



Memorandum

Date: December 9, 2022

To: Merhej & Sons Realty, LLC

From: John G. Morgan Jr., P.E., PTOE

Re: Traffic Impact Study Update
Hingham Gas
#19 and 27 Whiting Street Redevelopment
Hingham, MA

CHA Consulting, Inc. (CHA) has prepared this Memorandum to provide documentation for the updated trip generation and site operations expected as a result of the additional gasoline pumps to the previously approved redevelopment at the Hingham Gas project at 19 Whiting Street in Hingham. This Memorandum includes background information on the approved development plan and proposed modifications, documentation of the expected difference in vehicle trips at the site and on the adjacent roadway based on Institute of Transportation Engineers (ITE) methodology for calculating Trip Generation, and capacity analysis of the site driveways based on HCM methodology using Synchro 10 software.

Background Information

The previously approved project involved the reuse of the existing gas station at 19 Whiting Street and the demolition of a single-family house at 27 Whiting Street for the construction of a proposed retail store with gasoline station on the combined lots. The existing 200 s.f. kiosk building at the gas station will be razed as part of the re-development. Access to the proposed site will be provided via three of the four curb cut locations that previously existed at the two lots. One existing driveway curb cut is proposed to be closed.

The approved site development plan included retaining the eight existing fueling stations at the gas station and constructing a new 2,531 s.f. retail store with associated storage areas. The proposed modification involves adding a gas island with two pumps (4 fueling stations) resulting in a total of 12 fueling stations at the site.

Trip Generation

For the approved development project, CHA determined the trip generation using the Institute of Transportation Engineers (ITE) Trip Generation Manual 10th Edition. Under the existing condition, the number of vehicle trips per day at the site were derived using the sum of ITE Land Use Code (LUC) 944 Gasoline / Service Station and the Land Use Code 210 Single-Family Detached Housing. The trip generation for the proposed site conditions was estimated using ITE Land Use Code 853 Convenience Market with Gasoline Pumps and the number of fueling positions.

Similar to the previously approved methodology, the Land Use Code 853 Convenience Market with Gasoline Pumps will be used to estimate the number of vehicle trips expected at the site with the proposed modification. The resultant estimate of the number of existing daily and peak hour trips at the site are depicted in Table 1.

Table 1: Trip Generation Summary

	Existing Use	Proposed Use – 8 fueling stations	Proposed Use – 12 fueling stations	Difference between Proposed Conditions	Total New Trips
Time Period / Direction	LUC 944 ^a Gasoline / Service Station and LUC 210 ^a Single-Family Detached Housing (vehicles)	LUC 853 ^a Convenience Market with Gasoline Pumps (vehicles)	LUC 853 ^a Convenience Market with Gasoline Pumps (vehicles)	Trip Generation (vehicles)	Trip Generation (vehicles)
Weekday Daily	1385	2580	3870	1290	2485
Weekday AM Peak Hour	83	166	249	83	166
Entering	41	83	125	42	84
Exiting	42	83	124	41	82
Weekday PM Peak Hour	113	184	276	92	163
Entering	57	92	138	46	81
Exiting	56	92	138	46	82

^aInstitute of Transportation Engineers, Trip Generation, 10th Edition, Washington, 2017

As evident in Table 1, the anticipated trip generation of the fueling station addition to the Gasoline / Service Station with Convenience Market will represent an increase from both the existing site use and previously approved project. The calculated daily trip generation from adding four fueling stations increases by 2,485 vehicles per day, while the projected traffic volumes for the AM and PM peak hour increases by 166 and 163 vehicles per hour, respectively.

Pass-By Traffic

Pass-by trips are vehicles that were already traveling on the roadway and turn into the site and exit the site to continue their journey. As indicated in the original traffic study, ITE data shows that past studies of gasoline / service stations found that 60 percent of customers of these facilities were pass-by vehicles. Table 2 depicts the number of new vs. pass-by trips predicted for the proposed addition to the site based on the ITE data.

Table 2: Pass-By Traffic Summary

Time Period/Direction	Total New Trips to Site (vehicles)	New Pass-By Trips to Site (vehicles)	Total New Trips to Adjacent Roadway (vehicles)
Weekday Daily	2485	1491	994
Weekday AM Peak Hour	166	100	66
Entering	84	51	33
Exiting	82	49	33
Weekday PM Peak Hour	163	98	65
Entering	81	49	32
Exiting	82	49	33

As indicated in Table 2, the number of new vehicle trip on the existing roadway adjacent to the site expected in the AM and PM peak hours as a result of the additional fueling station is 66 and 65 vehicles, respectively. This is a combination of entering and exiting traffic and represents the number of vehicles directly in front of the site. Assuming that these trips would be distributed fairly evenly in each direction on Whiting Street, the number of new trips at other locations along Whiting Street would be approximately 33 vehicles in the peak hours.

Trip Distribution and Traffic Volumes

The traffic generated by the fueling station additions was distributed in a similar manner as the previous project. The trip distribution was assigned to the three access driveways to the site based on a set of assumptions and traffic patterns in the surrounding area. The trip distribution assumptions and explanations can be found in the #19 and 27 Whiting Street Redevelopment Traffic Impact Study dated September 2020.

The additional trips expected from the four added fueling stations was combined with the originally calculated 2027 Build volumes to represent the estimated future volume conditions for the site. The 2027 Build volumes for the AM Peak Hour are shown on Figure 1 and for the PM Peak Hour on Figure 2.

Capacity Analysis

The traffic operating conditions for the modified site was analyzed using Synchro 10 software and HCM methodology. Table 3 shows the results for the 2027 Build conditions for all three driveways for both the modified condition and approved condition.

Table 3: Level of Service Summary

Location/Movement	Modified Site Condition (12 Fueling Station)				Approved Site Condition (8 fueling Stations)			
	Delay (spv)	LOS	V/C Ratio	95 th % Queues (veh)	Delay (spv)	LOS	V/C Ratio	95 th % Queues (veh)
<i>Weekday Morning Peak Hour</i>								
<i>Driveway #1</i>								
SB - R	11.6	B	0.037	0.1	11.4	B	0.024	0.1
<i>Driveway #2</i>								
EB - LT	10.2	B	0.081	0.3	9.9	A	0.052	0.2
SB - LR	33.6	D	0.373	1.6	25.2	D	0.219	0.8
<i>Driveway #3</i>								
EB - LT	9.9	A	0.01	0.0	11.2	B	0.007	0.0
SB - LR	26.8	D	0.201	0.7	34.5	D	0.176	0.6
<i>Weekday Evening Peak Hour</i>								
<i>Driveway #1</i>								
SB - R	12.4	B	0.045	0.1	12.1	B	0.029	0.1
<i>Driveway #2</i>								
EB - LT	11.0	B	0.099	0.3	10.6	B	0.065	0.2
SB - LR	135.6	F	0.861	4.8	60.0	F	0.470	2.1
<i>Driveway #3</i>								
EB - LT	10.6	B	0.012	0.0	10.4	B	0.008	0.0
SB - LR	51.2	F	0.368	1.5	40.6	E	0.226	0.8

Driveway #1

Similar to the approved project condition, the southbound site driveway movement is estimated to operate at LOS B or better for both the AM and PM peak hours with the addition of the four fueling stations. Vehicle queues exiting the site driveway are expected to be one or less during the morning and evening peak hours. The major street traffic flow is unaffected by the site driveway movement in this case.

Driveway #2

For the AM peak hour with additional fueling stations, the eastbound Whiting Street approach operates at LOS B while the southbound driveway approach operates at LOS D. For the PM peak hour, the eastbound approach operates at LOS B and the southbound approach operates at LOS F. The projected delay does increase for the southbound movement from the approved project to the modified project, with a calculated delay of 33.6 seconds per vehicle in the AM and 135.6 second per vehicle in the PM. Similarly, the queue lengths increase for both peak hours, with the maximum 95th percentile queue of two vehicles in the AM Peak and five vehicles in the PM peak. However, it should be noted if there are vehicles waiting to exit Driveway #2, drivers will have the option to utilize one of the other curb cuts that are projected to have shorter queues to exit the site.

Driveway #3

The eastbound Whiting Street approach is estimated to operate at LOS B or better for both the AM and PM peak hours. The southbound driveway will operate at LOS D in the AM peak hour, and at LOS F in the PM peak hour. Vehicle queues exiting the site driveway are expected to be two or less during the morning and evening peak hours.

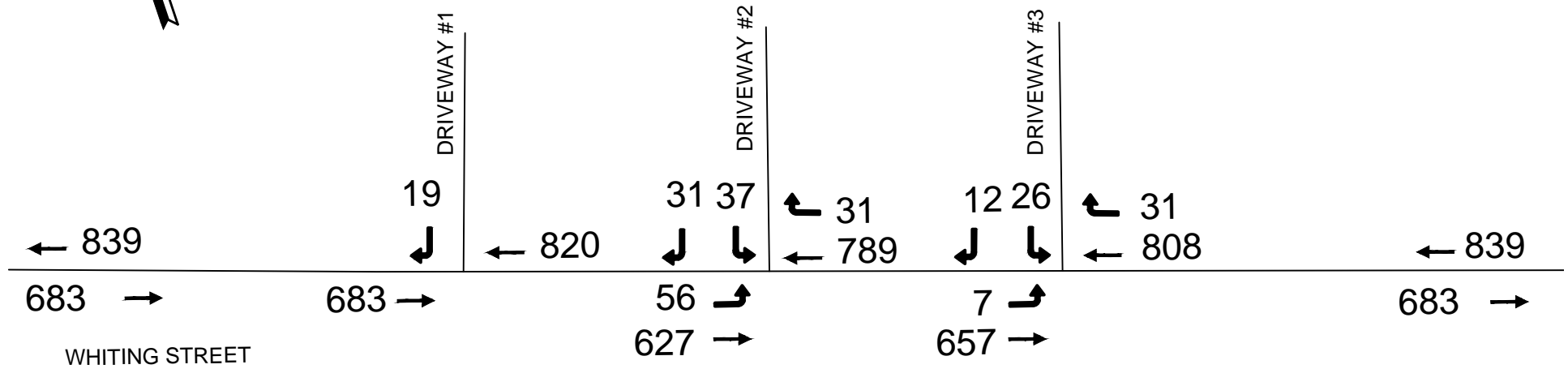
Conclusion

CHA reviewed the effect of the modified plan to the gas station re-development project at 19 Whiting Street relative to expected traffic increases. The analysis was performed utilizing the same standard ITE Trip Generation methodology used in the original traffic study for the redevelopment project. The results of our analysis indicate that the traffic at the proposed site is expected to increase from what was previously predicted, but that the majority of this traffic will be pass-by trips that involve vehicles already on the adjacent roadway. The number of new vehicle trips expected on Whiting Street at locations away from the site is less than 33 vehicles in the peak hours and is not expected to have a significant impact on operations of the roadway, which includes two travel lanes in each direction and carries over 22,000 vehicles per day.

Furthermore, the expected traffic increases from the additional fueling stations will increase delay and queues at the site driveways from what was previously predicted. However, the maximum 95th percentile queue is less than five cars, and it is expected vehicles will utilize one of the other site driveways if experiencing a long delay.

If there are any questions regarding this Memorandum and the estimated change in traffic conditions expected at the site as a result of the added fueling stations, please do not hesitate to contact us.

LEGEND:
 XX # of Vehicles



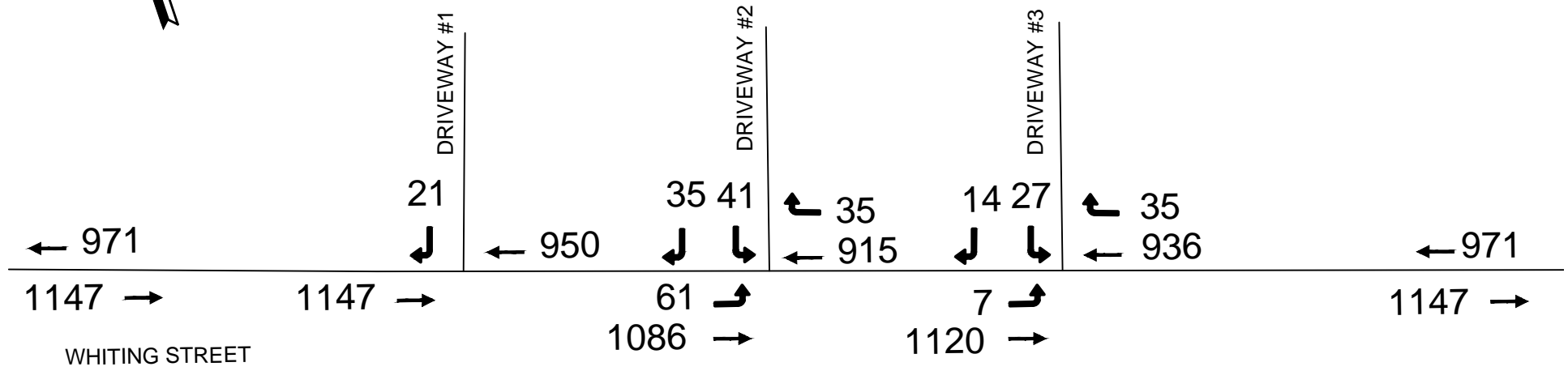
Not to Scale

2027 Build Conditions



141 Longwater Drive - Suite 104
 Norwell, MA 02061
 781.982.5400 • www.chacompanies.com

LEGEND:
 XX # of Vehicles



Not to Scale

2027 Build Conditions



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Intersection						
Int Delay, s/veh	0.1					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			↑
Traffic Vol, veh/h	0	683	820	0	0	19
Future Vol, veh/h	0	683	820	0	0	19
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	0	0
Mvmt Flow	0	742	891	0	0	21

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	-	0	-
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	-	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	-	-
Pot Cap-1 Maneuver	0	-	-
Stage 1	0	-	-
Stage 2	0	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	-	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	11.6
HCM LOS			B

Minor Lane/Major Mvmt	EBT	WBT	SBLn1
Capacity (veh/h)	-	-	565
HCM Lane V/C Ratio	-	-	0.037
HCM Control Delay (s)	-	-	11.6
HCM Lane LOS	-	-	B
HCM 95th %tile Q(veh)	-	-	0.1

Intersection						
Int Delay, s/veh	2.1					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↑↑	
Traffic Vol, veh/h	56	627	789	31	37	31
Future Vol, veh/h	56	627	789	31	37	31
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	0	0
Mvmt Flow	61	682	858	34	40	34

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	892	0	0	1338	446
Stage 1	-	-	-	875	-
Stage 2	-	-	-	463	-
Critical Hdwy	4.14	-	-	6.8	6.9
Critical Hdwy Stg 1	-	-	-	5.8	-
Critical Hdwy Stg 2	-	-	-	5.8	-
Follow-up Hdwy	2.22	-	-	3.5	3.3
Pot Cap-1 Maneuver	756	-	-	147	565
Stage 1	-	-	-	373	-
Stage 2	-	-	-	606	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	756	-	-	128	565
Mov Cap-2 Maneuver	-	-	-	128	-
Stage 1	-	-	-	325	-
Stage 2	-	-	-	606	-

Approach	EB	WB	SB
HCM Control Delay, s	1.4	0	33.6
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	756	-	-	-	198
HCM Lane V/C Ratio	0.081	-	-	-	0.373
HCM Control Delay (s)	10.2	0.6	-	-	33.6
HCM Lane LOS	B	A	-	-	D
HCM 95th %tile Q(veh)	0.3	-	-	-	1.6

Intersection						
Int Delay, s/veh	0.7					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↑↑	
Traffic Vol, veh/h	7	657	808	31	26	12
Future Vol, veh/h	7	657	808	31	26	12
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	0	0
Mvmt Flow	8	714	878	34	28	13

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	912	0	-	0	1268 456
Stage 1	-	-	-	-	895 -
Stage 2	-	-	-	-	373 -
Critical Hdwy	4.14	-	-	-	6.8 6.9
Critical Hdwy Stg 1	-	-	-	-	5.8 -
Critical Hdwy Stg 2	-	-	-	-	5.8 -
Follow-up Hdwy	2.22	-	-	-	3.5 3.3
Pot Cap-1 Maneuver	743	-	-	-	163 557
Stage 1	-	-	-	-	364 -
Stage 2	-	-	-	-	672 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	743	-	-	-	160 557
Mov Cap-2 Maneuver	-	-	-	-	160 -
Stage 1	-	-	-	-	357 -
Stage 2	-	-	-	-	672 -

Approach	EB	WB	SB
HCM Control Delay, s	0.2	0	26.8
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	743	-	-	-	206
HCM Lane V/C Ratio	0.01	-	-	-	0.201
HCM Control Delay (s)	9.9	0.1	-	-	26.8
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0	-	-	-	0.7

Intersection						
Int Delay, s/veh	0.1					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			↑
Traffic Vol, veh/h	0	1147	950	0	0	21
Future Vol, veh/h	0	1147	950	0	0	21
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	0	0
Mvmt Flow	0	1247	1033	0	0	23

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	-	0	-	0	517
Stage 1	-	-	-	-	-
Stage 2	-	-	-	-	-
Critical Hdwy	-	-	-	-	6.9
Critical Hdwy Stg 1	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	3.3
Pot Cap-1 Maneuver	0	-	-	0	509
Stage 1	0	-	-	0	-
Stage 2	0	-	-	0	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	-	-	509
Mov Cap-2 Maneuver	-	-	-	-	-
Stage 1	-	-	-	-	-
Stage 2	-	-	-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	12.4
HCM LOS			B

Minor Lane/Major Mvmt	EBT	WBT	SBLn1
Capacity (veh/h)	-	-	509
HCM Lane V/C Ratio	-	-	0.045
HCM Control Delay (s)	-	-	12.4
HCM Lane LOS	-	-	B
HCM 95th %tile Q(veh)	-	-	0.1

Intersection						
Int Delay, s/veh	5.7					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↑↑	
Traffic Vol, veh/h	61	1086	915	35	41	35
Future Vol, veh/h	61	1086	915	35	41	35
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	0	0
Mvmt Flow	66	1180	995	38	45	38

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	1033	0	-	0	1736 517
Stage 1	-	-	-	-	1014 -
Stage 2	-	-	-	-	722 -
Critical Hdwy	4.14	-	-	-	6.8 6.9
Critical Hdwy Stg 1	-	-	-	-	5.8 -
Critical Hdwy Stg 2	-	-	-	-	5.8 -
Follow-up Hdwy	2.22	-	-	-	3.5 3.3
Pot Cap-1 Maneuver	668	-	-	-	80 509
Stage 1	-	-	-	-	316 -
Stage 2	-	-	-	-	447 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	668	-	-	-	57 509
Mov Cap-2 Maneuver	-	-	-	-	57 -
Stage 1	-	-	-	-	225 -
Stage 2	-	-	-	-	447 -

Approach	EB	WB	SB
HCM Control Delay, s	1.9	0	135.6
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	668	-	-	-	96
HCM Lane V/C Ratio	0.099	-	-	-	0.861
HCM Control Delay (s)	11	1.4	-	-	135.6
HCM Lane LOS	B	A	-	-	F
HCM 95th %tile Q(veh)	0.3	-	-	-	4.8

Intersection						
Int Delay, s/veh	1.1					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↑↑	
Traffic Vol, veh/h	7	1120	936	35	27	14
Future Vol, veh/h	7	1120	936	35	27	14
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	0	0
Mvmt Flow	8	1217	1017	38	29	15

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	1055	0	-	0	1661 528
Stage 1	-	-	-	-	1036 -
Stage 2	-	-	-	-	625 -
Critical Hdwy	4.14	-	-	-	6.8 6.9
Critical Hdwy Stg 1	-	-	-	-	5.8 -
Critical Hdwy Stg 2	-	-	-	-	5.8 -
Follow-up Hdwy	2.22	-	-	-	3.5 3.3
Pot Cap-1 Maneuver	656	-	-	-	90 500
Stage 1	-	-	-	-	308 -
Stage 2	-	-	-	-	501 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	656	-	-	-	87 500
Mov Cap-2 Maneuver	-	-	-	-	87 -
Stage 1	-	-	-	-	296 -
Stage 2	-	-	-	-	501 -

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	51.2
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	656	-	-	-	121
HCM Lane V/C Ratio	0.012	-	-	-	0.368
HCM Control Delay (s)	10.6	0.2	-	-	51.2
HCM Lane LOS	B	A	-	-	F
HCM 95th %tile Q(veh)	0	-	-	-	1.5