DEPARTMENT OF TRANSPORTATION

Evaluation of Traffic Safety for Heavy Commercial Vehicles at Roundabouts in Minnesota

Mark Wagner, Principal Investigator
Minnesota Department of Transportation

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16. Abstract (Limit: 250 words)

Modern roundabouts have been shown to be one of the safest methods of control for at-grade intersections. An evaluation of traffic safety at roundabouts published by MnDOT in 2017 shows substantial decreases in fatal and serious injury crashes at intersections after installation of a roundabout. Despite these benefits, concerns have been raised from citizens, commercial motor vehicle (CMV) drivers, and other stakeholders about the propensity for roundabouts to cause more rollover crashes for larger vehicles. The purpose of this evaluation is to further evaluate the safety of heavy commercial vehicles at roundabouts, investigate whether rollover crashes are more likely to occur at roundabouts, and break down the most common characteristics for CMV crashes at roundabouts in Minnesota. This report includes the results of an analysis comparing roundabouts to signalized intersections. The results of this evaluation indicate that roundabouts continue to be one of the safest forms of intersection control for heavy commercial vehicles, especially when compared to traffic signal control. Although roundabouts have experienced a greater number of rollover crashes compared to intersections with traffic signal control, their installation results in a decrease in high-severity crashes.

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Evaluation of Traffic Safety for Heavy Commercial Vehicles at Roundabouts in Minnesota

FINAL REPORT

Prepared by:

Mark Wagner, PE – MnDOT Office of Traffic Engineering
Eric DeVoe, Senior Research Analyst – MnDOT Office of Traffic Engineering
Ryan Mwangi, Student Worker – MnDOT Office of Traffic Engineering

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LIST OF ABBREVIATIONS & DEFINITIONS OF TERMS

Acronym	**Meaning**
AADT	Average Annual Daily Traffic
CMV	Commercial Motor Vehicle
CR	County Road
CSAH	County State Aid Highway
GDSU	Geometric Design Support Unit
HCAADT	Heavy Commercial Average Annual Daily Traffic
KA	Fatal and serious injury crash
KAB	Fatal, serious injury, and minor injury crashes
KABC	Fatal and all injury crashes
MEV	Million entering vehicles
MEHCV	Million entering heavy commercial vehicles
MnDOT	Minnesota Department of Transportation
MSAS	Minnesota State Aid Street
TH	Trunk Highway

Crash Severities

- K Crash: Fatal crash. At least one person involved in the crash died because of injuries sustained in the crash.
- A Crash: Suspected serious injury crash. The crash resulted in a suspected serious injury for at least one person involved in the crash.
- B Crash: Suspected minor injury crash. The crash resulted in a suspected minor injury for at least one person involved in the crash.
- C Crash: Possible injury crash. The crash resulted in a possible injury for at least one person involved in the crash.
- PDO Crash: Property damage only crash. The crash resulted in property damage with no injuries for anyone involved in the crash.

Other Definitions:

- Site-Year: One year of data at a site.

EXECUTIVE SUMMARY

By the end of 2023, nearly 500 roundabouts were constructed on Minnesota roadways. Roundabouts are a type of circular intersection defined by the presence of a central island, counterclockwise circulation of traffic, and yield control of entering vehicles. Roundabouts provide safety benefits by using geometric design to reduce vehicle speeds and splitter islands to separate entering and exiting traffic, providing refuge areas for pedestrians, and reducing the number of points within an intersection in which vehicle paths might intersect (aka conflict points). Modern roundabouts have been shown to be one of the safest methods of control for at-grade intersections. An evaluation of traffic safety at roundabouts published by MnDOT in 2017 shows substantial decreases in fatal and serious injury crashes at intersections after installation of a roundabout. Despite these benefits, concerns have been raised from citizens, CMV drivers, and other stakeholders about the propensity for roundabouts to cause more rollover crashes for larger vehicles. The purpose of this evaluation is to further evaluate the safety of heavy commercial vehicles at roundabouts, investigate whether rollover crashes are more likely to occur at roundabouts, and break down the most common characteristics for CMV crashes at roundabouts in Minnesota. This report includes the results of an analysis comparing roundabouts to signalized intersections.

The comparison analyses showed that heavy vehicle rollovers have been more prevalent at roundabouts, with 15 rollovers at roundabouts in the study and 1 in the traffic signal control group, but crash rates for fatal and injury crashes were 47% lower than at signalized intersections.

The results of this evaluation indicate that conversion of an intersection to roundabout control confers significant safety benefits and that roundabouts continue to be one of the safest forms of intersection control for heavy commercial vehicles, especially when compared to traffic signal control. These results are consistent with the safety goals of roundabouts as well as with the previous evaluation of roundabouts in Minnesota. Although roundabouts have experienced a greater number of rollover crashes compared to intersections with traffic signal control, there is a severity shift that results in a decrease in high-severity crashes.

CHAPTER 1: INTRODUCTION

To support the safety of all those traveling on Minnesota roads, the *2020-2024 Strategic Highway Safety Plan* (SHSP) lists commercial vehicles as one of its strategic focus areas for transportation safety improvements. Strategic focus areas are considered emerging priorities that are rising in importance due to changes in prevalence, public/stakeholder perception, and demographics. To help address this focus area, one of the improvements available to engineers and transportation practitioners in Minnesota is the roundabout.

Roundabouts are a type of circular intersection defined by the presence of a central island, counterclockwise flow of traffic, and yield control of entering vehicles. Other types of circular intersections commonly seen in the United States include rotaries, signalized traffic circles, and neighborhood traffic circles. A brief description of each type, and how they differ from roundabouts, is below:

- Rotaries are an older style of circular intersection popular until the 1960s. They feature large diameters, weaving sections between legs, and typically require lane changes within the rotary for some movements. Some operate with circulating traffic yielding to entering traffic as well, in direct contrast to the roundabout.
- Signalized traffic circles are another older style of circular intersection in which traffic signals control some or all the points of entry to the circulatory roadway. As a result, traffic regularly queues in the circulatory roadway and approach legs.
- Neighborhood traffic circles are usually constructed at the intersection of two or more local streets for traffic calming or aesthetic reasons. The approaches may be uncontrolled or yield- or stop-controlled, and they do not include the channelization features of modern roundabouts.

The first roundabout in Minnesota was installed in 1995 at the intersection of Setzler Parkway, Neddersen Parkway, and Founders Parkway in Brooklyn Park. Since then, nearly 500 more have been constructed in the state[1]. They have become increasingly accepted as an intersection type by traffic engineers, elected officials, and the public. Roundabouts are considered an appropriate alternative in a variety of contexts including urban, suburban, and rural locations; at low- and high-volume locations; as gateway treatments for school zones; and at interchange ramp terminals. Figure 1.1 shows a sample layout of a roundabout intersection.

[1] Roundabouts Database Home (kittelson.com)

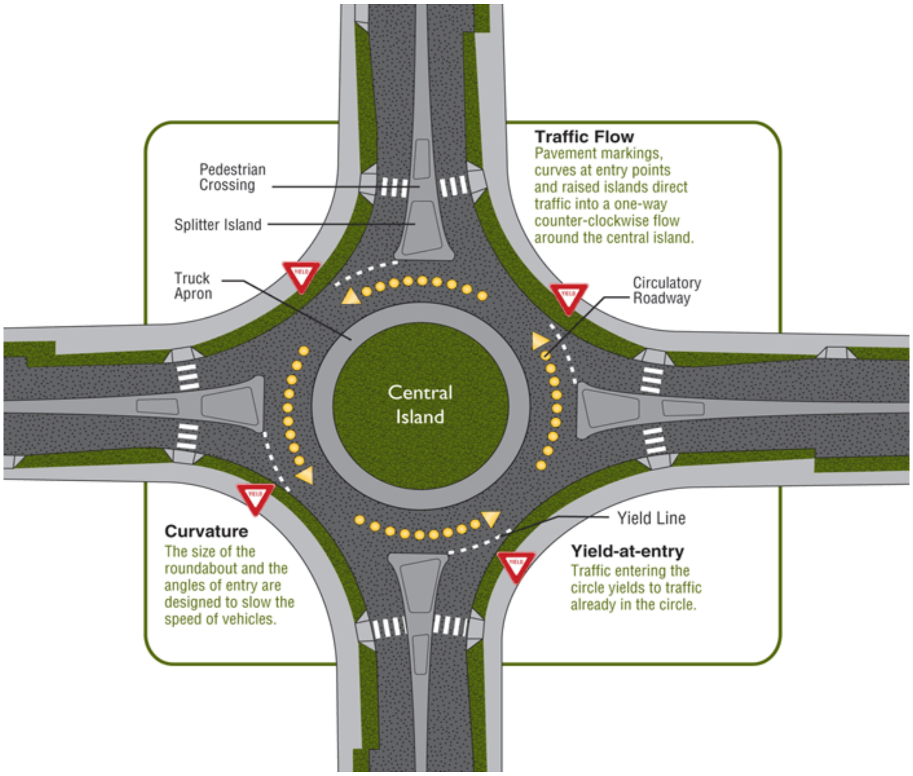

Figure 1.1 – Sample Roundabout Intersection

Modern roundabouts have been shown to be one of the safest methods of control for at-grade intersections.[2] Roundabouts provide safety benefits by using geometric design to reduce vehicle speeds and splitter islands to separate entering and exiting traffic, by providing refuge areas for pedestrians, and by reducing the number of points within an intersection in which vehicle paths might intersect. By eliminating the option for vehicles approaching the intersection to travel straight through the middle of the intersection, the overall likelihood of right-angle crashes at a roundabout is greatly reduced. Right-angle crashes, commonly referred to as T-bone crashes, often have severe outcomes.

An evaluation of traffic safety at roundabouts published by MnDOT in 2017[3] showed an 86% decrease in the fatal crash rate and an 83% reduction in the serious injury crash rate at intersections after installation of a roundabout. The report also noted that, as of its publishing, there had not been a multi-vehicle fatality at a roundabout in Minnesota. While this statement is no longer true, there has only been a single multi-vehicle crash at a roundabout resulting in a fatality in 27 years.

While the safety benefits of roundabouts for all vehicular traffic have been well-established, concerns regarding the safety of heavy commercial vehicles have been raised by citizens and other stakeholders.

[2] NCHRP 672

[3] *A Study of the Traffic Safety at Roundabouts in Minnesota 2017*

The purpose of this report is to evaluate the safety of heavy commercial vehicles at roundabouts when compared to a similar cohort of signalized intersections to determine whether the benefits identified in previous research are still applicable at roundabouts in Minnesota. This report will also investigate the incidence of rollover crashes involving heavy vehicles at each type of intersection. In 2018, to address concerns about commercial vehicle rollovers at roundabouts, MnDOT's Geometric Design Support Unit (GDSU) developed updated roundabout design guidance to reduce the possibility of rollover crashes based on input from MnDOT Districts, commercial vehicle operators, and other stakeholders. Whether these factors influenced the incidence of heavy commercial rollover crashes is investigated in Chapter 3.

The Transport Research International Documentation (TRID) database[4] was used to search for national research on truck and heavy commercial vehicle safety at roundabouts. Five studies[5,6,7,8,9] were identified from the past 10 years for review as part of this evaluation. The studies examined how various factors related to roundabout design, truck configuration, and driver behavior can impact the rollover risk for commercial trucks navigating roundabouts. Some major findings include:

Roundabout Geometry:

- The cross-sectional geometry (crown vs. cross-slope) of the circulatory roadway significantly influences roll stability, with crowned roadways improving stability for through/left movements but slightly reducing it for right turns.
- The truck apron design, particularly the curb height and slope at the interface with the circulatory lane, can increase rollover risk when trucks mount/dismount the apron.
- Wider multi-lane circulatory roadways tend to improve roll stability compared to single-lane roundabouts by allowing more maneuvering room.

Vehicle Factors:

- Different truck configurations exhibit varying levels of roll stability, with single-unit trucks being most stable followed by doubles with 28-ft trailers, while WB-67 semis and doubles with 40-ft trailers have higher rollover risk.
- Vehicle loading is a factor. Fully loaded trucks have a higher center of gravity increasing rollover risk, while empty trucks are also less stable than partially loaded ones, especially in single-lane roundabouts.

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[4] Home - Transport Research International Documentation - TRID (trb.org)
[5] SAE MOBILUS (2016-01-8038)
[6] Rollover Propensity of Heavy Vehicles at Roundabouts: Case Study on High- and Low-Speed Roads (sagepub.com)
[7] *Evaluation of Alternative Intersections and Interchanges: Volume I—Rou,* by Andrew P. Tarko, Mario Romero et al. (purdue.edu)
[8] SAE MOBILUS (2015-01-2741)
[9] *Accelerating Roundabout Implementation in the United States - Volume V of VII: Evaluation of Geometric Parameters that Affect Truck Maneuvering and Stability* (bts.gov)

- Non-static loads that can shift during travel were not studied but could further compromise stability.

Driver Behavior:

- Speeding, particularly through the circulatory roadway at 15 mph or higher, greatly increases rollover propensity even in roundabouts.
- Drivers tend to be more cautious at night, reducing rollover risk on approaches but not as much in the circulatory lane.
- Education for truck drivers on optimal speeds, effects of vehicle loading, and roundabout navigation techniques could improve safety.

Overall, the studies highlighted the need to carefully consider roundabout geometry, design the truck apron properly, understand how different truck configurations perform, and ensure drivers are educated on best practices because even low speeds can lead to rollovers without proper consideration of these factors. Further study on combinations of factors was recommended.

CHAPTER 2: METHODOLOGY

2.1 LOCATIONS

Roundabouts for this evaluation were chosen using the following criteria:

1. The roundabout was fully constructed and operational by 2017.
2. It was preferred but not necessary that Heavy Commercial Average Annual Daily Traffic (HCAADT) was available for the site.
3. The intersection was located on the Trunk Highway (TH), County State Aid Highway/County Road (CSAH/CR), or Minnesota State Aid Street (MSAS) system.
4. The intersection was not located in primarily residential areas.

107 roundabouts were selected for this evaluation. The locations are shown in Figure 2.1.

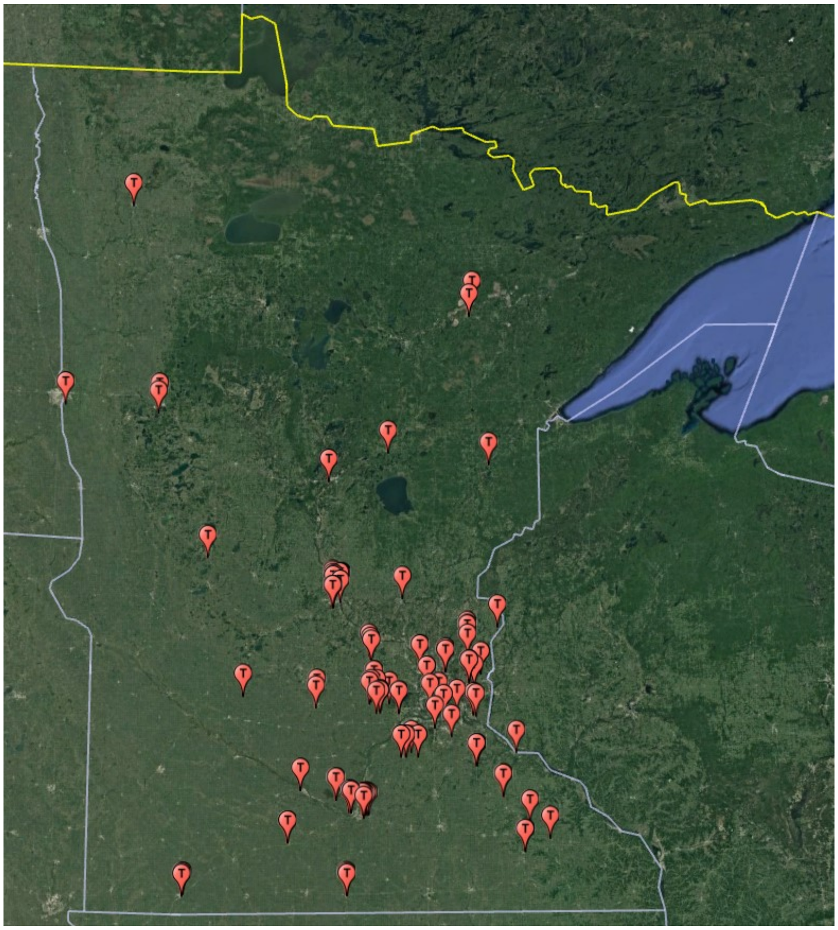

Figure 2.1 – Roundabout Locations

The analysis is a comparison between intersections controlled by a roundabout and those controlled by a traffic signal. To identify comparison locations, signalized intersections with similar entering volumes were selected using the same criteria listed above. 95 signalized comparison intersections were selected. Those locations are shown in Figure 2.2.

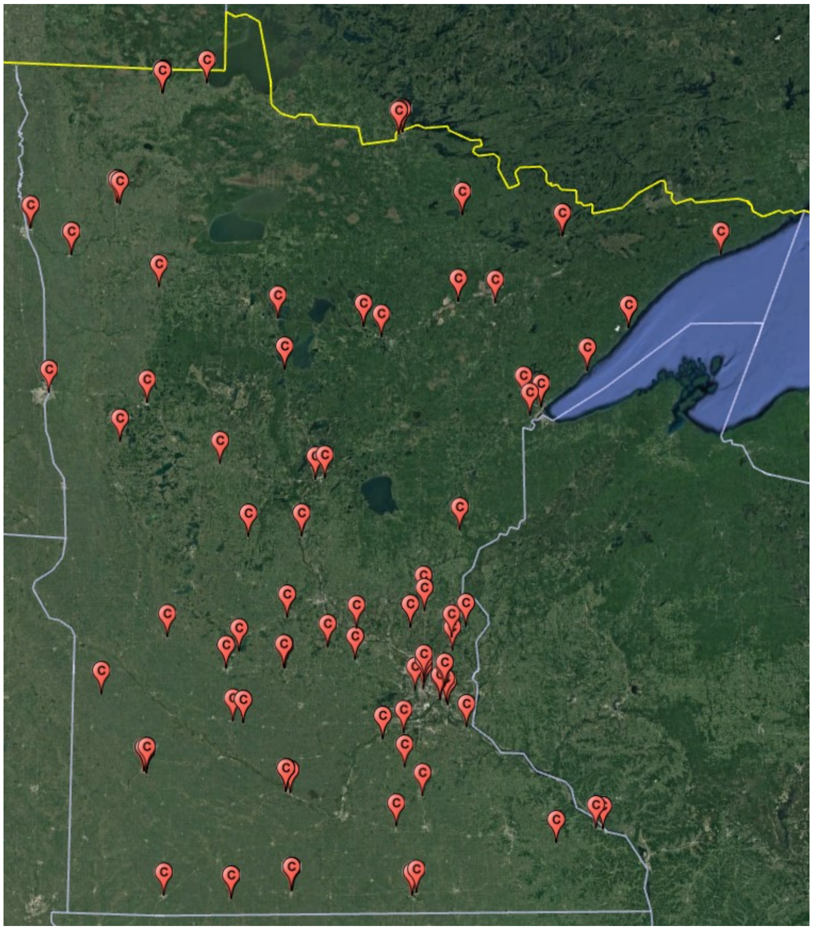

Figure 2.2 – Traffic Signal Comparison Intersections

2.2 CRASH DATA

For comparison purposes, crash data in this evaluation is analyzed by crash rate, crashes per million entering vehicles (MEV) and crashes per million entering heavy commercial vehicles (MEHCV), from 2017 through 2022. The analysis in this evaluation was conducted in 2023, so the most recent year of data analyzed was 2022 as there was not a complete year of data for 2023 at the time of analysis.

Crash data for the applicable years was collected spatially at each intersection. All crashes within 500 feet of the intersection on all approaches to the intersection were included.

Appendix A highlights all rollover crashes for both intersection types.

2.3 ANALYSIS OVERVIEW

This report is a **comparison of roundabouts and traffic signals**, comparing crash data for the years 2017-2022 at the 107 roundabouts to 95 similar locations with traffic signals as described in Section 2.1.

A discussion of the most common characteristics associated with heavy commercial vehicle crashes at both roundabout and signalized control sites is also included in Chapter 3.

CHAPTER 3: RESULTS

3.1 COMPARISON ANALYSIS

One of the typical alternatives to construction of a roundabout is installation of a traffic signal. This analysis compares the crash data at signalized intersections with volumes and characteristics like what would be found at the roundabouts selected for this evaluation.

3.1.1 Question Addressed

How do crash rates and densities for heavy commercial vehicles at roundabouts compare with traffic signal control at similar locations?

3.1.2 Locations

The 107 locations with roundabouts and 95 locations with traffic signals discussed in section 2.1 were utilized for the analysis.

3.1.3 Crash Data

For both roundabouts and signalized intersections, all crashes within 500 feet of the intersection on all approaches were included. Crash data from 2017 through 2022 was used for the analysis. Table 3.1 shows the total and heavy commercial entering volumes and the number of total and heavy commercial crashes.

Table 3.1 - Crash and Volume Data for Heavy Vehicles at Roundabouts and Traffic Signals

Intersection Type	Roundabout	Signal
Number of Sites	107	95
Total Entering Volume	2.03 billion	1.99 billion
Heavy Commercial Entering Volume	121 million	129 million
Total Crashes	2,043	1,808
Total Crash Rate (crashes per MEV)	100.68	90.78
Heavy Commercial Crashes	164	182
Total Heavy Commercial Crash Rate (crashes per MEHCV)	135.10	140.68

3.1.4 Crash Analysis

Table 3.2 shows heavy commercial crash numbers and rates (crashes per MEHCV) by severity at the roundabout and traffic signal control sites. The crash numbers and rates are broken down by severity according to the scale provided in the List of Definitions and Terms.

Table 3.2 – Comparison Analysis for Heavy Vehicles at Roundabouts and Traffic Signals

Intersection Control	Metric	K	A	K+A	B	C	PDO	Total
Traffic Signal	**Number of Crashes**	0	2	2	10	14	156	182
	Crashes per MEHCV	0.00	1.55	1.55	7.73	10.82	120.58	140.68
Roundabout	**Number of Crashes**	1	0	1	8	6	149	164
	Crashes per MEHCV	0.82	0.00	0.82	6.59	4.94	122.74	135.10
Percent Difference in Crashes per MEHCV		+100%	-100%	-47%	-15%	-54%	+17%	-4%

This analysis looked at the safety performance roundabouts compared to traffic signals in the context of number of crashes and intersection crash rate. Crash rate is a useful way to provide an equal comparison among sites with different traffic characteristics. Previous studies and crash records have indicated roundabouts tend to have higher crash rates compared to signalized intersection when it comes to overall crashes and considerably lower crash rates compared to signalized intersections when it comes to fatal (K) and suspected serious injury (A) crashes. The findings of this analysis are somewhat different from previous findings in that the roundabouts in this evaluation have fewer total crashes than the traffic signal comparison group while also having lower totals and rates of fatal and serious injury crashes. Table 3.2 shows that roundabouts have a lower crash rate for fatal and injury crashes as well as total crashes, but a higher rate of property damage crashes (PDO) compared to traffic signals.

3.2 ROLLOVER CRASH DISCUSSION

3.2.1 Question Addressed

Do rollover crashes involving heavy commercial vehicles occur more frequently at roundabouts compared with traffic signal control at similar locations?

3.2.2 Locations

The 107 locations with roundabouts and 95 locations with traffic signals discussed in section 2.1 were utilized for the discussion. An additional 181 roundabouts constructed from 2018-2023 were added for this analysis to evaluate the effects of changes in design guidance from the MnDOT Geometric Design Standards Unit (GDSU) to address concerns about rollovers and load shifting at roundabouts.

3.2.3 Crash Data

For both groups of roundabouts and the signalized intersections, all crashes within 500 feet of the intersection on all approaches were included. Crash data from 2018 through 2022 was used for the analysis of roundabouts built in 2017 or prior as well as the signal control sites. For the roundabouts constructed in 2018 or after, crash data from 2019-2023 was used.

3.2.4 Crash Analysis

The crash data for roundabouts constructed prior to or in the year 2017 indicates that 15 out of 157 (about 10%) commercial vehicles crashes at roundabouts were rollovers. The severity breakdown is 1 fatal, 3 suspected minor injury, and 11 property damage crashes. For the traffic signal control sites, 1 out of 178 (<1%) of commercial vehicle crashes were rollovers, which was a property damage crash.

A review of the crash reports for the rollover crashes at roundabouts shows that nearly half are concentrated at two locations:

- TH 7 & CSAH 10 in Carver County (3 rollovers)
- US 59/MN 60 & CSAH 35 in Nobles County (4 rollovers)

The crash reports for these 7 crashes cite suspected medical event, load shift in trailer, driver failed to negotiate approach curve, driver took turn too wide, and mechanical brake failure as contributing factors. It is possible that there are specific features of these two sites that are causing more rollover crashes, but the contributing factors from the crash reports indicate that the presence of the roundabout may not have been the primary cause of the rollover.

As previously mentioned, MnDOT GDSU in 2018 developed updated roundabout design guidance to reduce the possibility of rollover crashes. To see if these factors influenced the incidence of these crashes, 181 roundabouts constructed from 2018-2023 were analyzed.

The crash data for roundabouts constructed in 2018 or later counts 8 out of 227 commercial vehicle crashes (about 3%) were rollovers. The severity breakdown is 1 suspected minor injury and 7 property damage crashes. While other factors such as driver experience, changes in traffic patterns, or improvements to commercial vehicle suspension systems could, among others, explain the lower crash incidence, the numbers here suggest that the changes in design guidance in 2018 have contributed to a reduction in commercial vehicle rollovers at roundabouts.

3.3 COMMERCIAL VEHICLE CRASH FACTORS

3.3.1 Question Addressed

What crash characteristics occur most frequently at roundabouts compared with traffic signal control at similar locations?

3.3.2 Locations

The 107 locations with roundabouts and 95 locations with traffic signals discussed in section 2.1 were utilized for the discussion.

3.3.3 Crash Data

For both roundabouts and signalized intersections, all crashes within 500 feet of the intersection on all approaches were included. Crash data from 2017 through 2022 was used for the analysis.

3.3.4 Crash Analysis

The crash data for roundabouts and traffic signal control sites used for this evaluation are also broken down along five categories: Basic Type, Most Harmful Event, Vehicle Configuration, Cargo Body Type, and Precrash Vehicle Maneuver. The following series of charts highlights the most common characteristics for each category. Note that, because only the most frequent characteristics are listed, the percentages will not total 100%. Where Other is listed as a characteristic the intent is not to make the column sum to 100%.

Table 3.3 – Basic Type Frequency at Roundabouts and Signal Control Sites

Roundabout		Signal	
Characteristic*	**Percent of CMV Crashes**	**Characteristic****	**Percent of CMV Crashes**
Sideswipe – Passing	37%	Rear End	19%
Single Vehicle – Run Off Road	16%	Angle	17%
Angle	13%	Other	16%
Other	10%	Sideswipe – Passing	12%

**Unknown = 15%; **Unknown = 15%*

Table 3.4 – Most Harmful Event Frequency at Roundabouts and Signal Control Sites

Roundabout		Signal	
Characteristic*	**Percent of CMV Crashes**	**Characteristic****	**Percent of CMV Crashes**
Motor Vehicle in Transport	60%	Motor Vehicle in Transport	43%
Overturn/Rollover	9%	Parked Motor Vehicle	3%
Utility Pole/Light Pole	4%	Traffic Signal/Sign Structure	3%
Roadway Sign/Signal Structure	2%	Other Post, Pole, Support	2%

**Unknown = 19%; **Unknown = 43%*

Table 3.5 – Vehicle Configuration Frequency at Roundabouts and Signal Control Sites

Roundabout		Signal	
Characteristic*	**Percent of CMV Crashes**	**Characteristic****	**Percent of CMV Crashes**
Truck Tractor Semi-Trailer	28%	Truck Tractor Semi-Trailer	25%
Truck Pulling Trailer(s)	22%	Truck Pulling Trailer(s)	8%
Single-unit Truck/Pickup > 10,000 Lbs	7%	Single-unit Truck/Pickup > 10,000 Lbs	7%
Single-unit Truck (3+ Axles)	6%	Single-unit Truck (2-Axle, GVWR > 10,000 Lbs)	6%

**Unknown = 19%; **Unknown = 43%*

Table 3.6 – Cargo Body Type Frequency at Roundabouts and Signal Control Sites

Roundabout		Signal	
Characteristic*	**Percent of CMV Crashes**	**Characteristic****	**Percent of CMV Crashes**
Van/Enclosed Box	24%	Van/Enclosed Box	16%
Flatbed	13%	Other	8%
Hopper (Grain/Chips/Gravel)	7%	Flatbed	5%
Other	7%	Hopper (Grain/Chips/Gravel)	4%

**Unknown = 25%; **Unknown = 48%*

Table 3.7 – Precrash Vehicle Maneuver Frequency at Roundabouts and Signal Control Sites

Roundabout		Signal	
Characteristic*	**Percent of CMV Crashes**	**Characteristic****	**Percent of CMV Crashes**
Moving Forward	34%	Moving Forward	28%
Negotiating a Curve	22%	Turning Right	15%
Turning Right	6%	Turning Left	6%
Turning Left	6%	Vehicle Stopped or Stalled in Roadway	6%

**Unknown = 17%; **Unknown = 48%*

Looking at Tables 3.3 through 3.7, a few interesting results emerge. The biggest takeaway from table 3.3 is how many sideswipe-passing crashes with CMVs there are at roundabouts. That might suggest single lane roundabouts would lower CMV crashes even if it has the possibility to increase rollovers. It also may be a topic for more public awareness: give trucks space at roundabouts.

Also, in table 3.3, the percentages of Angle and Other crashes are somewhat similar between roundabouts and signals. This is likely due to the nature of intersections, where vehicles meet in perpendicular paths, but also indicates some discrepancy in the understanding of crash definitions. What many consider an angle crash at a roundabout is usually a sideswipe crash that occurred in such a manner that it was interpreted as an angle.

In Table 3.5, the order of crash characteristics is nearly identical for the two groups, with the only difference being the number of axles on single-unit vehicles in the fourth item. The most likely explanation is that these four vehicle configurations represent a majority or substantial percentage of the commercial vehicle fleet and are therefore have a higher chance of being involved in crashes. Likewise, in Table 3.6 the same characteristics are present for both roundabouts and signalized intersections, but the frequency of each cargo body type differed between the two groups. As with Table 3.5, this is probably a reflection of the most common cargo types in the commercial vehicle fleet.

The final interesting finding is in Table 3.7, where Negotiating a Curve represents 22% of pre-crash maneuvers for CMVs at roundabouts. This suggests further clarification may be needed when preparing crash reports, as there are no curves to negotiate at a roundabout. Instead, these crashes should be placed in the Turning Left, Turning Right, or potentially Moving Forward category.

CHAPTER 4: CONCLUSIONS

The results of this analysis find that roundabouts have lower rates of fatal and serious injury, suspected minor injury, possible injury, and total heavy commercial crashes compared to a group of similar intersections with traffic signal control. While the fatal rollover crash in the data was at a roundabout, it is unclear if, or to what extent, the roundabout was a contributing factor due to the driver experiencing a potential medical event. The investigation of rollover crashes for the roundabout and traffic signal control groups shows that heavy commercial vehicle rollover crashes have been more frequent at roundabouts, but changes in geometric design practices since 2018 have reduced the incidence of these crashes at roundabouts constructed between 2018 and 2023. The review of crash characteristics for this evaluation shows that the configuration and cargo body type of commercial vehicles are the most relevant factors related to CMV crashes at roundabouts.

These findings suggest that while rollover crashes have been more frequent at roundabouts compared to traffic signals, fatal, injury, and total heavy commercial crash rates at roundabouts are lower than at traffic signals, and the incidence of rollover crashes at roundabouts has decreased with changes in geometric design practices since 2018.

APPENDIX A
COMMERCIAL VEHICLE ROLLOVER CRASH DETAILS

Details about the rollover crashes that occurred from at roundabouts installed in 2017 or before and traffic signal-controlled intersections are in Table A.1.

Table A.1: Commercial Vehicle Rollover Crash Details (Year of Construction 2017 or Before)

Location	Intersection Control	Install Year	Crash Year	Crash Severity	Contributing Factors
US 59-TH 34/Willow St/Long Lake Rd, Becker County	Roundabout	2014	2018	PDO	None
TH 7/CSAH 10, Carver County	Roundabout	2008	2018	PDO	Load Shift
TH 7/CSAH 10, Carver County	Roundabout	2008	2018	PDO	Driver Error
TH 7/CSAH 10, Carver County	Roundabout	2008	2021	K	Possible Driver Medical Event
TH 58/US 52 EB Ramps/ CSAH 10/180th Ave, Goodhue County	Roundabout	2017	2019	PDO	Speed
CSAH 23/US 14 EB Ramps, Nicollet County	Roundabout	2017	2018	B	Driver Error/ Improper Turn
US 59-TH 60/CSAH 33, Nobles County	Roundabout	2013	2018	PDO	Defective 5th Wheel Coupling on Trailer
US 59-TH 60/CSAH 35, Nobles County	Roundabout	2012	2018	PDO	Failed to Negotiate Advance Curve
US 59-TH 60/CSAH 35, Nobles County	Roundabout	2012	2019	PDO	Failed to Negotiate Advance Curve
US 59-TH 60/CSAH 35, Nobles County	Roundabout	2012	2021	PDO	Speed
US 59-TH 60/I-90 EB Ramps, Nobles County	Roundabout	2013	2018	B	Load Shift
US 14/TH 42, Olmsted County	Roundabout	2015	2020	PDO	Driver Failed to Negotiate Right Turn
US 63/CSAH 33, Olmsted County	Roundabout	2012	2021	PDO	Speed, Brake Mechanical Failure
US 61/TH 97 N Jct, Washington County	Roundabout	2016	2019	B	Driver Error
US 61/TH 97 S Jct, Washington County	Roundabout	2016	2022	B	Load Shift
US 75/US 212, Lac Qui Parle County	Traffic Signal	---	2020	PDO	Wet/Snowy/Icy Road Condition

Details about the rollover crashes that occurred from at roundabouts installed in 2018 or after are in Table A.2.

Table A.2: Commercial Vehicle Rollover Crash Details (Year of Construction 2018 or Later)

Location	Intersection Control	Install Year	Crash Year	Crash Severity	Contributing Factors
TH 95 / CR 157, Mille Lacs County	Roundabout	2018	2018	B	Speed
US 14/CR 21/TH 15 SB Ramps, Nicollet County	Roundabout	2019	2020	PDO	Other/Unknown
US 14/CR 21/TH 15 NB Ramps, Nicollet County	Roundabout	2019	2021	PDO	Driver Error/ Load Shift
CSAH 49/CSAH 18/Country Dr, Ramsey County	Roundabout	2020	2021	PDO	Other/Unknown
Riverfront Dr/US 14 WB Ramps, Blue Earth County	Roundabout	2021	2021	PDO	Speed, Brake Mechanical Failure
US 12/CSAH 90, Hennepin County	Roundabout	2021	2022	PDO	Speed
CSAH 2/CSAH 91, Scott County	Roundabout	2020	2023	PDO	Other/Unknown