


MEMORANDUM

DATE: June 2, 2019

TO: Chris Claussen
Quarry North LLC
379 Concord Road
Sudbury, MA 01776

FROM: Robert J. Michaud, P.E. – Managing Principal
Daniel A. Dumais, P.E. – Senior Project Manager

RE: **Cold Brook Crossing – Expanded Analysis (Route 117 at Sudbury Road)**
North Road, Sudbury, MA



MDM Transportation Consultants, Inc. (MDM) has prepared an expanded analysis of traffic impacts to augment the *Traffic Impact and Access Study* prepared for the Cold Brook Crossing¹ development to examine the impact of the development on the signalized intersection of Fitchburg Turnpike (Route 117) and Sudbury Road in the Town of Concord, MA. The location of the Site relative to the expanded study area is shown in **Figure 1** for reference. This expanded analysis documents existing operational and safety-related characteristics of the intersection, estimates future year operating characteristics independent of the development, and identifies incremental impacts of Site-related traffic.

The expanded traffic assessment indicates that intersections along North Road from Nine Acres Corners in Concord to Powder Mill Road in Sudbury will not be materially impacted as the result of the development. Key findings of the expanded analysis are as follows:

- *Below Average Crash Rates.* The supplemental study intersection of Route 117 at Sudbury Road exhibits a crash rate that is below state average and is not listed by MassDOT as Highway Safety Improvement Project (HSIP) high crash locations; therefore, no immediate safety countermeasures are warranted based on the crash history at study intersections.

¹TIAS, *Cold Brook Crossing – North Road, Sudbury, MA*, prepared by MDM Transportation Consultants, Inc. (February 2020).



Figure 1

Site Location

- *Adequate Roadway Capacity & Operations.* Operations at the signalized intersection of Route 117 at Sudbury Road are below capacity at level-of-service (LOS) C or better under Baseline and future-year analysis scenarios. Incremental traffic associated with the proposed development results in no material impact to operating conditions at the signalized study intersection compared to No-Build conditions.

In summary, the incremental traffic associated with the proposed development is not expected to materially impact operating conditions at the signalized study intersection of Route 117 at Sudbury Road compared to No-Build conditions. The intersection will continue to operate below capacity at LOS C or better during the peak hours with a nominal increase in vehicle queues. The study intersection exhibited below-average crash rates based on historic crash data and is not listed as an HSIP location. The analysis indicates that neither capacity nor safety countermeasures are warranted to mitigate project impacts – a finding that is consistent with analysis of other locations along North Road including that indicates leading to the submitted February 2020 TIAS which includes the intersections of Pantry Road/Dakin Road and Powder Mill Road/Mossman Road. Applicant-sponsored access/egress improvements, and a robust TDM plan as outlined in the *Conclusions and Recommendations* section of the submitted February 2020 TIAS will enhance site access/egress, enhance pedestrian and bicycle accommodations on-site, and to reduce dependency on single-occupant auto use.

While project impacts at the study location are immaterial and operations are deemed acceptable based on standard transportation engineering analysis practices, MDM notes that the executed Development Agreement between the Developer and the Town of Sudbury includes a \$1-million funding obligation for off-site traffic or other mitigation improvements, or improvements not related to costs to the applicant for turning lanes or other safety improvements at the entrance of the Melone Property Development site. This funding provides the Town the means of implementing off-site transportation initiatives at its discretion, including maintenance-related improvements at the Route 117 study intersections (including the expanded Concord location). Detailed inventory of existing signal equipment along North Road including the Concord location indicates such improvements could include repair/replacement or upgrading of signal equipment including associated signal detection equipment. Such upgrades if implemented would allow optimized operations during peak traffic periods, reducing delays and queuing relative to existing conditions. The Traffic Signal Evaluation dated November 21, 2018 prepared for the Town by Ocean State Signal² provides specific recommendations for potential improvements, which MDM opines are not warranted by or necessary to support the limited project impacts.

EXISTING CONDITIONS

An overview of existing (Baseline) roadway conditions, traffic volumes and safety characteristics is provided below.

² Technical Memorandum entitled “Traffic Signal Evaluation at Eight Locations Associated with the Quarry North at Melone Development”, prepared by Ocean State Signal dated November 21, 2018.

Fitchburg Turnpike (Route 117) at Sudbury Road

Route 117 meets Sudbury Road to form a four-way, signalized intersection. The Route 117 eastbound and westbound approaches provide an exclusive left turn lane, an exclusive through lane, and an exclusive channelized right-turn lane. The Sudbury Road northbound approach provides a single shared left/through/right lane while the southbound approach provides two travel lanes: one exclusive left turn lane and a shared through/right-turn lane. Land use at the intersection consists of a convenience store, a pizzeria, a liquor store and an auto repair service.

Baseline Traffic Data

Traffic volume data was obtained for study area intersections from the Melone Residential Development Traffic Impact Study prepared by McMahon Associates, Inc.³ the for the weekday morning (7:00 AM – 9:00 AM) and the weekday evening (4:00 PM - 6:00 PM) peak traffic periods. Traffic data used in this evaluation were collected in September 2018, which is a period which represents average traffic conditions based on review of MassDOT permanent count station data for the area; therefore, no seasonal adjustment was required. To remain consistent with the TIAS⁴, the counts we adjusted by 0.5% to represent 2020 Baseline conditions. Turning movement counts and permanent count station data are provided in the **Attachments**. The Baseline weekday morning and weekday evening peak hour traffic volumes are shown in **Figure 2**.

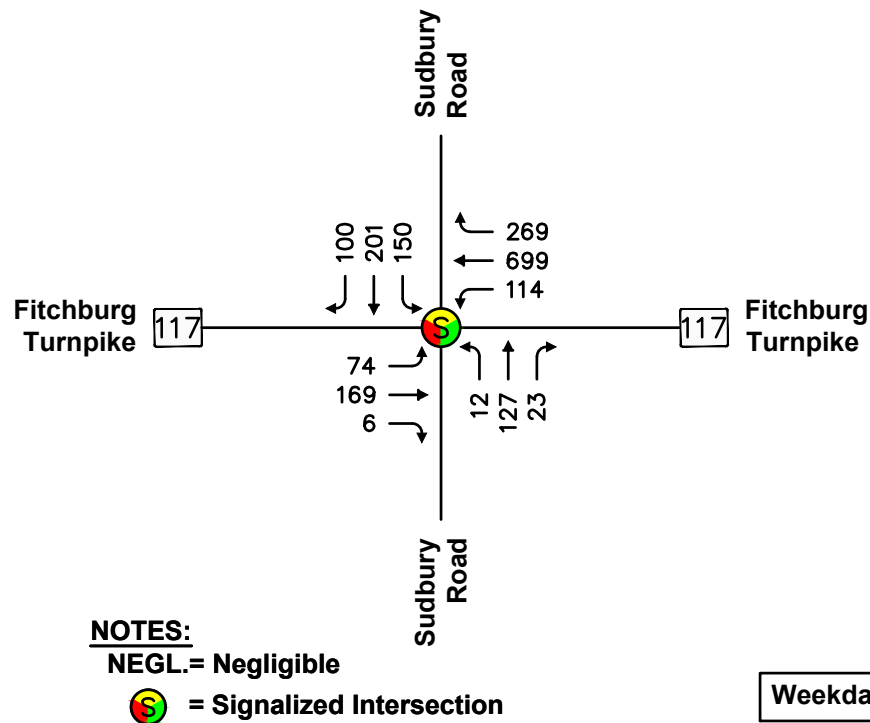
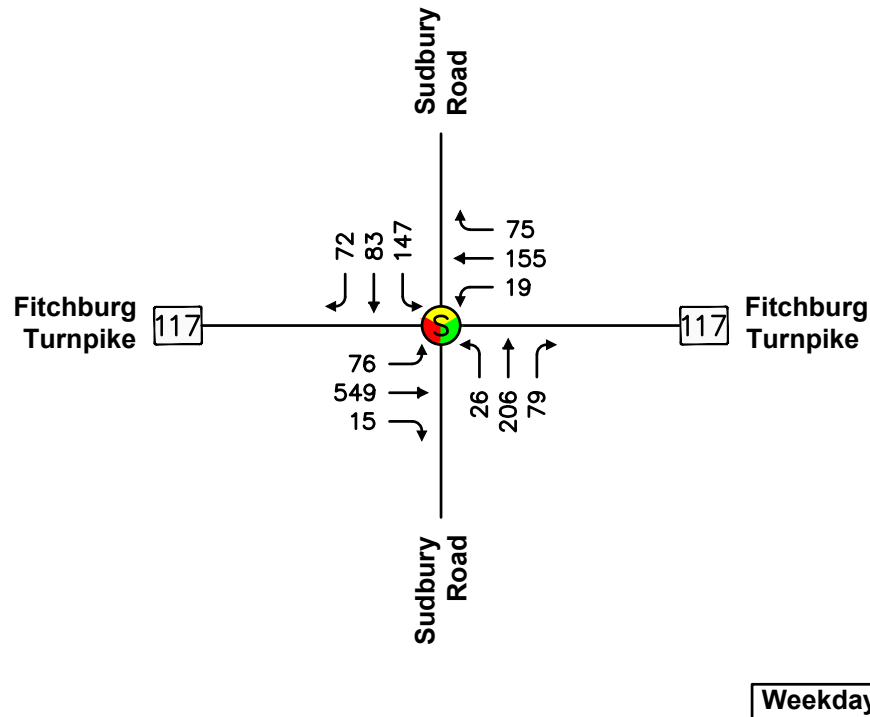
Safety

In order to identify crash trends and safety characteristics for study intersection, crash data was obtained from MassDOT for the Town of Concord for the five-year period 2015 through 2019 (the most recent full year of data currently available from MassDOT). Crash data for the study intersections is summarized in **Table 1** with detailed data provided in the **Attachments**.

Crash rates were calculated for the study intersection as reported in **Table 1**. This rate quantifies the number of crashes per million entering vehicles. MassDOT has determined the official District 4 (which includes the Town of Concord) crash rate to be 0.89 for signalized intersections. This rate represents MassDOT's "average" crash experience for District 3 communities and serves as a basis for comparing reported crash rates for the study intersections. Where calculated crash rates notably exceed the district average, some form of safety countermeasures may be warranted. In addition, review of the MassDOT high crash cluster mapping was conducted to determine locations listed as eligible for Highway Safety Improvement Program (HSIP) evaluation and funding.

³TIS, *Melone Residential Development – North Road, Sudbury, MA*, prepared by McMahon Associates, Inc. (October 2018).

⁴TIAS, *Cold Brook Crossing – North Road, Sudbury, MA*, prepared by MDM Transportation Consultants, Inc. (February 2020).



North

Scale: Not to Scale

Figure 2

**2020 Baseline Conditions
Weekday Peak Hour Volumes**

As summarized in **Table 1**, a total of twenty-seven (27) crashes were reported for the signalized intersection of Route 117 and Sudbury Road. The resulting crash rate of 0.70 is lower than the District 4 average. The reported crashes included fifteen (15) angle/ sideswipe type collisions, six (6) rear-end type collisions, three (3) head-on type collision, one (1) single vehicle collision and two (2) unknown or unreported type collisions. Eighty-one percent (81%) of the crashes resulted in property-damage only, generally indicative of low-speed crashes. No fatalities or pedestrian-related incidents were reported during the study period. In summary, the crash rates at the study intersection is lower than the District 4 average crash rate and are not listed as an HSIP location. No immediate safety countermeasures are warranted based on the crash history at the study location.

TABLE 1
INTERSECTION CRASH SUMMARY — 2015 THROUGH 2019¹

Data Category	Route 117 at Sudbury Road
Traffic Control	Signalized
Crash Rate ^{2 3}	0.70
MHD District 4 Avg. ³	0.73
<i>Year:</i>	
2015	8
2016	5
2017	2
2018	3
<u>2019</u>	<u>2</u>
Total	27
<i>Type:</i>	
Angle	14
Rear-End	6
Head-On	3
Sideswipe	1
Single Vehicle	1
Other/Unknown	2
<i>Severity:</i>	
P. Damage Only	22
Personal Injury	5
Fatality	0
Other/Unknown	0
<i>Conditions:</i>	
Dry	22
Wet	3
Snow	1
Other	1
<i>Time:</i>	
7:00 to 9:00 AM	4
4:00 to 6:00 PM	6
Rest of Day	17

¹Source: MassDOT Crash Database

²Crashes per million entering vehicles

³District 4 average = 0.73 for signalized intersections

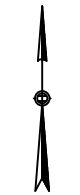
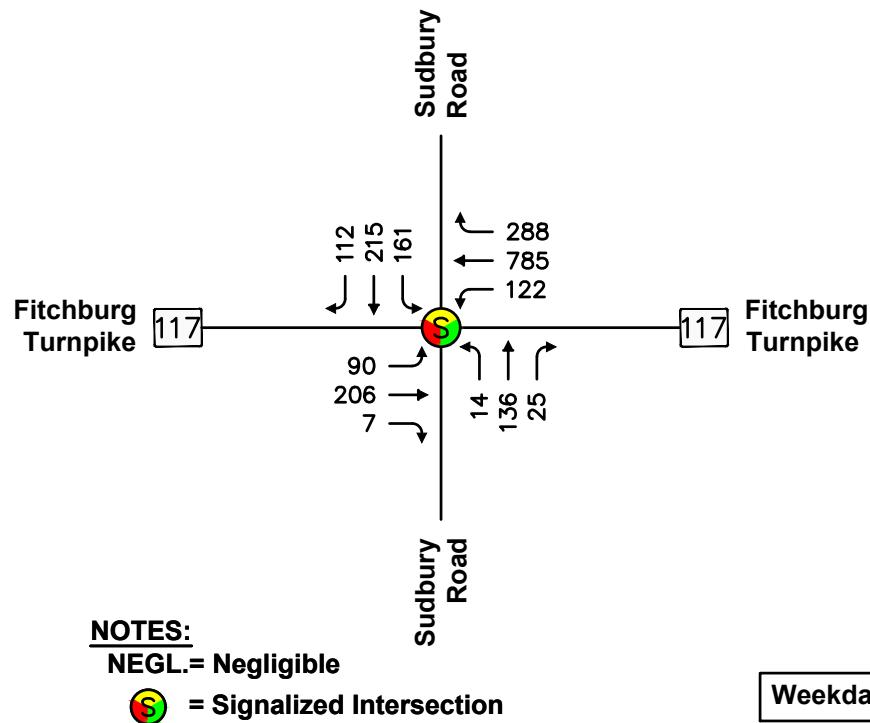
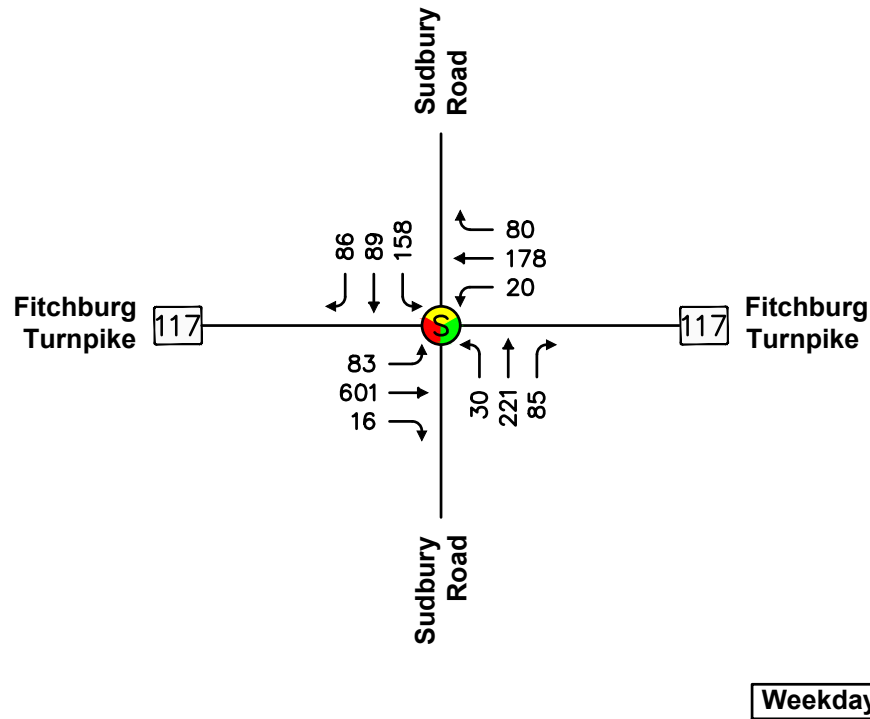
FUTURE CONDITIONS

The future (No-Build and Build) roadway conditions were developed following the procedure laid out in the February TIAS and the analysis includes the following assumptions expanded to the signalized Route 117 at Sudbury Road intersection:

- A 1-percent annual growth rate was applied to Baseline traffic volumes over a seven-year period.
- Traffic associated with the build-out of Maynard Crossing were added to the future networks. Background trip tracings are provided in the **Attachments**. Future 2027 No-Build traffic volumes are displayed in **Figure 3**.
- The distribution for projected traffic for the proposed development is based primarily on Journey to Work Census data for persons living within the Town of Sudbury. The resulting trip distribution for new trips is presented in **Figure 4**.
- Development-related trips for the proposed development are assigned to the roadway network using the ITE trip-generation estimates presented in the February TIAS and the distribution patterns presented in **Figure 4**. Development-related trips at each intersection approach for the weekday morning and weekday evening peak hours are quantified in **Figure 5**.
- 2027 Build condition traffic volumes are derived by adding the incremental traffic increases for development to the 2027 No-Build conditions. **Figure 6** presents the 2027 Build condition traffic-volume networks for the weekday morning and weekday evening peak hours.

Intersection Capacity Analysis Results

Level-of-Service (LOS) analyses were conducted for the Baseline, 2027 No-Build, and 2027 Build conditions for the signalized study intersection. The results of the intersection capacity are summarized below in **Table 2**. Detailed analysis results are presented in the **Attachments**.

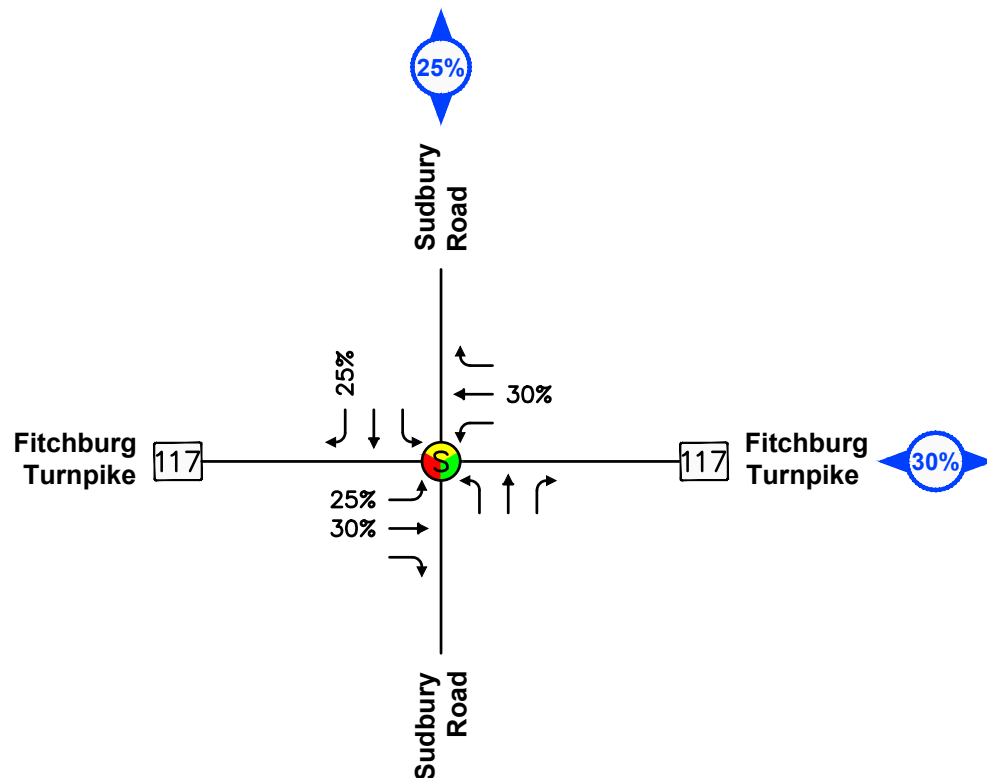


North

Scale: Not to Scale

Figure 3

**2027 No-Build Conditions
Weekday Peak Hour Volumes**



North

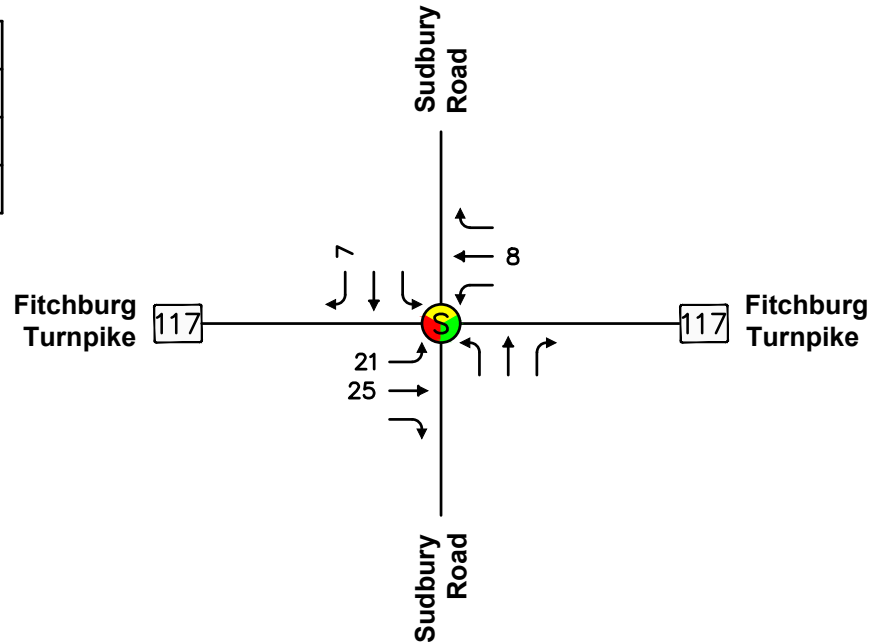
Scale: Not to Scale

NOTES:



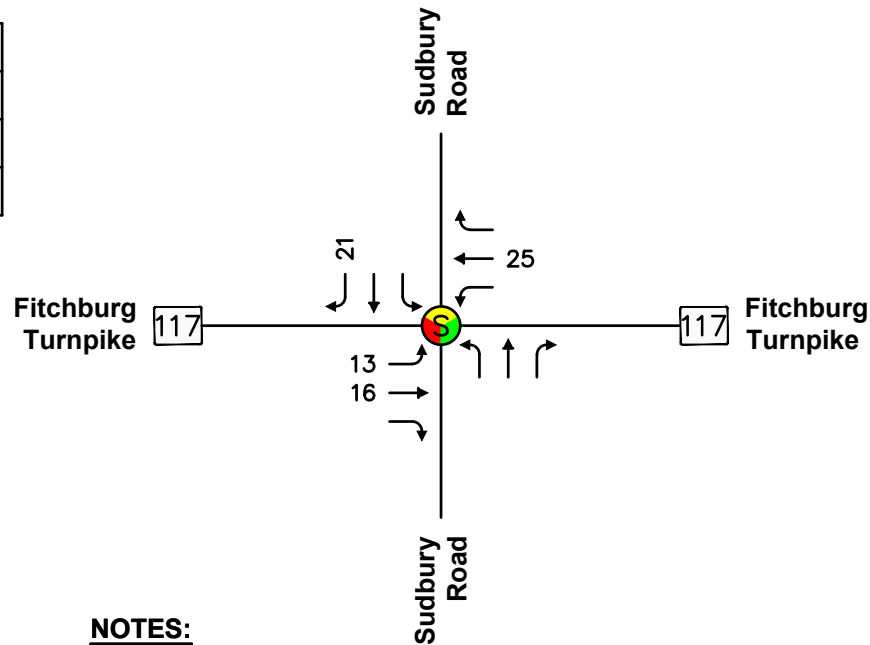
= Signalized Intersection

SITE TRIPS	
Enter	27
Exit	84
Total	111



Weekday Morning Peak Hour

SITE TRIPS	
Enter	83
Exit	52
Total	135



North

Scale: Not to Scale

NOTES:

NEGL.= Negligible

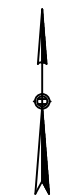
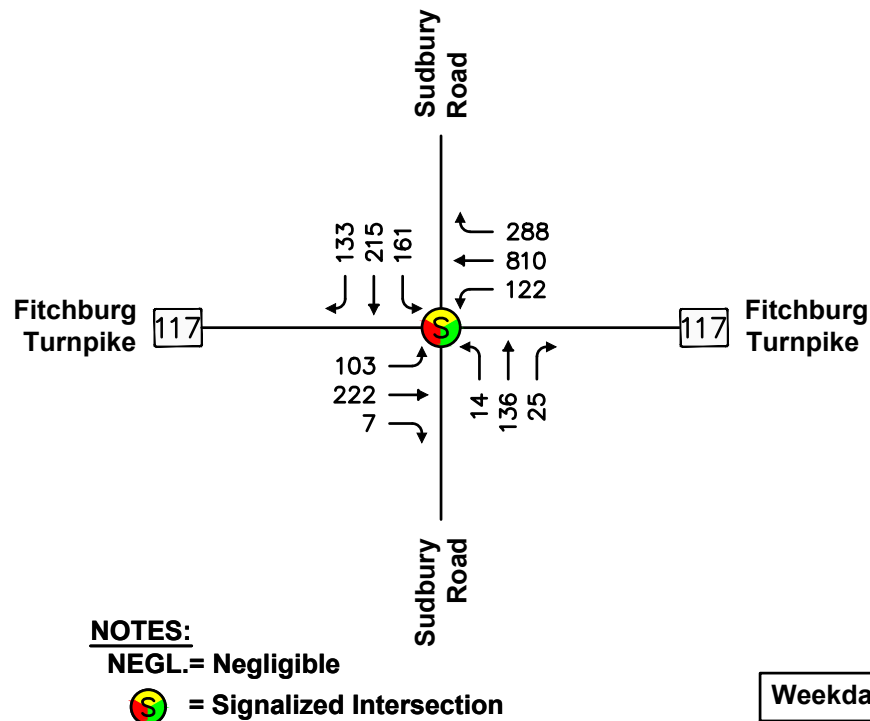
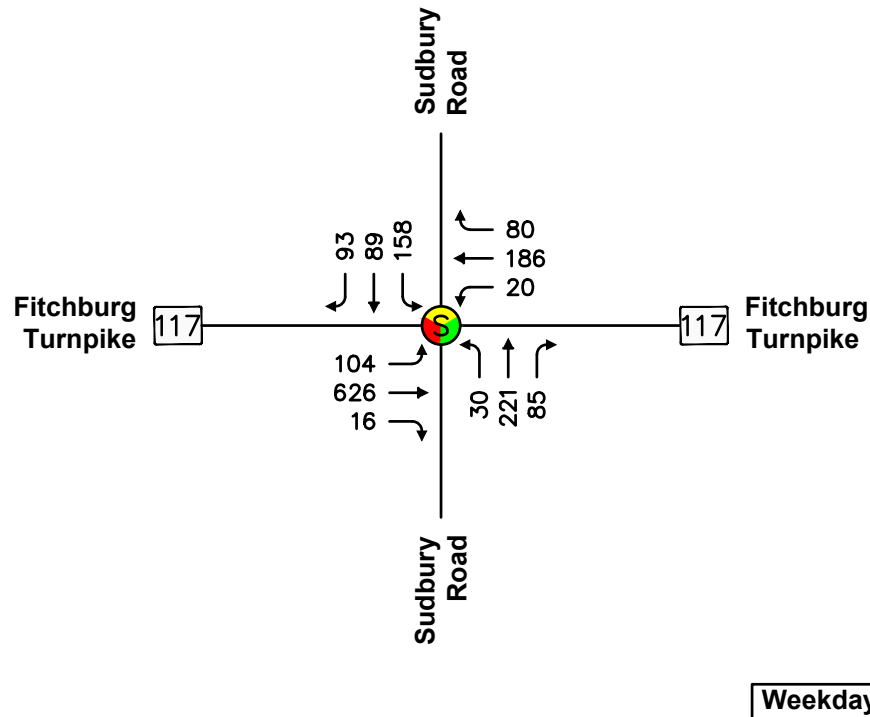


= Signalized Intersection

Weekday Evening Peak Hour

Figure 5

**Site Generated Trips
Weekday Peak Hour Volumes**



North

Scale: Not to Scale

Figure 6

**2027 Build Conditions
Weekday Peak Hour Volumes**

TABLE 2
INTERSECTION CAPACITY ANALYSIS RESULTS
FITCHBURG TURNPIKE (ROUTE 117) AT SUDBURY ROAD

Period	Approach	Baseline			2027 No-Build			2027 Build		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS	v/c	Delay	LOS
<i>Weekday Morning Peak hour</i>	Eastbound	0.70	15	B	0.76	17	B	0.76	17	B
	Westbound	0.20	7	A	0.22	7	A	0.23	7	A
	Northbound	0.58	19	B	0.60	21	C	0.61	22	C
	<u>Southbound</u>	<u>0.54</u>	<u>18</u>	<u>B</u>	<u>0.58</u>	<u>20</u>	<u>B</u>	<u>0.61</u>	<u>21</u>	<u>C</u>
	Overall	0.70	15	B	0.76	17	B	0.76	17	B
<i>Weekday Evening Peak Hour</i>	Eastbound	0.29	8	A	0.46	11	B	0.56	13	B
	Westbound	0.72	12	B	0.78	14	B	0.80	14	B
	Northbound	0.34	19	B	0.35	20	B	0.36	20	B
	<u>Southbound</u>	<u>0.62</u>	<u>23</u>	<u>C</u>	<u>0.67</u>	<u>29</u>	<u>C</u>	<u>0.69</u>	<u>30</u>	<u>C</u>
	Overall	0.72	14	B	0.78	17	B	0.80	18	B

¹Volume-to-capacity ratio

²Average control delay per vehicle (in seconds)

³Level of service

As shown in **Table 2**, the proposed development is expected to have no material change in delays at signalized study intersection of Route 117 at Sudbury Road. Operations at the signalized Main Street at Salisbury Street intersection are projected to remain at an overall LOS B during peak hours. The proposed development is expected to have minimal impact on the signalized study intersection and will not result in any material changes in traffic operations in the study area relative to No-Build conditions with each approach to the intersection continuing to operate at LOS C or better during the peak hours.

Independent Traffic Signal Inventory

The signal timings used in the analysis of the Route 117 at Sudbury Road intersection were obtained from an independent third-party traffic signal inventory prepared by Ocean State signal on November 21, 2018⁵ (see **Attachments**). These represent the latest known traffic signal timings for the intersection and provide an inventory of the traffic signal equipment. The signal inventory identified that the Sudbury Road northbound approach had malfunctioning vehicle loop detection and the intersection was observed to gap out for the mainline Route 117 approaches due to vehicle platooning during the peak hours.

Signal Queue Impacts

Vehicle queue results are presented for the signalized study intersection. These vehicle queues are compared to available storage lengths, which are defined as lengths of exclusive turn lanes or the distance to the nearest major intersection for through lanes. Vehicle queue results from the capacity analysis are summarized in **Table 3**. The estimated queue lengths are based on the

⁵ Ibid.

capacity analysis results provided using Synchro computer software. Detailed worksheets of the queuing analysis are provided in the **Attachments**.

TABLE 3
VEHICLE QUEUE ANALYSIS SUMMARY
FITCHBURG TURNPIKE (ROUTE 117) AT SUDBURY ROAD

Approach	Storage Length (feet)	2027 No-Build		2027 Build	
		Average Queue Length ¹	95 th Percentile Queue Length ¹	Average Queue Length	95 th Percentile Queue Length
Weekday Morning Peak Hour					
Eastbound L	225±	<25	35	<25	43
Eastbound T	>1000	163	259	174	277
Eastbound R	50±	<25	<25	<25	<25
Westbound L	100±	<25	<25	<25	<25
Westbound T	>1000	35	64	37	66
Westbound R	60±	<25	<25	<25	16
Northbound L/T/R	>1000	83	243	89	244
Southbound L	170±	42	155	45	158
Southbound T/R	>1000	25	88	28	90
Weekday Evening Peak Hour					
Eastbound L	225±	<25	61	25	87
Eastbound T	>1000	38	69	42	75
Eastbound R	50±	<25	<25	<25	<25
Westbound L	100±	<25	48	<25	48
Westbound T	>1000	221	367	237	388
Westbound R	60±	39	80	41	80
Northbound L/T/R	>1000	50	105	52	105
Southbound L	170±	56	144	58	145
Southbound T/R	>1000	99	190	109	201

¹Average and 95th percentile queue lengths are reported in feet per lane.

As summarized in **Table 3**, under Build conditions the average and 95th percentile queue lengths will generally remain within the available storage lengths. The project will result in a change in queue lengths of 1 vehicle or less during peak hours.

In summary, project trips represent less than a 4 percent change in No Build peak hour traffic volumes, do not result any material increases in intersection delays or vehicle queues relative to No Build conditions. Mitigative actions are therefore not warranted or necessary to support the proposed development.

CONCLUSIONS

In summary, the incremental traffic associated with the proposed development is not expected to materially impact operating conditions at the signalized study intersection of Route 117 at Sudbury Road compared to No-Build conditions. The intersection will continue to operate below capacity at LOS C or better during the peak hours with a nominal increase in vehicle queues. The study intersection exhibited below-average crash rates based on historic crash data and is not listed as an HSIP location. The analysis indicates that neither capacity nor safety countermeasures are warranted to mitigate project impacts – a finding that is consistent with analysis of other locations along North Road including that indicates leading to the submitted February 2020 TIAS which includes the intersections of Pantry Road/Dakin Road and Powder Mill Road/Mossman Road. Applicant-sponsored access/egress improvements, and a robust TDM plan as outlined in the *Conclusions and Recommendations* section of the submitted February 2020 TIAS will enhance site access/egress, enhance pedestrian and bicycle accommodations on-site, and to reduce dependency on single-occupant auto use.

While project impacts at the study location are immaterial and operations are deemed acceptable based on standard transportation engineering analysis practices, MDM notes that the executed Development Agreement between the Developer and the Town of Sudbury includes a \$1-million funding obligation for off-site traffic or other mitigation improvements, or improvements not related to costs to the applicant for turning lanes or other safety improvements at the entrance of the Melone Property Development site. This funding provides the Town the means of implementing off-site transportation initiatives at its discretion, including maintenance-related improvements at the Route 117 study intersections (including the expanded Concord location). Detailed inventory of existing signal equipment along North Road including the Concord location indicates such improvements could include repair/replacement or upgrading of signal equipment including associated signal detection equipment. Such upgrades if implemented would allow optimized operations during peak traffic periods, reducing delays and queuing relative to existing conditions. The Traffic Signal Evaluation dated November 21, 2018 prepared for the Town by Ocean State Signal⁶ provides specific recommendations for potential improvements, which MDM opines are not warranted by or necessary to support the limited project impacts.

⁶ Technical Memorandum entitled “Traffic Signal Evaluation at Eight Locations Associated with the Quarry North at Melone Development”, prepared by Ocean State Signal dated November 21, 2018.

ATTACHMENTS

- Traffic Volume Data
- Seasonal/ Yearly Growth Data
- Crash Data
- Background Projects
- Capacity Analysis
- Traffic Signal Inventory

□ Traffic Volume Data



120 Water Street, 4th Floor
 Boston, MA 02109
 617-556-0020

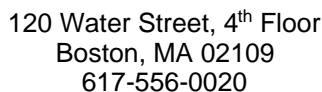
N/S: Sudbury Road
 E/W: Fitchburg Turnpike (Route 117)
 Sudbury, MA
 Weekday AM

File Name : AM_Fitchburg Tpk at Sudbury Rd
 Site Code : 09201801
 Start Date : 9/20/2018
 Page No : 1

Groups Printed- Cars & Peds - Heavy Vehicles

	Sudbury Road From North					Fitchburg Turnpike (Route 117) From East					Sudbury Road From South					Fitchburg Turnpike (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	7	16	42	0	65	11	22	3	0	36	31	54	0	0	85	1	143	19	0	163	349
07:15 AM	17	22	35	0	74	17	17	5	0	39	33	52	0	0	85	0	145	18	0	163	361
07:30 AM	14	20	53	0	87	19	28	4	0	51	20	38	7	0	65	0	126	19	0	145	348
07:45 AM	15	17	37	0	69	10	47	8	0	65	17	58	23	0	98	6	126	15	0	147	379
Total	53	75	167	0	295	57	114	20	0	191	101	202	30	0	333	7	540	71	0	618	1437
08:00 AM	22	14	33	0	69	18	32	4	0	54	12	37	3	0	52	7	128	19	0	154	329
08:15 AM	14	25	37	0	76	18	38	3	0	59	15	53	0	0	68	2	160	18	0	180	383
08:30 AM	20	26	39	1	86	28	36	4	0	68	34	56	0	0	90	0	130	23	0	153	397
08:45 AM	22	25	38	0	85	23	34	7	0	64	26	27	1	0	54	3	126	46	0	175	378
Total	78	90	147	1	316	87	140	18	0	245	87	173	4	0	264	12	544	106	0	662	1487
Grand Total	131	165	314	1	611	144	254	38	0	436	188	375	34	0	597	19	1084	177	0	1280	2924
Apprch %	21.4	27	51.4	0.2		33	58.3	8.7	0		31.5	62.8	5.7	0		1.5	84.7	13.8	0		
Total %	4.5	5.6	10.7	0	20.9	4.9	8.7	1.3	0	14.9	6.4	12.8	1.2	0	20.4	0.6	37.1	6.1	0	43.8	
Cars & Peds	120	150	301	0	571	138	244	34	0	416	182	357	31	0	570	16	1053	172	0	1241	2798
% Cars & Peds	91.6	90.9	95.9	0	93.5	95.8	96.1	89.5	0	95.4	96.8	95.2	91.2	0	95.5	84.2	97.1	97.2	0	97	95.7
Heavy Vehicles	11	15	13	1	40	6	10	4	0	20	6	18	3	0	27	3	31	5	0	39	126
% Heavy Vehicles	8.4	9.1	4.1	100	6.5	4.2	3.9	10.5	0	4.6	3.2	4.8	8.8	0	4.5	15.8	2.9	2.8	0	3	4.3

	Sudbury Road From North					Fitchburg Turnpike (Route 117) From East					Sudbury Road From South					Fitchburg Turnpike (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	15	17	37	0	69	10	47	8	0	65	17	58	23	0	98	6	126	15	0	147	379
08:00 AM	22	14	33	0	69	18	32	4	0	54	12	37	3	0	52	7	128	19	0	154	329
08:15 AM	14	25	37	0	76	18	38	3	0	59	15	53	0	0	68	2	160	18	0	180	383
08:30 AM	20	26	39	1	86	28	36	4	0	68	34	56	0	0	90	0	130	23	0	153	397
Total Volume	71	82	146	1	300	74	153	19	0	246	78	204	26	0	308	15	544	75	0	634	1488
% App. Total	23.7	27.3	48.7	0.3		30.1	62.2	7.7	0		25.3	66.2	8.4	0		2.4	85.8	11.8	0		
PHF	.807	.788	.936	.250	.872	.661	.814	.594	.000	.904	.574	.879	.283	.000	.786	.536	.850	.815	.000	.881	.937



File Name : AM_Fitchburg Tpk at Sudbury Rd
Site Code : 09201801
Start Date : 9/20/2018
Page No : 1

Groups Timed - Heavy Vehicles																					
	Sudbury Road From North					Fitchburg Turnpike (Route 117) From East					Sudbury Road From South					Fitchburg Turnpike (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	2	1	3	0	6	0	2	2	0	4	1	1	0	0	2	0	3	0	0	3	15
07:15 AM	0	0	2	0	2	1	0	0	0	1	2	4	0	0	6	0	6	1	0	7	16
07:30 AM	2	2	1	0	5	0	1	0	0	1	0	3	0	0	3	0	2	0	0	2	11
07:45 AM	0	2	1	0	3	2	1	0	0	3	0	4	3	0	7	0	3	1	0	4	17
Total	4	5	7	0	16	3	4	2	0	9	3	12	3	0	18	0	14	2	0	16	59
08:00 AM	3	2	2	0	7	1	1	1	0	3	1	1	0	0	2	1	6	1	0	8	20
08:15 AM	1	2	1	0	4	0	1	0	0	1	1	3	0	0	4	1	4	0	0	5	14
08:30 AM	1	1	2	1	5	1	1	1	0	3	1	2	0	0	3	0	4	1	0	5	16
08:45 AM	2	5	1	0	8	1	3	0	0	4	0	0	0	0	0	1	3	1	0	5	17
Total	7	10	6	1	24	3	6	2	0	11	3	6	0	0	9	3	17	3	0	23	67
Grand Total	11	15	13	1	40	6	10	4	0	20	6	18	3	0	27	3	31	5	0	39	126
Apprch %	27.5	37.5	32.5	2.5		30	50	20	0		22.2	66.7	11.1	0		7.7	79.5	12.8	0		
Total %	8.7	11.9	10.3	0.8	31.7	4.8	7.9	3.2	0	15.9	4.8	14.3	2.4	0	21.4	2.4	24.6	4	0	31	

[illegible]



120 Water Street, 4th Floor
 Boston, MA 02109
 617-556-0020

N/S: Sudbury Road
 E/W: Fitchburg Turnpike (Route 117)
 Sudbury, MA
 Weekday AM

File Name : AM_Fitchburg Tpk at Sudbury Rd
 Site Code : 09201801
 Start Date : 9/20/2018
 Page No : 1

Groups Printed- Bikes by Direction

	Sudbury Road From North					Fitchburg Turnpike (Route 117) From East					Sudbury Road From South					Fitchburg Turnpike (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1
Total	0	1	0	0	1	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	3
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
08:15 AM	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0	0	0	2
08:30 AM	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	2	0	0	2	0	1	0	0	1	1	0	0	0	1	0	1	0	0	1	5
Grand Total	0	3	0	0	3	0	1	0	0	1	1	2	0	0	3	0	1	0	0	1	8
Apprch %	0	100	0	0		0	100	0	0		33.3	66.7	0	0		0	100	0	0		
Total %	0	37.5	0	0	37.5	0	12.5	0	0	12.5	12.5	25	0	0	37.5	0	12.5	0	0	12.5	

	Sudbury Road From North					Fitchburg Turnpike (Route 117) From East					Sudbury Road From South					Fitchburg Turnpike (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
08:15 AM	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0	0	0	2
08:30 AM	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Total Volume	0	2	0	0	2	0	1	0	0	1	1	1	0	0	2	0	1	0	0	1	6
% App. Total	0	100	0	0		0	100	0	0		50	50	0	0		0	100	0	0		
PHF	.000	.250	.000	.000	.250	.000	.250	.000	.000	.250	.250	.250	.000	.000	.500	.000	.250	.000	.000	.250	.750



120 Water Street, 4th Floor
Boston, MA 02109
617-556-0020

N/S: Sudbury Road
E/W: Fitchburg Turnpike (Route 117)
Sudbury, MA
Weekday PM

File Name : PM_Fitchburg Tpk at Sudbury Rd
Site Code : 09281803
Start Date : 9/27/2018
Page No : 1

Groups Printed- Cars & Peds - Heavy Vehicles

	Sudbury Road From North					Fitchburg Turnpike (Route 117) From East					Sudbury Road From South					Fitchburg Turnpike (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	31	38	22	0	91	71	167	20	0	258	5	37	1	0	43	1	41	18	0	60	452
04:15 PM	29	52	32	0	113	61	171	23	0	255	4	27	4	0	35	0	35	22	0	57	460
04:30 PM	27	57	37	0	121	56	169	41	0	266	5	23	4	0	32	1	30	20	0	51	470
04:45 PM	22	56	20	1	99	54	174	35	0	263	6	17	3	0	26	1	40	12	0	53	441
Total	109	203	111	1	424	242	681	119	0	1042	20	104	12	0	136	3	146	72	0	221	1823
05:00 PM	19	39	39	0	97	66	177	31	0	274	1	30	5	0	36	1	47	22	0	70	477
05:15 PM	27	43	30	1	101	74	182	30	0	286	1	36	3	0	40	1	36	17	0	54	481
05:30 PM	30	63	38	0	131	60	163	28	0	251	9	33	1	1	44	3	38	19	0	60	486
05:45 PM	23	54	42	0	119	66	170	24	0	260	12	27	3	0	42	1	46	15	0	62	483
Total	99	199	149	1	448	266	692	113	0	1071	23	126	12	1	162	6	167	73	0	246	1927
Grand Total	208	402	260	2	872	508	1373	232	0	2113	43	230	24	1	298	9	313	145	0	467	3750
Apprch %	23.9	46.1	29.8	0.2		24	65	11	0		14.4	77.2	8.1	0.3		1.9	67	31	0		
Total %	5.5	10.7	6.9	0.1	23.3	13.5	36.6	6.2	0	56.3	1.1	6.1	0.6	0	7.9	0.2	8.3	3.9	0	12.5	
Cars & Peds	203	394	259	2	858	504	1357	230	0	2091	42	227	24	1	294	9	310	143	0	462	3705
% Cars & Peds	97.6	98	99.6	100	98.4	99.2	98.8	99.1	0	99	97.7	98.7	100	100	98.7	100	99	98.6	0	98.9	98.8
Heavy Vehicles	5	8	1	0	14	4	16	2	0	22	1	3	0	0	4	0	3	2	0	5	45
% Heavy Vehicles	2.4	2	0.4	0	1.6	0.8	1.2	0.9	0	1	2.3	1.3	0	0	1.3	0	1	1.4	0	1.1	1.2

	Sudbury Road From North					Fitchburg Turnpike (Route 117) From East					Sudbury Road From South					Fitchburg Turnpike (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
05:00 PM	19	39	39	0	97	66	177	31	0	274	1	30	5	0	36	1	47	22	0	70	477
05:15 PM	27	43	30	1	101	74	182	30	0	286	1	36	3	0	40	1	36	17	0	54	481
05:30 PM	30	63	38	0	131	60	163	28	0	251	9	33	1	1	44	3	38	19	0	60	486
05:45 PM	23	54	42	0	119	66	170	24	0	260	12	27	3	0	42	1	46	15	0	62	483
Total Volume	99	199	149	1	448	266	692	113	0	1071	23	126	12	1	162	6	167	73	0	246	1927
% App. Total	22.1	44.4	33.3	0.2		24.8	64.6	10.6	0		14.2	77.8	7.4	0.6		2.4	67.9	29.7	0		
PHF	.825	.790	.887	.250	.855	.899	.951	.911	.000	.936	.479	.875	.600	.250	.920	.500	.888	.830	.000	.879	.991
Cars & Peds	98.0	98.5	100	100	98.9	98.5	99.0	99.1	0	98.9	95.7	98.4	100	100	98.1	100	99.4	98.6	0	99.2	98.9
% Cars & Peds	2	3	0	0	5	4	7	1	0	12	1	2	0	0	3	0	1	1	0	2	22
Heavy Vehicles	2.0	1.5	0	0	1.1	1.5	1.0	0.9	0	1.1	4.3	1.6	0	0	1.9	0	0.6	1.4	0	0.8	1.1



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Site Code : 09281803
Start Date : 9/27/2018
Page No : 1

Groups Printed- Heavy Vehicles

	Sudbury Road From North					Fitchburg Turnpike (Route 117) From East					Sudbury Road From South					Fitchburg Turnpike (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	1	1	0	0	2	0	3	0	0	3	0	0	0	0	0	0	1	0	0	1	6
04:15 PM	1	1	0	0	2	0	4	0	0	4	0	1	0	0	1	0	1	0	0	1	8
04:30 PM	0	1	1	0	2	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1	4
04:45 PM	1	2	0	0	3	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	5
Total	3	5	1	0	9	0	9	1	0	10	0	1	0	0	1	0	2	1	0	3	23
05:00 PM	0	0	0	0	0	3	3	0	0	6	0	0	0	0	0	0	1	1	0	2	8
05:15 PM	1	0	0	0	1	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	3
05:30 PM	1	1	0	0	2	0	1	1	0	2	0	1	0	0	1	0	0	0	0	0	5
05:45 PM	0	2	0	0	2	0	2	0	0	2	1	1	0	0	2	0	0	0	0	0	6
Total	2	3	0	0	5	4	7	1	0	12	1	2	0	0	3	0	1	1	0	2	22
Grand Total	5	8	1	0	14	4	16	2	0	22	1	3	0	0	4	0	3	2	0	5	45
Apprch %	35.7	57.1	7.1	0		18.2	72.7	9.1	0		25	75	0	0		0	60	40	0		
Total %	11.1	17.8	2.2	0	31.1	8.9	35.6	4.4	0	48.9	2.2	6.7	0	0	8.9	0	6.7	4.4	0	11.1	

	Sudbury Road From North					Fitchburg Turnpike (Route 117) From East					Sudbury Road From South					Fitchburg Turnpike (Route 117) From West					
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Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	1	1	0	0	2	0	4	0	0	4	0	1	0	0	1	0	1	0	0	1	8
04:30 PM	0	1	1	0	2	0	1	0	0	1	0	0	0	0	0	0	0	1	0	1	4
04:45 PM	1	2	0	0	3	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	5
05:00 PM	0	0	0	0	0	3	3	0	0	6	0	0	0	0	0	0	1	1	0	2	8
Total Volume	2	4	1	0	7	3	9	1	0	13	0	1	0	0	1	0	2	2	0	4	25
% App. Total	28.6	57.1	14.3	0		23.1	69.2	7.7	0		0	100	0	0		0	50	50	0		
PHF	.500	.500	.250	.000	.583	.250	.563	.250	.000	.542	.000	.250	.000	.000	.250	.000	.500	.500	.000	.500	.781



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Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
04:15 PM	0	0	0	0	0	1	0	0	0	1	2	1	0	0	3	0	0	0	0	0	4
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Total	1	2	0	0	3	1	1	0	0	2	2	1	0	0	3	0	0	0	0	0	8
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1
05:45 PM	0	1	0	0	1	0	1	0	0	1	1	0	0	0	1	0	0	0	0	0	3
Total	0	1	0	0	1	0	1	0	0	1	1	1	0	0	2	0	0	0	0	0	4
Grand Total	1	3	0	0	4	1	2	0	0	3	3	2	0	0	5	0	0	0	0	0	12
Apprch %	25	75	0	0		33.3	66.7	0	0		60	40	0	0		0	0	0	0		
Total %	8.3	25	0	0	33.3	8.3	16.7	0	0	25	25	16.7	0	0	41.7	0	0	0	0	0	

	Sudbury Road From North					Fitchburg Turnpike (Route 117) From East					Sudbury Road From South					Fitchburg Turnpike (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
04:15 PM	0	0	0	0	0	1	0	0	0	1	2	1	0	0	3	0	0	0	0	0	4
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Total Volume	1	2	0	0	3	1	1	0	0	2	2	1	0	0	3	0	0	0	0	0	8
% App. Total	33.3	66.7	0	0		50	50	0	0		66.7	33.3	0	0		0	0	0	0		
PHF	.250	.500	.000	.000	.375	.250	.250	.000	.000	.500	.250	.250	.000	.000	.250	.000	.000	.000	.000	.000	.500

□ Seasonal Data/ Yearly Growth

STATION 403 - CONCORD - RTE.2 - 0.2 km EAST OF CONCORD ROTARY													
YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
10	41,546	41,883	46,472	50,492	45,910	46,524	43,534	39,595	40,709	46,285	43,576	44,350	44,240
	-6%	-4%	-6%	-12%	0%	-1%	0%	9%	10%	-2%	-1%	-5%	-2%
11	39,037	40,138	43,732	44,191	45,777	46,145	43,496	43,117	44,740	45,508	43,282	42,043	43,434
	6%	5%	-2%	0%	0%	-1%	-7%	4%	0%	-1%	-1%	-1%	0%
12	41,311	42,111	43,069	44,294	45,759	45,640	40,408	44,775	44,720	44,904	42,980	41,701	43,473
	1%	-7%	-2%	-3%	-3%	-1%	4%	-3%	-1%	0%	-1%	3%	-1%
13	41,792	39,095	42,007	42,993	44,222	44,984	41,995	43,310	44,422	45,062	42,684	42,773	42,945
	-3%	-3%	1%	1%	1%	1%	2%	0%	0%	1%	1%	5%	1%
15	39,457	36,908	42,703	44,051	45,401	45,790	43,572	43,700	43,992	46,043	43,701	47,474	43,566
	6%	15%	4%	1%	3%	4%	3%	6%	3%	2%	4%	-9%	3%
16	41,896	42,396	44,580	44,670	46,737	47,669	45,004	46,441	45,499	47,080	45,357	43,312	45,053
	3%	1%	1%	1%	2%	2%	1%	1%	4%	4%	3%	-2%	2%
17	43,250	43,008	45,196	45,139	47,491	48,619	45,489	46,860	47,255	48,955	46,715	42,282	45,855
	0%	3%	0%	4%	1%	1%	-2%	-2%	-5%	-1%	-9%	7%	0%
18	43,289	44,164	45,201	46,965	48,147	49,054	44,492	45,928	44,882	48,454	42,446	45,171	45,683
Seasonal Adjustment Factor (to average month)	1.07	1.08	1.00	0.98	0.96	0.95	1.02	1.00	1.00	0.95	1.01	1.02	
												Growth	0.4%

□ Crash Data

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Concord, MA COUNT DATE : May-20

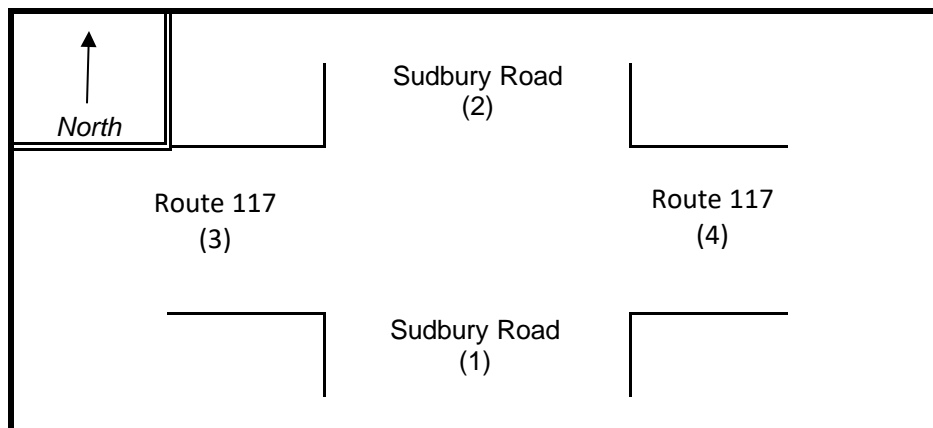
DISTRICT : 4 UNSIGNALIZED : ☐ SIGNALIZED : ☒

~ INTERSECTION DATA ~

MAJOR STREET : Fitchburg Turnpike (Route 117)

MINOR STREET(S) : Sudbury Road

INTERSECTION
 DIAGRAM
 (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB	WB		
PEAK HOURLY VOLUMES (PM) :	162	451	249	1,082		1,944

" K " FACTOR :

0.092

INTERSECTION ADT (V) = TOTAL DAILY
 APPROACH VOLUME :

21,130

TOTAL # OF CRASHES :

27

OF
 YEARS :

5

AVERAGE # OF
 CRASHES PER YEAR (A) :

5.40

CRASH RATE CALCULATION :

0.70

RATE = $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : MassDOT District 3 Avg: Signalized = 0.89; Unsignalized = 0.61






















Project Title & Date: 1073 - Sudbury

Crash Date	Crash Severity	Crash Time	Crash Year	Number of Vehicles	Light Conditions	Manner of Collision	Road Surface Condition	Roadway Junction Type	Total Fatalities	Total Non-Fatal Injuries	Vehicle Actions Prior to Crash (All Vehicles)	Vehicle Configuration (All Vehicles)	Vehicle Travel Directions (All Vehicles)	Weather Conditions	Most Harmful Event (All Vehicles)	X	Y	Roadway
01/12/2016	Property damage only (none injured)	6:44 AM	2016	2	Daylight	Angle	Dry	T-intersection	0	0	0 ahead V1: Travelling straight ahead / V2: Turning left	V1:(Single-unit truck (3-or-more axles)) / V2:(Passenger car)	V1: N / V2: W	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210572.3998	907875.877	FITCHBURG TURNPIKE
04/16/2019	Property damage only (none injured)	7:59 AM	2019	2	Daylight	Angle	Dry	T-intersection	0	0	0 left V1: Travelling straight ahead / V2: Turning left	V1:(Passenger car) / V2:(Passenger car)	V1: N / V2: S	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210521.4982	908013.38	SUDBURY RD
11/29/2017	Property damage only (none injured)	8:03 AM	2017	2	Daylight	Angle	Wet	Four-way intersection	0	0	0 left V1: Travelling straight ahead / V2: Turning left	V1:(Passenger car) / V2:(Passenger car)	V1: N / V2: E	Cloudy	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3907	907875.063	FITCHBURG TPKE / SUDBURY RD
08/31/2016	Property damage only (none injured)	8:35 AM	2016	2	Daylight	Angle	Dry	Four-way intersection	0	0	0 ahead V1: Travelling straight ahead / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: W / V2: S	Cloudy	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3907	907875.063	FITCHBURG TPKE Rte 117 / SUDBURY RD
06/02/2015	Non-fatal injury	9:46 AM	2015	2	Daylight	Angle	Wet	Four-way intersection	0	2	2 straight ahead V1: Travelling straight ahead / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: W / V2: N	Rain	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3907	907875.063	SUDBURY RD / FITCHBURG TPKE
02/11/2015	Property damage only (none injured)	1:06 PM	2015	2	Daylight	Angle	Wet	T-intersection	0	0	0 straight ahead V1: Travelling straight ahead / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: S / V2: E	Cloudy	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3907	907875.063	FITCHBURG TPKE / SUDBURY RD
04/16/2019	Property damage only (none injured)	2:06 PM	2019	2	Daylight	Angle	Dry	Four-way intersection	0	0	0 V2: Turning left V1: Travelling straight ahead / V2: Entering traffic lane	V1:(Passenger car) / V2:(Passenger car)	V1: W / V2: S	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3907	907875.063	SUDBURY RD / FITCHBURG TPKE
02/11/2015	Property damage only (none injured)	3:40 PM	2015	2	Daylight	Angle	Dry	T-intersection	0	0	0 traffic lane V1: Entering traffic lane / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: S / V2: E	Cloudy	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210530.6348	907982.99	SUDBURY RD
07/18/2019	Property damage only (none injured)	3:44 PM	2019	2	Daylight	Angle		Not at junction	0	0	0 ahead V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: W / V2: N	Cloudy	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210542.857	907949.707	SUDBURY RD
01/28/2019	Property damage only (none injured)	4:32 PM	2019	2	Dawn Dark - lighted	Angle	Dry	Four-way intersection	0	0	0 ahead V1: Travelling straight ahead / V2: Making U-turn	V1:(Passenger car) / V2:(Passenger car)	V1: E / V2: W	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210575.8216	907876.076	FITCHBURG TPKE
11/18/2015	Non-fatal injury	4:53 PM	2015	2	Daylight	Angle	Dry	Not at junction	0	2	2 V1: Turning right / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: E / V2: W	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210496.0788	907861.24	FITCHBURG TURNPIKE Rte 117 E
05/21/2018	Property damage only (none injured)	4:54 PM	2018	2	Daylight	Angle	Dry	Four-way intersection	0	0	0 ahead V1: Turning left / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: E / V2: E	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3907	907875.063	SUDBURY RD / FITCHBURG TPKE
06/07/2019	Property damage only (none injured)	6:43 PM	2019	2	Daylight	Angle	Dry	Not at junction	0	0	0 ahead V1: Travelling straight ahead / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: S / V2: S	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210533.2968	907870.116	FITCHBURG TPKE
07/12/2015	Property damage only (none injured)	7:43 PM	2015	2	Daylight	Angle	Dry	Four-way intersection	0	0	0 straight ahead V1: Turning left / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: E / V2: N	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3907	907875.063	FITCHBURG TPKE / SUDBURY RD
09/20/2019	Property damage only (none injured)	3:07 PM	2019	2	Daylight	Head-on	Dry	Four-way intersection	0	0	0 ahead V1: Travelling straight ahead / V2: Turning left	V1:(Passenger car) / V2:(Passenger car)	V1: E / V2: W	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3904	907875.062	SUDBURY RD / FITCHBURG TPKE
06/14/2019	Property damage only (none injured)	7:35 PM	2019	2	Daylight Dark - lighted	Head-on	Dry	Four-way intersection	0	0	0 left V1: Travelling straight ahead / V2: Slowing or stopped in traffic	V1:(Passenger car) / V2:(Passenger car)	V1: W / V2: E	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3907	907875.063	FITCHBURG TPKE / SUDBURY RD
06/12/2017	Non-fatal injury	11:40 PM	2017	2	Daylight	Head-on	Dry	Four-way intersection	0	2	2 stopped in traffic V1: Travelling straight ahead / V2: Slowing or stopped in traffic	V1:(Passenger car) / V2:(Passenger car)	V1: W / V2: E	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3907	907875.063	SUDBURY RD
12/04/2019	Property damage only (none injured)	6:42 AM	2019	2	Dawn	Rear-end	Ice	Not at junction	0	0	0 stopped in traffic V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: E / V2: E	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210528.5429	907869.179	FITCHBURG TPKE
06/13/2018	Property damage only (none injured)	8:36 AM	2018	2	Daylight	Rear-end	Dry	Not at junction	0	0	0 ahead V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: E / V2: E	Cloudy	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210572.3998	907875.877	FITCHBURG TPKE
08/16/2018	Property damage only (none injured)	12:28 PM	2018	2	Daylight Dark - lighted	Rear-end	Dry	Not at junction	0	0	0 ahead V1: Travelling straight ahead / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: E / V2: E	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210543.4382	907872.115	FITCHBURG TPKE
12/09/2016	Property damage only (none injured)	4:30 PM	2016	2	Daylight	Rear-end	Dry	Four-way intersection	0	0	0 straight ahead V1: Travelling straight ahead / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: E / V2: E	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3907	907875.063	SUDBURY RD / FITCHBURG TPKE
08/13/2015	Property damage only (none injured)	6:53 PM	2015	2	Daylight Dark - unknown roadway	Rear-end	Dry	Four-way intersection	0	0	0 straight ahead V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: W / V2: W	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3907	907875.063	SUDBURY RD / FITCHBURG TPKE
11/14/2016	Non-fatal injury	8:43 PM	2016	2	Daylight	Rear-end Sideswipe, same direction	Dry	Four-way intersection	0	1	1 ahead V1: Travelling straight ahead / V2: Turning left	V1:(Passenger car) / V2:(Passenger car)	V1: W / V2: W	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3907	907875.063	FITCHBURG TPKE Rte 117 W / SUDBURY RD
02/26/2016	Property damage only (none injured)	5:32 PM	2016	2	Dusk Dark - lighted	Single vehicle crash	Dry	Not at junction	0	0	0 left V1: Travelling straight ahead / V2: Turning left	V1:(Passenger car) / V2:(Passenger car)	V1: W / V2: W	Cloudy	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210542.5877	907829.021	SUDBURY RD
10/01/2015	Non-fatal injury	8:18 PM	2015	1	Daylight	Unknown	Dry	T-intersection	0	0	0 V1: Parked V1: Travelling straight ahead / V2: Entering traffic lane	V1:(Passenger car) / V2:(Passenger car)	V1: N	Clear	V1:(Collision with tree) / V1:(Collision with motor vehicle in traffic)	210542.5877	907829.021	SUDBURY RD
10/13/2015	Property damage only (none injured)	9:27 AM	2015	1	Daylight	Unknown	Dry	Not at junction	0	0	0 V1: Parked V1: Travelling straight ahead / V2: Entering traffic lane	V1:(Passenger car) / V2:(Passenger car)	V1: N	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210521.7446	908012.559	SUDBURY RD
03/20/2019	Property damage only (none injured)	5:32 PM	2019	2	Daylight	Unknown	Dry	Y-intersection	0	0	0 traffic lane V1: Travelling straight ahead / V2: Entering traffic lane	V1:(Passenger car) / V2:(Passenger car)	V1: N / V2: W	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	210558.3907	907875.063	FITCHBURG TPKE / SUDBURY RD

□ Capacity Analysis

Lanes, Volumes, Timings
1: Sudbury Road & Fitchburg Turnpike













2020 Baseline Conditions
Weekday Morning Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	76	549	15	19	155	75	26	206	79	147	83	72
Future Volume (vph)	76	549	15	19	155	75	26	206	79	147	83	72
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	175		50	120		20	0		0	160		0
Storage Lanes	1		1	1		1	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.966			0.930	
Flt Protected	0.950			0.950				0.996		0.950		
Satd. Flow (prot)	1736	1845	1429	1626	1845	1538	0	1735	0	1736	1635	0
Flt Permitted	0.653			0.314				0.968		0.486		
Satd. Flow (perm)	1193	1845	1429	537	1845	1538	0	1687	0	888	1635	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			16			80		24			63	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1000			1000			1000			1000	
Travel Time (s)		22.7			22.7			22.7			22.7	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	4%	3%	13%	11%	3%	5%	12%	5%	4%	4%	9%	7%
Adj. Flow (vph)	81	584	16	20	165	80	28	219	84	156	88	77
Shared Lane Traffic (%)												
Lane Group Flow (vph)	81	584	16	20	165	80	0	331	0	156	165	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6	20	20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	

Lanes, Volumes, Timings
1: Sudbury Road & Fitchburg Turnpike

2020 Baseline Conditions

Weekday Morning Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2		2	6		6	8			4		
Detector Phase	2	2	2	6	6	6	8	8		4	4	
Switch Phase												
Minimum Initial (s)	12.0	12.0	12.0	12.0	12.0	12.0	7.0	7.0		7.0	7.0	
Minimum Split (s)	18.0	18.0	18.0	18.0	18.0	18.0	11.0	11.0		11.0	11.0	
Total Split (s)	46.0	46.0	46.0	46.0	46.0	46.0	24.0	24.0		24.0	24.0	
Total Split (%)	65.7%	65.7%	65.7%	65.7%	65.7%	65.7%	34.3%	34.3%		34.3%	34.3%	
Maximum Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	20.0	20.0		20.0	20.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		4.0		4.0	4.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	Min	Min	Min	Min	Min	Min	None	None		None	None	
Act Effect Green (s)	22.3	22.3	22.3	22.3	22.3	22.3		16.1		16.1	16.1	
Actuated g/C Ratio	0.45	0.45	0.45	0.45	0.45	0.45		0.33		0.33	0.33	
v/c Ratio	0.15	0.70	0.02	0.08	0.20	0.11		0.58		0.54	0.29	
Control Delay	8.7	15.8	4.0	8.7	8.8	2.6		19.2		24.2	11.1	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Total Delay	8.7	15.8	4.0	8.7	8.8	2.6		19.2		24.2	11.1	
LOS	A	B	A	A	A	A		B		C	B	
Approach Delay		14.7			6.9			19.2			17.5	
Approach LOS		B			A			B			B	
90th %ile Green (s)	35.7	35.7	35.7	35.7	35.7	35.7	20.0	20.0		20.0	20.0	
90th %ile Term Code	Gap	Gap	Gap	Hold	Hold	Hold	Max	Max		Max	Max	
70th %ile Green (s)	27.2	27.2	27.2	27.2	27.2	27.2	20.0	20.0		20.0	20.0	
70th %ile Term Code	Gap	Gap	Gap	Hold	Hold	Hold	Hold	Hold		Max	Max	
50th %ile Green (s)	22.5	22.5	22.5	22.5	22.5	22.5	18.0	18.0		18.0	18.0	
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold	Hold	Hold	Hold		Gap	Gap	
30th %ile Green (s)	17.4	17.4	17.4	17.4	17.4	17.4	13.5	13.5		13.5	13.5	
30th %ile Term Code	Gap	Gap	Gap	Hold	Hold	Hold	Hold	Hold		Gap	Gap	
10th %ile Green (s)	12.0	12.0	12.0	12.0	12.0	12.0	9.3	9.3		9.3	9.3	
10th %ile Term Code	Min	Min	Min	Min	Min	Min	Hold	Hold		Gap	Gap	
Queue Length 50th (ft)	13	130	0	3	28	0		69		35	20	
Queue Length 95th (ft)	34	231	7	13	57	16		184		#115	72	
Internal Link Dist (ft)		920			920			920			920	
Turn Bay Length (ft)	175		50	120		20				160		
Base Capacity (vph)	973	1505	1168	438	1505	1269		748		386	747	
Starvation Cap Reductn	0	0	0	0	0	0		0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0		0		0	0	
Storage Cap Reductn	0	0	0	0	0	0		0		0	0	
Reduced v/c Ratio	0.08	0.39	0.01	0.05	0.11	0.06		0.44		0.40	0.22	

Intersection Summary

Area Type: Other

Cycle Length: 70

Actuated Cycle Length: 49.1

Lanes, Volumes, Timings

1: Sudbury Road & Fitchburg Turnpike

2020 Baseline Conditions
Weekday Morning Peak Hour

Natural Cycle: 45

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.70

Intersection Signal Delay: 14.9

Intersection LOS: B

Intersection Capacity Utilization 81.4%

ICU Level of Service D

Analysis Period (min) 15

90th %ile Actuated Cycle: 65.7

70th %ile Actuated Cycle: 57.2

50th %ile Actuated Cycle: 50.5

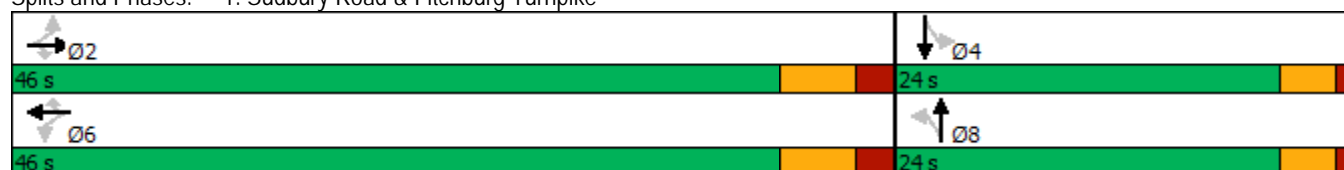
30th %ile Actuated Cycle: 40.9

10th %ile Actuated Cycle: 31.3

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






















Queue shown is maximum after two cycles.

Splits and Phases: 1: Sudbury Road & Fitchburg Turnpike















Lanes, Volumes, Timings
1: Sudbury Road & Fitchburg Turnpike

2020 Baseline Conditions
Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	74	169	6	114	699	269	12	127	23	150	201	100
Future Volume (vph)	74	169	6	114	699	269	12	127	23	150	201	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	175		50	120		20	0		0	160		0
Storage Lanes	1		1	1		1	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.981			0.950	
Flt Protected	0.950			0.950				0.996		0.950		
Satd. Flow (prot)	1787	1881	1615	1770	1881	1583	0	1842	0	1805	1764	0
Flt Permitted	0.261			0.649				0.967		0.674		
Satd. Flow (perm)	491	1881	1615	1209	1881	1583	0	1788	0	1281	1764	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			16			83		12			36	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1000			1000			1000			1000	
Travel Time (s)		22.7			22.7			22.7			22.7	
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Heavy Vehicles (%)	1%	1%	0%	2%	1%	2%	0%	1%	0%	0%	2%	3%
Adj. Flow (vph)	75	171	6	115	706	272	12	128	23	152	203	101
Shared Lane Traffic (%)												
Lane Group Flow (vph)	75	171	6	115	706	272	0	163	0	152	304	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6	20	20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	

Lanes, Volumes, Timings
1: Sudbury Road & Fitchburg Turnpike

2020 Baseline Conditions
Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2		2	6		6	8			4		
Detector Phase	2	2	2	6	6	6	8	8		4	4	
Switch Phase												
Minimum Initial (s)	12.0	12.0	12.0	12.0	12.0	12.0	7.0	7.0		7.0	7.0	
Minimum Split (s)	18.0	18.0	18.0	18.0	18.0	18.0	11.0	11.0		11.0	11.0	
Total Split (s)	46.0	46.0	46.0	46.0	46.0	46.0	24.0	24.0		24.0	24.0	
Total Split (%)	65.7%	65.7%	65.7%	65.7%	65.7%	65.7%	34.3%	34.3%		34.3%	34.3%	
Maximum Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	20.0	20.0		20.0	20.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		4.0		4.0	4.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	Min	Min	Min	Min	Min	Min	None	None		None	None	
Act Effect Green (s)	27.1	27.1	27.1	27.1	27.1	27.1		13.7		13.7	13.7	
Actuated g/C Ratio	0.52	0.52	0.52	0.52	0.52	0.52		0.26		0.26	0.26	
v/c Ratio	0.29	0.17	0.01	0.18	0.72	0.31		0.34		0.45	0.62	
Control Delay	10.9	7.1	1.7	7.5	14.3	5.9		18.7		23.3	22.6	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Total Delay	10.9	7.1	1.7	7.5	14.3	5.9		18.7		23.3	22.6	
LOS	B	A	A	A	B	A		B		C	C	
Approach Delay		8.1			11.5			18.7			22.8	
Approach LOS		A			B			B			C	
90th %ile Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	20.0	20.0		20.0	20.0	
90th %ile Term Code	Hold	Hold	Hold	Max	Max	Max	Hold	Hold		Max	Max	
70th %ile Green (s)	37.1	37.1	37.1	37.1	37.1	37.1	18.5	18.5		18.5	18.5	
70th %ile Term Code	Hold	Hold	Hold	Gap	Gap	Gap	Hold	Hold		Gap	Gap	
50th %ile Green (s)	28.0	28.0	28.0	28.0	28.0	28.0	13.4	13.4		13.4	13.4	
50th %ile Term Code	Hold	Hold	Hold	Gap	Gap	Gap	Hold	Hold		Gap	Gap	
30th %ile Green (s)	20.3	20.3	20.3	20.3	20.3	20.3	10.3	10.3		10.3	10.3	
30th %ile Term Code	Hold	Hold	Hold	Gap	Gap	Gap	Hold	Hold		Gap	Gap	
10th %ile Green (s)	13.5	13.5	13.5	13.5	13.5	13.5	7.4	7.4		7.4	7.4	
10th %ile Term Code	Hold	Hold	Hold	Gap	Gap	Gap	Hold	Hold		Gap	Gap	
Queue Length 50th (ft)	11	23	0	15	137	26		37		38	70	
Queue Length 95th (ft)	39	58	3	44	299	72		98		103	173	
Internal Link Dist (ft)		920			920			920			920	
Turn Bay Length (ft)	175		50	120		20				160		
Base Capacity (vph)	387	1483	1277	953	1483	1266		764		543	768	
Starvation Cap Reductn	0	0	0	0	0	0		0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0		0		0	0	
Storage Cap Reductn	0	0	0	0	0	0		0		0	0	
Reduced v/c Ratio	0.19	0.12	0.00	0.12	0.48	0.21		0.21		0.28	0.40	

Intersection Summary

Area Type: Other

Cycle Length: 70

Actuated Cycle Length: 51.7

Lanes, Volumes, Timings

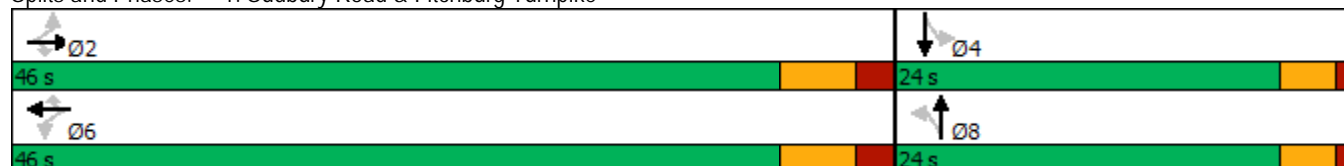
1: Sudbury Road & Fitchburg Turnpike

2020 Baseline Conditions
Weekday Evening Peak Hour

Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.72
Intersection Signal Delay: 14.3
Intersection Capacity Utilization 88.9%
Analysis Period (min) 15
90th %ile Actuated Cycle: 70
70th %ile Actuated Cycle: 65.6
50th %ile Actuated Cycle: 51.4
30th %ile Actuated Cycle: 40.6
10th %ile Actuated Cycle: 30.9






















Intersection LOS: B
ICU Level of Service E

Splits and Phases: 1: Sudbury Road & Fitchburg Turnpike















Lanes, Volumes, Timings
1: Sudbury Road & Fitchburg Turnpike

2027 No-Build Conditions
Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	83	601	16	20	178	80	30	221	85	158	89	86
Future Volume (vph)	83	601	16	20	178	80	30	221	85	158	89	86
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	175		50	120		20	0		0	160		0
Storage Lanes	1		1	1		1	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.966			0.927	
Flt Protected	0.950			0.950				0.996		0.950		
Satd. Flow (prot)	1736	1845	1429	1626	1845	1538	0	1735	0	1736	1631	0
Flt Permitted	0.639			0.254				0.964		0.459		
Satd. Flow (perm)	1167	1845	1429	435	1845	1538	0	1679	0	839	1631	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			16			85		24			69	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1000			1000			1000			1000	
Travel Time (s)		22.7			22.7			22.7			22.7	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	4%	3%	13%	11%	3%	5%	12%	5%	4%	4%	9%	7%
Adj. Flow (vph)	88	639	17	21	189	85	32	235	90	168	95	91
Shared Lane Traffic (%)												
Lane Group Flow (vph)	88	639	17	21	189	85	0	357	0	168	186	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6	20	20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	

Lanes, Volumes, Timings
1: Sudbury Road & Fitchburg Turnpike

2027 No-Build Conditions
Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2		2	6		6	8			4		
Detector Phase	2	2	2	6	6	6	8	8		4	4	
Switch Phase												
Minimum Initial (s)	12.0	12.0	12.0	12.0	12.0	12.0	7.0	7.0		7.0	7.0	
Minimum Split (s)	18.0	18.0	18.0	18.0	18.0	18.0	11.0	11.0		11.0	11.0	
Total Split (s)	46.0	46.0	46.0	46.0	46.0	46.0	24.0	24.0		24.0	24.0	
Total Split (%)	65.7%	65.7%	65.7%	65.7%	65.7%	65.7%	34.3%	34.3%		34.3%	34.3%	
Maximum Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	20.0	20.0		20.0	20.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		4.0		4.0	4.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	Min	Min	Min	Min	Min	Min	None	None		None	None	
Act Effect Green (s)	24.8	24.8	24.8	24.8	24.8	24.8		18.8		18.8	18.8	
Actuated g/C Ratio	0.46	0.46	0.46	0.46	0.46	0.46		0.35		0.35	0.35	
v/c Ratio	0.16	0.76	0.03	0.11	0.22	0.11		0.60		0.58	0.30	
Control Delay	8.9	18.2	3.9	9.0	9.1	2.4		21.3		28.7	12.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Total Delay	8.9	18.2	3.9	9.0	9.1	2.4		21.3		28.7	12.2	
LOS	A	B	A	A	A	A		C		C	B	
Approach Delay		16.8			7.2			21.3			20.0	
Approach LOS		B			A			C			B	
90th %ile Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	20.0	20.0		20.0	20.0	
90th %ile Term Code	Max	Max	Max	Hold	Hold	Hold	Max	Max		Max	Max	
70th %ile Green (s)	29.9	29.9	29.9	29.9	29.9	29.9	20.0	20.0		20.0	20.0	
70th %ile Term Code	Gap	Gap	Gap	Hold	Hold	Hold	Hold	Hold		Max	Max	
50th %ile Green (s)	24.7	24.7	24.7	24.7	24.7	24.7	20.0	20.0		20.0	20.0	
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold	Hold	Hold	Hold		Max	Max	
30th %ile Green (s)	20.0	20.0	20.0	20.0	20.0	20.0	19.0	19.0		19.0	19.0	
30th %ile Term Code	Gap	Gap	Gap	Hold	Hold	Hold	Hold	Hold		Gap	Gap	
10th %ile Green (s)	13.3	13.3	13.3	13.3	13.3	13.3	13.4	13.4		13.4	13.4	
10th %ile Term Code	Gap	Gap	Gap	Hold	Hold	Hold	Hold	Hold		Gap	Gap	
Queue Length 50th (ft)	16	163	0	4	35	0		83		42	25	
Queue Length 95th (ft)	35	259	7	14	64	16		#243		#155	88	
Internal Link Dist (ft)		920			920			920			920	
Turn Bay Length (ft)	175		50	120		20				160		
Base Capacity (vph)	883	1397	1086	329	1397	1185		665		325	674	
Starvation Cap Reductn	0	0	0	0	0	0		0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0		0		0	0	
Storage Cap Reductn	0	0	0	0	0	0		0		0	0	
Reduced v/c Ratio	0.10	0.46	0.02	0.06	0.14	0.07		0.54		0.52	0.28	

Intersection Summary

Area Type: Other

Cycle Length: 70

Actuated Cycle Length: 54.1

Lanes, Volumes, Timings

1: Sudbury Road & Fitchburg Turnpike

2027 No-Build Conditions
Weekday Evening Peak Hour

Natural Cycle: 50

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.76

Intersection Signal Delay: 16.7

Intersection Capacity Utilization 86.7%

Analysis Period (min) 15

90th %ile Actuated Cycle: 70

70th %ile Actuated Cycle: 59.9

50th %ile Actuated Cycle: 54.7

30th %ile Actuated Cycle: 49

10th %ile Actuated Cycle: 36.7

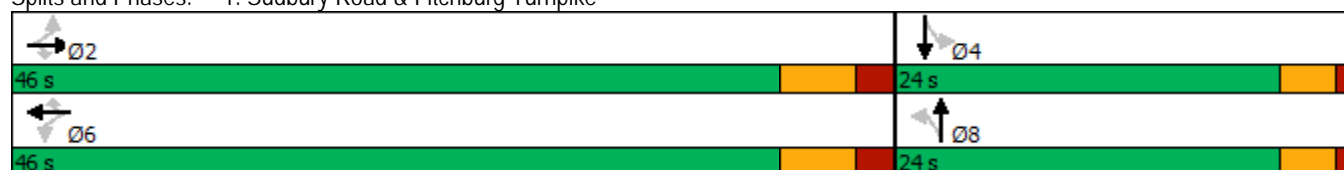
95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Intersection LOS: B






















ICU Level of Service E

Splits and Phases: 1: Sudbury Road & Fitchburg Turnpike















Lanes, Volumes, Timings
1: Sudbury Road & Fitchburg Turnpike

2027 No-Build Conditions
Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	90	206	7	122	785	288	14	136	25	161	215	112
Future Volume (vph)	90	206	7	122	785	288	14	136	25	161	215	112
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	175		50	120		20	0		0	160		0
Storage Lanes	1		1	1		1	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor										0.74		
Frt			0.850			0.850		0.981			0.949	
Flt Protected	0.950			0.950				0.996		0.950		
Satd. Flow (prot)	1787	1881	1615	1770	1881	1583	0	1842	0	1805	1762	0
Flt Permitted	0.197			0.628				0.963		0.629		
Satd. Flow (perm)	371	1881	1615	1170	1881	1583	0	1781	0	886	1762	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			16			79		12			37	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1000			1000			1000			1000	
Travel Time (s)		22.7			22.7			22.7			22.7	
Confl. Peds. (#/hr)										215		
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Heavy Vehicles (%)	1%	1%	0%	2%	1%	2%	0%	1%	0%	0%	2%	3%
Adj. Flow (vph)	91	208	7	123	793	291	14	137	25	163	217	113
Shared Lane Traffic (%)												
Lane Group Flow (vph)	91	208	7	123	793	291	0	176	0	163	330	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6	20	20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lanes, Volumes, Timings
1: Sudbury Road & Fitchburg Turnpike

2027 No-Build Conditions
Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2		2	6		6	8			4		
Detector Phase	2	2	2	6	6	6	8	8		4	4	
Switch Phase												
Minimum Initial (s)	12.0	12.0	12.0	12.0	12.0	12.0	7.0	7.0		7.0	7.0	
Minimum Split (s)	18.0	18.0	18.0	18.0	18.0	18.0	11.0	11.0		11.0	11.0	
Total Split (s)	46.0	46.0	46.0	46.0	46.0	46.0	24.0	24.0		24.0	24.0	
Total Split (%)	65.7%	65.7%	65.7%	65.7%	65.7%	65.7%	34.3%	34.3%		34.3%	34.3%	
Maximum Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	20.0	20.0		20.0	20.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		4.0		4.0	4.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	Min	Min	Min	Min	Min	Min	None	None		None	None	
Act Effect Green (s)	31.0	31.0	31.0	31.0	31.0	31.0		15.8		15.8	15.8	
Actuated g/C Ratio	0.54	0.54	0.54	0.54	0.54	0.54		0.27		0.27	0.27	
v/c Ratio	0.46	0.21	0.01	0.20	0.78	0.33		0.35		0.67	0.65	
Control Delay	17.6	7.7	1.9	8.1	17.4	6.6		19.8		36.9	24.5	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Total Delay	17.6	7.7	1.9	8.1	17.4	6.6		19.8		36.9	24.5	
LOS	B	A	A	A	B	A		B		D	C	
Approach Delay		10.5			13.9			19.8			28.6	
Approach LOS		B			B			B			C	
90th %ile Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	20.0	20.0		20.0	20.0	
90th %ile Term Code	Hold	Hold	Hold	Max	Max	Max	Hold	Hold		Max	Max	
70th %ile Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	20.0	20.0		20.0	20.0	
70th %ile Term Code	Hold	Hold	Hold	Max	Max	Max	Hold	Hold		Max	Max	
50th %ile Green (s)	36.1	36.1	36.1	36.1	36.1	36.1	19.2	19.2		19.2	19.2	
50th %ile Term Code	Hold	Hold	Hold	Gap	Gap	Gap	Hold	Hold		Gap	Gap	
30th %ile Green (s)	25.2	25.2	25.2	25.2	25.2	25.2	12.9	12.9		12.9	12.9	
30th %ile Term Code	Hold	Hold	Hold	Gap	Gap	Gap	Hold	Hold		Gap	Gap	
10th %ile Green (s)	16.2	16.2	16.2	16.2	16.2	16.2	8.3	8.3		8.3	8.3	
10th %ile Term Code	Hold	Hold	Hold	Gap	Gap	Gap	Hold	Hold		Gap	Gap	
Queue Length 50th (ft)	19	38	0	22	221	39		50		56	99	
Queue Length 95th (ft)	61	69	3	48	367	80		105		#144	190	
Internal Link Dist (ft)		920			920			920			920	
Turn Bay Length (ft)	175		50	120		20				160		
Base Capacity (vph)	266	1349	1163	839	1349	1158		674		332	683	
Starvation Cap Reductn	0	0	0	0	0	0		0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0		0		0	0	
Storage Cap Reductn	0	0	0	0	0	0		0		0	0	
Reduced v/c Ratio	0.34	0.15	0.01	0.15	0.59	0.25		0.26		0.49	0.48	

Intersection Summary

Area Type: Other

Lanes, Volumes, Timings

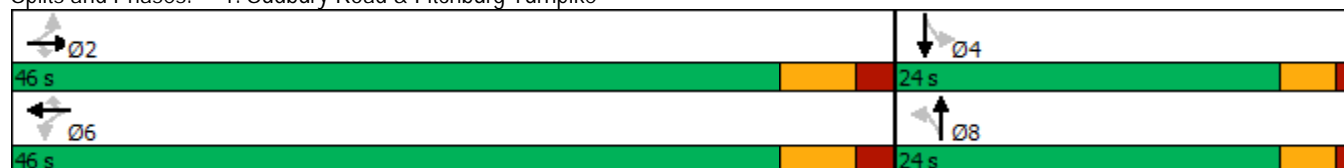
1: Sudbury Road & Fitchburg Turnpike

2027 No-Build Conditions
Weekday Evening Peak Hour

Cycle Length: 70
Actuated Cycle Length: 57.6
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 17.2
Intersection Capacity Utilization 95.6%
Analysis Period (min) 15
90th %ile Actuated Cycle: 70
70th %ile Actuated Cycle: 70
50th %ile Actuated Cycle: 65.3
30th %ile Actuated Cycle: 48.1
10th %ile Actuated Cycle: 34.5
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.






















Intersection LOS: B
ICU Level of Service F

Splits and Phases: 1: Sudbury Road & Fitchburg Turnpike















Lanes, Volumes, Timings
1: Sudbury Road & Fitchburg Turnpike

2020 Build Conditions
Weekday Morning Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	104	626	16	20	186	80	30	221	85	158	89	93
Future Volume (vph)	104	626	16	20	186	80	30	221	85	158	89	93
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	175		50	120		20	0		0	160		0
Storage Lanes	1		1	1		1	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.966			0.923	
Flt Protected	0.950			0.950				0.996		0.950		
Satd. Flow (prot)	1736	1845	1429	1626	1845	1538	0	1735	0	1736	1624	0
Flt Permitted	0.633			0.240				0.963		0.448		
Satd. Flow (perm)	1156	1845	1429	411	1845	1538	0	1677	0	818	1624	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			16			85		24			75	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1000			1000			1000			1000	
Travel Time (s)		22.7			22.7			22.7			22.7	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles (%)	4%	3%	13%	11%	3%	5%	12%	5%	4%	4%	9%	7%
Adj. Flow (vph)	111	666	17	21	198	85	32	235	90	168	95	99
Shared Lane Traffic (%)												
Lane Group Flow (vph)	111	666	17	21	198	85	0	357	0	168	194	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6	20	20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	

Lanes, Volumes, Timings
1: Sudbury Road & Fitchburg Turnpike

2020 Build Conditions
Weekday Morning Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	2		2	6		6	8			4		
Detector Phase	2	2	2	6	6	6	8	8		4	4	
Switch Phase												
Minimum Initial (s)	12.0	12.0	12.0	12.0	12.0	12.0	7.0	7.0		7.0	7.0	
Minimum Split (s)	18.0	18.0	18.0	18.0	18.0	18.0	11.0	11.0		11.0	11.0	
Total Split (s)	46.0	46.0	46.0	46.0	46.0	46.0	24.0	24.0		24.0	24.0	
Total Split (%)	65.7%	65.7%	65.7%	65.7%	65.7%	65.7%	34.3%	34.3%		34.3%	34.3%	
Maximum Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	20.0	20.0		20.0	20.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		4.0		4.0	4.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	Min	Min	Min	Min	Min	Min	None	None		None	None	
Act Effect Green (s)	26.3	26.3	26.3	26.3	26.3	26.3		18.9		18.9	18.9	
Actuated g/C Ratio	0.47	0.47	0.47	0.47	0.47	0.47		0.34		0.34	0.34	
v/c Ratio	0.20	0.76	0.02	0.11	0.23	0.11		0.61		0.61	0.32	
Control Delay	9.1	18.3	3.8	8.9	9.0	2.3		22.4		31.2	12.5	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Total Delay	9.1	18.3	3.8	8.9	9.0	2.3		22.4		31.2	12.5	
LOS	A	B	A	A	A	A		C		C	B	
Approach Delay		16.7			7.1			22.4			21.2	
Approach LOS		B			A			C			C	
90th %ile Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	20.0	20.0		20.0	20.0	
90th %ile Term Code	Max	Max	Max	Hold	Hold	Hold	Max	Max		Max	Max	
70th %ile Green (s)	32.4	32.4	32.4	32.4	32.4	32.4	20.0	20.0		20.0	20.0	
70th %ile Term Code	Gap	Gap	Gap	Hold	Hold	Hold	Max	Max		Max	Max	
50th %ile Green (s)	26.8	26.8	26.8	26.8	26.8	26.8	20.0	20.0		20.0	20.0	
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold	Hold	Hold	Hold		Max	Max	
30th %ile Green (s)	21.9	21.9	21.9	21.9	21.9	21.9	19.4	19.4		19.4	19.4	
30th %ile Term Code	Gap	Gap	Gap	Hold	Hold	Hold	Hold	Hold		Gap	Gap	
10th %ile Green (s)	13.9	13.9	13.9	13.9	13.9	13.9	13.4	13.4		13.4	13.4	
10th %ile Term Code	Gap	Gap	Gap	Hold	Hold	Hold	Hold	Hold		Gap	Gap	
Queue Length 50th (ft)	21	174	0	4	37	0		89		45	28	
Queue Length 95th (ft)	43	277	7	14	66	16		#244		#158	90	
Internal Link Dist (ft)		920			920			920			920	
Turn Bay Length (ft)	175		50	120		20				160		
Base Capacity (vph)	854	1364	1060	303	1364	1159		647		308	658	
Starvation Cap Reductn	0	0	0	0	0	0		0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0		0		0	0	
Storage Cap Reductn	0	0	0	0	0	0		0		0	0	
Reduced v/c Ratio	0.13	0.49	0.02	0.07	0.15	0.07		0.55		0.55	0.29	

Intersection Summary

Area Type: Other

Cycle Length: 70

Actuated Cycle Length: 55.6

Lanes, Volumes, Timings

1: Sudbury Road & Fitchburg Turnpike

2020 Build Conditions
Weekday Morning Peak Hour

Natural Cycle: 50

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.76

Intersection Signal Delay: 17.1

Intersection LOS: B

Intersection Capacity Utilization 88.5%

ICU Level of Service E

Analysis Period (min) 15

90th %ile Actuated Cycle: 70

70th %ile Actuated Cycle: 62.4

50th %ile Actuated Cycle: 56.8

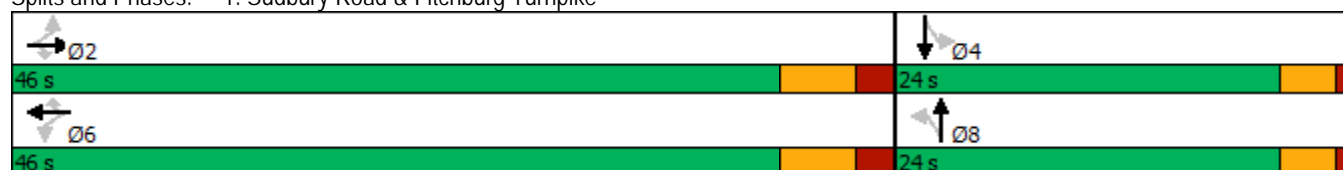
30th %ile Actuated Cycle: 51.3

10th %ile Actuated Cycle: 37.3

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






















Queue shown is maximum after two cycles.

Splits and Phases: 1: Sudbury Road & Fitchburg Turnpike



Lanes, Volumes, Timings
1: Sudbury Road & Fitchburg Turnpike













2027 Build Conditions
Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	103	222	7	122	810	288	14	136	25	161	215	133
Future Volume (vph)	103	222	7	122	810	288	14	136	25	161	215	133
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	175		50	120		20	0		0	160		0
Storage Lanes	1		1	1		1	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor										0.74		
Fr't			0.850			0.850		0.981			0.943	
Flt Protected	0.950			0.950				0.996		0.950		
Satd. Flow (prot)	1787	1881	1615	1770	1881	1583	0	1842	0	1805	1750	0
Flt Permitted	0.183			0.619				0.961		0.624		
Satd. Flow (perm)	344	1881	1615	1153	1881	1583	0	1777	0	878	1750	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			16			77		12			44	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1000			1000			1000			1000	
Travel Time (s)		22.7			22.7			22.7			22.7	
Confl. Peds. (#/hr)										215		
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Heavy Vehicles (%)	1%	1%	0%	2%	1%	2%	0%	1%	0%	0%	2%	3%
Adj. Flow (vph)	104	224	7	123	818	291	14	137	25	163	217	134
Shared Lane Traffic (%)												
Lane Group Flow (vph)	104	224	7	123	818	291	0	176	0	163	351	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2	1	1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100	20	20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0	0	0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6	20	20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	

Lanes, Volumes, Timings
1: Sudbury Road & Fitchburg Turnpike

2027 Build Conditions

Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2			6			8				4
Permitted Phases	2		2	6		6	8			4		
Detector Phase	2	2	2	6	6	6	8	8		4	4	
Switch Phase												
Minimum Initial (s)	12.0	12.0	12.0	12.0	12.0	12.0	7.0	7.0		7.0	7.0	
Minimum Split (s)	18.0	18.0	18.0	18.0	18.0	18.0	11.0	11.0		11.0	11.0	
Total Split (s)	46.0	46.0	46.0	46.0	46.0	46.0	24.0	24.0		24.0	24.0	
Total Split (%)	65.7%	65.7%	65.7%	65.7%	65.7%	65.7%	34.3%	34.3%		34.3%	34.3%	
Maximum Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	20.0	20.0		20.0	20.0	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		4.0		4.0	4.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	Min	Min	Min	Min	Min	Min	None	None		None	None	
Act Effect Green (s)	31.9	31.9	31.9	31.9	31.9	31.9		15.9		15.9	15.9	
Actuated g/C Ratio	0.54	0.54	0.54	0.54	0.54	0.54		0.27		0.27	0.27	
v/c Ratio	0.56	0.22	0.01	0.20	0.80	0.32		0.36		0.68	0.69	
Control Delay	23.3	7.8	1.9	8.1	18.2	6.6		20.1		38.4	26.0	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	
Total Delay	23.3	7.8	1.9	8.1	18.2	6.6		20.1		38.4	26.0	
LOS	C	A	A	A	B	A		C		D	C	
Approach Delay		12.5			14.4			20.1			30.0	
Approach LOS		B			B			C			C	
90th %ile Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	20.0	20.0		20.0	20.0	
90th %ile Term Code	Max	Max	Max	Max	Max	Max	Hold	Hold		Max	Max	
70th %ile Green (s)	40.0	40.0	40.0	40.0	40.0	40.0	20.0	20.0		20.0	20.0	
70th %ile Term Code	Hold	Hold	Hold	Max	Max	Max	Hold	Hold		Max	Max	
50th %ile Green (s)	37.6	37.6	37.6	37.6	37.6	37.6	19.6	19.6		19.6	19.6	
50th %ile Term Code	Hold	Hold	Hold	Gap	Gap	Gap	Hold	Hold		Gap	Gap	
30th %ile Green (s)	27.1	27.1	27.1	27.1	27.1	27.1	13.2	13.2		13.2	13.2	
30th %ile Term Code	Hold	Hold	Hold	Gap	Gap	Gap	Hold	Hold		Gap	Gap	
10th %ile Green (s)	17.0	17.0	17.0	17.0	17.0	17.0	8.3	8.3		8.3	8.3	
10th %ile Term Code	Hold	Hold	Hold	Gap	Gap	Gap	Hold	Hold		Gap	Gap	
Queue Length 50th (ft)	25	42	0	23	237	41		52		58	109	
Queue Length 95th (ft)	#87	75	3	48	388	80		105		#145	201	
Internal Link Dist (ft)		920			920			920			920	
Turn Bay Length (ft)	175		50	120		20				160		
Base Capacity (vph)	243	1329	1145	814	1329	1141		659		321	669	
Starvation Cap Reductn	0	0	0	0	0	0		0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0		0		0	0	
Storage Cap Reductn	0	0	0	0	0	0		0		0	0	
Reduced v/c Ratio	0.43	0.17	0.01	0.15	0.62	0.26		0.27		0.51	0.52	

Intersection Summary

Area Type: Other

Lanes, Volumes, Timings

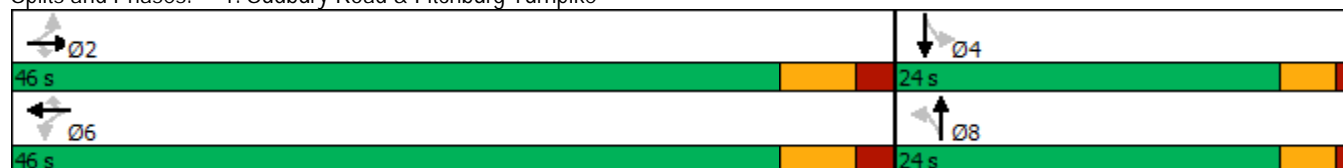
1: Sudbury Road & Fitchburg Turnpike

2027 Build Conditions
Weekday Evening Peak Hour

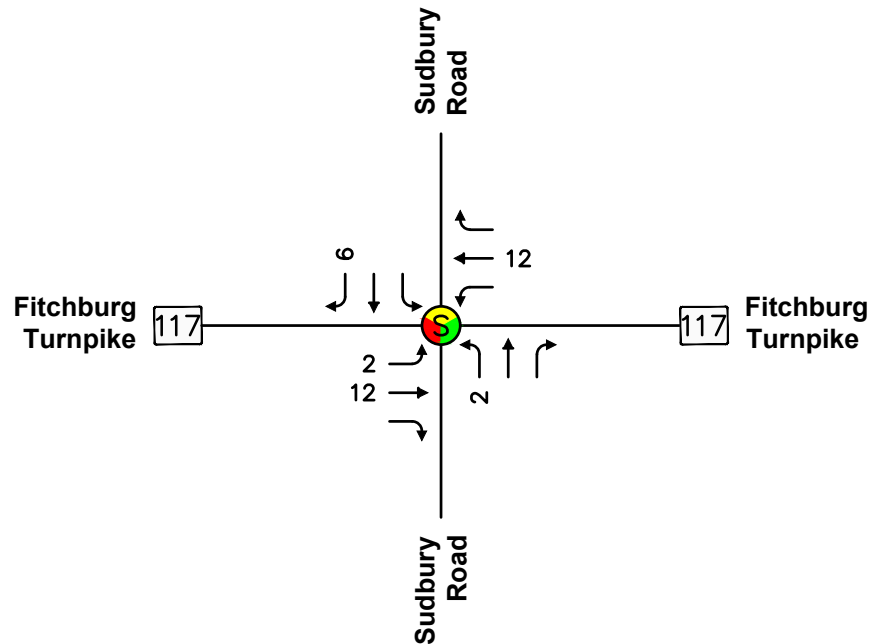
Cycle Length: 70
Actuated Cycle Length: 58.6
Natural Cycle: 55
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 18.1
Intersection Capacity Utilization 98.2%
Analysis Period (min) 15
90th %ile Actuated Cycle: 70
70th %ile Actuated Cycle: 70
50th %ile Actuated Cycle: 67.2
30th %ile Actuated Cycle: 50.3
10th %ile Actuated Cycle: 35.3
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Intersection LOS: B
ICU Level of Service F

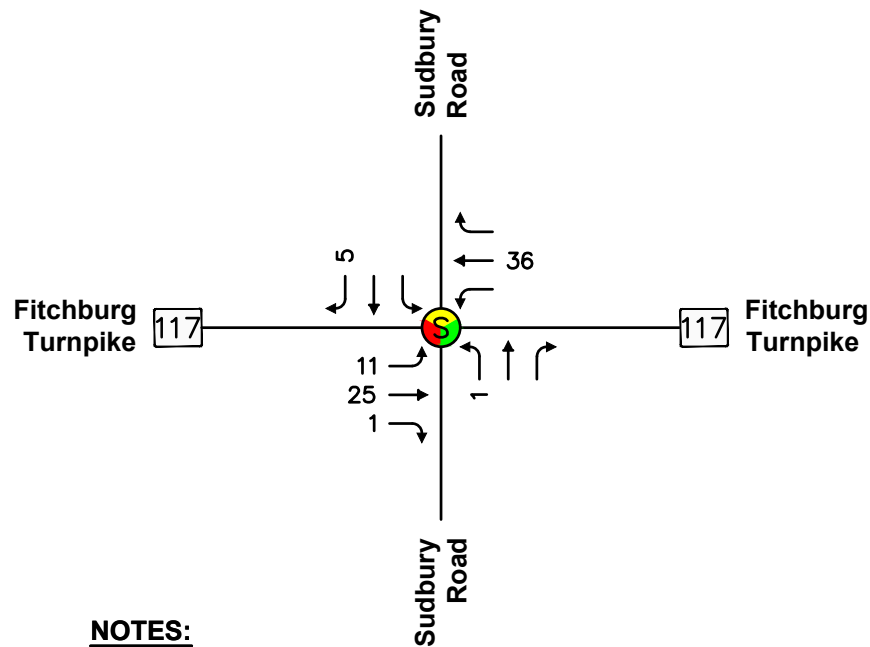
Splits and Phases: 1: Sudbury Road & Fitchburg Turnpike



□ Background Projects



Weekday Morning Peak Hour



Weekday Evening Peak Hour



North

Scale: Not to Scale

NOTES:

NEGL.= Negligible



= Signalized Intersection

- Traffic Signal Inventory

2. Route 117 at Sudbury Road

Jurisdiction:	Town of Concord
Controller Make:	Naztec
Controller Model:	980
Software Version:	unknown
Cabinet Architecture:	TS-2
Cabinet Size:	NEMA Size 6 (44" W x 25.5" D x 56" H)
Cabinet Assembly Date:	March-2013
Signal Phases:	2-Phase (E/W, N/S)
Vehicle Detection Type:	Video
Vehicle Detection Make:	Traficon
Vehicle Detection Model:	T1 x-stream edge
Number of Channels of Vehicle Detection:	4 (1 - Eastbound, 2 - Southbound, 3 - Westbound, 4 - Northbound)
Malfunctioning Vehicle Detection Channels:	Channel 4 – Sudbury Road Northbound
Operating Mode:	Fully Actuated
Maximum Green 1 Hours:	All Times
Maximum Green 1 Duration:	Route 117 E/W: 40 Seconds Sudbury Road N/S: 20 Seconds
Maximum Green 2 Hours:	None
Maximum Green 2 Duration:	Route 117 E/W: 40 Seconds Sudbury Road N/S: 20 Seconds
Number of Mast Arms:	3

2. Fitchburg Turnpike (Route 117) at Sudbury Road

This intersection operates with two vehicle phases (E/W and N/S). The signal provides up to 40 seconds of green time for Route 117 traffic at all times of the day. This duration is much shorter than the 60-70 seconds provided at the Pantry/Dakin Road intersection. The signal cabinet is in new condition. The controller is an a Naztec 980 which is also in new condition. The intersection has video vehicle detectors installed on all four approach roadways. Three of the four video cameras were observed to be functioning properly. The Sudbury Road northbound approach is not functioning and places a constant call for the north/south vehicle signal phase. The intersection has three traffic signal mast arms.

As with the Pantry Road/Dakin Road intersection, a number of vehicles traveling eastbound along Route 117 during the morning peak period were observed to allow a large gap to open between their vehicle and the vehicle in front of them. This gap was similarly interpreted as if all demand had been served on the east/west approaches and ended the green interval before reaching the maximum green duration in order to serve demand on the north/south approaches. Meanwhile a large queue of eastbound vehicles was present behind the lead vehicle. The traffic volume was observed to be mostly eastbound vehicles during the morning peak period. It is expected that the afternoon volume would mostly be westbound vehicles. It is also expected that the same queuing behavior can be observed during the afternoon peak period.