Information (feet)															
																Left Lane Group						Primary Lane Group (usually center/thru lanes)						Right Lane Group			
																		Queue Lengths		Lane Blockages				Queue Lengths		Lane Blockages				Queue Lengths	
		L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Type (LTR)	Storage (ft)	Avg.	Max	Blocking→	Blocking←	Type (LTR)	Link Length (ft)	Avg.	Max	Blocking→	Blocking←	Type (LTR)	Storage (ft)	Avg.	Max
Carmichael Rd & Vine St/County UU (Signal)	NB	180	330	85	595	31.4	C	16.4	B	3.1	A	19.1	B			L	302	82	173			T	3313	80	197			R	3313	11	48
	SB	30	490	160	380	31.1	C	33.5	C	9.6	A	28.0	C	24.4	C							LT	931	253	456	13%	22 veh			R	235	51	257
	EB	155	85	190	430	27.4	C	31.4	C	8.7	A	20.0	C			L	199	84	163	0%	0 veh	6%	22 veh	T	1035	59	139	6%	22 veh	3%	6 veh	R	80	58	124
	WB	230	190	85	505	32.3	C	35.0	D	7.1	A	29.1	C			L	186	117	222	2%	6 veh	1%	4 veh	T	1322	98	214	1%	4 veh			R	150	17	56
Carmichael Rd & I Illinest (Signal)	NB	210	445	15	370	31.8	C	4.3	A	0.6	A	12.7	D			L	165	98	232	3%	6 veh	0%	0 veh	T	467	41	160			R	135	2	16
	SB	15	815	80	910	11.5	B	20.1	C	9.9	A	19.1	B	19.5	B	L	100	8	43			4%	1 veh	T	3313	177	335	25%	20 veh	8%	0 veh	R	100	34	178
	EB	145	20	150	315	39.4	D	41.2	D	15.1	B	28.0	C			L	200	90	161					T	935	12	42			0%	0 veh	R	230	45	130
	WB	60	20	5	85	46.8	D	48.3	D	6.0	A	44.4	D			L	480	45	143	0%	0 veh			T	480	18	60					R	200	4	24
Carmichael Rd & Walgreens (Stop)	NB	0	960	10	370			1.6	A	1.4	A	1.6	A											T	467	4	60								
	SB	0	975	50	1025			3.7	A	2.6	A	3.6	A	3.6	A																		
	EB	0	0	100	100					16.2	C	16.2	C																	R	936	43	108
	WB	0	0	10	10					4.5	A	4.5	A																	R	432	6	24
Carmichael Rd & CoLlee Rd/I-94 WB ramp/loop (Signal)	NB	110	390	600	1100	44.2	D	7.0	A	3.6	A	9.1	A			L	369	52	111					T	369	54	123					R	359		6
	SB	0	965	210	1075			22.2	C	4.6	A	18.8	B	19.8	B									T	510	183	361	6%	12 veh			R	230	34	156
	EB	100	0	220	320	50.2	D			23.0	C	31.3	C			L	1333	52	128											0%	0 veh	R	200	98	206
	WB	510	125	180	815	37.6	D	29.7	C	13.4	B	31.0	C			L	150	152	256	8%	4 veh	0%	0 veh	T	369	53	219	0%	0 veh			TR	359	90	211
Carmichael Rd & I-94 N Ramp/EB to WB ramp (Stop)	NB	0	1100	0	1100			2.4	A			2.4	A																				
	SB	0	1160	435	1595			2.1	A	6.1	A	3.2	A	2.9	A																		
	EB	0	0	0	0																												
	WB	0	0	0	0																												
Carmichael Rd & I-94 EB exit ramp/loop (Signal)	NB	0	920	0	920			5.9	A			5.9	A											T	456	66	185						
	SB	0	1160	0	1160			11.0	B			11.0	B	10.4	B									T	641	122	284						
	EB	0	0	660	360					8.3	A	8.3	A																	R	1251	138	362
	WB	0	0	180	180					37.4	D	37.4	D																	R	523	67	141
Carmichael Rd & Crest View Dr/I-94 EB entrance (Signal)	NB	205	720	145	1070	34.9	C	9.1	A	5.5	A	13.6	B			L	329	71	136			T	600	62	132					R	325	28	86
	SB	160	1140	520	1820	34.1	C	18.1	B	12.1	B	17.8	B	18.1	B	L	189	56	103			0%	0 veh	T	456	109	226								
	EB	200	115	125	440	39.1	D	34.4	C	14.2	B	30.9	C			L	452	80	153	1%	1 veh			T	452	43	98					TR	452	56	160
	WB	0	0	0	0																												
Carmichael Rd & Center Dr/Stageline Rd (Signal)	NB	60	590	45	395	44.3	D	21.7	C	4.9	A	22.6	C			L	201	49	119			0%	0 veh	T	585	88	199	4%	2 veh			R	138	18	54
	SB	330	675	60	1285	24.9	C	10.6	B	2.7	A	13.8	B	16.4	B	L	250	95	157					T	800	59	141					R	800	5	39
	EB	55	20	50	125	33.0	C	37.9	D	11.2	B	24.9	C			L	033	32	89					T	033	12	40					R	133	20	82
	WB	30	30	425	485	27.5	C	33.0	C	9.8	A	12.2	B			L	93	14	55			0%	0 veh	T	1154	15	54	0%	0 veh			R	1154	94	222
Carmichael Rd & Harley Rd (Signal)	NB	15	430	65	310	13.4	B	14.1	B	2.8	A	12.6	B			L	156	8	35			0%	0 veh	T	856	72	149	0%	6 veh			R	159	17	57
	SB	190	695	70	955	17.0	B	12.1	B	3.5	A	12.4	B	17.0	B	L	241	75	167	0%	0 veh	0%	0 veh	T	748	119	222								
	EB	95	80	20	195	45.1	D	29.5	C	7.8	A	24.2	C			L	287	66	141			0%	0 veh	T	1479	51	114	0%	0 veh			R	120	15	33
	WB	130	145	170	445	40.5	D	33.3	C	2.8	A	23.7	C			L	287	71	163					T	1273	78	171								
Carmichael Rd & Albert St Ramps (Stop)	NB	0	0	110	110			0.0	A	0.1	A	0.1	A																				
	SB	0	0	0	0									0.4	A																		
	EB	0	400	0	400			0.4	A			0.4	A																				
	WB	0	475	370	845			0.3	A	0.5	A	0.4	A																				
Carmichael Rd & Mayer Rd (Stop)	NB	125	380	0	505	4.1	A	0.3	A			1.3	A			L	338	30	73														
	SB	0	450	25	475			0.8	A	0.3	A	0.8	A	1.6	A															R	254		5
	EB	20	0	95	115	16.6	C			3.6	A	6.0	A			L	119	16	47											R	939	27	64
	WB	0	0	0	0																												
Carmichael Rd & R/verview Dr (Stop)	NB	10	440	45	495	1.8	A	1.0	A	0.5	A	1.0	A			LT	311	4	50					TR	811	1	12								
	SB	215	310	20	545	5.0	A	2.1	A	0.3	A	3.2	A	2.5	A	LT	467	43	114														
	EB	10	0	10	20	16.2	C			3.8	A	9.6	A											LTR	730	14	48						
	WB	15	0	55	70	18.3	C			5.4	A	7.6	A											LTR	733	33	80						
Carmichael Rd & St Croix Meadows new access (Stop)	NB	0	480	90	550			0.7	A	0.7	A	0.7	A																				
	SB	130	305	0	335	5.2	A	0.7	A			2.4	A	1.7	A																		
	EB	0	0	0	0																												
	WB	30	0	35	65	11.1	B			3.7	A	7.0	A			L	393	20	73					LR	513		86			R		24	
Albert St & Carmichael Rd N Ramp (Stop)	NB	0	50	0	50			0.2	A			0.2	A																				
	SB	0	50	0	50			0.2	A			0.2	A	4.2	A																		
	EB	0	0	0	0																												
	WB	247	0	123	370	5.7	A			4.8	A	5.4	A			L	392	37	73					LR	513	53	86						
Albert St & Carmichael Rd S Ramp (Stop)	NB	0	50	73	123			0.4	A	0.2	A	0.3	A																				
	SB	37	260	0	297	7.7	A	0.6	A			0.9	A	0.7	A	LT	268	6	36														
	EB	0	0	0	0																												
	WB	0	0	0	0																												

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Project: HUDSO 142677
Date: 9/19/2018

Map by: thastings
CRS: NAD 1983 HARN WISCRS St Croix County Feet
Source:

SAMPLE: SYNCHRO/SIM TRAFFIC PRINTOUT: 2025 AM

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 17a

Carmichael Road Study
Hudson, WI
2025 Preferred Interchange Alternative (4:30-5:30 PM Weekdays)

TOTAL DELAY 293.4 VEH-HRS

TOTAL STOPS 18,695

Intersection	App	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queuing Information (feet)																
																Left Lane Group					Primary Lane Group (usually center/thru lanes)						Right Lane Group				
																		Queue Lengths		Lane Blockages				Queue Lengths		Lane Blockages				Queue Lengths	
		L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Type (L-TR)	Storage (ft)	Avg.	Max	Blocking →	Blocking ←	Type (LTR)	Link Length (ft)	Avg	Max	Blocking →	Blocking ←	Type (LTR)	Storage (ft)	Avg.	Max
Carmichael Rd & Vine St/County UU (Signal)	NB	325	610	230	1165	39.0	D	17.1	B	5.2	A	20.3	C			L	302	140	278	0% 1 veh	1% 4 veh	T	3313	141	351	1% 4 veh		R	3313	27	90
	SB	40	650	110	700	98.2	F	91.3	F	41.0	D	83.6	F	40.6	D							LT	681	647	866	47% 53 veh		R	206	184	303
	EB	95	110	205	400	34.8	C	43.5	D	9.1	A	23.9	C			L	199	59	112		16% 48 veh	T	1185	69	197	16% 48 veh	3% 6 veh	R	90	86	105
	WB	160	85	30	275	50.8	D	41.0	D	10.7	B	43.2	D			L	194	109	217	2% 3 veh	0% 0 veh	T	1322	48	197	0% 0 veh		R	160	9	30
	NB	400	895	75	1360	32.2	C	8.5	A	1.9	A	15.1	B			L	185	179	323	14% 62 veh	1% 2 veh	T	467	105	340	0% 0 veh		R	185	11	42
Carmichael Rd & Hillcrest (Signal)	SB	20	735	160	915	46.4	D	64.5	E	43.3	D	60.4	E	33.7	C	L	100	20	100	0% 1 veh	27% 5 veh	T	3313	321	900	46% 74 veh	0% 1 veh	R	100	102	250
	EB	295	30	250	575	49.1	D	42.3	D	19.2	B	34.6	C			L	200	174	306	9% 26 veh	0% 0 veh	T	996	19	132	0% 0 veh	1% 3 veh	R	200	86	206
	WB	45	30	15	90	44.5	D	59.1	E	10.5	B	44.5	D			L	480	28	79			T	480	28	86			R	200	9	33
Carmichael Rd & Walgreens (Stop)	NB	0	1350	25	1375			3.0	A	1.7	A	3.0	A															R	204	25	156
	SB	0	980	60	1030			19.8	C	4.7	A	19.0	C	18.1	C							T	467	88	249	13% 6 veh		R	204	25	156
	EB	0	0	130	130					184.8	F	184.8	F															R	836	171	456
	WB	0	0	10	10					13.0	B	13.0	B															R	432	7	32
Carmichael Rd & Coulee Rd/I-94 WB ramp/loop (Signal)	NB	430	360	615	2005	44.9	D	8.5	A	3.6	A	16.1	B			L	369	182	286			T	369	118	301						
	SB	0	930	180	1110			60.3	E	13.7	B	52.5	D	31.9	C							T	510	282	463	22% 38 veh		R	230	103	320
	EB	155	0	180	335	57.3	E			31.9	C	36.9	D			L	1393	85	319	0% 1 veh							15% 13 veh	R	200	272	392
	WB	330	160	250	740	50.1	D	42.9	D	29.0	C	41.5	D			L	150	128	236	4% 3 veh	1% 2 veh	T	369	92	262	1% 2 veh		TR	309	143	275
Carmichael Rd & I-94 N Ramp/SB to WB ramp (Stop)	NB	0	2065	0	2065			2.6	A			2.6	A																		
	SB	0	1425	315	1740			18.9	C	4.7	A	14.7	B	9.0	A							T	369	219	404						
	EB	0	0	0	0																										
	WB	0	0	0	0																										
Carmichael Rd & I-94 EB exit ramp/loop (Signal)	NB	0	1415	0	1415			5.3	A			5.3	A									T	456	67	147						
	SB	0	1425	0	1425			75.5	E			75.5	E	58.8	E							T	641	639	729						
	EB	0	0	1360	1360					109.3	F	109.3	F															R	1251	1047	1314
	WB	0	0	650	650					41.1	D	41.1	D														3% 10 veh	R	522	258	430
Carmichael Rd & Crest View Dr/I-94 EB entrance (Signal)	NB	255	935	575	1765	50.1	D	13.6	B	19.5	B	20.4	C			L	329	113	189			T	800	94	178		3% 10 veh	R	225	144	274
	SB	365	1605	815	2785	16.8	B	25.1	C	16.5	B	21.5	C	26.9	C	L	169	78	123		12% 45 veh	T	456	229	364			R	456	70	435
	EB	490	255	330	1005	46.5	D	44.2	D	43.1	D	44.9	D			L	452	178	306	19% 47 veh		T	452	130	292			TR	452	207	390
	WB	0	0	0	0																										
Carmichael Rd & Center Dr/Stageline Rd (Signal)	NB	140	1080	90	1310	59.7	E	34.9	C	11.4	B	35.8	D			L	201	117	234	1% 2 veh	10% 14 veh	T	565	246	424	33% 39 veh		R	138	68	304
	SB	645	1160	130	1935	31.3	C	15.9	B	3.4	A	20.0	C	28.6	C	L	250	161	245	0% 1 veh		T	800	101	203			R	800	11	39
	EB	125	40	190	355	61.7	D	39.3	D	22.6	C	30.6	C			L	933	76	170		0% 0 veh	T	933	26	111	0% 0 veh	3% 1 veh	R	133	79	184
	WB	95	40	560	695	36.7	D	40.5	D	21.6	C	24.5	C			L	98	51	119	2% 1 veh	0% 0 veh	T	1154	28	70	0% 0 veh		R	1154	213	422
Carmichael Rd & Hanley Rd (Signal)	NB	90	885	130	1025	14.8	B	18.3	B	6.4	A	16.7	B			L	156	17	51		4% 1 veh	T	958	134	358	4% 6 veh	0% 0 veh	R	159	37	126
	SB	522	635	275	1435	20.0	C	8.7	A	5.3	A	12.8	B	28.4	C	L	211	147	288	3% 14 veh	0% 0 veh	T	748	108	188	0% 0 veh		R	211	2	30
	EB	100	265	80	445	178.8	F	47.2	D	20.0	C	96.0	F			L	287	303	309	25% 60 veh	7% 14 veh	T	1479	233	484	7% 14 veh	0% 0 veh	R	126	22	111
	WB	120	170	295	585	97.6	F	27.3	D	4.5	A	29.6	C			L	287	162	254	2% 4 veh	0% 0 veh	T	1273	70	220	0% 0 veh		R	1273	9	172
Carmichael Rd & Albert St Ramps (Stop)	NB	0	0	265	265					0.4	A	0.4	A																		
	SB	0	0	0	0									0.5	A																
	EB	0	660	0	660			0.7	A			0.7	A																		
	WB	0	695	295	990			0.3	A	0.8	A	0.4	A																		
Carmichael Rd & Mayer Rd (Stop)	NB	120	625	0	745	6.5	A	0.6	A			1.5	A			L	339	35	86												
	SB	0	650	45	695			1.0	A	0.5	A	1.0	A	2.1	A													R	284	1	17
	EB	35	0	140	175	25.9	D			5.1	A	9.3	A			L	119	22	59									R	939	35	74
	WB	0	0	0	0																										
Carmichael Rd & Riverview Dr (Stop)	NB	10	405	35	450	3.7	A	1.3	A	0.8	A	1.3	A			LT	811	4	54			TR	811	1	12						
	SB	160	615	15	790	5.4	A	1.7	A	0.4	A	2.4	A	5.2	A	LT	467	39	103			TR	467	1	25						
	EB	30	0	15	45	26.8	D			6.8	A	21.3	C									LTR	750	38	82						
	WB	45	0	210	255	32.7	D			16.6	C	19.3	C									LTR	733	96	251						
Carmichael Rd & St Croix Meadows new access (Stop)	NB	0	420	75	495			0.8	A	0.8	A	0.8	A																		
	SB	100	575	0	675	4.8	A	1.0	A			1.6	A	2.3	A																
	EB	0	0	0	0																										
	WB	100	0	130	230	12.3	B			4.4	A	7.7	A			L	392	41	81			LR	513		81			R		43	
Albert St & Carmichael Rd N Ramp (stop)	NB	0	50	0	50			0.4	A			0.2	A																		
	SB	0	50	0	50			0.2	A			0.2	A	3.7	A																
	EB	0	0	0	0																										
	WB	197	0	98	295	5.4	A	0.0	A	4.0	A	4.9	A			L	392	41	81			LR	513	45	81						
Albert St & Carmichael Rd S Ramp (Stop)	NB	0	50	243	293			1.6	A	0.8	A	0.9	A									TR	603	1	21						
	SB	122	125	0	247	4.1	A	0.7	A			2.4	A	1.6	A	LT	266	30	80												
	EB	0	0	0	0																										
	WB	0	0	0	0																										

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CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 17b

Two Loops with Modified Frontage Roads (Concept D)

Geometric changes

- Addition of loops in the northeast and southeast quadrants
- East ramps to/from I-94 connect at Coulee Road and Crest View Drive
- East frontage roads are relocated farther away from I-94
- Bridge widening required

September 30, 2014

12

94 I-94, Hudson Area Interchange Study

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WISDOT PREFERRED ALTERNATE; 2014

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 18

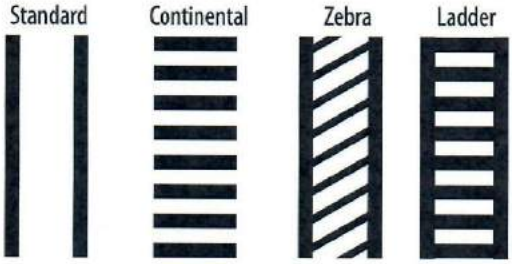

Exhibit 5-56: Common styles of crosswalk markings used in Wisconsin.

intersections, steps should be taken to ensure that motorists turn slowly and that motorists and pedestrians have advantageous sight distances.

Intersection crosswalks can be marked or unmarked. Marked crosswalks are beneficial because they inform motorists and pedestrians that they are in, or are approaching, the pedestrian right of way. Marked crosswalks also can be used to advise pedestrians of the best place to cross the street. Marked crosswalks are best used in combination with other treatments such as traffic signals, reduced speeds, signs, and pavement striping, color, or height changes. Under certain conditions, marked crosswalks may be used to supplement an existing or new traffic control feature.

The MUTCD permits four primary styles of crosswalk markings (Exhibit 5-56):

- Continental style: consists of a series of unconnected white longitudinal bars placed perpendicular to the pedestrian direction of travel and positioned to avoid the wheel paths of vehicles. The bars should be 1 to 2 feet wide and be placed 1 to 5 feet apart. The continental style is the most visible crosswalk marking style for motorists and is often the preferred option for higher pedestrian volumes.
- Standard style: consists of two solid white transverse lines not less than 6 inches wide, but often as wide as one-foot. The 2009 MUTCD allows up to 2 feet wide.
- Zebra style: similar to the standard style in that it consists of two solid white transverse lines. However, unlike the standard style, the two solid white transverse lines are connected at regular intervals by solid white diagonal bars. The bars should be 1 to 2 feet wide and be spaced 1 to 2 feet apart.
- Ladder style: combines the continental style and the standard style.

Exhibit 5-57: Contrasting colors can be used to demarcate the crosswalk, but white crosswalk lines should still be used in addition.

Refer to the MUTCD or the Wisconsin Manual of Traffic Control Devices (WMUTCD) for more information on styles of crosswalk markings.

For all styles of crosswalk markings, the marked crosswalk should typically be 6 feet to 8 feet wide. The minimum acceptable width for a crosswalk is 6 feet. The marked crosswalk should be wider (10 feet or greater) in special situations such as connecting a shared-use path, accommodating pedestrians within a pedestrian mall, or where pedestrian volumes are high. The marked crosswalk should completely contain curb ramps and other sloped areas within it, excluding any flared sides. The crosswalk lines should extend the full length of the crosswalk at unsignalized or uncontrolled crosswalks, in school zones, or areas where there is a substantial pedestrian presence, special emphasis styles of crosswalk markings should be considered such as the continental or zebra styles to increase visibility. The continental style is often recommended because it is most visible to motorists. However, it is also regarded as more expensive to maintain. High-contrast markings may also aid pedestrians with visual impairments. The MUTCD has not yet developed guidance for use of these types of markings however.

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Source: Wisconsin Guide to Best Pedestrian Practices

CROSSWALK MARKINGS
CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 19

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SYNCHRO SCREENS
VINE AND CARMICHAEL

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 20

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SYNCHRO SCREENS
HILLCREST AND CARMICHAEL

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 21

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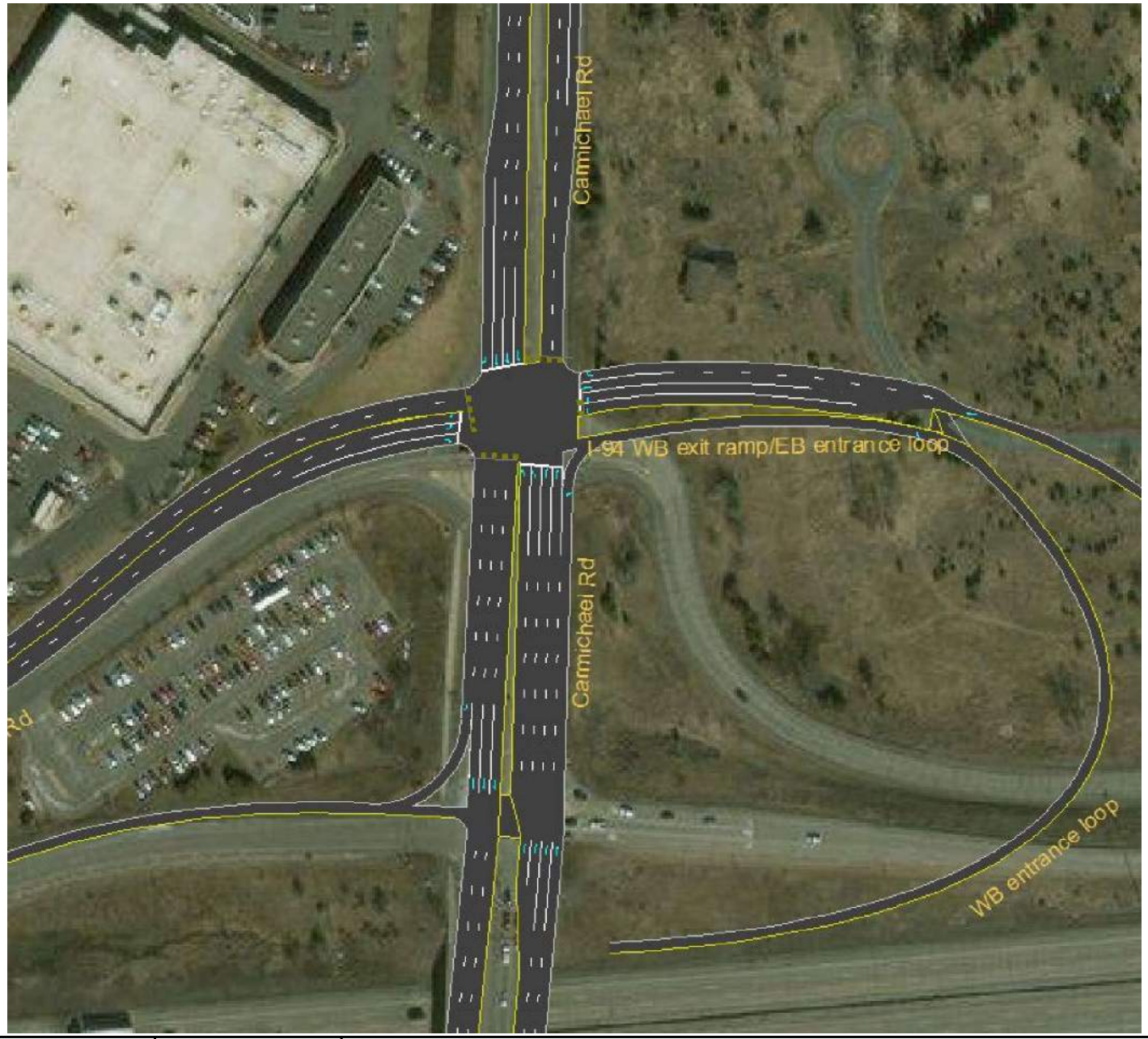
SYNCHRO SCREENS
WALGREENS AND CARMICHAEL

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 22



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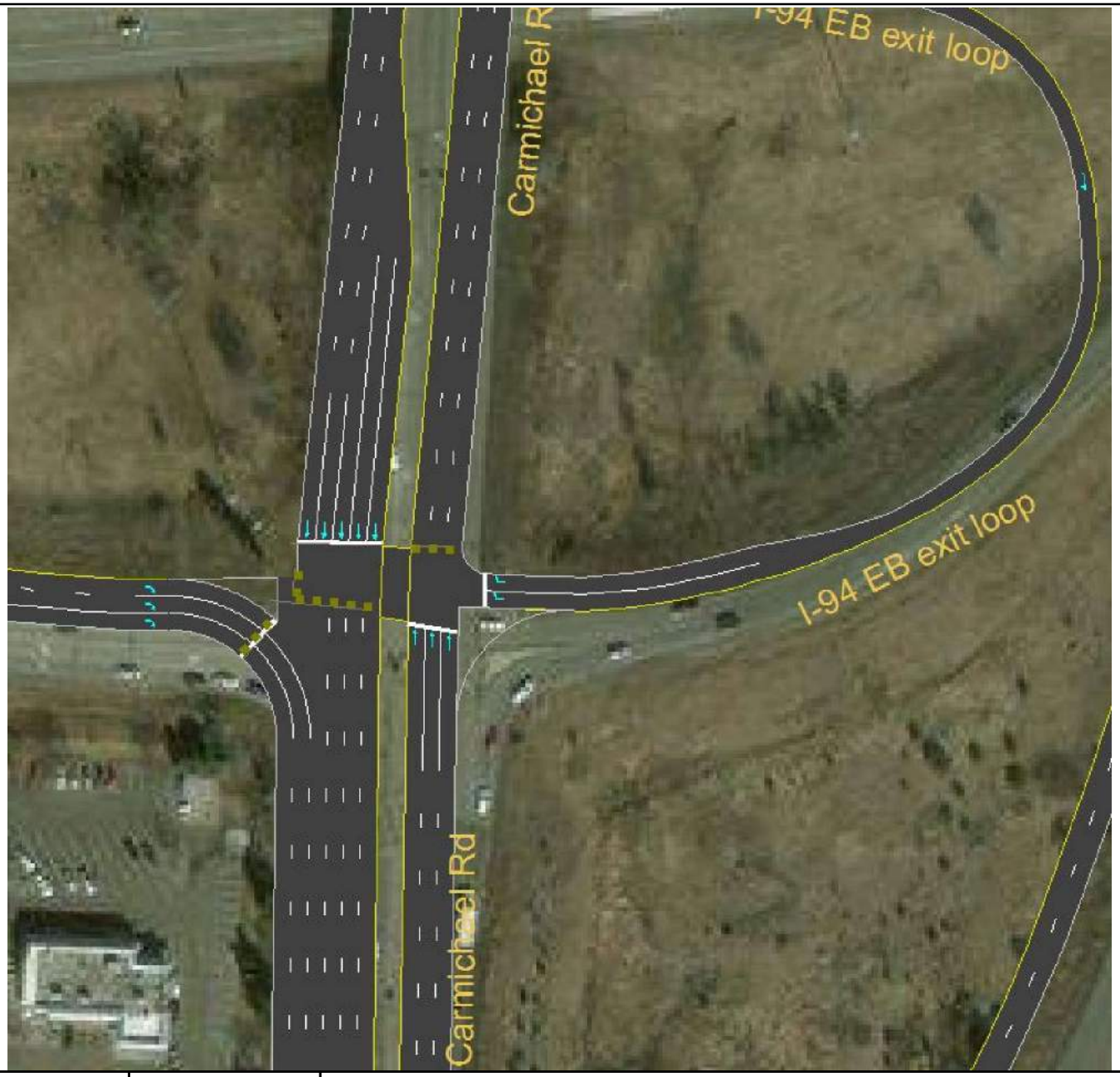
SYNCHRO SCREENS
COULEE AND CARMICHAEL

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 23



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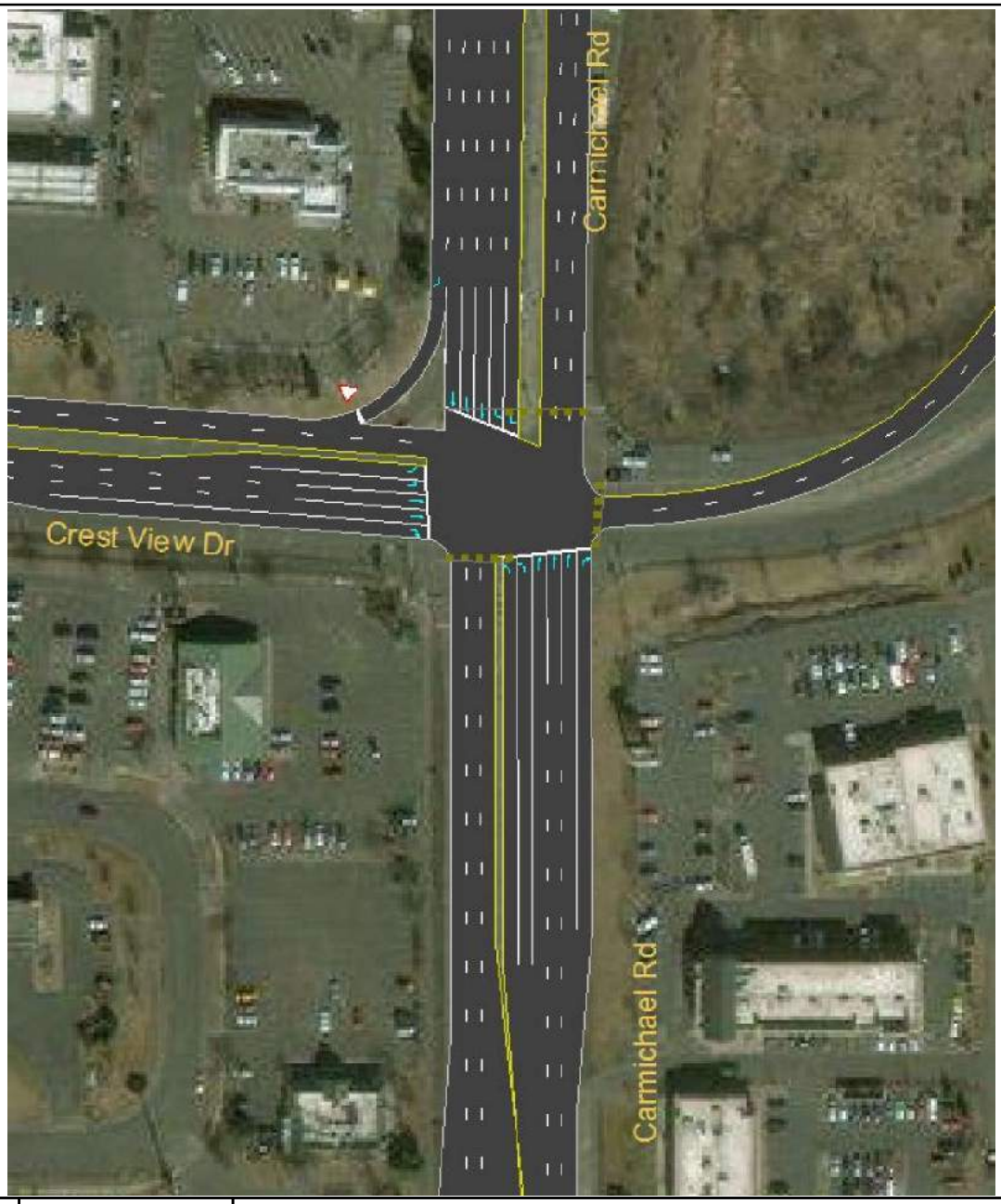
SYNCHRO SCREENS
SOUTH 94 RAMPS AND CARMICHAEL

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 24



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SYNCHRO SCREENS
CREST VIEW AND CARMICHAEL

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 25

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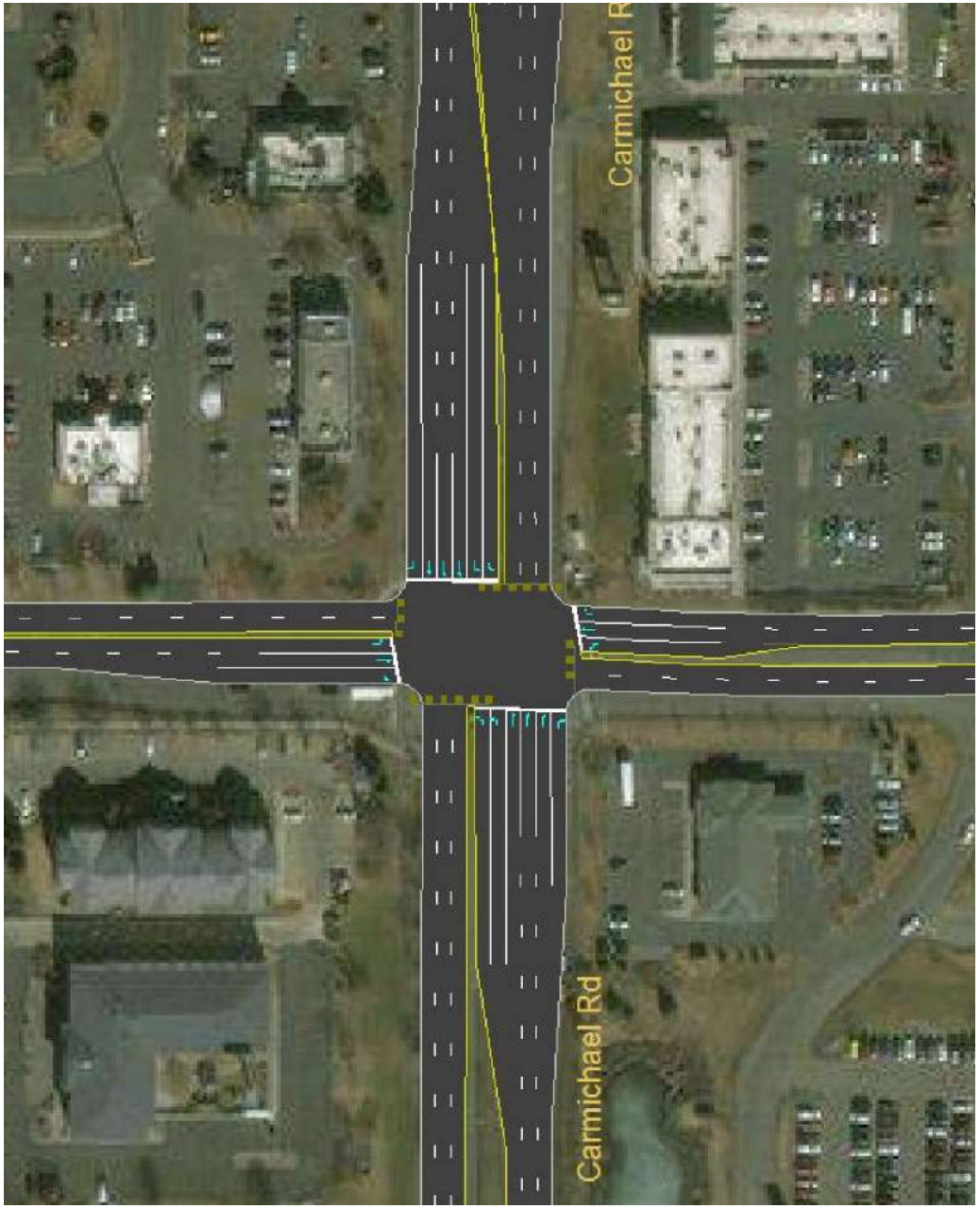

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SYNCHRO SCREENS CENTER AND CARMICHAEL

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 26

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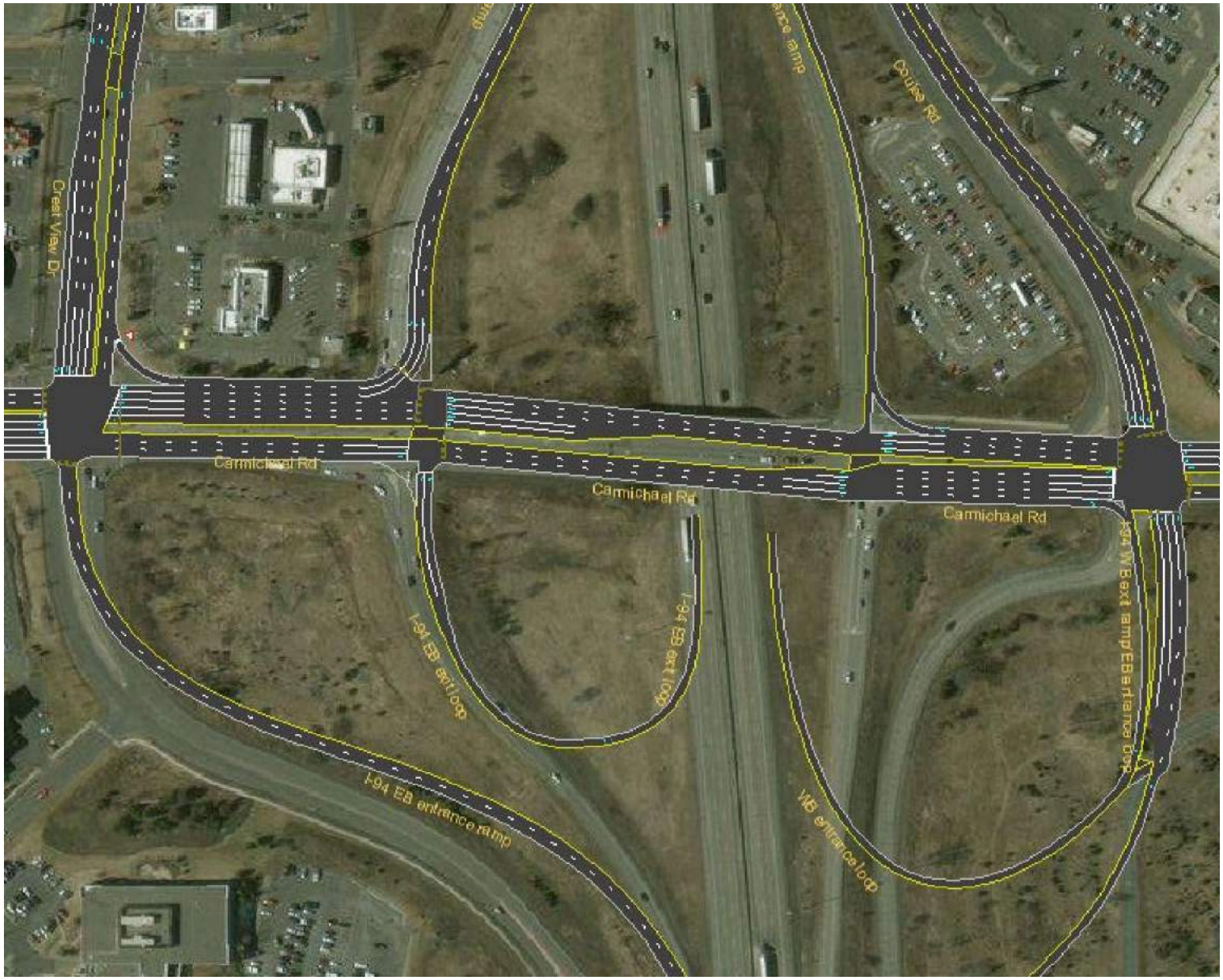
SYNCHRO SCREENS
HANLEY AND CARMICHAEL

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 27



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SYNCHRO SCREENS
COULEE TO CREST VIEW AND CARMICHAEL

CARMICHAEL CORRIDOR STUDY
Hudson, Wisconsin

Figure 28

Appendix A

Selected Pages of the Comprehensive Transportation Plan

Local Street System

Carmichael Road

Carmichael Road provides one of two continuous north/south routes through the city connecting CTH A on the north and CTH F south of Hudson. As discussed above, this road is a primary access to and across I-94 creating significant traffic on the roadway. Carmichael Road is a six lane divided roadway from the I-94 interchange area south to Center Drive with dual turn lanes at many locations. Further south, the roadway transitions from a four-lane divided roadway to a two-lane roadway as CTH F near Coulee Trail at the city's southern limits. On the north side of the city, Carmichael Road is a two-lane facility with turn lanes at major intersections transitioning to a four-lane road from south of Deer Haven Drive to the I-94 interchange.

Carmichael Road is one of two connections across I-94 and one of two full accesses to I-94 in the city of Hudson. As such, Carmichael Road serves regional and local trip purposes and is classified as a Principal Arterial. The Carmichael Road corridor provides regional access to the majority of the city's non-downtown commercial, institutional and industrial land uses. Commercial land uses are concentrated at the Carmichael Road/I-94 interchange and the I-94 frontage roadways (Coulee Road and Crestview Drive). The 2006 AADT was 29,900 north of Crestview Drive.

The spacing between the I-94 ramp terminals and the Crestview Drive and Coulee Road intersections is 535-feet and 450-feet, respectively. The intersection spacing and the volume of turning traffic through this segment of Carmichael Road requires a well designed signal coordination plan for the intersections to operate at optimum efficiency. Though there have been attempts to improve operations along Carmichael Road in the past with modifications to traffic signals and geometry, motorists continue to report excessive stopping and long queues of traffic.

The intersection spacing and the volume of turning traffic through this segment of Carmichael Road requires a well designed signal coordination plan for the intersections to operate at optimum efficiency.

Carmichael Intersection at ...

State and Regional Plans

WisDOT has planned for the expansion of I-94 to provide an additional lane in the westbound direction from the STH 12 interchange to the St. Croix River bridge in 2014. The expansion will eventually extend east to STH 65. The addition of a third through lane westbound will not eliminate the existing auxiliary lanes between ramp terminals in the Hudson area. The project will impact the area between I-94 and Coulee Road; however, the width of the existing lanes on Coulee Road will not change. Resurfacing work is also scheduled to take place along I-94 beginning in 2010.

The DOT is also conducting a study in 2009 along I-94 at the STH 12 and STH 35 South interchanges. The study will evaluate various alternatives to address the congestion eastbound between STH 35 and STH 12. Modeling of the corridor, including the Carmichael Road/I-94 interchange, will be completed to determine what modifications to the interchanges would improve operations.

WisDOT also recently published Connections 2030; the statewide long-range multimodal plan centered around seven themes. As part of the plan's Mobility and Transportation Choice theme, WisDOT committed to supporting the creation of new regional transit authorities.

The St. Croix County comprehensive planning process also began in the fall of 2008; thus, the document and transportation plan are not complete at this time.

Local and Area Plans

Carmichael Road/I-94 Area

Background

I-94 is a major element in the Hudson Transportation System and is an origin or destination for many Hudson trips. There is a high demand for access to I-94. Currently, there are two full interchanges and an additional single westbound on-ramp. At the same time, I-94 is one of several barriers to traffic flow in Hudson. Access across I-94 is limited to two locations. Since the main access across I-94, which is Carmichael Road, coincides with one of the two interchanges, there is a considerable amount of traffic (22,000 ADT on Carmichael Road) and congestion in that area. Reducing the congestion, delays, and undesirable stopping in the Carmichael Road corridor is a major objective for the Hudson transportation system. Numerous suggestions have been made in the past and some have been implemented. However, the congestion remains and is a major source of irritation to area motorists and business owners.

Carmichael Road

Approach

To reduce the congestion in the Carmichael Road area, in both the short term and long term, a three step process is suggested.

1. The existing signal system consists of traffic signals on Carmichael Road at Coulee Road, the westbound I-94 ramps, the eastbound I-94 ramps, Crestview Drive, Center Drive and Hanley Road, and the intersection of Crestview Drive and Gateway Boulevard. These may be physically interconnected. There is a mixture of phasing, including split phasing on either the main line or cross streets at some intersections. Based on limited observations, the system does not appear to be operating at peak efficiency.

   The most economical way to improve traffic flow would be to optimize the traffic signal coordination. A simulation model should be utilized and a variety of concepts tested in the model. This may require some traffic data collection to determine not only turning movement volumes but travel patterns through the system. Having the "through movement" use Crestview Drive to the west and Carmichael Road to the north is a coordination concept to consider. Having the Center Drive and Hanley Road signals run as an independent signal system is another concept.

   A final intersection and phasing concept for the system should be determined and the optimized timing should be developed and installed on the signal controllers, assuming the necessary interconnection cabling is in-place and any desirable phasing changes can be made. The system should be observed during implementation and modified if necessary in the field, noting the results.

2. The simulation model should again be run, this time with a series of potential lane rearrangements or additions. There are several dual left turns and one triple left turn in place. Some turn lanes become designated lanes later in the interchange area. One concept to test is the closure of the median on Crestview Drive at Gateway Boulevard. This by itself may not be desirable, but if it is a key to an improved flow of traffic in the area, some mitigating design may make it possible. Another concept might include provision of three or four eastbound through lanes on Crestview Drive at Gateway Boulevard to provide continuity with the three left turn lanes and single through lane at Carmichael Road. Additional single or dual right and left turn lanes at intersections should be considered. This approach would provide options for short term improvements.

3. A third series of simulation model runs should be made testing larger concept impacts on traffic flow. An interesting concept is the provision of a direct connection from eastbound I-94 to Crestview Drive as a slip ramp from the exit ramp, keeping this heavy "two right turn" movement off Carmichael Road. Moving the Coulee Road intersection to the north side of the Target/Fresh Foods development is another concept. The eastbound entrance ramp to I-94 could be realigned to come from Stageline Road instead of Carmichael Road which provides opportunities to reduce turn conflicts on Carmichael Road. Developing a loop ramp which merges onto the east side of northbound Carmichael Road for the eastbound I-94 to northbound movement also reduces conflicts. These, and potentially several others, will require concept designs to complete the evaluation. The simulation model could be run first to determine the amount of benefit any of the concepts will provide to the Carmichael Road area.

Underscoring the importance of pursuing this phased approach is the study that WisDOT will be conducting in 2009 along I-94 at the STH 12 and STH 35 South interchanges. The study will include the Carmichael Road/I-94 interchange and consider, and possibly test future interchange design alternatives at this location. It will be critical that the City pursue the phased study of improvements for Carmichael Road prior to the I-94/STH 12 study such that they can provide WisDOT with an informed local perspective of operations of not only the Carmichael Road interchange but the Carmichael Road corridor and the surrounding roadway network.

11th Street/Heggen Street

Background

A second access across I-94 occurs with the 11th Street/Heggen Street Bridge. This corridor connects to Hanley Road on the south and to Vine Street via Wisconsin Street on the north. A major role of the Heggen Street Bridge over I-94 is the connection of Crestview Drive on the south and Coulee Road on the north, which provides, among other things, a connection between the commercial and industrial area on the hill and the downtown area.

Approach

The intersections on both sides of the bridge, at Coulee Road and at Crestview Drive, should be reviewed for the most efficient use of turn lanes and traffic controls. All-way stop control, traffic signals and coordination, free flow right turn lanes, and left and right turn lanes should be among the options considered.

The desirability of increasing traffic flow on the 11th Street/ Heggen Street corridor should be evaluated. Sending more traffic down Coulee Road into the already congested downtown area may not be desirable. Increasing traffic volumes on 11th Street, Wisconsin Street or Laurel Avenue, all residential in nature, may also have limited appeal in the city.

Additional Connections Across I-94

Background

Removal of a portion of traffic crossing I-94 at the Carmichael Road interchange will reduce congestion in the interchange. With numerous destinations for shopping and employment on the south side and many residential trip generators on the north side, there are a lot of local and regional trips not using I-94, but still in the Carmichael Road interchange area. Building a nearby, convenient, alternate route across I-94 would reroute some traffic and reduce congestion in the interchange area.

Three problems exist with this concept. One is limited information on the origin and destination of non-freeway traffic in the Carmichael Road interchange area. A second is the relatively flat terrain and amount of development in the area making location of the crossing (bridge or tunnel) difficult. The third is the lack of continuity of the street system in the area.

Approach

An origin destination study of the commercial areas north and south of I-94 would provide useful information on trips ends and routes of traffic in the area. Since any long term improvement, such as a bridge or tunnel, would be expensive and require prime right of way, the cost of an origin/destination study would be relatively inexpensive and be of great value in final decisions on the best concept, the best route and whether a concept is a "go or a no go". Preliminary information could be obtained from individual businesses in the form of zip code or customer data, or from license plate registration checks of vehicles in business parking lots. License plate matching is another option.

Preliminary concepts for an additional I-94 crossing west of Carmichael Road have very limited "touchdown points" where the bridge or tunnel would meet the existing elevation of the area without impacting other components of the transportation system or prime land uses. Several concept sketches should be prepared. These could include a connection to a new road behind Target and Fresh Foods which would align with Ward Avenue. The south touchdown point could lead to revisions in the Rest Area and the Gateway Boulevard/Crestview Drive intersection area. Another concept could be a "semi-split diamond" interchange design, which would incorporate a similar new I-94 crossing. This

might allow an expanded Park and Ride site. Several concept sketches of various options were generated in the development of the Transportation Plan and would be a good starting point for this approach.

Coulee Road and Ward Avenue

Background

Coulee Road served as a frontage road for Highway 12 and now as a frontage road for I-94. It also is one of the few routes between Downtown Hudson and the commercial area on the hill. Coulee Road intersects Carmichael Road just north of the I-94 interchange. Most of the commercial properties along Coulee Road have one or more driveways.

Ward Avenue is an east/west street a block north of Coulee Road between 13th Street and the Hudson Country Club east of 19th Street. Many of the businesses fronting Coulee Road have back access to Ward Avenue. A shopping center is located on the north side of Ward Avenue east of 17th Street. West of 17th Street, there is a mix of commercial, multi-family residential and single family residential.

Some of the concepts reviewed as part of the analysis for access to or across I-94 involved relocating the Coulee Road intersection with Carmichael Road to the north side of the Target Store. This could be a relocated Coulee Road near the current east end of Ward Avenue.

Approach

Relocating the east end of Coulee Road, providing a new bridge across I-94, and/or some of the more extreme design concepts for the Carmichael Road interchange would result in a new roadway north of the Target store and perhaps other stores. This could lead to extension of Ward Avenue east to Carmichael Road and some connections to existing Coulee Road. This extension could be coupled with a new bridge over I-94 which would provide the distance and elevation for the north side connection.

Target, Fresh Foods, and a few other businesses have parking lots which would connect to existing or extended Ward Avenue. Other businesses would need to revise their existing buildings and parking lots to be oriented to Ward Avenue. If any of the existing Coulee Road properties were to redevelop, vacation of a part of Coulee Road and orientation to Ward Avenue may make the change in orientation more viable.

The biggest problem facing extension of Ward Avenue to the east is the impact on the Hudson Country Club. The construction of the Target development already required relocation of a portion of the golf course and construction of a substantial retaining wall.

Appendix B

St. Croix County Bicycle Plan, Corridor 1

Corridor 1: I-94-River Crest Elementary School Connection

Corridor Overview

The bikeway recommendations for Corridor 1 are intended to provide better connections between the south end of downtown Hudson and other existing bikeways and trails that create important regional connections. The segment along 2nd Street, between the intersection with Coulee Road and Interstate 94, improves upon the existing sidewalk connection to the separated path across the I-94 bridge, providing safer access for trips to and from Minnesota to the City of Hudson and its existing bikeways. With the connection to Coulee Road providing much needed access across the interstate highway at the 11th Street overpass, the commercial areas along and south of I-94 can be reached from the significantly lower-lying area along the river. Since Coulee Road ascends considerably from 2nd Street to 11th Street, this segment is best served with the proposed separated bike path.

To the south of I-94, the corridor serves bicycle and pedestrian trips to employment areas with connections to an existing path along Crest View Drive and to the industrial park. Continuing south in the Town of Troy, this corridor provides for safe travel to River Crest Elementary School and the YMCA's Camp St. Croix, while creating connections to existing trails along S. Carmichael Road and Coulee Trail, and to the trails and the bicycle/pedestrian underpass of County Highway F in the vicinity of the elementary school. This corridor also improves bicycle travel to Troy Beach, just south of the corridor along the river.

Figure 2-12: Corridor 1 Alignment

Alignment Description

- **Existing 5-foot wide sidewalk (I-94 bridge to the 2nd Street/Coulee Road intersection): Path**
  - Remove existing 5-foot wide sidewalk and replace with a minimum 10-foot wide path.
  - Minor earthwork may be needed.
  - Choke point: Existing W-Beam guardrail and steep slope makes widening difficult along the curve along 2nd Street (near St Croix Marina).
  - Careful design will be needed for the intersection transition at 2nd Street and Coulee Road, paying attention to the movement from the path to the separated bike lane across the intersection.
- **Coulee Road (2nd Street to 11th Street): Separated Bike Lane**
  - Roadway is approximately 34 feet (wider at intersections).
  - Preferred option: Two 10.5-foot travel lanes plus a single two-way separated bike lane (10-foot width plus 3-foot buffer) on Northeast side of the street.
  - Alternative: Two 11-foot travel lanes plus one two-way separated bike lane (9-foot width plus 3-foot buffer) on Northeast side of the street.
- **11th Street (bridge over I-94): Bike Lanes**
  - Bridge is approximately 42 feet wide, not including the sidewalk.
  - Proposed cross section: Two 11-foot travel lanes, one 10-foot left turn lane, and two 5-foot bike lanes.
  - Alternative: Reconfigure the roadway to include two 10.5-foot travel lanes, a 10-foot wide left turn lane, and a single two-way separated bike lane (9-foot width plus 2-foot buffer) on the west side of the bridge adjacent to the sidewalk.
- **Heggen Street (Crest View Drive to Hanley Road): Bike Lanes**
  - Existing path measures approximately 8 feet wide.
  - Existing roadway measures approximately 34 feet wide.
  - Proposed cross section: Two 11-foot travel lanes and two 6-foot bike lanes.
  - At the intersection with Crest View, may need to narrow travel lanes to approximately 10.5 feet to fit 5-foot wide bike lanes.
  - Alternative: Widen existing sidepath to 10 feet to accommodate bicyclists and pedestrians adequately.
- **Hanley Road (Heggen Street to Industrial Street): Bike Lanes**
  - Existing roadway measures approximately 34 feet wide.
  - Proposed cross section: Two 11-foot travel lanes and two 6-foot bike lanes.
  - Alternative: Construct a 10-foot wide sidepath on the south side of the road.
- **Industrial Street (Hanley Road to Mayer Road): Bike Lanes**
  - Existing roadway measures approximately 34 feet wide.
  - Proposed cross section: Two 11-foot travel lanes and two 6-foot bike lanes.
  - Alternative: Construct a 10-foot wide sidepath on either side of the road.
- **Mayer Road (Industrial Street to Carmichael Road): Bike Lanes**
  - The width of Mayer Road varies from about 27 feet to 44 feet.
  - Proposed cross section: Two 11-foot travel lanes and two 6-foot bike lanes (the turn lane at O'Keefe Road would be 10 feet wide).
  - At the intersection of Mayer Road and Carmichael Road, the proposed cross section is two 11-foot turn lanes, one 11-foot westbound lane, and two 5-foot bike lanes.
  - Pinch point at intersection of Industrial Street and Mayer Road. Near this intersection, the roadway is too narrow for bike lanes on both sides of the street for a length of approximately 200 feet.
    - Short Term: Shared lane markings on the north (westbound) side of the street and bike lane on the south (eastbound) side. Alternatively, a 10-foot wide path on the north side of the street and bike lanes on the south side.
    - Long Term (when roadway is reconstructed): Widen roadway to fit bike lanes.

- **Carmichael Road (Mayer Road to existing path underpass at River Crest Elementary School): Sidepath**
  - Construct a 10-foot wide sidepath on the west side of the road.
  - Steep slopes along the right-of-way will likely require drainage work and earthwork/grading.
  - Significant grading may be required to connect to the existing path near the underpass.
  - Significant clearing and grubbing may be required for portions of the path.
  - Existing W-Beam guardrail may make the connection to the existing path underpass more difficult.
  - Due to these factors, the cost estimate for this segment is increased by 25 percent.
- **Carmichael Road (Mayer Road to Albert Street): Path**
  - Construct a 10-foot wide sidepath on the west side of the road to connect to existing sidepath that terminates at Albert Street.
  - Connection from Carmichael Road to Albert Street is steep and may require switchback(s).

Planning Level Cost Estimate

The estimated cost of constructing the recommended bikeway facilities within this corridor is $1,080,000 This includes $302,000 for the replacement of 0.86 miles of existing sidewalk with a path, $240,000 for 0.89 miles of separated bike lanes, $58,000 for 1.59 miles of bike lanes, and $480,000 for 0.82 miles of path. Outside variables not included in this estimate are the cost of design, right-of-way acquisition, or changes to signalized traffic control.

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