



Charles D. Baker, Governor  
Karyn E. Polito, Lieutenant Governor  
Stephanie Pollack, Secretary & CEO  
Jonathan L. Gulliver, Highway Administrator



March 16, 2018

Leon Gaumond Jr.  
Town Administrator  
Town of Sturbridge  
308 Main Street  
Sturbridge, MA 01566

Dear Mr. Gaumond

MassDOT has recently completed a study of the Route 20 at New Boston Road intersection in the Town of Sturbridge. This study was the result of a number of inquiries that we received requesting improvements at this location.

MassDOT has evaluated a number of roadway improvement alternatives including signalization and restricting left-turns into and out of New Boston Road from Route 20. The recommended alternative will physically prohibit left-turns out of New Boston Road. These improvements will also require additional improvements at the Route 20/Route 131 intersection to help facilitate the U-turn movements for vehicles to access Route 20 eastbound. MassDOT intends to work towards implementation of this alternative. The complete study is enclosed with this letter.

If you need any additional assistance or information regarding the implementation of these improvements, please do not hesitate to contact the MassDOT District 3 Traffic section at (508) 929-3906.

Sincerely,

Barry J. Lorion  
Acting District Highway Director

cc: Traffic Correspondence File  
M.O. File



## INTEROFFICE MEMORANDUM

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**TO:** Barry Lorian, Acting District 3 Highway Director  
**FROM:** Erin Kinahan, District 3 Traffic Engineer  
**DATE:** March 16, 2018  
**SUBJECT:** Sturbridge –Route 20 at New Boston Road

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District Traffic Engineering staff recently evaluated traffic and safety operations at the New Boston Road/ Route 20 intersection in Sturbridge Massachusetts. This study was a result of a number of inquiries citing the need for improvements at this location. Key findings of the report include the following:

The intersection experienced a total of 14 crashes over the four year period between January 2013-December 2016. Half of these collisions, 7 total, were angle collisions with five crashes impacting vehicles either entering or exiting New Boston Road. The intersection is not eligible for Highway Safety Improvement Program funding since it does not exceed the top 5% of crash clusters in the Central Massachusetts region.

The intersection meets the Traffic Signal Warrant 1 for signalization based on the volume of vehicles exiting New Boston Road and vehicle speeds in excess of 40 mph. However signalization of this intersection is not desirable at this time due to the potential for increased crashes related to the high speeds along the Route 20 corridor.

Four separate alternatives were evaluated as part of this evaluation including: No improvements, signalization, restricting left-turns into and out of New Boston Road, and restricting left-turns out of New Boston Road.

Restricting left-turns out of New Boston Road is our preferred alternative. Improvements at the Route 20/Route 131 intersection including construction of a U-turn bubble and improvements to the left turn lane will be needed as part of this alternative. The full evaluation is provided on the following pages.

## **INTRODUCTION**

The Massachusetts Department of Transportation (MassDOT), Highway Division District 3 Traffic Engineering section has completed a study of traffic and safety operations at the intersection of Route 20 at New Boston Road in the Town of Sturbridge. This study was initiated as a result of several complaints citing the need for improvements due to a number of recent collisions at this intersection. The intersection of Route 20 at New Boston Road is unsignalized with vehicles exiting from New Boston Road under STOP-Control and vehicles turning left into New Boston Road expected to yield to Route 20 westbound. This report summarizes the methodology of the engineering study, describes the results of engineering study and considers several options for changing the operation of the intersection.

## **METHODOLOGY**

Existing traffic volume data was collected by MassDOT in October/November 2017. This data included automatic traffic recorder (ATR) counts on Route 20 and New Boston Road and turning movement counts (TMC) at the intersection of Route 20 at New Boston Road. Crash data for the most recent 4 years (January 2013 – December 2016) was supplied by the MassDOT Traffic and Safety section as well as the Town of Sturbridge. The crash data was also used to calculate a crash rate for the intersection.

As part of the traffic study, an analysis was performed using the traffic volume data and crash data to determine if a traffic signal would be warranted at the intersection. The traffic volume data was used to determine if the volume-based traffic signal warrants are met. The crash data was used to determine if the crash experience traffic signal warrant is met.

Alternatives were developed that may address the safety concerns at the Route 20/New Boston Road. In the 'Alternatives' section of this report, each alternative is described and the potential benefit of each alternative is discussed. It should be noted that each alternative has been evaluated at a conceptual level only.

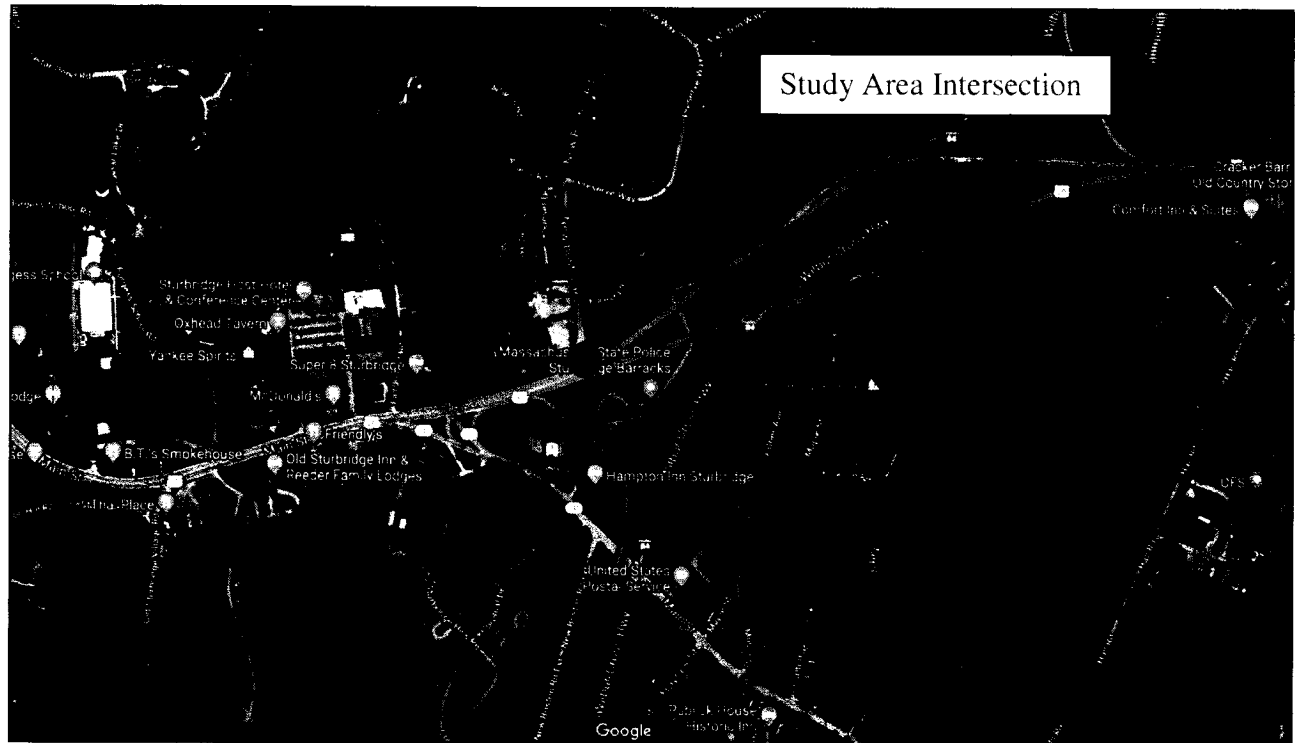
## **Existing Conditions**

### **Roadway Geometry**

Route 20 is a multi-lane median divided roadway that runs in the east-west direction and generally parallels the I-90 (MassTurnpike) in the vicinity of the study area intersection. This intersection is located approximately 1,500 feet west of the I-84/Route 20 interchange. The Route 20 eastbound approach consists of two through lanes with an additional storage lane provided for vehicles turning left onto New Boston Road. The Route 20 westbound approach consists of two through lanes with an additional small deceleration lane for right-turning vehicles. The posted speed limit along Route 20 in the vicinity of New Boston Road is 45 mph however approximately 100 feet from New Boston Road the speed limit is reduced to 30 mph.

New Boston Road consists of one lane in each direction with additional shoulder width provided for vehicles turning right out of New Boston Road onto Route 20 westbound.

**Figure 1 Study Area**



## **Traffic Volumes**

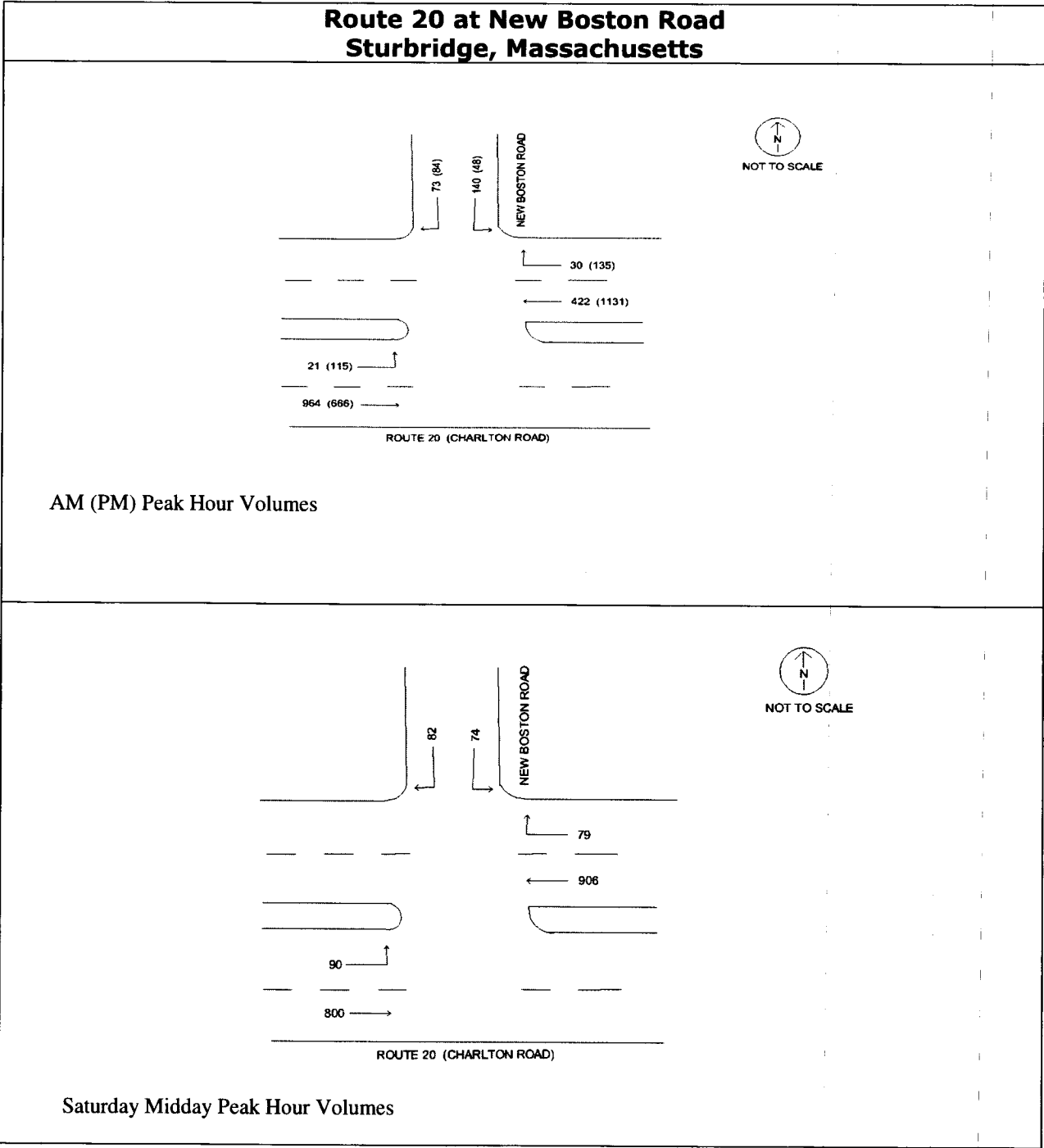
In order to determine the average daily vehicular traffic along Route 20, daily automatic traffic recorder (ATR) counts and peak hour turning movement traffic (TMC) counts were conducted between October 31, 2017 and November 4, 2017. ATRs were placed for a 48-hour period and peak hour turning movement counts were collected during the morning peak period (7:00 AM to 9:00 AM), the evening peak period (4:00 PM to 6:00 PM), and the Saturday peak period (11:00 AM to 2:00 PM). Speed data was also collected with the automatic traffic recorder counts. The results of the ATRs are presented below in Table 1.

**Table 1      Traffic Volume Speed Summary with 85% Speed Data**

Roadway	Direction		Total	85% Speed (mph)	
	Eastbound	Westbound		Eastbound	Westbound
Route 20, West of New Boston Road	10,988	11,406	22,394	50	45
Route 20, East of New Boston Road	11,328	11,266	22,594	49	49
			Total		
	Northbound	Southbound		Northbound	Southbound
New Boston Road	2,076	2,033	4,109	32	31

The turning movement counts indicate that the morning peak hour occurs between 7:00-8:00 am and the evening peak hour occurs between 4:15-5:15 pm. The Saturday peak hour occurs between 12:15 pm and 1:15 pm. The majority of vehicles exiting New Boston Road during the morning peak hour are turning left which closely matches the same amount of vehicles turning right into New Boston Road during the evening peak hour. The number of vehicles turning right out of New Boston Road is consistent, 70-85 vehicles, among the three peak hours evaluated. During the evening peak hour 120 vehicles were observed turning left onto New Boston Road from Route 20 EB. As presented in Table 1, there is no dominant movement of vehicles along Route 20 as the EB and WB directions vary slightly.

**Figure 2    Peak Hour Turning Movement Counts**



## SAFETY ANALYSIS

In total, 14 crashes occurred at the intersection of Route 20 at New Boston Road for the 4 year period studied. A summary of the number of crashes by severity and by year is shown in Table 2.

**Table 2: Crash Summary by Severity and by Year**

	2013	2014	2015	2016	4 Year Total
Property Damage Only	4	1	3	4	12
Injury Crashes	0	0	0	2	2
Fatal Crashes	0	0	0	0	0
Total	4	1	3	6	14

Key findings of the safety analysis include: of the 14 reported crashes, 12 (86%) were categorized as property damage only, nearly half (43%) of the crashes occurred in 2016, and there were no fatal crashes reported at this intersection during the 4 year study period.

A safety analysis can also be useful to determine if a significant number of crashes occur during one specific time of day (the morning peak period, midday, the evening peak hour, or the rest of the day). A summary of the number of crashes by time of day is shown in Table 3.

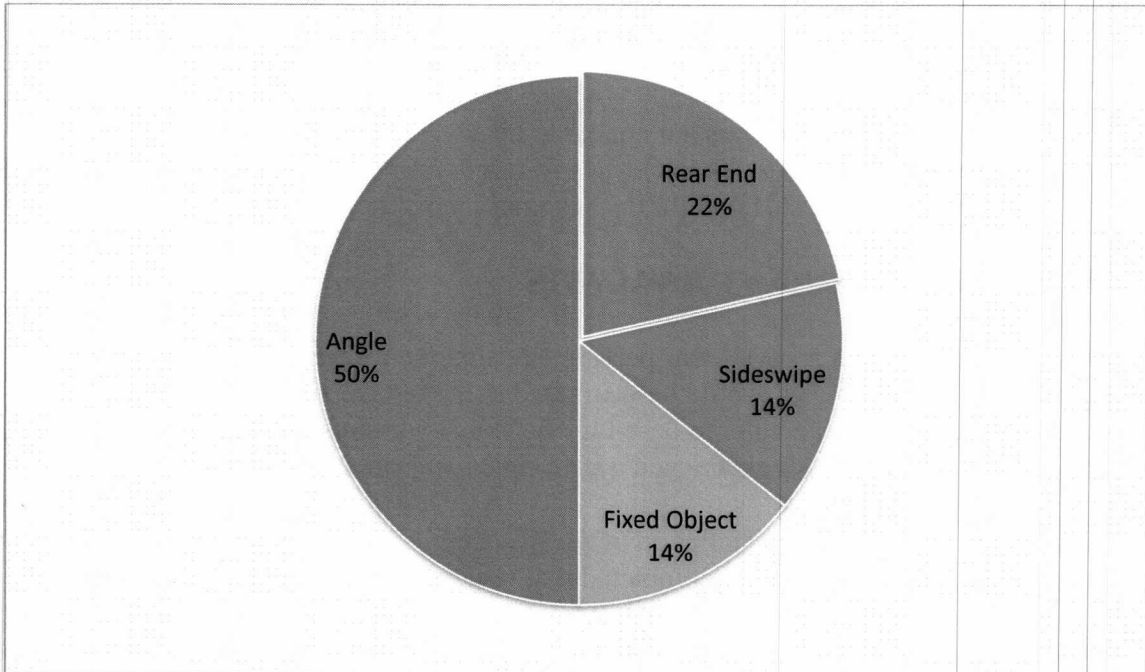
**Table 3: Crash Summary by Time of Day**

	2013	2014	2015	2016	4 Year Total
Morning (7:00 AM - 10:00 AM)	1	0	1	0	2
Midday (10:00 AM - 4:00 PM)	2	1	0	2	5
Evening (4:00 PM - 6:00 PM)	0	0	1	4	5
Rest of the Day (6:00 PM - 7:00 AM)	1	0	1	0	2
Total	4	1	3	6	14

Based on the information presented in Table 3, many of the crashes occurred in the midday and evening peak time frames with a total of five (36%) crashes occurring during each of these respective time frames (10:00 AM-4:00 PM and 4:00 PM-6:00 PM). However, there appears to be a trend of increasing peak hour crashes at this location with four of the six crashes recorded in 2016 occurring during this time frame (4:00 PM-6:00 PM).

Additionally, we determined the type of collision (for example: fixed object, rear-end, and broadside) for each crash that was reported. A pie chart showing the percentage of the total number of crashes that is of a particular type is shown in Figure 3.

**Figure 3: Crash Summary by Type**



Half of the crashes (50%) that occurred at the intersection were cross-movement collisions. These crashes are classified in Chart 1 as angle crashes. A collision diagram, showing where each crash occurred, is provided in the appendix.

The collision diagram shows four of the angle crashes were collisions involving a vehicle exiting New Boston Road colliding with a vehicle traveling on Route 20 westbound. The remaining crashes involved a vehicle entering New Boston Road from Route 20 eastbound, a vehicle making a U-turn from Route 20 eastbound to Route 20 westbound and a vehicle turning right into New Boston Road from Route 20 westbound. None of the angle crashes involving vehicle entering or exiting New Boston Road resulted in a personal injury. However, one of the personal injury accidents was a rear-end collision involving vehicles exiting New Boston Road.

A crash rate, in crashes per million entering vehicles (MEV), was calculated for the intersection. The crash rate can be an effective tool to measure the relative safety at a particular location, by comparing the crash rate at the study intersection to the average crash rate for unsignalized intersections statewide and for District 3. The crash rate for the intersection for the 4 year period studied is 0.39 crashes per MEV. This crash rate is lower than both the Statewide (0.58 crashes per MEV) and the District 3 (0.65 crashes per MEV) average crash rate for unsignalized intersections. Typically, improvements at an intersection to address safety concerns are not warranted if the crash rate is below the average crash rate.

One other factor that we use to identify intersection improvement projects is HSIP eligibility. The Highway Safety Improvement program (HSIP) is a federal program that provides a dedicated funding source for safety improvements at eligible locations. The proposed improvements must correct or improve a hazardous road location or addresses a highway safety



problem. In order to qualify for this program, the “equivalent property damage only” crashes in the cluster must fall within the top 5% of all clusters in that region. Based on the crash data for the 4-year study period, the New Boston Road/Route 20 intersection does not meet the threshold for HSIP funding.

Based on our safety analysis, there does not appear to be a significant crash problem at this intersection. However the recent uptick in crashes warrants further review of this intersection in the near future, as crash data for 2017 and 2018 becomes available.

## **TRAFFIC SIGNAL WARRANT ANALYSIS**

As part of the traffic study, an analysis was performed using the traffic volume data and crash data to determine if a traffic signal would be warranted at the intersection. The traffic volume data was used to determine if the volume-based traffic signal warrants are met. The crash data was used to determine if the crash experience traffic signal warrant is met.

In order to determine whether the installation of a traffic control signal is justified at a particular location, an engineering study must be completed that reviews traffic conditions, as well as pedestrian and physical characteristics of the intersection. The Manual of Uniform Traffic Control Devices (MUTCD) identifies nine warrants that could justify the installation of a traffic control signal as shown in Table 4.

**Table 4 – MUTCD Traffic Control Signal Warrants**

Warrant No.	Warrant Name
1	Eight-Hour Vehicular Volume
2	Four-Hour Vehicular Volume
3	Peak Hour
4	Pedestrian Volume
5	School Crossing
6	Coordinated Signal System
7	Crash Experience
8	Roadway Network
9	Intersection Near a Grade Crossing

The three traffic volume warrants (Warrants 1, 2 and 3) were evaluated for the study intersection. However, it should be noted that MassDOT generally expects Warrant 1, Eight-Hour Vehicular Volume, to be met for the installation of any proposed traffic signal on State Highway as outlined in the Massachusetts Amendments to the 2009 MUTCD and the Standard Municipal Traffic Code, January 2012. In order to satisfy Warrant 1, based on criteria for when the major street speed exceeds 40 miles per hour (mph) as observed on Route 20, at least one of two conditions must be met:

- Condition A, Minimum Vehicular Volume, where the total of both approaches on the major street (Route 20) must accommodate 420 vehicles per hour (vph) for 8 hours of the day, and the minor street approach (one direction only, the higher volume approach) must accommodate 105 vph for a one lane approach (New Boston Road) for the same 8 hours of the day; or
- Condition B, Interruption of Continuous Traffic, where the total of both approaches on the major street (Route 20) must accommodate 630 vph for at least 8 hours of the day, and the minor street approach (one direction only, the higher volume approach) must accommodate 53 vph for a one lane approach for the same 8 hours of the day.

The TSWA for Warrant 1, Eight-Hour Vehicular Volume for each of the three study intersections is summarized in Tables 5.

**Table 5 TSWA – Warrant 1 – Eight-Hour Vehicular Volume**

Time of Day	Route 20 Eastbound	Route 20 Westbound	Traffic Volume	Satisfied?	
			New Boston Rd	Condition A	Condition B
7:00 AM	801	266	179	Yes	Yes
8:00 AM	981	479	221	Yes	Yes
9:00 AM	881	495	192	Yes	Yes
10:00 AM	602	469	128	Yes	Yes
11:00 AM	569	458	104	No	Yes
12:00 PM	607	614	105	No	Yes
1:00 PM	679	645	104	No	Yes
2:00 PM	631	636	110	Yes	Yes
3:00 PM	763	807	103	No	Yes
4:00 PM	797	1038	116	Yes	Yes
5:00 PM	751	1270	126	Yes	Yes
6:00 PM	656	1217	120	Yes	Yes
7:00 PM	465	905	102	No	Yes

As can be seen in Table 5, the traffic volumes exiting New Boston Road exceed the threshold for any one hour for eight or more hours. Therefore, Warrant 1 is met.

In addition to Warrant 1, Warrant 2 (Four Hour Warrant), Warrant 3 (Peak Hour Warrant) and Warrant 7 (Crash Experience) were also analyzed. The TSWA summary for each of the three traffic volume warrants, Warrants 1, 2 3, and 7 is provided in Table 6. The TSWA for Warrant 7 is not met as there are on average only one crash per year that could be corrected with the installation of a traffic signal.

**Table 6: Traffic Signal Warrant Analysis Summary**

Warrant No.	Warrant Name	Warrant Met?
		Route 20 at New Boston Road
1	Eight Hour Vehicular	YES
2	Four-Hour Vehicular	YES
3	Peak Hour	YES
7	Crash Experience	NO

Our analysis found that all three of the volume-based warrants were met at the intersection including Warrant 1, the warrant that MassDOT expects to be met for the installation of a traffic signal on State Highway. Warrant 7, Crash Experience, was not met at the intersection, because our analysis found the average crash history per year is lower than the threshold. The TSWA worksheets are provided in the appendix.

## ALTERNATIVES ANALYSIS

The four alternatives that were developed are listed below:

- **Alternative 1 – No changes to the Route 20/New Boston Road intersection**
- **Alternative 2 – Install a traffic signal at the Route 20/New Boston Road intersection**
- **Alternative 3 – Prohibit left turns into or out of New Boston Road**
- **Alternative 4 – Prohibit left turns out of New Boston Road**

### Alternative 1 No Improvements

Alternative 1 is being considered because the intersection does not have a significant crash history. We feel that Alternative 1 is a viable alternative because the safety analysis shows that there is on average 3.5 crashes per year over the four year study period. However there appears to be a recent trend of increasing number of crashes, based on the number that occurred in 2016. Further evaluation of the crash trends at this location is warranted if no geometric improvements are implemented at this location.

### Alternative 2 Signalization

Alternative 2 is being considered due to the intersection meeting the Eight-Hour vehicular warrant. Installing a traffic signal at the intersection could potentially correct up to five (36%) of the 14 crashes that occurred at the intersection during the 4 year period studied. However, the other nine crashes would not be corrected by installing a traffic signal. Also, installing a traffic signal usually increases the number of rear-end crashes that occur at an intersection. Because of the high travel speeds on Route 20 and the proximity of the intersection to the Interstate 84/Route 20 interchange, it is our expectation that installing a traffic signal at the Route 20/New Boston Road intersection could increase the number of crashes that occur at the intersection. For this reason, we feel that installing a traffic signal at the Route 20/New Boston Road intersection is not desirable.

### **Alternative 3      Restrict All Left-Turns**

Alternative 3 would eliminate the cross-movement conflicts at the intersection potentially correcting up to five of the accidents that were recorded at this intersection. The turning vehicle movements into and out of New Boston Road would need to be accommodated elsewhere along Route 20. The left-turning vehicles exiting New Boston Road would be required to turn right and make a U-turn at the at the Route 131/Route 20 intersection. However the left-turning vehicles into New Boston Road could not be easily accommodated elsewhere with limited opportunities for vehicles to make a U-turn.

### **Alternative 4      Restrict Left-Turns from New Boston Road**

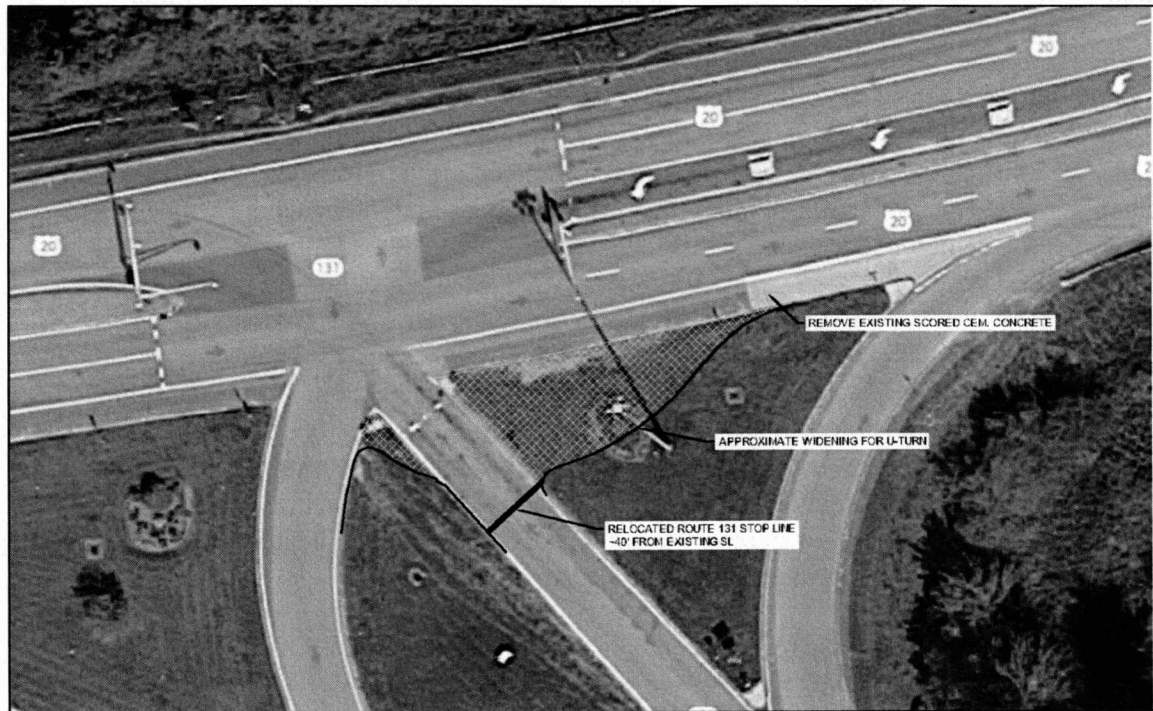
Alternative 4 would prohibit the vehicles exiting New Boston Road but would continue to allow the movement of vehicles entering New Boston Road. These restrictions would possibly correct up to four (29%) cross-movement crashes that occurred at the intersection. This permitted movement of vehicles entering New Boston Road resulted in only one crash over the 4 year study period. The vehicles exiting New Boston Road and wanting to head eastbound on Route 20 would need to be accommodated at with a U-turn at Route 131.

### **OTHER ROADWAY IMPROVEMENTS**

Both Alternative 3 and 4 will require additional roadway improvements to accommodate the left-turning vehicles out of and possibly into and New Boston Road. Alternative 3 will require improvements at the two adjacent intersections with the left-turn movements out of New Boston Road being rerouted to the Route 131/Route 20 intersection to make a U-turn. The left-turn vehicles into New Boston Road would need to travel further east as there is not a good turn-around location in close vicinity to New Boston Road. The signalized driveway to Hobbs Brook shopping plaza provides the most feasible location for these vehicles to turn around which is located approximately 1.5 miles east of New Boston Road.

Alternative 4 will require improvements at the Route 131/Route 20 intersection only. The left-turns out of New Boston Road can be accommodated at the Route 131/Route 20 intersection with some modifications to the intersection. There would be several physical modifications necessary at this intersection to accommodate U-turning vehicles including construction of a U-turn pocket along Route 20 eastbound to accommodate trucks as well as the lengthening of the existing left-turn lane to provide sufficient storage length for vehicles making this movement. Signal timing changes would also be required to accommodate the westbound U-turning traffic volume. These modifications are showing in Figure 4.

**FIGURE 4 Route 131/Route 20 Improvements**



### **Highway Safety Manual Analysis**

The installation of a traffic signal will often result in an increase in total number of crashes at an intersection. In order to determine the impacts of Alternative 2 on crash rates, methodology outlined in the Highway Safety Manual (HSM) was applied to this location using the previously collected data. This analysis assumed that all of the I-84/Route 20 interchange ramps are outside of the study area for the signal installation and there would be no geometric changes. Based on the HSM and MassDOT prediction spreadsheets, the existing stop-controlled intersection calculations shows an expected crash frequency of 2.79 crashes per year with 0.51 fatal+injury (F+I) crashes and 2.28 property damage only (PDO) crashes and a predicted overall crash frequency of 1.67 crashes per year and with 0.53 F+I and 1.14 PDO. The expected crashes/year is based on the intersection past crash history and the performance of similar sites while the predicted analysis is based on the Highway Safety Manual.

This same methodology was applied for the signalized intersection scenario. The scenario considered evaluated predicted crashes if the intersection is to be signalized with protected only left turns. This would result in a predicted crash frequency of 0.97 F+I and 2.07 PDO crashes. The results of this analysis are presented in the Table 7 below.

**Table 7: Highway Safety Analysis Summary**

	Expected crashes/Year	Unsignalized Intersection Predicted crashes/Year	Signalized Intersection Predicted crashes/Year
Total	2.79	1.67	3.04
F+I	0.51	0.53	0.97
PDO	2.28	1.14	2.07

It is important to note that the proposed signal predictions will be further impacted by whether or not right turns on red are allowed. It is expected that the installation of a median that would restrict either some or all of the left-turn at the Route 20/New Boston intersection and therefore there would be an overall reduction of crashes at this location. However, predicted crashes for Alternative 3 and Alternative 4 were not evaluated as the prohibited left-turns would need to be accommodated elsewhere. Conducting a safety analysis for proposed construction of the median along Route 20 would require data for the adjacent area intersections where U-turns would occur. As the Route 131/Route 20 intersection has a protected westbound left-turn phase, the U-turn movement would occur with few conflicts.

## **INTERSECTION OPERATIONS ANALYSIS**

Traffic operations at the Route 20 and New Boston Road intersection were analyzed through intersection Level of Service (LOS) analysis. The LOS was calculated using Synchro 8.0 which is based on the traffic operations analysis methodology presented in the 2010 Highway Capacity Manual for unsignalized intersections. The unsignalized intersection level of service analysis for the existing morning, evening and Saturday midday peak hour conditions level of services analysis for intersection indicate that the minor street movement, vehicles exiting New Boston Road, are operating at failing levels-of-service. Under the evening peak hour, volumes are exceeding the capacity which makes it that the HCM methodology does not accurately predict delay for vehicles exiting New Boston Road to calculate an accurate delay for vehicles exiting New Boston Road. Also Alternative 2 was analyzed based on the signalized intersection methodology in the HCM.

If the proposed alternative of restricting left-turns out of New Boston Road were to be implemented at this location, there would be a significant improvement in traffic operations for each of the three peak hour periods. The intersection operations analysis for the existing condition and mitigated condition are summarized in the Table 8 below.

**Table 8: Unsignalized Intersection Operations Analysis Summary  
New Boston Road approach**

		Delay (seconds)	LOS
Unsignalized-Existing	AM Peak Hour	53	F
	PM Peak Hour	*	F
	Saturday Midday	217	F
Unsignalized Right-Turns Only	AM Peak Hour	12	B
	PM Peak Hour	22	C
	Saturday Midday	18	C

\* Volume exceeds capacity

**Table 9: Signalized Intersection Operations Analysis Summary  
New Boston Road approach**

Approach	Morning Peak Hour			Evening Peak Hour			Saturday Midday Peak Hour		
	Delay	LOS	95% Queue	Delay	LOS	95% Queue	Delay	LOS	95% Queue
New Boston Rd	18.4	B	121'	22.6	C	89'	24.8	C	117'
Route 20 WB	10.7	B	114'	18.3	B	388'	17.8	B	295
Route 20 EB Left	22.7	C	27'	41.8	D	122'	35.6	D	99'
Route 20 EB Thru	10.8	B	176'	4.5	A	80'	6.3	A	126'

It is expected that if the intersection were to become signalized under Alternative 2, the overall traffic operations of the Route 20/New Boston Road would degrade as the heavier mainline movement would be required to stop at a red light. However traffic operations for vehicles exiting New Boston Road would improve.

## CONCLUSION

Based on the crash reports for the 4 year study period (January 2013 – December 2016), there is not a significant crash history at the Route 20/New Boston Road intersection. The District feels that making no changes to the traffic control or configuration of the intersection, which was considered as Alternative 1 in this engineering study, is a viable alternative at this time.

Alternative 2 which propose the installation of a traffic signal at the Route 20/New Boston Road intersection would likely increase the number of crashes at this intersection and further deteriorate traffic operations along the Route 20 corridor. At this time, MassDOT does not believe that installing a traffic signal at this location is desirable or appropriate.

However given the recent increase in vehicle crashes at New Boston Road, MassDOT feels that implementation of improvements should be considered if the recent trend of crashes seen in 2016

continues over the next two years. Alternative 3 and Alternative 4 would both reduce the crashes caused by vehicles exiting out of New Boston Road. However the left-turn movements would need to be accommodated elsewhere. MassDOT favors Alternative 4 over Alternative 3 because the left-turns out of New Boston Road could be directed to the Route 20/Route 131 intersection where they would be able to make a U-turn. Alternative 4 would require additional improvements at the adjacent Route 20/ Route 131 intersection to accommodate this movement.

MassDOT will continue to evaluate the crash history at the Route 20/New Boston Road intersection. MassDOT will also work with the Town of Sturbridge to determine the necessary improvements at the Route 20/New Boston Road and the Route 20/Route 131 intersections.

If you have any questions or require additional information, please contact Erin Kinahan, the District Traffic Engineer at (508) 929-3906 or Joe Frawley, District Traffic Operations Engineer, at (508) 929-3916.

cc: Traffic Correspondence Files  
EOK



## **Traffic Count Data**

## Traffic Count Data

## **Highway Capacity Analysis**

**Study Name** Sturbridge - Route 20 and New Boston Road TMC  
**Start Date** Thursday, November 02, 2017 7:00 AM  
**End Date** Saturday, November 04, 2017 2:00 PM  
**Site Code**

## Report Summary

Time Period	Class.	Southbound			Westbound			Eastbound			Total	Pedestrians	Total
		R	L	U	R	T	U	T	L	U	O		

Peak 1 Specified Period 7:00 AM - 9:00 AM One Hour Peak 7:00 AM - 8:00 AM	Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	58	122	0	180	32	20	343	825	12	0	0	1380
	Light Goods Vehicles	10	13	0	23	11	4	44	111	7	0	0	189
	Buses	2	0	0	2	2	0	2	3	2	0	4	9
	Single-Unit Trucks	3	5	0	8	6	6	25	31	20	0	28	59
	Articulated Trucks	0	0	0	0	8	0	5	5	0	0	8	13
	Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0
	Total	73	140	0	213	51	30	422	964	21	0	0	1650
	PHF	0.76	0.83	0	0.9	0.75	0.58	0.76	0.92	0.93	0	0.76	0.96
	Approach %	13%	13%	3%	13%	3%	27%	27%	67%	60%	30%	30%	

Peak 2 Specified Period 4:00 PM - 6:00 PM One Hour Peak 4:15 PM - 5:15 PM	Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	69	42	0	111	213	117	926	1043	96	1	996	1837
	Light Goods Vehicles	13	4	0	17	33	14	184	198	54	0	197	288
	Buses	0	0	0	0	0	0	2	2	2	0	2	4
	Single-Unit Trucks	1	1	0	2	4	4	14	18	14	0	15	34
	Articulated Trucks	1	1	0	2	4	4	14	15	14	0	15	34
	Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0
	Total	84	48	0	132	250	135	1131	1266	714	0	1216	2180
	PHF	0.78	0.71	0	0.94	0.93	0.89	0.93	0.96	0.9	0	0.92	0.96
	Approach %	10%	10%	0%	10%	11%	8%	10%	58%	100%	36%	56%	

	Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0
	Cars	69	42	0	111	213	117	926	1043	96	1	996	1837
	Light Goods Vehicles	13	4	0	17	33	14	184	198	54	0	197	288
	Buses	0	0	0	0	0	0	2	2	2	0	2	4
	Single-Unit Trucks	1	1	0	2	4	4	14	18	14	0	15	34
	Articulated Trucks	1	1	0	2	4	4	14	15	14	0	15	34
	Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0
	Total	84	48	0	132	250	135	1131	1266	714	0	1216	2180
	PHF	0.78	0.71	0	0.94	0.93	0.89	0.93	0.96	0.9	0	0.92	0.96
	Approach %	10%	10%	0%	10%	11%	8%	10%	58%	100%	36%	56%	

## Report Summary

Time Period		Class		Southbound										Westbound										Eastbound										Crosswalk	
Peak 1		Motorcycles	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Specified Period		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
11:00 AM - 12:00 PM		Cars	55	60	0	115	94	42	707	0	749	750	690	52	4	746	766	1610	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
One Hour Peak		%	79%	87%	0%	83%	78%	71%	88%	0%	87%	87%	84%	100%	87%	87%	86%	86%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
11:00 AM - 12:00 PM		Light Goods Vehicles	14	9	0	23	26	16	89	0	105	107	98	10	0	108	103	236	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		%	20%	13%	0%	17%	21%	27%	11%	0%	12%	12%	13%	16%	0%	13%	12%	13%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
		Buses	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
		Single-Unit Trucks	1	0	0	1	1	1	6	0	7	5	0	0	0	5	7	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
		Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
		Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
		Total	70	69	0	139	121	59	803	0	862	864	795	62	4	861	877	1862	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		PHF	0.76	0.72	0	0.85	0.92	0.82	0.95	0	0.95	0.92	0.9	0.78	0.5	0.93	0.94	0.94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Approach %	7%	6%							46%	46%				46%	47%																		
Peak 2		Motorcycles	1	0	0	1	2	0	3	0	3	7	7	2	0	9	4	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Specified Period		%	1%	0%	0%	1%	1%	0%	0%	0%	0%	1%	1%	2%	0%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
12:00 PM - 2:00 PM		Cars	67	64	0	131	139	68	774	0	842	786	722	71	4	797	845	1770	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
One Hour Peak		%	62%	56%	0%	63%	62%	56%	85%	0%	85%	90%	90%	79%	100%	89%	95%	92%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
12:15 PM - 1:15 PM		Light Goods Vehicles	14	8	0	22	22	7	116	0	123	65	57	15	0	72	130	217	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		%	17%	11%	0%	14%	13%	9%	13%	0%	12%	7%	7%	17%	0%	8%	13%	11%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
		Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

**Study Name** Sturbridge - Route 20 and New Boston Road TMC  
**Start Date** Thursday, November 02, 2017 7:00 AM  
**End Date** Saturday, November 04, 2017 2:00 PM  
**Site Code**

## Report Summary

		Southbound					Westbound					Eastbound					Crosswalk			
Time Period	Class.	R	L	U	I	O	R	T	U	I	O	T	L	U	I	O	Total		Pedestrians	Total
Peak 1	Motorcycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N	0	0
Specified Period	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		0%	
7:00 AM - 9:00 AM	Cars	58	122	0	180	32	20	343	0	363	947	825	12	0	837	401	1380	E	0	0
One Hour Peak	%	79%	87%	0%	85%	63%	67%	81%	0%	80%	84%	86%	57%	0%	88%	81%	84%		0%	
7:00 AM - 8:00 AM	Light Goods Vehicles	10	13	0	23	11	4	44	0	48	124	111	7	0	118	54	189	W	0	0
	%	14%	9%	0%	11%	22%	13%	10%	0%	11%	11%	10%	83%	0%	12%	11%	11%		0%	
	Buses	2	0	0	2	2	0	2	0	2	3	3	2	0	5	4	9		0	0
	%	3%	0%	0%	1%	4%	0%	0%	0%	1%	0%	0%	10%	0%	1%	1%	1%			
	Single-Unit Trucks	3	5	0	8	6	6	25	0	31	25	20	0	0	20	28	59			
	%	4%	4%	0%	4%	12%	20%	6%	0%	7%	7%	7%	0%	0%	2%	6%	4%			
	Articulated Trucks	0	0	0	0	0	0	8	0	8	5	5	0	0	5	8	13			
	%	0%	0%	0%	0%	0%	0%	2%	0%	2%	1%	1%	0%	0%	1%	2%	1%			
	Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	Total	73	140	0	213	51	30	422	0	452	1104	964	21	0	985	495	1650			
	PHF	0.76	0.83	0	0.9	0.75	0.58	0.76	0	0.79	0.92	0.93	0.66	0	0.93	0.76	0.96			
	Approach %				13%	3%				27%	27%				40%	10%				
Peak 2	Motorcycles	0	0	0	0	0	0	1	0	1	6	6	0	0	6	1	7	N	0	0
Specified Period	%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	0%	0%	1%	0%	0%		0%	
4:00 PM - 6:00 PM	Cars	69	42	0	111	213	117	926	0	1043	628	586	96	1	683	996	1837	E	0	0
One Hour Peak	%	82%	50%	0%	14%	28%	87%	92%	0%	92%	50%	88%	93%	100%	87%	92%	104%		0%	
4:15 PM - 5:15 PM	Light Goods Vehicles	13	4	0	17	33	14	184	0	198	58	54	19	0	73	197	288	W	0	0
	%	15%	8%	0%	11%	13%	10%	16%	0%	16%	4%	7%	17%	0%	9%	16%	14%		0%	
	Buses	0	0	0	0	0	0	2	0	2	2	2	0	0	2	2	4		0	0
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	Single-Unit Trucks	1	1	0	2	4	4	14	0	18	15	14	0	0	14	15	34			
	%	1%	2%	0%	2%	2%	3%	1%	0%	1%	2%	2%	0%	0%	2%	1%	2%			
	Articulated Trucks	1	1	0	2	0	0	4	0	4	5	4	0	0	4	5	10			
	%	1%	1%	0%	2%	0%	0%	0%	0%	0%	1%	1%	0%	0%	1%	0%	2%			
	Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	Total	84	48	0	132	250	135	1131	0	1266	714	666	115	1	782	1216	2180			
	PHF	0.78	0.71	0	0.94	0.93	0.89	0.93	0	0.96	0.9	0.89	0.85	0.25	0.88	0.92	0.96			
	Approach %				6%	11%				58%	33%				36%	55%				

## **Traffic Signal Warrants Analysis**

## TRAFFIC SIGNAL WARRANT ANALYSIS (VOLUME BASED)

**Intersection:** Route 20 (Charlton Road) at New Boston Road Sturbridge

**Major Street Direction:** Eastbound - Westbound

**Year:** 2017 **Condition:** Existing

**Operating speed on major roadway:** 50 mph

**Number of approaches:** 1

### Required Approach Volumes

Minimum*	Adjusted Minimum**
----------	--------------------

**Warrant 1 EIGHT-HOUR VEHICULAR VOLUME**

Warrant 1A MINIMUM VEHICULAR VOLUME (8 hours of day)

Major Street : 2 Lane(s) on each approach  
Minor Street : 1 Lane(s) on each approach

600	420
150	105

Warrant 1B INTERRUPTION OF CONTINUOUS TRAFFIC (8 hours of day)

Major Street : 2 Lane(s) on each approach  
Minor Street : 1 Lane(s) on each approach

900	630
75	53

80 PERCENT SATISFACTION OF WARRANT 1A AND WARRANT 1B

Major Street : 2 Lane(s) on each approach  
Minor Street : 1 Lane(s) on each approach

Warrant 1A	Warrant 1B
480	720
120	60

**Warrant 2 FOUR HOUR VEHICULAR VOLUME**

Major Street : 2 Lane(s) on each approach  
Minor Street : 1 Lane(s) on each approach

If "verify" indicated, see Figure 4C-1 or 4C-2.  
25 = accuracy of regression equations

**Warrant 3 PEAK HOUR VOLUME**

Major Street : 2 Lane(s) on each approach  
Minor Street : 1 Lane(s) on each approach

If "verify" indicated, see Figure 4C-3 or 4C-4.  
25 = accuracy of regression equations

Hour	Exiting Vol. Minor Road+	Entering Vol. on Major Road		Tot. Ent. Vol. On Major Rd	Meets the following volume-based warrants?				
		Eastbound	Westbound		1A	1B	80%(1A&1B)	2	3
6:00 - 7:00 AM	179	801	286	1087	Yes	Yes	Yes	Yes	Yes
7:00 - 8:00 AM	221	981	479	1460	Yes	Yes	Yes	Yes	Yes
8:00 - 9:00 AM	192	881	495	1376	Yes	Yes	Yes	Yes	Yes
9:00 - 10:00 AM	128	602	469	1071	Yes	Yes	Yes	Yes	Yes
10:00 - 11:00 AM	104	569	458	1027	No	Yes	No	Yes	Verify
11:00 - 12:00 AM	105	607	614	1221	No	Yes	No	Yes	Yes
12:00 - 1:00 PM	104	679	645	1324	No	Yes	No	Yes	Verify
1:00 - 2:00 PM	110	631	636	1267	Yes	Yes	No	Yes	Yes
2:00 - 3:00 PM	103	763	807	1570	No	Yes	No	Yes	Verify
3:00 - 4:00 PM	116	797	1038	1835	Yes	Yes	No	Yes	Verify
4:00 - 5:00 PM	126	751	1270	2021	Yes	Yes	Yes	Yes	Yes
5:00 - 6:00 PM	120	656	1217	1873	Yes	Yes	No	Yes	Verify
6:00 - 7:00 PM	102	465	905	1370	No	Yes	No	Yes	Verify
					Yes	Yes	No	Yes	Yes
					1			2	3
					Yes			Yes	Yes

\*From the criteria described for the warrant in the MUTCD.

\*\*If the operating speed is higher than 40mph then the volumes can be adjusted to 70%. (If no adjusted minimum, the minimum from the previous column is shown)

+If more than one approach, report the approach that has the higher volume.

### NON-VOLUME-BASED WARRANTS

**Warrant 4, Minimum Pedestrian Volume:** No

Peak Four Hour Pedestrian Volumes:  
(non-concurrent)

0  
0  
0  
0

**Warrant 5, School Crossing:** No  
See MUTCD for details.

**Warrant 6, Coordinated Signal System:** No

See MUTCD for details.

**Warrant 7, Crash Experience:** No  
# of accidents "correctable by  
signalization" occurring in the last 12 months:

**Warrant 8, Roadway Network:** No

See MUTCD for details.





















**Source:** 2003 Manual on Uniform Traffic Control Devices (MUTCD)



## **Crash Data**



# CRASH DIAGRAM

SYMBOLS		TYPE OF CRASH		SEVERITY
	Moving Vehicle		Head on	 Fatal
	Backing Vehicle		Rear End	
	Non-involved Vehicle	 Angle	 Turning Movement	 Fatal
	Involved Non-involved Vehicle			
	Pedestrian			
	Bicycle			
	Animal		Direction of Motion	 Property Damage Only
	Fixed Object		Out of Control	
	Night Time Crash		Sideswipe	
			Night Time Crash	

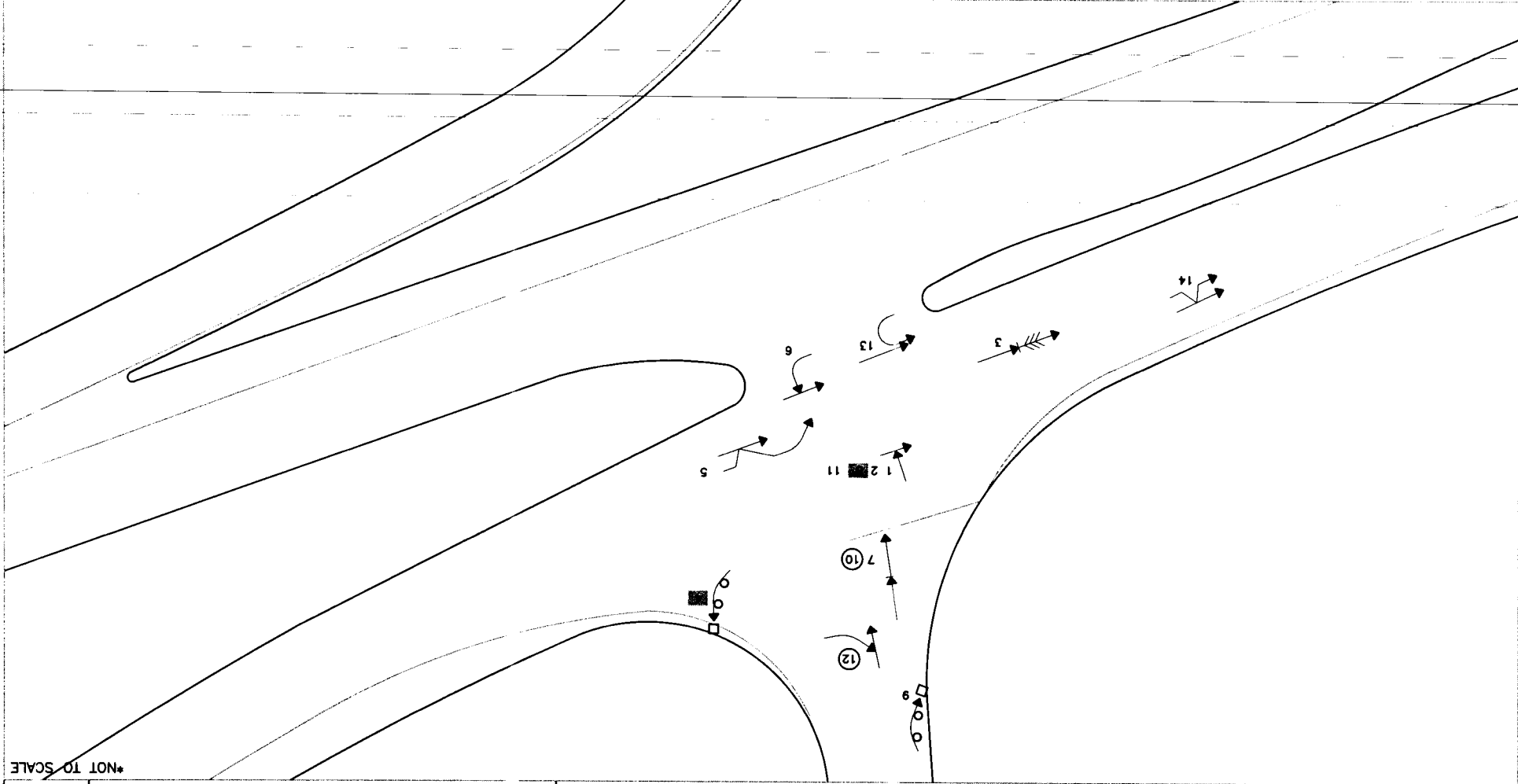
STURBRIDGE, MA  
ROUTE 20 AT NEW BOSTON ROAD  
REGION: CMRPC

TIME PERIOD ANALYZED: 2013-2016  
SOURCE OF CRASH REPORTS: STURBRIDGE AND STATE POLICE DEPARTMENT  
DATE PREPARED: 12/19/2017  
PREPARED BY: KEVIN FITZGERALD

SHEET 1 OF 1



\*NOT TO SCALE



# Crash Data Summary Table

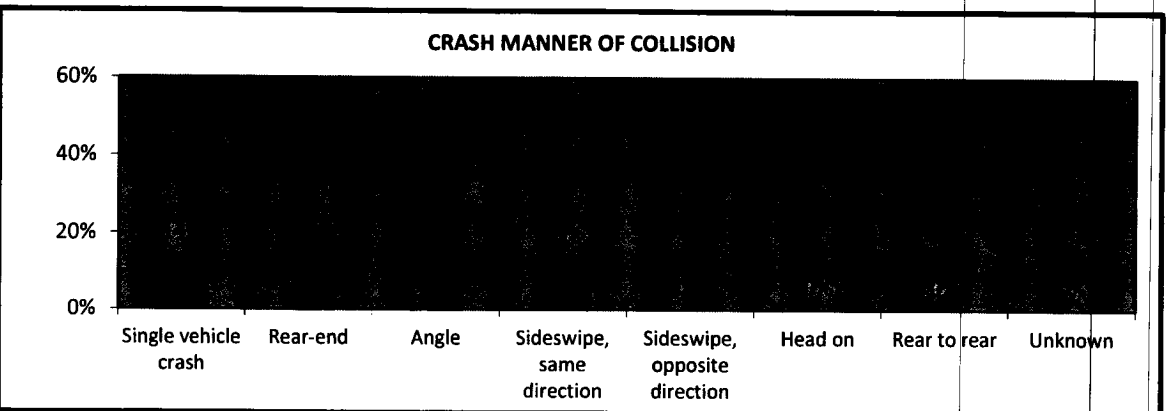
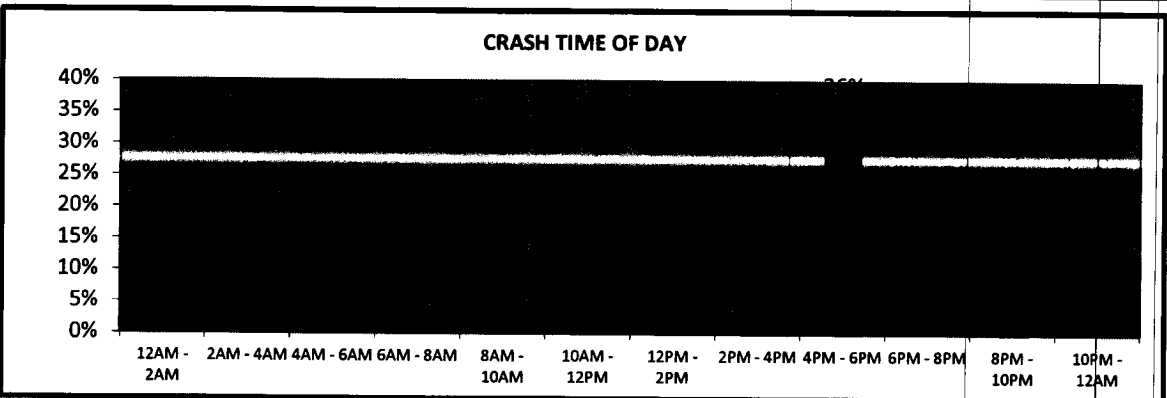
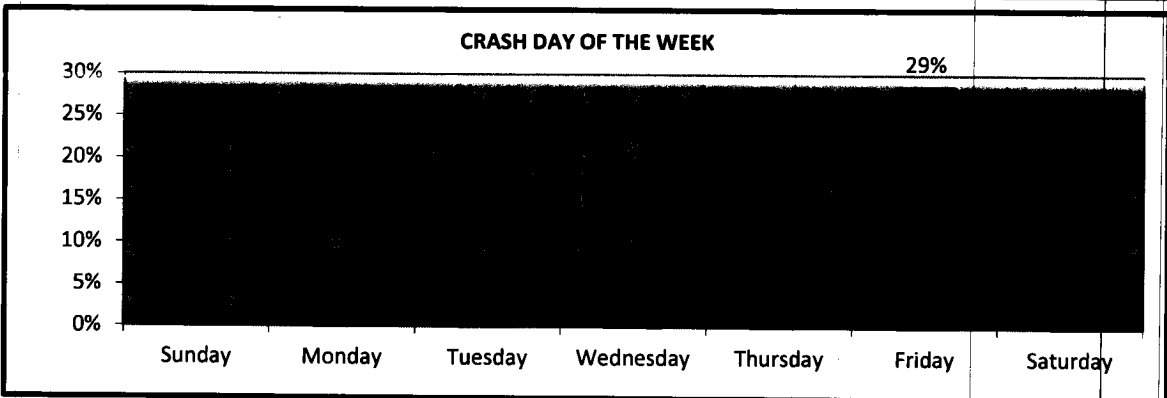
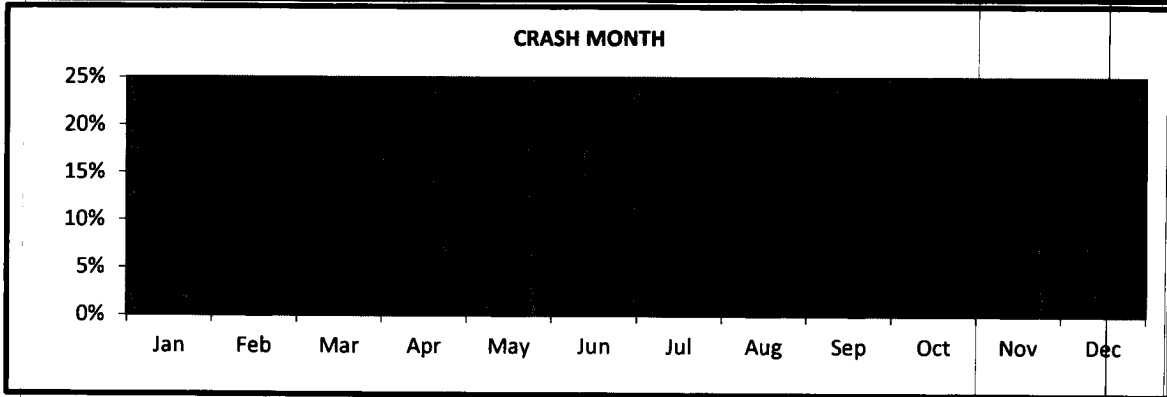
Route 20 at New Boston Road, Sturbridge, MA  
2013 - 2017

Crash #	Crash Date	Time of Day	Day of Week	Month/Day/Year	Location	Weather	Lighting	Crash Type	Severity	Count	Description
1	02/18/13	Monday	3:32 PM	Angle	Daylight	Clear	Dry	Failed to yield right of way	54	37	MV2 attempted to cross Rt 20 and struck MV1 WB on Rt 20
2	06/29/13	Saturday	9:57 AM	Angle	Daylight	Clear	Dry	Disregarded traffic signs, signals, road markings	62	24	MV2 attempted to cross Rt 20 and struck MV1 WB on Rt 20
3	07/14/13	Sunday	2:50 PM	Rear-end	Daylight	Clear	Dry	Wrong side or wrong way	20	34	MV2 WB, a tractor trailer, stopped and started to reverse on Rt 20 striking MV1 WB
4	09/18/13	Wednesday	9:45 PM	Single vehicle crash	Dark - lighted roadway	Clear	Dry	Exceeded authorized speed limit	26	49	MV1 attempted to take the turn onto New Boston Road at speeds greater than reasonable, lost control and struck a large rock
5	05/16/14	Friday	3:13 PM	Sideswipe, same direction	Daylight	Rain	Wet	Made an improper turn	68	49	MV1 attempted to make a left turn from the right lane and struck MV2
6	04/21/15	Tuesday	5:08 PM	Angle	Daylight	Cloudy	Dry	Failed to yield right of way	37	66	MV2 EB attempted to turn left to make a U-turn and struck MV1 WB
7	05/14/15	Thursday	8:56 AM	Rear-end	Daylight	Clear	Dry	Followed too closely	20	31	MV1 rear ended MV2
8	09/13/15	Sunday	8:01 PM	Angle	Dark - lighted roadway	Rain	Wet	Exceeded authorized speed limit	51	18	MV2 was travelling 35mph in a 30mph zone and slid past the stop sign striking MV1 WB
9	02/13/16	Saturday	5:11 PM	Single vehicle crash	Daylight	Clear	Ice	No improper driving	19	23	MV1 slid on an icy road and struck a fire hydrant
10	06/12/16	Sunday	10:00 AM	Rear-end	Daylight	Clear	Dry	No improper driving	71	23	MV2 rear ended MV1
11	08/12/16	Friday	1:07 PM	Angle	Daylight	Clear	Dry	Failed to yield right of way	82	21	MV1 failed to yield for MV2
12	09/10/16	Saturday	5:53 PM	Angle	Daylight	Clear	Dry	Operating defective equipment	67	18	MV2 was travelling at speeds greater than reasonable with brakes not functioning properly. MV2 failed to turn onto New Boston road and struck MV1
13	10/21/16	Friday	5:15 PM	Angle	Daylight	Rain	Wet	Failed to keep in proper lane or	37	66	MV1 attempted to turn left to make a U-turn and struck MV2
14	11/04/16	Friday	5:17 PM	Sideswipe, same direction	Daylight	Clear	Dry	Running off road	94	40	MV1 attempted to change lanes and struck MV2

\* Courtesy Crash - A term used to describe a crash that occurs subsequent to a non-involved mainline driver who gives the right of way, contrary to the rules of the road, to another driver. Summaries based on crash reports obtained from the Sturbridge and State Police Department.

# Crash Data Summary Charts

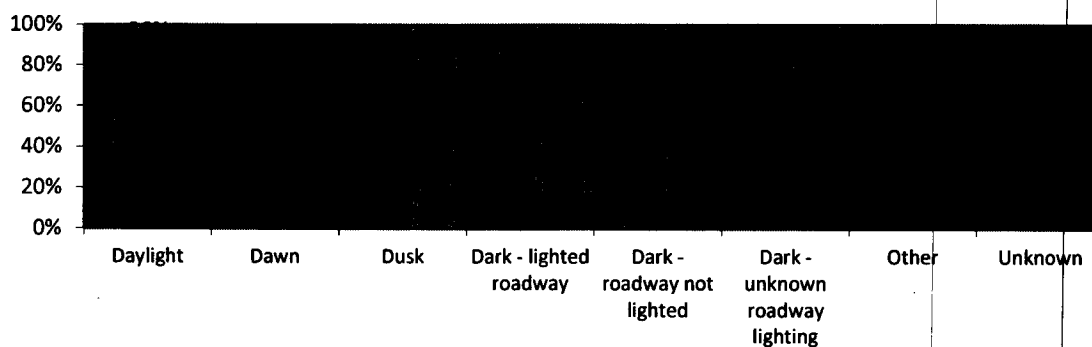
## Route 20 at New Boston Road, Sturbridge, MA



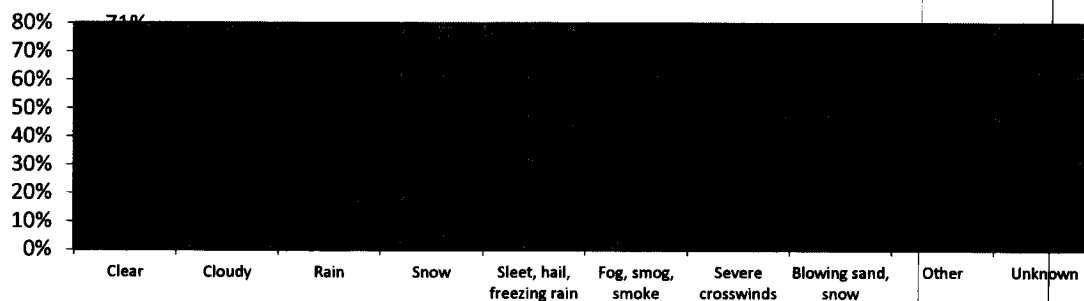
## Crash Data Summary Charts

### Route 20 at New Boston Road, Sturbridge, MA

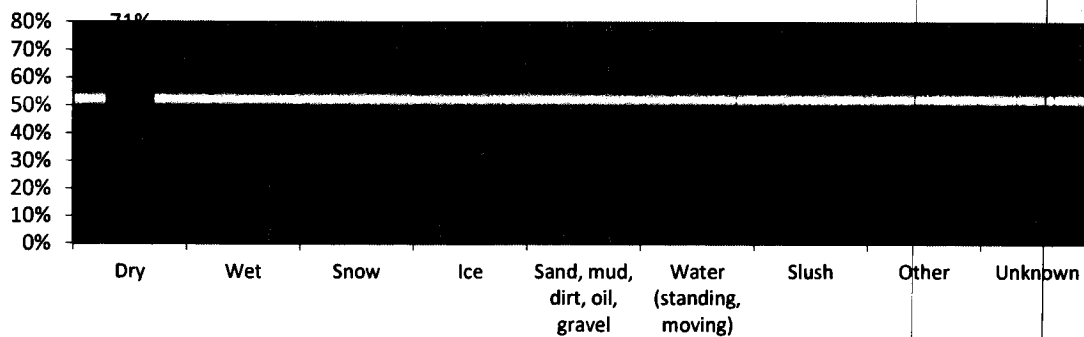
**CRASH LIGHT CONDITION**



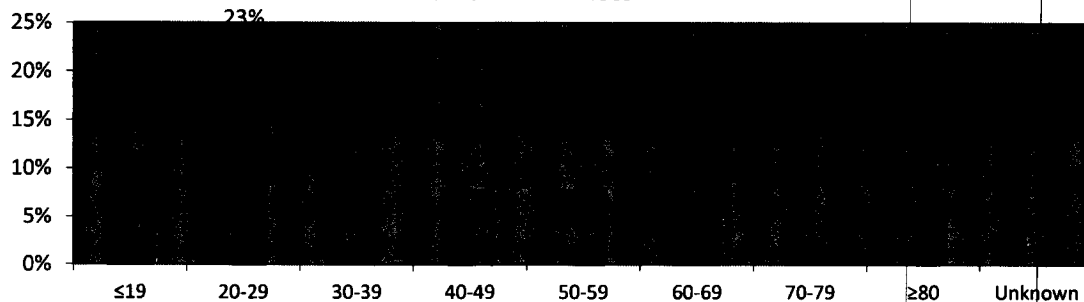
**CRASH WEATHER CONDITION**



**CRASH ROAD SURFACE**



**CRASH DRIVER AGES**



## INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN: STURBRIDGE COUNT DATE: \_\_\_\_\_

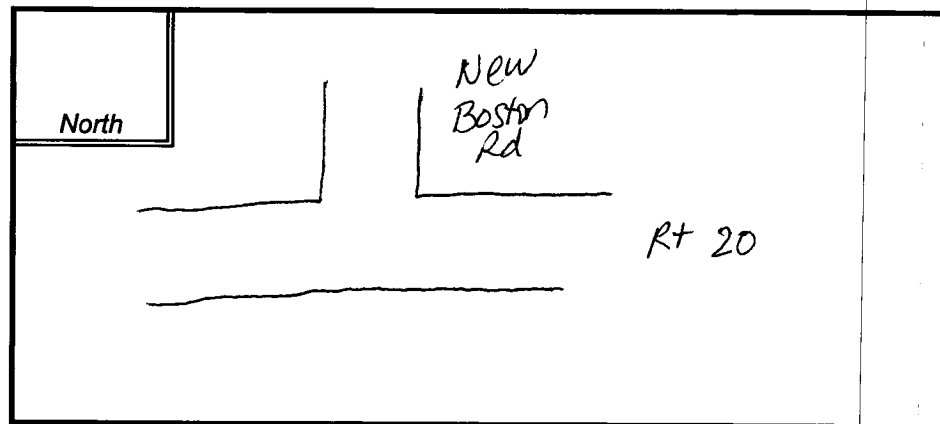
DISTRICT: 3 UNSIGNALIZED: ☒ SIGNALIZED: ☐

### ~ INTERSECTION DATA ~

MAJOR STREET: Route 20

MINOR STREET(S): New Boston Rd

**INTERSECTION  
 DIAGRAM**  
 (Label Approaches)



### PEAK HOUR VOLUMES

APPROACH:	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION:	EB	WB	SB			
PEAK HOURLY VOLUMES (AM/PM):	985/781	452/1266	213/132			

"K" FACTOR: 6.79/8.97 INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME: 24287

TOTAL # OF CRASHES: 14 # OF YEARS: 4 AVERAGE # OF CRASHES PER YEAR (A): 3.5

CRASH RATE CALCULATION: 0.39 RATE =  $\frac{(A * 1,000,000)}{(V * 365)}$

Comments: \_\_\_\_\_

Project Title & Date: Based on Comts FALL 2017

0.58 Statewide  
 0.65 District 3