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November 26, 2018

Ms. Debra Dellagiacoma
MORRIS COUNTY DEPARTMENT OF PUBLIC WORKS
DIVISION OF ENGINEERING & TRANSPORTATION
PO Box 900
10 Court Street, 2nd Floor
Administration & Records Building
Morristown, New Jersey 07963

Re: Intersection Safety Study
Mendham Road (CR 510) & Roxiticus Road
Township of Mendham, Morris County, NJ
FPA No. 6430.017

Dear Ms. Dellagiacoma:

FPA has performed evaluations of the existing conditions to evaluate the operations, safety, approach lane layouts, signage, and striping at the intersection of Mendham Road (CR 510) & Roxiticus Road in Mendham Township:

As part of this effort we reviewed available crash data, performed traffic counts and analyses, performed field investigations, and conducted traffic signal warrant analyses for the intersections. This data was compiled and utilized as a basis to develop both short, and long-term recommendations to improve driver safety, as well as traffic operations, at each intersection. The following is a summary of our findings and recommendations.

EXISTING CONDITIONS

The existing intersection of Mendham Road (CR 510) & Roxiticus Road is a four-legged, stop-controlled intersection. The intersection is located at MP 3.48 on Mendham Road, or approximately one (1) mile west of the signalized intersection with Mountain Avenue and Hilltop Road (CR 525). A copy of the NJDOT Straight line diagram for the area has been provided in Appendix A. It is also noted that an existing bridge is located approximately 175ft south of the intersection on Mendham Road.

Roadway Geometry

Under existing conditions, Mendham Road is a 2-lane undivided urban minor arterial with one (1) travel lane and no striped shoulders at the intersection. It is noted that the pavement is wide enough to accommodate full width shoulders, which are striped both east and west of the intersection. Each approach lane permits left, through, and right movements. The posted speed limit in the vicinity of the intersection is 40mph. An overhead sign structure with flashing beacons and curve warning sign (W1-1), accompanied by a 20mph plaque (W13-1P), is located just east providing advanced warning for a horizontal curve located approximately 650ft east of the intersection. In the vicinity of this intersection, Mendham Road carries a significant downgrade from east to west.



Roxiticus Road is also a 2-lane undivided roadway, with one (1) travel lane and no shoulders at each intersection approach. The post speed limit along Roxiticus Road is 35mph. Each approach lane permits left, through, and right movements.

Intersection Operations



The existing intersection is stop-controlled, with free movements provided for Mendham Road, and stop signs provided for both north and south Roxiticus Road approaches. All movements are permitted from all single lane approaches to the intersection.

No sidewalks, curb ramps, crosswalks, or pedestrian accommodations are provided at the intersection.

Based on field observations, sight distance is restricted on both Roxiticus Road approaches for vehicles approaching the intersection. Historic properties occupy the northeast (Ralston General Store) and northwest (Grist Mill) corners of the intersection, and single-family residential properties are located on the southeast and southwest corners of the intersection. A wooden privacy fence located along the Grist Mill property frontage and the Ralston General Store building and associated landscaping restrict driver sight distance for vehicles approaching from the north on Roxiticus Road. Existing trees and brush inhibit driver sight distance for vehicles approaching from the south.



It was observed in the field that vehicles appeared to frequently exceed the posted speed limit. This was confirmed by speed data provided by the County which showed an 85th percentile speed of 48mph on Mendham Road observed between 8/25/17 and 9/29/17. Additionally, it was observed that vehicles accessing a driveway for #9 Roxiticus Road (southwest corner of the intersection) slowed traffic considerably when attempting to make an eastbound right into the driveway. This driveway also appears to have limited sight distance because of vegetation.



Traffic Counts

Manual turning movement counts were performed at the intersection of Mendham Road (CR 510) & Roxiticus Road on Tuesday October 9, 2018 from 7:00 to 10:00am and 3:00 to 6:00pm. The following table is a summary of the peak hour volumes observed for each time period:

Existing Peak Hour Volumes

Roadway	Movement	AM Peak (7:45AM-8:45AM)	PM Peak (5:00PM-6:00PM)
Mendham Road (CR 510)	EB Left	40	9
	EB Thru	768	347
	EB Right	110	21
	WB Left	120	103
	WB Thru	240	976
	WB Right	3	2
Roxiticus Road	NB Left	19	35
	NB Thru	21	66
	NB Right	53	112
	SB Left	0	2
	SB Thru	58	15
	SB Right	11	22
Overall Intersection		1,443	1,710

Complete manual traffic count data for the intersection is provided in Appendix B.

A preliminary Level of Service (LOS) analysis was performed for the intersection based on the existing traffic volumes and summarized in the table below. Overall the major approaches operate with good levels of service, and the minor stop-controlled approaches operate with poor levels of service. The existing roadway network has adequate capacity to handle the peak hour volumes.



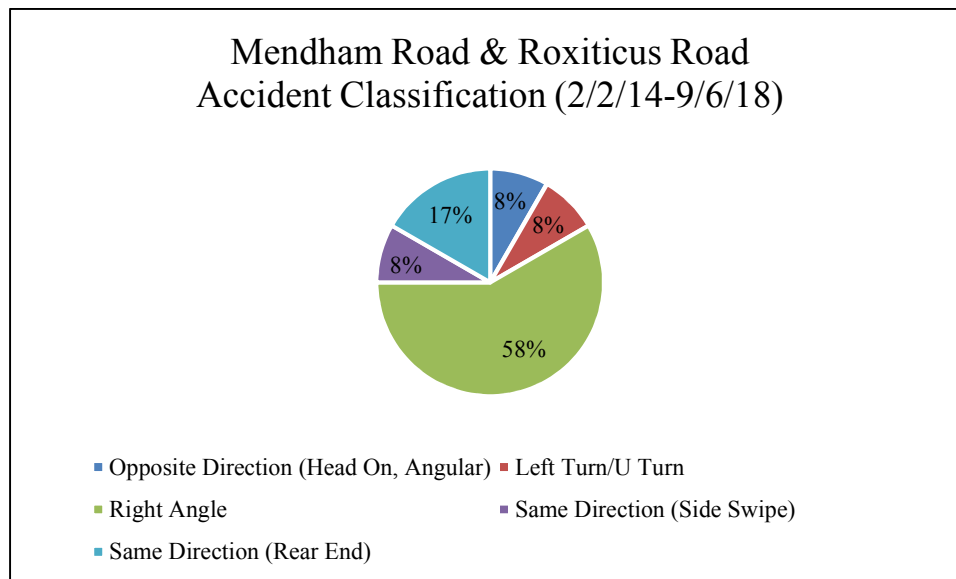
Existing Level of Service

Roadway	Movement	AM Peak (7:45AM-8:45AM)	PM Peak (5:00PM-6:00PM)
Mendham Road (CR 510)	EB (Left/Thru/Right)	A (0.9)	A (0.4)
	WB (Left/Thru/Right)	A (5.2)	A (2.8)
Roxiticus Road	NB (Left/Thru/Right)	F (371.3)	F (576.4)
	SB (Left/Thru/Right)	F (106.9)	F (81.6)
Overall Intersection		E (39.0)	F (87.7)

The existing Level of Service analyses for the intersection are provided in Appendix C.

Crash Data

Accident reports for the intersection were provided by the County for the period from February 2, 2014 to September 6, 2018. A total of twenty-three (23) vehicle crashes were reported over that time period. There were fifteen (15) reported injuries and one (1) reported fatality resulting from those crashes. A chart categorizing the types of crashes is shown below. Right angle collisions had the highest incidence (58% of all crashes), with many of those involving vehicles turning from the Roxiticus Road approaches being hit by cars traveling on Mendham Road.



Signal Warrant Analysis

A traffic signal warrant analysis was completed using the traffic volumes and accident reports provided to determine if the intersection meets any of the criteria defined in the MUTCD which would warrant installation of a new traffic signal. A total of eight (8) warrant conditions were evaluated which look at traffic volumes, ratios of traffic volumes of the side street to the main street, peak hour traffic, pedestrian volume/school crossing, and crash history. Based on the



collected data, the intersection of Mendham Road & Roxiticus Road meets the following warrants:

- Warrant 2 – 4-hour Vehicular Volumes
- Warrant 3 – Peak Hour Volume
- Warrant 8 – Roadway Network Operations

The absence of an eight-hour traffic volume count precluded the intersection from meeting Warrants 1 (8-hour vehicular volumes) & 7 (Crash Experience). However, we do note that all 6 hours during which traffic counts were obtained met the criteria for Warrants 1 & 7, therefore it is likely that the intersection would also meet these warrants if a longer count was performed.

In addition to meeting multiple traffic signal warrants, the intersection also met two conditions for installation of an All Way Stop, however installation of stop control on Mendham Road is not desirable, or appropriate, for this location.

The full warrant analyses are provided in Appendix D.

RECOMMENDATIONS

As described in the project's scope of work for the project, it is the County's desire to improve the overall safety and operation of the intersection. To achieve these goals for the project, FPA has developed recommendations for both short, and long-term improvements.

Short-term Improvements

1. Sight distance for the Roxiticus Road approaches should be improved. Improved sight distance would provide better visibility for vehicles on Roxiticus Road in determining when it is safe to progress through the intersection, as well as helping through traffic on Mendham Road see vehicles coming out of Roxiticus Road, which should help address the high occurrence of right-angle crashes. To achieve this, we recommend the following:
 - Selective vegetation trimming and removal on the southeasterly and southwesterly corners of the intersection to improve sight lines.
 - While the historic nature of the Ralston General Store on the northeasterly corner of the intersection prohibits alteration of the structure itself, the vegetation at the front of the store should be trimmed.
 - The wooden privacy fence on the northwesterly corner of the intersection also inhibits sight distance, and relocation, or replacement with a lower or more open style fence (such as post and rail) should be considered. Typically, municipal ordinances do not permit installation of a 6ft high privacy fences within front yard areas, particularly at intersections where they could restrict sight distance, however it is unknown if zoning approval was granted for the existing fence.
 - Based on the existing right-of-way widths as shown on the Mendham Township tax maps, it is likely that the clearing limits will extend outside of the existing right of way limits on Roxiticus Road (45'ROW) as well as on Mendham Road (66'ROW). Any work



outside of the right-of-way will require coordination with the adjacent property owners.

2. Striping on each approach is deteriorated, and intersection warning signs (W2-1) along Mendham Road appear to lack retroreflectivity meeting current MUTCD standards. Restriping the intersection, and replacing the signs is recommended to improve visibility at night.
3. Verify that the existing street light on the southeast corner provides adequate lighting for the intersection at night.
4. Since the observed speeds on Mendham Road are well above the posted speed limit, additional measures should be implemented to reduce speeds. We recommend installation of signs displaying actual travel speeds for traffic on Mendham Road to advise motorists that they are exceeding the speed limit. Police enforcement efforts could also be helpful in reducing speeds.

A sketch showing the proposed short-term improvements has been provided in Appendix E. We estimate that these short-term improvements would cost on the order of approximately \$10,000 or less to complete.

Long-term Improvements

If traffic volumes continue to grow and short-term improvements do not reduce the crash incidence, it is recommended that a traffic signal be installed at the intersection of Mendham Road and Roxiticus Road, particularly since the intersection does already meet multiple warrants for signal installation. In addition to improving safety at the intersection, the signal would also improve operations on the Roxiticus Road approaches. We estimate that installation of a traffic signal at the intersection along with associated minor improvements (ADA compliance, striping, etc.) would cost on the order of approximately \$150-200k to complete.

Upon your review of the enclosed documents, please advise our office if you concur with our recommendation. If you have any questions or require additional information, please do not hesitate to contact me.

Respectfully submitted,

FRENCH & PARRELLO ASSOCIATES

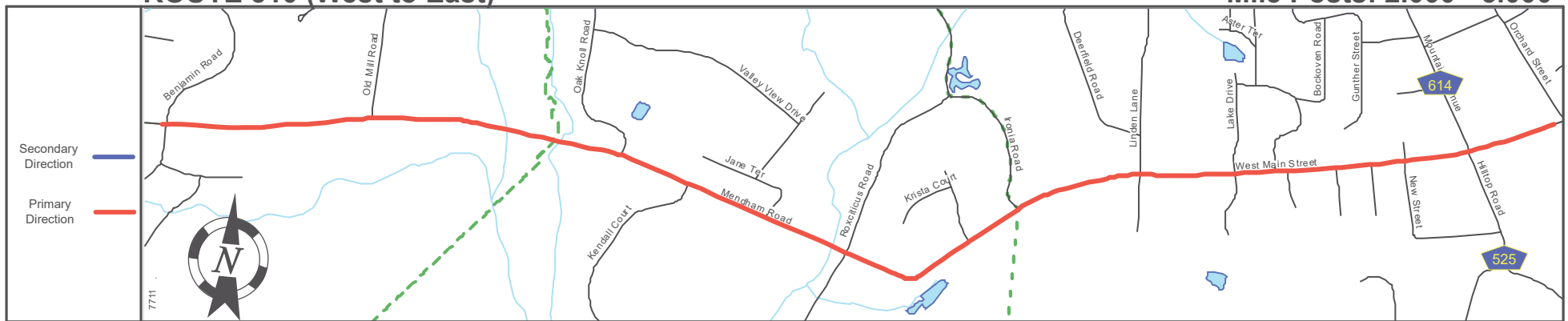
A handwritten signature in blue ink, appearing to read 'Michael Drobny', is written over a light blue circular stamp.

Michael Drobny, PE
Discipline Manager, Highway Engineering

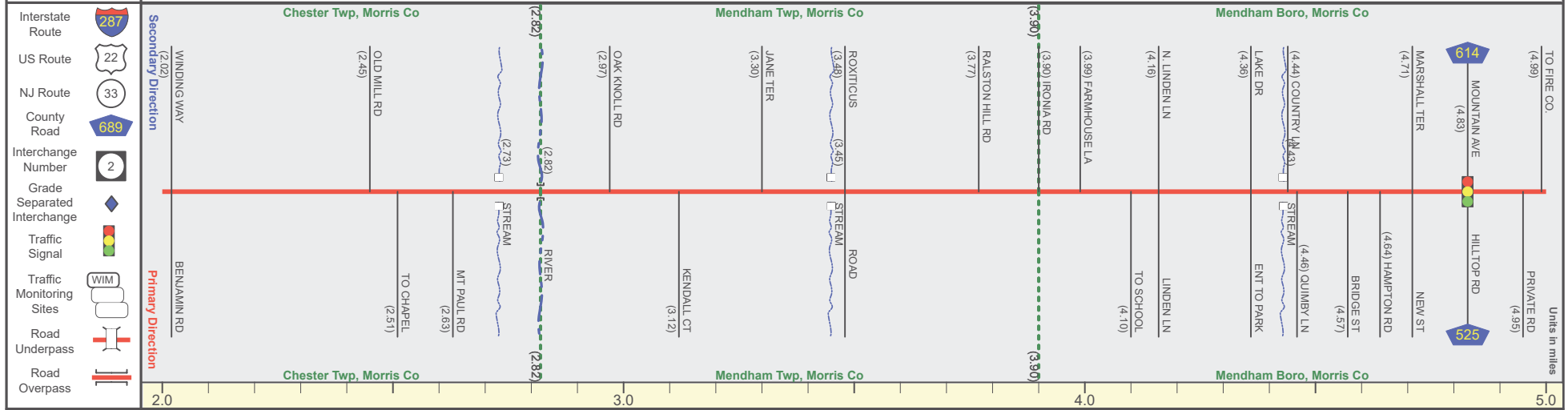
APPENDIX A
NJDOT STRAIGHT LINE DIAGRAMS

ROUTE 510 (West to East)

Mile Posts: 2.000 - 5.000



Pavement	
Shoulder	
Number of Lanes	
Speed Limit	
Street Name	



Street Name	Mendham Road					West Main Street					East Main Street
Jurisdiction						County					
Functional Class	Urban Minor Arterial		Rural Minor Arterial		Urban Minor Arterial						
Federal Aid - NHS Sy						STP					
Control Section											
Speed Limit	45				40			35		30	35
Number of Lanes	2										
Med. Type	None										
Med. Width	0										
Pavement	24					26		36		46	
Shoulder	2	4	2	10	2	0					
Traffic Volume	11,215,(2012)										
Traffic Sta. ID	1-4-413										
Structure No.	N/A		N/A		N/A			N/A			
Enlarged Views											

SRI = 0000510__

Date last inventoried: August 2007

APPENDIX B
TRAFFIC COUNT DATA

National Data & Surveying Services

Location: Roxiticus Rd & Mendham Rd
City: Mendham
Control: 2-Way Stop(NB/SB)

Intersection Turning Movement Count

Project ID: 18-12047-001
Date: 10/9/2018





















Total

NS/EW Streets:	Roxiticus Rd				Roxiticus Rd				Mendham Rd				Mendham Rd					
AM	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	
	NL	NT	NR	NU	SL	ST	SR	SU	EL	ET	ER	EU	WL	WT	WR	WU	TOTAL	
7:00 AM	0	6	12	0	0	12	4	0	17	238	12	0	13	39	1	0	354	
7:15 AM	0	2	6	0	0	13	0	0	41	166	25	0	27	59	1	0	340	
7:30 AM	2	3	11	0	0	14	3	0	11	142	20	0	26	76	0	0	308	
7:45 AM	4	2	10	0	0	16	2	0	9	217	26	0	42	49	2	0	379	
8:00 AM	1	6	23	0	0	13	1	0	7	193	19	0	26	62	0	0	351	
8:15 AM	2	2	9	0	0	13	4	0	14	198	29	0	26	64	0	0	361	
8:30 AM	12	11	11	0	0	16	4	0	10	160	36	0	26	65	1	0	352	
8:45 AM	9	5	15	0	3	17	3	0	7	165	21	0	16	65	0	0	326	
9:00 AM	3	5	6	0	0	11	4	0	2	190	16	0	12	55	1	0	305	
9:15 AM	4	3	15	0	0	6	2	0	2	136	7	0	15	66	1	0	257	
9:30 AM	5	2	13	0	2	2	1	0	2	101	6	0	18	59	0	0	211	
9:45 AM	7	2	13	0	0	4	2	0	1	81	1	0	12	45	0	0	168	
TOTAL VOLUMES :	NL 49	NT 49	NR 144	NU 0	SL 5	ST 137	SR 30	SU 0	EL 123	ET 1987	ER 218	EU 0	WL 259	WT 704	WR 7	WU 0	TOTAL 3712	
APPROACH %'s :	20.25%	20.25%	59.50%	0.00%	2.91%	79.65%	17.44%	0.00%	5.28%	85.35%	9.36%	0.00%	26.70%	72.58%	0.72%	0.00%		
PEAK HR :	07:45 AM - 08:45 AM																	TOTAL
PEAK HR VOL :	19	21	53	0	0	58	11	0	40	768	110	0	120	240	3	0	1443	
PEAK HR FACTOR :	0.396	0.477	0.576	0.000	0.000	0.906	0.688	0.000	0.714	0.885	0.764	0.000	0.714	0.923	0.375	0.000	0.952	
	0.684				0.863				0.911				0.976					





















PM	NORTHBOUND				SOUTHBOUND				EASTBOUND				WESTBOUND				TOTAL
	0 NL	1 NT	0 NR	0 NU	0 SL	1 ST	0 SR	0 SU	0 EL	1 ET	0 ER	0 EU	0 WL	1 WT	0 WR	0 WU	
3:00 PM	9	10	23	0	1	4	2	0	6	98	4	0	13	129	1	0	300
3:15 PM	6	5	21	0	1	1	2	0	1	80	7	0	16	152	0	0	292
3:30 PM	3	9	18	0	0	6	8	0	4	106	7	0	16	164	0	0	341
3:45 PM	6	13	16	0	0	4	3	0	1	88	1	0	10	155	1	0	298
4:00 PM	5	9	21	0	0	6	4	0	4	80	3	0	15	200	0	0	347
4:15 PM	8	10	27	0	0	3	3	0	2	91	5	0	16	194	1	0	360
4:30 PM	7	16	15	0	0	2	3	0	1	87	1	0	13	184	1	0	330
4:45 PM	2	14	25	0	0	2	5	0	1	86	4	0	17	196	0	0	352
5:00 PM	9	18	14	0	1	1	7	0	1	90	3	0	15	240	0	0	399
5:15 PM	11	12	36	0	0	2	7	0	3	95	9	0	23	252	0	0	450
5:30 PM	3	14	21	0	1	4	5	0	0	99	4	0	38	252	2	0	443
5:45 PM	12	22	41	0	0	8	3	0	5	63	5	0	27	232	0	0	418
TOTAL VOLUMES :	NL 81	NT 152	NR 278	NU 0	SL 4	ST 43	SR 52	SU 0	EL 29	ET 1063	ER 53	EU 0	WL 219	WT 2350	WR 6	WU 0	TOTAL 4330
APPROACH %'s :	15.85%	29.75%	54.40%	0.00%	4.04%	43.43%	52.53%	0.00%	2.53%	92.84%	4.63%	0.00%	8.50%	91.26%	0.23%	0.00%	
PEAK HR :	05:00 PM - 06:00 PM																TOTAL
PEAK HR VOL :	35	66	112	0	2	15	22	0	9	347	21	0	103	976	2	0	1710
PEAK HR FACTOR :	0.729	0.750	0.683	0.000	0.500	0.469	0.786	0.000	0.450	0.876	0.583	0.000	0.678	0.968	0.250	0.000	0.950
	0.710				0.886				0.881				0.926				

APPENDIX C
SYNCHRO ANALYSES – EXISTING CONDITIONS

Mendham Road (CR 510) & Roxiticus Road – AM – Existing

HCM 2000 SIGNING SETTINGS												
Lanes and Sharing (#RL)												
Traffic Volume (vph)	40	768	110	120	240	3	19	21	53	0	58	11
Future Volume (vph)	40	768	110	120	240	3	19	21	53	0	58	11
Sign Control	—	Free	—	—	Free	—	—	Stop	—	—	Stop	—
Median Width (ft)	—	0	—	—	0	—	—	0	—	—	0	—
TWLT Median	—		—	—		—	—		—	—		—
Right Turn Channelized	—	—	None	—	—	None	—	—	None	—	—	None
Critical Gap, tC (s)	4.1	—	—	4.1	—	—	7.3	6.7	6.4	—	6.6	6.3
Follow Up Time, tF (s)	2.2	—	—	2.2	—	—	3.7	4.2	3.5	—	4.1	3.4
Volume to Capacity Ratio	0.03	0.03	0.03	0.17	0.17	0.17	1.53	1.53	1.53	—	0.76	0.76
Control Delay (s)	0.6	0.9	0.9	2.3	5.2	5.2	371.3	371.3	371.3	—	106.9	106.9
Level of Service	A	A	A	A	A	A	F	F	F	—	F	F
Queue Length 95th (ft)	3	3	3	16	16	16	269	269	269	—	103	103
Approach Delay (s)	—	0.9	—	—	5.2	—	—	371.3	—	—	106.9	—

Mendham Road (CR 510) & Roxiticus Road – PM – Existing

HCM 2000 SIGNING SETTINGS												
Lanes and Sharing (#RL)												
Traffic Volume (vph)	9	347	21	103	976	2	35	66	112	2	15	22
Future Volume (vph)	9	347	21	103	976	2	35	66	112	2	15	22
Sign Control	—	Free	—	—	Free	—	—	Stop	—	—	Stop	—
Median Width (ft)	—	0	—	—	0	—	—	0	—	—	0	—
TWLT Median	—		—	—		—	—		—	—		—
Right Turn Channelized	—	—	None	—	—	None	—	—	None	—	—	None
Critical Gap, tC (s)	4.1	—	—	4.1	—	—	7.1	6.5	6.2	7.1	6.5	6.2
Follow Up Time, tF (s)	2.2	—	—	2.2	—	—	3.5	4.0	3.3	3.5	4.0	3.3
Volume to Capacity Ratio	0.02	0.02	0.02	0.10	0.10	0.10	2.10	2.10	2.10	0.49	0.49	0.49
Control Delay (s)	0.2	0.4	0.4	2.1	2.8	2.8	576.4	576.4	576.4	81.6	81.6	81.6
Level of Service	A	A	A	A	A	A	F	F	F	F	F	F
Queue Length 95th (ft)	1	1	1	8	8	8	572	572	572	52	52	52
Approach Delay (s)	—	0.4	—	—	2.8	—	—	576.4	—	—	81.6	—

APPENDIX D
SIGNAL WARRANT ANALYSES

Warrants Summary Report

2: Roxiticus Road & Mendham Road (Route 24)

Intersection Information

	Major Street	Minor Street
Street Name	Mendham Road (Route 24)	Roxiticus Road
Direction	EB/WB	NB/SB
Number of Lanes	1	1
Approach Speed	40	35

Warrant	Met?	Notes
Warrant 1, Eight-Hour Vehicular Volume		
	<input type="checkbox"/> No	
Condition A or B Met?	<input type="checkbox"/> No	6 Hours met (8 required)
Condition A and B Met?	<input type="checkbox"/> No	5 Hours met (8 required)
Warrant 2, Four-Hour Vehicular Volume		
	<input type="checkbox"/> Yes	6 Hours met (4 required)
Warrant 3, Peak Hour		
	<input type="checkbox"/> Yes	
Condition A Met?	<input type="checkbox"/> No	0 Hours met (1 required)
Condition B Met?	<input type="checkbox"/> Yes	5 Hours met (1 required)
Warrant 4, Pedestrian Volume		
	<input type="checkbox"/> No	
Condition A Met?	<input type="checkbox"/> No	0 Hours met (4 required)
Condition B Met?	<input type="checkbox"/> No	0 Hours met (1 required)
Warrant 5, School Crossing		
	<input type="checkbox"/> No	

Warrant 6, Coordinated Signal System☐ No**Warrant 7, Crash Experience**☐ NoTraffic Volume Condi ☐ No 6 Hours met (8 required)Ped Condition? ☐ No 0 Hours met (8 required)**Warrant 8, Roadway Network**☐ Yes**Warrant 9, Intersection Near a Grade Crossing**☐ No**AWSC Warrant, Multiway Stop Application**☐ YesCondition A Met? ☐ YesCondition B Met? ☐ YesCondition C Met? ☐ No

Warrant 1: Eight-hour Vehicular Volume

2: Roxiticus Road & Mendham Road (Route 24)

Intersection Information

Major Street Name: Mendham Road (Route 24)

Major Street Direction: EB/WB

Minor Street Direction: NB/SB

WARRANT 1 MET? **No**

Details:

Condition A Met? **No** 6 Hours met (8 required)

Condition B Met? **No** 5 Hours met (8 required)

Hour	Major Street Vehicles (Total of Both Approaches)	High Volume Minor Approach Vehicles	70% Standard Met? Cond. A OR Cond. B		56% Standard Met? Cond. A AND Cond. B	
			Condition A 70% Column	Condition B 70% Column	Condition A 56% Column	Condition B 56% Column
07:00 to 08:00	1,259	64	No	Yes*	No	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	No		
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	No		
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes		
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes		
07:15 to 08:15	1,246	70	No	Yes	No	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	No		
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	No		
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes		
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes		
07:30 to 08:30	1,258	75	No	Yes	No	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	No		
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	No		
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes		
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes		
07:45 to 08:45	1,281	93	No	Yes	Yes*	Yes*
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	No		
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes		
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes		
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes		

08:00 to 09:00		1,210	106		Yes*	Yes*	Yes	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	Yes				
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes				
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes				
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes				

08:15 to 09:15		1,179	90		No	Yes	Yes	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	No				
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes				
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes				
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes				

08:30 to 09:30		1,075	99		No	Yes	Yes	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	No				
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes				
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes				
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes				

08:45 to 09:45		963	85		No	Yes	Yes*	Yes*
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	No				
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes				
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes				
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes				

09:00 to 10:00		829	78		No	Yes*	No	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	No				
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	No				
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes				
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes				

09:15 to 10:15		553	64		No	Yes	No	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	No				
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	No				
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes				
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes				

09:30 to 10:30		326	42		No	No	No	No
Condition A	Volume >= 70% column (350)?	No	Volume >= 70% column (525)?	No				
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	No				
Condition B	Volume >= 70% column (525)?	No	Volume >= 70% column (53)?	No				
	Volume >= 56% column (420)?	No	Volume >= 56% column (42)?	Yes				

09:45 to 10:45		140	22		No	No	No	No
Condition A	Volume >= 70% column (350)?	No	Volume >= 70% column (525)?	No				
	Volume >= 56% column (280)?	No	Volume >= 56% column (420)?	No				
Condition B	Volume >= 70% column (525)?	No	Volume >= 70% column (53)?	No				
	Volume >= 56% column (420)?	No	Volume >= 56% column (42)?	No				

15:00 to 16:00		1,060	139		Yes*	Yes*	Yes*	Yes*
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	Yes				
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes				
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes				
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes				

15:15 to 16:15		1,111	132		Yes	Yes	Yes	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	Yes				
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes				
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes				
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes				

15:30 to 16:30		1,164	145		Yes	Yes	Yes	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	Yes				
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes				
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes				
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes				

15:45 to 16:45		1,154	153		Yes	Yes	Yes	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	Yes				
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes				
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes				
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes				

16:00 to 17:00	1,202	159	Yes*	Yes*	Yes*	Yes*
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	Yes		
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes		
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes		
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes		

16:15 to 17:15	1,249	165	Yes	Yes	Yes	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	Yes		
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes		
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes		
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes		

16:30 to 17:30	1,322	179	Yes	Yes	Yes	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	Yes		
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes		
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes		
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes		

16:45 to 17:45	1,430	179	Yes	Yes	Yes	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	Yes		
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes		
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes		
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes		

17:00 to 18:00	1,458	213	Yes*	Yes*	Yes*	Yes*
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	Yes		
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes		
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes		
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes		

17:15 to 18:15	1,109	172	Yes	Yes	Yes	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	Yes		
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes		
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes		
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes		

17:30 to 18:30		727	113		Yes	Yes	Yes	Yes
Condition A	Volume >= 70% column (350)?	Yes	Volume >= 70% column (525)?	Yes				
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	Yes				
Condition B	Volume >= 70% column (525)?	Yes	Volume >= 70% column (53)?	Yes				
	Volume >= 56% column (420)?	Yes	Volume >= 56% column (42)?	Yes				

17:45 to 18:45		332	75		No	No	No	No
Condition A	Volume >= 70% column (350)?	No	Volume >= 70% column (525)?	No				
	Volume >= 56% column (280)?	Yes	Volume >= 56% column (420)?	No				
Condition B	Volume >= 70% column (525)?	No	Volume >= 70% column (53)?	Yes				
	Volume >= 56% column (420)?	No	Volume >= 56% column (42)?	Yes				

Warrant 2: Four-hour Vehicular Volume

2: Roxiticus Road & Mendham Road (Route 24)

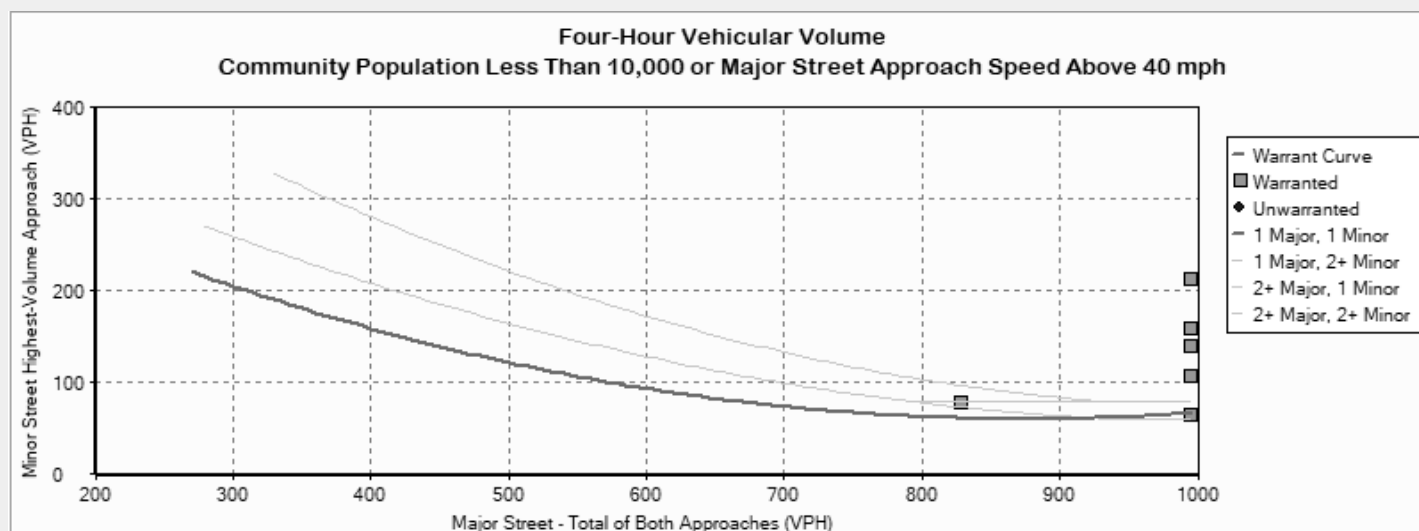
Intersection Information

	Major Street	Minor Street
Street Name	Mendham Road (Route 24)	Roxiticus Road
Direction	EB/WB	NB/SB
Number of Lanes	1	1
Approach Speed	40	35

Warrant 2 Met? **Yes**

Details:

Notes	6 Hours met (4 required)
Low population	Yes



Hourly Volumes

Hour	Major Street Total All Approaches (vph)	Minor Street Highest Volume Approach (vph)
00:00:00 - 01:00:00	0.00	0.00
01:00:00 - 02:00:00	0.00	0.00
02:00:00 - 03:00:00	0.00	0.00
03:00:00 - 04:00:00	0.00	0.00
04:00:00 - 05:00:00	0.00	0.00
05:00:00 - 06:00:00	0.00	0.00
06:00:00 - 07:00:00	0.00	0.00
07:00:00 - 08:00:00	1,259.00	64.00
08:00:00 - 09:00:00	1,210.00	106.00
09:00:00 - 10:00:00	829.00	78.00
10:00:00 - 11:00:00	0.00	0.00
11:00:00 - 12:00:00	0.00	0.00
12:00:00 - 13:00:00	0.00	0.00
13:00:00 - 14:00:00	0.00	0.00
14:00:00 - 15:00:00	0.00	0.00
15:00:00 - 16:00:00	1,060.00	139.00
16:00:00 - 17:00:00	1,202.00	159.00
17:00:00 - 18:00:00	1,458.00	213.00
18:00:00 - 19:00:00	0.00	0.00
19:00:00 - 20:00:00	0.00	0.00
20:00:00 - 21:00:00	0.00	0.00
21:00:00 - 22:00:00	0.00	0.00
22:00:00 - 23:00:00	0.00	0.00
23:00:00 - 00:00:00	0.00	0.00

Warranted Volumes

Hour	Major Street Total All Approaches (vph)	Minor Street Highest Volume Approach (vph)
07:00:00 - 08:00:00	1,259.00	64.00
08:00:00 - 09:00:00	1,210.00	106.00
09:00:00 - 10:00:00	829.00	78.00
15:00:00 - 16:00:00	1,060.00	139.00
16:00:00 - 17:00:00	1,202.00	159.00
17:00:00 - 18:00:00	1,458.00	213.00

Warrant 3: Peak Hour

2: Roxiticus Road & Mendham Road (Route 24)

Intersection Information

	Major Street	Minor Street
Street Name	Mendham Road (Route 24)	Roxiticus Road
Direction	EB/WB	NB/SB
Number of Lanes	1	1
Approach Speed	40	35

Warrant 3 Met? **Yes**

Details

Low Population? **Yes**

Condition A Met? **No**

Notes 0 Hours met (1 required)

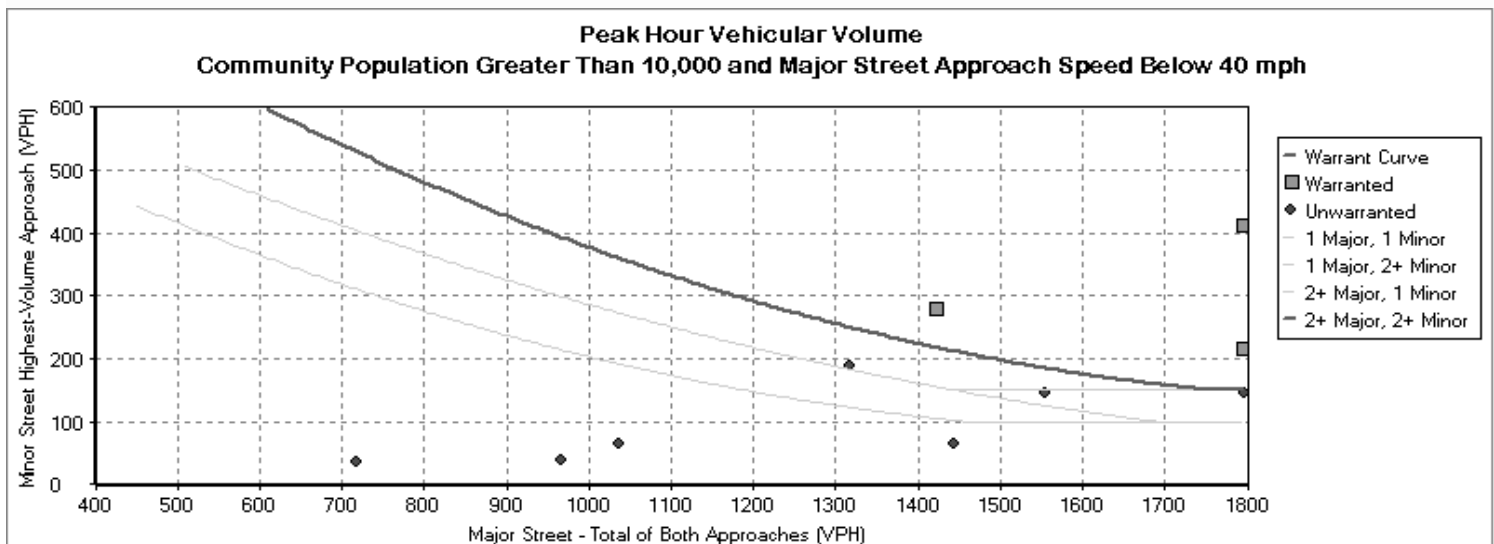
Minor Approach Time Delay Condition Met? **Not Met**

Minor Approach Volume Condition Met? **Met**

Total Entering Intersection Volume Condition Met? **Not Met**

Condition B Met? **Yes**

Notes 5 Hours met (1 required)



Hour	Major Street Total All Approaches (vph)	Minor Street Highest Volume Approach (vph)
7:00	1,259	64
7:30	1,258	75
8:30	1,075	99
9:30	326	42
15:00	1,060	139
16:00	1,202	159
17:00	1,458	213

Warrant 4: Pedestrian Volume

2: Roxiticus Road & Mendham Road (Route 24)

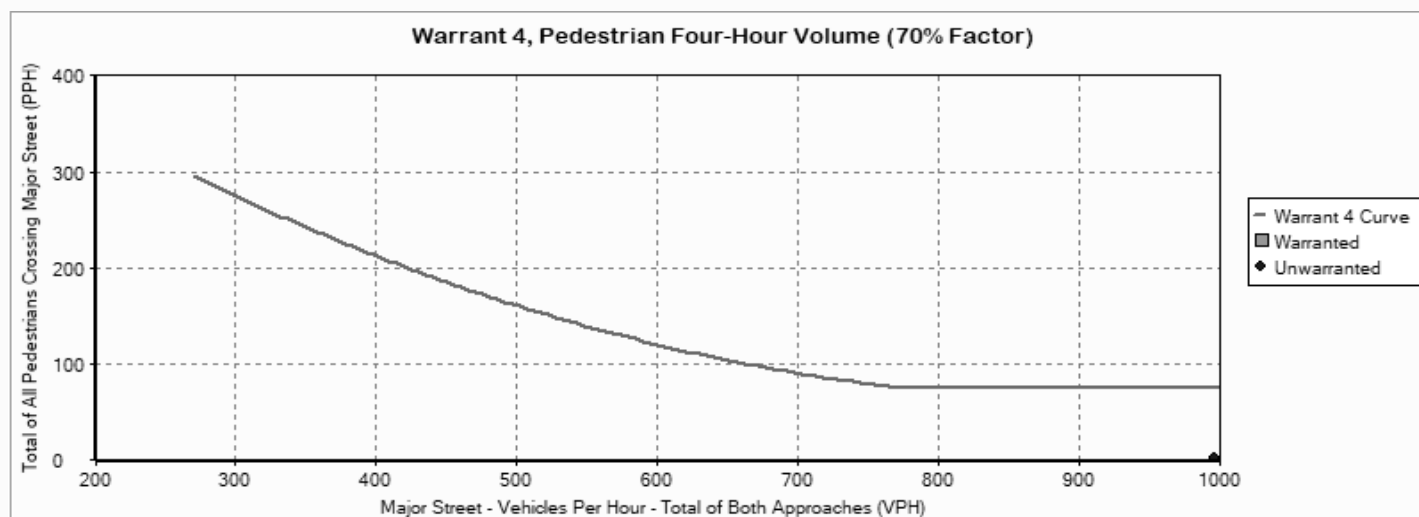
Intersection Information

	Major Street	Minor Street
Street Name	Mendham Road (Route 24)	Roxiticus Road
Direction	EB/WB	NB/SB
Number of Lanes	1	1
Approach Speed	40	35

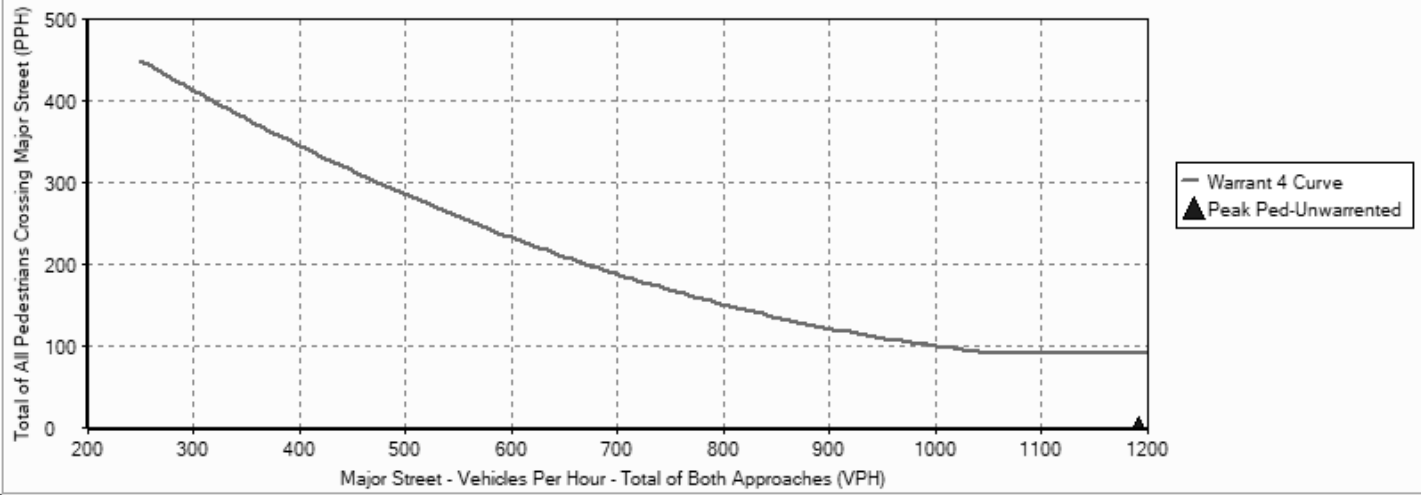
WARRANT 4 MET ? **No**

Details

Pedestrian Four Hour Volume Warrant Met?	No	
Pedestrian Peak Hour Warrant Met?	No	Notes 0 Hours met (4 required)
Speed Limit or 85th Percentile Speed on Major Street > 35mph, or Intersection lies within an Isolated Community with Population < 10,000?	Yes	



Warrant 4, Pedestrian Peak Hour (70% Factor)



Warrant 5: School Crossing

2: Roxiticus Road & Mendh

Intersection Information

Major Street Name Mendham Road (Route 24)

Major Street Direction EB/WB

WARRANT 5 MET? **No**

Details:

Time Period Interval for Students Crossing (min)

0

Number of Students Crossing in Time Period

0

Number of Adequate Gaps in Time Period

0

Other Remedial Measures Attempted?

No

Adjacent Signal on EB approach?

No

Distance to signal on EB Approach (ft)

-

Adjacent Signal on WB approach?

No

Distance to signal on WB Approach (ft)

-

Will New Signal Restrict Progressive Traffic?

Yes

Warrant 6: Coordinated Signal System

2: Roxiticus Road & Mendham Road (Route 24)

Intersection Information

Major Street Name Mendham Road (Route 24)

Major Street Direction EB/WB

WARRANT 6 MET? **No**

Details:

Approach Direction & Name	Acceptable Platooning?	Adjacent Coordinating Signal?	Adjacent Intersection Distance
SB Approach (Roxiticus Road)	Yes	No	N/A
NB Approach (Roxiticus Road)	Yes	No	N/A
WB Approach (Mendham Road (Route 24))	Yes	No	N/A
EB Approach (Mendham Road (Route 24))	Yes	No	N/A

Unacceptable Platooning?
(At least one approach)

No

Distance to Closest Signal
(Must be N/A or > 1000)

N/A

Warrant 7: Crash Experience

2: Roxiticus Road & Mendham Road (Route 24)

Intersection Information

Major Street Name Mendham Road (Route 24)
Major Street Direction EB/WB
Minor Street Direction NB/SB

WARRANT 7 MET? **No**

Details:

Low Population?	Yes	Traffic Volume Condition Met?	No
Major Street Speed Limit	40		6 Hours Met (8 Required)
Major Street 85th-% tile Speed	0.00	Ped Volume Condition Met?	No
			0 Hours Met (8 Required)
	Qualifying Crashes	6	
	Adequate Alternative Trials?	Yes	

Hour	Traffic Volumes				Pedestrian Volumes			
	Major Street Vehicles	Minor Street Vehicles	80% Standard Met? A or B		Northbound Ped Volumes		Southbound Ped Volumes	
			Condition A	Condition B	Peds	> 80?	Peds	> 80?
07:00 to 08:00	1,259	0	No	No	0	No	0	No
07:15 to 08:15	1,246	0	No	No	0	No	0	No
07:30 to 08:30	1,258	0	No	No	0	No	0	No
07:45 to 08:45	1,281	0	No	No	0	No	0	No
08:00 to 09:00	1,210	0	No	No	0	No	0	No
08:15 to 09:15	1,179	0	No	No	0	No	0	No
08:30 to 09:30	1,075	0	No	No	0	No	0	No

08:45 to 09:45	963	0	No	No	0	No	0	No
09:00 to 10:00	829	0	No	No	0	No	0	No
09:15 to 10:15	553	0	No	No	0	No	0	No
09:30 to 10:30	326	0	No	No	0	No	0	No
09:45 to 10:45	140	0	No	No	0	No	0	No
15:00 to 16:00	1,060	0	No	No	0	No	0	No
15:15 to 16:15	1,111	0	No	No	0	No	0	No
15:30 to 16:30	1,164	0	No	No	0	No	0	No
15:45 to 16:45	1,154	0	No	No	0	No	0	No
16:00 to 17:00	1,202	0	No	No	0	No	0	No
16:15 to 17:15	1,249	0	No	No	0	No	0	No
16:30 to 17:30	1,322	0	No	No	0	No	0	No
16:45 to 17:45	1,430	0	No	No	0	No	0	No
17:00 to 18:00	1,458	0	No	No	0	No	0	No
17:15 to 18:15	1,109	0	No	No	0	No	0	No
17:30 to 18:30	727	0	No	No	0	No	0	No
17:45 to 18:45	332	0	No	No	0	No	0	No

Warrant 8: Roadway Network

2: Roxiticus Road & Mendham Road (Route 24)

Intersection Information

Major Street Name	Mendham Road (Route 24)
Major Street Direction	EB/WB
Minor Street Direction	NB/SB

WARRANT 8 MET? (A or B) ☒ Yes

Details:

Growth Rates % (per year)				
	NB	SB	EB	WB
L	0.00	0.00	0.00	0.00
T	0.00	0.00	0.00	0.00
R	0.00	0.00	0.00	0.00

Condition A, Total Entering Volume		Condition B, Non-normal Business Day		
			Existing	Future
Existing Peak Hour	1,710	Highest Hour	0	0
Years	20.00	Second Highest Hour	0	0
Future Peak Hour	1,780	Third Highest Hour	0	0
Warrant 1 in 5 Years?	No	Fourth Highest Hour	0	0
Warrant 2 in 5 Years?	Yes	Fifth Highest Hour	0	0
Warrant 3 in 5 Years?	Yes	Yearly Growth Rate (%)	0.20	
		Years	20.00	

Condition A Met? ☒ Yes

Condition B Met? ☐ No

Warrant 9: Intersection Near a Grade Crossing

2: Roxiticus Road & Mendham Road (Route 24)

Intersection Information

	Major Street	Minor Street
Street Name	Mendham Road (Route 24)	Roxiticus Road
Direction	EB/WB	NB/SB
Number of Lanes	1	1
Approach Speed	40	35

WARRANT 9 MET ? **No**

Details

Note **No approach with a railroad grade crossing**

Minor street approach having a grade crossing

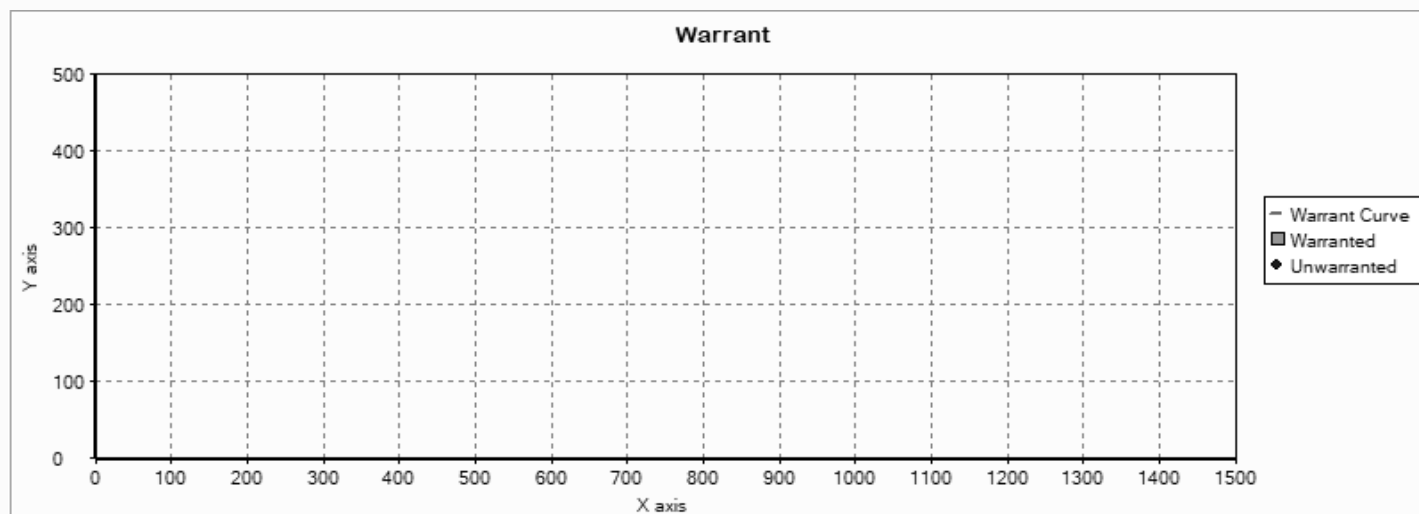
Distance from the center of the track to the stop or yield line Interpolated

Number of occurrences of rail traffic per day Adjustment Factor

Percentage of high-occupancy buses crossing the track (%) Adjustment Factor

Percentage of tractor-trailer trucks crossing the track (%) Adjustment Factor

The rail traffic arrival times are unknown, the highest traffic volume hour of the day is used



Hour	Major Street Total of Both Approaches (vph)	Minor Street Adjusted Volume Crossing Tracks (vph)

All-Way Stop Control Warrant: Multiway Stop Applications

2: Roxiticus Road & Mendham Road (Route 24)

Intersection Information

Major Street Name: Mendham Road (Route 24)

Major Street Direction: EB/WB

Minor Street Direction: NB/SB

AWSC WARRANT MET? **Yes**

Details:

Condition A Met?	Yes	Qualifying Crashes	6
Condition B Met?	Yes	Major Street 85th %-tile Speed	0.00
Condition C Met?	No	Major Street Speed Limit	40
Notes: 1 Hours Met (8 Required)			

Hour	Traffic Volumes		Bicycle Volumes		Ped Volumes		Condition C		
	Major Street	Minor Street	East Bound Bicycle Volumes	North Bound Bicycle Volumes	East Bound Ped Volumes	North Bound Ped Volumes	Major Street	Minor Street	
							Veh Volume > 300	Avg(Veh + Ped + Bicycle) > 200	Delay > 30
16:30 to 17:30	1,322	209	0	0	0	0	False	No	No

APPENDIX E
INTERSECTION IMPROVEMENT PLANS



Plotted by Michael Drobný 11/9/2018
C:\GK\6400\6430 - Morris County On-Call Engineering\6430.017 Mendham Intersection Studies\CADD\DWG\6430.017 - CONCEPT PLANS.dwg 1

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PROFESSIONAL ENGINEER, NJ LIC. No. 24GE04617800

RECOMMENDED SAFETY IMPROVEMENTS

FOR INTERSECTION IMPROVEMENTS AT
**MENDHAM ROAD (CR 510) &
ROXITICUS ROAD**

TOWNSHIP OF MENDHAM
MORRIS COUNTY, NEW JERSEY

DATE: NOVEMBER 2018	DESIGNED BY: ERH	SCALE: 1" = 30'	PROJECT NUMBER: 6430.017
DRAWN BY: ERH	CHECKED BY: MJD	FIELD BOOK: -----	SHEET: 1 of 2