

# Traffic Impact and Access Study

Chelmsford Fire Department Headquarters

Chelmsford, MA

*December 20, 2012*

*Prepared for:*



**Town of Chelmsford  
Chelmsford, Massachusetts**

## TRAFFIC IMPACT AND ACCESS STUDY

CHELMSFORD FIRE DEPARTMENT HEADQUARTERS  
CHELMSFORD, MASSACHUSETTS

*Prepared for:*



TOWN OF CHELMSFORD  
Chelmsford, MA



December 2012

*Prepared by:*

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## **EXECUTIVE SUMMARY**

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Vanasse & Associates, Inc. (VAI) has conducted a Traffic Impact and Access Study (TIAS) in order to assess the potential impacts on the transportation infrastructure that may be associated with the proposed construction of the new Chelmsford Fire Department Headquarters to be located at 50 Billerica Road (Route 129) in Chelmsford, Massachusetts (hereafter referred to as the "Project"). The Project will be situated within a portion of the parking area located to the immediate east of the Chelmsford Town Hall building and will entail the construction of a new 16,007± square foot (sf) building that will serve as the Chelmsford Fire Department Headquarters. Access to the Project will be provided by way of a new driveway that will intersect the north side of Route 129 and will be generally situated between the Town Hall entrance-only driveway and Town Hall Drive. In conjunction with the Project, a new parking area will be constructed behind the Town Hall and Town Hall Drive will be improved and continue to accommodate one-way travel between Route 129 and the new parking lot (northbound).

This study was prepared in consultation with the Town of Chelmsford and Massachusetts Department of Transportation (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 was conducted pursuant to the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports.

### **EXISTING CONDITIONS**

A comprehensive field inventory of existing conditions within the study area was conducted in October 2012. 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 for the Project was selected to contain the major roadway providing access to the Project site, Billerica Road (Route 129), as well as the following major intersections through which Project-related traffic will travel: Route 129 at Wilson Street; Route 129 at the Town Hall Driveways; and Route 129 at Perham Street and Town Hall Drive. Given the nature of the Project (i.e., not a generator of regular or sustained traffic), this study area is sufficient to evaluate existing and projected future conditions and accommodations as they may relate to the Project and the proximate environment.

### **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 October and December 2012. The ATR counts were conducted on Route 129 in the vicinity of the Project site in order to record weekday daily traffic conditions over an extended period, with weekday morning (7:00 to 9:00 AM) and evening (3:00 to 6:00 PM) peak-period manual TMCs performed at the study intersections. These time periods were selected for analysis purposes as they are representative of the peak traffic volume hours for the adjacent roadway network and are inclusive of school-related traffic. Traffic volumes during the months of October and December are representative of an above average-month condition and, therefore, were not adjusted downward in order to provide a conservative (above-average analysis) condition.

Route 129 in the vicinity of the Project site was found to accommodate approximately 11,110 vehicles on an average weekday (two-way, 24-hour volume), with approximately 1,145 vehicles per hour (vph) during the weekday morning peak-hour and 993 vph during the weekday evening peak-hour.

A review of the peak-period traffic counts indicates that the weekday morning peak-hour generally occurs between 7:30 and 8:30 AM, with the weekday evening peak-hour generally occurring between 5:00 PM and 6:00 PM.

### **Pedestrian and Bicycle Facilities**

A comprehensive field inventory of pedestrian and bicycle facilities within the study area was undertaken in October 2012. The field inventory consisted of a review of the location of sidewalks and pedestrian crossing locations along the study roadways and at the study intersections, as well as the location of existing and planned future bicycle facilities. Sidewalks are provided along the north side of Route 129 between Chelmsford Street (Route 110) and Golden Cove Road, along the south side of Route 129 between Wilson Street and Summer Street, and continuously along the east side of Wilson Street. Marked crosswalks are provided at the Route 129/Wilson Street intersection for crossing Wilson Street and to the west of Wilson Street for crossing Route 129 between Wilson Street and Summer Street (mid-block crossing).

At present, no formal existing bicycle facilities were identified within the immediate study area; however, both Route 129 and Wilson Street were found to provide sufficient roadway width (combined travel lane and shoulder) to support bicycle travel in a shared travelled-way configuration. Outside of the immediate study area, the Bruce Freeman Rail Trail traverses an alignment parallel to Chelmsford Street/Littleton Road (Route 110) to the north and west of the Project site.

### **Public Transportation**

The Project site and the study area are served by public transportation services provided by the Lowell Regional Transit Authority (LRTA) (fixed-route bus service). The LRTA operates Bus Route 15, *Chelmsford/Westford via Rtes. 129/110*, which originates from the Kennedy Center at Gallagher Terminal located at 101 Thorndike Street in Lowell and travels along Routes 129 and 110, and past the Project site. At the Kennedy Center, connections can be made to other LRTA bus lines and to the Massachusetts Bay Transportation Authority's

(MBTA's) Lowell Branch of the Commuter Rail Line, which provides service to North Station in Boston.

### **Spot Speed Measurements**

Vehicle travel speed measurements were performed on Route 129 in the vicinity of the Project site over a continuous 48-hour period on two consecutive weekdays in conjunction with the ATR counts. Based on these measurements, it was determined that the mean (average) vehicle travel speed along Route 129 in the vicinity of the Project site is approximately 28 miles per hour (mph). The average measured 85<sup>th</sup> percentile vehicle travel speed, or the speed at which 85 percent of the observed vehicles traveled at or below, was found to be approximately 35 mph, or 5 mph above the posted speed limit (30 mph), and is considered to be a reasonable variation from the posted speed limit. The 85<sup>th</sup> 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.

### **Motor Vehicle Crash Data**

Motor vehicle crash information for the study intersections was provided by the MassDOT Highway Division Safety Management/Traffic Operations Unit for the most recent three-year period available (2008 through 2010, inclusive) in order to examine motor vehicle crash trends occurring within the study area.

Based on a review of this information, no motor vehicle crashes were reported at the Route 129 intersections with the Town Hall driveways or at the Route 129/Perham Street/Town Hall Drive intersection. The intersection of Route 129 at Wilson Street was found to have experienced a total of four (4) reported motor vehicle crashes over the three-year review period, or approximately one (1) crash per year. The majority of crashes reported at this intersection resulted in property damage only; occurred on a weekday, during daylight under clear weather conditions; and were reported as rear-end type collisions. All of the study intersections were found to have a motor vehicle crash rate<sup>1</sup> below the MassDOT average for an unsignalized intersection for the MassDOT Highway Division District in which the intersections are located (District 4). No fatal motor vehicle crashes were reported at the study intersections over the three-year review period.

The reported level of crash frequency within the study area does not indicate the presence of an inherent safety deficiency with respect to the design or operation of the roadway network in the vicinity of the Project site.

### **FUTURE CONDITIONS**

Traffic volumes in the study area were projected to the year 2019, 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 for the 2019 Design Year include all existing traffic and new traffic resulting from background traffic growth and the Project.

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<sup>1</sup> Average number of motor vehicle crashes per million vehicles entering the intersection.

### **Specific Development by Others**

The Planning Department of the Town of Chelmsford 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 intersections. Based on this discussion, no projects were identified at this time that are expected to result in a material impact on future design year traffic volumes beyond the general 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 fluctuated over the past several years, ranging from increases of approximately 3.4 percent to decreases of approximately 6.5 percent. On average, traffic volumes were found to have generally decreased by approximately 0.7 percent per year. In order to provide a conservative (high) analysis scenario and a prudent planning condition for the Project, a 1.0 percent per year compounded annual background traffic growth rate was used to account for future traffic growth and presently unforeseen development within the study area.

### **Roadway Improvement Projects**

The Town of Chelmsford and MassDOT were contacted in order to determine if there were any planned roadway improvement projects expected to be completed within the study area. Based on these discussions, the following roadway improvement projects were identified:

- ***Westford Street Bridge Rehabilitation, Chelmsford, Massachusetts.*** This project is being undertaken by MassDOT and will entail the reconstruction of the Westford Street bridge over Interstate 495 to improve the wearing surface, structural system and bridge deck slab, and upgrading of the railing and guardrail system. This project is currently at the preliminary design stage with construction expected to commence in the Winter of 2015/2016.
- ***Interstate 495 Maintenance, Chelmsford, Massachusetts.*** This project is being undertaken by MassDOT and will entail the resurfacing of 44 miles of Interstate 495 between Milemarkers 85.1 and 90.6. In conjunction with the resurfacing project, safety and environmental improvements are also planned. This project is currently at the preliminary design stage with construction expected to commence in the Winter of 2013/2014.
- ***Interstate 495 Intelligent Transportation System, Chelmsford, Massachusetts.*** This design-build project is being undertaken by MassDOT and will entail the installation of cameras, changeable message signs and vehicle detectors as a part of an Intelligent Transportation System along Interstate 495 between Interstate 90 and Interstate 93. This project is currently at the 75 Percent design stage with construction expected to commence in the Summer of 2013.

These improvements are outside of the immediate study area that is the subject of this assessment and are not expected to have a material impact on traffic volumes or operating conditions within the study area. No other roadway improvement projects aside from routine maintenance activities were identified to be planned within the study area at this time.

## **Design Year Traffic Volumes**

The 2019 Design Year condition peak-hour traffic-volumes were developed by applying the 1.0 percent per year compounded annual background traffic growth rate to the 2012 Existing peak-hour traffic volumes and redistributing a portion of the traffic currently using the front Town Hall parking lot to the rear lot via Town Hall Drive to reflect the redistribution of parking spaces as a result of the Project. The Project itself is not expected to result in a regular or sustained increase in traffic within the study area. Any increase in traffic would be considered nominal and would be reflected in the general background traffic growth rate.

## **TRAFFIC OPERATIONS ANALYSIS**

In order to assess operating conditions (motorist delays and vehicle queuing) on the roadway network, traffic operations and vehicle queue analyses were performed at the study intersections under 2012 Existing and 2019 Design Year conditions.

With the exception of motorists exiting Wilson Street during the weekday morning peak-hour and the Town Hall driveway during the weekday evening peak-hour, all movements at the study intersections were shown to operate at a level-of-service of “D” or better (average motorist delay of between 25 and 35 seconds) under all analysis conditions. For reference, a level-of-service of “D” is generally considered to be the limit of acceptable operating conditions, with a level-of-service of “E” (average motorist delay of between 35 and 50 seconds) defined as a movement or intersection that is operating at its design capacity.

Motorists exiting Wilson Street during the weekday morning peak-hour and the Town Hall driveway during the weekday evening peak-hour were shown to experience excessive delays resulting in level-of-service “F” operating conditions (average delay in excess of 50 seconds) and, in the case of Wilson Street, extended vehicle queuing (between 30 and 37 vehicles). These conditions are a direct result of the relatively large volume of conflicting traffic travelling along Route 129 during these periods.

## **SCHOOL IMPACT ASSESSMENT**

An assessment of the potential impact of the Project on operating conditions and safety during school pick-up and drop-off periods was completed as these conditions relate to emergency vehicle operations. The Project is not expected to result in a regular or sustained increase in traffic that would materially impact traffic operations along Route 129 or its intersecting roadways or driveways, or that would impede school bus activity and travel routes. Upon exiting the Project site, a responding emergency vehicle will actuate the emergency vehicle traffic control signal (proposed) that will stop all traffic along Route 129 to allow the vehicle(s) to exit the facility in a safe and efficient manner. Responding emergency vehicles are required to activate both their siren and light bar which provide both an audible and visual warning to motorists and pedestrians. In accordance with Massachusetts General Law (MGL), motorists are required to yield to an approaching emergency vehicle; this includes school buses. Children waiting for a school bus should be located outside of the travelled-way and would not be in conflict with a responding emergency vehicle or any vehicle that is travelling within the travelled-way. The Project site is located approximately 950 feet west of the Center School, a distance that is sufficient to eliminate conflicts between exiting emergency vehicles and vehicles entering and exiting the school driveways.

## **SIGHT DISTANCE MEASUREMENTS**

Sight distance measurements were performed at the Project site driveway and at the study area intersections in accordance with MassDOT and American Association of State Highway and Transportation Officials (AASHTO)<sup>2</sup> standards. These measurements indicate that lines of sight at the subject intersections exceed the recommended minimum sight distance requirements for a 35 mph approach speed along Route 129, consistent with the measured 85<sup>th</sup> percentile vehicle travel speed and 5 mph above the posted speed limit (30 mph).

## **RECOMMENDATIONS**

A detailed transportation improvement program has been developed that is designed to maintain safe and efficient access to the Project site and address any deficiencies identified at off-site locations evaluated in conjunction with this study. The following sections detail the improvements that have been recommended as a part of this evaluation.

### **Project Access**

Access to the Project will be provided by way of a new driveway that will intersect the north side of Route 129 and will be generally situated between the Town Hall entrance-only driveway and Town Hall Drive. In conjunction with the Project, a new parking area will be constructed behind the Town Hall and Town Hall Drive will be improved and continue to accommodate one-way travel between Route 129 and the new parking lot (northbound). The following recommendations are offered with respect to the design and operation of the Project site driveway and the driveways serving the Town Hall:

- The one-way enter and exit driveways serving the Town Hall should be a minimum of 16-feet in width and should include appropriate signs (“One Way” (R6-1)<sup>3</sup>, “Do Not Enter” (R5-1), etc.) and pavement marking indicating the one-way traffic flow, with vehicles exiting the Town Hall placed under STOP-sign (R1-1) control with a marked STOP-line provided in advance of the sidewalk on Route 129.
- Town Hall Drive should be reconstructed as a paved roadway a minimum of 16-feet in width and accommodate one-way northbound travel between Route 129 and the new parking lot. “Do Not Enter” (R5-1) and “One-Way” (R6-1) signs should be installed at the interface of Town Hall Drive with the new parking lot facing the parking lot.
- Signs indicating “Authorized Vehicles Only” (R5-11) should be installed on either side of the new driveway that will serve the Project facing motorists on Route 129.
- An emergency vehicle traffic control signal should be installed at the Project site driveway that should be actuated by way of both an OPTICOM™ system (or similar) and hardwired to the Fire Station. Marked STOP-lines should be provided on either side of the driveway on Route 129 at the desired stopping point for vehicles with signs indicated “Stop Here On Red” (R10-6) provided at the STOP-lines.

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<sup>2</sup>A *Policy on Geometric Design of Highway and Streets*, Sixth Edition; American Association of State Highway and Transportation Officials (AASHTO); 2011.

<sup>3</sup>Sign designations as specified in the *Manual on Uniform Traffic Control Devices* (MUTCD); Federal Highway Administration; Washington, DC; 2009.

- An “Emergency Signal” sign (R10-13) shall be mounted on the emergency vehicle traffic control signal facing approaching traffic on Route 129.
- An “Emergency Vehicle” sign (W11-8) and an “Emergency Signal Ahead” (W11-12P) supplemental plaque should be installed approximately 125 feet east and west of the emergency vehicle signal on each approach to the Project site driveway.
- The driveway serving the Project and its intersection with Route 129 should be appropriately illuminated.
- All signs and other pavement markings to be installed within the Project site shall conform to the applicable standards of the Manual on Uniform Traffic Devices (MUTCD).<sup>4</sup>
- If centerline pavement markings are provided within the Project site or along Town Hall Drive, they shall consist of a double-yellow centerline.
- Signs and landscaping adjacent to the Project site driveway, the driveways serving the Town Hall and Town Hall Drive should be designed and maintained so as not to restrict lines of sight.
- It is suggested that all signs and pavement markings along the Town Hall and Project site frontage on Route 129 be reviewed, upgraded and replaced as necessary to enhance visibility and to eliminate potential conflicts with the signs and markings to be installed in conjunction with the emergency vehicle traffic control signal.

## **Off-Site Improvements**

### **Route 129 at Perham Street**

A STOP-sign (R1-1) and marked STOP-line should be provided on the Perham Street approach to Route 129 in order to define the desired stopping point for motorists exiting Perham Street and to reinforce the vehicular right-of-way at the intersection given the addition of the Project.

### **Route 129 at Wilson Street**

An analysis of operating conditions at this unsignalized intersection indicates that operating conditions are constrained during the weekday morning peak-hour, a condition that is a direct result of the relatively large volume of conflicting traffic travelling along Route 129. A preliminary review of the criteria (warrants) for the installation of a traffic control signal as specified in the MUTCD<sup>5</sup> indicates that at least two (2) of the nine warrants are satisfied under current traffic volume conditions (Warrant 2, *Four-Hour Vehicular Volume*, and Warrant 3, *Peak Hour*) indicating that the installation of a traffic control signal at the intersection may be justified in order to improve traffic operations.

Given: i) the absence of a pronounced motor vehicle crash history at the intersection; and ii) the limited duration of the reported constrained operating conditions; it is suggested that operating conditions and motor vehicle crashes at the intersection continue to be monitored on a periodic basis as a part of routine review by the Police Department. Should the frequency of occurrence

<sup>4</sup>*Manual on Uniform Traffic Control Devices (MUTCD)*; Federal Highway Administration; Washington, DC; 2009.

<sup>5</sup>Ibid.

of motor vehicle crashes experience a sustained and regular increase, it is suggested that a formal Traffic Signal Warrants Analysis be completed in accordance with the methodology and procedures outlined in the MUTCD, including the collection of 12-hour (7 AM to 7 PM) manual turning movement count and vehicle classification count on an average weekday (Tuesday, Wednesday or Thursday). Should it be determined that the installation of a traffic control signal is an appropriate measure to improve intersection conditions, the traffic signal system should be integrated into the emergency vehicle traffic control signal to be installed at the Project site driveway.

With implementation of the above recommendations, safe and efficient access will be provided to the Project and the Project can be safely accommodated within the confines of the transportation infrastructure.

## **INTRODUCTION**

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Vanasse & Associates, Inc. (VAI) has conducted a Traffic Impact and Access Study (TIAS) in order to assess the potential impacts on the transportation infrastructure that may be associated with the proposed construction of the new Chelmsford Fire Department Headquarters to be located at 50 Billerica Road (Route 129) in Chelmsford, Massachusetts (hereafter referred to as the "Project"). This study evaluates the following specific areas as they relate to the Project: i) access requirements; ii) potential off-site improvements; and iii) safety considerations; and identifies and analyzes existing traffic conditions and future traffic conditions, both with and without the Project, along Route 129, as well as at the following major intersections through which Project-related traffic will travel: Route 129 at Wilson Street; Route 129 at the Town Hall Driveways; and Route 129 at Perham Street and Town Hall Drive.

### **PROJECT DESCRIPTION**

The Project will entail the construction of the new Chelmsford Fire Department Headquarters to be located at 50 Billerica Road in Chelmsford, Massachusetts, and will consist of the construction of a new 16,007± square foot (sf) building within a portion of the parking area located to the immediate east of the Chelmsford Town Hall building. The Project site is generally bounded by the Little League Fields, the Chelmsford Housing Authority, and areas of open and wooded space to the north; Route 129 to the south; Town Hall Drive to the east; and a residential property, the Chelmsford Housing Authority, and areas of open and wooded space to the west. Figure 1 depicts the Project site location in relation to the existing roadway network.

Access to the Project will be provided by way of a new driveway that will intersect the north side of Route 129 and will be generally situated between the Town Hall entrance-only driveway and Town Hall Drive. In conjunction with the Project, a new parking area will be constructed behind the Town Hall and Town Hall Drive will be improved and continue to accommodate one-way travel between Route 129 and the new parking lot (northbound).



**CHELMSFORD**

**SITE**

**Figure 1**

**Site Location Map**



## **STUDY METHODOLOGY**

This study was prepared in consultation with the Town of Chelmsford and the Massachusetts Department of Transportation (MassDOT); was performed in 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 standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports; and was conducted in three distinct stages.

The first stage involved an assessment of existing conditions in the study area and included an inventory of roadway geometrics; pedestrian and bicycle facilities; public transportation services; observations of traffic flow; and collection of daily and peak period traffic counts.

In the second stage of the study, future traffic conditions were projected and analyzed. Specific travel demand forecasts for the Project were assessed along with future traffic demands due to expected traffic growth independent of the Project. A seven-year time horizon was selected for analysis purposes which is consistent with MassDOT guidelines for the preparation of Traffic Impact Assessments for Functional Design Reports (FDRs). The traffic analysis conducted in stage two identifies existing or projected future roadway capacity, traffic safety, and site access issues.

The third stage of the study presents and evaluates measures to address traffic and safety issues, if any, identified in stage two of the study.

## **EXISTING CONDITIONS**

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A comprehensive field inventory of existing conditions on the study area roadways was conducted in October 2012. 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 for the Project was selected to contain the major roadway providing access to the Project site, Billerica Road (Route 129), as well as the following major intersections through which Project-related traffic will travel: Route 129 at Wilson Street; Route 129 at the Town Hall Driveways; and Route 129 at Perham Street and Town Hall Drive. Given the nature of the Project (i.e., not a generator of regular or sustained traffic), this study area is sufficient to evaluate existing and projected future conditions and accommodations as they may relate to the Project and the proximate environment.

The following describes the study area roadway and intersections.

### **Roadways**

#### **Billerica Road (Route 129)**

Billerica Road (Route 129) within the study area is a two-lane urban arterial roadway under Town jurisdiction that traverses the study area in a general east-west direction and provides access to Route 4 and Route 110 to the west to the west of the Project site and to Route 3 to the east. Within the study area, Route 129 provides two 12 to 13-foot wide travel lanes separated by a double-yellow centerline with 3 to 5-foot wide marked shoulders provided. A sidewalk is provided along the north side of Route 129 between Chelmsford Street (Route 110) and Golden Cove Road, and along the south side between Wilson Street and Summer Street, with illumination provided by way of street lights mounted on wood poles. The posted speed limit along Route 129 proximate to the Project site is 30 miles per hour (mph). Land use along Route 129 within the study area consists of the Project site, the Center School, residential properties and areas of open and wooded space.

### **Intersections**

#### **Route 129 at Wilson Street**

Wilson Street intersects Route 129 from the north to form this three-legged, T-type, unsignalized intersection under STOP-sign control. The Route 129 east and westbound approaches to the

intersection consist of a 12-foot wide general-purpose travel lane with a 3-foot wide marked shoulder provided. The directions of travel along Route 129 are separated by a double-yellow centerline. The Wilson Street southbound approach consists of a 10-foot wide general-purpose travel lane with a 1-foot wide marked shoulder and vehicles approaching Route 129 under STOP-sign control. The directions of travel along Wilson Street are separated by a double-yellow centerline. A sidewalk is provided along the north side of Route 129 to the east and west of the intersection, along the south side between Wilson Street and Summer Street, and along the east side of Wilson Street. Marked crosswalks are provided for crossing Wilson Street and to the west of Wilson Street for crossing Route 129 between Wilson Street and Summer Street (mid-block crossing). Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of the Project site, residential properties, and areas of open and wooded space.

### **Route 129 at the Town Hall Driveways**

The Town Hall Driveways intersect Route 129 from the north to form two three-legged, T-type, unsignalized intersection under stop control. The Route 129 east and westbound approaches to the intersections consist of a 12-foot wide general-purpose travel lane with 3 to 4-foot wide marked shoulders provided. The directions of travel along Route 129 are separated by a double-yellow centerline. The Town Hall Driveways consist of two one-way driveways that are separated by approximately 110 feet. The Town Hall east driveway serves as a one-way entrance to the Town Hall and consists of a 20-foot wide paved drive with no marked shoulders provided. The Town Hall west driveway serves as a one-way exit from the Town Hall and consists of a 16-foot wide paved drive with no marked shoulders provided and vehicles approaching Route 129 under stop control; however, a STOP-sign is not currently provided. A sidewalk is provided along the north side of Route 129, with no marked crosswalks provided at or in the vicinity of the driveways. Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of the Project site, residential properties, and areas of open and wooded space.

### **Route 129 at Perham Street and Town Hall Drive**

Town Hall Drive and Perham Street intersect Route 129 from the north and south, respectively, to form this four-legged, off-set, unsignalized intersection under stop control. The Route 129 east and westbound approaches to the intersection consist of a 12 to 13-foot wide general-purpose travel lane with a 3 to 4-foot wide marked shoulder provided. The directions of travel along Route 129 are separated by a double-yellow centerline. Town Hall Drive is a one-way northbound roadway (away from Route 129) and consists of a 19-foot wide paved roadway with no marked shoulders provided. Perham Street is off-set to the east of Town Hall Drive and consists of a 22-foot wide paved roadway that accommodates two-way travel with no marked centerline or shoulders provided and vehicles approaching Route 129 under stop control; however, a STOP-sign is not currently provided. A sidewalk is provided along the north side of Route 129, with no marked crosswalks provided at or in the vicinity of the intersection. Illumination is provided by way of street lights mounted on wood poles. Land use in the vicinity of the intersection consists of the Project site, 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 October and December 2012. The ATR counts were conducted on Route 129 in the vicinity of the Project site in order to record weekday daily traffic conditions over an extended period, with weekday morning (7:00 to 9:00 AM) and evening (3:00 to 6:00 PM) peak-period manual TMCs performed at the study intersections. These time periods were selected for analysis purposes as they are representative of the peak traffic volume hours for the adjacent roadway network and are inclusive of school-related traffic.

### 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 MassDOT functional classification for Route 129) were reviewed.<sup>6</sup> Based on a review of this data, it was determined that traffic volumes for the months of October and December are approximately 7 percent and 3 percent above average-month conditions, respectively, and, therefore, were not adjusted downward in order to provide a conservative (above-average) analysis condition. The 2012 Existing traffic volumes are summarized in Table 1 and graphically depicted on Figure 2 for the weekday morning and evening peak hours.

**Table 1**  
**2012 EXISTING TRAFFIC VOLUMES**

Location	AWT <sup>a</sup>	Weekday Morning Peak-Hour			Weekday Evening Peak-Hour		
		VPH <sup>b</sup>	K Factor <sup>c</sup>	Directional Distribution <sup>d</sup>	VPH	K Factor	Directional Distribution
Route 129, east of the Chelmsford Town Hall	11,110	1,145	10.3	78.8% EB	993	8.9	62.7% WB

<sup>a</sup>Average weekday traffic in vehicles per day.

<sup>b</sup>Vehicles per hour.

<sup>c</sup>Percent of daily traffic occurring during the peak hour.

<sup>d</sup>Percent traveling in peak direction.

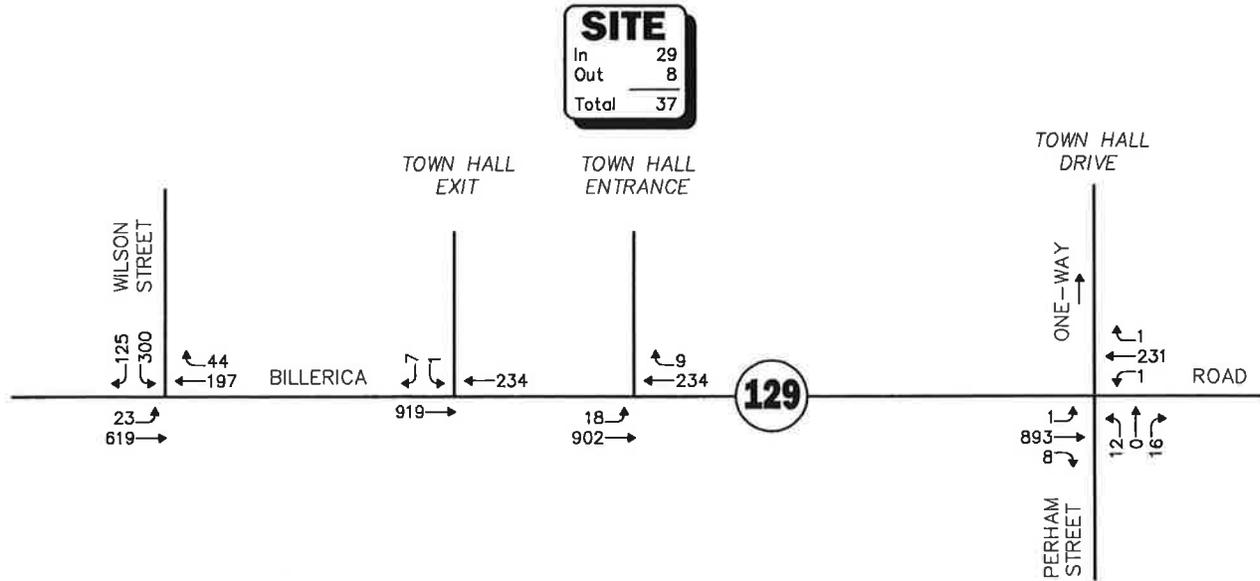
EB = eastbound; WB = westbound, NB = northbound; SB = southbound.

As can be seen in Table 1, Route 129 in the vicinity of the Project site was found to accommodate approximately 11,110 vehicles on an average weekday (two-way, 24-hour volume), with approximately 1,145 vehicles per hour (vph) during the weekday morning peak-hour and 993 vph during the weekday evening peak-hour.

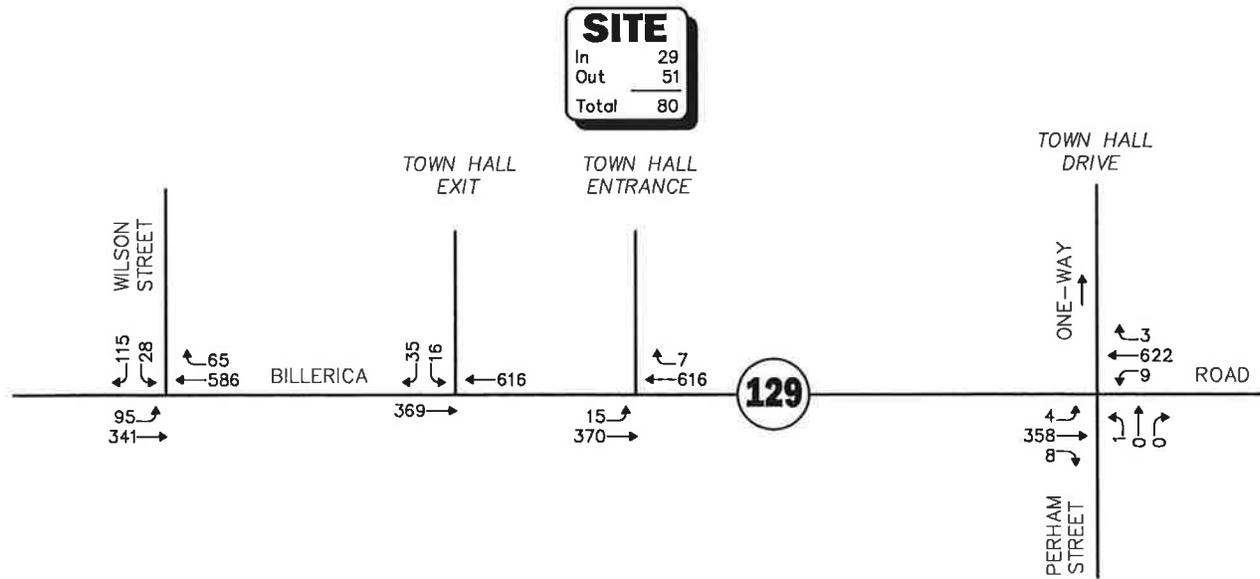
A review of the peak-period traffic counts indicates that the weekday morning peak-hour generally occurs between 7:30 and 8:30 AM, with the weekday evening peak-hour generally occurring between 5:00 PM and 6:00 PM.

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

**WEEKDAY MORNING PEAK HOUR**



**WEEKDAY EVENING PEAK HOUR**



Not To Scale **Figure 2**  
**2012 Existing Peak Hour Traffic Volumes**  
**Vanasse & Associates, Inc.**  
 Transportation Engineers & Planners

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## **PEDESTRIAN AND BICYCLE FACILITIES**

A comprehensive field inventory of pedestrian and bicycle facilities within the study area was undertaken in October 2012. The field inventory consisted of a review of the location of sidewalks and pedestrian crossing locations along the study roadways and at the study intersections, as well as the location of existing and planned future bicycle facilities. Sidewalks are provided along the north side of Route 129 between Chelmsford Street (Route 110) and Golden Cove Road, along the south side of Route 129 between Wilson Street and Summer Street, and continuously along the east side of Wilson Street. Marked crosswalks are provided at the Route 129/Wilson Street intersection for crossing Wilson Street and to the west of Wilson Street for crossing Route 129 between Wilson Street and Summer Street (mid-block crossing).

At present, no formal existing bicycle facilities were identified within the immediate study area; however, both Route 129 and Wilson Street were found to provide sufficient roadway width (combined travel lane and shoulder) to support bicycle travel in a shared travelled-way configuration. Outside of the immediate study area, the Bruce Freeman Rail Trail traverses an alignment parallel to Chelmsford Street/Littleton Road (Route 110) to the north and west of the Project site. A trail map is included in the Appendix.

## **PUBLIC TRANSPORTATION**

The Project site and the study area are served by public transportation services provided by the Lowell Regional Transit Authority (LRTA) (fixed-route bus service). The LRTA operates Bus Route 15, *Chelmsford/Westford via Rtes. 129/110*, which originates from the Kennedy Center at Gallagher Terminal located at 101 Thorndike Street in Lowell and travels along Routes 129 and 110, and past the Project site. At the Kennedy Center, connections can be made to other LRTA bus lines and to the Massachusetts Bay Transportation Authority's (MBTA's) Lowell Branch of the Commuter Rail Line, which provides service to North Station in Boston.

LRTA Bus Route 15 operates on weekdays between 6:00 AM and 7:45 PM and on holidays from 7:00 AM to 5:00 PM, with no service on Saturday or Sunday. Commuter Rail service on the Lowell branch of the MBTA Lowell Commuter Rail Line operates on weekdays between 5:35 AM and 12:54 AM, and on Saturday and Sunday from 7:00 AM to 12:13 AM. LRTA bus fares for adults are \$1.00; with a \$0.50 fare for senior citizens, persons with disabilities, and children from 6 to 12 years of age; children under age 5 ride free when accompanied by a paying adult. The MBTA commuter rail fare (one-way) from Lowell Station (Zone 6) to North Station in Boston is \$8.75. The LRTA bus and MBTA Commuter Rail routes, schedules, and fare information are provided in the Appendix.

## **SPOT SPEED MEASUREMENTS**

Vehicle travel speed measurements were performed on Route 129 in the vicinity of the Project site over a continuous 48-hour period on two consecutive weekdays in conjunction with the ATR counts. Table 2 summarizes the vehicle travel speed measurements.

**Table 2**  
**VEHICLE TRAVEL SPEED MEASUREMENTS**

	Route 129	
	Eastbound	Westbound
Mean Travel Speed (mph)	28	29
85 <sup>th</sup> Percentile Speed (mph)	36	35
Posted Speed Limit (mph)	30	30

mph = miles per hour.

As can be seen in Table 2, the mean (average) vehicle travel speed along Route 129 in the vicinity of the Project site was found to be approximately 28 mph. The average measured 85<sup>th</sup> percentile vehicle travel speed, or the speed at which 85 percent of the observed vehicles traveled at or below, was found to be approximately 35 mph, or 5 mph above the posted speed limit (30 mph), and is considered to be a reasonable variation from the posted speed limit. The 85<sup>th</sup> 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.

### **MOTOR VEHICLE CRASH DATA**

Motor vehicle crash information for the study area intersections was provided by the MassDOT Highway Division Safety Management/Traffic Operations Unit for the most recent three-year period available (2008 through 2010, inclusive) in order to examine motor vehicle crash trends occurring within the study area. The data is summarized by intersection, type, severity, and day of occurrence, and presented in Table 3.

As can be seen in Table 3, no motor vehicle crashes were reported at the Route 129 intersections with the Town Hall driveways or at the Route 129/Perham Street/Town Hall Drive intersection. The intersection of Route 129 at Wilson Street was found to have experienced a total of four (4) reported motor vehicle crashes over the three-year review period, or approximately one (1) crash per year. The majority of crashes reported at this intersection resulted in property damage only; occurred on a weekday, during daylight under clear weather conditions; and were reported as rear-end type collisions. All of the study intersections were found to have a motor vehicle crash rate<sup>7</sup> below the MassDOT average for an unsignalized intersection for the MassDOT Highway Division District in which the intersections are located (District 4). No fatal motor vehicle crashes were reported at the study intersections over the three-year review period. The detailed MassDOT Crash Rate Worksheets are provided in the Appendix.

The reported level of crash frequency within the study area does not indicate the presence of an inherent safety deficiency with respect to the design or operation of the roadway network in the vicinity of the Project site.

<sup>7</sup> Average number of motor vehicle crashes per million vehicles entering the intersection.

**Table 3**  
**MOTOR VEHICLE CRASH DATA SUMMARY<sup>a</sup>**

	Route 129/ Wilson Street	Route 129/ the Town Hall Driveways	Route 129/ Perham Street and Town Hall Drive
<i>Year:</i>			
2008	0	0	0
2009	2	0	0
<u>2010</u>	<u>2</u>	<u>0</u>	<u>0</u>
Total	4	0	0
Average	1.33	0.00	0.00
Rate <sup>b</sup>	0.27	0.00	0.00
Significant? <sup>c</sup>	No	No	No
<i>Severity:</i>			
Property Damage Only	2	0	0
Personal Injury	1	0	0
Fatal	0	0	0
<u>Unknown</u>	<u>1</u>	<u>0</u>	<u>0</u>
Total	4	0	0
<i>Type:</i>			
Angle	1	0	0
Rear-End	2	0	0
Head-On	1	0	0
Other Motor Vehicle	0	0	0
Sideswipe Same Direction	0	0	0
Sideswipe Opposite Direction	0	0	0
<u>Unknown/Other</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	4	0	0
<i>Weather Conditions:</i>			
Clear	4	0	0
Cloudy	0	0	0
Rain	0	0	0
Snow/Ice	0	0	0
<u>Unknown</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	4	0	0
<i>Lighting</i>			
Daylight	4	0	0
Dawn/Dusk	0	0	0
Dark (Road Lit)	0	0	0
Dark (Road Unlit)	0	0	0
Dark (No Street Lights)	0	0	0
<u>Other/Unknown</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	4	0	0
<i>Day of Week:</i>			
Monday through Friday	4	0	0
Saturday	0	0	0
<u>Sunday</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	4	0	0

<sup>a</sup>Source: MassDOT Safety Management/Traffic Operations Unit records, 2008 through 2010.

<sup>b</sup>Crash rate per million vehicles entering the intersection.

<sup>c</sup>The intersection crash rate is significant if it is found to exceed 0.59 crashes per million vehicles entering the intersection for unsignalized intersections and 0.78 crashes per million vehicles entering the intersection for signalized intersections as defined by MassDOT for the MassDOT Highway Division District in which the project is located (District 4).

## **FUTURE CONDITIONS**

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Traffic volumes in the study area were projected to the year 2019, 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 for the 2019 Design Year include all existing traffic and new traffic resulting from background traffic growth and the Project.

### **FUTURE TRAFFIC GROWTH**

Future traffic growth is a function of the expected land development in the immediate area and the surrounding region. Several methods can be used to estimate this growth. A procedure frequently employed estimates an annual percentage increase in traffic growth and applies that percentage to all traffic volumes under study. The drawback to such a procedure is that some turning volumes may actually grow at either a higher or a lower rate at particular intersections.

An alternative procedure identifies the location and type of planned development, estimates the traffic to be generated, and assigns it to the area roadway network. This procedure produces a more realistic estimate of growth for local traffic; however, potential population growth and development external to the study area would not be accounted for in the resulting traffic projections.

To provide a conservative analysis framework, both procedures were used, the salient components of which are described below.

### **Specific Development by Others**

The Planning Department of the Town of Chelmsford 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 intersections. Based on this discussion, no projects were identified at this time that are expected to result in a material impact on future traffic volumes beyond the general 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 fluctuated over the past several years, ranging from increases of approximately 3.4 percent to decreases of approximately 6.5 percent. On average, traffic volumes were found to have generally decreased by approximately 0.7 percent per year. In order to provide a conservative (high) analysis scenario and a prudent planning condition for the Project, a 1.0 percent per year compounded annual background traffic growth rate was used to account for future traffic growth and presently unforeseen development within the study area.

## **Roadway Improvement Projects**

The Town of Chelmsford and MassDOT were contacted in order to determine if there were any planned roadway improvement projects expected to be completed within the study area. Based on these discussions, the following roadway improvement projects were identified:

- ***Westford Street Bridge Rehabilitation, Chelmsford, Massachusetts.*** This project is being undertaken by MassDOT and will entail the reconstruction of the Westford Street bridge over Interstate 495 to improve the wearing surface, structural system and bridge deck slab, and upgrading of the railing and guardrail system. This project is currently at the preliminary design stage with construction expected to commence in the Winter of 2015/2016.
- ***Interstate 495 Maintenance, Chelmsford, Massachusetts.*** This project is being undertaken by MassDOT and will entail the resurfacing of 44 miles of Interstate 495 between Milemarkers 85.1 and 90.6. In conjunction with the resurfacing project, safety and environmental improvements are also planned. This project is currently at the preliminary design stage with construction expected to commence in the Winter of 2013/2014.
- ***Interstate 495 Intelligent Transportation System, Chelmsford, Massachusetts.*** This design-build project is being undertaken by MassDOT and will entail the installation of cameras, changeable message signs and vehicle detectors as a part of an Intelligent Transportation System along Interstate 495 between Interstate 90 and Interstate 93. This project is currently at the 75 Percent design stage with construction expected to commence in the Summer of 2013.

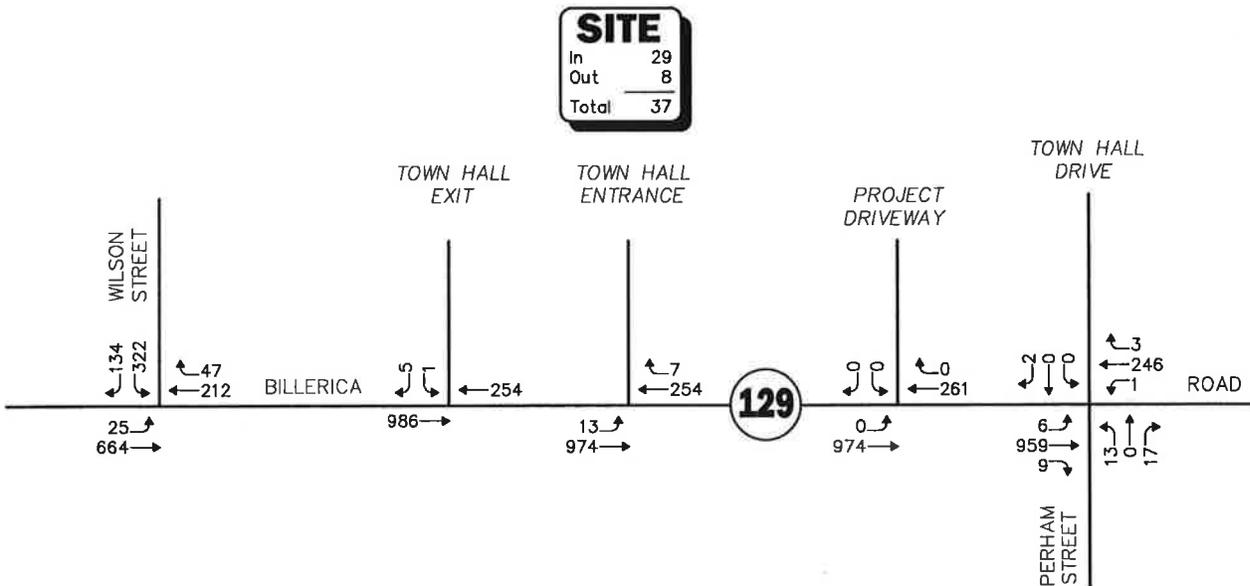
These improvements are outside of the immediate study area that is the subject of this assessment and are not expected to have a material impact on traffic volumes or operating conditions within the study area. No other roadway improvement projects aside from routine maintenance activities were identified to be planned within the study area at this time.

## **FUTURE TRAFFIC VOLUMES – DESIGN YEAR CONDITION**

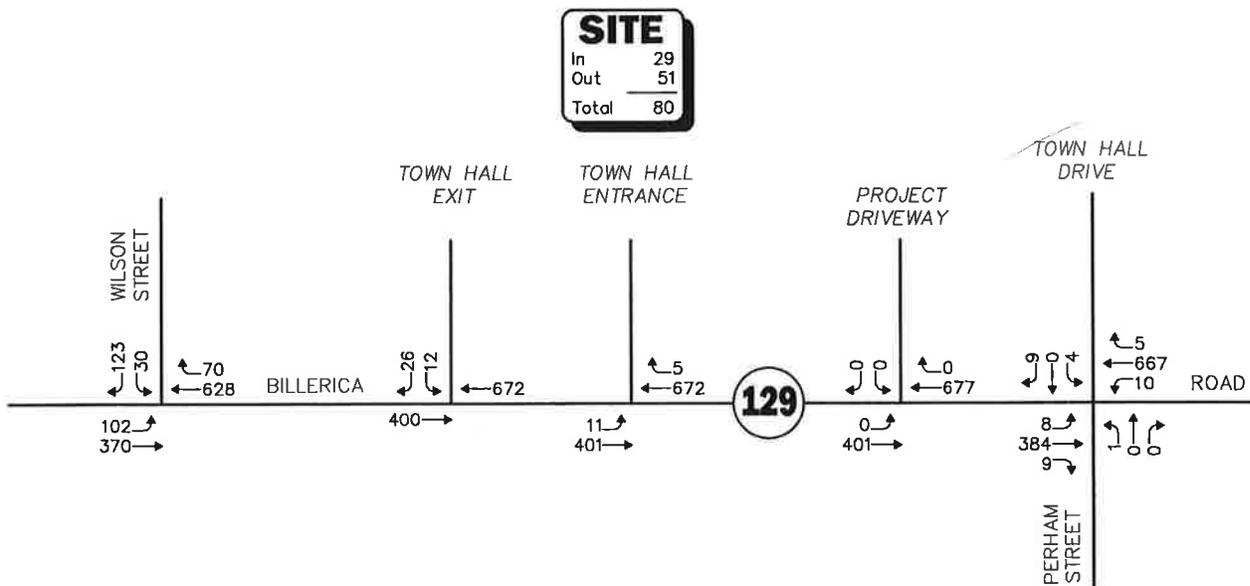
The 2019 Design Year condition peak-hour traffic-volumes were developed by applying the 1.0 percent per year compounded annual background traffic growth rate to the 2012 Existing peak-hour traffic volumes and redistributing a portion of the traffic currently using the front Town Hall parking lot to the rear lot via Town Hall Drive to reflect the redistribution of parking

spaces as a result of the Project. The resulting 2019 Design Year weekday morning and evening peak-hour traffic volumes are shown on Figure 3. The Project itself is not expected to result in a regular or sustained increase in traffic within the study area. Any increase in traffic would be considered nominal and would be reflected in the general background traffic growth rate. Traffic volume networks showing the redistribution of traffic associated with the parking lot modifications are provided in the Appendix.

**WEEKDAY MORNING PEAK HOUR**



**WEEKDAY EVENING PEAK HOUR**



Not To Scale



**Figure 3**

**2019 Design Year  
Peak Hour Traffic Volumes**

## **TRAFFIC OPERATIONS ANALYSIS**

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Measuring existing and future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity and vehicle queue analyses were conducted under Existing and Design Year traffic-volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

### **METHODOLOGY**

#### **Levels of Service**

A primary result of capacity analyses is the assignment of level of service to traffic facilities under various traffic-flow conditions.<sup>8</sup> The concept of level of service is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A level-of-service definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Six levels of service are defined for each type of facility. They are given letter designations from A to F, with level-of-service (LOS) A representing the best operating conditions and LOS F representing congested or constrained operating conditions.

Since the level of service of a traffic facility is a function of the traffic 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 year.

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<sup>8</sup>The capacity analysis methodology is based on the concepts and procedures presented in the *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010.

## Unsignalized Intersections

The six levels of service for unsignalized intersections may be described as follows:

- *LOS A* represents a condition with little or no control delay to minor street traffic.
- *LOS B* represents a condition with short control delays to minor street traffic.
- *LOS C* represents a condition with average control delays to minor street traffic.
- *LOS D* represents a condition with long control delays to minor street traffic.
- *LOS E* represents operating conditions at or near capacity level, with very long control delays to minor street traffic.
- *LOS F* represents a condition where minor street demand volume exceeds capacity of an approach lane, with extreme control delays resulting.

The levels of service of unsignalized intersections are determined by application of a procedure described in the 2010 *Highway Capacity Manual*.<sup>9</sup> Level of service is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and STOP signs. Control delay includes the affects of initial deceleration delay approaching a STOP sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for level of service at unsignalized intersections are also given in the 2010 *Highway Capacity Manual*. Table 4 summarizes the relationship between level of service and average control delay for two-way stop controlled and all-way stop controlled intersections.

**Table 4**  
**LEVEL-OF-SERVICE CRITERIA FOR**  
**UNSIGNALIZED INTERSECTIONS<sup>a</sup>**

Level-Of-Service by Volume-to-Capacity Ratio		Average Control Delay (Seconds Per Vehicle)
$v/c \leq 1.0$	$v/c > 1.0$	
A	F	$\leq 10.0$
B	F	10.1 to 15.0
C	F	15.1 to 25.0
D	F	25.1 to 35.0
E	F	35.1 to 50.0
F	F	$> 50.0$

<sup>a</sup>Source: *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010; page 19-2.

<sup>9</sup>*Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010.

## **Vehicle Queue Analysis**

Vehicle queue analyses are a direct measurement of an intersection's ability to process vehicles under various traffic control and volume scenarios and lane use arrangements. The vehicle queue analysis was performed using the Synchro™ intersection capacity analysis software which is based upon the methodology and procedures presented in the 2010 *Highway Capacity Manual*. The Synchro™ vehicle queue analysis methodology is a simulation based model which reports the number of vehicles that experience a delay of six seconds or more at an intersection. For unsignalized intersections, Synchro™ reports the 95<sup>th</sup> percentile vehicle queue; however, for all-way STOP-control intersections, Synchro™ does not report vehicle queues and it is necessary to use the associated SimTraffic™ traffic model to obtain vehicle queue data. Vehicle queue lengths are a function of the capacity of the movement under study and the volume of traffic being processed by the intersection during the analysis period. The 95<sup>th</sup> percentile vehicle queue is the vehicle queue length that will be exceeded only 5 percent of the time, or approximately three minutes out of sixty minutes during the peak one hour of the day (during the remaining fifty-seven minutes, the vehicle queue length will be less than the 95th percentile queue length).

## **ANALYSIS RESULTS**

Level-of-service and vehicle queue analyses were conducted for 2012 Existing and 2019 Design Year conditions for the intersections within the study area. The results of the intersection capacity and vehicle queue analyses are summarized in Table 5, with the detailed analysis results presented in the Appendix.

The following is a summary of the level-of-service and vehicle queue analyses for the intersections within the study area.

### **Unsignalized Intersections**

#### **Route 129 at Wilson Street**

Under 2012 Existing and 2019 Design Year conditions, the critical movements at this unsignalized intersection (all movements from Wilson Street) were shown to operate at LOS F during the weekday morning peak-hour as a result of the relatively large volume of conflicting traffic travelling along Route 129 during this time period, and at LOS D during the weekday evening peak-hour. Vehicle queues at the intersection were shown to range from 0 to 37 vehicles during the peak hours. The Route 129 approaches to the intersection were shown to operate at LOS A during the peak periods with minimal vehicle queuing (0 to 1 vehicle).

#### **Route 129 at the Town Hall Driveways**

Under 2012 Existing and 2019 Design Year conditions, the critical movements at these unsignalized intersections (all movements exiting the Town Hall west driveway) were shown to operate at LOS C during the weekday morning peak-hour and at LOS F during the weekday evening peak-hour as a result of the relatively large volume of conflicting traffic travelling along Route 129 during this time period. Vehicle queues at the intersection were shown to range from 0 to 5 vehicles during the peak hours. The Route 129 approaches to the intersections were shown to operate at LOS A during the peak periods with negligible vehicle queuing.

### **Route 129 at Perham Street and Town Hall Drive**

Under 2012 Existing conditions, the critical movements at this unsignalized intersection (all movements from Perham Street) were shown to operate at LOS D during the weekday morning peak-hour and at LOS C during the weekday evening peak-hour. Under 2019 Design Year conditions, with the reconstruction of Town Hall Drive to accommodate two-way traffic and the construction of a new parking lot behind the Town Hall, the critical movements were shown to continue to operate at LOS D during the weekday morning peak-hour and to degrade slightly (4.3 second increase in average motorist delay) to LOS D (from LOS C) during the weekday evening peak-hour. Vehicle queues at the intersection were shown to range from 0 to 1 vehicle during the peak hours. The Route 129 approaches to the intersection were shown to operate at LOS A during the peak periods with negligible vehicle queuing.

**Table 5**  
**UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY**

Unsignalized Intersection/Peak Hour/Movement	2012 Existing			2019 Design Year				
	Demand <sup>a</sup>	Delay <sup>b</sup>	LOS <sup>c</sup>	Queue <sup>d</sup> 95 <sup>th</sup>	Demand	Delay	LOS	Queue 95 <sup>th</sup>
<b>Route 129 at Wilson Street</b>								
<i>Weekday Morning:</i>								
Route 129 EB LT/TH	642	0.3	A	0	689	0.3	A	0
Route 129 WB TH/RT	241	0.0	A	0	259	0.0	A	0
Wilson Street SB LT/RT	425	>50.0	F	30	456	>50.0	F	37
<i>Weekday Evening:</i>								
Route 129 EB LT/TH	436	2.1	A	1	472	2.1	A	1
Route 129 WB TH/RT	651	0.0	A	0	698	0.0	A	0
Wilson Street SB LT/RT	143	25.3	D	3	153	31.9	D	4
<b>Route 129 at the Town Hall Driveways</b>								
<i>Weekday Morning:</i>								
Route 129 EB LT/TH	920	0.2	A	0	987	0.1	A	0
Route 129 WB TH/RT	243	0.0	A	0	261	0.0	A	0
Town Hall Driveways SB LT/RT	8	15.3	C	0	6	18.5	C	0
<i>Weekday Evening:</i>								
Route 129 EB LT/TH	385	0.5	A	0	412	0.4	A	0
Route 129 WB TH/RT	623	0.0	A	0	677	0.0	A	0
Town Hall Driveways SB LT/RT	51	>50.0	F	5	38	>50.0	F	5
<b>Route 129 at Perham Street and Town Hall Drive</b>								
<i>Weekday Morning:</i>								
Route 129 EB LT/TH/RT	902	0.0	A	0	974	0.0	A	0
Route 129 WB LT/TH/RT	233	0.0	A	0	250	0.1	A	0
Perham Street NB LT/TH/RT	28	26.9	D	1	30	27.6	D	1
Town Hall Drive SB LT/TH/RT	--	--	--	--	2	9.7	A	0
<i>Weekday Evening:</i>								
Route 129 EB LT/TH/RT	370	0.1	A	0	401	0.2	A	0
Route 129 WB LT/TH/RT	634	0.1	A	0	682	0.1	A	0
Perham Street NB LT/TH/RT	1	24.3	C	0	1	28.6	D	0
Town Hall Drive SB LT/TH/RT	--	--	--	--	13	19.0	C	1

<sup>a</sup>Demand in vehicles per hour.

<sup>b</sup>Average control delay per vehicle (in seconds).

<sup>c</sup>Level-of-Service.

<sup>d</sup>Queue length in vehicles.

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

## **SCHOOL IMPACT ASSESSMENT**

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An assessment of the potential impact of the Project on operating conditions and safety during school pick-up and drop-off periods was completed as these conditions relate to emergency vehicle operations. The Project is not expected to result in a regular or sustained increase in traffic that would materially impact traffic operations along Route 129 or its intersecting roadways or driveways, or that would impede school bus activity and travel routes. Upon exiting the Project site, a responding emergency vehicle will actuate the emergency vehicle traffic control signal (proposed) that will stop all traffic along Route 129 to allow the vehicle(s) to exit the facility in a safe and efficient manner. Responding emergency vehicles are required to activate both their siren and light bar which provide both an audible and visual warning to motorists and pedestrians. In accordance with Massachusetts General Law (MGL), motorists are required to yield to an approaching emergency vehicle; this includes school buses. Children waiting for a school bus should be located outside of the travelled-way and would not be in conflict with a responding emergency vehicle or any vehicle that is travelling within the travelled-way. The Project site is located approximately 950 feet west of the Center School, a distance that is sufficient to eliminate conflicts between exiting emergency vehicles and vehicles entering and exiting the school driveways.

## **SIGHT DISTANCE MEASUREMENTS**

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Sight distance measurements were performed at the Project site driveway and at the study area intersections in accordance with MassDOT and American Association of State Highway and Transportation Officials (AASHTO)<sup>10</sup> standards. 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 6 presents the measured SSD and ISD at the subject intersections.

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<sup>10</sup>Ibid 2.

**Table 6**  
**SIGHT DISTANCE MEASUREMENTS**

Intersection/Sight Distance Measurement	Required Minimum (Feet) <sup>a</sup>	ISD (Feet) <sup>a</sup>	Measured (Feet)
<b>Route 129 at Wilson Street</b>			
<i>Stopping Sight Distance:</i>			
Route 129 approaching from the east	250	--	480
Route 129 approaching from the west	250	--	375
<i>Intersection Sight Distance:</i>			
Looking to the east from Wilson Street	250	335/390 <sup>b</sup>	475
Looking to the west from Wilson Street	250	335/390 <sup>b</sup>	365
<b>Route 129 at the Town Exit Hall Driveway</b>			
<i>Stopping Sight Distance:</i>			
Route 129 approaching from the east	250	--	318
Route 129 approaching from the west	250	--	650+
<i>Intersection Sight Distance:</i>			
Looking to the east from the Town Hall Driveway	250	335/390 <sup>b</sup>	473
Looking to the west from the Town Hall Driveway	250	335/390 <sup>b</sup>	650+
<b>Route 129 at the Proposed Driveway</b>			
<i>Stopping Sight Distance:</i>			
Route 129 approaching from the east	250	--	397
Route 129 approaching from the west	250	--	322
<i>Intersection Sight Distance:</i>			
Looking to the east from the Proposed Driveway	250	335/390 <sup>b</sup>	360
Looking to the west from the Proposed Driveway	250	335/390 <sup>b</sup>	472
<b>Route 129 at Town Hall Drive</b>			
<i>Stopping Sight Distance:</i>			
Route 129 approaching from the east	250	--	500
Route 129 approaching from the west	250	--	375
<i>Intersection Sight Distance:</i>			
Looking to the east from Town Hall Drive	250	335/390 <sup>b</sup>	485
Looking to the west from Town Hall Drive	250	335/390 <sup>b</sup>	360
<b>Route 129 at Perham Street</b>			
<i>Stopping Sight Distance:</i>			
Route 129 approaching from the east	250	--	490
Route 129 approaching from the west	250	--	365
<i>Intersection Sight Distance:</i>			
Looking to the east from Perham Street	250	335/390 <sup>b</sup>	475
Looking to the west from Perham Street	250	335/390 <sup>b</sup>	350

<sup>a</sup>Recommended minimum values obtained from *A Policy on Geometric Design of Highways and Streets*, 6<sup>th</sup> Edition; American Association of State Highway and Transportation Officials (AASHTO); 2011; and based on a 35 mph approach speed on Route 129.

<sup>b</sup>Values 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 6, lines of sight at the subject intersections exceed the recommended minimum sight distance requirements for a 35 mph approach speed along Route 129, consistent with the measured 85<sup>th</sup> percentile vehicle travel speed and 5 mph above the posted speed limit (30 mph).

## **CONCLUSIONS AND RECOMMENDATIONS**

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### **CONCLUSIONS**

VAI has completed a detailed assessment of the potential impacts on the transportation infrastructure associated with the proposed construction of the new Chelmsford Fire Department Headquarters to be located at 50 Billerica Road (Route 129) in Chelmsford, Massachusetts. This assessment has been completed in accordance with state standards for the preparation of TIAs and was conducted pursuant to the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports. The following specific areas have been evaluated as they relate to the Project: i) access requirements; ii) potential off-site improvements; and iii) safety considerations; under existing and future conditions, both with and without the Project. Based on this assessment, we have concluded the following with respect to the Project:

1. The Project is not expected to result in a regular or sustained increase in traffic that would result in a material increase in motorist delays or vehicle queuing;
2. No inherent safety or operational deficiencies were noted with respect to the roadways and intersections proximate to the Project site that would indicate that the construction of the Project would result in an impact on the safe and efficient movement of vehicles, pedestrians or bicyclists;
3. An assessment of traffic volumes and operating conditions at the intersections of Route 129 at Wilson Street, Route 129 at the Town Hall Driveways, and Route 129 at Perham Street and Town Hall Drive indicates that the existing transportation infrastructure affords sufficient capacity to accommodate the Project;
4. The Project will not result in a degradation in safety or access as these conditions relate to school bus travel or drop-off/pick-up activities for school children; and
5. Lines of sight to and from the Project site driveway and the study intersections exceed the required minimum distances for the intersections to function in a safe and efficient manner.

Based on the above, we have concluded that the Project can be accommodated within the confines of the transportation infrastructure in a safe and efficient manner with implementation of recommendations that follow.

## **RECOMMENDATIONS**

A detailed transportation improvement program has been developed that is designed to maintain safe and efficient access to the Project site and address any deficiencies identified at off-site locations evaluated in conjunction with this study. The following sections detail the improvements that have been recommended as a part of this evaluation which are also graphically depicted on Figure 4.

### **Project Access**

Access to the Project will be provided by way of a new driveway that will intersect the north side of Route 129 and will be generally situated between the Town Hall entrance-only driveway and Town Hall Drive. In conjunction with the Project, a new parking area will be constructed behind the Town Hall and Town Hall Drive will be improved and continue to accommodate one-way travel between Route 129 and the new parking lot (northbound). The following recommendations are offered with respect to the design and operation of the Project site driveway and the driveways serving the Town Hall:

- The one-way enter and exit driveways serving the Town Hall should be a minimum of 16-feet in width and should include appropriate signs (“One Way” (R6-1)<sup>11</sup>, “Do Not Enter” (R5-1), etc.) and pavement marking indicating the one-way traffic flow, with vehicles exiting the Town Hall placed under STOP-sign (R1-1) control with a marked STOP-line provided in advance of the sidewalk on Route 129.
- Town Hall Drive should be reconstructed as a paved roadway a minimum of 16-feet in width and accommodate one-way northbound travel between Route 129 and the new parking lot. “Do Not Enter” (R5-1) and “One-Way” (R6-1) signs should be installed at the interface of Town Hall Drive with the new parking lot facing the parking lot.
- Signs indicating “Authorized Vehicles Only” (R5-11) should be installed on either side of the new driveway that will serve the Project facing motorists on Route 129.
- An emergency vehicle traffic control signal should be installed at the Project site driveway that should be actuated by way of both an OPTICOM™ system (or similar) and hardwired to the Fire Station. Marked STOP-lines should be provided on either side of the driveway on Route 129 at the desired stopping point for vehicles with signs indicated “Stop Here On Red” (R10-6) provided at the STOP-lines.
- An “Emergency Signal” sign (R10-13) shall be mounted on the emergency vehicle traffic control signal facing approaching traffic on Route 129.
- An “Emergency Vehicle” sign (W11-8) and an “Emergency Signal Ahead” (W11-12P) supplemental plaque should be installed approximately 125 feet east and west of the emergency vehicle signal on each approach to the Project site driveway.
- The driveway serving the Project and its intersection with Route 129 should be appropriately illuminated.

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<sup>11</sup>Sign designations as specified in the *Manual on Uniform Traffic Control Devices (MUTCD)*; Federal Highway Administration; Washington, DC; 2009.



Figure 4  
Conceptual Improvement Plan

- All signs and other pavement markings to be installed within the Project site shall conform to the applicable standards of the Manual on Uniform Traffic Devices (MUTCD).<sup>12</sup>
- If centerline pavement markings are provided within the Project site or along Town Hall Drive, they shall consist of a double-yellow centerline.
- Signs and landscaping adjacent to the Project site driveway, the driveways serving the Town Hall and Town Hall Drive should be designed and maintained so as not to restrict lines of sight.
- It is suggested that all signs and pavement markings along the Town Hall and Project site frontage on Route 129 be reviewed, upgraded and replaced as necessary to enhance visibility and to eliminate potential conflicts with the signs and markings to be installed in conjunction with the emergency vehicle traffic control signal.

### **Off-Site Improvements**

#### **Route 129 at Perham Street**

A STOP-sign (R1-1) and marked STOP-line should be provided on the Perham Street approach to Route 129 in order to define the desired stopping point for motorists exiting Perham Street and to reinforce the vehicular right-of-way at the intersection given the addition of the Project.

#### **Route 129 at Wilson Street**

An analysis of operating conditions at this unsignalized intersection indicates that operating conditions are constrained during the weekday morning peak-hour, a condition that is a direct result of the relatively large volume of conflicting traffic travelling along Route 129. A preliminary review of the criteria (warrants) for the installation of a traffic control signal as specified in the MUTCD<sup>13</sup> indicates that at least two (2) of the nine warrants are satisfied under current traffic volume conditions (Warrant 2, *Four-Hour Vehicular Volume*, and Warrant 3, *Peak Hour*) indicating that the installation of a traffic control signal at the intersection may be justified in order to improve traffic operations.

Given: i) the absence of a pronounced motor vehicle crash history at the intersection; and ii) the limited duration of the reported constrained operating conditions; it is suggested that operating conditions and motor vehicle crashes at the intersection continue to be monitored on a periodic basis as a part of routine review by the Police Department. Should the frequency of occurrence of motor vehicle crashes experience a sustained and regular increase, it is suggested that a formal Traffic Signal Warrants Analysis be completed in accordance with the methodology and procedures outlined in the MUTCD, including the collection of 12-hour (7 AM to 7 PM) manual turning movement count and vehicle classification count on an average weekday (Tuesday, Wednesday or Thursday). Should it be determined that the installation of a traffic control signal is an appropriate measure to improve intersection conditions, the traffic signal system should be integrated into the emergency vehicle traffic control signal to be installed at the Project site driveway.

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<sup>12</sup>Ibid 4.

<sup>13</sup>Ibid.

With implementation of the above recommendations, safe and efficient access will be provided to the Project and the Project can be safely accommodated within the confines of the transportation infrastructure.

## **APPENDIX**

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**AUTOMATIC TRAFFIC RECORDER COUNT DATA  
MANUAL TURNING MOVEMENT COUNT DATA  
SEASONAL ADJUSTMENT DATA  
PUBLIC TRANSPORTATION SCHEDULES  
BICYCLE TRAILS MAP  
VEHICLE TRAVEL SPEED DATA  
MASSDOT CRASH RATE WORKSHEETS  
GENERAL BACKGROUND TRAFFIC GROWTH  
PROJECT TRIP REDISTRIBUTION NETWORK  
CAPACITY ANALYSIS WORKSHEETS  
TRAFFIC SIGNAL WARRANT ANALYSIS**

AUTOMATIC TRAFFIC RECORDER COUNT DATA

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**Accurate Counts**  
978-664-2565

Location : Billerica Road (Route 129)  
Location : at #50 Billerica Road  
City/State: Chelmsford, MA

Start Time	24-Oct-12 Wed	EB	WB	Total
12:00 AM		5	4	9
12:15		2	3	5
12:30		5	5	10
12:45		1	3	4
01:00		4	2	6
01:15		1	0	1
01:30		5	0	5
01:45		1	1	2
02:00		4	2	6
02:15		0	1	1
02:30		1	1	2
02:45		2	2	4
03:00		3	0	3
03:15		1	6	7
03:30		2	1	3
03:45		2	3	5
04:00		2	10	12
04:15		5	6	11
04:30		7	3	10
04:45		10	8	18
05:00		12	5	17
05:15		15	10	25
05:30		29	10	39
05:45		36	19	55
06:00		65	10	75
06:15		96	28	124
06:30		166	36	202
06:45		190	32	222
07:00		204	29	233
07:15		223	47	270
07:30		232	50	282
07:45		173	38	211
08:00		194	36	230
08:15		175	55	230
08:30		164	52	216
08:45		162	91	253
09:00		122	71	193
09:15		101	53	154
09:30		90	53	143
09:45		91	63	154
10:00		70	58	128
10:15		68	49	117
10:30		67	53	120
10:45		88	64	152
11:00		56	57	113
11:15		59	87	146
11:30		81	97	178
11:45		81	119	200
<b>Total</b>		<b>3173</b>	<b>1433</b>	<b>4606</b>
<b>Percent</b>		<b>68.9%</b>	<b>31.1%</b>	
Peak	-	06:45	11:00	06:45
Vol.	-	849	360	1007
P.H.F.		0.915	0.756	0.893

**Accurate Counts**  
978-664-2565

Location : Billerica Road (Route 129)  
Location : at #50 Billerica Road  
City/State: Chelmsford, MA

Start Time	24-Oct-12 Wed	EB	WB							Total
12:00 PM		94	123							217
12:15		95	107							202
12:30		90	103							193
12:45		123	112							235
01:00		101	83							184
01:15		110	72							182
01:30		100	65							165
01:45		103	55							158
02:00		72	64							136
02:15		74	86							160
02:30		73	93							166
02:45		63	96							159
03:00		97	87							184
03:15		83	139							222
03:30		74	105							179
03:45		58	104							162
04:00		80	112							192
04:15		91	92							183
04:30		78	124							202
04:45		74	117							191
05:00		86	153							239
05:15		84	158							242
05:30		91	144							235
05:45		99	135							234
06:00		73	120							193
06:15		92	124							216
06:30		59	120							179
06:45		55	90							145
07:00		46	66							112
07:15		46	63							109
07:30		53	58							111
07:45		39	42							81
08:00		43	51							94
08:15		42	44							86
08:30		26	44							70
08:45		28	23							51
09:00		38	38							76
09:15		36	31							67
09:30		32	22							54
09:45		17	17							34
10:00		7	33							40
10:15		21	14							35
10:30		12	18							30
10:45		15	13							28
11:00		12	12							24
11:15		4	8							12
11:30		4	8							12
11:45		4	6							10
<b>Total</b>		<b>2897</b>	<b>3594</b>							<b>6491</b>
<b>Percent</b>		<b>44.6%</b>	<b>55.4%</b>							
<b>Peak</b>	-	<b>12:45</b>	<b>17:00</b>	-	-	-	-	-	-	<b>17:00</b>
<b>Vol.</b>	-	<b>434</b>	<b>590</b>	-	-	-	-	-	-	<b>950</b>
<b>P.H.F.</b>		<b>0.882</b>	<b>0.934</b>							<b>0.981</b>

**Accurate Counts**  
978-664-2565

Location : Billerica Road (Route 129)  
Location : at #50 Billerica Road  
City/State: Chelmsford, MA

Start Time	25-Oct-12 Thu	EB	WB	Total						
12:00 AM		5	6	11						
12:15		1	5	6						
12:30		4	7	11						
12:45		4	3	7						
01:00		1	4	5						
01:15		3	6	9						
01:30		6	2	8						
01:45		4	2	6						
02:00		1	0	1						
02:15		0	3	3						
02:30		6	2	8						
02:45		3	1	4						
03:00		4	1	5						
03:15		2	4	6						
03:30		2	3	5						
03:45		2	4	6						
04:00		3	4	7						
04:15		3	4	7						
04:30		7	5	12						
04:45		4	2	6						
05:00		11	6	17						
05:15		12	21	33						
05:30		20	21	41						
05:45		43	13	56						
06:00		62	20	82						
06:15		101	22	123						
06:30		170	34	204						
06:45		173	39	212						
07:00		176	28	204						
07:15		222	38	260						
07:30		208	47	255						
07:45		186	50	236						
08:00		193	49	242						
08:15		189	46	235						
08:30		209	59	268						
08:45		211	77	288						
09:00		124	77	201						
09:15		113	44	157						
09:30		91	49	140						
09:45		73	65	138						
10:00		66	59	125						
10:15		68	68	136						
10:30		67	46	113						
10:45		61	51	112						
11:00		69	73	142						
11:15		57	84	141						
11:30		75	85	160						
11:45		82	114	196						
Total		3197	1453	4650						
Percent		68.8%	31.2%							
Peak	-	07:15	11:00	-	-	-	-	-	-	08:00
Vol.	-	809	356	-	-	-	-	-	-	1033
P.H.F.		0.911	0.781							0.897

**Accurate Counts**  
978-664-2565

Location : Billerica Road (Route 129)  
Location : at #50 Billerica Road  
City/State: Chelmsford, MA

Start Time	25-Oct-12 Thu	EB	WB	Total						
12:00 PM		80	141	221						
12:15		98	93	191						
12:30		114	92	206						
12:45		110	72	182						
01:00		102	80	182						
01:15		96	59	155						
01:30		72	61	133						
01:45		92	81	173						
02:00		62	87	149						
02:15		75	62	137						
02:30		72	83	155						
02:45		96	88	184						
03:00		87	100	187						
03:15		103	133	236						
03:30		68	99	167						
03:45		75	99	174						
04:00		89	108	197						
04:15		96	119	215						
04:30		78	116	194						
04:45		64	127	191						
05:00		81	133	214						
05:15		104	156	260						
05:30		83	110	193						
05:45		85	121	206						
06:00		84	126	210						
06:15		81	122	203						
06:30		75	120	195						
06:45		61	91	152						
07:00		54	85	139						
07:15		44	77	121						
07:30		49	65	114						
07:45		61	43	104						
08:00		32	49	81						
08:15		33	46	79						
08:30		29	53	82						
08:45		35	31	66						
09:00		28	36	64						
09:15		34	30	64						
09:30		20	32	52						
09:45		19	23	42						
10:00		10	15	25						
10:15		12	29	41						
10:30		18	22	40						
10:45		11	17	28						
11:00		13	18	31						
11:15		7	11	18						
11:30		3	6	9						
11:45		4	6	10						
<b>Total</b>		<b>2899</b>	<b>3573</b>	<b>6472</b>						
<b>Percent</b>		<b>44.8%</b>	<b>55.2%</b>							
Peak	-	12:15	16:30	-	-	-	-	-	-	17:00
Vol.	-	424	532	-	-	-	-	-	-	873
P.H.F.		0.930	0.853							0.839
<b>Grand Total</b>		<b>12166</b>	<b>10053</b>							<b>22219</b>
<b>Percent</b>		<b>54.8%</b>	<b>45.2%</b>							
<b>ADT</b>	<b>ADT 11,110</b>		<b>AADT 11,110</b>							

## Accurate Counts 978-664-2565

Location : Billerica Road (Route 129)  
 Location : at #50 Billerica Road  
 City/State: Chelmsford, MA

Start Time	24-Oct-12 Wed	EB	WB	Total
12:00 AM		13	15	28
01:00		11	3	14
02:00		7	6	13
03:00		8	10	18
04:00		24	27	51
05:00		92	44	136
06:00		517	106	623
07:00		<b>832</b>	164	<b>996</b>
08:00		695	234	929
09:00		404	240	644
10:00		293	224	517
11:00		277	<b>360</b>	637
12:00 PM		402	445	847
01:00		<b>414</b>	275	689
02:00		282	339	621
03:00		312	435	747
04:00		323	445	768
05:00		360	<b>590</b>	<b>950</b>
06:00		279	454	733
07:00		184	229	413
08:00		139	162	301
09:00		123	108	231
10:00		55	78	133
11:00		24	34	58
Total		6070	5027	11097
Percent		54.7%	45.3%	
AM Peak		07:00	11:00	07:00
Vol.		832	360	996
PM Peak		13:00	17:00	17:00
Vol.		414	590	950

**Accurate Counts**  
978-664-2565

Location : Billerica Road (Route 129)  
 Location : at #50 Billerica Road  
 City/State: Chelmsford, MA

Start Time	25-Oct-12 Thu	EB	WB	Total
12:00 AM	14	21	35	
01:00	14	14	28	
02:00	10	6	16	
03:00	10	12	22	
04:00	17	15	32	
05:00	86	61	147	
06:00	506	115	621	
07:00	792	163	955	
08:00	802	231	1033	
09:00	401	235	636	
10:00	262	224	486	
11:00	283	356	639	
12:00 PM	402	398	800	
01:00	362	281	643	
02:00	305	320	625	
03:00	333	431	764	
04:00	327	470	797	
05:00	353	520	873	
06:00	301	459	760	
07:00	208	270	478	
08:00	129	179	308	
09:00	101	121	222	
10:00	51	83	134	
11:00	27	41	68	
Total	6096	5026	11122	
Percent	54.8%	45.2%		
AM Peak	-	11:00	-	08:00
Vol.	802	356	-	1033
PM Peak	-	17:00	-	17:00
Vol.	402	520	-	873
Grand Total	12166	10053		22219
Percent	54.8%	45.2%		
ADT	ADT 11,110		ADT 11,110	

**Accurate Counts**  
978-664-2565

Location : Billerica Road (Route 129)  
Location : at #50 Billerica Road  
City/State: Chelmsford, MA

Start Time	05-Dec-12 Wed	EB		Hour Totals		WB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		1	104			2	118				
12:15		0	118			4	105				
12:30		4	97			0	90				
12:45		2	126	7	445	2	87	8	400	15	845
01:00		1	112			5	98				
01:15		1	101			6	101				
01:30		1	89			0	71				
01:45		4	91	7	393	3	68	14	338	21	731
02:00		0	79			0	69				
02:15		0	69			0	86				
02:30		2	77			1	86				
02:45		2	73	4	298	1	74	2	315	6	613
03:00		2	85			8	96				
03:15		3	93			2	150				
03:30		3	79			5	123				
03:45		2	84	10	341	2	92	17	461	27	802
04:00		4	95			7	119				
04:15		3	91			10	104				
04:30		2	91			2	102				
04:45		11	72	20	349	6	111	25	436	45	785
05:00		9	73			5	113				
05:15		16	106			8	161				
05:30		31	93			19	154				
05:45		27	74	83	346	16	124	48	552	131	898
06:00		64	70			15	109				
06:15		99	78			14	117				
06:30		183	77			43	113				
06:45		182	56	528	281	48	106	120	445	648	726
07:00		184	45			50	74				
07:15		218	36			54	64				
07:30		206	23			55	44				
07:45		231	35	839	139	61	39	220	221	1059	360
08:00		191	41			89	68				
08:15		199	23			81	59				
08:30		229	25			134	45				
08:45		199	24	818	113	152	20	456	192	1274	305
09:00		189	32			108	26				
09:15		152	25			113	24				
09:30		134	29			80	50				
09:45		135	26	610	112	66	19	367	119	977	231
10:00		120	14			72	18				
10:15		127	13			60	21				
10:30		116	7			62	19				
10:45		121	14	484	48	67	15	261	73	745	121
11:00		94	10			60	14				
11:15		110	2			77	6				
11:30		77	10			113	12				
11:45		90	4	371	26	109	7	359	39	730	65
Total		3781	2891			1897	3591			5678	6482
Percent		56.7%	43.3%			34.6%	65.4%			46.7%	53.3%

**Accurate Counts**  
978-664-2565

Location : Billerica Road (Route 129)  
Location : at #50 Billerica Road  
City/State: Chelmsford, MA

Start Time	06-Dec-12 Thu	EB		Hour Totals		WB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		3	89			2	131				
12:15		4	122			5	110				
12:30		2	108			3	100				
12:45		0	125	9	444	0	87	10	428	19	872
01:00		1	91			3	76				
01:15		1	138			2	74				
01:30		1	90			2	89				
01:45		4	100	7	419	1	63	8	302	15	721
02:00		2	76			1	77				
02:15		2	84			5	75				
02:30		1	83			2	83				
02:45		2	92	7	335	1	79	9	314	16	649
03:00		1	96			2	99				
03:15		1	102			1	124				
03:30		3	66			7	130				
03:45		4	82	9	346	4	120	14	473	23	819
04:00		3	73			6	122				
04:15		6	83			14	114				
04:30		6	93			7	122				
04:45		8	81	23	330	4	140	31	498	54	828
05:00		11	90			5	130				
05:15		21	99			10	143				
05:30		24	95			15	131				
05:45		42	75	98	359	12	111	42	515	140	874
06:00		60	73			12	117				
06:15		105	69			23	129				
06:30		158	67			35	94				
06:45		170	60	493	269	35	107	105	447	598	716
07:00		204	52			29	79				
07:15		210	45			60	56				
07:30		230	42			64	50				
07:45		184	43	828	182	82	56	235	241	1063	423
08:00		215	50			53	50				
08:15		170	40			103	67				
08:30		225	36			63	38				
08:45		199	34	809	160	99	36	318	191	1127	351
09:00		167	29			78	31				
09:15		140	22			71	30				
09:30		80	17			79	50				
09:45		62	25	449	93	83	18	311	129	760	222
10:00		79	15			43	13				
10:15		85	12			83	19				
10:30		86	12			45	10				
10:45		68	15	318	54	74	21	245	63	563	117
11:00		92	9			77	7				
11:15		77	12			71	14				
11:30		74	2			105	16				
11:45		73	3	316	26	128	8	381	45	697	71
<b>Total</b>		<b>3366</b>	<b>3017</b>			<b>1709</b>	<b>3646</b>			<b>5075</b>	<b>6663</b>
<b>Percent</b>		<b>52.7%</b>	<b>47.3%</b>			<b>31.9%</b>	<b>68.1%</b>			<b>43.2%</b>	<b>56.8%</b>
<b>Grand Total</b>		<b>7147</b>	<b>5908</b>			<b>3606</b>	<b>7237</b>			<b>10753</b>	<b>13145</b>
<b>Percent</b>		<b>54.7%</b>	<b>45.3%</b>			<b>33.3%</b>	<b>66.7%</b>			<b>45.0%</b>	<b>55.0%</b>

ADT                      ADT 11,887                      AADT 11,887



MANUAL TURNING MOVEMENT COUNT DATA

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**Accurate Counts**  
978-664-2565

N/S Street : Wilson Street  
E/W Street : Billerica Road  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730001  
Site Code : 63730001  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Cars - Trucks**

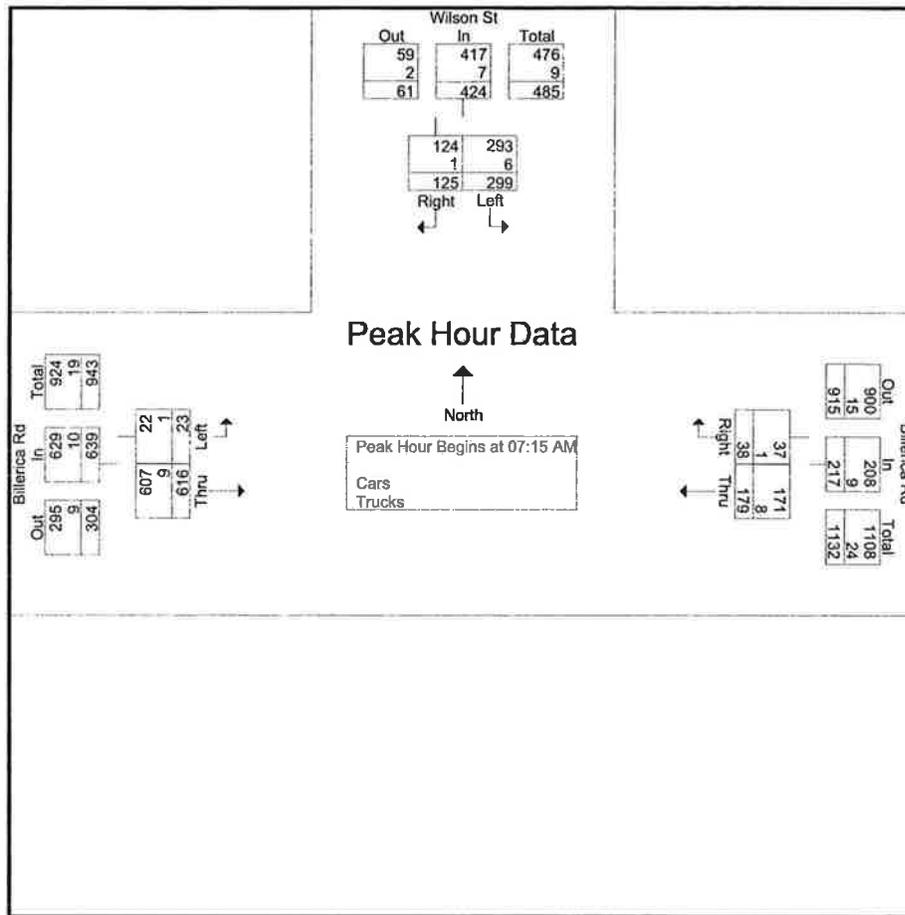
Start Time	Wilson St From North		Billerica Rd From East		Billerica Rd From West		Int. Total
	Left	Right	Thru	Right	Left	Thru	
07:00 AM	60	40	31	5	12	141	289
07:15 AM	77	56	31	9	9	150	332
07:30 AM	79	39	48	7	3	163	339
07:45 AM	76	12	54	14	4	148	308
Total	292	147	164	35	28	602	1268
08:00 AM	67	18	46	8	7	155	301
08:15 AM	56	32	48	12	4	157	309
08:30 AM	75	38	47	9	0	124	293
08:45 AM	51	22	62	23	1	129	288
Total	249	110	203	52	12	565	1191
Grand Total	541	257	367	87	40	1167	2459
Apprch %	67.8	32.2	80.8	19.2	3.3	96.7	
Total %	22	10.5	14.9	3.5	1.6	47.5	
Cars	532	253	352	85	39	1150	2411
% Cars	98.3	98.4	95.9	97.7	97.5	98.5	98
Trucks	9	4	15	2	1	17	48
% Trucks	1.7	1.6	4.1	2.3	2.5	1.5	2

Start Time	Wilson St From North			Billerica Rd From East			Billerica Rd From West			Int. Total
	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 07:15 AM										
07:15 AM	77	56	133	31	9	40	9	150	159	332
07:30 AM	79	39	118	48	7	55	3	163	166	339
07:45 AM	76	12	88	54	14	68	4	148	152	308
08:00 AM	67	18	85	46	8	54	7	155	162	301
Total Volume	299	125	424	179	38	217	23	616	639	1280
% App. Total	70.5	29.5		82.5	17.5		3.6	96.4		
PHF	.946	.558	.797	.829	.679	.798	.639	.945	.962	.944
Cars	293	124	417	171	37	208	22	607	629	1254
% Cars	98.0	99.2	98.3	95.5	97.4	95.9	95.7	98.5	98.4	98.0
Trucks	6	1	7	8	1	9	1	9	10	26
% Trucks	2.0	0.8	1.7	4.5	2.6	4.1	4.3	1.5	1.6	2.0

**Accurate Counts**  
978-664-2565

N/S Street : Wilson Street  
E/W Street : Billerica Road  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730001  
Site Code : 63730001  
Start Date : 10/24/2012  
Page No : 2



Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1  
Peak Hour for Each Approach Begins at:

	07:00 AM			08:00 AM			07:30 AM		
+0 mins.	60	40	100	46	8	54	3	163	166
+15 mins.	77	56	133	48	12	60	4	148	152
+30 mins.	79	39	118	47	9	56	7	155	162
+45 mins.	76	12	88	62	23	85	4	157	161
Total Volume	292	147	439	203	52	255	18	623	641
% App. Total	66.5	33.5		79.6	20.4		2.8	97.2	
PHF	.924	.656	.825	.819	.565	.750	.643	.956	.965
Cars	287	146	433	196	50	246	18	612	630
% Cars	98.3	99.3	98.6	96.6	96.2	96.5	100	98.2	98.3
Trucks	5	1	6	7	2	9	0	11	11
% Trucks	1.7	0.7	1.4	3.4	3.8	3.5	0	1.8	1.7

**Accurate Counts**  
978-664-2565

N/S Street : Wilson Street  
E/W Street : Billerica Road  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730001  
Site Code : 63730001  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Cars**

Start Time	Wilson St From North		Billerica Rd From East		Billerica Rd From West		Int. Total
	Left	Right	Thru	Right	Left	Thru	
07:00 AM	59	40	28	5	12	139	283
07:15 AM	74	56	31	9	8	149	327
07:30 AM	78	39	48	7	3	160	335
07:45 AM	76	11	49	14	4	145	299
<b>Total</b>	<b>287</b>	<b>146</b>	<b>156</b>	<b>35</b>	<b>27</b>	<b>593</b>	<b>1244</b>
08:00 AM	65	18	43	7	7	153	293
08:15 AM	55	30	47	12	4	154	302
08:30 AM	74	38	45	8	0	123	288
08:45 AM	51	21	61	23	1	127	284
<b>Total</b>	<b>245</b>	<b>107</b>	<b>196</b>	<b>50</b>	<b>12</b>	<b>557</b>	<b>1167</b>
<b>Grand Total</b>	<b>532</b>	<b>253</b>	<b>352</b>	<b>85</b>	<b>39</b>	<b>1150</b>	<b>2411</b>
Apprch %	67.8	32.2	80.5	19.5	3.3	96.7	
Total %	22.1	10.5	14.6	3.5	1.6	47.7	

Start Time	Wilson St From North			Billerica Rd From East			Billerica Rd From West			Int. Total
	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 07:15 AM										
07:15 AM	74	56	130	31	9	40	8	149	157	327
07:30 AM	78	39	117	48	7	55	3	160	163	335
07:45 AM	76	11	87	49	14	63	4	145	149	299
08:00 AM	65	18	83	43	7	50	7	153	160	293
<b>Total Volume</b>	<b>293</b>	<b>124</b>	<b>417</b>	<b>171</b>	<b>37</b>	<b>208</b>	<b>22</b>	<b>607</b>	<b>629</b>	<b>1254</b>
<b>% App. Total</b>	<b>70.3</b>	<b>29.7</b>		<b>82.2</b>	<b>17.8</b>		<b>3.5</b>	<b>96.5</b>		
PHF	.939	.554	.802	.872	.661	.825	.688	.948	.965	.936

**Accurate Counts**  
978-664-2565

N/S Street : Wilson Street  
E/W Street : Billerica Road  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730001  
Site Code : 63730001  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Trucks**

Start Time	Wilson St From North		Billerica Rd From East		Billerica Rd From West		Int. Total
	Left	Right	Thru	Right	Left	Thru	
07:00 AM	1	0	3	0	0	2	6
07:15 AM	3	0	0	0	1	1	5
07:30 AM	1	0	0	0	0	3	4
07:45 AM	0	1	5	0	0	3	9
<b>Total</b>	<b>5</b>	<b>1</b>	<b>8</b>	<b>0</b>	<b>1</b>	<b>9</b>	<b>24</b>
08:00 AM	2	0	3	1	0	2	8
08:15 AM	1	2	1	0	0	3	7
08:30 AM	1	0	2	1	0	1	5
08:45 AM	0	1	1	0	0	2	4
<b>Total</b>	<b>4</b>	<b>3</b>	<b>7</b>	<b>2</b>	<b>0</b>	<b>8</b>	<b>24</b>
<b>Grand Total</b>	<b>9</b>	<b>4</b>	<b>15</b>	<b>2</b>	<b>1</b>	<b>17</b>	<b>48</b>
Apprch %	69.2	30.8	88.2	11.8	5.6	94.4	
Total %	18.8	8.3	31.2	4.2	2.1	35.4	

Start Time	Wilson St From North			Billerica Rd From East			Billerica Rd From West			Int. Total
	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 07:45 AM										
07:45 AM	0	1	1	5	0	5	0	3	3	9
08:00 AM	2	0	2	3	1	4	0	2	2	8
08:15 AM	1	2	3	1	0	1	0	3	3	7
08:30 AM	1	0	1	2	1	3	0	1	1	5
<b>Total Volume</b>	<b>4</b>	<b>3</b>	<b>7</b>	<b>11</b>	<b>2</b>	<b>13</b>	<b>0</b>	<b>9</b>	<b>9</b>	<b>29</b>
% App. Total	57.1	42.9		84.6	15.4		0	100		
PHF	.500	.375	.583	.550	.500	.650	.000	.750	.750	.806

**Accurate Counts**  
978-664-2565

N/S Street : Wilson Street  
E/W Street : Billerica Road  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730001  
Site Code : 63730001  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Cars - Trucks**

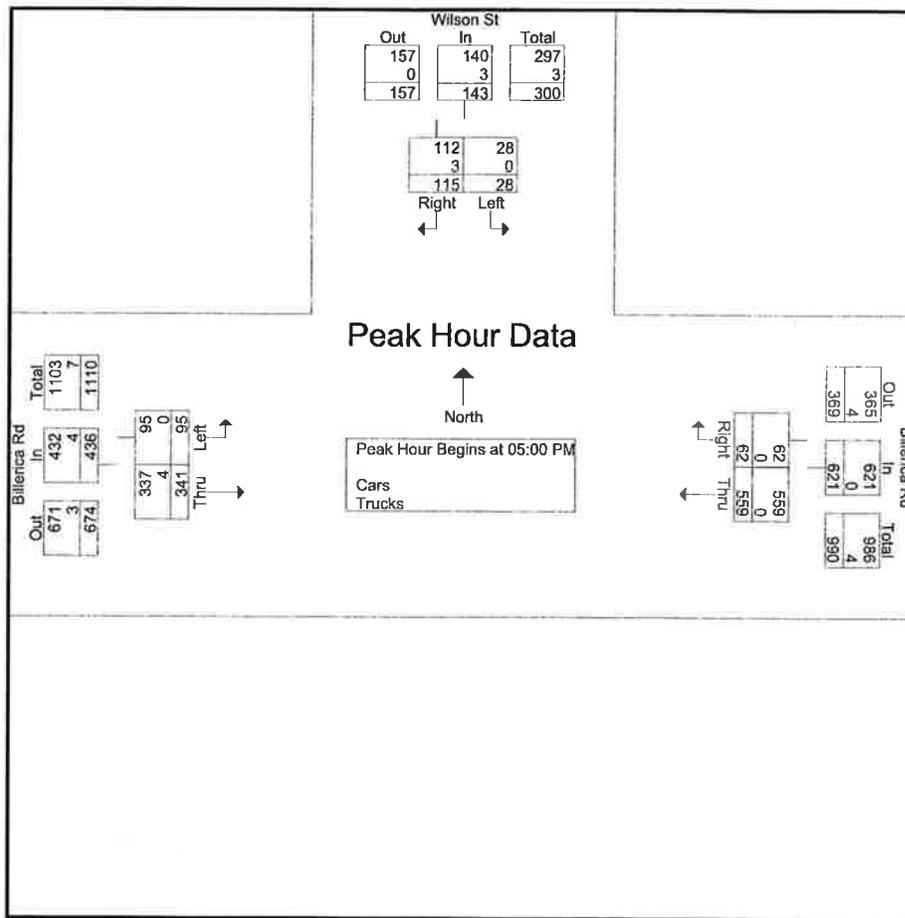
Start Time	Wilson St From North		Billerica Rd From East		Billerica Rd From West		Int. Total
	Left	Right	Thru	Right	Left	Thru	
03:00 PM	12	23	97	11	20	71	234
03:15 PM	17	17	100	19	19	79	251
03:30 PM	8	25	117	28	22	78	278
03:45 PM	7	12	96	10	14	45	184
<b>Total</b>	<b>44</b>	<b>77</b>	<b>410</b>	<b>68</b>	<b>75</b>	<b>273</b>	<b>947</b>
04:00 PM	11	24	88	18	16	64	221
04:15 PM	12	22	105	15	23	89	266
04:30 PM	10	23	105	15	25	75	253
04:45 PM	14	32	115	16	21	65	263
<b>Total</b>	<b>47</b>	<b>101</b>	<b>413</b>	<b>64</b>	<b>85</b>	<b>293</b>	<b>1003</b>
05:00 PM	8	27	123	13	20	77	268
05:15 PM	6	37	149	16	23	92	323
05:30 PM	5	30	141	16	23	79	294
05:45 PM	9	21	146	17	29	93	315
<b>Total</b>	<b>28</b>	<b>115</b>	<b>559</b>	<b>62</b>	<b>95</b>	<b>341</b>	<b>1200</b>
<b>Grand Total</b>	<b>119</b>	<b>293</b>	<b>1382</b>	<b>194</b>	<b>255</b>	<b>907</b>	<b>3150</b>
Apprch %	28.9	71.1	87.7	12.3	21.9	78.1	
Total %	3.8	9.3	43.9	6.2	8.1	28.8	
Cars	118	285	1372	194	254	879	3102
% Cars	99.2	97.3	99.3	100	99.6	96.9	98.5
Trucks	1	8	10	0	1	28	48
% Trucks	0.8	2.7	0.7	0	0.4	3.1	1.5

Start Time	Wilson St From North			Billerica Rd From East			Billerica Rd From West			Int. Total
	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 05:00 PM										
05:00 PM	8	27	35	123	13	136	20	77	97	268
05:15 PM	6	37	43	149	16	165	23	92	115	323
05:30 PM	5	30	35	141	16	157	23	79	102	294
05:45 PM	9	21	30	146	17	163	29	93	122	315
<b>Total Volume</b>	<b>28</b>	<b>115</b>	<b>143</b>	<b>559</b>	<b>62</b>	<b>621</b>	<b>95</b>	<b>341</b>	<b>436</b>	<b>1200</b>
% App. Total	19.6	80.4		90	10		21.8	78.2		
PHF	.778	.777	.831	.938	.912	.941	.819	.917	.893	.929
Cars	28	112	140	559	62	621	95	337	432	1193
% Cars	100	97.4	97.9	100	100	100	100	98.8	99.1	99.4
Trucks	0	3	3	0	0	0	0	4	4	7
% Trucks	0	2.6	2.1	0	0	0	0	1.2	0.9	0.6

**Accurate Counts**  
978-664-2565

N/S Street : Wilson Street  
E/W Street : Billerica Road  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730001  
Site Code : 63730001  
Start Date : 10/24/2012  
Page No : 2



Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1  
Peak Hour for Each Approach Begins at:

	04:45 PM			05:00 PM			05:00 PM		
+0 mins.	14	32	46	123	13	136	20	77	97
+15 mins.	8	27	35	149	16	165	23	92	115
+30 mins.	6	37	43	141	16	157	23	79	102
+45 mins.	5	30	35	146	17	163	29	93	122
Total Volume	33	126	159	559	62	621	95	341	436
% App. Total	20.8	79.2		90	10		21.8	78.2	
PHF	.589	.851	.864	.938	.912	.941	.819	.917	.893
Cars	33	124	157	559	62	621	95	337	432
% Cars	100	98.4	98.7	100	100	100	100	98.8	99.1
Trucks	0	2	2	0	0	0	0	4	4
% Trucks	0	1.6	1.3	0	0	0	0	1.2	0.9

**Accurate Counts**  
978-664-2565

N/S Street : Wilson Street  
E/W Street : Billerica Road  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730001  
Site Code : 63730001  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Cars**

Start Time	Wilson St From North		Billerica Rd From East		Billerica Rd From West		Int. Total
	Left	Right	Thru	Right	Left	Thru	
03:00 PM	12	22	97	11	20	67	229
03:15 PM	17	17	97	19	19	76	245
03:30 PM	7	24	115	28	21	74	269
03:45 PM	7	11	94	10	14	44	180
<b>Total</b>	<b>43</b>	<b>74</b>	<b>403</b>	<b>68</b>	<b>74</b>	<b>261</b>	<b>923</b>
04:00 PM	11	24	86	18	16	63	218
04:15 PM	12	21	105	15	23	84	260
04:30 PM	10	22	104	15	25	71	247
04:45 PM	14	32	115	16	21	63	261
<b>Total</b>	<b>47</b>	<b>99</b>	<b>410</b>	<b>64</b>	<b>85</b>	<b>281</b>	<b>986</b>
05:00 PM	8	27	123	13	20	76	267
05:15 PM	6	35	149	16	23	91	320
05:30 PM	5	30	141	16	23	79	294
05:45 PM	9	20	146	17	29	91	312
<b>Total</b>	<b>28</b>	<b>112</b>	<b>559</b>	<b>62</b>	<b>95</b>	<b>337</b>	<b>1193</b>
<b>Grand Total</b>	<b>118</b>	<b>285</b>	<b>1372</b>	<b>194</b>	<b>254</b>	<b>879</b>	<b>3102</b>
Apprch %	29.3	70.7	87.6	12.4	22.4	77.6	
Total %	3.8	9.2	44.2	6.3	8.2	28.3	

Start Time	Wilson St From North			Billerica Rd From East			Billerica Rd From West			Int. Total
	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 05:00 PM										
05:00 PM	8	27	35	123	13	136	20	76	96	267
05:15 PM	6	35	41	149	16	165	23	91	114	320
05:30 PM	5	30	35	141	16	157	23	79	102	294
05:45 PM	9	20	29	146	17	163	29	91	120	312
<b>Total Volume</b>	<b>28</b>	<b>112</b>	<b>140</b>	<b>559</b>	<b>62</b>	<b>621</b>	<b>95</b>	<b>337</b>	<b>432</b>	<b>1193</b>
% App. Total	20	80		90	10		22	78		
PHF	.778	.800	.854	.938	.912	.941	.819	.926	.900	.932

**Accurate Counts**  
978-664-2565

N/S Street : Wilson Street  
E/W Street : Billerica Road  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730001  
Site Code : 63730001  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Trucks**

Start Time	Wilson St From North		Billerica Rd From East		Billerica Rd From West		Int. Total
	Left	Right	Thru	Right	Left	Thru	
03:00 PM	0	1	0	0	0	4	5
03:15 PM	0	0	3	0	0	3	6
03:30 PM	1	1	2	0	1	4	9
03:45 PM	0	1	2	0	0	1	4
Total	1	3	7	0	1	12	24
04:00 PM	0	0	2	0	0	1	3
04:15 PM	0	1	0	0	0	5	6
04:30 PM	0	1	1	0	0	4	6
04:45 PM	0	0	0	0	0	2	2
Total	0	2	3	0	0	12	17
05:00 PM	0	0	0	0	0	1	1
05:15 PM	0	2	0	0	0	1	3
05:30 PM	0	0	0	0	0	0	0
05:45 PM	0	1	0	0	0	2	3
Total	0	3	0	0	0	4	7
Grand Total	1	8	10	0	1	28	48
Apprch %	11.1	88.9	100	0	3.4	96.6	
Total %	2.1	16.7	20.8	0	2.1	58.3	

Start Time	Wilson St From North			Billerica Rd From East			Billerica Rd From West			Int. Total
	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 03:00 PM										
03:00 PM	0	1	1	0	0	0	0	4	4	5
03:15 PM	0	0	0	3	0	3	0	3	3	6
03:30 PM	1	1	2	2	0	2	1	4	5	9
03:45 PM	0	1	1	2	0	2	0	1	1	4
Total Volume	1	3	4	7	0	7	1	12	13	24
% App. Total	25	75		100	0		7.7	92.3		
PHF	.250	.750	.500	.583	.000	.583	.250	.750	.650	.667

**Accurate Counts**  
978-664-2565

N/S Street : Town Hall Driveway  
E/W Street : Billerica Road (Route 129)  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730002  
Site Code : 63730002  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Cars - Trucks**

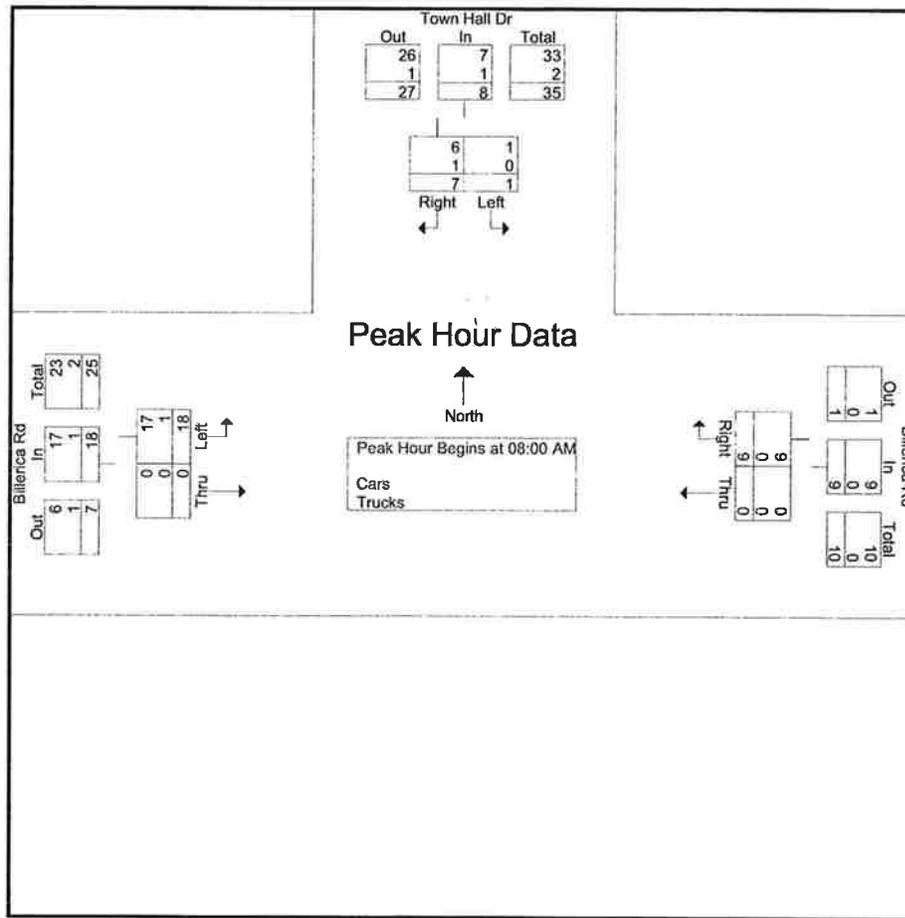
Start Time	Town Hall Dr From North		Billerica Rd From East		Billerica Rd From West		Int. Total
	Left	Right	Thru	Right	Left	Thru	
07:00 AM	0	1	0	2	2	0	5
07:15 AM	0	1	0	0	1	0	2
07:30 AM	0	1	0	0	3	0	4
07:45 AM	1	0	0	1	1	0	3
<b>Total</b>	<b>1</b>	<b>3</b>	<b>0</b>	<b>3</b>	<b>7</b>	<b>0</b>	<b>14</b>
08:00 AM	0	1	0	1	1	0	3
08:15 AM	1	2	0	3	7	0	13
08:30 AM	0	2	0	3	6	0	11
08:45 AM	0	2	0	2	4	0	8
<b>Total</b>	<b>1</b>	<b>7</b>	<b>0</b>	<b>9</b>	<b>18</b>	<b>0</b>	<b>35</b>
<b>Grand Total</b>	<b>2</b>	<b>10</b>	<b>0</b>	<b>12</b>	<b>25</b>	<b>0</b>	<b>49</b>
Apprch %	16.7	83.3	0	100	100	0	
Total %	4.1	20.4	0	24.5	51	0	
Cars	2	9	0	12	24	0	47
% Cars	100	90	0	100	96	0	95.9
Trucks	0	1	0	0	1	0	2
% Trucks	0	10	0	0	4	0	4.1

Start Time	Town Hall Dr From North			Billerica Rd From East			Billerica Rd From West			Int. Total
	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 08:00 AM										
08:00 AM	0	1	1	0	1	1	1	0	1	3
08:15 AM	1	2	3	0	3	3	7	0	7	13
08:30 AM	0	2	2	0	3	3	6	0	6	11
08:45 AM	0	2	2	0	2	2	4	0	4	8
<b>Total Volume</b>	<b>1</b>	<b>7</b>	<b>8</b>	<b>0</b>	<b>9</b>	<b>9</b>	<b>18</b>	<b>0</b>	<b>18</b>	<b>35</b>
% App. Total	12.5	87.5		0	100		100	0		
PHF	.250	.875	.667	.000	.750	.750	.643	.000	.643	.673
Cars	1	6	7	0	9	9	17	0	17	33
% Cars	100	85.7	87.5	0	100	100	94.4	0	94.4	94.3
Trucks	0	1	1	0	0	0	1	0	1	2
% Trucks	0	14.3	12.5	0	0	0	5.6	0	5.6	5.7

**Accurate Counts**  
978-664-2565

N/S Street : Town Hall Driveway  
E/W Street : Billerica Road (Route 129)  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730002  
Site Code : 63730002  
Start Date : 10/24/2012  
Page No : 2



Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1  
Peak Hour for Each Approach Begins at:

	08:00 AM			08:00 AM			08:00 AM		
+0 mins.	0	1	1	0	1	1	1	0	1
+15 mins.	1	2	3	0	3	3	7	0	7
+30 mins.	0	2	2	0	3	3	6	0	6
+45 mins.	0	2	2	0	2	2	4	0	4
Total Volume	1	7	8	0	9	9	18	0	18
% App. Total	12.5	87.5		0	100		100	0	
PHF	.250	.875	.667	.000	.750	.750	.643	.000	.643
Cars	1	6	7	0	9	9	17	0	17
% Cars	100	85.7	87.5	0	100	100	94.4	0	94.4
Trucks	0	1	1	0	0	0	1	0	1
% Trucks	0	14.3	12.5	0	0	0	5.6	0	5.6

**Accurate Counts**  
978-664-2565

N/S Street : Town Hall Driveway  
E/W Street : Billerica Road (Route 129)  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730002  
Site Code : 63730002  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Cars**

Start Time	Town Hall Dr From North		Billerica Rd From East		Billerica Rd From West		Int. Total
	Left	Right	Thru	Right	Left	Thru	
07:00 AM	0	1	0	2	2	0	5
07:15 AM	0	1	0	0	1	0	2
07:30 AM	0	1	0	0	3	0	4
07:45 AM	1	0	0	1	1	0	3
Total	1	3	0	3	7	0	14
08:00 AM	0	1	0	1	1	0	3
08:15 AM	1	2	0	3	6	0	12
08:30 AM	0	1	0	3	6	0	10
08:45 AM	0	2	0	2	4	0	8
Total	1	6	0	9	17	0	33
Grand Total	2	9	0	12	24	0	47
Apprch %	18.2	81.8	0	100	100	0	
Total %	4.3	19.1	0	25.5	51.1	0	

Start Time	Town Hall Dr From North			Billerica Rd From East			Billerica Rd From West			Int. Total
	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 08:00 AM										
08:00 AM	0	1	1	0	1	1	1	0	1	3
08:15 AM	1	2	3	0	3	3	6	0	6	12
08:30 AM	0	1	1	0	3	3	6	0	6	10
08:45 AM	0	2	2	0	2	2	4	0	4	8
Total Volume	1	6	7	0	9	9	17	0	17	33
% App. Total	14.3	85.7		0	100		100	0		
PHF	.250	.750	.583	.000	.750	.750	.708	.000	.708	.688

**Accurate Counts**  
978-664-2565

N/S Street : Town Hall Driveway  
E/W Street : Billerica Road (Route 129)  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730002  
Site Code : 63730002  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Trucks**

Start Time	Town Hall Dr From North		Billerica Rd From East		Billerica Rd From West		Int. Total
	Left	Right	Thru	Right	Left	Thru	
07:00 AM	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	1	0	1
08:30 AM	0	1	0	0	0	0	1
08:45 AM	0	0	0	0	0	0	0
Total	0	1	0	0	1	0	2
Grand Total	0	1	0	0	1	0	2
Apprch %	0	100	0	0	100	0	
Total %	0	50	0	0	50	0	

Start Time	Town Hall Dr From North			Billerica Rd From East			Billerica Rd From West			Int. Total
	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 07:45 AM										
07:45 AM	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	1	0	1	1
08:30 AM	0	1	1	0	0	0	0	0	0	1
Total Volume	0	1	1	0	0	0	1	0	1	2
% App. Total	0	100		0	0		100	0		
PHF	.000	.250	.250	.000	.000	.000	.250	.000	.250	.500

**Accurate Counts**  
978-664-2565

N/S Street : Town Hall Driveway  
E/W Street : Billerica Road (Route 129)  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730002  
Site Code : 63730002  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Cars**

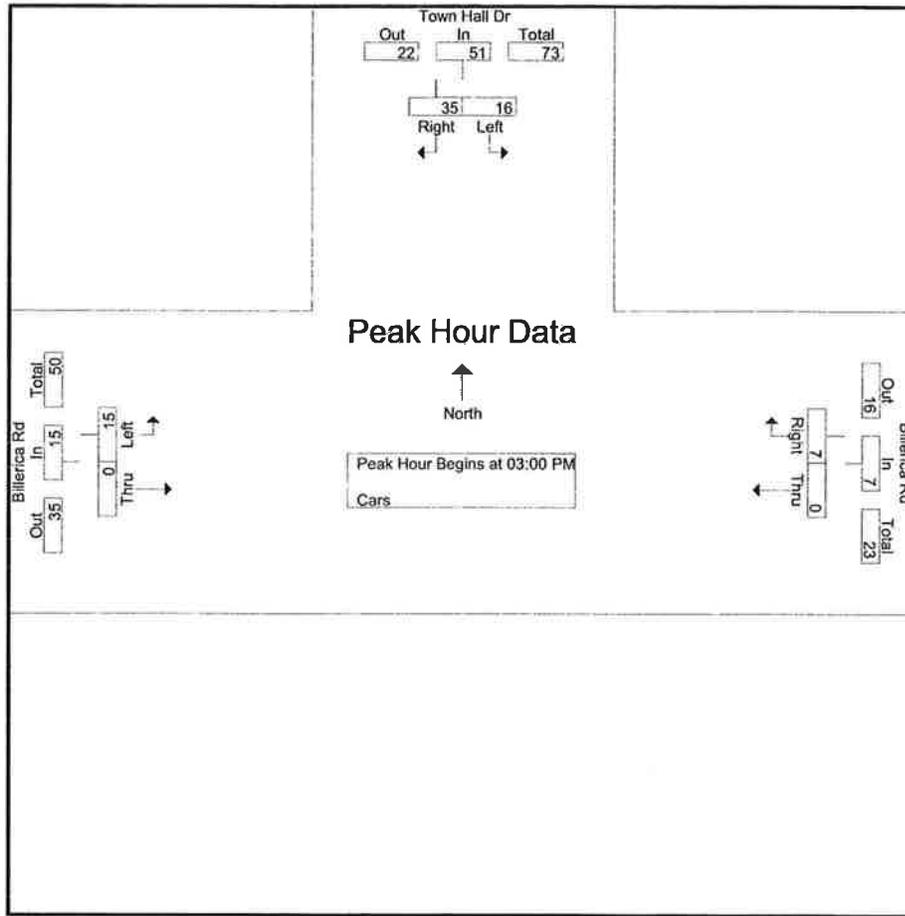
Start Time	Town Hall Dr From North		Billerica Rd From East		Billerica Rd From West		Int. Total
	Left	Right	Thru	Right	Left	Thru	
03:00 PM	9	14	0	4	6	0	33
03:15 PM	3	9	0	0	3	0	15
03:30 PM	3	6	0	1	4	0	14
03:45 PM	1	6	0	2	2	0	11
<b>Total</b>	<b>16</b>	<b>35</b>	<b>0</b>	<b>7</b>	<b>15</b>	<b>0</b>	<b>73</b>
04:00 PM	0	2	0	0	2	0	4
04:15 PM	2	4	0	1	2	0	9
04:30 PM	2	9	0	1	0	0	12
04:45 PM	0	0	0	0	0	0	0
<b>Total</b>	<b>4</b>	<b>15</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>0</b>	<b>25</b>
05:00 PM	1	4	0	1	1	0	7
05:15 PM	0	1	0	0	0	0	1
05:30 PM	0	1	0	0	0	0	1
05:45 PM	0	2	0	0	1	0	3
<b>Total</b>	<b>1</b>	<b>8</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>12</b>
<b>Grand Total</b>	<b>21</b>	<b>58</b>	<b>0</b>	<b>10</b>	<b>21</b>	<b>0</b>	<b>110</b>
<b>Apprch %</b>	<b>26.6</b>	<b>73.4</b>	<b>0</b>	<b>100</b>	<b>100</b>	<b>0</b>	
<b>Total %</b>	<b>19.1</b>	<b>52.7</b>	<b>0</b>	<b>9.1</b>	<b>19.1</b>	<b>0</b>	

Start Time	Town Hall Dr From North			Billerica Rd From East			Billerica Rd From West			Int. Total
	Left	Right	App. Total	Thru	Right	App. Total	Left	Thru	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 03:00 PM										
03:00 PM	9	14	23	0	4	4	6	0	6	33
03:15 PM	3	9	12	0	0	0	3	0	3	15
03:30 PM	3	6	9	0	1	1	4	0	4	14
03:45 PM	1	6	7	0	2	2	2	0	2	11
<b>Total Volume</b>	<b>16</b>	<b>35</b>	<b>51</b>	<b>0</b>	<b>7</b>	<b>7</b>	<b>15</b>	<b>0</b>	<b>15</b>	<b>73</b>
<b>% App. Total</b>	<b>31.4</b>	<b>68.6</b>		<b>0</b>	<b>100</b>		<b>100</b>	<b>0</b>		
<b>PHF</b>	<b>.444</b>	<b>.625</b>	<b>.554</b>	<b>.000</b>	<b>.438</b>	<b>.438</b>	<b>.625</b>	<b>.000</b>	<b>.625</b>	<b>.553</b>

**Accurate Counts**  
978-664-2565

N/S Street : Town Hall Driveway  
E/W Street : Billerica Road (Route 129)  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730002  
Site Code : 63730002  
Start Date : 10/24/2012  
Page No : 2



Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1  
Peak Hour for Each Approach Begins at:

	03:00 PM			03:00 PM			03:00 PM		
+0 mins.	9	14	23	0	4	4	6	0	6
+15 mins.	3	9	12	0	0	0	3	0	3
+30 mins.	3	6	9	0	1	1	4	0	4
+45 mins.	1	6	7	0	2	2	2	0	2
<b>Total Volume</b>	16	35	51	0	7	7	15	0	15
<b>% App. Total</b>	31.4	68.6		0	100		100	0	
<b>PHF</b>	.444	.625	.554	.000	.438	.438	.625	.000	.625

**Accurate Counts**  
978-664-2565

N/S Street : Perham St / Town Hall Dr  
E/W Street: Billerica Road (Route 129)  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730004  
Site Code : 63730004  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Cars - Trucks**

Start Time	Town Hall Dr From North			Billerica Rd From East			Perham St From South			Billerica Rd From West			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 AM	0	0	0	1	33	0	1	0	0	0	205	0	240
07:15 AM	1	0	0	0	34	0	3	0	0	0	225	0	263
07:30 AM	0	0	0	1	49	0	4	0	1	1	235	2	293
07:45 AM	0	0	0	0	71	1	2	0	3	0	226	1	304
<b>Total</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>187</b>	<b>1</b>	<b>10</b>	<b>0</b>	<b>4</b>	<b>1</b>	<b>891</b>	<b>3</b>	<b>1100</b>
08:00 AM	3	0	0	0	53	0	0	0	1	0	221	4	282
08:15 AM	0	0	0	0	58	0	6	0	11	0	211	1	287
08:30 AM	0	0	1	0	41	0	10	1	33	0	191	0	277
08:45 AM	0	0	0	0	82	1	6	0	33	0	182	2	306
<b>Total</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>234</b>	<b>1</b>	<b>22</b>	<b>1</b>	<b>78</b>	<b>0</b>	<b>805</b>	<b>7</b>	<b>1152</b>
<b>Grand Total</b>	<b>4</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>421</b>	<b>2</b>	<b>32</b>	<b>1</b>	<b>82</b>	<b>1</b>	<b>1696</b>	<b>10</b>	<b>2252</b>
<b>Apprch %</b>	<b>80</b>	<b>0</b>	<b>20</b>	<b>0.5</b>	<b>99.1</b>	<b>0.5</b>	<b>27.8</b>	<b>0.9</b>	<b>71.3</b>	<b>0.1</b>	<b>99.4</b>	<b>0.6</b>	
<b>Total %</b>	<b>0.2</b>	<b>0</b>	<b>0</b>	<b>0.1</b>	<b>18.7</b>	<b>0.1</b>	<b>1.4</b>	<b>0</b>	<b>3.6</b>	<b>0</b>	<b>75.3</b>	<b>0.4</b>	
<b>Cars</b>	<b>4</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>402</b>	<b>2</b>	<b>32</b>	<b>1</b>	<b>82</b>	<b>1</b>	<b>1662</b>	<b>7</b>	<b>2196</b>
<b>% Cars</b>	<b>100</b>	<b>0</b>	<b>100</b>	<b>100</b>	<b>95.5</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>98</b>	<b>70</b>	<b>97.5</b>
<b>Trucks</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>19</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>34</b>	<b>3</b>	<b>56</b>
<b>% Trucks</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4.5</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>30</b>	<b>2.5</b>

Start Time	Town Hall Dr From North				Billerica Rd From East				Perham St From South				Billerica Rd From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	0	0	0	0	1	49	0	50	4	0	1	5	1	235	2	238	293
07:45 AM	0	0	0	0	0	71	1	72	2	0	3	5	0	226	1	227	304
08:00 AM	3	0	0	3	0	53	0	53	0	0	1	1	0	221	4	225	282
08:15 AM	0	0	0	0	0	58	0	58	6	0	11	17	0	211	1	212	287
<b>Total Volume</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>1</b>	<b>231</b>	<b>1</b>	<b>233</b>	<b>12</b>	<b>0</b>	<b>16</b>	<b>28</b>	<b>1</b>	<b>893</b>	<b>8</b>	<b>902</b>	<b>1166</b>
<b>% App. Total</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.4</b>	<b>99.1</b>	<b>0.4</b>		<b>42.9</b>	<b>0</b>	<b>57.1</b>		<b>0.1</b>	<b>99</b>	<b>0.9</b>		
<b>PHF</b>	<b>.250</b>	<b>.000</b>	<b>.000</b>	<b>.250</b>	<b>.250</b>	<b>.813</b>	<b>.250</b>	<b>.809</b>	<b>.500</b>	<b>.000</b>	<b>.364</b>	<b>.412</b>	<b>.250</b>	<b>.950</b>	<b>.500</b>	<b>.947</b>	<b>.959</b>
<b>Cars</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>1</b>	<b>219</b>	<b>1</b>	<b>221</b>	<b>12</b>	<b>0</b>	<b>16</b>	<b>28</b>	<b>1</b>	<b>876</b>	<b>6</b>	<b>883</b>	<b>1135</b>
<b>% Cars</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>100</b>	<b>100</b>	<b>94.8</b>	<b>100</b>	<b>94.8</b>	<b>100</b>	<b>0</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>98.1</b>	<b>75.0</b>	<b>97.9</b>	<b>97.3</b>
<b>Trucks</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>12</b>	<b>0</b>	<b>12</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>17</b>	<b>2</b>	<b>19</b>	<b>31</b>
<b>% Trucks</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5.2</b>	<b>0</b>	<b>5.2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1.9</b>	<b>25.0</b>	<b>2.1</b>	<b>2.7</b>

**Accurate Counts**  
978-664-2565

N/S Street : Perham St / Town Hall Dr  
E/W Street: Billerica Road (Route 129)  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730004  
Site Code : 63730004  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Trucks**

Start Time	Town Hall Dr From North			Billerica Rd From East			Perham St From South			Billerica Rd From West			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
03:00 PM	0	0	0	0	0	0	0	0	0	0	2	0	2
03:15 PM	0	0	0	0	4	0	0	0	0	0	4	1	9
03:30 PM	0	0	0	0	2	0	1	0	0	0	7	1	11
03:45 PM	0	0	0	0	2	0	0	0	0	0	1	0	3
Total	0	0	0	0	8	0	1	0	0	0	14	2	25
04:00 PM	0	0	0	0	4	0	0	0	0	0	3	0	7
04:15 PM	0	0	0	0	0	0	0	0	0	0	5	0	5
04:30 PM	0	0	0	0	2	0	0	0	0	0	4	0	6
04:45 PM	0	0	0	0	0	0	0	0	0	0	4	0	4
Total	0	0	0	0	6	0	0	0	0	0	16	0	22
05:00 PM	0	0	0	0	0	0	0	0	0	0	1	0	1
05:15 PM	0	0	0	0	0	0	0	0	0	0	1	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	2	0	0	0	0	0	2	0	4
Total	0	0	0	0	2	0	0	0	0	0	4	0	6
Grand Total	0	0	0	0	16	0	1	0	0	0	34	2	53
Apprch %	0	0	0	0	100	0	100	0	0	0	94.4	5.6	
Total %	0	0	0	0	30.2	0	1.9	0	0	0	64.2	3.8	

Start Time	Town Hall Dr From North				Billerica Rd From East				Perham St From South				Billerica Rd From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 03:15 PM																	
03:15 PM	0	0	0	0	0	4	0	4	0	0	0	0	0	4	1	5	9
03:30 PM	0	0	0	0	0	2	0	2	1	0	0	1	0	7	1	8	11
03:45 PM	0	0	0	0	0	2	0	2	0	0	0	0	0	1	0	1	3
04:00 PM	0	0	0	0	0	4	0	4	0	0	0	0	0	3	0	3	7
Total Volume	0	0	0	0	0	12	0	12	1	0	0	1	0	15	2	17	30
% App. Total	0	0	0	0	0	100	0	100	100	0	0	0	0	88.2	11.8		
PHF	.000	.000	.000	.000	.000	.750	.000	.750	.250	.000	.000	.250	.000	.536	.500	.531	.682

**Accurate Counts**  
978-664-2565

N/S Street : Perham St / Town Hall Dr  
E/W Street: Billerica Road (Route 129)  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730004  
Site Code : 63730004  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Cars**

Start Time	Town Hall Dr From North			Billerica Rd From East			Perham St From South			Billerica Rd From West			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 AM	0	0	0	1	31	0	1	0	0	0	202	0	235
07:15 AM	1	0	0	0	32	0	3	0	0	0	221	0	257
07:30 AM	0	0	0	1	49	0	4	0	1	1	231	2	289
07:45 AM	0	0	0	0	65	1	2	0	3	0	222	1	294
<b>Total</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>177</b>	<b>1</b>	<b>10</b>	<b>0</b>	<b>4</b>	<b>1</b>	<b>876</b>	<b>3</b>	<b>1075</b>
08:00 AM	3	0	0	0	48	0	0	0	1	0	215	2	269
08:15 AM	0	0	0	0	57	0	6	0	11	0	208	1	283
08:30 AM	0	0	1	0	39	0	10	1	33	0	185	0	269
08:45 AM	0	0	0	0	81	1	6	0	33	0	178	1	300
<b>Total</b>	<b>3</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>225</b>	<b>1</b>	<b>22</b>	<b>1</b>	<b>78</b>	<b>0</b>	<b>786</b>	<b>4</b>	<b>1121</b>
<b>Grand Total</b>	<b>4</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>402</b>	<b>2</b>	<b>32</b>	<b>1</b>	<b>82</b>	<b>1</b>	<b>1662</b>	<b>7</b>	<b>2196</b>
Apprch %	80	0	20	0.5	99	0.5	27.8	0.9	71.3	0.1	99.5	0.4	
Total %	0.2	0	0	0.1	18.3	0.1	1.5	0	3.7	0	75.7	0.3	

Start Time	Town Hall Dr From North				Billerica Rd From East				Perham St From South				Billerica Rd From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	0	0	0	0	1	49	0	50	4	0	1	5	1	231	2	234	289
07:45 AM	0	0	0	0	0	65	1	66	2	0	3	5	0	222	1	223	294
08:00 AM	3	0	0	3	0	48	0	48	0	0	1	1	0	215	2	217	269
08:15 AM	0	0	0	0	0	57	0	57	6	0	11	17	0	208	1	209	283
<b>Total Volume</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>1</b>	<b>219</b>	<b>1</b>	<b>221</b>	<b>12</b>	<b>0</b>	<b>16</b>	<b>28</b>	<b>1</b>	<b>876</b>	<b>6</b>	<b>883</b>	<b>1135</b>
% App. Total	100	0	0		0.5	99.1	0.5		42.9	0	57.1		0.1	99.2	0.7		
PHF	.250	.000	.000	.250	.250	.842	.250	.837	.500	.000	.364	.412	.250	.948	.750	.943	.965

**Accurate Counts**  
978-664-2565

N/S Street : Perham St / Town Hall Dr  
E/W Street: Billerica Road (Route 129)  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730004  
Site Code : 63730004  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Trucks**

Start Time	Town Hall Dr From North			Billerica Rd From East			Perham St From South			Billerica Rd From West			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
07:00 AM	0	0	0	0	2	0	0	0	0	0	3	0	5
07:15 AM	0	0	0	0	2	0	0	0	0	0	4	0	6
07:30 AM	0	0	0	0	0	0	0	0	0	0	4	0	4
07:45 AM	0	0	0	0	6	0	0	0	0	0	4	0	10
Total	0	0	0	0	10	0	0	0	0	0	15	0	25
08:00 AM	0	0	0	0	5	0	0	0	0	0	6	2	13
08:15 AM	0	0	0	0	1	0	0	0	0	0	3	0	4
08:30 AM	0	0	0	0	2	0	0	0	0	0	6	0	8
08:45 AM	0	0	0	0	1	0	0	0	0	0	4	1	6
Total	0	0	0	0	9	0	0	0	0	0	19	3	31
Grand Total	0	0	0	0	19	0	0	0	0	0	34	3	56
Apprch %	0	0	0	0	100	0	0	0	0	0	91.9	8.1	
Total %	0	0	0	0	33.9	0	0	0	0	0	60.7	5.4	

Start Time	Town Hall Dr From North				Billerica Rd From East				Perham St From South				Billerica Rd From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:45 AM																	
07:45 AM	0	0	0	0	0	6	0	6	0	0	0	0	0	4	0	4	10
08:00 AM	0	0	0	0	0	5	0	5	0	0	0	0	0	6	2	8	13
08:15 AM	0	0	0	0	0	1	0	1	0	0	0	0	0	3	0	3	4
08:30 AM	0	0	0	0	0	2	0	2	0	0	0	0	0	6	0	6	8
Total Volume	0	0	0	0	0	14	0	14	0	0	0	0	0	19	2	21	35
% App. Total	0	0	0	0	0	100	0		0	0	0		0	90.5	9.5		
PHF	.000	.000	.000	.000	.000	.583	.000	.583	.000	.000	.000	.000	.000	.792	.250	.656	.673

**Accurate Counts**  
978-664-2565

N/S Street : Perham St / Town Hall Dr  
E/W Street: Billerica Road (Route 129)  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730004  
Site Code : 63730004  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Cars - Trucks**

Start Time	Town Hall Dr From North			Billerica Rd From East			Perham St From South			Billerica Rd From West			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
03:00 PM	2	0	0	2	100	0	1	0	3	0	90	2	200
03:15 PM	0	0	2	0	109	0	0	0	1	0	98	1	211
03:30 PM	0	0	0	5	137	0	3	1	2	0	80	4	232
03:45 PM	0	0	0	3	99	0	2	0	3	0	50	2	159
Total	2	0	2	10	445	0	6	1	9	0	318	9	802
04:00 PM	0	0	0	1	109	0	1	0	1	0	69	3	184
04:15 PM	0	0	0	4	114	0	0	0	4	0	90	3	215
04:30 PM	0	0	0	1	106	0	2	0	0	0	86	2	197
04:45 PM	0	0	0	1	111	0	0	0	1	0	71	3	187
Total	0	0	0	7	440	0	3	0	6	0	316	11	783
05:00 PM	0	0	0	1	143	1	1	0	0	0	80	4	230
05:15 PM	0	0	0	3	162	1	0	0	0	0	98	1	265
05:30 PM	0	0	0	2	170	0	0	0	0	1	82	2	257
05:45 PM	0	0	0	3	147	1	0	0	0	3	93	1	248
Total	0	0	0	9	622	3	1	0	0	4	353	8	1000
Grand Total	2	0	2	26	1507	3	10	1	15	4	987	28	2585
Apprch %	50	0	50	1.7	98.1	0.2	38.5	3.8	57.7	0.4	96.9	2.7	
Total %	0.1	0	0.1	1	58.3	0.1	0.4	0	0.6	0.2	38.2	1.1	
Cars	2	0	2	26	1491	3	9	1	15	4	953	26	2532
% Cars	100	0	100	100	98.9	100	90	100	100	100	96.6	92.9	97.9
Trucks	0	0	0	0	16	0	1	0	0	0	34	2	53
% Trucks	0	0	0	0	1.1	0	10	0	0	0	3.4	7.1	2.1

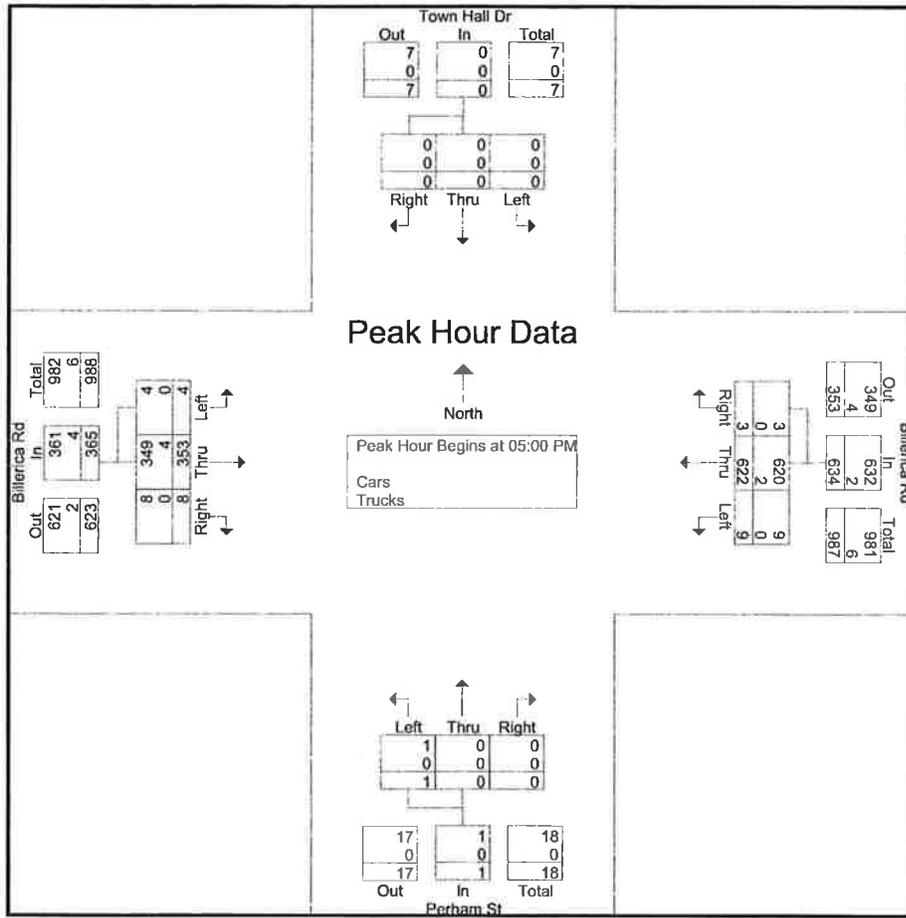
Start Time	Town Hall Dr From North				Billerica Rd From East				Perham St From South				Billerica Rd From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 05:00 PM																	
05:00 PM	0	0	0	0	1	143	1	145	1	0	0	1	0	80	4	84	230
05:15 PM	0	0	0	0	3	162	1	166	0	0	0	0	0	98	1	99	265
05:30 PM	0	0	0	0	2	170	0	172	0	0	0	0	1	82	2	85	257
05:45 PM	0	0	0	0	3	147	1	151	0	0	0	0	3	93	1	97	248
Total Volume	0	0	0	0	9	622	3	634	1	0	0	1	4	353	8	365	1000
% App. Total	0	0	0	0	1.4	98.1	0.5	99.7	100	0	0	100	1.1	96.7	2.2	98.9	99.4
PHF	.000	.000	.000	.000	.750	.915	.750	.922	.250	.000	.000	.250	.333	.901	.500	.922	.943
Cars	0	0	0	0	9	620	3	632	1	0	0	1	4	349	8	361	994
% Cars	0	0	0	0	100	99.7	100	99.7	100	0	0	100	100	98.9	100	98.9	99.4
Trucks	0	0	0	0	0	2	0	2	0	0	0	0	0	4	0	4	6
% Trucks	0	0	0	0	0	0.3	0	0.3	0	0	0	0	0	1.1	0	1.1	0.6

# Accurate Counts

978-664-2565

N/S Street : Perham St / Town Hall Dr  
 E/W Street: Billerica Road (Route 129)  
 City/State : Chelmsford, MA  
 Weather : Clear

File Name : 63730004  
 Site Code : 63730004  
 Start Date : 10/24/2012  
 Page No : 2



Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1  
 Peak Hour for Each Approach Begins at:

	03:00 PM				05:00 PM				03:30 PM				05:00 PM			
+0 mins.	2	0	0	2	1	143	1	145	3	1	2	6	0	80	4	84
+15 mins.	0	0	2	2	3	162	1	166	2	0	3	5	0	98	1	99
+30 mins.	0	0	0	0	2	170	0	172	1	0	1	2	1	82	2	85
+45 mins.	0	0	0	0	3	147	1	151	0	0	4	4	3	93	1	97
Total Volume	2	0	2	4	9	622	3	634	6	1	10	17	4	353	8	365
% App. Total	50	0	50		1.4	98.1	0.5		35.3	5.9	58.8		1.1	96.7	2.2	
PHF	.250	.000	.250	.500	.750	.915	.750	.922	.500	.250	.625	.708	.333	.901	.500	.922
Cars	2	0	2	4	9	620	3	632	5	1	10	16	4	349	8	361
% Cars	100	0	100	100	100	99.7	100	99.7	83.3	100	100	94.1	100	98.9	100	98.9
Trucks	0	0	0	0	0	2	0	2	1	0	0	1	0	4	0	4
% Trucks	0	0	0	0	0	0.3	0	0.3	16.7	0	0	5.9	0	1.1	0	1.1

**Accurate Counts**  
978-664-2565

N/S Street : Perham St / Town Hall Dr  
E/W Street: Billerica Road (Route 129)  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730004  
Site Code : 63730004  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Cars**

Start Time	Town Hall Dr From North			Billerica Rd From East			Perham St From South			Billerica Rd From West			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
03:00 PM	2	0	0	2	100	0	1	0	3	0	88	2	198
03:15 PM	0	0	2	0	105	0	0	0	1	0	94	0	202
03:30 PM	0	0	0	5	135	0	2	1	2	0	73	3	221
03:45 PM	0	0	0	3	97	0	2	0	3	0	49	2	156
Total	2	0	2	10	437	0	5	1	9	0	304	7	777
04:00 PM	0	0	0	1	105	0	1	0	1	0	66	3	177
04:15 PM	0	0	0	4	114	0	0	0	4	0	85	3	210
04:30 PM	0	0	0	1	104	0	2	0	0	0	82	2	191
04:45 PM	0	0	0	1	111	0	0	0	1	0	67	3	183
Total	0	0	0	7	434	0	3	0	6	0	300	11	761
05:00 PM	0	0	0	1	143	1	1	0	0	0	79	4	229
05:15 PM	0	0	0	3	162	1	0	0	0	0	97	1	264
05:30 PM	0	0	0	2	170	0	0	0	0	1	82	2	257
05:45 PM	0	0	0	3	145	1	0	0	0	3	91	1	244
Total	0	0	0	9	620	3	1	0	0	4	349	8	994
Grand Total	2	0	2	26	1491	3	9	1	15	4	953	26	2532
Apprch %	50	0	50	1.7	98.1	0.2	36	4	60	0.4	96.9	2.6	
Total %	0.1	0	0.1	1	58.9	0.1	0.4	0	0.6	0.2	37.6	1	

Start Time	Town Hall Dr From North				Billerica Rd From East				Perham St From South				Billerica Rd From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 05:00 PM																	
05:00 PM	0	0	0	0	1	143	1	145	1	0	0	1	0	79	4	83	229
05:15 PM	0	0	0	0	3	162	1	166	0	0	0	0	0	97	1	98	264
05:30 PM	0	0	0	0	2	170	0	172	0	0	0	0	1	82	2	85	257
05:45 PM	0	0	0	0	3	145	1	149	0	0	0	0	3	91	1	95	244
Total Volume	0	0	0	0	9	620	3	632	1	0	0	1	4	349	8	361	994
% App. Total	0	0	0		1.4	98.1	0.5		100	0	0		1.1	96.7	2.2		
PHF	.000	.000	.000	.000	.750	.912	.750	.919	.250	.000	.000	.250	.333	.899	.500	.921	.941

**Accurate Counts**  
978-664-2565

N/S Street : Perham St / Town Hall Dr  
E/W Street: Billerica Road (Route 129)  
City/State : Chelmsford, MA  
Weather : Clear

File Name : 63730004  
Site Code : 63730004  
Start Date : 10/24/2012  
Page No : 1

**Groups Printed- Trucks**

Start Time	Town Hall Dr From North			Billerica Rd From East			Perham St From South			Billerica Rd From West			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
03:00 PM	0	0	0	0	0	0	0	0	0	0	2	0	2
03:15 PM	0	0	0	0	4	0	0	0	0	0	4	1	9
03:30 PM	0	0	0	0	2	0	1	0	0	0	7	1	11
03:45 PM	0	0	0	0	2	0	0	0	0	0	1	0	3
<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>14</b>	<b>2</b>	<b>25</b>
04:00 PM	0	0	0	0	4	0	0	0	0	0	3	0	7
04:15 PM	0	0	0	0	0	0	0	0	0	0	5	0	5
04:30 PM	0	0	0	0	2	0	0	0	0	0	4	0	6
04:45 PM	0	0	0	0	0	0	0	0	0	0	4	0	4
<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>16</b>	<b>0</b>	<b>22</b>
05:00 PM	0	0	0	0	0	0	0	0	0	0	1	0	1
05:15 PM	0	0	0	0	0	0	0	0	0	0	1	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	2	0	0	0	0	0	2	0	4
<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>6</b>
<b>Grand Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>16</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>34</b>	<b>2</b>	<b>53</b>
Apprch %	0	0	0	0	100	0	100	0	0	0	94.4	5.6	
Total %	0	0	0	0	30.2	0	1.9	0	0	0	64.2	3.8	

Start Time	Town Hall Dr From North				Billerica Rd From East				Perham St From South				Billerica Rd From West				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 03:15 PM																	
03:15 PM	0	0	0	0	0	4	0	4	0	0	0	0	0	4	1	5	9
03:30 PM	0	0	0	0	0	2	0	2	1	0	0	1	0	7	1	8	11
03:45 PM	0	0	0	0	0	2	0	2	0	0	0	0	0	1	0	1	3
04:00 PM	0	0	0	0	0	4	0	4	0	0	0	0	0	3	0	3	7
<b>Total Volume</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>12</b>	<b>0</b>	<b>12</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>15</b>	<b>2</b>	<b>17</b>	<b>30</b>
<b>% App. Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>100</b>	<b>0</b>	<b>100</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>88.2</b>	<b>11.8</b>		
<b>PHF</b>	<b>.000</b>	<b>.000</b>	<b>.000</b>	<b>.000</b>	<b>.000</b>	<b>.750</b>	<b>.000</b>	<b>.750</b>	<b>.250</b>	<b>.000</b>	<b>.000</b>	<b>.250</b>	<b>.000</b>	<b>.536</b>	<b>.500</b>	<b>.531</b>	<b>.682</b>

SEASONAL ADJUSTMENT DATA

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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, 7079,7080,7090,7091,7092,7093,7094,7095,7096,7097,7106,7178
- 3.MARTHA'S VINEYARD
- 4.NANTUCKET

- \*\*\*GROUP 3B:
- 5.PERMANENTS 2 & 189

- 1066,1067,1068,1069,1085,1086,1087,1088,1089,1090,1091,1092,
- 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

I-84 0.83

0 - 999.....10

> 1,000.....100

ROUND OFF

PUBLIC TRANSPORTATION SCHEDULES

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# LRTA DOWNTOWN SHUTTLE



The LRTA offers a Shuttle between  
**DOWNTOWN LOWELL**  
(JOHN & MERRIMACK STREETS)

&  
**ROBERT B. KENNEDY BUS TRANSFER CENTER**

**Monday - Friday: 5:30 am - 7:00 pm**  
Every 15 minutes

First Shuttle departs Downtown Lowell at 5:30 AM  
Last Shuttle departs Downtown Lowell at 7:00 PM

**Saturday: 7:30 am - 6:00 pm**  
Every 30 minutes

First Shuttle departs Downtown Lowell at 7:30 AM  
Last Shuttle departs Downtown Lowell at 6:00 PM

## TO CATCH A BUS

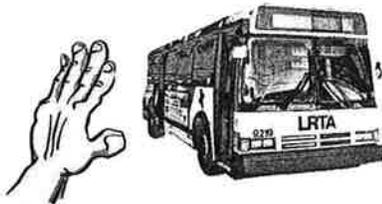
In order to catch a bus, you need only to be at a safe location on the same side of the street as the bus and

## WAVE YOUR HAND

in order to alert the driver to stop.

**OR**

If you are at a designated bus stop, your bus will pick you up and take you to your destination.



## LRTA FARE RATES

### BUS FARES

City/Local/Shuttle - Full Fare .....\$1.00  
City/Local/Shuttle - Reduced Fare .....\$0.50  
Suburban - Full Fare (Additional) .....\$0.50  
Suburban - Reduced Fare (Additional) .....\$0.25

### TRANSFERS (after paying proper fare)

- Only Issued on Inbound Routes
- Only Accepted on Outbound Routes
- Free to the Downtown Shuttle Outbound
- Free from the Downtown Shuttle Inbound to Local Routes Outbound

In-Town - Full Fare .....\$0.25  
In-Town - Reduced Fare .....\$0.10  
Suburban - Full Fare .....\$0.50  
Suburban - Reduced Fare .....\$0.25

### LRTA MONTHLY PASS FARES STORED ON YOUR CHARLIECARD Ride Systemwide Unlimited

Adult Pass for Adult CharlieCard .....\$35  
Student Pass for Student CharlieCard ..\$20  
Senior Pass for Senior CharlieCard .....\$20  
Persons with Disabilities Pass for  
Persons with Disabilities/TAP CharlieCard ..\$20

### CHARLIECARD INFORMATION

Stored Value Minimum First Time Purchase ..\$5  
Registration Fee for Senior CharlieCards and  
CharlieCards for Persons with Disabilities ...\$3

## FARE CATEGORIES

### FULL FARE

Persons from 13 to 59 Years of Age.

**Students:** Elementary School, Middle School and High School students up to and including Grade 12 can purchase an LRTA Monthly Pass at a discounted rate for students. Students without the LRTA Monthly Pass pay full fare.

### REDUCED FARE

**Senior Citizens:** 60 Years of Age or Older with I.D.

**Persons with Disabilities:** With Statewide Transportation Access Pass (TAP) or Medicare Card.

**Children:** From 6 to 12 Years of Age  
**Children 5 and under Ride Free.**  
**Must be accompanied by an adult.**

**THE LRTA WILL NO LONGER ACCEPT  
TOKENS EFFECTIVE 12/31/12**

## FOR BUS INFORMATION

978-452-6161

WWW.LRTA.COM



## BUS SCHEDULES EFFECTIVE MARCH 19, 2012



### BUS INFORMATION

978-452-6161 • WWW.LRTA.COM

### WHERE TO GET YOUR NEW CHARLIECARD AND PURCHASE LRTA MONTHLY PASSES

You must be issued a CharlieCard before you can purchase any LRTA Monthly Passes.

**LRTA GALLAGHER TERMINAL** (145 Thorndike Street, Lowell)  
All LRTA Monthly Passes can be purchased on the last 5 days of each month until the 18th day of the following month at the following locations:

**TICKET VENDING MACHINE (INSIDE LOBBY)**

Also Issues Adult CharlieCards.

**RIDER INFORMATION BOOTH (KENNEDY CENTER)**

Regular Hours: Monday - Friday: 8 AM to 4 PM

Extended Hours last 2 and first 2 business days of each month:

Monday - Friday: 6 AM to 6 PM

Also Issues Adult & Student CharlieCards.

To Get Your Student CharlieCard bring a valid Student ID or Class Schedule from your school.

### LOWELL HIGH SCHOOL CAFETERIA

LHS Students can go to the LHS Cafeteria the last and first school day of each month from 10:40 AM to 1:40 PM during the school year.

Issues Student CharlieCards and Purchase Student Passes

**LRTA ROAD RUNNER OFFICE (978-459-0152)**

113 Thorndike Street, Lowell (Located next to the Kennedy Center)

Monday - Friday: 9 AM to 4 PM

Only Issues Senior CharlieCards & CharlieCards for Persons with Disabilities/TAP.

Monthly Passes cannot be purchased at this location.

To Get Your Senior CharlieCard:

- Bring Photo ID that includes Date of Birth (Must be 60+ years)
- Must Fill Out an Application.
- Senior CharlieCard Registration Fee: \$3

To Get Your CharlieCard for Persons with Disabilities/TAP:

- First time applicants for the TAP ID, or applicants with expired TAP ID Cards need to fill out an application.
- The LRTA will process your application within 14 days of receipt.
- Once approved, you will need to bring a photo ID.
- CharlieCard Registration Fee: \$3

# LRTA DAILY SCHEDULE: MONDAY THROUGH FRIDAY



**INBOUND**

LEAVING KENNEDY CENTER AT  
GALLAGHER INTERMODAL TRANSPORTATION CENTER

TO KENNEDY CENTER AT  
GALLAGHER INTERMODAL TRANSPORTATION CENTER

01 CHRISTIAN HILL	02 BELVIDERE	03 SOUTH LOWELL	04 HIGHLANDS VIA STEVENS	05 WESTFORD STREET/ DRUM HILL	06 BROADWAY/ UMASS LOWELL	07 PAW/LINCOLN/VILLE/ UMASS LOWELL NORTH	08 CENTRALVILLE	09 DOWNTOWN CIRCULATOR	10 DRA CUT/ TYNGSBORO	11 IRS/ RAYTHEON VIA RTE. 133	12 TEWKSBURY VIA RTE. 38	13 BILLERICA VIA EDSON	14 BURLINGTON MALL/ LAHEY CLINIC	15 CHELMSFORD /WESTFORD VIA RTES. 129/110	16 CHELMSFORD VIA CHELMSFORD STREET	17 NORTH CHELMSFORD VIA MIDDLESEX
AM 5:55 BH 6:40 7:40 8:40 9:40 10:40 11:40	AM 6:15 6:45 7:15 7:45 8:15 8:45 9:15 9:45 10:15 10:45 11:15 11:45	AM 6:55 7:30 8:00 8:30 9:00 9:30 10:00 10:30 11:00	AM 6:10 6:35 7:05 7:35 8:05 8:35 9:05 9:35 10:05 10:35 11:05	AM 5:50 B 6:40 7:30 8:20 9:10 10:00 10:50 11:40	AM 6:25 6:55 7:25 7:55 8:25 8:55 9:25 9:55 10:25 10:55 11:25 11:55	AM 6:55 7:25 7:55 8:25 8:55 9:25 9:55 10:25 10:55 11:25 11:55	AM 6:15 6:45 7:15 7:45 8:15 8:45 9:15 9:45 10:15 10:45 11:15	AM 6:10 6:40 7:10 7:40 8:10 8:40 9:10 9:40 10:10 10:40 11:10	AM 6:35 7:05 7:35 8:05 8:35 9:05 9:35 10:05 10:35 11:05	AM 6:00 6:30 7:00	AM 7:00 7:30 8:00 8:30 9:00 9:30 10:00 10:30 11:00	AM 6:30 7:00 7:30 8:00 8:30 9:00 9:30 10:00 10:30 11:00	AM 6:00 6:30 7:00 7:30 8:00 8:30 9:00 9:30 10:00 10:30 11:00	AM 6:45 7:15 7:45 8:15 8:45 9:15 9:45 10:15 10:45 11:15	AM 6:15 C 6:40 C 7:10 7:30 8:00 8:20 8:50 9:20 9:50 10:20 10:50	AM 6:20 6:45 7:15 7:45 8:15 8:45 9:15 9:45 10:15 10:45 11:15
PM 12:40 1:40 2:40 3:40 4:40 5:45 6:50	PM 12:15 12:45 1:15 1:45 2:15 2:45 3:15 3:45 4:15 4:45 5:15 5:45 6:15 6:50	PM 12:00 1:00 2:00 2:40 S,P 3:15 3:50 4:15 4:45 5:00 5:30 6:00 6:35	PM 12:40 1:40 2:40 2:40 S,P 3:15 3:50 4:00 4:30 5:00 5:30 6:00 6:30	PM 12:00 12:30 1:05 1:40 2:15 2:50 3:20 3:50 4:20 4:50 5:10 5:40 6:10 6:50	PM 12:30 1:05 1:35 2:05 2:35 3:05 3:35 4:05 4:35 5:05 5:35 6:05 6:35	PM 12:25 1:25 2:25 3:25 4:25 5:25 6:25 7:25 8:25 9:25 10:25 11:25	PM 12:20 1:20 2:20 3:20 4:20 5:20 6:20	PM 12:30 1:10 2:10 3:10 4:10 5:10 6:10 7:10 8:10	PM 12:40 JD 1:40 JD 2:40 JD 3:40 JD 4:35 JD 5:30 JD	PM 3:00 4:00	PM 12:00 1:00 2:00 2:40 S,P 3:00 4:10 5:10 6:00	PM 12:20 1:20 2:20 2:40 S,P 3:10 4:10 5:10 6:00	PM 12:00 1:00 2:00 2:40 S,P 3:10 4:10 5:00 6:00	PM 12:45 1:15 1:45 2:15 2:45 3:15 3:45 4:15 4:45 5:15 5:45 6:15	PM 1:00 2:30 3:00 4:00 4:50 5:30 7:00	PM 12:25 1:25 2:25 3:20 4:00 4:50 5:35 6:35
AM 6:40 7:05 7:45 8:05 8:55 10:05 11:05	AM 6:20 DT 6:50 DT 7:05 S 7:20 DT 7:50 DT 8:20 DT 8:50 9:20 9:50 10:20 10:50 11:20 11:50	AM 6:15 6:55 7:20 7:50 8:20 DT 8:50 9:20 9:50 10:20 10:50 11:20	AM 6:55 7:30 7:55 S 8:20 8:50 9:20 9:50 10:20 10:50 11:20 11:50	AM 6:00 6:30 6:55 7:20 7:50 S 8:20 8:50 9:20 9:50 10:20 10:50 11:20 11:50	AM 6:20 6:55 7:20 7:50 S 8:20 8:50 9:20 9:50 10:20 10:50 11:20 11:50	AM 6:50 7:25 7:55 8:20 8:50 9:20 9:50 10:20 10:50 11:20 11:50	AM 6:10 6:40 7:10 7:40 8:10 8:40 9:10 9:40 10:10 10:40 11:10	AM 6:30 7:00 7:30 8:00 8:30 9:00 9:30 10:00 10:30 11:00	AM 6:10 6:40 7:10 7:40 8:10 8:40 9:10 9:40 10:10 10:40 11:10	AM 6:30 7:30	AM 6:45 7:30 8:15 9:00 9:45 10:30 11:15	AM 5:30 E 6:10 E 7:00 7:45 8:30 9:15 10:00 10:45 11:30	AM 7:00 8:00 9:00 10:00 10:30	AM 6:00 7:30 8:00 9:15 SR 9:45 SR 10:15 SR 10:45 SR	AM 6:00 C 6:25 C 7:15 S 7:45 SR 8:00 9:00 10:00 11:00	AM 6:00 7:00 7:15 S 8:00 9:00 10:00 11:00
PM 12:05 1:05 2:05 3:10 4:10 5:10 6:15 7:15	PM 12:20 12:50 1:20 1:50 2:20 2:50 3:20 3:50 4:20 4:50 5:20 5:50 6:20 6:50 7:20	PM 12:20 1:20 2:20 3:10 S 3:40 4:20 5:00 5:30 6:10	PM 12:00 1:00 2:00 3:05 3:35 4:20 5:00 5:30 6:15	PM 12:20 12:50 1:20 1:50 2:20 2:50 3:20 3:50 4:20 4:50 5:20 5:50 6:20 6:50 7:10	PM 12:10 12:45 1:20 1:55 2:30 3:05 3:35 4:15 4:50 5:25 6:00	PM 12:25 1:25 2:25 3:25 4:25 5:25 6:25 7:25	PM 12:40 1:40 2:40 3:40 4:40 5:40 6:40	PM 12:30 1:30 2:30 3:30 4:30 5:30 6:30	PM 12:25 JD 1:25 JD 2:25 JD 3:25 JD 4:25 JD 5:20 JD 6:25 JD	PM 3:30 4:30	PM 12:50 1:50 2:50 3:50 4:50 5:50 6:50	PM 12:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00	PM 12:00 1:30 2:00 3:00 4:00 5:00 6:00 7:00	PM 12:00 1:30 2:00 3:00 4:00 5:00 6:00 7:00	PM 12:15 SR 1:45 SR 2:00 3:15 SR 4:45 SR 5:30 SR 6:10	PM 12:00 1:00 2:00 3:00 4:05 SR 4:45 SR 5:05 5:35 6:10

**LEGEND**  
 B Stems at Pleasant Blvd. & Baldwin Street  
 C Starts/Terminates at the Radisson (Does Not Service Needon Brook Center)  
 CH Combination Route with Christian Hill  
 D Terminates at Drum Hill  
 DT Inbound via Downtown  
 E Starts/Terminates at Lowell/Cheholford Line  
 F Terminates at Downtown  
 JD On Call for Inmate D'Arcy (Bridge Street) & Dorset Senior Housing  
 MB Starts at Market Basket & Bridge Street  
 P On School Days Leaves from Paige & Kirk  
 S Supplemental Service on School Days Only (Does Not Service Kennedy Center)  
 SR On Call for South Row Plaza

## LRTA SATURDAY SCHEDULE

\* ROUTES 3 & 4 ARE COMBINED INTO ONE ROUTE ON SATURDAY

\*\* ROUTES 6 & 9 ARE COMBINED INTO ONE ROUTE ON SATURDAY

## LRTA SATURDAY SCHEDULE

**INBOUND**

**OUTBOUND**

AM 9:20 11:20	AM 7:50 8:50 9:50 10:50	* AM 8:00 10:00	* AM 8:00 10:00	AM 8:10 9:10 10:10 11:10	** AM 9:30 11:30	AM 7:45 8:45 9:45 10:45 11:45	AM 9:20 CH 11:20 CH	** AM 9:30 11:30	AM 8:45 10:15 11:45	AM 7:00 9:00 11:00	AM 7:30 9:00 10:30	AM 8:00 9:40 11:20	AM 8:00 9:40 11:20	AM 8:20 9:40 11:00	AM 8:45 10:15 11:45
PM 1:20 3:20 5:20	PM 12:50 1:50 2:50 4:50 5:50	PM 12:00 2:00 4:00	PM 12:00 2:00 4:00	PM 12:10 1:10 2:10 3:10 4:10 5:10 6:10	PM 1:30 3:30 5:30	PM 12:45 1:45 2:45 3:45 4:50 5:50	PM 1:20 CH 3:20 CH 5:20 CH	PM 1:30 3:30 5:30	PM 1:15 2:45 4:15	PM 1:00 3:00	PM 1:00 1:30 3:00 4:30	PM 1:00 1:30 3:00 4:30	PM 1:00 1:30 3:00 4:30	PM 12:20 1:40 3:00 5:40	PM 1:15 2:45 4:15
AM 9:35 11:35	AM 8:25 9:25 10:25 11:25	AM 8:25 10:25	AM 8:25 10:25	AM 8:30 9:30 10:30 11:30	AM 9:45 11:45	AM 8:20 9:20 10:20 11:20	AM 9:35 CH 11:35 CH	AM 9:45 11:45	AM 9:30 11:00	AM 7:45 9:45 11:45	AM 8:10 9:40 10:30 11:10	AM 8:50 10:30	AM 8:50 10:30	AM 8:55 SR 10:15 SR 11:35 SR	AM 7:50 9:20 10:50
PM 1:35 3:35 5:35	PM 12:25 1:25 2:25 4:25 5:25	PM 12:25 2:25 4:25	PM 12:25 2:25 4:25	PM 12:30 1:30 2:30 3:30 4:30 5:30	PM 1:45 3:45 5:45	PM 12:20 1:20 2:20 3:20 4:20 5:20	PM 1:35 CH 3:35 CH 5:35 CH	PM 1:45 3:45 5:45	PM 1:20 2:50 5:00	PM 1:45 3:45	PM 12:40 2:10 3:40 5:10	PM 12:10 1:50 3:25 5:25	PM 12:10 1:50 3:25 5:25	PM 12:45 SR 2:15 SR 3:45 SR 4:55 SR	PM 12:20 1:50 3:20 4:50

- For your convenience, making all these stops along the way
- 1 The Kennedy Center
  - 2 Gorham St & Carlisle Sts
  - 3 United Parcel Service
  - 4 Alpha Road
  - 5 Harvard Pilgrim
  - 6 Chelmsford Center
  - 7 Littleton & Hunt Roads
  - 8 Kidder Rd
  - 9 Nashoba Regional Tech
  - 10 Hampton Inn
  - 11 Westford Valley Market Place
  - 12 Westford Regency
  - 13 Residence Inn
  - 14 IBM

**Lowell Regional Transit Authority**

**Route 15**

**Chelmsford & Westford**

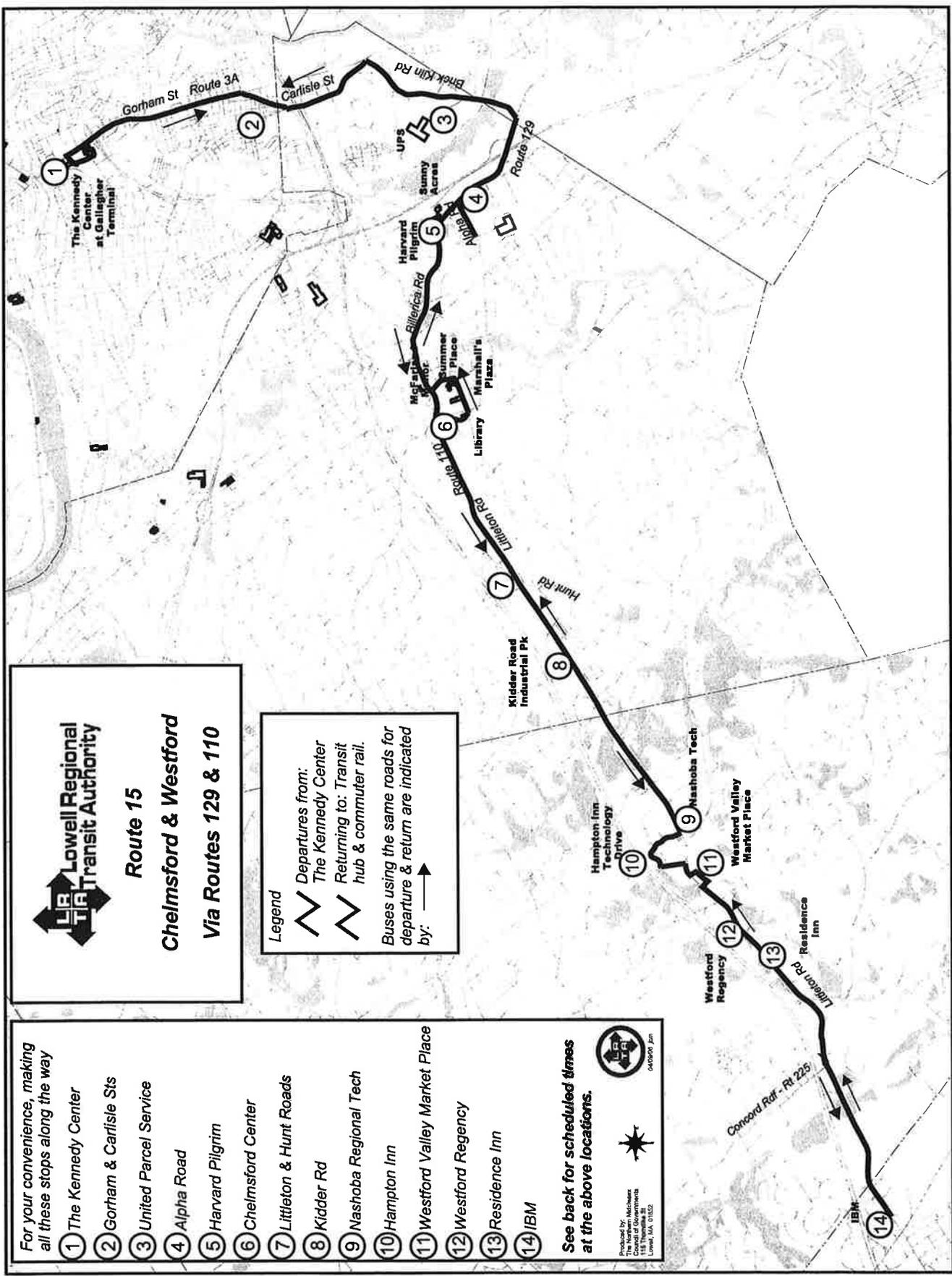
**Via Routes 129 & 110**

**Legend**

Departures from:  
The Kennedy Center

Returning to: Transit hub & commuter rail.

Buses using the same roads for departure & return are indicated by: →



See back for scheduled times at the above locations.

Prepared by: Melissa  
Council of Governments  
Lowell, MA 01522

04/2009 km

15 Chelmsford\Westford Via Rte 129/110

Please visit [lra.com](http://lra.com) or call (978) 452-6161 for more information

Effective 8/26/2009

**Outbound**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Kennedy Center & Gallagher	Carlisle St & Gorham St	UPS	Alpha Rd	Harvard Pilgrim Vanguard	Chelmsford Center	Littleton Rd & Hunt Rd	Kidder Road	Nashoba Tech	Hampton Inn Technology Drive	Westford Valley Market Place	Westford Regency Hotel	Residence Inn	IBM
AM	6:45	6:50	6:55	6:59	7:02	7:06	7:09	7:10	7:12	7:14	7:17	7:20	7:21	7:30
	8:15	8:20	8:25	8:29	8:32	8:36	8:39	8:40	8:42	8:44	8:47	8:50	8:51	9:00
	9:45	9:50	9:55	9:59	10:02	10:06	10:09	10:10	10:12	10:14	10:17	10:20	10:21	10:30
	11:15	11:20	11:25	11:29	11:32	11:36	11:39	11:40	11:42	11:44	11:47	11:50	11:51	12:00
PM	12:45	12:50	12:55	12:59	1:02	1:06	1:09	1:10	1:12	1:14	1:17	1:20	1:21	1:30
	2:15	2:20	2:25	2:29	2:32	2:36	2:39	2:40	2:42	2:44	2:47	2:50	2:51	3:00
	3:45	3:50	3:55	3:59	4:02	4:06	4:09	4:10	4:12	4:14	4:17	4:20	4:21	4:30
	5:15	5:20	5:25	5:29	5:32	5:36	5:39	5:40	5:42	5:44	5:47	5:50	5:51	6:00
	6:15	6:20	6:25	6:29	6:32	6:36	6:39	6:40	6:42	6:44	6:47	6:50	6:51	7:00

^ Services UPS Waiting Area

**Weekday Schedule**

	14	13	12	11	10	9	8	7	6	5	4	3	2	1
	IBM	Residence Inn	Westford Regency Hotel	Westford Valley Market Place	Hampton Inn Technology Drive	Nashoba Tech	Kidder Road	Littleton Rd & Hunt Rd	Chelmsford Center	Harvard Pilgrim Vanguard	Alpha Rd	UPS	Carlisle St. & Gorham	Kennedy Center Gallagher
AM	6:00	6:02	6:03	6:06	6:08	6:10	6:13	6:14	6:16	6:24	6:26	6:31	6:36	6:45
	7:30	7:32	7:33	7:36	7:38	7:40	7:43	7:44	7:46	7:54	7:56	8:01	8:06	8:15
	9:00	9:02	9:03	9:06	9:08	9:10	9:13	9:14	9:16	9:24	9:26	9:31	9:36	9:45
	10:30	10:32	10:33	10:36	10:38	10:40	10:43	10:44	10:46	10:54	10:56	11:01	11:06	11:15
PM	12:00	12:02	12:03	12:06	12:08	12:10	12:13	12:14	12:16	12:24	12:26	12:31	12:36	12:45
	1:30	1:32	1:33	1:36	1:38	1:40	1:43	1:44	1:46	1:54	1:56	2:01	2:06	2:15
	3:00	3:02	3:03	3:06	3:08	3:10	3:13	3:14	3:16	3:24	3:26	3:31	3:36	3:45
	4:30	4:32	4:33	4:36	4:38	4:40	4:43	4:44	4:46	4:54	4:56	5:01	5:06	5:15
	6:00	6:02	6:03	6:06	6:08	6:10	6:13	6:14	6:16	6:24	6:26	6:31	6:36	6:45
	7:00	7:02	7:03	7:06	7:08	7:10	7:13	7:14	7:16	7:24	7:26	7:31	7:36	7:45

^ Services UPS Waiting Area

**No Saturday Service**

**Holiday Schedule**

**Outbound**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Kenned Center Gallagher	Carlisle St. & Gorham	UPS	Alpha Rd	Harvard Pilgrim Vanguard	Chelmsford Center	Littleton Rd & Hunt Rd	Kidder Road	Nashoba Tech	Hampton Inn Technology Drive	Westford Valley Market Place	Westford Regency Hotel	Residence Inn	IBM
	7:00	7:05	7:10	7:14	7:17	7:21	7:24	7:25	7:27	7:29	7:32	7:35	7:36	7:45
	8:30	8:35	8:40	8:44	8:47	8:51	8:54	8:55	8:57	8:59	9:02	9:05	9:06	9:15
AM	10:00	10:05	10:10	10:14	10:17	10:21	10:24	10:25	10:27	10:29	10:32	10:35	10:36	10:45
PM	1:00	1:05	1:10	1:14	1:17	1:21	1:24	1:25	1:27	1:29	1:32	1:35	1:36	1:45
	3:30	3:35	3:40	3:44	3:47	3:51	3:54	3:55	3:57	3:59	4:02	4:05	4:06	4:15

**Inbound**

	14	13	12	11	10	9	8	7	6	5	4	3	2	1
	IBM	Residence Inn	Westford Regency Hotel	Westford Valley Market Place	Hampton Inn Technology Drive	Nashoba Tech	Kidder Road	Littleton Rd & Hunt Rd	Chelmsford Center	Harvard Pilgrim Vanguard	Alpha Rd	UPS	Carlisle St. & Gorham	Kennedy Center Gallagher
	7:45	7:47	7:48	7:51	7:53	7:55	7:58	7:59	8:01	8:09	8:11	8:16	8:21	8:30
	9:15	9:17	9:18	9:21	9:23	9:25	9:28	9:29	9:31	9:39	9:41	9:46	9:51	10:00
AM	10:45	10:47	10:48	10:51	10:53	10:55	10:58	10:59	11:01	11:09	11:11	11:16	11:21	11:30
PM	1:45	1:47	1:48	1:51	1:53	1:55	1:58	1:59	2:01	2:09	2:11	2:16	2:21	2:30
	4:15	4:17	4:18	4:21	4:23	4:25	4:28	4:29	4:31	4:39	4:41	4:46	4:51	5:00



Lowell Line Effective July 1, 2012

Monday through Friday

Inbound to North Station

Table with 24 columns representing train numbers and times for various stations from Lowell to North Station.

Outbound from North Station

Table with 24 columns representing train numbers and times for various stations from North Station to Lowell.

Saturday and Sunday

Inbound to North Station

Table with 24 columns representing train numbers and times for various stations from Lowell to North Station on weekends.

Outbound from North Station

Table with 24 columns representing train numbers and times for various stations from North Station to Lowell on weekends.

Notes: This schedule is effective July 1, 2012 and replaces the schedule of November 22, 2010.

Times shown in this schedule are train departure times; customers are asked to arrive at the station platform for a prompt departure.

Holiday Service: Trains will operate on a Saturday or Sunday service on the holidays indicated.

Saturday Service: President's Day and 4th of July (train no. 1315 may be held for 30 minutes after the conclusion of the 4th of July fireworks)

Sunday Service: New Year's Day, Memorial Day, Labor Day, Thanksgiving Day and Christmas Day.

All other holidays: Regular service is provided on all other holidays. Consult 'Service Updates' at www.mbta.com or call Customer Service at 617-222-3200 for any extra service that may be provided.

Times in red indicate an L stop. Passengers must notify the conductor that they wish to get off at these designated stations. Passengers who wish to board at these designated stations must be on the platform in full view of the engineer.

Times in blue indicate an L stop. This is a regular stop to discharge or pick up passengers; however the train may leave ahead of schedule.

VIA HAV - operates via the Haverhill line between Wilmington and Haverhill Stations. See the Haverhill line schedule for all stops.

☿ Bicycles are allowed on trains with the bicycle symbol shown above the train number.

Shaded area indicates peak hour trains.

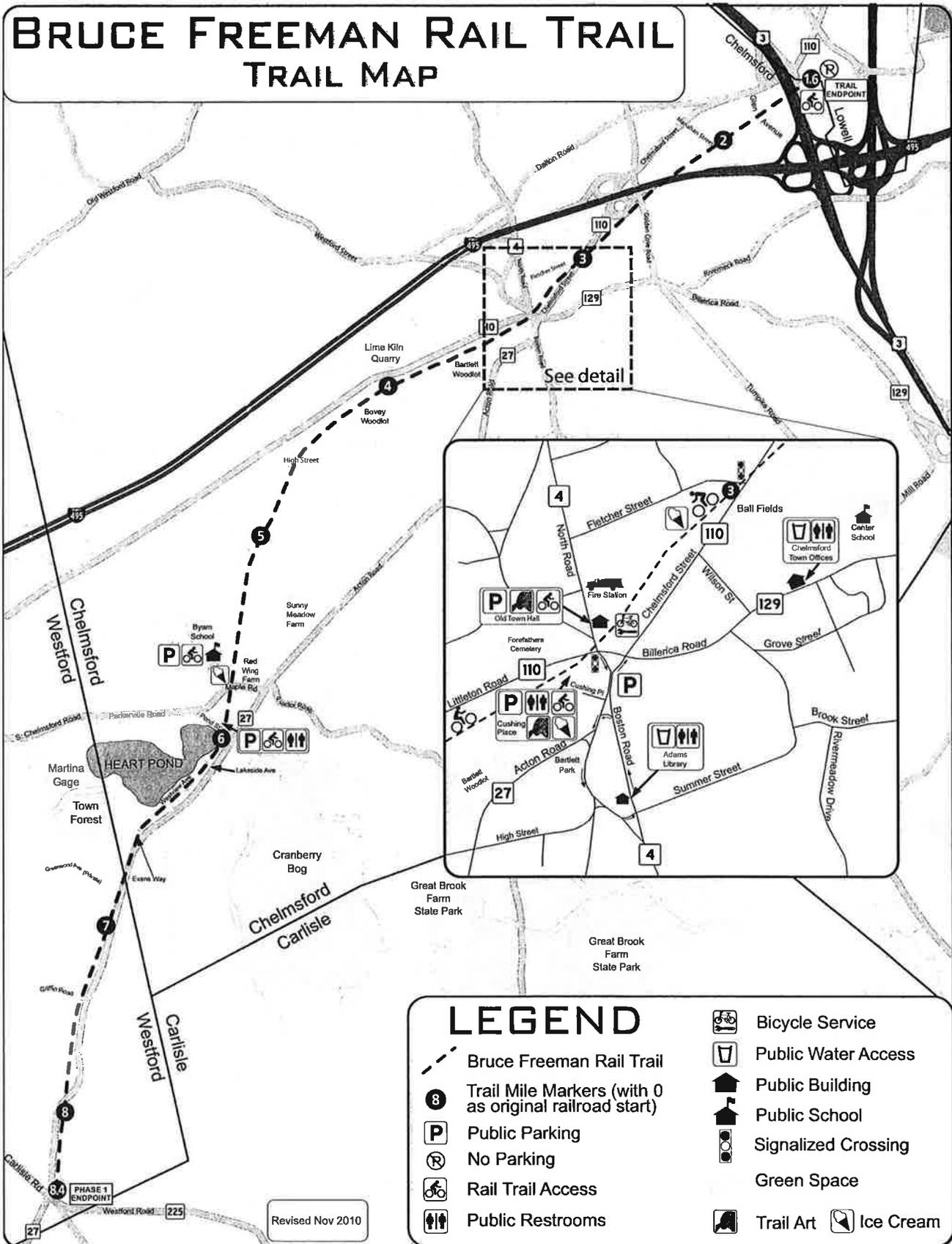
Scan the QR code on your smartphone to load the MBTA's mobile web site and receive access to schedules, T-Alerts and service updates.



**BICYCLE TRAILS MAP**

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# BRUCE FREEMAN RAIL TRAIL TRAIL MAP



Revised Nov 2010

## LEGEND

- Bruce Freeman Rail Trail
- Trail Mile Markers (with 0 as original railroad start)
- Public Parking
- No Parking
- Rail Trail Access
- Public Restrooms
- Bicycle Service
- Public Water Access
- Public Building
- Public School
- Signalized Crossing
- Green Space
- Trail Art
- Ice Cream

VEHICLE TRAVEL SPEED DATA

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## Accurate Counts 978-664-2565

Location : Billerica Road (Route 129)  
 Location : at #50 Billerica Road  
 City/State: Chelmsford, MA

Start Time	15	16	21	26	31	36	41	46	51	56	61	66	71	76	81	85th Percent	95th Percent
10/25/12	0	0	0	3	5	6	0	0	0	0	0	0	0	0	0	14	40
01:00	0	0	0	2	9	2	1	0	0	0	0	0	0	0	0	14	37
02:00	0	0	0	3	3	4	0	0	0	0	0	0	0	0	0	10	39
03:00	0	0	0	1	4	3	0	1	1	0	0	0	0	0	0	10	47
04:00	0	0	2	1	5	8	1	0	0	0	0	0	0	0	0	17	39
05:00	0	0	0	4	28	42	12	0	0	0	0	0	0	0	0	86	43
06:00	9	2	8	61	283	133	9	1	0	0	0	0	0	0	0	506	39
07:00	201	89	91	126	212	71	2	0	0	0	0	0	0	0	0	792	36
08:00	174	102	148	182	163	32	1	0	0	0	0	0	0	0	0	802	34
09:00	12	0	14	81	194	96	4	0	0	0	0	0	0	0	0	401	37
10:00	13	0	12	55	110	62	7	3	0	0	0	0	0	0	0	262	40
11:00	14	2	11	59	127	65	5	0	0	0	0	0	0	0	0	283	39
12 PM	17	4	14	85	202	75	4	1	0	0	0	0	0	0	0	402	39
13:00	9	1	10	74	189	67	12	0	0	0	0	0	0	0	0	362	40
14:00	14	2	21	52	132	76	8	0	0	0	0	0	0	0	0	305	37
15:00	23	3	13	70	164	49	11	0	0	0	0	0	0	0	0	333	39
16:00	15	4	8	52	164	68	14	1	1	0	0	0	0	0	0	327	37
17:00	13	0	4	74	170	81	11	0	0	0	0	0	0	0	0	353	40
18:00	23	1	9	79	136	47	5	0	1	0	0	0	0	0	0	301	39
19:00	4	1	6	40	106	48	3	0	0	0	0	0	0	0	0	208	37
20:00	4	2	0	27	58	33	5	0	0	0	0	0	0	0	0	129	40
21:00	3	0	3	28	38	27	2	0	0	0	0	0	0	0	0	101	39
22:00	0	1	0	7	28	11	4	0	0	0	0	0	0	0	0	51	41
23:00	0	0	0	4	12	9	2	0	0	0	0	0	0	0	0	27	39
Total	548	214	374	1170	2542	1115	123	7	3	0	0	0	0	0	0	6096	
Percent	9.0%	3.5%	6.1%	19.2%	41.7%	18.3%	2.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
AM Peak	07:00	08:00	08:00	08:00	06:00	06:00	05:00	10:00	03:00							08:00	
PM Peak	15:00	12:00	14:00	12:00	12:00	17:00	16:00	12:00	16:00	12:00	12:00	12:00	16:00	12:00	12:00	12:00	12:00
Vol.	23	4	21	85	202	81	14	1	1	1	4	1	4	1	1	402	
Total	1133	463	797	2521	4919	2071	241	16	4	1	0	0	0	0	0	12166	
Percent	9.3%	3.8%	6.6%	20.7%	40.4%	17.0%	2.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		

Stat	Value
15th Percentile :	13 MPH
50th Percentile :	30 MPH
85th Percentile :	36 MPH
95th Percentile :	39 MPH
10 MPH Pace Speed :	28-37 MPH
Number in Pace :	6639
Percent in Pace :	54.6%
Number of Vehicles > 30 MPH :	7252
Percent of Vehicles > 30 MPH :	59.6%
Mean Speed(Average) :	28 MPH

### Accurate Counts 978-664-2565

Location : Billerica Road (Route 129)  
 Location : at #50 Billerica Road  
 City/State: Chelmsford, MA  
 Westbound

Start Time	1	15	20	21	25	26	30	31	35	36	40	41	45	46	50	51	55	56	60	61	65	66	70	71	75	76	799	Total	85th Percent	95th Percent
10/25/12	0	0	0	0	0	3	3	8	8	9	9	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	21	38	41
01:00	1	0	0	0	0	1	1	9	9	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	14	38	46	
02:00	0	0	0	0	0	0	0	3	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	6	40	43	
03:00	0	0	0	0	0	0	0	8	8	3	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	12	38	41	
04:00	0	0	0	1	1	1	1	7	7	4	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	15	39	43	
05:00	1	0	0	1	1	14	14	25	25	15	15	1	1	2	2	2	2	0	0	0	0	0	0	0	0	0	61	38	47	
06:00	9	2	7	7	7	25	25	48	48	21	21	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	115	36	39	
07:00	30	9	13	13	13	42	42	54	54	14	14	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	163	33	36	
08:00	33	8	10	10	10	61	61	91	91	28	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	231	34	37	
09:00	24	4	8	8	8	53	53	115	115	31	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	235	35	37	
10:00	9	13	20	20	20	61	61	85	85	31	31	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	224	35	39	
11:00	9	9	18	18	18	121	121	155	155	42	42	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	356	35	38	
12 PM	20	7	8	8	8	117	117	185	185	61	61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	398	35	38	
13:00	12	17	17	17	17	66	66	125	125	51	51	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	281	36	38	
14:00	10	9	17	17	17	79	79	147	147	55	55	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	320	36	38	
15:00	11	16	20	20	20	101	101	208	208	68	68	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	431	35	39	
16:00	21	18	7	7	7	139	139	207	207	74	74	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	470	35	38	
17:00	11	4	4	4	4	189	189	219	219	49	49	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	520	34	37	
18:00	9	4	4	4	4	172	172	195	195	51	51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	459	34	37	
19:00	2	1	4	4	4	90	90	123	123	45	45	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	270	36	39	
20:00	3	1	1	1	1	26	26	94	94	48	48	4	4	2	2	0	0	0	0	0	0	0	0	0	0	0	179	37	40	
21:00	0	0	0	1	1	16	16	70	70	31	31	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	121	37	40	
22:00	0	0	0	3	3	9	9	44	44	24	24	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	83	38	40	
23:00	0	0	0	0	0	2	2	18	18	19	19	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	41	39	41	
Total	215	122	219	219	219	1388	1388	2243	2243	777	777	52	52	8	8	2	2	0	0	0	0	0	0	0	0	0	5026			
Percent	4.3%	2.4%	4.4%	4.4%	4.4%	27.6%	27.6%	44.6%	44.6%	15.5%	15.5%	1.0%	1.0%	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%				
AM Peak	08:00	10:00	10:00	10:00	10:00	11:00	11:00	11:00	11:00	11:00	11:00	10:00	10:00	05:00	05:00	05:00	05:00	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	11:00			
PM Peak	16:00	16:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	16:00	16:00	15:00	15:00	20:00	20:00	20:00	20:00	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17:00			
Vol.	21	18	44	44	44	189	189	219	219	74	74	7	7	2	2	2	2	0	0	0	0	0	0	0	0	0	520			
Total	511	286	544	544	544	2909	2909	4321	4321	1360	1360	108	108	12	12	2	2	0	0	0	0	0	0	0	0	0	10053			
Percent	5.1%	2.8%	5.4%	5.4%	5.4%	28.9%	28.9%	43.0%	43.0%	13.5%	13.5%	1.1%	1.1%	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%				
																	15th Percentile :	22 MPH												
																	50th Percentile :	30 MPH												
																	85th Percentile :	35 MPH												
																	95th Percentile :	38 MPH												
Stats	10 MPH Pace Speed :										27-36 MPH																			
	Number in Pace :										6358																			
	Percent in Pace :										63.2%																			
	Number of Vehicles > 30 MPH :										5803																			
	Percent of Vehicles > 30 MPH :										57.7%																			
	Mean Speed(Average) :										29 MPH																			

## Accurate Counts 978-664-2565

Location : Billerica Road (Route 129)  
 Location : at #50 Billerica Road  
 City/State: Chelmsford, MA  
 Eastbound, Westbound

Start Time	1	16	21	26	31	36	41	46	51	56	61	66	71	76	81	85th Percent	95th Percent
10/25/12	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	88	91
01:00	0	0	0	6	13	15	1	1	0	0	0	0	0	0	0	35	40
02:00	1	0	0	3	18	3	2	1	0	0	0	0	0	0	0	28	44
03:00	0	0	0	3	6	6	1	0	0	0	0	0	0	0	0	16	41
04:00	0	0	0	1	12	6	1	1	1	0	0	0	0	0	0	22	49
05:00	0	0	3	2	12	12	3	0	0	0	0	0	0	0	0	32	42
06:00	1	0	1	18	53	57	13	2	2	0	0	0	0	0	0	147	43
07:00	18	4	15	86	331	154	12	1	0	0	0	0	0	0	0	621	39
08:00	231	98	104	168	266	85	3	0	0	0	0	0	0	0	0	955	36
09:00	207	110	158	243	254	60	1	0	0	0	0	0	0	0	0	1033	35
10:00	36	4	22	134	309	127	4	0	0	0	0	0	0	0	0	636	39
11:00	22	13	32	116	195	93	12	3	0	0	0	0	0	0	0	486	39
12 PM	37	11	22	202	387	136	4	1	0	0	0	0	0	0	0	639	38
13:00	21	18	18	140	314	118	13	1	0	0	0	0	0	0	0	800	38
14:00	24	11	38	131	279	131	11	0	0	0	0	0	0	0	0	643	39
15:00	34	19	33	171	372	117	18	0	0	0	0	0	0	0	0	625	39
16:00	36	22	15	191	371	142	18	1	1	0	0	0	0	0	0	764	39
17:00	24	4	48	263	389	130	15	0	0	0	0	0	0	0	0	797	39
18:00	32	5	37	251	331	98	5	0	1	0	0	0	0	0	0	873	39
19:00	6	2	10	130	229	93	8	0	0	0	0	0	0	0	0	760	38
20:00	7	3	1	53	152	81	9	2	0	0	0	0	0	0	0	478	39
21:00	3	0	4	44	108	58	4	1	0	0	0	0	0	0	0	308	40
22:00	0	1	3	16	72	35	7	0	0	0	0	0	0	0	0	222	40
23:00	0	0	0	6	30	28	3	1	0	0	0	0	0	0	0	134	40
Total	763	336	593	2558	4785	1892	175	15	5	0	0	0	0	0	0	11122	41
Percent	6.9%	3.0%	5.3%	23.0%	43.0%	17.0%	1.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
AM Peak Vol.	231	110	158	243	331	154	13	3	2							08:00	
PM Peak Vol.	37	22	48	263	389	142	18	2	1							17:00	
Total	1644	749	1341	5430	9240	3431	349	28	6	1	0	0	0	0	0	873	22219
Percent	7.4%	3.4%	6.0%	24.4%	41.6%	15.4%	1.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		

15th Percentile : 16 MPH  
 50th Percentile : 30 MPH  
 85th Percentile : 35 MPH  
 95th Percentile : 38 MPH

Stats  
 10 MPH Pace Speed : 27-36 MPH  
 Number in Pace : 12894  
 Percent in Pace : 58.0%  
 Number of Vehicles > 30 MPH : 13055  
 Percent of Vehicles > 30 MPH : 56.8%  
 Mean Speed(Average) : 28 MPH

**MASS DOT CRASH RATE WORKSHEETS**

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**GENERAL BACKGROUND TRAFFIC GROWTH**

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**General Background Traffic Growth**

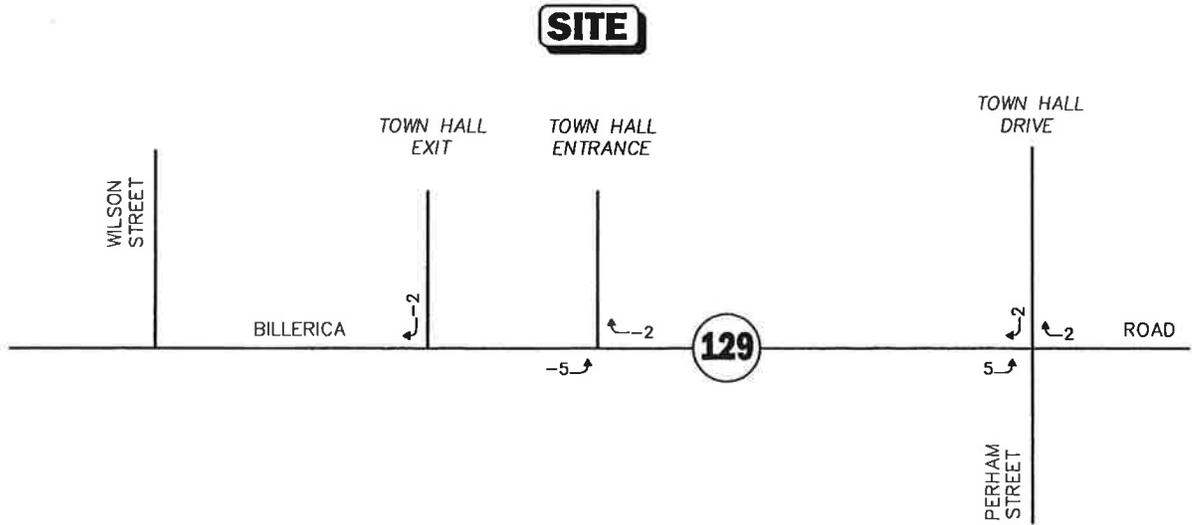
STA.	CITY/TOWN	ROUTE/STREET	LOCATION	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Average Annual Growth Rate
4042	CHELMSFORD	CONCORD RD.	AT CARLISLE T.L.	4,200	3,800	2,900	2,800	2,800	2,800	2,800	2,800	2,600	2,600	-6.51%
4055	CHELMSFORD	DALTON RD.	WEST OF RTE 4	2,900		2,900		2,900			2,400			-1.07%
4046	CHELMSFORD	GORHAM ST.	SOUTH OF CARLISLE ST.	12,700			14,000			11,100			8,900	-4.10%
4046	CHELMSFORD	GRANITEVILLE RD.	SOUTH OF RICHARDSON RD.	4,300			4,200		25,400	24,313	24,682	23,814	25,119	-1.4%
4114	CHELMSFORD	LOWELL CONNECTOR	SOUTH OF RTE I-495		3,800	4,300			3,800		2,300	2,000		0.31%
4135	CHELMSFORD	MAPLE RD.	WEST OF RTE 27		2,300	2,500		2,400	2,200	5,100				-2.17%
4041	CHELMSFORD	PARKERVILLE RD.	AT WESTFORD T.L.	6,100			6,900						4,900	-9.93%
4044	CHELMSFORD	PRINCETON ST.	AT LOWELL C.L.	63,229	60,067									-5.00%
0019 L	CHELMSFORD	RTE. 3	0.3 km SOUTH OF RTE I-495	84,300						92,900	118,600	105,500	105,600	3.40%
4048	CHELMSFORD	RTE. 3	AT LOWELL C.L.							99,000	100,800			1.82%
4052	CHELMSFORD	RTE. 3	NORTH OF RTE I-495	91,400						94,300		91,200	85,900	-1.79%
4050	CHELMSFORD	RTE. 3	SOUTH OF RTE 40	22,400			23,200			21,800			18,100	-2.29%
4115	CHELMSFORD	RTE. 4	OVER RTE I-495	3,800	3,800	4,100	3,800		5,200	4,500		3,900		1.41%
4040	CHELMSFORD	RTE. 27	AT WESTFORD T.L.	10,100	11,900		12,100	11,400		13,300	13,100		12,900	2.62%
4047	CHELMSFORD	RTE. 40	AT WESTFORD T.L.		13,400			13,100			14,400			1.22%
4053	CHELMSFORD	RTE 110	NORTH OF STEDMAN ST.	24,900		25,500	26,300		28,500	24,700		33,600	19,800	-1.34%
4054	CHELMSFORD	RTE I-495	SOUTH OF RTE I-495	104,733	107,069	110,870	106,955			113,100				1.06%
0414 L	CHELMSFORD	RTE I-495	0.5 km SOUTH OF RTE 4					104,300				97,622	98,138	-2.18%
4170	CHELMSFORD	RTE I-495	NORTH OF RTE 4						96,600	104,470	101,550			-0.18%
4285	CHELMSFORD	RTE I-495	SOUTH OF RTE 3								97,600			-2.19%
4051	CHELMSFORD	SCHOOL ST.	NORTH OF GRANITEVILLE RD.	2,900				3,300			3,100			1.15%
4056	CHELMSFORD	TURNPIKE RD.	SOUTH OF BILLERICA RD.	2,800				3,400			3,200			2.31%
4136	CHELMSFORD	WESTFORD ST.	NORTH OF RTE 110	3,600			3,500			3,400			3,100	-1.59%

Ave. Total -0.68%

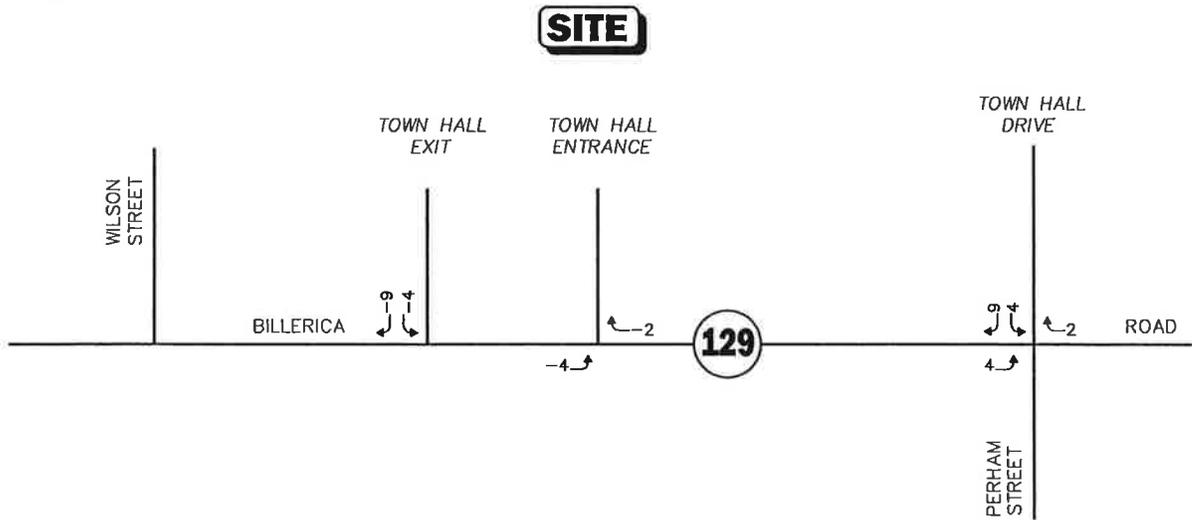
**PROJECT TRIP REDISTRIBUTION NETWORK**

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WEEKDAY MORNING PEAK HOUR



WEEKDAY EVENING PEAK HOUR



Not To Scale

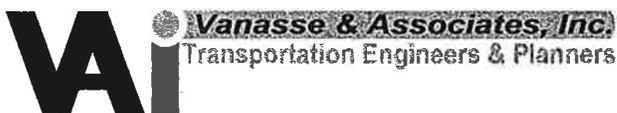


Figure A1

2019 Design Year  
Project Trip Redistribution

**CAPACITY ANALYSIS WORKSHEETS**

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**Route 129 at Wilson Street**

**Route 129 at the Town Hall Driveways**

**Route 129 at Perham Street and Town Hall Drive**

**Route 129 at the Project Driveway**

Route 129 at Wilson Street

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Intersection  
 Intersection Delay (sec/veh): 99.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	23	619	197	44	300	125
Conflicting Peds. (#/hr)	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
Right Turn Channelized	None	None	None	None	None	None
Storage Length	0			0	0	0
Median Width		0	0		10	
Grade (%)		0%	0%		0%	
Peak Hour Factor	0.97	0.97	0.75	0.75	0.83	0.83
Heavy Vehicles(%)	4	2	5	3	2	1
Movement Flow Rate	24	638	263	59	361	151
Number of Lanes	0	1	1	0	1	0

Major/Minor	Major 1	Major 2
Conflicting Flow Rate - All	322	0
Stage 1	-	-
Stage 2	-	-
Follow-up Headway	2.236	-
Pot Capacity-1 Maneuver	1227	-
Stage 1	-	-
Stage 2	-	-
Time blocked-Platoon(%)	0	-
Mov Capacity-1 Maneuver	1227	-
Mov Capacity-2 Maneuver	-	-
Stage 1	-	-
Stage 2	-	-

Approach	EB	WB	SB
HCM Control Delay (s)	0.3	0	289.7
HCM LOS	A	A	F

Lane	EBL	EBT	WBT	WBR	SBLn1
Capacity (vph)					331
HCM Control Delay (s)	7.992	-	-	-	289.7
HCM Lane VC Ratio	0.019	-	-	-	1.547
HCM Lane LOS	A	-	-	-	F
HCM 95th Percentile Queue (veh)	0.059	-	-	-	29.206

**Intersection**

Intersection Delay (sec/veh): 3.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	95	341	586	65	28	115
Conflicting Peds.(#/hr)	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
Right Turn Channelized	None	None	None	None	None	None
Storage Length	0			0	0	0
Median Width		0	0		10	
Grade (%)		0%	0%		0%	
Peak Hour Factor	0.89	0.89	0.94	0.94	0.86	0.86
Heavy Vehicles(%)	0	1	0	0	0	3
Movement Flow Rate	107	383	623	69	33	134
Number of Lanes	0	1	1	0	1	0

Major/Minor	Major 1		Major 2			
Conflicting Flow Rate - All	692	0	0	0	1255	658
Stage 1	-	-	-	-	658	-
Stage 2	-	-	-	-	597	-
Follow-up Headway	2.2	-	-	-	3.5	3.327
Pot Capacity-1 Maneuver	912	-	-	-	191	462
Stage 1	-	-	-	-	519	-
Stage 2	-	-	-	-	554	-
Time blocked-Platoon(%)	0	-	-	-	0	0
Mov Capacity-1 Maneuver	912	-	-	-	163	462
Mov Capacity-2 Maneuver	-	-	-	-	163	-
Stage 1	-	-	-	-	519	-
Stage 2	-	-	-	-	471	-

Approach	EB	WB	SB
HCM Control Delay (s)	2.1	0	25.3
HCM LOS	A	A	D

Lane	EBL	EBT	WBT	WBR	SBLn1
Capacity (vph)					340
HCM Control Delay (s)	9.47	-	-	-	25.3
HCM Lane VC Ratio	0.117	-	-	-	0.489
HCM Lane LOS	A	-	-	-	D
HCM 95th Percentile Queue (veh)	0.396	-	-	-	2.568

Intersection

Intersection Delay (sec/veh): 141.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	25	664	212	47	322	134
Conflicting Peds.(#/hr)	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
Right Turn Channelized	None	None	None	None	None	None
Storage Length	0			0	0	0
Median Width		0	0		10	
Grade (%)		0%	0%		0%	
Peak Hour Factor	0.97	0.97	0.75	0.75	0.83	0.83
Heavy Vehicles(%)	4	2	5	3	2	1
Movement Flow Rate	26	685	283	63	388	161
Number of Lanes	0	1	1	0	1	0

Major/Minor	Major 1		Major 2			
Conflicting Flow Rate - All	346	0	0	0	1052	315
Stage 1	-	-	-	-	315	-
Stage 2	-	-	-	-	737	-
Follow-up Headway	2.236	-	-	-	3.518	3.309
Pot Capacity-1 Maneuver	1202	-	-	-	# 251	728
Stage 1	-	-	-	-	740	-
Stage 2	-	-	-	-	473	-
Time blocked-Platoon(%)	0	-	-	-	0	0
Mov Capacity-1 Maneuver	1202	-	-	-	# 242	728
Mov Capacity-2 Maneuver	-	-	-	-	# 242	-
Stage 1	-	-	-	-	740	-
Stage 2	-	-	-	-	456	-

Approach	EB	WB	SB
HCM Control Delay (s)	0.3	0	\$ 413.1
HCM LOS	A	A	F

Lane	EBL	EBT	WBT	WBR	SBL1
Capacity (vph)					301
HCM Control Delay (s)	8.061	-	-	-	\$ -1
HCM Lane VC Ratio	0.021	-	-	-	1.825
HCM Lane LOS	A	-	-	-	F
HCM 95th Percentile Queue (veh)	0.066	-	-	-	36.668

**Intersection**

Intersection Delay (sec/veh): 4.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	102	370	628	70	30	123
Conflicting Peds.(#/hr)	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
Right Turn Channelized	None	None	None	None	None	None
Storage Length	0			0	0	0
Median Width		0	0		10	
Grade (%)		0%	0%		0%	
Peak Hour Factor	0.89	0.89	0.94	0.94	0.86	0.86
Heavy Vehicles(%)	0	1	0	0	0	3
Movement Flow Rate	115	416	668	74	35	143
Number of Lanes	0	1	1	0	1	0

Major/Minor	Major 1	Major 2				
Conflicting Flow Rate - All	742	0	0	0	1351	705
Stage 1	-	-	-	-	705	-
Stage 2	-	-	-	-	646	-
Follow-up Headway	2.2	-	-	-	3.5	3.327
Pot Capacity-1 Maneuver	874	-	-	-	167	435
Stage 1	-	-	-	-	494	-
Stage 2	-	-	-	-	526	-
Time blocked-Platoon(%)	0	-	-	-	0	0
Mov Capacity-1 Maneuver	874	-	-	-	138	435
Mov Capacity-2 Maneuver	-	-	-	-	138	-
Stage 1	-	-	-	-	494	-
Stage 2	-	-	-	-	436	-

Approach	EB	WB	SB
HCM Control Delay (s)	2.1	0	31.9
HCM LOS	A	A	D

Lane	EBL	EBT	WBT	WBR	SBLn1
Capacity (vph)					306
HCM Control Delay (s)	9.74	-	-	-	31.9
HCM Lane VC Ratio	0.131	-	-	-	0.581
HCM Lane LOS	A	-	-	-	D
HCM 95th Percentile Queue (veh)	0.451	-	-	-	3.431

Route 129 at the Town Hall Driveways

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**Intersection**

Intersection Delay (sec/veh): 0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	18	902	234	9	1	7
Conflicting Peds. (#/hr)	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
Right Turn Channelized	None	None	None	None	None	None
Storage Length	0			0	0	0
Median Width		0	0		16	
Grade (%)		0%	0%		0%	
Peak Hour Factor	0.64	0.64	0.75	0.75	0.67	0.67
Heavy Vehicles(%)	0	0	0	0	0	14
Movement Flow Rate	28	1409	312	12	1	10
Number of Lanes	0	1	1	0	1	0

Major/Minor	Major 1	Major 2				
Conflicting Flow Rate - All	324	0	0	0	1783	318
Stage 1	-	-	-	-	318	-
Stage 2	-	-	-	-	1465	-
Follow-up Headway	2.2	-	-	-	3.5	3.426
Pot Capacity-1 Maneuver	1247	-	-	-	91	696
Stage 1	-	-	-	-	742	-
Stage 2	-	-	-	-	214	-
Time blocked-Platoon(%)	0	-	-	-	0	0
Mov Capacity-1 Maneuver	1247	-	-	-	82	696
Mov Capacity-2 Maneuver	-	-	-	-	82	-
Stage 1	-	-	-	-	742	-
Stage 2	-	-	-	-	192	-

Approach	EB	WB	SB
HCM Control Delay (s)	0.2	0	15.3
HCM LOS	A	A	C

Lane	EBL	EBT	WBT	WBR	SBL1
Capacity (vph)					360
HCM Control Delay (s)	7.954	-	-	-	15.3
HCM Lane VC Ratio	0.023	-	-	-	0.033
HCM Lane LOS	A	-	-	-	C
HCM 95th Percentile Queue (veh)	0.069	-	-	-	0.103

Intersection	
Intersection Delay (sec/veh):	5.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	15	370	616	7	16	35
Conflicting Peds.(#/hr)	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
Right Turn Channelized	None	None	None	None	None	None
Storage Length	0			0	0	0
Median Width		0	0		16	
Grade (%)		0%	0%		0%	
Peak Hour Factor	0.63	0.63	0.44	0.44	0.55	0.55
Heavy Vehicles(%)	0	0	0	0	0	0
Movement Flow Rate	24	587	1400	16	29	64
Number of Lanes	0	1	1	0	1	0

Major/Minor	Major 1		Major 2			
Conflicting Flow Rate - All	1416	0	0	0	2043	1408
Stage 1	-	-	-	-	1408	-
Stage 2	-	-	-	-	635	-
Follow-up Headway	2.2	-	-	-	3.5	3.3
Pot Capacity-1 Maneuver	487	-	-	-	63	172
Stage 1	-	-	-	-	228	-
Stage 2	-	-	-	-	532	-
Time blocked-Platoon(%)	0	-	-	-	0	0
Mov Capacity-1 Maneuver	487	-	-	-	58	172
Mov Capacity-2 Maneuver	-	-	-	-	58	-
Stage 1	-	-	-	-	228	-
Stage 2	-	-	-	-	493	-

Approach	EB	WB	SB
HCM Control Delay (s)	0.5	0	129.8
HCM LOS	A	A	F

Lane	EBL	EBT	WBT	WBR	SBLn1
Capacity (vph)					106
HCM Control Delay (s)	12.772	-	-	-	129.8
HCM Lane VC Ratio	0.049	-	-	-	0.875
HCM Lane LOS	B	-	-	-	F
HCM 95th Percentile Queue (veh)	0.154	-	-	-	5.125

**Intersection**

Intersection Delay (sec/veh): 0.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	13	974	254	7	1	5
Conflicting Peds.(#/hr)	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
Right Turn Channelized	None	None	None	None	None	None
Storage Length	0			0	0	0
Median Width		0	0		16	
Grade (%)		0%	0%		0%	
Peak Hour Factor	0.64	0.64	0.75	0.75	0.67	0.67
Heavy Vehicles(%)	6	0	0	0	0	0
Movement Flow Rate	20	1522	339	9	1	7
Number of Lanes	0	1	1	0	1	0

**Major/Minor**

	Major 1	Major 2
Conflicting Flow Rate - All	348	0
Stage 1	-	-
Stage 2	-	-
Follow-up Headway	2.254	-
Pot Capacity-1 Maneuver	1189	-
Stage 1	-	-
Stage 2	-	-
Time blocked-Platoon(%)	0	-
Mov Capacity-1 Maneuver	1189	-
Mov Capacity-2 Maneuver	-	-
Stage 1	-	-
Stage 2	-	-

**Approach**

	EB	WB	SB
HCM Control Delay (s)	0.1	0	18.5
HCM LOS	A	A	C

**Lane**

	EBL	EBT	WBT	WBR	SBLr1
Capacity (vph)				275	
HCM Control Delay (s)	8.08	-	-	-	18.5
HCM Lane VC Ratio	0.017	-	-	-	0.033
HCM Lane LOS	A	-	-	-	C
HCM 95th Percentile Queue (veh)	0.052	-	-	-	0.101

**Intersection**

Intersection Delay (sec/veh): 4.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	11	401	672	5	12	26
Conflicting Peds.(#/hr)	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
Right Turn Channelized	None	None	None	None	None	None
Storage Length	0			0	0	0
Median Width		0	0		16	
Grade (%)		0%	0%		0%	
Peak Hour Factor	0.63	0.63	0.44	0.44	0.55	0.55
Heavy Vehicles(%)	0	0	0	0	0	0
Movement Flow Rate	17	637	1527	11	22	47
Number of Lanes	0	1	1	0	1	0

Major/Minor	Major 1	Major 2				
Conflicting Flow Rate - All	1538	0	0	0	2204	1533
Stage 1	-	-	-	-	1533	-
Stage 2	-	-	-	-	671	-
Follow-up Headway	2.2	-	-	-	3.5	3.3
Pot Capacity-1 Maneuver	438	-	-	-	50	145
Stage 1	-	-	-	-	198	-
Stage 2	-	-	-	-	512	-
Time blocked-Platoon(%)	0	-	-	-	0	0
Mov Capacity-1 Maneuver	438	-	-	-	47	145
Mov Capacity-2 Maneuver	-	-	-	-	47	-
Stage 1	-	-	-	-	198	-
Stage 2	-	-	-	-	481	-

Approach	EB	WB	SB
HCM Control Delay (s)	0.4	0	130.2
HCM LOS	A	A	F

Lane	EBL	EBT	WBT	WBR	SBLn1
Capacity (vph)					87
HCM Control Delay (s)	13.56	-	-	-	130.2
HCM Lane VC Ratio	0.04	-	-	-	0.794
HCM Lane LOS	B	-	-	-	F
HCM 95th Percentile Queue (veh)	0.124	-	-	-	4.092

Route 129 at Perham Street and Town Hall Drive

**Intersection**

Intersection Delay (sec/veh): 1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	1	893	8	1	231	1	12	0	16	0	0	0
Conflicting Peds.(#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
Right Turn Channelized	None											
Storage Length	0		0	0		0	0		0	0		0
Median Width		0			0			0			0	
Grade (%)		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.71	0.71	0.71	0.57	0.57	0.57	0.33	0.33	0.33
Heavy Vehicles(%)	2	2	2	0	2	0	2	0	0	0	0	2
Movement Flow Rate	1	930	8	1	325	1	21	0	28	0	0	0
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Major/Minor	Major 1			Major 2			Minor 1			Minor 2		
Conflicting Flow Rate - All	326	0	0	938	0	0	1264	1264	934	1278	1268	326
Stage 1	-	-	-	-	-	-	936	936	-	328	328	-
Stage 2	-	-	-	-	-	-	328	328	-	950	940	-
Follow-up Headway	2.218	-	-	2.2	-	-	3.518	4	3.3	3.5	4	3.318
Pot Capacity-1 Maneuver	1234	-	-	739	-	-	146	171	325	144	170	715
Stage 1	-	-	-	-	-	-	318	346	-	689	651	-
Stage 2	-	-	-	-	-	-	685	651	-	315	345	-
Time blocked-Platoon(%)	0	-	-	0	-	-	0	0	0	0	0	0
Mov Capacity-1 Maneuver	1234	-	-	739	-	-	146	170	325	131	169	715
Mov Capacity-2 Maneuver	-	-	-	-	-	-	146	170	-	131	169	-
Stage 1	-	-	-	-	-	-	317	345	-	688	650	-
Stage 2	-	-	-	-	-	-	684	650	-	287	344	-

Approach	EB	WB	NB	SB
HCM Control Delay (s)	0	0	26.9	0
HCM LOS	A	A	D	A

Lane	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (vph)	213							0
HCM Control Delay (s)	26.9	7.92	0	-	9.881	0	-	0
HCM Lane VC Ratio	0.231	0.001	-	-	0.002	-	-	-
HCM Lane LOS	D	A	A	-	A	A	-	A
HCM 95th Percentile Queue (veh)	0.863	0.003	-	-	0.006	-	-	-

**Site/Section**

Intersection Delay (sec/veh): 0.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	4	358	8	9	622	3	1	0	0	0	0	0
Conflicting Peds.(#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
Right Turn Channelized	None											
Storage Length	0		0	0		0	0		0	0		0
Median Width		0			0			0			0	
Grade (%)		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.71	0.71	0.71	0.50	0.50	0.50
Heavy Vehicles(%)	0	1	0	0	1	0	0	0	0	0	0	0
Movement Flow Rate	4	389	9	10	676	3	1	0	0	0	0	0
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Major/Minor	Major 1			Major 2			Minor 1			Minor 2		
Conflicting Flow Rate - All	679	0	0	398	0	0	1100	1101	394	1100	1104	678
Stage 1	-	-	-	-	-	-	402	402	-	698	698	-
Stage 2	-	-	-	-	-	-	698	699	-	402	406	-
Follow-up Headway	2.2	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.3
Pot Capacity-1 Maneuver	923	-	-	1172	-	-	191	214	659	191	213	456
Stage 1	-	-	-	-	-	-	629	604	-	434	446	-
Stage 2	-	-	-	-	-	-	434	445	-	629	601	-
Time blocked-Platoon(%)	0	-	-	0	-	-	0	0	0	0	0	0
Mov Capacity-1 Maneuver	923	-	-	1172	-	-	188	210	659	188	209	456
Mov Capacity-2 Maneuver	-	-	-	-	-	-	188	210	-	188	209	-
Stage 1	-	-	-	-	-	-	625	600	-	431	440	-
Stage 2	-	-	-	-	-	-	428	439	-	625	597	-

Approach	EB	WB	NB	SB
HCM Control Delay (s)	0.1	0.1	24.3	0
HCM LOS	A	A	C	A

Lane	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (vph)	188							0
HCM Control Delay (s)	24.3	8.919	0	-	8.098	0	-	0
HCM Lane VC Ratio	0.007	0.005	-	-	0.008	-	-	-
HCM Lane LOS	C	A	A	-	A	A	-	A
HCM 95th Percentile Queue (veh)	0.023	0.014	-	-	0.025	-	-	-

**Intersection**

Intersection Delay (sec/veh): 0.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SEB
Volume (vph)	6	959	9	1	246	3	13	0	17	0	0	2
Conflicting Peds.(#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
Right Turn Channelized	None											
Storage Length	0		0	0		0	0		0	0		0
Median Width		0			0			0			0	
Grade (%)		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.71	0.92	0.71	0.92	0.57	0.57	0.33	0.33	0.92
Heavy Vehicles(%)	2	2	2	0	2	0	2	0	0	0	0	2
Movement Flow Rate	7	1042	10	1	267	4	14	0	30	0	0	2
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Major/Minor	Major 1			Major 2			Minor 1			Minor 2		
Conflicting Flow Rate - All	271	0	0	1052	0	0	1333	1334	1047	1347	1337	269
Stage 1	-	-	-	-	-	-	1061	1061	-	271	271	-
Stage 2	-	-	-	-	-	-	272	273	-	1076	1066	-
Follow-up Headway	2.218	-	-	2.2	-	-	3.518	4	3.3	3.5	4	3.318
Pot Capacity-1 Maneuver	1292	-	-	669	-	-	131	155	280	129	155	770
Stage 1	-	-	-	-	-	-	271	303	-	739	689	-
Stage 2	-	-	-	-	-	-	734	688	-	268	301	-
Time blocked-Platoon(%)	0	-	-	0	-	-	0	0	0	0	0	0
Mov Capacity-1 Maneuver	1292	-	-	669	-	-	129	153	280	114	153	770
Mov Capacity-2 Maneuver	-	-	-	-	-	-	129	153	-	114	153	-
Stage 1	-	-	-	-	-	-	267	299	-	729	688	-
Stage 2	-	-	-	-	-	-	730	687	-	236	297	-

Approach	EB	WB	NB	SB
HCM Control Delay (s)	0	0.1	27.6	9.7
HCM LOS	A	A	D	A

Lane	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (vph)	203							770
HCM Control Delay (s)	27.6	7.801	0	-	10.393	0	-	9.7
HCM Lane VC Ratio	0.217	0.005	-	-	0.002	-	-	0.003
HCM Lane LOS	D	A	A	-	B	A	-	A
HCM 95th Percentile Queue (veh)	0.797	0.015	-	-	0.006	-	-	0.008

**Intersection**

Intersection Delay (sec/veh): 0.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	8	384	9	10	667	5	1	0	0	4	0	9
Conflicting Peds.(#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
Right Turn Channelized	None											
Storage Length	0		0	0		0	0		0	0		0
Median Width		0			0			0			0	
Grade (%)		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.71	0.71	0.71	0.50	0.50	0.50
Heavy Vehicles(%)	0	1	0	0	1	0	0	0	0	0	0	0
Movement Flow Rate	9	417	10	11	725	5	1	0	0	8	0	18
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Major/Minor	Major 1			Major 2			Minor 1			Minor 2		
Conflicting Flow Rate - All	730	0	0	427	0	0	1199	1192	422	1190	1195	728
Stage 1	-	-	-	-	-	-	440	440	-	750	750	-
Stage 2	-	-	-	-	-	-	759	752	-	440	445	-
Follow-up Headway	2.2	-	-	2.2	-	-	3.5	4	3.3	3.5	4	3.3
Pot Capacity-1 Maneuver	883	-	-	1143	-	-	164	189	636	166	188	427
Stage 1	-	-	-	-	-	-	600	581	-	407	422	-
Stage 2	-	-	-	-	-	-	402	421	-	600	578	-
Time blocked-Platoon(%)	0	-	-	0	-	-	0	0	0	0	0	0
Mov Capacity-1 Maneuver	883	-	-	1143	-	-	154	184	636	162	183	427
Mov Capacity-2 Maneuver	-	-	-	-	-	-	154	184	-	162	183	-
Stage 1	-	-	-	-	-	-	592	573	-	402	415	-
Stage 2	-	-	-	-	-	-	379	414	-	592	570	-

Approach	EB	WB	NB	SB
HCM Control Delay (s)	0.2	0.1	28.6	19
HCM LOS	A	A	D	C

Lane	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (vph)	154							284
HCM Control Delay (s)	28.6	9.118	0	-	8.18	0	-	19
HCM Lane VC Ratio	0.009	0.01	-	-	0.01	-	-	0.092
HCM Lane LOS	D	A	A	-	A	A	-	C
HCM 95th Percentile Queue (veh)	0.028	0.03	-	-	0.029	-	-	0.3

Route 129 at the Project Driveway

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**Intersection**

Intersection Delay (sec/veh): 0

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	0	974	261	0	0	0
Conflicting Peds.(#/hr)	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
Right Turn Channelized	None	None	None	None	None	None
Storage Length	0			0	0	0
Median Width		0	0		12	
Grade (%)		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles(%)	100	0	0	100	100	100
Movement Flow Rate	0	1059	284	0	0	0
Number of Lanes	0	1	1	0	1	0

Major/Minor	Major 1		Major 2			
Conflicting Flow Rate - All	-	0	0	-	1343	-
Stage 1	-	-	-	-	284	-
Stage 2	-	-	-	-	1059	-
Follow-up Headway	0	-	-	0	4.4	0
Pot Capacity-1 Maneuver	0	-	-	0	105	0
Stage 1	0	-	-	0	584	0
Stage 2	0	-	-	0	222	0
Time blocked-Platoon(%)	0	-	-	0	0	0
Mov Capacity-1 Maneuver	-	-	-	-	105	-
Mov Capacity-2 Maneuver	-	-	-	-	105	-
Stage 1	-	-	-	-	584	-
Stage 2	-	-	-	-	222	-

Approach	EB	WB	SB
HCM Control Delay (s)	0	0	0
HCM LOS	A	A	A

Lane	EBT	WBT	SBLn1
Capacity (vph)			0
HCM Control Delay (s)	-	-	0
HCM Lane VC Ratio	-	-	-
HCM Lane LOS	-	-	A
HCM 95th Percentile Queue (veh)	-	-	-

**Intersection**

Intersection Delay (sec/veh): 0

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	0	401	677	0	0	0
Conflicting Peds. (#/hr)	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
Right Turn Channelized	None	None	None	None	None	None
Storage Length	0			0	0	0
Median Width		0	0		16	
Grade (%)		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles(%)	100	0	0	100	100	100
Movement Flow Rate	0	436	736	0	0	0
Number of Lanes	0	1	1	0	1	0

Major/Minor	Major 1	Major 2
Conflicting Flow Rate - All	- 0	0 - 1172
Stage 1	- -	- - 736
Stage 2	- -	- - 436
Follow-up Headway	0 -	- 0 4.4
Pot Capacity-1 Maneuver	0 -	- 0 138
Stage 1	0 -	- 0 335
Stage 2	0 -	- 0 486
Time blocked-Platoon(%)	0 -	- 0 0
Mov Capacity-1 Maneuver	- -	- - 138
Mov Capacity-2 Maneuver	- -	- - 138
Stage 1	- -	- - 335
Stage 2	- -	- - 486

Approach	EB	WB	SB
HCM Control Delay (s)	0	0	0
HCM LOS	A	A	A

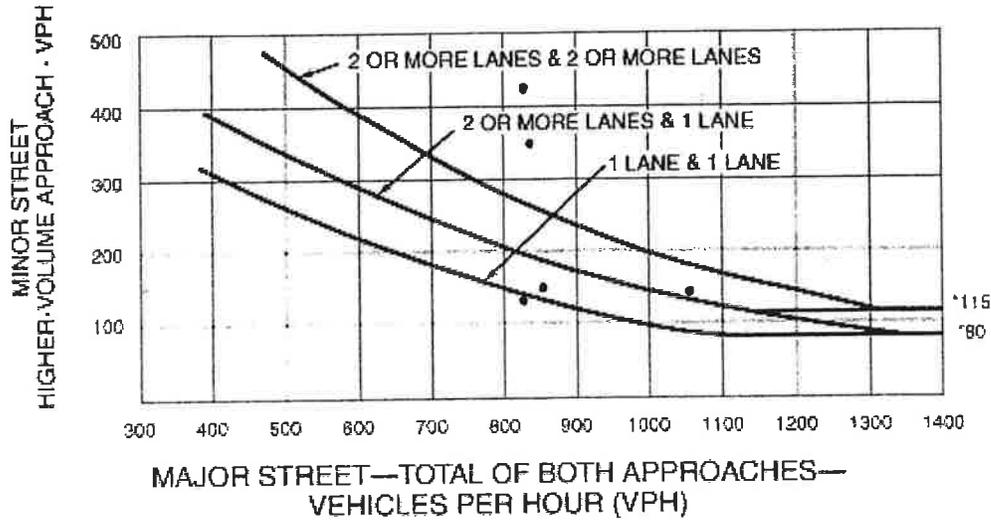
Lane	EBT	WBT	SBLn1
Capacity (vph)			0
HCM Control Delay (s)	-	-	0
HCM Lane VC Ratio	-	-	-
HCM Lane LOS	-	-	A
HCM 95th Percentile Queue (veh)	-	-	-

**TRAFFIC SIGNAL WARRANT ANALYSIS**

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2012 Existing Traffic Volumes  
 Route 129 @ Wilson Street  
 (1-lane)

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



\*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

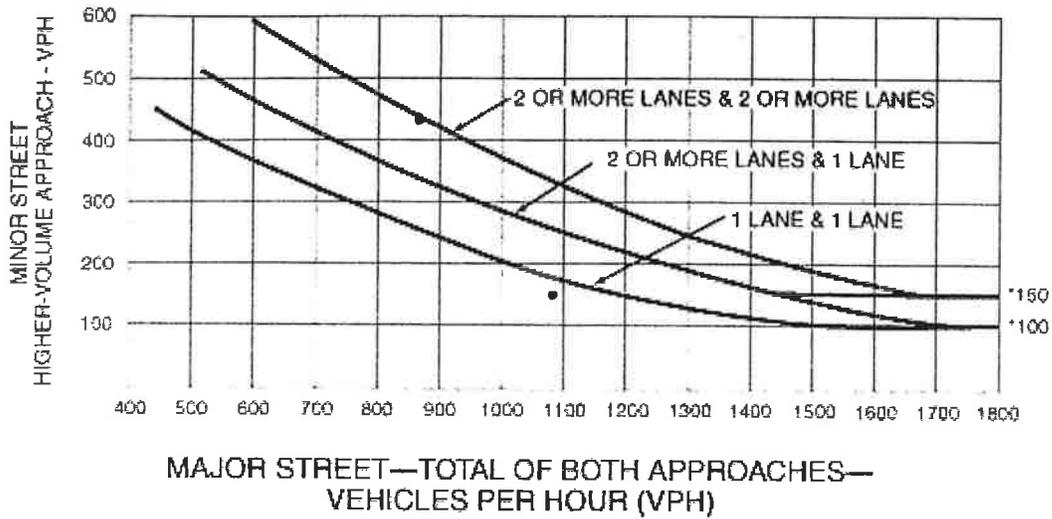
	<u>Major Street</u>	<u>Minor Street</u>
7-8 AM	829	439
8-9 AM	832	359
3-4 PM	826	121
4-5 PM	855	148
5-6 PM	1,057	143

Does meet Warrant 2!

# 2012 Existing Traffic Volumes

Route 129 @ Wilson Street  
(1-lane)

**Figure 4C-3. Warrant 3, Peak Hour**



\*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

	<u>Major Street</u>	<u>Minor Street</u>
AM	883	425
PM	1,092	143

Does meet Warrant 3!