

Mr. David R. Consigli
Chairman
Milford Zoning Board of Appeals
Town of Milford
52 Main Street
Milford, MA 01757

November 23, 2020

Ref. T0718.02

Re: The Residences at Stone Ridge Phase II
Response to Traffic Comments

Dear Mr. Consigli:

TEC offers this letter as a formal response to technical transportation related comments provided by the Town's peer reviewer, BSC Group in their letter to the Zoning Board of Appeals (ZBA) dated July 8, 2020.

The following is a summary of our responses to the traffic comments listed within each memorandum.

Transportation Peer Review, BSC Comments (July 8, 2020)

Trip Generation

- 1. BSC verified the trip generation for the apartment component of Phase I and concurs with the methodology and estimates. BSC also concurs that the mitigation implemented as part of Phase I will address the traffic impacts of the full build-out of Phase I. No additional mitigation is required as part of Phase I of the project*

TEC Response: Agreed.

- 2. BSC verified the trip generation for Phase II and concurs with the methodology and estimates. However, peak hour trip generation for office developments and residential uses have different directional characteristics. The current Phase II development program is estimated to generate 162 exiting trips during the weekday morning peak hour and 168 entering trips during the weekday evening peak hour. The directional peak hour trips exceed the Phase II threshold estimates by 102 exiting trips during the weekday morning peak hour and by 90 entering trips during the weekday evening peak hour. Based on these variations in peak hour directional flow, BSC recommends further evaluation of the impacts of the Phase II development. Our specific recommendations are presented in the following section.*

TEC Response: TEC's responses are presented below.

Phase II Improvements and Recommendations

3. *The nature of the Phase I and Phase II land uses have significantly changed since the issuance of the Section 61 findings. Although the total peak hour trip generation estimates are expected to be reduced under the current proposal when compared to the 2009 approved program, the directional peak hour trip generation estimates exhibit major differences that may have a material impact on traffic operations along the site driveway, at the intersection with Cedar Street, and at the I-495/Cedar Street interchange. The mitigation measures defined in the Section 61 Findings should be re-evaluated for their appropriateness. BSC recommends that the Proponent provide an updated traffic operations analysis, in accordance with MassDOT guidelines, based on the updated Phase II traffic volumes at the following intersections:*

- *Cedar Street/Deer Street*
- *Cedar Street/I-495 Northbound Ramps*
- *Cedar Street/I-495 Southbound Ramps*

TEC Response: TEC acknowledges that the peak hour trip distribution characteristics of the previously approved office building and the proposed residential development are different. However, the overall peak hour trip generation for the residential development continues to be significantly lower than the office buildings projected in Phase II. Further, the residential distribution of traffic allows for a better balance of traffic flow to and from Deer Street with the other commercial uses.

TEC has prepared traffic operations analysis for the three intersections above. Traffic counts conducted at Cedar Street / Deer Street in 2019 to obtain the current trip generation of the site were used as well as 2018 counts conducted at the intersections of Cedar Street with the Route 495 Ramps. The seasonal adjustment and background growth rates used within TEC's Phase I Technical Memorandum, dated March 12, 2018 were used to project the traffic volumes to a design year of 2027. The projected trips from Phase I were added to provide the No Build volumes. The distribution of the Phase II site generated traffic volumes was calculated based upon 2000 Census Journey-to-Work data to provide the Build volumes. This distribution was previously reviewed and approved. Figures 1 through 3 detail the No Build, Site Generated, and Build volumes calculated.

Capacity analyses were prepared for the No Build and Build conditions at the three intersections. The worksheets are attached. The results are summarized as follows:

- Cedar Street / Deer Street
The intersection does operate with a projected level of service F on the left turns exiting the site in the unsignalized condition during the weekday evening peak period with the Phase II residential development traffic. The projected queue length on this approach is one vehicle, which can be accommodated without restricting on-site circulation or restricting right turn exiting vehicles.

This level of service is common for unsignalized intersections. TEC notes that the capacity analysis model does not account for the gaps in traffic flow northbound along Cedar Street caused by the signalized I-495 northbound ramp intersection less than 1000 feet to the south, which will allow left turning vehicles to exit with reduced delays over those projected. Further, the site traffic generation and the background traffic growth rates are both conservative, indicating that the intersection may operate with better levels of service in the future should these volumes not be realized.

The installation of a traffic signal at the intersection was considered. The primary movements entering and exiting the site are to the south along Cedar Street toward I-495. The existing exclusive right turn lane along Deer Street and minimal delay would suggest removing these volumes from the traffic signal warrant analysis would be appropriate, per the *MUTCD*¹. The left turn movement volumes exiting the site do not meet signal warrant requirements.

- Cedar Street / I-495 NB Ramps

The intersection continues to operate with acceptable levels of service during the weekday morning and weekday evening peak periods with the Phase II residential traffic.

- Cedar Street / I-495 SB Ramps

This intersection operates with levels of service F on the eastbound Route I-495 Ramp approach movements during both peak hours in the No Build condition. The approach volumes exceed capacity. In this condition, the capacity analysis model typically will project unrealistic delays and queue lengths that are not actually observed or experienced at the intersection. Further, TEC notes that the capacity analysis model does not account for the gaps in traffic flow along Cedar Street caused by traffic signals located approximately 1000 feet to both the north and the south of this intersection, which will allow turning vehicles to exit the ramp with reduced delays over those projected. The levels of service F will continue with the addition of Phase II residential traffic volumes. The residential project has no identifiable impact on the operation of the intersection. TEC notes that the overall Phase II traffic volumes increase the volume of traffic through this intersection by 1.7% during the morning peak hour and 2.0% during the evening peak hour, which will not be noticeable as it is approximately one additional vehicle through the intersection each minute of the peak hour.

The installation of a traffic signal at the intersection was considered. The primary movement exiting the I-495 SB Ramp is the right turn movement, toward the south, with less than 10% of the vehicles using the ramp turning left during the peak hours. The existing channelized right turn lane along the

¹ *Manual of Uniform Traffic Control Devices*, 2009 Edition; Federal Highway Administration; 2009

SB Ramp approach would suggest that removing most if not all of these volumes from the traffic signal warrant analysis would be appropriate, per the *MUTCD*. Considering the left turn volumes exiting the ramp only, the intersection would not meet signal warrant requirements in the existing or future conditions.

4. *BSC recommends that the Proponent review the operations analysis and determine if additional or alternative mitigation is necessary at the above locations. The mitigation measures defined in the Section 61 Findings are currently over ten years old. Due to the change of the development program and potential changes in traffic patterns over the past ten years, the overall needs of the surrounding transportation network may have changed.*

TEC Response: Agreed. The Project will require a Notice of Project Change (NPC) with the MEPA office. Within that submission, the Applicant and TEC will discuss any changes necessary to the Section 61 Findings with MassDOT and the MEPA office.

5. *The intersection of Cedar Street/Dilla Street/Fortune Boulevard is listed as a Highway Safety Improvement Program (HSIP) high crash cluster. BSC recommends that the Proponent conduct a detailed crash analysis at this intersection using available crash records from the Milford Police Department. The crash analysis should identify any correctable safety issues and provide recommendations for improvement.*

TEC Response: Crash data for this intersection was compiled and analyzed for the most recent approximate three-year period (2017-present) on file with MassDOT, which were obtained from MassDOT Interactive Mapping Portal for Analysis and Crash Tracking (IMPACT) online database. The motor vehicle crash data was reviewed to determine crash trends at the intersection.

In addition to examining the number of crashes at the intersection, a crash rate was calculated to compare the occurrence of crashes to the volume of traffic passing through the intersection. The crash rate per million entering vehicles (MEV) was calculated using the weekday evening peak hour volumes from 2017 turning movement counts, a calculated K-factor obtained from 2017 ATR counts, and the total years of analyzed crash data. The crash rates at the study area intersections were compared to the statewide and district- wide averages published by MassDOT in June 2018 to determine the significance of the crash occurrence. The statewide average for signalized intersections is 0.78, and the District 3 average for signalized intersections is 0.89. This intersection has a crash rate of 2.02, well above the District 3 and statewide average.

A summary of the vehicle crash data and rates is provided in the following table. There is an average of 23 crashes per year recorded at the intersection. A total of 33% of the crashes are rear-end crashes, 30% are angled crashes, and 29% are sideswipe crashes. The number of rear-end crashes and angled crashes may indicate that the traffic signal clearance intervals, signal timings and/or signal phasing need to be revisited to meet the current demands at the intersection. The intersection should be studied in detail and a Road Safety Audit performed to identify recommendations for improvement. TEC notes that the Phase II residential project adds 31 vehicles through the intersection during the morning peak hour and 42 vehicles during the

evening peak hour, which will not be noticeable or measurably impact the operations of this intersection.

Crash Data Summary

<u>Parameter</u>		Dilla Street / Fortune Boulevard / Cedar Street
Year	2017	18
	2018	29
	<u>2019</u>	<u>22</u>
	TOTAL	69
Average Annual Crashes		23
Crash Rate		2.02
Manner of Crash	Angle	21
	Rear-end	23
	Single Vehicle	3
	Sideswipe	20
	Head-on	0
	Pedestrian / Cyclist	0
	<u>Other / Not Reported</u>	<u>2</u>
TOTAL		69
Road Surface Conditions	Dry	54
	Wet	9
	Snow / Ice	4
	<u>Other / Unknown</u>	<u>2</u>
TOTAL		69
Injury Status (Crash Severity)	Property Damage	56
	Non-Fatal Injury	10
	<u>Not Reported</u>	<u>3</u>
	TOTAL	69
Day of Week	Monday-Friday	52
	<u>Saturday-Sunday</u>	<u>17</u>
	TOTAL	69
Time of Day	6:00AM-9:00AM	10
	9:00AM-3:00PM	31
	3:00PM-6:00PM	13
	<u>6:00PM-6:00AM</u>	<u>15</u>
	TOTAL	69

6. *BSC recommends that the Proponent conduct a traffic monitoring study upon 85 percent occupancy of the Phase I residential units. The monitoring study should include 48-hour automatic traffic recorder (ATR) counts along Deer Street and weekday morning and evening peak hour turning movement counts (TMCs) at the following locations:*

- *Cedar Street/Deer Street*
- *Cedar Street/I-495 Northbound Ramps*
- *Cedar Street/I-495 Southbound Ramps*
- *Cedar Street/Dilla Street/Fortune Boulevard*
- *Cedar Street/East Main Street*
- *Dilla Street/Purchase Street*

TEC Response: The Applicant will commit to performing a monitoring study at the intersection of Cedar Street / Deer Street to confirm the trip generation projections for the residential units upon 85 percent occupancy of the Phase II units. This monitoring will include a 72-hour Automatic Traffic Recorded along Deer Street recorded mid-week as well as 12-hour manual turning movement counts at the intersection of Deer Street / Cedar Street on a typical weekday when school is in session to determine peak hour and daily traffic generated by Stone Ridge. Should the traffic volume generated by the site be lower than projected, further study of the remaining intersections would be unnecessary as these intersections were analyzed for the original Section 61 Finding under higher traffic generation conditions.

7. *BSC recommends that the Proponent use the results of the traffic monitoring study to determine the need for traffic signal timing, phasing, or geometric modifications at the signalized intersections and the need for traffic signal installation or other geometric modifications at the unsignalized intersections.*

TEC Response: Should the counted site generated trip generation be more than projected within the Phase II traffic analyses, prepared by TEC, dated March 16, 2020, a traffic signal warrant analysis at the intersection of Cedar Street and Deer Street will be performed.

Site Access

8. *Access to the project site is via Deer Street off Cedar Street. The provision of a singular access/egress to the proposed residential development is a concern. The Proponent should explore additional access options for emergency purposes.*

TEC Response: TEC acknowledges that access to the site is via Deer Street from Cedar Street. The Applicant has explored additional means of access. Given that the site is bounded by I-495 to the southwest and restricted conservation land to the northwest and east, there is no other means to provide alternative vehicular access. It should be noted that the Deer Street bridge crossing across the Charles River was built to the highest level of bridge design designated by FEMA. It should also be noted that the site has reserved a cleared area that can accommodate

an emergency helicopter landing. Each project located along the site has a dedicated driveway onto Deer Street and all buildings are provided 360-degree fire vehicle access. The site design provides sufficient emergency access to the site while remaining environmentally responsible. The Applicant will continue to ensure that Deer Street will remain accessible at all times.

We trust that the above information adequately addresses the comments regarding traffic for the Stone Ridge residential development in Milford. Please do not hesitate to contact me directly at (978) 794-1792 if you have any additional questions. Thank you for your consideration.

Sincerely,
TEC, Inc.
*"The **E**ngineering **C**orporation"*

A handwritten signature in blue ink that reads "Elizabeth Oldman".

Elizabeth Oldman, PE
Transportation Planning Services Director

Attachments

296 UNITS

Intersection Capacity and Queue Analysis Summary Cedar Street (Route 85) / Deer Street

Intersection / Lane Group	2027 No Build				2027 Build			
	V/C ^a	Delay ^b	LOS ^c	Queue ^d	V/C	Delay	LOS	Queue
Cedar Street (Route 85) / Deer Street								
<i>Weekday Morning Peak Period</i>								
Cedar Street NBL	0.003	8.1	A	<25	0.07	8.3	A	<25
Deer Street EBL	0.19	30.8	D	25	0.27	42.3	E	25
Deer Street EBR	0.16	11.5	B	<25	0.25	12.3	B	25
<i>Weekday Evening Peak Period</i>								
Cedar Street NBL	0.14	9.7	A	<25	0.22	10.2	B	<25
Deer Street EBL	0.17	37.6	E	<25	0.25	53.9	F	25
Deer Street EBR	0.18	14.6	B	<25	0.27	15.8	C	25

^a Volume-to-capacity ratio

^b Delay expressed in seconds per vehicle (average)

^c Level of service

^d 50th/95th Percentile Queue for signalized intersections

Intersection Capacity and Queue Analysis Summary Cedar Street (Route 85) / I-495 NB Ramps

Intersection / Lane Group	2027 No Build				2027 Build			
	V/C ^a	Delay ^b	LOS ^c	Queue ^d	V/C	Delay	LOS	Queue
Cedar Street (Route 85) / I-495 NB Ramps								
<i>Weekday Morning Peak Period</i>								
I-495 NB Off-ramp WBL	0.60	22.6	C	107/160	0.60	23.1	C	110/164
I-495 NB Off-ramp WBR	0.01	0.1	A	<25/<25	0.01	0.1	A	<25/<25
Cedar Street NBL	0.89	14.3	B	278/638	0.90	15.2	B	249/551
Cedar Street NBT	0.45	7.0	A	201/719	0.47	7.0	A	119/214
Cedar Street SB Approach	0.67	22.9	C	133/214	0.68	23.0	C	141/212
Overall Intersection	-	16.0	B	-	-	16.5	B	-
<i>Weekday Evening Peak Period</i>								
I-495 NB Off-ramp WBL	0.72	41.6	D	142/191	0.73	42.5	D	142/194
I-495 NB Off-ramp WBR	0.01	0.1	A	51/174	0.01	0.1	A	<25/<25
Cedar Street NBL	0.97	45.7	D	602/906	0.98	47.9	D	545/805
Cedar Street NBT	0.33	5.7	A	124/219	0.37	6.0	A	123/203
Cedar Street SB Approach	0.88	42.8	D	308/498	0.89	45.0	D	305/474
Overall Intersection	-	37.0	D	-	-	37.9	D	-

^a Volume-to-capacity ratio

^b Delay expressed in seconds per vehicle (average)

^c Level of service

^d 50th/95th Percentile Queue for signalized intersections

**Intersection Capacity and Queue Analysis Summary
Cedar Street (Route 85) / I-495 SB Ramps**

Intersection / Lane Group	2027 No Build				2027 Build			
	V/C ^a	Delay ^b	LOS ^c	Queue ^d	V/C	Delay	LOS	Queue
Cedar Street (Route 85) / I-495 SB Ramps								
<i>Weekday Morning Peak Period</i>								
Cedar Street SBL	0.29	13.4	B	25	0.32	13.8	B	50
I-495 SB Off-ramp EBL	1.29	exceed	F	100	>1.5	exceed	F	150
I-495 SB Off-ramp EBR	1.26	147.9	F	775	1.3	149.5	F	775
<i>Weekday Evening Peak Period</i>								
Cedar Street SBL	0.55	18.1	C	75	0.56	19.2	C	100
I-495 SB Off-ramp EBL	>1.5	exceed	F	exceed	>1.5	exceed	F	exceed
I-495 SB Off-ramp EBR	1.37	200.7	F	850	1.39	207.4	F	850

^a Volume-to-capacity ratio

^b Delay expressed in seconds per vehicle (average)

^c Level of service

^d 95th Percentile Queue for unsignalized intersections

Attachments

Traffic Volume Figures

Capacity Analyses Worksheets (296 Units)

Crash Data

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Not to Scale

Cedar Street (Route 85) / I-495 Ramps - Milford, Massachusetts

TIA Response to Comments (RTC)

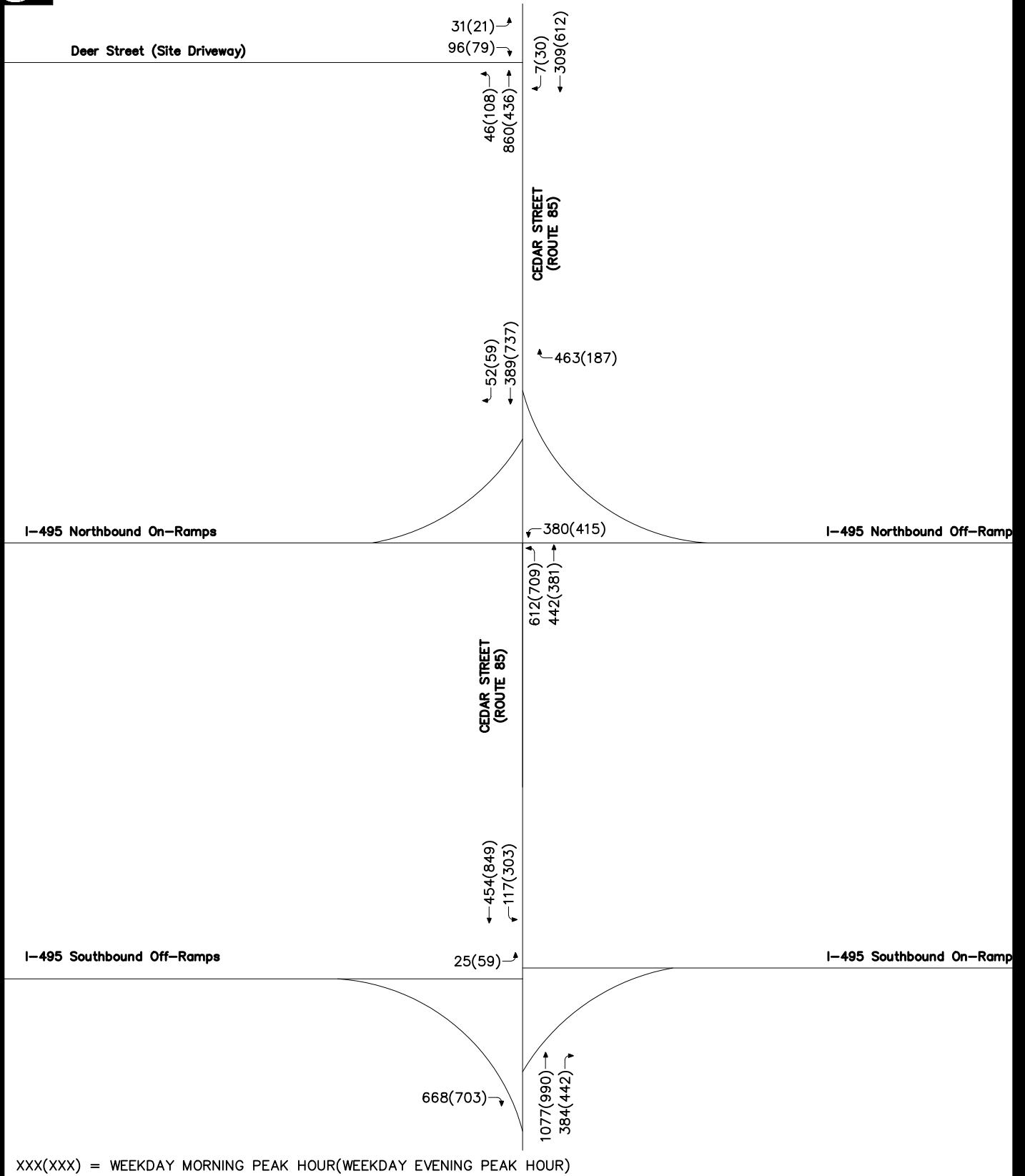


Figure 1



No Build
Weekday Morning, and
Weekday Evening
Peak Hour Traffic Volumes

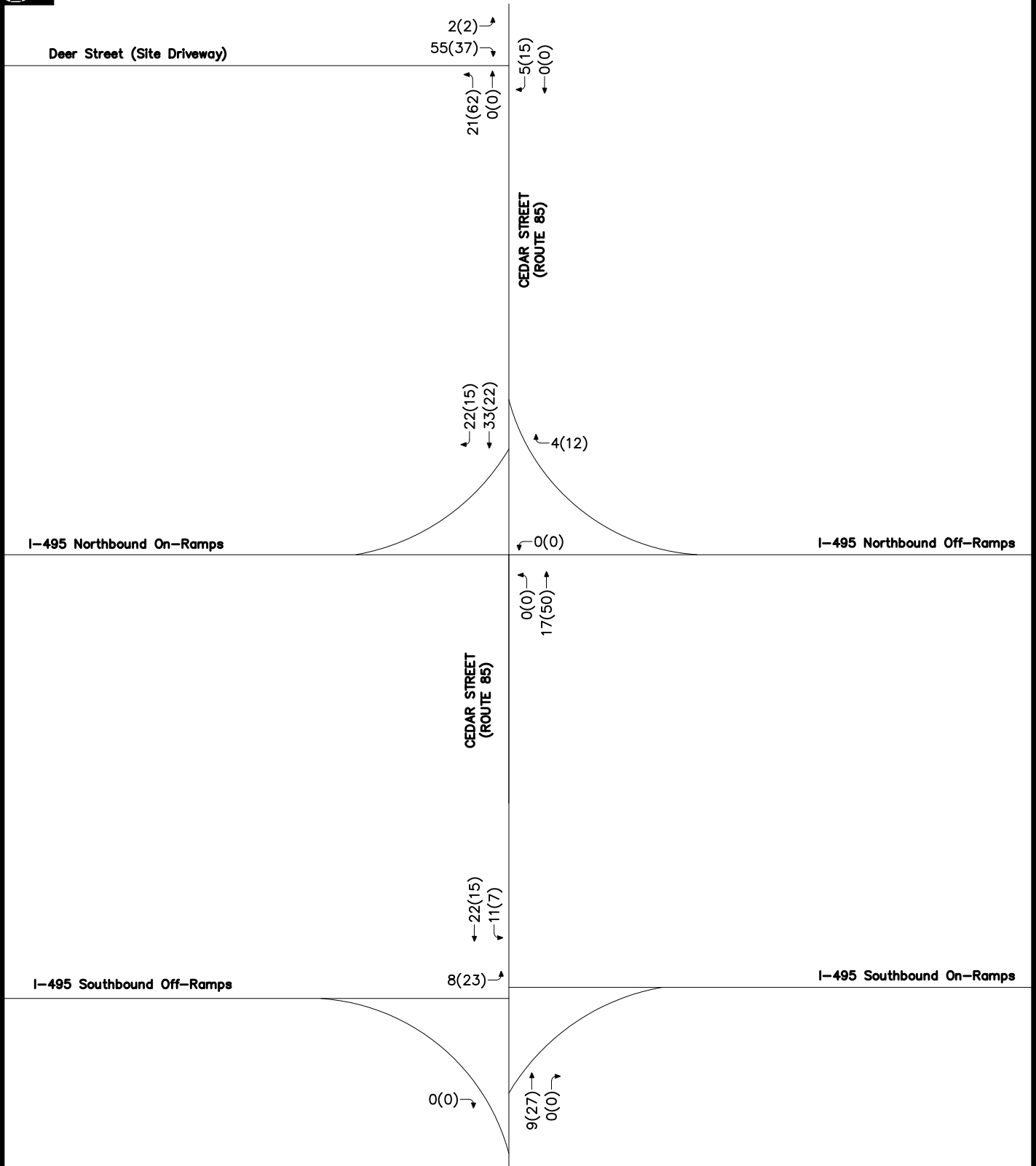
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Not to Scale

Cedar Street (Route 85) / I-495 Ramps - Milford, Massachusetts

TIA Response to Comments (RTC)



XXX(XXX) = WEEKDAY MORNING PEAK HOUR(WEEKDAY EVENING PEAK HOUR)

Figure 2



Site Generated 296 Units
Weekday Morning, and
Weekday Evening
Peak Hour Traffic Volumes

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Not to Scale

Cedar Street (Route 85) / I-495 Ramps - Milford, Massachusetts

TIA Response to Comments (RTC)

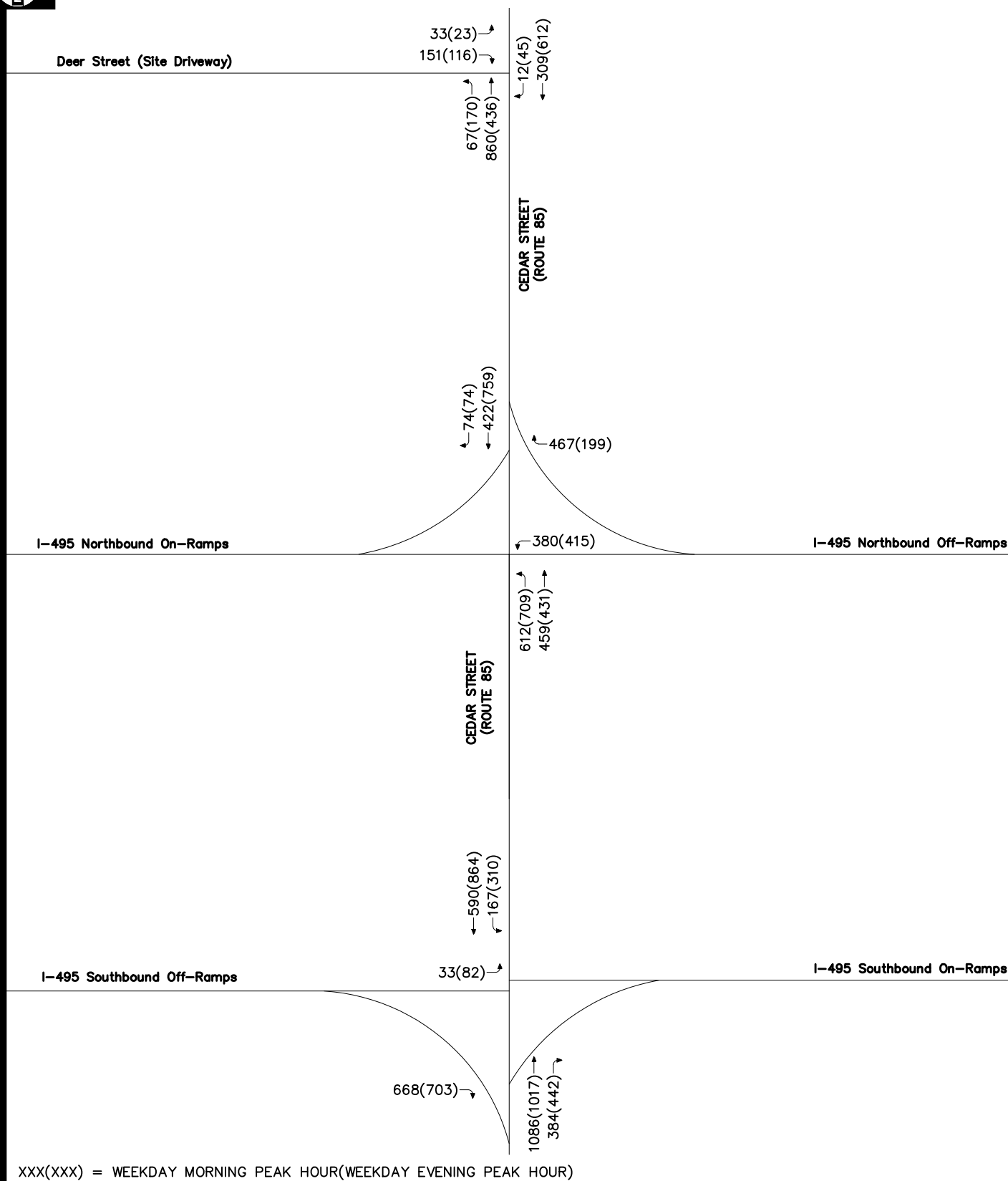


Figure 3



Build Conditions 296 Units
Weekday Morning, and
Weekday Evening
Peak Hour Traffic Volumes

Lanes, Volumes, Timings
1: Cedar Street (Route 85) & Deer Street (Site Driveway)

2027 No-Build Conditions

Timing Plan: Weekday AM

						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	31	96	3	860	309	7
Future Volume (vph)	31	96	3	860	309	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	300			0
Storage Lanes	1	1	1			0
Taper Length (ft)	25		25			
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			469	467	
Travel Time (s)	7.3			10.7	10.6	
Peak Hour Factor	0.94	0.94	0.88	0.88	0.91	0.91
Heavy Vehicles (%)	0%	23%	9%	2%	4%	0%
Shared Lane Traffic (%)						
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

HCM 2010 TWSC
1: Cedar Street (Route 85) & Deer Street (Site Driveway)

2027 No-Build Conditions
Timing Plan: Weekday AM

Intersection

Int Delay, s/veh 1.5

Movement EBL EBR NBL NBT SBT SBR

Lane Configurations						
Traffic Vol, veh/h	31	96	3	860	309	7
Future Vol, veh/h	31	96	3	860	309	7
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	300	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	88	88	91	91
Heavy Vehicles, %	0	23	9	2	4	0
Mvmt Flow	33	102	3	977	340	8

Major/Minor Minor2 Major1 Major2

Conflicting Flow All	1327	344	348	0	-	0
Stage 1	344	-	-	-	-	-
Stage 2	983	-	-	-	-	-
Critical Hdwy	6.4	6.43	4.19	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.507	2.281	-	-	-
Pot Cap-1 Maneuver	173	654	1173	-	-	-
Stage 1	722	-	-	-	-	-
Stage 2	366	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	172	654	1173	-	-	-
Mov Cap-2 Maneuver	172	-	-	-	-	-
Stage 1	720	-	-	-	-	-
Stage 2	366	-	-	-	-	-

Approach EB NB SB

HCM Control Delay, s	16.2	0	0
HCM LOS	C		

Minor Lane/Major Mvmt NBL NBT EBLn1 EBLn2 SBT SBR

Capacity (veh/h)	1173	-	172	654	-	-
HCM Lane V/C Ratio	0.003	-	0.192	0.156	-	-
HCM Control Delay (s)	8.1	-	30.8	11.5	-	-
HCM Lane LOS	A	-	D	B	-	-
HCM 95th %tile Q(veh)	0	-	0.7	0.6	-	-

Lanes, Volumes, Timings
2: Cedar Street (Route 85) & I-495 Northbound Ramps

2027 No-Build Conditions

Timing Plan: Weekday AM

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	380	0	463	612	442	0	0	389	52
Future Volume (vph)	0	0	0	380	0	463	612	442	0	0	389	52
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	350		0	0		0
Storage Lanes	0		0	2		1	1		0	0		0
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		300			300			799			486	
Travel Time (s)		6.8			6.8			18.2			11.0	
Confl. Peds. (#/hr)			2									
Confl. Bikes (#/hr)			3									
Peak Hour Factor	0.95	0.95	0.95	0.87	0.87	0.87	0.88	0.88	0.88	0.91	0.91	0.91
Heavy Vehicles (%)	0%	0%	0%	1%	0%	2%	7%	0%	0%	0%	1%	0%
Shared Lane Traffic (%)												
Turn Type				Prot		Perm	pm+pt	NA			NA	
Protected Phases				4			1	6			2	
Permitted Phases						4	6					
Detector Phase				4		4	1	6			2	
Switch Phase												
Minimum Initial (s)				6.0		6.0	6.0	10.0			10.0	
Minimum Split (s)				12.0		12.0	9.0	16.0			16.0	
Total Split (s)				41.0		41.0	38.0	79.0			41.0	
Total Split (%)				34.2%		34.2%	31.7%	65.8%			34.2%	
Maximum Green (s)				35.0		35.0	35.0	73.0			35.0	
Yellow Time (s)				3.0		3.0	3.0	3.0			3.0	
All-Red Time (s)				3.0		3.0	0.0	3.0			3.0	
Lost Time Adjust (s)				0.0		0.0	0.0	0.0			0.0	
Total Lost Time (s)				6.0		6.0	3.0	6.0			6.0	
Lead/Lag							Lead				Lag	
Lead-Lag Optimize?							Yes				Yes	
Vehicle Extension (s)				5.0		5.0	2.0	2.0			2.0	
Recall Mode				None		None	None	Min			Min	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 91.5
Natural Cycle: 65
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Cedar Street (Route 85) & I-495 Northbound Ramps

 Ø1	 Ø2	 Ø4
38 s	41 s	41 s
 Ø6		
79 s		

Queues
2: Cedar Street (Route 85) & I-495 Northbound Ramps

2027 No-Build Conditions
Timing Plan: Weekday AM

					
Lane Group	WBL	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	437	532	695	502	484
v/c Ratio	0.48	0.77	0.91	0.44	0.73
Control Delay	30.5	17.6	36.0	12.2	41.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	30.5	17.6	36.0	12.2	41.9
Queue Length 50th (ft)	108	76	278	138	133
Queue Length 95th (ft)	161	199	#638	267	214
Internal Link Dist (ft)				719	406
Turn Bay Length (ft)			350		
Base Capacity (vph)	1348	844	770	1541	1374
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.32	0.63	0.90	0.33	0.35

Intersection Summary

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

HCM 2010 Signalized Intersection Summary

2: Cedar Street (Route 85) & I-495 Northbound Ramps

2027 No-Build Conditions

Timing Plan: Weekday AM

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	380	0	463	612	442	0	0	389	52
Future Volume (veh/h)	0	0	0	380	0	463	612	442	0	0	389	52
Number				7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				1881	0	1863	1776	1900	0	0	1883	1900
Adj Flow Rate, veh/h				437	0	0	695	502	0	0	427	0
Adj No. of Lanes				2	0	1	1	1	0	0	2	0
Peak Hour Factor				0.87	0.87	0.87	0.88	0.88	0.88	0.91	0.91	0.91
Percent Heavy Veh, %				1	0	2	7	0	0	0	1	1
Cap, veh/h				732	0	333	785	1111	0	0	639	0
Arrive On Green				0.21	0.00	0.00	0.36	0.58	0.00	0.00	0.18	0.00
Sat Flow, veh/h				3476	0	1583	1691	1900	0	0	3767	0
Grp Volume(v), veh/h				437	0	0	695	502	0	0	427	0
Grp Sat Flow(s),veh/h/ln				1738	0	1583	1691	1900	0	0	1789	0
Q Serve(g_s), s				6.7	0.0	0.0	17.7	8.7	0.0	0.0	6.5	0.0
Cycle Q Clear(g_c), s				6.7	0.0	0.0	17.7	8.7	0.0	0.0	6.5	0.0
Prop In Lane				1.00		1.00	1.00		0.00	0.00		0.00
Lane Grp Cap(c), veh/h				732	0	333	785	1111	0	0	639	0
V/C Ratio(X)				0.60	0.00	0.00	0.89	0.45	0.00	0.00	0.67	0.00
Avail Cap(c_a), veh/h				2076	0	946	1194	2367	0	0	2137	0
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh				20.9	0.0	0.0	10.4	6.9	0.0	0.0	22.5	0.0
Incr Delay (d2), s/veh				1.7	0.0	0.0	3.8	0.1	0.0	0.0	0.5	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				3.3	0.0	0.0	8.7	4.5	0.0	0.0	3.2	0.0
LnGrp Delay(d),s/veh				22.6	0.0	0.0	14.3	7.0	0.0	0.0	22.9	0.0
LnGrp LOS				C			B	A			C	
Approach Vol, veh/h					437			1197			427	
Approach Delay, s/veh					22.6			11.2			22.9	
Approach LOS					C			B			C	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2		4		6						
Phs Duration (G+Y+Rc), s	23.8	16.5		18.3		40.3						
Change Period (Y+Rc), s	3.0	6.0		6.0		6.0						
Max Green Setting (Gmax), s	35.0	35.0		35.0		73.0						
Max Q Clear Time (g_c+I1), s	19.7	8.5		8.7		10.7						
Green Ext Time (p_c), s	1.1	1.9		3.7		2.2						
Intersection Summary												
HCM 2010 Ctrl Delay				16.0								
HCM 2010 LOS				B								

Lanes, Volumes, Timings

2027 No-Build Conditions

8: Cedar Street (Route 85) & I-495 SB Ramp /I-495 SB Ramp

Timing Plan: Weekday AM

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											 	
Traffic Volume (vph)	25	0	668	0	0	0	0	1077	384	156	586	0
Future Volume (vph)	25	0	668	0	0	0	0	1077	384	156	586	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		297			406			324			799	
Travel Time (s)		6.8			9.2			7.4			18.2	
Peak Hour Factor	0.81	0.81	0.81	0.94	0.94	0.94	0.93	0.93	0.93	0.87	0.87	0.87
Heavy Vehicles (%)	0%	0%	3%	0%	0%	0%	0%	3%	2%	1%	2%	0%
Shared Lane Traffic (%)												
Sign Control		Stop			Free			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection

Int Delay, s/veh 43.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	25	0	668	0	0	0	0	1077	384	156	586	0
Future Vol, veh/h	25	0	668	0	0	0	0	1077	384	156	586	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	Yield	-	-	Yield	-	-	None
Storage Length	0	-	0	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	16979	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	81	81	81	94	94	94	93	93	93	87	87	87
Heavy Vehicles, %	0	0	3	0	0	0	0	3	2	1	2	0
Mvmt Flow	31	0	825	0	0	0	0	1158	413	179	674	0

Major/Minor	Minor2		Major1		Major2		
Conflicting Flow All	2190	-	337	-	0	0	1158
Stage 1	1032	-	-	-	-	-	-
Stage 2	1158	-	-	-	-	-	-
Critical Hdwy	6.6	-	6.945	-	-	-	4.115
Critical Hdwy Stg 1	5.8	-	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-	-
Follow-up Hdwy	3.5	-	3.3285	-	-	-	2.2095
Pot Cap-1 Maneuver	45	0	~ 657	0	-	-	606
Stage 1	309	0	-	0	-	-	-
Stage 2	302	0	-	0	-	-	-
Platoon blocked, %					-	-	-
Mov Cap-1 Maneuver	~ 24	0	~ 657	-	-	-	606
Mov Cap-2 Maneuver	~ 24	0	-	-	-	-	-
Stage 1	309	0	-	-	-	-	-
Stage 2	159	0	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	161.4	0	4.5
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	EBLn1	EBLn2	SBL	SBT
Capacity (veh/h)	-	-	24	657	606	-
HCM Lane V/C Ratio	-	-	1.286	1.255	0.296	-
HCM Control Delay (s)	-	-	\$ 520.9	147.9	13.4	2.1
HCM Lane LOS	-	-	F	F	B	A
HCM 95th %tile Q(veh)	-	-	3.9	31	1.2	-

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lanes, Volumes, Timings
1: Cedar Street (Route 85) & Deer Street (Site Driveway)

2027 No-Build Conditions
Timing Plan: Weekday PM

						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	21	79	108	436	612	30
Future Volume (vph)	21	79	108	436	612	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	300			0
Storage Lanes	1	1	1			0
Taper Length (ft)	25		25			
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			469	467	
Travel Time (s)	7.3			10.7	10.6	
Peak Hour Factor	0.96	0.96	0.87	0.87	0.94	0.94
Heavy Vehicles (%)	0%	3%	5%	1%	1%	0%
Shared Lane Traffic (%)						
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized

HCM 2010 TWSC
1: Cedar Street (Route 85) & Deer Street (Site Driveway)

2027 No-Build Conditions
Timing Plan: Weekday PM

Intersection

Int Delay, s/veh 2.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
----------	-----	-----	-----	-----	-----	-----

Lane Configurations						
Traffic Vol, veh/h	21	79	108	436	612	30
Future Vol, veh/h	21	79	108	436	612	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	300	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	87	87	94	94
Heavy Vehicles, %	0	3	5	1	1	0
Mvmt Flow	22	82	124	501	651	32

Major/Minor	Minor2	Major1	Major2
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Conflicting Flow All	1416	667	683	0	-	0
Stage 1	667	-	-	-	-	-
Stage 2	749	-	-	-	-	-
Critical Hdwy	6.4	6.23	4.15	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.327	2.245	-	-	-
Pot Cap-1 Maneuver	153	457	896	-	-	-
Stage 1	514	-	-	-	-	-
Stage 2	471	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	132	457	896	-	-	-
Mov Cap-2 Maneuver	132	-	-	-	-	-
Stage 1	443	-	-	-	-	-
Stage 2	471	-	-	-	-	-

Approach	EB	NB	SB
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HCM Control Delay, s	19.4	1.9	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
-----------------------	-----	-----	-------	-------	-----	-----

Capacity (veh/h)	896	-	132	457	-	-
HCM Lane V/C Ratio	0.139	-	0.166	0.18	-	-
HCM Control Delay (s)	9.7	-	37.6	14.6	-	-
HCM Lane LOS	A	-	E	B	-	-
HCM 95th %tile Q(veh)	0.5	-	0.6	0.7	-	-

Lanes, Volumes, Timings

2: Cedar Street (Route 85) & I-495 Northbound Ramps

2027 No-Build Conditions

Timing Plan: Weekday PM

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations				 		 	 	 			  	
Traffic Volume (vph)	0	0	0	415	0	487	709	381	0	0	737	59
Future Volume (vph)	0	0	0	415	0	487	709	381	0	0	737	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	350		0	0		0
Storage Lanes	0		0	2		1	1		0	0		0
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		300			300			799			486	
Travel Time (s)		6.8			6.8			18.2			11.0	
Confl. Peds. (#/hr)			2									
Confl. Bikes (#/hr)			3									
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.87	0.87	0.87	0.94	0.94	0.94
Heavy Vehicles (%)	0%	0%	0%	1%	0%	2%	3%	1%	0%	0%	2%	0%
Shared Lane Traffic (%)												
Turn Type				Prot		Perm	pm+pt	NA			NA	
Protected Phases				4			1	6			2	
Permitted Phases						4	6					
Detector Phase				4		4	1	6			2	
Switch Phase												
Minimum Initial (s)				6.0		6.0	6.0	10.0			10.0	
Minimum Split (s)				12.0		12.0	9.0	16.0			16.0	
Total Split (s)				41.0		41.0	45.0	79.0			34.0	
Total Split (%)				34.2%		34.2%	37.5%	65.8%			28.3%	
Maximum Green (s)				35.0		35.0	42.0	73.0			28.0	
Yellow Time (s)				3.0		3.0	3.0	3.0			3.0	
All-Red Time (s)				3.0		3.0	0.0	3.0			3.0	
Lost Time Adjust (s)				0.0		0.0	0.0	0.0			0.0	
Total Lost Time (s)				6.0		6.0	3.0	6.0			6.0	
Lead/Lag							Lead				Lag	
Lead-Lag Optimize?							Yes				Yes	
Vehicle Extension (s)				5.0		5.0	2.0	2.0			2.0	
Recall Mode				None		None	None	Min			Min	

Intersection Summary

Area Type: Other
 Cycle Length: 120
 Actuated Cycle Length: 110.5
 Natural Cycle: 80
 Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Cedar Street (Route 85) & I-495 Northbound Ramps

 Ø1	 Ø2	 Ø4
45 s	34 s	41 s
 Ø6		
79 s		

Queues
2: Cedar Street (Route 85) & I-495 Northbound Ramps

2027 No-Build Conditions

Timing Plan: Weekday PM

					
Lane Group	WBL	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	441	518	815	438	847
v/c Ratio	0.56	0.75	1.10	0.35	0.95
Control Delay	40.2	14.5	91.6	10.0	60.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	40.2	14.5	91.6	10.0	60.8
Queue Length 50th (ft)	142	51	~602	124	308
Queue Length 95th (ft)	191	174	#906	219	#498
Internal Link Dist (ft)				719	406
Turn Bay Length (ft)			350		
Base Capacity (vph)	1101	797	741	1246	895
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.40	0.65	1.10	0.35	0.95

Intersection Summary

- ~ 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.

HCM 2010 Signalized Intersection Summary

2: Cedar Street (Route 85) & I-495 Northbound Ramps

2027 No-Build Conditions

Timing Plan: Weekday PM

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	415	0	487	709	381	0	0	737	59
Future Volume (veh/h)	0	0	0	415	0	487	709	381	0	0	737	59
Number				7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				1881	0	1863	1845	1881	0	0	1865	1900
Adj Flow Rate, veh/h				441	0	0	815	438	0	0	784	0
Adj No. of Lanes				2	0	1	1	1	0	0	2	0
Peak Hour Factor				0.94	0.94	0.94	0.87	0.87	0.87	0.94	0.94	0.94
Percent Heavy Veh, %				1	0	2	3	1	0	0	2	2
Cap, veh/h				611	0	278	837	1320	0	0	892	0
Arrive On Green				0.18	0.00	0.00	0.42	0.70	0.00	0.00	0.25	0.00
Sat Flow, veh/h				3476	0	1583	1757	1881	0	0	3731	0
Grp Volume(v), veh/h				441	0	0	815	438	0	0	784	0
Grp Sat Flow(s),veh/h/ln				1738	0	1583	1757	1881	0	0	1772	0
Q Serve(g_s), s				11.7	0.0	0.0	38.8	8.9	0.0	0.0	20.8	0.0
Cycle Q Clear(g_c), s				11.7	0.0	0.0	38.8	8.9	0.0	0.0	20.8	0.0
Prop In Lane				1.00		1.00	1.00		0.00	0.00		0.00
Lane Grp Cap(c), veh/h				611	0	278	837	1320	0	0	892	0
V/C Ratio(X)				0.72	0.00	0.00	0.97	0.33	0.00	0.00	0.88	0.00
Avail Cap(c_a), veh/h				1242	0	566	853	1402	0	0	1013	0
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh				38.1	0.0	0.0	21.6	5.7	0.0	0.0	35.2	0.0
Incr Delay (d2), s/veh				3.4	0.0	0.0	24.1	0.1	0.0	0.0	7.5	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				5.9	0.0	0.0	26.9	4.5	0.0	0.0	11.1	0.0
LnGrp Delay(d),s/veh				41.6	0.0	0.0	45.7	5.7	0.0	0.0	42.8	0.0
LnGrp LOS				D			D	A			D	
Approach Vol, veh/h					441			1253			784	
Approach Delay, s/veh					41.6			31.7			42.8	
Approach LOS					D			C			D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2		4		6						
Phs Duration (G+Y+Rc), s	44.1	30.6		23.2		74.7						
Change Period (Y+Rc), s	3.0	6.0		6.0		6.0						
Max Green Setting (Gmax), s	42.0	28.0		35.0		73.0						
Max Q Clear Time (g_c+I1), s	40.8	22.8		13.7		10.9						
Green Ext Time (p_c), s	0.3	1.8		3.5		1.9						
Intersection Summary												
HCM 2010 Ctrl Delay				37.0								
HCM 2010 LOS				D								

Lanes, Volumes, Timings

2027 No-Build Conditions

8: Cedar Street (Route 85) & I-495 SB Ramp /I-495 SB Ramp

Timing Plan: Weekday PM

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											  	
Traffic Volume (vph)	59	0	703	0	0	0	0	990	442	303	849	0
Future Volume (vph)	59	0	703	0	0	0	0	990	442	303	849	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		297			406			324			799	
Travel Time (s)		6.8			9.2			7.4			18.2	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.86	0.86	0.86	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	3%	0%	0%	0%	0%	2%	2%	3%	1%	0%
Shared Lane Traffic (%)												
Sign Control		Stop			Free			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

HCM 2010 TWSC
8: Cedar Street (Route 85) & I-495 SB Ramp /I-495 SB Ramp

2027 No-Build Conditions

Timing Plan: Weekday PM

Intersection

Int Delay, s/veh 2.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	59	0	703	0	0	0	0	990	442	303	849	0
Future Vol, veh/h	59	0	703	0	0	0	0	990	442	303	849	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	Yield	-	-	Yield	-	-	None
Storage Length	0	-	0	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	16979	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	86	86	86	92	92	92
Heavy Vehicles, %	0	0	3	0	0	0	0	2	2	3	1	0
Mvmt Flow	63	0	748	0	0	0	0	1151	514	329	923	0

Major/Minor	Minor2			Major1			Major2		
Conflicting Flow All	2732	-	462	-	0	0	1151	0	0
Stage 1	1581	-	-	-	-	-	-	-	-
Stage 2	1151	-	-	-	-	-	-	-	-
Critical Hdwy	6.6	-	6.945	-	-	-	4.145	-	-
Critical Hdwy Stg 1	5.8	-	-	-	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	-	3.3285	-	-	-	2.2285	-	-
Pot Cap-1 Maneuver	~ 20	0	~ 545	0	-	-	600	-	0
Stage 1	158	0	-	0	-	-	-	-	0
Stage 2	304	0	-	0	-	-	-	-	0
Platoon blocked, %					-	-		-	
Mov Cap-1 Maneuver	0	0	~ 545	-	-	-	600	-	-
Mov Cap-2 Maneuver	0	0	-	-	-	-	-	-	-
Stage 1	158	0	-	-	-	-	-	-	-
Stage 2	0	0	-	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s		0	8.7
HCM LOS	-		

Minor Lane/Major Mvmt	NBT	NBR	EBLn1	EBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	545	600	-
HCM Lane V/C Ratio	-	-	-	1.372	0.549	-
HCM Control Delay (s)	-	-	-	200.7	18.1	5.3
HCM Lane LOS	-	-	-	F	C	A
HCM 95th %tile Q(veh)	-	-	-	33.7	3.3	-

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lanes, Volumes, Timings
1: Cedar Street (Route 85) & Deer Street (Site Driveway)

2027 Build Conditions
Timing Plan: Weekday AM

						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	33	151	67	860	309	12
Future Volume (vph)	33	151	67	860	309	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	300			0
Storage Lanes	1	1	1			0
Taper Length (ft)	25		25			
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			469	467	
Travel Time (s)	7.3			10.7	10.6	
Peak Hour Factor	0.94	0.94	0.88	0.88	0.91	0.91
Heavy Vehicles (%)	0%	23%	9%	2%	4%	0%
Shared Lane Traffic (%)						
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized

HCM 2010 TWSC
1: Cedar Street (Route 85) & Deer Street (Site Driveway)

2027 Build Conditions
Timing Plan: Weekday AM

Intersection

Int Delay, s/veh 2.6

Movement EBL EBR NBL NBT SBT SBR

Lane Configurations						
Traffic Vol, veh/h	33	151	67	860	309	12
Future Vol, veh/h	33	151	67	860	309	12
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	300	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	88	88	91	91
Heavy Vehicles, %	0	23	9	2	4	0
Mvmt Flow	35	161	76	977	340	13

Major/Minor Minor2 Major1 Major2

Conflicting Flow All	1476	347	353	0	-	0
Stage 1	347	-	-	-	-	-
Stage 2	1129	-	-	-	-	-
Critical Hdwy	6.4	6.43	4.19	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.507	2.281	-	-	-
Pot Cap-1 Maneuver	140	651	1168	-	-	-
Stage 1	720	-	-	-	-	-
Stage 2	312	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	131	651	1168	-	-	-
Mov Cap-2 Maneuver	131	-	-	-	-	-
Stage 1	673	-	-	-	-	-
Stage 2	312	-	-	-	-	-

Approach EB NB SB

HCM Control Delay, s	17.7	0.6	0
HCM LOS	C		

Minor Lane/Major Mvmt NBL NBT EBLn1 EBLn2 SBT SBR

Capacity (veh/h)	1168	-	131	651	-	-
HCM Lane V/C Ratio	0.065	-	0.268	0.247	-	-
HCM Control Delay (s)	8.3	-	42.3	12.3	-	-
HCM Lane LOS	A	-	E	B	-	-
HCM 95th %tile Q(veh)	0.2	-	1	1	-	-

Lanes, Volumes, Timings
2: Cedar Street (Route 85) & I-495 Northbound Ramps

2027 Build Conditions

Timing Plan: Weekday AM

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	380	0	467	612	459	0	0	422	74
Future Volume (vph)	0	0	0	380	0	467	612	459	0	0	422	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	350		0	0		0
Storage Lanes	0		0	2		1	1		0	0		0
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		300			300			799			486	
Travel Time (s)		6.8			6.8			18.2			11.0	
Confl. Peds. (#/hr)			2									
Confl. Bikes (#/hr)			3									
Peak Hour Factor	0.95	0.95	0.95	0.87	0.87	0.87	0.88	0.88	0.88	0.91	0.91	0.91
Heavy Vehicles (%)	0%	0%	0%	1%	0%	2%	7%	0%	0%	0%	1%	0%
Shared Lane Traffic (%)												
Turn Type				Prot		Free	pm+pt	NA			NA	
Protected Phases				4			1	6			2	
Permitted Phases						Free	6					
Detector Phase				4			1	6			2	
Switch Phase												
Minimum Initial (s)				6.0			6.0	10.0			10.0	
Minimum Split (s)				12.0			9.0	16.0			16.0	
Total Split (s)				41.0			38.0	79.0			41.0	
Total Split (%)				34.2%			31.7%	65.8%			34.2%	
Maximum Green (s)				35.0			35.0	73.0			35.0	
Yellow Time (s)				3.0			3.0	3.0			3.0	
All-Red Time (s)				3.0			0.0	3.0			3.0	
Lost Time Adjust (s)				0.0			0.0	0.0			0.0	
Total Lost Time (s)				6.0			3.0	6.0			6.0	
Lead/Lag							Lead				Lag	
Lead-Lag Optimize?							Yes				Yes	
Vehicle Extension (s)				5.0			2.0	2.0			2.0	
Recall Mode				None			None	Min			Min	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 86.9
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Cedar Street (Route 85) & I-495 Northbound Ramps

 Ø1	 Ø2	 Ø4
38 s	41 s	41 s
 Ø6		
79 s		

Queues
2: Cedar Street (Route 85) & I-495 Northbound Ramps

2027 Build Conditions

Timing Plan: Weekday AM

					
Lane Group	WBL	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	437	537	695	522	545
v/c Ratio	0.59	0.34	0.87	0.42	0.74
Control Delay	34.8	0.6	29.5	9.1	38.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	34.8	0.6	29.5	9.1	38.1
Queue Length 50th (ft)	110	0	249	119	141
Queue Length 95th (ft)	164	0	#551	214	212
Internal Link Dist (ft)				719	406
Turn Bay Length (ft)			350		
Base Capacity (vph)	1409	1583	800	1611	1433
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.31	0.34	0.87	0.32	0.38

Intersection Summary

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

HCM 2010 Signalized Intersection Summary

2: Cedar Street (Route 85) & I-495 Northbound Ramps

2027 Build Conditions

Timing Plan: Weekday AM

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	380	0	467	612	459	0	0	422	74
Future Volume (veh/h)	0	0	0	380	0	467	612	459	0	0	422	74
Number				7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				1881	0	1863	1776	1900	0	0	1884	1900
Adj Flow Rate, veh/h				437	0	0	695	522	0	0	464	0
Adj No. of Lanes				2	0	1	1	1	0	0	2	0
Peak Hour Factor				0.87	0.87	0.87	0.88	0.88	0.88	0.91	0.91	0.91
Percent Heavy Veh, %				1	0	2	7	0	0	0	1	1
Cap, veh/h				726	0	331	774	1121	0	0	679	0
Arrive On Green				0.21	0.00	0.00	0.35	0.59	0.00	0.00	0.19	0.00
Sat Flow, veh/h				3476	0	1583	1691	1900	0	0	3768	0
Grp Volume(v), veh/h				437	0	0	695	522	0	0	464	0
Grp Sat Flow(s),veh/h/ln				1738	0	1583	1691	1900	0	0	1790	0
Q Serve(g_s), s				6.8	0.0	0.0	17.8	9.3	0.0	0.0	7.2	0.0
Cycle Q Clear(g_c), s				6.8	0.0	0.0	17.8	9.3	0.0	0.0	7.2	0.0
Prop In Lane				1.00		1.00	1.00		0.00	0.00		0.00
Lane Grp Cap(c), veh/h				726	0	331	774	1121	0	0	679	0
V/C Ratio(X)				0.60	0.00	0.00	0.90	0.47	0.00	0.00	0.68	0.00
Avail Cap(c_a), veh/h				2038	0	928	1173	2324	0	0	2099	0
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(l)				1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh				21.4	0.0	0.0	10.5	6.9	0.0	0.0	22.5	0.0
Incr Delay (d2), s/veh				1.7	0.0	0.0	4.7	0.1	0.0	0.0	0.5	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				3.4	0.0	0.0	8.9	4.8	0.0	0.0	3.6	0.0
LnGrp Delay(d),s/veh				23.1	0.0	0.0	15.2	7.0	0.0	0.0	23.0	0.0
LnGrp LOS				C			B	A			C	
Approach Vol, veh/h					437			1217			464	
Approach Delay, s/veh					23.1			11.7			23.0	
Approach LOS					C			B			C	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2		4		6						
Phs Duration (G+Y+Rc), s	23.9	17.3		18.5		41.2						
Change Period (Y+Rc), s	3.0	6.0		6.0		6.0						
Max Green Setting (Gmax), s	35.0	35.0		35.0		73.0						
Max Q Clear Time (g_c+l1), s	19.8	9.2		8.8		11.3						
Green Ext Time (p_c), s	1.1	2.1		3.7		2.3						
Intersection Summary												
HCM 2010 Ctrl Delay				16.5								
HCM 2010 LOS				B								

Lanes, Volumes, Timings

8: Cedar Street (Route 85) & I-495 SB Ramp /I-495 SB Ramp

2027 Build Conditions

Timing Plan: Weekday AM

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											 	
Traffic Volume (vph)	33	0	668	0	0	0	0	1086	384	167	590	0
Future Volume (vph)	33	0	668	0	0	0	0	1086	384	167	590	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		297			406			324			799	
Travel Time (s)		6.8			9.2			7.4			18.2	
Peak Hour Factor	0.81	0.81	0.81	0.94	0.94	0.94	0.93	0.93	0.93	0.87	0.87	0.87
Heavy Vehicles (%)	0%	0%	3%	0%	0%	0%	0%	3%	2%	1%	2%	0%
Shared Lane Traffic (%)												
Sign Control		Stop			Free			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection

Int Delay, s/veh 49.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	33	0	668	0	0	0	0	1086	384	167	590	0
Future Vol, veh/h	33	0	668	0	0	0	0	1086	384	167	590	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	Yield	-	-	Yield	-	-	None
Storage Length	0	-	0	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	16979	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	81	81	81	94	94	94	93	93	93	87	87	87
Heavy Vehicles, %	0	0	3	0	0	0	0	3	2	1	2	0
Mvmt Flow	41	0	825	0	0	0	0	1168	413	192	678	0

Major/Minor	Minor2		Major1		Major2		
Conflicting Flow All	2230	-	339	-	0	0	1168
Stage 1	1062	-	-	-	-	-	-
Stage 2	1168	-	-	-	-	-	-
Critical Hdwy	6.6	-	6.945	-	-	-	4.115
Critical Hdwy Stg 1	5.8	-	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-	-
Follow-up Hdwy	3.5	-	3.3285	-	-	-	2.2095
Pot Cap-1 Maneuver	42	0	~ 655	0	-	-	601
Stage 1	298	0	-	0	-	-	-
Stage 2	298	0	-	0	-	-	-
Platoon blocked, %					-	-	-
Mov Cap-1 Maneuver	~ 20	0	~ 655	-	-	-	601
Mov Cap-2 Maneuver	~ 20	0	-	-	-	-	-
Stage 1	298	0	-	-	-	-	-
Stage 2	145	0	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	184.2	0	4.8
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	EBLn1	EBLn2	SBL	SBT
Capacity (veh/h)	-	-	20	655	601	-
HCM Lane V/C Ratio	-	-	2.037	1.259	0.319	-
HCM Control Delay (s)	-	-	\$ 886.8	149.5	13.8	2.3
HCM Lane LOS	-	-	F	F	B	A
HCM 95th %tile Q(veh)	-	-	5.4	31.1	1.4	-

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lanes, Volumes, Timings
1: Cedar Street (Route 85) & Deer Street (Site Driveway)

2027 Build Conditions
Timing Plan: Weekday PM

						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	23	116	170	436	612	45
Future Volume (vph)	23	116	170	436	612	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	300			0
Storage Lanes	1	1	1			0
Taper Length (ft)	25		25			
Link Speed (mph)	30			30	30	
Link Distance (ft)	322			469	467	
Travel Time (s)	7.3			10.7	10.6	
Peak Hour Factor	0.96	0.96	0.87	0.87	0.94	0.94
Heavy Vehicles (%)	0%	3%	5%	1%	1%	0%
Shared Lane Traffic (%)						
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized

HCM 2010 TWSC
1: Cedar Street (Route 85) & Deer Street (Site Driveway)

2027 Build Conditions
Timing Plan: Weekday PM

Intersection

Int Delay, s/veh 3.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
----------	-----	-----	-----	-----	-----	-----

Lane Configurations						
Traffic Vol, veh/h	23	116	170	436	612	45
Future Vol, veh/h	23	116	170	436	612	45
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	300	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	87	87	94	94
Heavy Vehicles, %	0	3	5	1	1	0
Mvmt Flow	24	121	195	501	651	48

Major/Minor	Minor2	Major1	Major2
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Conflicting Flow All	1566	675	699	0	-	0
Stage 1	675	-	-	-	-	-
Stage 2	891	-	-	-	-	-
Critical Hdwy	6.4	6.23	4.15	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.327	2.245	-	-	-
Pot Cap-1 Maneuver	124	452	884	-	-	-
Stage 1	510	-	-	-	-	-
Stage 2	404	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	97	452	884	-	-	-
Mov Cap-2 Maneuver	97	-	-	-	-	-
Stage 1	397	-	-	-	-	-
Stage 2	404	-	-	-	-	-

Approach	EB	NB	SB
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HCM Control Delay, s	22.1	2.9	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
-----------------------	-----	-----	-------	-------	-----	-----

Capacity (veh/h)	884	-	97	452	-	-
HCM Lane V/C Ratio	0.221	-	0.247	0.267	-	-
HCM Control Delay (s)	10.2	-	53.9	15.8	-	-
HCM Lane LOS	B	-	F	C	-	-
HCM 95th %tile Q(veh)	0.8	-	0.9	1.1	-	-

Lanes, Volumes, Timings
2: Cedar Street (Route 85) & I-495 Northbound Ramps

2027 Build Conditions

Timing Plan: Weekday PM

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations				 							 	
Traffic Volume (vph)	0	0	0	415	0	199	709	431	0	0	759	74
Future Volume (vph)	0	0	0	415	0	199	709	431	0	0	759	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	350		0	0		0
Storage Lanes	0		0	2		1	1		0	0		0
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		300			300			799			486	
Travel Time (s)		6.8			6.8			18.2			11.0	
Confl. Peds. (#/hr)			2									
Confl. Bikes (#/hr)			3									
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.87	0.87	0.87	0.94	0.94	0.94
Heavy Vehicles (%)	0%	0%	0%	1%	0%	1%	3%	1%	0%	0%	2%	0%
Shared Lane Traffic (%)												
Turn Type				Prot		Free	pm+pt	NA			NA	
Protected Phases				4			1	6			2	
Permitted Phases						Free	6					
Detector Phase				4			1	6			2	
Switch Phase												
Minimum Initial (s)				6.0			6.0	10.0			10.0	
Minimum Split (s)				12.0			9.0	16.0			16.0	
Total Split (s)				41.0			45.0	79.0			34.0	
Total Split (%)				34.2%			37.5%	65.8%			28.3%	
Maximum Green (s)				35.0			42.0	73.0			28.0	
Yellow Time (s)				3.0			3.0	3.0			3.0	
All-Red Time (s)				3.0			0.0	3.0			3.0	
Lost Time Adjust (s)				0.0			0.0	0.0			0.0	
Total Lost Time (s)				6.0			3.0	6.0			6.0	
Lead/Lag							Lead				Lag	
Lead-Lag Optimize?							Yes				Yes	
Vehicle Extension (s)				5.0			2.0	2.0			2.0	
Recall Mode				None			None	Min			Min	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 105.7
Natural Cycle: 80
Control Type: Actuated-Uncoordinated

Splits and Phases: 2: Cedar Street (Route 85) & I-495 Northbound Ramps

 Ø1	 Ø2	 Ø4
45 s	34 s	41 s
 Ø6		
79 s		

Queues
2: Cedar Street (Route 85) & I-495 Northbound Ramps

2027 Build Conditions

Timing Plan: Weekday PM

					
Lane Group	WBL	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	441	212	815	495	886
v/c Ratio	0.65	0.13	1.05	0.38	0.95
Control Delay	44.0	0.2	74.2	8.3	58.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	44.0	0.2	74.2	8.3	58.3
Queue Length 50th (ft)	142	0	~545	123	305
Queue Length 95th (ft)	194	0	#805	203	#474
Internal Link Dist (ft)				719	406
Turn Bay Length (ft)			350		
Base Capacity (vph)	1149	1599	773	1300	933
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.38	0.13	1.05	0.38	0.95

Intersection Summary

- ~ 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.

HCM 2010 Signalized Intersection Summary

2: Cedar Street (Route 85) & I-495 Northbound Ramps

2027 Build Conditions

Timing Plan: Weekday PM

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	0	415	0	199	709	431	0	0	759	74
Future Volume (veh/h)	0	0	0	415	0	199	709	431	0	0	759	74
Number				7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh				0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)				1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln				1881	0	1881	1845	1881	0	0	1866	1900
Adj Flow Rate, veh/h				441	0	0	815	495	0	0	807	0
Adj No. of Lanes				2	0	1	1	1	0	0	2	0
Peak Hour Factor				0.94	0.94	0.94	0.87	0.87	0.87	0.94	0.94	0.94
Percent Heavy Veh, %				1	0	1	3	1	0	0	2	2
Cap, veh/h				607	0	279	834	1327	0	0	904	0
Arrive On Green				0.17	0.00	0.00	0.42	0.71	0.00	0.00	0.26	0.00
Sat Flow, veh/h				3476	0	1599	1757	1881	0	0	3732	0
Grp Volume(v), veh/h				441	0	0	815	495	0	0	807	0
Grp Sat Flow(s),veh/h/ln				1738	0	1599	1757	1881	0	0	1773	0
Q Serve(g_s), s				12.0	0.0	0.0	40.0	10.5	0.0	0.0	21.9	0.0
Cycle Q Clear(g_c), s				12.0	0.0	0.0	40.0	10.5	0.0	0.0	21.9	0.0
Prop In Lane				1.00		1.00	1.00		0.00	0.00		0.00
Lane Grp Cap(c), veh/h				607	0	279	834	1327	0	0	904	0
V/C Ratio(X)				0.73	0.00	0.00	0.98	0.37	0.00	0.00	0.89	0.00
Avail Cap(c_a), veh/h				1217	0	560	834	1374	0	0	993	0
HCM Platoon Ratio				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)				1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Uniform Delay (d), s/veh				39.0	0.0	0.0	22.4	5.9	0.0	0.0	35.9	0.0
Incr Delay (d2), s/veh				3.5	0.0	0.0	25.5	0.1	0.0	0.0	9.1	0.0
Initial Q Delay(d3),s/veh				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln				6.1	0.0	0.0	27.9	5.4	0.0	0.0	11.9	0.0
LnGrp Delay(d),s/veh				42.5	0.0	0.0	47.9	6.0	0.0	0.0	45.0	0.0
LnGrp LOS				D			D	A			D	
Approach Vol, veh/h					441			1310			807	
Approach Delay, s/veh					42.5			32.1			45.0	
Approach LOS					D			C			D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2		4		6						
Phs Duration (G+Y+Rc), s	45.0	31.5		23.5		76.5						
Change Period (Y+Rc), s	3.0	6.0		6.0		6.0						
Max Green Setting (Gmax), s	42.0	28.0		35.0		73.0						
Max Q Clear Time (g_c+I1), s	42.0	23.9		14.0		12.5						
Green Ext Time (p_c), s	0.0	1.6		3.5		2.2						
Intersection Summary												
HCM 2010 Ctrl Delay				37.9								
HCM 2010 LOS				D								

Lanes, Volumes, Timings

8: Cedar Street (Route 85) & I-495 SB Ramp /I-495 SB Ramp

2027 Build Conditions

Timing Plan: Weekday PM

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											 	
Traffic Volume (vph)	82	0	703	0	0	0	0	1017	442	310	864	0
Future Volume (vph)	82	0	703	0	0	0	0	1017	442	310	864	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		297			406			324			799	
Travel Time (s)		6.8			9.2			7.4			18.2	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.86	0.86	0.86	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	3%	0%	0%	0%	0%	2%	2%	3%	1%	0%
Shared Lane Traffic (%)												
Sign Control		Stop			Free			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection

Int Delay, s/veh 3.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	82	0	703	0	0	0	0	1017	442	310	864	0
Future Vol, veh/h	82	0	703	0	0	0	0	1017	442	310	864	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	Yield	-	-	Yield	-	-	None
Storage Length	0	-	0	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	16979	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	86	86	86	92	92	92
Heavy Vehicles, %	0	0	3	0	0	0	0	2	2	3	1	0
Mvmt Flow	87	0	748	0	0	0	0	1183	514	337	939	0

Major/Minor	Minor2			Major1			Major2		
Conflicting Flow All	2796	-	470	-	0	0	1183	0	0
Stage 1	1613	-	-	-	-	-	-	-	-
Stage 2	1183	-	-	-	-	-	-	-	-
Critical Hdwy	6.6	-	6.945	-	-	-	4.145	-	-
Critical Hdwy Stg 1	5.8	-	-	-	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	-	3.3285	-	-	-	2.2285	-	-
Pot Cap-1 Maneuver	~ 18	0	~ 539	0	-	-	584	-	0
Stage 1	152	0	-	0	-	-	-	-	0
Stage 2	294	0	-	0	-	-	-	-	0
Platoon blocked, %					-	-		-	
Mov Cap-1 Maneuver	0	0	~ 539	-	-	-	584	-	-
Mov Cap-2 Maneuver	0	0	-	-	-	-	-	-	-
Stage 1	152	0	-	-	-	-	-	-	-
Stage 2	0	0	-	-	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s		0	9.2
HCM LOS	-		

Minor Lane/Major Mvmt	NBT	NBR	EBLn1	EBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	539	584	-
HCM Lane V/C Ratio	-	-	-	1.388	0.577	-
HCM Control Delay (s)	-	-	-	207.4	19.2	5.6
HCM Lane LOS	-	-	-	F	C	A
HCM 95th %tile Q(veh)	-	-	-	34.3	3.7	-

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Crash Data Summary Tables
Dilla @ Fortune @ Cedar - Milford, MA
1/1/2017 - 12/31/2019

Collision Diagram	Crash Number	Crash Date	Crash Time	Ambient Light	Weather Condition	Road Surface	Crash Severity	Manner of Collision	Driver Contributing Codes	Detailed Narrative (from Crash Report)
1	4343958	3/12/2017	12:34 PM	Daylight	Clear	Dry	Property Damage Only	Rear-end	No Improper Driving	
2	4349310	3/29/2017	6:52 AM	Daylight	Rain	Wet	Property Damage Only	Sideswipe	Inattention / Distracted	
3	4349315	3/31/2017	4:55 PM	Daylight	Rain	Wet	Property Damage Only	Rear-end	Inattention / Distracted	
4	4349326	3/24/2017	5:11 PM	Daylight	Cloudy	Wet	Non-fatal injury	Rear-end	No Improper Driving	
5	4461699	11/28/2017	6:57 AM	Daylight	Clear	Dry	Property Damage Only	Angled	Failure to Yield Right-of-Way	
6	4461746	11/4/2017	2:34 PM	Daylight	Clear	Dry	Property Damage Only	Sideswipe	Failure to Yield Right-of-Way	
7	4485391	1/4/2018	2:32 PM	Daylight	Snow	Snow	Non-fatal injury	Rear-end	Followed Too Closely	
8	4485484	1/3/2018	2:51 PM	Daylight	Clear	Dry	Property Damage Only	Angled	Failure to Yield Right-of-Way	
9	4485504	12/29/2017	7:21 PM	Dark - Lighted	Cloudy	Dry	Property Damage Only	Angled	No Improper Driving	
10	4485505	1/2/2018	5:39 PM	Dark - Lighted	Clear	Snow	Property Damage Only	Rear-end	Inattention / Distracted	
11	4602738	9/30/2018	2:11 PM	Daylight	Clear	Dry	Property Damage Only	Sideswipe	No Improper Driving	
12	4692055	3/30/2019	11:55 AM	Daylight	Clear	Dry	Property Damage Only	Rear-end	Followed Too Closely	
13	4692397	4/7/2019	12:39 PM	Daylight	Clear	Dry	Property Damage Only	Rear-end	No Improper Driving	
14	4707955	5/28/2019	1:18 PM	Daylight	Clear	Dry	Property Damage Only	Rear-end	Inattention / Distracted	
15	4736667	7/24/2019	10:14 PM	Dark - Lighted	Clear	Dry	Property Damage Only	Rear-end	Inattention / Distracted	
16	4797284	12/27/2019	10:21 AM	Daylight	Clear	Dry	Property Damage Only	Angled	Disregarded Traffic Controls	
17	4797437	12/12/2019	9:17 AM	Daylight	Clear	Dry	Property Damage Only	Angled	Disregarded Traffic Controls	
18	4797444	12/16/2019	7:29 AM	Daylight	Clear	Dry	Property Damage Only	Angled	Not Reported	
19	4768654	10/28/2019	8:54 PM	Dark - Lighted	Rain	Wet	Non-fatal injury	Angled	Disregarded Traffic Controls	
20	4768626	10/8/2019	9:28 PM	Dark - Lighted	Clear	Dry	Property Damage Only	Angled	Disregarded Traffic Controls	
21	4768625	10/8/2019	10:25 AM	Daylight	Cloudy	Not reported	Property Damage Only	Sideswipe	Failure to Keep in Proper Lane	
22	4758081	9/24/2019	3:53 PM	Daylight	Clear	Dry	Property Damage Only	Sideswipe	No Improper Driving	
23	4756794	9/17/2019	4:29 PM	Daylight	Clear	Dry	Property Damage Only	Angled	Visibility Obstructed	
24	4747025	9/1/2019	6:53 PM	Dusk	Clear	Dry	Property Damage Only	Rear-end	Inattention / Distracted	
25	4723575	7/2/2019	3:43 PM	Daylight	Clear	Not reported	Property Damage Only	Single vehicle	Not Reported	
26	4715349	6/8/2019	11:03 AM	Daylight	Clear	Dry	Non-fatal injury	Rear-end	Not Reported	
27	4699196	5/1/2019	11:11 AM	Daylight	Cloudy	Dry	Property Damage Only	Angled	No Improper Driving	
28	4699063	4/25/2019	4:15 PM	Daylight	Clear	Dry	Not reported	Not reported	Not Reported	
29	4679187	3/4/2019	6:31 AM	Dark - Lighted	Snow	snow	Not reported	Sideswipe	Not Reported	
30	4679171	3/16/2019	12:11 PM	Daylight	Clear	Dry	Property Damage Only	Rear-end	Inattention / Distracted	
31	4662504	2/8/2019	8:09 AM	Daylight	Rain	Wet	Property Damage Only	Sideswipe	Not Reported	
32	4645119	12/12/2018	6:12 PM	Dark - Lighted	Clear	Dry	Property Damage Only	Sideswipe	Other	
33	4645111	12/10/2018	7:56 PM	Dark - Lighted	Clear	Dry	Property Damage Only	Angled	Failure to Yield Right-of-Way	
34	4645108	12/10/2018	11:55 AM	Daylight	Clear	Dry	Property Damage Only	Rear-end	Inattention / Distracted	
35	4632025	11/26/2018	12:16 PM	Daylight	Cloudy	Wet	Property Damage Only	Rear-end	Followed Too Closely	
36	4629591	11/17/2018	5:47 PM	Dark - Lighted	Clear	Dry	Property Damage Only	Sideswipe	No Improper Driving	
37	4623429	10/23/2018	9:23 AM	Daylight	Clear	Dry	Property Damage Only	Rear-end	Inattention / Distracted	
38	4623354	11/7/2018	2:00 PM	Daylight	Clear	dry	Property Damage Only	Sideswipe	Inattention / Distracted	
39	4610658	10/4/2018	3:13 PM	Daylight	Cloudy	dry	Property Damage Only	Angled	Not Reported	
40	4593403	8/31/2018	1:07 PM	Daylight	Clear	dry	Non-fatal injury	Angled	Failure to Yield Right-of-Way	
41	4585275	8/9/2018	9:31 AM	Daylight	Clear	dry	Property Damage Only	Sideswipe	Failure to Yield Right-of-Way	
42	4576761	7/29/2018	2:51 PM	Daylight	Clear	Dry	Non-fatal injury	Angled	Disregarded Traffic Controls	
43	4572010	7/16/2018	3:01 PM	Daylight	Clear	Dry	Property Damage Only	Sideswipe	No Improper Driving	
44	4564786	6/30/2018	3:20 PM	Daylight	Clear	Dry	Property Damage Only	Angled	No Improper Driving	
45	4558179	6/20/2018	3:41 PM	Daylight	Clear	Dry	Non-fatal injury	Rear-end	Inattention / Distracted	
46	4558166	6/16/2018	4:10 AM	Dark - Lighted	Clear	Dry	Property Damage Only	Single vehicle	Inattention / Distracted	
47	4558160	6/12/2018	9:18 PM	Dark - Lighted	Clear	Dry	Property Damage Only	Sideswipe	Failure to Yield Right-of-Way	
48	4547078	5/18/2018	5:56 PM	Not reported	Not reported	Dry	Not reported	Not reported	Not Reported	
49	4546967	5/25/2018	9:00 AM	Daylight	Clear	Dry	Property Damage Only	Rear-end	Followed Too Closely	
50	4536413	5/1/2018	10:07 AM	Daylight	Cloudy	dry	Property Damage Only	Rear-end	Followed Too Closely	
51	4536391	4/23/2018	4:28 PM	Daylight	Clear	Dry	Property Damage Only	Sideswipe	No Improper Driving	
52	4526753	4/12/2018	8:00 AM	Daylight	clear	dry	Property Damage Only	Sideswipe	No Improper Driving	
53	4522792	3/26/2018	2:14 PM	Daylight	Clear	Dry	Property Damage Only	Angled	Over-Steering / Over-Correcting	
54	4522790	3/26/2018	11:18 AM	Daylight	Clear	Dry	Property Damage Only	Sideswipe	Not Reported	
55	4513896	3/5/2018	9:55 AM	Daylight	Clear	Dry	Property Damage Only	Angled	Disregarded Traffic Controls	
56	4491154	1/19/2018	7:54 AM	Daylight	Clear	Dry	Property Damage Only	Sideswipe	Not Reported	
57	4462168	11/6/2017	9:12 AM	Daylight	Cloudy	Dry	Property Damage Only	Sideswipe	Not Reported	
58	4444126	10/22/2017	4:23 AM	Dark - Lighted	Clear	Dry	Property Damage Only	Sideswipe	Other	

Crash Data Summary Tables
Dilla @ Fortune @ Cedar - Milford, MA
1/1/2017 - 12/31/2019

Collision Diagram	Crash Number	Crash Date	Crash Time	Ambient Light	Weather Condition	Road Surface	Crash Severity	Manner of Collision	Driver Contributing Codes	Detailed Narrative (from Crash Report)
59	4443830	10/24/2017	9:41 AM	Daylight	Cloudy	wet	Property Damage Only	Angled	No Improper Driving	
60	4443829	10/23/2017	7:14 PM	Dark - Lighted	Clear	Dry	Non-fatal injury	Angled	Disregarded Traffic Controls	
61	4427947	9/9/2017	5:00 PM	Daylight	Clear	Dry	Non-fatal injury	Rear-end	Inattention / Distracted	
62	4398328	7/25/2017	5:10 PM	Daylight	Clear	Dry	Property Damage Only	Sideswipe	Inattention / Distracted	
63	4390746	7/1/2017	2:25 PM	Daylight	Clear	Dry	Property Damage Only	Angled	Failure to Yield Right-of-Way	
64	4383445	6/19/2017	1:07 PM	Daylight	Clear	Dry	Property Damage Only	Angled	Inattention / Distracted	
65	4374212	5/14/2017	1:07 PM	Daylight	Cloudy	Wet	Property Damage Only	Rear-end	Followed Too Closely	
66	4357214	4/15/2017	11:26 AM	Dawn	Clear	Dry	Property Damage Only	Rear-end	Followed Too Closely	
67	4332872	2/21/2017	6:51 AM	Daylight	Clear	Dry	Property Damage Only	Single vehicle	Inattention / Distracted	
68	4787927	12/2/2019	4:59 PM	Dark - Lighted	Snow	Snow	Non-fatal injury	Rear-end	No Improper Driving	
69	4787279	11/20/2019	5:30 PM	Dark - Lighted	Rain	Wet	Property Damage Only	Rear-end	Followed Too Closely	