# Roundabout Justification Report

## *Eagle Creek Boulevard at Vierling Drive*

***In the City of Shakopee, Minnesota***

***State Aid Project No.: 166-104-012 (Vierling Drive)***

***State Aid Project No.: 166-131-002 (Eagle Creek Blvd)***

**City of Shakopee**

SRF

September 2023

SRF No. 023 14532

# Roundabout Justification Report

## *Eagle Creek Boulevard at Vierling Drive*

Proposed Letting Date: January 2024

**Report Certification:**

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Brent Clark — Print Name
57198 — Reg. No.

Signature
9/20/2023 — Date

**Approved:**

City of Shakopee
City Engineer
9/21/23 — Date

Lucas Lortie Digitally signed by Lucas Lortie
Date: 2023.09.22 13:33:03 -05'00'

For MnDOT
Metro District State Aid Engineer
Date

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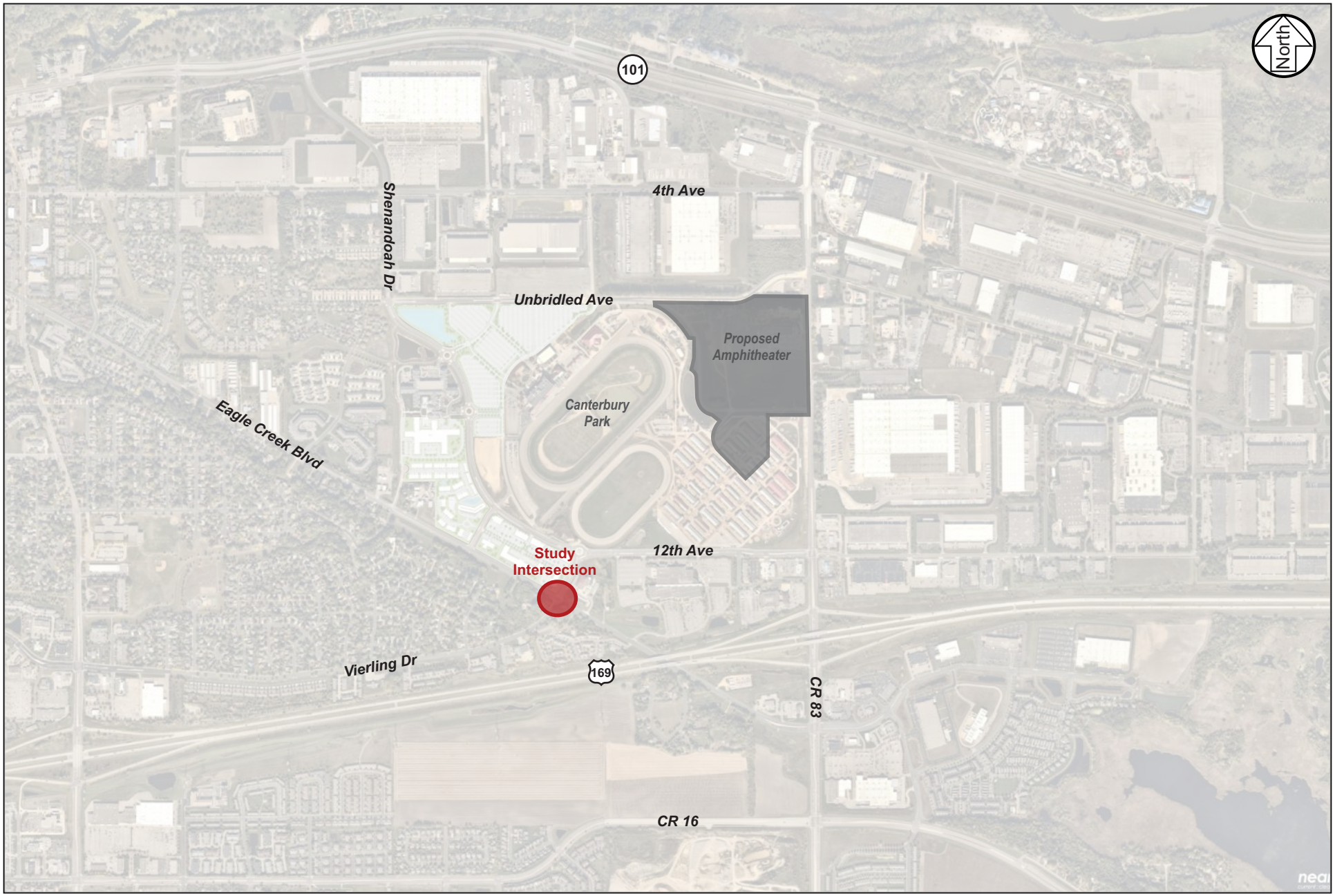
# Project Description

This roundabout justification report has been prepared for the Eagle Creek Boulevard/Vierling Drive intersection located in the City of Shakopee (see Figure 1). This report is the result of recommendations/assumptions made from previous studies completed within the study area:

- *Canterbury Commons Areawide Assessment*, SRF Consulting (July 2018)
    - Provided a comprehensive areawide review of planned developments and infrastructure surrounding Canterbury Park.
    - Identified existing safety issues at the Eagle Creek Boulevard/Vierling Drive intersection and recommended a roundabout be constructed to improve safety and better delineate right-of-way.
    - The assessment also recommended that Vierling Drive (from Eagle Creek Boulevard to Miller Street) and Eagle Creek Boulevard (from Vierling Drive to Marshall Road) be considered for four- to three-lane conversions to improve safety, reduce speeds, and enhance pedestrian/bicyclist facilities.
        - Note a roundabout at the study intersection could also provide a transition point for potential future 3-lane conversions.
- *Canterbury Event District EAW Transportation Analysis*, SRF Consulting (January 2022)
    - Documented the issues and proposed mitigation strategies/improvements associated with events at the proposed 19,000-capacity amphitheater adjacent to Canterbury Park.
    - Based on discussions with City staff, a roundabout was assumed to be constructed at the Eagle Creek Boulevard/Vierling Drive intersection prior to the amphitheater opening. Note the study intersection is one of the primary access points to Canterbury Park and the proposed amphitheater, and a roundabout is expected to accommodate event traffic surges more effectively than the current all-way stop control.

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## Intersection Location

Roundabout Justification Report
Eagle Creek Boulevard at Vierling Drive
Shakopee, Minnesota

02315876
July 2023

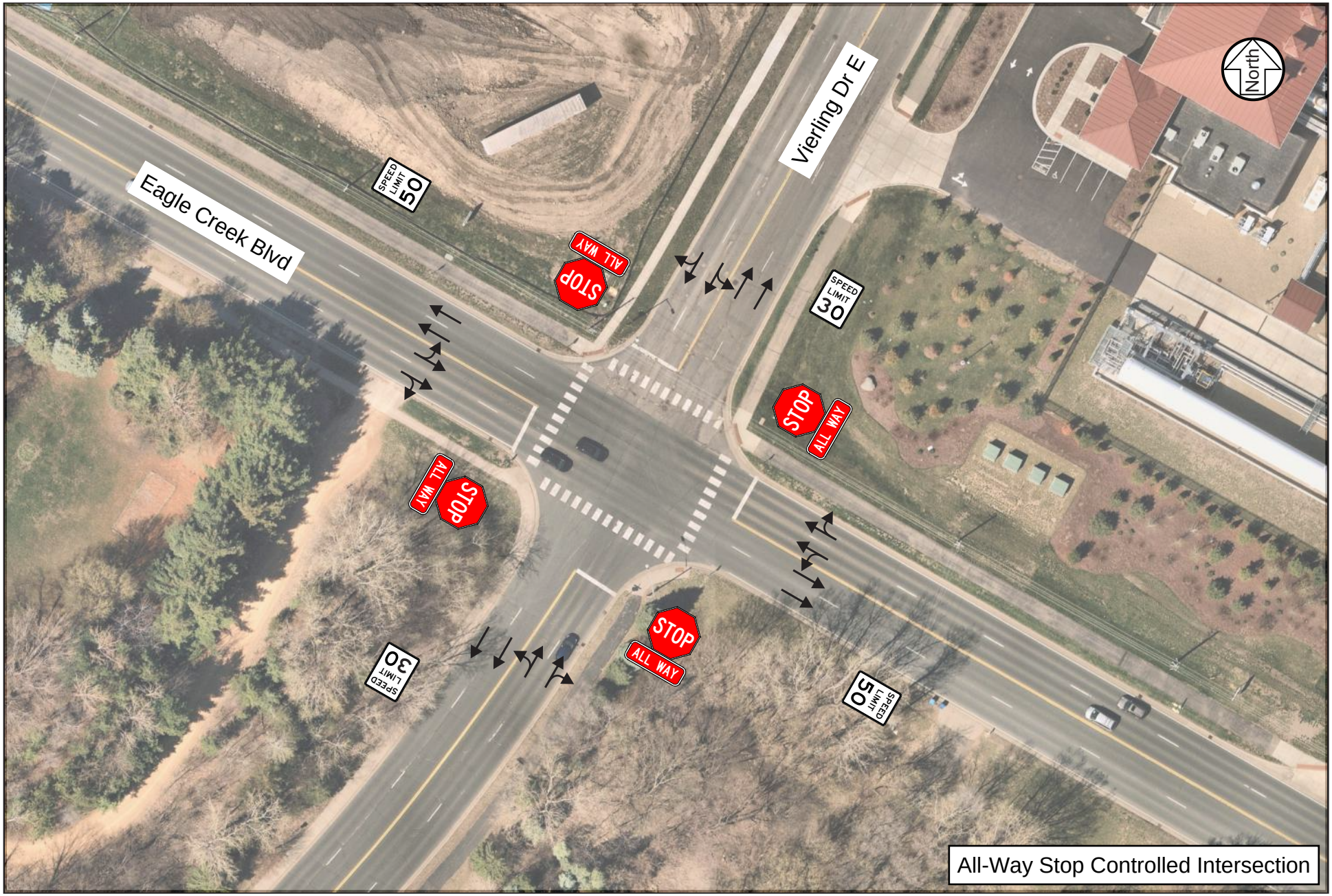
**Figure 1**

## Existing Conditions

The Eagle Creek Boulevard/Vierling Drive intersection is currently under all-way stop control (AWSC). Eagle Creek Boulevard is a four-lane undivided roadway that is functionally classified as a Minor Arterial with a posted speed limit of 50 miles per hour (mph). Vierling Drive is a four-lane undivided roadway that is functionally classified as a Major Collector with a posted speed limit of 30 mph. The current intersection geometrics are listed in Table 1 and shown in Figure 2.

**Table 1. Existing Conditions**

| Approach | Lane Configurations |
|---|---|
| Eastbound Eagle Creek Boulevard | One shared left-thru lane and one shared right-thru lane |
| Westbound Eagle Creek Boulevard | One shared left-thru lane and one shared right-thru lane |
| Northbound Vierling Drive | One shared left-thru lane and one shared right-thru lane |
| Southbound Vierling Drive | One shared left-thru lane and one shared right-thru lane |

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## Existing Conditions

Roundabout Justification Report
Eagle Creek Boulevard at Vierling Drive
Shakopee, Minnesota

14532
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**Figure 2**

## Proposed Conditions

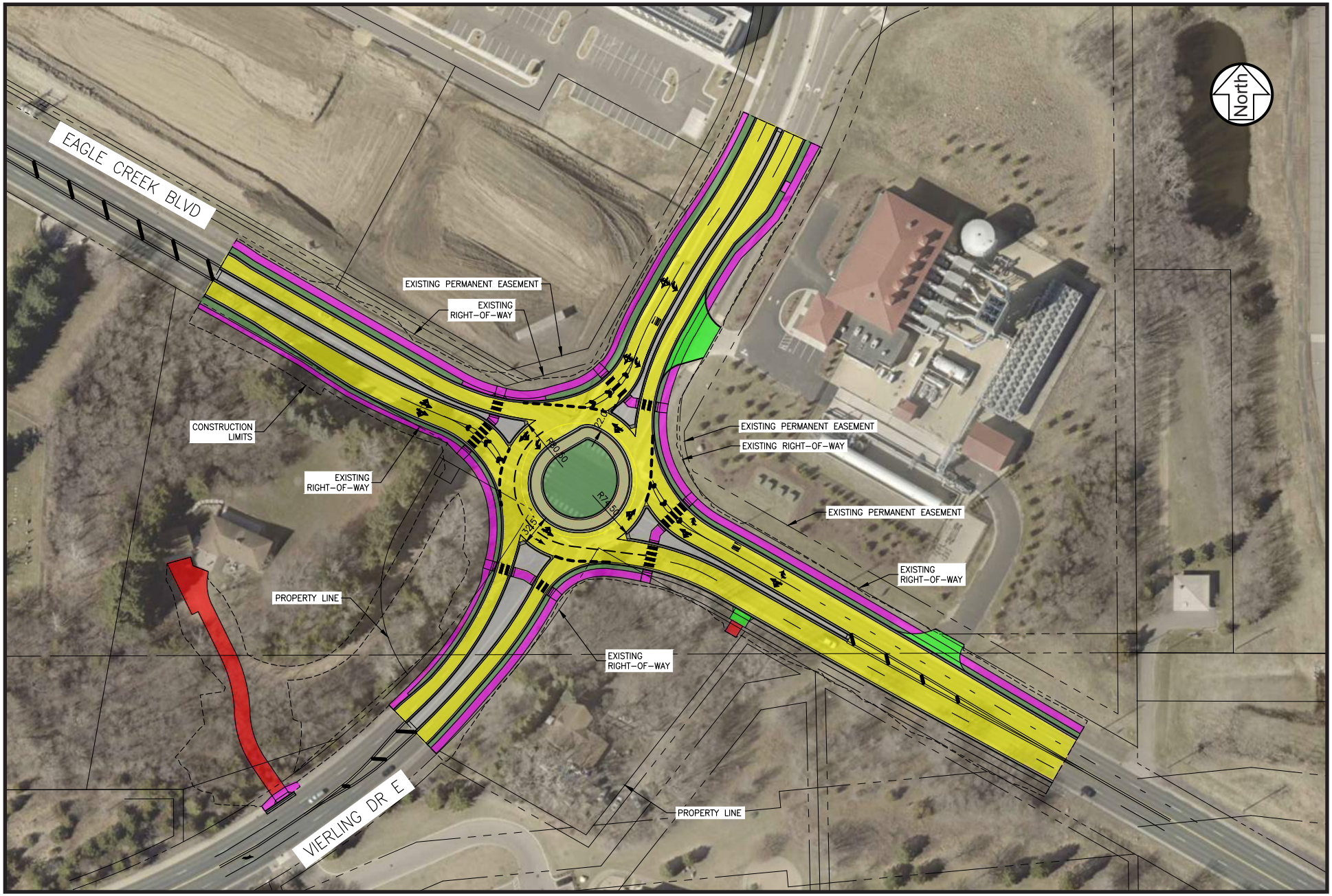
Previous studies have recommended/assumed a roundabout control at the Eagle Creek Boulevard/Vierling Drive intersection to mitigate existing safety issues and manage event traffic associated with Canterbury Park and the proposed amphitheater. While a traffic signal could be considered to help accommodate event traffic surges, a traffic signal may not mitigate the existing safety issues and the existing lane configurations with a signal may cause additional friction and driver confusion. Therefore, a traffic signal alternative was eliminated from consideration for the project.

While a smaller roundabout footprint may be adequate for non-event conditions, the proposed roundabout configuration was designed to accommodate frequent event conditions expected within the area. As mentioned previously, a 19,000-capacity amphitheater is proposed adjacent to Canterbury Park and is expected to have approximately 40-60 annual events from May to October. The *Canterbury Event District EAW Transportation Study* identified that several visitor, rideshare, and shuttle vehicles are expected to be coned/directed to exit the site and utilize the Eagle Creek Boulevard/Vierling Drive intersection during post-event conditions. During larger events, over 1,100 vehicles are expected to route to the intersection within 30-45 minutes post-event, with most vehicles destined eastbound to access US 169. Therefore, to help facilitate this movement and reduce significant queuing and delay, a hybrid roundabout with a dual southbound left-turn configuration is recommended at the intersection. Note this configuration aligns with the existing roadway network, while also providing a transition point for potential 3-lane conversions along Eagle Creek Boulevard and Vierling Drive.

The proposed intersection lane configurations/geometrics are summarized in Table 2 and shown in Figure 3. Figures detailing the fastest path and heavy vehicle turning movement analyses for the proposed roundabout can be seen in the Appendix.

**Table 2. Proposed Conditions**

| Approach | Lane Configurations |
|---|---|
| Eastbound Eagle Creek Boulevard | One shared left/thru lane and one shared right/thru lane |
| Westbound Eagle Creek Boulevard | One shared left/thru lane and one right-turn lane |
| Northbound Vierling Drive | One shared left/thru/right lane |
| Southbound Vierling Drive | One shared left/thru/right lane and one left-turn only lane |

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## Proposed Roundabout Layout

Roundabout Justification Report
Eagle Creek Boulevard at Vierling Drive
Shakopee, Minnesota

02315876
July 2023

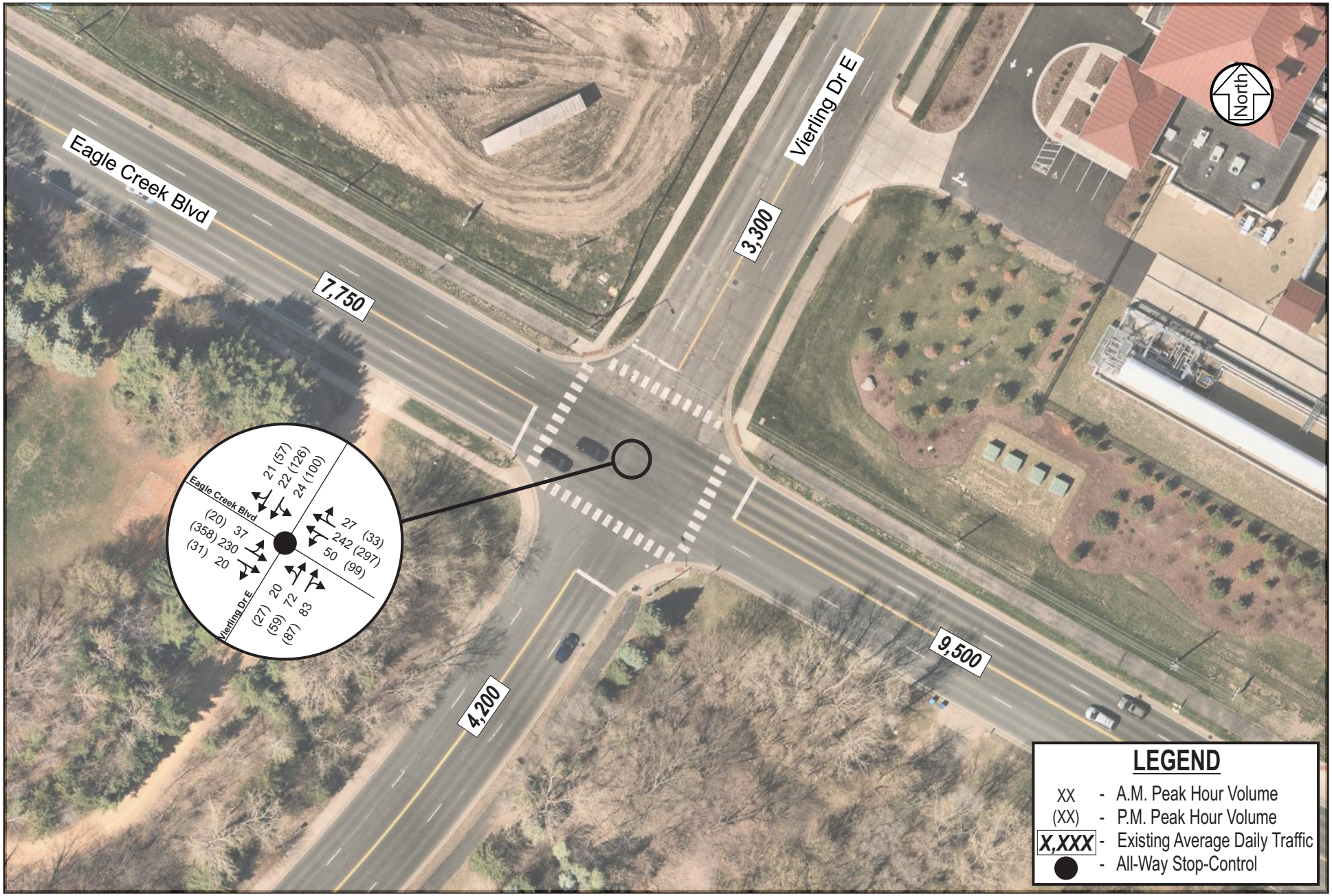
**Figure 3**

## Traffic Volumes

Weekday 13-hour (i.e., 6 a.m. to 7 p.m.) vehicular and pedestrian/bicyclist turning movement counts were collected at the study intersection on Tuesday, September 13, 2022. The existing peak hour volumes are shown in Figure 4, and the total 13-hour counts are in the Appendix.

To understand how area planned developments and general background growth are expected to impact the study intersection, opening year 2024 and forecast year 2044 traffic forecasts were developed. To account for background growth in the area, an annual growth rate of one (1) percent was applied to the existing peak hour traffic volumes. Note this growth rate was generally consistent with previous studies within the area. To account for traffic impacts associated with proposed developments surrounding Canterbury Park (also known as the Canterbury Commons development), trip generation estimates were developed during the a.m. and p.m. peak hours using the *ITE Trip Generation Manual, 11th Edition* and distributed to the adjacent roadway network. Development timelines and assumptions were based on discussions with City staff. Note the 2044 traffic forecasts are based on a full buildout condition for the Canterbury Commons development. These forecasts are development driven, and a full buildout may occur sooner than 2044.

The resultant opening year 2024 and forecast year 2044 traffic forecasts are shown in Figure 5 and 6, respectively.

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## Existing Volumes

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Shakopee, Minnesota

02315876
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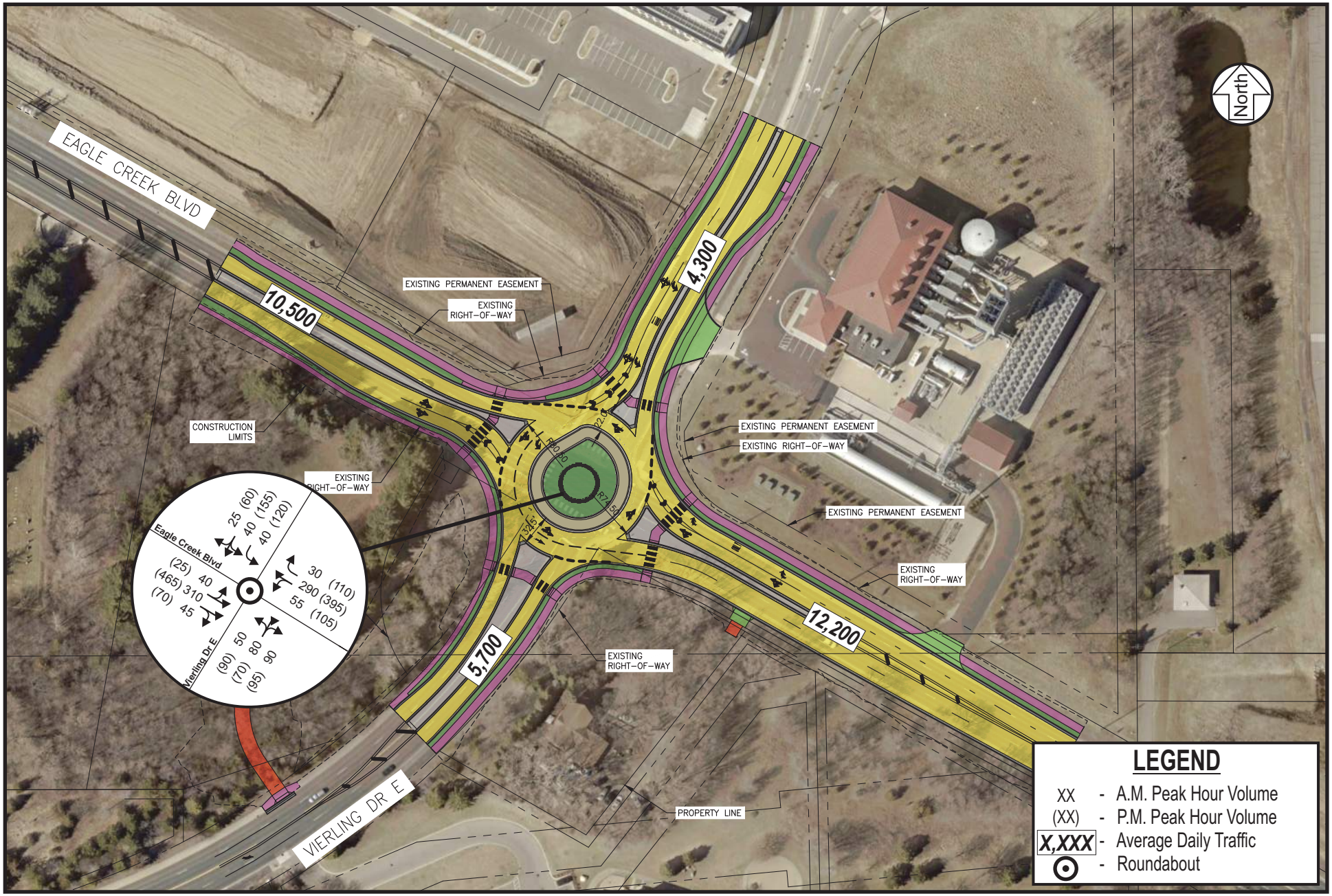
**Figure 4**

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## Opening Day Year 2024 Traffic Volumes

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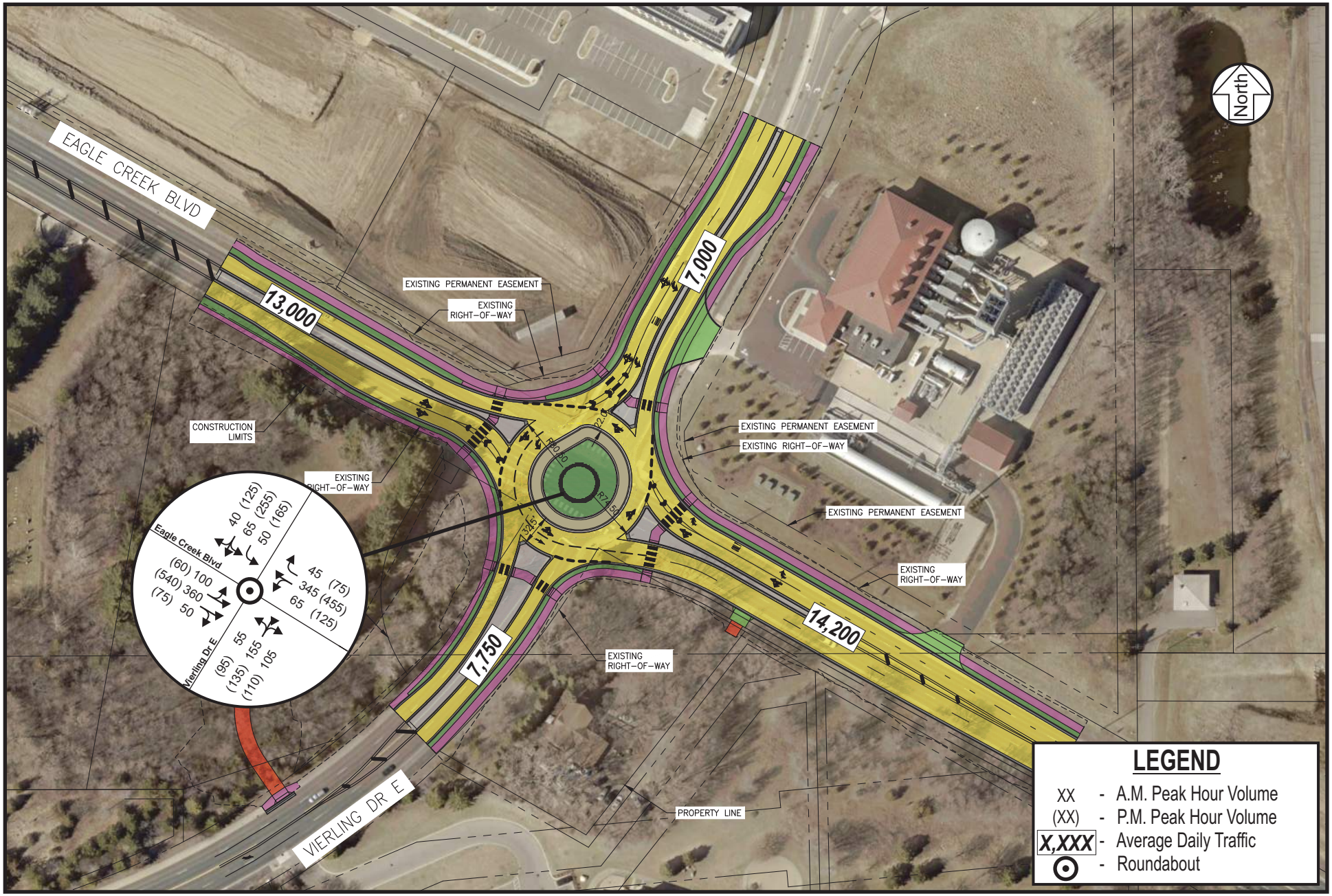
**Figure 5**

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**Forecast Year 2044 Traffic Volumes**

Roundabout Justification Report
Eagle Creek Boulevard at Vierling Drive
Shakopee, Minnesota

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**Figure 6**

# Schedule and Project Manager

| | |
|---|---|
| City Project Manager: | Darin Manning, PE<br>Project Engineer<br>City of Shakopee<br>485 Gorman Street<br>Shakopee, MN 55379<br>952-233-9364 |
| Proposed Letting Date: | January 2024 |
| Estimated Construction Completion Date: | Fall 2024 |

# Need for Project/Project Discussion

The intersection is currently over the critical crash rate, indicating a statistically significant crash problem. Over 75 percent of crashes at the intersection were the result of vehicles running stop signs and/or failing to yield right-of-way, which is often common for multi-lane all-way stop controlled intersections. Future development surrounding Canterbury Park is expected to increase traffic volumes at the intersection which may increase safety/crash issues. A roundabout will better delineate right-of-way, which will improve safety and mobility, and reduce driver confusion at the intersection.

In addition to the safety and mobility benefits, a roundabout is expected to accommodate event traffic surges more effectively than the current all-way stop control. As mentioned previously, one of the proposed developments surrounding Canterbury Park includes a 19,000-capacity amphitheater, which is expected to have approximately 40-60 annual events from May to October. A roundabout will help reduce congestion and safely manage frequent event traffic in/out of the site.

# Design Criteria and Exceptions

No design exceptions to MnDOT or AASHTO standards are required.

# Justification

## Safety Analysis

A safety analysis was completed to understand any trends or geometric issues at the study intersection. The safety analysis was based on reported crashes using MnDOT's Crash Mapping Analysis Tool (MnCMAT) from January 1, 2018, through December 31, 2022, which represents the most recent five-year period available. Based on this data, which is summarized below, there were a total of 21 crashes reported over the analysis period at the study intersection. The intersection crashes predominantly consisted of angle and rear-end crashes. Of the 21 total crashes, 16 were the result of vehicles running stop signs or failing to yield right-of-way.

- **Crash Severity:**
  - 3 – Minor Injury (Type B) Crashes
  - 6 – Possible Injury (Type C) Crashes
  - 12 – Property Damage Only Crashes

- **Crash Type:**
  - 11 – Angle Crashes
  - 6 – Rear-end Crashes
  - 2 – Other Type
  - 1 – Sideswipe Crash
  - 1 – Run off Road Crash

In addition to reviewing the specific crash types that occurred at the study intersection, overall intersection crash and severity rates were calculated. Note since there were no fatal or serious injury crashes, the severity rate at the intersection was zero. The overall intersection crash and severity rates were compared to average rates for intersections with similar characteristics published by MnDOT. Results of the crash and severity rate analysis, shown in Table 3, indicate that the intersection is above the critical crash rate, indicating that there is a statistically significant crash problem at the intersection. A roundabout would help delineate right-of-way which would significantly reduce the number of crashes caused by running stop signs/failing to yield right-of-way.

**Table 3. Crash and Severity Rate Analysis (2018-2022)**

| Location | Number of Crashes | Crash Rate (1) | | | Severity Crash Rate (2) | | |
|---|---|---|---|---|---|---|---|
| | | Average | Actual | Critical | Average | Actual | Critical |
| Eagle Creek Blvd/Vierling Dr | 21 | 0.27 | 0.93 | 0.48 | 0.22 | 0.0 | 3.70 |

(1) Intersection crash rates are expressed in crashes per million entering vehicles.
(2) Intersection crash rates are expressed in crashes per 100 million entering vehicles.

## Operations Analysis

Operations analysis was conducted for both the existing all-way stop control, as well as the proposed roundabout configuration. The all-way stop control was analyzed using Synchro/SimTraffic, whereas the roundabout was analyzed using RODEL software. RODEL is a software that is based on existing roundabout operational research and uses an empirical formula method to determine roundabout delay based on geometric features and traffic flows.

The operations analysis identifies a Level of Service (LOS) which indicates how well an intersection is operating based on delay per vehicle. Delay is calculated based on procedures outlined in the HCM. Intersections are given a ranking from LOS A to LOS F. LOS A indicates the best traffic operation and LOS F indicates an intersection where demand exceeds capacity. LOS A through LOS D are considered acceptable because the intersection would be operating under capacity.

Results of the analysis, which is summarized in Tables 4 and 5, indicate that both the existing all-way stop control and proposed roundabout control are expected to operate acceptably under year of opening (2024) and forecast year 2044 conditions. As mentioned previously, a smaller roundabout roundabout configuration would likely accommodate non-event conditions, however, a hybrid roundabout is recommended to align with the current roadway configurations and facilitate frequent event traffic surges.

**Table 4. Opening Day Year 2024 Operations Analysis Summary**

| Year 2024 | Analysis Tool | AM Peak Hour | | PM Peak Hour | |
|---|---|---|---|---|---|
| | | Delay (sec/veh) | LOS | Delay (sec/veh) | LOS |
| All-Way Stop Control | Synchro/SimTraffic | 8/10 | A/A | 11/13 | B/B |
| Roundabout Control | RODEL | 3/4 | A/A | 3/5 | A/A |

Note: Overall results are followed by the worst approach results.

**Table 5. Forecast Year 2044 Operations Analysis Summary**

| Year 2044 | Analysis Tool | AM Peak Hour | | PM Peak Hour | |
|---|---|---|---|---|---|
| | | Delay (sec/veh) | LOS | Delay (sec/veh) | LOS |
| All-Way Stop Control | Synchro/SimTraffic | 11/12 | B/B | 21/24 | C/C |
| Roundabout Control | RODEL | 3/5 | A/A | 4/6 | A/A |

Note: Overall results are followed by the worst approach results.

## Warrants Analysis

The Minnesota Manual on Uniform Traffic Control Devices (MN MUTCD) provides guidance on when it may be appropriate to use all-way stop or signal control at an intersection. This guidance is provided in the form of "warrants", or criteria, and engineering analysis of the intersection's design factors to determine when all-way stop or signal control may be justified.

Meeting a warrant at an intersection does not in itself require the installation of a particular control type. The particular control type also requires an engineering analysis of the intersection's design for it to be justified. Per MnDOT guidance, roundabouts are typically considered to be warranted if traffic volumes meet the criteria for either all-way stop or traffic signal control.

To determine if the intersection currently meets warrants during non-event conditions, signal warrants 1 through 3, as well as the Multiway Stop Applications Warrant Condition C (MWSA C) outlined in the *Minnesota Manual on Uniform Traffic Control Devices* (MnMUTCD) were reviewed utilizing the 13-hour counts collected. Signal warrants 4-9 were investigated and were determined to not be applicable to the study.

For the analysis, minor street right-turn volumes were not removed as these vehicles are not given a dedicated lane and thus impact other traffic at the approach. Approach speeds of 50 mph along Eagle Creek Boulevard and 30 mph along Vierling Drive were used for the analysis. Since the mainline speed exceeds 40 mph, the 70 percent traffic volume factor was used for the warrants analysis.

The results of the warrant analysis, which is shown in Table 6, indicate that the intersection currently meets Signal Warrant 1A, 1C, and 3B, as well as the Multiway Stop Warrant (MWSA C).

**Table 6. Warrants Analysis Summary**

| MN MUTCD Warrant | Hours Required | Existing Volumes | |
|---|---|---|---|
| | | Hours Met | Warrant Met? |
| Warrant 1A: Minimum Vehicular Volume | 8 | 9 | **Yes** |
| Warrant 1B: Interruption of Continuous Traffic | 8 | 3 | No |
| Warrant 1C: Combination of Warrants | 8 | 8 | **Yes** |
| Warrant 2: Four-Hour Volume | 4 | 3 | No |
| Warrant 3B: Peak Hour Volume | 1 | 1 | **Yes** |
| MWSA C: Minimum Volumes | 8 | 13 | **Yes** |
| Warrants 4-9 | Not Applicable | | |

# Other Considerations

## Pedestrian Safety

Pedestrian safety is not anticipated to be negatively impacted as a result of the roundabout alternative. The design of a roundabout allows pedestrians to cross one direction of traffic at a time with a small refuge space in the middle of each leg of the roundabout. In addition, certain movements/approaches (such as the northbound approach) will have less lanes to cross than under existing conditions. However, given the hybrid configuration, dual threat will still be present on certain approaches. If pedestrian volumes increase and/or safety issues arise, rectangular rapid flashing beacons could be considered for installation.

## Additional Wayfinding

While the hybrid roundabout configuration may provide increased capacity during event conditions, given the inner southbound left-turn lane acts as a drop-lane, it may cause some initial driver confusion. Additional signage and pavement marking should be considered to help reduce driver confusion. While costly, overhead wayfinding signage could also be considered prior to the roundabout, particularly on the southbound approach.

# Conclusions

A hybrid roundabout is recommended at the Eagle Creek Boulevard/Vierling Drive intersection to mitigate existing safety issues and manage event traffic associated with Canterbury Park and the proposed amphitheater. The intersection currently meets Signal Warrants 1A, 1C, 3B, and MWSA C during non-event conditions and future development surrounding Canterbury Park is anticipated to further increase traffic volumes at the intersection. While a smaller roundabout layout may be adequate for non-event conditions, the proposed roundabout configuration was designed to accommodate frequent event conditions expected within the area. In addition to the roundabout configuration, the following considerations were identified as part of the roundabout justification report:

- If pedestrian volumes increase and/or safety issues occur, rectangular rapid flashing beacons could be considered for installation.
- Consider providing additional signage/pavement markings to reduce driver confusion through the hybrid roundabout. While costly, overhead wayfinding signage could also be considered prior to the roundabout, particularly on the southbound approach.

# Appendix

- Year 2022 Intersection Turning Movement Data
- Warrants Analysis
- Fastest Path Analysis
- WR-62 and BUS-36 AutoTurn Movements

# Year 2022 Intersection Turning Movement Count Data

# SRF Consulting Group

3701 Wayzata Blvd, Suite 100, Minneapolis, MN 55416

Intersection: Eagle Creek Blvd /Vierling Dr
Date: 9/13/2022

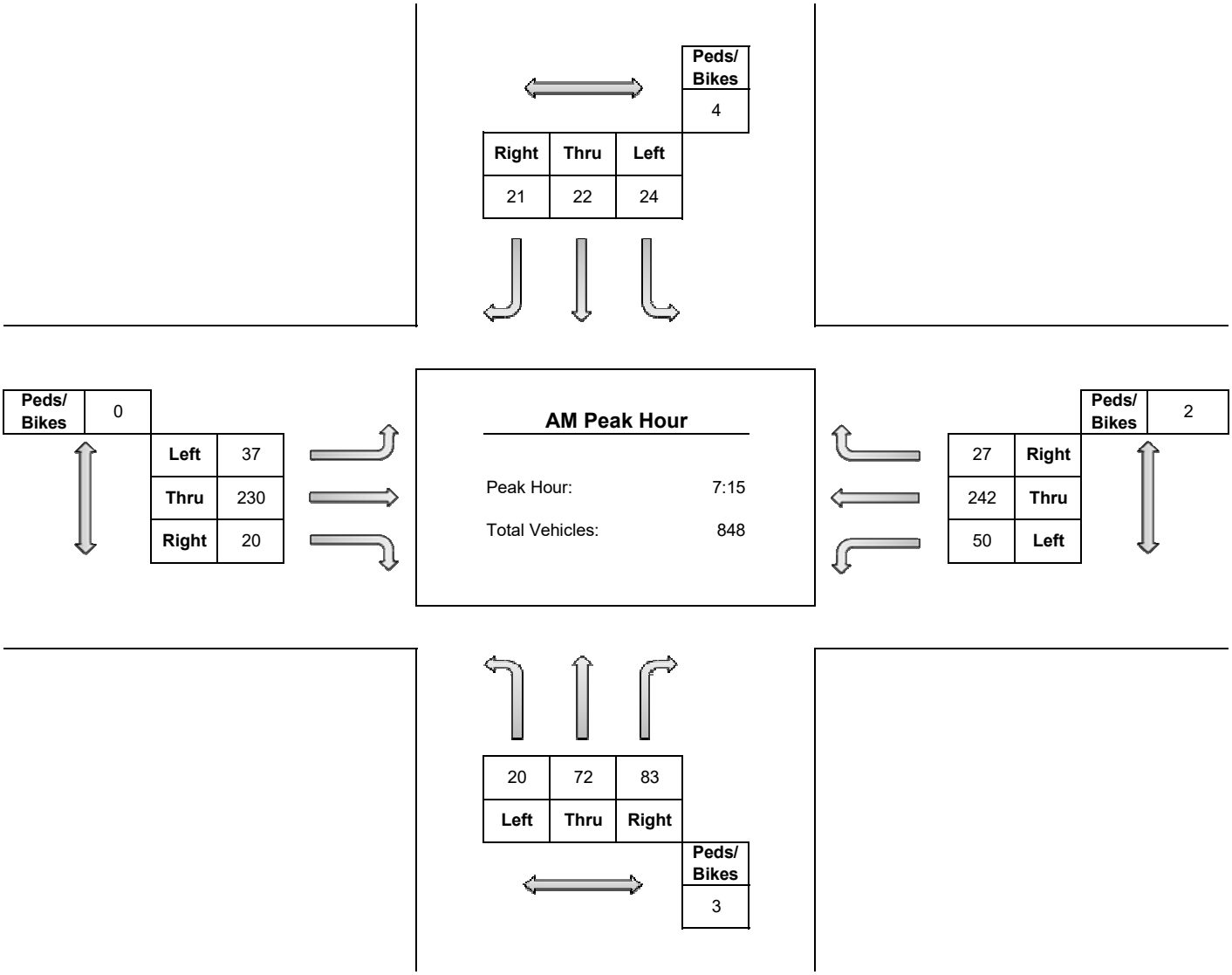
| Start Time | Eagle Creek Blvd EB | | | | Eagle Creek Blvd WB | | | | Vierling Dr NB | | | | Vierling Dr SB | | | | 15 min Veh. Total | 15 min Ped Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L | T | R | Ped | L | T | R | Ped | L | T | R | Ped | L | T | R | Ped | | |
| 600 | 5 | 39 | 1 | - | 2 | 22 | 5 | - | 1 | 10 | 12 | - | 3 | 3 | 4 | - | 107 | - |
| 615 | 3 | 37 | 1 | 1 | 3 | 20 | 6 | - | 2 | 8 | 16 | - | 4 | 6 | 5 | - | 111 | 1 |
| 630 | 1 | 47 | 2 | - | 4 | 31 | 3 | - | 3 | 14 | 19 | - | 7 | 6 | 3 | - | 140 | - |
| 645 | 6 | 65 | - | 1 | 2 | 30 | 10 | - | 2 | 17 | 13 | 2 | 3 | 8 | 5 | - | 161 | 3 |
| 700 | 1 | 62 | 3 | 2 | 4 | 41 | 5 | - | 3 | 10 | 22 | - | 7 | 7 | 2 | 4 | 167 | 6 |
| 715 | 7 | 55 | 7 | - | 13 | 52 | 7 | 1 | 4 | 13 | 21 | - | 4 | 5 | 6 | - | 194 | 1 |
| 730 | 10 | 66 | 4 | - | 18 | 61 | 4 | - | 6 | 21 | 18 | 2 | 6 | 6 | 5 | - | 225 | 2 |
| 745 | 11 | 56 | 6 | - | 12 | 63 | 10 | 1 | 7 | 20 | 23 | 1 | 10 | 7 | 4 | - | 229 | 2 |
| 800 | 9 | 53 | 3 | - | 7 | 66 | 6 | - | 3 | 18 | 21 | - | 4 | 4 | 6 | 4 | 200 | 4 |
| 815 | 7 | 49 | 5 | - | 9 | 47 | 8 | - | 1 | 16 | 20 | - | 5 | 8 | 3 | - | 178 | - |
| 830 | 10 | 54 | 4 | - | 9 | 42 | 8 | - | 2 | 10 | 20 | - | 2 | 4 | 3 | 2 | 168 | 2 |
| 845 | 4 | 47 | 1 | 1 | 9 | 43 | 2 | 1 | 4 | 14 | 18 | - | 5 | 5 | 5 | - | 157 | 2 |
| 900 | 5 | 44 | 3 | 2 | 9 | 45 | 3 | - | 2 | 10 | 16 | 1 | 5 | 4 | 2 | 2 | 148 | 5 |
| 915 | 5 | 46 | 2 | 1 | 14 | 45 | 4 | - | 1 | 5 | 14 | - | 9 | 8 | 3 | - | 156 | 1 |
| 930 | 4 | 46 | - | - | 6 | 45 | 5 | - | 3 | 4 | 18 | - | 7 | 4 | 4 | - | 146 | - |
| 945 | 8 | 45 | 5 | - | 12 | 27 | 3 | - | 7 | 6 | 17 | - | 5 | 6 | 5 | - | 146 | - |
| 1000 | 4 | 47 | 3 | - | 14 | 35 | 4 | 1 | 2 | 9 | 20 | - | 4 | 6 | 2 | - | 150 | 1 |
| 1015 | - | 32 | 2 | - | 14 | 34 | 5 | - | 2 | 5 | 20 | - | 6 | 8 | 8 | - | 136 | - |
| 1030 | 2 | 37 | 4 | - | 8 | 40 | 5 | - | 2 | 8 | 10 | - | 9 | 10 | 2 | - | 137 | - |
| 1045 | 5 | 40 | 2 | - | 17 | 32 | 3 | - | 3 | 11 | 10 | - | 6 | 10 | 4 | - | 143 | - |
| 1100 | 5 | 48 | 5 | - | 12 | 34 | 6 | - | 2 | 7 | 17 | - | 6 | 11 | 5 | - | 158 | - |
| 1115 | 2 | 42 | 8 | - | 12 | 39 | 5 | - | 2 | 7 | 12 | - | 5 | 15 | 6 | - | 155 | - |
| 1130 | 8 | 57 | 5 | - | 24 | 45 | 15 | - | 3 | 12 | 22 | - | 6 | 16 | 6 | 1 | 219 | 1 |
| 1145 | 3 | 47 | 6 | - | 17 | 47 | 6 | - | 6 | 13 | 25 | - | 12 | 21 | 10 | 3 | 213 | 3 |
| 1200 | 6 | 52 | 5 | - | 22 | 63 | 3 | - | 5 | 21 | 20 | - | 12 | 22 | 2 | - | 233 | - |
| 1215 | 8 | 61 | 5 | - | 17 | 41 | 4 | - | 4 | 22 | 24 | - | 8 | 23 | 7 | - | 224 | - |
| 1230 | 10 | 57 | 3 | - | 15 | 46 | 3 | 1 | 2 | 29 | 22 | - | 7 | 17 | 1 | 1 | 212 | 2 |
| 1245 | 7 | 45 | 2 | - | 14 | 40 | 8 | - | 5 | 22 | 13 | - | 5 | 13 | 8 | - | 182 | - |
| 1300 | 4 | 56 | 3 | - | 16 | 42 | 5 | 1 | 10 | 19 | 26 | 1 | 8 | 13 | 6 | 1 | 208 | 3 |
| 1315 | 5 | 51 | 3 | - | 14 | 44 | 4 | 2 | 3 | 17 | 13 | - | 8 | 12 | 6 | 1 | 180 | 3 |
| 1330 | 12 | 62 | 3 | - | 18 | 44 | 7 | 2 | 1 | 17 | 19 | - | 13 | 13 | 14 | - | 223 | 2 |
| 1345 | 7 | 43 | 4 | - | 15 | 48 | 12 | 1 | 3 | 19 | 17 | - | 7 | 8 | 6 | 1 | 189 | 2 |
| 1400 | 6 | 44 | 6 | - | 20 | 54 | 5 | 1 | 5 | 12 | 19 | - | 9 | 20 | 9 | - | 209 | 1 |
| 1415 | 10 | 52 | 3 | - | 12 | 65 | 4 | - | 2 | 19 | 16 | - | 9 | 17 | 4 | 1 | 213 | 1 |
| 1430 | 2 | 66 | 4 | - | 23 | 49 | 2 | - | 6 | 22 | 19 | - | 18 | 23 | 11 | - | 245 | - |
| 1445 | 3 | 58 | 2 | - | 25 | 58 | 12 | - | 5 | 12 | 19 | - | 11 | 18 | 11 | - | 234 | - |
| 1500 | 5 | 72 | 5 | - | 23 | 53 | 6 | 1 | 3 | 12 | 12 | 1 | 11 | 16 | 12 | 1 | 230 | 3 |
| 1515 | 3 | 74 | 1 | - | 19 | 56 | 10 | - | 4 | 12 | 18 | - | 13 | 20 | 15 | - | 245 | - |
| 1530 | 8 | 69 | 9 | - | 24 | 68 | 4 | - | 2 | 7 | 30 | - | 16 | 21 | 14 | - | 272 | - |
| 1545 | 4 | 73 | 6 | 1 | 24 | 71 | 4 | - | 7 | 6 | 16 | - | 17 | 18 | 11 | 1 | 257 | 2 |
| 1600 | 2 | 86 | 5 | 1 | 18 | 93 | 5 | - | 2 | 11 | 15 | - | 18 | 17 | 13 | - | 285 | 1 |
| 1615 | 5 | 68 | 9 | - | 32 | 81 | 9 | - | 7 | 11 | 25 | - | 13 | 27 | 10 | - | 297 | - |
| 1630 | 5 | 99 | 5 | 1 | 21 | 72 | 7 | - | 6 | 13 | 23 | - | 32 | 42 | 18 | 1 | 343 | 2 |
| 1645 | 8 | 95 | 6 | - | 18 | 75 | 11 | - | 4 | 8 | 19 | - | 19 | 24 | 11 | 1 | 298 | 1 |
| 1700 | 4 | 79 | 12 | - | 30 | 74 | 7 | - | 8 | 16 | 19 | 1 | 31 | 39 | 19 | 1 | 338 | 2 |
| 1715 | 3 | 85 | 8 | - | 30 | 76 | 8 | 1 | 9 | 22 | 26 | - | 18 | 21 | 9 | - | 315 | 1 |
| 1730 | 9 | 75 | 8 | - | 20 | 46 | 6 | 1 | 3 | 13 | 24 | - | 18 | 23 | 7 | 2 | 252 | 3 |
| 1745 | 3 | 67 | 5 | - | 20 | 59 | 6 | - | 4 | 18 | 31 | - | 14 | 14 | 6 | 1 | 247 | 1 |
| 1800 | 1 | 63 | 4 | - | 20 | 66 | 4 | - | 9 | 16 | 18 | - | 6 | 13 | 12 | 3 | 232 | 3 |
| 1815 | 1 | 54 | 8 | - | 9 | 63 | 3 | - | 5 | 12 | 21 | 1 | 8 | 6 | 4 | 2 | 194 | 3 |
| 1830 | 3 | 53 | 7 | 1 | 20 | 57 | 6 | 3 | 3 | 16 | 20 | 2 | 10 | 15 | 3 | 3 | 213 | 9 |
| 1845 | 2 | 52 | 9 | - | 14 | 43 | 4 | - | 5 | 13 | 18 | - | 9 | 13 | 8 | 1 | 190 | 1 |
| **Total** | **271** | **2,972** | **232** | **12** | **804** | **2,633** | **307** | **18** | **205** | **705** | **986** | **12** | **508** | **716** | **365** | **38** | **10,704** | **80** |
| **Trucks** | 3% | 3% | 4% | | 3% | 3% | 4% | | 4% | 5% | 2% | | 2% | 4% | 4% | | 3% | - |

# SRF Consulting Group

3701 Wayzata Blvd, Suite 100, Minneapolis, MN 55416

Intersection: Eagle Creek Blvd /Vierling Dr
Date: 9/13/2022

| Start Time | Eagle Creek Blvd EB | | | | Eagle Creek Blvd WB | | | | Vierling Dr NB | | | | Vierling Dr SB | | | | 15 min Veh. Total | 15 min Ped Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L | T | R | Ped | L | T | R | Ped | L | T | R | Ped | L | T | R | Ped | | |
| 715 | 7 | 55 | 7 | - | 13 | 52 | 7 | 1 | 4 | 13 | 21 | - | 4 | 5 | 6 | - | 194 | 1 |
| 730 | 10 | 66 | 4 | - | 18 | 61 | 4 | - | 6 | 21 | 18 | 2 | 6 | 6 | 5 | - | 225 | 2 |
| 745 | 11 | 56 | 6 | - | 12 | 63 | 10 | 1 | 7 | 20 | 23 | 1 | 10 | 7 | 4 | - | 229 | 2 |
| 800 | 9 | 53 | 3 | - | 7 | 66 | 6 | - | 3 | 18 | 21 | - | 4 | 4 | 6 | 4 | 200 | 4 |
| **Total** | **37** | **230** | **20** | **-** | **50** | **242** | **27** | **2** | **20** | **72** | **83** | **3** | **24** | **22** | **21** | **4** | **848** | **9** |
| **PHF** | 0.84 | 0.87 | 0.71 | | 0.69 | 0.92 | 0.68 | | 0.71 | 0.86 | 0.90 | | 0.60 | 0.79 | 0.88 | | 0.93 | |
| **Trucks** | 3% | 5% | 5% | | 10% | 4% | 0% | | 0% | 6% | 5% | | 8% | 5% | 5% | | 5% | |

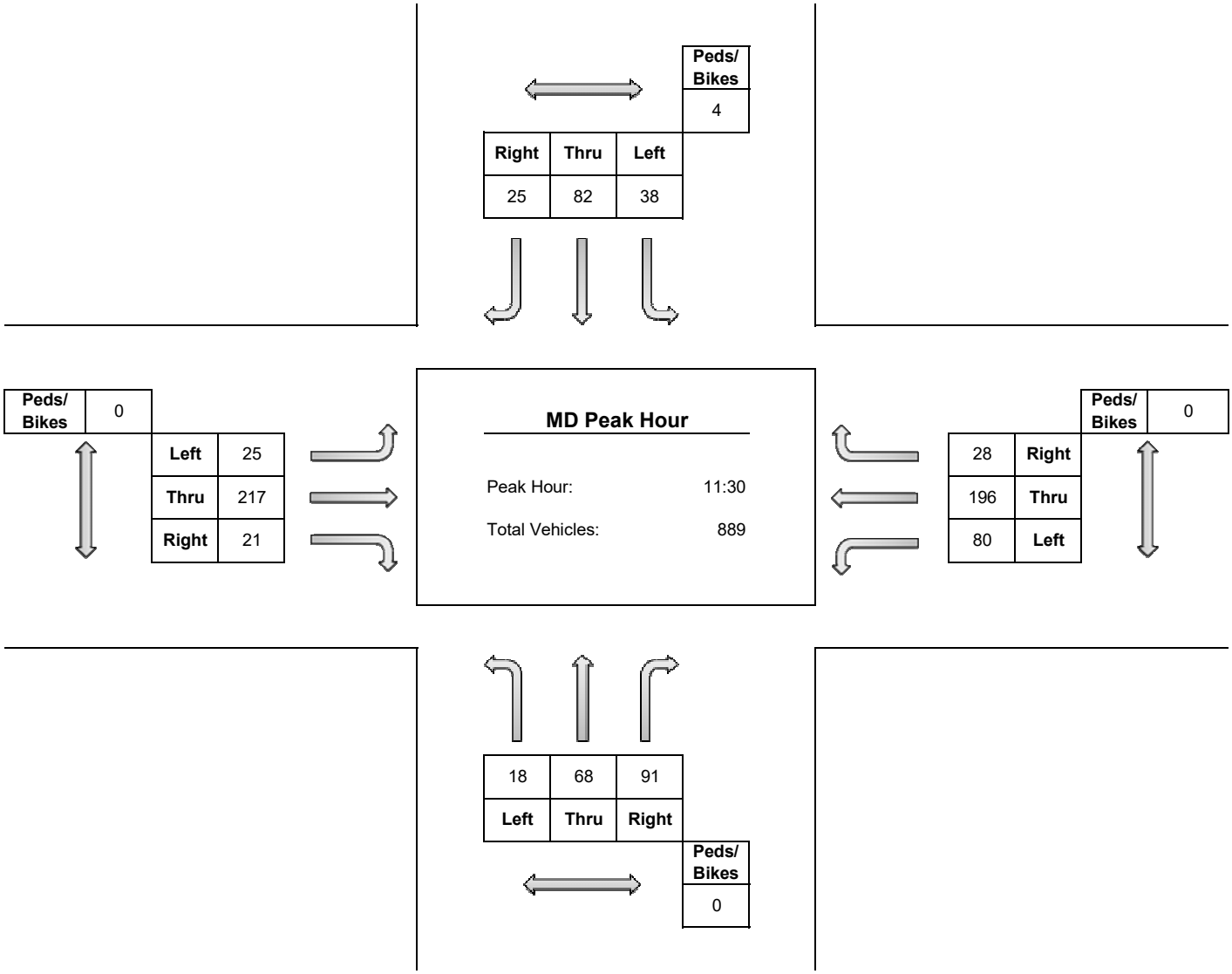


# SRF Consulting Group

3701 Wayzata Blvd, Suite 100, Minneapolis, MN 55416

Intersection: Eagle Creek Blvd /Vierling Dr
Date: 9/13/2022

| Start Time | Eagle Creek Blvd EB | | | | Eagle Creek Blvd WB | | | | Vierling Dr NB | | | | Vierling Dr SB | | | | **15 min Veh. Total** | **15 min Ped Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L | T | R | Ped | L | T | R | Ped | L | T | R | Ped | L | T | R | Ped | | |
| 1130 | 8 | 57 | 5 | - | 24 | 45 | 15 | - | 3 | 12 | 22 | - | 6 | 16 | 6 | 1 | 219 | 1 |
| 1145 | 3 | 47 | 6 | - | 17 | 47 | 6 | - | 6 | 13 | 25 | - | 12 | 21 | 10 | 3 | 213 | 3 |
| 1200 | 6 | 52 | 5 | - | 22 | 63 | 3 | - | 5 | 21 | 20 | - | 12 | 22 | 2 | - | 233 | - |
| 1215 | 8 | 61 | 5 | - | 17 | 41 | 4 | - | 4 | 22 | 24 | - | 8 | 23 | 7 | - | 224 | - |
| **Total** | **25** | **217** | **21** | **-** | **80** | **196** | **28** | **-** | **18** | **68** | **91** | **-** | **38** | **82** | **25** | **4** | **889** | **4** |
| **PHF** | 0.78 | 0.89 | 0.88 | | 0.83 | 0.78 | 0.47 | | 0.75 | 0.77 | 0.91 | | 0.79 | 0.89 | 0.63 | | 0.95 | |
| **Trucks** | 4% | 6% | 5% | | 3% | 4% | 4% | | 6% | 4% | 2% | | 0% | 2% | 8% | | 4% | |

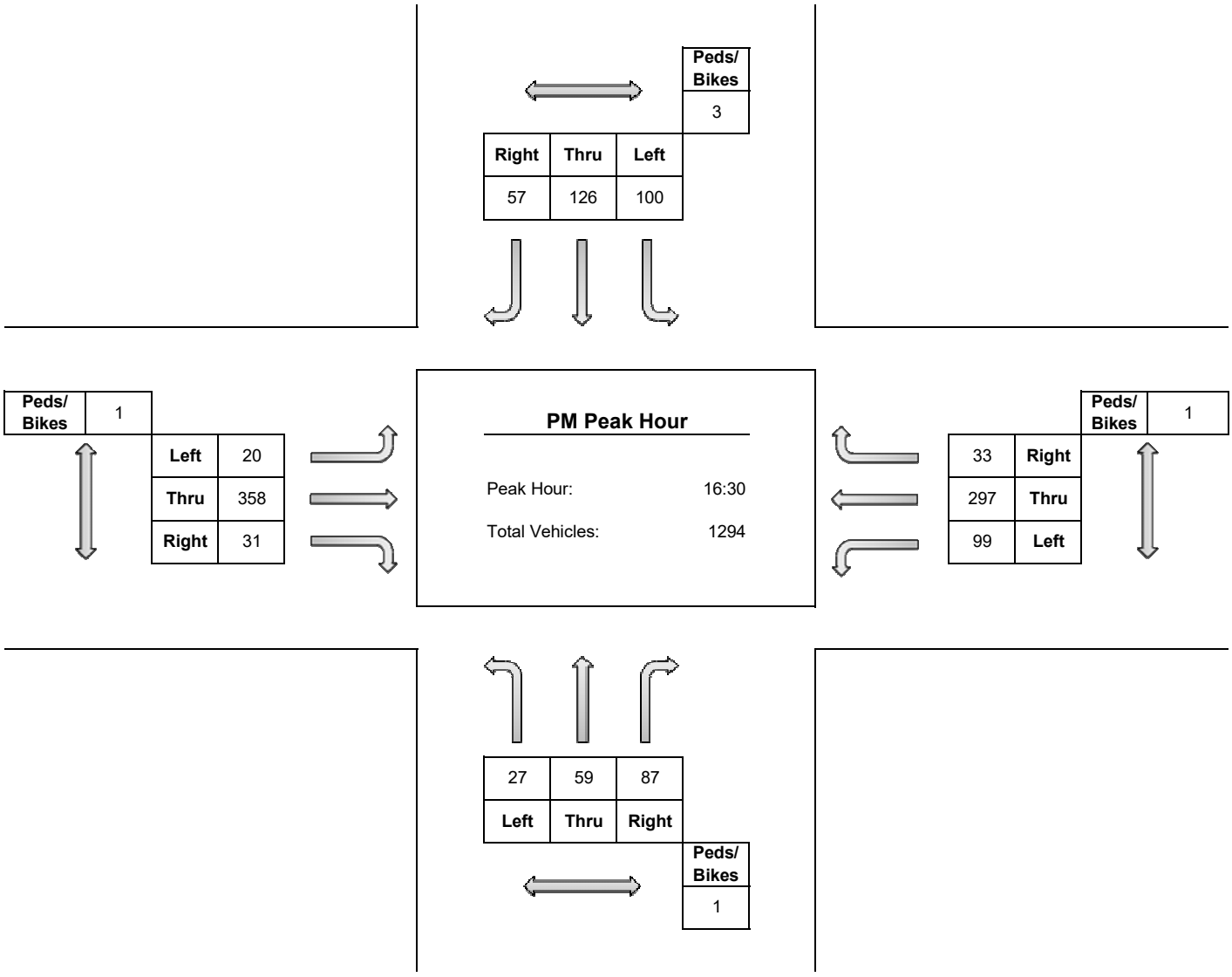


# SRF Consulting Group

3701 Wayzata Blvd, Suite 100, Minneapolis, MN 55416

Intersection: Eagle Creek Blvd /Vierling Dr
Date: 9/13/2022

| Start Time | Eagle Creek Blvd EB | | | | Eagle Creek Blvd WB | | | | Vierling Dr NB | | | | Vierling Dr SB | | | | **15 min Veh. Total** | **15 min Ped Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L | T | R | Ped | L | T | R | Ped | L | T | R | Ped | L | T | R | Ped | | |
| 1630 | 5 | 99 | 5 | 1 | 21 | 72 | 7 | - | 6 | 13 | 23 | - | 32 | 42 | 18 | 1 | 343 | 2 |
| 1645 | 8 | 95 | 6 | - | 18 | 75 | 11 | - | 4 | 8 | 19 | - | 19 | 24 | 11 | 1 | 298 | 1 |
| 1700 | 4 | 79 | 12 | - | 30 | 74 | 7 | - | 8 | 16 | 19 | 1 | 31 | 39 | 19 | 1 | 338 | 2 |
| 1715 | 3 | 85 | 8 | - | 30 | 76 | 8 | 1 | 9 | 22 | 26 | - | 18 | 21 | 9 | - | 315 | 1 |
| **Total** | **20** | **358** | **31** | **1** | **99** | **297** | **33** | **1** | **27** | **59** | **87** | **1** | **100** | **126** | **57** | **3** | **1,294** | **6** |
| **PHF** | 0.63 | 0.90 | 0.65 | | 0.83 | 0.98 | 0.75 | | 0.75 | 0.67 | 0.84 | | 0.78 | 0.75 | 0.75 | | 0.94 | |
| **Trucks** | 10% | 2% | 0% | | 0% | 1% | 3% | | 4% | 7% | 0% | | 0% | 1% | 2% | | 1% | |



# Warrants Analysis

# *WARRANTS ANALYSIS*

**Existing Year 2022**

Eagle Creek Blvd at Vierling Dr
Eagle Creek Blvd at Vierling Dr RAB
Shakopee, MN

**Background Information**

| | | Speed (mph) | Lanes | Approach | |
|---|---|---|---|---|---|
| **Location :** | Shakopee, MN | 50 | 2 or more | Major Approach 1: | Eastbound Eagle Creek Blvd |
| **Date:** | 7/19/2023 | 50 | 2 or more | Major Approach 3: | Westbound Eagle Creek Blvd |
| **Analysis Prepared By:** | Edwin Jarquin | 30 | 2 or more | Minor Approach 2: | Northbound Vierling Dr |
| **Population Less than 10,000:** | No | 30 | 2 or more | Minor Approach 4: | Southbound Vierling Dr |
| **Seventy Percent Factor Used:** | Yes | 30 | 2 or more | | |

**Warrants Analysis: Warrants 1A, 1B and 1C**

| Hour | Major Approach 1 | Major Approach 3 | Total 1 + 3 | Warrant Met 420 | Warrant Met 630 | Minor Approach 2 | Minor Approach 4 | Largest Minor App. | Warrant Met 140 | Warrant Met 70 | Met Same Hours Condition A | Met Same Hours Condition B | Combination A | Combination B | MWSA (C) 210 | MWSA (C) 140 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 - 7 AM | 207 | 138 | 345 | | | 117 | 57 | 117 | | X | | | X | | X | X |
| 7 - 8 AM | 288 | 290 | 578 | X | | 168 | 69 | 168 | X | X | X | | X | X | X | X |
| 8 - 9 AM | 246 | 256 | 502 | X | | 147 | 54 | 147 | X | X | X | | X | | X | X |
| 9 - 10 AM | 213 | 218 | 431 | X | | 103 | 62 | 103 | | X | | | | | X | X |
| 10 - 11 AM | 178 | 211 | 389 | | | 102 | 75 | 102 | | X | | | | | X | X |
| 11 - 12 AM | 236 | 262 | 498 | X | | 128 | 119 | 128 | | X | | | X | | X | X |
| 12 - 1 PM | 261 | 276 | 537 | X | | 189 | 125 | 189 | X | X | X | | X | X | X | X |
| 1 - 2 PM | 253 | 269 | 522 | X | | 164 | 114 | 164 | X | X | X | | X | X | X | X |
| 2 - 3 PM | 256 | 329 | 585 | X | | 156 | 160 | 160 | X | X | X | | X | X | X | X |
| 3 - 4 PM | 329 | 362 | 691 | X | X | 129 | 184 | 184 | X | X | X | X | X | X | X | X |
| 4 - 5 PM | 393 | 442 | 835 | X | X | 144 | 244 | 244 | X | X | X | X | X | X | X | X |
| 5 - 6 PM | 358 | 382 | 740 | X | X | 193 | 219 | 219 | X | X | X | X | X | X | X | X |
| 6 - 7 PM | 257 | 309 | 566 | X | | 156 | 107 | 156 | X | X | X | | X | X | X | X |
| 7 - 8 PM | 0 | 0 | 0 | | | 0 | 0 | 0 | | | | | | | | |
| 8 - 9 PM | 0 | 0 | 0 | | | 0 | 0 | 0 | | | | | | | | |
| 9 - 10 PM | 0 | 0 | 0 | | | 0 | 0 | 0 | | | | | | | | |
| 10 - 11 PM | 0 | 0 | 0 | | | 0 | 0 | 0 | | | | | | | | |
| | | | | | | | | | | | 9 | 3 | 11 | 8 | 13 | |

**Warrant Summary**

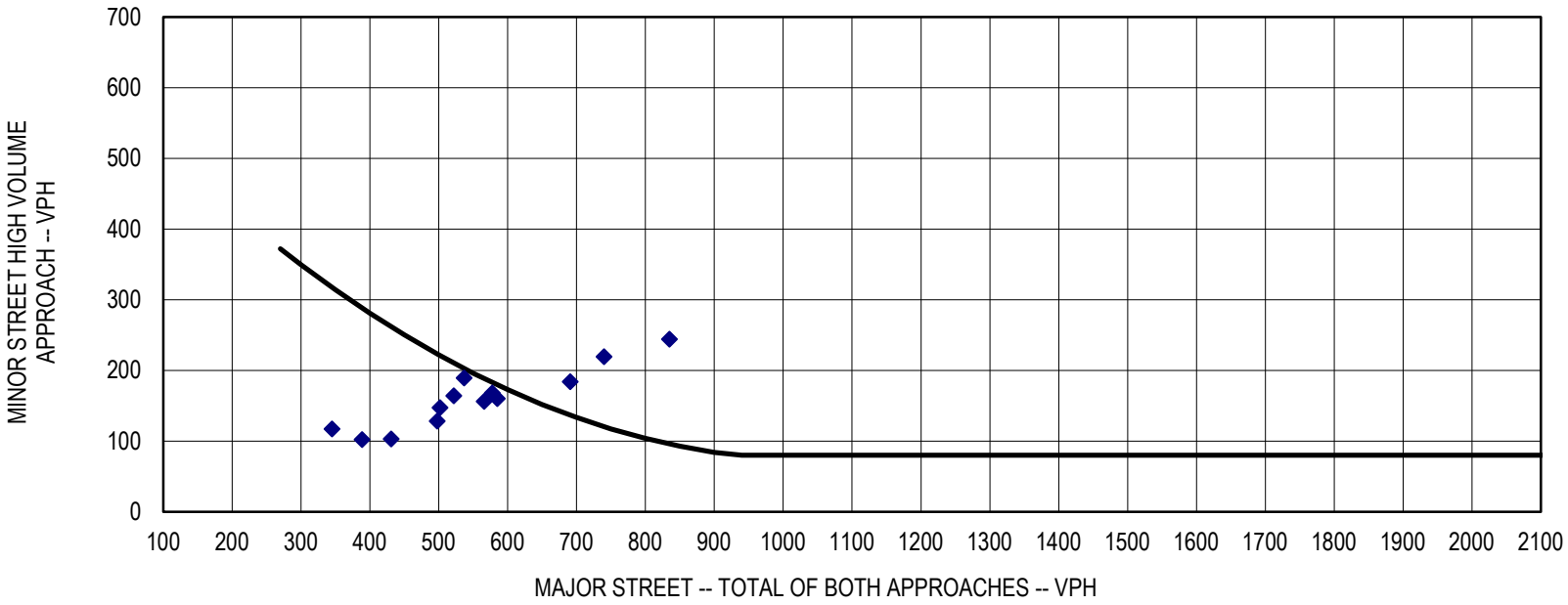
| Warrant and Description | | Hours Met | Hours Required | Met/Not Met |
|---|---|---|---|---|
| MWSA (C): | Multiway Stop Applications Condition C | 13 | 8 | Met - Multiway Stop Applications |
| Warrant 1A: | Minimum Vehicular Volume | 9 | 8 | Met - Warrant 1A Satisfied |
| Warrant 1B: | Interruption of Continuous Traffic | 3 | 8 | Not Met |
| Warrant 1C: | Combination of Warrants | 8 | 8 | Met - Warrant 1C Satisfied |
| Warrant 2: | Four-Hour Vehicular Volume | 3 | 4 | Not Met |
| Warrant 3B: | Peak Hour | 1 | 1 | Met - Warrant 3B Satisfied |

## *WARRANTS ANALYSIS*

**Existing Year 2022**

Eagle Creek Blvd at Vierling Dr
Eagle Creek Blvd at Vierling Dr RAB
Shakopee, MN

**Warrants Analysis: Warrant 2**




| Number of Hours Satisfying Requirements: | 3 |
|---|---|

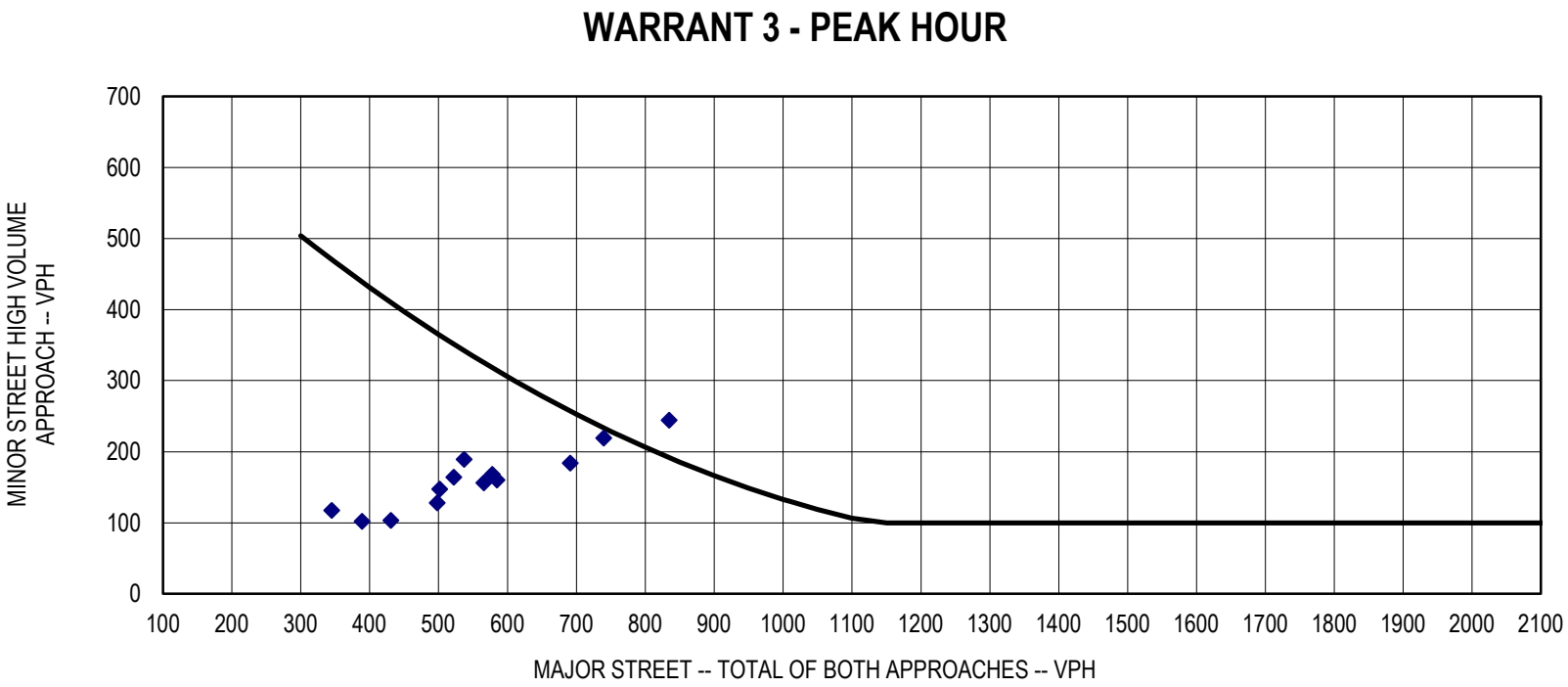
Notes:
1. 80 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACH WITH TWO OR MORE LANES AND 60 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACHING WITH ONE LANE.
2. INTERSECTION IS EITHER (1) WITHIN A COMMUNITY LESS THAN 10,000 POPULATION OR (2) HAS SPEEDS ABOVE 40 MPH ON MAJOR STREET.

## *WARRANTS ANALYSIS*

**Existing Year 2022**

Eagle Creek Blvd at Vierling Dr
Eagle Creek Blvd at Vierling Dr RAB
Shakopee, MN

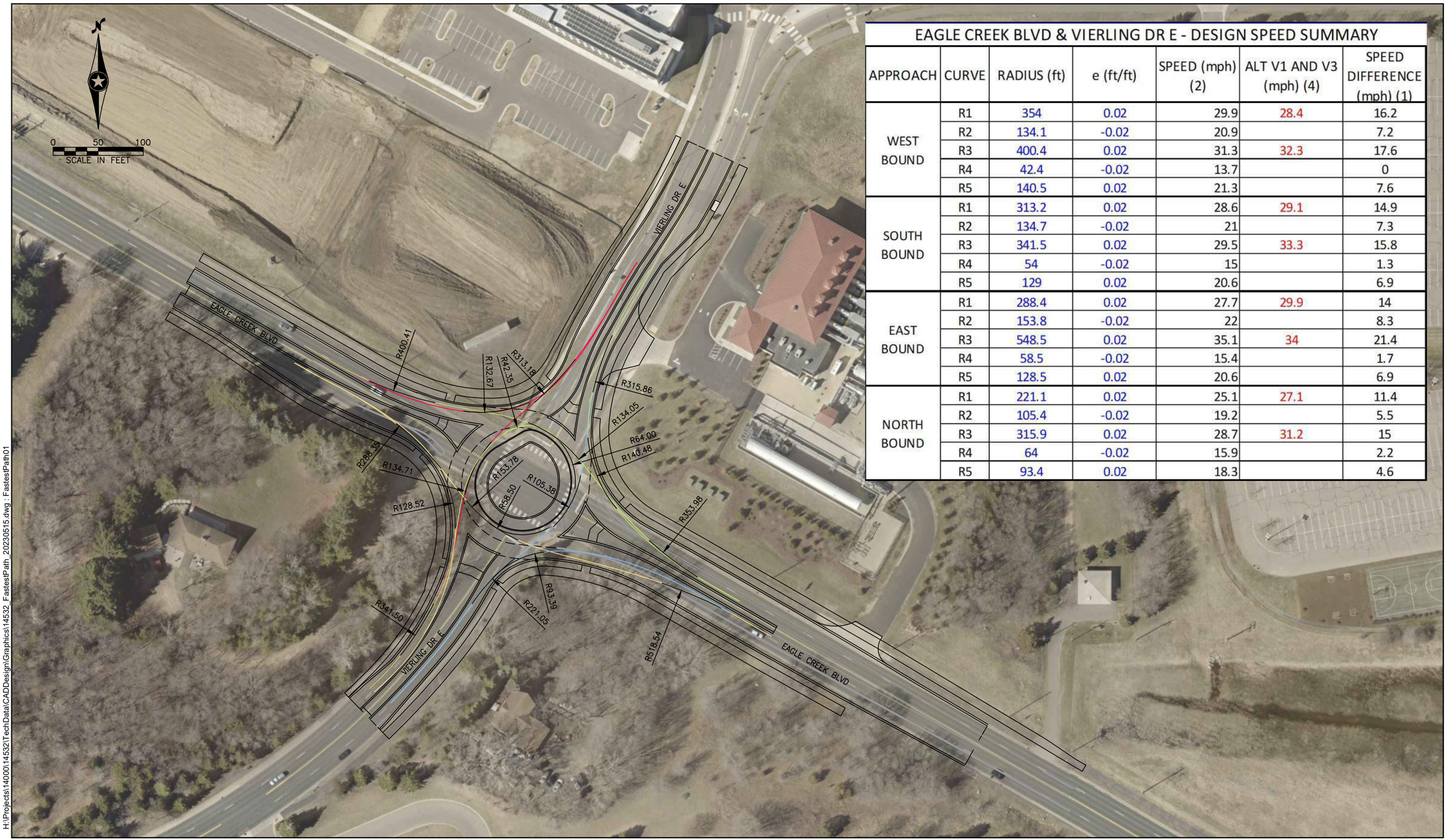
**Warrants Analysis: Warrant 3**




| Number of Hours Satisfying Requirements: | 1 |
|---|---|

Notes:
1. 100 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACH WITH TWO OR MORE LANES AND 75 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACHING WITH ONE LANE.
2. INTERSECTION IS EITHER (1) WITHIN A COMMUNITY LESS THAN 10,000 POPULATION OR (2) HAS SPEEDS ABOVE 40 MPH ON MAJOR STREET.

# Fastest Path Analysis




| EAGLE CREEK BLVD & VIERLING DR E - DESIGN SPEED SUMMARY | | | | | | |
|---|---|---|---|---|---|---|
| APPROACH | CURVE | RADIUS (ft) | e (ft/ft) | SPEED (mph) (2) | ALT V1 AND V3 (mph) (4) | SPEED DIFFERENCE (mph) (1) |
| WEST BOUND | R1 | 354 | 0.02 | 29.9 | 28.4 | 16.2 |
| | R2 | 134.1 | -0.02 | 20.9 | | 7.2 |
| | R3 | 400.4 | 0.02 | 31.3 | 32.3 | 17.6 |
| | R4 | 42.4 | -0.02 | 13.7 | | 0 |
| | R5 | 140.5 | 0.02 | 21.3 | | 7.6 |
| SOUTH BOUND | R1 | 313.2 | 0.02 | 28.6 | 29.1 | 14.9 |
| | R2 | 134.7 | -0.02 | 21 | | 7.3 |
| | R3 | 341.5 | 0.02 | 29.5 | 33.3 | 15.8 |
| | R4 | 54 | -0.02 | 15 | | 1.3 |
| | R5 | 129 | 0.02 | 20.6 | | 6.9 |
| EAST BOUND | R1 | 288.4 | 0.02 | 27.7 | 29.9 | 14 |
| | R2 | 153.8 | -0.02 | 22 | | 8.3 |
| | R3 | 548.5 | 0.02 | 35.1 | 34 | 21.4 |
| | R4 | 58.5 | -0.02 | 15.4 | | 1.7 |
| | R5 | 128.5 | 0.02 | 20.6 | | 6.9 |
| NORTH BOUND | R1 | 221.1 | 0.02 | 25.1 | 27.1 | 11.4 |
| | R2 | 105.4 | -0.02 | 19.2 | | 5.5 |
| | R3 | 315.9 | 0.02 | 28.7 | 31.2 | 15 |
| | R4 | 64 | -0.02 | 15.9 | | 2.2 |
| | R5 | 93.4 | 0.02 | 18.3 | | 4.6 |

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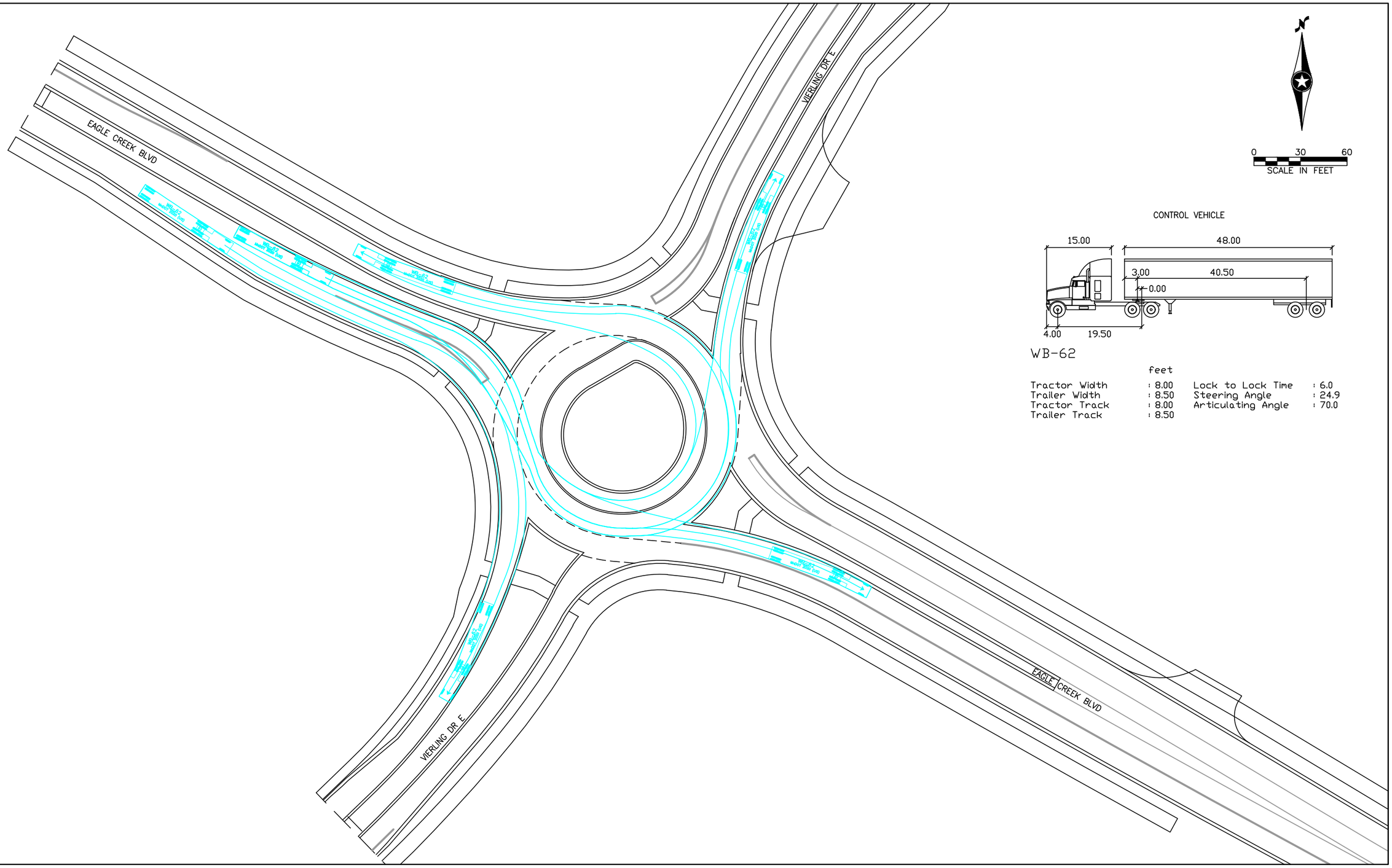
Job #
5/17/2023 - 11:27AM

**Roundabout - Fastest Path**

Vierling Dr E & Eagle Creek Bvld Roundabout
Shakopee, MN

**Figure 1**

# WR-62 and BUS-36 Turning Movement




0 30 60
SCALE IN FEET

CONTROL VEHICLE




WB-62

| | feet | | |
|---|---|---|---|
| Tractor Width | : 8.00 | Lock to Lock Time | : 6.0 |
| Trailer Width | : 8.50 | Steering Angle | : 24.9 |
| Tractor Track | : 8.00 | Articulating Angle | : 70.0 |
| Trailer Track | : 8.50 | | |

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SRF

Job #
5/17/2023 - 11:30AM

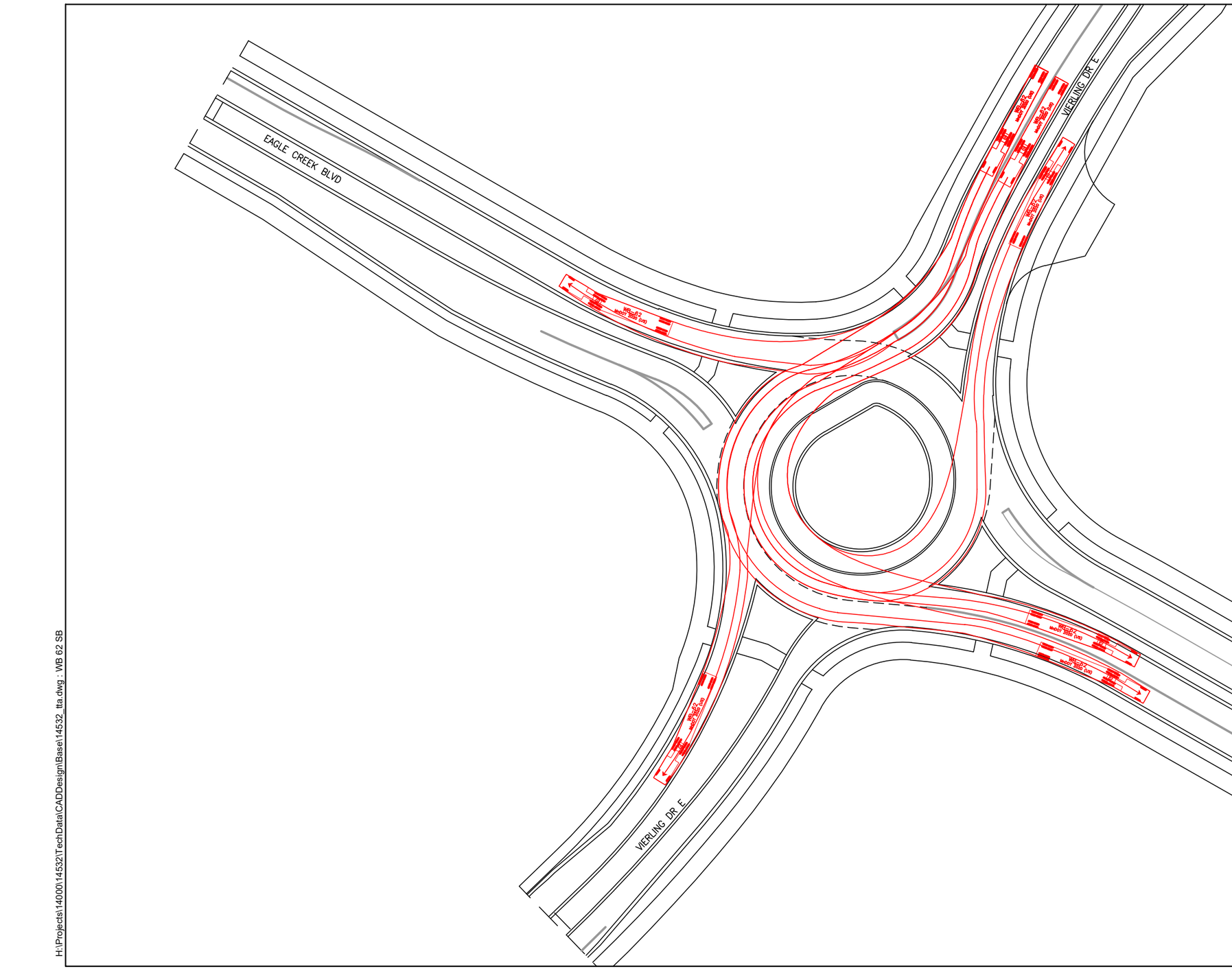
**ROUNDABOUT - WR62 EB TURNING MOVEMENT**

VIERLING DR E & EAGLE CREEK BVLD ROUNDABOUT
SHAKOPEE, MN

**Figure 1**

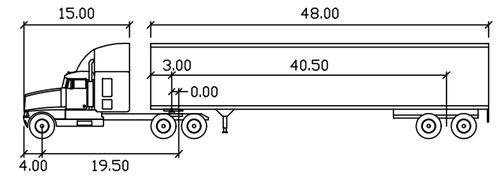
EAGLE CREEK BLVD

VIERLING DR E





CONTROL VEHICLE




WB-62

| | feet | | |
|---|---|---|---|
| Tractor Width | : 8.00 | Lock to Lock Time | : 6.0 |
| Trailer Width | : 8.50 | Steering Angle | : 24.9 |
| Tractor Track | : 8.00 | Articulating Angle | : 70.0 |
| Trailer Track | : 8.50 | | |

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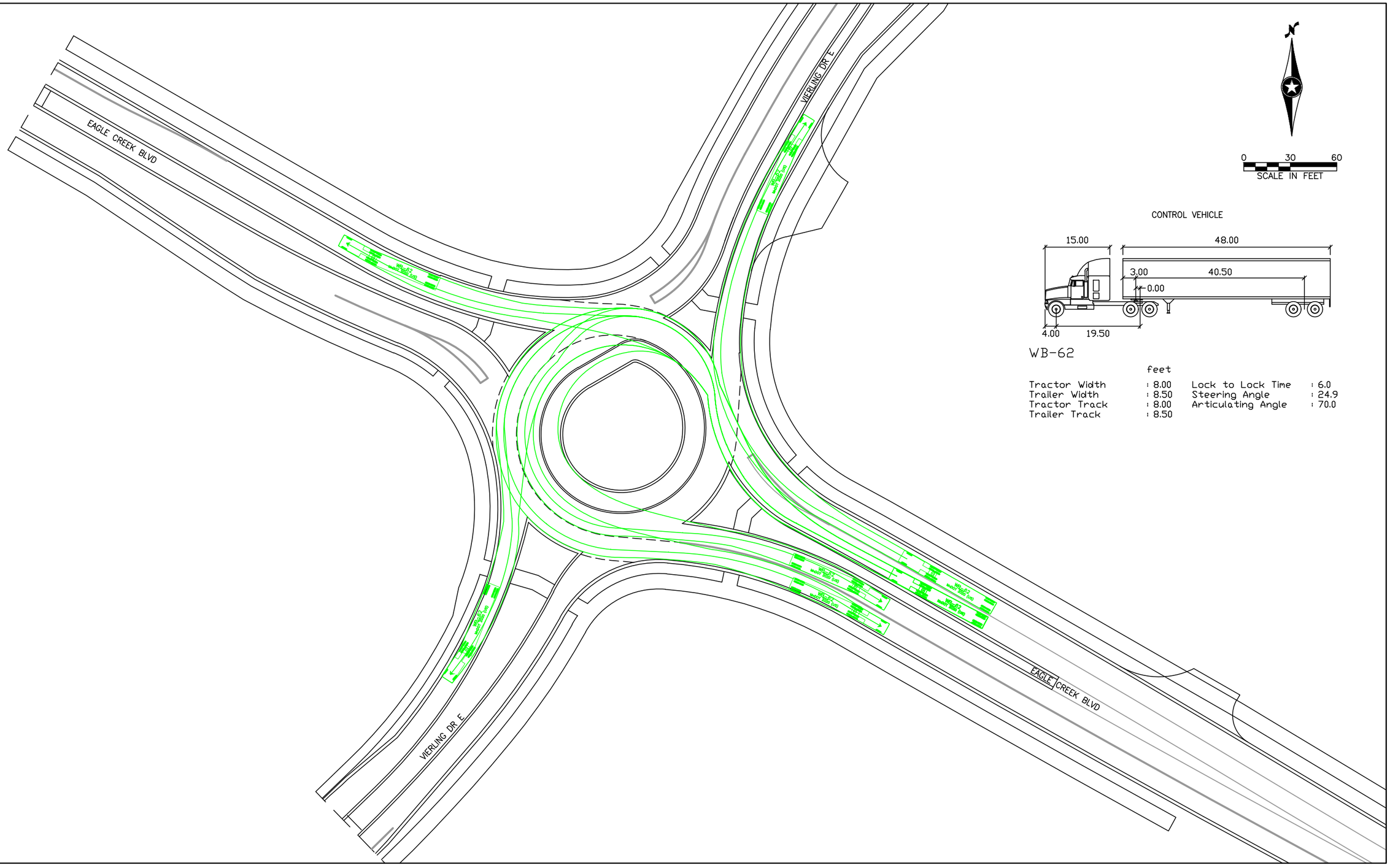
SRF

Job #
5/17/2023 - 11:30AM

**ROUNDABOUT - WR62 SB TURNING MOVEMENT**

VIERLING DR E & EAGLE CREEK BVLD ROUNDABOUT
SHAKOPEE, MN

**Figure 2**







CONTROL VEHICLE




WB-62

| | feet | | |
|---|---|---|---|
| Tractor Width | : 8.00 | Lock to Lock Time | : 6.0 |
| Trailer Width | : 8.50 | Steering Angle | : 24.9 |
| Tractor Track | : 8.00 | Articulating Angle | : 70.0 |
| Trailer Track | : 8.50 | | |

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Job #
5/17/2023 - 11:30AM

**ROUNDABOUT - WR62 WB TURNING MOVEMENT**

VIERLING DR E & EAGLE CREEK BVLD ROUNDABOUT
SHAKOPEE, MN

**Figure 3**

EAGLE CREEK BLVD

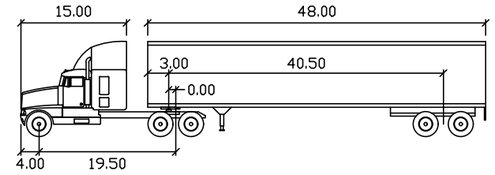
VIERLING DR E

VIERLING DR E

EAGLE CREEK BLVD

0 30 60
SCALE IN FEET

CONTROL VEHICLE




WB-62

| | feet | | |
|---|---|---|---|
| Tractor Width | : 8.00 | Lock to Lock Time | : 6.0 |
| Trailer Width | : 8.50 | Steering Angle | : 24.9 |
| Tractor Track | : 8.00 | Articulating Angle | : 70.0 |
| Trailer Track | : 8.50 | | |

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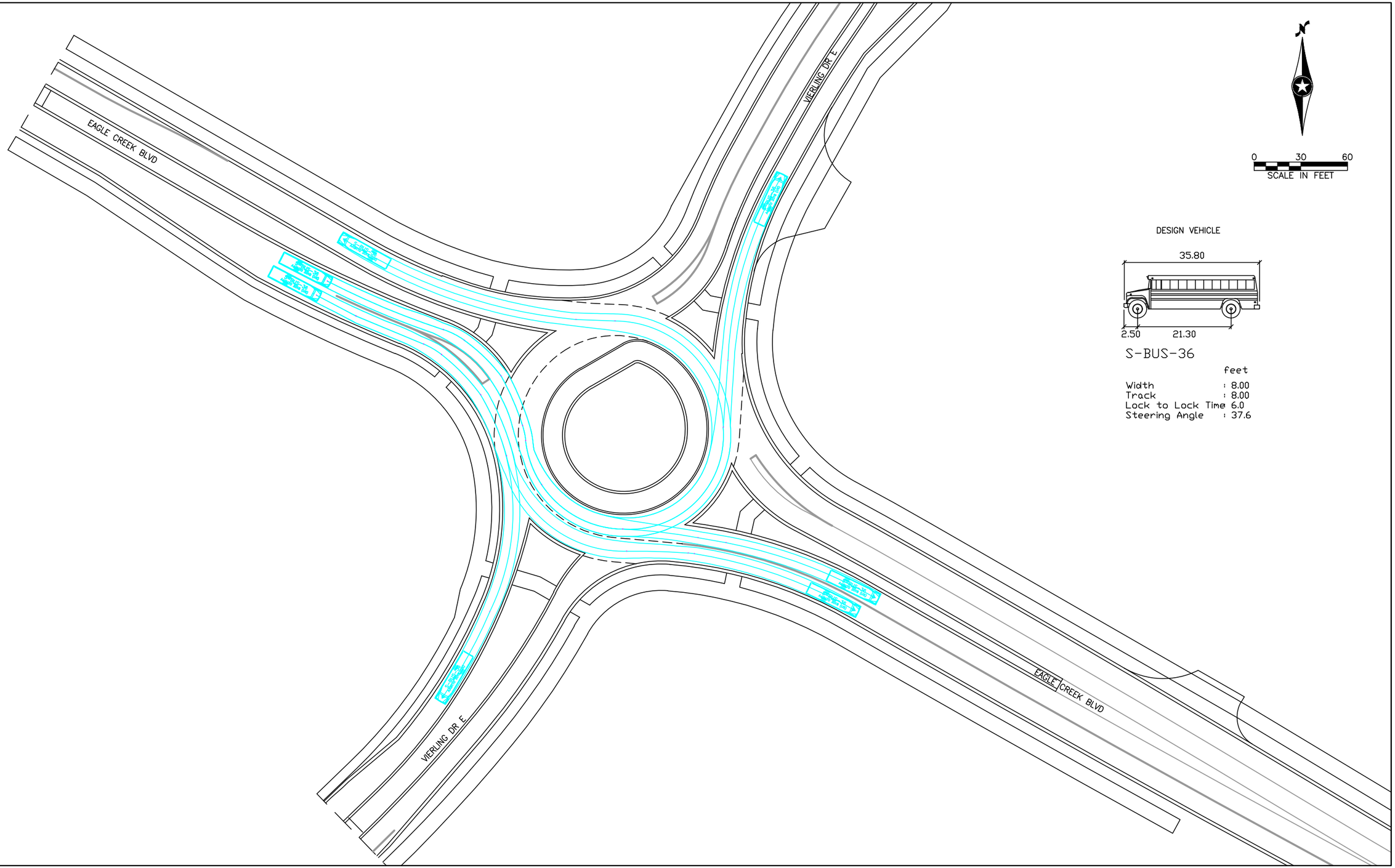
SRF

Job #
5/17/2023 - 11:30AM

**ROUNDABOUT - WR62 NB TURNING MOVEMENT**

VIERLING DR E & EAGLE CREEK BVLD ROUNDABOUT
SHAKOPEE, MN

**Figure 4**




0 30 60
SCALE IN FEET

DESIGN VEHICLE




S-BUS-36

| | feet |
|---|---|
| Width | : 8.00 |
| Track | : 8.00 |
| Lock to Lock Time | 6.0 |
| Steering Angle | : 37.6 |

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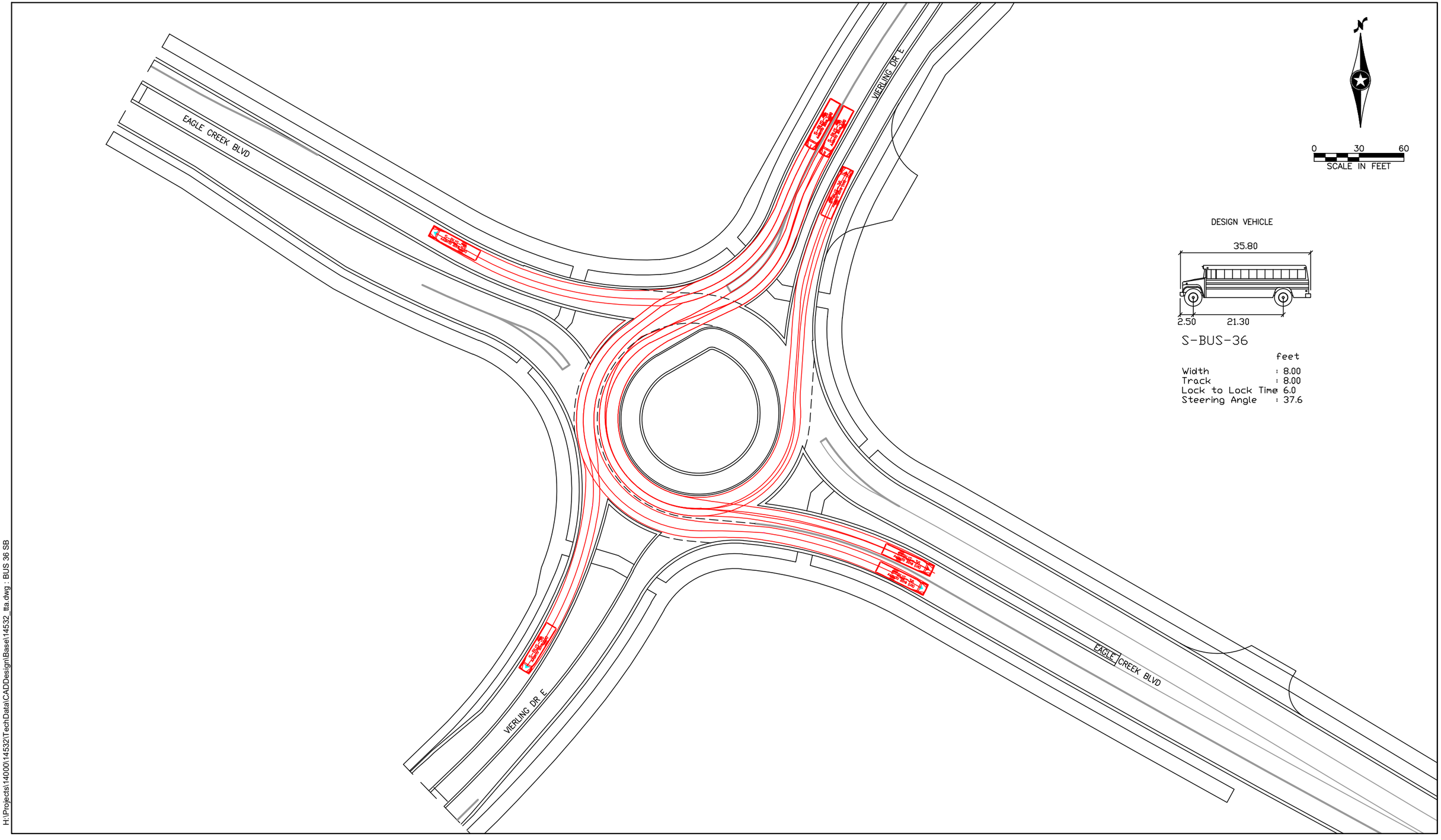
Job #
5/17/2023 - 11:30AM

**ROUNDABOUT - AASHTO BUS 36 EB TURNING MOVEMENT**

VIERLING DR E & EAGLE CREEK BVLD ROUNDABOUT
SHAKOPEE, MN

**Figure 5**




0 30 60
SCALE IN FEET

DESIGN VEHICLE




S-BUS-36

| | feet |
|---|---|
| Width | : 8.00 |
| Track | : 8.00 |
| Lock to Lock Time | 6.0 |
| Steering Angle | : 37.6 |

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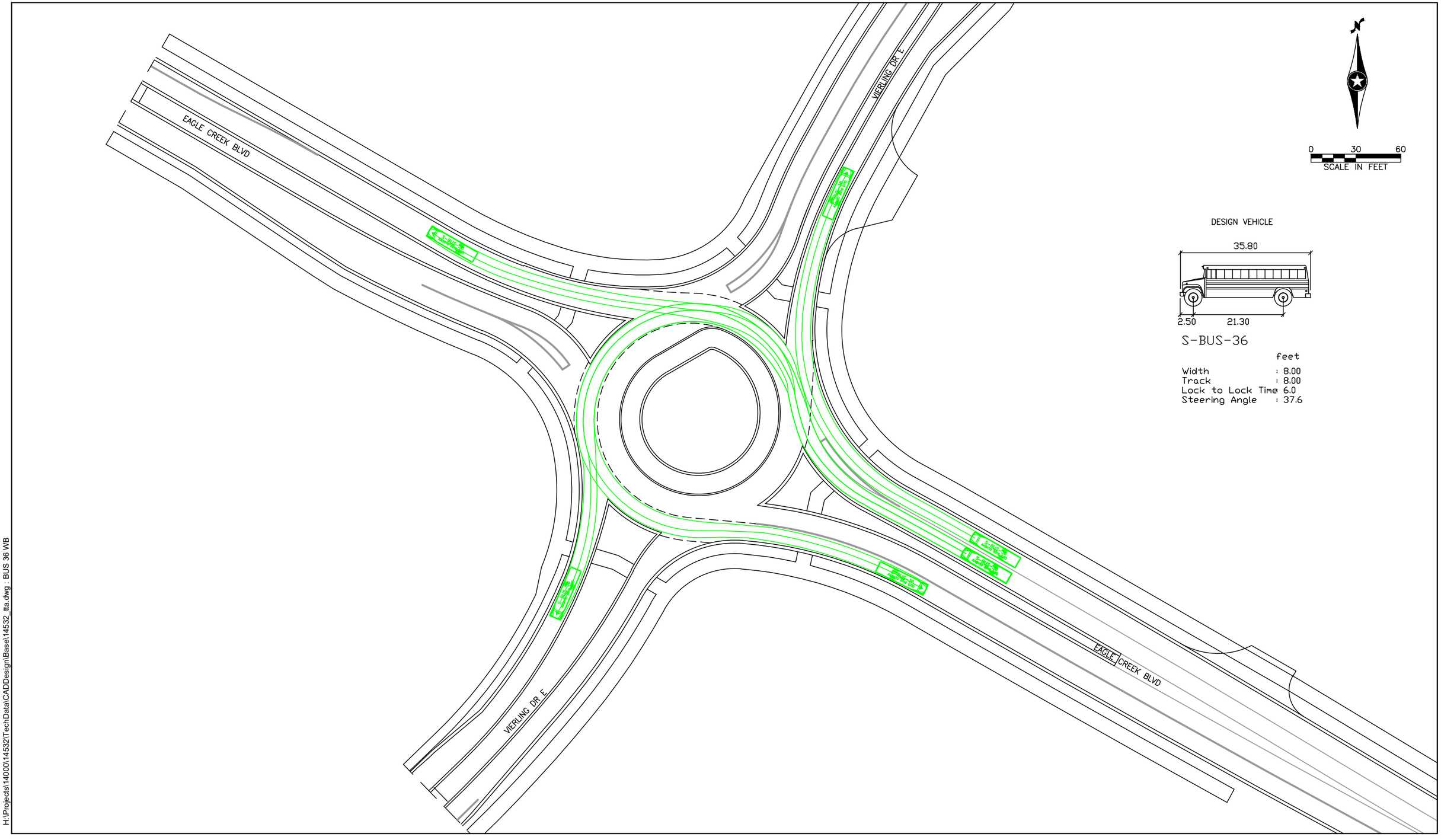
SRF

Job #
5/17/2023 - 11:30AM

**ROUNDABOUT - AASHTO BUS 36 SB TURNING MOVEMENT**

VIERLING DR E & EAGLE CREEK BVLD ROUNDABOUT
SHAKOPEE, MN

**Figure 6**




0 30 60
SCALE IN FEET

DESIGN VEHICLE




S-BUS-36

| | feet |
|---|---|
| Width | : 8.00 |
| Track | : 8.00 |
| Lock to Lock Time | : 6.0 |
| Steering Angle | : 37.6 |

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SRF

Job #
5/17/2023 - 11:30AM

**ROUNDABOUT - AASHTO BUS 36 WB TURNING MOVEMENT**

VIERLING DR E & EAGLE CREEK BVLD ROUNDABOUT
SHAKOPEE, MN

**Figure 7**

EAGLE CREEK BLVD

VIERLING DR E

VIERLING DR E

EAGLE CREEK BLVD

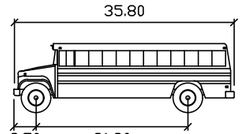
N

0 30 60

SCALE IN FEET

DESIGN VEHICLE

35.80



2.50 21.30

S-BUS-36

| | feet |
|---|---|
| Width | : 8.00 |
| Track | : 8.00 |
| Lock to Lock Time | 6.0 |
| Steering Angle | : 37.6 |

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SRF

Job #
5/17/2023 - 11:30AM

**ROUNDABOUT - AASHTO BUS 36 NB TURNING MOVEMENT**

VIERLING DR E & EAGLE CREEK BVLD ROUNDABOUT
SHAKOPEE, MN

**Figure 8**