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TECHNICAL MEMORANDUM

DATE: February 7, 2022

TO: Pete Rogalsky, Public Works Director, City of Richland

CC: Cary Roe, Public Works Director, City of Kennewick
John Deskins, Traffic Engineer, City of Richland

FROM: Spencer Montgomery, J-U-B Engineers, Inc.
Aimee Loudenslager, PE (ID, UT), PTOE

SUBJECT: 20-Year Projections of 95th Percentile Queuing Analysis for the Intersection of Clearwater Avenue/Ridgeline Drive/Badger Road/Leslie Road

Executive Summary

This memo presents the results of the 20-year 95th percentile queuing analysis predicted to occur on the Leslie Road approach to the roundabout at the Clearwater Avenue/Ridgeline Drive/Badger Road/Leslie Road intersection. The analysis was completed to evaluate the likelihood of queues backing up across the railroad tracks.

Using SIDRA software, which specializes in roundabout analysis, it was determined that the existing 95th percentile queues on the eastbound approach do not exceed 70 feet during the AM or PM peak hours. This is substantially less than the available 155' between the roundabout and the railroad crossing west of the intersection.

Twenty year turning movement forecasts were developed for the AM and PM peak hours using the recently prepared regional traffic model. This model accounts for substantial traffic growth as well as relevant roadway network changes including the extension of Center Parkway west of Steptoe Street to connect with Leslie Road as well as the extension of Ridgeline Drive to the east to connect to US 395.

The results of the 20-year queueing analysis indicate that, without improvements, both the morning and evening queues will exceed the available storage on the eastbound approach. Depending on individual driver alertness this could result in vehicles stopping on the railroad tracks on the inside lane. Some drivers may recognize the queues and stop prior to the railroad crossing. The existing lane configuration and Shorter queues in the outside lane allow for an escape route in the event of a train.

A test of queue lengths under a modified lane use (used for analysis in previous report submittals), where the inside lane is for left turns only and the outside lane is for left/thru/right turns resulted in AM queues less than the available storage, but with outside lane queues even longer during the PM peak. Further analysis using the modified lane use plus an eastbound right turn bypass lane reduced queues significantly to less than 80 feet for all lanes during both the AM and PM peak hours.

The changes in lane use and provision of an eastbound right turn bypass lane are not without its own challenges. Traffic wishing to turn right from Leslie Road and then turn left to use the loop ramp to

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westbound I-82 has a short distance (200-300') to weave left. This situation can be improved by drivers using the existing right turn lane to enter the roundabout rather than the bypass lane to reduce the number of lanes to weave prior to the left turn and maximize the distance to perform this weave.

Introduction and Background

A Joint Agreement between the Cities of Richland and Kennewick and Benton County requires that updated 20-year traffic volumes and analysis of 95th percentile queues on the Leslie Road approach for the intersection of Clearwater Avenue and Leslie Road be prepared and submitted to Burlington Northern Santa Fe Railroad every five years. The agreement also requires that the traffic volumes be developed using the most recent Benton-Franklin Council of Governments Regional Travel Demand Model. This report is past due, but the Covid-19 travel restrictions made data collection of meaningful traffic volumes unachievable, and by the time traffic volumes returned to normal conditions a new regional model was imminent and the benefits of waiting a few more months were deemed worthwhile.

The intersection commonly known as Clearwater Avenue and Leslie Road sits on the outside edges of both Kennewick and Richland, one half within Kennewick and the other within the Urban Growth Area of Richland. As growth has occurred over the years various improvements to the intersection have been installed, with turn lanes, then an interim improvement of a 4-way stop in 2007 in anticipation of a higher level of traffic control. The existing roundabout opened to traffic in April 2011.

The roundabout has performed very well as expected and no significant changes have been made or considered since the original opening date. The roundabout design was a result of a Value Engineering study performed by WSDOT. There were concerns, however, that it was not a common practice to install a roundabout so near a railroad track. It was noted that the arrangement is not significantly different from having the same approach controlled by a stop sign other than that roundabouts are generally much more efficient, and thus the potential for queuing across the tracks is much reduced. To address the concerns of the BNSF, the cities agreed to provide specific periodic analysis of current and future traffic volumes and queuing of the Leslie Road approach.

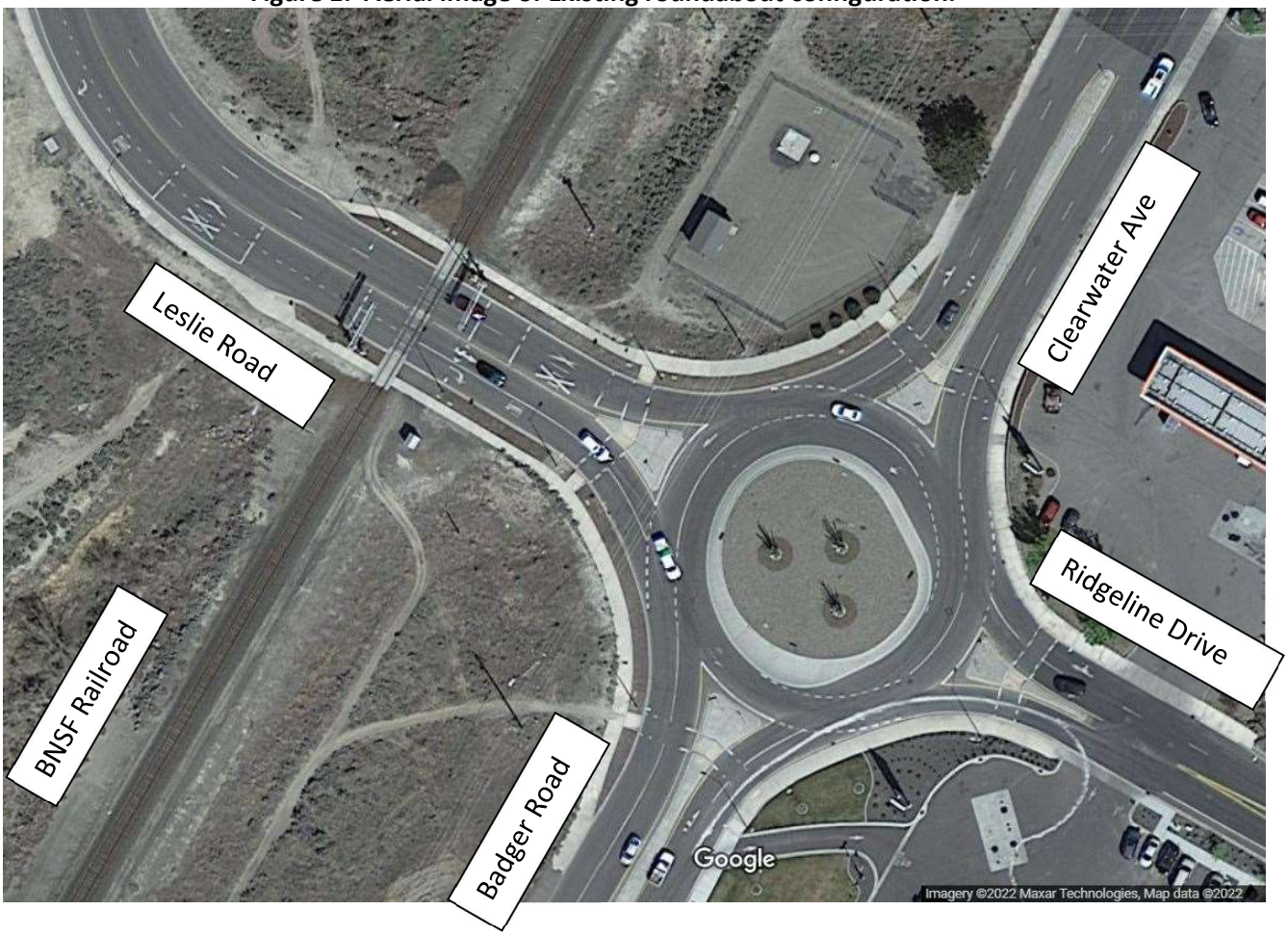
Existing Conditions

The existing roundabout at the intersection is shown below in Figure 1. Each approach has two lanes. The northbound and southbound approaches each have a shared through/left turn lane and a shared through/right turn lane. The westbound approach has an exclusive left turn lane and a shared through/right turn lane. The eastbound approach has a shared left/through/right turn lane and an exclusive right turn lane. This lane use allows for eastbound right turn vehicles with a destination to I 82 westbound to use the loop ramp at the I-82 freeway to use the inside lane of the roundabout and eliminate the need to weave across other lanes. It also allows for significantly shorter queues in the outside lane on the eastbound approach such that the outside lane can be used as an escape route if there are long queues in the inside lane during a train event. It is important to note the available storage on the eastbound approach provides 155 feet from the yield line to the railroad tracks – enough for 6 vehicles in the inside lane. The outside lane has slightly longer storage of 166 feet.

AM and PM turning movement volumes were collected in the spring of 2021. These volumes were compared with volumes used in the 2016 report for this intersection. This comparison noted that the growth in the AM counts was less than 0.5% per year while the PM volumes had grown nearly 5% per

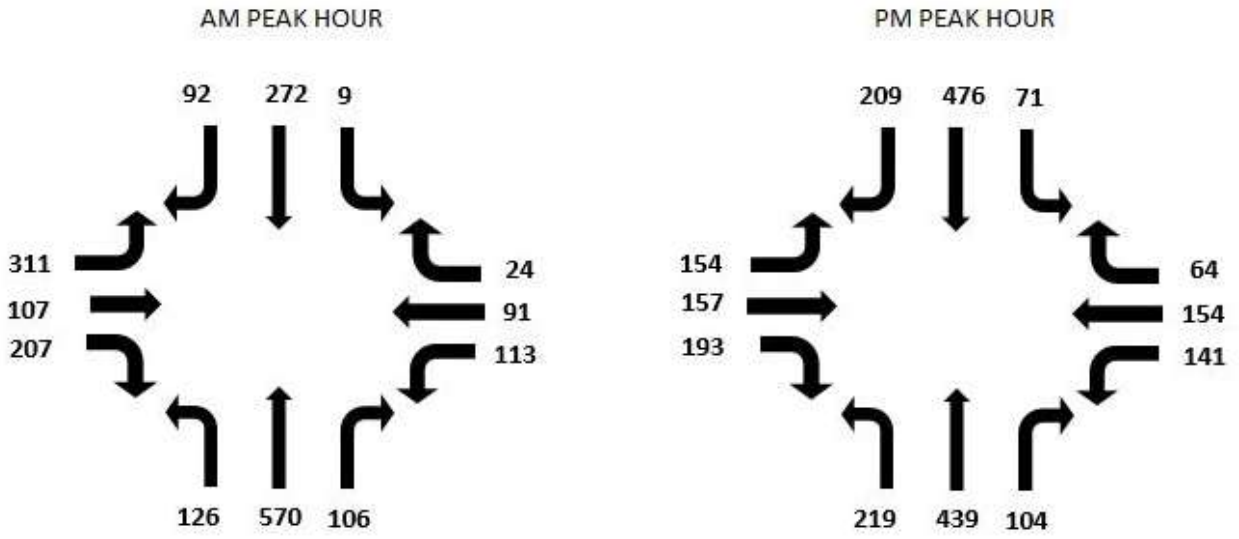
year. Counts collected in 2018 prior to the COVID-19 travel restrictions were also evaluated and the AM counts were higher than the 2021 counts. This resulted in making some adjustments to the AM counts to reflect similar growth rates as observed during the PM conditions. The 2021 AM and PM Peak hour volumes used for this analysis are shown in Figure 2, with raw counts included in Appendix A.

Figure 1. Aerial Image of Existing roundabout configuration.



Existing 2021 traffic volumes were evaluated for delay and Level of Service (LOS) using SIDRA 9 software which is established as an industry standard tool for roundabout evaluation. Existing lane usage and roundabout geometry were used to estimate existing AM and PM delay and Level of Service. All approaches currently operate with Level of Service "A" during both peak hours except for the westbound Ridgeline Drive approach which functions with LOS "B" and 10.8 seconds of average vehicle delay. No queues at the intersection currently exceed 100', with the longest queue being the northbound Badger Road approach at 97' during the PM peak hour. The longest queue on the eastbound Leslie Road approach is in the inside lane at 70' during the AM peak hour and 65' during the PM peak hour. Detailed results are included in Appendix B.

Figure 2. 2021 AM and PM Peak Hour Traffic Volumes at Clearwater Avenue/Leslie Road



2042 Traffic Forecasting

Before assessing the likelihood of future queue lengths exceeding the available storage at the roundabout a traffic forecast needed to be prepared. As a tool in preparing the Regional Transportation Plan (RTP), the Benton Franklin Council of Governments (BFCOG) maintains a set of regional computerized transportation models. The model is developed using current traffic data and land uses in the region (representing year 2019) using Transportation Analysis Zones (TAZs) that are defined with various attributes describing the number and type of households and employees as well as other land uses within each zone. The model is calibrated for existing conditions using Federal Highway Administration procedures and methods. Once calibrated, changes in assumptions for future land uses and roadway networks can be made to determine the potential impacts of developments and/or roadway scenarios. Land use assumptions representing future conditions are developed to determine various impacts on the roadway network at a regional level. The current future year model representing the year 2045 developed by BFCOG was completed the fall of 2021 represents the best land use and roadway network assumptions available at the time it was created.

It must be recognized that although traffic models are calibrated within acceptable ranges, the model is a tool in transportation planning and traffic forecasting. The BFCOG model is a PM peak hour model that provides roadway segment volumes (not specific turn movement volumes). Professional judgment should be used in interpreting model outputs. To arrive at reasonable estimates of traffic volumes for the year 2042 the following information was used:

- Existing entering volumes from the 2018 PM peak hour turning movement counts were increased at the annual growth rate identified during the existing conditions volumes evaluation to compare with the 2019 base year model. The base year model volumes, which represent 2-hours were multiplied by 53% to arrive at a peak hour volume. (53% is the amount of the peak period traffic that occurred during the peak hour of the 2018 ground counts.) Although the individual entry volumes are not exact, the total combined volumes compared quite favorably

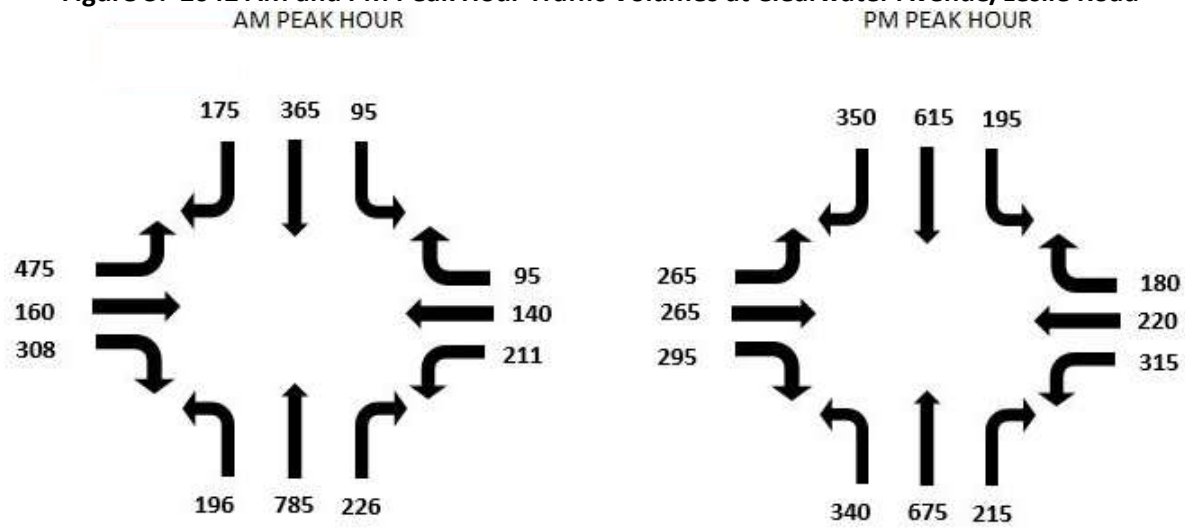
at 2,257 and 2,250. Given this level of accuracy, no adjustments to the base year model were made and the 2045 model was felt to be reasonably accurate.

- The 2045 regional model volumes entering the roundabout were reviewed and it was determined that total forecast growth was nearly 185% over the 24 years, which is a significant amount of growth. This represents almost 2.5% annual growth. Typically, high growth areas may experience 2% annual growth for shorter time periods but rarely for a long range forecast. This situation was discussed with the City of Richland Traffic Engineer. It was determined that given the geographic location of the subject intersection, which is situated between multiple high growth areas such as Badger Mountain South in Richland, Southridge in Kennewick, Badger Canyon in Benton County as well as the I-82 interchange and Clearwater Avenue, that this forecast may be achievable and should be used, even if it represents a conservatively high 20-year forecast.
- Assuming there would be peak some peak hour spreading in the future, the two-hour PM peak period volumes in the 2045 model were multiplied by 52%. The growth in the model volumes between 2021 and 2045 was interpolated to estimate growth by 2042 and this growth was added to the 2021 volumes for each approach.
- As noted, the regional model provides roadway segment volumes and not turning movement volumes. To estimate future queue lengths estimates for each turn movement at the intersection are needed. With all the future development and changes in the roadway network, such as the Center Parkway connection between Steptoe Street and Leslie Road and the Ridgeline Drive connection east to US 395 existing turn movements were not considered a reliable method of estimating future turning volumes. Rather, a process developed by the National Cooperative Highway Research Program (NCHRP) Report 255 was used. This process uses the forecast segment entering and exiting volumes to estimate the amount of traffic each approach would contribute to entering and exiting volumes based on the percentage of contributing movements for each leg. This is done using both the entering volumes and exiting volume percentages. The process is not perfect, and a final post processing step is used that adjusts specific movements using judgement that attempts to balance the total entering and exiting traffic to the target amounts from the regional model.
- Resulting volumes were reviewed with the City Traffic Engineer with minor adjustments incorporated and rounded to the nearest 5 vehicles. Once the PM peak hour volumes were finalized, two methods were used and then averaged to estimate the AM volumes since there is no AM peak hour travel demand model. First, the PM growth percentages from the 2021 to 2042 were applied to the AM 2021 turn movements. Secondly, the growth rates in the reverse movements from the PM peak hour were applied to the 2021 AM turn movements. This was felt to be a reasonable approach since often the reverse movement from the AM commute to work is the mirror movement from the PM return trip home (e.g. if a home to work trip is northbound through then a work to home trip is southbound through). The resulting 2042 AM and PM peak hour traffic volumes are shown in Figure 3 below.

2042 Level of Service and Queue Analysis

Traffic volumes for 2042 AM and PM were evaluated for delay and Level of Service using the existing lane usage and roundabout geometry to estimate future AM and PM delay and Level of Service. All approaches during both peak hours are forecast to operate with acceptable Level of Service (LOS). In the morning the overall LOS is “B” with 19.6 seconds of average vehicle delay, with the worst approach

Figure 3. 2042 AM and PM Peak Hour Traffic Volumes at Clearwater Avenue/Leslie Road



being the northbound at 31.9 seconds and LOS "C". The PM is forecast to operate at LOS "C" overall with 22.6 seconds of average vehicle delay with the worst approach also being the northbound approach at 35.6 seconds and LOS "D". See Appendix C for detailed capacity analysis and queue analysis results.

Although the LOS for the intersection overall as well as all approaches during both the AM and PM peak hours meets both City and regional standards for LOS, the forecast queue lengths for the eastbound approach are anticipated to exceed the available storage without crossing the railroad trucks without modifications to the intersection. The AM and PM peak hour forecast exceed the available storage at 8 vehicles and 11 vehicles, respectively. As mentioned, alert drivers can avoid stopping on the tracks to avoid a potential collision during a train event.

Given the forecast queue lengths additional analysis was performed to determine potential mitigation as well as the timeframe at which the queues might exceed the available storage in front of the railroad tracks. Two scenarios were evaluated for mitigation:

1) A modified lane configuration for the eastbound approach that creates a double left turn by making the inside lane a left turn only lane, with the outside lane allowing left turns, through and right turns. To achieve this configuration, minor modifications would be necessary on the Leslie Road and Badger Road approach splitter islands, and removal of a portion of the south side truck apron with appropriate striping changes would be required. See Appendix D for detailed capacity analysis and queue analysis results.

   This option was evaluated in the 2016 memo for the evaluation of queues. Overall delay is reduced seven seconds in the morning and 5 seconds in the evening. Queues in the inside lane are shortened to five vehicles in both the AM and PM peak hours. However, the PM peak hour queues in the outside lane are forecast at 15 vehicles, exceeding the available storage.

2) Given the results of the mitigation option described above, further analysis was performed to evaluate adding an exclusive eastbound right turn bypass lane to that alternative. This alternative reduces overall delay a little more but reduces the eastbound queues significantly to two or three vehicles in each lane during both the AM and PM peak hours. See Appendix E for detailed capacity analysis and queue analysis results.

   The changes in lane use and provision of an eastbound right turn bypass lane are not without its own challenges. Traffic wishing to turn right from Leslie Road and then turn left to use the loop ramp to westbound I-82 has a short distance (200-300') to weave left. This situation can be improved by drivers using the existing right turn lane to enter the roundabout rather than the bypass lane to reduce the number of lanes to weave prior to the left turn and maximize the distance to perform this weave.

The queue lengths in vehicles for multiple scenarios during both the AM and PM peak hours is summarized in Table 1 below.

Table 1: 95% Queue Summary - in Vehicles
Leslie Road (Eastbound Approach)
(Rounded up to the next whole vehicle)

Scenario and Lane Use	AM			PM		
	Lane 1	Lane 2	Lane 3	Lane 1	Lane 2	Lane 3
2021 Existing Lanes	3	2	N/A	3	2	N/A
2042 Existing Lanes	8	3	N/A	11	6	N/A
2042 Modified Lane use eastbound dual left turn lane	5	5	N/A	5	15	N/A
2042 modified with dual eastbound left turn and right turn bypass lane	2	2	2	2	3	2

In an effort to identify the potential timeframe for when the eastbound queues might exceed the available storage without improvements, traffic volumes for year 2032 were prepared by interpolating the growth between 2021 and 2042 and adding the growth to the volumes for 2021. The detailed capacity analysis and queue analysis results are included in Appendix F and show that queues in 2032 are projected to be five vehicles in both the AM and PM peak hours in the inside lane and two or three vehicles in the outside lane. Therefore, there are no anticipated changes needed within the next ten years.

APPENDICES

A: Traffic Volumes
B: 2021 Existing Conditions
C: 2042 Analysis, Existing Lane Configurations
D: 2042 Analysis with Modified Eastbound Approach
E: 2042 Analysis with Modified Eastbound Approach and Eastbound Right-turn Lane
F: 2032 Analysis with Existing Lane Configuration

Appendix A: Traffic Volumes

Leslie Road/Clearwater Avenue Roundabout Analysis

AM	Northbound			Southbound			Eastbound			Westbound				% of PM
Scenario	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Total**	
2016	**100**	**451**	**84**	**7**	**215**	**73**	**246**	**85**	**164**	**89**	**72**	**19**	**1605**	0.851
2018	72	498	125	14	192	90	270	88	169	121	76	67	**1782**	0.811
2021	80	436	97	10	227	79	199	85	140	135	82	73	**1643**	0.690
2021 Adjusted (2018*2.7%/yr 3 yrs)	78	539	135	15	208	97	292	95	183	131	82	73	1930	0.811
2021 Adjusted (2016*4.8%/yr 5 yrs)	126	570	106	9	272	92	311	107	207	113	91	24	2029	0.852

PERCENTAGES														Annual growth
Growth 2016 - 2018	0.72	1.10	1.49	2.00	0.89	1.23	1.10	1.04	1.03	1.36	1.06	3.53	1.11	
Annual Growth 2016 - 20	0.36	0.55	0.74	1.00	0.45	0.62	0.55	0.52	0.52	0.68	0.53	1.76	0.56	5.4%/yr
Growth 2016 - 2021	0.80	0.97	1.15	1.43	1.06	1.08	0.81	1.00	0.85	1.52	1.14	3.84	1.02	
Annual Growth 2016 - 20	0.16	0.19	0.23	0.29	0.21	0.22	0.16	0.20	0.17	0.30	0.23	0.77	0.20	0.46%/yr
Growth 2018 - 2021	1.11	0.88	0.78	0.71	1.18	0.88	0.74	0.97	0.83	1.12	1.08	1.09	0.92	
Annual Growth 2018 - 20	0.56	0.44	0.39	0.36	0.59	0.44	0.37	0.48	0.41	0.56	0.54	0.54	0.46	2.7%/yr

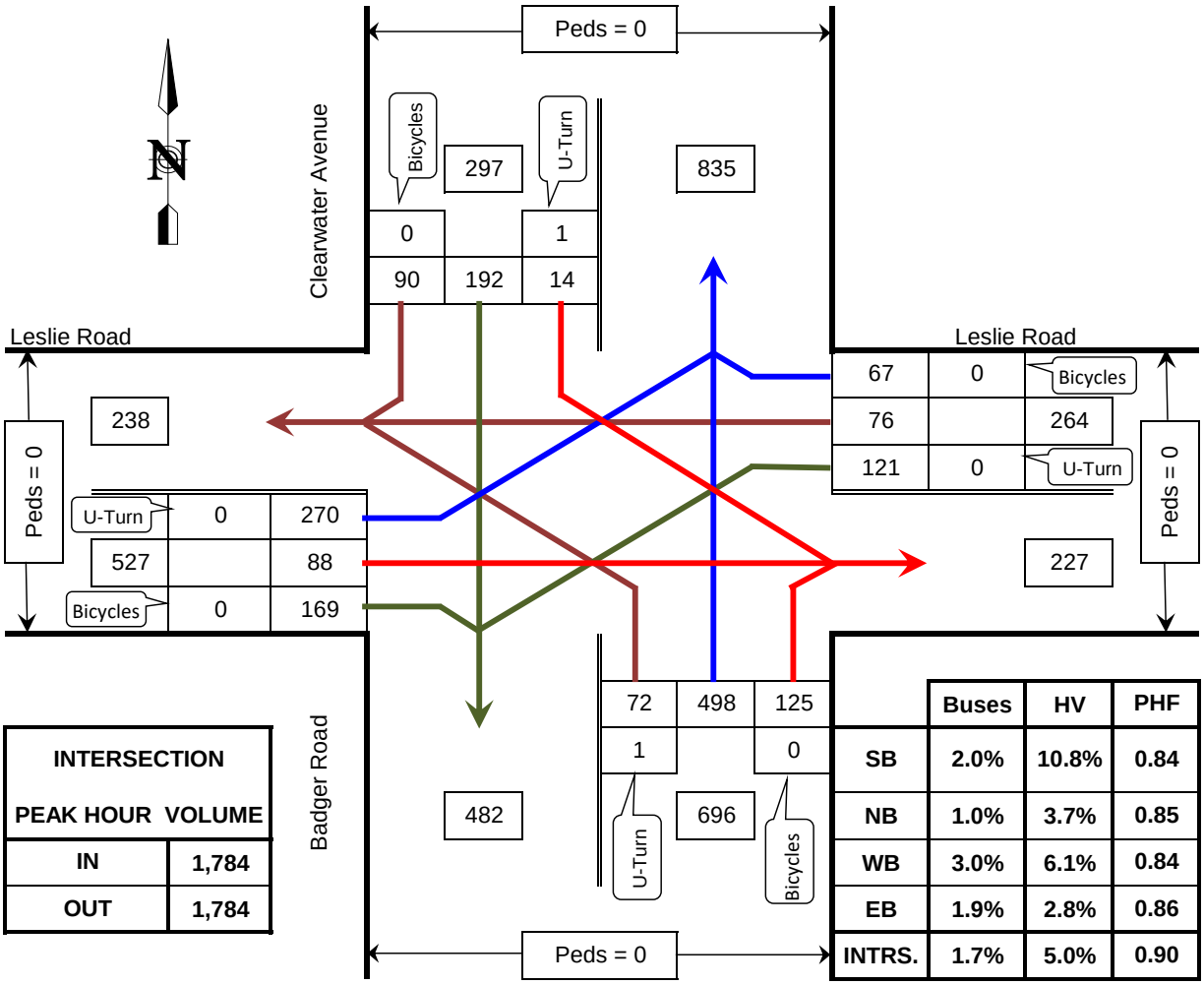
PM	Northbound			Southbound			Eastbound			Westbound				
Scenario	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Total**	
2016	211	360	100	5	397	232	120	101	179	89	72	19	**1885**	
2018	193	446	116	18	442	269	161	125	183	108	114	23	**2198**	
2021	219	439	104	71	476	209	154	157	193	141	154	64	**2381**	2.7%-3years

PERCENTAGES														Annual growth
Growth 2016 - 2018	0.91	1.24	1.16	3.60	1.11	1.16	1.34	1.24	1.02	1.21	1.58	1.21	1.17	
Annual Growth 2016 - 20	0.46	0.62	0.58	1.80	0.56	0.58	0.67	0.62	0.51	0.61	0.79	0.61	0.58	8%/yr
Growth 2016 - 2021	1.04	1.22	1.04	14.20	1.20	0.90	1.28	1.55	1.08	1.58	2.14	3.37	1.26	
Annual Growth 2016 - 20	0.21	0.24	0.21	2.84	0.24	0.18	0.26	0.31	0.22	0.32	0.43	0.67	0.25	4.8%/yr
Growth 2018 - 2021	1.13	0.98	0.90	3.94	1.08	0.78	0.96	1.26	1.05	1.31	1.35	2.78	1.08	
Annual Growth 2018 - 20	0.57	0.49	0.45	1.97	0.54	0.39	0.48	0.63	0.53	0.65	0.68	1.39	0.54	2.7%/yr

TRAFFIC DATA GATHERING

TURNING MOVEMENTS DIAGRAM

7:00 AM - 9:00 AM PEAK HOUR: 7:15 AM TO 8:15 AM



INTERSECTION PEAK HOUR VOLUME	
IN	1,784
OUT	1,784

	Buses	HV	PHF
SB	2.0%	10.8%	0.84
NB	1.0%	3.7%	0.85
WB	3.0%	6.1%	0.84
EB	1.9%	2.8%	0.86
INTRS.	1.7%	5.0%	0.90

PHF : Peak Hour Factor
HV : Heavy Vehicles (any vehicle including trailers with 6 or more tires)
Buses : School, Transit, Access & Tour Buses
Motorcycles are counted as vehicles

Leslie Road @ Clearwater Avenue/Badger Road

Kennewick, WA

COUNTED BY: TDG

DATE OF COUNT: Tue. 9/25/18

REDUCTION DATE: Wed. 10/17/18

TIME OF COUNT: 7:00 AM - 9:00 AM

TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION: Leslie Road @ Clearwater Avenue/Badger Road
Kennewick, WA

DATE OF COUNT: Tue. 9/25/18
TIME OF COUNT: 7:00 AM - 9:00 AM

COUNTED BY: TDG
DATE OF REDUCTION: 10/17/2018

TIME INTERVAL ENDING AT	FROM NORTH ON Clearwater Avenue								FROM SOUTH ON Badger Road								FROM EAST ON Leslie Road								FROM WEST ON Leslie Road								INTERVAL TOTALS
	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	
05:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	2	0	6	9	0	2	60	21	0	4	2	6	0	13	80	26	0	0	1	7	0	28	12	7	0	0	0	1	0	46	21	35	351
07:30 AM	0	0	1	5	0	3	48	8	0	0	2	6	1	17	137	35	0	0	1	1	0	30	12	23	0	0	4	7	0	86	17	48	465
07:45 AM	0	0	2	11	0	4	45	20	0	0	4	10	0	16	119	45	0	0	5	10	0	34	18	20	0	0	5	6	0	62	40	51	474
08:00 AM	0	0	1	7	0	6	50	32	0	0	1	6	0	22	152	30	0	0	1	3	0	32	33	14	0	0	0	0	0	65	20	37	493
08:15 AM	0	0	2	9	1	1	49	30	0	0	0	4	0	17	90	15	0	0	1	2	0	25	13	10	0	0	1	2	0	57	11	33	352
08:30 AM	0	0	0	5	0	3	44	23	0	0	1	8	0	20	117	30	0	0	4	9	0	23	11	9	0	0	5	6	0	59	13	26	378
08:45 AM	0	0	0	5	0	3	51	24	0	0	4	10	0	36	109	26	0	1	1	8	0	24	17	11	0	0	2	4	0	39	12	34	386
09:00 AM	0	0	1	3	3	4	47	27	0	0	2	5	0	39	83	15	0	0	0	3	0	12	16	6	0	0	1	4	0	26	11	32	321
PEAK HOUR TOTALS	**0**	**0**	**6**	**32**	**1**	**14**	**192**	**90**	**0**	**0**	**7**	**26**	**1**	**72**	**498**	**125**	**0**	**0**	**8**	**16**	**0**	**121**	**76**	**67**	**0**	**0**	**10**	**15**	**0**	**270**	**88**	**169**	**INTERSECTION**
ALL MOVEMENTS						**297**								**696**								**264**								**527**			**1784**
% Buses			**2.0%**								**1.0%**								**3.0%**								**1.9%**					**1.7%**
% HV				**10.8%**								**3.7%**								**6.1%**								**2.8%**				**5.0%**
PEAK HOUR FACTOR						**0.84**								**0.85**								**0.84**								**0.86**			**0.90**

Buses = School, Transit, Access & Tour Buses

HV = Heavy Vehicle (any vehicle including trailers with six or more tires)

PHF = Peak Hour Factor

Motorcycles are counted as vehicles

7:00 AM - 9:00 AM PEAK HOUR: 7:15 AM TO 8:15 AM

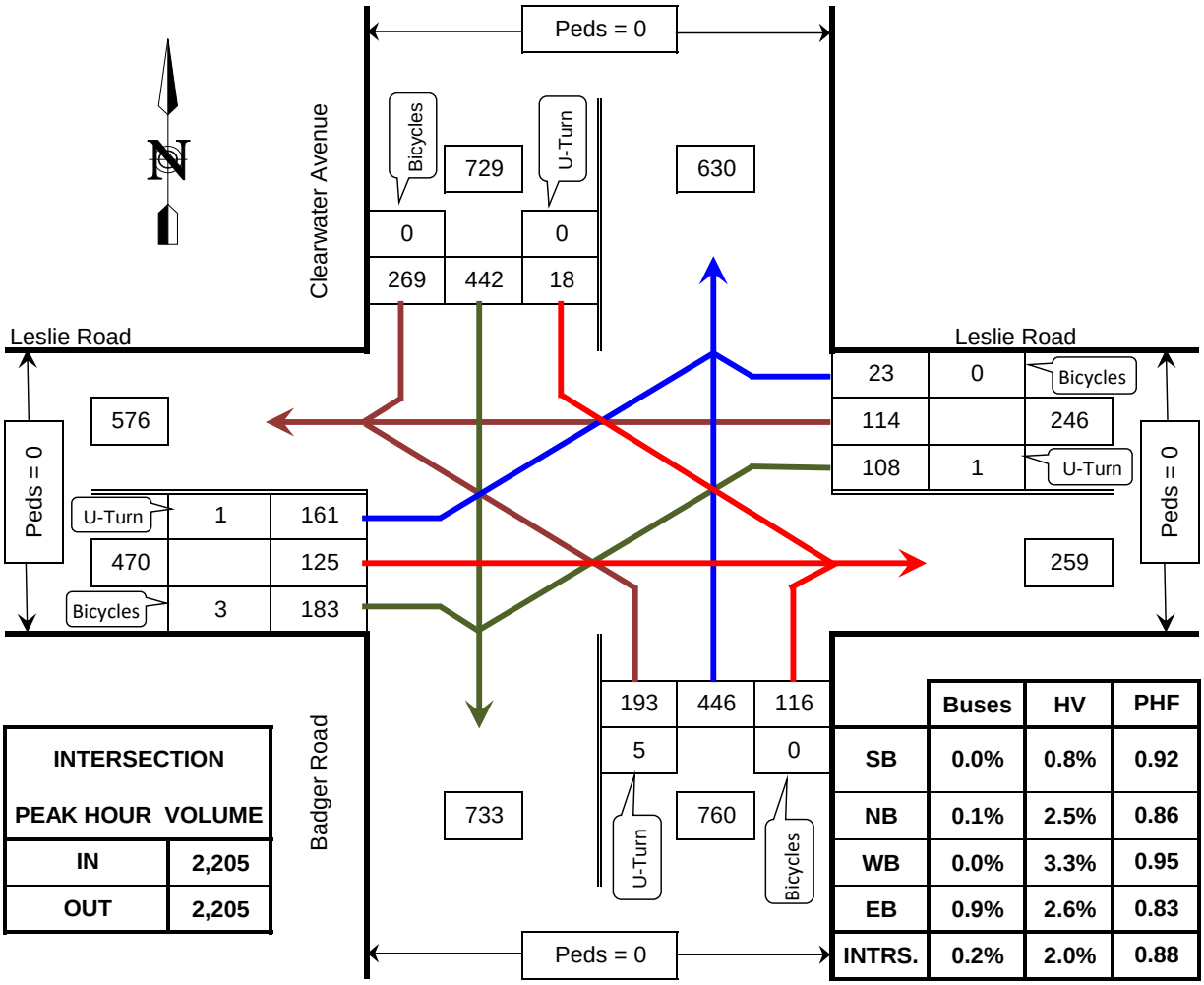
ROLLING HOUR COUNT

TIME INTERVAL	FROM NORTH ON Clearwater Avenue								FROM SOUTH ON Badger Road								FROM EAST ON Leslie Road								FROM WEST ON Leslie Road								INTERVAL TOTALS
	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	
5:00 AM - 6:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 AM - 6:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:30 AM - 6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:45 AM - 6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00 AM - 7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15 AM - 7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:30 AM - 7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM - 7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM - 8:00 AM	2	0	10	32	0	15	203	81	0	4	9	28	1	68	488	136	0	0	8	21	0	124	75	64	0	0	9	14	0	259	98	171	1783
7:15 AM - 8:15 AM	0	0	6	32	1	14	192	90	0	0	7	26	1	72	498	125	0	0	8	16	0	121	76	67	0	0	10	15	0	270	88	169	1784
7:30 AM - 8:30 AM	0	0	5	32	1	14	188	105	0	0	6	28	0	75	478	120	0	0	11	24	0	114	75	53	0	0	11	14	0	243	84	147	1697
7:45 AM - 8:45 AM	0	0	3	26	1	13	194	109	0	0	6	28	0	95	468	101	0	1	7	22	0	104	74	44	0	0	8	12	0	220	56	130	1609
8:00 AM - 9:00 AM	0	0	3	22	4	11	191	104	0	0	7	27	0	112	399	86	0	1	6	22	0	84	57	36	0	0	9	16	0	181	47	125	1437
7:00 AM - 9:00 AM Total:	2	0	13	54	4	26	394	185	0	4	16	55	1	180	887	222	0	1	14	43	0	208	132	100	0	0	18	30	0	440	145	296	3220

TRAFFIC DATA GATHERING

TURNING MOVEMENTS DIAGRAM

4:00 PM - 6:00 PM PEAK HOUR: 4:45 PM TO 5:45 PM



INTERSECTION PEAK HOUR VOLUME	
IN	2,205
OUT	2,205

	Buses	HV	PHF
SB	0.0%	0.8%	0.92
NB	0.1%	2.5%	0.86
WB	0.0%	3.3%	0.95
EB	0.9%	2.6%	0.83
INTRS.	0.2%	2.0%	0.88

PHF : Peak Hour Factor
HV : Heavy Vehicles (any vehicle including trailers with 6 or more tires)
Buses : School, Transit, Access & Tour Buses
Motorcycles are counted as vehicles

Leslie Road @ Clearwater Avenue/Badger Road

Kennewick, WA

COUNTED BY: TDG

DATE OF COUNT: Tue. 9/25/18

REDUCTION DATE: Wed. 10/17/18

TIME OF COUNT: 4:00 PM - 6:00 PM

TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION: Leslie Road @ Clearwater Avenue/Badger Road
Kennewick, WA

DATE OF COUNT: Tue. 9/25/18
TIME OF COUNT: 4:00 PM - 6:00 PM

COUNTED BY: TDG
DATE OF REDUCTION: 10/17/2018

TIME INTERVAL ENDING AT	FROM NORTH ON Clearwater Avenue								FROM SOUTH ON Badger Road								FROM EAST ON Leslie Road								FROM WEST ON Leslie Road								INTERVAL TOTALS
	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	
02:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	1	0	7	87	47	0	0	1	4	0	28	111	29	0	0	1	4	0	32	28	11	0	0	3	4	1	38	21	29	469
04:30 PM	0	0	1	3	0	4	77	54	0	0	1	6	1	44	95	26	0	0	0	2	0	35	32	5	0	0	0	2	0	24	25	34	456
04:45 PM	0	0	1	1	0	7	100	62	0	0	0	3	1	42	90	23	0	0	0	1	0	20	21	4	0	0	0	0	0	22	18	38	448
05:00 PM	0	0	0	1	0	3	103	54	0	0	0	0	1	42	120	22	0	0	0	1	0	31	31	3	0	0	3	5	0	39	31	42	522
05:15 PM	0	0	0	0	0	4	114	58	0	0	0	10	2	51	99	39	0	0	0	0	0	25	28	6	0	0	0	1	1	25	30	44	526
05:30 PM	0	0	0	3	0	5	114	80	0	0	1	5	1	63	127	30	0	0	0	3	1	26	27	8	0	1	0	3	0	57	40	45	624
05:45 PM	0	0	0	2	0	6	111	77	0	0	0	4	1	37	100	25	0	0	0	4	0	26	28	6	0	2	1	3	0	40	24	52	533
06:00 PM	0	0	0	2	0	8	95	47	0	0	0	4	1	38	84	23	0	0	0	0	0	32	17	8	0	0	0	2	1	45	39	57	495
PEAK HOUR TOTALS	**0**	**0**	**0**	**6**	**0**	**18**	**442**	**269**	**0**	**0**	**1**	**19**	**5**	**193**	**446**	**116**	**0**	**0**	**0**	**8**	**1**	**108**	**114**	**23**	**0**	**3**	**4**	**12**	**1**	**161**	**125**	**183**	**INTERSECTION**
ALL MOVEMENTS						**729**								**760**								**246**								**470**			**2205**
% Buses			**0.0%**								**0.1%**								**0.0%**								**0.9%**					**0.2%**
% HV				**0.8%**								**2.5%**								**3.3%**								**2.6%**				**2.0%**
PEAK HOUR FACTOR						**0.92**								**0.86**								**0.95**								**0.83**			**0.88**

Buses = School, Transit, Access & Tour Buses

HV = Heavy Vehicle (any vehicle including trailers with six or more tires)

PHF = Peak Hour Factor

4:00 PM - 6:00 PM PEAK HOUR: 4:45 PM TO 5:45 PM

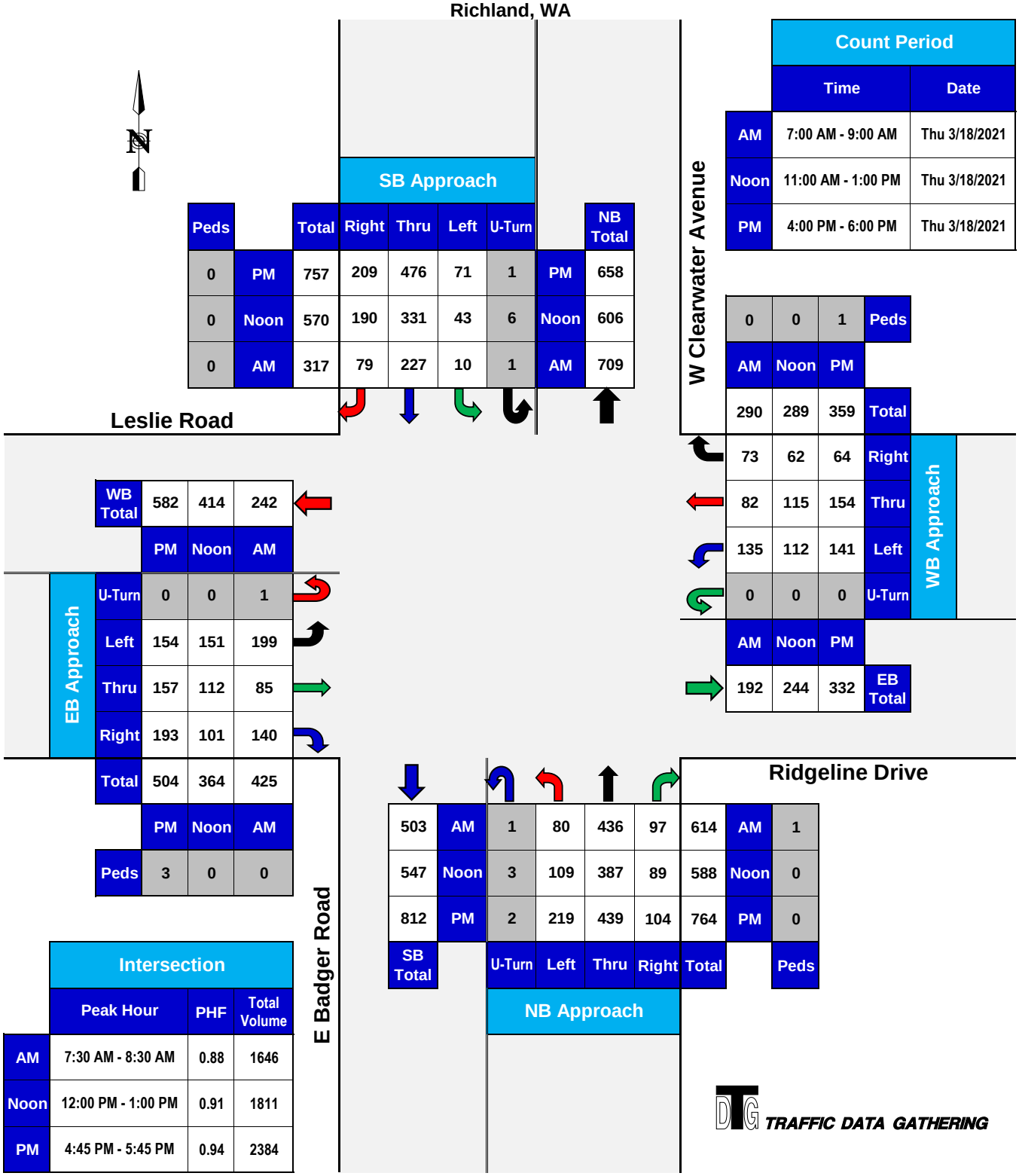
Motorcycles are counted as vehicles

ROLLING HOUR COUNT

TIME INTERVAL	FROM NORTH ON Clearwater Avenue								FROM SOUTH ON Badger Road								FROM EAST ON Leslie Road								FROM WEST ON Leslie Road								INTERVAL TOTALS
	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	Buses	HV	U-Turn	Left	Thru	Right	
2:00 PM - 3:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:15 PM - 3:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:30 PM - 3:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:45 PM - 3:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00 PM - 4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:15 PM - 4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:30 PM - 4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:45 PM - 4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:00 PM - 5:00 PM	0	0	2	6	0	21	367	217	0	0	2	13	3	156	416	100	0	0	1	8	0	118	112	23	0	0	6	11	1	123	95	143	1895
4:15 PM - 5:15 PM	0	0	2	5	0	18	394	228	0	0	1	19	5	179	404	110	0	0	0	4	0	111	112	18	0	0	3	8	1	110	104	158	1952
4:30 PM - 5:30 PM	0	0	1	5	0	19	431	254	0	0	1	18	5	198	436	114	0	0	0	5	1	102	107	21	0	1	3	9	1	143	119	169	2120
4:45 PM - 5:45 PM	0	0	0	6	0	18	442	269	0	0	1	19	5	193	446	116	0	0	0	8	1	108	114	23	0	3	4	12	1	161	125	183	2205
5:00 PM - 6:00 PM	0	0	0	7	0	23	434	262	0	0	1	23	5	189	410	117	0	0	0	7	1	109	100	28	0	3	1	9	2	167	133	198	2178
4:00 PM - 6:00 PM Total:	0	0	2	13	0	44	801	479	0	0	3	36	8	345	826	217	0	0	1	15	1	227	212	51	0	3	7	20	3	290	228	341	4073

W Clearwater Avenue @ Leslie Road

Richland, WA



DTG TRAFFIC DATA GATHERING

TURNING MOVEMENTS DIAGRAM - Daily Summary

TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION: W Clearwater Avenue @ Leslie Road
Richland, WA

DATE OF COUNT: Thu. 3/18/2021
START OF COUNT: 7:00 AM
TIME OF COUNT: 7:00 AM - 9:00 AM

COUNTED BY: TDG
DATE OF REDUCTION: 4/18/2021
DURATION OF COUNT: 2

TIME INTERVAL ENDING AT	SOUTHBOUND W Clearwater Avenue							NORTHBOUND E Badger Road							WESTBOUND Ridgeline Drive							EASTBOUND Leslie Road							INTERVAL TOTALS
	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
07:15 AM	0	0	6	0	4	41	15	0	0	1	0	10	76	20	0	0	7	0	42	16	8	0	0	2	0	40	24	32	328
07:30 AM	0	0	9	0	3	44	16	0	0	3	4	19	90	20	0	0	5	0	19	14	19	0	0	2	0	54	23	38	363
07:45 AM	0	0	4	0	5	50	10	0	0	6	0	14	144	25	0	0	7	0	38	13	26	0	0	8	0	42	29	38	434
08:00 AM	0	0	8	0	3	50	28	1	0	8	1	25	114	38	0	0	10	0	42	29	24	0	0	2	0	52	26	37	469
08:15 AM	0	0	8	0	1	67	15	0	0	8	0	18	82	18	0	0	5	0	27	24	14	0	0	2	1	46	17	38	368
08:30 AM	0	0	7	1	1	60	26	0	0	7	0	23	96	16	0	0	5	0	28	16	9	0	0	4	0	59	13	27	375
08:45 AM	0	0	3	0	10	60	36	0	0	10	0	26	105	15	0	0	2	0	34	20	17	0	0	2	0	39	12	35	409
09:00 AM	0	0	6	0	5	39	25	0	0	4	0	24	93	15	0	0	2	0	26	16	12	0	0	2	0	53	13	27	348
PEAK HOUR TOTALS	**0**	**0**	**27**	**1**	**10**	**227**	**79**	**1**	**0**	**29**	**1**	**80**	**436**	**97**	**0**	**0**	**27**	**0**	**135**	**82**	**73**	**0**	**0**	**16**	**1**	**199**	**85**	**140**	**INTERSECTION**
ALL MOVEMENTS				**317**							**614**							**290**							**425**				**1646**
% HV			**8.5%**							**4.7%**							**9.3%**							**3.8%**				**6.0%**
PEAK HOUR FACTOR				**0.90**							**0.84**							**0.76**							**0.92**				**0.88**

HV = Heavy Vehicle
PHF = Peak Hour Factor

7:00 AM - 9:00 AM PEAK HOUR: 7:30 AM - 8:30 AM

ROLLING HOUR COUNT

	SOUTHBOUND W Clearwater Avenue							NORTHBOUND E Badger Road							WESTBOUND Ridgeline Drive							EASTBOUND Leslie Road							INTERVAL TOTALS
TIME INTERVAL	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
7:00 AM - 8:00 AM	0	0	27	0	15	185	69	1	0	18	5	68	424	103	0	0	29	0	141	72	77	0	0	14	0	188	102	145	1594
7:15 AM - 8:15 AM	0	0	29	0	12	211	69	1	0	25	5	76	430	101	0	0	27	0	126	80	83	0	0	14	1	194	95	151	1634
7:30 AM - 8:30 AM	0	0	27	1	10	227	79	1	0	29	1	80	436	97	0	0	27	0	135	82	73	0	0	16	1	199	85	140	1646
7:45 AM - 8:45 AM	0	0	26	1	15	237	105	1	0	33	1	92	397	87	0	0	22	0	131	89	64	0	0	10	1	196	68	137	1621
8:00 AM - 9:00 AM	0	0	24	1	17	226	102	0	0	29	0	91	376	64	0	0	14	0	115	76	52	0	0	10	1	197	55	127	1500
7:00 AM - 9:00 AM Total:	0	0	51	1	32	411	171	1	0	47	5	159	800	167	0	0	43	0	256	148	129	0	0	24	1	385	157	272	3094

Leslie/Clearwater Roundabout
Turning Movement Volumes

AM	Northbound			Southbound			Eastbound			Westbound			
Scenario	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
2021 PM	126	570	106	9	272	92	311	107	207	113	91	24	**2028**
2032 Refined	155	685	170	55	325	135	405	140	250	165	115	60	**2660**
2042 Refined	196	785	226	95	365	175	475	160	308	211	140	95	**3230**

PM	Northbound			Southbound			Eastbound			Westbound			
Scenario	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
2021 PM	219	439	104	71	476	209	154	157	193	141	154	64	**2381**
2032 Refined	280	580	145	140	535	295	215	220	230	255	175	110	**3180**
2042 Refined	340	675	215	195	615	350	265	265	295	315	220	180	**3930**

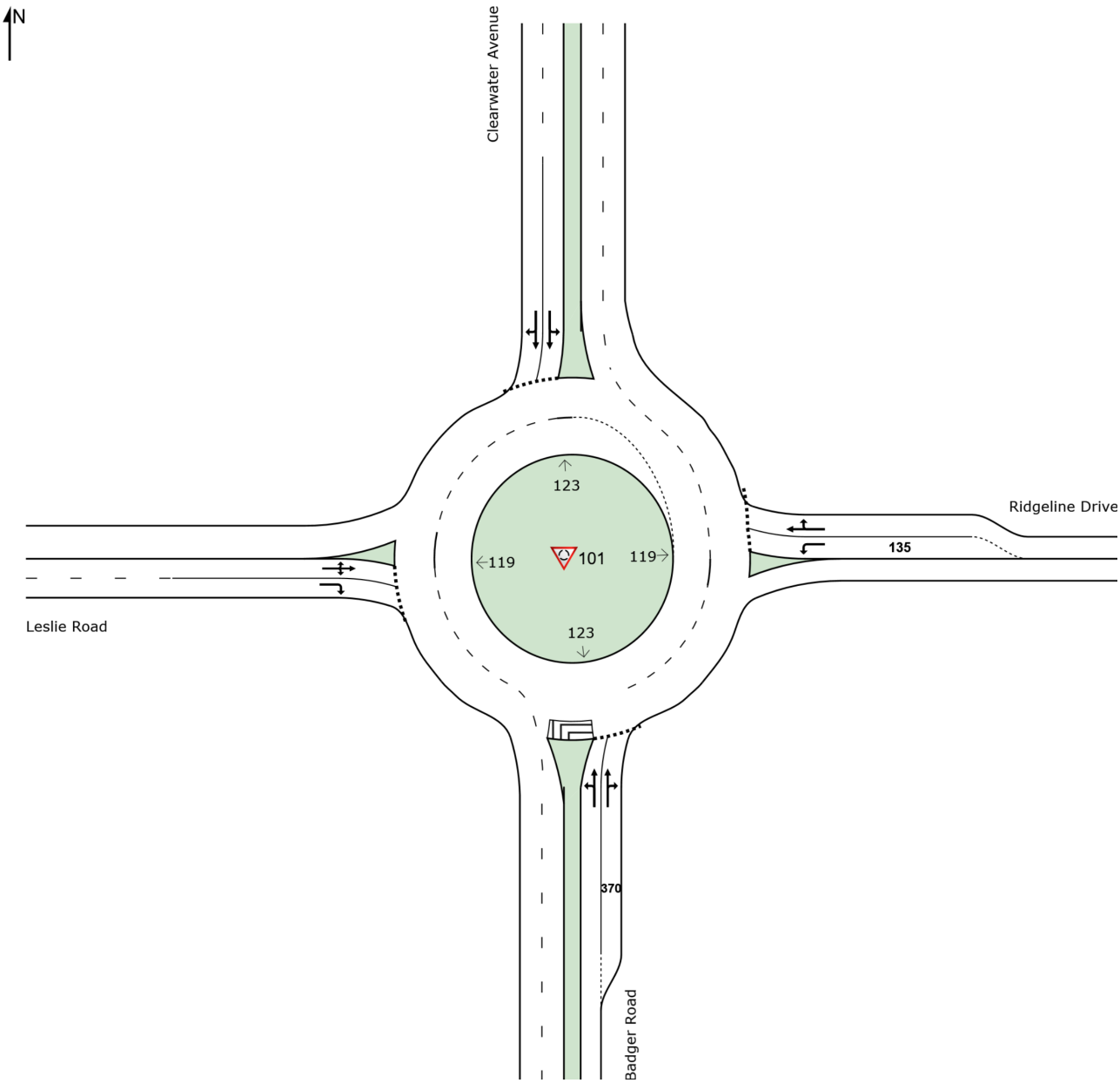
Appendix B: 2021 Existing Conditions

SITE LAYOUT

Site: 101 [Leslie Rd and Clearwater Ave

Site Category: Existing Design
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101 [Leslie Rd and Clearwater Ave 2021 Existing AM (Site Folder: Existing)]

Site Category: Existing Design
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] ft	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed mph
South: Badger Road														
3	L2	126	3.0	140	3.0	0.439	14.7	LOS B	3.3	84.9	0.77	0.75	0.77	36.4
8	T1	570	3.0	633	3.0	0.439	7.5	LOS A	3.6	92.3	0.77	0.69	0.77	37.9
18	R2	106	3.0	118	3.0	0.439	7.1	LOS A	3.6	92.3	0.76	0.65	0.76	36.0
Approach		802	3.0	891	3.0	0.439	8.6	LOS A	3.6	92.3	0.77	0.70	0.77	37.4
East: Ridgeline Drive														
1	L2	113	3.0	126	3.0	0.216	14.3	LOS B	1.0	26.1	0.73	0.91	0.73	33.9
6	T1	91	3.0	101	3.0	0.185	7.3	LOS A	0.9	23.5	0.72	0.71	0.72	35.9
16	R2	24	3.0	27	3.0	0.185	7.3	LOS A	0.9	23.5	0.72	0.71	0.72	35.6
Approach		228	3.0	253	3.0	0.216	10.8	LOS B	1.0	26.1	0.72	0.81	0.72	34.8
North: Clearwater Avenue														
7	L2	9	3.0	10	3.0	0.196	12.7	LOS B	0.9	23.6	0.48	0.55	0.48	38.3
4	T1	272	3.0	302	3.0	0.196	6.2	LOS A	0.9	24.0	0.47	0.56	0.47	39.2
14	R2	92	3.0	102	3.0	0.196	6.0	LOS A	0.9	24.0	0.47	0.57	0.47	36.9
Approach		373	3.0	414	3.0	0.196	6.3	LOS A	0.9	24.0	0.47	0.56	0.47	38.6
West: Leslie Road														
5	L2	311	3.0	346	3.0	0.452	12.4	LOS B	2.7	69.4	0.62	0.75	0.63	35.4
2	T1	107	3.0	119	3.0	0.452	5.8	LOS A	2.7	69.4	0.62	0.75	0.63	34.6
12	R2	207	3.0	230	3.0	0.287	6.5	LOS A	1.4	36.6	0.58	0.70	0.58	36.6
Approach		625	3.0	694	3.0	0.452	9.3	LOS A	2.7	69.4	0.61	0.73	0.61	35.6
All Vehicles		2028	3.0	2253	3.0	0.452	8.6	LOS A	3.6	92.3	0.66	0.70	0.66	36.7

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Leslie Rd and Clearwater Ave 2021 Existing PM (Site Folder: Existing)]

Site Category: Existing Design
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] ft	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed mph
South: Badger Road														
3	L2	219	3.0	238	3.0	0.307	14.1	LOS B	2.1	53.6	0.68	0.76	0.68	35.5
8	T1	439	3.0	477	3.0	0.459	6.9	LOS A	3.8	97.1	0.72	0.64	0.72	38.3
18	R2	104	3.0	113	3.0	0.459	6.8	LOS A	3.8	97.1	0.73	0.62	0.73	36.1
Approach		762	3.0	828	3.0	0.459	9.0	LOS A	3.8	97.1	0.71	0.67	0.71	37.1
East: Ridgeline Drive														
1	L2	141	3.0	153	3.0	0.235	13.3	LOS B	1.0	26.3	0.66	0.88	0.66	34.3
6	T1	154	3.0	167	3.0	0.293	6.4	LOS A	1.4	35.7	0.66	0.64	0.66	36.2
16	R2	64	3.0	70	3.0	0.293	6.4	LOS A	1.4	35.7	0.66	0.64	0.66	35.8
Approach		359	3.0	390	3.0	0.293	9.1	LOS A	1.4	35.7	0.66	0.73	0.66	35.3
North: Clearwater Avenue														
7	L2	71	3.0	77	3.0	0.437	14.3	LOS B	2.5	64.2	0.65	0.73	0.69	37.1
4	T1	476	3.0	517	3.0	0.437	7.7	LOS A	2.5	65.1	0.65	0.72	0.68	38.2
14	R2	209	3.0	227	3.0	0.437	7.2	LOS A	2.5	65.1	0.64	0.70	0.66	36.3
Approach		756	3.0	822	3.0	0.437	8.2	LOS A	2.5	65.1	0.65	0.72	0.68	37.5
West: Leslie Road														
5	L2	154	3.0	167	3.0	0.405	13.6	LOS B	2.4	61.5	0.73	0.81	0.76	35.6
2	T1	157	3.0	171	3.0	0.405	7.0	LOS A	2.4	61.5	0.73	0.81	0.76	34.7
12	R2	193	3.0	210	3.0	0.314	7.8	LOS A	1.6	41.1	0.70	0.83	0.70	35.9
Approach		504	3.0	548	3.0	0.405	9.3	LOS A	2.4	61.5	0.72	0.82	0.74	35.4
All Vehicles		2381	3.0	2588	3.0	0.459	8.8	LOS A	3.8	97.1	0.69	0.73	0.70	36.6

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). 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.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

QUEUE ANALYSIS

Site: 101 [Leslie Rd and Clearwater Ave 2021 Existing AM (Site Folder: Existing)]

Site Category: Existing Design
Roundabout

Lane Queues (Distance)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (ft)	Back of Queue (ft) Av.	Back of Queue (ft) 95%	Queue at Start of Green (ft) Av.	Queue at Start of Green (ft) 95%	Cycle Average Queue (ft) Av.	Cycle Average Queue (ft) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.439	1.000	0.0	34.2	84.9	NA	NA	9.8	17.8	0.02	0.05	0.0	NA	NA
Lane 2		0.439	1.000	0.0	37.1	92.3	NA	NA	9.6	17.4	0.10	0.25	NA	0.0	1
Approach		0.439			37.1	92.3	NA	NA	9.8	17.8	0.02	0.05			
East: Ridgeline Drive															
Lane 1		0.216	1.000	0.0	10.5	26.1	NA	NA	3.8	6.9	0.08	0.19	NA	0.0	2
Lane 2		0.185	1.000	0.0	9.4	23.5	NA	NA	3.2	5.8	0.01	0.01	0.0	NA	NA
Approach		0.216			10.5	26.1	NA	NA	3.8	6.9	0.01	0.01			
North: Clearwater Avenue															
Lane 1		0.196	1.000	0.0	9.5	23.6	NA	NA	2.1	3.8	0.01	0.01	0.0	NA	NA
Lane 2		0.196	1.000	0.0	9.7	24.0	NA	NA	2.0	3.6	0.01	0.02	0.0	NA	NA
Approach		0.196			9.7	24.0	NA	NA	2.1	3.8	0.01	0.02			
West: Leslie Road															
Lane 1		0.452	1.000	0.2	27.9	69.4	NA	NA	7.6	13.8	0.02	0.04	0.0	NA	NA
Lane 2		0.287	1.000	0.0	14.7	36.6	NA	NA	4.4	8.0	0.01	0.02	0.0	NA	NA
Approach		0.452			27.9	69.4	NA	NA	7.6	13.8	0.02	0.04			
Intersection		0.452			37.1	92.3	NA	NA	9.8	17.8	0.02	0.05			

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Lane Queues (Vehicles)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (veh)	Back of Queue (veh) Av.	Back of Queue (veh) 95%	Queue at Start of Green (veh) Av.	Queue at Start of Green (veh) 95%	Cycle Average Queue (veh) Av.	Cycle Average Queue (veh) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.439	1.000	0.0	1.3	3.3	NA	NA	0.4	0.7	0.02	0.05	0.0	NA	NA
Lane 2		0.439	1.000	0.0	1.5	3.6	NA	NA	0.4	0.7	0.10	0.25	NA	0.0	1
Approach		0.439			1.5	3.6	NA	NA	0.4	0.7	0.02	0.05			
East: Ridgeline Drive															
Lane 1		0.216	1.000	0.0	0.4	1.0	NA	NA	0.1	0.3	0.08	0.19	NA	0.0	2
Lane 2		0.185	1.000	0.0	0.4	0.9	NA	NA	0.1	0.2	0.01	0.01	0.0	NA	NA
Approach		0.216			0.4	1.0	NA	NA	0.1	0.3	0.01	0.01			
North: Clearwater Avenue															
Lane 1		0.196	1.000	0.0	0.4	0.9	NA	NA	0.1	0.1	0.01	0.01	0.0	NA	NA
Lane 2		0.196	1.000	0.0	0.4	0.9	NA	NA	0.1	0.1	0.01	0.02	0.0	NA	NA
Approach		0.196			0.4	0.9	NA	NA	0.1	0.1	0.01	0.02			
West: Leslie Road															
Lane 1		0.452	1.000	0.0	1.1	2.7	NA	NA	0.3	0.5	0.02	0.04	0.0	NA	NA
Lane 2		0.287	1.000	0.0	0.6	1.4	NA	NA	0.2	0.3	0.01	0.02	0.0	NA	NA

Approach	0.452	1.1	2.7	NA	NA	0.3	0.5	0.02	0.04
Intersection	0.452	1.5	3.6	NA	NA	0.4	0.7	0.02	0.05

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Continuous Lane Performance

Lane Number	Deg. Satn	Unint. Speed	Unint. Travel Delay	Hdwy Spacing	Aver. Vehicle Length	Occup. Time	Space Time	Space Occup. Ratio	Time Occup. Ratio	Density		LOS (Density Method)
	v/c	mph	sec	sec	ft	ft	sec	sec	%	%	veh/mi	pc/mi	
South: Badger Road													
This approach does not have any continuous lanes													
East: Ridgeline Drive													
This approach does not have any continuous lanes													
North: Clearwater Avenue													
This approach does not have any continuous lanes													
West: Leslie Road													
This approach does not have any continuous lanes													

Midblock Effective Detection Zone Length = 7 ft

QUEUE ANALYSIS

Site: 101 [Leslie Rd and Clearwater Ave 2021 Existing PM (Site Folder: Existing)]

Site Category: Existing Design
Roundabout

Lane Queues (Distance)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (ft)	Back of Queue (ft) Av.	Back of Queue (ft) 95%	Queue at Start of Green (ft) Av.	Queue at Start of Green (ft) 95%	Cycle Average Queue (ft) Av.	Cycle Average Queue (ft) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.307	1.000	0.0	21.6	53.6	NA	NA	5.7	10.3	0.01	0.03	0.0	NA	NA
Lane 2		0.459	1.000	0.0	39.1	97.1	NA	NA	9.3	16.9	0.11	0.26	NA	0.0	1
Approach		0.459			39.1	97.1	NA	NA	9.3	16.9	0.01	0.03			
East: Ridgeline Drive															
Lane 1		0.235	1.000	0.0	10.6	26.3	NA	NA	3.6	6.5	0.08	0.19	NA	0.0	2
Lane 2		0.293	1.000	0.0	14.3	35.7	NA	NA	4.4	7.9	0.01	0.02	0.0	NA	NA
Approach		0.293			14.3	35.7	NA	NA	4.4	7.9	0.01	0.02			
North: Clearwater Avenue															
Lane 1		0.437	1.000	1.1	25.8	64.2	NA	NA	8.4	15.2	0.02	0.04	0.0	NA	NA
Lane 2		0.437	1.000	0.6	26.2	65.1	NA	NA	7.8	14.2	0.02	0.04	0.0	NA	NA
Approach		0.437			26.2	65.1	NA	NA	8.4	15.2	0.02	0.04			
West: Leslie Road															
Lane 1		0.405	1.000	0.9	24.7	61.5	NA	NA	8.4	15.3	0.02	0.04	0.0	NA	NA
Lane 2		0.314	1.000	0.0	16.5	41.1	NA	NA	5.9	10.8	0.01	0.03	0.0	NA	NA
Approach		0.405			24.7	61.5	NA	NA	8.4	15.3	0.02	0.04			
Intersection		0.459			39.1	97.1	NA	NA	9.3	16.9	0.02	0.04			

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Lane Queues (Vehicles)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (veh)	Back of Queue (veh) Av.	Back of Queue (veh) 95%	Queue at Start of Green (veh) Av.	Queue at Start of Green (veh) 95%	Cycle Average Queue (veh) Av.	Cycle Average Queue (veh) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.307	1.000	0.0	0.8	2.1	NA	NA	0.2	0.4	0.01	0.03	0.0	NA	NA
Lane 2		0.459	1.000	0.0	1.5	3.8	NA	NA	0.4	0.7	0.11	0.26	NA	0.0	1
Approach		0.459			1.5	3.8	NA	NA	0.4	0.7	0.01	0.03			
East: Ridgeline Drive															
Lane 1		0.235	1.000	0.0	0.4	1.0	NA	NA	0.1	0.3	0.08	0.19	NA	0.0	2
Lane 2		0.293	1.000	0.0	0.6	1.4	NA	NA	0.2	0.3	0.01	0.02	0.0	NA	NA
Approach		0.293			0.6	1.4	NA	NA	0.2	0.3	0.01	0.02			
North: Clearwater Avenue															
Lane 1		0.437	1.000	0.0	1.0	2.5	NA	NA	0.3	0.6	0.02	0.04	0.0	NA	NA
Lane 2		0.437	1.000	0.0	1.0	2.5	NA	NA	0.3	0.6	0.02	0.04	0.0	NA	NA
Approach		0.437			1.0	2.5	NA	NA	0.3	0.6	0.02	0.04			
West: Leslie Road															
Lane 1		0.405	1.000	0.0	1.0	2.4	NA	NA	0.3	0.6	0.02	0.04	0.0	NA	NA
Lane 2		0.314	1.000	0.0	0.6	1.6	NA	NA	0.2	0.4	0.01	0.03	0.0	NA	NA

Approach	0.405	1.0	2.4	NA	NA	0.3	0.6	0.02	0.04
Intersection	0.459	1.5	3.8	NA	NA	0.4	0.7	0.02	0.04

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Continuous Lane Performance

Lane Number	Deg. Satn	Unint. Speed	Unint. Travel Delay	Hdwy Spacing	Aver. Vehicle Length	Occup. Time	Space Time	Space Occup. Ratio	Time Occup. Ratio	Density		LOS (Density Method)
	v/c	mph	sec	sec	ft	ft	sec	sec	%	%	veh/mi	pc/mi	
South: Badger Road													
This approach does not have any continuous lanes													
East: Ridgeline Drive													
This approach does not have any continuous lanes													
North: Clearwater Avenue													
This approach does not have any continuous lanes													
West: Leslie Road													
This approach does not have any continuous lanes													

Midblock Effective Detection Zone Length = 7 ft

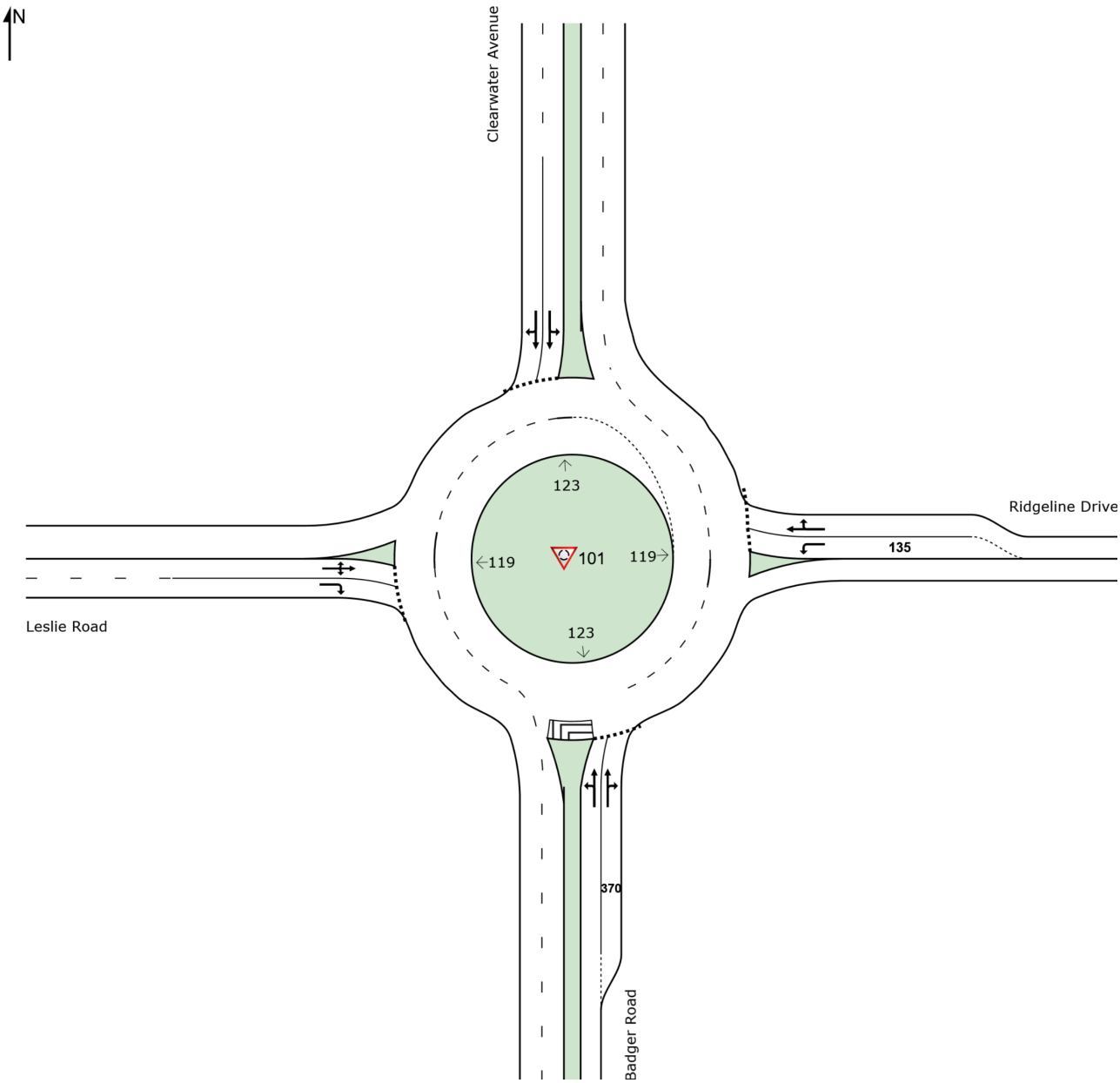
Appendix C: 2042 Analysis, Existing Lane Configurations

SITE LAYOUT

Site: 101 [Leslie Rd and Clearwater Ave 2042 PM (Site Folder: 2042)]

Site Category: Existing Design
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101 [Leslie Rd and Clearwater Ave 2042 AM (Site Folder: 2042)]

Site Category: Existing Design
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] ft	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed mph
South: Badger Road														
3	L2	196	3.0	218	3.0	0.887	40.7	LOS D	17.3	441.8	1.00	1.42	2.17	26.2
8	T1	785	3.0	872	3.0	0.887	30.7	LOS C	21.6	554.2	1.00	1.39	2.14	28.0
18	R2	226	3.0	251	3.0	0.887	28.6	LOS C	21.6	554.2	1.00	1.37	2.13	27.6
Approach		1207	3.0	1341	3.0	0.887	31.9	LOS C	21.6	554.2	1.00	1.39	2.15	27.6
East: Ridgeline Drive														
1	L2	211	3.0	234	3.0	0.607	23.7	LOS C	4.1	105.0	0.92	1.09	1.28	29.9
6	T1	140	3.0	156	3.0	0.472	11.6	LOS B	3.3	85.3	0.93	1.02	1.11	34.1
16	R2	95	3.0	106	3.0	0.472	11.7	LOS B	3.3	85.3	0.93	1.02	1.11	33.8
Approach		446	3.0	496	3.0	0.607	17.3	LOS B	4.1	105.0	0.93	1.05	1.19	31.9
North: Clearwater Avenue														
7	L2	95	3.0	106	3.0	0.357	13.7	LOS B	1.9	48.4	0.65	0.71	0.65	36.9
4	T1	365	3.0	406	3.0	0.357	7.0	LOS A	2.0	51.4	0.64	0.67	0.64	38.1
14	R2	175	3.0	194	3.0	0.357	6.5	LOS A	2.0	51.4	0.63	0.63	0.63	36.4
Approach		635	3.0	706	3.0	0.357	7.9	LOS A	2.0	51.4	0.64	0.66	0.64	37.4
West: Leslie Road														
5	L2	475	3.0	528	3.0	0.718	16.6	LOS B	7.3	187.5	0.87	1.08	1.21	33.7
2	T1	160	3.0	178	3.0	0.718	9.9	LOS A	7.3	187.5	0.87	1.08	1.21	32.8
12	R2	308	3.0	342	3.0	0.471	8.8	LOS A	3.0	75.8	0.76	0.90	0.87	35.3
Approach		943	3.0	1048	3.0	0.718	12.9	LOS B	7.3	187.5	0.83	1.02	1.10	34.0
All Vehicles		3231	3.0	3590	3.0	0.887	19.6	LOS B	21.6	554.2	0.87	1.09	1.41	31.5

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). 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.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Leslie Rd and Clearwater Ave 2042 PM (Site Folder: 2042)]

Site Category: Existing Design
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] ft	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed mph
South: Badger Road														
3	L2	340	3.0	370	3.0	0.654	23.3	LOS C	7.7	196.8	1.00	1.11	1.38	31.3
8	T1	675	3.0	734	3.0	0.975	39.7	LOS D	33.3	853.4	1.00	1.62	2.73	25.3
18	R2	215	3.0	234	3.0	0.975	41.9	LOS D	33.3	853.4	1.00	1.67	2.85	23.8
Approach		1230	3.0	1337	3.0	0.975	35.6	LOS D	33.3	853.4	1.00	1.49	2.37	26.5
East: Ridgeline Drive														
1	L2	315	3.0	342	3.0	0.718	20.2	LOS C	5.0	129.2	0.91	1.09	1.31	31.3
6	T1	220	3.0	239	3.0	0.658	10.5	LOS B	5.0	127.1	0.92	1.05	1.20	34.7
16	R2	180	3.0	196	3.0	0.658	10.6	LOS B	5.0	127.1	0.92	1.05	1.20	34.4
Approach		715	3.0	777	3.0	0.718	14.8	LOS B	5.0	129.2	0.92	1.07	1.25	33.0
North: Clearwater Avenue														
7	L2	195	3.0	212	3.0	0.787	21.6	LOS C	7.6	195.5	0.93	1.14	1.47	33.2
4	T1	615	3.0	668	3.0	0.787	14.0	LOS B	8.5	218.3	0.93	1.13	1.45	34.9
14	R2	350	3.0	380	3.0	0.787	12.7	LOS B	8.5	218.3	0.93	1.13	1.42	34.0
Approach		1160	3.0	1261	3.0	0.787	14.9	LOS B	8.5	218.3	0.93	1.13	1.44	34.3
West: Leslie Road														
5	L2	265	3.0	288	3.0	0.849	27.2	LOS C	11.0	282.2	1.00	1.32	1.90	29.8
2	T1	265	3.0	288	3.0	0.849	20.5	LOS C	11.0	282.2	1.00	1.32	1.90	29.1
12	R2	295	3.0	321	3.0	0.661	16.0	LOS B	5.2	132.4	0.93	1.10	1.34	31.7
Approach		825	3.0	897	3.0	0.849	21.1	LOS C	11.0	282.2	0.98	1.24	1.70	30.2
All Vehicles		3930	3.0	4272	3.0	0.975	22.6	LOS C	33.3	853.4	0.96	1.25	1.75	30.4

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). 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.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

QUEUE ANALYSIS

Site: 101 [Leslie Rd and Clearwater Ave 2042 AM (Site Folder: 2042)]

Site Category: Existing Design
Roundabout

Lane Queues (Distance)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (ft)	Back of Queue (ft) Av.	Back of Queue (ft) 95%	Queue at Start of Green (ft) Av.	Queue at Start of Green (ft) 95%	Cycle Average Queue (ft) Av.	Cycle Average Queue (ft) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.887	1.000	74.2	177.7	441.8	NA	NA	115.2	209.0	0.11	0.28	0.0	NA	NA
Lane 2		0.887	1.000	88.6	223.0	554.2	NA	NA	136.2	247.2	0.60	1.50	NA	18.6	1
Approach		0.887			223.0	554.2	NA	NA	136.2	247.2	0.11	0.28			
East: Ridgeline Drive															
Lane 1		0.607	1.000	8.8	42.2	105.0	NA	NA	22.7	41.2	0.31	0.78	NA	0.0	2
Lane 2		0.472	1.000	4.1	34.3	85.3	NA	NA	14.6	26.5	0.02	0.05	0.0	NA	NA
Approach		0.607			42.2	105.0	NA	NA	22.7	41.2	0.02	0.05			
North: Clearwater Avenue															
Lane 1		0.357	1.000	0.0	19.5	48.4	NA	NA	5.5	9.9	0.01	0.03	0.0	NA	NA
Lane 2		0.357	1.000	0.0	20.7	51.4	NA	NA	5.1	9.3	0.01	0.03	0.0	NA	NA
Approach		0.357			20.7	51.4	NA	NA	5.5	9.9	0.01	0.03			
West: Leslie Road															
Lane 1		0.718	1.000	15.7	75.5	187.5	NA	NA	32.4	58.8	0.05	0.12	0.0	NA	NA
Lane 2		0.471	1.000	3.0	30.5	75.8	NA	NA	12.1	21.9	0.02	0.05	0.0	NA	NA
Approach		0.718			75.5	187.5	NA	NA	32.4	58.8	0.05	0.12			
Intersection		0.887			223.0	554.2	NA	NA	136.2	247.2	0.11	0.28			

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Lane Queues (Vehicles)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (veh)	Back of Queue (veh) Av.	Back of Queue (veh) 95%	Queue at Start of Green (veh) Av.	Queue at Start of Green (veh) 95%	Cycle Average Queue (veh) Av.	Cycle Average Queue (veh) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.887	1.000	2.9	6.9	17.3	NA	NA	4.5	8.2	0.11	0.28	0.0	NA	NA
Lane 2		0.887	1.000	3.5	8.7	21.6	NA	NA	5.3	9.7	0.60	1.50	NA	18.6	1
Approach		0.887			8.7	21.6	NA	NA	5.3	9.7	0.11	0.28			
East: Ridgeline Drive															
Lane 1		0.607	1.000	0.3	1.6	4.1	NA	NA	0.9	1.6	0.31	0.78	NA	0.0	2
Lane 2		0.472	1.000	0.2	1.3	3.3	NA	NA	0.6	1.0	0.02	0.05	0.0	NA	NA
Approach		0.607			1.6	4.1	NA	NA	0.9	1.6	0.02	0.05			
North: Clearwater Avenue															
Lane 1		0.357	1.000	0.0	0.8	1.9	NA	NA	0.2	0.4	0.01	0.03	0.0	NA	NA
Lane 2		0.357	1.000	0.0	0.8	2.0	NA	NA	0.2	0.4	0.01	0.03	0.0	NA	NA
Approach		0.357			0.8	2.0	NA	NA	0.2	0.4	0.01	0.03			
West: Leslie Road															
Lane 1		0.718	1.000	0.6	2.9	7.3	NA	NA	1.3	2.3	0.05	0.12	0.0	NA	NA
Lane 2		0.471	1.000	0.1	1.2	3.0	NA	NA	0.5	0.9	0.02	0.05	0.0	NA	NA

Approach	0.718	2.9	7.3	NA	NA	1.3	2.3	0.05	0.12
Intersection	0.887	8.7	21.6	NA	NA	5.3	9.7	0.11	0.28

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Continuous Lane Performance

Lane Number	Deg. Satn	Unint. Speed	Unint. Travel Delay	Hdwy Spacing	Aver. Vehicle Length	Occup. Time	Space Time	Space Occup. Ratio	Time Occup. Ratio	Density		LOS (Density Method)
	v/c	mph	sec	sec	ft	ft	sec	sec	%	%	veh/mi	pc/mi	
South: Badger Road													
This approach does not have any continuous lanes													
East: Ridgeline Drive													
This approach does not have any continuous lanes													
North: Clearwater Avenue													
This approach does not have any continuous lanes													
West: Leslie Road													
This approach does not have any continuous lanes													

Midblock Effective Detection Zone Length = 7 ft

QUEUE ANALYSIS

Site: 101 [Leslie Rd and Clearwater Ave 2042 PM (Site Folder: 2042)]

Site Category: Existing Design
Roundabout

Lane Queues (Distance)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (ft)	Back of Queue (ft) Av.	Back of Queue (ft) 95%	Queue at Start of Green (ft) Av.	Queue at Start of Green (ft) 95%	Cycle Average Queue (ft) Av.	Cycle Average Queue (ft) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.654	1.000	16.9	79.2	196.8	NA	NA	37.1	67.3	0.05	0.12	0.0	NA	NA
Lane 2		0.975	1.000	175.7	343.4	853.4	NA	NA	240.7	436.7	0.93	2.31	NA	42.5	1
Approach		0.975			343.4	853.4	NA	NA	240.7	436.7	0.05	0.12			
East: Ridgeline Drive															
Lane 1		0.718	1.000	11.5	52.0	129.2	NA	NA	24.6	44.6	0.39	0.96	NA	3.7	2
Lane 2		0.658	1.000	8.8	51.2	127.1	NA	NA	20.9	37.9	0.03	0.08	0.0	NA	NA
Approach		0.718			52.0	129.2	NA	NA	24.6	44.6	0.03	0.08			
North: Clearwater Avenue															
Lane 1		0.787	1.000	21.7	78.7	195.5	NA	NA	40.0	72.5	0.05	0.12	0.0	NA	NA
Lane 2		0.787	1.000	22.4	87.8	218.3	NA	NA	40.8	73.9	0.05	0.14	0.0	NA	NA
Approach		0.787			87.8	218.3	NA	NA	40.8	73.9	0.05	0.14			
West: Leslie Road															
Lane 1		0.849	1.000	42.2	113.5	282.2	NA	NA	70.0	126.9	0.07	0.18	0.0	NA	NA
Lane 2		0.661	1.000	12.2	53.3	132.4	NA	NA	27.8	50.5	0.03	0.08	0.0	NA	NA
Approach		0.849			113.5	282.2	NA	NA	70.0	126.9	0.07	0.18			
Intersection		0.975			343.4	853.4	NA	NA	240.7	436.7	0.07	0.18			

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Lane Queues (Vehicles)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (veh)	Back of Queue (veh) Av.	Back of Queue (veh) 95%	Queue at Start of Green (veh) Av.	Queue at Start of Green (veh) 95%	Cycle Average Queue (veh) Av.	Cycle Average Queue (veh) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.654	1.000	0.7	3.1	7.7	NA	NA	1.4	2.6	0.05	0.12	0.0	NA	NA
Lane 2		0.975	1.000	6.9	13.4	33.3	NA	NA	9.4	17.1	0.93	2.31	NA	42.5	1
Approach		0.975			13.4	33.3	NA	NA	9.4	17.1	0.05	0.12			
East: Ridgeline Drive															
Lane 1		0.718	1.000	0.4	2.0	5.0	NA	NA	1.0	1.7	0.39	0.96	NA	3.7	2
Lane 2		0.658	1.000	0.3	2.0	5.0	NA	NA	0.8	1.5	0.03	0.08	0.0	NA	NA
Approach		0.718			2.0	5.0	NA	NA	1.0	1.7	0.03	0.08			
North: Clearwater Avenue															
Lane 1		0.787	1.000	0.8	3.1	7.6	NA	NA	1.6	2.8	0.05	0.12	0.0	NA	NA
Lane 2		0.787	1.000	0.9	3.4	8.5	NA	NA	1.6	2.9	0.05	0.14	0.0	NA	NA
Approach		0.787			3.4	8.5	NA	NA	1.6	2.9	0.05	0.14			
West: Leslie Road															
Lane 1		0.849	1.000	1.6	4.4	11.0	NA	NA	2.7	5.0	0.07	0.18	0.0	NA	NA
Lane 2		0.661	1.000	0.5	2.1	5.2	NA	NA	1.1	2.0	0.03	0.08	0.0	NA	NA

Approach	0.849	4.4	11.0	NA	NA	2.7	5.0	0.07	0.18
Intersection	0.975	13.4	33.3	NA	NA	9.4	17.1	0.07	0.18

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Continuous Lane Performance

Lane Number	Deg. Satn	Unint. Speed	Unint. Travel Delay	Hdwy Spacing	Aver. Vehicle Length	Occup. Time	Space Time	Space Occup. Ratio	Time Occup. Ratio	Density		LOS (Density Method)
	v/c	mph	sec	sec	ft	ft	sec	sec	%	%	veh/mi	pc/mi	
South: Badger Road													
This approach does not have any continuous lanes													
East: Ridgeline Drive													
This approach does not have any continuous lanes													
North: Clearwater Avenue													
This approach does not have any continuous lanes													
West: Leslie Road													
This approach does not have any continuous lanes													

Midblock Effective Detection Zone Length = 7 ft

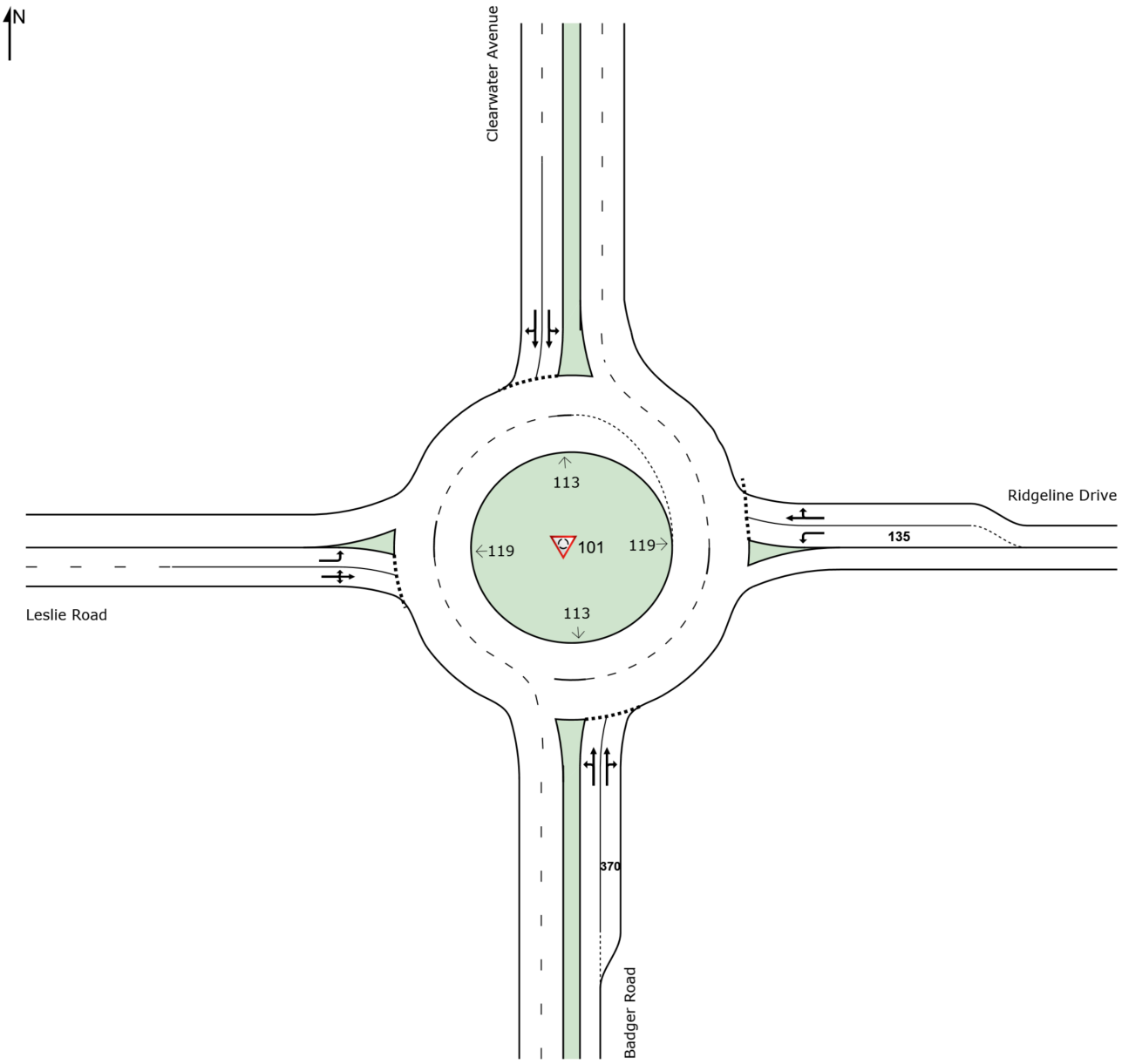
Appendix D: 2042 Analysis with Modified Eastbound Approach

SITE LAYOUT

Site: 101 [Leslie Rd and Clearwater Ave 2042 PM - Modified Geometry (Site Folder: 2042)]

Site Category: Dual EBLT Turn Lane
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101 [Leslie Rd and Clearwater Ave 2042 AM - Modified Geometry (Site Folder: 2042)]

Site Category: Dual EBLT Turn Lane
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] ft	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed mph
South: Badger Road														
3	L2	196	3.0	218	3.0	0.788	20.2	LOS C	7.9	201.1	0.92	1.12	1.41	33.9
8	T1	785	3.0	872	3.0	0.788	12.6	LOS B	8.5	218.8	0.92	1.11	1.37	35.8
18	R2	226	3.0	251	3.0	0.788	11.6	LOS B	8.5	218.8	0.92	1.10	1.34	34.6
Approach		1207	3.0	1341	3.0	0.788	13.6	LOS B	8.5	218.8	0.92	1.11	1.37	35.3
East: Ridgeline Drive														
1	L2	211	3.0	234	3.0	0.561	22.0	LOS C	3.6	92.8	0.90	1.06	1.21	30.5
6	T1	140	3.0	156	3.0	0.436	10.8	LOS B	2.9	75.2	0.90	0.99	1.05	34.6
16	R2	95	3.0	106	3.0	0.436	10.8	LOS B	2.9	75.2	0.90	0.99	1.05	34.3
Approach		446	3.0	496	3.0	0.561	16.1	LOS B	3.6	92.8	0.90	1.03	1.13	32.4
North: Clearwater Avenue														
7	L2	95	3.0	106	3.0	0.356	13.6	LOS B	1.9	48.1	0.65	0.71	0.65	36.8
4	T1	365	3.0	406	3.0	0.356	7.0	LOS A	2.0	51.0	0.64	0.67	0.64	38.1
14	R2	175	3.0	194	3.0	0.356	6.5	LOS A	2.0	51.0	0.63	0.63	0.63	36.4
Approach		635	3.0	706	3.0	0.356	7.9	LOS A	2.0	51.0	0.64	0.67	0.64	37.4
West: Leslie Road														
5	L2	475	3.0	528	3.0	0.598	16.0	LOS B	4.9	125.7	0.81	1.01	1.03	33.4
2	T1	160	3.0	178	3.0	0.598	8.5	LOS A	4.9	125.7	0.80	0.93	0.99	35.3
12	R2	308	3.0	342	3.0	0.598	8.5	LOS A	4.9	125.7	0.80	0.93	0.99	35.0
Approach		943	3.0	1048	3.0	0.598	12.3	LOS B	4.9	125.7	0.81	0.97	1.01	34.2
All Vehicles		3231	3.0	3590	3.0	0.788	12.4	LOS B	8.5	218.8	0.83	0.97	1.09	34.9

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). 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.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Leslie Rd and Clearwater Ave 2042 PM - Modified Geometry (Site Folder: 2042)]

Site Category: Dual EBLT Turn Lane
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] ft	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed mph
South: Badger Road														
3	L2	340	3.0	370	3.0	0.790	20.5	LOS C	8.1	207.8	0.93	1.14	1.42	33.0
8	T1	675	3.0	734	3.0	0.790	12.6	LOS B	8.9	226.7	0.93	1.12	1.38	35.7
18	R2	215	3.0	234	3.0	0.790	11.9	LOS B	8.9	226.7	0.93	1.11	1.36	34.5
Approach		1230	3.0	1337	3.0	0.790	14.6	LOS B	8.9	226.7	0.93	1.12	1.38	34.7
East: Ridgeline Drive														
1	L2	315	3.0	342	3.0	0.736	23.0	LOS C	5.7	146.1	0.94	1.14	1.43	30.2
6	T1	220	3.0	239	3.0	0.679	12.4	LOS B	5.7	145.4	0.95	1.10	1.32	33.7
16	R2	180	3.0	196	3.0	0.679	12.5	LOS B	5.7	145.4	0.95	1.10	1.32	33.4
Approach		715	3.0	777	3.0	0.736	17.1	LOS B	5.7	146.1	0.94	1.11	1.37	31.9
North: Clearwater Avenue														
7	L2	195	3.0	212	3.0	0.792	21.7	LOS C	7.8	198.8	0.93	1.15	1.49	33.1
4	T1	615	3.0	668	3.0	0.792	14.2	LOS B	8.7	222.1	0.93	1.14	1.46	34.8
14	R2	350	3.0	380	3.0	0.792	12.8	LOS B	8.7	222.1	0.94	1.13	1.43	33.9
Approach		1160	3.0	1261	3.0	0.792	15.0	LOS B	8.7	222.1	0.93	1.14	1.46	34.2
West: Leslie Road														
5	L2	265	3.0	288	3.0	0.607	21.1	LOS C	4.4	113.3	0.92	1.08	1.25	30.9
2	T1	265	3.0	288	3.0	0.908	26.6	LOS C	14.1	361.6	1.00	1.45	2.25	27.8
12	R2	295	3.0	321	3.0	0.908	26.6	LOS C	14.1	361.6	1.00	1.45	2.25	27.6
Approach		825	3.0	897	3.0	0.908	24.8	LOS C	14.1	361.6	0.97	1.33	1.93	28.7
All Vehicles		3930	3.0	4272	3.0	0.908	17.3	LOS B	14.1	361.6	0.94	1.17	1.52	32.6

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). 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.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

QUEUE ANALYSIS

Site: 101 [Leslie Rd and Clearwater Ave 2042 AM - Modified Geometry (Site Folder: 2042)]

Site Category: Dual EBLT Turn Lane
Roundabout

Lane Queues (Distance)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (ft)	Back of Queue (ft) Av.	Back of Queue (ft) 95%	Queue at Start of Green (ft) Av.	Queue at Start of Green (ft) 95%	Cycle Average Queue (ft) Av.	Cycle Average Queue (ft) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.788	1.000	20.6	80.9	201.1	NA	NA	37.7	68.3	0.05	0.13	0.0	NA	NA
Lane 2		0.788	1.000	20.4	88.0	218.8	NA	NA	37.1	67.4	0.24	0.59	NA	0.0	1
Approach		0.788			88.0	218.8	NA	NA	37.7	68.3	0.05	0.13			
East: Ridgeline Drive															
Lane 1		0.561	1.000	7.1	37.3	92.8	NA	NA	19.9	36.1	0.28	0.69	NA	0.0	2
Lane 2		0.436	1.000	3.0	30.3	75.2	NA	NA	13.0	23.6	0.02	0.05	0.0	NA	NA
Approach		0.561			37.3	92.8	NA	NA	19.9	36.1	0.02	0.05			
North: Clearwater Avenue															
Lane 1		0.356	1.000	0.0	19.4	48.1	NA	NA	5.5	9.9	0.01	0.03	0.0	NA	NA
Lane 2		0.356	1.000	0.0	20.5	51.0	NA	NA	5.1	9.3	0.01	0.03	0.0	NA	NA
Approach		0.356			20.5	51.0	NA	NA	5.5	9.9	0.01	0.03			
West: Leslie Road															
Lane 1		0.598	1.000	7.7	47.5	118.2	NA	NA	20.2	36.6	0.03	0.07	0.0	NA	NA
Lane 2		0.598	1.000	7.3	50.6	125.7	NA	NA	19.6	35.5	0.03	0.08	0.0	NA	NA
Approach		0.598			50.6	125.7	NA	NA	20.2	36.6	0.03	0.08			
Intersection		0.788			88.0	218.8	NA	NA	37.7	68.3	0.05	0.13			

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Lane Queues (Vehicles)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (veh)	Back of Queue (veh) Av.	Back of Queue (veh) 95%	Queue at Start of Green (veh) Av.	Queue at Start of Green (veh) 95%	Cycle Average Queue (veh) Av.	Cycle Average Queue (veh) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.788	1.000	0.8	3.2	7.9	NA	NA	1.5	2.7	0.05	0.13	0.0	NA	NA
Lane 2		0.788	1.000	0.8	3.4	8.5	NA	NA	1.5	2.6	0.24	0.59	NA	0.0	1
Approach		0.788			3.4	8.5	NA	NA	1.5	2.7	0.05	0.13			
East: Ridgeline Drive															
Lane 1		0.561	1.000	0.3	1.5	3.6	NA	NA	0.8	1.4	0.28	0.69	NA	0.0	2
Lane 2		0.436	1.000	0.1	1.2	2.9	NA	NA	0.5	0.9	0.02	0.05	0.0	NA	NA
Approach		0.561			1.5	3.6	NA	NA	0.8	1.4	0.02	0.05			
North: Clearwater Avenue															
Lane 1		0.356	1.000	0.0	0.8	1.9	NA	NA	0.2	0.4	0.01	0.03	0.0	NA	NA
Lane 2		0.356	1.000	0.0	0.8	2.0	NA	NA	0.2	0.4	0.01	0.03	0.0	NA	NA
Approach		0.356			0.8	2.0	NA	NA	0.2	0.4	0.01	0.03			
West: Leslie Road															
Lane 1		0.598	1.000	0.3	1.9	4.6	NA	NA	0.8	1.4	0.03	0.07	0.0	NA	NA
Lane 2		0.598	1.000	0.3	2.0	4.9	NA	NA	0.8	1.4	0.03	0.08	0.0	NA	NA

Approach	0.598	2.0	4.9	NA	NA	0.8	1.4	0.03	0.08
Intersection	0.788	3.4	8.5	NA	NA	1.5	2.7	0.05	0.13

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Continuous Lane Performance

Lane Number	Deg. Satn	Unint. Speed	Unint. Travel Delay	Hdwy Spacing	Aver. Vehicle Length	Occup. Time	Space Time	Space Occup. Ratio	Time Occup. Ratio	Density		LOS (Density Method)
	v/c	mph	sec	sec	ft	ft	sec	sec	%	%	veh/mi	pc/mi	
South: Badger Road													
This approach does not have any continuous lanes													
East: Ridgeline Drive													
This approach does not have any continuous lanes													
North: Clearwater Avenue													
This approach does not have any continuous lanes													
West: Leslie Road													
This approach does not have any continuous lanes													

Midblock Effective Detection Zone Length = 7 ft

QUEUE ANALYSIS

Site: 101 [Leslie Rd and Clearwater Ave 2042 PM - Modified Geometry (Site Folder: 2042)]

Site Category: Dual EBLT Turn Lane
Roundabout

Lane Queues (Distance)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (ft)	Back of Queue (ft) Av.	Back of Queue (ft) 95%	Queue at Start of Green (ft) Av.	Queue at Start of Green (ft) 95%	Cycle Average Queue (ft) Av.	Cycle Average Queue (ft) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.790	1.000	21.3	83.6	207.8	NA	NA	38.7	70.2	0.05	0.13	0.0	NA	NA
Lane 2		0.790	1.000	21.3	91.2	226.7	NA	NA	38.4	69.7	0.25	0.61	NA	0.0	1
Approach		0.790			91.2	226.7	NA	NA	38.7	70.2	0.05	0.13			
East: Ridgeline Drive															
Lane 1		0.736	1.000	15.3	58.8	146.1	NA	NA	31.4	57.0	0.44	1.08	NA	7.4	2
Lane 2		0.679	1.000	12.3	58.5	145.4	NA	NA	26.8	48.6	0.04	0.09	0.0	NA	NA
Approach		0.736			58.8	146.1	NA	NA	31.4	57.0	0.04	0.09			
North: Clearwater Avenue															
Lane 1		0.792	1.000	22.3	80.0	198.8	NA	NA	40.7	73.9	0.05	0.12	0.0	NA	NA
Lane 2		0.792	1.000	23.1	89.4	222.1	NA	NA	41.5	75.4	0.06	0.14	0.0	NA	NA
Approach		0.792			89.4	222.1	NA	NA	41.5	75.4	0.06	0.14			
West: Leslie Road															
Lane 1		0.607	1.000	9.0	45.6	113.3	NA	NA	22.5	40.9	0.03	0.07	0.0	NA	NA
Lane 2		0.908	1.000	65.0	145.5	361.6	NA	NA	98.8	179.3	0.09	0.23	0.0	NA	NA
Approach		0.908			145.5	361.6	NA	NA	98.8	179.3	0.09	0.23			
Intersection		0.908			145.5	361.6	NA	NA	98.8	179.3	0.09	0.23			

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Lane Queues (Vehicles)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (veh)	Back of Queue (veh) Av.	Back of Queue (veh) 95%	Queue at Start of Green (veh) Av.	Queue at Start of Green (veh) 95%	Cycle Average Queue (veh) Av.	Cycle Average Queue (veh) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.790	1.000	0.8	3.3	8.1	NA	NA	1.5	2.7	0.05	0.13	0.0	NA	NA
Lane 2		0.790	1.000	0.8	3.6	8.9	NA	NA	1.5	2.7	0.25	0.61	NA	0.0	1
Approach		0.790			3.6	8.9	NA	NA	1.5	2.7	0.05	0.13			
East: Ridgeline Drive															
Lane 1		0.736	1.000	0.6	2.3	5.7	NA	NA	1.2	2.2	0.44	1.08	NA	7.4	2
Lane 2		0.679	1.000	0.5	2.3	5.7	NA	NA	1.0	1.9	0.04	0.09	0.0	NA	NA
Approach		0.736			2.3	5.7	NA	NA	1.2	2.2	0.04	0.09			
North: Clearwater Avenue															
Lane 1		0.792	1.000	0.9	3.1	7.8	NA	NA	1.6	2.9	0.05	0.12	0.0	NA	NA
Lane 2		0.792	1.000	0.9	3.5	8.7	NA	NA	1.6	2.9	0.06	0.14	0.0	NA	NA
Approach		0.792			3.5	8.7	NA	NA	1.6	2.9	0.06	0.14			
West: Leslie Road															
Lane 1		0.607	1.000	0.4	1.8	4.4	NA	NA	0.9	1.6	0.03	0.07	0.0	NA	NA
Lane 2		0.908	1.000	2.5	5.7	14.1	NA	NA	3.9	7.0	0.09	0.23	0.0	NA	NA

Approach	0.908	5.7	14.1	NA	NA	3.9	7.0	0.09	0.23
Intersection	0.908	5.7	14.1	NA	NA	3.9	7.0	0.09	0.23

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Continuous Lane Performance

Lane Number	Deg. Satn	Unint. Speed	Unint. Travel Delay	Hdwy Spacing	Aver. Vehicle Length	Occup. Time	Space Time	Space Occup. Ratio	Time Occup. Ratio	Density		LOS (Density Method)
	v/c	mph	sec	sec	ft	ft	sec	sec	%	%	veh/mi	pc/mi	
South: Badger Road													
This approach does not have any continuous lanes													
East: Ridgeline Drive													
This approach does not have any continuous lanes													
North: Clearwater Avenue													
This approach does not have any continuous lanes													
West: Leslie Road													
This approach does not have any continuous lanes													

Midblock Effective Detection Zone Length = 7 ft

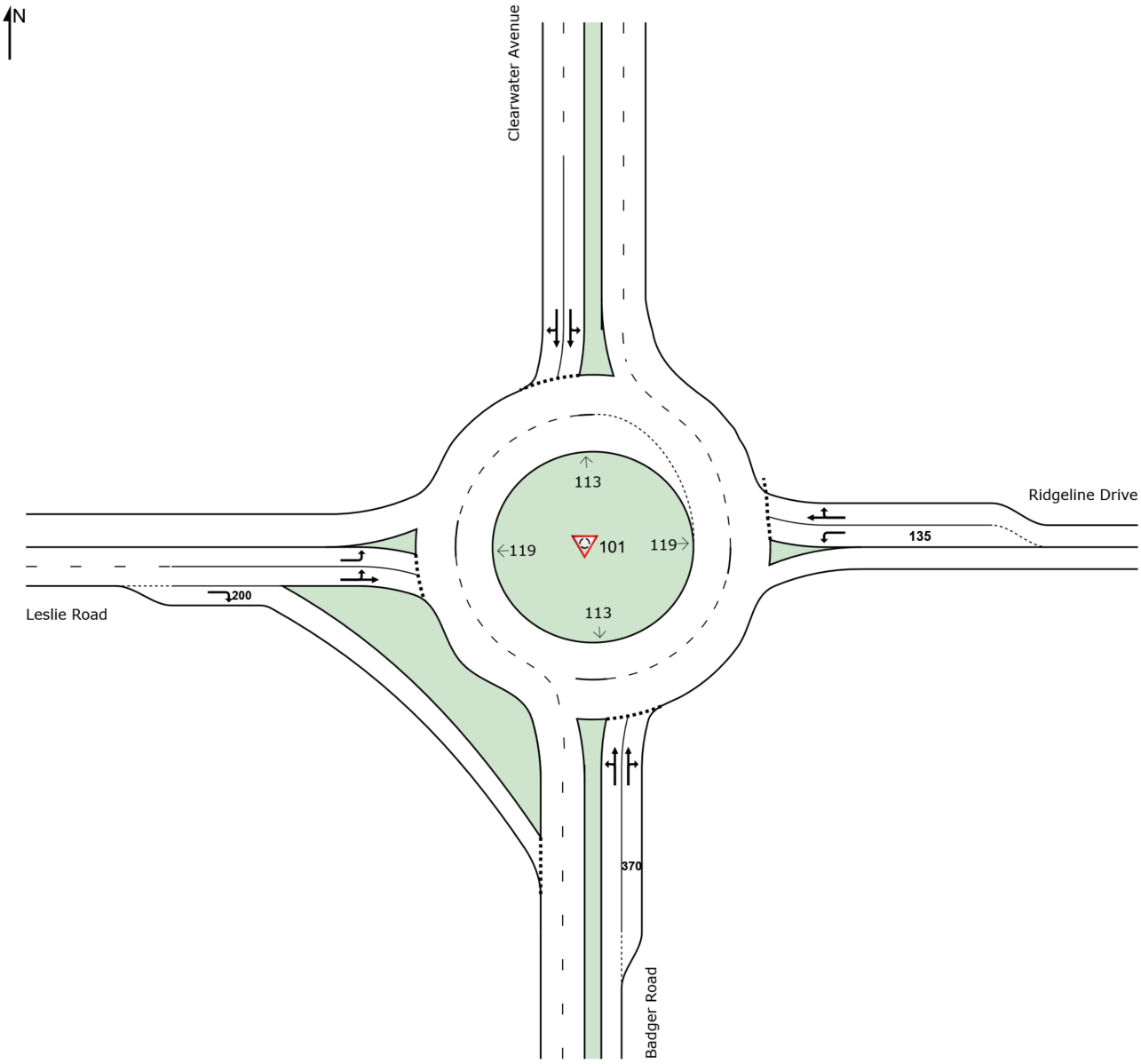
Appendix E: 2042 Analysis with Modified Eastbound Approach and Eastbound Right-turn Lane

SITE LAYOUT

Site: 101 [Leslie Rd and Clearwater Ave 2042 PM - EB RT Bypass Lane (Site Folder: 2042)]

Site Category: Dual EBLT Turn Lane plus right turn bypass lane
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101 [Leslie Rd and Clearwater Ave 2042 AM - EB RT Bypass Lane (Site Folder: 2042)]

Site Category: Dual EBLT Turn Lane plus right turn bypass lane
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] ft	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed mph
South: Badger Road														
3	L2	196	3.0	218	3.0	0.775	20.3	LOS C	7.7	196.9	0.91	1.12	1.39	33.9
8	T1	785	3.0	872	3.0	0.775	12.7	LOS B	8.4	214.5	0.91	1.10	1.35	35.8
18	R2	226	3.0	251	3.0	0.775	11.7	LOS B	8.4	214.5	0.91	1.09	1.32	34.6
Approach		1207	3.0	1341	3.0	0.775	13.7	LOS B	8.4	214.5	0.91	1.10	1.35	35.2
East: Ridgeline Drive														
1	L2	211	3.0	234	3.0	0.511	18.6	LOS B	2.9	75.1	0.85	1.02	1.08	31.9
6	T1	140	3.0	156	3.0	0.394	8.7	LOS A	2.4	60.2	0.85	0.89	0.94	35.4
16	R2	95	3.0	106	3.0	0.394	8.7	LOS A	2.4	60.2	0.85	0.89	0.94	35.1
Approach		446	3.0	496	3.0	0.511	13.4	LOS B	2.9	75.1	0.85	0.95	1.01	33.6
North: Clearwater Avenue														
7	L2	95	3.0	106	3.0	0.355	13.6	LOS B	1.9	47.5	0.64	0.71	0.64	36.8
4	T1	365	3.0	406	3.0	0.355	7.0	LOS A	2.0	50.3	0.63	0.67	0.63	38.1
14	R2	175	3.0	194	3.0	0.355	6.5	LOS A	2.0	50.3	0.62	0.63	0.62	36.4
Approach		635	3.0	706	3.0	0.355	7.9	LOS A	2.0	50.3	0.63	0.67	0.63	37.5
West: Leslie Road														
5	L2	475	3.0	528	3.0	0.323	12.5	LOS B	2.0	50.9	0.68	0.78	0.68	34.9
2	T1	160	3.0	178	3.0	0.323	5.7	LOS A	2.0	50.9	0.67	0.70	0.67	34.8
12	R2	308	3.0	342	3.0	0.253	5.3	LOS A	1.4	36.6	0.59	0.61	0.59	36.6
Approach		943	3.0	1048	3.0	0.323	9.0	LOS A	2.0	50.9	0.65	0.71	0.65	35.4
All Vehicles		3231	3.0	3590	3.0	0.775	11.1	LOS B	8.4	214.5	0.77	0.88	0.96	35.4

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). 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.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Leslie Rd and Clearwater Ave 2042 PM - EB RT Bypass Lane (Site Folder: 2042)]

Site Category: Dual EBLT Turn Lane plus right turn bypass lane
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] ft	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed mph
South: Badger Road														
3	L2	340	3.0	370	3.0	0.788	21.0	LOS C	8.3	213.5	0.94	1.14	1.44	32.8
8	T1	675	3.0	734	3.0	0.788	13.1	LOS B	9.1	233.7	0.94	1.13	1.40	35.4
18	R2	215	3.0	234	3.0	0.788	12.3	LOS B	9.1	233.7	0.94	1.12	1.38	34.2
Approach		1230	3.0	1337	3.0	0.788	15.1	LOS B	9.1	233.7	0.94	1.13	1.41	34.5
East: Ridgeline Drive														
1	L2	315	3.0	342	3.0	0.703	21.0	LOS C	5.1	130.3	0.91	1.10	1.33	30.9
6	T1	220	3.0	239	3.0	0.647	11.1	LOS B	5.1	129.3	0.92	1.06	1.23	34.4
16	R2	180	3.0	196	3.0	0.647	11.1	LOS B	5.1	129.3	0.92	1.06	1.23	34.1
Approach		715	3.0	777	3.0	0.703	15.4	LOS B	5.1	130.3	0.92	1.08	1.28	32.7
North: Clearwater Avenue														
7	L2	195	3.0	212	3.0	0.788	21.6	LOS C	7.7	196.1	0.93	1.14	1.48	33.2
4	T1	615	3.0	668	3.0	0.788	14.0	LOS B	8.5	218.8	0.93	1.14	1.45	34.9
14	R2	350	3.0	380	3.0	0.788	12.7	LOS B	8.5	218.8	0.93	1.13	1.42	34.0
Approach		1160	3.0	1261	3.0	0.788	14.9	LOS B	8.5	218.8	0.93	1.13	1.44	34.3
West: Leslie Road														
5	L2	265	3.0	288	3.0	0.378	15.1	LOS B	2.8	71.4	0.87	0.92	0.92	33.8
2	T1	265	3.0	288	3.0	0.378	7.2	LOS A	2.8	71.4	0.90	0.72	0.90	34.8
12	R2	295	3.0	321	3.0	0.296	6.1	LOS A	1.9	49.8	0.78	0.71	0.78	36.1
Approach		825	3.0	897	3.0	0.378	9.4	LOS A	2.8	71.4	0.85	0.78	0.86	34.9
All Vehicles		3930	3.0	4272	3.0	0.788	13.9	LOS B	9.1	233.7	0.91	1.05	1.28	34.2

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). 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.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

QUEUE ANALYSIS

Site: 101 [Leslie Rd and Clearwater Ave 2042 AM - EB RT Bypass Lane (Site Folder: 2042)]

Site Category: Dual EBLT Turn Lane plus right turn by-pass lane
Roundabout

Lane Queues (Distance)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (ft)	Back of Queue (ft) Av.	Back of Queue (ft) 95%	Queue at Start of Green (ft) Av.	Queue at Start of Green (ft) 95%	Cycle Average Queue (ft) Av.	Cycle Average Queue (ft) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.775	1.000	20.2	79.2	196.9	NA	NA	37.9	68.7	0.05	0.12	0.0	NA	NA
Lane 2		0.775	1.000	20.2	86.3	214.5	NA	NA	37.7	68.4	0.23	0.58	NA	0.0	1
Approach		0.775			86.3	214.5	NA	NA	37.9	68.7	0.05	0.12			
East: Ridgeline Drive															
Lane 1		0.511	1.000	4.5	30.2	75.1	NA	NA	14.2	25.8	0.22	0.56	NA	0.0	2
Lane 2		0.394	1.000	1.6	24.2	60.2	NA	NA	9.1	16.5	0.02	0.04	0.0	NA	NA
Approach		0.511			30.2	75.1	NA	NA	14.2	25.8	0.02	0.04			
North: Clearwater Avenue															
Lane 1		0.355	1.000	0.0	19.1	47.5	NA	NA	5.5	9.9	0.01	0.03	0.0	NA	NA
Lane 2		0.355	1.000	0.0	20.2	50.3	NA	NA	5.1	9.3	0.01	0.03	0.0	NA	NA
Approach		0.355			20.2	50.3	NA	NA	5.5	9.9	0.01	0.03			
West: Leslie Road															
Lane 1		0.323	1.000	0.0	18.4	45.7	NA	NA	6.0	10.8	0.01	0.03	0.0	NA	NA
Lane 2		0.323	1.000	0.0	20.5	50.9	NA	NA	5.7	10.4	0.01	0.03	0.0	NA	NA
Lane 3		0.253	1.000	0.0	14.7	36.6	NA	NA	3.7	6.7	0.07	0.18	NA	0.0	2
Approach		0.323			20.5	50.9	NA	NA	6.0	10.8	0.01	0.03			
Intersection		0.775			86.3	214.5	NA	NA	37.9	68.7	0.05	0.12			

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Lane Queues (Vehicles)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (veh)	Back of Queue (veh) Av.	Back of Queue (veh) 95%	Queue at Start of Green (veh) Av.	Queue at Start of Green (veh) 95%	Cycle Average Queue (veh) Av.	Cycle Average Queue (veh) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.775	1.000	0.8	3.1	7.7	NA	NA	1.5	2.7	0.05	0.12	0.0	NA	NA
Lane 2		0.775	1.000	0.8	3.4	8.4	NA	NA	1.5	2.7	0.23	0.58	NA	0.0	1
Approach		0.775			3.4	8.4	NA	NA	1.5	2.7	0.05	0.12			
East: Ridgeline Drive															
Lane 1		0.511	1.000	0.2	1.2	2.9	NA	NA	0.6	1.0	0.22	0.56	NA	0.0	2
Lane 2		0.394	1.000	0.1	0.9	2.4	NA	NA	0.4	0.6	0.02	0.04	0.0	NA	NA
Approach		0.511			1.2	2.9	NA	NA	0.6	1.0	0.02	0.04			
North: Clearwater Avenue															
Lane 1		0.355	1.000	0.0	0.7	1.9	NA	NA	0.2	0.4	0.01	0.03	0.0	NA	NA
Lane 2		0.355	1.000	0.0	0.8	2.0	NA	NA	0.2	0.4	0.01	0.03	0.0	NA	NA
Approach		0.355			0.8	2.0	NA	NA	0.2	0.4	0.01	0.03			
West: Leslie Road															
Lane 1		0.323	1.000	0.0	0.7	1.8	NA	NA	0.2	0.4	0.01	0.03	0.0	NA	NA

Lane 2	0.323	1.000	0.0	0.8	2.0	NA	NA	0.2	0.4	0.01	0.03	0.0	NA	NA
Lane 3	0.253	1.000	0.0	0.6	1.4	NA	NA	0.1	0.3	0.07	0.18	NA	0.0	2
Approach	0.323			0.8	2.0	NA	NA	0.2	0.4	0.01	0.03			
Intersection	0.775			3.4	8.4	NA	NA	1.5	2.7	0.05	0.12			

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Continuous Lane Performance

Lane Number	Deg. Satn	Unint. Speed	Unint. Travel Delay	Hdwy Spacing		Aver. Vehicle Length	Occup. Time	Space Time	Space Occup. Ratio	Time Occup. Ratio	Density		LOS (Density Method)
	v/c	mph	sec	sec	ft	ft	sec	sec	%	%	veh/mi	pc/mi	
South: Badger Road													
This approach does not have any continuous lanes													
East: Ridgeline Drive													
This approach does not have any continuous lanes													
North: Clearwater Avenue													
This approach does not have any continuous lanes													
West: Leslie Road													
This approach does not have any continuous lanes													

Midblock Effective Detection Zone Length = 7 ft

QUEUE ANALYSIS

Site: 101 [Leslie Rd and Clearwater Ave 2042 PM - EB RT Bypass Lane (Site Folder: 2042)]

Site Category: Dual EBLT Turn Lane plus right turn by-pas lane
Roundabout

Lane Queues (Distance)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (ft)	Back of Queue (ft) Av.	Back of Queue (ft) 95%	Queue at Start of Green (ft) Av.	Queue at Start of Green (ft) 95%	Cycle Average Queue (ft) Av.	Cycle Average Queue (ft) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.788	1.000	22.5	85.9	213.5	NA	NA	40.8	74.0	0.05	0.13	0.0	NA	NA
Lane 2		0.788	1.000	22.7	94.0	233.7	NA	NA	41.0	74.4	0.25	0.63	NA	0.0	1
Approach		0.788			94.0	233.7	NA	NA	41.0	74.4	0.05	0.13			
East: Ridgeline Drive															
Lane 1		0.703	1.000	12.2	52.4	130.3	NA	NA	26.6	48.2	0.39	0.97	NA	4.0	2
Lane 2		0.647	1.000	9.8	52.0	129.3	NA	NA	22.5	40.8	0.03	0.08	0.0	NA	NA
Approach		0.703			52.4	130.3	NA	NA	26.6	48.2	0.03	0.08			
North: Clearwater Avenue															
Lane 1		0.788	1.000	21.9	78.9	196.1	NA	NA	40.1	72.8	0.05	0.12	0.0	NA	NA
Lane 2		0.788	1.000	22.5	88.1	218.8	NA	NA	40.9	74.2	0.06	0.14	0.0	NA	NA
Approach		0.788			88.1	218.8	NA	NA	40.9	74.2	0.06	0.14			
West: Leslie Road															
Lane 1		0.378	1.000	1.1	24.7	61.4	NA	NA	8.9	16.1	0.02	0.04	0.0	NA	NA
Lane 2		0.378	1.000	0.0	28.7	71.4	NA	NA	8.6	15.6	0.02	0.04	0.0	NA	NA
Lane 3		0.296	1.000	0.0	20.0	49.8	NA	NA	5.4	9.8	0.10	0.25	NA	0.0	2
Approach		0.378			28.7	71.4	NA	NA	8.9	16.1	0.02	0.04			
Intersection		0.788			94.0	233.7	NA	NA	41.0	74.4	0.06	0.14			

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Lane Queues (Vehicles)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (veh)	Back of Queue (veh) Av.	Back of Queue (veh) 95%	Queue at Start of Green (veh) Av.	Queue at Start of Green (veh) 95%	Cycle Average Queue (veh) Av.	Cycle Average Queue (veh) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.788	1.000	0.9	3.4	8.3	NA	NA	1.6	2.9	0.05	0.13	0.0	NA	NA
Lane 2		0.788	1.000	0.9	3.7	9.1	NA	NA	1.6	2.9	0.25	0.63	NA	0.0	1
Approach		0.788			3.7	9.1	NA	NA	1.6	2.9	0.05	0.13			
East: Ridgeline Drive															
Lane 1		0.703	1.000	0.5	2.0	5.1	NA	NA	1.0	1.9	0.39	0.97	NA	4.0	2
Lane 2		0.647	1.000	0.4	2.0	5.1	NA	NA	0.9	1.6	0.03	0.08	0.0	NA	NA
Approach		0.703			2.0	5.1	NA	NA	1.0	1.9	0.03	0.08			
North: Clearwater Avenue															
Lane 1		0.788	1.000	0.9	3.1	7.7	NA	NA	1.6	2.8	0.05	0.12	0.0	NA	NA
Lane 2		0.788	1.000	0.9	3.4	8.5	NA	NA	1.6	2.9	0.06	0.14	0.0	NA	NA
Approach		0.788			3.4	8.5	NA	NA	1.6	2.9	0.06	0.14			
West: Leslie Road															
Lane 1		0.378	1.000	0.0	1.0	2.4	NA	NA	0.3	0.6	0.02	0.04	0.0	NA	NA

Lane 2	0.378	1.000	0.0	1.1	2.8	NA	NA	0.3	0.6	0.02	0.04	0.0	NA	NA
Lane 3	0.296	1.000	0.0	0.8	1.9	NA	NA	0.2	0.4	0.10	0.25	NA	0.0	2
Approach	0.378			1.1	2.8	NA	NA	0.3	0.6	0.02	0.04			
Intersection	0.788			3.7	9.1	NA	NA	1.6	2.9	0.06	0.14			

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Continuous Lane Performance

Lane Number	Deg. Satn v/c	Unint. Speed mph	Unint. Travel Delay sec	Hdwy Spacing sec	Hdwy Spacing ft	Aver. Vehicle Length ft	Occup. Time sec	Space Time sec	Space Occup. Ratio %	Time Occup. Ratio %	Density veh/mi	Density pc/mi	LOS (Density Method)
South: Badger Road													
This approach does not have any continuous lanes													
East: Ridgeline Drive													
This approach does not have any continuous lanes													
North: Clearwater Avenue													
This approach does not have any continuous lanes													
West: Leslie Road													
This approach does not have any continuous lanes													

Midblock Effective Detection Zone Length = 7 ft

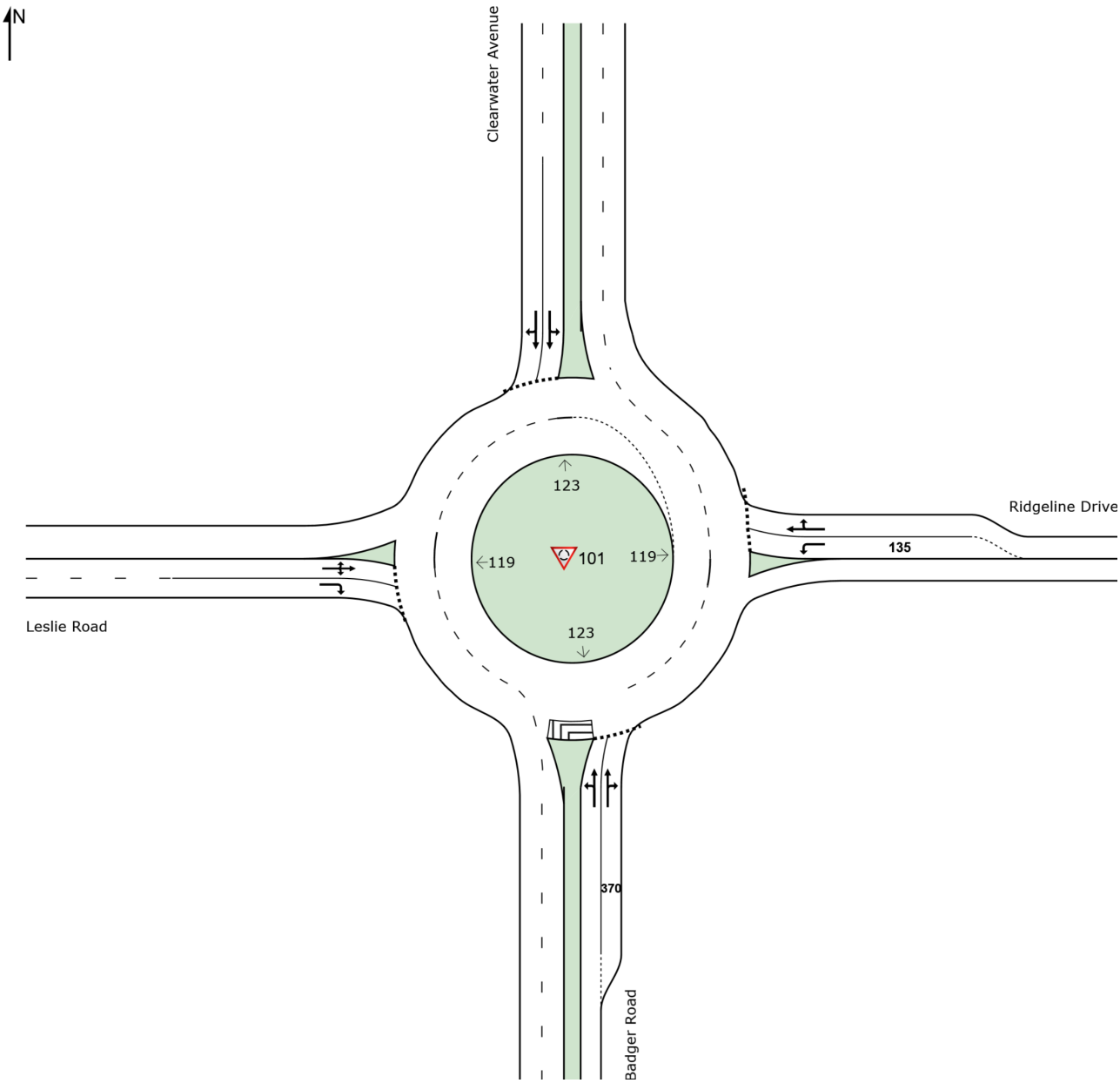
Appendix F: 2032 Analysis with Existing Lane Configuration

SITE LAYOUT

Site: 101 [Leslie Rd and Clearwater Ave

Site Category: Existing Design
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101 [Leslie Rd and Clearwater Ave 2032 AM (Site Folder: 2032)]

Site Category: Existing Design
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] ft	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed mph
South: Badger Road														
3	L2	155	3.0	172	3.0	0.607	19.5	LOS B	6.5	166.4	0.96	1.01	1.21	34.4
8	T1	685	3.0	761	3.0	0.607	11.3	LOS B	7.3	186.5	0.97	0.95	1.17	36.5
18	R2	170	3.0	189	3.0	0.607	10.3	LOS B	7.3	186.5	0.97	0.92	1.14	35.1
Approach		1010	3.0	1122	3.0	0.607	12.4	LOS B	7.3	186.5	0.97	0.96	1.17	35.9
East: Ridgeline Drive														
1	L2	165	3.0	183	3.0	0.382	16.6	LOS B	2.1	54.9	0.84	0.98	0.93	32.8
6	T1	115	3.0	128	3.0	0.297	8.0	LOS A	1.8	44.9	0.84	0.80	0.84	35.5
16	R2	60	3.0	67	3.0	0.297	8.0	LOS A	1.8	44.9	0.84	0.80	0.84	35.2
Approach		340	3.0	378	3.0	0.382	12.2	LOS B	2.1	54.9	0.84	0.89	0.89	34.1
North: Clearwater Avenue														
7	L2	55	3.0	61	3.0	0.267	13.1	LOS B	1.3	34.1	0.56	0.63	0.56	37.5
4	T1	325	3.0	361	3.0	0.267	6.5	LOS A	1.4	35.6	0.55	0.61	0.55	38.6
14	R2	135	3.0	150	3.0	0.267	6.1	LOS A	1.4	35.6	0.54	0.59	0.54	36.7
Approach		515	3.0	572	3.0	0.267	7.1	LOS A	1.4	35.6	0.55	0.61	0.55	38.0
West: Leslie Road														
5	L2	405	3.0	450	3.0	0.566	13.7	LOS B	4.3	111.3	0.73	0.87	0.85	34.9
2	T1	140	3.0	156	3.0	0.566	7.0	LOS A	4.3	111.3	0.73	0.87	0.85	34.1
12	R2	250	3.0	278	3.0	0.350	7.0	LOS A	1.8	46.8	0.66	0.78	0.66	36.3
Approach		795	3.0	883	3.0	0.566	10.4	LOS B	4.3	111.3	0.71	0.84	0.79	35.2
All Vehicles		2660	3.0	2956	3.0	0.607	10.7	LOS B	7.3	186.5	0.79	0.85	0.90	35.8

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). 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.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Leslie Rd and Clearwater Ave 2032 PM (Site Folder: 2032)]

Site Category: Existing Design
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] ft	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed mph
South: Badger Road														
3	L2	280	3.0	304	3.0	0.437	15.8	LOS B	3.5	89.5	0.86	0.86	0.88	34.7
8	T1	580	3.0	630	3.0	0.653	10.5	LOS B	8.5	216.5	0.96	0.92	1.16	37.2
18	R2	145	3.0	158	3.0	0.653	10.6	LOS B	8.5	216.5	0.97	0.93	1.18	35.1
Approach		1005	3.0	1092	3.0	0.653	12.0	LOS B	8.5	216.5	0.93	0.91	1.08	36.1
East: Ridgeline Drive														
1	L2	255	3.0	277	3.0	0.476	15.0	LOS B	2.7	69.3	0.81	0.98	0.94	33.5
6	T1	175	3.0	190	3.0	0.403	6.9	LOS A	2.4	60.2	0.80	0.73	0.85	35.8
16	R2	110	3.0	120	3.0	0.403	7.0	LOS A	2.4	60.2	0.80	0.73	0.85	35.4
Approach		540	3.0	587	3.0	0.476	10.8	LOS B	2.7	69.3	0.80	0.85	0.90	34.6
North: Clearwater Avenue														
7	L2	140	3.0	152	3.0	0.578	16.3	LOS B	4.1	104.7	0.78	0.94	0.97	36.1
4	T1	535	3.0	582	3.0	0.578	9.3	LOS A	4.4	111.9	0.78	0.90	0.95	37.4
14	R2	295	3.0	321	3.0	0.578	8.5	LOS A	4.4	111.9	0.77	0.86	0.92	35.9
Approach		970	3.0	1054	3.0	0.578	10.0	LOS B	4.4	111.9	0.78	0.90	0.94	36.7
West: Leslie Road														
5	L2	215	3.0	234	3.0	0.581	16.2	LOS B	4.7	121.1	0.88	1.03	1.11	34.6
2	T1	220	3.0	239	3.0	0.581	9.5	LOS A	4.7	121.1	0.88	1.03	1.11	33.8
12	R2	230	3.0	250	3.0	0.422	9.8	LOS A	2.5	65.1	0.81	0.93	0.92	34.7
Approach		665	3.0	723	3.0	0.581	11.8	LOS B	4.7	121.1	0.86	1.00	1.04	34.4
All Vehicles		3180	3.0	3457	3.0	0.653	11.1	LOS B	8.5	216.5	0.85	0.91	1.00	35.7

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). 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.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

QUEUE ANALYSIS

Site: 101 [Leslie Rd and Clearwater Ave 2032 AM (Site Folder: 2032)]

Site Category: Existing Design
Roundabout

Lane Queues (Distance)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (ft)	Back of Queue (ft) Av.	Back of Queue (ft) 95%	Queue at Start of Green (ft) Av.	Queue at Start of Green (ft) 95%	Cycle Average Queue (ft) Av.	Cycle Average Queue (ft) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.607	1.000	10.9	67.0	166.4	NA	NA	27.6	50.0	0.04	0.10	0.0	NA	NA
Lane 2		0.607	1.000	9.4	75.0	186.5	NA	NA	27.3	49.5	0.20	0.50	NA	0.0	1
Approach		0.607			75.0	186.5	NA	NA	27.6	50.0	0.04	0.10			
East: Ridgeline Drive															
Lane 1		0.382	1.000	1.5	22.1	54.9	NA	NA	8.6	15.6	0.16	0.41	NA	0.0	2
Lane 2		0.297	1.000	0.0	18.1	44.9	NA	NA	5.8	10.5	0.01	0.03	0.0	NA	NA
Approach		0.382			22.1	54.9	NA	NA	8.6	15.6	0.01	0.03			
North: Clearwater Avenue															
Lane 1		0.267	1.000	0.0	13.7	34.1	NA	NA	3.4	6.2	0.01	0.02	0.0	NA	NA
Lane 2		0.267	1.000	0.0	14.3	35.6	NA	NA	3.2	5.7	0.01	0.02	0.0	NA	NA
Approach		0.267			14.3	35.6	NA	NA	3.4	6.2	0.01	0.02			
West: Leslie Road															
Lane 1		0.566	1.000	4.8	44.8	111.3	NA	NA	15.3	27.8	0.03	0.07	0.0	NA	NA
Lane 2		0.350	1.000	0.0	18.8	46.8	NA	NA	6.3	11.5	0.01	0.03	0.0	NA	NA
Approach		0.566			44.8	111.3	NA	NA	15.3	27.8	0.03	0.07			
Intersection		0.607			75.0	186.5	NA	NA	27.6	50.0	0.04	0.10			

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Lane Queues (Vehicles)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (veh)	Back of Queue (veh) Av.	Back of Queue (veh) 95%	Queue at Start of Green (veh) Av.	Queue at Start of Green (veh) 95%	Cycle Average Queue (veh) Av.	Cycle Average Queue (veh) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.607	1.000	0.4	2.6	6.5	NA	NA	1.1	2.0	0.04	0.10	0.0	NA	NA
Lane 2		0.607	1.000	0.4	2.9	7.3	NA	NA	1.1	1.9	0.20	0.50	NA	0.0	1
Approach		0.607			2.9	7.3	NA	NA	1.1	2.0	0.04	0.10			
East: Ridgeline Drive															
Lane 1		0.382	1.000	0.1	0.9	2.1	NA	NA	0.3	0.6	0.16	0.41	NA	0.0	2
Lane 2		0.297	1.000	0.0	0.7	1.8	NA	NA	0.2	0.4	0.01	0.03	0.0	NA	NA
Approach		0.382			0.9	2.1	NA	NA	0.3	0.6	0.01	0.03			
North: Clearwater Avenue															
Lane 1		0.267	1.000	0.0	0.5	1.3	NA	NA	0.1	0.2	0.01	0.02	0.0	NA	NA
Lane 2		0.267	1.000	0.0	0.6	1.4	NA	NA	0.1	0.2	0.01	0.02	0.0	NA	NA
Approach		0.267			0.6	1.4	NA	NA	0.1	0.2	0.01	0.02			
West: Leslie Road															
Lane 1		0.566	1.000	0.2	1.7	4.3	NA	NA	0.6	1.1	0.03	0.07	0.0	NA	NA
Lane 2		0.350	1.000	0.0	0.7	1.8	NA	NA	0.2	0.4	0.01	0.03	0.0	NA	NA

Approach	0.566	1.7	4.3	NA	NA	0.6	1.1	0.03	0.07
Intersection	0.607	2.9	7.3	NA	NA	1.1	2.0	0.04	0.10

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Continuous Lane Performance

Lane Number	Deg. Satn	Unint. Speed	Unint. Travel Delay	Hdwy Spacing	Aver. Vehicle Length	Occup. Time	Space Time	Space Occup. Ratio	Time Occup. Ratio	Density		LOS (Density Method)
	v/c	mph	sec	sec	ft	ft	sec	sec	%	%	veh/mi	pc/mi	
South: Badger Road													
This approach does not have any continuous lanes													
East: Ridgeline Drive													
This approach does not have any continuous lanes													
North: Clearwater Avenue													
This approach does not have any continuous lanes													
West: Leslie Road													
This approach does not have any continuous lanes													

Midblock Effective Detection Zone Length = 7 ft

QUEUE ANALYSIS

Site: 101 [Leslie Rd and Clearwater Ave 2032 PM (Site Folder: 2032)]

Site Category: Existing Design
Roundabout

Lane Queues (Distance)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (ft)	Back of Queue (ft) Av.	Back of Queue (ft) 95%	Queue at Start of Green (ft) Av.	Queue at Start of Green (ft) 95%	Cycle Average Queue (ft) Av.	Cycle Average Queue (ft) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.437	1.000	0.5	36.0	89.5	NA	NA	11.5	20.9	0.02	0.06	0.0	NA	NA
Lane 2		0.653	1.000	13.0	87.1	216.5	NA	NA	32.3	58.5	0.24	0.59	NA	0.0	1
Approach		0.653			87.1	216.5	NA	NA	32.3	58.5	0.02	0.06			
East: Ridgeline Drive															
Lane 1		0.476	1.000	2.8	27.9	69.3	NA	NA	9.8	17.8	0.21	0.51	NA	0.0	2
Lane 2		0.403	1.000	1.2	24.2	60.2	NA	NA	6.9	12.6	0.02	0.04	0.0	NA	NA
Approach		0.476			27.9	69.3	NA	NA	9.8	17.8	0.02	0.04			
North: Clearwater Avenue															
Lane 1		0.578	1.000	6.0	42.1	104.7	NA	NA	16.6	30.1	0.03	0.07	0.0	NA	NA
Lane 2		0.578	1.000	5.5	45.0	111.9	NA	NA	15.9	28.8	0.03	0.07	0.0	NA	NA
Approach		0.578			45.0	111.9	NA	NA	16.6	30.1	0.03	0.07			
West: Leslie Road															
Lane 1		0.581	1.000	7.7	48.7	121.1	NA	NA	20.3	36.9	0.03	0.08	0.0	NA	NA
Lane 2		0.422	1.000	2.2	26.2	65.1	NA	NA	10.6	19.3	0.02	0.04	0.0	NA	NA
Approach		0.581			48.7	121.1	NA	NA	20.3	36.9	0.03	0.08			
Intersection		0.653			87.1	216.5	NA	NA	32.3	58.5	0.03	0.08			

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Lane Queues (Vehicles)

Lane Number	Contin. Lane	Deg. Satn v/c	Prog. Factor (Queue)	Overflow Queue (veh)	Back of Queue (veh) Av.	Back of Queue (veh) 95%	Queue at Start of Green (veh) Av.	Queue at Start of Green (veh) 95%	Cycle Average Queue (veh) Av.	Cycle Average Queue (veh) 95%	Queue Storage Ratio Av.	Queue Storage Ratio 95%	Prob. Block. %	Prob. SL Ov. %	Ov. Lane No.
South: Badger Road															
Lane 1		0.437	1.000	0.0	1.4	3.5	NA	NA	0.4	0.8	0.02	0.06	0.0	NA	NA
Lane 2		0.653	1.000	0.5	3.4	8.5	NA	NA	1.3	2.3	0.24	0.59	NA	0.0	1
Approach		0.653			3.4	8.5	NA	NA	1.3	2.3	0.02	0.06			
East: Ridgeline Drive															
Lane 1		0.476	1.000	0.1	1.1	2.7	NA	NA	0.4	0.7	0.21	0.51	NA	0.0	2
Lane 2		0.403	1.000	0.0	0.9	2.4	NA	NA	0.3	0.5	0.02	0.04	0.0	NA	NA
Approach		0.476			1.1	2.7	NA	NA	0.4	0.7	0.02	0.04			
North: Clearwater Avenue															
Lane 1		0.578	1.000	0.2	1.6	4.1	NA	NA	0.6	1.2	0.03	0.07	0.0	NA	NA
Lane 2		0.578	1.000	0.2	1.8	4.4	NA	NA	0.6	1.1	0.03	0.07	0.0	NA	NA
Approach		0.578			1.8	4.4	NA	NA	0.6	1.2	0.03	0.07			
West: Leslie Road															
Lane 1		0.581	1.000	0.3	1.9	4.7	NA	NA	0.8	1.4	0.03	0.08	0.0	NA	NA
Lane 2		0.422	1.000	0.1	1.0	2.5	NA	NA	0.4	0.8	0.02	0.04	0.0	NA	NA

Approach	0.581	1.9	4.7	NA	NA	0.8	1.4	0.03	0.08
Intersection	0.653	3.4	8.5	NA	NA	1.3	2.3	0.03	0.08

Queue Model: HCM Queue Formula.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

Continuous Lane Performance

Lane Number	Deg. Satn	Unint. Speed	Unint. Travel Delay	Hdwy Spacing	Aver. Vehicle Length	Occup. Time	Space Time	Space Occup. Ratio	Time Occup. Ratio	Density		LOS (Density Method)
	v/c	mph	sec	sec	ft	ft	sec	sec	%	%	veh/mi	pc/mi	
South: Badger Road													
This approach does not have any continuous lanes													
East: Ridgeline Drive													
This approach does not have any continuous lanes													
North: Clearwater Avenue													
This approach does not have any continuous lanes													
West: Leslie Road													
This approach does not have any continuous lanes													

Midblock Effective Detection Zone Length = 7 ft