TERRA ENGINEERING LTD.

DUTCH BROS BALLWIN
TRAFFIC IMPACT STUDY

PROJECT ADDRESS

15200 Manchester Road
Saint Louis, MO 63011

PREPARED BY

Michael C. Hutchinson, P.E., PTOE
Senior Traffic Engineer

PREPARED FOR

CAE Investments
1776 Montano Rd. NW, Suite 25
Albuquerque, NM 87107

DRAFT REPORT DATE

May 22, 2024

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SECTION I

EXECUTIVE SUMMARY

This traffic impact study is to evaluate a new Dutch Bros coffee shop on the southwest corner of Manchester Road and Old Ballwin Road which includes two drive-through lanes and no indoor seating. Existing traffic data was collected in April 2024 at the intersections near the site to determine the existing traffic patterns around the vacant parcel. In the existing condition traffic model, it was noted that the adjacent signalized intersections performed well. It was also noted that during the AM peak, the intersections under two-way stop control (TWSC) operated well for the right turn movements but had significant modeled delays where left turns from the stop-controlled streets existed.

New vehicle trips were generated for the proposed site using the Land Use Code for Coffee/Donut shop w/Drive-Thru Window and No Indoor Seating. This estimated the total trip in the AM peak to the proposed site at 89 total trips (45 entering and 44 exiting) and 30 trips in the PM peak (15 entering, 15 exiting). Many of these trips are pass-by trips which are already in the network on Manchester Road.

The new trips were assigned to the network based on the existing traffic patterns in the network and where vehicles were likely to access the site. This information was then placed into the Synchro models for analysis and evaluation for Opening Day conditions which showed similar results to existing conditions, however the proposed limitation of right-in/right-out movements for the driveway improve the performance and safety. This limitation will require westbound drivers to utilize the McDonald's driveway to turn left or travel to New Ballwin Road via Parker Drive to head west.

It appears the Dutch Bros driveways will operate with similar characteristics to other businesses in the area. It appears that the expected queues at the site will be contained within the project site and the new development should have little to no impact on the existing traffic flows on Manchester Road or Old Ballwin Road.

SECTION II

INTRODUCTION/SITE BACKGROUND

TERRA Engineering has been asked to evaluate the potential traffic impact of redeveloping a parcel at the southwest corner of Manchester Road and Old Ballwin Road in Ballwin, Missouri, a suburb in St. Louis County. The existing development is located on the parcel at 15200 Manchester Road and is proposed to be a new Dutch Bros Coffee Shop with an approximate size of 950 square feet. An additional parcel is located just west of the proposed coffee site and is slated for a future development but is not to be developed at this time. The existing site has two entrances from existing Manchester Road and another two entrances onto Old Ballwin Road.

Old Ballwin Road continues to the south of the proposed site and provides connections to residential neighborhoods located to the south of the site. Directly across Old Ballwin to the east is the existing Elco Cadillac car dealership. Directly to the west of the site is an existing McDonald's restaurant which provides cross access onto the proposed parcel at the south part of the site.

SECTION III

STUDY AREA

The existing site is located at 15200 Manchester Road. A layout of the site location and adjacent street network is provided in Figure 1 with the proposed site shown in blue. The roadways included as part of the study area around the proposed site development are described as follows:

Manchester Road (MO 100) is a five-lane (two lanes in each direction and one two-way left turn lane) road running in the east-west direction. It is considered a principal arterial which primarily serves businesses and collects vehicles from local roads near the project site. The posted speed limit is 40 miles-per-hour (mph). Sidewalk exists on both sides of Manchester Road. Near the intersection with Old Ballwin Road, there is a raised median on Manchester Road that provides a pedestrian refuge at a midblock crosswalk. The midblock crosswalk includes yield bars on Manchester and a Rectangular Rapid Flashing Beacon (RRFB) to

Figure 1 - Project area.

assist pedestrians in safely crossing Manchester Road at this location. This raised median would also prevent northbound left turns from Old Ballwin Road from turning into the Two-Way Left Turn Lane (TWLTL) to use it as an acceleration lane or storage area to head westbound on Manchester.

Old Ballwin Road is a two-lane (one lane in each direction) road running in the north-south direction. It primarily serves a residential area, with access to the proposed parcel, the Elco Cadillac site, and a church. Further to the south, it connects to The Pointe at Ballwin Commons which is a large recreation center for the City of Ballwin before turning to the west to connect to New Ballwin Road. Sidewalk exists on both sides of the road near the site and across Fishpot Creek and then terminates on the east side of the road. The posted speed limit is 25 mph along the roadway.

SECTION IV

EXISTING TRAFFIC CONDITIONS

Traffic data was collected on April 24, 2024, at the following locations:

- Manchester Rd & Old Ballwin Rd
- Manchester Rd & Coral Terrace/Site West Entrance
- Manchester Rd & Holloway Rd

Traffic data was collected on Manchester Road at the three subject intersections from 7:00 AM to 9:00 AM and from 3:00 PM to 6:00 PM to include the morning and evening peak hours of vehicle traffic, colloquially called “rush hour.” This data is included in Appendix A. In addition, TERRA provided additional traffic data which was collected for another recent project at the intersection of Manchester Road and New Ballwin Road which was collected on March 12, 2024.

At the intersection of Manchester Road and New Ballwin Road, the AM peak hour of traffic occurred starting at 7:30 AM, and the PM peak hour of traffic occurred starting at 4:30 PM. These are the two hours in which the greatest number of vehicles were counted on the adjacent streets of Manchester Road and New Ballwin Road. At the intersections of Manchester with Coral Terrace, Old Ballwin Road and Holloway Rd, the AM peak hour was at from 7:45 AM to 8:45 AM. The PM peak hour was from 4:45 PM to 5:45 PM at the Old Ballwin and Coral Terrace intersections but was slightly earlier from 4:30 PM to 5:30 PM at the Holloway intersection.

The aim of this study is to estimate the impact of the proposed new coffee shop to be located on the southwest corner of the intersection of Manchester Road and Old Ballwin Road during these peak hours. To evaluate the worst-case scenario for the traffic along Manchester Road, TERRA will use the peak volumes of traffic during the AM and PM peak as shown in the traffic counts. As the times don’t always match, the traffic volumes may not balance perfectly along the corridor, however this would be expected in any case due to the number of entrances to developments along Manchester Rd which add and subtract vehicles from the roadway throughout the study area. The existing traffic collected at each of the study area intersections is provided in Figure 2.

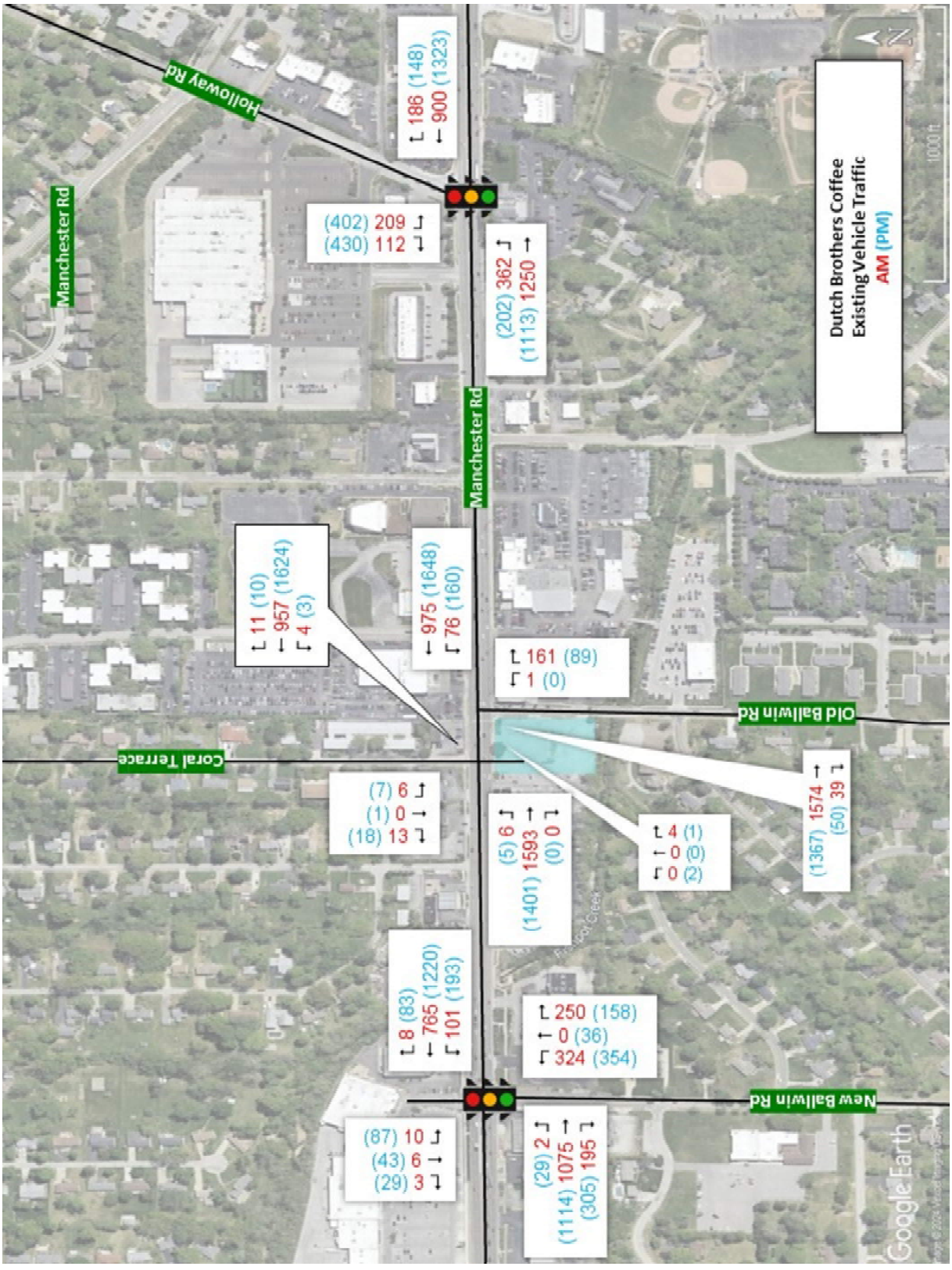


Figure 2 – Existing traffic.

Level of Service and Delay

Delay is one of the main components of measuring the service of an interrupted flow roadway. The principal measure of this delay is control delay which is defined by the Highway Capacity Manual (HCM) as "a quantitative stratification of a performance measure or measures representing quality of service."

The Level of Service (LOS) designation was created as a tool to help laypersons and decision makers determine the difference in operating conditions for a particular location. There are six representative levels of service defined for each type of facility which can be analyzed, and they are designated using letters A through F. These letters are an attempt to translate "complex numerical performance results into a simple A-F system representative of travelers' perceptions of the quality of service." LOS calculations are provided for different modes of travel such as motorized vehicle, pedestrian, bicycle and transit modes. Safety of the intersection is not included in the analysis of LOS. Level of Service is defined separately for signalized intersections and unsignalized intersections as shown in Table 1.

Table 1 - Vehicular Level of Service for Control Delay

Level of Service	Control Delay per Vehicle (seconds / vehicle)		Interpretation
	Signalized	Unsignalized	
A	0 - 10	0 - 10	Minimal control delay; traffic operates at primarily free-flow conditions; unimpeded movement within traffic stream.
B	10 - 20	10 - 15	Minor control delay at signalized intersections; traffic operates at an unimpeded level with slightly restricted movement within the traffic stream.
C	20 - 35	15 -25	Moderate control delay; movement within traffic stream more restricted than at LOS B; formation of queues contributes to lower average travel speeds.
D	35 - 55	25 - 35	Considerable control delay that may be substantially increased by small increases in flow; average travel speeds continue to decrease.
E	55 - 80	35 - 50	High control delay; average travel speed no more than 33 percent of free flow speed.
F	> 80	> 50	Extremely high control delay; extensive queuing and high volumes create exceedingly restricted traffic flow.

LOS is a measure of the acceptability of the amount of delay and is therefore considered slightly subjective as what is acceptable in a major metropolitan area may not be acceptable in a smaller city or rural area. These delays are computed as the average control delay per vehicle arriving at the intersection. For signalized intersections, delays are evaluated for the overall intersection; at intersections without traffic signals, delay is analyzed for each movement separately and only includes side street traffic and left turns from the major street as the through movements on the major road are free flow movements.

Another factor evaluated when determining traffic operations at an intersection is the volume to capacity (v/c) ratio of the critical lane group. This ratio compares the rate of flow to the available capacity of the intersection and is considered a measure of the degree of saturation. Sustainable values of a v/c ratio range from 0.01 to 1.0. Values in excess of 1.0 indicate a possible excess of capacity and are considered to be LOS F.

In a dense urban area, it is generally acceptable to provide LOS D in all areas but consider LOS E in certain situations where traffic demand is very high on major arterial routes. Occasionally, side streets will be allowed to operate at LOS F when volume and demand on the side street is considered very low and servicing these vehicles would cause a greater negative impact on the progression of through traffic on the main route.

The peak hours of traffic from the collected traffic volumes were modeled in Synchro 12 modeling software for analysis. The analysis was conducted for the existing conditions during the peak hours of traffic in the morning and afternoon. Table 2 provides the results of the analysis, summarizing the Level of Service, delay, and the v/c ratio for the existing intersection conditions while the full model analysis is provided in Appendix B.

From the Synchro analysis using peak vehicle volume data at each intersection, the two signalized intersections appear to perform at acceptable levels for the overall intersection in both the AM and PM peak hours. It was noted that the signal cycle length for the AM peak is 130 seconds and the PM peak is 140 seconds. This leads to long side street delays while priority is given to Manchester Road traffic. This helps to provide good overall performance at the signalized intersections but provides longer average delays for the side streets which need to wait longer for their green indication to come up which results in LOS D and E for these movements.

Table 2 - Existing Traffic Analysis						
	Weekday AM Peak			Weekday PM Peak		
	LOS	Delay	v/c	LOS	Delay	v/c
Manchester Road & New Ballwin Road						
Overall Performance	**C**	**20.2**	**0.67**	**D**	**35.6**	**0.79**
Eastbound	C	20.2	0.58	C	28.6	0.71
Westbound	A	4.6	0.38	C	31.0	0.72
Northbound	D	42.9	0.67	E	57.6	0.79
Southbound	D	52.0	0.10	E	66.5	0.58
Manchester Road & Old Ballwin Rd						
Westbound Left	C	18.3	0.23	C	19.1	0.41
Northbound	D	34.2	0.61	C	19.6	0.28
Manchester Road & Coral Terrace/West Driveway						
Eastbound Left	B	10.5	0.02	C	15.6	0.02
Westbound Left	C	15.1	0.01	B	13.4	0.01
Northbound	C	17.3	0.17	F	224.4	0.17
Southbound	E	48.1	0.79	F	252.5	0.79
Manchester Road & Holloway Rd						
Overall Performance	**B**	**16.4**	**0.82**	**C**	**28.9**	**0.91**
Eastbound	A	9.4	0.82	B	12.8	0.78
Westbound	B	18.0	0.56	C	29.8	0.81
Southbound	D	45.8	0.62	D	52.7	0.91

At the two-way stop controlled (TWSC) intersections, Manchester Road is free flowing which provides no delays for through traffic. The left turning movements from Manchester onto Old Ballwin, Coral Grove and into the west site driveway have minimal waits of 20 seconds or less on average during the AM and PM peaks to turn resulting in LOS B and C. The side street movements are required to wait for a gap in traffic to exit onto Manchester Road. This can be difficult during the peak hour with the high volumes of up to 1575-1650 in the main direction of flow along Manchester Road. This can make left turns difficult in the northbound and southbound direction, while right turns are able to enter the traffic flow more easily. Northbound left turns from Old Ballwin Rd are prohibited, although one (1) vehicle was observed making this turn in the AM peak hour. This turn was omitted from the existing model as it was an illegal turn. LOS for the northbound movements at Old Ballwin Road and Manchester Rd function at LOS C or D. At Coral Terrace and the west driveway to the site, the northbound and southbound movements function at LOS C and E in the PM peak are LOS F, with very long delays due to the high volumes on Manchester Road.

SECTION V

SITE LAYOUT

The proposal for the site is to subdivide the existing lot into two different parcels, with the west parcel being left vacant for now and a new Dutch Bros coffee shop with approximately 900 square-feet of building with a dual drive through. The existing site has two driveways along Manchester Road however these will be consolidated to a single driveway which is right-in, right-out. There are also two driveways along Old Ballwin Road, however the driveway closest to the intersection of Manchester and Old Ballwin Road will be closed. This will leave 2 remaining driveways, leaving one (1) access drive on Manchester Road and one (1) access drive on Old Ballwin Road. Figure 3 shows the proposed site plan.

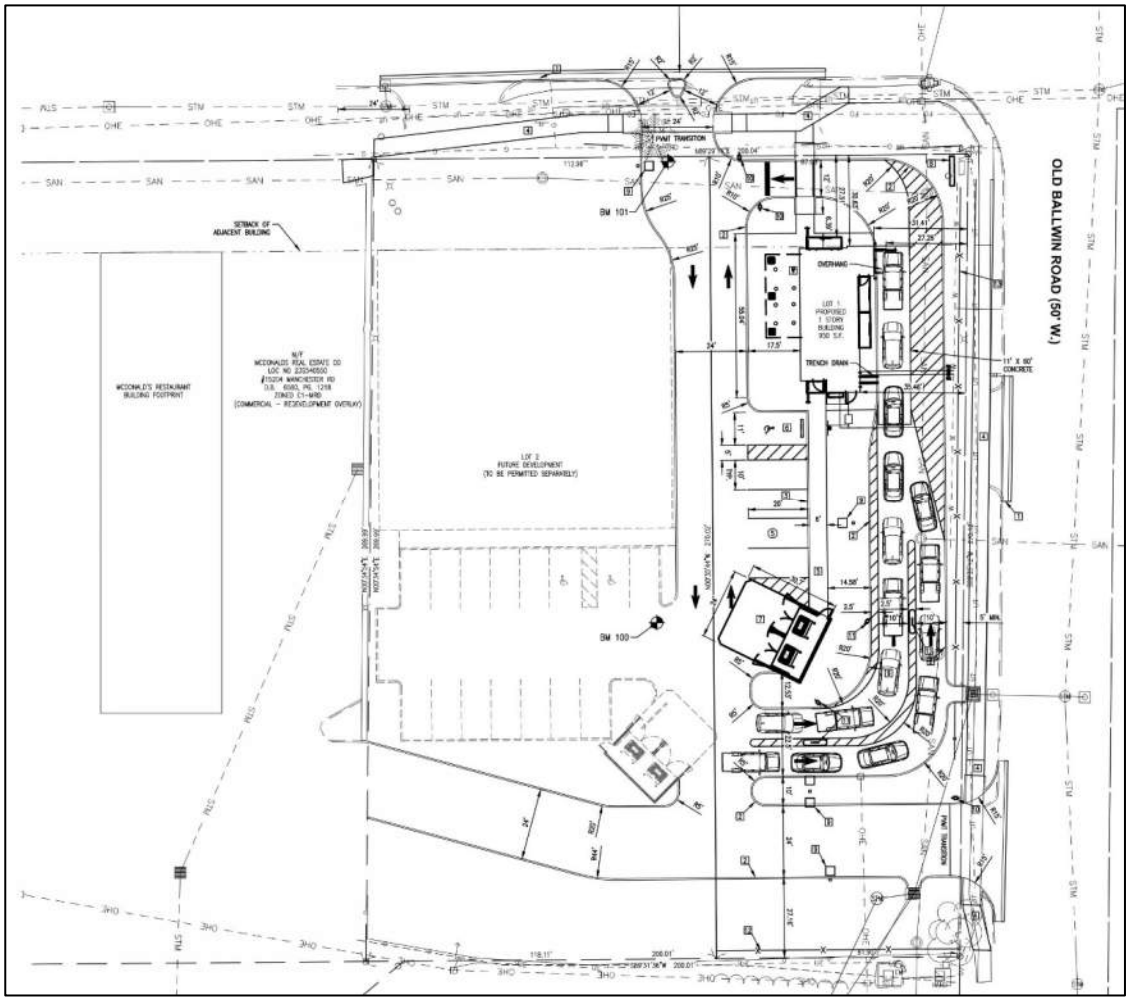


Figure 3 – Proposed site plan

SECTION VI

TRIP GENERATION

When evaluating proposed traffic at a new development, it is necessary to estimate the number of new vehicle trips which will be created by the new uses at the site. This estimation of trips is generated using data obtained from traffic counts at other similar locations or by using the Institute of Transportation Engineers (ITE) Trip Generation Manual. The ITE Manual collects data at existing sites for all types of uses such as schools, hotels, shopping centers, apartment complexes, subdivisions, offices, etc. and compiles it into book form as a reference for designers. The data in the 11th edition is based on more than 5,000 trip generation studies which have been collected over several decades by transportation professionals.

For most land uses, the collected data is broken into many different independent variables which can be used to perform the calculations, including comparing the number of trips to the gross floor area of the building, or in the case of residential comparing the number of trips to the number of housing units. Calculations can also be completed for an entire weekday, the traditional peak hours of adjacent street traffic (one hour between 7:00 AM and 9:00 AM or one hour between 4:00 PM and 6:00 PM), the peak hour of activity for the use type (known as AM Peak Generators or PM Peak Generators), Saturday traffic, or Sunday traffic.

For the proposed site, the trips generated by the land use could closely be modeled by Land Use (938) Coffee/Donut Shop with Drive-Through Window and No Indoor Seating. TERRA reviewed the description for the land use.

Land Use (938) Coffee/Donut Shop with Drive-Through Window and No Indoor Seating

"This land use includes any coffee and donut restaurant that has only drive-through window service. A patron cannot walk into the shop and purchase items. The restaurant sells freshly brewed coffee (along with coffee-related accessories) and a variety of food/drink products such as donuts, bagels, breads, muffins, cakes, sandwiches, wraps, salads, and other hot and cold beverages. The restaurant marketing and sales may emphasize coffee beverages over food (or vice versa).

The coffee/donut shops contained in this land use typically hold long store hours (more than 15 hours) with an early morning opening."

Trip Generation Calculations

For a complete evaluation, TERRA ran calculations on Land Use (938) Coffee/Donut Shop with Drive-Through Window and No Indoor Seating using the number of drive through lanes (2) as the independent variable. For the purpose of this study the trip generation plots used included the AM Peak of Adjacent Street Traffic from 7-9 AM and the PM Peak of Adjacent Street Traffic from 4-6 PM which coincide with the peak traffic volumes on Manchester Road which were collected.

Trip generation calculations are performed using both the average rate provided for the vehicle trips per unit, and a fitted curve equation which is developed from the plots of data collected. Using both methods allows the higher value to be chosen should there be a difference in the total trips, however for this use a fitted curve equation was only available for the AM Peak of Adjacent Street Traffic.

A summary of the calculations is provided in Table 3 for the proposed site while plots from the trip generation manual showing the plots of the data based on the proposed site of the shop are provided in Appendix C.

Table 3 - Trip Generation Data				
Land Use (938) Coffee/Donut Shop with Drive-Through Window with No Indoor Seating				
	Average Rate		Fitted Curve	
	Enter	Exit	Enter	Exit
AM Peak of adj. street 7am-9am	40	40	45	44
PM Peak of adj. street 4pm-6pm	15	15	-	-

For external trips, The ITE manual differentiates between three different types of trips. “Primary Trips” are trips made for the sole purpose of visiting a site, meaning that drivers leave an origin for the specific purpose of visiting the site and then potentially return to the origin. “Pass-By” trips are trips made by vehicles already on the adjacent road which are driving past the access point to the site and enter the development as they are passing by before continuing on their original path to another destination. “Diverted Link” trips are vehicles that are nearby in the roadway network but alter their path from their primary destination along a roadway not connected to the site entrances to visit the site before rerouting back through the network toward their original destination.

The Trip Generation Manual provides data on Pass-by trips which are trips already in the network . The manual does include estimates for pass-by trips for the Land Use (938) Coffee/Donut Shop with Drive-Through Window and No Indoor Seating which has an average pass-by rate of 90% in the AM peak and 97.5% for the PM peak. This would imply that most trips to a coffee shop with only a drive through would be by vehicles already on Manchester Road. The proposed percentages are shown in Table 4.

Table 4 – Percentage of Primary and Pass-by Trips		
Land Use (938) Coffee/Donut Shop with Drive-Through Window with No Indoor Seating		
	AM Peak Hour of Traffic	PM Peak Hour of Traffic
Pass-By Trips	90%	97.5%
Non-Pass-By Trips	10%	2.5%

Using these values to adjust the previously calculated trips, we can split the values into primary trips which are new trips added to the network and pass-by trips which are captured from the existing volumes on Manchester Rd and Old Ballwin Rd.

Table 5 - Primary and Pass-by Trips			
Land Use (938) Coffee/Donut Shop with Drive-Through Window with No Indoor Seating			
	Total Trips	Primary	Pass-by
AM Entering	45	4	41
AM Exiting	44	4	40
PM Entering	15	0	15
PM Exiting	15	0	15

These updated values will be used in the next step to assign trips into the roadway network and calculate future traffic volumes. It should be noted that as expected the volumes of traffic during the morning hours are much higher than what is seen in the afternoon. This may be a consideration as the morning volumes of traffic on Manchester are much lighter than the volumes in the afternoon.

SECTION VII

TRIP ASSIGNMENTS

After the total vehicle trips the development would generate into the traffic network was calculated, the next step was to determine how the vehicles entering or exiting the site would maneuver around the traffic network. This is done by determining where the generated vehicles would enter and exit the network and assigning the generated trips as turning movements throughout the network.

One method for evaluating the potential for trips would be to calculate flows based on the vehicles already in the network. The traffic volumes passing the site show that over 60% of the traffic in the area is travelling eastbound during the AM peak of flow with 57% coming from the west leg into the intersection and 61% continuing eastbound exiting the intersection which includes added traffic from northbound Old Ballwin Road, while conversely only about 35% is traveling westbound. During the PM peak the volumes are a little more split with slightly over 50% traveling westbound and around 44% eastbound. Table 6 shows the percent of vehicles in each direction vehicles entered and exited the intersection.

Table 6 - Directionality on Manchester Rd & Old Ballwin Rd		
	Entering Intersection	
	AM Peak	PM Peak
Westbound (east leg)	37%	54%
Northbound (south leg)	6%	3%
Eastbound (west leg)	57%	43%
	Exiting Intersection	
	AM Peak	PM Peak
Eastbound (east leg)	61%	44%
Southbound (south leg)	4%	6%
Westbound (west leg)	35%	50%

Primary trips were assigned entering and exiting the road network based on the percentages in Table 6. For vehicles exiting to the east along Manchester Road from the 50% were assigned making an eastbound left out of the coffee shop onto Old Ballwin Road, and 50% were assigned making a northbound right out of the site directly onto Manchester Road. Any trips wishing to travel west on Manchester would not be able to do so from the site directly, these drivers would either need to cut-through the McDonald's parking lot, or would need to turn right onto Old Ballwin and cut through the neighborhood to the south. With no traffic available for the McDonald's exit and the uncertainty of if drivers would understand if this was an acceptable movement, all drivers were assumed to be directed to the south on Old Ballwin Road and to make a left turn at New Ballwin Road after cutting through the adjacent neighborhood via Parker Drive. Vehicles headed to the south on Old Ballwin would make a right turn at the southern entrance. Figure 4 shows the primary trip assignment map.

For pass-by trips, the trips all come from the existing traffic. As over 90% of the traffic in the area is on Manchester Road, most of this volume comes from the eastbound and westbound traffic. Similarly, the percentages of traffic in the network can be used to assign these trips based on the direction vehicles entered and exited the intersection in the existing condition.

The trips were assigned based on the percentages with the primary trips shown in Figure 4. The assumptions split the primary trips approaching the site into eastbound, westbound and northbound trips to the site. Westbound trips would need to turn onto Old Ballwin to access the site and cannot use the Manchester Road Driveway. Eastbound trips were split with 75% entering the Manchester driveway and 25% turning right onto Old Ballwin to enter the site. For trips exiting the site, westbound trips either need to cut through McDonald's or use Old Ballwin to the south through the neighborhood and again were assumed to use the neighborhood to New Ballwin Road. Eastbound trips were split evenly between the Manchester Rd and Old Ballwin Rd. driveways.

Pass-by trips were developed similarly to the primary trips; however, these trips require that negative values be assigned where trips deviate from their original path and that they then reenter the traffic stream in the same direction they were traveling. These trips are shown in Figure 5.

Finally, the Primary Trips and Pass-by trips are added together, including where numbers are negative in the pass-by trips to get a combined total trip values for the proposed site. These values are shown in the map provided in Figure 6. These combined trips will then be added to the existing traffic to provide an estimate of the traffic expected on the Opening Day of the development.

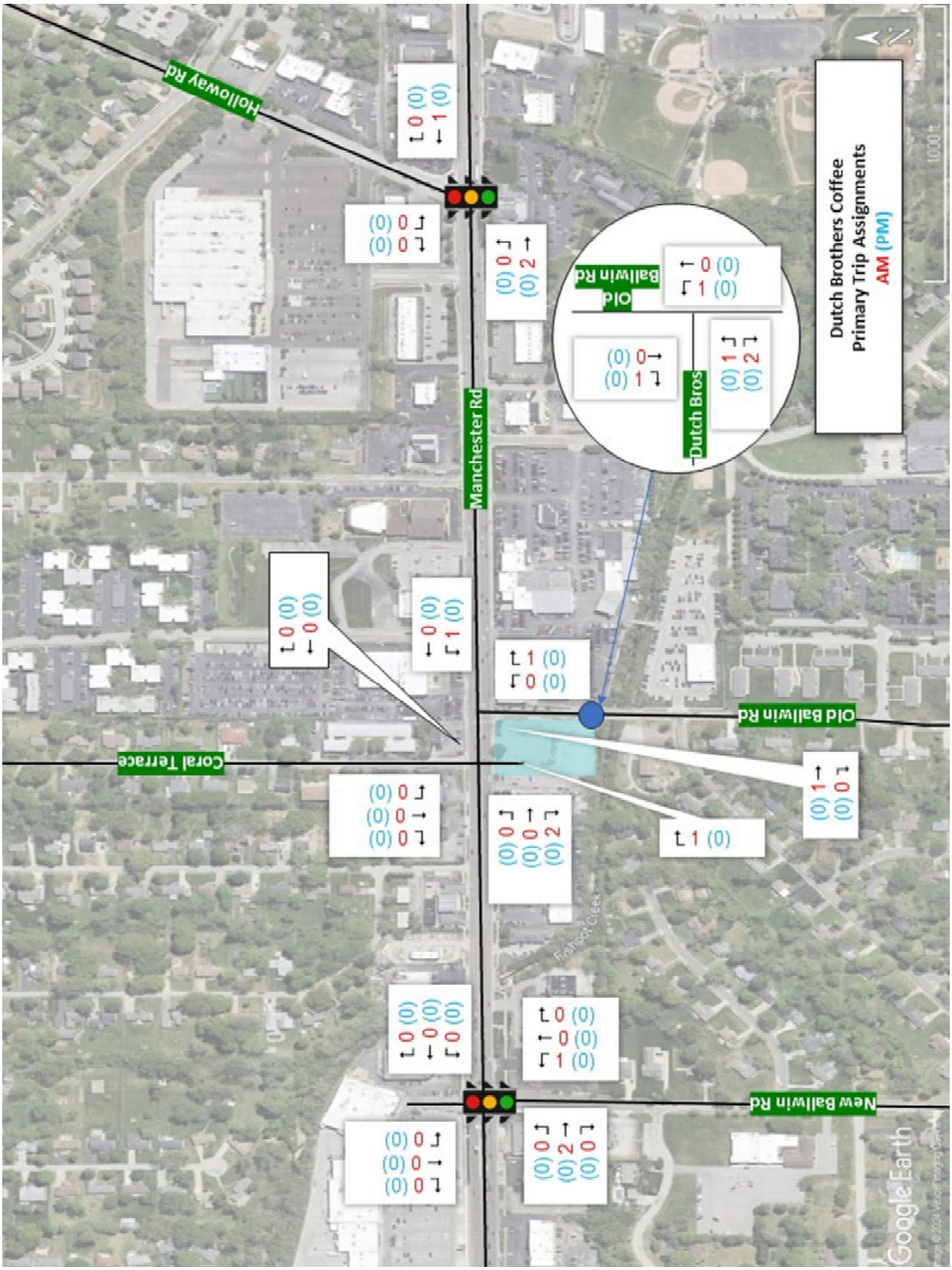


Figure 4 – Trip assignment map for primary trips.

TERRA ENGINEERING LTD.

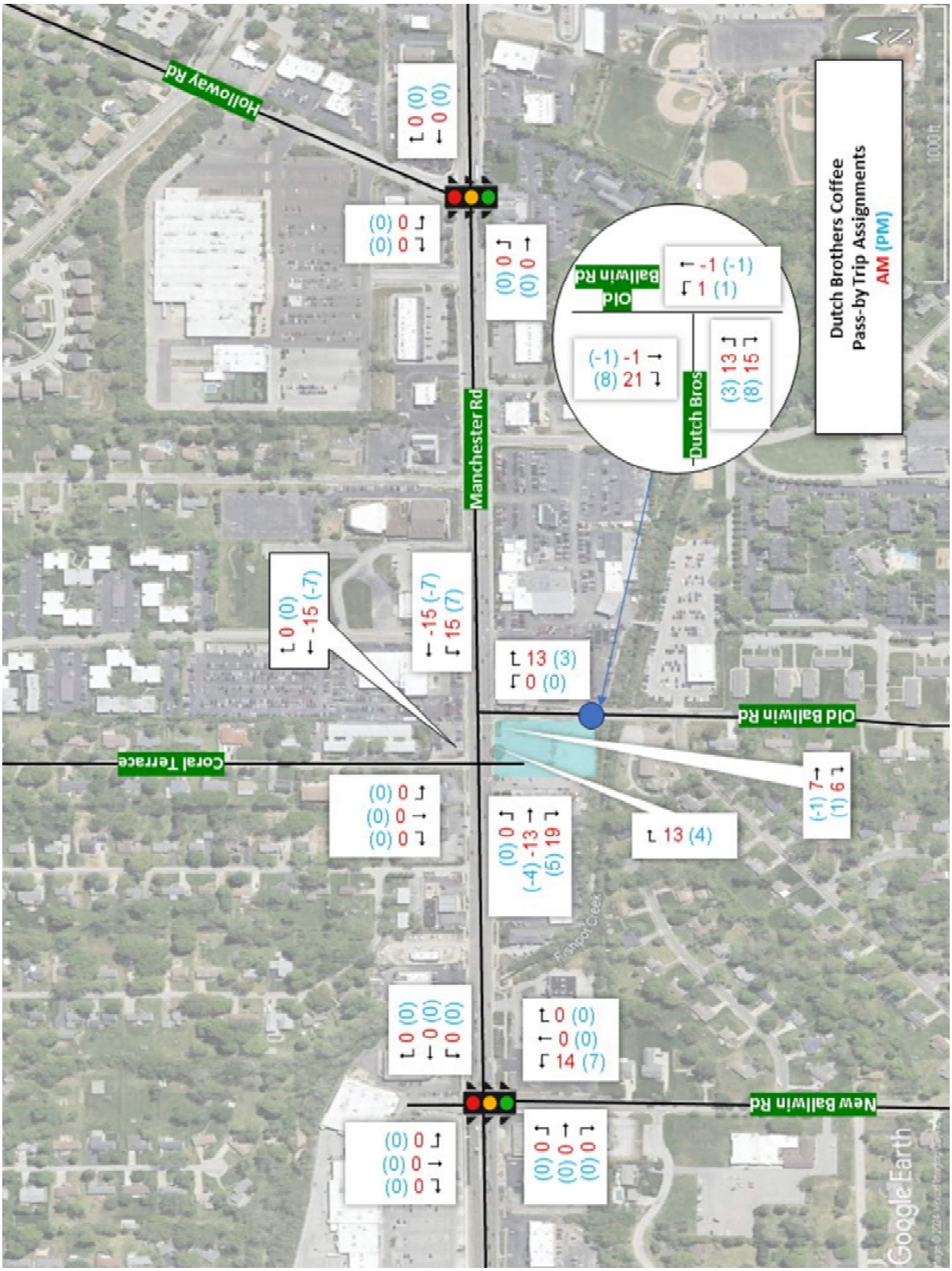


Figure 5 – Trip assignment map for pass-by trips.

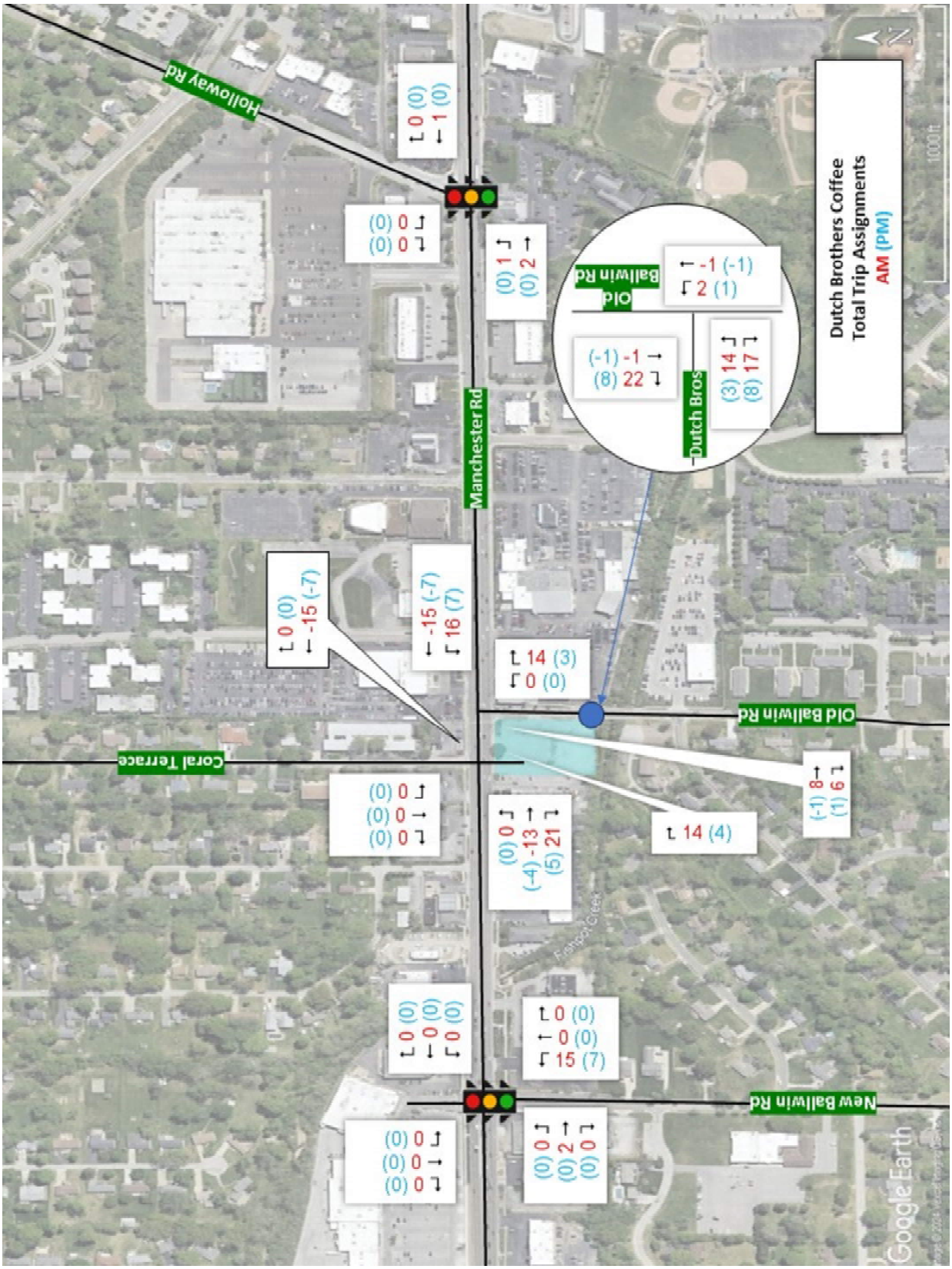


Figure 6 – Combined Trip assignment map.

SECTION VIII

OPENING DAY ANALYSIS

The next step in the process was to develop the expected trips on the opening day of the development. As it is expected that it will take some time to construct the new site, it is expected that the opening day will potentially be a year in the future. To account for potential background growth of traffic, it is necessary to estimate some increase in traffic which is typically seen year over year. For this study, it was assumed that the area is fairly stable, but a 0.5% increase in traffic may be possible. The existing traffic counts were increased by this percentage for one year.

The newly generated trips were then added to increased volumes to develop "Opening Day" traffic volumes which are shown in Figure 7. The opening day traffic model represents traffic around the study area with the new development fully built out and in operation.

The opening day traffic volumes were inserted into the Synchro 12 traffic modeling software and compared with the existing traffic model to determine if there were any significant changes to the traffic delay or LOS levels at the study intersections around the site. The modeled traffic performance of the intersection network for opening day is shown in Table 7. The full Synchro analysis is included in Appendix D.

Comparing the opening day scenario to the existing scenario, there is very little impact to the signalized intersections upstream and downstream of the site as the increase in new traffic volumes in very small. It was noted that the delay does go up slightly with additional average delays of less than half a second at each of the signalized intersections.

The entrance from the Dutch Bros site onto Old Ballwin Road functions well with little to no delay and LOS A with under 10 second delays leaving the driveway and LOS A for those northbound on Old Ballwin to turn into the new site. This could drive additional exiting traffic from the site this driveway if there are backups for the right turn onto Manchester Road.

The Manchester Road at Old Ballwin Rd right turn gains additional traffic during the AM peak which increases the average delay from 34.2 seconds to 39.7 seconds and changes the LOS from LOS D to LOS E. In the PM peak the delay for westbound left turns also increases, but only by 0.3 seconds from 19.6 to 19.9 seconds.

The west driveway from the Dutch Bros site onto Manchester Road will allow for only right turns onto Manchester Road from the site. During the AM Peak in the existing condition there

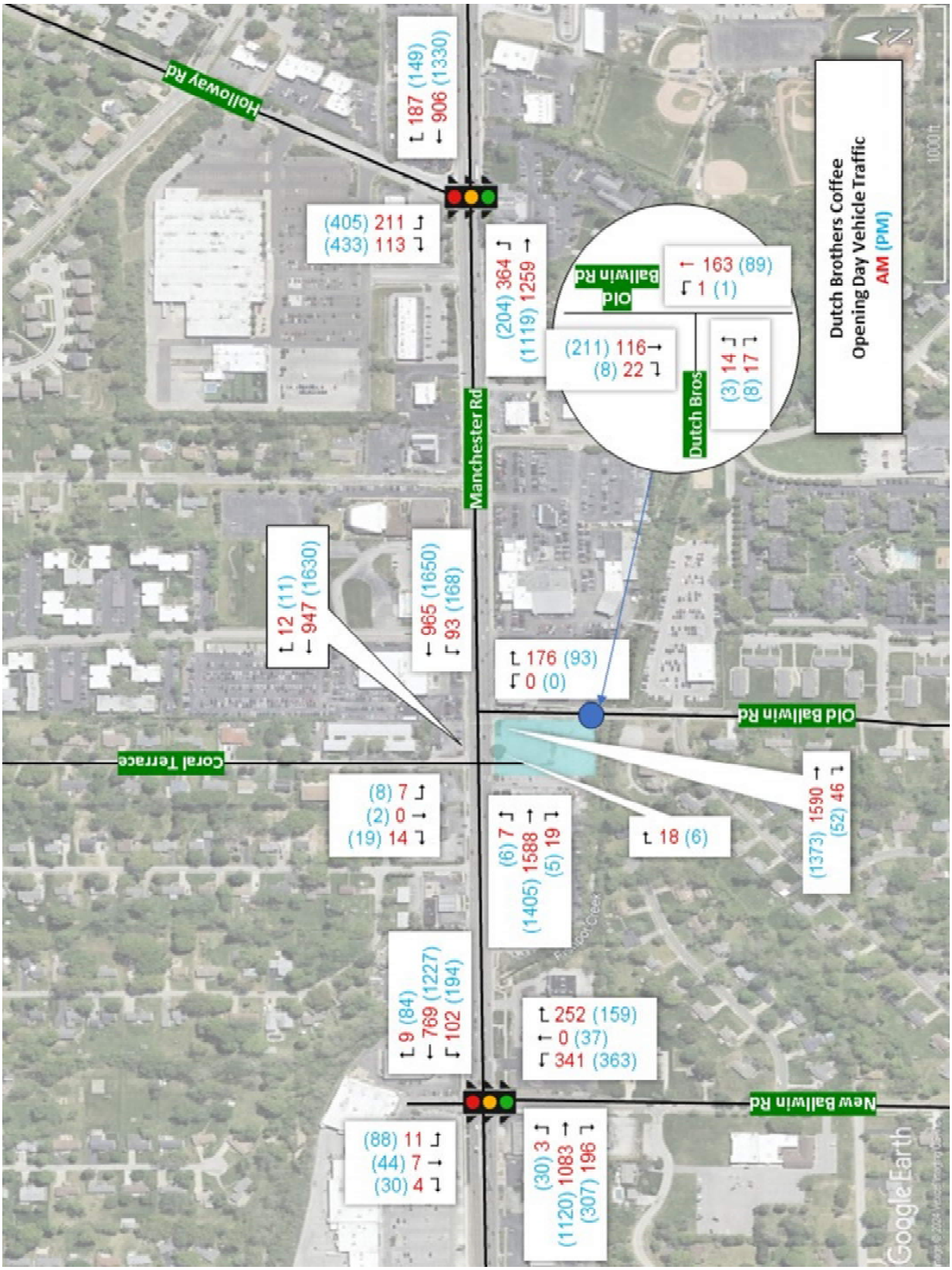


Figure 7 – Opening Day traffic

Table 7 – Opening Day Traffic Analysis						
	Weekday AM Peak			Weekday PM Peak		
	LOS	Delay	v/c	LOS	Delay	v/c
Manchester Road & New Ballwin Road						
Overall Performance	**C**	**20.9**	**0.68**	**D**	**36.1**	**0.80**
Eastbound	C	21.0	0.59	C	29.0	0.72
Westbound	A	4.9	0.40	C	31.5	0.73
Northbound	D	43.1	0.68	E	58.5	0.80
Southbound	D	50.8	0.11	E	66.8	0.59
Manchester Road & Old Ballwin Rd						
Westbound Left	C	19.7	0.29	C	19.8	0.43
Northbound	E	39.7	0.67	C	19.9	0.30
Manchester Road & Coral Terrace/West Driveway						
Eastbound Left	B	10.5	0.02	C	15.6	0.02
Northbound	C	18.2	0.07	C	15.6	0.02
Southbound	C	19.7	0.08	E	36.2	0.20
Manchester Road & Holloway Rd						
Overall Performance	**B**	**16.7**	**0.83**	**C**	**29.4**	**0.92**
Eastbound	A	9.7	0.83	B	13.2	0.79
Westbound	B	18.5	0.57	C	30.4	0.82
Southbound	D	45.7	0.62	D	53.0	0.92
Dutch Bros Driveway & Old Ballwin Rd						
Eastbound	A	9.8	0.04	A	9.8	0.01
Northbound Left	A	7.5	0.01	A	7.7	0.01

were only 4 right turns from the existing driveway, which is currently an empty lot with no buildings. The delays for these right turns averaged 17.3 seconds for the right turn and are LOS C. In the PM peak there were two left turns noted as exiting from the existing driveway however this movement will no longer be allowed at the driveway. With only right turns allowed northbound the LOS in the AM and PM peak is LOS C with delays under 20 seconds on average.

To validate the model results, TERRA traffic staff observed the adjacent driveway at the existing McDonald's drive-through during the AM peak for approximately 45 minutes. This driveway allows full access and is located approximately 60 feet west of the Dutch Bros driveway. TERRA staff observed that the signal coordination for eastbound Manchester created large platoons of vehicles which could cause some delay for vehicles exiting the McDonald's driveway, however it also created large gaps which allowed the queue of cars to clear the driveway. TERRA recorded some turning movements to estimate the actual delays experienced for northbound turns during a typical peak hour as shown in Table 8. The values for right turns from this driveway in the AM existing condition are consistent with the modeled traffic estimate and help to confirm the results.

Table 8 – Field Turning Movement Observations		
Vehicle Observation	Turning Direction	Elapsed Time (sec)
1	Left	65
2	Right	15
3	Left	14
4	Right	8
5	Left	13
6	Left	7
7	Left	36
8	Right	16
9	Right	5
10	Right	53
11	Right	35
12	Right	12
13	Right	10
14	Left	72
15	Right	25
16	Right	33
17	Right	29
18	Right	8
19	Right	32
20	Right	6
21	Right	5
22	Right	67
23	Right	74
24	Right	38
25 (max queue of 4)	Right	25
26	Right	4
27	Right	3
28	Left	8
29	Left	12
30	Right	30
31	Right	18
32	Left	25
33	Left	8
33 observations	Average Turning Time	24.5 seconds
23 observations	Average for Right Turns	24.0 Seconds
10 observations	Average for Left turns	26.0 seconds

Drivers wishing to travel westbound on Manchester will now be required to either cut through the McDonald's to make a left turn onto Manchester Road to travel to the west, or will need to travel southbound on Old Ballwin Road, west on Parker Road and north on New Ballwin Road to reach Manchester Road where they can turn left. As shown in Table 8, it appears that left turns at the McDonald's in the AM peak would average 26 seconds but would be functional.

For analysis in the study, it was assumed that all vehicles would use the Parker Road route to New Ballwin and then be added to the northbound left turns at the signal. The analysis in the model results shows that the delay goes up slightly for northbound traffic from 42.9 seconds in the AM to 43.1 seconds both of which are LOS D and for the PM from 57.6 seconds to 58.5 seconds which are both LOS E.

SECTION IX

SUMMARY AND CONCLUSIONS

This study was undertaken to determine the impact of developing a parcel on the southwest corner of Manchester Road and Old Ballwin Road to develop a new Dutch Bros coffee shop which is to include two drive-through lanes and no indoor seating. Existing traffic data was collected in April 2024 at the intersections near the site to determine the existing traffic patterns around the vacant parcel.

In the existing condition traffic model, it was noted that the signalized intersections on either side of the site performed at a Level of Service (LOS) C or better during the AM and LOS D during the PM peak hour of traffic. It was also noted that during the AM peak, the intersections under two-way stop control (TWSC) generally operated well for the right turn movements in the traffic model but had some significant modeled delays where left turns from the stop-controlled streets existed. These left turn movements caused the modeled intersections to operate at LOS F with delays estimated in the 3-to-4-minute range for the PM peak. It is understood that the traffic on Manchester Road is very high during the peak periods of traffic and that side street delays are common throughout the corridor for many businesses along the corridor.

New vehicle trips generated by the development were estimated using the Institute of Transportation Engineers (ITE) Trip Generation Manual. These trip estimates used the information provided on the proposed land use being considered for the site and used the Land Use Code for Coffee/Donut shop w/Drive-Thru Window and No Indoor Seating. This

estimated the total trip in the AM peak to the proposed site at 89 total trips (45 entering and 44 exiting) and 30 trips in the PM peak (15 entering, 15 exiting).

The coffee shop land use features a large number of pass-by trips which are captured from vehicles already in the network on Manchester Road. Using the 90% am Peak and 97.5% PM peak averages for Pass-by trips results in very few trips being added to the roadway network which are not already using Manchester Road past the site. The total additional trips generated in the AM peak was eight (8) trips, while in the PM peak this total is zero (0).

The new trips were assigned to the network based on the existing traffic patterns in the network and where vehicles were likely to access the site. This information was then placed into the Synchro models for analysis and evaluation for Opening Day conditions.

The Opening Day scenario was considered with the development in place with the projected traffic added to the existing collected data. The overall intersection performance appears similar to the existing condition with the signalized intersections seeing little to no change in the average delay and LOS which is due to the very small change in additional new primary trips.

The models for the proposed entrance to the site show that the driveway access onto Old Ballwin Rd functions very well with LOS A for all movements and delays at most of about 10 seconds. The Manchester driveway will be converted to a right-in/right-out only configuration which will eliminate the left turns onto Manchester Road. With only right turning traffic possible at the driveway, the delays are under 20 seconds with LOS C performance which is well within acceptable ranges. Vehicles wishing to travel westbound on Manchester Road will either need to use the McDonald's driveway to make a left turn or will need to go south on Old Ballwin Road to Parker Dr to New Ballwin Road and to use the traffic signal at New Ballwin to turn onto westbound Manchester.

Based on the observed values for average delay, it appears the Dutch Bros driveways will operate with similar characteristics to other businesses in the area. The removal of the left turns onto Manchester Road from the site driveway will improve the safety and performance of the driveway onto Manchester Road. It appears that the expected queues at the site will be easily contained within the project site and the new development should have little to no impact on the existing traffic flows on Manchester Road or Old Ballwin Road. While there may be some additional volume added to Parker Drive, the City of Ballwin prefers this operation to the left turns form the driveway and the performance of the northbound traffic at the New Ballwin signal has minimal impacts which will allow this option to function as an acceptable option.

APPENDIX A
EXISTING TRAFFIC DATA

TERRA ENGINEERING LTD.

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Coral Terrace
Site Code:
Start Date: 04/24/2024

Turning Movement Data

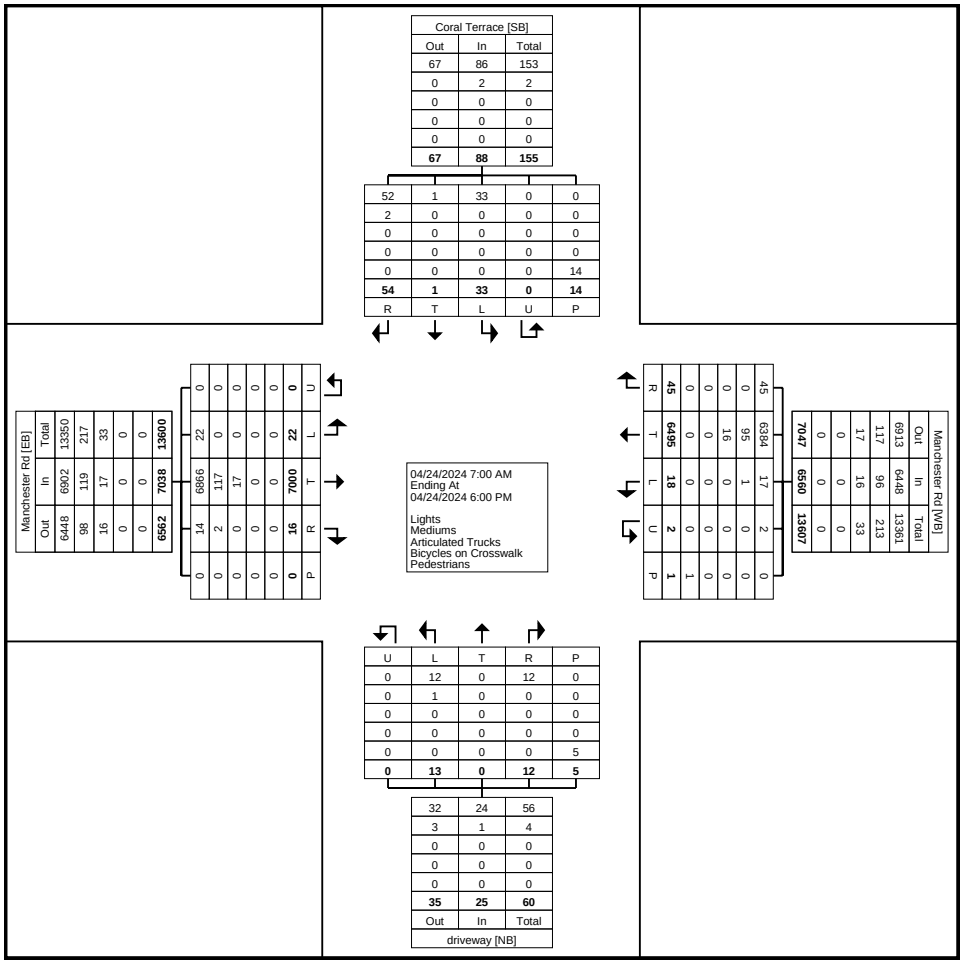
Start Time	Coral Terrace Southbound						Manchester Rd Westbound						driveway Northbound						Manchester Rd Eastbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
7:00 AM	0	0	2	0	1	2	0	184	2	0	0	186	0	0	1	0	0	1	0	284	1	0	0	285	474
7:15 AM	1	0	0	0	0	1	0	196	1	0	1	197	0	0	0	0	0	0	0	330	0	0	0	330	528
7:30 AM	4	0	1	0	1	5	0	220	1	0	0	221	1	0	0	0	0	1	0	349	4	0	0	353	580
7:45 AM	1	0	2	0	0	3	1	251	2	0	0	254	0	0	3	0	1	3	0	413	0	0	0	413	673
Hourly Total	6	0	5	0	2	11	1	851	6	0	1	858	1	0	4	0	1	5	0	1376	5	0	0	1381	2255
8:00 AM	2	0	4	0	4	6	1	211	6	0	0	218	0	0	0	0	0	0	3	432	0	0	0	435	659
8:15 AM	1	0	3	0	0	4	2	219	0	1	0	222	0	0	0	0	0	0	3	394	0	0	0	397	623
8:30 AM	2	0	4	0	0	6	0	276	3	0	0	279	0	0	1	0	1	1	0	354	0	0	0	354	640
8:45 AM	2	0	1	0	0	3	0	240	1	0	0	241	0	0	1	0	1	1	2	332	0	0	0	334	579
Hourly Total	7	0	12	0	4	19	3	946	10	1	0	960	0	0	2	0	2	2	8	1512	0	0	0	1520	2501
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	2	0	1	0	2	3	0	343	2	0	0	345	0	0	0	0	0	0	0	372	0	0	0	372	720
3:15 PM	1	0	3	0	1	4	1	383	1	0	0	385	1	0	0	0	0	1	1	318	1	0	0	320	710
3:30 PM	1	0	1	0	1	2	3	392	1	1	0	397	0	0	0	0	0	0	0	325	2	0	0	327	726
3:45 PM	1	0	4	0	3	5	2	399	1	0	0	402	1	0	1	0	2	2	1	340	7	0	0	348	757
Hourly Total	5	0	9	0	7	14	6	1517	5	1	0	1529	2	0	1	0	2	3	2	1355	10	0	0	1367	2913
4:00 PM	1	0	1	0	0	2	3	393	4	0	0	400	3	0	1	0	0	4	1	342	1	0	0	344	750
4:15 PM	3	0	4	0	0	7	0	393	3	0	0	396	2	0	3	0	0	5	3	328	0	0	0	331	739
4:30 PM	2	0	3	0	0	5	2	361	4	0	0	367	2	0	0	0	0	2	1	341	0	0	0	342	716
4:45 PM	2	0	3	0	0	5	2	435	3	0	0	440	0	0	0	0	0	0	0	364	0	0	0	364	809
Hourly Total	8	0	11	0	0	19	7	1582	14	0	0	1603	7	0	4	0	0	11	5	1375	1	0	0	1381	3014
5:00 PM	1	0	9	0	0	10	0	384	5	0	0	389	1	0	0	0	0	1	2	339	0	0	0	341	741
5:15 PM	1	0	4	0	0	5	0	409	1	0	0	410	0	0	0	0	0	0	1	362	0	0	0	363	778
5:30 PM	3	1	2	0	1	6	1	396	1	0	0	398	1	0	1	0	0	2	2	336	0	0	0	338	744
5:45 PM	2	0	2	0	0	4	0	410	3	0	0	413	1	0	0	0	0	1	2	345	0	0	0	347	765
Hourly Total	7	1	17	0	1	25	1	1599	10	0	0	1610	3	0	1	0	0	4	7	1382	0	0	0	1389	3028
Grand Total	33	1	54	0	14	88	18	6495	45	2	1	6560	13	0	12	0	5	25	22	7000	16	0	0	7038	13711
Approach %	37.5	1.1	61.4	0.0	-	-	0.3	99.0	0.7	0.0	-	-	52.0	0.0	48.0	0.0	-	-	0.3	99.5	0.2	0.0	-	-	-
Total %	0.2	0.0	0.4	0.0	-	0.6	0.1	47.4	0.3	0.0	-	47.8	0.1	0.0	0.1	0.0	-	0.2	0.2	51.1	0.1	0.0	-	51.3	-
Lights	33	1	52	0	-	86	17	6384	45	2	-	6448	12	0	12	0	-	24	22	6866	14	0	-	6902	13460
% Lights	100.0	100.0	96.3	-	-	97.7	94.4	98.3	100.0	100.0	-	98.3	92.3	-	100.0	-	-	96.0	100.0	98.1	87.5	-	-	98.1	98.2
Mediums	0	0	2	0	-	2	1	95	0	0	-	96	1	0	0	0	-	1	0	117	2	0	-	119	218
% Mediums	0.0	0.0	3.7	-	-	2.3	5.6	1.5	0.0	0.0	-	1.5	7.7	-	0.0	-	-	4.0	0.0	1.7	12.5	-	-	1.7	1.6
Articulated Trucks	0	0	0	0	-	0	0	16	0	0	-	16	0	0	0	0	-	0	0	17	0	0	-	17	33
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.2	0.0	0.0	-	0.2	0.0	-	0.0	-	-	0.0	0.0	0.2	0.0	-	-	0.2	0.2

Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	14	-	-	-	-	-	1	-	-	-	-	-	5	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Coral Terrace
Site Code:
Start Date: 04/24/2024



Turning Movement Data Plot

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Coral Terrace
Site Code:
Start Date: 04/24/2024

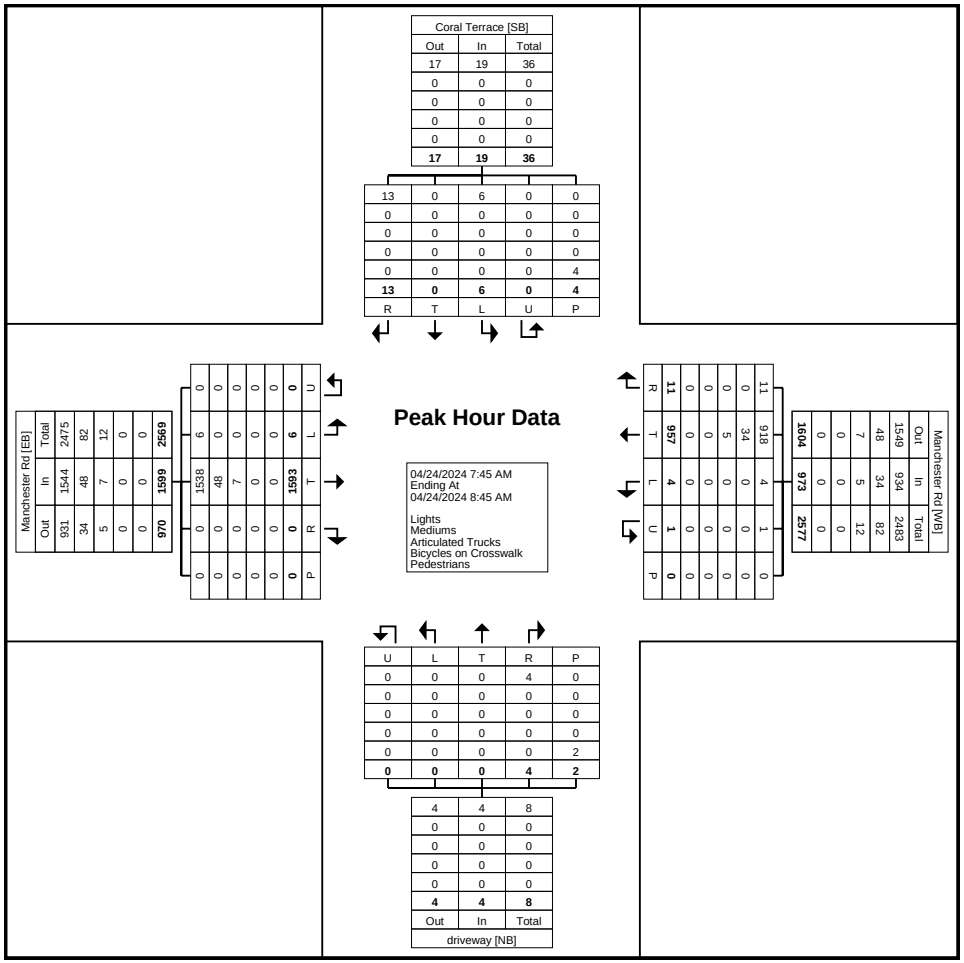
Turning Movement Peak Hour Data (7:45 AM)

Start Time	Coral Terrace Southbound						Manchester Rd Westbound						driveway Northbound						Manchester Rd Eastbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
7:45 AM	1	0	2	0	0	3	1	251	2	0	0	254	0	0	3	0	1	3	0	413	0	0	0	413	673
8:00 AM	2	0	4	0	4	6	1	211	6	0	0	218	0	0	0	0	0	0	3	432	0	0	0	435	659
8:15 AM	1	0	3	0	0	4	2	219	0	1	0	222	0	0	0	0	0	0	3	394	0	0	0	397	623
8:30 AM	2	0	4	0	0	6	0	276	3	0	0	279	0	0	1	0	1	1	0	354	0	0	0	354	640
Total	6	0	13	0	4	19	4	957	11	1	0	973	0	0	4	0	2	4	6	1593	0	0	0	1599	2595
Approach %	31.6	0.0	68.4	0.0	-	-	0.4	98.4	1.1	0.1	-	-	0.0	0.0	100.0	0.0	-	-	0.4	99.6	0.0	0.0	-	-	-
Total %	0.2	0.0	0.5	0.0	-	0.7	0.2	36.9	0.4	0.0	-	37.5	0.0	0.0	0.2	0.0	-	0.2	0.2	61.4	0.0	0.0	-	61.6	-
PHF	0.750	0.000	0.813	0.000	-	0.792	0.500	0.867	0.458	0.250	-	0.872	0.000	0.000	0.333	0.000	-	0.333	0.500	0.922	0.000	0.000	-	0.919	0.964
Lights	6	0	13	0	-	19	4	918	11	1	-	934	0	0	4	0	-	4	6	1538	0	0	-	1544	2501
% Lights	100.0	-	100.0	-	-	100.0	100.0	95.9	100.0	100.0	-	96.0	-	-	100.0	-	-	100.0	100.0	96.5	-	-	-	96.6	96.4
Mediums	0	0	0	0	-	0	0	34	0	0	-	34	0	0	0	0	-	0	0	48	0	0	-	48	82
% Mediums	0.0	-	0.0	-	-	0.0	0.0	3.6	0.0	0.0	-	3.5	-	-	0.0	-	-	0.0	0.0	3.0	-	-	-	3.0	3.2
Articulated Trucks	0	0	0	0	-	0	0	5	0	0	-	5	0	0	0	0	-	0	0	7	0	0	-	7	12
% Articulated Trucks	0.0	-	0.0	-	-	0.0	0.0	0.5	0.0	0.0	-	0.5	-	-	0.0	-	-	0.0	0.0	0.4	-	-	-	0.4	0.5
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	4	-	-	-	-	-	0	-	-	-	-	-	2	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Coral Terrace
Site Code:
Start Date: 04/24/2024



Turning Movement Peak Hour Data Plot (7:45 AM)

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Coral Terrace
Site Code:
Start Date: 04/24/2024

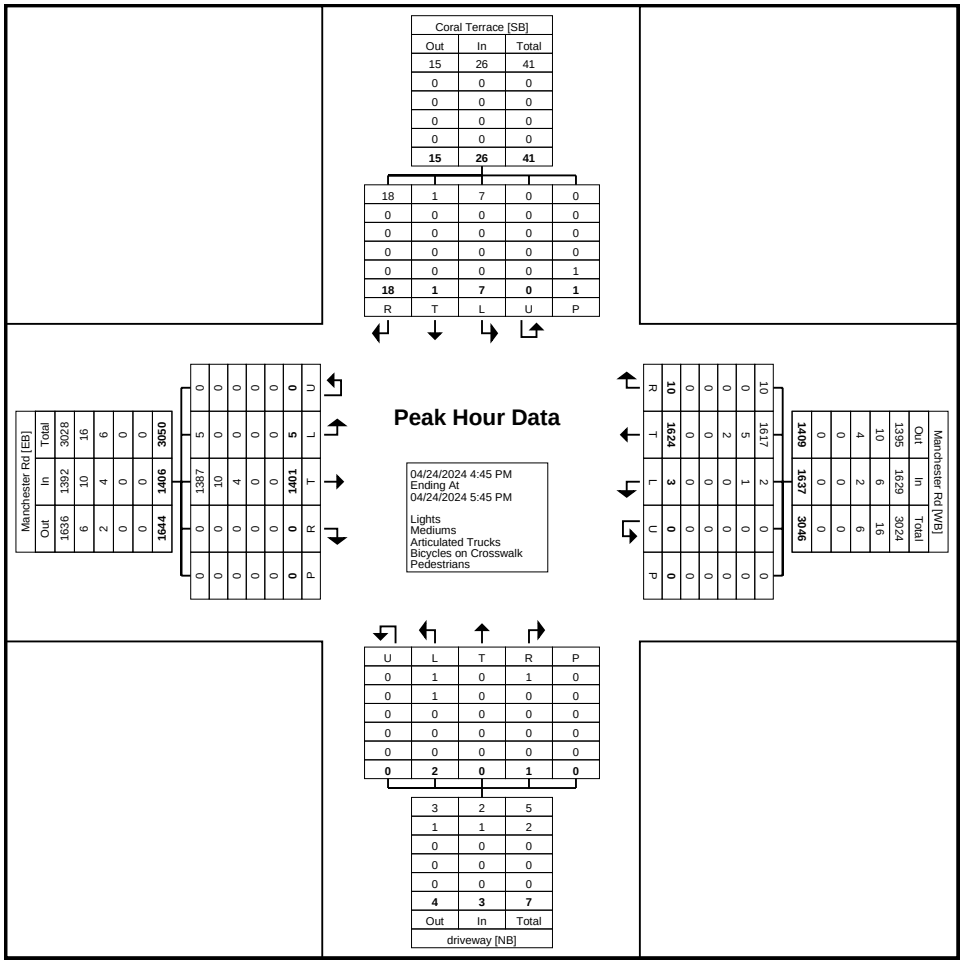
Turning Movement Peak Hour Data (4:45 PM)

Start Time	Coral Terrace Southbound						Manchester Rd Westbound						driveway Northbound						Manchester Rd Eastbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
4:45 PM	2	0	3	0	0	5	2	435	3	0	0	440	0	0	0	0	0	0	0	364	0	0	0	364	809
5:00 PM	1	0	9	0	0	10	0	384	5	0	0	389	1	0	0	0	0	1	2	339	0	0	0	341	741
5:15 PM	1	0	4	0	0	5	0	409	1	0	0	410	0	0	0	0	0	0	1	362	0	0	0	363	778
5:30 PM	3	1	2	0	1	6	1	396	1	0	0	398	1	0	1	0	0	2	2	336	0	0	0	338	744
Total	7	1	18	0	1	26	3	1624	10	0	0	1637	2	0	1	0	0	3	5	1401	0	0	0	1406	3072
Approach %	26.9	3.8	69.2	0.0	-	-	0.2	99.2	0.6	0.0	-	-	66.7	0.0	33.3	0.0	-	-	0.4	99.6	0.0	0.0	-	-	-
Total %	0.2	0.0	0.6	0.0	-	0.8	0.1	52.9	0.3	0.0	-	53.3	0.1	0.0	0.0	0.0	-	0.1	0.2	45.6	0.0	0.0	-	45.8	-
PHF	0.583	0.250	0.500	0.000	-	0.650	0.375	0.933	0.500	0.000	-	0.930	0.500	0.000	0.250	0.000	-	0.375	0.625	0.962	0.000	0.000	-	0.966	0.949
Lights	7	1	18	0	-	26	2	1617	10	0	-	1629	1	0	1	0	-	2	5	1387	0	0	-	1392	3049
% Lights	100.0	100.0	100.0	-	-	100.0	66.7	99.6	100.0	-	-	99.5	50.0	-	100.0	-	-	66.7	100.0	99.0	-	-	-	99.0	99.3
Mediums	0	0	0	0	-	0	1	5	0	0	-	6	1	0	0	0	-	1	0	10	0	0	-	10	17
% Mediums	0.0	0.0	0.0	-	-	0.0	33.3	0.3	0.0	-	-	0.4	50.0	-	0.0	-	-	33.3	0.0	0.7	-	-	-	0.7	0.6
Articulated Trucks	0	0	0	0	-	0	0	2	0	0	-	2	0	0	0	0	-	0	0	4	0	0	-	4	6
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.1	0.0	-	-	0.1	0.0	-	0.0	-	-	0.0	0.0	0.3	-	-	-	0.3	0.2
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Coral Terrace
Site Code:
Start Date: 04/24/2024



Turning Movement Peak Hour Data Plot (4:45 PM)

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Holloway Rd
Site Code:
Start Date: 04/24/2024

Turning Movement Data

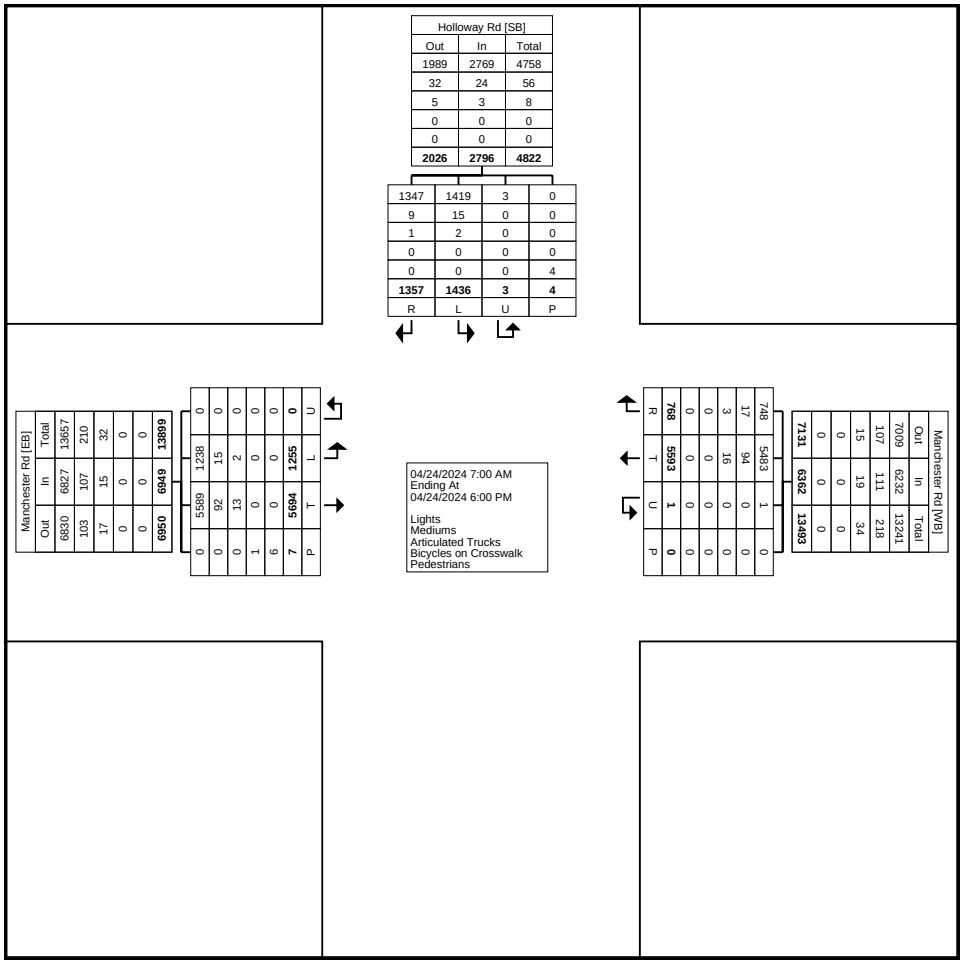
Start Time	Holloway Rd Southbound					Manchester Rd Westbound					Manchester Rd Eastbound					Int. Total
	Left	Right	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	
7:00 AM	21	19	3	0	43	169	28	0	0	197	55	262	0	0	317	557
7:15 AM	26	29	0	0	55	200	26	0	0	226	72	306	0	0	378	659
7:30 AM	46	30	0	0	76	207	32	0	0	239	96	307	0	0	403	718
7:45 AM	44	21	0	1	65	216	45	0	0	261	113	323	0	2	436	762
Hourly Total	137	99	3	1	239	792	131	0	0	923	336	1198	0	2	1534	2696
8:00 AM	46	24	0	0	70	215	51	0	0	266	111	308	0	0	419	755
8:15 AM	60	24	0	1	84	215	44	0	0	259	82	330	0	0	412	755
8:30 AM	59	43	0	0	102	254	46	0	0	300	56	289	0	0	345	747
8:45 AM	54	32	0	0	86	239	46	0	0	285	58	271	0	0	329	700
Hourly Total	219	123	0	1	342	923	187	0	0	1110	307	1198	0	0	1505	2957
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	63	50	0	1	113	285	39	0	0	324	52	311	0	0	363	800
3:15 PM	82	73	0	0	155	350	37	0	0	387	45	280	0	2	325	867
3:30 PM	84	70	0	0	154	327	39	0	0	366	50	252	0	0	302	822
3:45 PM	73	90	0	0	163	322	38	0	0	360	59	260	0	0	319	842
Hourly Total	302	283	0	1	585	1284	153	0	0	1437	206	1103	0	2	1309	3331
4:00 PM	83	88	0	0	171	334	39	1	0	374	51	261	0	0	312	857
4:15 PM	98	116	0	0	214	286	42	0	0	328	51	276	0	0	327	869
4:30 PM	106	88	0	0	194	352	34	0	0	386	49	282	0	0	331	911
4:45 PM	96	123	0	0	219	311	36	0	0	347	57	262	0	0	319	885
Hourly Total	383	415	0	0	798	1283	151	1	0	1435	208	1081	0	0	1289	3522
5:00 PM	97	111	0	0	208	331	38	0	0	369	54	287	0	0	341	918
5:15 PM	103	108	0	0	211	329	40	0	0	369	42	282	0	1	324	904
5:30 PM	125	107	0	1	232	306	32	0	0	338	51	274	0	0	325	895
5:45 PM	70	111	0	0	181	345	36	0	0	381	51	271	0	2	322	884
Hourly Total	395	437	0	1	832	1311	146	0	0	1457	198	1114	0	3	1312	3601
Grand Total	1436	1357	3	4	2796	5593	768	1	0	6362	1255	5694	0	7	6949	16107
Approach %	51.4	48.5	0.1	-	-	87.9	12.1	0.0	-	-	18.1	81.9	0.0	-	-	-
Total %	8.9	8.4	0.0	-	17.4	34.7	4.8	0.0	-	39.5	7.8	35.4	0.0	-	43.1	-
Lights	1419	1347	3	-	2769	5483	748	1	-	6232	1238	5589	0	-	6827	15828
% Lights	98.8	99.3	100.0	-	99.0	98.0	97.4	100.0	-	98.0	98.6	98.2	-	-	98.2	98.3
Mediums	15	9	0	-	24	94	17	0	-	111	15	92	0	-	107	242
% Mediums	1.0	0.7	0.0	-	0.9	1.7	2.2	0.0	-	1.7	1.2	1.6	-	-	1.5	1.5
Articulated Trucks	2	1	0	-	3	16	3	0	-	19	2	13	0	-	15	37
% Articulated Trucks	0.1	0.1	0.0	-	0.1	0.3	0.4	0.0	-	0.3	0.2	0.2	-	-	0.2	0.2
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	1	-	-

% Bicycles on Crosswalk	-	-	-	0.0	-	-	-	-	-	-	-	-	-	14.3	-	-
Pedestrians	-	-	-	4	-	-	-	-	0	-	-	-	-	6	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	85.7	-	-

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Holloway Rd
Site Code:
Start Date: 04/24/2024



Turning Movement Data Plot

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Holloway Rd
Site Code:
Start Date: 04/24/2024

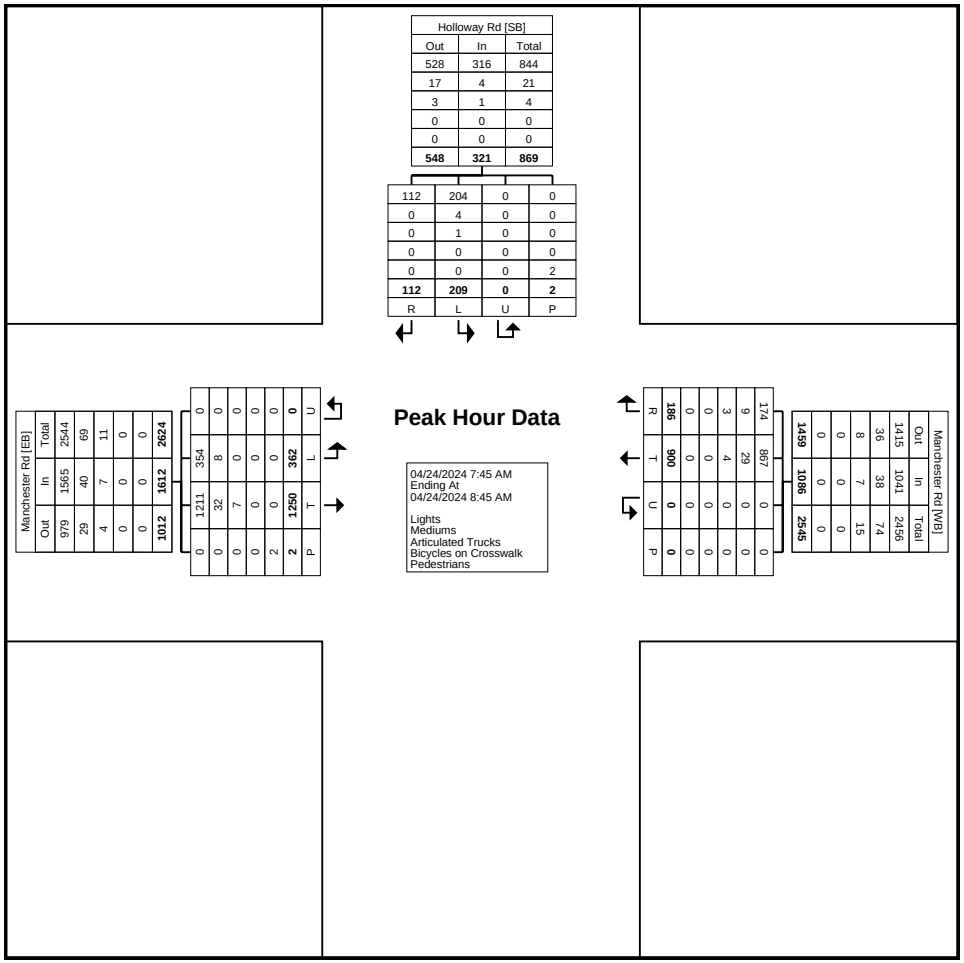
Turning Movement Peak Hour Data (7:45 AM)

Start Time	Holloway Rd Southbound					Manchester Rd Westbound					Manchester Rd Eastbound					
	Left	Right	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Int. Total
7:45 AM	44	21	0	1	65	216	45	0	0	261	113	323	0	2	436	762
8:00 AM	46	24	0	0	70	215	51	0	0	266	111	308	0	0	419	755
8:15 AM	60	24	0	1	84	215	44	0	0	259	82	330	0	0	412	755
8:30 AM	59	43	0	0	102	254	46	0	0	300	56	289	0	0	345	747
Total	209	112	0	2	321	900	186	0	0	1086	362	1250	0	2	1612	3019
Approach %	65.1	34.9	0.0	-	-	82.9	17.1	0.0	-	-	22.5	77.5	0.0	-	-	-
Total %	6.9	3.7	0.0	-	10.6	29.8	6.2	0.0	-	36.0	12.0	41.4	0.0	-	53.4	-
PHF	0.871	0.651	0.000	-	0.787	0.886	0.912	0.000	-	0.905	0.801	0.947	0.000	-	0.924	0.990
Lights	204	112	0	-	316	867	174	0	-	1041	354	1211	0	-	1565	2922
% Lights	97.6	100.0	-	-	98.4	96.3	93.5	-	-	95.9	97.8	96.9	-	-	97.1	96.8
Mediums	4	0	0	-	4	29	9	0	-	38	8	32	0	-	40	82
% Mediums	1.9	0.0	-	-	1.2	3.2	4.8	-	-	3.5	2.2	2.6	-	-	2.5	2.7
Articulated Trucks	1	0	0	-	1	4	3	0	-	7	0	7	0	-	7	15
% Articulated Trucks	0.5	0.0	-	-	0.3	0.4	1.6	-	-	0.6	0.0	0.6	-	-	0.4	0.5
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	0.0	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	2	-	-	-	-	0	-	-	-	-	2	-	-
% Pedestrians	-	-	-	100.0	-	-	-	-	-	-	-	-	-	100.0	-	-

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Holloway Rd
Site Code:
Start Date: 04/24/2024



Turning Movement Peak Hour Data Plot (7:45 AM)

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Holloway Rd
Site Code:
Start Date: 04/24/2024

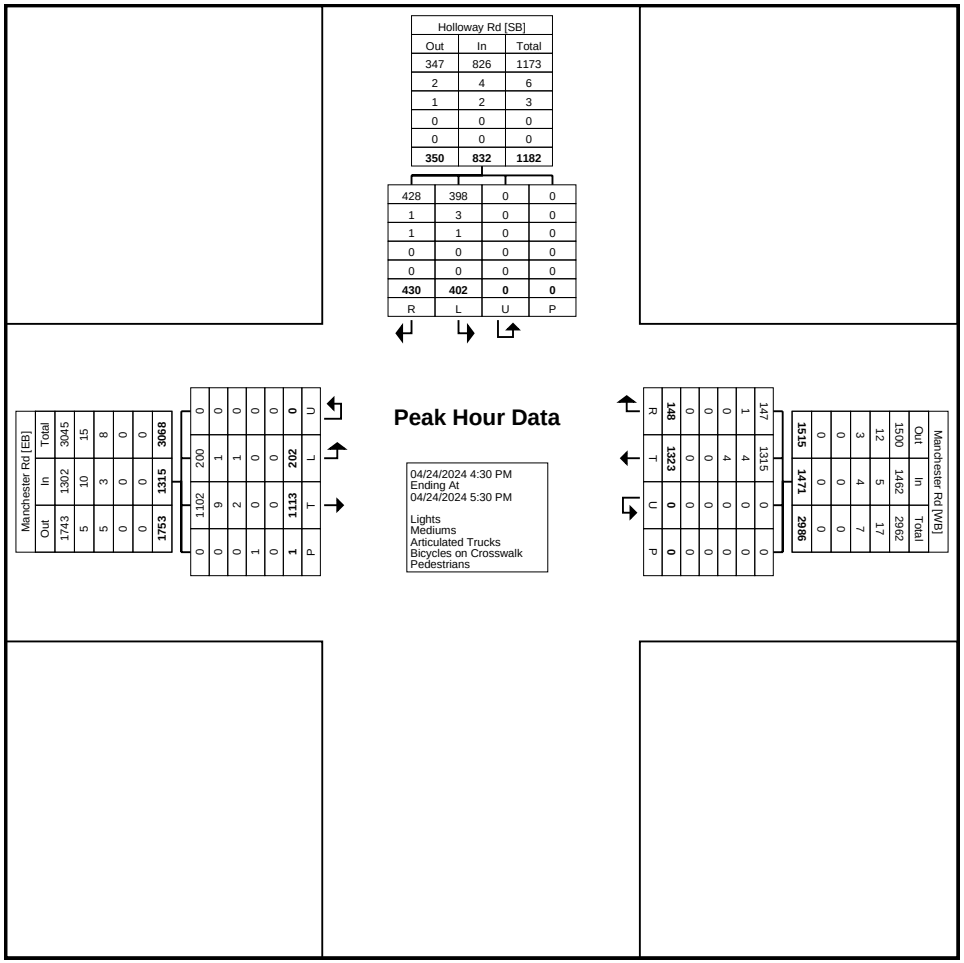
Turning Movement Peak Hour Data (4:30 PM)

Start Time	Holloway Rd Southbound					Manchester Rd Westbound					Manchester Rd Eastbound					
	Left	Right	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	U-Turn	Peds	App. Total	Int. Total
4:30 PM	106	88	0	0	194	352	34	0	0	386	49	282	0	0	331	911
4:45 PM	96	123	0	0	219	311	36	0	0	347	57	262	0	0	319	885
5:00 PM	97	111	0	0	208	331	38	0	0	369	54	287	0	0	341	918
5:15 PM	103	108	0	0	211	329	40	0	0	369	42	282	0	1	324	904
Total	402	430	0	0	832	1323	148	0	0	1471	202	1113	0	1	1315	3618
Approach %	48.3	51.7	0.0	-	-	89.9	10.1	0.0	-	-	15.4	84.6	0.0	-	-	-
Total %	11.1	11.9	0.0	-	23.0	36.6	4.1	0.0	-	40.7	5.6	30.8	0.0	-	36.3	-
PHF	0.948	0.874	0.000	-	0.950	0.940	0.925	0.000	-	0.953	0.886	0.970	0.000	-	0.964	0.985
Lights	398	428	0	-	826	1315	147	0	-	1462	200	1102	0	-	1302	3590
% Lights	99.0	99.5	-	-	99.3	99.4	99.3	-	-	99.4	99.0	99.0	-	-	99.0	99.2
Mediums	3	1	0	-	4	4	1	0	-	5	1	9	0	-	10	19
% Mediums	0.7	0.2	-	-	0.5	0.3	0.7	-	-	0.3	0.5	0.8	-	-	0.8	0.5
Articulated Trucks	1	1	0	-	2	4	0	0	-	4	1	2	0	-	3	9
% Articulated Trucks	0.2	0.2	-	-	0.2	0.3	0.0	-	-	0.3	0.5	0.2	-	-	0.2	0.2
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	1	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Holloway Rd
Site Code:
Start Date: 04/24/2024



Turning Movement Peak Hour Data Plot (4:30 PM)

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Old Ballwin Rd
Site Code:
Start Date: 04/24/2024

Turning Movement Data

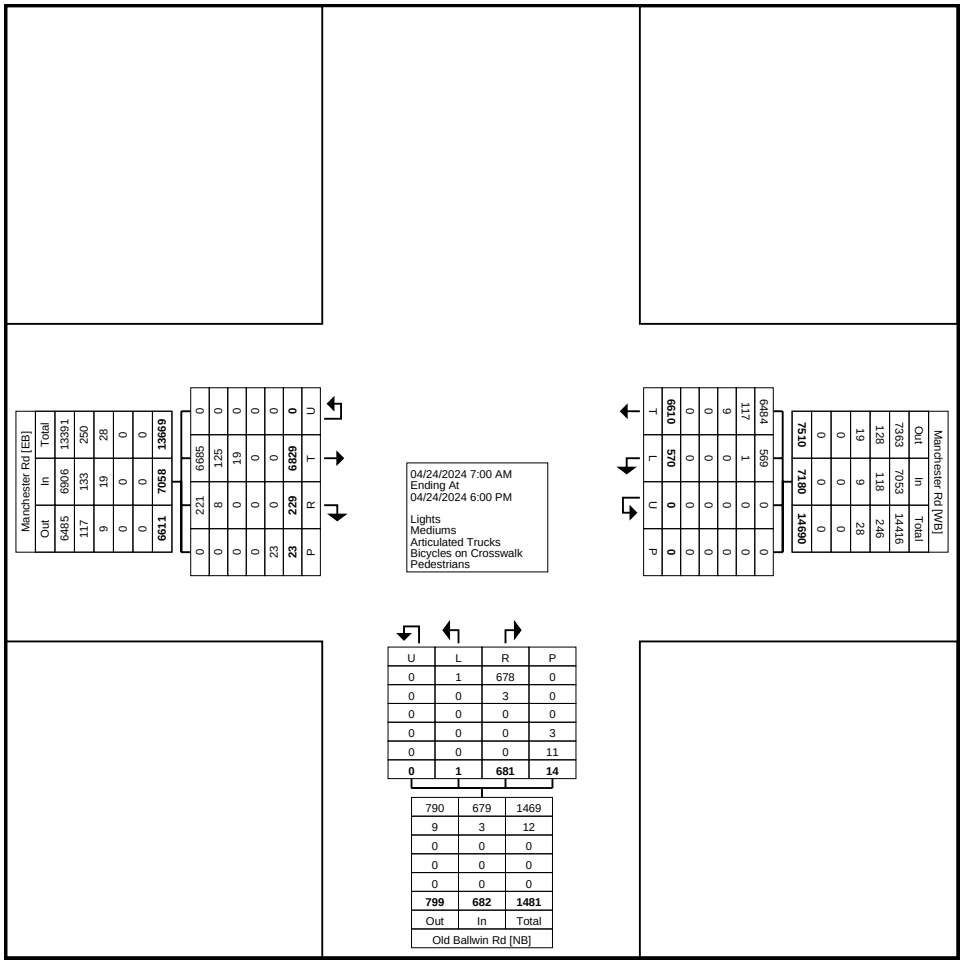
Start Time	Manchester Rd Westbound					Old Ballwin Rd Northbound					Manchester Rd Eastbound					
	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Int. Total
7:00 AM	13	188	0	0	201	0	32	0	0	32	279	6	0	0	285	518
7:15 AM	20	202	0	0	222	0	50	0	2	50	317	10	0	2	327	599
7:30 AM	19	224	0	0	243	0	86	0	0	86	340	11	0	0	351	680
7:45 AM	13	253	0	0	266	0	63	0	0	63	415	7	0	1	422	751
Hourly Total	65	867	0	0	932	0	231	0	2	231	1351	34	0	3	1385	2548
8:00 AM	28	217	0	0	245	1	39	0	0	40	427	10	0	1	437	722
8:15 AM	15	224	0	0	239	0	26	0	0	26	388	10	0	1	398	663
8:30 AM	20	281	0	0	301	0	33	0	0	33	344	12	0	1	356	690
8:45 AM	18	243	0	0	261	0	27	0	0	27	325	11	0	1	336	624
Hourly Total	81	965	0	0	1046	1	125	0	0	126	1484	43	0	4	1527	2699
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	11	345	0	0	356	0	47	0	1	47	374	5	0	2	379	782
3:15 PM	33	388	0	0	421	0	23	0	2	23	308	8	0	1	316	760
3:30 PM	29	398	0	0	427	0	23	0	0	23	303	17	0	1	320	770
3:45 PM	40	406	0	0	446	0	28	0	2	28	332	17	0	1	349	823
Hourly Total	113	1537	0	0	1650	0	121	0	5	121	1317	47	0	5	1364	3135
4:00 PM	30	401	0	0	431	0	36	0	0	36	329	12	0	3	341	808
4:15 PM	35	399	0	0	434	0	32	0	2	32	331	11	0	2	342	808
4:30 PM	44	377	0	0	421	0	24	0	1	24	324	18	0	1	342	787
4:45 PM	26	444	0	0	470	0	25	0	2	25	358	16	0	1	374	869
Hourly Total	135	1621	0	0	1756	0	117	0	5	117	1342	57	0	7	1399	3272
5:00 PM	53	392	0	0	445	0	20	0	0	20	329	8	0	0	337	802
5:15 PM	46	410	0	0	456	0	19	0	1	19	351	14	0	1	365	840
5:30 PM	35	402	0	0	437	0	25	0	1	25	329	12	0	3	341	803
5:45 PM	42	416	0	0	458	0	23	0	0	23	326	14	0	0	340	821
Hourly Total	176	1620	0	0	1796	0	87	0	2	87	1335	48	0	4	1383	3266
Grand Total	570	6610	0	0	7180	1	681	0	14	682	6829	229	0	23	7058	14920
Approach %	7.9	92.1	0.0	-	-	0.1	99.9	0.0	-	-	96.8	3.2	0.0	-	-	-
Total %	3.8	44.3	0.0	-	48.1	0.0	4.6	0.0	-	4.6	45.8	1.5	0.0	-	47.3	-
Lights	569	6484	0	-	7053	1	678	0	-	679	6685	221	0	-	6906	14638
% Lights	99.8	98.1	-	-	98.2	100.0	99.6	-	-	99.6	97.9	96.5	-	-	97.8	98.1
Mediums	1	117	0	-	118	0	3	0	-	3	125	8	0	-	133	254
% Mediums	0.2	1.8	-	-	1.6	0.0	0.4	-	-	0.4	1.8	3.5	-	-	1.9	1.7
Articulated Trucks	0	9	0	-	9	0	0	0	-	0	19	0	0	-	19	28
% Articulated Trucks	0.0	0.1	-	-	0.1	0.0	0.0	-	-	0.0	0.3	0.0	-	-	0.3	0.2
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	3	-	-	-	-	0	-	-

% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	21.4	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	0	-	-	-	-	11	-	-	-	-	23	-	-
% Pedestrians	-	-	-	-	-	-	-	-	78.6	-	-	-	-	100.0	-	-

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Old Ballwin Rd
Site Code:
Start Date: 04/24/2024
Page No: 3



Turning Movement Data Plot

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Old Ballwin Rd
Site Code:
Start Date: 04/24/2024

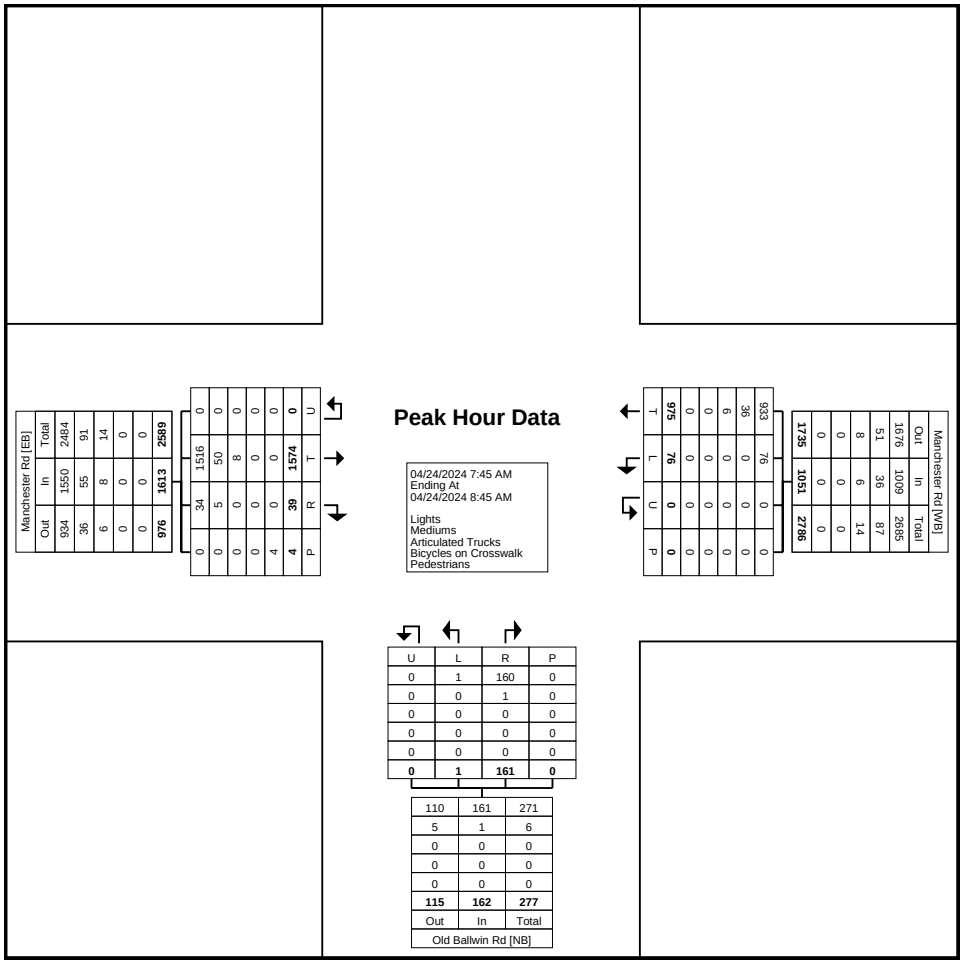
Turning Movement Peak Hour Data (7:45 AM)

Start Time	Manchester Rd Westbound					Old Ballwin Rd Northbound					Manchester Rd Eastbound					
	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Int. Total
7:45 AM	13	253	0	0	266	0	63	0	0	63	415	7	0	1	422	751
8:00 AM	28	217	0	0	245	1	39	0	0	40	427	10	0	1	437	722
8:15 AM	15	224	0	0	239	0	26	0	0	26	388	10	0	1	398	663
8:30 AM	20	281	0	0	301	0	33	0	0	33	344	12	0	1	356	690
Total	76	975	0	0	1051	1	161	0	0	162	1574	39	0	4	1613	2826
Approach %	7.2	92.8	0.0	-	-	0.6	99.4	0.0	-	-	97.6	2.4	0.0	-	-	-
Total %	2.7	34.5	0.0	-	37.2	0.0	5.7	0.0	-	5.7	55.7	1.4	0.0	-	57.1	-
PHF	0.679	0.867	0.000	-	0.873	0.250	0.639	0.000	-	0.643	0.922	0.813	0.000	-	0.923	0.941
Lights	76	933	0	-	1009	1	160	0	-	161	1516	34	0	-	1550	2720
% Lights	100.0	95.7	-	-	96.0	100.0	99.4	-	-	99.4	96.3	87.2	-	-	96.1	96.2
Mediums	0	36	0	-	36	0	1	0	-	1	50	5	0	-	55	92
% Mediums	0.0	3.7	-	-	3.4	0.0	0.6	-	-	0.6	3.2	12.8	-	-	3.4	3.3
Articulated Trucks	0	6	0	-	6	0	0	0	-	0	8	0	0	-	8	14
% Articulated Trucks	0.0	0.6	-	-	0.6	0.0	0.0	-	-	0.0	0.5	0.0	-	-	0.5	0.5
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	4	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Old Ballwin Rd
Site Code:
Start Date: 04/24/2024



Turning Movement Peak Hour Data Plot (7:45 AM)

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Old Ballwin Rd
Site Code:
Start Date: 04/24/2024

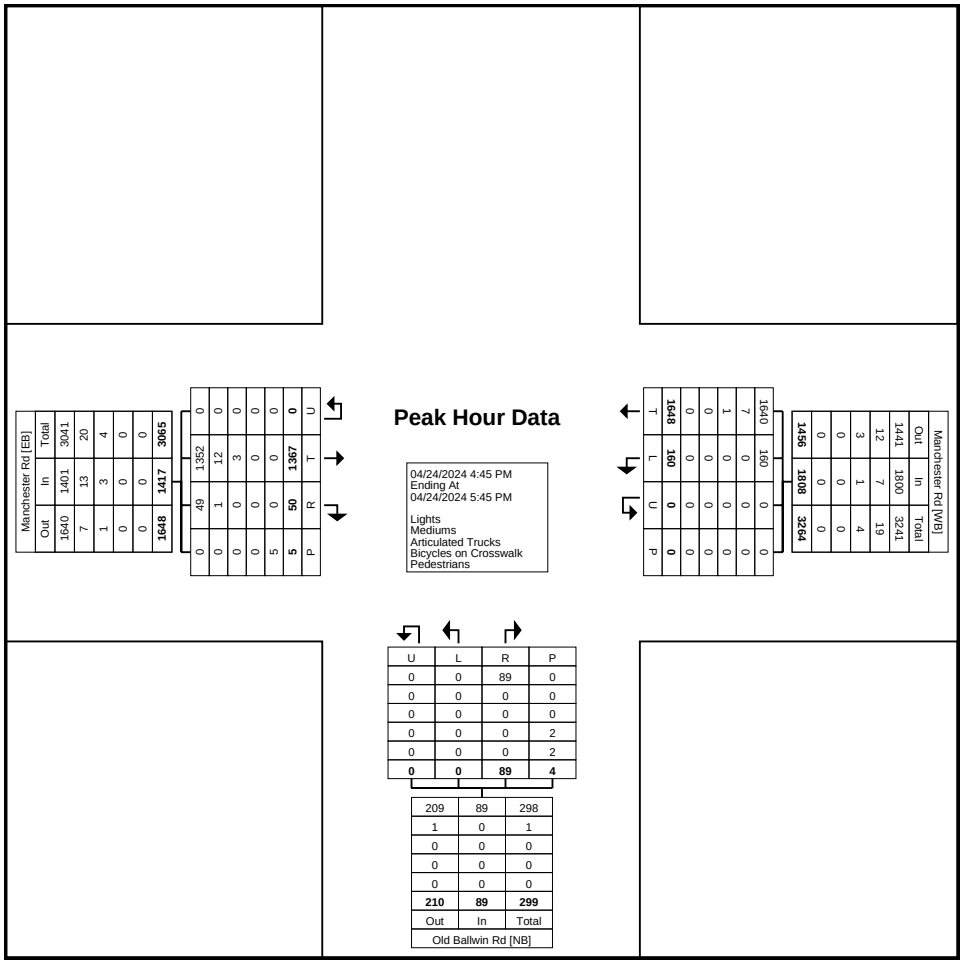
Turning Movement Peak Hour Data (4:45 PM)

Start Time	Manchester Rd Westbound					Old Ballwin Rd Northbound					Manchester Rd Eastbound					
	Left	Thru	U-Turn	Peds	App. Total	Left	Right	U-Turn	Peds	App. Total	Thru	Right	U-Turn	Peds	App. Total	Int. Total
4:45 PM	26	444	0	0	470	0	25	0	2	25	358	16	0	1	374	869
5:00 PM	53	392	0	0	445	0	20	0	0	20	329	8	0	0	337	802
5:15 PM	46	410	0	0	456	0	19	0	1	19	351	14	0	1	365	840
5:30 PM	35	402	0	0	437	0	25	0	1	25	329	12	0	3	341	803
Total	160	1648	0	0	1808	0	89	0	4	89	1367	50	0	5	1417	3314
Approach %	8.8	91.2	0.0	-	-	0.0	100.0	0.0	-	-	96.5	3.5	0.0	-	-	-
Total %	4.8	49.7	0.0	-	54.6	0.0	2.7	0.0	-	2.7	41.2	1.5	0.0	-	42.8	-
PHF	0.755	0.928	0.000	-	0.962	0.000	0.890	0.000	-	0.890	0.955	0.781	0.000	-	0.947	0.953
Lights	160	1640	0	-	1800	0	89	0	-	89	1352	49	0	-	1401	3290
% Lights	100.0	99.5	-	-	99.6	-	100.0	-	-	100.0	98.9	98.0	-	-	98.9	99.3
Mediums	0	7	0	-	7	0	0	0	-	0	12	1	0	-	13	20
% Mediums	0.0	0.4	-	-	0.4	-	0.0	-	-	0.0	0.9	2.0	-	-	0.9	0.6
Articulated Trucks	0	1	0	-	1	0	0	0	-	0	3	0	0	-	3	4
% Articulated Trucks	0.0	0.1	-	-	0.1	-	0.0	-	-	0.0	0.2	0.0	-	-	0.2	0.1
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	2	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	50.0	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	0	-	-	-	-	2	-	-	-	-	5	-	-
% Pedestrians	-	-	-	-	-	-	-	-	50.0	-	-	-	-	100.0	-	-

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 chutchinson@terraengineering.com

Count Name: Manchester Rd & Old Ballwin Rd
Site Code:
Start Date: 04/24/2024



Turning Movement Peak Hour Data Plot (4:45 PM)

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 song@terraengineering.com

Count Name: Manchester Rd & New Ballwin Rd
Site Code:
Start Date: 03/12/2024

Turning Movement Data

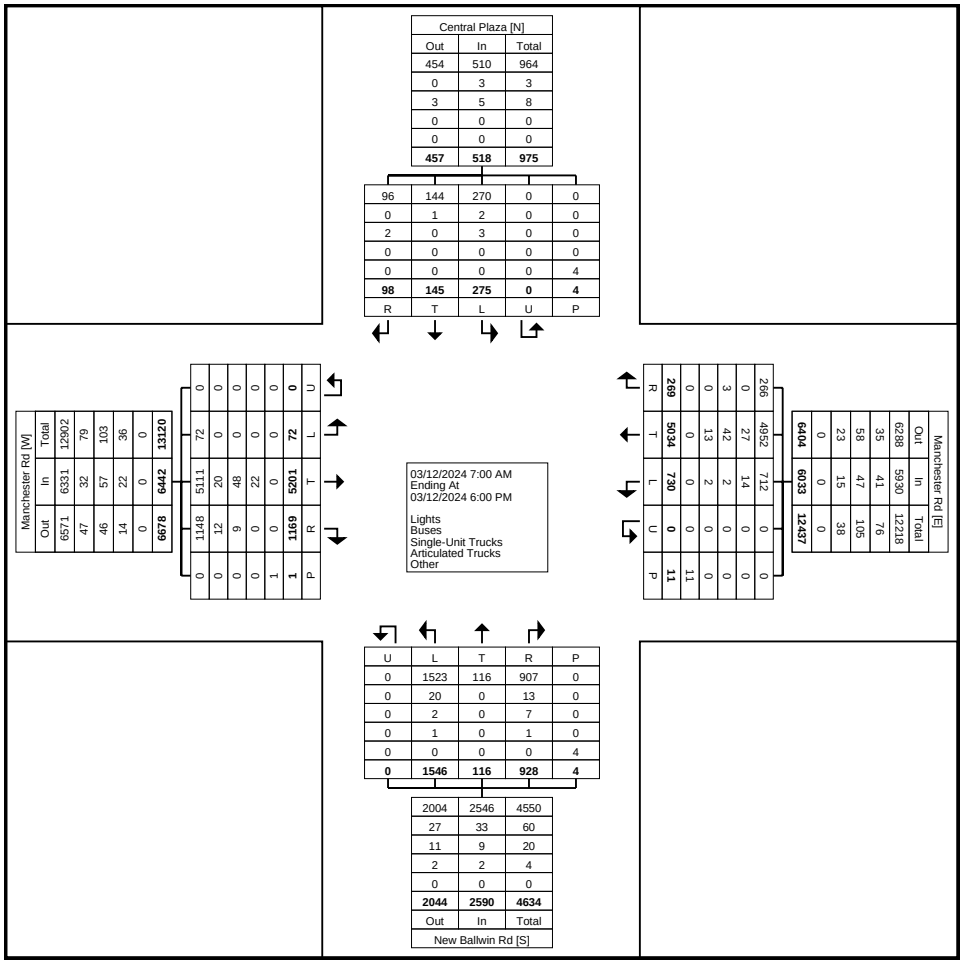
Start Time	Central Plaza Southbound						Manchester Rd Westbound						New Ballwin Rd Northbound						Manchester Rd Eastbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
7:00 AM	0	1	0	0	0	1	15	141	0	0	0	156	50	0	53	0	0	103	0	189	37	0	0	226	486
7:15 AM	0	2	0	0	0	2	36	147	0	0	0	183	67	0	54	0	0	121	0	259	73	0	0	332	638
7:30 AM	3	2	1	0	0	6	44	170	2	0	0	216	74	0	59	0	0	133	2	238	72	0	0	312	667
7:45 AM	3	0	2	0	0	5	18	205	0	0	0	223	107	0	72	0	1	179	0	288	55	0	0	343	750
Hourly Total	6	5	3	0	0	14	113	663	2	0	0	778	298	0	238	0	1	536	2	974	237	0	0	1213	2541
8:00 AM	1	2	0	0	0	3	15	194	1	0	0	210	85	0	62	0	0	147	0	265	34	0	0	299	659
8:15 AM	3	2	0	0	1	5	24	196	5	0	0	225	58	0	57	0	0	115	0	284	34	0	1	318	663
8:30 AM	2	0	2	0	0	4	26	173	3	0	0	202	65	0	44	0	0	109	0	255	28	0	0	283	598
8:45 AM	2	0	1	0	0	3	20	203	4	0	0	227	62	0	48	0	0	110	0	238	34	0	0	272	612
Hourly Total	8	4	3	0	1	15	85	766	13	0	0	864	270	0	211	0	0	481	0	1042	130	0	1	1172	2532
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3:00 PM	25	19	12	0	0	56	27	302	20	0	0	349	101	12	48	0	0	161	1	241	46	0	0	288	854
3:15 PM	26	4	12	0	0	42	32	274	17	0	0	323	73	7	33	0	0	113	5	220	47	0	0	272	750
3:30 PM	16	10	4	0	0	30	44	360	16	0	3	420	53	4	19	0	0	76	4	305	89	0	0	398	924
3:45 PM	17	18	5	0	0	40	37	280	27	0	0	344	69	13	50	0	1	132	8	244	66	0	0	318	834
Hourly Total	84	51	33	0	0	168	140	1216	80	0	3	1436	296	36	150	0	1	482	18	1010	248	0	0	1276	3362
4:00 PM	21	3	9	0	0	33	38	309	26	0	0	373	96	12	49	0	0	157	5	290	56	0	0	351	914
4:15 PM	18	13	9	0	1	40	63	289	19	0	0	371	81	9	49	0	0	139	4	281	63	0	0	348	898
4:30 PM	25	10	8	0	0	43	45	302	19	0	0	366	83	10	44	0	0	137	8	274	80	0	0	362	908
4:45 PM	21	11	8	0	0	40	48	302	23	0	0	373	82	7	41	0	0	130	9	279	69	0	0	357	900
Hourly Total	85	37	34	0	1	156	194	1202	87	0	0	1483	342	38	183	0	0	563	26	1124	268	0	0	1418	3620
5:00 PM	18	12	6	0	0	36	47	309	22	0	1	378	107	7	39	0	1	153	6	281	82	0	0	369	936
5:15 PM	23	10	7	0	2	40	53	307	19	0	1	379	82	12	34	0	1	128	6	280	74	0	0	360	907
5:30 PM	29	13	7	0	0	49	49	273	23	0	0	345	85	8	35	0	0	128	8	232	61	0	0	301	823
5:45 PM	22	13	5	0	0	40	49	298	23	0	6	370	66	15	38	0	0	119	6	258	69	0	0	333	862
Hourly Total	92	48	25	0	2	165	198	1187	87	0	8	1472	340	42	146	0	2	528	26	1051	286	0	0	1363	3528
Grand Total	275	145	98	0	4	518	730	5034	269	0	11	6033	1546	116	928	0	4	2590	72	5201	1169	0	1	6442	15583
Approach %	53.1	28.0	18.9	0.0	-	-	12.1	83.4	4.5	0.0	-	-	59.7	4.5	35.8	0.0	-	-	1.1	80.7	18.1	0.0	-	-	-
Total %	1.8	0.9	0.6	0.0	-	3.3	4.7	32.3	1.7	0.0	-	38.7	9.9	0.7	6.0	0.0	-	16.6	0.5	33.4	7.5	0.0	-	41.3	-
Lights	270	144	96	0	-	510	712	4952	266	0	-	5930	1523	116	907	0	-	2546	72	5111	1148	0	-	6331	15317
% Lights	98.2	99.3	98.0	-	-	98.5	97.5	98.4	98.9	-	-	98.3	98.5	100.0	97.7	-	-	98.3	100.0	98.3	98.2	-	-	98.3	98.3
Buses	2	1	0	0	-	3	14	27	0	0	-	41	20	0	13	0	-	33	0	20	12	0	-	32	109
% Buses	0.7	0.7	0.0	-	-	0.6	1.9	0.5	0.0	-	-	0.7	1.3	0.0	1.4	-	-	1.3	0.0	0.4	1.0	-	-	0.5	0.7
Single-Unit Trucks	3	0	2	0	-	5	2	42	3	0	-	47	2	0	7	0	-	9	0	48	9	0	-	57	118
% Single-Unit Trucks	1.1	0.0	2.0	-	-	1.0	0.3	0.8	1.1	-	-	0.8	0.1	0.0	0.8	-	-	0.3	0.0	0.9	0.8	-	-	0.9	0.8

Articulated Trucks	0	0	0	0	-	0	2	13	0	0	-	15	1	0	1	0	-	2	0	22	0	0	-	22	39
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.3	0.3	0.0	-	-	0.2	0.1	0.0	0.1	-	-	0.1	0.0	0.4	0.0	-	-	0.3	0.3
Bicycles on Road	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	5	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	45.5	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	4	-	-	-	-	-	6	-	-	-	-	-	4	-	-	-	-	-	1	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	54.5	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 song@terraengineering.com

Count Name: Manchester Rd & New Ballwin Rd
Site Code:
Start Date: 03/12/2024



Turning Movement Data Plot

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 song@terraengineering.com

Count Name: Manchester Rd & New Ballwin Rd
Site Code:
Start Date: 03/12/2024

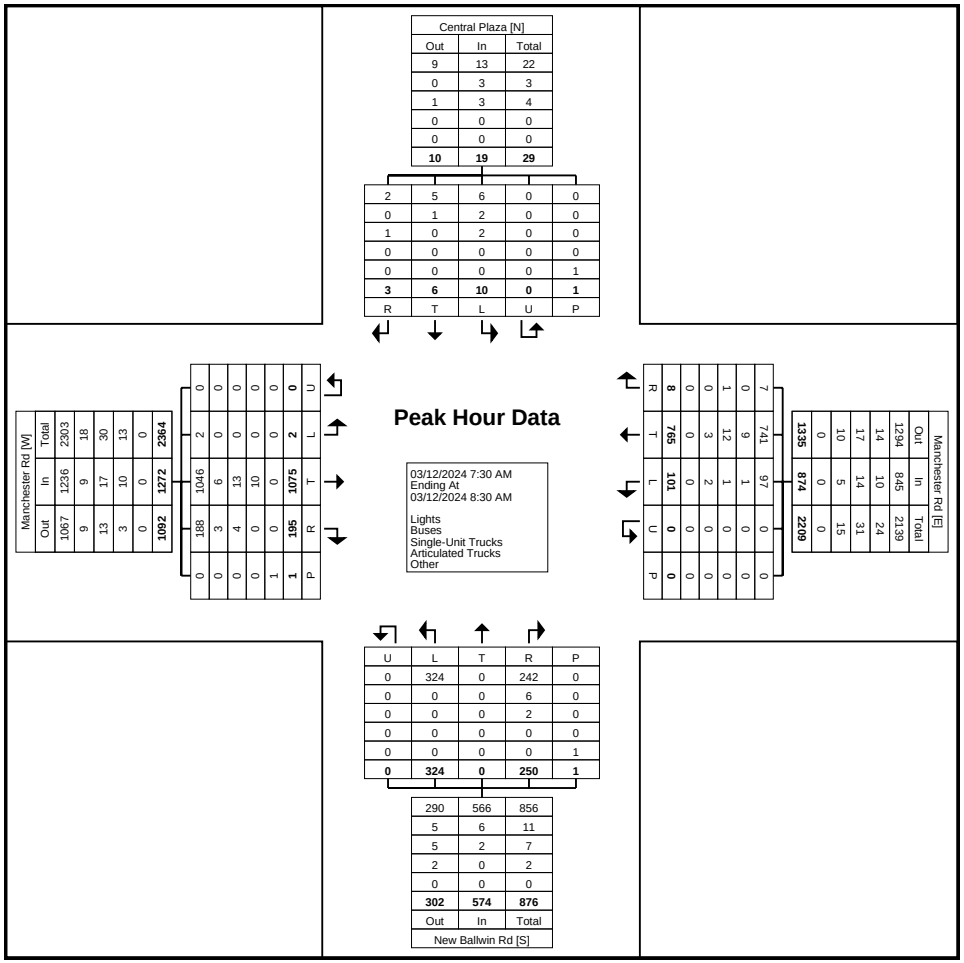
Turning Movement Peak Hour Data (7:30 AM)

Start Time	Central Plaza Southbound						Manchester Rd Westbound						New Ballwin Rd Northbound						Manchester Rd Eastbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
7:30 AM	3	2	1	0	0	6	44	170	2	0	0	216	74	0	59	0	0	133	2	238	72	0	0	312	667
7:45 AM	3	0	2	0	0	5	18	205	0	0	0	223	107	0	72	0	1	179	0	288	55	0	0	343	750
8:00 AM	1	2	0	0	0	3	15	194	1	0	0	210	85	0	62	0	0	147	0	265	34	0	0	299	659
8:15 AM	3	2	0	0	1	5	24	196	5	0	0	225	58	0	57	0	0	115	0	284	34	0	1	318	663
Total	10	6	3	0	1	19	101	765	8	0	0	874	324	0	250	0	1	574	2	1075	195	0	1	1272	2739
Approach %	52.6	31.6	15.8	0.0	-	-	11.6	87.5	0.9	0.0	-	-	56.4	0.0	43.6	0.0	-	-	0.2	84.5	15.3	0.0	-	-	-
Total %	0.4	0.2	0.1	0.0	-	0.7	3.7	27.9	0.3	0.0	-	31.9	11.8	0.0	9.1	0.0	-	21.0	0.1	39.2	7.1	0.0	-	46.4	-
PHF	0.833	0.750	0.375	0.000	-	0.792	0.574	0.933	0.400	0.000	-	0.971	0.757	0.000	0.868	0.000	-	0.802	0.250	0.933	0.677	0.000	-	0.927	0.913
Lights	6	5	2	0	-	13	97	741	7	0	-	845	324	0	242	0	-	566	2	1046	188	0	-	1236	2660
% Lights	60.0	83.3	66.7	-	-	68.4	96.0	96.9	87.5	-	-	96.7	100.0	-	96.8	-	-	98.6	100.0	97.3	96.4	-	-	97.2	97.1
Buses	2	1	0	0	-	3	1	9	0	0	-	10	0	0	6	0	-	6	0	6	3	0	-	9	28
% Buses	20.0	16.7	0.0	-	-	15.8	1.0	1.2	0.0	-	-	1.1	0.0	-	2.4	-	-	1.0	0.0	0.6	1.5	-	-	0.7	1.0
Single-Unit Trucks	2	0	1	0	-	3	1	12	1	0	-	14	0	0	2	0	-	2	0	13	4	0	-	17	36
% Single-Unit Trucks	20.0	0.0	33.3	-	-	15.8	1.0	1.6	12.5	-	-	1.6	0.0	-	0.8	-	-	0.3	0.0	1.2	2.1	-	-	1.3	1.3
Articulated Trucks	0	0	0	0	-	0	2	3	0	0	-	5	0	0	0	0	-	0	0	10	0	0	-	10	15
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	2.0	0.4	0.0	-	-	0.6	0.0	-	0.0	-	-	0.0	0.0	0.9	0.0	-	-	0.8	0.5
Bicycles on Road	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	-	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	1	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 song@terraengineering.com

Count Name: Manchester Rd & New Ballwin Rd
Site Code:
Start Date: 03/12/2024



Turning Movement Peak Hour Data Plot (7:30 AM)

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 song@terraengineering.com

Count Name: Manchester Rd & New Ballwin Rd
Site Code:
Start Date: 03/12/2024

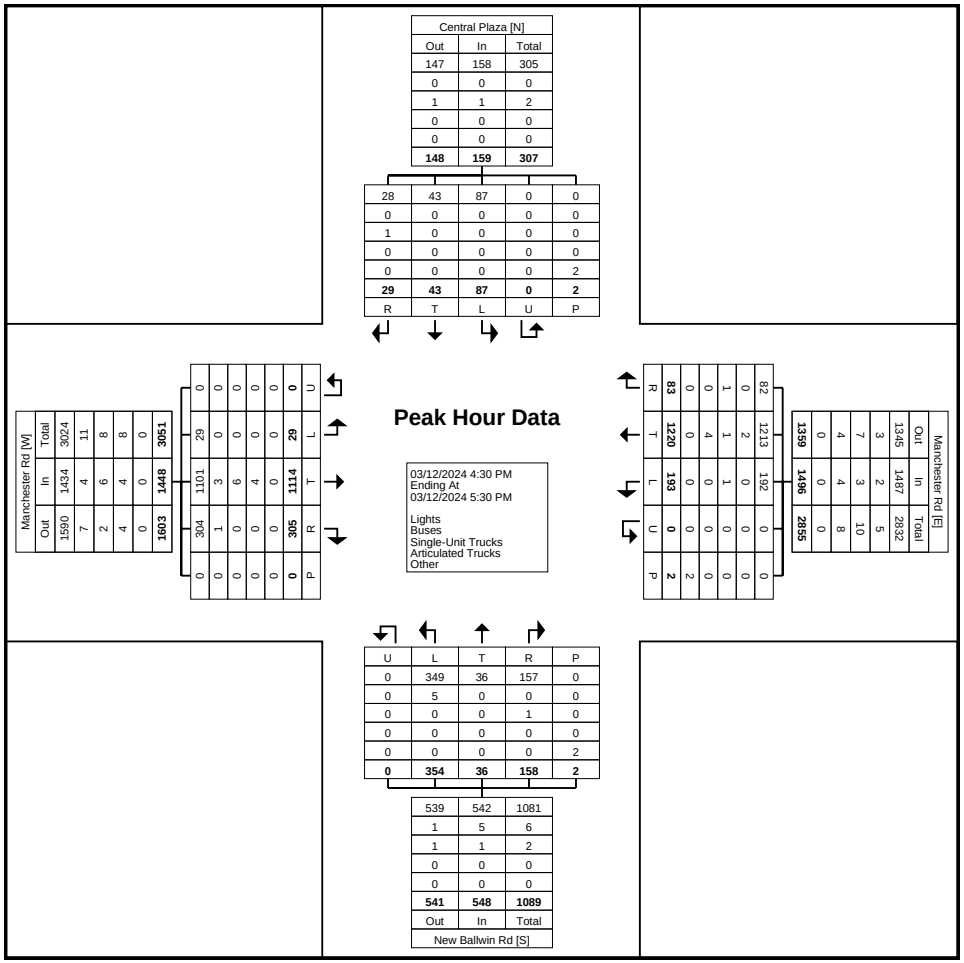
Turning Movement Peak Hour Data (4:30 PM)

Start Time	Central Plaza Southbound						Manchester Rd Westbound						New Ballwin Rd Northbound						Manchester Rd Eastbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
4:30 PM	25	10	8	0	0	43	45	302	19	0	0	366	83	10	44	0	0	137	8	274	80	0	0	362	908
4:45 PM	21	11	8	0	0	40	48	302	23	0	0	373	82	7	41	0	0	130	9	279	69	0	0	357	900
5:00 PM	18	12	6	0	0	36	47	309	22	0	1	378	107	7	39	0	1	153	6	281	82	0	0	369	936
5:15 PM	23	10	7	0	2	40	53	307	19	0	1	379	82	12	34	0	1	128	6	280	74	0	0	360	907
Total	87	43	29	0	2	159	193	1220	83	0	2	1496	354	36	158	0	2	548	29	1114	305	0	0	1448	3651
Approach %	54.7	27.0	18.2	0.0	-	-	12.9	81.6	5.5	0.0	-	-	64.6	6.6	28.8	0.0	-	-	2.0	76.9	21.1	0.0	-	-	-
Total %	2.4	1.2	0.8	0.0	-	4.4	5.3	33.4	2.3	0.0	-	41.0	9.7	1.0	4.3	0.0	-	15.0	0.8	30.5	8.4	0.0	-	39.7	-
PHF	0.870	0.896	0.906	0.000	-	0.924	0.910	0.987	0.902	0.000	-	0.987	0.827	0.750	0.898	0.000	-	0.895	0.806	0.991	0.930	0.000	-	0.981	0.975
Lights	87	43	28	0	-	158	192	1213	82	0	-	1487	349	36	157	0	-	542	29	1101	304	0	-	1434	3621
% Lights	100.0	100.0	96.6	-	-	99.4	99.5	99.4	98.8	-	-	99.4	98.6	100.0	99.4	-	-	98.9	100.0	98.8	99.7	-	-	99.0	99.2
Buses	0	0	0	0	-	0	0	2	0	0	-	2	5	0	0	0	-	5	0	3	1	0	-	4	11
% Buses	0.0	0.0	0.0	-	-	0.0	0.0	0.2	0.0	-	-	0.1	1.4	0.0	0.0	-	-	0.9	0.0	0.3	0.3	-	-	0.3	0.3
Single-Unit Trucks	0	0	1	0	-	1	1	1	1	0	-	3	0	0	1	0	-	1	0	6	0	0	-	6	11
% Single-Unit Trucks	0.0	0.0	3.4	-	-	0.6	0.5	0.1	1.2	-	-	0.2	0.0	0.0	0.6	-	-	0.2	0.0	0.5	0.0	-	-	0.4	0.3
Articulated Trucks	0	0	0	0	-	0	0	4	0	0	-	4	0	0	0	0	-	0	0	4	0	0	-	4	8
% Articulated Trucks	0.0	0.0	0.0	-	-	0.0	0.0	0.3	0.0	-	-	0.3	0.0	0.0	0.0	-	-	0.0	0.0	0.4	0.0	-	-	0.3	0.2
Bicycles on Road	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-

Terra Engineering
1804 Borman Circle Drive

Saint Louis, Missouri, United States 63146
314-395-9899 song@terraengineering.com

Count Name: Manchester Rd & New Ballwin Rd
Site Code:
Start Date: 03/12/2024



Turning Movement Peak Hour Data Plot (4:30 PM)

APPENDIX B
EXISTING SYNCHRO OUTPUT

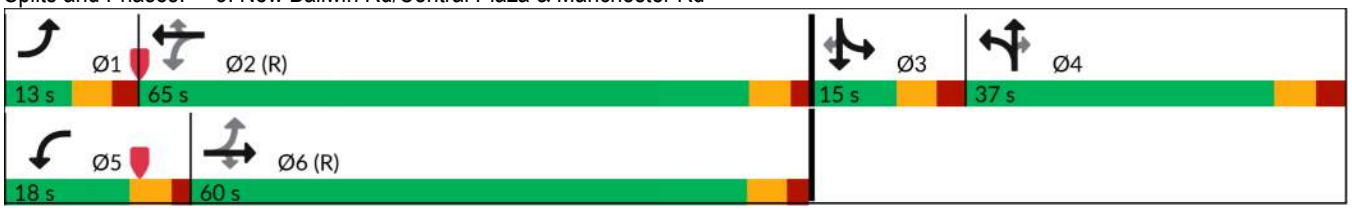
TERRA ENGINEERING LTD.

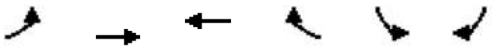
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	1075	195	101	765	8	324	0	250	10	6	3
Future Volume (vph)	2	1075	195	101	765	8	324	0	250	10	6	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	180		150	190		175	190		190	115		20
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950	0.950		0.950	0.989	
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1681	1681	1583	1681	1750	1583
Flt Permitted	0.320			0.148			0.950	0.950		0.950	0.989	
Satd. Flow (perm)	596	3539	1583	276	3539	1583	1681	1681	1583	1681	1750	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			143			143			229			138
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1190			1201			2193			203	
Travel Time (s)		27.0			27.3			49.8			4.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	1168	212	110	832	9	352	0	272	11	7	3
Shared Lane Traffic (%)							50%			20%		
Lane Group Flow (vph)	2	1168	212	110	832	9	176	176	272	9	9	3
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane					Yes							
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	1	6		5	2		4	4		3	3	
Permitted Phases	6		6	2		2			4			3
Detector Phase	1	6	6	5	2	2	4	4	4	3	3	3
Switch Phase												
Minimum Initial (s)	5.0	20.0	20.0	5.0	20.0	20.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	11.5	26.1	26.1	10.8	25.8	25.8	13.9	13.9	13.9	13.6	13.6	13.6
Total Split (s)	13.0	60.0	60.0	18.0	65.0	65.0	37.0	37.0	37.0	15.0	15.0	15.0
Total Split (%)	10.0%	46.2%	46.2%	13.8%	50.0%	50.0%	28.5%	28.5%	28.5%	11.5%	11.5%	11.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.5	2.1	2.1	1.8	1.8	1.8	2.9	2.9	2.9	2.6	2.6	2.6
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.1	6.1	5.8	5.8	5.8	6.9	6.9	6.9	6.6	6.6	6.6
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lag	Lag	Lag	Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Min	C-Min	None	C-Min	C-Min	None	None	None	None	None	None
Act Effct Green (s)	79.1	73.9	73.9	88.8	86.3	86.3	20.2	20.2	20.2	7.1	7.1	7.1
Actuated g/C Ratio	0.61	0.57	0.57	0.68	0.66	0.66	0.16	0.16	0.16	0.05	0.05	0.05
v/c Ratio	0.00	0.58	0.22	0.38	0.35	0.01	0.67	0.67	0.62	0.10	0.09	0.01

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Control Delay (s/veh)	11.5	22.5	7.4	12.5	3.6	0.0	63.6	63.6	16.0	60.8	60.5	0.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	11.5	22.5	7.4	12.5	3.6	0.0	63.6	63.6	16.0	60.8	60.5	0.0
LOS	B	C	A	B	A	A	E	E	B	E	E	A
Approach Delay (s/veh)		20.2			4.6			42.9			52.0	
Approach LOS		C			A			D			D	
Stops (vph)	2	699	40	27	74	0	149	149	51	9	9	0
Fuel Used(gal)	0	19	2	1	8	0	6	6	5	0	0	0
CO Emissions (g/hr)	2	1312	162	95	568	5	398	398	375	11	11	0
NOx Emissions (g/hr)	0	255	32	18	111	1	77	77	73	2	2	0
VOC Emissions (g/hr)	1	304	38	22	132	1	92	92	87	3	3	0
Dilemma Vehicles (#)	0	0	0	0	0	0	0	0	0	0	0	0
Queue Length 50th (ft)	1	348	27	6	22	0	149	149	32	7	7	0
Queue Length 95th (ft)	5	528	88	53	88	m0	215	215	113	27	27	0
Internal Link Dist (ft)		1110			1121			2113			123	
Turn Bay Length (ft)	180		150	190		175	190		190	115		20
Base Capacity (vph)	425	2011	961	330	2350	1099	389	389	542	108	113	231
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.00	0.58	0.22	0.33	0.35	0.01	0.45	0.45	0.50	0.08	0.08	0.01

Intersection Summary			
Area Type:	Other		
Cycle Length: 130			
Actuated Cycle Length: 130			
Offset: 26 (20%), Referenced to phase 2:WBTL and 6:EBTL, Start of 1st Green			
Natural Cycle: 75			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.67			
Intersection Signal Delay (s/veh): 20.2		Intersection LOS: C	
Intersection Capacity Utilization 67.4%		ICU Level of Service C	
Analysis Period (min) 15			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 3: New Ballwin Rd/Central Plaza & Manchester Rd





Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	362	1250	900	186	209	112
Future Volume (vph)	362	1250	900	186	209	112
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150			0	155	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	0.95	0.97	1.00
Frt			0.974			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	3539	3447	0	3433	1583
Flt Permitted	0.178				0.950	
Satd. Flow (perm)	332	3539	3447	0	3433	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			31			122
Link Speed (mph)		30	30		30	
Link Distance (ft)		1830	1002		984	
Travel Time (s)		41.6	22.8		22.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	393	1359	978	202	227	122
Shared Lane Traffic (%)						
Lane Group Flow (vph)	393	1359	1180	0	227	122
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		24	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane		Yes	Yes			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	1	6	2		4	
Permitted Phases	6					4
Detector Phase	1	6	2		4	4
Switch Phase						
Minimum Initial (s)	5.0	20.0	20.0		7.0	7.0
Minimum Split (s)	10.9	25.8	25.5		24.9	24.9
Total Split (s)	25.0	105.0	80.0		25.0	25.0
Total Split (%)	19.2%	80.8%	61.5%		19.2%	19.2%
Yellow Time (s)	4.0	4.0	4.1		4.0	4.0
All-Red Time (s)	1.9	1.8	1.4		2.9	2.9
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	5.9	5.8	5.5		6.9	6.9
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Recall Mode	None	C-Min	C-Min		None	None
Act Effct Green (s)	103.3	103.4	78.5		13.9	13.9
Actuated g/C Ratio	0.79	0.80	0.60		0.11	0.11
v/c Ratio	0.82	0.48	0.56		0.62	0.44

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Control Delay (s/veh)	34.5	2.1	18.0		62.9	13.9
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay (s/veh)	34.5	2.1	18.0		62.9	13.9
LOS	C	A	B		E	B
Approach Delay (s/veh)		9.4	18.0		45.8	
Approach LOS		A	B		D	
Stops (vph)	191	123	634		195	18
Fuel Used(gal)	9	19	16		5	1
CO Emissions (g/hr)	613	1332	1116		374	89
NOx Emissions (g/hr)	119	259	217		73	17
VOC Emissions (g/hr)	142	309	259		87	21
Dilemma Vehicles (#)	0	0	0		0	0
Queue Length 50th (ft)	135	60	294		95	0
Queue Length 95th (ft)	264	66	451		135	57
Internal Link Dist (ft)		1750	922		904	
Turn Bay Length (ft)	150				155	
Base Capacity (vph)	518	2816	2157		477	325
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.76	0.48	0.55		0.48	0.38

Intersection Summary			
Area Type:	Other		
Cycle Length: 130			
Actuated Cycle Length: 130			
Offset: 91 (70%), Referenced to phase 2:WBT and 6:EBTL, Start of 1st Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.82			
Intersection Signal Delay (s/veh): 16.4		Intersection LOS: B	
Intersection Capacity Utilization 72.1%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 6: Manchester Rd

Intersection	
Int Delay, s/veh	2.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1574	39	76	975	0	161
Future Vol, veh/h	1574	39	76	975	0	161
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	50	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1711	42	83	1060	0	175

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1753	0	-	877
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	4.14	-	-	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	2.22	-	-	3.32
Pot Cap-1 Maneuver	-	-	353	-	0	292
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	353	-	-	292
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s/v	0	1.32	34.25
HCM LOS			D

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	292	-	-	353	-
HCM Lane V/C Ratio	0.6	-	-	0.234	-
HCM Control Delay (s/veh)	34.2	-	-	18.3	-
HCM Lane LOS	D	-	-	C	-
HCM 95th %tile Q(veh)	3.6	-	-	0.9	-

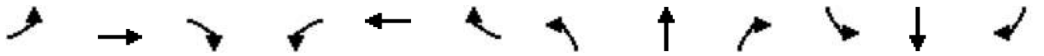
Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	6	1593	0	4	957	11	0	0	4	6	0	13
Future Vol, veh/h	6	1593	0	4	957	11	0	0	4	6	0	13
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	50	-	-	50	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	7	1732	0	4	1040	12	0	0	4	7	0	14

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1052	0	0	1732	0	0	2273	2805	866	1934	2799	526
Stage 1	-	-	-	-	-	-	1745	1745	-	1055	1055	-
Stage 2	-	-	-	-	-	-	529	1061	-	879	1745	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	657	-	-	360	-	-	22	18	297	40	18	496
Stage 1	-	-	-	-	-	-	90	139	-	241	301	-
Stage 2	-	-	-	-	-	-	501	299	-	309	139	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	657	-	-	360	-	-	21	18	297	38	18	496
Mov Cap-2 Maneuver	-	-	-	-	-	-	21	18	-	38	18	-
Stage 1	-	-	-	-	-	-	89	137	-	238	297	-
Stage 2	-	-	-	-	-	-	481	295	-	301	137	-

Approach	EB	WB	NB	SB
HCM Control Delay, s/v	0.04	0.06	17.32	48.11
HCM LOS			C	E

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	297	657	-	-	360	-	-	104
HCM Lane V/C Ratio	0.015	0.01	-	-	0.012	-	-	0.199
HCM Control Delay (s/veh)	17.3	10.5	-	-	15.1	-	-	48.1
HCM Lane LOS	C	B	-	-	C	-	-	E
HCM 95th %tile Q(veh)	0	0	-	-	0	-	-	0.7

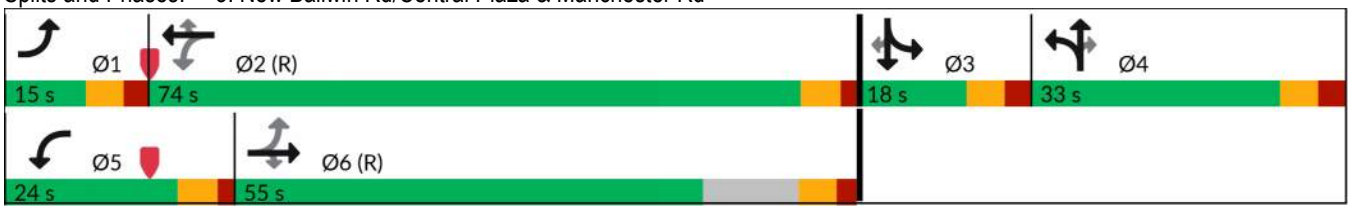


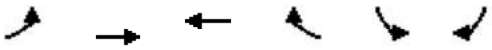
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	1114	305	193	1220	83	354	36	158	87	43	29
Future Volume (vph)	29	1114	305	193	1220	83	354	36	158	87	43	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	180		150	190		175	190		190	115		20
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950	0.961		0.950	0.983	
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1681	1701	1583	1681	1740	1583
Flt Permitted	0.133			0.107			0.950	0.961		0.950	0.983	
Satd. Flow (perm)	248	3539	1583	199	3539	1583	1681	1701	1583	1681	1740	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			178			132			172			174
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1190			1211			2193			203	
Travel Time (s)		27.0			27.5			49.8			4.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	32	1211	332	210	1326	90	385	39	172	95	47	32
Shared Lane Traffic (%)							45%			26%		
Lane Group Flow (vph)	32	1211	332	210	1326	90	212	212	172	70	72	32
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane					Yes							
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	1	6		5	2		4	4		3	3	
Permitted Phases	6		6	2		2			4			3
Detector Phase	1	6	6	5	2	2	4	4	4	3	3	3
Switch Phase												
Minimum Initial (s)	5.0	20.0	20.0	5.0	20.0	20.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	11.5	26.1	26.1	10.8	25.8	25.8	13.9	13.9	13.9	13.6	13.6	13.6
Total Split (s)	15.0	55.0	55.0	24.0	74.0	74.0	33.0	33.0	33.0	18.0	18.0	18.0
Total Split (%)	10.7%	39.3%	39.3%	17.1%	52.9%	52.9%	23.6%	23.6%	23.6%	12.9%	12.9%	12.9%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.5	2.1	2.1	1.8	1.8	1.8	2.9	2.9	2.9	2.6	2.6	2.6
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.1	6.1	5.8	5.8	5.8	6.9	6.9	6.9	6.6	6.6	6.6
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lag	Lag	Lag	Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Min	C-Min	None	C-Min	C-Min	None	None	None	None	None	None
Act Effct Green (s)	73.6	67.5	67.5	88.3	80.2	80.2	22.3	22.3	22.3	10.1	10.1	10.1
Actuated g/C Ratio	0.53	0.48	0.48	0.63	0.57	0.57	0.16	0.16	0.16	0.07	0.07	0.07
v/c Ratio	0.16	0.71	0.39	0.72	0.65	0.09	0.79	0.79	0.43	0.58	0.58	0.12

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Control Delay (s/veh)	14.5	33.3	13.0	37.3	31.7	6.2	77.3	76.2	10.2	81.8	80.8	0.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	14.5	33.3	13.0	37.3	31.7	6.2	77.3	76.2	10.2	81.8	80.8	0.9
LOS	B	C	B	D	C	A	E	E	B	F	F	A
Approach Delay (s/veh)		28.6			31.0			57.6			66.5	
Approach LOS		C			C			E			E	
Stops (vph)	15	875	96	137	775	12	185	184	19	60	63	0
Fuel Used(gal)	0	23	4	4	24	1	7	7	3	1	2	0
CO Emissions (g/hr)	31	1588	291	283	1655	67	519	516	219	105	108	4
NOx Emissions (g/hr)	6	309	57	55	322	13	101	100	43	20	21	1
VOC Emissions (g/hr)	7	368	68	66	384	15	120	119	51	24	25	1
Dilemma Vehicles (#)	0	0	0	0	0	0	0	0	0	0	0	0
Queue Length 50th (ft)	11	475	86	138	457	5	195	195	0	65	67	0
Queue Length 95th (ft)	27	599	176	m190	584	m15	288	287	64	122	125	0
Internal Link Dist (ft)		1110			1131			2113			123	
Turn Bay Length (ft)	180		150	190		175	190		190	115		20
Base Capacity (vph)	226	1705	855	329	2026	963	313	317	435	136	141	288
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.71	0.39	0.64	0.65	0.09	0.68	0.67	0.40	0.51	0.51	0.11

Intersection Summary			
Area Type:	Other		
Cycle Length: 140			
Actuated Cycle Length: 140			
Offset: 84 (60%), Referenced to phase 2:WBTL and 6:EBTL, Start of 1st Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.79			
Intersection Signal Delay (s/veh): 35.6		Intersection LOS: D	
Intersection Capacity Utilization 74.6%		ICU Level of Service D	
Analysis Period (min) 15			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 3: New Ballwin Rd/Central Plaza & Manchester Rd



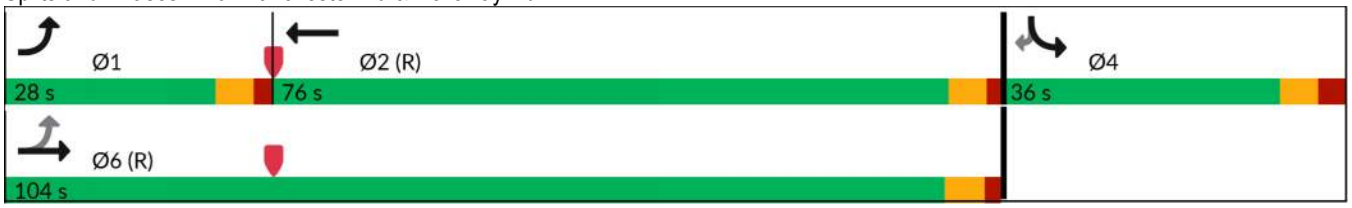


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	202	1113	1323	148	402	430
Future Volume (vph)	202	1113	1323	148	402	430
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150			0	155	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	0.95	0.97	1.00
Frt			0.985			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	3539	3486	0	3433	1583
Flt Permitted	0.057				0.950	
Satd. Flow (perm)	106	3539	3486	0	3433	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			12			278
Link Speed (mph)		30	30		30	
Link Distance (ft)		1830	1002		984	
Travel Time (s)		41.6	22.8		22.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	220	1210	1438	161	437	467
Shared Lane Traffic (%)						
Lane Group Flow (vph)	220	1210	1599	0	437	467
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		24	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane		Yes	Yes			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	60			60	60	60
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	1	6	2		4	
Permitted Phases	6					4
Detector Phase	1	6	2		4	4
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	10.9	22.5	22.5		25.9	25.9
Total Split (s)	28.0	104.0	76.0		36.0	36.0
Total Split (%)	20.0%	74.3%	54.3%		25.7%	25.7%
Yellow Time (s)	4.0	4.0	4.1		4.0	4.0
All-Red Time (s)	1.9	1.8	1.4		2.9	2.9
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	5.9	5.8	5.5		6.9	6.9
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Recall Mode	None	C-Min	C-Min		None	None
Act Effct Green (s)	102.1	102.2	79.3		25.1	25.1
Actuated g/C Ratio	0.73	0.73	0.57		0.18	0.18
v/c Ratio	0.78	0.47	0.81		0.71	0.91

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Control Delay (s/veh)	45.6	6.9	29.8		60.4	45.4
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay (s/veh)	45.6	6.9	29.8		60.4	45.4
LOS	D	A	C		E	D
Approach Delay (s/veh)		12.8	29.8		52.7	
Approach LOS		B	C		D	
Stops (vph)	246	669	1132		369	180
Fuel Used(gal)	6	21	27		10	8
CO Emissions (g/hr)	427	1478	1865		704	578
NOx Emissions (g/hr)	83	287	363		137	112
VOC Emissions (g/hr)	99	342	432		163	134
Dilemma Vehicles (#)	0	0	0		0	0
Queue Length 50th (ft)	96	365	619		190	182
Queue Length 95th (ft)	m193	167	800		245	#368
Internal Link Dist (ft)		1750	922		904	
Turn Bay Length (ft)	150				155	
Base Capacity (vph)	339	2584	1979		713	549
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.65	0.47	0.81		0.61	0.85

Intersection Summary			
Area Type:	Other		
Cycle Length: 140			
Actuated Cycle Length: 140			
Offset: 61 (44%), Referenced to phase 2:WBT and 6:EBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.91			
Intersection Signal Delay (s/veh): 28.9		Intersection LOS: C	
Intersection Capacity Utilization 79.2%		ICU Level of Service D	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 6: Manchester Rd & Holloway Rd



Intersection	
Int Delay, s/veh	1.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1367	50	160	1648	0	89
Future Vol, veh/h	1367	50	160	1648	0	89
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	50	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1486	54	174	1791	0	97

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1540	0	-	770
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	4.14	-	-	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	2.22	-	-	3.32
Pot Cap-1 Maneuver	-	-	427	-	0	343
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	427	-	-	343
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s/v	0	1.69	19.56
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	343	-	-	427	-
HCM Lane V/C Ratio	0.282	-	-	0.407	-
HCM Control Delay (s/veh)	19.6	-	-	19.1	-
HCM Lane LOS	C	-	-	C	-
HCM 95th %tile Q(veh)	1.1	-	-	1.9	-

Intersection	
Int Delay, s/veh	2.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	1401	0	3	1624	10	2	0	1	7	1	18
Future Vol, veh/h	5	1401	0	3	1624	10	2	0	1	7	1	18
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	50	-	-	50	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	1523	0	3	1765	11	2	0	1	8	1	20

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1776	0	0	1523	0	0	2423	3316	761	2549	3311	888
Stage 1	-	-	-	-	-	-	1534	1534	-	1777	1777	-
Stage 2	-	-	-	-	-	-	890	1783	-	772	1534	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	346	-	-	434	-	-	17	8	348	13	8	287
Stage 1	-	-	-	-	-	-	122	177	-	85	134	-
Stage 2	-	-	-	-	-	-	304	133	-	358	177	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	346	-	-	434	-	-	13	8	348	13	8	287
Mov Cap-2 Maneuver	-	-	-	-	-	-	13	8	-	13	8	-
Stage 1	-	-	-	-	-	-	120	174	-	85	133	-
Stage 2	-	-	-	-	-	-	279	132	-	351	174	-

Approach	EB	WB	NB	SB
HCM Control Delay, s/v	0.06	0.02	224.44	252.5
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	19	346	-	-	434	-	-	36
HCM Lane V/C Ratio	0.168	0.016	-	-	0.008	-	-	0.788
HCM Control Delay (s/veh)	224.4	15.6	-	-	13.4	-	-	252.5
HCM Lane LOS	F	C	-	-	B	-	-	F
HCM 95th %tile Q(veh)	0.5	0	-	-	0	-	-	2.8

APPENDIX C
TRIP GENERATION CALCULATIONS

TERRA ENGINEERING LTD.

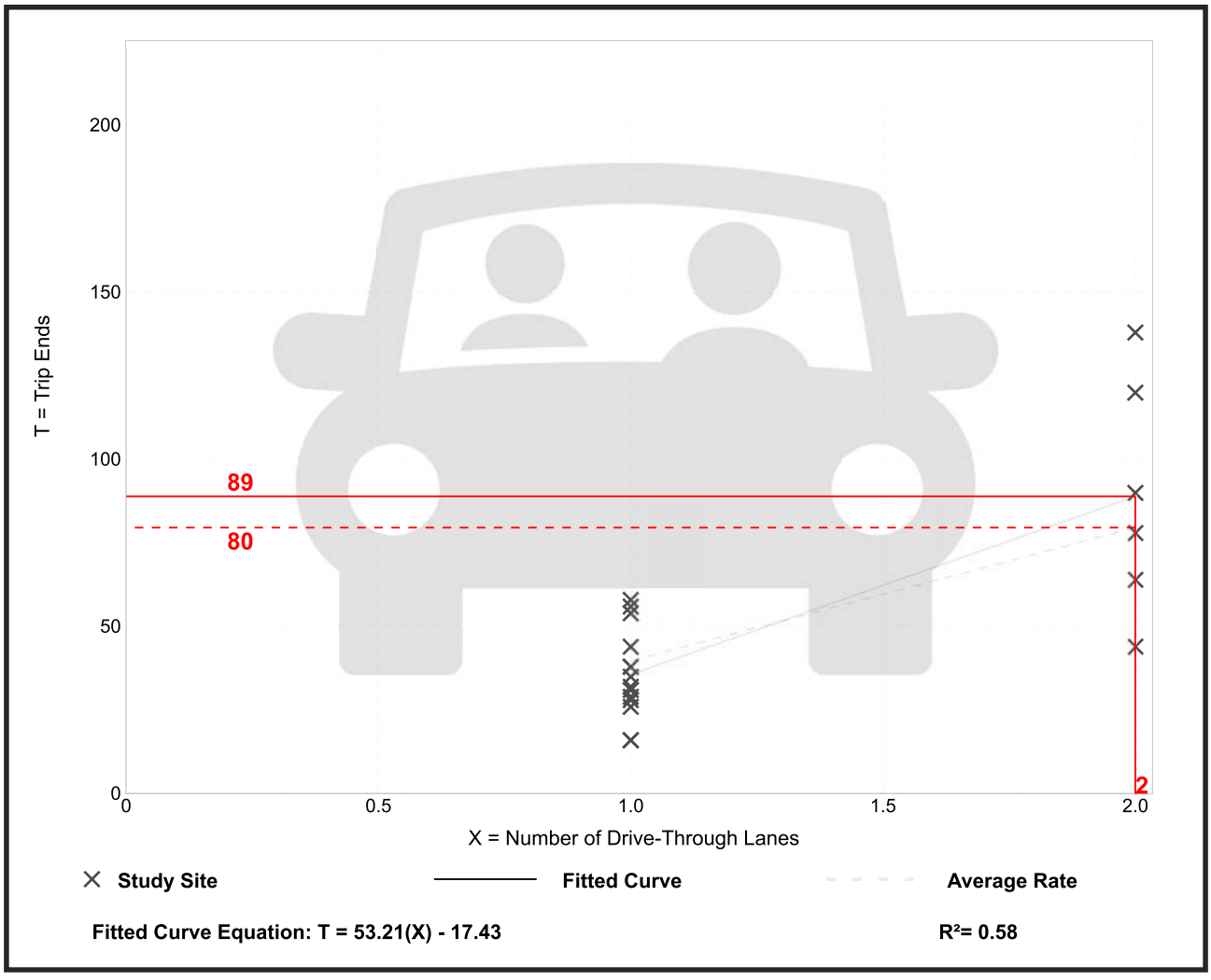
Coffee/Donut Shop with Drive-Through Window and No Indoor Seating (938)

Vehicle Trip Ends vs:	**Drive-Through Lanes**
On a:	**Weekday,**
	Peak Hour of Adjacent Street Traffic,
	One Hour Between 7 and 9 a.m.
Setting/Location:	**General Urban/Suburban**
Number of Studies:	20
Avg. Num. of Drive-Through Lanes:	1
Directional Distribution:	50% entering, 50% exiting

Vehicle Trip Generation per Drive-Through Lane

Average Rate	Range of Rates	Standard Deviation
39.81	16.00 - 69.00	15.44

Data Plot and Equation



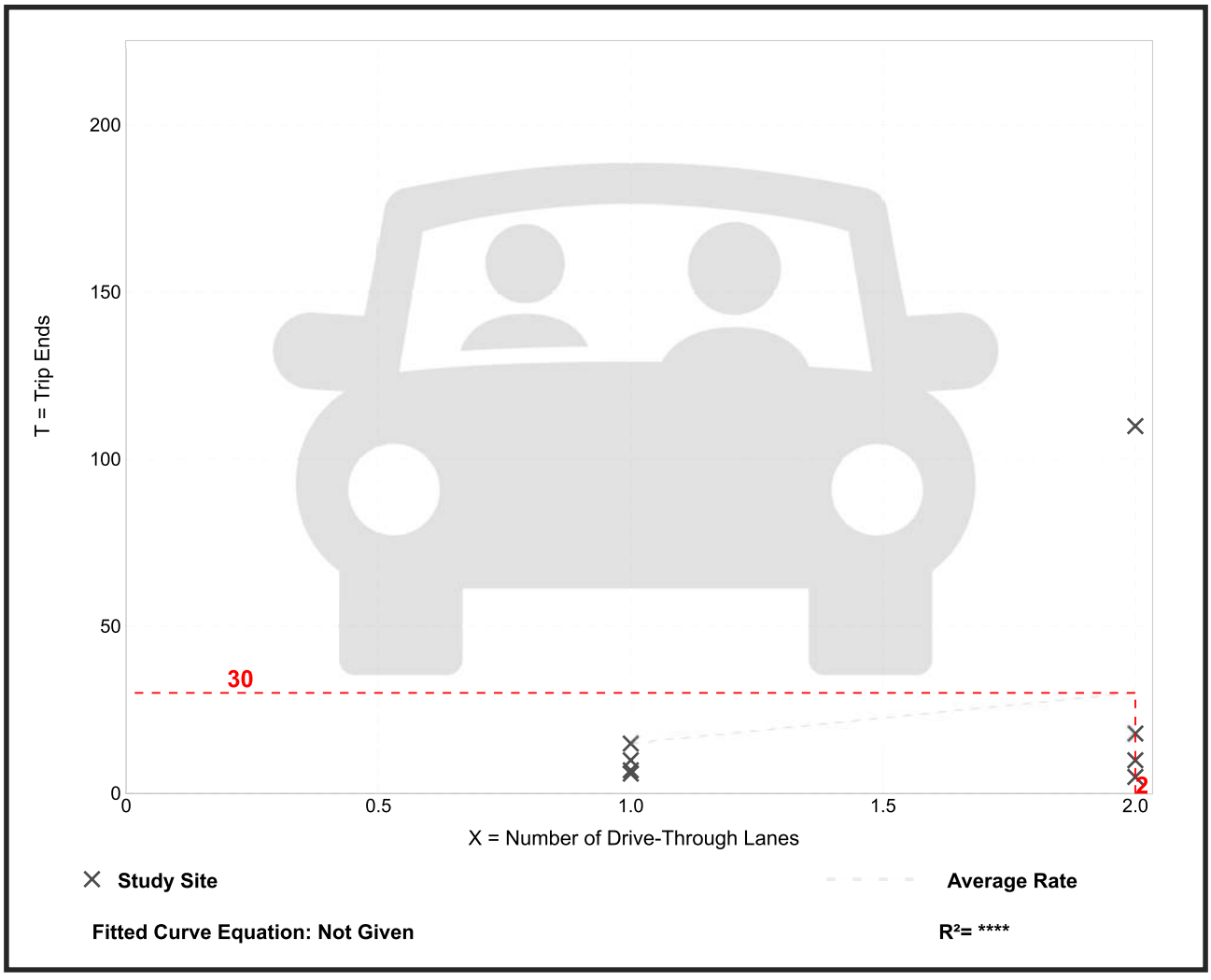
Coffee/Donut Shop with Drive-Through Window and No Indoor Seating (938)

Vehicle Trip Ends vs:	**Drive-Through Lanes**
On a:	**Weekday,**
	Peak Hour of Adjacent Street Traffic,
	One Hour Between 4 and 6 p.m.
Setting/Location:	**General Urban/Suburban**
Number of Studies:	8
Avg. Num. of Drive-Through Lanes:	2
Directional Distribution:	50% entering, 50% exiting

Vehicle Trip Generation per Drive-Through Lane

Average Rate	Range of Rates	Standard Deviation
15.08	2.50 - 55.00	19.41

Data Plot and Equation



APPENDIX D
OPENING DAY SYNCHRO OUTPUT

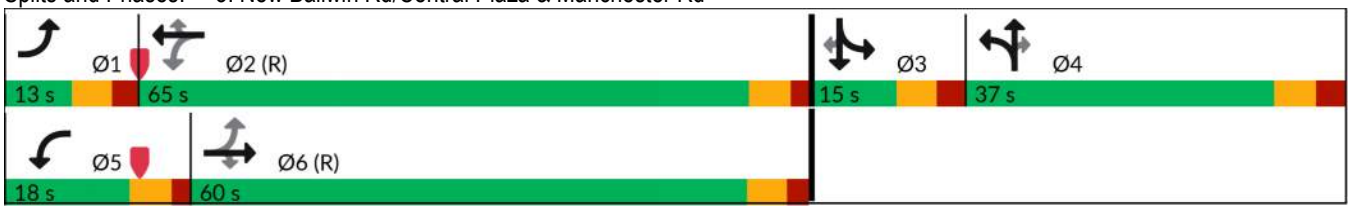
TERRA ENGINEERING LTD.

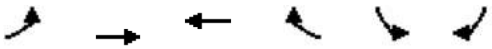
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	3	1083	196	102	769	9	341	0	252	11	7	4
Future Volume (vph)	3	1083	196	102	769	9	341	0	252	11	7	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	180		150	190		175	190		190	115		20
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950	0.950		0.950	0.990	
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1681	1681	1583	1681	1752	1583
Flt Permitted	0.317			0.142			0.950	0.950		0.950	0.990	
Satd. Flow (perm)	590	3539	1583	265	3539	1583	1681	1681	1583	1681	1752	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			143			143			226			138
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1190			1201			2193			203	
Travel Time (s)		27.0			27.3			49.8			4.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3	1177	213	111	836	10	371	0	274	12	8	4
Shared Lane Traffic (%)							50%			18%		
Lane Group Flow (vph)	3	1177	213	111	836	10	185	186	274	10	10	4
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane					Yes							
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	1	6		5	2		4	4		3	3	
Permitted Phases	6		6	2		2			4			3
Detector Phase	1	6	6	5	2	2	4	4	4	3	3	3
Switch Phase												
Minimum Initial (s)	5.0	20.0	20.0	5.0	20.0	20.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	11.5	26.1	26.1	10.8	25.8	25.8	13.9	13.9	13.9	13.6	13.6	13.6
Total Split (s)	13.0	60.0	60.0	18.0	65.0	65.0	37.0	37.0	37.0	15.0	15.0	15.0
Total Split (%)	10.0%	46.2%	46.2%	13.8%	50.0%	50.0%	28.5%	28.5%	28.5%	11.5%	11.5%	11.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.5	2.1	2.1	1.8	1.8	1.8	2.9	2.9	2.9	2.6	2.6	2.6
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.1	6.1	5.8	5.8	5.8	6.9	6.9	6.9	6.6	6.6	6.6
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lag	Lag	Lag	Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Min	C-Min	None	C-Min	C-Min	None	None	None	None	None	None
Act Effct Green (s)	78.1	72.8	72.8	87.8	85.3	85.3	21.2	21.2	21.2	7.2	7.2	7.2
Actuated g/C Ratio	0.60	0.56	0.56	0.68	0.66	0.66	0.16	0.16	0.16	0.06	0.06	0.06
v/c Ratio	0.01	0.59	0.22	0.40	0.36	0.01	0.68	0.68	0.61	0.11	0.10	0.02

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Control Delay (s/veh)	12.0	23.5	7.7	14.2	3.8	0.0	62.8	63.0	16.2	61.0	60.8	0.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	12.0	23.5	7.7	14.2	3.8	0.0	62.8	63.0	16.2	61.0	60.8	0.3
LOS	B	C	A	B	A	A	E	E	B	E	E	A
Approach Delay (s/veh)		21.0			4.9			43.1			50.8	
Approach LOS		C			A			D			D	
Stops (vph)	3	721	40	29	78	0	156	157	52	11	11	0
Fuel Used(gal)	0	19	2	1	8	0	6	6	5	0	0	0
CO Emissions (g/hr)	4	1343	164	99	575	6	415	418	379	13	13	0
NOx Emissions (g/hr)	1	261	32	19	112	1	81	81	74	3	3	0
VOC Emissions (g/hr)	1	311	38	23	133	1	96	97	88	3	3	0
Dilemma Vehicles (#)	0	0	0	0	0	0	0	0	0	0	0	0
Queue Length 50th (ft)	1	363	29	6	23	0	155	156	35	8	8	0
Queue Length 95th (ft)	6	544	90	61	92	m0	224	225	116	28	28	0
Internal Link Dist (ft)		1110			1121			2113			123	
Turn Bay Length (ft)	180		150	190		175	190		190	115		20
Base Capacity (vph)	417	1982	949	322	2323	1088	389	389	540	108	113	231
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.59	0.22	0.34	0.36	0.01	0.48	0.48	0.51	0.09	0.09	0.02

Intersection Summary			
Area Type:	Other		
Cycle Length: 130			
Actuated Cycle Length: 130			
Offset: 26 (20%), Referenced to phase 2:WBTL and 6:EBTL, Start of 1st Green			
Natural Cycle: 80			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.68			
Intersection Signal Delay (s/veh): 20.9		Intersection LOS: C	
Intersection Capacity Utilization 67.7%		ICU Level of Service C	
Analysis Period (min) 15			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 3: New Ballwin Rd/Central Plaza & Manchester Rd





Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	364	1259	906	187	211	113
Future Volume (vph)	364	1259	906	187	211	113
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150			0	155	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	0.95	0.97	1.00
Frt			0.974			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	3539	3447	0	3433	1583
Flt Permitted	0.174				0.950	
Satd. Flow (perm)	324	3539	3447	0	3433	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			31			123
Link Speed (mph)		30	30		30	
Link Distance (ft)		1830	1002		984	
Travel Time (s)		41.6	22.8		22.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	396	1368	985	203	229	123
Shared Lane Traffic (%)						
Lane Group Flow (vph)	396	1368	1188	0	229	123
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		24	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane		Yes	Yes			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	1	6	2		4	
Permitted Phases	6					4
Detector Phase	1	6	2		4	4
Switch Phase						
Minimum Initial (s)	5.0	20.0	20.0		7.0	7.0
Minimum Split (s)	10.9	25.8	25.5		24.9	24.9
Total Split (s)	25.0	105.0	80.0		25.0	25.0
Total Split (%)	19.2%	80.8%	61.5%		19.2%	19.2%
Yellow Time (s)	4.0	4.0	4.1		4.0	4.0
All-Red Time (s)	1.9	1.8	1.4		2.9	2.9
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	5.9	5.8	5.5		6.9	6.9
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Recall Mode	None	C-Min	C-Min		None	None
Act Effct Green (s)	103.3	103.4	77.8		13.9	13.9
Actuated g/C Ratio	0.79	0.80	0.60		0.11	0.11
v/c Ratio	0.83	0.49	0.57		0.62	0.44

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Control Delay (s/veh)	35.7	2.2	18.5		62.8	13.8
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay (s/veh)	35.7	2.2	18.5		62.8	13.8
LOS	D	A	B		E	B
Approach Delay (s/veh)		9.7	18.5		45.7	
Approach LOS		A	B		D	
Stops (vph)	200	129	649		199	18
Fuel Used(gal)	9	19	16		5	1
CO Emissions (g/hr)	625	1345	1135		379	90
NOx Emissions (g/hr)	122	262	221		74	17
VOC Emissions (g/hr)	145	312	263		88	21
Dilemma Vehicles (#)	0	0	0		0	0
Queue Length 50th (ft)	144	64	303		96	0
Queue Length 95th (ft)	270	67	457		136	57
Internal Link Dist (ft)		1750	922		904	
Turn Bay Length (ft)	150				155	
Base Capacity (vph)	515	2813	2143		477	326
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.77	0.49	0.55		0.48	0.38

Intersection Summary			
Area Type:	Other		
Cycle Length: 130			
Actuated Cycle Length: 130			
Offset: 91 (70%), Referenced to phase 2:WBT and 6:EBTL, Start of 1st Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.83			
Intersection Signal Delay (s/veh): 16.7		Intersection LOS: B	
Intersection Capacity Utilization 72.4%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 6: Manchester Rd

Intersection	
Int Delay, s/veh	3.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1590	46	93	965	0	176
Future Vol, veh/h	1590	46	93	965	0	176
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	50	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1728	50	101	1049	0	191

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1778	0	2480	889
Stage 1	-	-	-	-	1753	-
Stage 2	-	-	-	-	727	-
Critical Hdwy	-	-	4.14	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	-	-	2.22	-	3.52	3.32
Pot Cap-1 Maneuver	-	-	345	-	24	286
Stage 1	-	-	-	-	124	-
Stage 2	-	-	-	-	440	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	345	-	17	286
Mov Cap-2 Maneuver	-	-	-	-	87	-
Stage 1	-	-	-	-	124	-
Stage 2	-	-	-	-	311	-

Approach	EB	WB	NB
HCM Control Delay, s/v	0	1.73	39.66
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	286	-	-	345	-
HCM Lane V/C Ratio	0.668	-	-	0.293	-
HCM Control Delay (s/veh)	39.7	-	-	19.7	-
HCM Lane LOS	E	-	-	C	-
HCM 95th %tile Q(veh)	4.4	-	-	1.2	-

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	7	1588	19	0	947	12	0	0	18	7	0	14
Future Vol, veh/h	7	1588	19	0	947	12	0	0	18	7	0	14
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	50	-	-	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	8	1726	21	0	1029	13	0	0	20	8	0	15

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1042	0	0	-	-	0	-	-	873	1914	2798	521
Stage 1	-	-	-	-	-	-	-	-	-	1036	1036	-
Stage 2	-	-	-	-	-	-	-	-	-	878	1762	-
Critical Hdwy	4.14	-	-	-	-	-	-	-	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	-	-	-	-	-	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	663	-	-	0	-	-	0	0	293	41	18	500
Stage 1	-	-	-	0	-	-	0	0	-	248	307	-
Stage 2	-	-	-	0	-	-	0	0	-	309	136	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	663	-	-	-	-	-	-	-	293	38	18	500
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	138	92	-
Stage 1	-	-	-	-	-	-	-	-	-	248	307	-
Stage 2	-	-	-	-	-	-	-	-	-	285	135	-

Approach	EB	WB	NB	SB
HCM Control Delay, s/v	0.05	0	18.15	19.74
HCM LOS			C	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBT	WBR	SBLn1
Capacity (veh/h)	293	663	-	-	-	-	267
HCM Lane V/C Ratio	0.067	0.011	-	-	-	-	0.085
HCM Control Delay (s/veh)	18.2	10.5	-	-	-	-	19.7
HCM Lane LOS	C	B	-	-	-	-	C
HCM 95th %tile Q(veh)	0.2	0	-	-	-	-	0.3

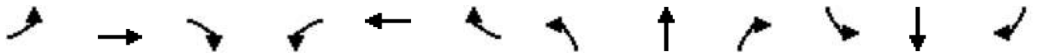
Intersection	
Int Delay, s/veh	0.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	14	17	1	163	116	22
Future Vol, veh/h	14	17	1	163	116	22
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	15	18	1	177	126	24

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	317	138	150	0	-	0
Stage 1	138	-	-	-	-	-
Stage 2	179	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	676	910	1431	-	-	-
Stage 1	889	-	-	-	-	-
Stage 2	852	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	675	910	1431	-	-	-
Mov Cap-2 Maneuver	675	-	-	-	-	-
Stage 1	888	-	-	-	-	-
Stage 2	852	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	9.78	0.05	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	11	-	787	-	-
HCM Lane V/C Ratio	0.001	-	0.043	-	-
HCM Control Delay (s/veh)	7.5	0	9.8	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

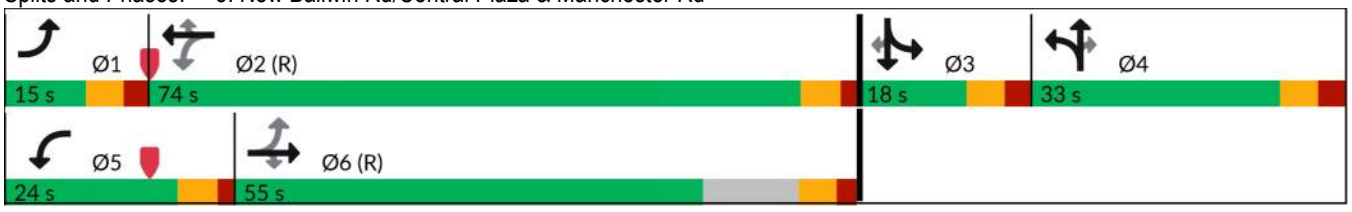


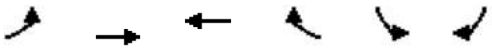
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	1120	307	194	1227	84	363	37	159	88	44	30
Future Volume (vph)	30	1120	307	194	1227	84	363	37	159	88	44	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	180		150	190		175	190		190	115		20
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950	0.961		0.950	0.983	
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1681	1701	1583	1681	1740	1583
Flt Permitted	0.131			0.105			0.950	0.961		0.950	0.983	
Satd. Flow (perm)	244	3539	1583	196	3539	1583	1681	1701	1583	1681	1740	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			178			132			173			174
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1190			1211			2193			203	
Travel Time (s)		27.0			27.5			49.8			4.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	33	1217	334	211	1334	91	395	40	173	96	48	33
Shared Lane Traffic (%)							45%			26%		
Lane Group Flow (vph)	33	1217	334	211	1334	91	217	218	173	71	73	33
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane					Yes							
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Split	NA	Perm	Split	NA	Perm
Protected Phases	1	6		5	2		4	4		3	3	
Permitted Phases	6		6	2		2			4			3
Detector Phase	1	6	6	5	2	2	4	4	4	3	3	3
Switch Phase												
Minimum Initial (s)	5.0	20.0	20.0	5.0	20.0	20.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	11.5	26.1	26.1	10.8	25.8	25.8	13.9	13.9	13.9	13.6	13.6	13.6
Total Split (s)	15.0	55.0	55.0	24.0	74.0	74.0	33.0	33.0	33.0	18.0	18.0	18.0
Total Split (%)	10.7%	39.3%	39.3%	17.1%	52.9%	52.9%	23.6%	23.6%	23.6%	12.9%	12.9%	12.9%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.5	2.1	2.1	1.8	1.8	1.8	2.9	2.9	2.9	2.6	2.6	2.6
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.1	6.1	5.8	5.8	5.8	6.9	6.9	6.9	6.6	6.6	6.6
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lag	Lag	Lag	Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Min	C-Min	None	C-Min	C-Min	None	None	None	None	None	None
Act Effct Green (s)	73.3	67.1	67.1	88.1	79.9	79.9	22.5	22.5	22.5	10.1	10.1	10.1
Actuated g/C Ratio	0.52	0.48	0.48	0.63	0.57	0.57	0.16	0.16	0.16	0.07	0.07	0.07
v/c Ratio	0.17	0.72	0.39	0.73	0.66	0.09	0.80	0.80	0.43	0.59	0.58	0.12

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Control Delay (s/veh)	14.6	33.7	13.2	37.6	32.2	6.3	78.2	77.3	10.2	82.4	81.4	0.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	14.6	33.7	13.2	37.6	32.2	6.3	78.2	77.3	10.2	82.4	81.4	0.9
LOS	B	C	B	D	C	A	E	E	B	F	F	A
Approach Delay (s/veh)		29.0			31.5			58.5			66.8	
Approach LOS		C			C			E			E	
Stops (vph)	15	884	97	139	788	12	191	190	19	61	63	0
Fuel Used(gal)	0	23	4	4	24	1	8	8	3	2	2	0
CO Emissions (g/hr)	31	1604	294	286	1676	68	535	535	221	107	109	4
NOx Emissions (g/hr)	6	312	57	56	326	13	104	104	43	21	21	1
VOC Emissions (g/hr)	7	372	68	66	389	16	124	124	51	25	25	1
Dilemma Vehicles (#)	0	0	0	0	0	0	0	0	0	0	0	0
Queue Length 50th (ft)	12	482	88	140	468	5	200	201	0	66	68	0
Queue Length 95th (ft)	27	604	176	m188	588	m15	294	295	65	123	126	0
Internal Link Dist (ft)		1110			1131			2113			123	
Turn Bay Length (ft)	180		150	190		175	190		190	115		20
Base Capacity (vph)	223	1696	851	328	2020	960	313	317	435	136	141	288
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.72	0.39	0.64	0.66	0.09	0.69	0.69	0.40	0.52	0.52	0.11

Intersection Summary			
Area Type:	Other		
Cycle Length: 140			
Actuated Cycle Length: 140			
Offset: 84 (60%), Referenced to phase 2:WBTL and 6:EBTL, Start of 1st Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.80			
Intersection Signal Delay (s/veh): 36.1		Intersection LOS: D	
Intersection Capacity Utilization 75.1%		ICU Level of Service D	
Analysis Period (min) 15			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 3: New Ballwin Rd/Central Plaza & Manchester Rd



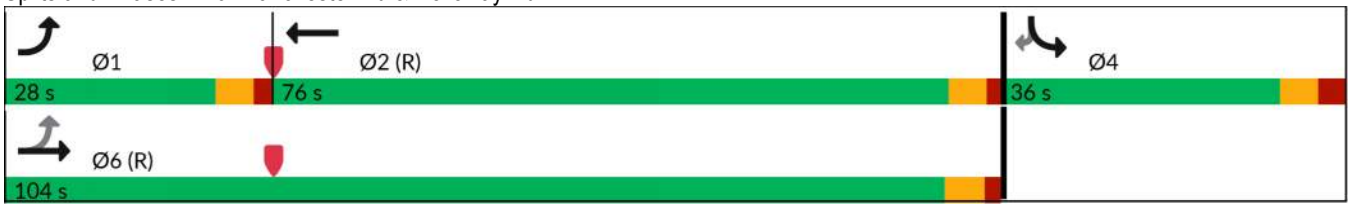


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	204	1119	1330	149	405	433
Future Volume (vph)	204	1119	1330	149	405	433
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150			0	155	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	0.95	0.95	0.95	0.97	1.00
Frt			0.985			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	3539	3486	0	3433	1583
Flt Permitted	0.055				0.950	
Satd. Flow (perm)	102	3539	3486	0	3433	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			12			278
Link Speed (mph)		30	30		30	
Link Distance (ft)		1830	1002		984	
Travel Time (s)		41.6	22.8		22.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	222	1216	1446	162	440	471
Shared Lane Traffic (%)						
Lane Group Flow (vph)	222	1216	1608	0	440	471
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		24	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane		Yes	Yes			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	60			60	60	60
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	1	6	2		4	
Permitted Phases	6					4
Detector Phase	1	6	2		4	4
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	10.9	22.5	22.5		25.9	25.9
Total Split (s)	28.0	104.0	76.0		36.0	36.0
Total Split (%)	20.0%	74.3%	54.3%		25.7%	25.7%
Yellow Time (s)	4.0	4.0	4.1		4.0	4.0
All-Red Time (s)	1.9	1.8	1.4		2.9	2.9
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	5.9	5.8	5.5		6.9	6.9
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Recall Mode	None	C-Min	C-Min		None	None
Act Effct Green (s)	101.9	102.0	78.9		25.3	25.3
Actuated g/C Ratio	0.73	0.73	0.56		0.18	0.18
v/c Ratio	0.79	0.47	0.82		0.71	0.92

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Control Delay (s/veh)	47.6	7.0	30.4		60.2	46.3
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay (s/veh)	47.6	7.0	30.4		60.2	46.3
LOS	D	A	C		E	D
Approach Delay (s/veh)		13.2	30.4		53.0	
Approach LOS		B	C		D	
Stops (vph)	257	675	1147		371	185
Fuel Used(gal)	6	21	27		10	8
CO Emissions (g/hr)	441	1488	1890		707	589
NOx Emissions (g/hr)	86	289	368		138	115
VOC Emissions (g/hr)	102	345	438		164	136
Dilemma Vehicles (#)	0	0	0		0	0
Queue Length 50th (ft)	102	367	634		191	185
Queue Length 95th (ft)	m197	169	808		248	#377
Internal Link Dist (ft)		1750	922		904	
Turn Bay Length (ft)	150				155	
Base Capacity (vph)	337	2578	1970		713	549
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.66	0.47	0.82		0.62	0.86

Intersection Summary			
Area Type:	Other		
Cycle Length: 140			
Actuated Cycle Length: 140			
Offset: 61 (44%), Referenced to phase 2:WBT and 6:EBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.92			
Intersection Signal Delay (s/veh): 29.4		Intersection LOS: C	
Intersection Capacity Utilization 79.6%		ICU Level of Service D	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 6: Manchester Rd & Holloway Rd



Intersection	
Int Delay, s/veh	1.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1373	52	168	1650	0	93
Future Vol, veh/h	1373	52	168	1650	0	93
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	50	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1492	57	183	1793	0	101

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1549	0	2783	774
Stage 1	-	-	-	-	1521	-
Stage 2	-	-	-	-	1262	-
Critical Hdwy	-	-	4.14	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	-	-	2.22	-	3.52	3.32
Pot Cap-1 Maneuver	-	-	424	-	15	341
Stage 1	-	-	-	-	167	-
Stage 2	-	-	-	-	230	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	424	-	9	341
Mov Cap-2 Maneuver	-	-	-	-	71	-
Stage 1	-	-	-	-	167	-
Stage 2	-	-	-	-	131	-

Approach	EB	WB	NB
HCM Control Delay, s/v	0	1.83	19.95
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	341	-	-	424	-
HCM Lane V/C Ratio	0.296	-	-	0.431	-
HCM Control Delay (s/veh)	19.9	-	-	19.8	-
HCM Lane LOS	C	-	-	C	-
HCM 95th %tile Q(veh)	1.2	-	-	2.1	-

Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	6	1405	5	0	1626	11	0	0	6	8	0	19
Future Vol, veh/h	6	1405	5	0	1626	11	0	0	6	8	0	19
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	50	-	-	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	7	1527	5	0	1767	12	0	0	7	9	0	21

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1779	0	0	-	-	0	-	-	766	2550	3319	890
Stage 1	-	-	-	-	-	-	-	-	-	1773	1773	-
Stage 2	-	-	-	-	-	-	-	-	-	777	1546	-
Critical Hdwy	4.14	-	-	-	-	-	-	-	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	-	-	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	-	-	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	-	-	-	-	-	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	345	-	-	0	-	-	0	0	345	13	8	286
Stage 1	-	-	-	0	-	-	0	0	-	86	134	-
Stage 2	-	-	-	0	-	-	0	0	-	356	174	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	345	-	-	-	-	-	-	-	345	13	8	286
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	-	-	66	72	-
Stage 1	-	-	-	-	-	-	-	-	-	86	134	-
Stage 2	-	-	-	-	-	-	-	-	-	343	171	-

Approach	EB	WB	NB	SB
HCM Control Delay, s/v	0.07	0	15.63	36.2
HCM LOS			C	E

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBT	WBR	SBLn1
Capacity (veh/h)	345	345	-	-	-	-	144
HCM Lane V/C Ratio	0.019	0.019	-	-	-	-	0.203
HCM Control Delay (s/veh)	15.6	15.6	-	-	-	-	36.2
HCM Lane LOS	C	C	-	-	-	-	E
HCM 95th %tile Q(veh)	0.1	0.1	-	-	-	-	0.7

Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	3	8	1	89	211	8
Future Vol, veh/h	3	8	1	89	211	8
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	3	9	1	97	229	9

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	333	234	238	0	-	0
Stage 1	234	-	-	-	-	-
Stage 2	99	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	662	805	1329	-	-	-
Stage 1	805	-	-	-	-	-
Stage 2	925	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	662	805	1329	-	-	-
Mov Cap-2 Maneuver	662	-	-	-	-	-
Stage 1	804	-	-	-	-	-
Stage 2	925	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s/v	9.81	0.09	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	20	-	760	-	-
HCM Lane V/C Ratio	0.001	-	0.016	-	-
HCM Control Delay (s/veh)	7.7	0	9.8	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-