

MEMORANDUM

TO: Mr. Michael P. Gilleberto
Town Administrator
Town of Tyngsborough
25 Bryants Lane
Tyngsborough, MA 01879

FROM: Mr. Jeffrey S. Dirk, P.E., PTOE, FITE
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DATE: July 14, 2014

RE: 6616

SUBJECT: Intersection Safety and Operations Assessment
Lakeview Avenue at Coburn Road
Tyngsborough, Massachusetts

Vanasse & Associates, Inc. (VAI) has been retained by the Town of Tyngsborough to conduct an Intersection Safety and Operations Assessment for the intersection of Lakeview Avenue at Coburn Road in Tyngsborough, Massachusetts. The purpose of this assessment is to evaluate potential improvement strategies for the intersection that would accomplish the following objectives: i) facilitate the efficient flow of vehicles, pedestrians and bicyclists; ii) accommodate existing and projected future traffic volumes; and iii) enhance safety at the intersection. The improvement strategies that have been identified for the subject intersection have been designed in accordance with Massachusetts Department of Transportation (MassDOT) standards and follow MassDOT's "Complete Streets" and "GreenDOT" design policies with respect to accommodating all roadway users. As such, the recommended improvements are designed to be eligible for funding through the State Transportation Improvement Program (STIP) should the Town decide to pursue such funding.

This study was prepared in consultation with the Town of Tyngsborough and MassDOT; was performed in general accordance with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs (EEA)/MassDOT Guidelines for Environmental Impact Report/Environmental Impact Statement Traffic Impact Assessments (TIAs) and the MassDOT standards for the preparation of Traffic Impact Assessments for Functional Design Reports (FDRs); and was conducted pursuant to the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports.

As a result of this assessment, it has been recommended that Intersection Improvement Alternative 2 – *Multi-Way STOP-Sign Control*, depicted on Figure 4 be considered for implementation at the intersection in order to improve traffic operations and safety under both existing and projected future traffic volume conditions.

The following details our assessment of improvement strategies for the intersection of Lakeview Avenue at Coburn Road.



EXISTING CONDITIONS

A comprehensive field inventory of existing conditions within the study area was conducted in January and February 2014. The field investigation consisted of an inventory of existing roadway geometrics; pedestrian and bicycle facilities; public transportation services; traffic volumes; and operating characteristics; as well as posted speed limits and land use information within the study area. The study area is depicted on Figure 1 and consisted of the intersection of Lakeview Avenue at Coburn Road and its associated approaches.

The following describes existing conditions within the study area.

Roadways

Lakeview Avenue



Lakeview Avenue is a two-lane, urban principal arterial roadway¹ that is under Town jurisdiction and traverses the study area in a general northwest-southeast direction between Frost Road (Route 3A) and Parham Road. Within the immediate study area, Lakeview Avenue provides two (2) 12 to 16-foot wide travel lanes separated by a double-yellow centerline with no marked shoulders provided. A Sidewalk is provided along the west side of Lakeview Avenue south of Coburn Road. The posted speed limit along

Lakeview Avenue within the study area is 35 miles per hour (mph). Land use along Lakeview Avenue consists of residential properties and areas of open and wooded space.

Coburn Road



Coburn Road is a two-lane roadway under Town jurisdiction that traverses the study area in a general east-west direction between Parham Road and Sherburne Road, and is classified as an urban minor arterial roadway east of Lakeview Avenue and as a local collector roadway to the west. Within the immediate study area, Coburn Road provides two (2) 11 to 15-foot wide travel lanes separated by a double-yellow centerline with variable width or no marked shoulder provided. A sidewalk is provided along the

south side of Coburn Road between Maplewood Avenue and a point approximately 150 feet east of Lakeview Avenue. The posted speed limit along Coburn Road within the study area is 25 mph approaching Lakeview Avenue and 35 mph thereafter. Land use along Coburn Road consists of residential properties and areas of open and wooded space.

¹Roadway functional classifications defined by the MassDOT Office of Transportation Planning.



Figure 1

Project Location Map



Intersection

Lakeview Avenue at Coburn Road



Coburn Road intersects Lakeview Avenue from the east and west to form this four-legged, unsignalized intersection under STOP-sign control. Existing intersection attributes are as follows:

- Coburn Road approaches are under STOP-sign control with marked STOP-lines provided and “Stop Sign Ahead” warning signs (graphic symbol) provided in advance of the intersection
- A 4-way flashing beacon is centered over the intersection that provides flashing “yellow” indications for the Lakeview Avenue approaches and flashing “red” indications for the Coburn Road approaches
- Lakeview Avenue north and southbound approaches provide a single general-purpose travel lane (14 to 15-foot wide)
- Coburn Road east and westbound approach provides a single general-purpose travel lane (12 to 14-foot wide)
- Directions of travel along both Lakeview Avenue and Coburn Road are separated by a double-yellow centerline
- Posted speed limit on Coburn Road approaches to the intersection is 25 mph
- Posted speed limit on Lakeview Avenue approaches to the intersection is 35 mph
- Sidewalks are provided along the west side of Coburn Road east and west of the intersection, and along the west side of Lakeview Avenue south of the intersection
- A marked crosswalk is provided for crossing the south leg of the intersection, with pedestrian crossing warning signs provided at and in advance of the crossing on Lakeview Avenue
- A Lowell Regional Transit Authority (LRTA) bus stop is located on Lakeview Avenue north of Coburn Road
- Land use in the vicinity of the intersection consists of residential properties and areas of open and wooded space

Existing Traffic Volumes

In order to determine existing traffic-volume demands and flow patterns within the study area, automatic traffic recorder (ATR) counts, manual turning movement counts (TMCs) and vehicle classification counts were completed in January and February 2014. The ATR counts were conducted on Lakeview Avenue north of Coburn Road and on Coburn Road east of Lakeview Avenue in order to record weekday daily traffic conditions along these roadways over an extended period. In addition, a continuous 12-hour (7:00 AM to 7:00 PM) manual TMC was performed on a weekday at the Lakeview Avenue/Coburn Road intersection in order to allow for an evaluation of implementation of traffic signal control at the intersection (discussion follows).

Traffic Volume Adjustments

In order to evaluate the potential for seasonal fluctuation of traffic volumes within the study area, MassDOT weekday seasonal factors for Group 6 roadways (urban arterials, collectors and rural arterials, the functional classification of both Lakeview Avenue and Coburn Road) were reviewed.² Based on a review of this data, it was determined that traffic volumes for the months of January and February are approximately 3 percent below and 1 percent above average-month conditions, respectively. As such, the January traffic volume data was adjusted upward by 3 percent in order to be representative of average-month traffic volume conditions; the February traffic volume data was not adjusted downward to average-month conditions in order to provide a conservative (above-average) analysis condition. The 2014 Existing traffic volumes are summarized in Table 1, with the weekday morning and evening peak-hour traffic volumes graphically depicted on Figure 2.

Table 1
2014 EXISTING TRAFFIC VOLUMES

Location	AWT ^a	Weekday Morning Peak-Hour (7:15 – 8:15 AM)			Weekday Evening Peak-Hour (4:15 – 5:15 PM)		
		VPH ^b	K Factor ^c	Directional Distribution ^d	VPH	K Factor	Directional Distribution
Lakeview Avenue, north of Coburn Road	2,485	181	7.3	51.4% NB	220	8.9	55.5% SB
Coburn Road, east of Lakeview Avenue	1,550	171	11.0	70.2% WB	125	8.1	65.6% EB

^aAverage weekday traffic in vehicles per day.

^bVehicles per hour.

^cPercent of daily traffic occurring during the peak hour.

^dPercent traveling in peak direction.

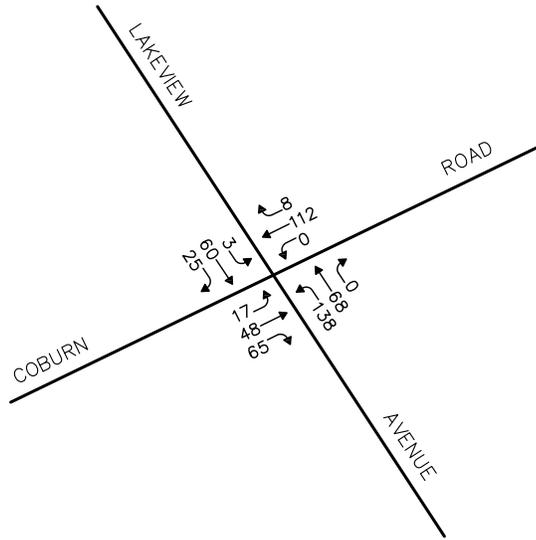
^eNB = northbound; SB = southbound; EB = eastbound; WB = westbound.

As can be seen in Table 1, Lakeview Avenue, north of Coburn Road, was found to accommodate approximately 2,485 vehicles on an average weekday (two-way, 24-hour volume), with approximately 181 vehicles per hour (vph) during the weekday morning peak-hour and 220 vph during the weekday evening peak-hour.

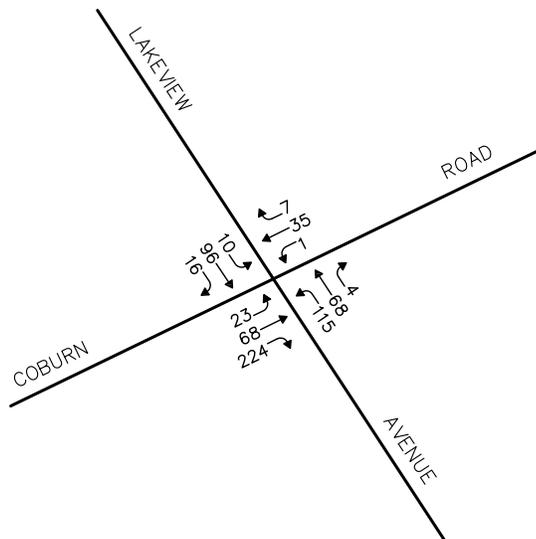
²MassDOT Traffic Volumes for the Commonwealth of Massachusetts; 2007 Weekday Seasonal Factors, Group 6 – Urban Arterials, Collectors and Rural Arterials.



WEEKDAY MORNING PEAK HOUR (7:15 AM - 8:15 AM)



WEEKDAY EVENING PEAK HOUR (4:15 PM - 5:15 PM)



 Not To Scale



Figure 2

2014 Existing Peak Hour Traffic Volumes

Coburn Road, east of Lakeview Avenue, was found to accommodate approximately 1,550 vehicles on an average weekday (two-way, 24-hour volume), with approximately 171 vph during the weekday morning peak-hour and 125 vph during the weekday evening peak-hour.

Pedestrian and Bicycle Facilities

A comprehensive field inventory of pedestrian and bicycle facilities within the study area was undertaken in January 2014. The field inventory consisted of a review of the location of sidewalks and pedestrian crossing locations at the study intersection, as well as the location of existing and proposed bicycle facilities. Sidewalks are provided along the west side of Lakeview Avenue south of Coburn Road and along the south side of Coburn Road between Maplewood Avenue and a point approximately 150 feet east of Lakeview Avenue. A marked crosswalk is provided for crossing the Lakeview Avenue south leg of the intersection, with pedestrian crossing warning signs provided at and in advance of the crossing on Lakeview Avenue.

At present, no formal existing bicycle facilities were identified within the immediate study area; however, it appears that both Lakeview Avenue and Coburn Road provide sufficient width to support bicycle travel in a shared travelled-way condition (i.e., bicycles and motor vehicle sharing the travelled-way).³

Public Transportation Services

The Lowell Regional Transit Authority (LRTA) provides public bus and paratransit services to the Town of Tyngsborough. Within the study area, LRTA Bus Route 10, *Dracut/Tyngsborough*, provides fixed-route bus route service with a designated (by sign) stop on Lakeview Avenue north of Coburn Road. Paratransit services are provided to eligible residents of the Town through the Council on Aging by way of the LRTA Road Runner service. LRTA Bus Route 10 provides service between the Kennedy Center at Gallagher Terminal in Lowell and Ayotte's Market in Hudson, New Hampshire, and operates between 6:35 AM and 8:10 PM on weekdays, and from 8:30 AM to 6:56 PM on Saturday; no service on Sunday. Fare costs are \$1.50 one-way.

The LRTA Road Runner paratransit service is available to eligible persons with disabilities who are unable to use the LRTA fixed-route bus service. All Road Runner vehicles are equipped to provide service to individuals with wheelchairs or other mobility assistance devices. The LRTA Road Runner service operates during the same hours as the LRTA fixed route bus service, but does not operate during some holidays and when extreme weather conditions exist. Reservations for Road Runner service can be made up to one day prior and cancellations are required at least one hour in advance. Fares cost for the Road Runner service are \$1.00 for in-town trips and \$1.50 for out of town service. Public transportation service information is included in the Appendix.

Spot Speed Measurements

Vehicle travel speed measurements were performed on Lakeview Avenue and Coburn Road within the study area over a continuous 48-hour period (two weekdays) in conjunction with the ATR counts. Table 2 summarizes the vehicle travel speed measurements.

³The minimum width required to support bicycle travel in a shared travelled-way configuration is 14-feet consisting of the travel lane and shoulder area where present.



Table 2
VEHICLE TRAVEL SPEED MEASUREMENTS

	Lakeview Avenue		Coburn Road	
	Northbound	Southbound	Eastbound	Westbound
Mean Travel Speed (mph)	27	27	31	30
85 th Percentile Speed (mph)	33	33	35	34
Posted Speed Limit (mph)	35	35	25	25

mph = miles per hour.

As can be seen in Table 2, the mean (average) vehicle travel speed along Lakeview Avenue within the study area was found to be approximately 27 miles per hour (mph). The average measured 85th percentile vehicle travel speed, or the speed at which 85 percent of the observed vehicles traveled at or below, was found to be approximately 33 mph, or 2 mph below the posted speed limit (35 mph). The 85th percentile speed is used as the basis of engineering design and in the evaluation of sight distances, and is often used in establishing posted speed limits.

The mean (average) vehicle travel speed along Coburn Road within the study area was found to be approximately 31 mph, with the average measured 85th percentile vehicle travel speed found to be approximately 34 mph, or 9 mph above the posted speed limit approaching the intersection (25 mph). The detailed speed measurements are provided in the Appendix.

Motor Vehicle Crash Data

Motor vehicle crash information for the intersection of Lakeview Avenue at Coburn Road was provided by the Tyngsborough Police Department for the most recent five-year period available (2009 through 2013, inclusive) in order to examine motor vehicle crash trends occurring at the intersection. The data is summarized by type, severity, and day of occurrence, and presented in Table 3.



Table 3
MOTOR VEHICLE CRASH DATA SUMMARY^a

	Lakeview Avenue/ Coburn Road
Traffic Control Type: ^b	U
<i>Year:</i>	
2009	0
2010	4
2011	2
2012	4
<u>2013</u>	<u>2</u>
Total	12
Average	2.40
Calculated Crash Rate ^c	0.89
MassDOT Crash Rate	0.58
Significant? ^d	Yes
<i>Severity:</i>	
Property Damage Only	11
Personal Injury	1
Fatal	0
<u>Unknown</u>	<u>0</u>
Total	12
<i>Type:</i>	
Angle	8
Rear-End	2
Head-On	0
Fixed Object	0
Sideswipe Same Direction	0
Sideswipe Opposite Direction	0
<u>Unknown/Other</u>	<u>1</u>
Total	12
<i>Weather Conditions:</i>	
Clear	8
Cloudy	3
Rain	0
Snow/Ice	0
<u>Unknown</u>	<u>1</u>
Total	12
<i>Lighting</i>	
Daylight	9
Dawn/Dusk	0
Dark (Road Lit)	0
Dark (Road Unlit)	3
Dark (No Street Lights)	0
<u>Other/Unknown</u>	<u>0</u>
Total	12
<i>Day of Week:</i>	
Monday through Friday	9
Saturday	1
<u>Sunday</u>	<u>2</u>
Total	12

^aSource: Tyngsborough Police Department crash reports 2009 through 2013.

^bTraffic Control Type: U = Unsignalized Intersection.

^cCrash rate per million vehicles entering the intersection.

^dThe intersection crash rate is significant if it is found to exceed MassDOT Crash Rate for the MassDOT Highway Division District in which the intersection is located (District 4).



As can be seen in Table 3, the intersection of Lakeview Avenue at Coburn Road was found to have experienced a total of 12 reported motor vehicle crashes over the five-year review period, or approximately three (3) crashes per year. The majority of the reported crashes involved property damage only; occurred on a weekday, during daylight, under clear weather conditions; and were reported as angle-type collisions. A further review of the reported motor vehicle crashes indicates that the predominant crash pattern involved motorists turning or crossing the intersection from Coburn Road. These types of collisions at an unsignalized intersection can be attributed to: sight distance limitations; vehicle travel speeds that are not conducive to the roadway/intersection geometry; inadequate or missing signs and/or pavement markings; intersection geometry or alignment; constrained operating conditions; and/or driver error.

In addition, the calculated crash rate at the intersection (average number of motor vehicle crashes reported per year per million vehicles travelling through the intersection) was found to be above the MassDOT average for an unsignalized intersection for the MassDOT Highway Division District in which the intersection is located (District 4). This does not necessarily indicate that a specific safety deficiency exists at the intersection; however, the crash data does indicate the need to review the current intersection geometry and sight lines in order to determine if these features are a contributing factor to the cause of the motor vehicle collisions occurring at the intersection. No fatal motor vehicle crashes were reported at the intersection over the five-year review period. The detailed MassDOT Crash Rate Worksheet is provided in the Appendix.

Existing Traffic Operations

In order to evaluate existing traffic operations at the study intersection, a detailed traffic operations analysis was completed under 2014 Existing traffic volume conditions. In brief, six levels of service are defined for each type of facility. They are given letter designations ranging from “A” to “F”, with a level-of-service (LOS) “A” representing the best operating conditions and a LOS “F” representing congested or constrained operations. A LOS “E” is representative of a transportation facility that is operating at its design capacity with a LOS “D” generally defined as the limit of “acceptable” traffic operations. Since the level-of-service of a traffic facility is a function of the flows placed upon it, such a facility may operate at a wide range of levels of service depending on the time of day, day of week, or period of the year. The Synchro™ intersection capacity analysis software, which is based on the analysis methodologies and procedures presented in the 2010 *Highway Capacity Manual* (HCM),⁴ was used to complete the level-of-service and vehicle queue analyses, the results of which are summarized in Table 4.

As can be seen in Table 4, under 2014 Existing conditions, the critical movements at this unsignalized intersection (all movements from Coburn Road) were shown to operate at LOS “C” during both the weekday morning and evening peak hours, with reported queues of 1 to 3 vehicles. All movements along Lakeview Avenue were shown to operate at LOS “A” during the peak periods, with reported queues of 0 to 1 vehicle. These results indicate that the intersection is generally operating under acceptable conditions with respect to motorist delays and vehicle queuing.

⁴*Highway Capacity Manual*, Transportation Research Board; Washington, DC; 2010.



Table 4
TRAFFIC OPERATIONS ANALYSIS SUMMARY
LAKEVIEW AVENUE AT COBURN ROAD

Peak Hour/Movement	2014 Existing			Queue ^d 95 th
	Demand ^a	Delay ^b	LOS ^c	
<i>Weekday Morning:</i>				
Coburn Road EB LT/TH/RT	130	18.4	B	2
Coburn Road WB LT/TH/RT	120	23.8	C	3
Lakeview Avenue NB LT/TH/RT	206	5.3	A	1
Lakeview Avenue SB LT/TH/RT	88	0.3	A	0
<i>Weekday Evening:</i>				
Coburn Road EB LT/TH/RT	315	15.8	C	3
Coburn Road WB LT/TH/RT	43	14.2	B	1
Lakeview Avenue NB LT/TH/RT	187	4.8	A	1
Lakeview Avenue SB LT/TH/RT	122	0.6	A	0

^aDemand in vehicle per hour.

^bAverage control delay per vehicle (in seconds).

^cLevel-of-Service.

^dQueue length in vehicle.

NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

SIGHT DISTANCE EVALUATION

Sight distance measurements were performed at the Lakeview Avenue/Coburn Road intersection in accordance with MassDOT and American Association of State Highway and Transportation Officials (AASHTO)⁵ requirements. Both stopping sight distance (SSD) and intersection sight distance (ISD) measurements were performed. In brief, SSD is the distance required by a vehicle traveling at the design speed of a roadway, on wet pavement, to stop prior to striking an object in its travel path. ISD or corner sight distance (CSD) is the sight distance required by a driver entering or crossing an intersecting roadway to perceive an on-coming vehicle and safely complete a turning or crossing maneuver with on-coming traffic. In accordance with AASHTO standards, if the measured ISD is at least equal to the required SSD value for the appropriate design speed, the intersection can operate in a safe manner. Table 5 presents the measured SSD and ISD at the subject intersection.

⁵A Policy on Geometric Design of Highway and Streets, 6th Edition; American Association of State Highway and Transportation Officials (AASHTO); 2011.



**Table 5
SIGHT DISTANCE MEASUREMENTS^a**

Intersection/Sight Distance Measurement	Feet		
	Required Minimum (SSD)	ISD ^b	Measured
<i>Lakeview Avenue at Coburn Road</i>			
<i>Stopping Sight Distance:</i>			
Coburn Road approaching from the east	250	--	220
Coburn Road approaching from the west	250	--	416
Lakeview Avenue approaching from the north	250	--	320
Lakeview Avenue approaching from the south	250	--	240
<i>Intersection Sight Distance:</i>			
Looking to the north from Coburn Road eastbound	250	335/390	475
Looking to the south from Coburn Road eastbound	250	335/390	500+
Looking to the north from Coburn Road westbound	250	335/390	300
Looking to the south from Coburn Road westbound	250	335/390	220

^aRecommended minimum values obtained from *A Policy on Geometric Design of Highways and Streets*, 6th Edition; American Association of State Highway and Transportation Officials (AASHTO); 2011; and based on a 35 mph approach speed on both Lakeview Avenue and Coburn Road.

^bValues shown are the intersection sight distance for a vehicle turning right/left exiting a roadway under STOP control such that motorists approaching the intersection on the major street should not need to adjust their travel speed to less than 70 percent of their initial approach speed.

As can be seen in Table 5, the available lines of sight on the westbound approach to Coburn Road and along Lakeview Avenue approaching Coburn Road from the south were found to be slightly below the required minimum sight distance (SSD) for a 35 mph approach speed. The noted sight line limitations were identified as vegetation located both within the public right-of-way and on private property proximate to the intersection. Recommendations for vegetation maintenance and sign and pavement marking enhancements have been detailed as a part of this assessment to improve sight lines and safety at the intersection.

FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2021, which reflects a seven-year planning horizon from the current year consistent with MassDOT guidelines for the preparation of Traffic Impact Assessments for Functional Design Reports (FDRs). Traffic volumes on the roadway network in the year 2021 under Design-Year conditions include all existing traffic and new traffic resulting from background traffic growth and specific development projects in the area.

Specific Development Projects

The Planning Board of the Town of Tyngsborough was contacted in order to determine if there were any projects planned within the study area that would have an impact on future traffic volumes at the study intersection. Based on this discussion, no developments were identified at this time that are expected to result in an increase in traffic within the study area beyond the background traffic growth rate.



General Background Traffic Growth

Traffic-volume data compiled by MassDOT from permanent count stations and historic traffic counts in the area were reviewed in order to determine general background traffic growth trends. Based on a review of this data, it was determined that traffic volumes within the study area have declined by an average of approximately 1.0 percent over the past several years. In order to provide a conservative (high) analysis scenario and a prudent planning condition for review of potential improvement strategies at the subject intersection, a 2.0 percent per year compounded annual background traffic growth rate was used in order to account for future traffic growth and presently unforeseen development within the study area.

Design-Year Traffic Volumes

The 2021 Design-Year peak-hour traffic volumes were developed by applying the 2.0 percent per year compounded annual background traffic growth rate to the 2014 Existing peak-hour traffic volumes. The resulting 2021 Design-Year weekday morning and evening peak-hour traffic volumes are depicted on Figure 3.

INTERSECTION IMPROVEMENT ALTERNATIVES AND ANALYSIS

Based on a review of existing and projected future traffic volume conditions, three (3) potential improvement alternatives were identified for evaluation for the intersection of Lakeview Avenue at Coburn Road: 1) traffic signal control; 2) Multi-way STOP-sign control; and 3) reconfiguring the intersection as a modern roundabout. A detailed assessment of each of the three identified alternatives was completed with respect to their ability to: i) facilitate the efficient flow of vehicles, pedestrians and bicyclists; ii) accommodate existing and projected future traffic volumes at the intersection; and iii) enhance safety. The following summarizes the assessment of the three (3) intersection improvement alternatives, with preliminary cost estimates also provided for each alternative.

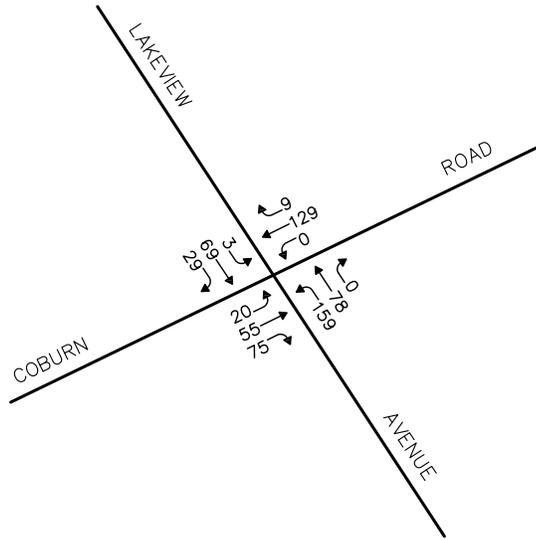
Alternative 1 – Traffic Signal Control

Intersection Improvement Alternative 1 would entail the installation of a traffic control signal at the intersection of Lakeview Avenue at Coburn Road within the confines of the existing intersection geometry (i.e., single-lane approaches). In order to determine if the installation of a traffic control signal is justified at the intersection, a detailed Traffic Signal Warrants Analysis (TSWA) was completed in accordance with the methodology and procedures outlined in the Manual on Uniform Traffic Control Devices (MUTCD).⁶ In brief, The MUTCD establishes nine warrants or criteria to evaluate a location for the installation (or retention) of a traffic signal. At least one of the nine warrants must be satisfied in order to justify the installation or retention of a traffic signal; however, satisfaction of a warrant in and of itself does not necessarily indicate that the installation of a traffic signal is the best traffic control solution. An engineering evaluation of the location in question should indicate that the establishment of traffic signal control will improve the overall safety and/or operation of the intersection. Table 6 lists the nine warrants used to evaluate an intersection for traffic signal control as presented in the MUTCD.

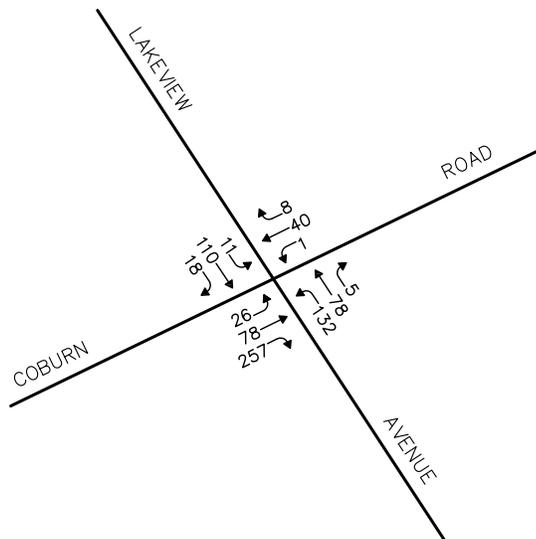
⁶*Manual on Uniform Traffic Control Devices (MUTCD)*; Federal Highway Administration; Washington, DC; 2009.



WEEKDAY MORNING PEAK HOUR (7:15 AM - 8:15 AM)



WEEKDAY EVENING PEAK HOUR (4:15 PM - 5:15 PM)



 Not To Scale



Figure 3

2021 Design-Year
Peak Hour Traffic Volumes

Table 6
TRAFFIC SIGNAL WARRANTS

Warrant No.	Description
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

Each of the nine traffic signal warrants listed in Table 6 were evaluated for the intersection of Lakeview Avenue at Coburn Road based on the current intersection geometry and under 2014 Existing and 2021 Design-Year traffic volume conditions. Table 7 summarizes the results of the TSWA for the intersection with the detailed worksheets and supporting materials attached.

Table 7
TRAFFIC SIGNAL WARRANTS ANALYSIS
LAKEVIEW AVENUE AT COBURN ROAD

Warrant No.	Description	Satisfied?	
		2014 Existing	2021 Design-Year
1	Eight-Hour Vehicular Volume	No	No
2	Four-Hour Vehicular Volume	No	No
3	Peak-Hour	No	No
4	Pedestrian Volume	No	No
5	School Crossing	No	No
6	Coordinated Signal System	No	No
7	Crash Experience	No	No
8	Roadway Network	No	No
9	Intersection Near a Grade Crossing	No	No

As can be seen in Table 7, the intersection of Lakeview Avenue at Coburn Road was not found to satisfy any of the warrants evaluated justifying the installation of a traffic control signal at the intersection under either 2014 Existing or 2021 Design-Year conditions. As such, the installation of a traffic control signal is not justified at the intersection as a potential improvement measure.



Alternative 2 – Multi-Way STOP-Sign Control

Intersection Improvement Alternative 2 would entail the implementation of multi-way STOP-sign control at the intersection and is depicted on Figure 4. The MUTCD provides four general criteria as guidance in order to determine if the implementation of multi-way STOP-sign control at an intersection is an appropriate measure to improve operating conditions and safety at an unsignalized intersection. A review of the motor vehicle crash history at the intersection (predominantly angle-type crashes) for a 12-month period indicates that implementation of multi-way STOP-sign control would be warranted and could be an appropriate measure to enhance safety, address noted sight line deficiencies from Coburn Road and improve traffic operations at the intersection. In addition, the installation of supplemental and enhanced warning signs in advance of the intersection and the trimming of vegetation within the public right-of-way are also recommended.

As depicted on Figure 4, the enhanced warning signs would include the installation of “Intersection Ahead” warning signs (W2-1)⁷ with supplemental street name sign placards (W16-8P) on both sides of the roadway approaching the intersection, as well as “Stop Sign Ahead” warning signs (W3-1). Further, new STOP-signs would be installed on breakaway posts on all approaches with red reflective tape added to the posts to enhance visibility and motorist awareness of the stop control of the intersection. The existing flashing beacon would be relamped with LED-type indications and would display flashing “red” on all approaches.

Table 8 summarizes the resulting traffic operations at the Lakeview Avenue/Coburn Road intersection with implementation of multi-way STOP-sign control under 2021 Design-Year traffic volume conditions. As can be seen in Table 8, all movements at the intersection are predicted to operate at a LOS “B” or better during the peak hours with implementation of multi-way STOP-sign control under 2021 Design-Year conditions, an improvement over the 2021 Design-Year base condition (without improvements) where the Coburn Road approaches were predicted to operate at a LOS “C”/“D”. That being said, the Lakeview Avenue approaches would experience a slight decline in LOS from LOS “A” under the base condition to LOS “B” with implementation of multi-way STOP-sign control. Residual vehicle queues at the intersection under multi-way STOP-sign control were shown to range from 1 to 3 vehicles during the peak-hours.

The estimated cost to implement multi-way STOP-sign control at the intersection as depicted on Figure 4 is \$26,000.

⁷Sign designations are as specified in: *Manual on Uniform Traffic Control Devices* (MUTCD); Federal Highway Administration; Washington, DC; 2009.



Table 8
2021 DESIGN-YEAR TRAFFIC OPERATIONS ANALYSIS SUMMARY
LAKEVIEW AVENUE AT COBURN ROAD

Peak Hour/Movement	Existing Intersection Geometry				Alternative 2 Multi-Way STOP				Alternative 3 Mini-Roundabout			
	Demand ^a	Delay ^b	LOS ^c	Queue ^d 95 th	Demand	Delay	LOS	Queue ^d 95 th	Demand	Delay	LOS	Queue ^d 95 th
<i>Weekday Morning:</i>												
Coburn Road EB LT/TH/RT	150	27.1	D	4	150	10.6	B	2	150	5.2	A	1
Coburn Road WB LT/TH/RT	129	34.8	D	4	129	10.7	B	1	129	7.2	A	1
Lakeview Avenue NB LT/TH/RT	246	5.4	A	1	246	14.2	B	3	246	7.3	A	2
Lakeview Avenue SB LT/TH/RT	101	0.2	A	0	101	10.0	A	1	101	7.2	A	1
<i>Weekday Evening:</i>												
Coburn Road EB LT/TH/RT	361	20.1	C	5	361	10.6	B	2	361	7.8	A	2
Coburn Road WB LT/TH/RT	49	15.8	C	1	49	10.7	B	1	49	5.0	A	1
Lakeview Avenue NB LT/TH/RT	215	4.8	A	1	215	14.2	B	3	215	6.2	A	1
Lakeview Avenue SB LT/TH/RT	139	0.6	A	0	139	10.0	A	1	139	5.9	A	1

^aDemand in vehicles per hour.

^bAverage control delay per vehicle (in seconds).

^cLevel-of-Service.

^dQueue length in vehicle.

EB = eastbound; WB = westbound; NB = northbound; SB = southbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.



Alternative 3 – Modern Roundabout

Intersection Improvement Alternative 3 would entail reconstructing the existing intersection to function under modern roundabout control to enhance safety and improve traffic operations. This improvement alternative is depicted on Figure 5 and has been designed with appropriate geometry to accommodate the turning and maneuvering requirements of an LRTA bus, a fire truck, and a small tractor semi-trailer (WB-62 design vehicle). As shown, the implementation of this improvement alternative would require private property acquisitions in both the northeast and southwest corners of the intersection.

As can be seen in Table 8, with implementation of Intersection Improvement Alternative 3, operating conditions at the intersection were shown to improve over the 2021 Design-Year Base condition to LOS “A” during both weekday morning and evening peak hours. Residual vehicle queuing on the approaches to the roundabout were shown to range from 1 to 2 vehicles during the peak hours. An added advantage of modern roundabout control that is not reflected in the traffic operations analysis is that the number of potential conflict points for motor vehicle crashes at the intersection is reduced from 32 to 8.

The estimated cost to design and construct Intersection Improvement Alternative 3 as depicted on Figure 5 is \$340,000, excluding private property acquisition.

PREFERRED INTERSECTION IMPROVEMENT ALTERNATIVE

Based on a review of: i) existing and projected future traffic volumes and operating conditions; ii) the motor vehicle crash history and the associated crash patterns; and iii) the estimated construction cost in relation to the net benefit to operating conditions and safety; Intersection Improvement Alternative 2 – *Multi-Way STOP-Sign Control*, was selected as the preferred intersection improvement alternative. Implementation of this improvement strategy would enhance safety and achieve improved overall traffic operations (LOS “B” or better) with reduced vehicle queuing and overall motorist delay when compared to 2014 Existing and 2021 Design-Year conditions without improvements.

SUMMARY

VAI has completed an Intersection Safety and Operations Assessment for the intersection of Lakeview Avenue at Coburn Road in Tyngsborough, Massachusetts. The purpose of this assessment was to evaluate potential improvement strategies for the intersection that would accomplish the following objectives: i) facilitate the efficient flow of vehicles, pedestrians and bicyclists; ii) accommodate existing and projected future traffic volumes; and iii) enhance safety at the intersection. The improvement strategies that have been identified for the subject intersection were designed in accordance with MassDOT standards and follow MassDOT’s “Complete Streets” and “GreenDOT” design policies with respect to accommodating all roadway users. As such, the recommended improvements are designed to be eligible for funding through the State Transportation Improvement Program (STIP) should the Town decide to pursue such funding.

As a result of this assessment, it has been recommended that Intersection Improvement Alternative 2 – *Multi-Way STOP-Sign Control*, depicted on Figure 4 be considered for implementation at the intersection in order to improve traffic operations and safety under both existing and projected future traffic volume conditions. The estimated cost to design and construct the recommended improvements at the intersection is \$26,000.

cc: BG, File



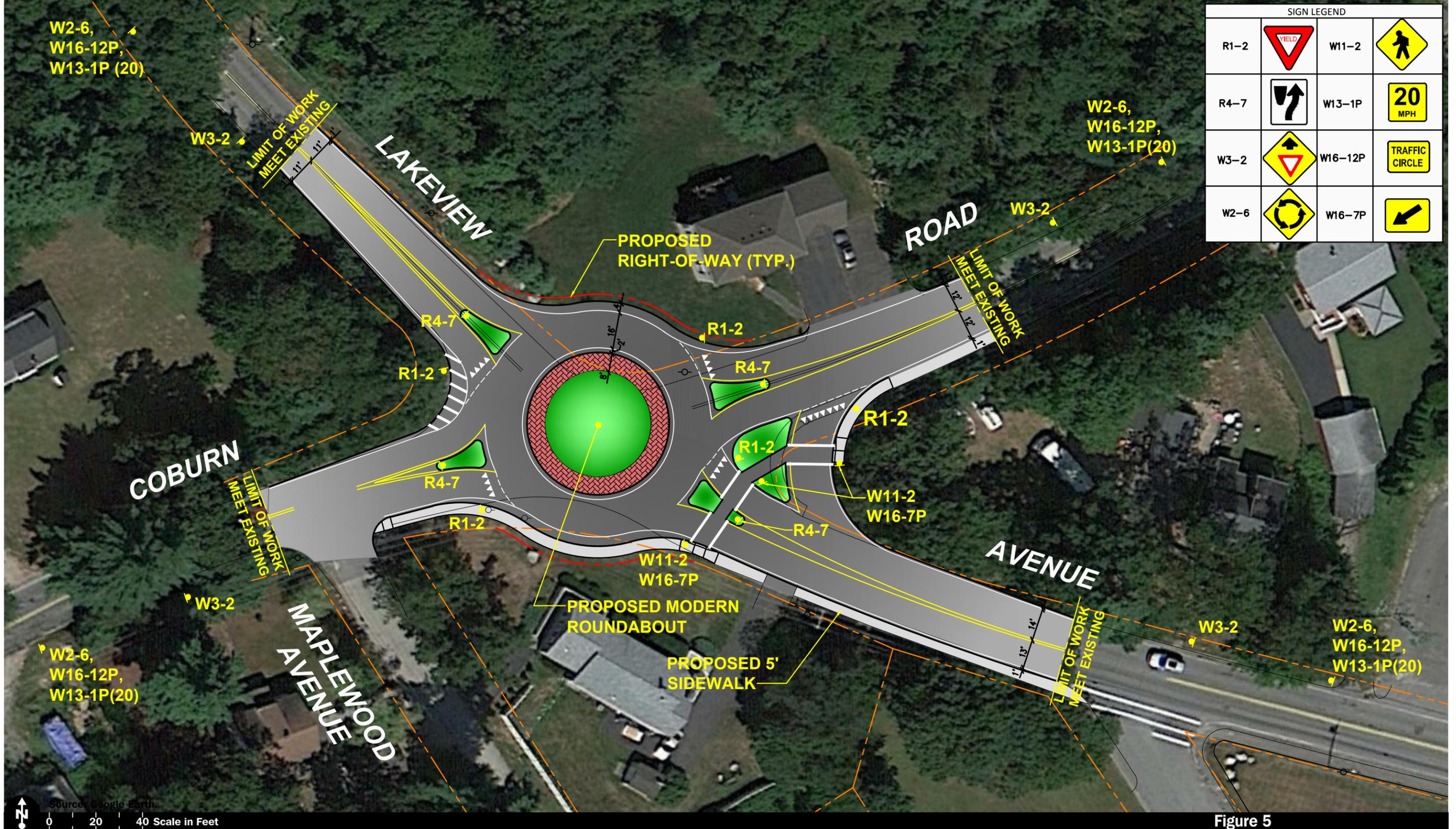


Figure 5
 Conceptual Improvement Plan
 Modern Roundabout

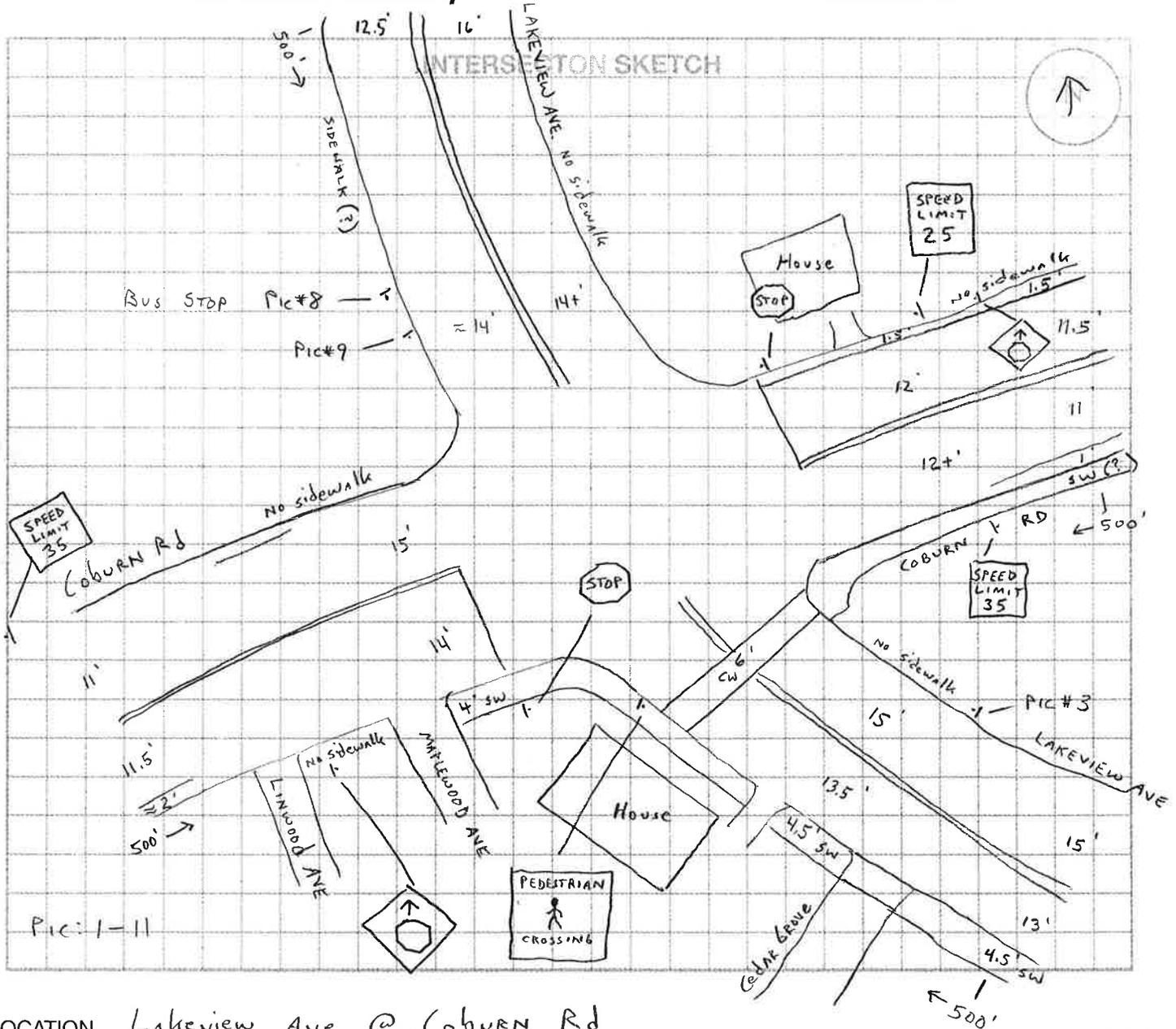
R:\6616\6616cn2.dwg, 3/24/2014 1:23:34 PM

APPENDIX

INTERSECTION GEOMETRY
AUTOMATIC TRAFFIC RECORDER COUNTS
MANUAL TURNING MOVEMENT COUNTS
SEASONAL ADJUSTMENT DATA
PUBLIC TRANSPORTATION SERVICE INFORMATION
VEHICLE SPEED MEASUREMENTS
MASSDOT CRASH RATE WORKSHEET
GENERAL BACKGROUND TRAFFIC GROWTH
TRAFFIC SIGNAL WARRANT ANALYSIS
CAPACITY ANALYSIS WORKSHEETS
COST ESTIMATES

INTERSECTION GEOMETRY

Intersection Inventory



LOCATION Lakeview Ave @ Coburn Rd
 CITY & STATE: Tyngsboro JOB NUMBER: 6616
 TYPE OF CURBING: Granite TYPE OF SIDEWALKS: Bit Conc
 TYPE OF PAVEMENT: Bit Conc PAVEMENT CONDITION: Good
 TRAFFIC CONTROL DEVICES: Blinking Yellow on Lakeview / Blinking Red on Coburn
 DEFICIENCIES: NO PAVEMENT MARKINGS NO TRAFFIC CONTROL DEVICES UNUSUAL GEOMETRY
 PAVEMENT MARKINGS FADED POOR SIGHT DISTANCE NON-STANDARD SIGNING
 OTHER _____

COMMENTS _____

CHECKLIST

- | | | | | | |
|--|---|--|--|--|--|
| <input type="checkbox"/> Width | <input type="checkbox"/> Offsets | <input type="checkbox"/> Pavement Markings | <input type="checkbox"/> Stopping Sight Distance | <input type="checkbox"/> Illumination | <input type="checkbox"/> Pedestrians |
| <input type="checkbox"/> Curbing | <input type="checkbox"/> Lane Line | <input type="checkbox"/> Bus Stops | <input type="checkbox"/> Passing Sight Distance | <input type="checkbox"/> Approach Speeds | <input type="checkbox"/> Land Use |
| <input type="checkbox"/> Shoulders | <input type="checkbox"/> Sidewalks | <input type="checkbox"/> Loading Zones | <input type="checkbox"/> Horizontal Alignment | <input type="checkbox"/> Speed Limits | <input type="checkbox"/> Catch Basins/Drainage |
| <input type="checkbox"/> Radii | <input type="checkbox"/> Parking Restrictions | <input type="checkbox"/> School Zones | <input type="checkbox"/> Vertical Alignment | <input type="checkbox"/> Weight Limits | <input type="checkbox"/> Utility Poles |
| <input type="checkbox"/> Approach Angles | <input type="checkbox"/> Signing | <input type="checkbox"/> Traffic Signal | <input type="checkbox"/> Lateral Obstructions | <input type="checkbox"/> Pavement Conditions | <input type="checkbox"/> Hydrants |

AUTOMATIC TRAFFIC RECORDER COUNTS

Accurate Counts
978-664-2565

Location : Coburn Road
Location : East of Lakeview Avenue
City/State: Tyngsborough, MA

Site Code: 66160002
6616VOL2

Start Time	29-Jan-14 Wed	EB		Hour Totals		WB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		5	10			0	5				
12:15		1	16			1	8				
12:30		0	11			1	12				
12:45		0	9	6	46	2	8	4	33	10	79
01:00		1	5			0	7				
01:15		0	9			0	8				
01:30		1	15			0	5				
01:45		0	17	2	46	0	8	0	28	2	74
02:00		0	18			0	17				
02:15		0	8			0	17				
02:30		0	13			0	11				
02:45		0	17	0	56	0	15	0	60	0	116
03:00		0	22			0	14				
03:15		0	18			0	18				
03:30		0	19			0	10				
03:45		0	15	0	74	1	10	1	52	1	126
04:00		0	24			0	14				
04:15		0	19			0	14				
04:30		0	26			0	17				
04:45		1	25	1	94	4	8	4	53	5	147
05:00		0	29			5	16				
05:15		0	21			5	11				
05:30		0	21			9	15				
05:45		4	21	4	92	8	10	27	52	31	144
06:00		4	16			5	13				
06:15		3	11			11	14				
06:30		3	12			17	10				
06:45		7	14	17	53	17	9	50	46	67	99
07:00		8	6			23	3				
07:15		12	17			29	5				
07:30		9	8			27	5				
07:45		12	12	41	43	16	5	95	18	136	61
08:00		12	5			26	4				
08:15		11	14			23	3				
08:30		5	9			20	4				
08:45		10	3	38	31	10	6	79	17	117	48
09:00		7	5			15	1				
09:15		8	7			10	2				
09:30		8	0			8	1				
09:45		5	5	28	17	8	3	41	7	69	24
10:00		6	4			5	3				
10:15		4	5			8	0				
10:30		7	6			10	1				
10:45		7	1	24	16	9	1	32	5	56	21
11:00		4	2			8	1				
11:15		2	4			8	3				
11:30		3	1			10	3				
11:45		8	0	17	7	9	3	35	10	52	17
Total		178	575			368	381			546	956
Percent		23.6%	76.4%			49.1%	50.9%			36.4%	63.6%

Accurate Counts
978-664-2565

Location : Coburn Road
Location : East of Lakeview Avenue
City/State: Tyngsborough, MA

Site Code: 66160002
6616VOL2

Start Time	30-Jan-14 Thu	EB		Hour Totals		WB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		0	7			0	8				
12:15		1	11			0	13				
12:30		0	8			0	15				
12:45		1	7	2	33	0	9	0	45	2	78
01:00		1	9			0	13				
01:15		0	14			0	2				
01:30		0	12			0	6				
01:45		0	10	1	45	0	6	0	27	1	72
02:00		0	14			0	20				
02:15		0	13			0	14				
02:30		0	8			0	8				
02:45		0	12	0	47	0	14	0	56	0	103
03:00		0	18			0	16				
03:15		0	18			0	17				
03:30		0	16			0	9				
03:45		0	18	0	70	1	14	1	56	1	126
04:00		0	26			0	14				
04:15		0	19			0	9				
04:30		0	16			1	12				
04:45		0	23	0	84	3	11	4	46	4	130
05:00		0	30			3	10				
05:15		1	22			4	12				
05:30		0	40			5	13				
05:45		2	10	3	102	13	15	25	50	28	152
06:00		2	13			9	5				
06:15		5	18			14	14				
06:30		5	13			22	9				
06:45		4	18	16	62	23	4	68	32	84	94
07:00		8	9			24	10				
07:15		16	12			38	10				
07:30		10	12			25	8				
07:45		15	8	49	41	24	4	111	32	160	73
08:00		10	14			29	3				
08:15		15	6			7	4				
08:30		2	2			16	2				
08:45		8	8	35	30	11	1	63	10	98	40
09:00		7	8			14	3				
09:15		5	4			10	4				
09:30		7	4			8	4				
09:45		4	6	23	22	4	1	36	12	59	34
10:00		4	8			4	1				
10:15		8	5			5	4				
10:30		6	2			5	1				
10:45		8	1	26	16	7	1	21	7	47	23
11:00		12	1			8	2				
11:15		8	7			8	4				
11:30		5	2			9	2				
11:45		9	3	34	13	8	1	33	9	67	22
Total		189	565			362	382			551	947
Percent		25.1%	74.9%			48.7%	51.3%			36.8%	63.2%
Grand Total		367	1140			730	763			1097	1903
Percent		24.4%	75.6%			48.9%	51.1%			36.6%	63.4%
ADT		ADT 1,500		AADT 1,500							

Location : Lakeview Avenue
Location : North of Coburn Road
City/State: Tyngsborough, MA

Site Code: 66160001
6616VOL1

Start Time	04-Feb-14 Tue	NB		Hour Totals		SB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		0	12			2	14				
12:15		0	15			0	16				
12:30		0	20			0	18				
12:45		1	18	1	65	0	16	2	64	3	129
01:00		0	21			0	14				
01:15		1	10			1	18				
01:30		0	13			0	15				
01:45		1	18	2	62	1	13	2	60	4	122
02:00		0	26			0	24				
02:15		3	19			0	54				
02:30		0	13			1	32				
02:45		0	21	3	79	0	25	1	135	4	214
03:00		1	28			0	22				
03:15		0	30			1	29				
03:30		0	19			0	27				
03:45		0	25	1	102	1	30	2	108	3	210
04:00		0	19			1	18				
04:15		1	18			0	27				
04:30		1	34			1	28				
04:45		2	21	4	92	4	31	6	104	10	196
05:00		3	20			2	30				
05:15		2	22			4	36				
05:30		8	18			2	34				
05:45		8	26	21	86	1	32	9	132	30	218
06:00		9	20			6	22				
06:15		10	19			8	25				
06:30		19	19			12	17				
06:45		13	10	51	68	11	21	37	85	88	153
07:00		21	21			20	16				
07:15		52	14			25	20				
07:30		20	13			33	19				
07:45		17	21	110	69	16	14	94	69	204	138
08:00		13	11			12	18				
08:15		25	12			22	6				
08:30		12	6			15	12				
08:45		21	14	71	43	14	19	63	55	134	98
09:00		14	5			16	11				
09:15		17	11			7	15				
09:30		5	16			23	13				
09:45		11	5	47	37	17	5	63	44	110	81
10:00		15	5			14	12				
10:15		11	4			13	4				
10:30		10	3			19	4				
10:45		11	1	47	13	10	2	56	22	103	35
11:00		8	0			12	2				
11:15		18	3			17	5				
11:30		15	2			16	2				
11:45		9	1	50	6	24	1	69	10	119	16
Total		408	722			404	888			812	1610
Percent		36.1%	63.9%			31.3%	68.7%			33.5%	66.5%

Location : Lakeview Avenue
Location : North of Coburn Road
City/State: Tyngsborough, MA

Site Code: 66160001
6616VOL1

Start Time	05-Feb-14 Wed	NB		Hour Totals		SB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		2	4			3	8				
12:15		0	8			4	7				
12:30		1	7			0	7				
12:45		0	3	3	22	1	10	8	32	11	54
01:00		0	12			0	6				
01:15		0	3			1	11				
01:30		1	7			0	10				
01:45		0	5	1	27	0	8	1	35	2	62
02:00		2	9			0	12				
02:15		0	10			1	14				
02:30		1	11			1	12				
02:45		1	10	4	40	2	9	4	47	8	87
03:00		2	7			0	11				
03:15		0	2			0	8				
03:30		1	10			1	14				
03:45		0	9	3	28	1	15	2	48	5	76
04:00		1	8			0	10				
04:15		1	9			2	8				
04:30		0	8			1	15				
04:45		3	7	5	32	1	16	4	49	9	81
05:00		6	9			2	12				
05:15		3	12			1	14				
05:30		6	14			1	12				
05:45		9	8	24	43	5	13	9	51	33	94
06:00		10	6			6	13				
06:15		8	11			3	11				
06:30		7	13			6	11				
06:45		7	10	32	40	8	19	23	54	55	94
07:00		6	11			3	4				
07:15		7	8			5	19				
07:30		10	4			4	8				
07:45		4	5	27	28	6	6	18	37	45	65
08:00		9	6			4	12				
08:15		6	2			5	6				
08:30		5	10			9	9				
08:45		2	9	22	27	3	6	21	33	43	60
09:00		9	4			2	10				
09:15		3	1			7	3				
09:30		5	5			6	9				
09:45		5	8	22	18	2	8	17	30	39	48
10:00		7	4			8	2				
10:15		5	4			3	2				
10:30		6	4			11	4				
10:45		11	1	29	13	4	0	26	8	55	21
11:00		10	2			4	2				
11:15		8	1			11	6				
11:30		8	1			8	0				
11:45		5	1	31	5	9	1	32	9	63	14
Total		203	323			165	433			368	756
Percent		38.6%	61.4%			27.6%	72.4%			32.7%	67.3%

Location : Lakeview Avenue
Location : North of Coburn Road
City/State: Tyngsborough, MA

Site Code: 66160001
6616VOL1

Start Time	06-Feb-14 Thu	NB		Hour Totals		SB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		0	16			2	19				
12:15		2	14			0	24				
12:30		0	9			2	21				
12:45		0	16	2	55	1	11	5	75	7	130
01:00		1	16			0	19				
01:15		0	11			1	22				
01:30		1	15			1	16				
01:45		1	22	3	64	0	24	2	81	5	145
02:00		1	27			0	25				
02:15		1	20			0	43				
02:30		1	24			1	32				
02:45		0	22	3	93	0	18	1	118	4	211
03:00		1	23			0	26				
03:15		0	24			0	27				
03:30		0	27			0	37				
03:45		0	27	1	101	1	23	1	113	2	214
04:00		0	28			0	31				
04:15		1	20			1	26				
04:30		3	19			1	30				
04:45		3	23	7	90	1	29	3	116	10	206
05:00		0	16			5	38				
05:15		5	20			1	26				
05:30		8	28			5	27				
05:45		8	22	21	86	3	28	14	119	35	205
06:00		24	25			5	22				
06:15		13	31			11	25				
06:30		10	23			9	41				
06:45		21	12	68	91	16	24	41	112	109	203
07:00		24	12			22	32				
07:15		46	12			22	21				
07:30		14	10			36	17				
07:45		18	20	102	54	12	13	92	83	194	137
08:00		11	7			12	15				
08:15		26	15			19	15				
08:30		17	12			20	15				
08:45		17	22	71	56	7	22	58	67	129	123
09:00		13	11			13	15				
09:15		15	12			15	16				
09:30		15	10			17	15				
09:45		8	4	51	37	13	12	58	58	109	95
10:00		11	7			16	14				
10:15		14	1			13	7				
10:30		16	2			14	5				
10:45		5	6	46	16	10	3	53	29	99	45
11:00		14	2			11	4				
11:15		15	1			18	2				
11:30		11	0			13	1				
11:45		11	2	51	5	15	4	57	11	108	16
Total		426	748			385	982			811	1730
Percent		36.3%	63.7%			28.2%	71.8%			31.9%	68.1%
Grand Total		1037	1793			954	2303			1991	4096
Percent		36.6%	63.4%			29.3%	70.7%			32.7%	67.3%

ADT ADT 2,029 AADT 2,029

MANUAL TURNING MOVEMENT COUNTS

Accurate Counts

978-664-2565

N/S Street : Lakeview Avenue
 E/W Street : Coburn Road
 City/State : Tyngsborough, MA
 Weather : Clear

File Name : 66160001
 Site Code : 66160001
 Start Date : 1/30/2014
 Page No : 1

Start Time	Groups Printed- Cars - Trucks												Int. Total
	Lakeview Ave From North			Coburn Rd From East			Lakeview Ave From South			Coburn Rd From West			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 AM	1	9	1	0	18	4	35	19	6	7	8	108	
07:15 AM	1	15	5	0	34	3	48	28	16	11	14	175	
07:30 AM	1	19	13	0	27	1	32	18	9	3	14	137	
07:45 AM	0	10	2	0	21	1	27	8	14	2	21	106	
Total	3	53	21	0	100	9	142	73	45	23	57	526	
08:00 AM	1	14	4	0	27	3	27	12	8	1	14	111	
08:15 AM	1	11	4	0	9	1	34	13	15	3	14	108	
08:30 AM	2	14	2	0	10	5	25	17	0	4	10	89	
08:45 AM	1	4	5	0	9	0	27	17	7	5	11	86	
Total	5	43	15	0	55	9	113	59	30	13	49	394	
09:00 AM	0	12	0	0	13	3	20	6	6	3	15	79	
09:15 AM	1	7	3	0	7	0	22	9	2	1	10	62	
09:30 AM	1	14	4	1	8	0	33	6	6	3	17	93	
09:45 AM	0	9	3	1	3	0	16	12	2	0	14	60	
Total	2	42	10	2	31	3	91	33	16	7	56	294	
10:00 AM	1	5	1	0	2	0	20	14	3	1	12	59	
10:15 AM	0	10	2	0	3	1	15	6	7	3	16	64	
10:30 AM	2	20	4	0	2	4	19	9	4	0	12	77	
10:45 AM	0	11	3	0	7	0	30	3	6	2	14	77	
Total	3	46	10	0	14	5	84	32	20	6	54	277	
11:00 AM	3	15	0	1	5	1	25	15	10	2	8	85	
11:15 AM	0	15	1	0	8	0	31	14	7	0	21	98	
11:30 AM	2	9	3	0	11	1	16	9	3	2	25	81	
11:45 AM	0	12	2	0	11	0	16	8	9	2	19	79	
Total	5	51	6	1	35	2	88	46	29	6	73	343	
12:00 PM	2	11	1	0	8	0	16	15	4	1	16	75	
12:15 PM	1	16	4	0	7	3	19	9	7	1	16	85	
12:30 PM	1	11	0	1	11	2	17	9	5	2	71	85	
12:45 PM	0	11	3	0	10	0	12	10	6	1	14	68	
Total	4	49	8	1	36	5	64	43	22	5	58	299	
01:00 PM	1	8	3	1	7	5	12	13	7	4	26	89	
01:15 PM	1	11	2	1	1	0	19	11	9	3	14	73	
01:30 PM	1	20	1	0	6	0	21	10	10	3	20	92	
01:45 PM	1	12	2	1	4	3	10	21	8	1	8	73	
Total	4	51	8	3	18	8	62	55	34	11	68	327	
02:00 PM	3	30	12	0	15	3	20	9	8	4	23	127	

Accurate Counts

978-664-2565

N/S Street : Lakeview Avenue
 E/W Street : Coburn Road
 City/State : Tyngsborough, MA
 Weather : Clear

File Name : 66160001
 Site Code : 66160001
 Start Date : 1/30/2014
 Page No : 2

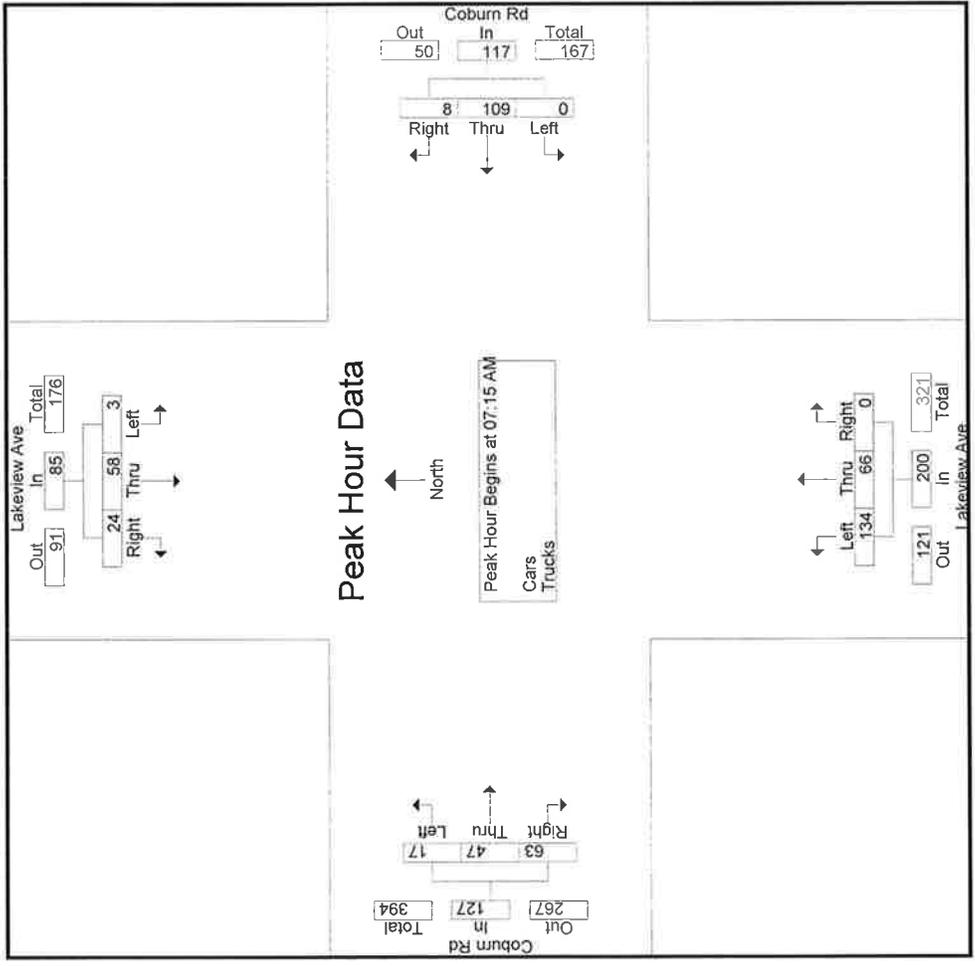
Start Time	Groups Printed - Cars - Trucks															
	Lakeview Ave From North				Coburn Rd From East				Lakeview Ave From South				Coburn Rd From West			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
02:15 PM	3	26	6	1	11	3	27	15	0	27	11	2	27	11	132	
02:30 PM	0	20	3	0	7	1	24	13	0	3	7	3	22	7	100	
02:45 PM	1	17	3	0	12	1	23	13	3	0	8	0	23	8	104	
Total	7	93	24	1	45	8	94	50	3	9	34	9	95	34	463	
03:00 PM	2	15	2	0	13	2	20	13	0	1	13	1	47	13	128	
03:15 PM	3	17	7	0	16	1	21	15	1	6	13	6	43	13	143	
03:30 PM	5	28	3	0	6	2	17	10	3	2	11	2	47	11	134	
03:45 PM	1	20	4	0	15	1	26	26	0	4	17	4	46	17	160	
Total	11	80	16	0	50	6	84	64	4	13	54	13	183	54	565	
04:00 PM	6	25	5	1	8	3	14	15	0	4	18	4	43	18	142	
04:15 PM	2	31	4	0	8	2	22	19	1	9	17	9	56	17	171	
04:30 PM	1	17	7	0	10	2	33	14	1	6	12	6	66	12	169	
04:45 PM	2	22	3	1	7	1	26	11	0	4	18	4	43	18	138	
Total	11	95	19	2	33	8	95	59	2	23	65	23	208	65	620	
05:00 PM	5	23	2	0	9	2	31	22	2	3	19	3	52	19	170	
05:15 PM	4	26	3	0	8	0	21	14	0	2	19	2	47	19	144	
05:30 PM	4	27	3	1	12	2	32	23	1	3	32	3	44	32	184	
05:45 PM	0	11	6	0	12	2	24	8	3	7	7	7	31	7	111	
Total	13	87	14	1	41	6	108	67	6	15	77	15	174	77	609	
06:00 PM	2	18	4	0	5	0	19	17	0	3	13	3	36	13	117	
06:15 PM	0	12	9	0	7	2	28	14	1	2	16	2	28	16	119	
06:30 PM	0	16	1	0	8	1	16	15	0	5	14	5	26	14	102	
06:45 PM	0	19	3	0	1	2	16	10	0	6	16	6	19	16	92	
Total	2	65	17	0	21	5	79	56	1	16	59	16	109	59	430	
Grand Total	70	755	168	11	479	74	1104	637	33	147	485	147	1184	485	5147	
Approach %	7	76	16.9	2	84.9	13.1	62.2	35.9	1.9	8.1	26.7	8.1	65.2	26.7	65.2	
Total %	1.4	14.7	3.3	0.2	9.3	1.4	21.4	12.4	0.6	2.9	9.4	2.9	23	9.4	23	
% Cars	68	733	165	10	474	73	1099	620	33	145	483	145	1177	483	5080	
% Trucks	2	22	98.2	90.9	99	98.6	99.5	97.3	100	98.6	99.6	98.6	99.4	99.6	98.7	
% Trucks	2.9	2.9	1.8	9.1	1	1.4	0.5	2.7	0	1.4	0.4	1.4	0.6	0.4	1.3	

Accurate Counts

978-664-2565

N/S Street : Lakeview Avenue
 E/W Street: Coburn Road
 City/State : Tyngsborough, MA
 Weather : Clear

File Name : 66160001
 Site Code : 66160001
 Start Date : 1/30/2014
 Page No : 4

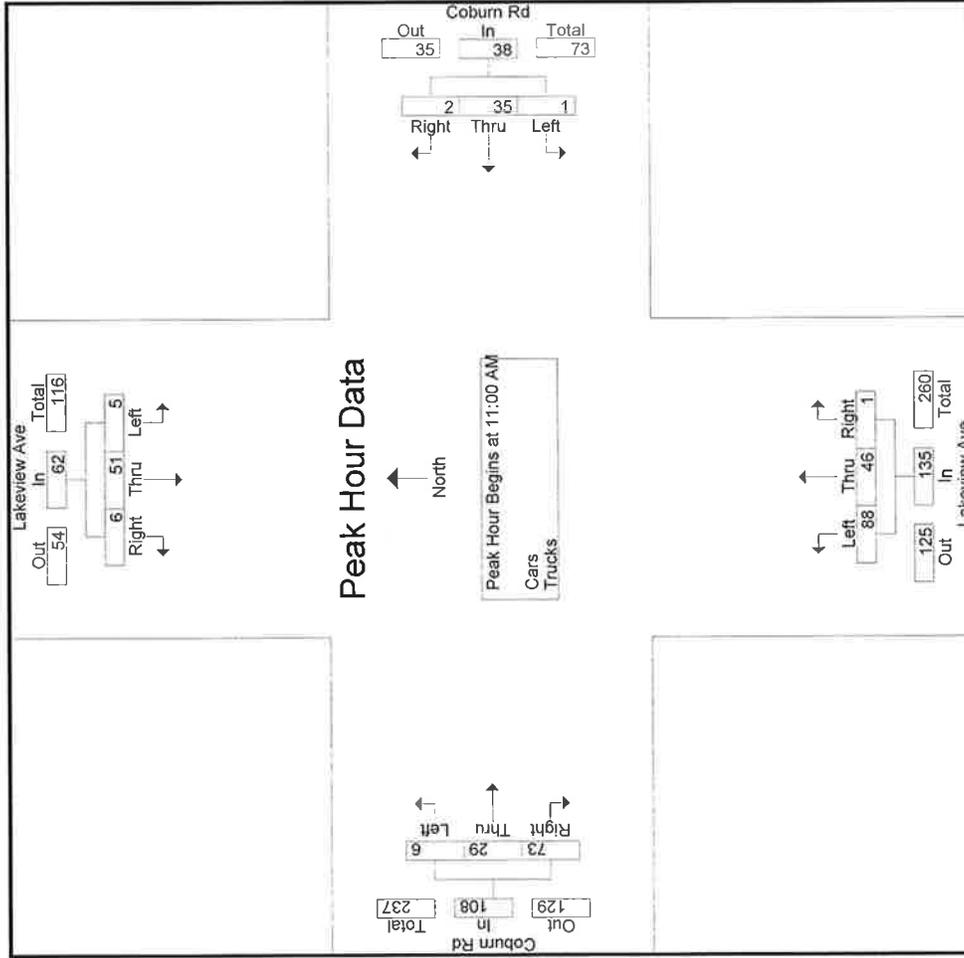


Accurate Counts

978-664-2565

File Name : 66160001
 Site Code : 66160001
 Start Date : 1/30/2014
 Page No : 8

N/S Street : Lakeview Avenue
 E/W Street: Coburn Road
 City/State : Tyngsborough, MA
 Weather : Clear

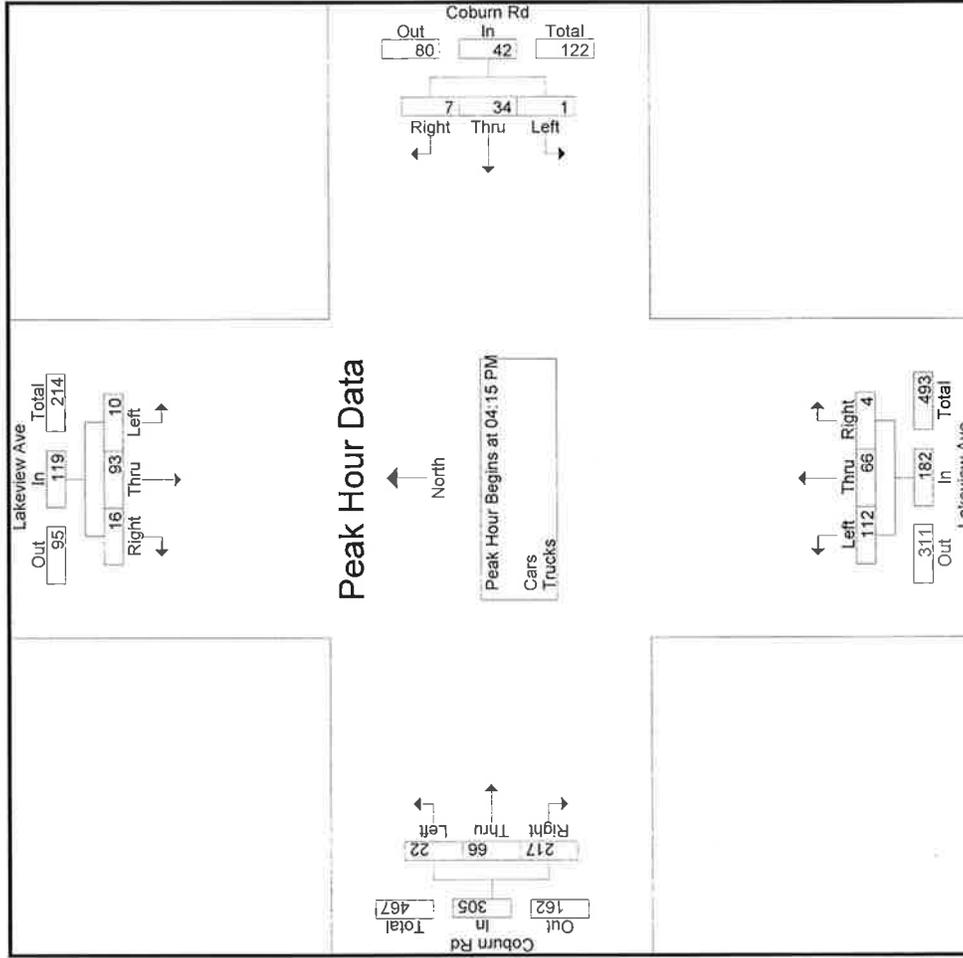


Accurate Counts

978-664-2565

N/S Street : Lakeview Avenue
 E/W Street: Coburn Road
 City/State : Tyngsborough, MA
 Weather : Clear

File Name : 66160001
 Site Code : 66160001
 Start Date : 1/30/2014
 Page No : 12



Accurate Counts

978-664-2565

N/S Street : Lakeview Avenue
 E/W Street: Coburn Road
 City/State : Tyngsborough, MA
 Weather : Clear

File Name : 66160001
 Site Code : 66160001
 Start Date : 1/30/2014
 Page No : 1

Groups Printed- Cars

Start Time	Lakeview Ave From North			Coburn Rd From East			Lakeview Ave From South			Coburn Rd From West			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 AM	1	6	1	0	18	4	34	19	0	6	8	103	
07:15 AM	1	15	5	0	34	3	48	28	0	11	13	174	
07:30 AM	1	19	13	0	27	1	32	18	0	3	14	137	
07:45 AM	0	10	2	0	21	1	27	7	0	2	21	105	
Total	3	50	21	0	100	9	141	72	0	22	45	519	
08:00 AM	1	13	4	0	27	3	27	11	0	1	14	109	
08:15 AM	1	9	4	0	8	1	33	12	3	3	12	101	
08:30 AM	2	14	2	0	9	5	24	13	0	4	10	83	
08:45 AM	1	4	5	0	9	0	27	17	0	4	7	85	
Total	5	40	15	0	53	9	111	53	3	12	30	378	
09:00 AM	0	12	0	0	13	3	20	6	1	3	6	79	
09:15 AM	1	7	3	0	7	0	22	9	0	1	2	62	
09:30 AM	1	14	4	1	8	0	33	6	0	3	6	93	
09:45 AM	0	9	3	1	3	0	16	12	0	0	2	60	
Total	2	42	10	2	31	3	91	33	1	7	16	294	
10:00 AM	1	5	1	0	2	0	19	13	0	1	3	57	
10:15 AM	0	10	2	0	3	1	15	6	1	3	7	64	
10:30 AM	2	19	4	0	2	4	19	9	1	0	4	76	
10:45 AM	0	11	3	0	7	0	30	3	1	2	6	77	
Total	3	45	10	0	14	5	83	31	3	6	20	274	
11:00 AM	3	15	0	1	5	1	25	14	0	2	10	84	
11:15 AM	0	14	1	0	8	0	31	14	1	0	7	97	
11:30 AM	2	9	3	0	11	1	16	9	0	2	3	81	
11:45 AM	0	12	2	0	11	0	16	8	0	2	9	78	
Total	5	50	6	1	35	2	88	45	1	6	29	340	
12:00 PM	2	11	1	0	8	0	16	15	1	1	4	75	
12:15 PM	0	16	4	0	7	3	19	9	2	1	7	84	
12:30 PM	1	11	0	1	11	2	16	9	0	2	5	70	
12:45 PM	0	11	3	0	9	0	12	10	1	1	6	67	
Total	3	49	8	1	35	5	63	43	4	5	22	296	
01:00 PM	1	8	3	1	7	5	12	12	2	4	7	88	
01:15 PM	1	10	2	1	1	0	19	11	1	3	9	72	
01:30 PM	1	20	1	0	6	0	21	10	0	3	10	92	
01:45 PM	1	12	2	1	4	3	10	20	2	1	8	72	
Total	4	50	8	3	18	8	62	53	5	11	34	324	
02:00 PM	3	28	11	0	15	3	20	8	0	4	8	123	

Accurate Counts

978-664-2565

N/S Street : Lakeview Avenue
 E/W Street : Coburn Road
 City/State : Tyngsborough, MA
 Weather : Clear

File Name : 66160001
 Site Code : 66160001
 Start Date : 1/30/2014
 Page No : 2

Groups Printed- Cars

Start Time	Lakeview Ave From North			Coburn Rd From East			Lakeview Ave From South			Coburn Rd From West			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
02:15 PM	3	26	5	1	10	3	27	15	0	2	11	26	129
02:30 PM	0	14	3	0	7	1	24	13	0	3	7	21	93
02:45 PM	1	17	3	0	12	1	23	13	3	0	8	23	104
Total	7	85	22	1	44	8	94	49	3	9	34	93	449
03:00 PM	2	15	2	0	13	2	20	13	0	1	13	47	128
03:15 PM	3	17	7	0	16	1	21	14	1	6	11	43	140
03:30 PM	5	26	3	0	6	2	17	8	3	2	11	46	129
03:45 PM	1	20	4	0	15	1	26	25	0	4	17	46	159
Total	11	78	16	0	50	6	84	60	4	13	52	182	566
04:00 PM	5	25	5	0	8	3	14	15	0	4	18	43	140
04:15 PM	2	30	4	0	8	2	22	19	1	9	17	56	170
04:30 PM	1	17	7	0	9	2	33	14	1	6	12	66	168
04:45 PM	2	22	3	1	7	1	26	11	0	4	18	43	138
Total	10	94	19	1	32	8	95	59	2	23	65	208	616
05:00 PM	5	23	1	0	9	2	31	22	2	3	19	52	169
05:15 PM	4	25	3	0	8	0	21	14	0	2	19	47	143
05:30 PM	4	27	3	1	12	2	32	23	1	3	32	44	184
05:45 PM	0	11	6	0	12	2	24	8	3	7	7	31	111
Total	13	86	13	1	41	6	108	67	6	15	77	174	607
06:00 PM	2	18	4	0	5	0	19	17	0	3	13	36	117
06:15 PM	0	12	9	0	7	2	28	14	1	2	16	28	119
06:30 PM	0	16	1	0	8	0	16	14	0	5	14	26	100
06:45 PM	0	18	3	0	1	2	16	10	0	6	16	19	91
Total	2	64	17	0	21	4	79	55	1	16	59	109	427
Grand Total	68	733	165	10	474	73	1099	620	33	145	483	1177	5080
Apprch %	7	75.9	17.1	1.8	85.1	13.1	62.7	35.4	1.9	8	26.8	65.2	
Total %	1.3	14.4	3.2	0.2	9.3	1.4	21.6	12.2	0.6	2.9	9.5	23.2	

Accurate Counts

978-664-2565

N/S Street : Lakeview Avenue
 E/W Street: Coburn Road
 City/State : Tyngsborough, MA
 Weather : Clear

File Name : 66160001
 Site Code : 66160001
 Start Date : 1/30/2014
 Page No : 1

Groups Printed- Trucks

Start Time	Lakeview Ave From North			Coburn Rd From East			Lakeview Ave From South			Coburn Rd From West			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 AM	0	3	0	0	0	0	1	0	0	1	0	0	5
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	1	1
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	1	0	0	0	0	1
Total	0	3	0	0	0	0	1	1	0	1	0	1	7
08:00 AM	0	1	0	0	0	0	0	1	0	0	0	0	2
08:15 AM	0	2	0	0	1	0	1	1	0	0	0	2	7
08:30 AM	0	0	0	0	1	0	1	4	0	0	0	0	6
08:45 AM	0	0	0	0	0	0	0	0	0	1	0	0	1
Total	0	3	0	0	2	0	2	6	0	1	0	2	16
09:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
09:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
09:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
09:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
10:00 AM	0	0	0	0	0	0	1	1	0	0	0	0	2
10:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
10:30 AM	0	1	0	0	0	0	0	0	0	0	0	0	1
10:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	0	0	0	1	1	0	0	0	0	3
11:00 AM	0	0	0	0	0	0	0	1	0	0	0	0	1
11:15 AM	0	1	0	0	0	0	0	0	0	0	0	0	1
11:30 AM	0	0	0	0	0	0	0	0	0	0	0	1	1
11:45 AM	0	0	0	0	0	0	0	0	0	0	0	1	1
Total	0	1	0	0	0	0	0	1	0	0	0	1	3
12:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
12:15 PM	1	0	0	0	0	0	0	0	0	0	0	0	1
12:30 PM	0	0	0	0	0	0	1	0	0	0	0	0	1
12:45 PM	0	0	0	0	1	0	0	0	0	0	0	0	1
Total	1	0	0	0	1	0	1	0	0	0	0	0	3
01:00 PM	0	0	0	0	0	0	0	1	0	0	0	0	1
01:15 PM	0	1	0	0	0	0	0	0	0	0	0	0	1
01:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
01:45 PM	0	0	0	0	0	0	0	1	0	0	0	0	1
Total	0	1	0	0	0	0	0	2	0	0	0	0	3
02:00 PM	0	2	1	0	0	0	0	1	0	0	0	0	4

Accurate Counts

978-664-2565

N/S Street : Lakeview Avenue
 E/W Street: Coburn Road
 City/State : Tyngsborough, MA
 Weather : Clear

File Name : 66160001
 Site Code : 66160001
 Start Date : 1/30/2014
 Page No : 2

Start Time	Groups Printed - Trucks												
	Lakeview Ave From North			Coburn Rd From East			Lakeview Ave From South			Coburn Rd From West			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Int. Total
02:15 PM	0	0	1	0	1	0	0	0	0	0	0	1	3
02:30 PM	0	6	0	0	0	0	0	0	0	0	0	1	7
02:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	8	2	0	1	0	0	1	0	0	0	2	14
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	0	0	0	1	0	0	2	0	3
03:30 PM	0	2	0	0	0	0	0	2	0	0	0	1	5
03:45 PM	0	0	0	0	0	0	0	1	0	0	0	0	1
Total	0	2	0	0	0	0	0	4	0	0	2	1	9
04:00 PM	1	0	0	1	0	0	0	0	0	0	0	0	2
04:15 PM	0	1	0	0	0	0	0	0	0	0	0	0	1
04:30 PM	0	0	0	0	1	0	0	0	0	0	0	0	1
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	1	0	1	1	0	0	0	0	0	0	0	4
05:00 PM	0	0	1	0	0	0	0	0	0	0	0	0	1
05:15 PM	0	1	0	0	0	0	0	0	0	0	0	0	1
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	1	0	0	0	0	0	0	0	0	0	2
06:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
06:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 PM	0	0	0	0	0	1	0	1	0	0	0	0	2
06:45 PM	0	1	0	0	0	0	0	0	0	0	0	0	1
Total	0	1	0	0	0	1	0	1	0	0	0	0	3
Grand Total	2	22	3	1	5	1	5	17	1	2	2	7	67
Apprch %	7.4	81.5	11.1	14.3	71.4	14.3	22.7	77.3	18.2	63.6	18.2	10.4	
Total %	3	32.8	4.5	1.5	7.5	1.5	7.5	25.4	3	3	3	10.4	

Accurate Counts

978-664-2565

N/S Street : Lakeview Avenue
 E/W Street : Coburn Road
 City/State : Tyngsborough, MA
 Weather : Clear

File Name : 66160001
 Site Code : 66160001
 Start Date : 1/30/2014
 Page No : 2

Start Time	Groups Printed- Bikes- Peds																		
	Lakeview Ave From North				Coburn Rd From East				Lakeview Ave From South				Coburn Rd From West						
	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
02:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	4	0	4
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1
05:00 PM	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
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	5	0	5
Apprch %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0
Total %																			

Start Time	Coburn Rd From East												Lakeview Ave From South												Coburn Rd From West											
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total							
	07:00 AM	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						
07:15 AM	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							
07:30 AM	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							
07:45 AM	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 Volume	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							
% App. Total	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							
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000							

Peak Hour Analysis From 07:00 AM to 09:45 AM - Peak 1 of 1
 Peak Hour for Entire Intersection Begins at 07:00 AM

SEASONAL ADJUSTMENT DATA

MASSACHUSETTS HIGHWAY DEPARTMENT - STATEWIDE TRAFFIC DATA COLLECTION

2007 WEEKDAY SEASONAL FACTORS *

* Note: These are weekday factors. The average of the factors for the year will not equal 1, as weekend data are not considered.

FACTOR GROUP	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
GROUP 1 - WEST INTERSTATE	0.95	0.91	0.85	0.85	0.87	0.86	0.91	0.96	0.90	0.88	0.90	0.91
GROUP 2 - RURAL MAJOR COLLECTOR (R-5)	1.11	1.07	1.07	0.98	0.92	0.88	0.88	0.86	0.89	0.93	1.01	1.04
GROUP 3A - RECREATIONAL ***(1-4) See below	1.26	1.20	1.18	1.04	0.96	0.86	0.78	0.79	0.93	0.99	1.07	1.12
GROUP 3B - RECREATIONAL ****(5) See below	1.22	1.18	1.20	1.04	0.96	0.88	0.73	0.74	0.99	1.02	1.12	1.17
GROUP 4 - I-495 INTERSTATE	1.05	1.03	1.03	0.95	0.93	0.87	0.86	0.83	0.89	0.93	0.93	0.96
GROUP 5 - EAST INTERSTATE	1.02	0.99	0.97	0.94	0.95	0.91	0.92	0.92	0.94	0.94	0.98	0.99
GROUP 6 - URBAN ARTERIALS, COLLECTORS & RURAL ARTERIALS (R-2, R-3)	1.03	0.99	0.97	0.92	0.91	0.90	0.92	0.91	0.92	0.93	0.97	0.97
GROUP 7 - I-84 PROXIMITY (STA. 17)	0.84	1.15	1.17	1.08	1.10	1.02	1.01	0.96	1.06	1.06	1.11	1.15
GROUP 8 - I-295 PROXIMITY (STA. 6590)	0.95	1.01	0.96	0.92	0.89	0.88	0.91	0.86	0.91	0.93	0.95	0.92
GROUP 9 - I-195 PROXIMITY (STA. 7)	1.10	1.03	1.00	0.94	0.91	0.87	0.84	0.82	0.88	0.93	1.03	0.99

RECREATIONAL: (ALL YEARS)

- **GROUP 3A:
- 1. CAPE COD (ALL TOWNS)
- 2. PLYMOUTH(SOUTH OF RTE.3A)

- 7014, 7079, 7080, 7090, 7091, 7092, 7093, 7094, 7095, 7096, 7097, 7108, 7178
- 3. MARTHA'S VINEYARD
- 4. NANTUCKET

*****GROUP 3B:**

- 5. PERMANENTS 2 & 189
- 1066, 1067, 1083, 1084, 1085, 1086, 1087, 1088, 1089, 1090, 1091, 1092,
- 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1101, 1102, 1103, 1104,
- 1105, 1106, 1107, 1108, 1113, 1114, 1116, 2196, 2197, 2198

Apply I-84 factor to stations: 3290, 3921, 3929

2007 AXLE CORRECTION FACTORS

ROAD INVENTORY FUNCTIONAL CLASSIFICATION

RURAL

- 1 0.90
- 2 0.93
- 3 0.98
- 0,5,6 0.98
- URBAN
- 1 0.96
- 2,3 0.97
- 5 0.99
- 0,6 0.99

AXLE CORRECTION FACTOR

ROUND OFF

- 0 - 999.....10
- > 1,000.....100

PUBLIC TRANSPORTATION SERVICE INFORMATION

10 Dracut/Tyngsborough

Please visit lra.com or call (978) 452-6161 for more information

Weekday Schedule									
	1 Kennedy Center Departure	2 Sunrise Plaza Bridge St	3 Village Square Plaza (Sat Only)	Outbound 4 Hannaford	5 Dracut High School	6 Lakeview Ave & Mammoth Rd	7 Lakeview Apartments Tyngsborough	8 Four Corners	9 Ayotte's Market Hudson, NH
AM	6:35	6:48	---	6:52	6:56	6:58	7:03	7:05	7:09
	7:35	7:48	---	7:52	7:56	7:58	8:03	8:05	8:09
	8:40	8:53	---	8:57	9:01	9:03	9:08	9:10	9:14
	9:40	9:53	---	9:57	10:01	10:03	10:08	10:10	10:14
	10:35	10:48	---	10:52	10:56	10:58	11:03	11:05	11:09
	11:40	11:53	---	11:57	12:01	12:03	12:08	12:10	12:14
PM	12:40	12:53	---	12:57	13:01	13:03	1:03	1:05	1:09
	1:40	1:53	---	1:57	2:01	2:03	2:08	2:10	2:14
	2:40	2:53	---	2:57	3:01	3:03	3:08	3:10	3:14
	3:40	3:53	---	3:57	4:01	4:03	4:08	4:10	4:14
	4:35	4:48	---	4:52	4:56	4:58	5:03	5:05	5:09
	5:50	6:03	---	6:07	6:11	6:13	6:18	6:20	6:24
	7:00	7:13	---	7:17	7:21	7:23	7:28	7:30	7:34

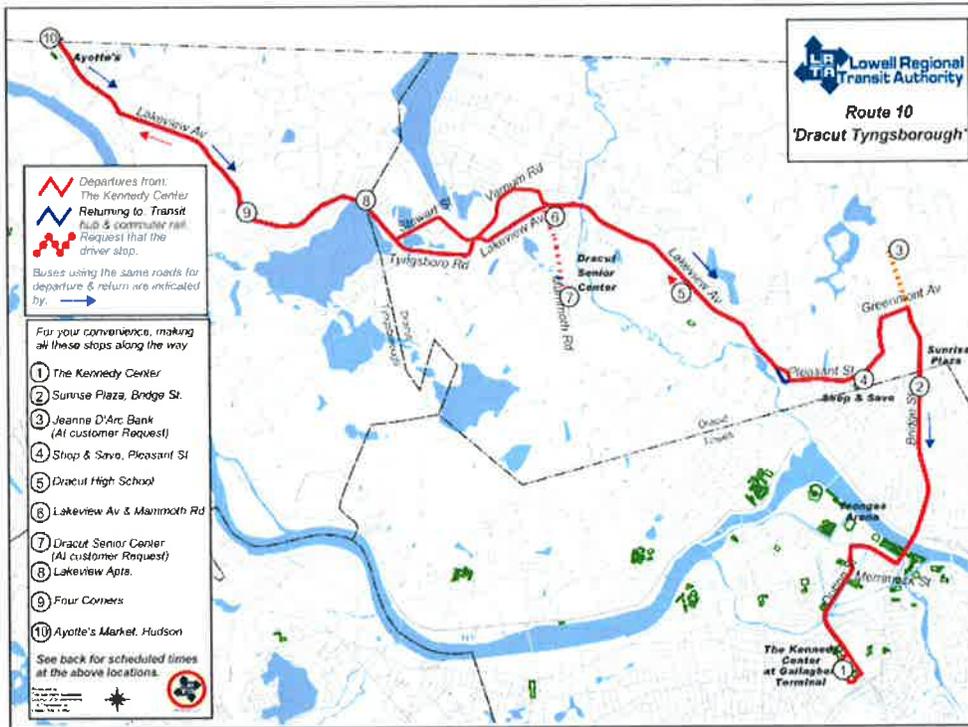
Weekday Schedule									
	9 Ayotte's Market Hudson, NH	8 Four Corners	7 Lakeview Apartments (Tyngsboro)	Inbound 6 Lakeview Ave & Mammoth Rd	5 Dracut High School	4 Hannaford	3 Village Square Plaza (Sat Only)	2 Sunrise Plaza Bridge St	1 Kennedy Center Arrival
AM	6:10	6:15	6:17	6:20	6:23	6:29	---	6:32	6:45
	7:20	7:25	7:27	7:30	7:33	7:39	---	7:42	7:55
	8:20	8:25	8:27	8:30	8:33	8:39	---	8:42	8:55
	9:25	9:30	9:32	9:35	9:38	9:44	---	9:47	10:00
	10:25	10:30	10:32	10:35	10:38	10:44	---	10:47	11:00
	11:20	11:25	11:27	11:30	11:33	11:39	---	11:42	11:55
PM	12:25	12:30	12:32	12:35	12:38	12:44	---	12:47	13:00
	1:25	1:30	1:32	1:35	1:38	1:44	---	1:47	2:00
	2:25	2:30	2:32	2:35	2:38	2:44	---	2:47	3:00
	3:25	3:30	3:32	3:35	3:38	3:44	---	3:47	4:00
	4:25	4:30	4:32	4:35	4:38	4:44	---	4:47	5:00
	5:20	5:25	5:27	5:30	5:33	5:39	---	5:42	5:55
	6:24	6:29	6:31	6:34	6:37	6:43	---	6:46	6:59
	7:35	7:40	7:42	7:45	7:48	7:54	7:57	8:10	

Saturday Schedule

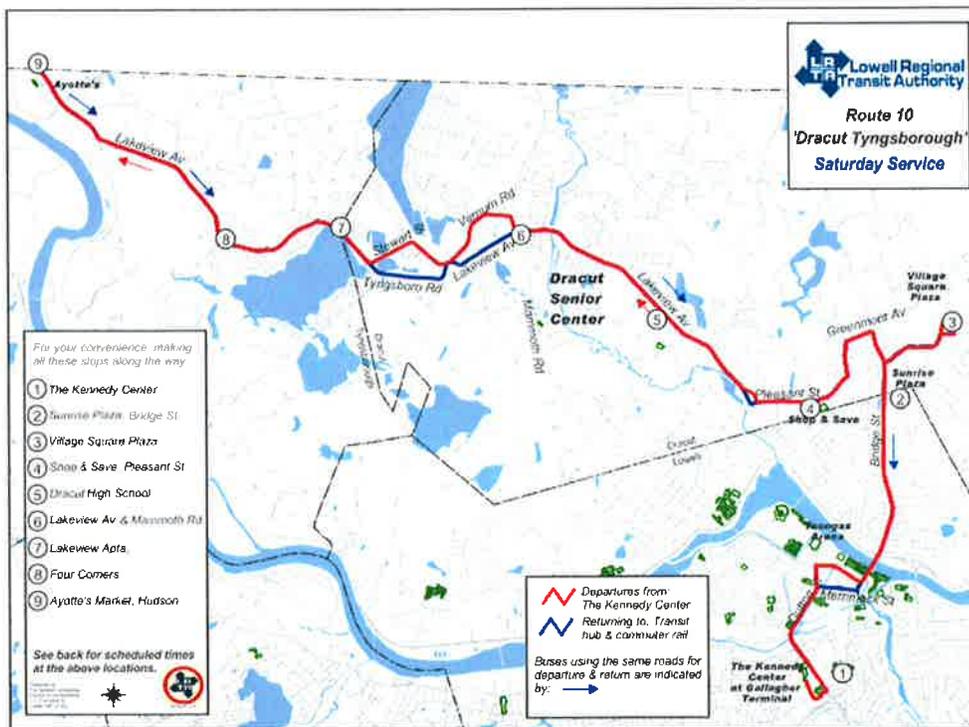
	Kennedy Center Departure	Sunrise Plaza Bridge St.	Village Square Plaza	Outbound Hannaford	Dracut High School	Lakeview Ave & Mammoth Rd.	Lakeview Apartments (Tyngsboro)	Four Corners	Ayotte's Market Hudson, NH
AM	8:30	8:43	8:47	8:52	8:56	8:58	9:03	9:05	9:09
	9:30	9:43	9:47	9:52	9:56	9:58	10:03	10:05	10:09
	10:30	10:43	10:47	10:52	10:56	10:58	11:03	11:05	11:09
	11:30	11:43	11:47	11:52	11:56	11:58	12:03	12:05	12:09
PM	12:30	12:43	12:47	12:52	12:56	12:58	13:03	13:05	13:09
	1:30	1:43	1:47	1:52	1:56	1:58	2:03	2:05	2:09
	2:30	2:43	2:47	2:52	2:56	2:58	3:03	3:05	3:09
	3:30	3:43	3:47	3:52	3:56	3:58	4:03	4:05	4:09
	4:30	4:43	4:47	4:52	4:56	4:58	5:03	5:05	5:09
	5:30	5:43	5:47	5:52	5:56	5:58	6:03	6:05	6:09

Saturday Schedule

	Ayotte's Market Hudson, NH	Four Corners	Lakeview Apartments (Tyngsboro)	Inbound Lakeview ave & Mammoth Rd.	Dracut High School	Hannaford	Village Square Plaza	Sunrise Plaza Bridge St.	Kennedy Center Arrival
AM	9:15	9:20	9:22	9:25	9:28	9:34	9:39	9:43	9:56
	10:15	10:20	10:22	10:25	10:28	10:34	10:39	10:43	10:56
	11:15	11:20	11:22	11:25	11:28	11:34	11:39	11:43	11:56
PM	12:15	12:20	12:22	12:25	12:28	12:34	12:39	12:43	12:56
	1:15	1:20	1:22	1:25	1:28	1:34	1:39	1:43	1:56
	2:15	2:20	2:22	2:25	2:28	2:34	2:39	2:43	2:56
	3:15	3:20	3:22	3:25	3:28	3:34	3:39	3:43	3:56
	4:15	4:20	4:22	4:25	4:28	4:34	4:39	4:43	4:56
	5:15	5:20	5:22	5:25	5:28	5:34	5:39	5:43	5:56
	6:15	6:20	6:22	6:25	6:28	6:34	6:39	6:43	6:56



Weekday Route Map



Saturday Route Map

978-452-6161

QUICK LINKS

-  [Schedules & Maps ▶](#)
-  [Fare Info ▶](#)
-  [Paratransit ▶](#)
-  [Parking ▶](#)
-  [Service Alerts ▶](#)
-  [CharlieCard ▶](#)
-  [Public Information ▶](#)
-  [Regional Connections ▶](#)

TRIP PLANNER

Start (e.g. Belvidere)

End (e.g. Centralville)

[Get Started ▶](#)

Fare Information

[Fixed Route](#) | [Paratransit \(Roadrunner\)](#) | [Parking](#)

Fixed Route Bus Service

Cash Fares

City/ Local/ Shuttle- Regular	\$1.00
City/ Local/ Shuttle- Reduced	\$0.50
Suburban – Regular	\$1.50
Suburban- Reduced	\$.75

Transfers

Free transfers are available to and from the Downtown Shuttle.

In-Town- Regular	\$0.25
In-Town- Reduced	\$0.10
Suburban – Regular	\$0.50
Suburban- Reduced	\$0.25

CharlieCard Monthly Passes

Adult Pass	\$35.00
Senior Pass	\$20.00
Student Pass	\$20.00
Persons with Disabilities Pass	\$20.00

(for persons with Disabilities/TAP CharlieCard)

LRTA Monthly Passes can be purchased at the following locations:

(Please note that we only accept cash, check or money order).

LRTA Transit Center- Kennedy Center 145 Thorndike St., Lowell, MA 01852

- Passes can be purchased at the Bus Information Booth outside, or inside at our Ticket Vending Machine (TVM).

Lowell High School - Kirk St. Lowell, MA. 01852 (sold on the last day & first day of each month in both cafeterias to LHS students).

Passes may also be purchased by sending a check or money order to:

*Lowell Transportation Management, Inc.
 Attn.: Monthly Bus Passes
 100 Hale St. Lowell, MA. 01851
 Telephone: (978) 452-6161 ext. 202*

Fare Categories

Regular

- Persons from 13 to 59 years of age.

[Translate](#)

Reduced

- 60 years or older with I.D.
- With Statewide Transportation Access Pass or Medicare Card.

Children

- From 6 to 12 years of age.
- Children 5 and under ride free and must be accompanied by an adult.

Paratransit (Roadrunner)

In-town	\$1.00
Travel between Communities	\$1.50
Boston (Wednesdays)	\$25.00
Bedford VA (Wednesdays)	\$12.50

For Paratransit questions, please call (978) 459-0152

Parking

Gallagher Intermodal Parking Garage (Thorndike St., Lowell)

Daily	\$5.00
Overnight	\$10.00
Monthly	\$50.00

Parking at North Billerica Train Station

Daily	\$4.00
Billerica Residents	\$2.00
Monthly (Billerica Residents)	\$40.00
Monthly (Non-Residents)	\$70.00

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 Bus Info (978) 452-6161 • Main Office (978) 459-0164
 Site design by [PENTA Communications, Inc.](#)

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VEHICLE SPEED MEASUREMENTS

Site Code: 66160002
6616spd2

Accurate Counts
978-664-2565

Location : Coburn Road
Location : East of Lakeview Avenue
City/State: Tyngsborough, MA
Eastbound

Start Time	15	16	20	21	26	31	36	41	46	51	56	61	66	71	76	Total	Pace Speed	Number In Pace
01/29/14	0	0	0	0	1	4	1	0	0	0	0	0	0	0	0	6	26-35	5
01:00	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	20-29	2
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	39-48	1
05:00	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	4	24-33	3
06:00	0	0	0	1	4	9	3	0	0	0	0	0	0	0	0	17	28-37	13
07:00	0	0	0	1	9	21	10	0	0	0	0	0	0	0	0	41	29-38	31
08:00	0	0	0	1	15	19	3	0	0	0	0	0	0	0	0	38	27-36	30
09:00	3	0	0	1	10	13	1	0	0	0	0	0	0	0	0	28	26-35	19
10:00	1	0	0	1	10	11	1	0	0	0	0	0	0	0	0	24	26-35	18
11:00	0	0	0	2	3	7	5	0	0	0	0	0	0	0	0	17	30-39	11
12 PM	0	0	0	2	15	26	3	0	0	0	0	0	0	0	0	46	27-36	37
13:00	0	0	0	5	8	27	6	0	0	0	0	0	0	0	0	46	28-37	34
14:00	0	0	0	5	19	23	9	0	0	0	0	0	0	0	0	56	26-35	39
15:00	1	0	0	2	19	40	11	1	0	0	0	0	0	0	0	74	28-37	55
16:00	0	0	0	1	30	53	10	0	0	0	0	0	0	0	0	94	27-36	76
17:00	0	1	0	3	33	51	4	0	0	0	0	0	0	0	0	92	27-36	75
18:00	0	0	0	2	20	28	2	1	0	0	0	0	0	0	0	53	26-35	43
19:00	0	0	0	1	16	19	6	1	0	0	0	0	0	0	0	43	26-35	32
20:00	0	0	0	0	12	18	1	0	0	0	0	0	0	0	0	31	26-35	27
21:00	0	0	0	0	9	7	1	0	0	0	0	0	0	0	0	17	26-35	14
22:00	2	0	0	0	5	7	2	0	0	0	0	0	0	0	0	16	27-36	10
23:00	0	0	0	0	0	6	1	0	0	0	0	0	0	0	0	7	29-38	7
Total	7	1	1	29	241	391	80	3	1	0	0	0	0	0	0	753		
Percent	0.9%	0.1%	0.1%	3.9%	32.0%	51.9%	10.6%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	09:00			11:00	08:00	07:00	07:00	04:00								07:00		
Vol.	3			2	15	21	10	1								41		
PM Peak	22:00	17:00		13:00	17:00	16:00	15:00	15:00								16:00		
Vol.	2	1		5	33	53	11	1								94		

Site Code: 66160002
6616spd2

Accurate Counts
978-664-2565

Location : Coburn Road
City/State: Tyngsborough, MA
Eastbound

Start Time	15	16	20	21	26	31	36	41	46	51	56	61	66	71	76	Total	Pace Speed	Number In Pace
01/30/14	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	25-34	2
01:00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	24-33	1
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
05:00	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	3	24-33	3
06:00	0	1	0	2	2	7	4	0	0	0	0	0	0	0	0	16	28-37	10
07:00	2	0	0	0	14	28	5	0	0	0	0	0	0	0	0	49	28-37	37
08:00	0	0	0	0	14	15	6	0	0	0	0	0	0	0	0	35	27-36	26
09:00	0	1	0	2	8	10	2	0	0	0	0	0	0	0	0	23	25-34	16
10:00	0	1	0	2	12	8	3	0	0	0	0	0	0	0	0	26	25-34	18
11:00	1	0	0	1	11	14	7	0	0	0	0	0	0	0	0	34	27-36	23
12 PM	0	0	0	3	16	12	2	0	0	0	0	0	0	0	0	33	26-35	25
13:00	0	1	0	5	12	23	4	0	0	0	0	0	0	0	0	45	27-36	32
14:00	1	0	0	2	18	25	1	0	0	0	0	0	0	0	0	47	26-35	38
15:00	0	0	0	4	27	30	9	0	0	0	0	0	0	0	0	70	26-35	52
16:00	0	0	0	2	25	46	10	1	0	0	0	0	0	0	0	84	27-36	66
17:00	0	0	0	6	41	48	6	1	0	0	0	0	0	0	0	102	26-35	80
18:00	0	0	0	3	23	31	5	0	0	0	0	0	0	0	0	62	27-36	49
19:00	0	0	0	0	22	15	3	1	0	0	0	0	0	0	0	41	25-34	33
20:00	0	0	0	2	7	21	0	0	0	0	0	0	0	0	0	30	27-36	26
21:00	0	0	0	0	9	12	1	0	0	0	0	0	0	0	0	22	26-35	19
22:00	0	0	0	0	7	8	1	0	0	0	0	0	0	0	0	16	27-36	13
23:00	0	0	0	1	7	3	2	0	0	0	0	0	0	0	0	13	26-35	9
Total	4	4	4	35	277	360	71	3	0	0	0	0	0	0	0	754		
Percent	0.5%	0.5%	0.5%	4.6%	36.7%	47.7%	9.4%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	07:00		
AM Peak	07:00	06:00	06:00	06:00	07:00	07:00	11:00									49		
Vol.	2	1	1	2	14	28	7									17:00		
PM Peak	14:00	13:00	17:00	17:00	17:00	17:00	16:00	16:00								102		
Total	1	1	1	6	41	48	10	1								1507		
Percent	0.7%	0.3%	0.3%	4.2%	34.4%	49.8%	10.0%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
15th Percentile : 26 MPH																		
50th Percentile : 30 MPH																		
85th Percentile : 35 MPH																		
95th Percentile : 37 MPH																		

Stats
10 MPH Pace Speed : 27-36 MPH
Number in Pace : 1145
Percent in Pace : 76.0%
Number of Vehicles > 25 MPH : 1427
Percent of Vehicles > 25 MPH : 94.7%
Mean Speed(Average) : 31 MPH

Site Code: 66160002
6616spd2

Accurate Counts
978-664-2565

Location : Coburn Road
City/State: Tyngsborough, MA
Westbound

Start Time	15	16	20	21	26	31	36	41	46	51	56	61	66	71	76	Total	Pace Speed	Number In Pace
01/29/14	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	4	29-38	3
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29-38	1
03:00	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	34-43	3
04:00	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	4	27-36	21
05:00	0	0	0	1	12	12	2	0	0	0	0	0	0	0	0	50	25-34	40
06:00	0	0	0	4	28	16	2	0	0	0	0	0	0	0	0	95	26-35	77
07:00	0	1	1	4	42	45	3	0	0	0	0	0	0	0	0	79	25-34	56
08:00	0	1	1	11	35	26	6	0	0	0	0	0	0	0	0	41	27-36	32
09:00	0	0	0	2	15	21	3	0	0	0	0	0	0	0	0	32	28-37	26
10:00	0	0	0	1	7	21	3	0	0	0	0	0	0	0	0	35	27-36	27
11:00	0	0	0	2	12	18	3	0	0	0	0	0	0	0	0	33	25-34	24
12 PM	0	1	1	0	16	11	5	0	0	0	0	0	0	0	0	28	27-36	20
13:00	0	0	0	1	11	11	5	0	0	0	0	0	0	0	0	60	26-35	44
14:00	0	0	0	8	22	27	3	0	0	0	0	0	0	0	0	52	26-35	37
15:00	1	0	0	7	17	25	1	1	0	0	0	0	0	0	0	53	26-35	39
16:00	0	0	0	4	21	22	5	1	0	0	0	0	0	0	0	52	26-35	43
17:00	0	0	0	3	26	22	1	0	0	0	0	0	0	0	0	46	25-34	36
18:00	0	0	0	4	25	14	3	0	0	0	0	0	0	0	0	18	27-36	16
19:00	0	0	0	0	5	12	1	0	0	0	0	0	0	0	0	17	27-36	13
20:00	0	0	0	1	7	8	1	0	0	0	0	0	0	0	0	7	27-36	5
21:00	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	5	24-33	4
22:00	0	0	0	0	3	1	1	0	0	0	0	0	0	0	0	10	26-35	8
23:00	0	0	0	1	4	5	0	0	0	0	0	0	0	0	0	749		
Total	1	3	3	55	312	323	52	3	0	0	0	0	0	0	0	749		
Percent	0.1%	0.4%	0.4%	7.3%	41.7%	43.1%	6.9%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
AM Peak	07:00	07:00	07:00	08:00	07:00	07:00	08:00	04:00	04:00	04:00	04:00	04:00	04:00	04:00	04:00	07:00		
Vol.	1	1	1	11	42	45	6	1	1	1	1	1	1	1	1	95		
PM Peak	15:00	12:00	12:00	14:00	17:00	14:00	12:00	15:00	15:00	15:00	15:00	15:00	15:00	15:00	15:00	14:00		
Vol.	1	1	1	8	26	27	5	1	1	1	1	1	1	1	1	60		

Site Code: 66160002
6616spd2

Accurate Counts
978-664-2565

Location : Coburn Road
City/State: East of Lakeview Avenue
Westborough, MA

Start Time	15	16	20	21	25	26	30	31	35	36	40	41	45	46	50	51	55	56	60	61	65	66	70	71	75	76	999	Total	Pace Speed	Number in Pace	
01/30/14	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	*	*	
01:00	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	*	*	
02:00	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	*	*	
03:00	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	34-43	1	
04:00	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	31-40	3	
05:00	0	0	0	0	1	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27-36	17	
06:00	0	0	2	6	11	6	6	11	20	6	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25-34	46	
07:00	0	1	11	50	40	9	9	40	22	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26-35	81	
08:00	0	0	0	32	22	1	0	22	1	4	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25-34	49	
09:00	0	0	0	9	18	9	9	18	9	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28-37	25	
10:00	0	0	0	1	9	9	9	9	9	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26-35	16	
11:00	0	0	0	13	17	17	17	17	17	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26-35	27	
12 PM	0	1	2	21	19	2	2	19	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26-35	35	
13:00	0	0	0	3	9	3	3	9	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26-35	19	
14:00	0	0	0	8	8	35	12	12	12	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24-33	45	
15:00	0	0	0	8	8	23	23	23	23	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25-34	42	
16:00	0	0	0	21	18	21	21	18	21	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26-35	35	
17:00	0	0	0	6	21	21	21	21	21	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25-34	38	
18:00	0	0	0	3	13	13	13	13	13	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26-35	24	
19:00	0	0	0	2	14	14	14	12	12	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26-35	24	
20:00	0	0	0	7	7	7	7	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26-35	8	
21:00	0	0	0	3	8	3	3	8	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28-37	10	
22:00	0	0	0	1	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27-36	5	
23:00	0	0	0	4	4	4	4	0	0	3	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22-31	5	
Total	0	4	75	326	278	55	5	5	5	55	5	5	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	744			
Percent	0.0%	0.5%	10.1%	43.8%	37.4%	7.4%	0.7%	0.7%	0.7%	7.4%	0.7%	0.7%	0.7%	0.0%	0.0%	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%			
AM Peak	06:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	03:00	03:00	03:00	03:00	11:00	11:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00
Vol.	2	11	50	40	40	9	9	9	9	9	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	111			
PM Peak	12:00	14:00	14:00	14:00	15:00	15:00	15:00	15:00	15:00	15:00	15:00	16:00	16:00	16:00	16:00	16:00	16:00	14:00	14:00	14:00	14:00	14:00	14:00	14:00	14:00	14:00	14:00	14:00	14:00	14:00	14:00
Vol.	1	7	130	638	601	107	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	56			
Total	1	7	130	638	601	107	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	1493			
Percent	0.1%	0.5%	8.7%	42.7%	40.3%	7.2%	0.5%	0.5%	0.5%	7.2%	0.5%	0.5%	0.5%	0.0%	0.0%	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%	

Stats
 10 MPH Pace Speed : 26-35 MPH
 Number in Pace : 1116
 Percent in Pace : 74.7%
 Number of Vehicles > 25 MPH : 1355
 Percent of Vehicles > 25 MPH : 90.8%
 Mean Speed(Average) : 30 MPH

Site Code: 66160002
6616spd2

Accurate Counts
978-664-2565

Location : Coburn Road
Location : East of Lakeview Avenue
City/State: Tyngsborough, MA
Eastbound, Westbound

Start Time	15	16	20	21	25	26	30	31	35	36	40	41	45	46	50	51	55	56	60	61	65	66	70	71	75	76	999	Total	Pace Speed	Number in Pace	
01/29/14	0	0	0	0	0	2	2	6	6	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	29-38	8	
01:00	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	20-29	2	
02:00	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	*	*	
03:00	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	
04:00	0	0	0	0	0	0	0	1	1	1	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	29-38	1	1	
05:00	0	0	0	0	2	13	13	14	14	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	34-43	3	3	
06:00	0	0	0	5	32	32	25	25	25	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	26-35	24	24	
07:00	0	1	1	5	51	51	66	66	66	13	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	136	26-35	51	51	
08:00	0	1	1	12	50	45	45	45	45	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117	27-36	105	105	
09:00	3	0	0	3	25	34	34	34	34	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	69	26-35	51	51	
10:00	1	0	0	2	17	17	32	32	32	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	27-36	44	44	
11:00	0	0	0	4	15	15	25	25	25	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	28-37	37	37	
12 PM	0	1	1	2	31	31	37	37	37	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	26-35	61	61	
13:00	0	0	0	6	19	19	38	38	38	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	27-36	54	54	
14:00	0	0	0	13	41	41	50	50	50	12	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	116	26-35	83	83	
15:00	2	0	0	9	36	36	65	65	65	12	12	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	126	27-36	92	92	
16:00	0	0	0	5	51	51	75	75	75	15	15	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	147	27-36	115	115	
17:00	0	1	1	6	59	59	73	73	73	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	144	26-35	117	117	
18:00	0	0	0	6	45	45	42	42	42	5	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	99	26-35	78	78	
19:00	0	0	0	1	21	21	31	31	31	7	7	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	61	27-36	47	47	
20:00	0	0	0	1	19	19	26	26	26	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	26-35	40	40	
21:00	0	0	0	1	12	12	10	10	10	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	26-35	20	20	
22:00	2	0	0	0	8	8	8	8	8	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	28-37	13	13	
23:00	0	0	0	1	4	4	11	11	11	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	27-36	14	14	
Total	8	4	4	84	553	553	714	714	714	132	132	6	6	1	1	0	0	0	0	0	0	0	0	0	0	0	1502				
Percent	0.5%	0.3%	0.3%	5.6%	36.8%	36.8%	47.5%	47.5%	47.5%	8.8%	8.8%	0.4%	0.4%	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%				
AM Peak	09:00	07:00	07:00	08:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	04:00	04:00	04:00	04:00													07:00			
Vol.	3	1	1	12	51	51	66	66	66	13	13	1	1	1	1													136			
PM Peak	15:00	12:00	12:00	14:00	17:00	17:00	16:00	16:00	16:00	16:00	16:00	15:00	15:00	15:00	15:00													16:00			
Vol.	2	1	1	13	59	59	75	75	75	15	15	2	2	2	2													147			

Site Code: 66160002
6616spd2

Accurate Counts
978-664-2565

Location : Coburn Road
Location : East of Lakeview Avenue
City/State: Tyngsborough, MA
Eastbound, Westbound

Start Time	16	21	26	31	36	41	46	51	56	61	66	71	76	Total	Pace Speed	Number In Pace
01/30/14	15	20	25	30	35	40	45	50	55	60	65	70	75	999	25-34	2
01:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	24-33	1
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	1	0	0	0	0	0	0	1	34-43	1
04:00	0	0	1	0	0	2	0	0	0	0	0	0	0	4	31-40	3
05:00	0	2	8	8	12	6	0	0	0	0	0	0	0	28	28-37	19
06:00	0	3	11	32	27	10	1	0	0	0	0	0	0	84	26-35	53
07:00	2	1	11	64	68	14	0	0	0	0	0	0	0	160	26-35	118
08:00	0	0	8	46	37	7	0	0	0	0	0	0	0	98	26-35	75
09:00	0	1	6	17	28	6	1	0	0	0	0	0	0	59	27-36	41
10:00	0	1	3	21	17	5	0	0	0	0	0	0	0	47	26-35	34
11:00	1	0	2	24	31	8	0	1	0	0	0	0	0	67	27-36	49
12 PM	0	1	5	37	31	4	0	0	0	0	0	0	0	78	26-35	61
13:00	0	1	8	24	32	7	0	0	0	0	0	0	0	72	26-35	51
14:00	1	0	10	53	37	2	0	0	0	0	0	0	0	103	25-34	81
15:00	0	0	12	50	53	11	0	0	0	0	0	0	0	126	26-35	93
16:00	0	0	6	46	64	12	2	0	0	0	0	0	0	130	27-36	100
17:00	0	0	12	62	69	8	1	0	0	0	0	0	0	152	26-35	118
18:00	0	0	6	36	44	8	0	0	0	0	0	0	0	94	26-35	72
19:00	0	0	2	36	27	7	1	0	0	0	0	0	0	73	26-35	57
20:00	0	0	2	14	23	1	0	0	0	0	0	0	0	40	27-36	33
21:00	0	0	12	12	20	2	0	0	0	0	0	0	0	34	27-36	29
22:00	0	0	1	10	11	1	0	0	0	0	0	0	0	23	26-35	19
23:00	0	0	2	11	3	5	1	0	0	0	0	0	0	22	24-33	14
Total	4	8	110	603	638	126	8	0	1	0	0	0	0	1498		
Percent	0.3%	0.5%	7.3%	40.3%	42.6%	8.4%	0.5%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	07:00		
AM Peak	07:00	06:00	06:00	07:00	07:00	07:00	03:00	11:00						160		
Vol.	2	3	11	64	68	14	1	1						17:00		
PM Peak	14:00	12:00	15:00	17:00	17:00	16:00	16:00							152		
Vol.	1	1	12	62	69	12	2							3000		
Total	12	12	194	1156	1352	258	14	1	0	0	0	0	0			
Percent	0.4%	0.4%	6.5%	38.5%	45.1%	8.6%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			

Stat	10 MPH Pace Speed	26-35 MPH
Number in Pace	2250	
Percent in Pace	75.0%	
Number of Vehicles > 25 MPH	2782	
Percent of Vehicles > 25 MPH	92.7%	
Mean Speed(Average)	31 MPH	

Accurate Counts
978-664-2.565

Location : Lakeview Avenue
Location : North of Coburn Road
City/State: Tyngsborough, MA
Northbound

Site Code: 66160001
6616SPDI

Start Time	15	16	21	26	31	36	41	46	51	56	61	66	71	76	Total	85th Percent	95th Percent
02/04/14	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	24	25
01:00	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2	33	35
02:00	0	1	0	1	1	0	0	0	0	0	0	0	0	0	3	32	34
03:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	34	35
04:00	0	0	1	1	2	0	0	0	0	0	0	0	0	0	4	33	35
05:00	3	1	6	5	5	1	0	0	0	0	0	0	0	0	21	32	35
06:00	2	0	5	21	23	0	0	0	0	0	0	0	0	0	51	33	35
07:00	1	0	12	40	50	6	1	0	0	0	0	0	0	0	110	34	36
08:00	7	1	6	36	18	3	0	0	0	0	0	0	0	0	71	32	35
09:00	2	0	9	10	17	9	0	0	0	0	0	0	0	0	47	36	38
10:00	2	0	4	14	21	6	0	0	0	0	0	0	0	0	47	35	37
11:00	3	0	3	17	18	9	0	0	0	0	0	0	0	0	50	35	38
12 PM	3	2	6	20	28	6	0	0	0	0	0	0	0	0	65	34	37
13:00	1	1	6	19	29	5	0	1	0	0	0	0	0	0	62	34	37
14:00	0	0	7	25	36	11	0	0	0	0	0	0	0	0	79	35	38
15:00	3	1	9	25	55	9	0	0	0	0	0	0	0	0	102	34	37
16:00	7	0	5	30	40	10	0	0	0	0	0	0	0	0	92	34	37
17:00	7	0	6	24	45	4	0	0	0	0	0	0	0	0	86	34	36
18:00	5	1	5	27	28	2	0	0	0	0	0	0	0	0	68	33	35
19:00	1	1	4	25	33	4	1	0	0	0	0	0	0	0	69	34	36
20:00	2	0	5	14	17	5	0	0	0	0	0	0	0	0	43	34	37
21:00	2	0	5	8	20	2	0	0	0	0	0	0	0	0	37	34	36
22:00	0	0	2	5	6	0	0	0	0	0	0	0	0	0	13	33	35
23:00	0	0	0	2	3	1	0	0	0	0	0	0	0	0	6	35	38
Total	51	9	107	370	497	93	2	1	0	0	0	0	0	0	1130		
Percent	4.5%	0.8%	9.5%	32.7%	44.0%	8.2%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak Vol.	08:00	02:00	07:00	07:00	07:00	09:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00		
PM Peak Vol.	16:00	12:00	15:00	16:00	15:00	14:00	19:00	13:00							15:00		
	7	2	9	30	55	11	1	1						102			

Accurate Counts
978-664-2565

Location : Lakeview Avenue
 Location : North of Coburn Road
 City/State: Tyngsborough, MA
 Northbound
 Site Code: 66160001
 6616SPD1

Start Time	1	16	21	26	31	36	41	46	51	56	61	66	71	76	85th Percent	95th Percent
02/06/14	15	20	25	30	35	40	45	50	55	60	65	70	75	999	2	20
01:00	0	1	0	0	1	0	0	0	0	0	0	0	0	0	3	34
02:00	0	0	2	1	0	0	0	0	0	0	0	0	0	0	3	29
03:00	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	30
04:00	0	0	1	4	2	0	0	0	0	0	0	0	0	0	7	34
05:00	0	0	9	10	2	0	0	0	0	0	0	0	0	0	21	32
06:00	0	2	29	27	8	2	0	0	0	0	0	0	0	0	68	34
07:00	1	2	31	43	25	0	0	0	0	0	0	0	0	0	102	34
08:00	6	1	13	37	14	0	0	0	0	0	0	0	0	0	71	33
09:00	1	1	5	27	15	2	0	0	0	0	0	0	0	0	51	35
10:00	1	1	4	22	15	3	0	0	0	0	0	0	0	0	46	36
11:00	0	0	7	19	21	4	0	0	0	0	0	0	0	0	51	36
12 PM	5	0	2	17	30	1	0	0	0	0	0	0	0	0	55	35
13:00	0	0	12	20	25	7	0	0	0	0	0	0	0	0	64	37
14:00	3	0	10	35	37	7	1	0	0	0	0	0	0	0	93	37
15:00	0	1	14	31	45	10	0	0	0	0	0	0	0	0	101	37
16:00	0	2	3	32	46	6	1	0	0	0	0	0	0	0	90	37
17:00	4	1	13	33	31	4	0	0	0	0	0	0	0	0	86	35
18:00	3	0	12	45	27	4	0	0	0	0	0	0	0	0	91	35
19:00	0	1	8	24	19	2	0	0	0	0	0	0	0	0	54	35
20:00	0	1	6	28	15	6	0	0	0	0	0	0	0	0	56	37
21:00	0	0	5	19	11	1	1	0	0	0	0	0	0	0	37	36
22:00	0	0	5	8	3	0	0	0	0	0	0	0	0	0	16	33
23:00	0	0	1	3	1	0	0	0	0	0	0	0	0	0	5	33
Total	24	16	193	486	393	59	3	0	0	0	0	0	0	0	1174	
Percent	2.0%	1.4%	16.4%	41.4%	33.5%	5.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		

AM Peak Vol.	08:00	07:00	07:00	11:00
AM Peak Vol.	6	2	31	43
PM Peak Vol.	5	2	14	45
Grand Total	97	110	507	1026
Percent	3.4%	3.9%	17.9%	36.3%
15th Percentile :	20 MPH			
50th Percentile :	28 MPH			
85th Percentile :	33 MPH			
95th Percentile :	36 MPH			

Statistic	10 MPH Pace Speed :	25-34 MPH
Number in Pace :	1736	
Percent in Pace :	61.3%	
Number of Vehicles > 30 MPH :	1090	
Percent of Vehicles > 30 MPH :	38.5%	
Mean Speed(Average) :	27 MPH	

Accurate Counts
978-664-2.565

Location : Lakeview Avenue
 Location : North of Coburn Road
 City/State: Tyngsborough, MA
 Southbound
 Site Code: 66160001
 6616SPD1

Start Time	15	16	21	26	31	36	41	46	51	56	61	66	71	76	Total	85th Percent	95th Percent
02/04/14	0	1	0	0	0	1	0	0	0	0	0	0	0	0	2	38	39
01:00	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2	33	35
02:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	34	35
03:00	0	0	1	0	1	0	0	0	0	0	0	0	0	0	2	33	35
04:00	0	0	4	1	1	0	0	0	0	0	0	0	0	0	6	30	33
05:00	0	0	2	4	3	0	0	0	0	0	0	0	0	0	9	32	34
06:00	0	0	8	18	11	0	0	0	0	0	0	0	0	0	37	32	34
07:00	2	3	24	40	22	3	0	0	0	0	0	0	0	0	94	32	35
08:00	3	0	11	21	25	3	0	0	0	0	0	0	0	0	63	33	36
09:00	0	0	8	30	19	6	0	0	0	0	0	0	0	0	63	34	37
10:00	2	2	7	21	17	6	1	0	0	0	0	0	0	0	56	34	38
11:00	3	0	5	26	27	8	0	0	0	0	0	0	0	0	69	34	37
12 PM	1	0	8	20	29	6	0	0	0	0	0	0	0	0	64	34	37
13:00	1	0	4	19	33	3	0	0	0	0	0	0	0	0	60	34	36
14:00	0	0	20	67	39	9	0	0	0	0	0	0	0	0	135	33	36
15:00	1	0	16	31	47	13	0	0	0	0	0	0	0	0	108	35	37
16:00	0	0	12	44	37	10	1	0	0	0	0	0	0	0	104	34	37
17:00	2	0	9	60	52	9	0	0	0	0	0	0	0	0	132	34	36
18:00	1	1	12	40	24	5	1	1	0	0	0	0	0	0	85	33	37
19:00	1	3	8	29	24	4	0	0	0	0	0	0	0	0	69	33	36
20:00	0	0	5	27	19	3	1	0	0	0	0	0	0	0	55	34	37
21:00	0	0	5	21	17	1	0	0	0	0	0	0	0	0	44	33	35
22:00	0	0	2	9	5	6	0	0	0	0	0	0	0	0	22	37	39
23:00	0	0	4	1	5	0	0	0	0	0	0	0	0	0	10	33	35
Total	17	10	175	530	459	96	4	1	0	0	0	0	0	0	1292		
Percent	1.3%	0.8%	13.5%	41.0%	35.5%	7.4%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	07:00	07:00	07:00	11:00	11:00	10:00								07:00		
Vol.	3	3	24	40	27	8	1								94		
PM Peak	17:00	19:00	14:00	14:00	17:00	15:00	16:00	18:00							14:00		
Vol.	2	3	20	67	52	13	1	1							135		

Accurate Counts
978-664-2565

Location : Lakeview Avenue
 Location : North of Coburn Road
 City/State: Tyngsborough, MA
 Southbound
 Site Code: 66160001
 6616SPD1

Start Time	15	16	20	21	26	31	36	41	46	51	56	61	66	71	76	Total	85th Percent	95th Percent
02/05/14	0	0	0	0	5	3	0	0	0	0	0	0	0	0	0	8	33	34
01:00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	34	35
02:00	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	4	29	30
03:00	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2	33	35
04:00	0	2	2	0	1	1	0	0	0	0	0	0	0	0	0	4	31	33
05:00	0	2	2	3	2	1	1	0	0	0	0	0	0	0	0	9	32	37
06:00	0	1	1	15	7	0	0	0	0	0	0	0	0	0	0	23	27	29
07:00	0	5	5	7	6	0	0	0	0	0	0	0	0	0	0	18	27	29
08:00	2	1	1	13	4	1	0	0	0	0	0	0	0	0	0	21	26	30
09:00	0	0	0	10	7	0	0	0	0	0	0	0	0	0	0	17	28	29
10:00	1	6	6	11	8	0	0	0	0	0	0	0	0	0	0	26	27	29
11:00	1	6	6	16	8	1	0	0	0	0	0	0	0	0	0	32	27	30
12 PM	1	1	1	19	9	2	0	0	0	0	0	0	0	0	0	32	28	31
13:00	3	7	7	15	8	2	0	0	0	0	0	0	0	0	0	35	27	30
14:00	0	9	9	20	16	2	0	0	0	0	0	0	0	0	0	47	28	30
15:00	2	6	6	26	13	1	0	0	0	0	0	0	0	0	0	48	27	29
16:00	6	7	7	18	15	3	0	0	0	0	0	0	0	0	0	49	28	31
17:00	0	9	9	27	13	2	0	0	0	0	0	0	0	0	0	51	27	30
18:00	5	10	10	26	13	0	0	0	0	0	0	0	0	0	0	54	26	28
19:00	2	10	10	16	9	0	0	0	0	0	0	0	0	0	0	37	26	28
20:00	0	5	5	18	8	2	0	0	0	0	0	0	0	0	0	33	27	31
21:00	0	5	5	12	9	4	0	0	0	0	0	0	0	0	0	30	29	32
22:00	0	2	2	3	2	1	0	0	0	0	0	0	0	0	0	8	29	32
23:00	1	0	0	4	2	2	0	0	0	0	0	0	0	0	0	9	31	33
Total	24	94	94	280	169	30	1	0	0	0	0	0	0	0	0	598		
Percent	4.0%	15.7%	15.7%	46.8%	28.3%	5.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			

AM Peak	08:00	10:00	11:00	11:00	10:00	00:00	05:00	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	11:00		
Vol.	2	6	6	16	8	3	1									32		
PM Peak	16:00	18:00	17:00	17:00	14:00	21:00										18:00		
Vol.	6	10	27	27	16	4										54		

Accurate Counts
978-664-2565

Location : Lakeview Avenue
 Location : North of Coburn Road
 City/State: Tyngsborough, MA
 Southbound
 Site Code: 66160001
 6616SPD1

Start Time	16	21	26	31	36	41	46	51	56	61	66	71	76	85th Percent	95th Percent
02/06/14	1	3	0	1	0	0	0	0	0	0	0	0	0	30	33
01:00	0	1	1	0	0	0	0	0	0	0	0	0	0	28	30
02:00	0	0	1	0	0	0	0	0	0	0	0	0	0	29	30
03:00	0	0	1	0	0	0	0	0	0	0	0	0	0	29	30
04:00	0	0	1	0	0	0	0	0	0	0	0	0	0	29	30
05:00	0	10	4	0	0	0	0	0	0	0	0	0	0	27	29
06:00	0	18	15	3	0	0	0	0	0	0	0	0	0	28	31
07:00	1	41	35	5	0	0	0	0	0	0	0	0	0	28	31
08:00	0	21	27	10	0	0	0	0	0	0	0	0	0	30	33
09:00	1	13	29	13	1	0	0	0	0	0	0	0	0	31	34
10:00	1	13	20	14	3	0	0	0	0	0	0	0	0	33	36
11:00	0	10	29	15	3	0	0	0	0	0	0	0	0	33	36
12 PM	1	5	30	36	3	0	0	0	0	0	0	0	0	34	35
13:00	0	15	31	31	4	0	0	0	0	0	0	0	0	33	36
14:00	3	23	49	36	3	0	0	0	0	0	0	0	0	32	35
15:00	0	12	47	47	6	0	0	0	0	0	0	0	0	34	36
16:00	0	21	43	44	7	0	0	0	0	0	0	0	0	33	36
17:00	2	21	54	37	2	0	0	0	0	0	0	0	0	32	35
18:00	1	17	58	30	3	0	0	0	0	0	0	0	0	32	35
19:00	0	15	40	25	3	0	0	0	0	0	0	0	0	33	35
20:00	0	13	28	24	2	0	0	0	0	0	0	0	0	33	35
21:00	0	11	22	20	3	0	0	0	0	0	0	0	0	33	36
22:00	0	6	12	8	2	0	0	0	0	0	0	0	0	33	36
23:00	0	3	3	3	2	0	0	0	0	0	0	0	0	35	38
Total	10	293	581	402	47	0	1367								
Percent	0.7%	21.4%	42.5%	29.4%	3.4%	0.0%									
AM Peak	07:00	07:00	07:00	11:00	10:00										
Vol.	1	10	41	35	3									92	
PM Peak	14:00	14:00	14:00	15:00	16:00										
Vol.	3	4	23	58	7									119	
Grand Total	51	138	748	1280	144	4	1	0	0	0	0	0	0	3257	
Percent	1.6%	4.2%	23.0%	39.3%	4.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
15th Percentile : 21 MPH 50th Percentile : 27 MPH 85th Percentile : 33 MPH 95th Percentile : 35 MPH															

Statistic : 10 MPH Pace Speed : 24-33 MPH
 Number in Pace : 2045
 Percent in Pace : 62.8%
 Number of Vehicles > 30 MPH : 1040
 Percent of Vehicles > 30 MPH : 31.9%
 Mean Speed(Average) : 27 MPH

Accurate Counts
978-664-2.565

Location : Lakeview Avenue
 Location : North of Coburn Road
 City/State: Tyngsborough, MA
 Northbound, Southbound
 Site Code: 66160001
 6616SPD1

Start Time	15	16	21	26	31	36	41	46	51	56	61	66	71	76	Total	85th Percent	95th Percent
02/04/14	1	20	25	30	35	40	45	50	55	60	65	70	75	999	3	37	39
01:00	0	0	0	2	2	0	0	0	0	0	0	0	0	0	4	33	35
02:00	0	1	0	1	2	0	0	0	0	0	0	0	0	0	4	33	35
03:00	0	0	1	0	2	0	0	0	0	0	0	0	0	0	3	34	35
04:00	0	0	5	2	3	0	0	0	0	0	0	0	0	0	10	32	34
05:00	3	1	8	9	8	1	0	0	0	0	0	0	0	0	30	32	35
06:00	2	0	13	39	34	0	0	0	0	0	0	0	0	0	88	33	34
07:00	3	3	36	80	72	9	1	0	0	0	0	0	0	0	204	33	36
08:00	10	1	17	57	43	6	0	0	0	0	0	0	0	0	134	33	35
09:00	2	0	17	40	36	15	0	0	0	0	0	0	0	0	110	35	38
10:00	4	2	11	35	38	12	1	0	0	0	0	0	0	0	103	35	38
11:00	6	0	8	43	45	17	0	0	0	0	0	0	0	0	119	35	38
12 PM	4	2	14	40	57	12	0	0	0	0	0	0	0	0	129	34	37
13:00	2	1	10	38	62	8	0	1	0	0	0	0	0	0	122	34	36
14:00	0	0	27	92	75	20	0	0	0	0	0	0	0	0	214	34	37
15:00	4	1	25	56	102	22	0	0	0	0	0	0	0	0	210	34	37
16:00	7	0	17	74	77	20	1	0	0	0	0	0	0	0	196	34	37
17:00	9	0	15	84	97	13	0	0	0	0	0	0	0	0	218	34	36
18:00	6	2	17	67	52	7	1	1	0	0	0	0	0	0	153	33	36
19:00	2	4	12	54	57	8	1	0	0	0	0	0	0	0	138	34	36
20:00	2	0	10	41	36	8	1	0	0	0	0	0	0	0	98	34	37
21:00	2	0	10	29	37	3	0	0	0	0	0	0	0	0	81	33	35
22:00	0	0	4	14	11	6	0	0	0	0	0	0	0	0	35	35	38
23:00	0	0	4	3	8	1	0	0	0	0	0	0	0	0	16	34	36
Total	68	19	282	900	956	189	6	2	0	0	0	0	0	0	2422		
Percent	2.8%	0.8%	11.6%	37.2%	39.5%	7.8%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	07:00	07:00	07:00	07:00	11:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00		
Vol.	10	3	36	80	72	17	1								204		
PM Peak	17:00	19:00	14:00	14:00	15:00	15:00	16:00	13:00							17:00		
Vol.	9	4	27	92	102	22	1	1							218		

Accurate Counts
978-664-2565

Location : Lakeview Avenue
 Location : North of Coburn Road
 City/State: Tyngsborough, MA
 Northbound, Southbound
 Site Code: 66160001
 6616SPDI

Start Time	1	16	21	26	31	36	41	46	51	56	61	66	71	76	Total	85th Percent	95th Percent
02/05/14	15	20	25	30	35	40	45	50	55	60	65	70	75	80	999	33	35
01:00	0	0	0	6	5	0	0	0	0	0	0	0	0	0	11	33	35
02:00	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2	33	35
03:00	0	1	2	4	1	0	1	0	0	0	0	0	0	0	8	30	42
04:00	0	1	0	1	3	0	0	0	0	0	0	0	0	0	5	33	35
05:00	0	4	0	2	1	2	0	0	0	0	0	0	0	0	9	35	38
06:00	2	2	8	11	10	2	0	0	0	0	0	0	0	0	33	33	36
07:00	2	10	26	17	0	0	0	0	0	0	0	0	0	0	55	27	29
08:00	1	8	18	16	2	0	0	0	0	0	0	0	0	0	45	28	30
09:00	5	4	21	12	1	0	0	0	0	0	0	0	0	0	43	27	29
10:00	0	3	23	13	0	0	0	0	0	0	0	0	0	0	39	27	29
11:00	1	14	31	14	2	1	0	0	0	0	0	0	0	0	55	26	29
12 PM	2	4	29	15	4	0	0	0	0	0	0	0	0	0	63	27	30
13:00	7	9	27	16	3	0	0	0	0	0	0	0	0	0	54	28	31
14:00	2	19	36	25	5	0	0	0	0	0	0	0	0	0	62	27	30
15:00	2	9	37	27	1	0	0	0	0	0	0	0	0	0	87	28	30
16:00	8	11	36	23	3	0	0	0	0	0	0	0	0	0	76	27	30
17:00	0	14	43	30	7	0	0	0	0	0	0	0	0	0	81	27	30
18:00	7	15	40	31	1	0	0	0	0	0	0	0	0	0	94	28	31
19:00	5	15	26	17	2	0	0	0	0	0	0	0	0	0	94	27	29
20:00	0	9	28	19	4	0	0	0	0	0	0	0	0	0	65	27	29
21:00	0	10	16	15	7	0	0	0	0	0	0	0	0	0	60	28	31
22:00	0	5	8	6	2	0	0	0	0	0	0	0	0	0	48	30	33
23:00	1	0	7	3	3	0	0	0	0	0	0	0	0	0	21	28	32
Total	46	179	487	339	67	5	1	0	0	0	0	0	0	0	1124	31	33
Percent	4.1%	15.9%	43.3%	30.2%	6.0%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			

AM Peak Vol.	08:00	11:00	11:00	06:00	05:00	04:00	02:00	11:00
PM Peak Vol.	5	14	31	17	10	2	1	63
	16:00	14:00	17:00	18:00	17:00	17:00	17:00	94
	8	19	43	31	7			

Accurate Counts
978-664-2565

Location : Lakeview Avenue
 City/State : North of Coburn Road
 City/State : Tyngsborough, MA
 Northbound, Southbound
 Site Code: 66160001
 6616SPD1

Start Time	16	21	26	31	36	41	46	51	56	61	66	71	76	85th Percent	95th Percent
02/06/14	15	20	30	35	40	45	50	55	60	65	70	75	999	25	32
01:00	0	3	0	1	0	0	0	0	0	0	0	0	0	7	33
02:00	0	1	2	1	0	0	0	0	0	0	0	0	0	5	30
03:00	0	0	2	0	0	0	0	0	0	0	0	0	0	4	28
04:00	0	0	2	0	0	0	0	0	0	0	0	0	0	2	29
05:00	0	2	6	2	0	0	0	0	0	0	0	0	0	10	31
06:00	0	19	14	2	0	0	0	0	0	0	0	0	0	35	29
07:00	2	47	42	11	2	0	0	0	0	0	0	0	0	109	29
08:00	6	72	78	30	0	0	0	0	0	0	0	0	0	194	30
09:00	2	34	64	24	0	0	0	0	0	0	0	0	0	129	31
10:00	2	18	56	28	3	0	0	0	0	0	0	0	0	109	32
11:00	0	17	42	29	6	0	0	0	0	0	0	0	0	99	33
12 PM	6	7	47	36	7	0	0	0	0	0	0	0	0	108	33
13:00	0	27	51	66	4	0	0	0	0	0	0	0	0	130	33
14:00	6	33	84	56	11	0	0	0	0	0	0	0	0	145	34
15:00	0	26	78	73	10	1	0	0	0	0	0	0	0	211	33
16:00	0	2	24	92	16	0	0	0	0	0	0	0	0	214	34
17:00	6	3	75	90	13	1	0	0	0	0	0	0	0	206	34
18:00	4	3	87	68	6	0	0	0	0	0	0	0	0	205	33
19:00	0	29	103	57	7	0	0	0	0	0	0	0	0	203	32
20:00	0	1	64	44	5	0	0	0	0	0	0	0	0	137	33
21:00	0	19	56	39	8	0	0	0	0	0	0	0	0	123	33
22:00	0	2	41	31	4	1	0	0	0	0	0	0	0	95	33
23:00	0	11	20	11	2	0	0	0	0	0	0	0	0	45	32
Total	34	50	486	795	106	3	0	0	0	0	0	0	0	2541	34
Percent	1.3%	2.0%	19.1%	31.3%	4.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		

AM Peak	08:00	07:00	07:00	11:00	11:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00
Vol.	6	12	72	36	7										
PM Peak	12:00	14:00	17:00	15:00	15:00	14:00	14:00	14:00	14:00	14:00	14:00	14:00	14:00	14:00	14:00
Vol.	6	4	34	92	16	1									
Grand Total	148	248	1255	1818	300	10	2	0	0	0	0	0	0	6087	6087
Percent	2.4%	4.1%	20.6%	29.9%	4.9%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

15th Percentile : 21 MPH
 50th Percentile : 27 MPH
 85th Percentile : 33 MPH
 95th Percentile : 35 MPH

Statistic s
 10 MPH Pace Speed : 25-34 MPH
 Number in Pace : 3759
 Percent in Pace : 61.8%
 Number of Vehicles > 30 MPH : 2130
 Percent of Vehicles > 30 MPH : 35.0%
 Mean Speed(Average) : 27 MPH

MASSDOT CRASH RATE WORKSHEET

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Tyngsborough COUNT DATE : Jan-14

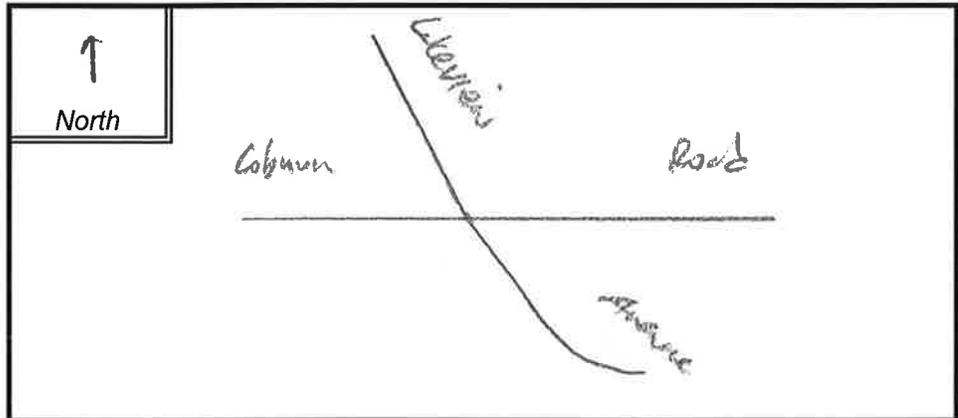
DISTRICT : 4 UNSIGNALIZED : SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Lakeview Avenue

MINOR STREET(S) : Coburn Road

**INTERSECTION
 DIAGRAM**
 (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB	SB		
PEAK HOURLY VOLUMES (PM) :	315	43	187	122		667

"K" FACTOR : INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME :

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

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

Comments : Above District 4 crash rate of 0.58 for unsignalized intersection

Project Title & Date : Safety and Operations Assessment - 3/3/14

GENERAL BACKGROUND TRAFFIC GROWTH

General Background Traffic Growth

STA.	CITY/TOWN	ROUTE/STREET	LOCATION	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Annual Growth
4058	TYNGSBOROUGH	COBURN RD.	EAST OF LAKEVIEW AVE.	2,000			2,100			2,100			1,800	-0.01042136
4162	TYNGSBOROUGH	RTE. 3	AT NEW HAMPSHIRE S.L.							76,500	77,200			0.00915033
0021 L	TYNGSBOROUGH	RTE. 113	2.4 km WEST OF LOWELL C.L.	10,073	10,162	9,693								-0.01876682

-0.67%

TRAFFIC SIGNAL WARRANT ANALYSIS

**Traffic Signal Warrant Analysis Summary - Lakeview Avenue at Coburn Road
2014 Average-Month Conditions**

Time	Lakeview Avenue Volume (Major Street) ^a	Coburn Road Volume (Minor Street) ^b	Warrant 1 Condition A ^c	Warrant 1 Condition B ^d	Warrant 2 ^e	Warrant 3 ^f
7:00	301	129	No	No	No	No
8:00	245	95	No	No	No	No
9:00	184	81	No	No	No	No
10:00	174	82	No	No	No	No
11:00	203	111	No	No	No	No
12:00	177	88	No	No	No	No
1:00	191	116	No	No	No	No
2:00	279	151	No	No	No	No
3:00	267	157	No	No	No	No
4:00	289	161	No	No	No	No
5:00	304	186	No	No	No	No
6:00	227	140	No	No	No	No
Warrant Satisfied?			No	No	No	No

^aBased on weekday 12-hour TMC counts conducted on Lakeview Avenue/Coburn Road intersection by VAI in January 2014. Volume includes total of both approaches.

^bBased on weekday 12-hour TMC counts conducted on Lakeview Avenue/Coburn Road intersection by VAI in January 2014.

^cWarrant 1 Condition A - Eight Hour Vehicular Volume, Minimum Vehicular Volume - satisfied when major street volume > 500 and minor street volume > 150.

^dWarrant 1 Condition B - Eight Hour Vehicular Volume, Interruption of Continuous Traffic - satisfied when major street volume > 750 and minor street volume > 75.

^eWarrant 2 - Four Hour Vehicular Volume - see Figure 4C-1.

^fWarrant 3 - Peak Hour Vehicular Volume - see Figure 4C-3.

Traffic Signal Warrant Analysis Summary - Lakeview Avenue at Coburn Road
2021 Average-Month Conditions

<u>Time</u>	<u>Lakeview Avenue Volume (Major Street)^a</u>	<u>Coburn Road Volume (Minor Street)^b</u>	<u>Warrant 1 Condition A^c</u>	<u>Warrant 1 Condition B^d</u>	<u>Warrant 2^e</u>	<u>Warrant 3^f</u>
7:00	346	148	No	No	No	No
8:00	281	109	No	No	No	No
9:00	211	93	No	No	No	No
10:00	200	94	No	No	No	No
11:00	233	128	No	No	No	No
12:00	203	101	No	No	No	No
1:00	219	133	No	No	No	No
2:00	320	173	No	No	No	No
3:00	307	180	No	No	No	No
4:00	332	185	No	No	No	No
5:00	349	214	No	No	No	No
6:00	330	161	No	No	No	No
Warrant Satisfied?			No	No	No	No

^aBased on weekday 12-hour TMC counts conducted on Lakeview Avenue/Coburn Road intersection by VAI in January 2014. Volume includes total of both approaches.

^bBased on weekday 12-hour TMC counts conducted on Lakeview Avenue/Coburn Road intersection by VAI in January 2014.

^cWarrant 1 Condition A - Eight Hour Vehicular Volume, Minimum Vehicular Volume - satisfied when major street volume > 500 and minor street volume > 150.

^dWarrant 1 Condition B - Eight Hour Vehicular Volume, Interruption of Continuous Traffic - satisfied when major street volume > 750 and minor street volume > 75.

^eWarrant 2 - Four Hour Vehicular Volume - see Figure 4C-1.

^fWarrant 3 - Peak Hour Vehicular Volume - see Figure 4C-3.

CAPACITY ANALYSIS WORKSHEETS

Existing Conditions

2014 Existing AM Peak Hour
3: Lakeview Avenue & Coburn Road

2/26/2014

Intersection												
Intersection Delay, s/veh	10.9											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	17	48	65	0	112	8	138	68	0	3	60	25
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	77	77	77	79	79	79	66	66	66	64	64	64
Heavy Vehicles, %	0	0	2	0	0	0	0	3	0	0	2	0
Mvmt Flow	22	62	84	0	142	10	209	103	0	5	94	39

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	720	644	113	717	663	103	133	0	0	103	0	0
Stage 1	123	123	-	521	521	-	-	-	-	-	-	-
Stage 2	597	521	-	196	142	-	-	-	-	-	-	-
Follow-up Headway	3.5	4	3.318	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Capacity-1 Maneuver	346	394	940	347	384	957	1464	-	-	1502	-	-
Stage 1	886	798	-	542	535	-	-	-	-	-	-	-
Stage 2	493	535	-	810	783	-	-	-	-	-	-	-
Time blocked-Platoon, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Capacity-1 Maneuver	201	333	940	239	325	957	1464	-	-	1502	-	-
Mov Capacity-2 Maneuver	201	333	-	239	325	-	-	-	-	-	-	-
Stage 1	752	795	-	460	454	-	-	-	-	-	-	-
Stage 2	285	454	-	677	780	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	18.4	23.9	5.3	0.3
HCM LOS	C	C		

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1464	-	-	436	340	1502	-	-
HCM Lane V/C Ratio	0.143	-	-	0.387	0.447	0.003	-	-
HCM Control Delay (s)	7.868	0	-	18.4	23.9	7.404	0	-
HCM Lane LOS	A	A		C	C	A	A	
HCM 95th %tile Q(veh)	0.498	-	-	1.799	2.214	0.009	-	-

Notes
~ : Volume Exceeds Capacity; \$: Delay Exceeds 300 Seconds; Error : Computation Not Defined

2014 Existing PM Peak Hour
3: Lakeview Avenue & Coburn Road

2/26/2014

Intersection	
Intersection Delay, s/veh	9.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	23	68	224	1	35	7	115	68	4	10	96	16
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	88	88	88	83	83	83	80	80	80
Heavy Vehicles, %	0	0	0	0	3	0	0	0	0	0	1	0
Mvmt Flow	25	75	246	1	40	8	139	82	5	12	120	20

Major/Minor	Minor2		Minor1			Major1		Major2				
Conflicting Flow All	540	519	130	676	526	84	140	0	0	87	0	0
Stage 1	155	155	-	361	361	-	-	-	-	-	-	-
Stage 2	385	364	-	315	165	-	-	-	-	-	-	-
Follow-up Headway	3.5	4	3.3	3.5	4.027	3.3	2.2	-	-	2.2	-	-
Pot Capacity-1 Maneuver	456	464	925	370	455	981	1456	-	-	1522	-	-
Stage 1	852	773	-	662	624	-	-	-	-	-	-	-
Stage 2	642	627	-	700	760	-	-	-	-	-	-	-
Time blocked-Platoon, %								-	-	-	-	-
Mov Capacity-1 Maneuver	384	414	925	215	406	981	1456	-	-	1522	-	-
Mov Capacity-2 Maneuver	384	414	-	215	406	-	-	-	-	-	-	-
Stage 1	767	766	-	596	562	-	-	-	-	-	-	-
Stage 2	533	564	-	459	753	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	15.8	14.2	4.8	0.6
HCM LOS	C	B		

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1456	-	-	676	439	1522	-	-
HCM Lane V/C Ratio	0.095	-	-	0.512	0.111	0.008	-	-
HCM Control Delay (s)	7.732	0	-	15.8	14.2	7.385	0	-
HCM Lane LOS	A	A	-	C	B	A	A	-
HCM 95th %tile Q(veh)	0.315	-	-	2.939	0.373	0.025	-	-

Notes
~ : Volume Exceeds Capacity; \$: Delay Exceeds 300 Seconds; Error : Computation Not Defined

2021 Design-Year – Existing Intersection Geometry

2021 Design-Year AM Peak Hour
3: Lakeview Avenue & Coburn Road

2/26/2014

Intersection												
Intersection Delay, s/veh	15											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	20	55	75	0	129	9	159	78	0	3	69	29
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	77	77	77	79	79	79	66	66	66	64	64	64
Heavy Vehicles, %	0	0	2	0	0	0	0	3	0	0	2	0
Mvmt Flow	26	71	97	0	163	11	241	118	0	5	108	45

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	827	740	130	824	763	118	153	0	0	118	0	0
Stage 1	140	140	-	600	600	-	-	-	-	-	-	-
Stage 2	687	600	-	224	163	-	-	-	-	-	-	-
Follow-up Headway	3.5	4	3.318	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Capacity-1 Maneuver	293	347	920	294	337	939	1440	-	-	1483	-	-
Stage 1	868	785	-	491	493	-	-	-	-	-	-	-
Stage 2	440	493	-	783	767	-	-	-	-	-	-	-
Time blocked-Platoon, %												
Mov Capacity-1 Maneuver	134	284	920	183	276	939	1440	-	-	1483	-	-
Mov Capacity-2 Maneuver	134	284	-	183	276	-	-	-	-	-	-	-
Stage 1	713	782	-	403	405	-	-	-	-	-	-	-
Stage 2	213	405	-	634	764	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	27.1		34.8		5.4		0.2	
HCM LOS	D		D					

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1440	-	-	353	289	1483	-	-
HCM Lane V/C Ratio	0.167	-	-	0.552	0.604	0.003	-	-
HCM Control Delay (s)	8.002	0	-	27.1	34.8	7.435	0	-
HCM Lane LOS	A	A		D	D	A	A	
HCM 95th %tile Q(veh)	0.6	-	-	3.182	3.651	0.01	-	-

Notes
~ : Volume Exceeds Capacity; \$: Delay Exceeds 300 Seconds; Error : Computation Not Defined

2021 Design-Year PM Peak Hour
3: Lakeview Avenue & Coburn Road

2/26/2014

Intersection

Intersection Delay, s/veh 11.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	26	78	257	1	40	8	132	78	5	11	110	18
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	88	88	88	83	83	83	80	80	80
Heavy Vehicles, %	0	0	0	0	3	0	0	0	0	0	1	0
Mvmt Flow	29	86	282	1	45	9	159	94	6	14	138	22

Major/Minor	Minor2		Minor1			Major1		Major2				
Conflicting Flow All	618	594	149	775	603	97	160	0	0	100	0	0
Stage 1	176	176	-	415	415	-	-	-	-	-	-	-
Stage 2	442	418	-	360	188	-	-	-	-	-	-	-
Follow-up Headway	3.5	4	3.3	3.5	4.027	3.3	2.2	-	-	2.2	-	-
Pot Capacity-1 Maneuver	404	421	903	318	412	965	1432	-	-	1505	-	-
Stage 1	831	757	-	619	591	-	-	-	-	-	-	-
Stage 2	598	594	-	662	743	-	-	-	-	-	-	-
Time blocked-Platoon, %								-	-	-	-	-
Mov Capacity-1 Maneuver	327	368	903	163	360	965	1432	-	-	1505	-	-
Mov Capacity-2 Maneuver	327	368	-	163	360	-	-	-	-	-	-	-
Stage 1	733	749	-	546	521	-	-	-	-	-	-	-
Stage 2	477	524	-	399	736	-	-	-	-	-	-	-

Approach	EB		WB			NB		SB			
HCM Control Delay, s	20.1		15.8			4.8		0.6			
HCM LOS	C		C								

Minor Lane / Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1432	-	-	627	390	1505	-	-
HCM Lane V/C Ratio	0.111	-	-	0.633	0.143	0.009	-	-
HCM Control Delay (s)	7.828	0	-	20.1	15.8	7.414	0	-
HCM Lane LOS	A	A		C	C	A	A	
HCM 95th %tile Q(veh)	0.374	-	-	4.473	0.494	0.028	-	-

Notes

~ : Volume Exceeds Capacity; \$: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection Improvement Alternative 2

2021 Design-Year AM Peak Hour - Multi-Way STOP

3: Lakeview Avenue & Coburn Road

2/26/2014

Intersection												
Intersection Delay, s/veh	12											
Intersection LOS	B											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	20	55	75	0	129	9	159	78	0	3	69	29
Peak Hour Factor	0.77	0.77	0.77	0.79	0.79	0.79	0.66	0.66	0.66	0.64	0.64	0.64
Heavy Vehicles, %	0	0	2	0	0	0	0	3	0	0	2	0
Mvmt Flow	26	71	97	0	163	11	241	118	0	5	108	45
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	10.6	10.7	14.2	10
HCM LOS	B	B	B	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	67%	13%	0%	3%
Vol Thru, %	33%	37%	93%	68%
Vol Right, %	0%	50%	7%	29%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	237	150	138	101
LT Vol	78	55	129	69
Through Vol	0	75	9	29
RT Vol	159	20	0	3
Lane Flow Rate	359	195	175	158
Geometry Grp	1	1	1	1
Degree of Util (X)	0.53	0.289	0.271	0.234
Departure Headway (Hd)	5.312	5.335	5.594	5.338
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	679	672	641	671
Service Time	3.349	3.382	3.643	3.385
HCM Lane V/C Ratio	0.529	0.29	0.273	0.235
HCM Control Delay	14.2	10.6	10.7	10
HCM Lane LOS	B	B	B	A
HCM 95th-tile Q	3.1	1.2	1.1	0.9

Notes

~ : Volume Exceeds Capacity; \$: Delay Exceeds 300 Seconds; Error : Computation Not Defined

2021 Design-Year AM Peak Hour - Multi-Way STOP

3: Lakeview Avenue & Coburn Road

2/26/2014

Intersection												
Intersection Delay, s/veh	12											
Intersection LOS	B											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	20	55	75	0	129	9	159	78	0	3	69	29
Peak Hour Factor	0.77	0.77	0.77	0.79	0.79	0.79	0.66	0.66	0.66	0.64	0.64	0.64
Heavy Vehicles, %	0	0	2	0	0	0	0	3	0	0	2	0
Mvmt Flow	26	71	97	0	163	11	241	118	0	5	108	45
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	10.6	10.7	14.2	10
HCM LOS	B	B	B	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	67%	13%	0%	3%
Vol Thru, %	33%	37%	93%	68%
Vol Right, %	0%	50%	7%	29%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	237	150	138	101
LT Vol	78	55	129	69
Through Vol	0	75	9	29
RT Vol	159	20	0	3
Lane Flow Rate	359	195	175	158
Geometry Grp	1	1	1	1
Degree of Util (X)	0.53	0.289	0.271	0.234
Departure Headway (Hd)	5.312	5.335	5.594	5.338
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	679	672	641	671
Service Time	3.349	3.382	3.643	3.385
HCM Lane V/C Ratio	0.529	0.29	0.273	0.235
HCM Control Delay	14.2	10.6	10.7	10
HCM Lane LOS	B	B	B	A
HCM 95th-tile Q	3.1	1.2	1.1	0.9

Notes

~ : Volume Exceeds Capacity; \$: Delay Exceeds 300 Seconds; Error : Computation Not Defined

Intersection Improvement Alternative 3

MOVEMENT SUMMARY

Site: New Site - 1

Lakeview Avenue at Coburn Road - 2021 Wkdy AM Peak Hour
Roundabout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Lakeview Avenue NB											
3	L	241	0.0	0.357	7.3	LOS A	1.7	43.8	0.30	0.74	26.0
8	T	118	3.0	0.357	7.3	LOS A	1.7	43.8	0.30	0.51	28.3
18	R	2	0.0	0.357	7.3	LOS A	1.7	43.8	0.30	0.58	27.8
Approach		361	1.0	0.357	7.3	LOS A	1.7	43.8	0.30	0.66	26.7
East: Coburn Road WB											
1	L	1	0.0	0.230	7.2	LOS A	0.9	22.3	0.49	0.91	26.4
6	T	163	0.0	0.230	7.2	LOS A	0.9	22.3	0.49	0.71	28.6
16	R	11	0.0	0.230	7.2	LOS A	0.9	22.3	0.49	0.77	28.2
Approach		176	0.0	0.230	7.2	LOS A	0.9	22.3	0.49	0.71	28.5
North: Lakeview Avenue SB											
7	L	5	0.0	0.212	7.2	LOS A	0.8	20.1	0.49	0.92	26.4
4	T	108	2.0	0.212	7.2	LOS A	0.8	20.1	0.49	0.68	28.9
14	R	45	0.0	0.212	7.2	LOS A	0.8	20.1	0.49	0.78	28.3
Approach		158	1.4	0.212	7.2	LOS A	0.8	20.1	0.49	0.71	28.6
West: Coburn Road EB											
5	L	26	0.0	0.189	5.2	LOS A	0.5	13.6	0.19	0.87	27.2
2	T	71	0.0	0.189	5.2	LOS A	0.5	13.6	0.19	0.48	30.2
12	R	97	2.0	0.189	5.2	LOS A	0.5	13.6	0.19	0.51	30.0
Approach		195	1.0	0.189	5.2	LOS A	0.5	13.6	0.19	0.55	29.6
All Vehicles		889	0.9	0.357	6.8	LOS A	1.7	43.8	0.34	0.66	28.0

Level of Service (LOS) Method: Delay & v/c (HCM 2010).

Roundabout LOS Method: Same as Sign Control.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement

LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).

Roundabout Capacity Model: US HCM 2010.

HCM Delay Model used. Geometric Delay not included.

Processed: Thursday, February 27, 2014 10:21:32 AM
SIDRA INTERSECTION 5.1.13.2093
Project: S:\Jobs\6616\Analysis\2021am.sip
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SIDRA
INTERSECTION

MOVEMENT SUMMARY

Site: New Site - 1

Lakeview Avenue at Coburn Road - 2021 Wkdy PM Peak Hour
Roundabout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Lakeview Avenue NB											
3	L	159	0.0	0.261	6.2	LOS A	1.1	28.2	0.30	0.76	26.6
8	T	94	0.0	0.261	6.2	LOS A	1.1	28.2	0.30	0.52	29.0
18	R	6	0.0	0.261	6.2	LOS A	1.1	28.2	0.30	0.59	28.5
Approach		259	0.0	0.261	6.2	LOS A	1.1	28.2	0.30	0.67	27.4
East: Coburn Road WB											
1	L	1	0.0	0.067	5.0	LOS A	0.2	5.8	0.37	0.83	27.4
6	T	45	3.0	0.067	5.0	LOS A	0.2	5.8	0.37	0.59	30.0
16	R	9	0.0	0.067	5.0	LOS A	0.2	5.8	0.37	0.66	29.5
Approach		56	2.4	0.067	5.0	LOS A	0.2	5.8	0.37	0.61	29.8
North: Lakeview Avenue SB											
7	L	14	0.0	0.192	5.9	LOS A	0.7	18.8	0.35	0.87	27.0
4	T	138	1.0	0.192	5.9	LOS A	0.7	18.8	0.35	0.55	29.8
14	R	23	6.0	0.192	5.9	LOS A	0.7	18.8	0.35	0.68	29.0
Approach		174	1.6	0.192	5.9	LOS A	0.7	18.8	0.35	0.59	29.4
West: Coburn Road EB											
5	L	29	0.0	0.391	7.8	LOS A	1.4	36.0	0.28	0.87	26.0
2	T	86	0.0	0.391	7.8	LOS A	1.4	36.0	0.28	0.52	28.6
12	R	282	0.0	0.391	7.8	LOS A	1.4	36.0	0.28	0.55	28.4
Approach		397	0.0	0.391	7.8	LOS A	1.4	36.0	0.28	0.57	28.3
All Vehicles		885	0.5	0.391	6.8	LOS A	1.4	36.0	0.30	0.61	28.3

Level of Service (LOS) Method: Delay & v/c (HCM 2010).

Roundabout LOS Method: Same as Sign Control.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement

LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).

Roundabout Capacity Model: US HCM 2010.

HCM Delay Model used. Geometric Delay not included.

COST ESTIMATES

PRELIMINARY CONSTRUCTION COST ESTIMATE

SHEET 2 OF 3

PROJECT Intersection Safety and Operations Analysis	BASIS FOR ESTIMATE <input checked="" type="checkbox"/> STUDY <input type="checkbox"/> FINAL DESIGN OTHER (SPECIFY) _____
LOCATION Tyngsboro, Massachusetts	
Vanasse & Associates, Inc.	

DEPARTMENT HIGHWAY	ESTIMATOR DAD	SITE VISITED ON: n/a	CHECKED BY SMB	DATE 24-Mar-14
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SUBJECT ESTIMATE- Lakeview Ave/Coburn Rd Multi-way Stop Control	FILE USED: R:/6616/6616CN2.DWG
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ITEM NO	ITEM DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	TOTAL COST
1	CLEAR & GRUB	AC	\$15,000.00	0.2	\$3,000
2	EARTH WORK (LEDGE NOT INCLUDED)	CY	\$32.00	10	\$320
3	FULL DEPTH PVTM (8"+ 4" SUB, 4" BASE, 2" BINDER, 2" TOP)	SY	\$60.00	0	\$0
4	2" OVERLAY (DOES NOT INCLUDE FULL DEPTH AREAS)	SY	\$11.00	0	\$0
5	COLD PLANING	SY	\$9.00	0	\$0
6	VERTICAL GRANITE CURB - TYPE VB (NEW)	LF	\$36.00	30	\$1,080
7	VERTICAL GRANITE CURB (R&R)	LF	\$20.00	0	\$0
8	SLOPED GRANITE EDGING	LF	\$26.00	0	\$0
9	BITUMINOUS CONCRETE CURB	LF	\$8.00	0	\$0
10	DRAINAGE (INC. 2-CB, 1-MH, 340'-RCP PER 300' OF ROAD)	LF	\$115.00	0	\$0
11	5' BIT. CONC. SIDEWALK (EARTHWORK NOT INCLUDED)	LF	\$19.00	10	\$190
12	5' CEM. CONC. SIDEWALK (EARTHWORK NOT INCLUDED)	LF	\$32.50	0	\$0
13	WHEEL CHAIR RAMPS	EA	\$1,500.00	2	\$3,000
14	EROSION CONTROL	LF	\$9.00	0	\$0
15	LOAM & SEED	LF	\$9.00	50	\$450
16	GUARD RAIL (\$28 for W BEAM, \$36 for THRIE BEAM)	LF	\$28.00	0	\$0
17	REINFORCED CONCRETE WALLS	SF	\$150.00	0	\$0
18	BRIDGE STRUCTURES	SF	\$400.00	0	\$0
19	WATER LINE (TRENCH PAVING NOT INCLUDED)	LF	\$120.00	0	\$0
20	TRAFFIC SIGNAL (NEW)	LS	\$185,000.00	0	\$0
21	TRAFFIC SIGNAL (UPGRADE)	LS	\$2,000.00	1	\$2,000
22	SIGNAL COORDINATION (NOT INC. SURFACE TREATMENT)	LF	\$35.00	0	\$0
23	PERMANENT PAVEMENT MARKINGS	LS	\$1,000.00	1	\$1,000
24	SIGNS (REGULATORY w/ BREAKAWAY POST)	EA	\$200.00	24	\$4,800
25	UTILITY POLES (RELOCATE)	EA	\$20,000.00	0	\$0
				SUB-TOTAL	\$15,840
	CONSTRUCTION CONTINGENCIES (15%)				\$2,376
	MAINTENANCE OF TRAFFIC (10%)				\$1,584
	MOBILIZATION (5%)				\$792
				SUB-TOTAL	\$20,592
	ENGINEERING				\$5,000
				SUB-TOTAL	\$25,592
				SAY	\$26,000

PRELIMINARY CONSTRUCTION COST ESTIMATE				SHEET 3 OF 3	
PROJECT Intersection Safety and Operations Analysis			BASIS FOR ESTIMATE <input checked="" type="checkbox"/> STUDY <input type="checkbox"/> FINAL DESIGN OTHER (SPECIFY) _____		
LOCATION Tyngsboro, Massachusetts					
Vanasse & Associates, Inc.					
DEPARTMENT HIGHWAY		ESTIMATOR DAD	SITE VISITED ON: n/a	CHECKED BY SMB	DATE 17-Mar-14
SUBJECT ESTIMATE - Lakeview Ave/Coburn Rd Modern Roundabout			FILE USED: R:/6616/6616CN3.DWG		
ITEM NO	ITEM DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	TOTAL COST
1	CLEAR & GRUB	AC	\$15,000.00	0.33	\$4,950
2	EARTH WORK (LEDGE NOT INCLUDED)	CY	\$32.00	700	\$22,400
3	FULL DEPTH PVMT (8"+ 4" SUB, 4" BASE, 2" BINDER, 2" TOP)	SY	\$60.00	650	\$39,000
4	2" OVERLAY (DOES NOT INCLUDE FULL DEPTH AREAS)	SY	\$11.00	1850	\$20,350
5	COLD PLANING	SY	\$6.00	1850	\$11,100
6	VERTICAL GRANITE CURB - TYPE VB (NEW)	LF	\$36.00	400	\$14,400
7	VERTICAL GRANITE CURB (R&R)	LF	\$20.00	400	\$8,000
8	SLOPED GRANITE EDGING	LF	\$26.00	500	\$13,000
9	BITUMINOUS CONCRETE CURB	LF	\$8.00	0	\$0
10	DRAINAGE (NOT INCLUDED - NOT ENOUGH INFO)	N/Inc.	\$0.00	0	\$0
11	5' BIT. CONC. SIDEWALK (EARTHWORK NOT INCLUDED)	LF	\$19.00	375	\$7,125
12	CEM. CONC. MEDIAN SURFACE (EARTHWORK see Item 2)	SY	\$65.00	150	\$9,750
13	WHEEL CHAIR RAMPS	EA	\$1,500.00	4	\$6,000
14	EROSION CONTROL	LF	\$9.00	200	\$1,800
15	LOAM & SEED	LF	\$9.00	1000	\$9,000
16	GUARD RAIL (\$28 for W BEAM, \$36 for THRIE BEAM)	LF	\$28.00	0	\$0
17	REINFORCED CONCRETE WALLS	SF	\$150.00	0	\$0
18	BRIDGE STRUCTURES	SF	\$400.00	0	\$0
19	WATER LINE (TRENCH PAVING NOT INCLUDED)	LF	\$120.00	0	\$0
20	TRAFFIC SIGNAL (NEW)	LS	\$185,000.00	0	\$0
21	TRAFFIC SIGNAL (REMOVE FLASHER AND POLES)	LS	\$3,000.00	1	\$3,000
22	SIGNAL COORDINATION (NOT INC. SURFACE TREATMENT)	LF	\$35.00	0	\$0
23	PERMANENT PAVEMENT MARKINGS (2 LANE ROAD)	LF	\$4.00	750	\$3,000
24	SIGNS (REGULATORY w/ BREAKAWAY POST)	EA	\$200.00	24	\$4,800
25	UTILITY POLES (RELOCATE)	EA	\$20,000.00	2	\$40,000
				SUB-TOTAL	\$217,675
	CONSTRUCTION CONTINGENCIES (15%)				\$32,651
	MAINTENANCE OF TRAFFIC (10%)				\$21,768
	MOBILIZATION (5%)				\$10,884
				SUB-TOTAL	\$282,978
	ENGINEERING				\$50,000
				SUB-TOTAL	\$332,978
	Note: There is not enough information to determine the drainage requirements and therefore possible drainage costs are not included in the estimate. ROW acquisition cost is not included.			SAY	\$340,000