



## **TRAFFIC IMPACT ANALYSIS**

**3737 Lander Road, Pepper Pike, OH  
(Proposed Willey Creek Overlay District)**

Prepared For

**ADG Willey Creek, LLC  
25825 Science Park Drive, Suite 100  
Beachwood, Ohio 44122**

Prepared by:



**1300 East 9<sup>th</sup>. Street, Suite 500  
Cleveland, Ohio 44114  
216-622-2400**

**May 2020**

**This Page Left Intentionally Blank**

**TABLE OF CONTENTS**

TABLE OF CONTENTS..... I

1 EXECUTIVE SUMMARY ..... 2

2 INTRODUCTION ..... 3

    2.1 Study Area and Parameters ..... 3

3 TRAFFIC VOLUMES AND ANALYSIS ..... 4

    3.1 Overlay District Trip Generation and Distribution ..... 4

    3.2 Capacity Analysis ..... 8

4 SUMMARY OF TRAFFIC CONDITIONS..... 13

**LIST OF FIGURES**

Figure 1. Lander Circle ..... 3

Figure 2. Opening Day (2023) No Build Traffic ..... 6

Figure 3. Opening Day (2023) Build Preferred Scenario Traffic ..... 7

Figure 4. Opening Day (2023) No Build Scenario LOS..... 9

Figure 5. Opening Day (2023) Build Preferred Scenario LOS ..... 10

Figure 6. One-Lane Roundabout Opening Day (2023) Build Preferred Scenario LOS ..... 11

Figure 7. Two-Lane Roundabout Opening Day (2023) Build Preferred Scenario LOS ..... 12

- APPENDIX A: Traffic Data
- APPENDIX B: NCHRP Internal Capture Estimation
- APPENDIX C: No- Build Capacity Analysis
- APPENDIX D: Build Capacity Analysis
- APPENDIX E: Build / Roundabout Designs Capacity Analysis
- APPENDIX F: Schematic Roundabout Designs

## 1 EXECUTIVE SUMMARY

In order to understand the potential traffic impacts associated with the Proposed Willey Creek Overlay District, Axiom Development Group has retained AECOM Technical Services, Inc. to perform preliminary traffic analyses. Three prior development scenarios have been studied for the site. Scenario 1 included a residential-only development and Scenarios 2 and 3 incorporate different proportions of mixed-use development (residential, office, and retail). The preferred alternative examined herein consists of a mix of residential, office and retail. The previously studied scenarios varied in how the development was accessed. The preferred alternative has two access points, one on Lander Road and one on Chagrin Boulevard, with a roundabout at each end of a connector road bisecting the development. The exact location of the bisector road termini has not yet been finalized but this development scenario assumes that the bisector will remain entirely north Willey Creek. This modification from previous alternatives does not have an impact on the traffic analyses performed.

As determined by this analysis and previously completed studies, Lander Circle has significant existing operational deficiencies that requires a complete reconfiguration to holistically address the problem. Previously, two roundabout concepts were developed to preliminarily assess the impacts of a newly configured roundabout with respect to Level of Service (LOS) and traffic delays for each leg of the intersection. Driveway reconstruction/realignments will be necessary with a properly designed roundabout. There are several existing access points that would be eliminated. Some potential locations for proposed driveways are shown in the Roundabout Concept exhibits, but in general the new drives shown are re-routed from the circle to the approach legs, and all the new drives shown would be accessible by right or left turns.

Additionally, the preferred development scenario offers a way to mitigate existing and potential traffic impacts resulting from the development. A connector road that would divert the traffic that currently uses Lander Circle by providing a more direct route between Lander Road (south) and Chagrin Boulevard (southeast) has been included. All development traffic coming from the south and southeast would also use the Connector Road and avoid Lander Circle. This bypass scenario was accounted for in the trip distribution and analysis of this study.

Pass-by trips are those where a motorist makes an intermittent stop between their primary origin and destination. These are new trips for the proposed development, but not new trips on the existing roadway network. Internal capture trips are those generated as a result of a new development but never reach the external roadway network. Using the *NCHRP 684 Internal Capture Estimation Tool*, the number of new trips was reduced based on the land uses within the development. The *ITE Trip Generation Handbook, 3<sup>rd</sup> Edition*, shows an average reduction of the site-generated retail trips during the PM Peak of 26% (15 entering trips, 15 exiting trips).

In reviewing the existing conditions within the study area and the preferred development scenario, this preliminary analysis has identified that the development will attract new traffic to Lander Circle and the approaching roadways. The bisector road will mitigate impacts by removing a percentage of both existing and future traffic from entering Lander Circle. Additionally, the reconfiguration of Lander Circle into a proper roundabout significantly reduces delays and improves safety as compared to the existing condition.

2 INTRODUCTION

AECOM previously performed an evaluation of the existing and potential traffic conditions in the vicinity of the Beech Brook Facility on Lander Road in Pepper Pike, Ohio. The evaluation was part of a due diligence study completed for ADG Willey Creek, LLC (ADG).

As the development of the property is moving forward, ADG retained AECOM to update the traffic analysis to identify the potential for traffic impacts and mitigation for the preferred development scenario. The traffic evaluation is not a comprehensive traffic impact study, but rather an initial step in the evaluation of the potential traffic changes that could result from the redevelopment of the property. Geometric improvements resulting in the conversion of the existing Lander Road/Chagrin Boulevard Circle to a traditional roundabout design (1-lane and 2-lane) were considered. Both a one-lane and two-lane roundabout were schematically developed and the impacts of the geometric improvements to the Level of Service at the intersections was evaluated.

2.1 Study Area and Parameters

The study area for this traffic analysis includes the existing intersection of Chagrin Boulevard, Lander Road, and Pinetree Road, which is a large traffic circle with an outside diameter of approximately 340 feet (see **Figure 1**). Each of the six approach roadways operate with stop sign control entering the circle, which has two unmarked circulating lanes with a total pavement width of approximately 40 feet.

Several private commercial driveways have direct access to the circle between the approach roadways. The large size of the circle, excessive width of the circulating lane, high traffic volumes, and number of access points all contribute to a confusing and congested intersection.



Figure 1. Lander Circle

The study area also includes proposed access points to the Proposed Willey Creek Overlay District on both Lander Road and the southeast leg of Chagrin Boulevard.

The Ohio Department of Transportation (ODOT) website indicates a growth rate of 3% per year which was used to expand Average Daily Traffic (ADT) volumes from 2016 to 2017 values. The surrounding area is near its development capacity except for the area of the Proposed Willey Creek Overlay District, therefore a growth rate of 1% per year was used to project the existing traffic volumes for the Opening Day. This is more in line with growth rates used for other traffic studies and design projects in the region.

Miovision video traffic data collection units were deployed on each leg of the circular intersection to collect peak hour traffic volumes. Due to the size and configuration of the circle, individual traffic volumes were collected for each approach entering the circle and traffic exiting the circle to the approach roadways, as well as at a single location on the circle itself to establish circulating volumes. Traffic was collected during morning and afternoon peak hours on typical weekdays in May 2018 when school was in session and there were no holidays or adverse weather conditions. The traffic data collected is provided in **Appendix A**.

The traffic volumes were summarized, and system-wide peak hours were identified for the overall intersection as occurring at 8:00-9:00 a.m. and 4:15-5:15 p.m. The existing volumes were then projected to Opening Day 2023 volumes using the 1% annual growth rate as previously discussed.

### **3 TRAFFIC VOLUMES AND ANALYSIS**

#### **3.1 Overlay District Trip Generation and Distribution**

This analysis studies the preferred development scenario (as defined in **Table 1**) for the Proposed Willey Creek Overlay District. This would be a mixed-use development of single-family detached homes, single-family attached homes (townhomes/condos), retail, and office space. A connector road between the southeast leg of Chagrin Boulevard and the south leg of Lander Road would bisect the proposed development, providing access to the new development and a bypass route for traffic between those two roadways.

Trip generation was performed using the ITE *Trip Generation Manual, 10<sup>th</sup> Edition* to calculate AM peak hour and PM peak hour traffic for the site. Trip generation for each land use was performed using an appropriate independent variable (square footage of retail, office, and restaurants; dwelling units for residential) and was based on the peak hour of traffic on adjacent roadways. Trip generation for the AM and PM peak hours by land use is shown in Table 1, below. The reduction based on internal capture between land uses at the site is also shown. Internal capture trips are those generated as a result of a new development but never reach the external roadway network. For example, someone working in an office at the development might also stop at a retail shop after work before heading home. Instead of counting this as two separate trips, it would be reduced to one. The calculations for internal capture rate between specific land uses based on the *NCHRP 684 Internal Capture Estimation Tool* is included in **Appendix B**.

Table 1. Trip Generation – Redevelopment Scenario

Land Use	ITE Code	Size	AM Peak Trips		PM Peak Trips		After Internal Capture Reduction			
							AM Peak Trips		PM Peak Trips	
			Enter	Exit	Enter	Exit	Enter	Exit	Enter	Exit
Detached Single Family	210	140 units	26	78	89	52	25	75	57	42
Attached single family (Low rise)	220	60 units	7	23	24	14	7	23	17	11
Retail (Shopping Centre)	820	40,000 sq ft	107	65	132	144	99	58	114	105
Office	710	125,000 sq ft	125	20	23	121	116	14	18	110
Total			265	186	268	331	247	170	206	268

Pass-by traffic was also considered in the trip generation forecast. Pass-by trips are those where a motorist makes an intermittent stop between their primary origin and destination. The Pass-by reduction only applied to the PM Peak traffic. An average of 26% of retail-generated traffic during the PM peak could be considered pass-by. Dividing this between entering and exiting trips, the reduction would be 15 trips inbound and 15 outbound and that would be divided between the two access points at Lander Road and Chagrin Boulevard. This reduction was not considered significant enough to impact the analysis, so it was not included. The site-generated trips for each scenario were distributed onto the roadway network based on existing travel patterns and engineering judgment of general origin-destination in the study area. Most of the traffic will traverse the Lander/Chagrin Circle, but a portion of site-generated trips will come from the south on Lander Road or the southeast on Chagrin Boulevard and never enter the traffic circle. A summary of the distribution of the site-generated trips is provided in Table 2.

Table 2. Site-Generated Trip Distribution

Direction From/To	Percentage (AM)	Percentage (PM)	Volume (AM)	Volume (PM)	Percentage (AM)	Percentage (PM)	Volume (AM)	Volume (PM)
<b>Preferred Scenario</b>	<b>Entering Traffic</b>				<b>Exiting Traffic</b>			
From/To East on Pinetree Road	15	15	37	31	15	15	26	40
From/To North on Lander Road	30	25	74	52	25	20	43	54
From/To West on Chagrin Road	15	30	37	62	35	25	60	67
From/To South on Lander Road	20	15	49	31	10	20	17	54
From/To SE on Chagrin Road	20	15	49	31	15	20	26	54
<b>Total</b>	<b>100</b>	<b>100</b>	<b>247</b>	<b>206</b>	<b>100</b>	<b>100</b>	<b>170</b>	<b>268</b>

Site-generated trips were overlaid with the projected existing traffic volumes, which were adjusted to reflect traffic diversions that would occur with the Connector Road in place. The Opening Day trips are depicted in Figures 2 and 3 for the no build and development scenarios.

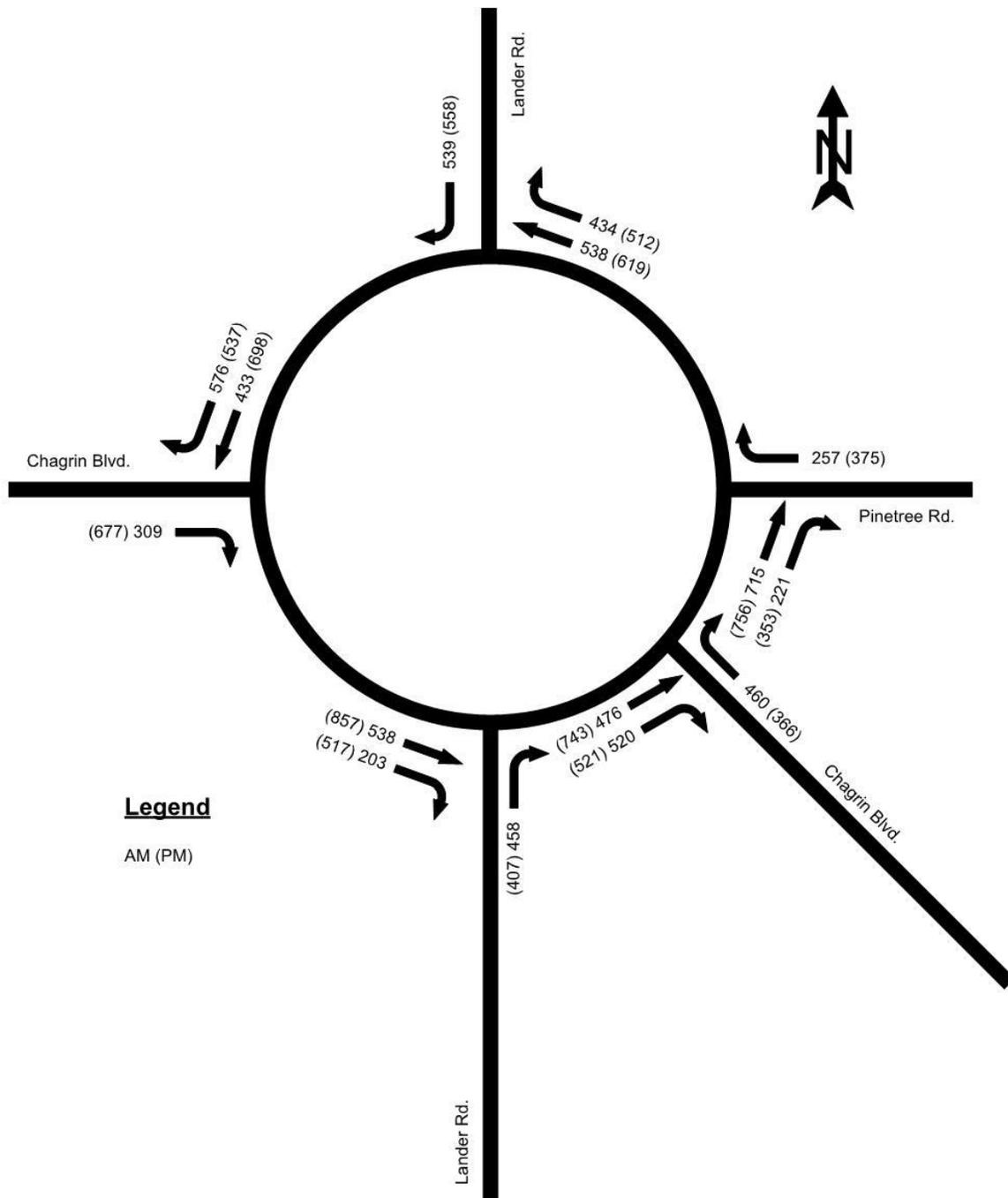


Figure 2. Opening Day (2023) No Build Traffic

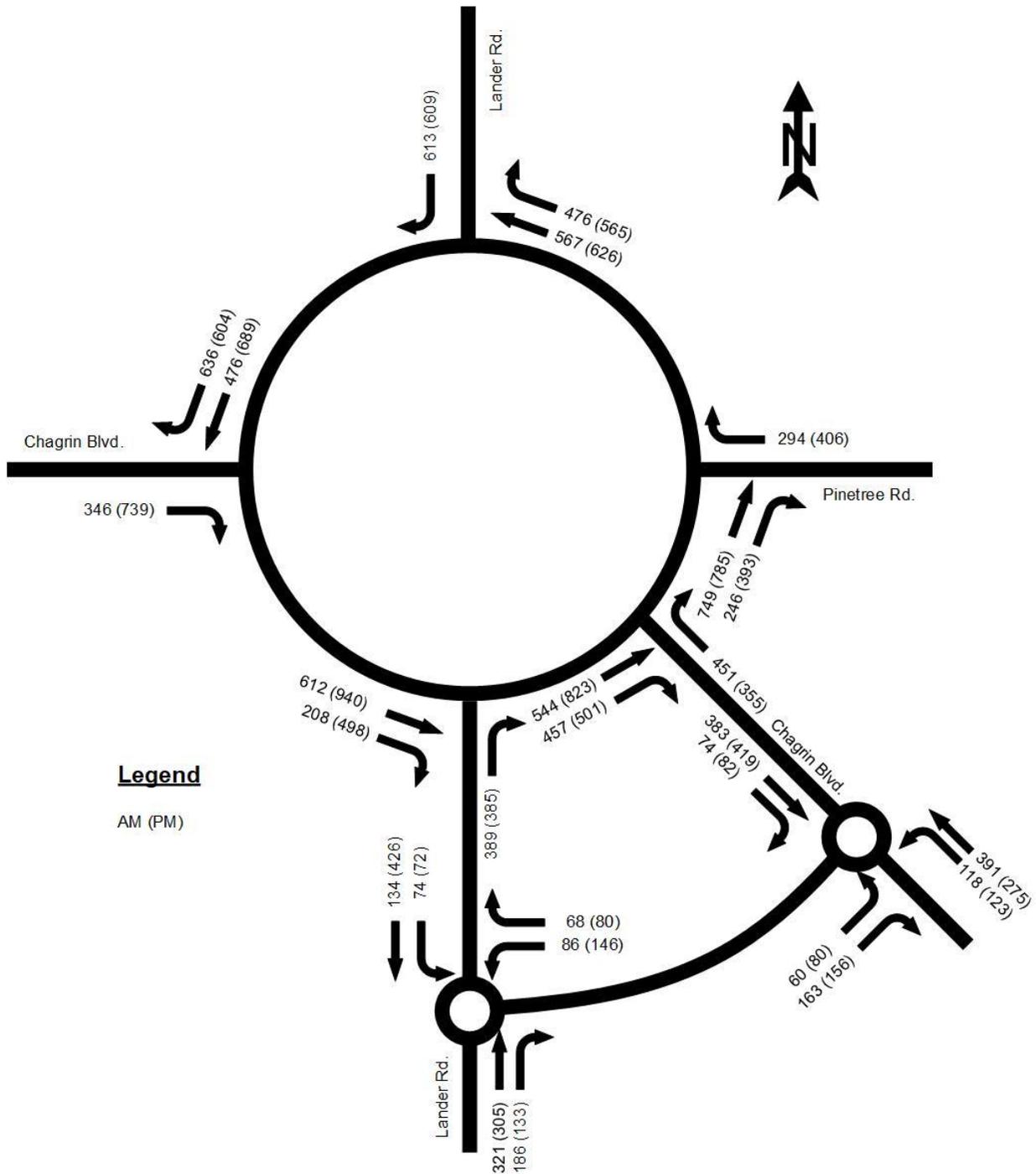


Figure 3. Opening Day (2023) Build Preferred Scenario Traffic

### 3.2 Capacity Analysis

The No Build and the Opening Day Build Scenario volumes were analyzed with HCS to determine the potential traffic impact of site development on the Lander/Chagrin Circle using the existing geometry, as well as expected traffic conditions at the terminal intersections of the connector road (Build Scenario Only). The termini of the connector road were assumed to be single-lane roundabouts.

In the No Build 2023 scenario, with no added development traffic, there are several approaches to Lander Circle that will operate with LOS D or F in the morning and all approaches operate at LOS F in the afternoon. The HCS analysis reports are included in **Appendix C**. **Figure 4** presents the capacity analysis results.

The 2023 Build Preferred Scenario introduces approximately 417 new trips in the AM peak hour and approximately 474 new trips in the PM peak hour. **Figure 5** presents the capacity analysis results. The LOS for each leg of the circle and each time of day do not change from the No-Build scenario, but delays do increase on the Pinetree Road, Lander Road (north leg) and Chagrin Blvd (west leg) approaches. The connector road provides relief to Lander Road (south leg) and Chagrin Blvd (southeast leg) so delays in the Build scenarios for these approaches are within 10 seconds of the No-Build delays. Both roundabouts at the ends of the Connector Road will operate efficiently with LOS A and low delays for all traffic movements. The HCS analysis reports are included in **Appendix D**.

In order to evaluate the one and two-lane roundabout scenarios to replace the Lander/Chagrin Circle, the Opening Day Build Scenario volumes were also analyzed using SIDRA. SIDRA is the preferred software to analyze 5-leg roundabouts. The full SIDRA reports are included in **Appendix E**. The schematic and geometric assumptions used for analysis associated with the design of the roundabouts is included in **Appendix F**. The LOS and delay information for the one-lane roundabout replacement of Lander/Chagrin Circle is shown in Figure 6. The Two-lane roundabout LOS and delay information is shown in Figure 7.

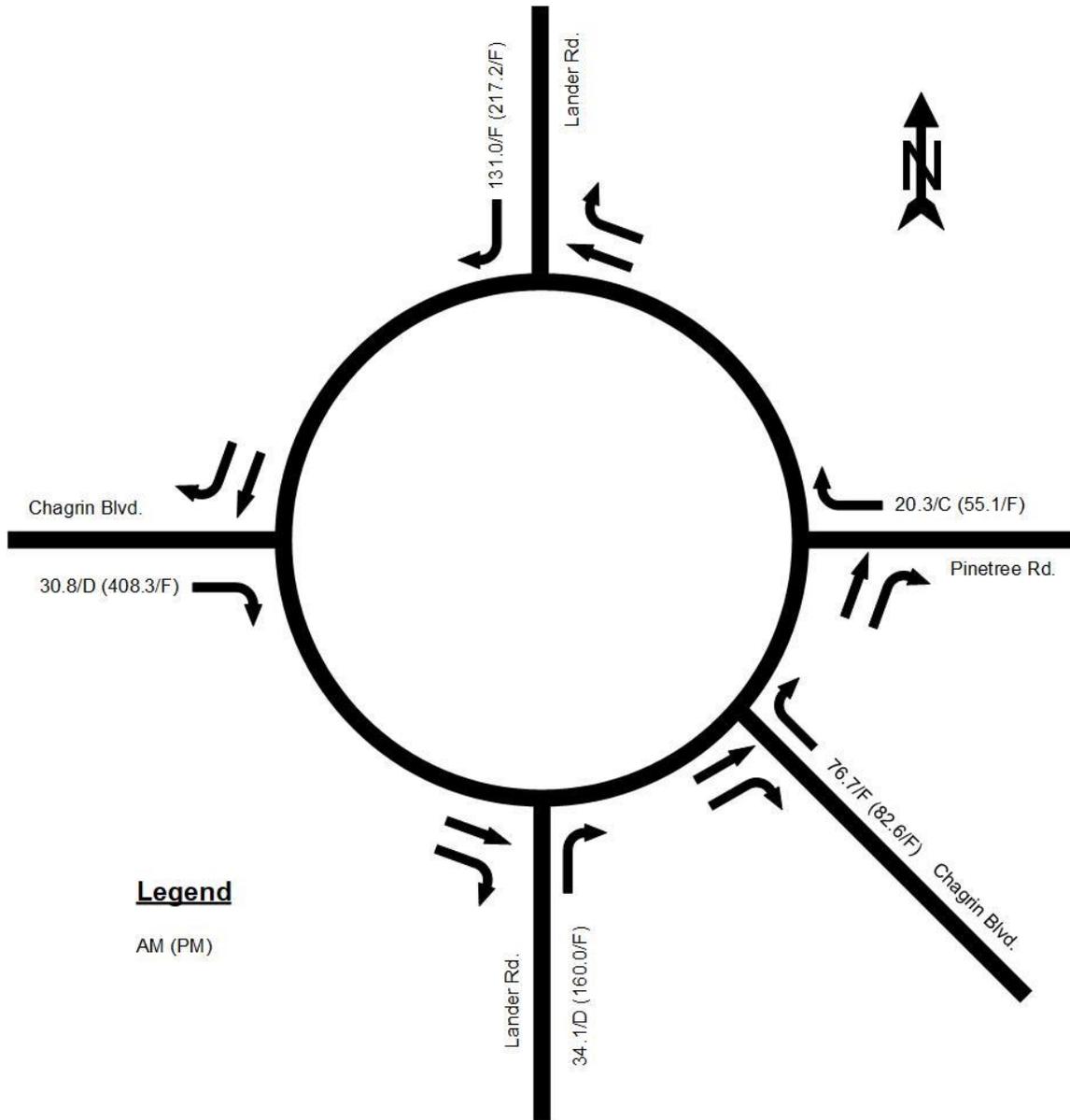


Figure 4. Opening Day (2023) No Build Scenario LOS

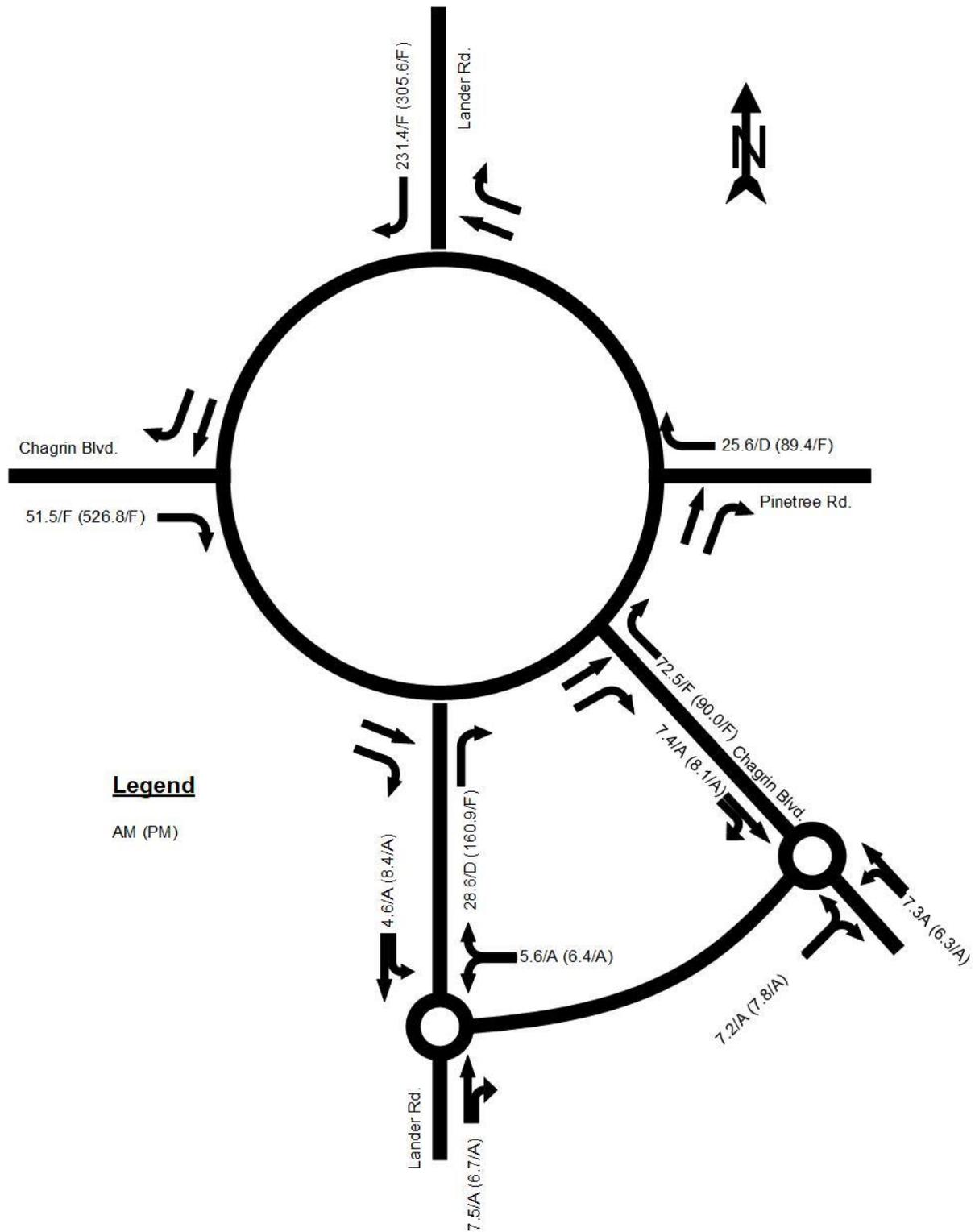


Figure 5. Opening Day (2023) Build Preferred Scenario LOS

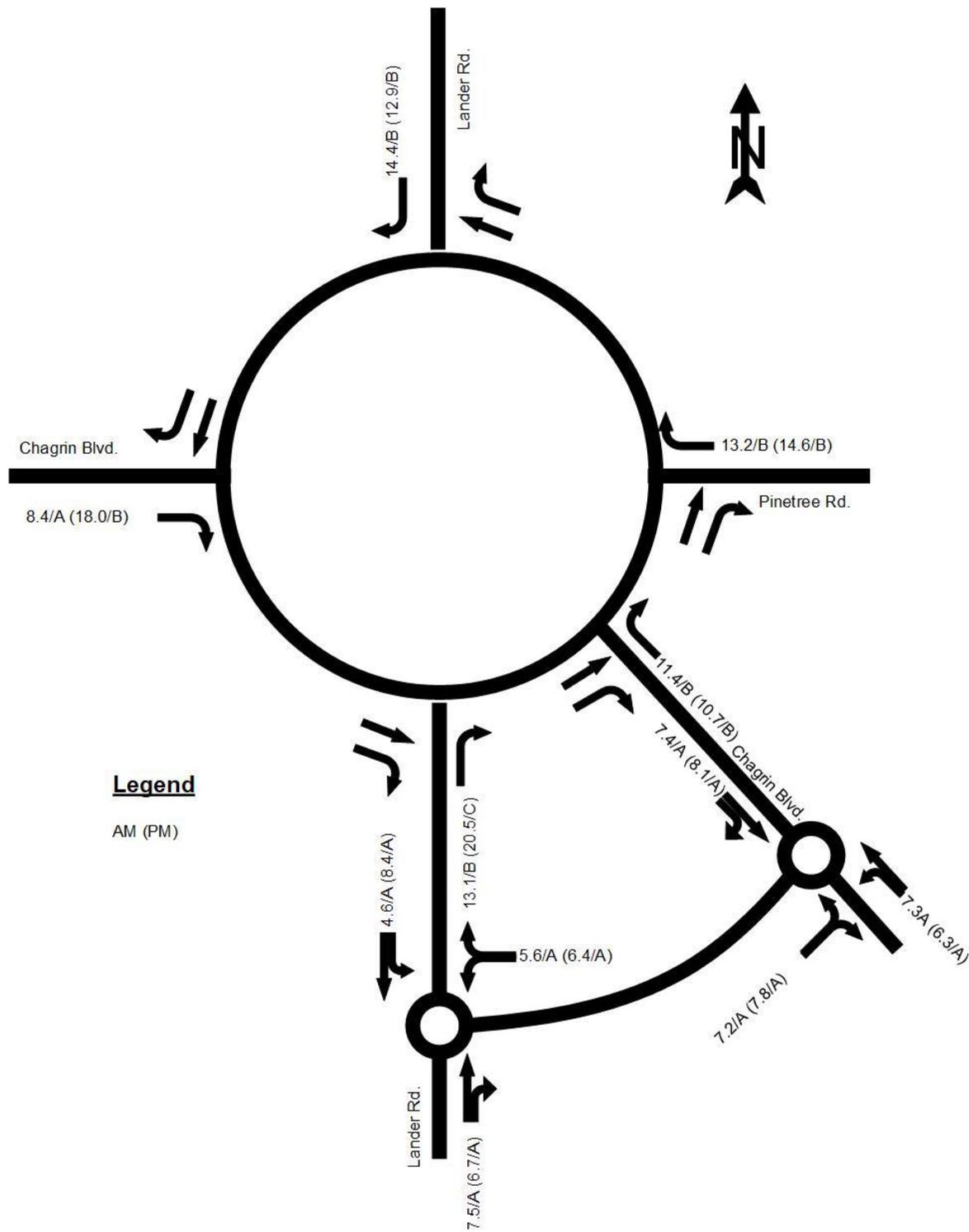


Figure 6. One-Lane Roundabout Opening Day (2023) Build Preferred Scenario LOS

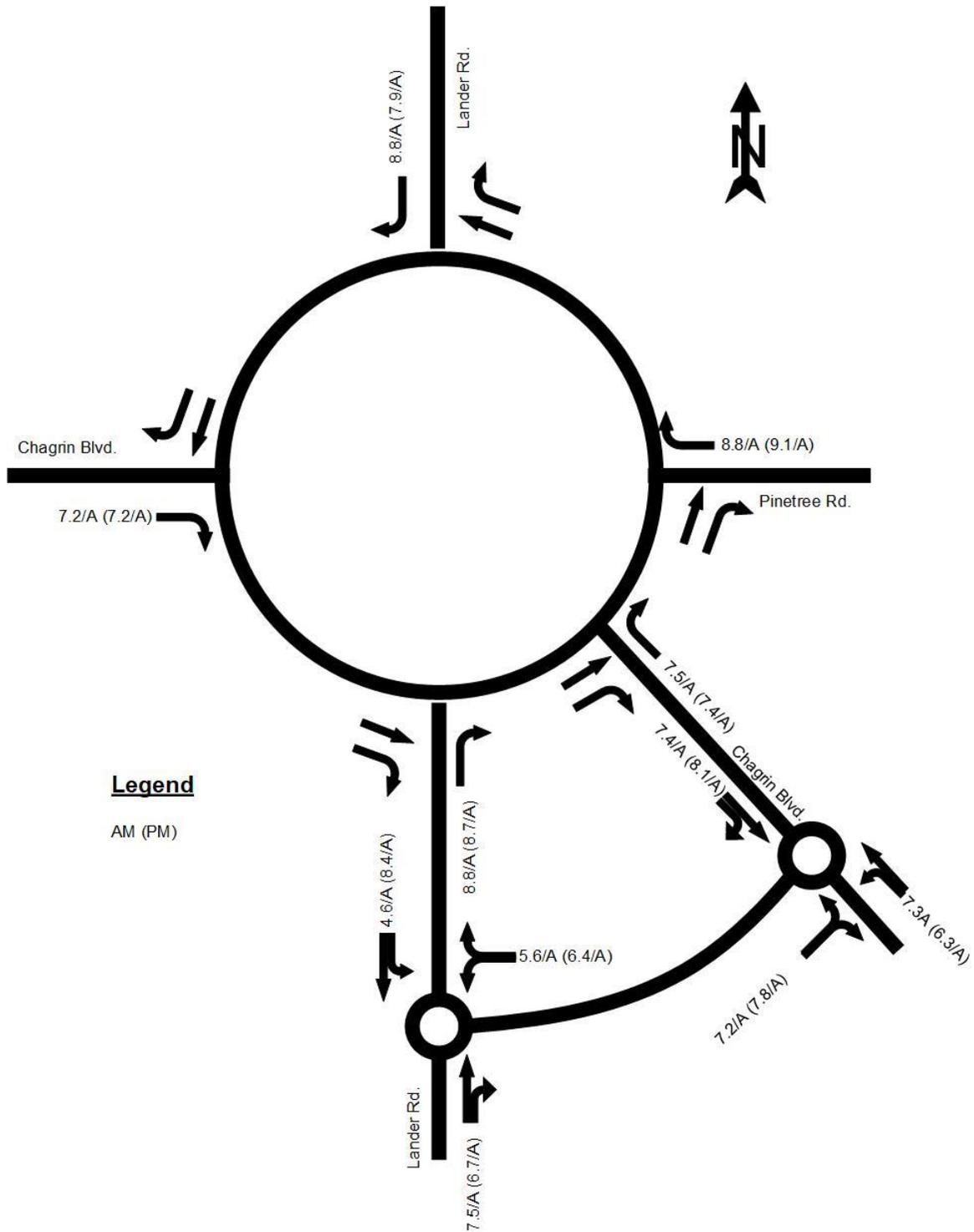


Figure 7. Two-Lane Roundabout Opening Day (2023) Build Preferred Scenario LOS

4 SUMMARY OF TRAFFIC CONDITIONS

Based on the existing traffic counts, there are significant operational deficiencies on the Lander Road/Chagrin Boulevard/Pinetree Road circle. The intersection is very confusing, with multiple commercial driveways having direct access to the circle in addition to the five individual roadway approaches. The wide pavement of the circle is not marked as separate lanes but is treated as a two-lane circulating roadway. Vehicles must stop on each approach before entering the circle, unlike the yield condition of a typical roundabout. During the AM peak hour, two of the approach roadways operate at LOS F, and two operate at a LOS D. During the PM peak hour, all approach roadways operate at LOS F, with delays ranging from approximately 1 minutes to 6 minutes.

The development of the Proposed Willey Creek Overlay District will introduce new traffic to the roadway network, estimated at 417 trips during the AM Peak and 474 trips during the PM Peak.

Table 3. Comparison of Traffic LOS and Delay (In seconds)

Approach Roadway	No-Build		Preferred Scenario		Preferred 1-Lane Roundabout		Preferred 2-Lane Roundabout	
	AM	PM	AM	PM	AM	PM	AM	PM
Chagrin Boulevard (west)	30.8/D	408.3/F	51.5/F	526.8/F	8.4/A	18.0/B	7.2/A	7.2/A
Lander Road (south)	34.1/D	160.0/F	28.6/D	160.9/F	13.1/B	20.5/C	8.8/A	8.7/A
Chagrin Boulevard (southeast)	76.7/F	82.6/F	72.5/F	90.0/F	11.4/B	10.7/B	7.5/A	7.4/B
Pinetree Road	20.3/C	55.1/F	25.6/D	89.4/F	13.2/B	14.6/B	8.8/A	9.4/A
Lander Road (north)	131.0/F	217.2/F	231.4/F	305.6/F	14.4/B	12.9/B	8.8/A	7.9/A

In all scenarios, with or without new development, the traffic volumes projected for 2023 in this area will result in poor LOS and unacceptable delays on most approaches during peak hours if the geometry at the existing Lander Road/Chagrin Boulevard Circle is not improved. The additional traffic from the proposed development would generate new traffic that would enter Lander Circle and lower its functional performance, except for the two legs that would benefit from the connector road constructed for the development access. The LOS and delays on the southern legs would remain relatively similar to no build conditions. Providing a connector road between Lander Road (south) and Chagrin Boulevard (southeast) will divert all traffic heading west on Chagrin Boulevard towards Lander Road (south) and all traffic that is headed north on Lander towards Chagrin Boulevard (southeast), as these vehicles will no longer have to traverse the circle. Although only two roadways would be directly impacted by the connector road, reducing the circulating traffic will improve conditions for the respective Lander Circle approaches. The proposed two roundabouts proposed to be constructed as part of the development will provide adequate operations at the access points to the development. No dedicated turn lanes on either Chagrin Boulevard or Lander Road are needed at the access points under any scenario.

The greater traffic operations issue is Lander Circle itself. It is understood that the City of Pepper Pike is pursuing improvements at the Circle which will eliminate or restrict access at driveways, provide pedestrian facilities, reduce lanes on the Chagrin Boulevard (southeast) approach, delineate travel lanes within the circle itself, and modify the access points to a yield condition rather than stop, with splitter islands to be constructed on each approach roadway. These improvements provide increase safety by reducing intermittent access at private driveways and better delineating travel lanes within the circle. The analysis in this study examined the impacts of constructing a traditional one-lane or two-lane roundabouts and both alternatives provide substantial traffic benefits. The installation of a roundabout in this area would improve existing traffic conditions greatly and eliminate a noticeable impact from trips generated by the proposed development, while also increasing safety in the area. A complete reconfiguration of Lander Circle is the ultimate solution to resolve both existing and anticipated operational deficiencies in the study area.

**APPENDIX A**

**TRAFFIC DATA**

Study Name Chagrin Blvd SE Leg  
 Start Date 05/16/2018  
 Start Time 6:00 AM  
 Site Code  
 Classification All Vehicles

Channel Direction	Direction	Direction	<b>15 min Total Hourly</b>	
	Northwestbound	Southeastbound		

6:00 AM	24	22	46	
6:15 AM	36	20	56	
6:30 AM	40	32	72	
6:45 AM	45	50	95	269
7:00 AM	65	126	191	414
7:15 AM	90	132	222	580
7:30 AM	141	86	227	735
7:45 AM	98	99	197	837
8:00 AM	69	86	155	801
8:15 AM	99	107	206	785
8:30 AM	118	149	267	825
8:45 AM	152	153	305	933
3:00 PM	96	108	204	
3:15 PM	94	111	205	
3:30 PM	159	81	240	
3:45 PM	132	101	233	882
4:00 PM	96	125	221	899
4:15 PM	89	137	226	920
4:30 PM	90	129	219	899
4:45 PM	77	113	190	856
5:00 PM	93	117	210	845
5:15 PM	85	119	204	823
5:30 PM	73	117	190	794
5:45 PM	83	136	219	823

Study Name Chagrin Blvd West Leg

Start Date 05/10/2018

Start Time 6:00 AM

Site Code

Classification All Vehicles

Channel	Direction	Direction		
Direction	Westbound	Eastbound	15 min Total	Hourly
6:00 AM	21	8	29	
6:15 AM	37	20	57	
6:30 AM	42	27	69	
6:45 AM	60	50	110	265
7:00 AM	63	81	144	380
7:15 AM	92	63	155	478
7:30 AM	111	46	157	566
7:45 AM	118	73	191	647
8:00 AM	147	72	219	722
8:15 AM	127	73	200	767
8:30 AM	133	79	212	822
8:45 AM	142	70	212	843
3:00 PM	143	113	256	
3:15 PM	133	155	288	
3:30 PM	143	128	271	
3:45 PM	132	143	275	1090
4:00 PM	131	145	276	1110
4:15 PM	114	157	271	1093
4:30 PM	134	159	293	1115
4:45 PM	132	168	300	1140
5:00 PM	131	161	292	1156
5:15 PM	3	4	7	892

Study Name Lander Rd South Leg  
 Start Date 05/10/2018  
 Start Time 6:00 AM  
 Site Code  
 Classification All Vehicles

Channel Direction	Direction	Direction	15 min Total	Hourly
	Southbound	Northbound		

6:00 AM	8	14	22	
6:15 AM	14	26	40	
6:30 AM	24	47	71	
6:45 AM	25	61	86	219
7:00 AM	30	119	149	346
7:15 AM	54	123	177	483
7:30 AM	43	104	147	559
7:45 AM	39	118	157	630
8:00 AM	53	106	159	640
8:15 AM	39	127	166	629
8:30 AM	56	97	153	635
8:45 AM	46	106	152	630
3:00 PM	89	98	187	
3:15 PM	96	112	208	
3:30 PM	120	79	199	
3:45 PM	99	85	184	778
4:00 PM	118	101	219	810
4:15 PM	123	99	222	824
4:30 PM	128	93	221	846
4:45 PM	111	98	209	871
5:00 PM	131	97	228	880
5:15 PM	118	111	229	887
5:30 PM	114	112	226	892
5:45 PM	108	104	212	895

Study Name Lander Road North Leg  
 Start Date 05/09/2018  
 Start Time 6:00 AM  
 Site Code  
 Classification All Vehicles

Channel Direction	Direction	Direction	15 min Total Hourly
	Southbound	Northbound	

6:00 AM	16	18	34	
6:15 AM	24	25	49	
6:30 AM	42	45	87	
6:45 AM	51	48	99	269
7:00 AM	84	65	149	384
7:15 AM	113	95	208	543
7:30 AM	83	123	206	662
7:45 AM	103	122	225	788
8:00 AM	90	108	198	837
8:15 AM	128	99	227	856
8:30 AM	127	91	218	868
8:45 AM	132	115	247	890
3:00 PM	110	96	206	
3:15 PM	105	105	210	
3:30 PM	108	129	237	
3:45 PM	136	99	235	888
4:00 PM	119	114	233	915
4:15 PM	135	112	247	952
4:30 PM	132	108	240	955
4:45 PM	137	142	279	999
5:00 PM	127	125	252	1018
5:15 PM	149	108	257	1028
5:30 PM	145	108	253	1041
5:45 PM	157	89	246	1008

Study Name Pinetree Rd Approach  
 Start Date 05/08/2018  
 Start Time 6:00 AM  
 Site Code  
 Classification All Vehicles

Channel Direction	Direction	Direction	15 min Total Hourly
	Westbound	Eastbound	

6:00 AM	10	7	17	
6:15 AM	19	14	33	
6:30 AM	22	19	41	
6:45 AM	25	30	55	146
7:00 AM	29	31	60	189
7:15 AM	38	25	63	219
7:30 AM	56	33	89	267
7:45 AM	60	46	106	318
8:00 AM	55	41	96	354
8:15 AM	63	55	118	409
8:30 AM	70	54	124	444
8:45 AM	57	60	117	455
3:00 PM	84	83	167	
3:15 PM	82	87	169	
3:30 PM	80	79	159	
3:45 PM	90	87	177	672
4:00 PM	88	96	184	689
4:15 PM	80	90	170	690
4:30 PM	92	89	181	712
4:45 PM	93	89	182	717
5:00 PM	92	68	160	693
5:15 PM	91	96	187	710
5:30 PM	76	97	173	702
5:45 PM	65	77	142	662

**Lander/Chagrin Circle Traffic Summary**

Time Period	Lander South Leg	Lander North Leg	Chagrin West Leg	Chargin SE Leg	Pinetree	Hourly Total
6:00 AM	22	34	29	46	10	
6:15 AM	40	49	57	56	19	
6:30 AM	71	87	69	72	22	
6:45 AM	86	99	110	95	25	1098
7:00 AM	149	149	144	191	29	1619
7:15 AM	177	208	155	222	38	2198
7:30 AM	147	206	157	227	56	2670
7:45 AM	157	225	191	197	60	3085
8:00 AM	159	198	219	155	55	3209
8:15 AM	166	227	200	206	63	3271
8:30 AM	153	218	212	267	70	3398
8:45 AM	152	247	212	305	57	3541
3:00 PM	187	206	256	204	84	
3:15 PM	208	210	288	205	82	
3:30 PM	199	237	271	240	80	
3:45 PM	184	235	275	233	90	3974
4:00 PM	219	233	276	221	88	4074
4:15 PM	222	247	271	226	80	4127
4:30 PM	221	240	293	219	92	4165
4:45 PM	209	279	300	190	93	4219
5:00 PM	228	252	292	210	92	4256
5:15 PM	229	257	7	204	91	3998
5:30 PM	226	253		190	76	3678
5:45 PM	212	246		219	65	3349

**APPENDIX B**

**NCHRP INTERNAL CAPTURE ESTIMATION**

NCHRP 684 Internal Trip Capture Estimation Tool			
<b>Project Name:</b>	Willey Creek Overlay District	<b>Organization:</b>	AECOM
<b>Project Location:</b>	Pepper Piek, Ohio	<b>Performed By:</b>	Vanessa Nghiem
<b>Scenario Description:</b>	Build Scenario 4	<b>Date:</b>	5/13/2020
<b>Analysis Year:</b>	2023	<b>Checked By:</b>	
<b>Analysis Period:</b>	AM Street Peak Hour	<b>Date:</b>	

Table 1-A: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)						
Land Use	Development Data (For Information Only)			Estimated Vehicle-Trips <sup>3</sup>		
	ITE LUCs <sup>1</sup>	Quantity	Units	Total	Entering	Exiting
Office	710	125	1000sf	145	125	20
Retail	820	40	1000sf	172	107	65
Restaurant				0		
Cinema/Entertainment				0		
Residential	210 and 220	140 and 60	units	134	33	101
Hotel				0		
All Other Land Uses <sup>2</sup>				0		
				451	265	186

Table 2-A: Mode Split and Vehicle Occupancy Estimates						
Land Use	Entering Trips			Exiting Trips		
	Veh. Occ. <sup>4</sup>	% Transit	% Non-Motorized	Veh. Occ. <sup>4</sup>	% Transit	% Non-Motorized
Office	1.20	2%	2%	1.20	2%	2%
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						
All Other Land Uses <sup>2</sup>						

Table 3-A: Average Land Use Interchange Distances (Feet Walking Distance)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Table 4-A: Internal Person-Trip Origin-Destination Matrix*						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		7	0	0	0	0
Retail	6		0	0	1	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	2	1	0	0		0
Hotel	0	0	0	0	0	

Table 5-A: Computations Summary			
	Total	Entering	Exiting
All Person-Trips	480	290	190
Internal Capture Percentage	7%	6%	9%
External Vehicle-Trips <sup>5</sup>	414	244	170
External Transit-Trips <sup>6</sup>	3	3	0
External Non-Motorized Trips <sup>6</sup>	3	3	0

Table 6-A: Internal Trip Capture Percentages by Land Use		
Land Use	Entering Trips	Exiting Trips
Office	5%	29%
Retail	7%	11%
Restaurant	N/A	N/A
Cinema/Entertainment	N/A	N/A
Residential	3%	3%
Hotel	N/A	N/A

<sup>1</sup>Land Use Codes (LUCs) from *Trip Generation Manual*, published by the Institute of Transportation Engineers.

<sup>2</sup>Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator.

<sup>3</sup>Enter trips assuming no transit or non-motorized trips (as assumed in *ITE Trip Generation Manual*).

<sup>4</sup>Enter vehicle occupancy assumed in Table 1-A vehicle trips. If vehicle occupancy changes for proposed mixed-use project, manual adjustments must be made to Tables 5-A, 9-A (O and D). Enter transit, non-motorized percentages that will result with proposed mixed-use project complete.

<sup>5</sup>Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A.

<sup>6</sup>Person-Trips

\*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas A&M Transportation Institute - Version 2013.1

<b>Project Name:</b>	Willey Creek Overlay District
<b>Analysis Period:</b>	AM Street Peak Hour

Land Use	Table 7-A (D): Entering Trips			Table 7-A (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*	Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.20	125	150	1.20	20	24
Retail	1.00	107	107	1.00	65	65
Restaurant	1.00	0	0	1.00	0	0
Cinema/Entertainment	1.00	0	0	1.00	0	0
Residential	1.00	33	33	1.00	101	101
Hotel	1.00	0	0	1.00	0	0

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		7	15	0	0	0
Retail	19		8	0	9	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	2	1	20	0		0
Hotel	0	0	0	0	0	

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		34	0	0	0	0
Retail	6		0	0	1	0
Restaurant	21	9		0	2	0
Cinema/Entertainment	0	0	0		0	0
Residential	5	18	0	0		0
Hotel	5	4	0	0	0	

Destination Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles <sup>1</sup>	Transit <sup>2</sup>	Non-Motorized <sup>2</sup>
Office	8	142	150	113	3	3
Retail	8	99	107	99	0	0
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	1	32	33	32	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses <sup>3</sup>	0	0	0	0	0	0

Origin Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles <sup>1</sup>	Transit <sup>2</sup>	Non-Motorized <sup>2</sup>
Office	7	17	24	14	0	0
Retail	7	58	65	58	0	0
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	3	98	101	98	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses <sup>3</sup>	0	0	0	0	0	0

<sup>1</sup>Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A  
<sup>2</sup>Person-Trips  
<sup>3</sup>Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator  
\*Indicates computation that has been rounded to the nearest whole number.

NCHRP 684 Internal Trip Capture Estimation Tool			
<b>Project Name:</b>	Wiley Creek Overlay District	<b>Organization:</b>	AECOM
<b>Project Location:</b>	Pepper Pike, Ohio	<b>Performed By:</b>	Vanessa Nghiem
<b>Scenario Description:</b>	Build Scenario 4	<b>Date:</b>	5/13/2020
<b>Analysis Year:</b>	2023	<b>Checked By:</b>	
<b>Analysis Period:</b>	PM Street Peak Hour	<b>Date:</b>	

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)						
Land Use	Development Data (For Information Only)			Estimated Vehicle-Trips <sup>3</sup>		
	ITE LUCs <sup>1</sup>	Quantity	Units	Total	Entering	Exiting
Office	710	125	1000sf	144	23	121
Retail	820	40	1000sf	276	132	144
Restaurant				0		
Cinema/Entertainment				0		
Residential	210 and 220	140 and 60	units	179	113	66
Hotel				0		
All Other Land Uses <sup>2</sup>				0		
				599	268	331

Table 2-P: Mode Split and Vehicle Occupancy Estimates						
Land Use	Entering Trips			Exiting Trips		
	Veh. Occ. <sup>4</sup>	% Transit	% Non-Motorized	Veh. Occ. <sup>4</sup>	% Transit	% Non-Motorized
Office	1.20	2%	2%	1.20	2%	2%
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						
All Other Land Uses <sup>2</sup>						

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		900	900		900	
Retail					900	
Restaurant					900	
Cinema/Entertainment					900	
Residential		900	900			
Hotel					900	

Table 4-P: Internal Person-Trip Origin-Destination Matrix*						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		8	0	0	3	0
Retail	3		0	0	36	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	3	10	0	0		0
Hotel	0	0	0	0	0	

Table 5-P: Computations Summary			
	Total	Entering	Exiting
All Person-Trips	628	273	355
Internal Capture Percentage	20%	23%	18%
External Vehicle-Trips <sup>5</sup>	471	206	265
External Transit-Trips <sup>6</sup>	3	0	3
External Non-Motorized Trips <sup>6</sup>	3	0	3

Table 6-P: Internal Trip Capture Percentages by Land Use		
Land Use	Entering Trips	Exiting Trips
Office	21%	8%
Retail	14%	27%
Restaurant	N/A	N/A
Cinema/Entertainment	N/A	N/A
Residential	35%	20%
Hotel	N/A	N/A

<sup>1</sup>Land Use Codes (LUCs) from *Trip Generation Manual*, published by the Institute of Transportation Engineers.

<sup>2</sup>Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator.

<sup>3</sup>Enter trips assuming no transit or non-motorized trips (as assumed in *ITE Trip Generation Manual*).

<sup>4</sup>Enter vehicle occupancy assumed in Table 1-P vehicle trips. If vehicle occupancy changes for proposed mixed-use project, manual adjustments must be made.

<sup>5</sup>Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P.

<sup>6</sup>Person-Trips

\*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas A&M Transportation Institute - Version 2013.1

<b>Project Name:</b>	Willey Creek Overlay District
<b>Analysis Period:</b>	PM Street Peak Hour

Table 7-P: Conversion of Vehicle-Trip Ends to Person-Trip Ends						
Land Use	Table 7-P (D): Entering Trips			Table 7-P (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*	Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.20	23	28	1.20	121	145
Retail	1.00	132	132	1.00	144	144
Restaurant	1.00	0	0	1.00	0	0
Cinema/Entertainment	1.00	0	0	1.00	0	0
Residential	1.00	113	113	1.00	66	66
Hotel	1.00	0	0	1.00	0	0

Table 8-P (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		23	5	0	3	0
Retail	3		42	6	36	7
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	3	22	11	0		2
Hotel	0	0	0	0	0	

Table 8-P (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		8	0	0	5	0
Retail	9		0	0	52	0
Restaurant	8	66		0	18	0
Cinema/Entertainment	2	5	0		5	0
Residential	16	10	0	0		0
Hotel	0	3	0	0	0	

Table 9-P (D): Internal and External Trips Summary (Entering Trips)						
Destination Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles <sup>1</sup>	Transit <sup>2</sup>	Non-Motorized <sup>2</sup>
Office	6	22	28	18	0	0
Retail	18	114	132	114	0	0
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	39	74	113	74	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses <sup>3</sup>	0	0	0	0	0	0

Table 9-P (O): Internal and External Trips Summary (Exiting Trips)						
Origin Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles <sup>1</sup>	Transit <sup>2</sup>	Non-Motorized <sup>2</sup>
Office	11	134	145	107	3	3
Retail	39	105	144	105	0	0
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	13	53	66	53	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses <sup>3</sup>	0	0	0	0	0	0

<sup>1</sup>Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P  
<sup>2</sup>Person-Trips  
<sup>3</sup>Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator  
\*Indicates computation that has been rounded to the nearest whole number.

Table 7.1a Adjusted Internal Trip Capture Rates for Trip Origins within a Multi-Use Development

Land Use Pairs		Weekday	
		AM Peak Hour	PM Peak Hour
From OFFICE	To Office	0.0%	0.0%
	To Retail	28.0%	15.8%
	To Restaurant	63.0%	3.2%
	To Cinema/Entertainment	0.0%	0.0%
	To Residential	1.0%	1.9%
	To Hotel	0.0%	0.0%
From RETAIL	To Office	29.0%	2.0%
	To Retail	0.0%	0.0%
	To Restaurant	13.0%	29.0%
	To Cinema/Entertainment	0.0%	4.0%
	To Residential	14.0%	25.0%
	To Hotel	0.0%	5.0%
From RESTAURANT	To Office	31.0%	3.0%
	To Retail	14.0%	41.0%
	To Restaurant	0.0%	0.0%
	To Cinema/Entertainment	0.0%	8.0%
	To Residential	4.0%	17.3%
	To Hotel	3.0%	7.0%
From CINEMA/ENTERTAINMENT	To Office	0.0%	2.0%
	To Retail	0.0%	21.0%
	To Restaurant	0.0%	31.0%
	To Cinema/Entertainment	0.0%	0.0%
	To Residential	0.0%	7.7%
	To Hotel	0.0%	2.0%
From RESIDENTIAL	To Office	2.0%	4.0%
	To Retail	1.0%	33.2%
	To Restaurant	20.0%	16.6%
	To Cinema/Entertainment	0.0%	0.0%
	To Residential	0.0%	0.0%
	To Hotel	0.0%	3.0%
From HOTEL	To Office	75.0%	0.0%
	To Retail	14.0%	16.0%
	To Restaurant	9.0%	68.0%
	To Cinema/Entertainment	0.0%	0.0%
	To Residential	0.0%	1.9%
	To Hotel	0.0%	0.0%

Table 7.2a Adjusted Internal Trip Capture Rates for Trip Destinations within a Multi-Use Development

Land Use Pairs		Weekday	
		AM Peak Hour	PM Peak Hour
To OFFICE	From Office	0.0%	0.0%
	From Retail	4.0%	31.0%
	From Restaurant	14.0%	30.0%
	From Cinema/Entertainment	0.0%	6.0%
	From Residential	3.0%	57.0%
	From Hotel	3.0%	0.0%
To RETAIL	From Office	32.0%	6.3%
	From Retail	0.0%	0.0%
	From Restaurant	8.0%	50.0%
	From Cinema/Entertainment	0.0%	4.0%
	From Residential	17.0%	7.9%
	From Hotel	4.0%	2.0%
To RESTAURANT	From Office	23.0%	1.6%
	From Retail	50.0%	29.0%
	From Restaurant	0.0%	0.0%
	From Cinema/Entertainment	0.0%	3.0%
	From Residential	20.0%	11.1%
	From Hotel	6.0%	5.0%
To CINEMA/ENTERTAINMENT	From Office	0.0%	1.0%
	From Retail	0.0%	26.0%
	From Restaurant	0.0%	32.0%
	From Cinema/Entertainment	0.0%	0.0%
	From Residential	0.0%	0.0%
	From Hotel	0.0%	0.0%
To RESIDENTIAL	From Office	0.0%	4.0%
	From Retail	2.0%	46.0%
	From Restaurant	5.0%	16.0%
	From Cinema/Entertainment	0.0%	4.0%
	From Residential	0.0%	0.0%
	From Hotel	0.0%	0.0%
To HOTEL	From Office	0.0%	0.0%
	From Retail	0.0%	17.0%
	From Restaurant	4.0%	71.0%
	From Cinema/Entertainment	0.0%	1.0%
	From Residential	0.0%	12.0%
	From Hotel	0.0%	0.0%

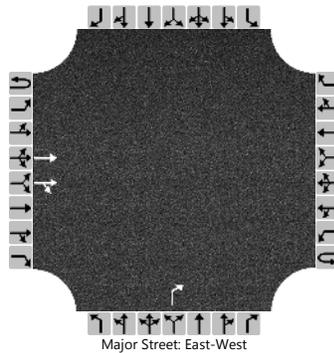
**APPENDIX C**

**NO-BUILD CAPACITY ANALYSIS**

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	KKM			Intersection	Chagrin Boulevard SE		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	6/17/2019			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Chagrin Boulevard SE		
Time Analyzed	AM			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	No Build						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	2	0	0	0	0	0		0	0	1		0	0	0
Configuration			T	TR								R				
Volume (veh/h)			476	520								460				
Percent Heavy Vehicles (%)												1				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized									No							
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)																	6.9
Critical Headway (sec)																	6.92
Base Follow-Up Headway (sec)																	3.3
Follow-Up Headway (sec)																	3.31

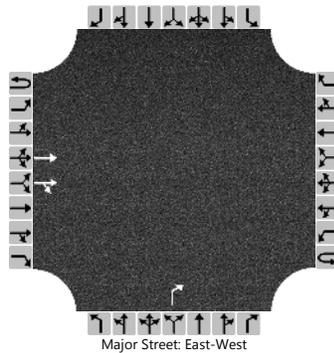
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)																	500
Capacity, c (veh/h)																	488
v/c Ratio																	1.03
95% Queue Length, Q <sub>95</sub> (veh)																	14.5
Control Delay (s/veh)																	76.7
Level of Service (LOS)																	F
Approach Delay (s/veh)									76.7								
Approach LOS									F								

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	KKM	Intersection	Chagrin Boulevard SE				
Agency/Co.		Jurisdiction	Pepper Pike				
Date Performed	6/17/2019	East/West Street	Lander Circle				
Analysis Year	2023	North/South Street	Chagrin Boulevard SE				
Time Analyzed	PM	Peak Hour Factor	0.92				
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25				
Project Description	No Build						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6	7	8	9		10	11	12	
Priority																
Number of Lanes	0	0	2	0	0	0	0	0	0	0	1		0	0	0	
Configuration			T	TR							R					
Volume (veh/h)			743	521							366					
Percent Heavy Vehicles (%)											1					
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized									No							
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)													6.9				
Critical Headway (sec)													6.92				
Base Follow-Up Headway (sec)													3.3				
Follow-Up Headway (sec)													3.31				

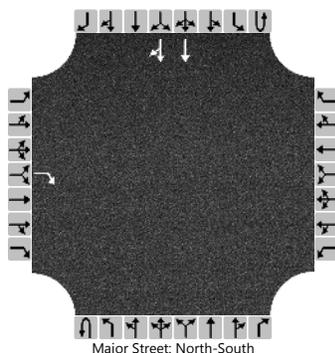
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)													398				
Capacity, c (veh/h)													392				
v/c Ratio													1.02				
95% Queue Length, Q <sub>95</sub> (veh)													12.6				
Control Delay (s/veh)													82.6				
Level of Service (LOS)													F				
Approach Delay (s/veh)									82.6								
Approach LOS									F								

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	KKM			Intersection	Chagrin Boulevard West		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	6/17/2019			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Chagrin Road West		
Time Analyzed	AM			Peak Hour Factor	0.92		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	No Build						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	0	0	0	0	0	0	0	2	0
Configuration				R											T	TR
Volume (veh/h)				309											433	576
Percent Heavy Vehicles (%)				9												
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized	No															
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)				6.9												
Critical Headway (sec)				7.08												
Base Follow-Up Headway (sec)				3.3												
Follow-Up Headway (sec)				3.39												

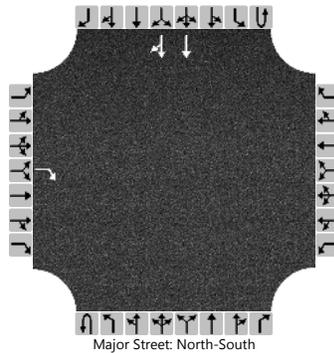
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				336												
Capacity, c (veh/h)				462												
v/c Ratio				0.73												
95% Queue Length, Q <sub>95</sub> (veh)				5.8												
Control Delay (s/veh)				30.8												
Level of Service (LOS)				D												
Approach Delay (s/veh)	30.8															
Approach LOS	D															

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	KKM			Intersection	Chagrin Boulevard West		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	6/17/2019			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Chagrin Road West		
Time Analyzed	PM			Peak Hour Factor	0.92		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	No Build						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	0	0	0	0	0	0	0	2	0
Configuration				R											T	TR
Volume (veh/h)				677											698	537
Percent Heavy Vehicles (%)				1												
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized	No															
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)				6.9												
Critical Headway (sec)				6.92												
Base Follow-Up Headway (sec)				3.3												
Follow-Up Headway (sec)				3.31												

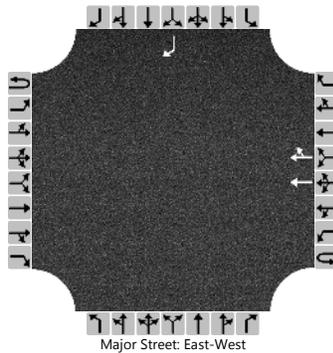
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				736												
Capacity, c (veh/h)				401												
v/c Ratio				1.83												
95% Queue Length, Q <sub>95</sub> (veh)				47.6												
Control Delay (s/veh)				408.3												
Level of Service (LOS)				F												
Approach Delay (s/veh)	408.3															
Approach LOS	F															

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	KKM			Intersection	Lander Rd North		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	6/17/2019			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Lander Rd North		
Time Analyzed	AM			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	No Build						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	0	0	0	0	2	0		0	0	0		0	0	1
Configuration							T	TR								R
Volume (veh/h)							538	434								539
Percent Heavy Vehicles (%)																3
Proportion Time Blocked																
Percent Grade (%)																0
Right Turn Channelized																No
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)																	6.9
Critical Headway (sec)																	6.96
Base Follow-Up Headway (sec)																	3.3
Follow-Up Headway (sec)																	3.33

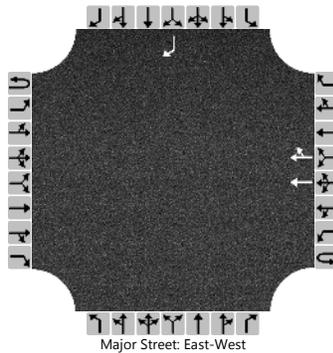
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)																	586
Capacity, c (veh/h)																	492
v/c Ratio																	1.19
95% Queue Length, Q <sub>95</sub> (veh)																	21.8
Control Delay (s/veh)																	131.0
Level of Service (LOS)																	F
Approach Delay (s/veh)																	131.0
Approach LOS																	F

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	KKM			Intersection	Lander Rd North		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	6/17/2019			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Lander Rd North		
Time Analyzed	PM			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	No Build						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	0	0	0	0	2	0		0	0	0		0	0	1
Configuration							T	TR								R
Volume (veh/h)							619	512								558
Percent Heavy Vehicles (%)																2
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)																	6.9
Critical Headway (sec)																	6.94
Base Follow-Up Headway (sec)																	3.3
Follow-Up Headway (sec)																	3.32

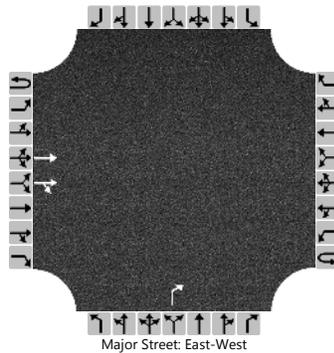
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)																	607
Capacity, c (veh/h)																	434
v/c Ratio																	1.40
95% Queue Length, Q <sub>95</sub> (veh)																	29.3
Control Delay (s/veh)																	217.2
Level of Service (LOS)																	F
Approach Delay (s/veh)													217.2				
Approach LOS													F				

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	KKM	Intersection	Lander Rd South				
Agency/Co.		Jurisdiction	Pepper Pike				
Date Performed	6/17/2019	East/West Street	Lander Circle				
Analysis Year	2023	North/South Street	Lander Rd South				
Time Analyzed	AM	Peak Hour Factor	0.92				
Intersection Orientation	East-West	Analysis Time Period (hrs)	0.25				
Project Description	No Build						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	2	0	0	0	0	0		0	0	1		0	0	0
Configuration			T	TR								R				
Volume (veh/h)			538	203								458				
Percent Heavy Vehicles (%)												2				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized									No							
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)												6.9				
Critical Headway (sec)												6.94				
Base Follow-Up Headway (sec)												3.3				
Follow-Up Headway (sec)												3.32				

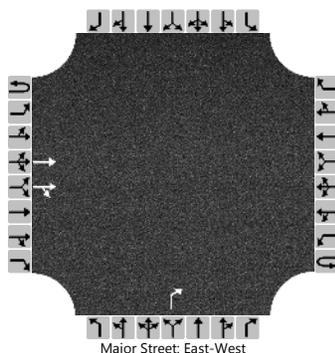
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)												498				
Capacity, c (veh/h)												597				
v/c Ratio												0.83				
95% Queue Length, Q <sub>95</sub> (veh)												8.8				
Control Delay (s/veh)												34.1				
Level of Service (LOS)												D				
Approach Delay (s/veh)									34.1							
Approach LOS									D							

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	KKM			Intersection	Lander Rd South		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	6/17/2019			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Lander Rd South		
Time Analyzed	PM			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	No Build						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	2	0	0	0	0	0		0	0	1		0	0	0
Configuration			T	TR								R				
Volume (veh/h)			857	517								407				
Percent Heavy Vehicles (%)												1				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized										No						
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)																	6.9
Critical Headway (sec)																	6.92
Base Follow-Up Headway (sec)																	3.3
Follow-Up Headway (sec)																	3.31

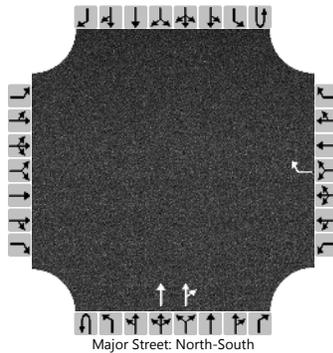
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)																	442
Capacity, c (veh/h)																	358
v/c Ratio																	1.24
95% Queue Length, Q <sub>95</sub> (veh)																	19.2
Control Delay (s/veh)																	160.0
Level of Service (LOS)																	F
Approach Delay (s/veh)																	160.0
Approach LOS																	F

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	KKM			Intersection	Pinetree Road		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	6/17/2019			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Pinetree Road		
Time Analyzed	AM			Peak Hour Factor	0.92		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	No Build						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	1	0	0	2	0	0	0	0	0
Configuration								R			T	TR				
Volume (veh/h)								257			715	221				
Percent Heavy Vehicles (%)								2								
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized					No											
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)								6.9								
Critical Headway (sec)								6.94								
Base Follow-Up Headway (sec)								3.3								
Follow-Up Headway (sec)								3.32								

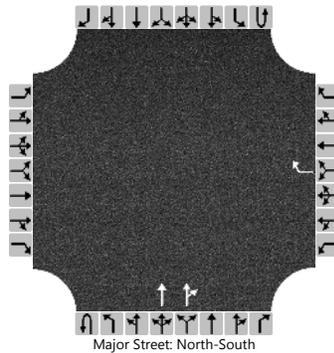
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)								279								
Capacity, c (veh/h)								510								
v/c Ratio								0.55								
95% Queue Length, Q <sub>95</sub> (veh)								3.3								
Control Delay (s/veh)								20.3								
Level of Service (LOS)								C								
Approach Delay (s/veh)					20.3											
Approach LOS					C											

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	KKM	Intersection	Pinetree Road				
Agency/Co.		Jurisdiction	Pepper Pike				
Date Performed	6/17/2019	East/West Street	Lander Circle				
Analysis Year	2023	North/South Street	Pinetree Road				
Time Analyzed	PM	Peak Hour Factor	0.92				
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25				
Project Description	No Build						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound				
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R	
Movement																	
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6	
Number of Lanes		0	0	0		0	0	1		0	0	2	0		0	0	0
Configuration								R			T	TR					
Volume (veh/h)								375			756	353					
Percent Heavy Vehicles (%)								1									
Proportion Time Blocked																	
Percent Grade (%)					0												
Right Turn Channelized					No												
Median Type   Storage	Undivided																

## Critical and Follow-up Headways

Base Critical Headway (sec)								6.9								
Critical Headway (sec)								6.92								
Base Follow-Up Headway (sec)								3.3								
Follow-Up Headway (sec)								3.31								

## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)								408								
Capacity, c (veh/h)								445								
v/c Ratio								0.92								
95% Queue Length, Q <sub>95</sub> (veh)								10.3								
Control Delay (s/veh)								55.1								
Level of Service (LOS)								F								
Approach Delay (s/veh)					55.1											
Approach LOS					F											

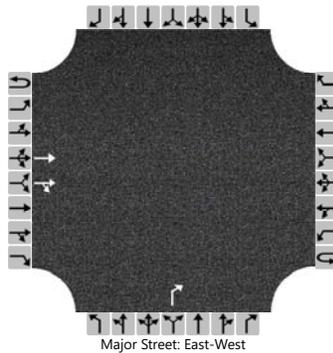
**APPENDIX D**

**BUILD CAPACITY ANALYSIS**

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	VMN			Intersection	Chagrin Boulevard SE		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	5/17/20			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Chagrin Boulevard SE		
Time Analyzed	AM			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Preferred Scenario						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	2	0	0	0	0	0		0	0	1		0	0	0
Configuration			T	TR								R				
Volume (veh/h)			544	457								451				
Percent Heavy Vehicles (%)												1				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized									No							
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)																	6.9
Critical Headway (sec)																	6.92
Base Follow-Up Headway (sec)																	3.3
Follow-Up Headway (sec)																	3.31

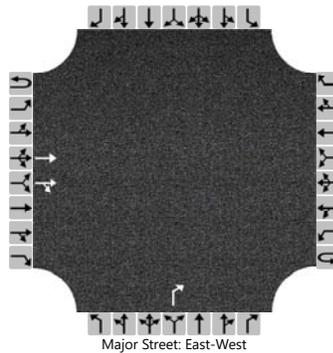
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)																	490
Capacity, c (veh/h)																	486
v/c Ratio																	1.01
95% Queue Length, Q <sub>95</sub> (veh)																	13.8
Control Delay (s/veh)																	72.5
Level of Service (LOS)																	F
Approach Delay (s/veh)									72.5								
Approach LOS									F								

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	VMN			Intersection	Chagrin Boulevard SE		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	5/17/2020			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Chagrin Boulevard SE		
Time Analyzed	PM			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Preferred Scenario						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	2	0	0	0	0	0		0	0	1		0	0	0
Configuration			T	TR								R				
Volume (veh/h)			823	501								355				
Percent Heavy Vehicles (%)												1				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized									No							
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)													6.9				
Critical Headway (sec)													6.92				
Base Follow-Up Headway (sec)													3.3				
Follow-Up Headway (sec)													3.31				

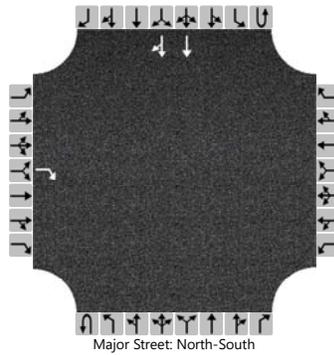
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)													386				
Capacity, c (veh/h)													373				
v/c Ratio													1.03				
95% Queue Length, Q <sub>95</sub> (veh)													12.9				
Control Delay (s/veh)													90.0				
Level of Service (LOS)													F				
Approach Delay (s/veh)									90.0								
Approach LOS									F								

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	VMN	Intersection	Chagrin Boulevard West				
Agency/Co.		Jurisdiction	Pepper Pike				
Date Performed	5/17/2020	East/West Street	Lander Circle				
Analysis Year	2023	North/South Street	Chagrin Road West				
Time Analyzed	AM	Peak Hour Factor	0.92				
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25				
Project Description	Preferred Scenario						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	0	0	0	0	0	0	0	2	0
Configuration				R											T	TR
Volume (veh/h)				346											476	636
Percent Heavy Vehicles (%)				9												
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized	No															
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)				6.9												
Critical Headway (sec)				7.08												
Base Follow-Up Headway (sec)				3.3												
Follow-Up Headway (sec)				3.39												

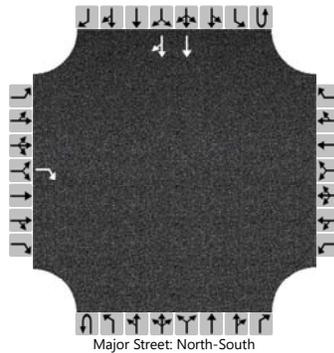
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				376												
Capacity, c (veh/h)				424												
v/c Ratio				0.89												
95% Queue Length, Q <sub>95</sub> (veh)				9.2												
Control Delay (s/veh)				51.5												
Level of Service (LOS)				F												
Approach Delay (s/veh)	51.5															
Approach LOS	F															

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	VMN	Intersection	Chagrin Boulevard West				
Agency/Co.		Jurisdiction	Pepper Pike				
Date Performed	5/17/2020	East/West Street	Lander Circle				
Analysis Year	2023	North/South Street	Chagrin Road West				
Time Analyzed	PM	Peak Hour Factor	0.92				
Intersection Orientation	North-South	Analysis Time Period (hrs)	0.25				
Project Description	Preferred Scenario						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	1		0	0	0	0	0	0	0	0	0	2	0
Configuration				R											T	TR
Volume (veh/h)				739											689	604
Percent Heavy Vehicles (%)				1												
Proportion Time Blocked																
Percent Grade (%)	0															
Right Turn Channelized	No															
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)				6.9												
Critical Headway (sec)				6.92												
Base Follow-Up Headway (sec)				3.3												
Follow-Up Headway (sec)				3.31												

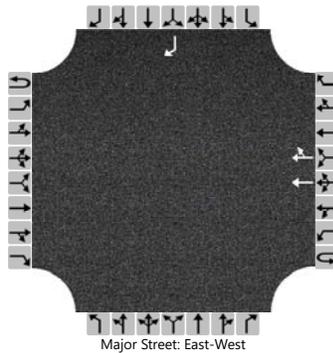
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)				803												
Capacity, c (veh/h)				382												
v/c Ratio				2.10												
95% Queue Length, Q <sub>95</sub> (veh)				57.8												
Control Delay (s/veh)				526.8												
Level of Service (LOS)				F												
Approach Delay (s/veh)	526.8															
Approach LOS	F															

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	VMN			Intersection	Lander Rd North		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	5/17/2020			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Lander Rd North		
Time Analyzed	AM			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Preferred Scenario						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	0	0	0	0	2	0		0	0	0		0	0	1
Configuration							T	TR								R
Volume (veh/h)							567	476								613
Percent Heavy Vehicles (%)																3
Proportion Time Blocked																
Percent Grade (%)															0	
Right Turn Channelized															No	
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)																	6.9
Critical Headway (sec)																	6.96
Base Follow-Up Headway (sec)																	3.3
Follow-Up Headway (sec)																	3.33

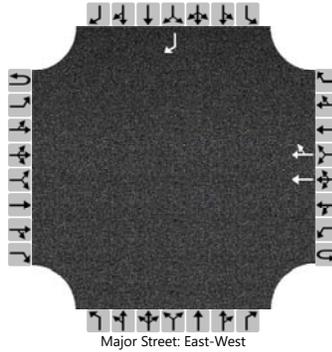
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)																	666
Capacity, c (veh/h)																	464
v/c Ratio																	1.44
95% Queue Length, Q <sub>95</sub> (veh)																	32.9
Control Delay (s/veh)																	231.4
Level of Service (LOS)																	F
Approach Delay (s/veh)																231.4	
Approach LOS																F	

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	VMN			Intersection	Lander Rd North		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	5/17/2020			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Lander Rd North		
Time Analyzed	PM			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Preferred Scenario						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	0	0	0	0	2	0		0	0	0		0	0	1
Configuration							T	TR								R
Volume (veh/h)							626	565								609
Percent Heavy Vehicles (%)																2
Proportion Time Blocked																
Percent Grade (%)													0			
Right Turn Channelized													No			
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)																	6.9
Critical Headway (sec)																	6.94
Base Follow-Up Headway (sec)																	3.3
Follow-Up Headway (sec)																	3.32

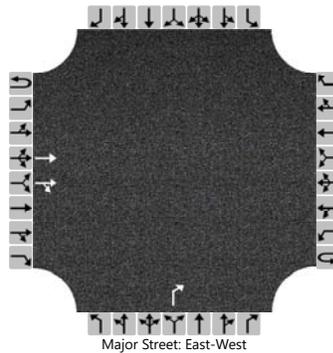
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)																	662
Capacity, c (veh/h)																	413
v/c Ratio																	1.60
95% Queue Length, Q <sub>95</sub> (veh)																	37.7
Control Delay (s/veh)																	305.6
Level of Service (LOS)																	F
Approach Delay (s/veh)													305.6				
Approach LOS													F				

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	VMN			Intersection	Lander Rd South		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	5/17/2020			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Lander Rd South		
Time Analyzed	AM			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Preferred Scenario						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	2	0	0	0	0	0		0	0	1		0	0	0
Configuration			T	TR								R				
Volume (veh/h)			612	208								389				
Percent Heavy Vehicles (%)												2				
Proportion Time Blocked																
Percent Grade (%)										0						
Right Turn Channelized										No						
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)																	6.9
Critical Headway (sec)																	6.94
Base Follow-Up Headway (sec)																	3.3
Follow-Up Headway (sec)																	3.32

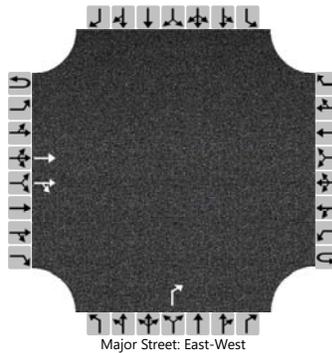
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)																	423
Capacity, c (veh/h)																	560
v/c Ratio																	0.75
95% Queue Length, Q <sub>95</sub> (veh)																	6.7
Control Delay (s/veh)																	28.6
Level of Service (LOS)																	D
Approach Delay (s/veh)	28.6																
Approach LOS	D																

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	VMN			Intersection	Lander Rd South		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	5/17/2020			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Lander Rd South		
Time Analyzed	PM			Peak Hour Factor	0.92		
Intersection Orientation	East-West			Analysis Time Period (hrs)	0.25		
Project Description	Preferred Scenario						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement	1U	1	2	3	4U	4	5	6		7	8	9		10	11	12
Priority																
Number of Lanes	0	0	2	0	0	0	0	0		0	0	1		0	0	0
Configuration			T	TR								R				
Volume (veh/h)			940	498								385				
Percent Heavy Vehicles (%)												1				
Proportion Time Blocked																
Percent Grade (%)									0							
Right Turn Channelized									No							
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)																	6.9
Critical Headway (sec)																	6.92
Base Follow-Up Headway (sec)																	3.3
Follow-Up Headway (sec)																	3.31

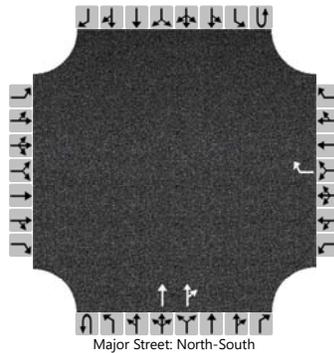
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)																	418
Capacity, c (veh/h)																	339
v/c Ratio																	1.23
95% Queue Length, Q <sub>95</sub> (veh)																	18.4
Control Delay (s/veh)																	160.9
Level of Service (LOS)																	F
Approach Delay (s/veh)									160.9								
Approach LOS									F								

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	VMN			Intersection	Pinetree Road		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	5/17/2020			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Pinetree Road		
Time Analyzed	AM			Peak Hour Factor	0.92		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Preferred Scenario						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	1	0	0	2	0	0	0	0	0
Configuration								R			T	TR				
Volume (veh/h)								294			749	246				
Percent Heavy Vehicles (%)								2								
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized					No											
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)								6.9								
Critical Headway (sec)								6.94								
Base Follow-Up Headway (sec)								3.3								
Follow-Up Headway (sec)								3.32								

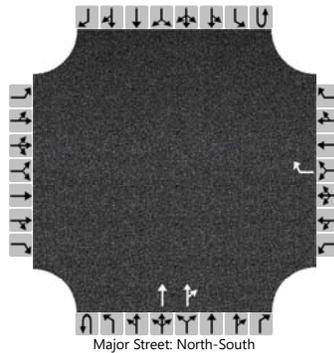
## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)								320								
Capacity, c (veh/h)								486								
v/c Ratio								0.66								
95% Queue Length, Q <sub>95</sub> (veh)								4.7								
Control Delay (s/veh)								25.6								
Level of Service (LOS)								D								
Approach Delay (s/veh)					25.6											
Approach LOS					D											

# HCS7 Two-Way Stop-Control Report

General Information				Site Information			
Analyst	VMN			Intersection	Pinetree Road		
Agency/Co.				Jurisdiction	Pepper Pike		
Date Performed	5/17/2020			East/West Street	Lander Circle		
Analysis Year	2023			North/South Street	Pinetree Road		
Time Analyzed	PM			Peak Hour Factor	0.92		
Intersection Orientation	North-South			Analysis Time Period (hrs)	0.25		
Project Description	Preferred Scenario						

## Lanes



## Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	0	0		0	0	1	0	0	2	0	0	0	0	0
Configuration								R			T	TR				
Volume (veh/h)								406			785	393				
Percent Heavy Vehicles (%)								1								
Proportion Time Blocked																
Percent Grade (%)					0											
Right Turn Channelized					No											
Median Type   Storage	Undivided															

## Critical and Follow-up Headways

Base Critical Headway (sec)								6.9								
Critical Headway (sec)								6.92								
Base Follow-Up Headway (sec)								3.3								
Follow-Up Headway (sec)								3.31								

## Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)								441								
Capacity, c (veh/h)								420								
v/c Ratio								1.05								
95% Queue Length, Q <sub>95</sub> (veh)								14.2								
Control Delay (s/veh)								89.4								
Level of Service (LOS)								F								
Approach Delay (s/veh)					89.4											
Approach LOS					F											

# HCS7 Roundabouts Report

General Information				Site Information			
Analyst	VMN			Intersection	Chagrin SE / Connector		
Agency or Co.				E/W Street Name	Connector Rd		
Date Performed	5/17/2020			N/S Street Name	Chagrin Blvd SE		
Analysis Year	2023			Analysis Time Period (hrs)	0.25		
Time Analyzed	AM			Peak Hour Factor	0.92		
Project Description	Preferred Scenario			Jurisdiction	Pepper Pike		

Volume Adjustments and Site Characteristics																
Approach	EB				WB				NB				SB			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Number of Lanes (N)	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0
Lane Assignment	LR								LT				TR			
Volume (V), veh/h	0	60		163					0	118	391		0		383	74
Percent Heavy Vehicles, %	3	3		3					3	3	3		3		3	3
Flow Rate (V <sub>PCE</sub> ), pc/h	0	67		182					0	132	438		0		429	83
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1								1				1			
Pedestrians Crossing, p/h	0								0				0			

Critical and Follow-Up Headway Adjustment													
Approach	EB			WB			NB			SB			
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	
Critical Headway (s)		4.9763						4.9763			4.9763		
Follow-Up Headway (s)		2.6087						2.6087			2.6087		

Flow Computations, Capacity and v/c Ratios													
Approach	EB			WB			NB			SB			
	Left	Right	Bypass										
Entry Flow (v <sub>e</sub> ), pc/h		249						570			512		
Entry Volume, veh/h		242						553			497		
Circulating Flow (v <sub>c</sub> ), pc/h	429			637			67			132			
Exiting Flow (v <sub>ex</sub> ), pc/h	0			215			505			611			
Capacity (C <sub>PCE</sub> ), pc/h		891						1289			1206		
Capacity (c), veh/h		865						1251			1171		
v/c Ratio (x)		0.28						0.44			0.42		

Delay and Level of Service													
Approach	EB			WB			NB			SB			
	Left	Right	Bypass										
Lane Control Delay (d), s/veh		7.2						7.3			7.4		
Lane LOS		A						A			A		
95% Queue, veh		1.1						2.3			2.2		
Approach Delay, s/veh	7.2						7.3			7.4			
Approach LOS	A						A			A			
Intersection Delay, s/veh   LOS	7.4						A						

# HCS7 Roundabouts Report

General Information				Site Information			
Analyst	VMN			Intersection	Chagrin SE / Connector		
Agency or Co.				E/W Street Name	Connector Road		
Date Performed	5/17/2020			N/S Street Name	Chagrin Blvd SE		
Analysis Year	2023			Analysis Time Period (hrs)	0.25		
Time Analyzed	PM			Peak Hour Factor	0.92		
Project Description	Preferred Scenario			Jurisdiction	Pepper Plke		

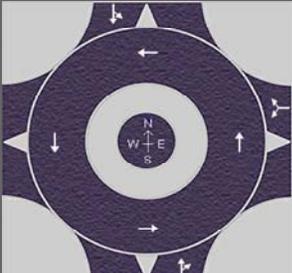
Volume Adjustments and Site Characteristics																
Approach	EB				WB				NB				SB			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Number of Lanes (N)	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0
Lane Assignment	LR								LT				TR			
Volume (V), veh/h	0	80		156					0	123	275		0		419	82
Percent Heavy Vehicles, %	3	3		3					3	3	3		3		3	3
Flow Rate (v <sub>PCE</sub> ), pc/h	0	90		175					0	138	308		0		469	92
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1								1				1			
Pedestrians Crossing, p/h	0								0				0			

Critical and Follow-Up Headway Adjustment													
Approach	EB			WB			NB			SB			
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	
Critical Headway (s)		4.9763						4.9763			4.9763		
Follow-Up Headway (s)		2.6087						2.6087			2.6087		

Flow Computations, Capacity and v/c Ratios													
Approach	EB			WB			NB			SB			
	Left	Right	Bypass										
Entry Flow (v <sub>e</sub> ), pc/h		265						446			561		
Entry Volume, veh/h		257						433			545		
Circulating Flow (v <sub>c</sub> ), pc/h	469			536			90			138			
Exiting Flow (v <sub>ex</sub> ), pc/h	0			230			398			644			
Capacity (C <sub>PCE</sub> ), pc/h		855						1259			1199		
Capacity (c), veh/h		830						1222			1164		
v/c Ratio (x)		0.31						0.35			0.47		

Delay and Level of Service													
Approach	EB			WB			NB			SB			
	Left	Right	Bypass										
Lane Control Delay (d), s/veh		7.8						6.3			8.1		
Lane LOS		A						A			A		
95% Queue, veh		1.3						1.6			2.6		
Approach Delay, s/veh	7.8						6.3			8.1			
Approach LOS	A						A			A			
Intersection Delay, s/veh   LOS	7.4						A						

# HCS7 Roundabouts Report

General Information				Site Information			
Analyst	VMN		Intersection	Lander Rd / Connector			
Agency or Co.			E/W Street Name	Connector Road			
Date Performed	5/17/2020		N/S Street Name	Lander Road			
Analysis Year	2023		Analysis Time Period (hrs)	0.25			
Time Analyzed	AM		Peak Hour Factor	0.92			
Project Description	Preferred Scenario		Jurisdiction	Pepper Pike			

Volume Adjustments and Site Characteristics																
Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment					LR				TR				LT			
Volume (V), veh/h					0	86		68	0		321	186	0	74	134	
Percent Heavy Vehicles, %					3	3		3	3		3	3	3	3	3	
Flow Rate (v <sub>PCE</sub> ), pc/h					0	96		76	0		359	208	0	83	150	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes					1				1				1			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment													
Approach	EB			WB			NB			SB			
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	
Critical Headway (s)					4.9763			4.9763			4.9763		
Follow-Up Headway (s)					2.6087			2.6087			2.6087		

Flow Computations, Capacity and v/c Ratios													
Approach	EB			WB			NB			SB			
Lane	Left	Right	Bypass										
Entry Flow (v <sub>e</sub> ), pc/h					172			567			233		
Entry Volume, veh/h					167			550			226		
Circulating Flow (v <sub>c</sub> ), pc/h	329			359			83			96			
Exiting Flow (v <sub>ex</sub> ), pc/h	291			0			435			246			
Capacity (C <sub>PCE</sub> ), pc/h					957			1268			1251		
Capacity (c), veh/h					929			1231			1215		
v/c Ratio (x)					0.18			0.45			0.19		

Delay and Level of Service													
Approach	EB			WB			NB			SB			
Lane	Left	Right	Bypass										
Lane Control Delay (d), s/veh					5.6			7.5			4.6		
Lane LOS					A			A			A		
95% Queue, veh					0.7			2.4			0.7		
Approach Delay, s/veh				5.6			7.5			4.6			
Approach LOS				A			A			A			
Intersection Delay, s/veh   LOS	6.5						A						

# HCS7 Roundabouts Report

General Information				Site Information			
Analyst	VMN		Intersection	Lander Rd / Connector			
Agency or Co.			E/W Street Name	Connector Road			
Date Performed	5/17/2020		N/S Street Name	Lander Road			
Analysis Year	2023		Analysis Time Period (hrs)	0.25			
Time Analyzed	PM		Peak Hour Factor	0.92			
Project Description	Preferred Scenario		Jurisdiction	Pepper Pike			

Volume Adjustments and Site Characteristics																
Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment							LR				TR					LT
Volume (V), veh/h					0	146		80	0		305	133	0	72	426	
Percent Heavy Vehicles, %					3	3		3	3		3	3	3	3	3	
Flow Rate (v <sub>PCE</sub> ), pc/h					0	163		90	0		341	149	0	81	477	
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes					1				1				1			
Pedestrians Crossing, p/h					0				0				0			

Critical and Follow-Up Headway Adjustment													
Approach	EB			WB			NB			SB			
Lane	Left	Right	Bypass										
Critical Headway (s)						4.9763			4.9763			4.9763	
Follow-Up Headway (s)						2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios													
Approach	EB			WB			NB			SB			
Lane	Left	Right	Bypass										
Entry Flow (v <sub>e</sub> ), pc/h						253			490			558	
Entry Volume, veh/h						246			476			542	
Circulating Flow (v <sub>c</sub> ), pc/h	721			341			81			163			
Exiting Flow (v <sub>ex</sub> ), pc/h	230			0			431			640			
Capacity (C <sub>PCE</sub> ), pc/h						975			1271			1169	
Capacity (c), veh/h						946			1234			1135	
v/c Ratio (x)						0.26			0.39			0.48	

Delay and Level of Service													
Approach	EB			WB			NB			SB			
Lane	Left	Right	Bypass										
Lane Control Delay (d), s/veh						6.4			6.7			8.4	
Lane LOS						A			A			A	
95% Queue, veh						1.0			1.8			2.6	
Approach Delay, s/veh				6.4			6.7			8.4			
Approach LOS				A			A			A			
Intersection Delay, s/veh   LOS	7.4						A						

**APPENDIX E**

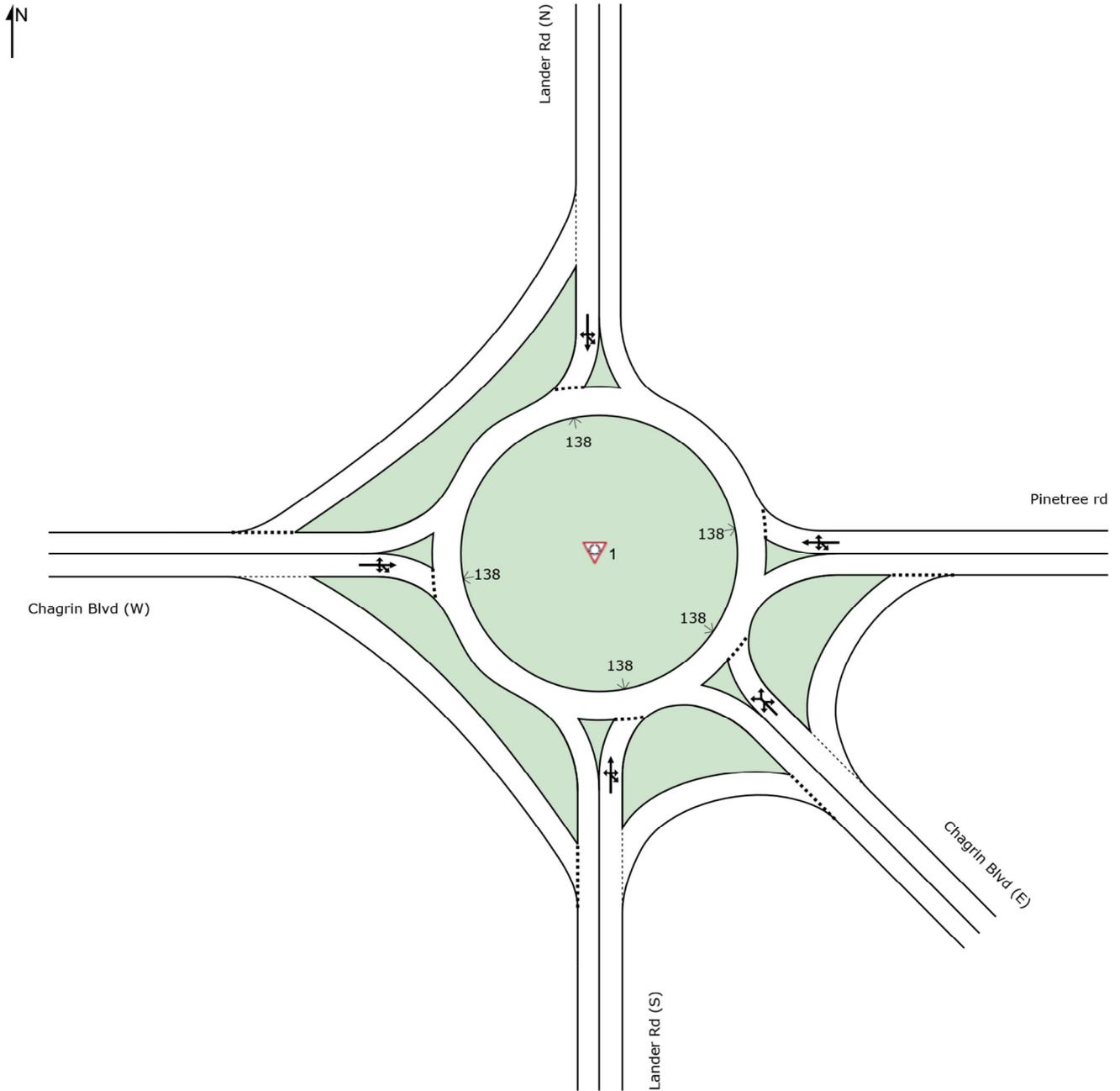
**BUILD W/ ROUNDABOUT DESIGNS CAPACITY ANALYSIS**

# SITE LAYOUT

## Site: 1 [Rou 5-way 1-Lane-AM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)  
Roundabout



# INPUT VOLUMES

## Vehicles and pedestrians per 60 minutes

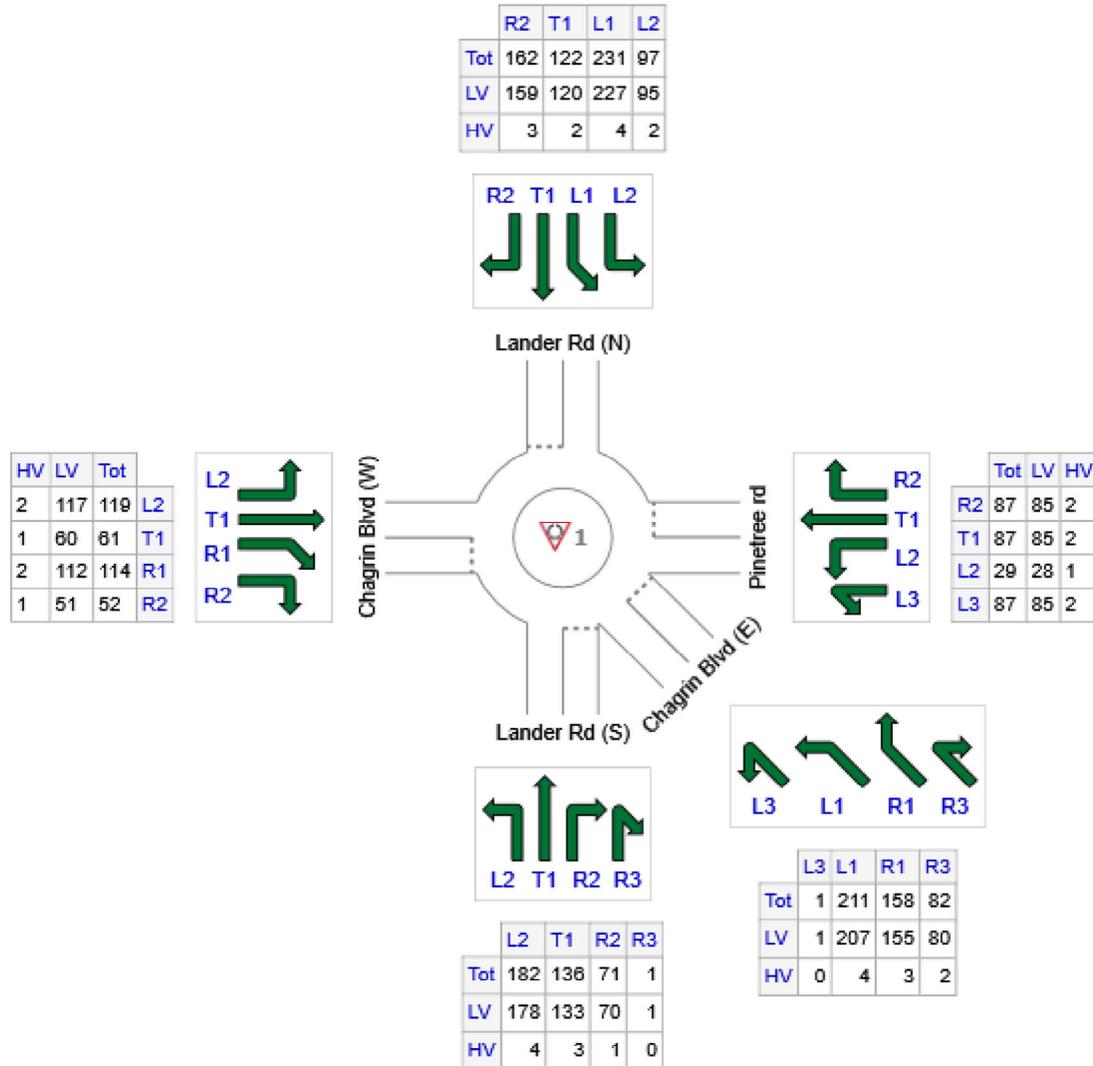
Site: 1 [Rou 5-way 1-Lane-AM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)

Roundabout

Volume Display Method: Separate



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Lander Rd (S)	390	382	8
SE: Chagrin Blvd (E)	452	443	9
E: Pinetree rd	290	283	7
N: Lander Rd (N)	612	601	11
W: Chagrin Blvd (W)	346	340	6
Total	2090	2049	41

# LANE LEVEL OF SERVICE

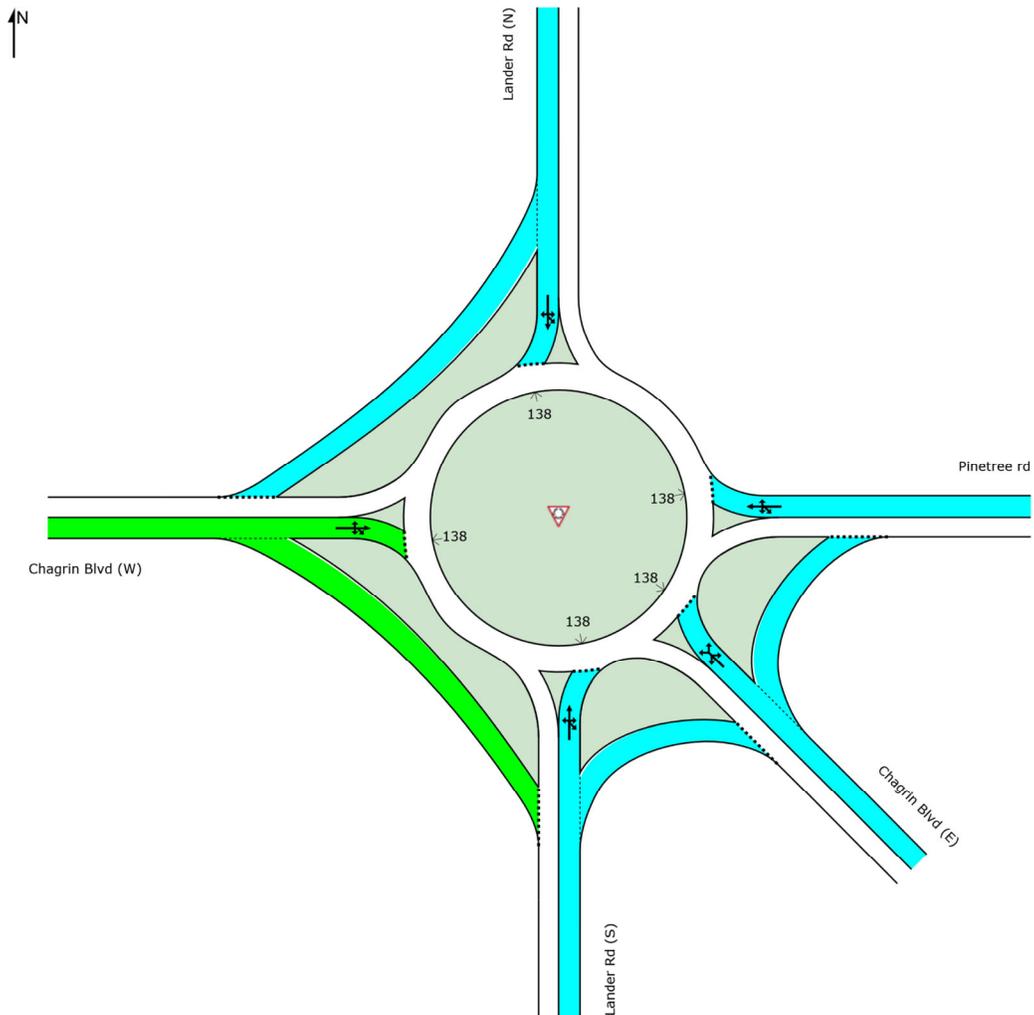
## Lane Level of Service

### Site: 1 [Rou 5-way 1-Lane-AM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)  
Roundabout

	Approaches					Intersection
	South	Southeast	East	North	West	
LOS	B	B	B	B	A	B



Colour code based on Level of Service



Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

# MOVEMENT SUMMARY

## Site: 1 [Rou 5-way 1-Lane-AM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)  
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: Lander Rd (S)												
3	L2	198	2.2	0.520	17.0	LOS B	4.7	118.5	0.89	0.96	1.05	34.0
8	T1	148	2.2	0.520	9.6	LOS A	4.7	118.5	0.89	0.96	1.05	33.7
12x	R2	77	1.4	0.520	10.0	LOS B	4.7	118.5	0.89	0.96	1.05	32.6
18b	R3	1	0.0	0.520	7.3	LOS A	4.7	118.5	0.89	0.96	1.05	32.2
Approach		424	2.1	0.520	13.1	LOS B	4.7	118.5	0.89	0.96	1.05	33.6
SouthEast: Chagrin Blvd (E)												
3bx	L3	1	0.0	0.554	17.8	LOS B	5.2	131.8	0.83	0.89	0.97	35.4
3ax	L1	229	1.9	0.554	15.3	LOS B	5.2	131.8	0.83	0.89	0.97	34.2
18ax	R1	172	1.9	0.554	9.0	LOS A	5.2	131.8	0.83	0.89	0.97	34.1
18bx	R3	89	2.4	0.554	6.0	LOS A	5.2	131.8	0.83	0.89	0.97	32.8
Approach		491	2.0	0.554	11.4	LOS B	5.2	131.8	0.83	0.89	0.97	33.9
East: Pinetree rd												
1b	L3	95	2.3	0.429	18.3	LOS B	3.4	86.5	0.90	0.93	0.96	34.4
3x	L2	32	3.4	0.429	17.0	LOS B	3.4	86.5	0.90	0.93	0.96	33.9
6	T1	95	2.3	0.429	9.6	LOS A	3.4	86.5	0.90	0.93	0.96	33.7
16	R2	95	2.3	0.429	10.3	LOS B	3.4	86.5	0.90	0.93	0.96	32.5
Approach		315	2.4	0.429	13.2	LOS B	3.4	86.5	0.90	0.93	0.96	33.6
North: Lander Rd (N)												
7	L2	105	2.1	0.693	18.6	LOS B	8.3	210.8	0.90	1.03	1.23	33.3
7a	L1	251	1.7	0.693	17.2	LOS B	8.3	210.8	0.90	1.03	1.23	32.8
4	T1	133	1.6	0.693	11.2	LOS B	8.3	210.8	0.90	1.03	1.23	33.0
14	R2	176	1.9	0.693	10.3	LOS B	8.3	210.8	0.90	1.03	1.23	32.0
Approach		665	1.8	0.693	14.4	LOS B	8.3	210.8	0.90	1.03	1.23	32.7
West: Chagrin Blvd (W)												
5	L2	129	1.7	0.402	13.7	LOS B	3.0	76.7	0.72	0.71	0.72	36.1
2	T1	66	1.6	0.402	6.4	LOS A	3.0	76.7	0.72	0.71	0.72	35.7
12a	R1	124	1.8	0.402	6.1	LOS A	3.0	76.7	0.72	0.71	0.72	35.3
12	R2	57	1.9	0.402	4.0	LOS A	3.0	76.7	0.72	0.71	0.72	34.5
Approach		376	1.7	0.402	8.4	LOS A	3.0	76.7	0.72	0.71	0.72	35.5
All Vehicles		2272	2.0	0.693	12.4	LOS B	8.3	210.8	0.86	0.92	1.02	33.7

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.

Intersection and Approach LOS values are based on average delay for all movements (v/c not used).

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

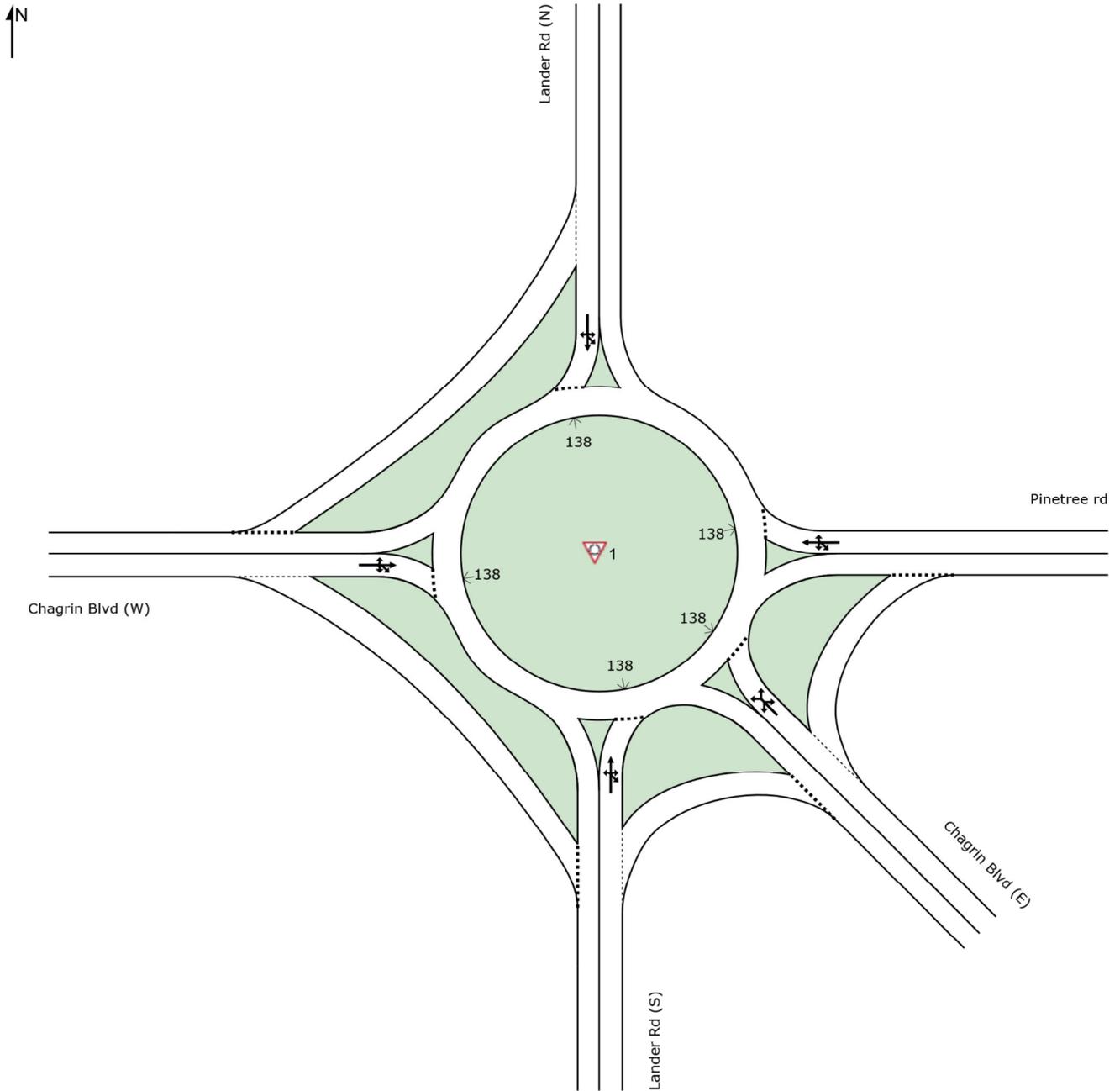
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# SITE LAYOUT

## Site: 1 [Rou 5-way 1-Lane-PM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)  
Roundabout



# INPUT VOLUMES

## Vehicles and pedestrians per 60 minutes

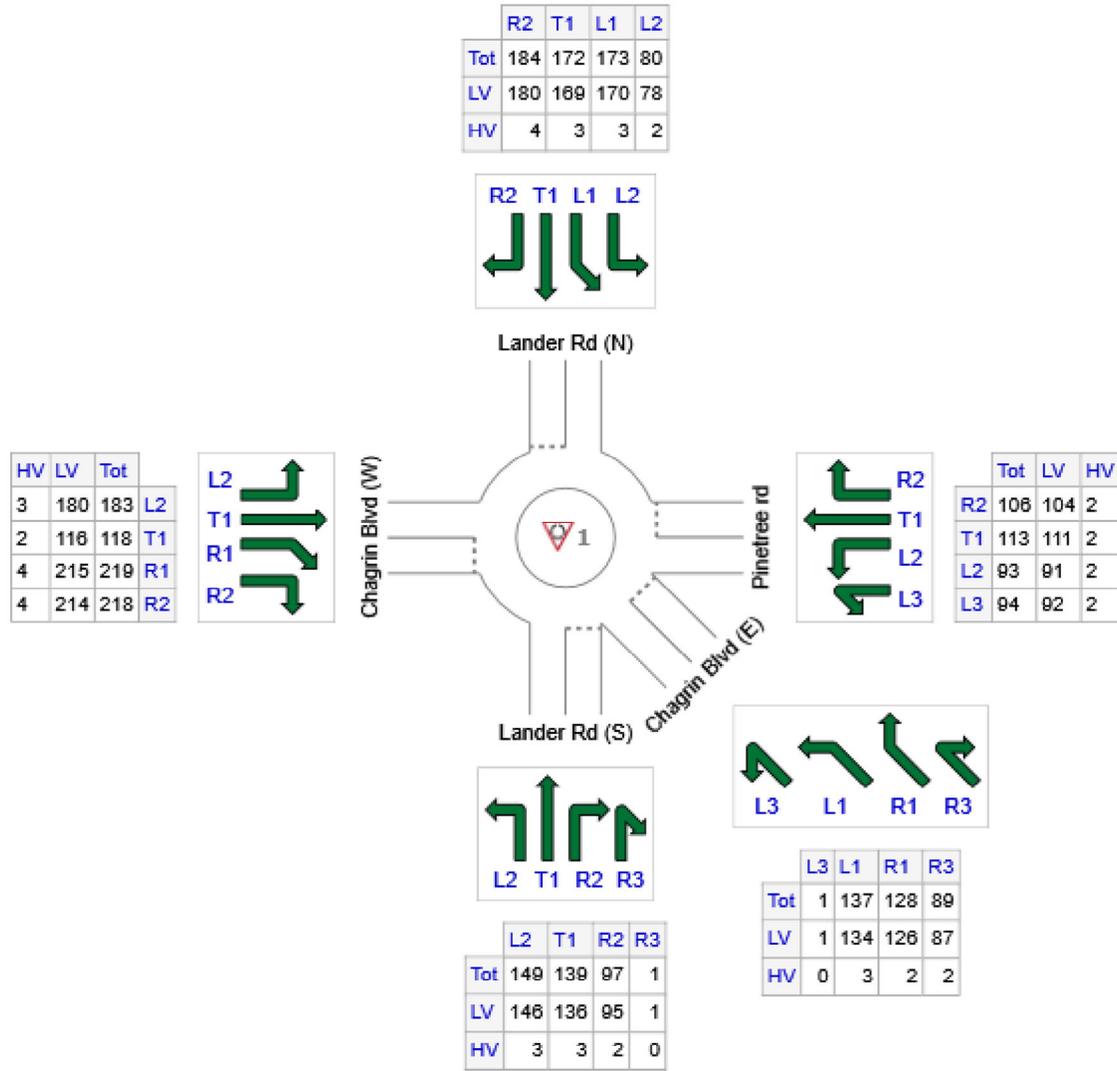
Site: 1 [Rou 5-way 1-Lane-PM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)

Roundabout

Volume Display Method: Separate



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Lander Rd (S)	386	378	8
SE: Chagrin Blvd (E)	355	348	7
E: Pinetree rd	406	398	8
N: Lander Rd (N)	609	597	12
W: Chagrin Blvd (W)	738	725	13
Total	2494	2446	48

# LANE LEVEL OF SERVICE

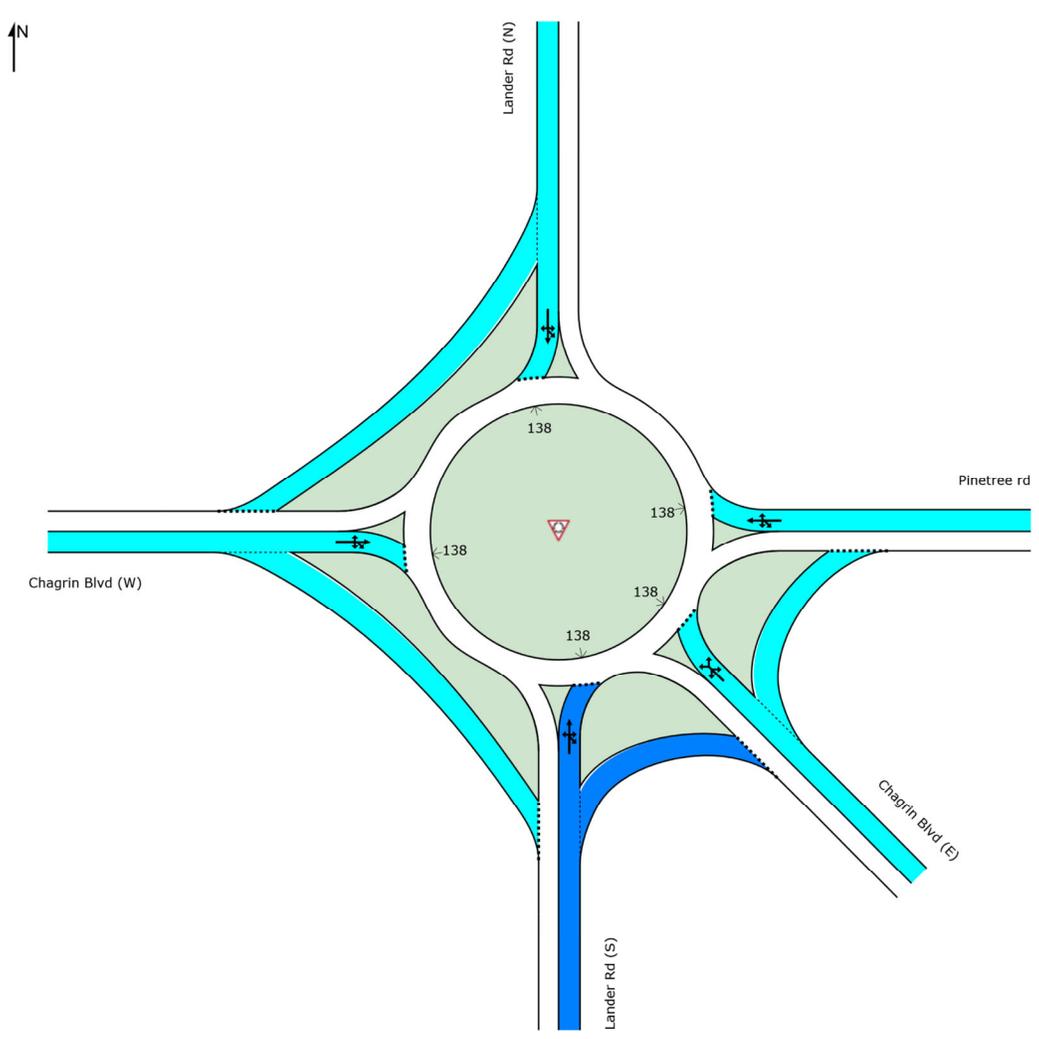
## Lane Level of Service

### Site: 1 [Rou 5-way 1-Lane-PM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)  
Roundabout

	Approaches					Intersection
	South	Southeast	East	North	West	
LOS	C	B	B	B	B	B



Colour code based on Level of Service



Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

# MOVEMENT SUMMARY

## Site: 1 [Rou 5-way 1-Lane-PM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)  
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: Lander Rd (S)												
3	L2	162	2.0	0.667	24.9	LOS C	8.0	203.2	1.00	1.18	1.47	30.6
8	T1	151	2.2	0.667	17.6	LOS B	8.0	203.2	1.00	1.18	1.47	30.4
12x	R2	105	2.1	0.667	18.0	LOS B	8.0	203.2	1.00	1.18	1.47	29.5
18b	R3	1	0.0	0.667	13.1	LOS B	8.0	203.2	1.00	1.18	1.47	29.2
Approach		420	2.1	0.667	20.5	LOS C	8.0	203.2	1.00	1.18	1.47	30.2
SouthEast: Chagrin Blvd (E)												
3bx	L3	1	0.0	0.470	17.9	LOS B	3.9	98.1	0.84	0.86	0.90	35.8
3ax	L1	149	2.2	0.470	15.4	LOS B	3.9	98.1	0.84	0.86	0.90	34.6
18ax	R1	139	1.6	0.470	9.1	LOS A	3.9	98.1	0.84	0.86	0.90	34.5
18bx	R3	97	2.2	0.470	5.5	LOS A	3.9	98.1	0.84	0.86	0.90	33.2
Approach		386	2.0	0.470	10.7	LOS B	3.9	98.1	0.84	0.86	0.90	34.2
East: Pinetree rd												
1b	L3	102	2.1	0.553	19.5	LOS B	5.3	134.5	0.91	1.01	1.13	33.7
3x	L2	101	2.2	0.553	18.1	LOS B	5.3	134.5	0.91	1.01	1.13	33.2
6	T1	123	1.8	0.553	10.8	LOS B	5.3	134.5	0.91	1.01	1.13	33.0
16	R2	115	1.9	0.553	11.4	LOS B	5.3	134.5	0.91	1.01	1.13	31.9
Approach		441	2.0	0.553	14.6	LOS B	5.3	134.5	0.91	1.01	1.13	32.9
North: Lander Rd (N)												
7	L2	87	2.5	0.688	18.1	LOS B	8.2	207.1	0.90	0.99	1.18	34.0
7a	L1	188	1.7	0.688	16.7	LOS B	8.2	207.1	0.90	0.99	1.18	33.5
4	T1	187	1.7	0.688	10.7	LOS B	8.2	207.1	0.90	0.99	1.18	33.7
14	R2	200	2.2	0.688	9.1	LOS A	8.2	207.1	0.90	0.99	1.18	32.6
Approach		662	2.0	0.688	12.9	LOS B	8.2	207.1	0.90	0.99	1.18	33.4
West: Chagrin Blvd (W)												
5	L2	199	1.6	0.849	24.7	LOS C	15.6	396.7	1.00	1.18	1.63	31.6
2	T1	128	1.7	0.849	17.4	LOS B	15.6	396.7	1.00	1.18	1.63	31.3
12a	R1	238	1.8	0.849	17.1	LOS B	15.6	396.7	1.00	1.18	1.63	31.0
12	R2	237	1.8	0.849	13.7	LOS B	15.6	396.7	1.00	1.18	1.63	30.4
Approach		802	1.8	0.849	18.0	LOS B	15.6	396.7	1.00	1.18	1.63	31.0
All Vehicles		2711	1.9	0.849	15.6	LOS B	15.6	396.7	0.94	1.06	1.31	32.2

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.

Intersection and Approach LOS values are based on average delay for all movements (v/c not used).

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

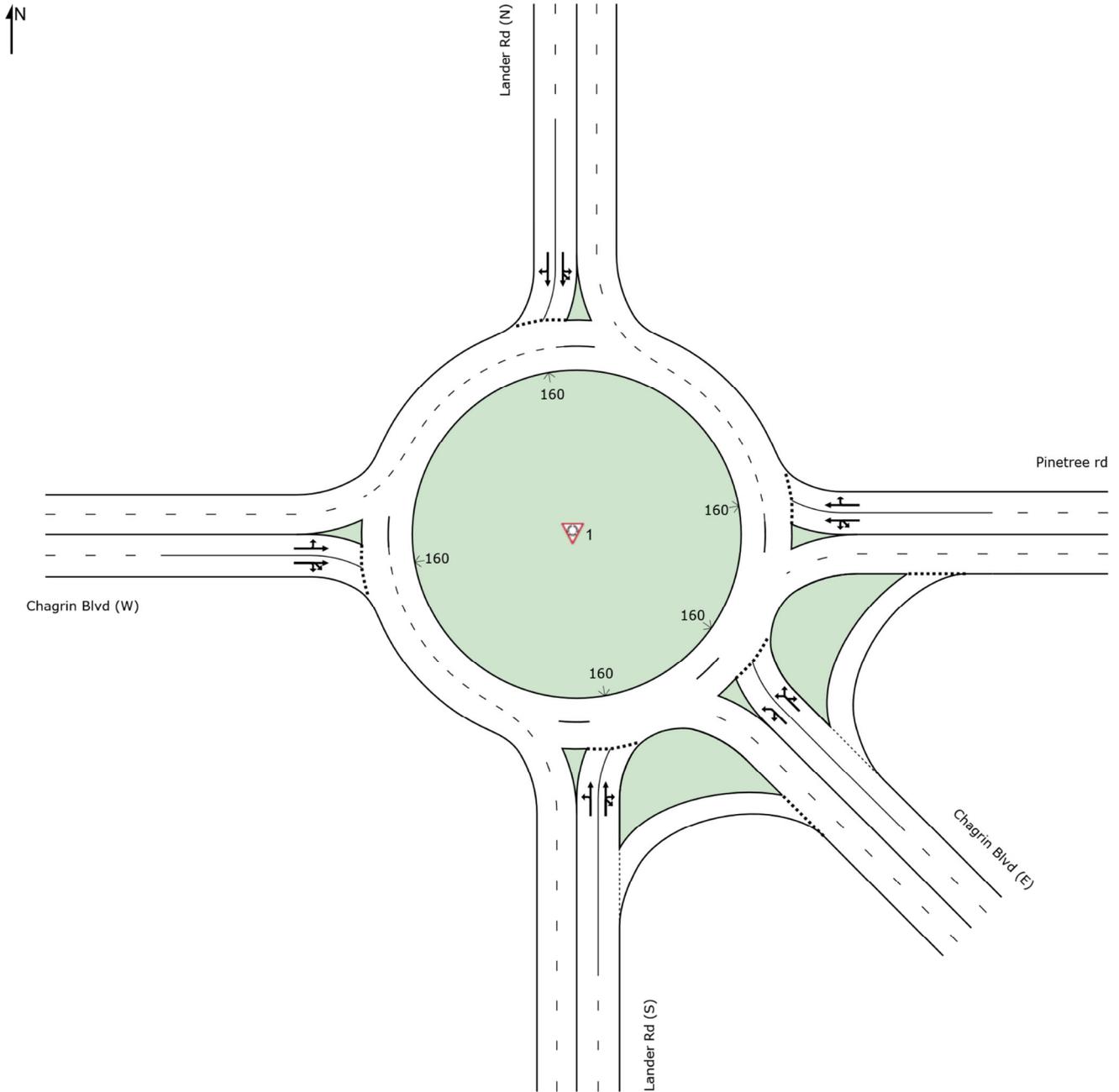
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# SITE LAYOUT

## Site: 1 [5-leg 2 lane circulating Roundabout-AM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)  
Roundabout



# INPUT VOLUMES

## Vehicles and pedestrians per 60 minutes

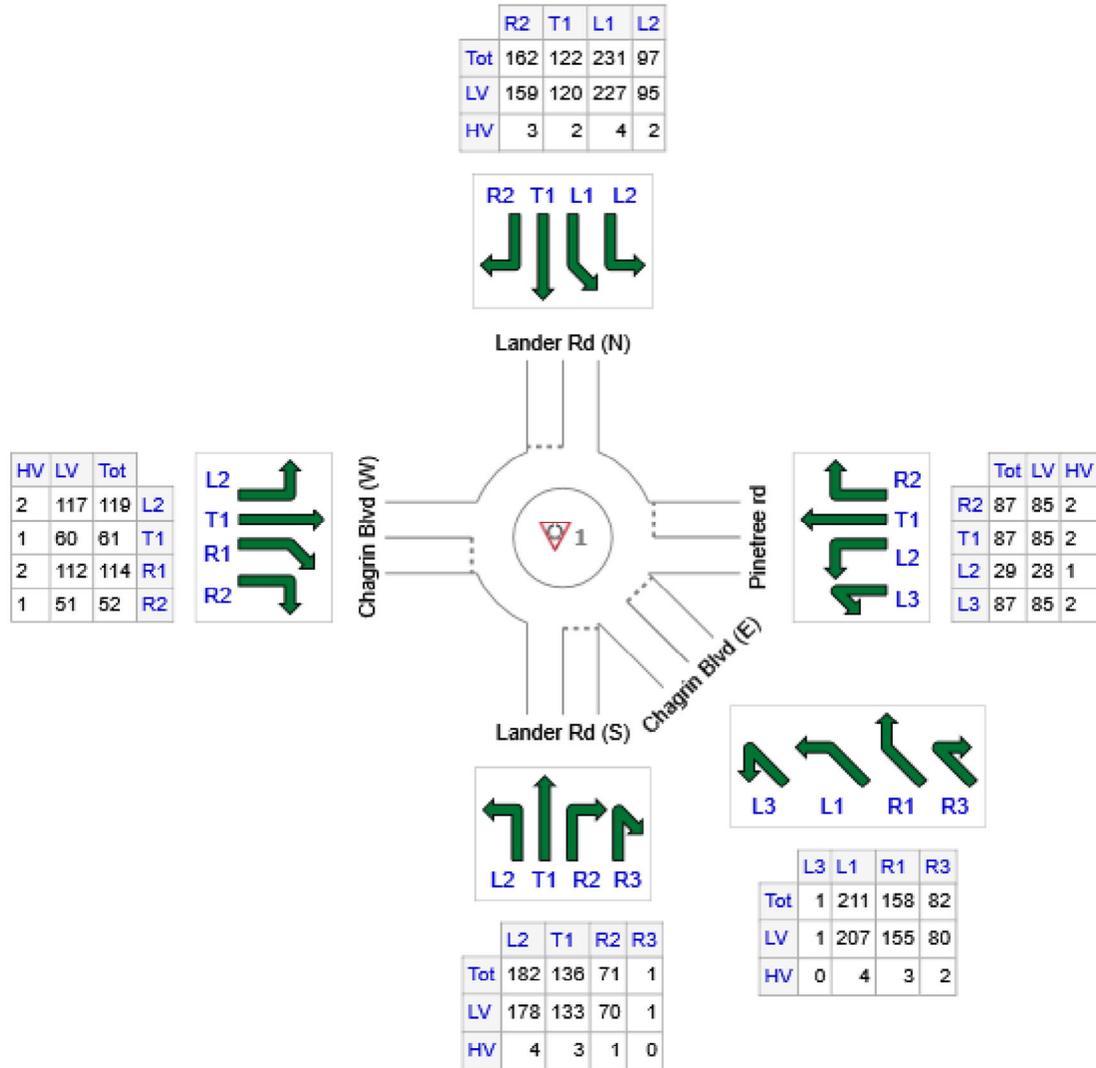
### Site: 1 [5-leg 2 lane circulating Roundabout-AM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)

Roundabout

Volume Display Method: Separate



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Lander Rd (S)	390	382	8
SE: Chagrin Blvd (E)	452	443	9
E: Pinetree rd	290	283	7
N: Lander Rd (N)	612	601	11
W: Chagrin Blvd (W)	346	340	6
Total	2090	2049	41

# LANE LEVEL OF SERVICE

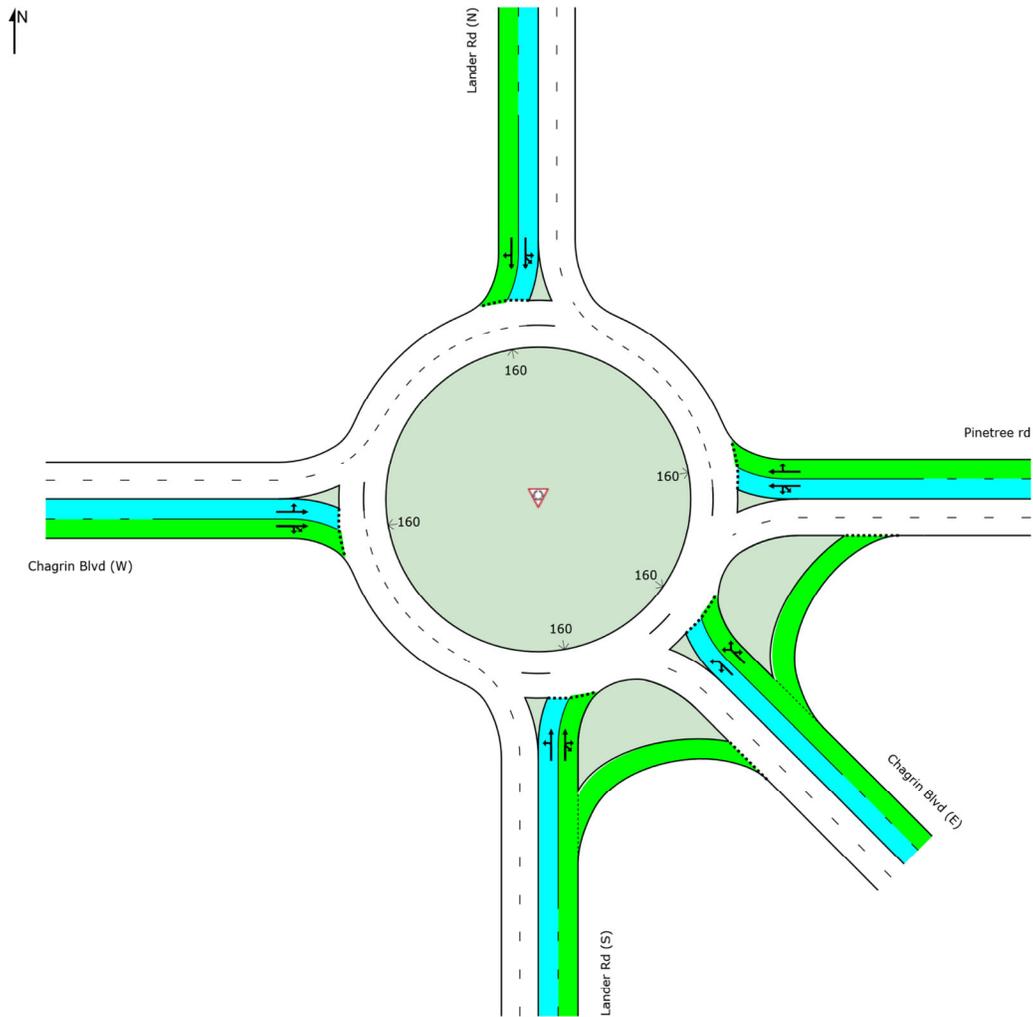
## Lane Level of Service

### Site: 1 [5-leg 2 lane circulating Roundabout-AM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)  
Roundabout

	Approaches					Intersection
	South	Southeast	East	North	West	
LOS	A	A	A	A	A	A



Colour code based on Level of Service



Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

# MOVEMENT SUMMARY

## Site: 1 [5-leg 2 lane circulating Roundabout-AM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)  
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: Lander Rd (S)												
3	L2	198	2.2	0.223	12.6	LOS B	1.1	27.0	0.58	0.76	0.58	35.3
8	T1	148	2.2	0.223	5.5	LOS A	1.1	27.0	0.59	0.64	0.59	36.8
12x	R2	77	1.4	0.223	5.8	LOS A	1.0	25.5	0.59	0.61	0.59	36.0
18b	R3	1	0.0	0.223	4.7	LOS A	1.0	25.5	0.59	0.61	0.59	35.4
Approach		424	2.1	0.223	8.8	LOS A	1.1	27.0	0.58	0.69	0.58	35.9
SouthEast: Chagrin Blvd (E)												
3bx	L3	1	0.0	0.215	13.5	LOS B	1.0	24.5	0.54	0.75	0.54	36.1
3ax	L1	229	1.9	0.215	10.8	LOS B	1.0	24.5	0.54	0.75	0.54	34.7
18ax	R1	172	1.9	0.262	4.9	LOS A	1.2	29.4	0.47	0.51	0.47	37.8
18bx	R3	89	2.4	0.262	4.1	LOS A	1.2	29.4	0.47	0.51	0.47	36.0
Approach		491	2.0	0.262	7.5	LOS A	1.2	29.4	0.50	0.62	0.50	36.0
East: Pinetree rd												
1b	L3	95	2.3	0.168	14.5	LOS B	0.7	17.4	0.57	0.81	0.57	35.1
3x	L2	32	3.4	0.168	13.1	LOS B	0.7	17.4	0.57	0.81	0.57	34.7
6	T1	95	2.3	0.168	5.1	LOS A	0.7	18.3	0.56	0.61	0.56	37.0
16	R2	95	2.3	0.168	5.5	LOS A	0.7	18.3	0.55	0.57	0.55	36.0
Approach		315	2.4	0.168	8.8	LOS A	0.7	18.3	0.56	0.68	0.56	35.9
North: Lander Rd (N)												
7	L2	105	2.1	0.328	12.5	LOS B	1.6	41.6	0.57	0.77	0.57	35.1
7a	L1	251	1.7	0.328	11.1	LOS B	1.6	41.6	0.57	0.77	0.57	34.5
4	T1	133	1.6	0.328	5.5	LOS A	1.6	41.6	0.58	0.63	0.58	37.5
14	R2	176	1.9	0.328	6.0	LOS A	1.6	39.6	0.58	0.63	0.58	35.9
Approach		665	1.8	0.328	8.8	LOS A	1.6	41.6	0.58	0.71	0.58	35.5
West: Chagrin Blvd (W)												
5	L2	129	1.7	0.186	12.4	LOS B	0.8	21.0	0.54	0.72	0.54	35.8
2	T1	66	1.6	0.186	4.7	LOS A	0.9	21.9	0.54	0.64	0.54	36.1
12a	R1	124	1.8	0.186	4.2	LOS A	0.9	21.9	0.53	0.49	0.53	37.4
12	R2	57	1.9	0.186	5.0	LOS A	0.9	21.9	0.53	0.49	0.53	36.3
Approach		376	1.7	0.186	7.2	LOS A	0.9	21.9	0.53	0.60	0.53	36.4
All Vehicles		2272	2.0	0.328	8.3	LOS A	1.6	41.6	0.55	0.66	0.55	35.9

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.

Intersection and Approach LOS values are based on average delay for all movements (v/c not used).

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

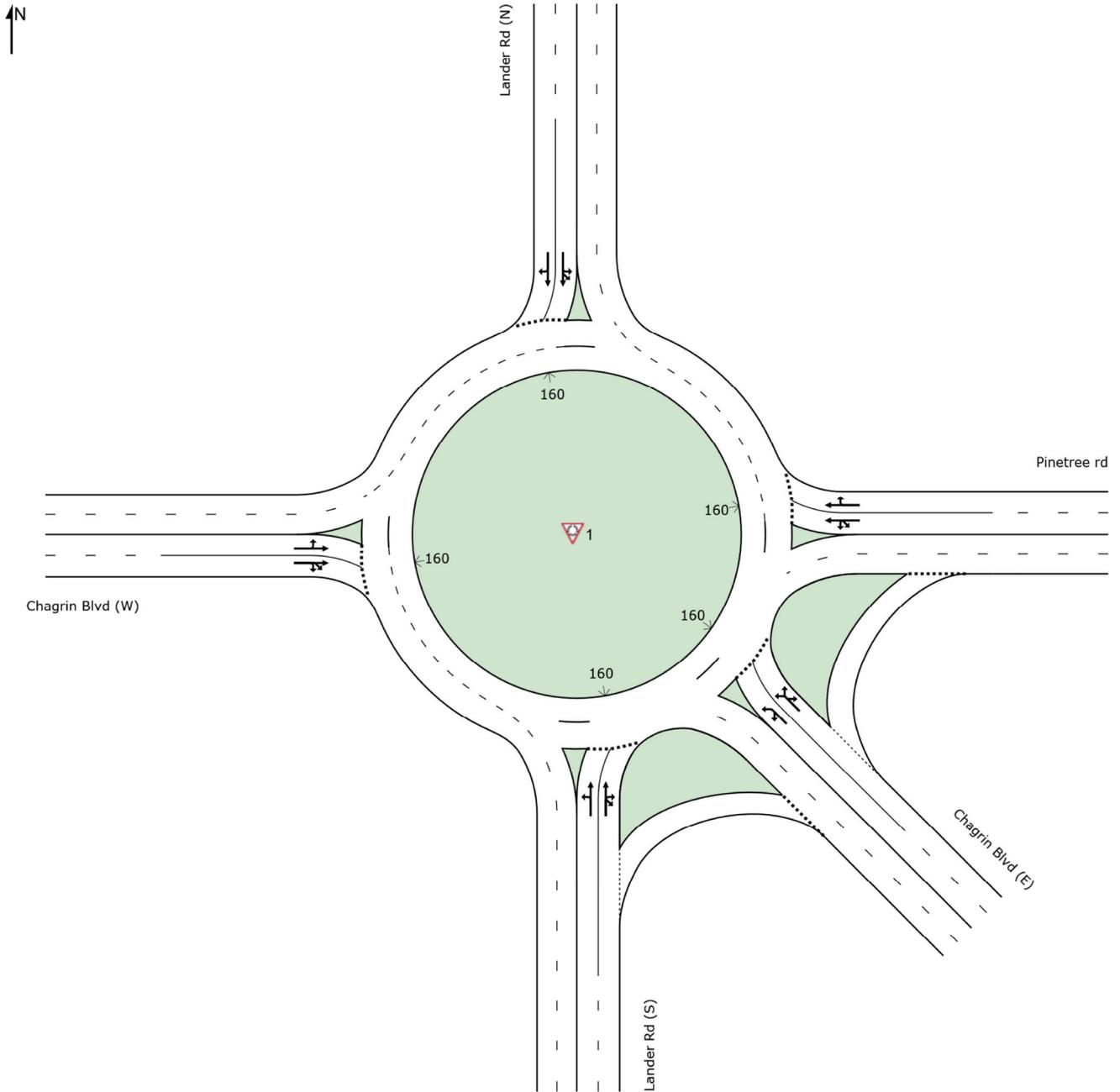
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# SITE LAYOUT

## Site: 1 [5-leg 2 lane circulating Roundabout-PM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)  
Roundabout



# INPUT VOLUMES

## Vehicles and pedestrians per 60 minutes

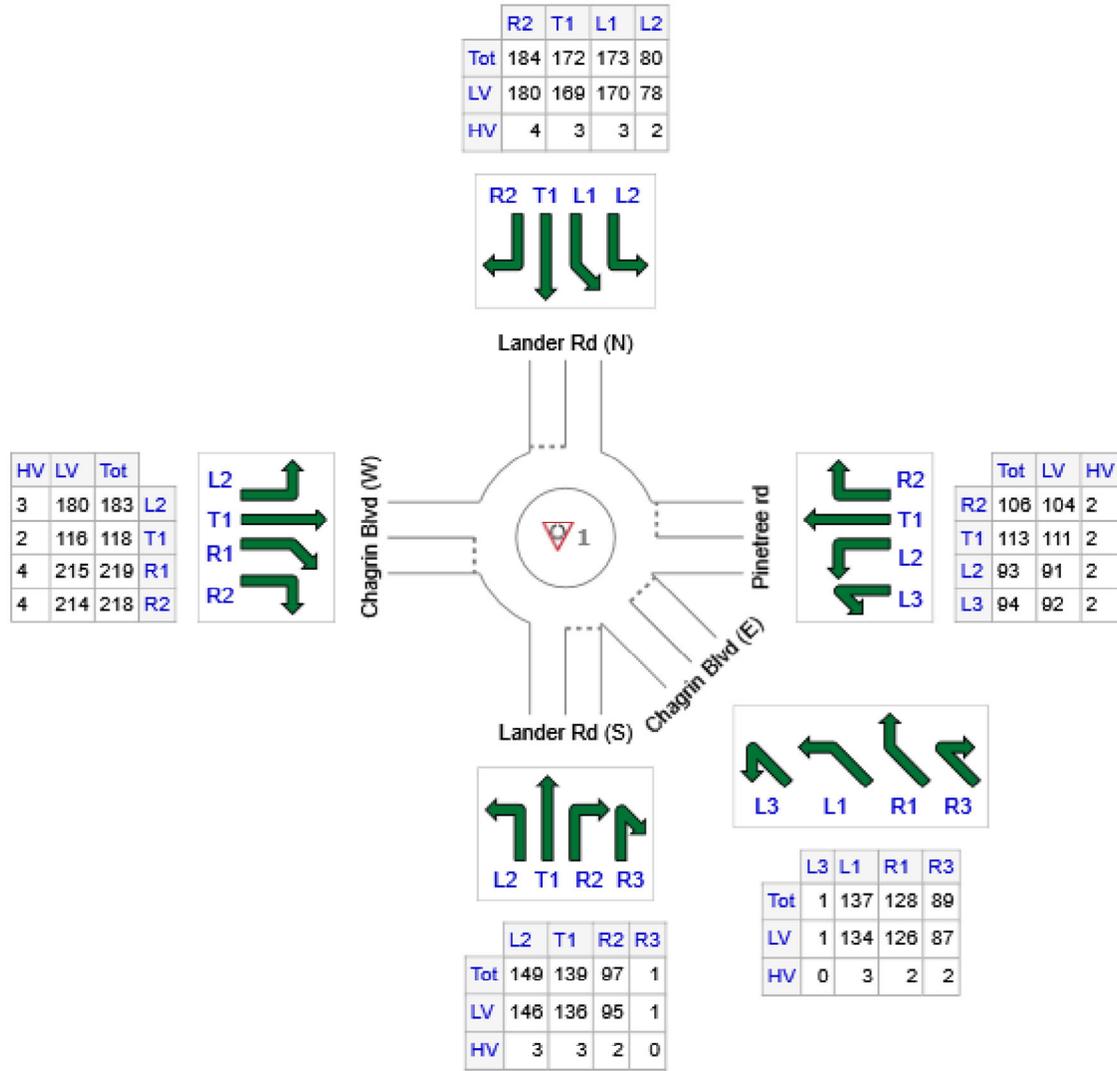
### Site: 1 [5-leg 2 lane circulating Roundabout-PM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)

Roundabout

Volume Display Method: Separate



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Lander Rd (S)	386	378	8
SE: Chagrin Blvd (E)	355	348	7
E: Pinetree rd	406	398	8
N: Lander Rd (N)	609	597	12
W: Chagrin Blvd (W)	738	725	13
Total	2494	2446	48

# LANE LEVEL OF SERVICE

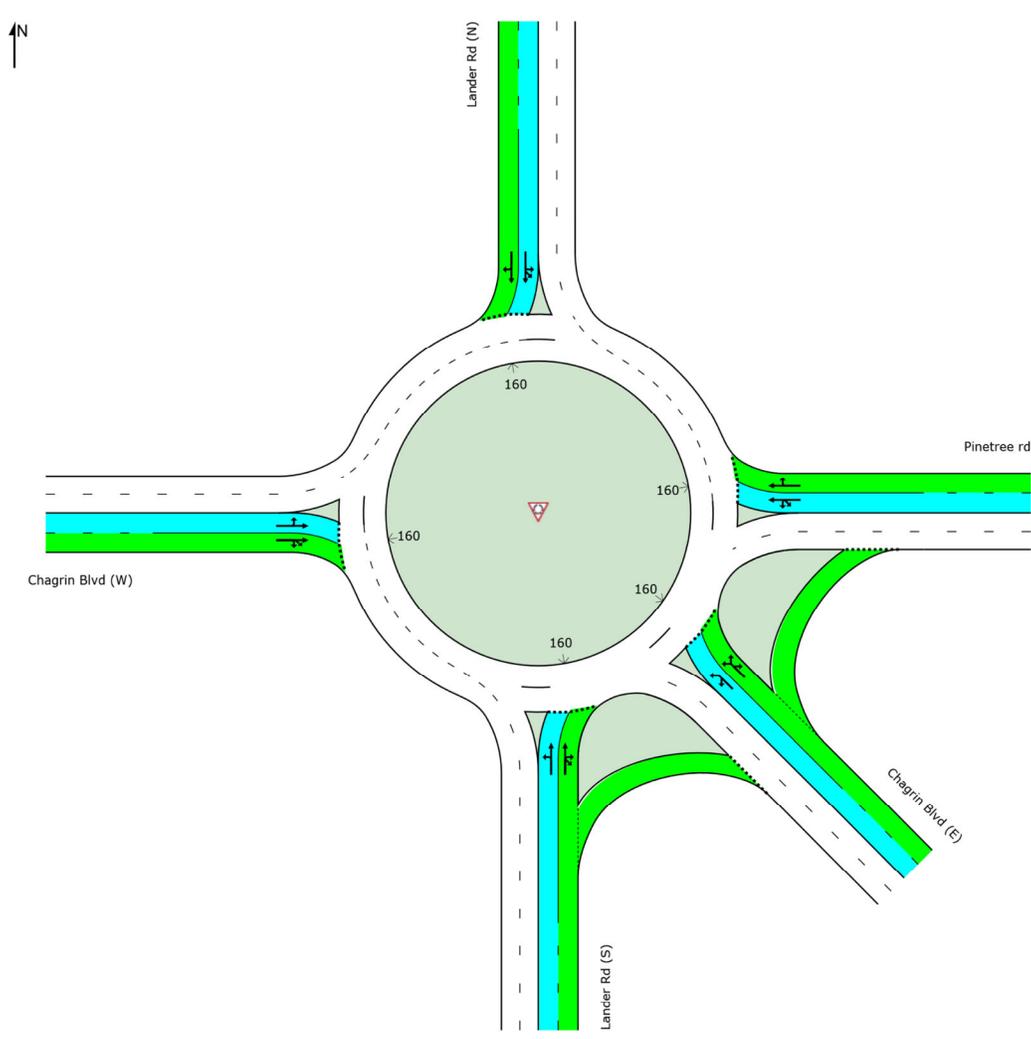
## Lane Level of Service

### Site: 1 [5-leg 2 lane circulating Roundabout-PM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)  
Roundabout

	Approaches					Intersection
	South	Southeast	East	North	West	
LOS	A	A	A	A	A	A



Colour code based on Level of Service



Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

# MOVEMENT SUMMARY

## Site: 1 [5-leg 2 lane circulating Roundabout-PM]

Roundabout with 5 legs, and 1-lane approaches and circulating road

Site Category: (None)  
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: Lander Rd (S)												
3	L2	162	2.0	0.245	13.0	LOS B	1.2	31.3	0.65	0.77	0.65	35.7
8	T1	151	2.2	0.245	5.8	LOS A	1.2	31.3	0.65	0.73	0.65	36.3
12x	R2	105	2.1	0.245	6.4	LOS A	1.1	29.1	0.65	0.70	0.65	35.8
18b	R3	1	0.0	0.245	4.8	LOS A	1.1	29.1	0.65	0.70	0.65	35.2
Approach		420	2.1	0.245	8.7	LOS A	1.2	31.3	0.65	0.73	0.65	35.9
SouthEast: Chagrin Blvd (E)												
3bx	L3	1	0.0	0.150	13.9	LOS B	0.7	17.7	0.58	0.77	0.58	36.0
3ax	L1	149	2.2	0.150	11.1	LOS B	0.7	17.7	0.58	0.77	0.58	34.6
18ax	R1	139	1.6	0.249	5.5	LOS A	1.1	28.6	0.51	0.55	0.51	37.6
18bx	R3	97	2.2	0.249	4.3	LOS A	1.1	28.6	0.51	0.55	0.51	35.9
Approach		386	2.0	0.249	7.4	LOS A	1.1	28.6	0.54	0.64	0.54	36.0
East: Pinetree rd												
1b	L3	102	2.1	0.234	14.4	LOS B	1.0	25.7	0.58	0.83	0.58	34.7
3x	L2	101	2.2	0.234	13.0	LOS B	1.0	25.7	0.58	0.83	0.58	34.3
6	T1	123	1.8	0.226	5.0	LOS A	1.0	26.0	0.56	0.56	0.56	37.6
16	R2	115	1.9	0.226	5.5	LOS A	1.0	26.0	0.56	0.56	0.56	36.0
Approach		441	2.0	0.234	9.1	LOS A	1.0	26.0	0.57	0.68	0.57	35.7
North: Lander Rd (N)												
7	L2	87	2.5	0.326	12.8	LOS B	1.5	39.3	0.58	0.78	0.58	35.4
7a	L1	188	1.7	0.326	11.3	LOS B	1.5	39.3	0.58	0.78	0.58	34.8
4	T1	187	1.7	0.326	4.9	LOS A	1.6	41.1	0.57	0.59	0.57	37.2
14	R2	200	2.2	0.326	5.3	LOS A	1.6	41.1	0.57	0.56	0.57	36.0
Approach		662	2.0	0.326	7.9	LOS A	1.6	41.1	0.57	0.66	0.57	35.9
West: Chagrin Blvd (W)												
5	L2	199	1.6	0.371	12.9	LOS B	1.8	46.1	0.62	0.74	0.62	36.0
2	T1	128	1.7	0.371	5.5	LOS A	1.8	46.1	0.62	0.74	0.62	35.4
12a	R1	238	1.8	0.441	4.9	LOS A	2.5	63.7	0.63	0.62	0.66	37.1
12	R2	237	1.8	0.441	5.7	LOS A	2.5	63.7	0.63	0.62	0.66	36.0
Approach		802	1.8	0.441	7.2	LOS A	2.5	63.7	0.63	0.67	0.65	36.2
All Vehicles		2711	1.9	0.441	8.0	LOS A	2.5	63.7	0.60	0.67	0.60	35.9

Site Level of Service (LOS) Method: Delay & Degree of Saturation (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.

Intersection and Approach LOS values are based on average delay for all movements (v/c not used).

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

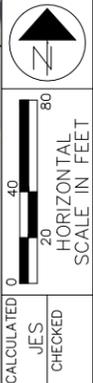
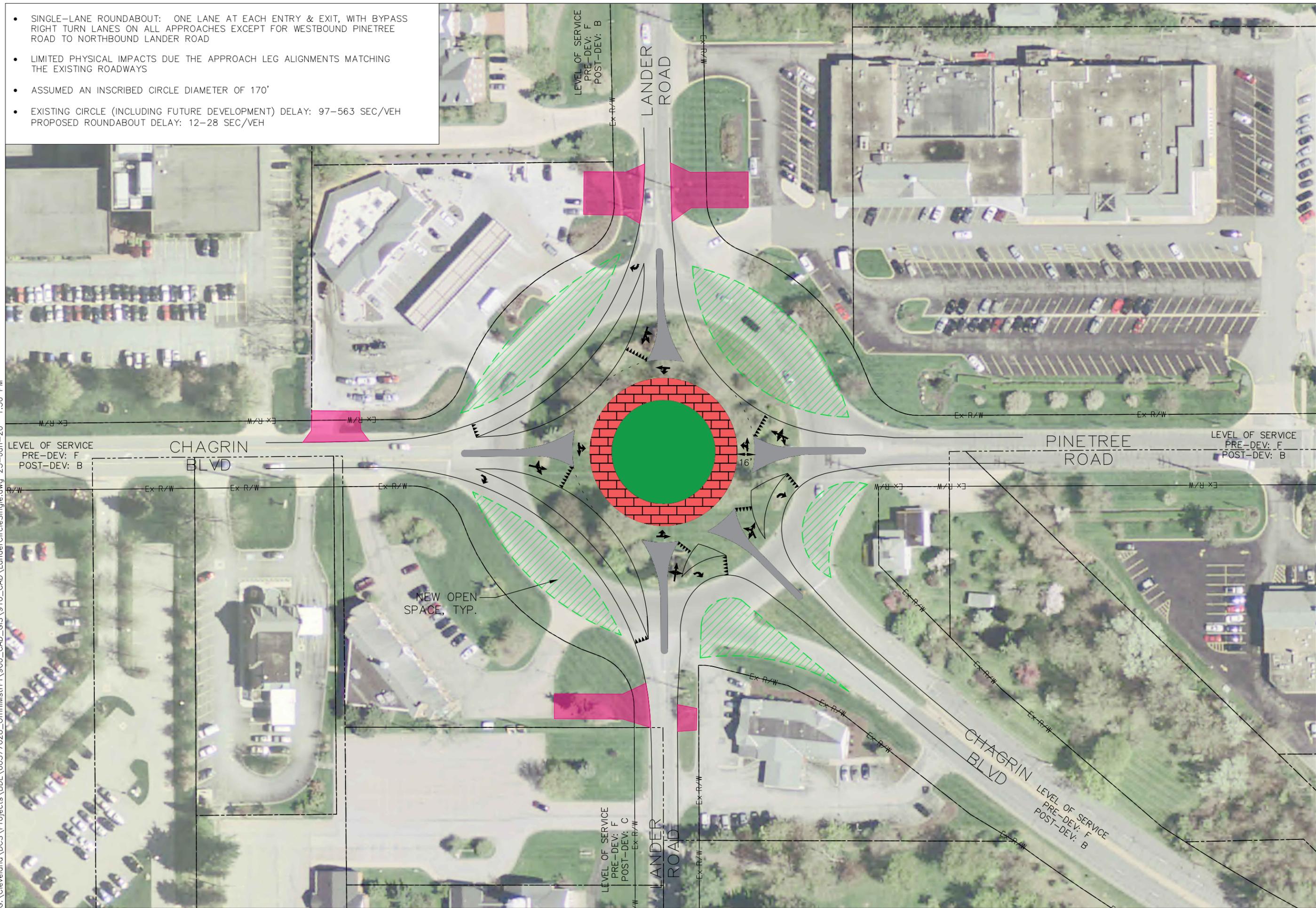
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

**APPENDIX F**

**SCHEMATIC ROUNDABOUT DESIGNS**

G:\Cleveland\DCS\Projects\BDL\60577628\_OmniMstr\900\_CAD\_GIS\910\_CAD\LanderCircleSingle.dwg 23-Jan-20 1:36 PM

- SINGLE-LANE ROUNDABOUT: ONE LANE AT EACH ENTRY & EXIT, WITH BYPASS RIGHT TURN LANES ON ALL APPROACHES EXCEPT FOR WESTBOUND PINETREE ROAD TO NORTHBOUND LANDER ROAD
- LIMITED PHYSICAL IMPACTS DUE THE APPROACH LEG ALIGNMENTS MATCHING THE EXISTING ROADWAYS
- ASSUMED AN INSCRIBED CIRCLE DIAMETER OF 170'
- EXISTING CIRCLE (INCLUDING FUTURE DEVELOPMENT) DELAY: 97-563 SEC/VEH  
PROPOSED ROUNDABOUT DELAY: 12-28 SEC/VEH



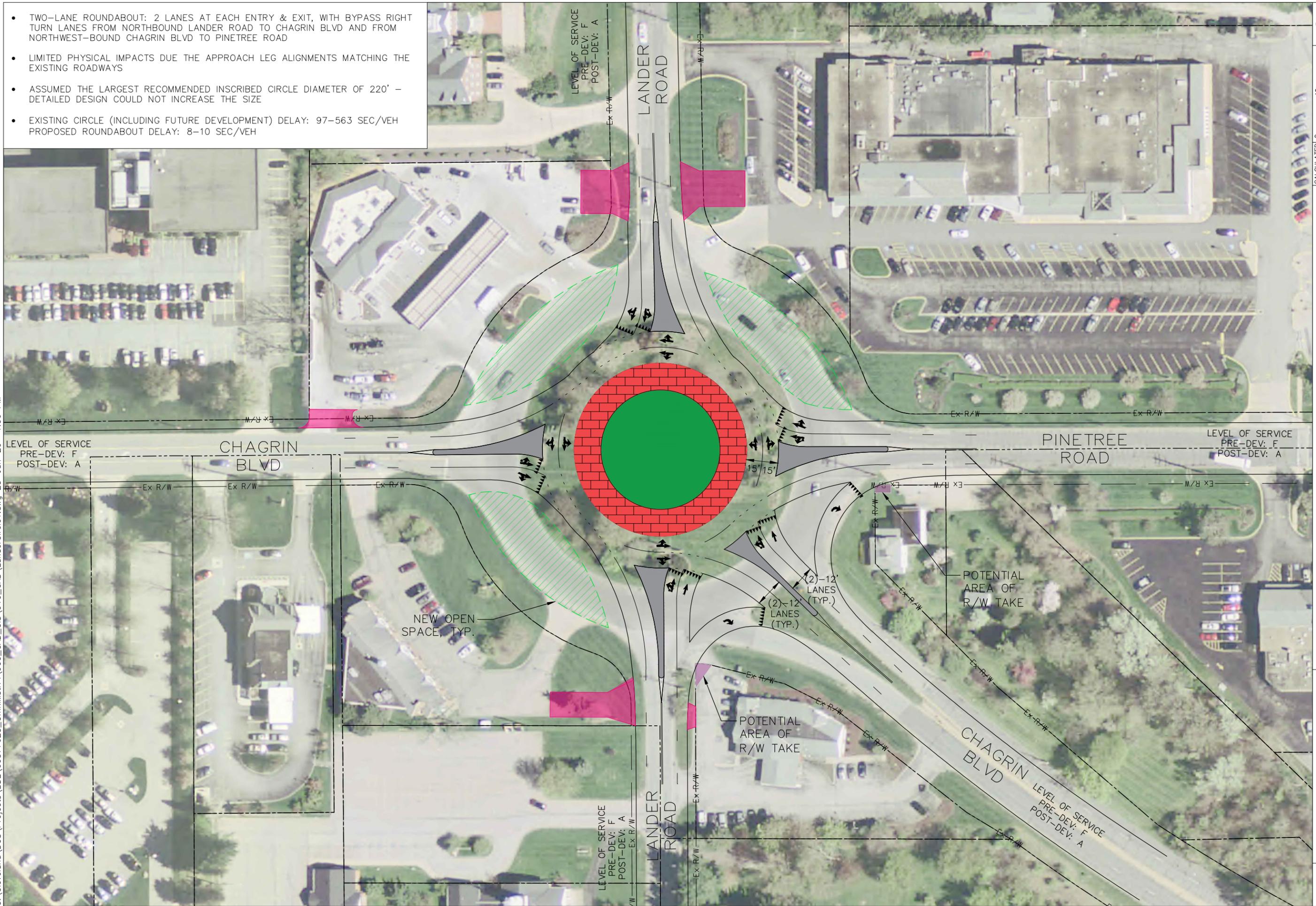
LANDER CIRCLE  
ROUNDABOUT CONCEPT - EXHIBIT 2

LANDER CIRCLE

CALCULATED	JES	CHECKED

- TWO-LANE ROUNDABOUT: 2 LANES AT EACH ENTRY & EXIT, WITH BYPASS RIGHT TURN LANES FROM NORTHBOUND LANDER ROAD TO CHAGRIN BLVD AND FROM NORTHWEST-BOUND CHAGRIN BLVD TO PINETREE ROAD
- LIMITED PHYSICAL IMPACTS DUE THE APPROACH LEG ALIGNMENTS MATCHING THE EXISTING ROADWAYS
- ASSUMED THE LARGEST RECOMMENDED INSCRIBED CIRCLE DIAMETER OF 220' - DETAILED DESIGN COULD NOT INCREASE THE SIZE
- EXISTING CIRCLE (INCLUDING FUTURE DEVELOPMENT) DELAY: 97-563 SEC/VEH  
PROPOSED ROUNDABOUT DELAY: 8-10 SEC/VEH

G:\Cleveland\DCS\Projects\BDL\60577628\_OmniMstrPr\900\_CAD\_GIS\910\_CAD\LanderCircle1.dwg 23-Jan-20 1:06 PM



CALCULATED  
JES  
CHECKED

0 20 40 80  
HORIZONTAL  
SCALE IN FEET

LANDER CIRCLE  
ROUNDABOUT CONCEPT - EXHIBIT 1

LANDER CIRCLE

1 1