


## MEMORANDUM

**TO:** SLV Silverstrand Walpole, LLC  
c/o Messrs. Justin Krebs *and*  
Geoff Engler  
257 Hillside Avenue  
Needham, MA 02492

**FROM:** Mr. Jeffrey S. Dirk, P.E., PTOE, FITE   
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*Professional Engineer in CT, MA, ME, NH, RI and VA*

**DATE:** April 27, 2023

**RE:** 9210

**SUBJECT:** Transportation Impact Assessment Update  
Proposed Multifamily Residential Development – 981 and 1015 East Street  
Walpole, Massachusetts

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Vanasse & Associates, Inc. (VAI) has prepared an update to the October 2022 *Transportation Impact Assessment* that was prepared in support of the proposed construction of a multifamily residential development to be located at 981 and 1015 East Street (Route 27) in Walpole, Massachusetts (hereafter referred to as the “Project”). Specifically, this assessment updates the trip-generation calculations for the Project to reflect a decrease in the number of proposed residential units and evaluates the impact of the reduced trips on traffic operations (i.e., motorist delays, vehicle queuing and level of service) at the Project site driveways and the off-site intersections that were assessed in the October 2022 *Transportation Impact Assessment* (the “October 2022 TIA”).

***Based on this updated assessment, the following changes were identified from the conditions that were reported in the October 2022 TIA.***

- 1. The revised development program for the Project will produce approximately 3 fewer automobile trips during the weekday morning peak-hour and 1 fewer automobile trip during the weekday evening peak-hour when compared to the development program that was assessed in the October 2022 TIA, with 22 fewer automobile trips expected on a weekday over a 24-hour period; and***
- 2. The reported operating conditions at the study area intersections were shown to be similar to those that were identified in the October 2022 TIA, with changes noted as a decrease in overall average motorist delay during the weekday evening peak-hour of 0.3 seconds and in vehicle queuing of up to one (1) vehicle at the Main Street/East Street intersection and a decrease in vehicle queuing of up to two (2) vehicles at the Elm Street/East Street intersection during the weekday morning peak-hour.***

***As such, the recommendations that were provided in the October 2022 TIA for the Project continue to be appropriate to afford safe and efficient access to the Project site and to off-set the predicted impact of the Project on the transportation infrastructure.***

The following details the updated assessment of the Project.





## **PROJECT DESCRIPTION**

As currently proposed, the Project will entail the construction of a six-story, 142-unit multifamily residential building to be located at 981 and 1015 East Street (Route 27) in Walpole, Massachusetts. The development program that was assessed in the October 2022 TIA included a 148-unit multifamily residential building.

Since the publication of the October 2022 TIA, the applicant has acquired the property at 981 East Street which has been incorporated into the development. The expanded Project site encompasses approximately 1.91± acres of land that is generally bounded by a Massachusetts Bay Transportation Authority (MBTA) Commuter Rail track to the north; East Street to the south; commercial properties to the east; and the MBTA Commuter Rail track and a commercial property to the west. The Project site currently contains Gilmore's Pet and Garden Supply store and associated appurtenances that will be removed to accommodate the Project.

Access to the Project site will be provided by way of four (4) driveways that will be configured as follows: two (2) full-access driveways that will intersect the north side of East Street parallel to the east and west property lines, respectively, and a one-way entrance and a one-way exit driveway that will intersect the north side of East Street at the center of the Project site that will serve a surface parking lot at the front of the building. The existing driveways along East Street that currently serve the Project site will be closed in conjunction with the Project.

On-site parking will be provided for 171 vehicles to accommodate parking for residents and guests, or a parking ratio of 1.2 parking spaces per unit, and will include 112 surface parking spaces and 59 parking spaces to be located within a parking garage situated beneath the residential levels. As the applicant has acknowledged and represented, this parking ratio is below the minimum parking requirements for residential dwellings as specified by Table 5-B.1. *Use Table* and Table 8.3.1 *Parking Requirements* of the Town of Walpole Zoning Bylaw.<sup>1</sup> The proposed parking ratio is consistent with the parking ratios observed for other multifamily residential communities in a similar setting documented by the ITE.<sup>2</sup> The ITE parking demand observations indicate that the peak parking demands ratio for a multifamily residential development range from 0.75 to 2.03 spaces per residential unit.

## **PROJECT-GENERATED TRAFFIC**

In order to develop the traffic characteristics of the Project, trip-generation statistics published by the Institute of Transportation Engineers (ITE)<sup>3</sup> for similar land uses as those proposed was used. Consistent with the October 2022 TIA, ITE Land Use Code (LUC) 221, *Multifamily Housing (Mid-Rise)*, was used to develop the base trip-generation characteristics for the Project.

### **Transit Use**

Consistent with the methodology that was used in the October 2022 TIA, it was assumed that a portion of the residents of the Project would use public transportation given the availability of public transportation services to the Project site that are provided by the Massachusetts Bay Transportation Authority (MBTA) (bus and Commuter Rail service) and the interconnected network of sidewalks. In order to determine the proportion of residents of the Project that may use transit, walk, or bicycle as their primary mode of

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<sup>1</sup>The Zoning Bylaw of the Town of Walpole requires two parking spaces per dwelling unit.

<sup>2</sup>*Parking Generation*, 5<sup>th</sup> Edition; Institute of Transportation Engineers; Washington D.C.; January 2019.

<sup>3</sup>*Trip Generation*, 11<sup>th</sup> Edition; Institute of Transportation Engineers; Washington, DC; 2021.





transportation, travel mode data obtained from the 2015 through 2019 American Community Survey (ACS) for the Census Tract that contains the Project site (Census Tract 4113.02) was reviewed. Based on the ACS data, the following commuting modes were identified for workers aged 16 or older who reside within the Town:

- Single-Occupant Vehicle: 72.8%
- Car/Vanpool/Taxi: 8.2%
- Public Transportation: 7.4%
- Walk/Bike/Other: 4.0%
- Worked at Home: 7.6%

According to the ACS, approximately 27 percent of workers that reside in the Census Tract reported they used an alternative mode of transportation to SOV to travel to/from work, with approximately 8 percent participating in car or vanpool, 7 percent using public transportation (transit), 4 percent walking/bicycling or using other methods of transportation and 8 percent reporting that they work at home.

In order to account for the use of alternative modes of transportation to SOV's, the Base ITE trip-generation calculations for the Project were first converted to person trips using a vehicle occupancy ratio (VOR) of 1.06 persons per vehicle, which was obtained from the ACS and is representative of the average VOR for Census Tract 4113.02, and were then disseminated to the modes of transportation that are accessible at the Project: public transportation (transit), pedestrian/bicycle and automobile.

Consistent with the approach that was used in the October 2022 TIA, it was assumed that 89 percent of the trips generated by the Project would consist of automobile trips (vs. 73 percent from the ACS), with 7 percent of trips assumed to be made using transit and 4 percent consisting of pedestrian/bicycle trips in order to provide conservative (high) traffic volumes from which to assess the potential impact of the Project.

Table 5R (to correspond to Table 5 of the October 2022 TIA) summarizes the automobile trips that are expected to be generated by the current development program for the Project using the above methodology and compares the automobile trips associated with the current development program to the development program that was assessed in the October 2022 TIA. The detailed trip-generation calculations for the current development program are attached.





**Table 5R**  
**TRIP-GENERATION SUMMARY AND COMPARISON – AUTOMOBILE TRIPS<sup>a</sup>**

Time Period/Direction	Automobile Trips		
	(A) Current Development Program (142 units)	(B) October 2022 TIA Development Program (148 units)	(A-B) Difference
<i>Average Weekday Daily:</i>			
Entering	288	299	-11
<u>Exiting</u>	<u>288</u>	<u>299</u>	<u>-11</u>
Total	576	598	-22
<i>Weekday Morning Peak Hour:</i>			
Entering	11	11	0
<u>Exiting</u>	<u>34</u>	<u>37</u>	<u>-3</u>
Total	45	48	-3
<i>Weekday Evening Peak Hour:</i>			
Entering	30	31	-1
<u>Exiting</u>	<u>20</u>	<u>20</u>	<u>0</u>
Total	50	51	-1

<sup>a</sup>Based on ITE LUC 221, *Multifamily Housing (Mid-Rise)* and with reductions to account for transit trips.

### Project-Generated Traffic-Volume Summary

As can be seen in Table 5R, the revised development program for the Project (142 residential units) is predicted to generate approximately 576 automobile trips on an average weekday (two-way, 24-hour volume, or 288 vehicles entering and 288 exiting), with 45 automobile trips (11 vehicles entering and 34 exiting) expected during the weekday morning peak-hour and 50 automobile trips (30 vehicles entering and 20 exiting) expected during the weekday evening peak-hour.

In comparison to the development program that was assessed in the October 2022 TIA (148 residential units) the current development program is expected to generate 22 *fewer* automobile trips on an average weekday, with 3 *fewer* automobile trips expected during the weekday morning peak-hour and 1 *fewer* automobile trip expected during the weekday evening peak-hour.

### TRIP DISTRIBUTION AND ASSIGNMENT

As described in the October 2022 TIA, the directional distribution of generated trips to and from the Project site was determined based on a review of Journey-to-Work data obtained from the U.S. Census for persons residing in the Town of Walpole and then refined based on existing traffic patterns within the study area. The general trip distribution for the Project is graphically depicted on Figure 7R. The additional traffic expected to be generated by the revised development program for the Project was assigned on the study area roadway network as shown on Figures 8R and 9R for the weekday morning and evening peak hours, respectively.







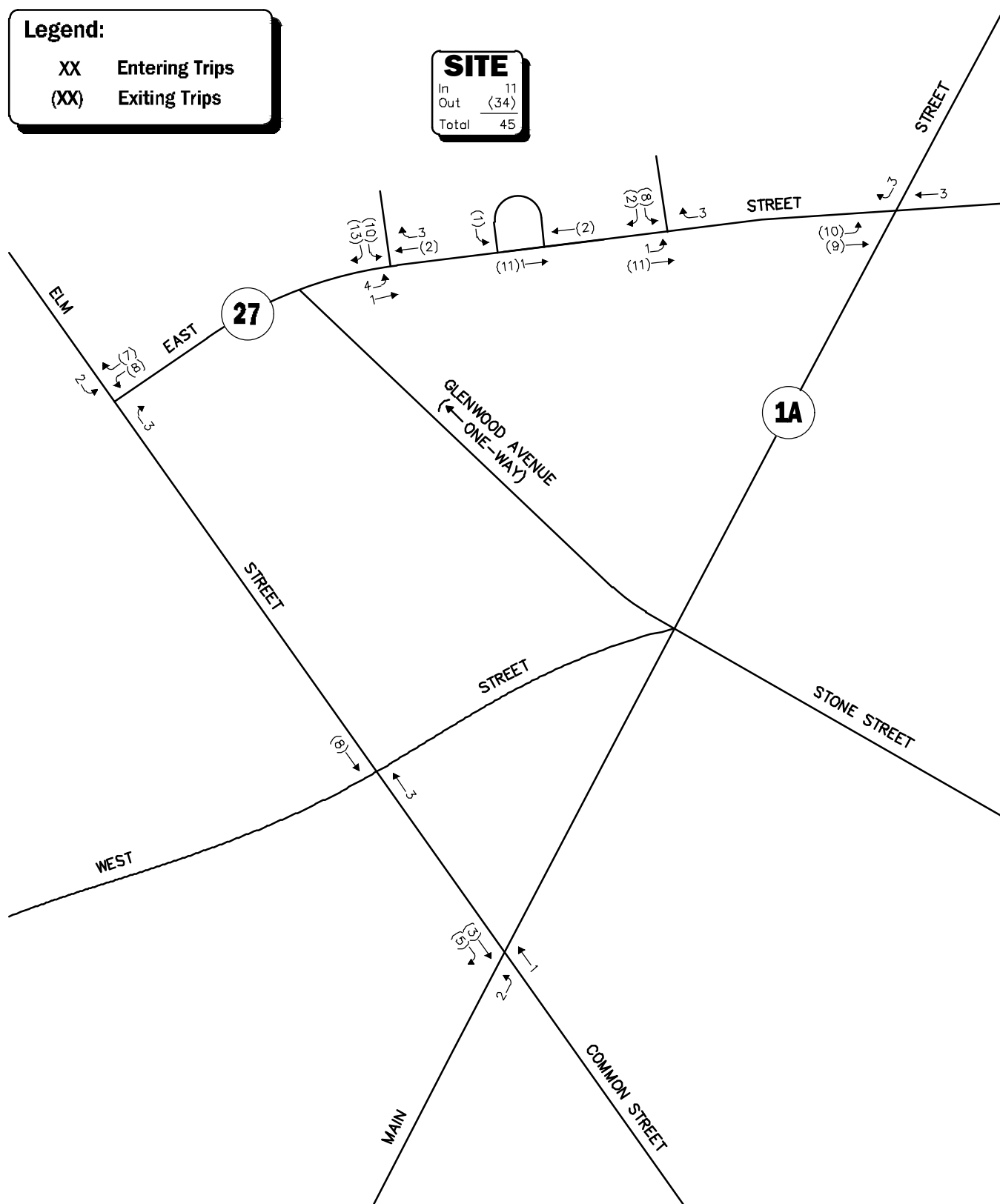


**Legend:**

XX Entering Trips  
(XX) Exiting Trips

**SITE**

In	11
Out	(34)
Total	45



Not To Scale



**Figure 8R**

**Project-Generated  
Weekday Morning  
Peak-Hour Traffic Volumes**

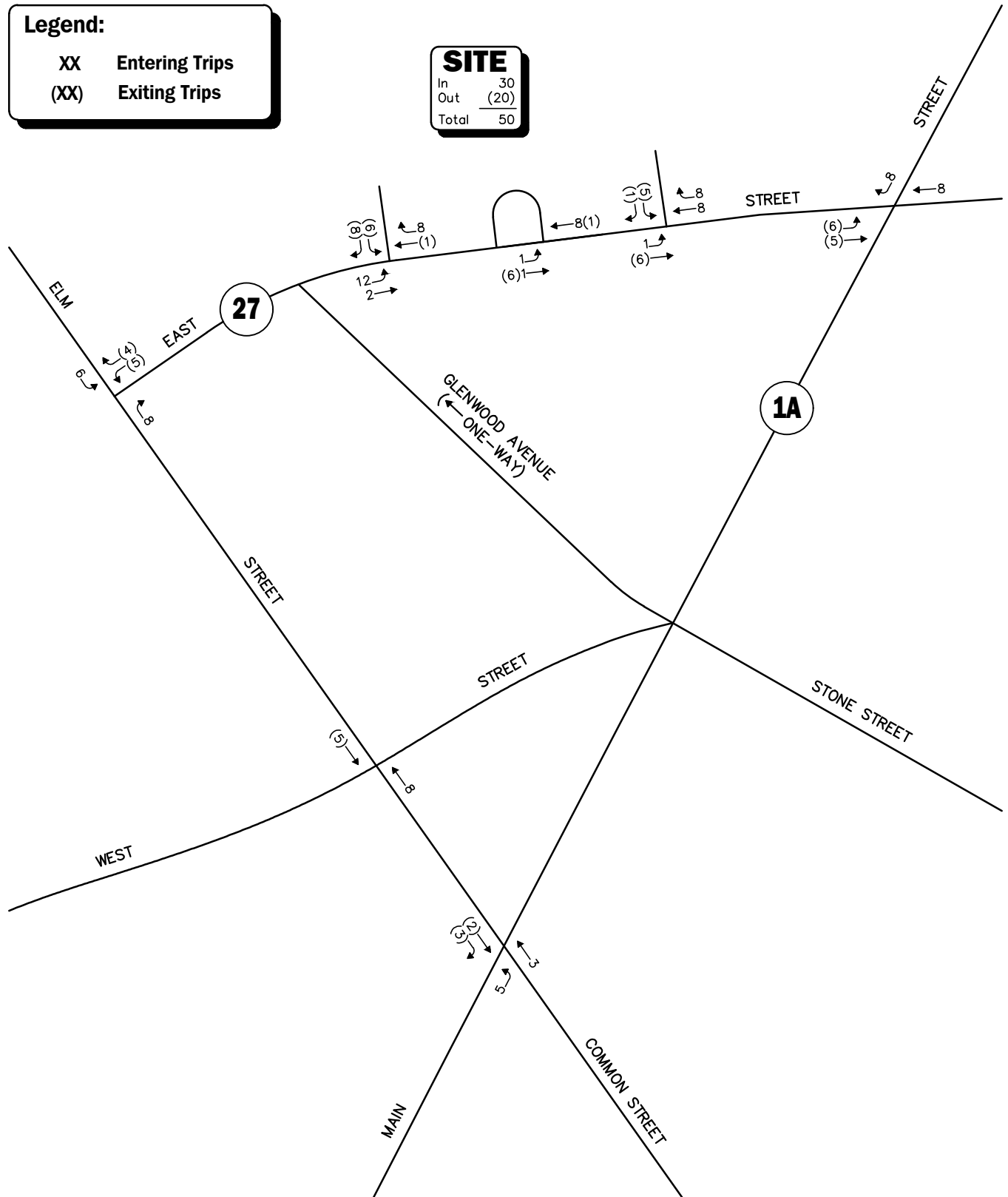


**Legend:**

XX Entering Trips  
(XX) Exiting Trips

**SITE**

In	30
Out	(20)
Total	50



Not To Scale

**Figure 9R**

**VA** Vanasse & Associates inc

**Project-Generated  
Weekday Evening  
Peak-Hour Traffic Volumes**



## **FUTURE TRAFFIC VOLUMES - BUILD CONDITION**

The revised 2029 Build condition traffic volumes consist of the 2029 No-Build traffic volumes (as presented in the October 2022 TIA on Figures 5 and 6) with the additional traffic expected to be generated by the revised development program for the Project (Figures 8R and 9R) added to them. The revised 2029 Build weekday morning and evening peak-hour traffic volumes are graphically depicted on Figures 10R and 11R, respectively.

## **TRAFFIC OPERATIONS ANALYSIS**

In order to assess the potential impact of the revised development program for the Project on the roadway network, a detailed traffic operations analysis (motorist delays, vehicle queuing, and level of service) was performed at the study area intersections. Capacity analyses provide an indication of how well transportation facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

As more fully described in the October 2022 TIA, six levels of service are defined for each type of facility. They are given letter designations ranging from A to F, with LOS “A” representing the best operating conditions and LOS “F” representing congested or constrained operations. An LOS of “E” is representative of a transportation facility that is operating at its design capacity with an LOS of “D” generally defined as the limit of “acceptable” traffic operations. Since the level of service of a traffic facility is a function of the flows placed upon it, such a facility may operate at a wide range of levels of service depending on the time of day, day of week, or period of the year. The Synchro® 11 intersection capacity analysis software was used to complete the level-of-service and vehicle queue analyses.

### **Analysis Results**

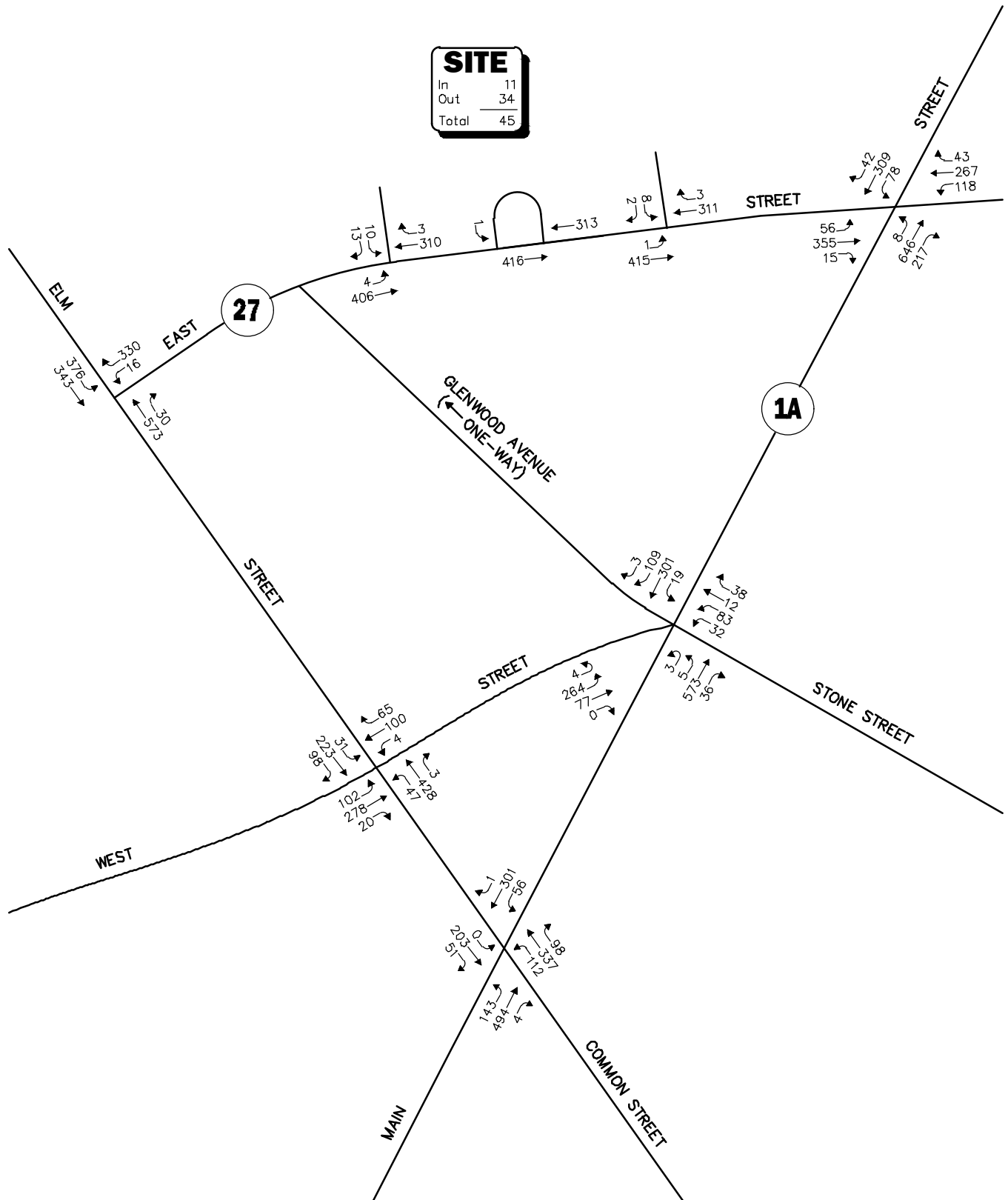
Level-of-service and vehicle queue analyses were conducted for 2022 Existing, 2029 No-Build and revised 2029 Build conditions for the intersections within the study area. The results of the intersection capacity and vehicle queue analyses are summarized in Tables 9R and 10R, with the detailed analysis results for the revised 2029 Build conditions attached. Note that the analysis results for 2022 Existing and 2029 No-Build conditions have not changed from the results that were presented in Tables 9 and 10 in the October 2022 TIA.

The following is a summary of the level-of-service and vehicle queue analyses for the intersections within the study area. For context, we note that an LOS of “D” or better is generally defined as “acceptable” operating conditions.

For ease of comparison, changes in reported motorist delay, level of service and vehicle queuing from the results that were identified in Tables 9 and 10 of the October 2022 TIA have been highlighted in Tables 9R and 10R. **The reported operating conditions at the study area intersections were shown to be similar to those that were identified in the October 2022 TIA, with changes noted as a decrease in overall average motorist delay during the weekday evening peak-hour of 0.3 seconds and in vehicle queuing of up to one (1) vehicle at the Main Street/East Street intersection and a decrease in vehicle queuing of up to two (2) vehicles at the Elm Street/East Street intersection during the weekday morning peak-hour.**







Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

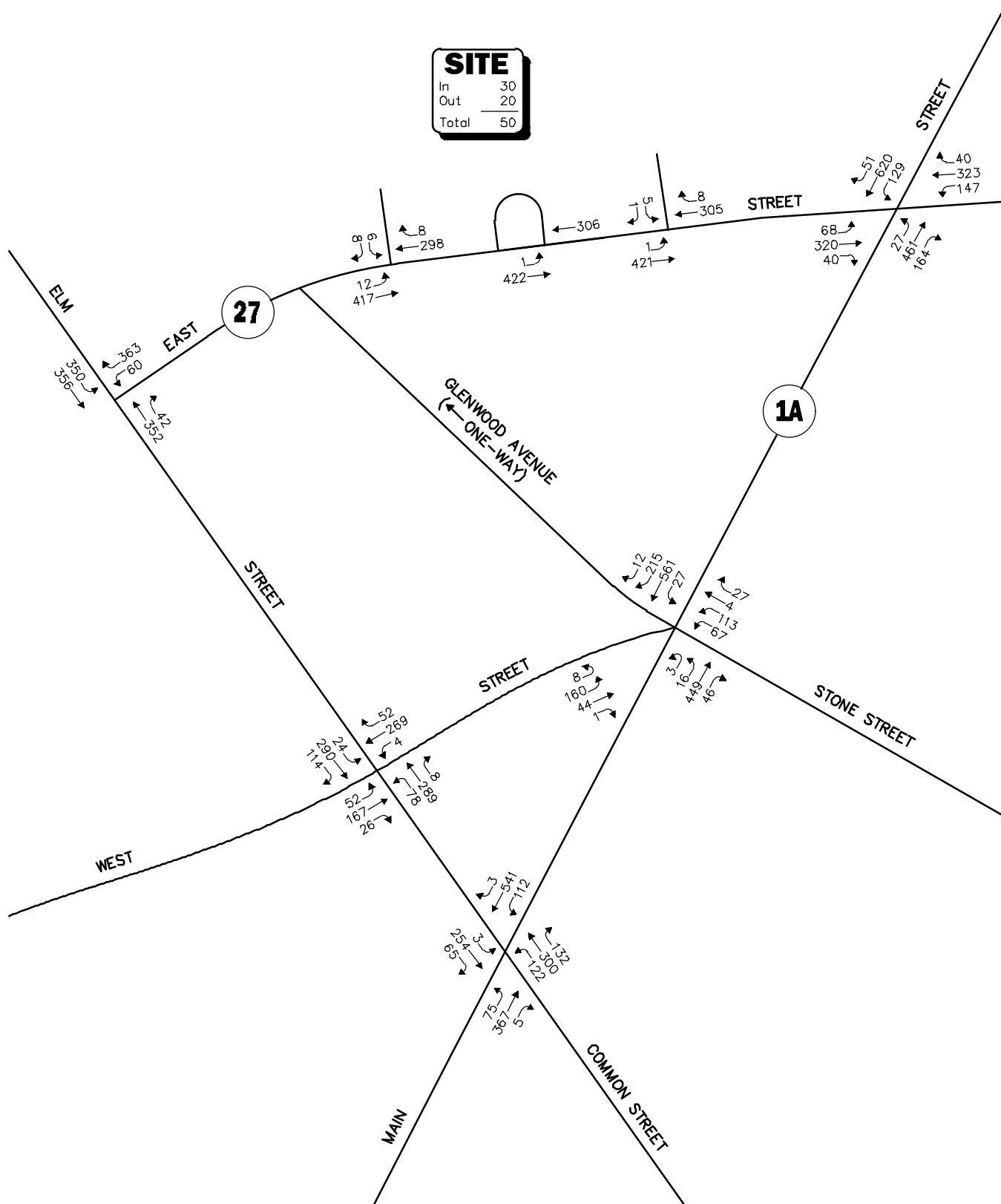
Not To Scale

Figure 10R



2029 Build  
Weekday Morning  
Peak-Hour Traffic Volumes





Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

**Figure 11R**



**Vanasse &  
Associates inc**

**2029 Build  
Weekday Evening  
Peak-Hour Traffic Volumes**



## **Signalized Intersections (Table 9R)**

### **Main Street at East Street**

*Consistent with the findings of the October 2022 TIA, the addition of Project-related traffic was not shown to result in a change in the overall level of service at the intersection, with Project-related impacts generally defined as a predicted increase in overall average motorist delay of up to 7.6 seconds and an increase in vehicle queuing of up to one (1) vehicle, a difference in overall motorist delay of 0.3 seconds and in vehicle queuing of one (1) vehicle from the results that were presented in the October 2022 TIA.* Focusing on individual movements, operating conditions for all movements on the Main Street southbound approach were shown to degrade over No-Build conditions from LOS E to LOS F during the weekday evening peak-hour as a result of the addition of Project-related traffic. Independent of the Project, left-turn movements from the Main Street southbound approach were shown to be operating over capacity (i.e., LOS “F”) under Existing conditions during the weekday morning peak-hour.

### **Main Street at Stone Street, West Street, and Glenwood Avenue**

*Consistent with the findings of the October 2022 TIA, the addition of Project-related traffic was not shown to result in a change in the overall level of service at the intersection, with Project-related impacts generally defined as an increase in average motorist delay that did not result in a material increase in vehicle queuing.* Independent of the Project, several movements at this intersection were shown to be operating at or over capacity (i.e., LOS “E” or “F”) under Existing conditions during both peak hours.

### **Main Street at Common Street and Elm Street**

*Consistent with the findings of the October 2022 TIA, the addition of Project-related traffic was shown to result in an increase in overall average motorist delay of up to 1.0 seconds that resulted in a change in overall intersection level-of-service from LOS C to LOS D during the weekday evening peak-hour, with vehicle queues at the intersection shown to increase by up to one (1) vehicle as a result of the Project.* Independent of the Project, left-turn movements from the Main Street southbound approach during the weekday morning peak-hour and from the northbound approach during the weekday evening peak-hour were shown to be operating over capacity under Existing conditions.

## **Unsignalized Intersections (Table 10R)**

### **Elm Street at West Street**

*Consistent with the findings of the October 2022 TIA, the addition of Project-related traffic was shown to result in a predicted increase in motorist delay of up to 2.7 seconds for the West Street approach that resulted in a degradation in level-of-service from LOS E to LOS F during the weekday evening peak-hour, with vehicle queues at the intersection shown to increase by up to one (1) vehicle as a result of the Project.* Independent of the Project, the Elm Street approaches are currently operating at or over capacity under Existing conditions during both peak hours, and the West Street northbound approach is currently operating over capacity during the weekday morning peak-hour.

### **Elm Street at East Street**

*Consistent with the findings of the October 2022 TIA, the addition of Project-related traffic was not shown to result in a change in the overall level of service at the intersection, with Project-related impacts generally defined as an increase average motorist delay that resulted in an increase in vehicle queuing of up to seven (7) vehicles, a reduction in vehicle queuing of two (2) from the results that were presented*





***in the October 2022 TIA.*** Independent of the Project, the East Street approach is currently operating over capacity under Existing conditions, with residual vehicle queues of up to 14 vehicles.

#### **East Street at the East Project Site Driveway**

All movements exiting the east Project site driveway to East Street were shown to operate at LOS B during both peak hours with negligible vehicle queuing predicted. All movements along East Street approaching the driveway were shown to operate at LOS A, also with negligible vehicle queuing predicted.

#### **East Street at the Center Exit Project Site Driveway**

All movements exiting the center exit Project site driveway to East Street were shown to operate at LOS C during the weekday morning peak-hour and at LOS A during the weekday evening peak-hour with negligible vehicle queuing predicted. All movements along East Street approaching the driveway were shown to operate at LOS A, also with negligible vehicle queuing predicted. It should be noted that actual operating conditions at the Project site driveway intersection will be directly related to vehicle queuing on the East Street approach to Elm Street.

#### **East Street at the West Project Site Driveway**

All movements exiting the west Project site driveway to East Street were shown to operate at LOS B during both peak hours with negligible vehicle queuing predicted. All movements along East Street approaching the driveway were shown to operate at LOS A, also with negligible vehicle queuing predicted. It should be noted that actual operating conditions at the Project site driveway intersection will be directly related to vehicle queuing on the East Street approach to Elm Street.





**Table 9R**  
**SIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY**

Signalized Intersection/Peak Hour/Movement	2022 Existing				2029 No-Build				2029 Build			
	V/C <sup>a</sup>	Delay <sup>b</sup>	LOS <sup>c</sup>	Queue <sup>d</sup> 50 <sup>th</sup> /95 <sup>th</sup>	V/C	Delay	LOS	Queue 50 <sup>th</sup> /95 <sup>th</sup>	V/C	Delay	LOS	Queue 50 <sup>th</sup> /95 <sup>th</sup>
<b>Main Street at East Street</b>												
<i>Weekday Morning:</i>												
East Street EB: LT	0.15	18.6	B	1/3	0.19	20.4	C	1/3	0.23	20.9	C	1/3
East Street EB: TH/RT	0.55	23.5	C	8/17	0.62	26.7	C	9/19	0.64	27.1	C	10/19
East Street WB: LT	0.46	22.7	C	3/8	0.59	28.7	C	3/9	0.61	30.0	C	3/9
East Street WB: TH/RT	0.42	21.5	C	6/13	0.48	23.7	C	6/15	0.48	23.7	C	7/15
Main Street NB: LT	0.03	16.6	B	0/0	0.03	16.6	B	0/0	0.03	16.6	B	0/0
Main Street NB: TH	0.89	29.9	C	13/18	0.91	29.9	C	13/20	0.91	29.9	C	13/20
Main Street NB: RT	0.29	18.4	B	3/3	0.31	18.4	B	3/4	0.31	18.4	B	3/4
Main Street SB: LT	1.51	>80.0	F	4/5	1.70	>80.0	F	4/6	1.70	>80.0	F	4/6
Main Street SB: TH/RT	0.54	26.7	C	8/10	0.55	26.7	C	8/11	0.55	26.7	C	8/11
<b>Overall</b>	--	<b>36.6</b>	<b>D</b>	--	--	<b>40.2</b>	<b>D</b>	--	--	<b>40.2</b>	<b>D</b>	--
<i>Weekday Evening:</i>												
East Street EB: LT	0.28	24.6	C	1/3	0.28	24.6	C	1/3	0.28	24.6	C	1/3
East Street EB: TH/RT	0.57	28.2	C	7/12	0.57	28.2	C	7/13	0.57	28.2	C	7/13
East Street WB: LT	0.69	37.5	D	3/8	0.69	37.5	D	3/8	0.69	37.5	D	3/8
East Street WB: TH/RT	0.59	28.7	C	7/12	0.59	28.7	C	7/13	0.59	28.7	C	7/14
Main Street NB: LT	0.14	12.8	B	0/1	0.40	27.3	C	1/1	0.40	28.5	C	1/1
Main Street NB: TH	0.50	16.3	B	7/15	0.70	26.0	C	12/16	0.74	28.2	C	12/16
Main Street NB: RT	0.17	11.5	B	1/3	0.22	17.8	B	2/3	0.23	19.3	B	2/3
Main Street SB: LT	0.40	19.0	B	2/9	0.86	70.1	E	3/9	1.01	>80.0	F	4/9
Main Street SB: TH/RT	0.71	23.7	C	12/26	0.99	61.7	E	17/29	1.06	>80.0	F	18/29
<b>Overall</b>	--	<b>23.3</b>	<b>C</b>	--	--	<b>35.2</b>	<b>D</b>	--	--	<b>42.8</b>	<b>D</b>	--

See notes at end of Table.



**Table 9R (Continued)**

**SIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY**

Signalized Intersection/Peak Hour/Movement	2022 Existing				2029 No-Build				2029 Build			
	V/C <sup>a</sup>	Delay <sup>b</sup>	LOS <sup>c</sup>	Queue <sup>d</sup> 50 <sup>th</sup> /95 <sup>th</sup>	V/C	Delay	LOS	Queue 50 <sup>th</sup> /95 <sup>th</sup>	V/C	Delay	LOS	Queue 50 <sup>th</sup> /95 <sup>th</sup>
<b><i>Main Street at Stone Street, West Street, and Glenwood Avenue</i></b>												
<i>Weekday Morning:</i>												
West Street EB: LT/LTH/RTH/RT	2.47	>80.0	F	19/23	2.62	>80.0	F	21/25	2.62	>80.0	F	21/25
Stone Street WB: LT/LTH/RTH/RT	0.90	>80.0	F	6/9	0.97	>80.0	F	6/10	0.97	>80.0	F	6/10
Main Street NB: LT/LTH	0.06	10.2	B	0/0	0.08	10.7	B	0/0	0.08	10.7	B	0/0
Main Street NB: RTH/RT	1.03	61.1	E	17/27	1.11	>80.0	F	17/30	1.11	>80.0	F	17/30
Main Street SB: LT	0.29	47.6	D	1/1	0.32	48.1	D	1/1	0.32	48.1	D	1/1
Main Street SB: LTH/RTH/RT	0.78	53.6	D	13/15	0.84	56.5	E	14/16	0.84	56.5	E	14/16
<b>Overall</b>	--	<b>&gt;80.0</b>	<b>F</b>	--	--	<b>&gt;80.0</b>	<b>F</b>	--	--	<b>&gt;80.0</b>	<b>F</b>	--
<i>Weekday Evening:</i>												
West Street EB: LT/LTH/RTH/RT	1.30	>80.0	F	8/16	1.41	>80.0	F	9/16	1.41	>80.0	F	9/16
Stone Street WB: LT/LTH/RTH/RT	1.13	>80.0	F	8/11	1.21	>80.0	F	9/12	1.21	>80.0	F	9/12
Main Street NB: LT/LTH	0.26	29.2	C	1/1	0.28	29.9	C	1/1	0.28	29.9	C	1/1
Main Street NB: RTH/RT	0.73	32.6	C	11/15	0.78	35.1	D	12/17	0.78	35.1	D	12/17
Main Street SB: LT	0.16	32.1	C	1/1	0.21	36.6	D	1/1	0.21	36.6	D	1/1
Main Street SB: LTH/RTH/RT	1.10	>80.0	F	18/31	1.18	>80.0	F	25/31	1.18	>80.0	F	25/31
<b>Overall</b>	--	<b>&gt;80.0</b>	<b>F</b>	--	--	<b>&gt;80.0</b>	<b>F</b>	--	--	<b>&gt;80.0</b>	<b>F</b>	--

See notes at end of Table.



**Table 9R (Continued)**

**SIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY**

Signalized Intersection/Peak Hour/Movement	2022 Existing				2029 No-Build				2029 Build			
	V/C <sup>a</sup>	Delay <sup>b</sup>	LOS <sup>c</sup>	Queue <sup>d</sup> 50 <sup>th</sup> /95 <sup>th</sup>	V/C	Delay	LOS	Queue 50 <sup>th</sup> /95 <sup>th</sup>	V/C	Delay	LOS	Queue 50 <sup>th</sup> /95 <sup>th</sup>
<b>Main Street at Common Street and Elm Street</b>												
<i>Weekday Morning:</i>												
Elm Street EB: LT/TH/RT	0.31	14.5	B	4/9	0.34	15.6	B	5/10	0.35	15.8	B	5/10
Common Street WB: LT/TH	0.61	19.0	B	8/22	0.70	23.1	C	10/25	0.71	23.5	C	10/25
Common Street WB: RT	0.13	12.8	B	2/4	0.14	13.7	B	2/4	0.14	13.7	B	2/4
Main Street NB: LT	0.66	46.1	D	4/6	0.70	48.1	D	4/7	0.71	48.8	D	4/7
Main Street NB: TH/TH	0.88	52.3	D	13/17	0.90	53.9	D	14/19	0.90	53.9	D	14/19
Main Street SB: LT	0.77	>80.0	F	1/2	0.91	>80.0	F	1/2	0.91	>80.0	F	1/2
Main Street SB: TH/RT	0.55	47.0	D	6/7	0.57	47.0	D	6/7	0.57	47.0	D	6/7
<b>Overall</b>	--	<b>35.6</b>	<b>D</b>	--	--	<b>37.8</b>	<b>D</b>	--	--	<b>37.8</b>	<b>D</b>	--
<i>Weekday Evening:</i>												
Elm Street EB: LT/TH/RT	0.39	15.6	B	6/12	0.43	17.2	B	7/13	0.44	17.3	B	7/13
Common Street WB: LT/TH	0.56	18.2	B	7/21	0.65	21.7	C	9/23	0.65	21.9	C	9/24
Common Street WB: RT	0.16	13.4	B	2/5	0.18	14.6	B	2/6	0.18	14.6	B	2/6
Main Street NB: LT	0.89	>80.0	F	2/5	1.03	>80.0	F	2/6	1.10	>80.0	F	2/6
Main Street NB: TH/TH	0.59	34.7	C	8/11	0.60	34.7	C	8/11	0.60	33.5	C	8/11
Main Street SB: LT	0.53	39.4	D	3/4	0.57	39.6	D	3/5	0.57	39.6	D	3/5
Main Street SB: TH/RT	0.86	48.4	D	13/16	0.87	48.4	D	14/18	0.87	48.4	D	14/18
<b>Overall</b>	--	<b>32.7</b>	<b>C</b>	--	--	<b>34.9</b>	<b>C</b>	--	--	<b>35.9</b>	<b>D</b>	--

<sup>a</sup>Volume-to-capacity ratio.

<sup>b</sup>Control (signal) delay per vehicle in seconds.

<sup>c</sup>Level of service.

<sup>d</sup>Queue length in vehicles based on 25-feet per vehicle.

NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; LTH = left-through movements; RTH = right-through movements; TH = through movements; RT = right-turning movements



**Table 10R**  
**UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY**

Unsignalized Intersection/Peak Hour/Movement	2022 Existing				2029 No-Build				2029 Build			
	Demand <sup>a</sup>	Delay <sup>b</sup>	LOS <sup>c</sup>	Queue <sup>d</sup> 95 <sup>th</sup>	Demand	Delay	LOS	Queue 95 <sup>th</sup>	Demand	Delay	LOS	Queue 95 <sup>th</sup>
<b><i>Elm Street at West Street</i></b>												
<i>Weekday Morning:</i>												
Elm Street EB: LT/TH/RT	322	42.3	E	8	344	>50.0	F	10	352	>50.0	F	10
Elm Street WB: LT/TH/RT	443	>50.0	F	15	475	>50.0	F	19	478	>50.0	F	19
West Street NB: LT/TH/RT	374	>50.0	F	14	400	>50.0	F	18	400	>50.0	F	18
West Street SB: LT/TH/RT	157	20.8	C	3	169	24.2	C	3	169	24.7	C	3
<i>Weekday Evening:</i>												
Elm Street EB: LT/TH/RT	396	48.7	E	10	423	>50.0	F	14	428	>50.0	F	14
Elm Street WB: LT/TH/RT	343	47.8	E	10	367	>50.0	F	13	375	>50.0	F	14
West Street NB: LT/TH/RT	229	22.7	C	4	245	29.0	D	5	245	30.1	D	5
West Street SB: LT/TH/RT	304	33.1	D	7	325	48.3	E	9	325	>50.0	F	9
<b><i>Elm Street at East Street</i></b>												
<i>Weekday Morning:</i>												
Elm Street EB: LT/TH	669	6.1	A	2	717	6.6	A	3	719	6.7	A	3
Elm Street WB: TH/RT	559	0.0	A	0	600	0.0	A	0	603	0.0	A	0
East Street SB: LT/RT	309	>50.0	F	10	331	>50.0	F	15	346	>50.0	F	22
<i>Weekday Evening:</i>												
Elm Street EB: LT/TH	653	4.6	A	1	700	4.7	A	2	706	4.8	A	2
Elm Street WB: TH/RT	360	0.0	A	0	386	0.0	A	0	394	0.0	A	0
East Street SB: LT/RT	386	>50.0	F	14	414	>50.0	F	20	423	>50.0	F	23
<b><i>East Street at the East Project Site Driveway</i></b>												
<i>Weekday Morning:</i>												
East Street EB: LT/TH	--	--	--	--	--	--	--	--	416	0.0	A	0
East Street WB: TH/RT	--	--	--	--	--	--	--	--	314	0.0	A	0
Project Site Driveway SB: LT/RT	--	--	--	--	--	--	--	--	10	14.3	B	0
<i>Weekday Evening:</i>												
East Street EB: LT/TH	--	--	--	--	--	--	--	--	422	0.0	A	0
East Street WB: TH/RT	--	--	--	--	--	--	--	--	313	0.0	A	0
Project Site Driveway SB: LT/RT	--	--	--	--	--	--	--	--	6	14.4	B	0

See notes at end of Table.





**Table 10R (Continued)**

**UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY**

Unsignalized Intersection/Peak Hour/Movement	2022 Existing				2029 No-Build				2029 Build			
	Demand <sup>a</sup>	Delay <sup>b</sup>	LOS <sup>c</sup>	Queue <sup>d</sup> 95 <sup>th</sup>	Demand	Delay	LOS	Queue 95 <sup>th</sup>	Demand	Delay	LOS	Queue 95 <sup>th</sup>
<b>East Street at the Center Exit Project</b>												
<b>Site Driveway</b>												
<i>Weekday Morning:</i>												
East Street EB: LT/TH	--	--	--	--	--	--	--	--	416	0.0	A	0
East Street WB: TH/RT	--	--	--	--	--	--	--	--	313	0.0	A	0
Project Site Driveway SB: LT/RT	--	--	--	--	--	--	--	--	1	15.1	C	0
<i>Weekday Evening:</i>												
East Street EB: LT/TH	--	--	--	--	--	--	--	--	422	0.0	A	0
East Street WB: TH/RT	--	--	--	--	--	--	--	--	306	0.0	A	0
Project Site Driveway SB: LT/RT	--	--	--	--	--	--	--	--	0	0.0	A	0
<b>East Street at the West Project Site Driveway</b>												
<i>Weekday Morning:</i>												
East Street EB: LT/TH	--	--	--	--	--	--	--	--	410	0.1	A	0
East Street WB: TH/RT	--	--	--	--	--	--	--	--	313	0.0	A	0
Project Site Driveway SB: LT/RT	--	--	--	--	--	--	--	--	23	12.6	B	0
<i>Weekday Evening:</i>												
East Street EB: LT/TH	--	--	--	--	--	--	--	--	429	0.2	A	0
East Street WB: TH/RT	--	--	--	--	--	--	--	--	306	0.0	A	0
Project Site Driveway SB: LT/RT	--	--	--	--	--	--	--	--	14	12.6	B	0

<sup>a</sup>Demand in vehicles per hour.

<sup>b</sup>Average control delay per vehicle (in seconds).

<sup>c</sup>Level of service.

<sup>d</sup>Queue length in vehicles.

NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.



## **SUMMARY**

VAI has prepared an update to the October 2022 TIA that was prepared in support of the proposed construction of a multifamily residential development to be located at 981 and 1015 East Street (Route 27) in Walpole, Massachusetts. This assessment has presented updated trip-generation calculations for the Project to reflect a decrease in the number of proposed residential units and evaluated the impact of the reduced trips on traffic operations (i.e., motorist delays, vehicle queuing and level of service) at the Project site driveways and the off-site intersections that were assessed in the October 2022 TIA.

- 1. The revised development program for the Project will produce approximately 3 fewer automobile trips during the weekday morning peak-hour and 1 fewer automobile trip during the weekday evening peak-hour when compared to the development program that was assessed in the October 2022 TIA, with 22 fewer automobile trips expected on a weekday over a 24-hour period; and*
- 2. The reported operating conditions at the study area intersections were shown to be similar to those that were identified in the October 2022 TIA, with changes noted as a decrease in overall average motorist delay during the weekday evening peak-hour of 0.3 seconds and in vehicle queuing of up to one (1) vehicle at the Main Street/East Street intersection and a decrease in vehicle queuing of up to two (2) vehicles at the Elm Street/East Street intersection during the weekday morning peak-hour.*

*As such, the recommendations that were provided in the October 2022 TIA for the Project continue to be appropriate to afford safe and efficient access to the Project site and to off-set the predicted impact of the Project on the transportation infrastructure.*

With implementation of the recommendations that are defined in the October 2022 TIA, safe and efficient access will be provided to the Project site and the Project can be accommodated within the confines of the existing and improved transportation system.

cc: File





## ATTACHMENTS

---

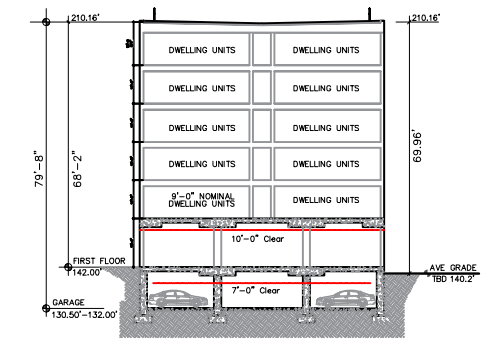
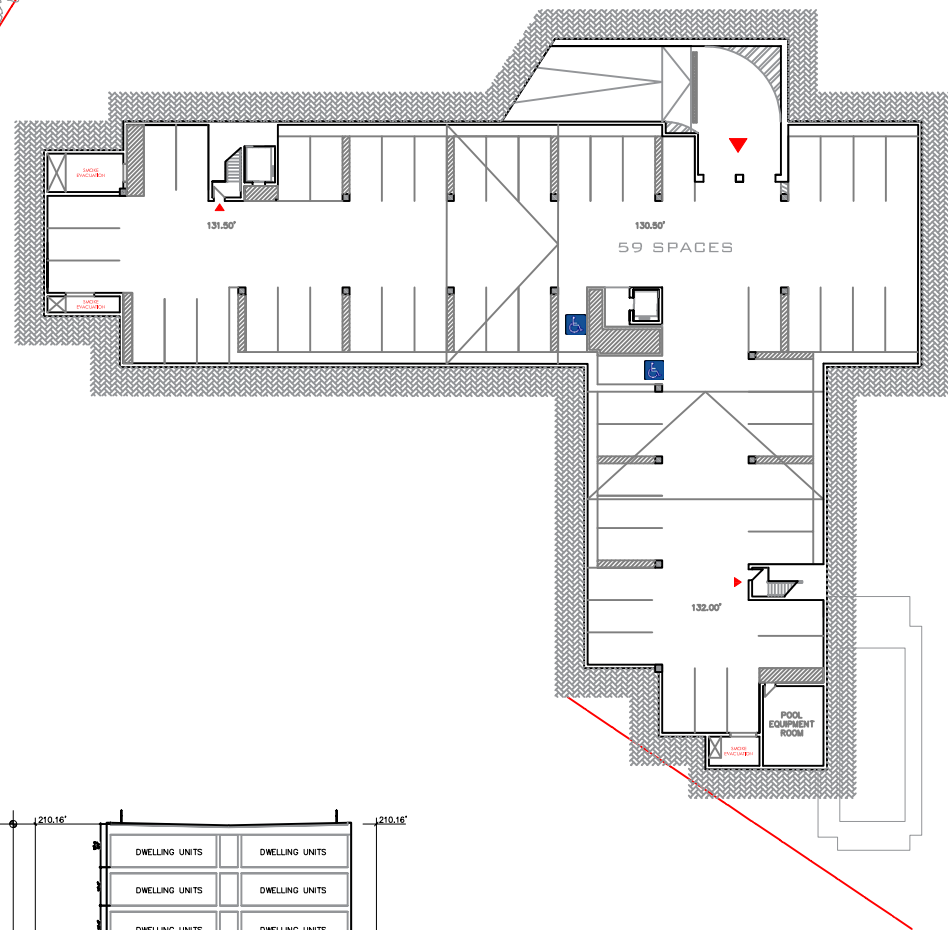
PROJECT SITE PLAN  
TRIP-GENERATION CALCULATIONS  
CAPACITY ANALYSIS WORKSHEETS



## PROJECT SITE PLAN

---





BUILDING SECTION

	TOTAL	TOTAL	S	1	2	3
FLOOR						
GARAGE	23,950 GSF		—	—	—	—
FLOOR 1	24,650 GSF	12	1	11	—	—
FLOOR 2	24,650 GSF	26	3	15	5	3
FLOOR 3	24,650 GSF	26	3	15	5	3
FLOOR 4	24,650 GSF	26	3	15	5	3
FLOOR 5	24,650 GSF	26	3	15	5	3
FLOOR 6	24,650 GSF	26	3	15	5	3
TOTAL	171,850 GSF	142	16	86	25	15

PROPOSED PARKING COUNT = 172

ARCHITECT  
**EMBARC**  
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C: 617.765.8000  
www.embarcstudio.com

OWNER

CONSULTANTS

**1015 EAST STREET**  
WALPOLE, MA

REVISIONS

DRAWING INFORMATION

ISSUE: \_\_\_\_\_  
DATE: APRIL 19, 2023  
PROJECT #: \_\_\_\_\_  
SCALE: NTS

DRAWING TITLE  
**PRELIMINARY  
YIELD STUDY**

DRAWING NUMBER



## TRIP-GENERATION CALCULATIONS

---





Query

Filter

DATA SOURCE:

Trip Generation Manual, 11th Ed

SEARCH BY LAND USE CODE:

221



LAND USE GROUP:

(200-299) Residential

LAND USE:

221 - Multifamily Housing (Mid-Rise)

LAND USE SUBCATEGORY:

Not Close to Rail Transit

SETTING/LOCATION:

General Urban/Suburban

INDEPENDENT VARIABLE (IV):

Dwelling Units

TIME PERIOD:

Weekday

TRIP TYPE:

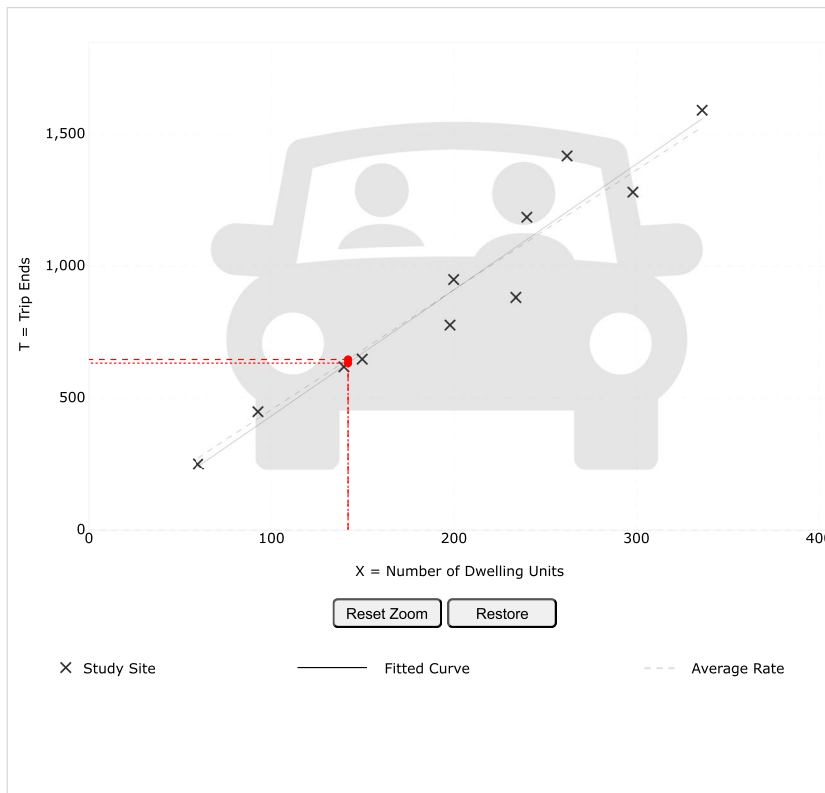
Vehicle

ENTER IV VALUE TO CALCULATE TRIPS:

142

Calculate

Data Plot and Equation



Use the mouse wheel to Zoom Out or Zoom In.  
Hover the mouse pointer on data points to view X and T values.

DATA STATISTICS

Land Use:

Multifamily Housing (Mid-Rise) - Not Close to Rail Transit (221) [Click for Description and Data Plots](#)

Independent Variable:

Dwelling Units

Time Period:

Weekday

Setting/Location:

General Urban/Suburban

Trip Type:

Vehicle

Number of Studies:

11

Avg. Num. of Dwelling Units:

201

Average Rate:

4.54

Range of Rates:

3.76 - 5.40

Standard Deviation:

0.51

Fitted Curve Equation:

$T = 4.77(X) - 46.46$

R<sup>2</sup>:

0.93

Directional Distribution:

50% entering, 50% exiting

Calculated Trip Ends:

Average Rate: 645 (Total), 322 (Entry), 323 (Exit)

Fitted Curve: 631 (Total), 315 (Entry), 316 (Exit)





Query

Filter

DATA SOURCE:

Trip Generation Manual, 11th Ed

SEARCH BY LAND USE CODE:

221



LAND USE GROUP:

(200-299) Residential

LAND USE :

221 - Multifamily Housing (Mid-Rise)

LAND USE SUBCATEGORY:

Not Close to Rail Transit

SETTING/LOCATION:

General Urban/Suburban

INDEPENDENT VARIABLE (IV):

Dwelling Units

TIME PERIOD:

Weekday, Peak Hour of Adjacent Street Traffic

TRIP TYPE:

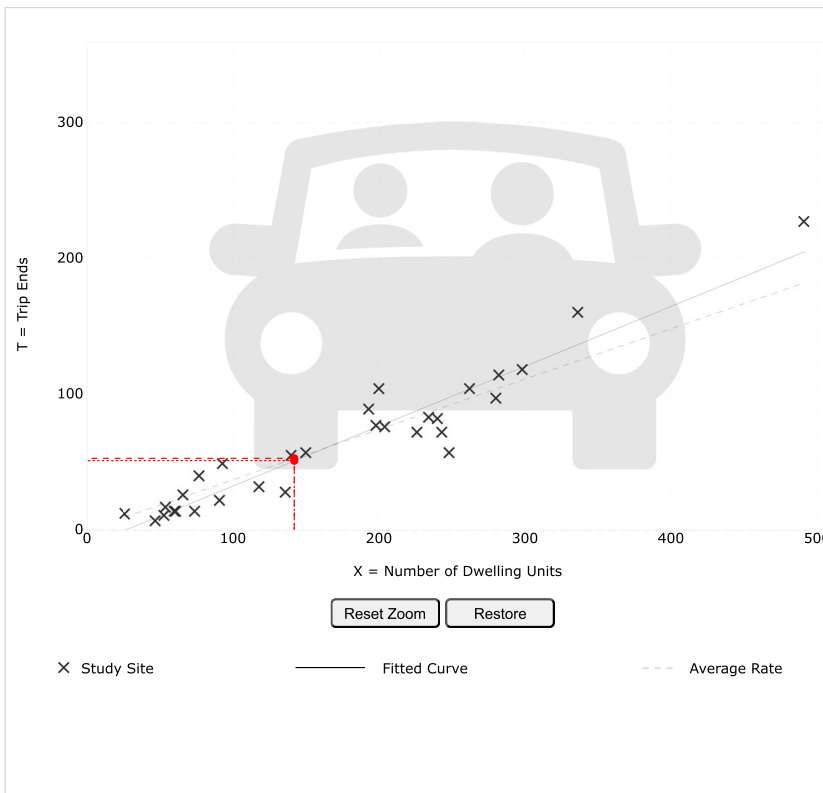
Vehicle

ENTER IV VALUE TO CALCULATE TRIPS:

142

Calculate

Data Plot and Equation



Use the mouse wheel to Zoom Out or Zoom In.  
Hover the mouse pointer on data points to view X and T values.

DATA STATISTICS

Land Use:

Multifamily Housing (Mid-Rise) - Not Close to Rail Transit (221) [Click for Description and Data Plots](#)

Independent Variable:

Dwelling Units

Time Period:

Weekday  
Peak Hour of Adjacent Street Traffic  
One Hour Between 7 and 9 a.m.

Setting/Location:

General Urban/Suburban

Trip Type:

Vehicle

Number of Studies:

30

Avg. Num. of Dwelling Units:

173

Average Rate:

0.37

Range of Rates:

0.15 - 0.53

Standard Deviation:

0.09

Fitted Curve Equation:

$T = 0.44(X) - 11.61$

$R^2$ :

0.91

Directional Distribution:

23% entering, 77% exiting

Calculated Trip Ends:

Average Rate: 53 (Total), 12 (Entry), 41 (Exit)

Fitted Curve: 51 (Total), 12 (Entry), 39 (Exit)





Query

Filter

DATA SOURCE:

Trip Generation Manual, 11th Ed

SEARCH BY LAND USE CODE:

221



LAND USE GROUP:

(200-299) Residential

LAND USE:

221 - Multifamily Housing (Mid-Rise)

LAND USE SUBCATEGORY:

Not Close to Rail Transit

SETTING/LOCATION:

General Urban/Suburban

INDEPENDENT VARIABLE (IV):

Dwelling Units

TIME PERIOD:

Weekday, Peak Hour of Adjacent Street Traffic

TRIP TYPE:

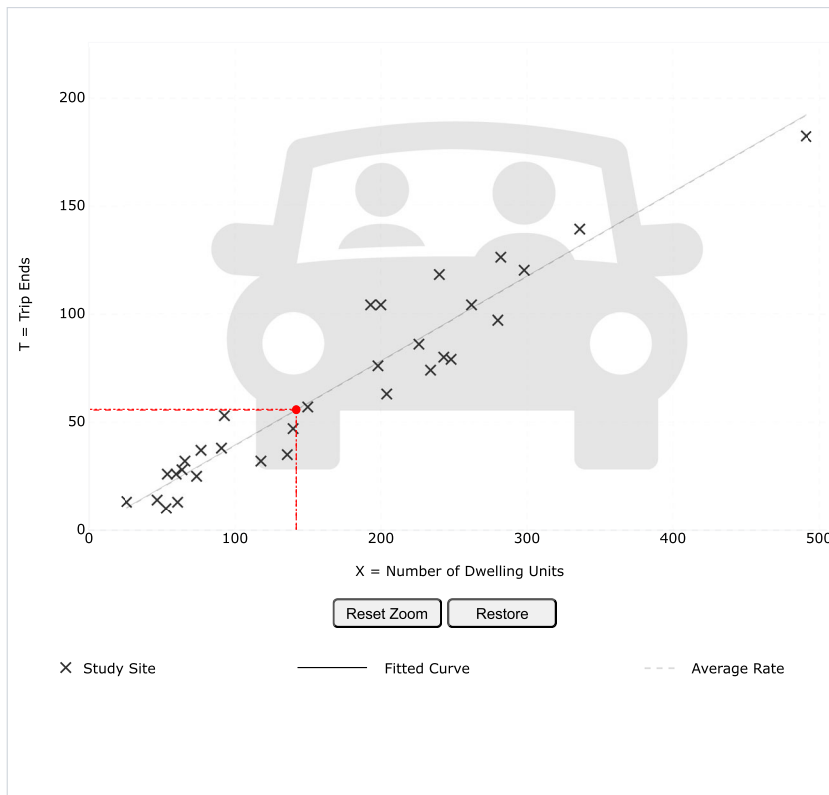
Vehicle

ENTER IV VALUE TO CALCULATE TRIPS:

142

Calculate

Data Plot and Equation



Use the mouse wheel to Zoom Out or Zoom In.  
Hover the mouse pointer on data points to view X and T values.

DATA STATISTICS

Land Use:

Multifamily Housing (Mid-Rise) - Not Close to Rail Transit (221) [Click for Description and Data Plots](#)

Independent Variable:

Dwelling Units

Time Period:

Weekday  
Peak Hour of Adjacent Street Traffic  
One Hour Between 4 and 6 p.m.

Setting/Location:

General Urban/Suburban

Trip Type:

Vehicle

Number of Studies:

31

Avg. Num. of Dwelling Units:

169

Average Rate:

0.39

Range of Rates:

0.19 - 0.57

Standard Deviation:

0.08

Fitted Curve Equation:

$T = 0.39(X) + 0.34$

R<sup>2</sup>:

0.91

Directional Distribution:

61% entering, 39% exiting

Calculated Trip Ends:

Average Rate: 55 (Total), 34 (Entry), 21 (Exit)

Fitted Curve: 56 (Total), 34 (Entry), 22 (Exit)



**Table A-1**  
**TRIP GENERATION SUMMARY**  
**142 UNIT DEVELOPMENT PROGRAM**

Time Period/Direction	Vehicle Trips	Person Trips				(F = C ÷ 1.06) Total Automobile Trips <sup>c</sup>
	(A) Proposed Residential Development (142 Units) <sup>a</sup>	(B = A x 1.06) Total Person Trips <sup>b</sup>	(C) Automobile Trips (89%)	(D) Transit Trips (7%)	(E) Pedestrian/ Bicycle Trips (4%)	
<i>Average Weekday Daily:</i>						
Entering	323	343	305	24	14	<b>288</b>
<u>Exiting</u>	<u>323</u>	<u>343</u>	<u>305</u>	<u>24</u>	<u>14</u>	<u><b>288</b></u>
Total	646	686	610	48	28	<b>576</b>
<i>Weekday Morning Peak Hour:</i>						
Entering	12	13	12	1	0	<b>11</b>
<u>Exiting</u>	<u>39</u>	<u>41</u>	<u>36</u>	<u>3</u>	<u>2</u>	<u><b>34</b></u>
Total	51	54	48	4	2	<b>45</b>
<i>Weekday Evening Peak Hour:</i>						
Entering	34	36	32	2	2	<b>30</b>
<u>Exiting</u>	<u>22</u>	<u>23</u>	<u>21</u>	<u>2</u>	<u>0</u>	<u><b>20</b></u>
Total	56	59	53	4	2	<b>50</b>

<sup>a</sup>Based on ITE LUC 221, *Multifamily Housing (Mid-Rise)*.

<sup>b</sup>Total ITE vehicle trips multiplied by 1.06.

<sup>c</sup>Automobile person trips divided by 1.06.



## CAPACITY ANALYSIS WORKSHEETS

---

Main Street at East Street

Main Street at West Street, Glenwood Avenue and Stone Street

Main Street at Elm Street and Common Street

Elm Street at West Street

Elm Street at East Street

East Street at the East Project Site Driveway

East Street at the Center Exit Project Site Driveway

East Street at the West Project Site Driveway

























Main Street at East Street

---



2029 Build Weekday Morning  
1: Route 1A & Route 27

04/25/2023

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	56	355	15	118	267	43	8	646	217	78	309	42
Future Volume (vph)	56	355	15	118	267	43	8	646	217	78	309	42
Lane Util. 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
Frt		0.994			0.979				0.850		0.982	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1656	1730	0	1631	1697	0	1805	1845	1538	1491	1738	0
Flt Permitted	0.417			0.302			0.353			0.082		
Satd. Flow (perm)	727	1730	0	518	1697	0	671	1845	1538	129	1738	0
Satd. Flow (RTOR)		2			7				74		8	
Adj. Flow (vph)	70	444	19	133	300	48	9	743	249	95	377	51
Lane Group Flow (vph)	70	463	0	133	348	0	9	743	249	95	428	0
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		3			3			1			1	
Permitted Phases	3			3			1		1	1		
Detector Phase	3	3		3	3		1	1	1	1	1	
Switch Phase												
Minimum Initial (s)	3.0	3.0		3.0	3.0		5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	7.0	7.0		7.0	7.0		20.0	20.0	20.0	20.0	20.0	
Total Split (s)	31.0	31.0		31.0	31.0		55.0	55.0	55.0	55.0	55.0	
Total Split (%)	28.2%	28.2%		28.2%	28.2%		50.0%	50.0%	50.0%	50.0%	50.0%	
Maximum Green (s)	27.0	27.0		27.0	27.0		51.0	51.0	51.0	51.0	51.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lead/Lag							Lead	Lead	Lead	Lead	Lead	
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None		C-Min	C-Min	C-Min	C-Min	C-Min	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio	0.23	0.64		0.61	0.49		0.03	0.87	0.33	1.61	0.53	
Control Delay	27.1	32.3		42.6	28.2		13.9	27.4	11.4	366.1	23.5	
Queue Delay	0.0	0.2		0.6	0.0		0.0	49.1	0.0	0.0	0.0	
Total Delay	27.1	32.5		43.2	28.2		13.9	76.5	11.4	366.1	23.5	
Queue Length 50th (ft)	29	232		66	158		3	485	85	~96	205	
Queue Length 95th (ft)	76	#472		#223	#373		m3	m324	m59	#142	262	
Internal Link Dist (ft)		222			218			470			220	
Turn Bay Length (ft)	50			50			55		65	95		
Base Capacity (vph)	305	728		217	716		311	855	752	59	810	
Starvation Cap Reductn	0	0		0	0		0	228	0	0	0	
Spillback Cap Reductn	0	27		8	0		0	0	0	0	0	
Storage Cap Reductn	0	0		0	0		0	0	0	0	0	
Reduced v/c Ratio	0.23	0.66		0.64	0.49		0.03	1.19	0.33	1.61	0.53	
Intersection Summary												
Cycle Length: 110												



Lane Group	Ø2
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	2
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	24.0
Total Split (s)	24.0
Total Split (%)	22%
Maximum Green (s)	21.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lag
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	14.0
Pedestrian Calls (#/hr)	2
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	



Actuated Cycle Length: 110

Offset: 0 (0%), Referenced to phase 1:NBSB, Start of Green, Master Intersection

Natural Cycle: 130

Control Type: Actuated-Coordinated

~ Volume exceeds capacity, queue is theoretically infinite.

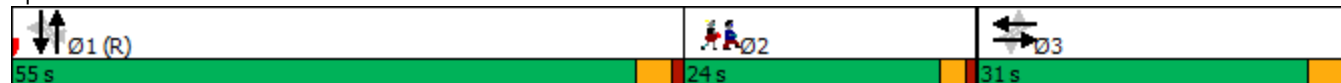
Queue shown is maximum after two cycles.

# 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: 1: Route 1A &amp; Route 27





2029 Build Weekday Morning  
1: Route 1A & Route 27























04/25/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	56	355	15	118	267	43	8	646	217	78	309	42
Future Volume (vph)	56	355	15	118	267	43	8	646	217	78	309	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	10	10	11	11	11	12	12	12	11	12	12
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	0.98		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1656	1729		1631	1697		1805	1845	1538	1491	1738	
Flt Permitted	0.42	1.00		0.30	1.00		0.35	1.00	1.00	0.08	1.00	
Satd. Flow (perm)	727	1729		519	1697		671	1845	1538	129	1738	
Peak-hour factor, PHF	0.80	0.80	0.80	0.89	0.89	0.89	0.87	0.87	0.87	0.82	0.82	0.82
Adj. Flow (vph)	70	444	19	133	300	48	9	743	249	95	377	51
RTOR Reduction (vph)	0	1	0	0	4	0	0	0	41	0	4	0
Lane Group Flow (vph)	70	462	0	133	344	0	9	743	208	95	424	0
Heavy Vehicles (%)	9%	2%	0%	7%	5%	12%	0%	3%	5%	17%	7%	10%
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		3			3			1				1
Permitted Phases	3			3			1		1	1		
Actuated Green, G (s)	46.2	46.2		46.2	46.2		48.6	48.6	48.6	48.6	48.6	
Effective Green, g (s)	46.2	46.2		46.2	46.2		48.6	48.6	48.6	48.6	48.6	
Actuated g/C Ratio	0.42	0.42		0.42	0.42		0.44	0.44	0.44	0.44	0.44	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	305	726		217	712		296	815	679	56	767	
v/s Ratio Prot		c0.27			0.20			0.40				0.24
v/s Ratio Perm	0.10			0.26			0.01		0.14	c0.74		
v/c Ratio	0.23	0.64		0.61	0.48		0.03	0.91	0.31	1.70	0.55	
Uniform Delay, d1	20.5	25.2		24.9	23.2		17.4	28.7	19.8	30.7	22.7	
Progression Factor	1.00	1.00		1.00	1.00		0.84	0.95	0.87	1.00	1.00	
Incremental Delay, d2	0.4	1.8		5.1	0.5		0.0	2.0	0.1	378.3	2.9	
Delay (s)	20.9	27.1		30.0	23.7		14.7	29.1	17.3	409.0	25.5	
Level of Service	C	C		C	C		B	C	B	F	C	
Approach Delay (s)		26.3			25.5			26.1			95.2	
Approach LOS		C			C			C			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			40.2			HCM 2000 Level of Service				D		
HCM 2000 Volume to Capacity ratio			1.12									
Actuated Cycle Length (s)			110.0			Sum of lost time (s)			11.0			
Intersection Capacity Utilization			77.8%			ICU Level of Service			D			
Analysis Period (min)			15									
c Critical Lane Group												



2029 Build Weekday Evening  
1: Route 1A & Route 27

04/25/2023

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	68	320	40	147	323	40	27	461	164	129	620	51
Future Volume (vph)	68	320	40	147	323	40	27	461	164	129	620	51
Lane Util. 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
Frt		0.983			0.984				0.850		0.989	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1743	0	1662	1791	0	1805	1863	1568	1711	1862	0
Flt Permitted	0.404			0.429			0.108			0.210		
Satd. Flow (perm)	753	1743	0	750	1791	0	205	1863	1568	378	1862	0
Satd. Flow (RTOR)		6			6				74		5	
Adj. Flow (vph)	71	333	42	163	359	44	30	507	180	140	674	55
Lane Group Flow (vph)	71	375	0	163	403	0	30	507	180	140	729	0
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		3			3			1			1	
Permitted Phases	3			3			1		1	1		
Detector Phase	3	3		3	3		1	1	1	1	1	
Switch Phase												
Minimum Initial (s)	3.0	3.0		3.0	3.0		5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	7.0	7.0		7.0	7.0		20.0	20.0	20.0	20.0	20.0	
Total Split (s)	34.0	34.0		34.0	34.0		42.0	42.0	42.0	42.0	42.0	
Total Split (%)	34.0%	34.0%		34.0%	34.0%		42.0%	42.0%	42.0%	42.0%	42.0%	
Maximum Green (s)	30.0	30.0		30.0	30.0		38.0	38.0	38.0	38.0	38.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lead/Lag							Lead	Lead	Lead	Lead	Lead	
Lead-Lag Optimize?							Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None		C-Min	C-Min	C-Min	C-Min	C-Min	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio	0.20	0.45		0.46	0.47		0.38	0.69	0.27	0.95	0.99	
Control Delay	20.3	21.4		26.1	21.8		30.3	26.6	11.2	94.0	62.4	
Queue Delay	0.0	69.7		89.7	0.0		0.0	0.8	0.0	0.0	19.2	
Total Delay	20.3	91.1		115.8	21.8		30.3	27.4	11.2	94.0	81.6	
Queue Length 50th (ft)	22	134		59	146		16	300	43	85	454	
Queue Length 95th (ft)	76	315		#197	340		m19	m391	m71	#212	#724	
Internal Link Dist (ft)		222			218			470			220	
Turn Bay Length (ft)	50			50			55		65	95		
Base Capacity (vph)	359	836		358	859		80	733	662	148	736	
Starvation Cap Reductn	0	0		0	0		0	61	0	0	0	
Spillback Cap Reductn	0	685		294	0		0	0	0	0	45	
Storage Cap Reductn	0	0		0	0		0	0	0	0	0	
Reduced v/c Ratio	0.20	2.48		2.55	0.47		0.38	0.75	0.27	0.95	1.05	
Intersection Summary												
Cycle Length: 100												



Lane Group	Ø2
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	2
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	24.0
Total Split (s)	24.0
Total Split (%)	24%
Maximum Green (s)	21.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lag
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	7.0
Flash Dont Walk (s)	14.0
Pedestrian Calls (#/hr)	2
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	



Actuated Cycle Length: 100

Offset: 0 (0%), Referenced to phase 1:NBSB, Start of Green, Master Intersection

Natural Cycle: 100

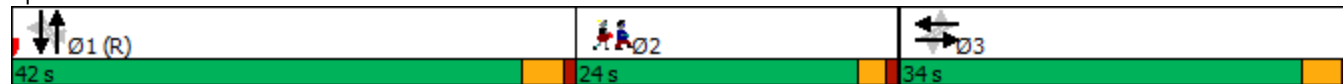
Control Type: Actuated-Coordinated

# 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: 1: Route 1A & Route 27





2029 Build Weekday Evening  
1: Route 1A & Route 27

04/25/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	68	320	40	147	323	40	27	461	164	129	620	51
Future Volume (vph)	68	320	40	147	323	40	27	461	164	129	620	51
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	10	10	11	11	11	12	12	12	11	12	12
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1744		1662	1791		1805	1863	1568	1711	1861	
Flt Permitted	0.40	1.00		0.43	1.00		0.11	1.00	1.00	0.21	1.00	
Satd. Flow (perm)	752	1744		750	1791		205	1863	1568	378	1861	
Peak-hour factor, PHF	0.96	0.96	0.96	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92
Adj. Flow (vph)	71	333	42	163	359	44	30	507	180	140	674	55
RTOR Reduction (vph)	0	3	0	0	3	0	0	0	47	0	3	0
Lane Group Flow (vph)	71	372	0	163	400	0	30	507	133	140	726	0
Heavy Vehicles (%)	2%	0%	0%	5%	1%	0%	0%	2%	3%	2%	1%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		3			3			1				1
Permitted Phases	3			3			1		1	1		
Actuated Green, G (s)	47.8	47.8		47.8	47.8		37.0	37.0	37.0	37.0	37.0	
Effective Green, g (s)	47.8	47.8		47.8	47.8		37.0	37.0	37.0	37.0	37.0	
Actuated g/C Ratio	0.48	0.48		0.48	0.48		0.37	0.37	0.37	0.37	0.37	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	359	833		358	856		75	689	580	139	688	
v/s Ratio Prot		0.21			c0.22			0.27			c0.39	
v/s Ratio Perm	0.09			0.22			0.15		0.09	0.37		
v/c Ratio	0.20	0.45		0.46	0.47		0.40	0.74	0.23	1.01	1.06	
Uniform Delay, d1	15.0	17.3		17.4	17.5		23.3	27.3	21.7	31.5	31.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	0.95	0.88	1.00	1.00	
Incremental Delay, d2	0.3	0.4		0.9	0.4		5.2	2.3	0.3	78.2	49.7	
Delay (s)	15.3	17.7		18.3	17.9		28.5	28.2	19.3	109.7	81.2	
Level of Service	B	B		B	B		C	C	B	F	F	
Approach Delay (s)		17.3			18.1			26.0			85.8	
Approach LOS		B			B			C			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			42.8			HCM 2000 Level of Service			D			
HCM 2000 Volume to Capacity ratio			0.69									
Actuated Cycle Length (s)			100.0			Sum of lost time (s)			11.0			
Intersection Capacity Utilization			80.6%			ICU Level of Service			D			
Analysis Period (min)			15									
c Critical Lane Group												



Main Street at West Street, Glenwood Avenue and Stone Street

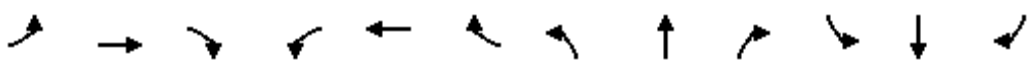
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# 2029 Build Weekday Morning

## 2: Route 1A & West Street/Glenwood Avenue/Stone Street

04/25/2023

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘		↗	↘	
Traffic Volume (vph)	268	77	0	32	95	38	8	573	36	19	301	112
Future Volume (vph)	268	77	0	32	95	38	8	573	36	19	301	112
Lane Util. 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
Frt					0.969			0.991			0.959	
Flt Protected		0.963			0.990		0.950			0.950		
Satd. Flow (prot)	0	1826	0	0	1833	0	1805	1798	0	1805	1734	0
Flt Permitted		0.242			0.834		0.186			0.112		
Satd. Flow (perm)	0	459	0	0	1544	0	353	1798	0	213	1734	0
Satd. Flow (RTOR)								3				
Adj. Flow (vph)	344	99	0	40	117	47	9	610	38	22	342	127
Lane Group Flow (vph)	0	443	0	0	204	0	9	648	0	22	469	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			4			1			1	
Permitted Phases	3			4			1			1		
Detector Phase	3	3		4	4		1	1		1	1	
Switch Phase												
Minimum Initial (s)	3.0	3.0		3.0	3.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	7.0	7.0		7.0	7.0		20.0	20.0		20.0	20.0	
Total Split (s)	27.0	27.0		19.0	19.0		42.0	42.0		42.0	42.0	
Total Split (%)	24.5%	24.5%		17.3%	17.3%		38.2%	38.2%		38.2%	38.2%	
Maximum Green (s)	23.0	23.0		15.0	15.0		38.0	38.0		38.0	38.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0			0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lead/Lag	Lead	Lead		Lag	Lag		Lead	Lead		Lead	Lead	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Min	C-Min		C-Min	C-Min	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio		2.62			0.97		0.07	1.04		0.30	0.78	
Control Delay		768.2			103.6		10.4	64.2		48.0	51.0	
Queue Delay		3.9			0.0		0.0	23.8		0.0	0.2	
Total Delay		772.1			103.6		10.4	88.0		48.0	51.2	
Queue Length 50th (ft)		~514			145		2	~58		13	344	
Queue Length 95th (ft)		#616			#249		m4	#744		m26	401	
Internal Link Dist (ft)		222			220			265			470	
Turn Bay Length (ft)							70			90		
Base Capacity (vph)		169			210		121	623		73	599	
Starvation Cap Reductn		0			0		0	132		0	7	
Spillback Cap Reductn		32			0		0	41		0	0	
Storage Cap Reductn		0			0		0	0		0	0	
Reduced v/c Ratio		3.23			0.97		0.07	1.32		0.30	0.79	
Intersection Summary												
Cycle Length: 110												



Lane Group	Ø2
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	2
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	20%
Maximum Green (s)	19.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lag
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	8.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	7
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	



Actuated Cycle Length: 110

Offset: 67.5 (61%), Referenced to phase 1:NBSB, Start of Green

Natural Cycle: 150

Control Type: Actuated-Coordinated

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 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: 2: Route 1A & West Street/Glenwood Avenue/Stone Street























# 2029 Build Weekday Morning

## 2: Route 1A & West Street/Glenwood Avenue/Stone Street

04/25/2023



















												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	268	77	0	32	95	38	8	573	36	19	301	112
Future Volume (vph)	268	77	0	32	95	38	8	573	36	19	301	112
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	13	13	13	12	12	12	12	12	12
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		1.00			0.97		1.00	0.99		1.00	0.96	
Flt Protected		0.96			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1825			1833		1805	1799		1805	1734	
Flt Permitted		0.24			0.83		0.19	1.00		0.11	1.00	
Satd. Flow (perm)		458			1543		353	1799		213	1734	
Peak-hour factor, PHF	0.78	0.78	0.78	0.81	0.81	0.81	0.94	0.94	0.94	0.88	0.88	0.88
Adj. Flow (vph)	344	99	0	40	117	47	9	610	38	22	342	127
RTOR Reduction (vph)	0	0	0	0	0	0	0	2	0	0	0	0
Lane Group Flow (vph)	0	443	0	0	204	0	9	646	0	22	469	0
Heavy Vehicles (%)	0%	1%	0%	0%	2%	7%	0%	5%	0%	0%	7%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			4			1			1	
Permitted Phases	3			4			1			1		
Actuated Green, G (s)		40.6			15.0		35.6	35.6		35.6	35.6	
Effective Green, g (s)		40.6			15.0		35.6	35.6		35.6	35.6	
Actuated g/C Ratio		0.37			0.14		0.32	0.32		0.32	0.32	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		169			210		114	582		68	561	
v/s Ratio Prot								c0.36			0.27	
v/s Ratio Perm		c0.97			c0.13		0.03			0.10		
v/c Ratio		2.62			0.97		0.08	1.11		0.32	0.84	
Uniform Delay, d1		34.7			47.3		25.8	37.2		28.1	34.5	
Progression Factor		1.00			1.00		0.37	0.53		1.34	1.29	
Incremental Delay, d2		746.4			53.6		1.0	67.1		10.3	11.9	
Delay (s)		781.1			100.9		10.7	86.6		47.9	56.3	
Level of Service		F			F		B	F		D	E	
Approach Delay (s)		781.1			100.9			85.6			55.9	
Approach LOS		F			F			F			E	
<b>Intersection Summary</b>												
HCM 2000 Control Delay		250.9			HCM 2000 Level of Service			F				
HCM 2000 Volume to Capacity ratio		1.69										
Actuated Cycle Length (s)		110.0			Sum of lost time (s)			15.0				
Intersection Capacity Utilization		70.3%			ICU Level of Service			C				
Analysis Period (min)		15										
c Critical Lane Group												



# 2029 Build Weekday Evening

## 2: Route 1A & West Street/Glenwood Avenue/Stone Street

04/25/2023

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	168	44	1	67	117	27	19	449	46	27	561	227
Future Volume (vph)	168	44	1	67	117	27	19	449	46	27	561	227
Lane Util. 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
Frt					0.983			0.986			0.957	
Flt Protected		0.962			0.984		0.950			0.950		
Satd. Flow (prot)	0	1820	0	0	1899	0	1805	1840	0	1805	1805	0
Flt Permitted		0.371			0.792		0.104			0.179		
Satd. Flow (perm)	0	702	0	0	1529	0	198	1840	0	340	1805	0
Satd. Flow (RTOR)								6				
Adj. Flow (vph)	215	56	1	88	154	36	21	504	52	28	584	236
Lane Group Flow (vph)	0	272	0	0	278	0	21	556	0	28	820	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			4			1			1	
Permitted Phases	3			4			1			1		
Detector Phase	3	3		4	4		1	1		1	1	
Switch Phase												
Minimum Initial (s)	3.0	3.0		3.0	3.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	7.0	7.0		7.0	7.0		20.0	20.0		20.0	20.0	
Total Split (s)	14.0	14.0		19.0	19.0		45.0	45.0		45.0	45.0	
Total Split (%)	14.0%	14.0%		19.0%	19.0%		45.0%	45.0%		45.0%	45.0%	
Maximum Green (s)	10.0	10.0		15.0	15.0		41.0	41.0		41.0	41.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0			0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lead/Lag	Lead	Lead		Lag	Lag		Lead	Lead		Lead	Lead	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Min	C-Min		C-Min	C-Min	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio		1.41			1.21		0.26	0.73		0.20	1.11	
Control Delay		242.1			167.6		29.7	31.6		35.5	102.6	
Queue Delay		0.0			0.0		0.0	52.9		0.0	0.5	
Total Delay		242.1			167.6		29.7	84.5		35.5	103.1	
Queue Length 50th (ft)		~213			~218		9	290		18	~622	
Queue Length 95th (ft)		#405			#297		31	414		m19	m#673	
Internal Link Dist (ft)		222			220			265			470	
Turn Bay Length (ft)							70			90		
Base Capacity (vph)		193			229		81	757		139	740	
Starvation Cap Reductn		0			0		0	262		0	60	
Spillback Cap Reductn		0			0		0	25		0	0	
Storage Cap Reductn		0			0		0	0		0	0	
Reduced v/c Ratio		1.41			1.21		0.26	1.12		0.20	1.21	
Intersection Summary												
Cycle Length: 100												



Lane Group	Ø2
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	2
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	22.0
Total Split (s)	22.0
Total Split (%)	22%
Maximum Green (s)	19.0
Yellow Time (s)	2.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lag
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	8.0
Flash Dont Walk (s)	11.0
Pedestrian Calls (#/hr)	7
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	



Actuated Cycle Length: 100

Offset: 67.5 (68%), Referenced to phase 1:NBSB, Start of Green

Natural Cycle: 150

Control Type: Actuated-Coordinated

~ Volume exceeds capacity, queue is theoretically infinite.

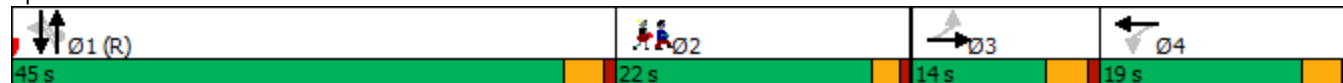
Queue shown is maximum after two cycles.

# 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: 2: Route 1A &amp; West Street/Glenwood Avenue/Stone Street























# 2029 Build Weekday Evening

## 2: Route 1A & West Street/Glenwood Avenue/Stone Street

04/25/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	168	44	1	67	117	27	19	449	46	27	561	227
Future Volume (vph)	168	44	1	67	117	27	19	449	46	27	561	227
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	13	13	13	12	12	12	12	12	12
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		1.00			0.98		1.00	0.99		1.00	0.96	
Flt Protected		0.96			0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1819			1899		1805	1840		1805	1805	
Flt Permitted		0.37			0.79		0.10	1.00		0.18	1.00	
Satd. Flow (perm)		702			1528		197	1840		340	1805	
Peak-hour factor, PHF	0.78	0.78	0.78	0.76	0.76	0.76	0.89	0.89	0.89	0.96	0.96	0.96
Adj. Flow (vph)	215	56	1	88	154	36	21	504	52	28	584	236
RTOR Reduction (vph)	0	0	0	0	0	0	0	4	0	0	0	0
Lane Group Flow (vph)	0	272	0	0	278	0	21	552	0	28	820	0
Heavy Vehicles (%)	0%	2%	0%	0%	0%	0%	0%	2%	0%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			4			1			1	
Permitted Phases	3			4			1			1		
Actuated Green, G (s)		27.6			15.0		38.6	38.6		38.6	38.6	
Effective Green, g (s)		27.6			15.0		38.6	38.6		38.6	38.6	
Actuated g/C Ratio		0.28			0.15		0.39	0.39		0.39	0.39	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		193			229		76	710		131	696	
v/s Ratio Prot								0.30			c0.45	
v/s Ratio Perm		c0.39			c0.18		0.11			0.08		
v/c Ratio		1.41			1.21		0.28	0.78		0.21	1.18	
Uniform Delay, d1		36.2			42.5		21.1	26.9		20.5	30.7	
Progression Factor		1.00			1.00		1.00	1.00		1.66	1.63	
Incremental Delay, d2		212.1			129.5		8.8	8.2		1.8	87.6	
Delay (s)		248.3			172.0		29.9	35.1		35.8	137.7	
Level of Service		F			F		C	D		D	F	
Approach Delay (s)		248.3			172.0			35.0			134.4	
Approach LOS		F			F			C			F	
<b>Intersection Summary</b>												
HCM 2000 Control Delay		126.3			HCM 2000 Level of Service			F				
HCM 2000 Volume to Capacity ratio		1.20										
Actuated Cycle Length (s)		100.0			Sum of lost time (s)			15.0				
Intersection Capacity Utilization		75.5%			ICU Level of Service			D				
Analysis Period (min)		15										
c Critical Lane Group												






















Main Street at Elm Street and Common Street

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2029 Build Weekday Morning  
3: Route 1A & Elm Street/Common Street

04/25/2023

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	203	51	112	337	98	143	494	4	56	301	1
Future Volume (vph)	0	203	51	112	337	98	143	494	4	56	301	1
Lane Util. 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
Frt		0.973				0.850		0.999				
Flt Protected					0.988		0.950			0.950		
Satd. Flow (prot)	0	1728	0	0	1763	1568	1736	1821	0	1805	1760	0
Flt Permitted					0.773		0.367			0.108		
Satd. Flow (perm)	0	1728	0	0	1379	1568	670	1821	0	205	1760	0
Satd. Flow (RTOR)												
Adj. Flow (vph)	0	254	64	127	383	111	159	549	4	62	334	1
Lane Group Flow (vph)	0	318	0	0	510	111	159	553	0	62	335	0
Turn Type		NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	
Permitted Phases	3			3		3	1			1		
Detector Phase	3	3		3	3	3	1	1		1	1	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	5.0	5.0		5.0	5.0	
Minimum Split (s)	8.0	8.0		8.0	8.0	8.0	20.0	20.0		20.0	20.0	
Total Split (s)	38.0	38.0		38.0	38.0	38.0	49.0	49.0		49.0	49.0	
Total Split (%)	34.5%	34.5%		34.5%	34.5%	34.5%	44.5%	44.5%		44.5%	44.5%	
Maximum Green (s)	34.0	34.0		34.0	34.0	34.0	45.0	45.0		45.0	45.0	
Yellow Time (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0			0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	
Lead/Lag							Lead	Lead		Lead	Lead	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None	None	C-Min	C-Min		C-Min	C-Min	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio		0.35			0.71	0.14	0.65	0.83		0.84	0.52	
Control Delay		20.5			30.5	18.4	41.6	43.1		87.4	39.1	
Queue Delay		0.0			0.0	0.0	0.0	30.3		0.0	1.5	
Total Delay		20.5			30.5	18.4	41.6	73.5		87.4	40.6	
Queue Length 50th (ft)		121			251	37	89	338		24	132	
Queue Length 95th (ft)		244			#623	102	163	463		m37	m174	
Internal Link Dist (ft)		220			220			220			265	
Turn Bay Length (ft)						65	95			80		
Base Capacity (vph)		898			717	815	274	744		83	720	
Starvation Cap Reductn		0			0	0	0	0		0	217	
Spillback Cap Reductn		0			0	0	0	212		0	0	
Storage Cap Reductn		0			0	0	0	0		0	0	
Reduced v/c Ratio		0.35			0.71	0.14	0.58	1.04		0.75	0.67	
Intersection Summary												
Cycle Length: 110												



Lane Group	Ø2
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	2
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	23.0
Total Split (s)	23.0
Total Split (%)	21%
Maximum Green (s)	19.0
Yellow Time (s)	3.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lag
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	10.0
Flash Dont Walk (s)	9.0
Pedestrian Calls (#/hr)	6
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	



2029 Build Weekday Morning  
3: Route 1A & Elm Street/Common Street

04/25/2023

Actuated Cycle Length: 110

Offset: 45.5 (41%), Referenced to phase 1:NBSB, Start of Green

Natural Cycle: 110

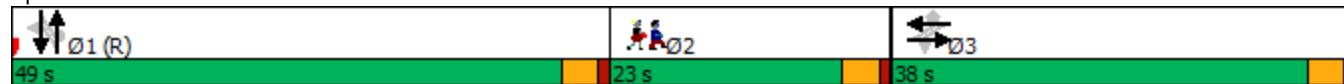
Control Type: Actuated-Coordinated

# 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: 3: Route 1A & Elm Street/Common Street





2029 Build Weekday Morning  
3: Route 1A & Elm Street/Common Street




















04/25/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	203	51	112	337	98	143	494	4	56	301	1
Future Volume (vph)	0	203	51	112	337	98	143	494	4	56	301	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frt		0.97			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00			0.99	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1728			1762	1568	1736	1821		1805	1759	
Flt Permitted		1.00			0.77	1.00	0.37	1.00		0.11	1.00	
Satd. Flow (perm)		1728			1379	1568	671	1821		205	1759	
Peak-hour factor, PHF	0.80	0.80	0.80	0.88	0.88	0.88	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	254	64	127	383	111	159	549	4	62	334	1
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	318	0	0	510	111	159	553	0	62	335	0
Heavy Vehicles (%)	0%	8%	3%	8%	6%	3%	4%	4%	33%	0%	8%	0%
Turn Type		NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	
Permitted Phases	3			3		3	1			1		
Actuated Green, G (s)		57.2			57.2	57.2	37.0	37.0		37.0	37.0	
Effective Green, g (s)		57.2			57.2	57.2	37.0	37.0		37.0	37.0	
Actuated g/C Ratio		0.52			0.52	0.52	0.34	0.34		0.34	0.34	
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		898			717	815	225	612		68	591	
v/s Ratio Prot		0.18						c0.30			0.19	
v/s Ratio Perm					c0.37	0.07	0.24			0.30		
v/c Ratio		0.35			0.71	0.14	0.71	0.90		0.91	0.57	
Uniform Delay, d1		15.5			20.1	13.6	31.8	34.8		34.9	29.9	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.23	1.39	
Incremental Delay, d2		0.2			3.3	0.1	17.1	19.1		64.1	2.4	
Delay (s)		15.8			23.5	13.7	48.8	53.9		107.0	44.1	
Level of Service		B			C	B	D	D		F	D	
Approach Delay (s)		15.8			21.7			52.8			53.9	
Approach LOS		B			C			D			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			37.8									HCM 2000 Level of Service D
HCM 2000 Volume to Capacity ratio			0.76									
Actuated Cycle Length (s)			110.0							12.0		
Intersection Capacity Utilization			81.5%									ICU Level of Service D
Analysis Period (min)			15									
c Critical Lane Group												



2029 Build Weekday Evening  
3: Route 1A & Elm Street/Common Street

04/25/2023

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	3	254	65	122	300	132	75	367	5	112	541	3
Future Volume (vph)	3	254	65	122	300	132	75	367	5	112	541	3
Lane Util. 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
Frt		0.973				0.850		0.998			0.999	
Flt Protected					0.986		0.950			0.950		
Satd. Flow (prot)	0	1827	0	0	1857	1599	1805	1859	0	1805	1879	0
Flt Permitted		0.997			0.735		0.108			0.314		
Satd. Flow (perm)	0	1821	0	0	1384	1599	205	1859	0	597	1879	0
Satd. Flow (RTOR)												
Adj. Flow (vph)	4	318	81	133	326	143	78	382	5	117	564	3
Lane Group Flow (vph)	0	403	0	0	459	143	78	387	0	117	567	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	
Permitted Phases	3			3		3	1			1		
Detector Phase	3	3		3	3	3	1	1		1	1	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0	4.0	5.0	5.0		5.0	5.0	
Minimum Split (s)	8.0	8.0		8.0	8.0	8.0	20.0	20.0		20.0	20.0	
Total Split (s)	35.0	35.0		35.0	35.0	35.0	51.0	51.0		51.0	51.0	
Total Split (%)	32.1%	32.1%		32.1%	32.1%	32.1%	46.8%	46.8%		46.8%	46.8%	
Maximum Green (s)	31.0	31.0		31.0	31.0	31.0	47.0	47.0		47.0	47.0	
Yellow Time (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	
Lost Time Adjust (s)		0.0			0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	
Lead/Lag							Lead	Lead		Lead	Lead	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None	None	C-Min	C-Min		C-Min	C-Min	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio		0.44			0.65	0.18	1.01	0.55		0.52	0.80	
Control Delay		22.8			29.2	19.6	143.9	29.2		34.2	39.3	
Queue Delay		0.0			0.0	0.0	0.0	0.0		0.0	45.2	
Total Delay		22.8			29.2	19.6	143.9	29.2		34.2	84.5	
Queue Length 50th (ft)		161			213	49	53	205		61	340	
Queue Length 95th (ft)		320			#582	134	#147	278		114	447	
Internal Link Dist (ft)		220			220			220			265	
Turn Bay Length (ft)						65	95			80		
Base Capacity (vph)		926			703	813	88	801		257	810	
Starvation Cap Reductn		0			0	0	0	0		0	285	
Spillback Cap Reductn		0			0	0	0	0		0	0	
Storage Cap Reductn		0			0	0	0	0		0	0	
Reduced v/c Ratio		0.44			0.65	0.18	0.89	0.48		0.46	1.08	
Intersection Summary												
Cycle Length: 109												



Lane Group	Ø2
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Satd. Flow (RTOR)	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	2
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	5.0
Minimum Split (s)	23.0
Total Split (s)	23.0
Total Split (%)	21%
Maximum Green (s)	19.0
Yellow Time (s)	3.0
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lag
Lead-Lag Optimize?	Yes
Vehicle Extension (s)	3.0
Recall Mode	None
Walk Time (s)	10.0
Flash Dont Walk (s)	9.0
Pedestrian Calls (#/hr)	6
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	



2029 Build Weekday Evening  
3: Route 1A & Elm Street/Common Street

04/25/2023

Actuated Cycle Length: 109

Offset: 45.5 (42%), Referenced to phase 1:NBSB, Start of Green

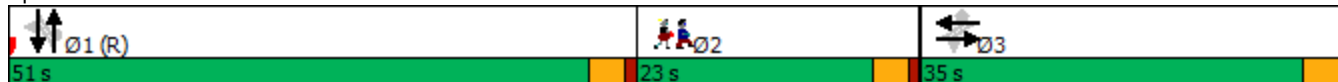
Natural Cycle: 90

Control Type: Actuated-Coordinated

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.




















Splits and Phases: 3: Route 1A & Elm Street/Common Street





2029 Build Weekday Evening  
3: Route 1A & Elm Street/Common Street

04/25/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	3	254	65	122	300	132	75	367	5	112	541	3
Future Volume (vph)	3	254	65	122	300	132	75	367	5	112	541	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frt		0.97			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00			0.99	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1826			1857	1599	1805	1860		1805	1880	
Flt Permitted		1.00			0.74	1.00	0.11	1.00		0.31	1.00	
Satd. Flow (perm)		1821			1385	1599	206	1860		597	1880	
Peak-hour factor, PHF	0.80	0.80	0.80	0.92	0.92	0.92	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	4	318	81	133	326	143	78	382	5	117	564	3
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	403	0	0	459	143	78	387	0	117	567	0
Heavy Vehicles (%)	0%	1%	2%	3%	0%	1%	0%	2%	0%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	
Permitted Phases	3			3		3	1			1		
Actuated Green, G (s)		55.4			55.4	55.4	37.8	37.8		37.8	37.8	
Effective Green, g (s)		55.4			55.4	55.4	37.8	37.8		37.8	37.8	
Actuated g/C Ratio		0.51			0.51	0.51	0.35	0.35		0.35	0.35	
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		925			703	812	71	645		207	651	
v/s Ratio Prot								0.21			0.30	
v/s Ratio Perm		0.22			0.33	0.09	0.38			0.20		
v/c Ratio		0.44			0.65	0.18	1.10	0.60		0.57	0.87	
Uniform Delay, d1		16.9			19.7	14.5	35.6	29.4		28.9	33.3	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.3			2.2	0.1	136.3	4.1		10.7	14.9	
Delay (s)		17.3			21.9	14.6	171.9	33.5		39.6	48.2	
Level of Service		B			C	B	F	C		D	D	
Approach Delay (s)		17.3			20.2			56.7			46.7	
Approach LOS		B			C			E			D	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			35.9									HCM 2000 Level of Service D
HCM 2000 Volume to Capacity ratio			0.80									
Actuated Cycle Length (s)			109.0									Sum of lost time (s) 12.0
Intersection Capacity Utilization			86.2%									ICU Level of Service E
Analysis Period (min)			15									
<b>c Critical Lane Group</b>												



Elm Street at West Street





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2029 Build Weekday Morning  
4: Elm Street & West Street

04/25/2023

Intersection	
Intersection Delay, s/veh	98.9
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	31	223	98	47	428	3	102	278	20	4	100	65
Future Vol, veh/h	31	223	98	47	428	3	102	278	20	4	100	65
Peak Hour Factor	0.87	0.87	0.87	0.93	0.93	0.93	0.79	0.79	0.79	0.80	0.80	0.80
Heavy Vehicles, %	4	8	1	3	6	0	0	0	0	0	3	2
Mvmt Flow	36	256	113	51	460	3	129	352	25	5	125	81
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	61.8	133.6	124.3	24.7
HCM LOS	F	F	F	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	26%	9%	10%	2%
Vol Thru, %	70%	63%	90%	59%
Vol Right, %	5%	28%	1%	38%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	400	352	478	169
LT Vol	102	31	47	4
Through Vol	278	223	428	100
RT Vol	20	98	3	65
Lane Flow Rate	506	405	514	211
Geometry Grp	1	1	1	1
Degree of Util (X)	1.159	0.935	1.184	0.538
Departure Headway (Hd)	8.826	9.28	8.894	10.315
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	415	392	411	353
Service Time	6.826	7.28	6.894	8.315
HCM Lane V/C Ratio	1.219	1.033	1.251	0.598
HCM Control Delay	124.3	61.8	133.6	24.7
HCM Lane LOS	F	F	F	C
HCM 95th-tile Q	18	10.2	18.8	3



2029 Build Weekday Evening  
4: Elm Street & West Street

04/25/2023

Intersection	
Intersection Delay, s/veh	68.4
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	24	290	114	78	289	8	52	167	26	4	269	52
Future Vol, veh/h	24	290	114	78	289	8	52	167	26	4	269	52
Peak Hour Factor	0.95	0.95	0.95	0.84	0.84	0.84	0.95	0.95	0.95	0.89	0.89	0.89
Heavy Vehicles, %	6	1	0	0	0	0	0	0	0	0	2	3
Mvmt Flow	25	305	120	93	344	10	55	176	27	4	302	58
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	86.4	86.7	30.1	51
HCM LOS	F	F	D	F




Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	21%	6%	21%	1%
Vol Thru, %	68%	68%	77%	83%
Vol Right, %	11%	27%	2%	16%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	245	428	375	325
LT Vol	52	24	78	4
Through Vol	167	290	289	269
RT Vol	26	114	8	52
Lane Flow Rate	258	451	446	365
Geometry Grp	1	1	1	1
Degree of Util (X)	0.668	1.045	1.045	0.883
Departure Headway (Hd)	9.683	8.652	8.73	9.008
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	377	423	420	405
Service Time	7.683	6.652	6.73	7.008
HCM Lane V/C Ratio	0.684	1.066	1.062	0.901
HCM Control Delay	30.1	86.4	86.7	51
HCM Lane LOS	D	F	F	F
HCM 95th-tile Q	4.6	14	13.9	8.9



Elm Street at East Street

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Intersection						
Int Delay, s/veh	56.8					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	376	343	573	30	16	330
Future Vol, veh/h	376	343	573	30	16	330
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	86	86	85	85	92	92
Heavy Vehicles, %	1	5	5	0	0	5
Mvmt Flow	437	399	674	35	17	359
Major/Minor	Major1	Major2	Minor2			
Conflicting Flow All	709	0	-	0	1965	692
Stage 1	-	-	-	-	692	-
Stage 2	-	-	-	-	1273	-
Critical Hdwy	4.11	-	-	-	6.4	6.25
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.209	-	-	-	3.5	3.345
Pot Cap-1 Maneuver	895	-	-	-	70	439
Stage 1	-	-	-	-	500	-
Stage 2	-	-	-	-	266	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	895	-	-	-	26	439
Mov Cap-2 Maneuver	-	-	-	-	26	-
Stage 1	-	-	-	-	187	-
Stage 2	-	-	-	-	266	-
Approach	EB	WB		SB		
HCM Control Delay, s	6.7	0		275.3		
HCM LOS				F		
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	895	-	-	-	253	
HCM Lane V/C Ratio	0.489	-	-	-	1.487	
HCM Control Delay (s)	12.8	0	-	-	275.3	
HCM Lane LOS	B	A	-	-	F	
HCM 95th %tile Q(veh)	2.7	-	-	-	21.8	



2029 Build Weekday Evening  
5: Elm Street & Route 27

04/25/2023

Intersection

Int Delay, s/veh 61.8

Movement EBL EBT WBT WBR SBL SBR

Lane Configurations   

Traffic Vol, veh/h 350 356 352 42 60 363

Future Vol, veh/h 350 356 352 42 60 363

Conflicting Peds, #/hr 0 0 0 0 0 0

Sign Control Free Free Free Free Stop Stop

RT Channelized - None - None - None

Storage Length - - - - 0 -

Veh in Median Storage, # - 0 0 - 0 -

Grade, % - 0 0 - 0 -

Peak Hour Factor 96 96 93 93 95 95

Heavy Vehicles, % 1 1 1 0 0 1

Mvmt Flow 365 371 378 45 63 382

Major/Minor Major1 Major2 Minor2

Conflicting Flow All 423 0 - 0 1502 401

Stage 1 - - - - 401 -

Stage 2 - - - - 1101 -

Critical Hdwy 4.11 - - - 6.4 6.21

Critical Hdwy Stg 1 - - - - 5.4 -

Critical Hdwy Stg 2 - - - - 5.4 -

Follow-up Hdwy 2.209 - - - 3.5 3.309

Pot Cap-1 Maneuver 1142 - - - 135 651

Stage 1 - - - - 681 -

Stage 2 - - - - 321 -

Platoon blocked, % - - - -

Mov Cap-1 Maneuver 1142 - - - 81 651

Mov Cap-2 Maneuver - - - - 81 -

Stage 1 - - - - 407 -

Stage 2 - - - - 321 -

Approach EB WB SB

HCM Control Delay, s 4.8 0 214.8

HCM LOS F

Minor Lane/Major Mvmt EBL EBT WBT WBR SBLn1

Capacity (veh/h) 1142 - - - 326

HCM Lane V/C Ratio 0.319 - - - 1.366

HCM Control Delay (s) 9.6 0 - - 214.8

HCM Lane LOS A A - - F

HCM 95th %tile Q(veh) 1.4 - - - 22.4






East Street at the East Project Site Driveway

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2029 Build Weekday Morning  
6: East Street & East Project Site Driveway

04/25/2023

Intersection						
Int Delay, s/veh	0.2					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	1	415	311	3	8	2
Future Vol, veh/h	1	415	311	3	8	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
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	1	451	338	3	9	2
Major/Minor	Major1	Major2		Minor2		
Conflicting Flow All	341	0	-	0	793	340
Stage 1	-	-	-	-	340	-
Stage 2	-	-	-	-	453	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1218	-	-	-	358	702
Stage 1	-	-	-	-	721	-
Stage 2	-	-	-	-	640	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1218	-	-	-	358	702
Mov Cap-2 Maneuver	-	-	-	-	358	-
Stage 1	-	-	-	-	720	-
Stage 2	-	-	-	-	640	-
Approach	EB	WB		SB		
HCM Control Delay, s	0	0		14.3		
HCM LOS				B		
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	1218	-	-	-	397	
HCM Lane V/C Ratio	0.001	-	-	-	0.027	
HCM Control Delay (s)	8	0	-	-	14.3	
HCM Lane LOS	A	A	-	-	B	
HCM 95th %tile Q(veh)	0	-	-	-	0.1	






2029 Build Weekday Evening  
6: East Street & East Project Site Driveway

04/25/2023

Intersection

Int Delay, s/veh 0.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	1	421	305	8	5	1
Future Vol, veh/h	1	421	305	8	5	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
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	1	458	332	9	5	1

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	341	0	0 797 337
Stage 1	-	-	- 337 -
Stage 2	-	-	- 460 -
Critical Hdwy	4.12	-	- 6.42 6.22
Critical Hdwy Stg 1	-	-	- 5.42 -
Critical Hdwy Stg 2	-	-	- 5.42 -
Follow-up Hdwy	2.218	-	- 3.518 3.318
Pot Cap-1 Maneuver	1218	-	- 356 705
Stage 1	-	-	- 723 -
Stage 2	-	-	- 636 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1218	-	- 356 705
Mov Cap-2 Maneuver	-	-	- 356 -
Stage 1	-	-	- 722 -
Stage 2	-	-	- 636 -

Approach	EB	WB	SB
HCM Control Delay, s	0	0	14.4
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1218	-	-	-	388
HCM Lane V/C Ratio	0.001	-	-	-	0.017
HCM Control Delay (s)	8	0	-	-	14.4
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.1






East Street at the Center Exit Project Site Driveway

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2029 Build Weekday Morning  
7: East Street & Center Project Site Driveway




04/25/2023

Intersection						
Int Delay, s/veh	0					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	0	416	313	0	1	0
Future Vol, veh/h	0	416	313	0	1	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
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	0	452	340	0	1	0
Major/Minor	Major1	Major2		Minor2		
Conflicting Flow All	340	0	-	0	792	340
Stage 1	-	-	-	-	340	-
Stage 2	-	-	-	-	452	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1219	-	-	-	358	702
Stage 1	-	-	-	-	721	-
Stage 2	-	-	-	-	641	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1219	-	-	-	358	702
Mov Cap-2 Maneuver	-	-	-	-	358	-
Stage 1	-	-	-	-	721	-
Stage 2	-	-	-	-	641	-
Approach	EB	WB		SB		
HCM Control Delay, s	0	0		15.1		
HCM LOS				C		
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	1219	-	-	-	358	
HCM Lane V/C Ratio	-	-	-	-	0.003	
HCM Control Delay (s)	0	-	-	-	15.1	
HCM Lane LOS	A	-	-	-	C	
HCM 95th %tile Q(veh)	0	-	-	-	0	



2029 Build Weekday Evening  
7: East Street & Center Project Site Driveway

04/25/2023

Intersection						
Int Delay, s/veh	0					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	0	422	306	0	0	0
Future Vol, veh/h	0	422	306	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
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	0	459	333	0	0	0
Major/Minor	Major1	Major2	Minor2			
Conflicting Flow All	333	0	-	0	792	333
Stage 1	-	-	-	-	333	-
Stage 2	-	-	-	-	459	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1226	-	-	-	358	709
Stage 1	-	-	-	-	726	-
Stage 2	-	-	-	-	636	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1226	-	-	-	358	709
Mov Cap-2 Maneuver	-	-	-	-	358	-
Stage 1	-	-	-	-	726	-
Stage 2	-	-	-	-	636	-
Approach	EB	WB		SB		
HCM Control Delay, s	0	0		0		
HCM LOS				A		
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	1226	-	-	-	-	
HCM Lane V/C Ratio	-	-	-	-	-	
HCM Control Delay (s)	0	-	-	-	0	
HCM Lane LOS	A	-	-	-	A	
HCM 95th %tile Q(veh)	0	-	-	-	-	






East Street at the West Project Site Driveway

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2029 Build Weekday Morning  
8: East Street & West Project Site Driveway




04/25/2023

Intersection						
Int Delay, s/veh	0.4					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	4	406	310	3	10	13
Future Vol, veh/h	4	406	310	3	10	13
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
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	4	441	337	3	11	14
Major/Minor	Major1	Major2		Minor2		
Conflicting Flow All	340	0	-	0	788	339
Stage 1	-	-	-	-	339	-
Stage 2	-	-	-	-	449	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1219	-	-	-	360	703
Stage 1	-	-	-	-	722	-
Stage 2	-	-	-	-	643	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1219	-	-	-	359	703
Mov Cap-2 Maneuver	-	-	-	-	359	-
Stage 1	-	-	-	-	719	-
Stage 2	-	-	-	-	643	-
Approach	EB	WB		SB		
HCM Control Delay, s	0.1	0		12.6		
HCM LOS				B		
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	1219	-	-	-	496	
HCM Lane V/C Ratio	0.004	-	-	-	0.05	
HCM Control Delay (s)	8	0	-	-	12.6	
HCM Lane LOS	A	A	-	-	B	
HCM 95th %tile Q(veh)	0	-	-	-	0.2	



2029 Build Weekday Evening  
8: East Street & West Project Site Driveway

04/25/2023

Intersection						
Int Delay, s/veh	0.4					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	12	417	298	8	6	8
Future Vol, veh/h	12	417	298	8	6	8
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
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	13	453	324	9	7	9
Major/Minor	Major1	Major2		Minor2		
Conflicting Flow All	333	0	-	0	808	329
Stage 1	-	-	-	-	329	-
Stage 2	-	-	-	-	479	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1226	-	-	-	350	712
Stage 1	-	-	-	-	729	-
Stage 2	-	-	-	-	623	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1226	-	-	-	345	712
Mov Cap-2 Maneuver	-	-	-	-	345	-
Stage 1	-	-	-	-	719	-
Stage 2	-	-	-	-	623	-
Approach	EB	WB		SB		
HCM Control Delay, s	0.2	0		12.6		
HCM LOS				B		
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	1226	-	-	-	489	
HCM Lane V/C Ratio	0.011	-	-	-	0.031	
HCM Control Delay (s)	8	0	-	-	12.6	
HCM Lane LOS	A	A	-	-	B	
HCM 95th %tile Q(veh)	0	-	-	-	0.1	