Memorandum

To: Mr. Philip Kroskin
Sunrise Senior Living
7902 Westpark Drive
McLean, VA 22102

Date: August 11, 2017

Project #: 13677.00

From: Randall Hart
Principal

Re: Response to Comments Memorandum
Sunrise Senior Living
Newton, Massachusetts

This memorandum has been prepared to respond to comments raised at the August 8, 2017 Land Use Committee Hearing in Newton City Hall by concerned residents. Regarding traffic associated with the redevelopment project, comments pertaining to appropriate traffic generation and credit for existing use onsite were raised by members of the public. To ensure that the Land Use Committee and concerned residents fully understand the analysis that was conducted in the March 2017 Traffic Impact Assessment (TIA), the following responses to the comments made have been prepared:

Traffic Generation

At the hearing a comment was made that the Proponents traffic assessment is not valid because of the Land Use Cod (LUC) from the Institute of Transportation Engineers (ITE) is not appropriate for the proposed use and may result in less traffic than what the project would generate in reality. As outlined in the project narrative:

Sunrise's approach to senior living is unique in that it caters to residents, as opposed to patients. That said, every resident has a dedicated care manager and each Sunrise community provides memory care services. Sunrise communities serve local needs as typically 70% of residents come from within five miles of a site. In terms of the elderly housing with services use, Newton is currently highly underserved.

After understanding the way that Sunrise operates their facilities, VHB evaluated the various Land Use Categories (LUC) that are available for these types of uses in the Institute of Transportation Engineers (ITE) Trip Generation Manual 9th Edition. Informed by the review there are four potential categories that could be considered:

- Continuing Care Retirement Community (LUC 255)
- Assisted Living (LUC 254)
- Congregate Care Facility (LUC 253)
- Senior Adult Housing (LUC 252)

After reviewing the descriptions of each use that ITE provides, it was apparent that application of Assisted Living (LUC 254) appeared to be the "best fit". This is primarily because the description suggests: *"Assisted living complexes are residential setting that provide either routine general protective oversight or assistance with activities necessary for independent living to mentally or physically limited persons. They commonly have separate living quarters for residents, and services include dining, housekeeping, social and physical activities, medication administration and transportation. Alzheimer's and ALS care are commonly offered by these facilities. Assisted care commonly bridges the gap between independent living and nursing homes."* The description for this use resembles the operations that Sunrise provide quite well.

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The commenter suggested that Senior Adult Housing may be a more appropriate application for this location. The ITE description for Senior Adult Housing (LUC 252) suggests: *Senior adult housing consists of attached independent living developments, age restricted housing and active adult communities. These developments may include limited social or recreational services. However, they generally lack centralized dining and onsite medical facilities. Residents in these communities live independently, are typically active (requiring little to no medical supervision) and may or may not be retired."* As you can see from the description, Senior Adult Housing is not a close fit to that being proposed at Sunrise which has centralized dining and onsite medical facilities. For the purpose of information, the ITE descriptions for all four related categories from the ITE Manual are included as an attachment to this memorandum.

While the Assisted Living LUC is the best fit category based on ITE, VHB has re-evaluated the traffic projections and intersection operations based on the Senior Adult Housing LUC, the results of which are provided below for informational purposes. Table 1 summarizes the projected trip generation associated with the proposed development based on the Assisted Living LUC and the Senior Adult Housing LUC.

Table 1 Project Trip Generation Summary

Time Period	Proposed Sunrise of Newton Trips based on Assisted Living LUC [b]	Proposed Sunrise of Newton Trips based on Senior Adult Housing LUC [b]	Change in Number of Trips
Weekday Daily			
Enter	167	192	+25
Exit	167	192	+25
Total	334	384	+50
Weekday Morning Peak Hour			
Enter	15	8	-7
Exit	7	16	+9
Total	22	24	+2
Weekday Evening Peak Hour			
Enter	18	17	-1
Exit	17	14	-3
Total	35	31	-4

a. Trip Generation estimate based ITE LUC 254 (Assisted Living) for 122 Occupied Beds.
b. Trip Generation estimate based ITE LUC 252 (Senior Adult Housing - Attached) for 122 Units.

As shown in Table 1, the proposed development based on the Senior Adult Housing LUC is estimated to generate approximately two additional site-generated trips (-7 entering/+9 exiting) compared to Assisted Living LUC during the weekday morning peak hour, and approximately four fewer site-generated trips (-1 entering/-3 exiting) compared to Assisted Living LUC during the weekday evening peak hour. The trip generation worksheet is included as an attachment to this memorandum.

Intersection capacity analyses were conducted at all intersections in the study area based on the revised trip generation. Analyses were conducted for the 2024 Build conditions and compared to the 2024 Build conditions presented in the TIA with the trip generation based on the Assisted Living LUC. Tables 2 and 3 summarize the capacity analyses for signalized and unsignalized intersections, respectively. The capacity analyses results are included as attachments to this memorandum.

Table 2 Signalized Intersection Capacity Analysis

Location / Movement	2024 Build Conditions based on Assisted Living LUC					2024 Build Conditions based on Senior Adult Housing LUC				
	v/c [a]	Del [b]	LOS [c]	50 Q [d]	95 Q [e]	v/c	Del	LOS	50 Q	95 Q
Washington Street at Church Street/ Site Driveway										
Weekday Morning										
EB L/T/R	0.78	19	B	203	#694	0.79	19	B	207	#703
WB L/T/R	1.120dl	25	C	129	#471	1.20dl	25	C	128	#468
NB L	0.74	32	C	127	280	0.74	36	D	127	280
NB T/R	0.13	8	A	0	29	0.13	8	A	0	29
SB L/T/R			n/a					n/a		
Overall		**23**	**C**				**23**	**C**		
Weekday Evening										
EB L/T/R	0.54	13	B	113	356	0.54	13	B	113	356
WB L/T/R	0.91	29	C	209	#668	0.91	29	C	209	#668
NB L	0.76	37	D	135	295	0.76	37	D	135	295
NB T/R	0.09	8	A	0	23	0.09	8	A	0	23
SB L/T/R			n/a					n/a		
Overall		**24**	**C**				**24**	**C**		

a Volume to capacity ratio.
b Average total delay, in seconds per vehicle.
c Level-of-service.
d 50th percentile queue, in feet.
e 95th percentile queue, in feet.
~ Volume exceeds capacity, queue is theoretically infinite.
# 95th percentile volume exceeds capacity, queue may be longer.
dl Defacto left lane.

Table 3 Unsignalized Intersection Capacity Analysis

Location / Movement	2024 Build Conditions based on Assisted Living LUC					2024 Build Conditions based on Senior Adult Housing LUC				
	D [a]	v/c [b]	Del [c]	LOS [d]	95 Q [e]	D	v/c	Del	LOS	95 Q
Washington Street at Jewett Street										
Weekday Morning										
EB L	145	0.25	13	B	25	145	0.25	13	B	25
Weekday Evening										
EB L	55	0.14	15	B	13	55	0.14	15	B	13
Washington Street at Hovey Street										
Weekday Morning										
EB L	75	0.11	10	B	10	75	0.11	10	B	10
SB L/R	50	0.24	26	D	23	50	0.24	26	D	23
Weekday Evening										
EB L	40	0.08	13	B	8	40	0.08	12	B	8
SB L/R	30	0.31	54	F	30	30	0.31	54	F	30
Hovey Street at Site Driveway/Walgreens Driveway										
Weekday Morning										
EB L/T/R	Neg.	0.00	0	A	0	Neg.	0.00	0	A	0
WB L/T/R	15	0.02	9	A	3	15	0.02	9	A	3
NB L			n/a					n/a		
SB L	5	0.00	8	A	0	5	0.00	8	A	0
Weekday Evening										
EB L/T/R	Neg.	0.00	0	A	0	Neg.	0.00	0	A	0
WB L/T/R	10	0.01	9	A	0	10	0.01	9	A	0
NB L			n/a					n/a		
SB L	5	0.00	7	A	0	5	0.00	7	A	0
Hovey Street at Waban Street										
Weekday Morning										
WB L	5	0.00	8	A	0	5	0.00	8	A	0
NB L/R	95	0.11	9	A	10	95	0.11	9	A	10
Weekday Evening										
WB L	10	0.01	7	A	0	10	0.01	7	A	0
NB L/R	55	0.06	9	A	5	55	0.06	9	A	5
Washington Street at Site Driveway										
Weekday Morning										
EB L	5	0.01	11	B	0	2	0.00	11	B	0
SB L/R	5	0.09	52	F	8	15	0.26	61	F	23
Weekday Evening										
EB L	5	0.01	13	B	0	5	0.01	13	B	0
SB L/R	20	0.35	92	F	33	20	0.35	92	F	33

a Demand.
b Volume to capacity ratio.
c Average total delay, in seconds per vehicle.
d Level-of-service.
e 95th percentile queue, in feet.
95th percentile volume exceeds capacity, queue may be longer.

As shown in Tables 2 and 3, all of the study area intersections are expected to operate at the same level-of-service with comparable delays and queues under the 2024 Build conditions when the trip generation is based on the Assisted Living LUC or the Senior Adult Housing LUC.

Credit for Existing Use On-site

At the hearing, there was a comment made that the analysis in the TIA is not appropriate because it relied on credit for the former use of the project, car dealership, based on ITE projections as the use was out of business at the time that the study was conducted. The comment further suggested that using straight ITE projections for a car dealership is not appropriate as the Clay Dealership stored many of their vehicles offsite. For the purposes of clarity, the section of the TIA (pages 21 and 22) pertaining to the former use and traffic projections is provided below in italics:

"Since the existing dealership closed shortly before our traffic counts were conducted, existing trip generation volumes could not be collected for the dealership. The number of vehicle trips generated by the existing dealership were estimated based on ITE land use code (LUC) 841 (Automobile Sales). Table 4 summarizes the estimated vehicle trips for the existing and future uses of the property.

Table 4 Potential Credit for By-Right Use

Time Period	Existing Dealership Trips [a]	Proposed Sunrise of Newton Trips [b]	Change in Trips
Weekday Daily			
Enter	633	167	-466
Exit	633	167	-466
Total	1,266	334	-932
Weekday Morning Peak Hour			
Enter	56	15	-41
Exit	19	7	-12
Total	75	22	-53
Weekday Evening Peak Hour			
Enter	40	18	-22
Exit	59	17	-42
Total	99	35	-64

a. Trip Generation estimate based ITE LUC 841 (Automobile Sales) for 39,160 sf.
b. Trip Generation estimate based ITE LUC 254 (Assisted Living) for 122 Occupied Beds.

As shown in Table 4, based on ITE trip generation estimates the proposed project is expected to result in a total of 932 fewer trips (-466 entering/-466 exiting) on a typical weekday. The proposed project is expected to result in a total of 53 fewer vehicle trips (-41 entering/-12 exiting) during the weekday morning peak hour, and 64 fewer vehicle trips (-22 entering/-42 exiting) during the weekday evening peak hour. The trip generation calculations are provided in the Attachments.

While the ITE trip generation estimates show a significant decrease in vehicular traffic associated with the project site, to present a highly conservative analysis no credit was taken associated with the former use.

As clearly stated in the TIA on page 22 (above in highlight), is the fact that the traffic projections for the existing use were provided for demonstration purposes to give the city an estimation of what the "change" in traffic could be between the former and proposed use. However, for estimating potential project impacts of the project, NO CREDIT for the former use was taken in the future condition traffic operational analysis. Therefore the operational results provided in the TIA are highly conservative.

Attachments

- ITE Land Use Descriptions
- Trip Generation Worksheets
- Capacity Analysis Worksheets

Land Use: 255
Continuing Care Retirement Community

Description

Continuing care retirement communities (CCRCs) are land uses that provide multiple elements of senior adult living. CCRCs combine aspects of independent living with increased care, as lifestyle needs change with time. Housing options may include various combinations of senior adult (detached), senior adult (attached), congregate care, assisted living and skilled nursing care—aimed at allowing the residents to live in one community as their medical needs change. The communities may also contain special services such as medical, dining, recreational and some limited, supporting retail facilities. CCRCs are usually self-contained villages. Senior adult housing—detached (Land Use 251), senior adult housing—attached (Land Use 252), congregate care facility (Land Use 253), assisted living (Land Use 254) and nursing home (Land Use 620) are related uses.

Additional Data

Caution should be used when applying these data. CCRCs are relatively new and unique land uses. These developments consist of various housing components (dwelling units, rooms and beds[1]) that often exist in varying proportions. Therefore, the use of a single housing component does not fully describe the trip generation characteristics of these communities. Based upon the limited data submitted for this land use, it was determined that a comprehensive independent variable, units, was the most appropriate descriptor of the characteristics. This variable is defined as an aggregate of all living accommodations common to these communities. The independent variable, occupied units, provides data on the number of units that were occupied at the study sites at the time of the survey.

To illustrate the varying proportions of housing options that exist, the following table is provided for nine of the CCRCs included in this land use as an example. Users are strongly cautioned to exercise proper engineering judgment in applying these data.

[1] Dwelling units, rooms and beds are the independent variables typically used to represent independent housing (detached/attached/congregate care), assisted living facilities and nursing homes, respectively. Occupied dwelling units/rooms may be private or shared accommodations.

Living Accommodations at CCRCs		
Occupied Dwelling Units/ Rooms[2]	Occupied Beds	Total Occupied Units
215	46	261
220	151	371
620	100	720
312	166	478
210	37	247
323	120[3]	443
233	121[3]	354
209	33	242
234	94	328

Peak hours of the generator—

The weekday A.M. peak hour varied between 9:00 a.m. and 12:00 p.m. The weekday P.M. peak hour varied between 12:00 p.m. and 4:00 p.m.

The sites were surveyed in the mid-1980s, the early 1990s and the 2000s in Connecticut, Illinois, Maryland, Pennsylvania and Virginia.

A complete study of CCRCs requires future analysis of their various components. Therefore, it is important to collect as much information as possible. At the very least, the total number of dwelling units, rooms and beds should be obtained; if possible, the number of corresponding occupied units should be recorded, as well.

Source Numbers

244, 253, 388, 501, 576, 713, 715

[2] Total number of combined dwelling units and rooms available within a community.

[3] For analysis purposes, an assumption was made that the total number of beds equaled the total number of occupied beds.

Land Use: 254
Assisted Living

Description

Assisted living complexes are residential settings that provide either routine general protective oversight or assistance with activities necessary for independent living to mentally or physically limited persons. They commonly have separate living quarters for residents, and services include dining, housekeeping, social and physical activities, medication administration and transportation. Alzheimer's and ALS care are commonly offered by these facilities, though the living quarters for these patients may be located separately from the other residents. Assisted care commonly bridges the gap between independent living and nursing homes. In some areas of the country, assisted living residences may be called personal care, residential care, or domiciliary care. Staff may be available at an assisted care facility 24 hours a day, but skilled medical care—which is limited in nature—is not required. Continuing care retirement community (Land Use 255) and nursing home (Land Use 620) are related uses.

Additional Data

The rooms in these facilities may be private or shared accommodations, consisting of either a single room or a small apartment-style unit with a kitchenette and living space.

One study reported that according to national and local data, less than 5 percent of the residents owned cars, which were rarely driven. Employees, visitors and delivery trucks make most of the trips to these facilities.

Truck traffic was captured for some studies in this land use and is presented in the following table. Although truck traffic was very low overall, most trips occurred during the mid-day period on a weekday.

The peak hour of the generator did not coincide with the peak hour of the adjacent street traffic for several sites included in this land use, primarily because of the shifts of the employees. For the data collected at those sites, shifts typically began at 7:00 a.m., 3:00 p.m. and 11:00 p.m. For all sites, the A.M. peak hour of the generator typically ranged from 6:00 a.m. to 9:00 a.m., while the P.M. peak hour of the generator typically ranged from 3:00 p.m. and 5:00 p.m.

Land Use: 254
Assisted Living

Time Period	% Trucks
Weekday Morning (6:30 a.m.–9:30 a.m.)	1
Weekday Mid-Day (11:00 a.m.–1:30 p.m.)	9
Weekday Evening (2:45 p.m.–6:45 p.m.)	2
Saturday Mid-Day (11:00 a.m.–2:00 p.m.)	4
Saturday Evening (3:00 p.m.–6:00 p.m.)	0
Sunday Mid-Day (11:00 a.m.–2:00 p.m.)	1
Sunday Evening (3:00 p.m.–6:00 p.m.)	0

The sites were surveyed in the late 1980s, the late 1990s and the 2000s in Connecticut, New Jersey, New York, Oregon, Pennsylvania and Tennessee.

Source Numbers

91, 244, 573, 581,611,725

Land Use: 253
Congregate Care Facility

Description

Congregate care facilities are independent living developments that provide centralized amenities such as dining, housekeeping, transportation and organized social/recreational activities. Limited medical services (such as nursing and dental) may or may not be provided. The resident may contract additional medical services or personal assistance. Senior adult housing—detached (Land Use 251), senior adult housing—attached (Land Use 252) and continuing care retirement community (Land Use 255) are related uses.

Additional Data

Vehicle ownership levels were very low at congregate care facilities; the facilities' employees or services provided to the residents generated the majority of the trips to the sites.

The peak hour of the generator typically did not coincide with the peak hour of the adjacent street traffic.

The sites were surveyed in the 1980s and the 2000s in Oregon.

Source Numbers

155, 584

Land Use: 252
Senior Adult Housing—Attached

Description

Senior adult housing consists of attached independent living developments, including retirement communities, age-restricted housing and active adult communities. These developments may include limited social or recreational services. However, they generally lack centralized dining and on-site medical facilities. Residents in these communities live independently, are typically active (requiring little to no medical supervision) and may or may not be retired. Senior adult housing—detached (Land Use 251), congregate care facility (Land Use 253) and continuing care retirement community (Land Use 255) are related uses.

Additional Data

The peak hour of the generator typically did not coincide with the peak hour of the adjacent street traffic. The A.M. peak hour of the generator typically ranged from 8:30 a.m. to 12:00 p.m. and the P.M. peak hour of the generator typically ranged from 1:00 p.m. to 6:00 p.m. **It should also be noted that in some cases, because of the limited sample size and variation in the data received, the projected trip generation estimate for the independent variable "dwelling units" exceeds the trip generation estimate for the independent variable "occupied dwelling units". By definition, this is impossible; therefore, knowledge of the project site and engineering judgment should be used to select the appropriate trip generation approximation.**

The sites were surveyed between the 1980s and the 2000s in California, Illinois, Maryland, New Hampshire, New Jersey, Pennsylvania and Canada.

Source Numbers

237, 272, 501, 576, 602, 703, 734, 741

ITE TRIP GENERATION WORKSHEET
(9th Edition, Updated 2012)

LANDUSE: Senior Adult Housing - Attached
LANDUSE CODE: 252 Independent Variable --- Dwelling Units

JOB NAME: **Sunrise Senior Living** **Dwelling Units** 122
JOB NUMBER: **13677.00**

WEEKDAY

RATES:			Total Trip Ends			Independent Variable Range			Directional Distribution	
	# Studies	R^2	Average	Low	High	Average	Low	High	Enter	Exit
DAILY	5	0.81	3.44	2.59	4.79	46	28	67	50%	50%
AM PEAK (ADJACENT ST)	10	0.98	0.20	0.06	0.27	138	28	680	34%	66%
PM PEAK (ADJACENT ST)	10	0.96	0.25	0.08	0.43	138	28	680	54%	46%

TRIPS:	BY AVERAGE			BY REGRESSION		
	Total	Enter	Exit	Total	Enter	Exit
DAILY	420	210	210	385	192	192
AM PEAK (ADJACENT ST)	24	8	16	24	8	16
PM PEAK (ADJACENT ST)	31	16	14	31	17	14

SATURDAY

RATES:			Total Trip Ends			Independent Variable Range			Directional Distribution	
	# Studies	R^2	Average	Low	High	Average	Low	High	Enter	Exit
DAILY	5	0.67	2.61	1.84	4.07	46	28	67	50%	50%
PEAK OF GENERATOR	6	1.00	0.31	0.23	0.43	63	28	150	57%	43%

TRIPS:	BY AVERAGE			BY REGRESSION		
	Total	Enter	Exit	Total	Enter	Exit
DAILY	318	159	159	281	140	140
PEAK OF GENERATOR	38	22	16	38	22	16

SUNDAY

RATES:			Total Trip Ends			Independent Variable Range			Directional Distribution	
	# Studies	R^2	Average	Low	High	Average	Low	High	Enter	Exit
DAILY	5	0.75	2.84	2.20	4.25	46	28	67	50%	50%
PEAK OF GENERATOR	5	0.63	0.41	0.27	0.55	46	28	67	50%	50%

TRIPS:	BY AVERAGE			BY REGRESSION		
	Total	Enter	Exit	Total	Enter	Exit
DAILY	346	173	173	304	152	152
PEAK OF GENERATOR	50	25	25	56	28	28

Intersection	
Int Delay, s/veh	3.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	145	1370	950	40	0	0
Future Vol, veh/h	145	1370	950	40	0	0
Conflicting Peds, #/hr	24	0	0	24	2	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, %	3	3	3	3	0	0
Mvmt Flow	158	1489	1033	43	0	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1100	0	-	0	-	562
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	4.16	-	-	-	-	6.9
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	2.23	-	-	-	-	3.3
Pot Cap-1 Maneuver	625	-	-	-	0	475
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	625	-	-	-	-	464
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	5.9	0	0
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	625	-	-	-	-
HCM Lane V/C Ratio	0.252	-	-	-	-
HCM Control Delay (s)	12.7	5.2	-	-	0
HCM Lane LOS	B	A	-	-	A
HCM 95th %tile Q(veh)	1	-	-	-	-

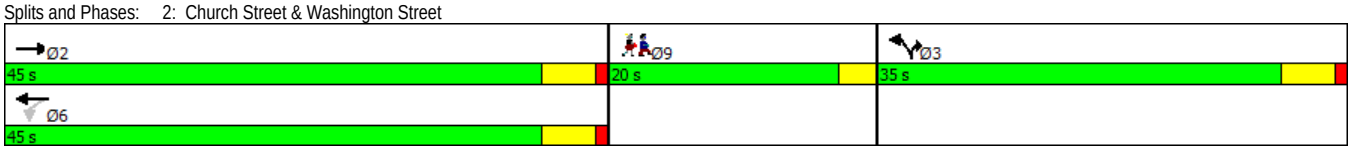
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	Ø9
Lane Configurations							
Traffic Volume (vph)	1020	365	110	685	310	55	
Future Volume (vph)	1020	365	110	685	310	55	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Storage Length (ft)		0	0		0	250	
Storage Lanes		0	0		1	1	
Taper Length (ft)			25		25		
Satd. Flow (prot)	3343	0	0	3480	1787	1599	
Flt Permitted				0.532	0.950		
Satd. Flow (perm)	3343	0	0	1865	1775	1599	
Right Turn on Red		Yes				Yes	
Satd. Flow (RTOR)	60					60	
Link Speed (mph)	30			30	30		
Link Distance (ft)	76			181	422		
Travel Time (s)	1.7			4.1	9.6		
Confl. Peds. (#/hr)		2	2		7	10	
Confl. Bikes (#/hr)		2					
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Heavy Vehicles (%)	3%	3%	3%	3%	1%	1%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	1506	0	0	865	337	60	
Turn Type	NA		Perm	NA	Prot	Prot	
Protected Phases	2			6	3	3	9
Permitted Phases			6				
Detector Phase	2		6	6	3	3	
Switch Phase							
Minimum Initial (s)	10.0		10.0	10.0	6.0	6.0	5.0
Minimum Split (s)	25.0		25.0	25.0	15.0	15.0	20.0
Total Split (s)	45.0		45.0	45.0	35.0	35.0	20.0
Total Split (%)	45.0%		45.0%	45.0%	35.0%	35.0%	20%
Yellow Time (s)	4.0		4.0	4.0	4.0	4.0	3.0
All-Red Time (s)	1.0		1.0	1.0	1.0	1.0	0.0
Lost Time Adjust (s)	0.0			0.0	0.0	0.0	
Total Lost Time (s)	5.0			5.0	5.0	5.0	
Lead/Lag							
Lead-Lag Optimize?							
Recall Mode	Max		Max	Max	None	None	None
Act Effct Green (s)	41.2			41.2	18.6	18.6	
Actuated g/C Ratio	0.56			0.56	0.25	0.25	
v/c Ratio	0.79			1.20dl	0.74	0.13	
Control Delay	19.0			24.9	36.1	7.5	
Queue Delay	0.0			0.0	0.0	0.0	
Total Delay	19.0			24.9	36.1	7.5	
LOS	B			C	D	A	
Approach Delay	19.0			24.9	31.8		
Approach LOS	B			C	C		
Queue Length 50th (ft)	207			128	127	0	
Queue Length 95th (ft)	#703			#468	280	29	
Internal Link Dist (ft)	1			101	342		
Turn Bay Length (ft)						250	
Base Capacity (vph)	1911			1051	755	710	
Starvation Cap Reductn	0			0	0	0	
Spillback Cap Reductn	0			0	0	0	
Storage Cap Reductn	0			0	0	0	
Reduced v/c Ratio	0.79			0.82	0.45	0.08	

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 73			
Natural Cycle: 90			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.82			
Intersection Signal Delay: 22.7		Intersection LOS: C	
Intersection Capacity Utilization 91.7%		ICU Level of Service F	
Analysis Period (min) 15			

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 2: Church Street & Washington Street



Intersection	
Int Delay, s/veh	1.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	75	1000	760	15	10	40
Future Vol, veh/h	75	1000	760	15	10	40
Conflicting Peds, #/hr	35	0	0	35	0	5
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, %	4	4	3	3	2	2
Mvmt Flow	82	1087	826	16	11	43

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	877	0	-	0	1576	461
Stage 1	-	-	-	-	869	-
Stage 2	-	-	-	-	707	-
Critical Hdwy	4.18	-	-	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	2.24	-	-	-	3.52	3.32
Pot Cap-1 Maneuver	753	-	-	-	100	547
Stage 1	-	-	-	-	371	-
Stage 2	-	-	-	-	450	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	749	-	-	-	68	526
Mov Cap-2 Maneuver	-	-	-	-	68	-
Stage 1	-	-	-	-	359	-
Stage 2	-	-	-	-	315	-

Approach	EB	WB	SB
HCM Control Delay, s	1.8	0	26.1
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	749	-	-	-	224
HCM Lane V/C Ratio	0.109	-	-	-	0.243
HCM Control Delay (s)	10.4	1.2	-	-	26.1
HCM Lane LOS	B	A	-	-	D
HCM 95th %tile Q(veh)	0.4	-	-	-	0.9

Intersection	
Int Delay, s/veh	1.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	5	10	85	5	5	45
Future Vol, veh/h	5	10	85	5	5	45
Conflicting Peds, #/hr	0	0	0	1	1	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	8	8	7	7	7	7
Mvmt Flow	5	11	92	5	5	49

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	156	96	0	0	99	0
Stage 1	96	-	-	-	-	-
Stage 2	60	-	-	-	-	-
Critical Hdwy	6.48	6.28	-	-	4.17	-
Critical Hdwy Stg 1	5.48	-	-	-	-	-
Critical Hdwy Stg 2	5.48	-	-	-	-	-
Follow-up Hdwy	3.572	3.372	-	-	2.263	-
Pot Cap-1 Maneuver	822	944	-	-	1463	-
Stage 1	913	-	-	-	-	-
Stage 2	948	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	818	943	-	-	1463	-
Mov Cap-2 Maneuver	818	-	-	-	-	-
Stage 1	912	-	-	-	-	-
Stage 2	944	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.1	0	0.7
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	897	1463	-
HCM Lane V/C Ratio	-	-	0.018	0.004	-
HCM Control Delay (s)	-	-	9.1	7.5	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0	-

Intersection	
Int Delay, s/veh	4.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	30	45	5	10	20	75
Future Vol, veh/h	30	45	5	10	20	75
Conflicting Peds, #/hr	0	8	8	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, %	3	3	7	7	6	6
Mvmt Flow	33	49	5	11	22	82

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	90	0	87	65
Stage 1	-	-	-	-	65	-
Stage 2	-	-	-	-	22	-
Critical Hdwy	-	-	4.17	-	6.46	6.26
Critical Hdwy Stg 1	-	-	-	-	5.46	-
Critical Hdwy Stg 2	-	-	-	-	5.46	-
Follow-up Hdwy	-	-	2.263	-	3.554	3.354
Pot Cap-1 Maneuver	-	-	1474	-	904	988
Stage 1	-	-	-	-	948	-
Stage 2	-	-	-	-	990	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1474	-	894	980
Mov Cap-2 Maneuver	-	-	-	-	894	-
Stage 1	-	-	-	-	941	-
Stage 2	-	-	-	-	987	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.5	9.2
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	961	-	-	1474	-
HCM Lane V/C Ratio	0.107	-	-	0.004	-
HCM Control Delay (s)	9.2	-	-	7.5	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.4	-	-	0	-

Intersection	
Int Delay, s/veh	0.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	2	1370	985	10	15	5
Future Vol, veh/h	2	1370	985	10	15	5
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, %	3	3	3	3	2	2
Mvmt Flow	2	1489	1071	11	16	5

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1082	0	-	0	1825	541
Stage 1	-	-	-	-	1076	-
Stage 2	-	-	-	-	749	-
Critical Hdwy	4.16	-	-	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	2.23	-	-	-	3.52	3.32
Pot Cap-1 Maneuver	635	-	-	-	68	485
Stage 1	-	-	-	-	289	-
Stage 2	-	-	-	-	428	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	635	-	-	-	67	485
Mov Cap-2 Maneuver	-	-	-	-	67	-
Stage 1	-	-	-	-	289	-
Stage 2	-	-	-	-	420	-

Approach	EB	WB	SB
HCM Control Delay, s	0.1	0	61.3
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	635	-	-	-	85
HCM Lane V/C Ratio	0.003	-	-	-	0.256
HCM Control Delay (s)	10.7	0.1	-	-	61.3
HCM Lane LOS	B	A	-	-	F
HCM 95th %tile Q(veh)	0	-	-	-	0.9

Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	55	950	1330	45	0	0
Future Vol, veh/h	55	950	1330	45	0	0
Conflicting Peds, #/hr	32	0	0	32	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	60	1033	1446	49	0	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1527	0	-	0	-	779
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	4.14	-	-	-	-	6.9
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	2.22	-	-	-	-	3.3
Pot Cap-1 Maneuver	432	-	-	-	0	343
Stage 1	-	-	-	-	0	-
Stage 2	-	-	-	-	0	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	432	-	-	-	-	333
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	2.8	0	0
HCM LOS			A

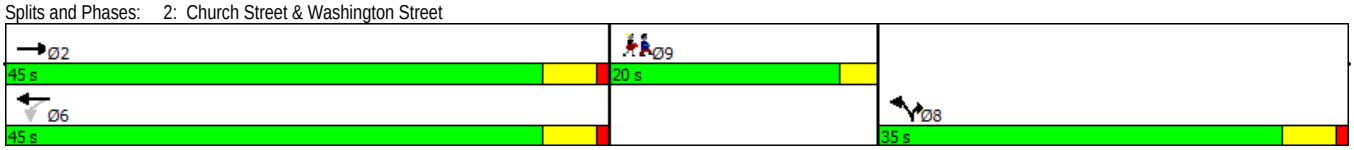
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	432	-	-	-	-
HCM Lane V/C Ratio	0.138	-	-	-	-
HCM Control Delay (s)	14.7	2.1	-	-	0
HCM Lane LOS	B	A	-	-	A
HCM 95th %tile Q(veh)	0.5	-	-	-	-

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	Ø9
Lane Configurations							
Traffic Volume (vph)	690	270	95	1060	325	35	
Future Volume (vph)	690	270	95	1060	325	35	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Storage Length (ft)		0	0		0	250	
Storage Lanes		0	0		1	1	
Taper Length (ft)			25		25		
Satd. Flow (prot)	3371	0	0	3525	1787	1599	
Flt Permitted				0.697	0.950		
Satd. Flow (perm)	3371	0	0	2467	1771	1599	
Right Turn on Red		Yes				Yes	
Satd. Flow (RTOR)	69					38	
Link Speed (mph)	30			30	30		
Link Distance (ft)	76			181	422		
Travel Time (s)	1.7			4.1	9.6		
Confl. Peds. (#/hr)					9	2	
Confl. Bikes (#/hr)		1					
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	1043	0	0	1255	353	38	
Turn Type	NA		Perm	NA	Prot	Prot	
Protected Phases	2			6	8	8	9
Permitted Phases			6				
Detector Phase	2		6	6	8	8	
Switch Phase							
Minimum Initial (s)	10.0		10.0	10.0	6.0	6.0	5.0
Minimum Split (s)	25.0		25.0	25.0	15.0	15.0	20.0
Total Split (s)	45.0		45.0	45.0	35.0	35.0	20.0
Total Split (%)	45.0%		45.0%	45.0%	35.0%	35.0%	20%
Yellow Time (s)	4.0		4.0	4.0	4.0	4.0	3.0
All-Red Time (s)	1.0		1.0	1.0	1.0	1.0	0.0
Lost Time Adjust (s)	0.0			0.0	0.0	0.0	
Total Lost Time (s)	5.0			5.0	5.0	5.0	
Lead/Lag							
Lead-Lag Optimize?							
Recall Mode	Min		Min	Min	None	None	None
Act Effct Green (s)	41.2			41.2	19.2	19.2	
Actuated g/C Ratio	0.56			0.56	0.26	0.26	
v/c Ratio	0.54			0.91	0.76	0.09	
Control Delay	13.4			29.1	36.9	8.4	
Queue Delay	0.0			0.0	0.0	0.0	
Total Delay	13.4			29.1	36.9	8.4	
LOS	B			C	D	A	
Approach Delay	13.4			29.1	34.1		
Approach LOS	B			C	C		
Queue Length 50th (ft)	113			209	135	0	
Queue Length 95th (ft)	356			#668	295	23	
Internal Link Dist (ft)	1			101	342		
Turn Bay Length (ft)						250	
Base Capacity (vph)	1915			1379	749	692	
Starvation Cap Reductn	0			0	0	0	
Spillback Cap Reductn	0			0	0	0	
Storage Cap Reductn	0			0	0	0	
Reduced v/c Ratio	0.54			0.91	0.47	0.05	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 73.6
Natural Cycle: 110
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 23.7 Intersection LOS: C
Intersection Capacity Utilization 90.3% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Church Street & Washington Street



Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	40	685	1140	10	15	15
Future Vol, veh/h	40	685	1140	10	15	15
Conflicting Peds, #/hr	52	0	0	52	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	43	745	1239	11	16	16

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1302	0	-	0	1756	677
Stage 1	-	-	-	-	1297	-
Stage 2	-	-	-	-	459	-
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	528	-	-	-	78	400
Stage 1	-	-	-	-	224	-
Stage 2	-	-	-	-	609	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	528	-	-	-	61	380
Mov Cap-2 Maneuver	-	-	-	-	61	-
Stage 1	-	-	-	-	213	-
Stage 2	-	-	-	-	498	-

Approach	EB	WB	SB
HCM Control Delay, s	1.4	0	54
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	528	-	-	-	105
HCM Lane V/C Ratio	0.082	-	-	-	0.311
HCM Control Delay (s)	12.4	0.8	-	-	54
HCM Lane LOS	B	A	-	-	F
HCM 95th %tile Q(veh)	0.3	-	-	-	1.2

Intersection	
Int Delay, s/veh	1.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	2	10	45	5	5	30
Future Vol, veh/h	2	10	45	5	5	30
Conflicting Peds, #/hr	0	0	0	1	1	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	2	11	49	5	5	33

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	96	53	0	0	55	0
Stage 1	53	-	-	-	-	-
Stage 2	43	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	908	1020	-	-	1563	-
Stage 1	975	-	-	-	-	-
Stage 2	985	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	904	1019	-	-	1563	-
Mov Cap-2 Maneuver	904	-	-	-	-	-
Stage 1	974	-	-	-	-	-
Stage 2	982	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.7	0	1
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	998	1563	-
HCM Lane V/C Ratio	-	-	0.013	0.003	-
HCM Control Delay (s)	-	-	8.7	7.3	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0	0	-

Intersection	
Int Delay, s/veh	5.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	5	25	10	10	15	40
Future Vol, veh/h	5	25	10	10	15	40
Conflicting Peds, #/hr	0	1	1	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, %	0	0	0	0	0	0
Mvmt Flow	5	27	11	11	16	43

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	34	0	53	20
Stage 1	-	-	-	-	20	-
Stage 2	-	-	-	-	33	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	1591	-	960	1064
Stage 1	-	-	-	-	1008	-
Stage 2	-	-	-	-	995	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1591	-	952	1063
Mov Cap-2 Maneuver	-	-	-	-	952	-
Stage 1	-	-	-	-	1007	-
Stage 2	-	-	-	-	988	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3.6	8.7
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	1030	-	-	1591	-
HCM Lane V/C Ratio	0.058	-	-	0.007	-
HCM Control Delay (s)	8.7	-	-	7.3	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.2	-	-	0	-

Intersection	
Int Delay, s/veh	0.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	5	945	1370	15	15	5
Future Vol, veh/h	5	945	1370	15	15	5
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	5	1027	1489	16	16	5

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1505	0	-	0	2021	753
Stage 1	-	-	-	-	1497	-
Stage 2	-	-	-	-	524	-
Critical Hdwy	4.14	-	-	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	2.22	-	-	-	3.52	3.32
Pot Cap-1 Maneuver	441	-	-	-	50	352
Stage 1	-	-	-	-	172	-
Stage 2	-	-	-	-	559	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	441	-	-	-	49	352
Mov Cap-2 Maneuver	-	-	-	-	49	-
Stage 1	-	-	-	-	172	-
Stage 2	-	-	-	-	544	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	91.6
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	441	-	-	-	62
HCM Lane V/C Ratio	0.012	-	-	-	0.351
HCM Control Delay (s)	13.3	0.2	-	-	91.6
HCM Lane LOS	B	A	-	-	F
HCM 95th %tile Q(veh)	0	-	-	-	1.3