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PRINCIPALS
Robert J. Michaud, P.E.
Ronald D. Desrosiers, P.E., PTOE
Daniel J. Mills, P.E., PTOE

MEMORANDUM

DATE: July 23, 2014

TO: Mr. Marc Levin
Chestnut Hill Realty
300 Independence Drive
Chestnut Hill, MA 02467

FROM: Robert J. Michaud, P.E. – Managing Principal
Courtney E. Jones, P.E. – Senior Transportation Engineer

RE: **Proposed Kesseler Woods Residential Development**
Lagrange Street – Newton, MA

MDM Transportation Consultants, Inc. (MDM) has prepared this traffic impact assessment (TIA) for the proposed residential development with access provided via Lagrange Street in Newton, Massachusetts. This memorandum documents existing (baseline) operational and safety-related characteristics of roadways serving the development Site, estimates future year operating characteristics of these roadways independent of the development, estimates development-related trip generation, and identifies incremental impacts of Site-related traffic. Access related improvements are identified for the development to meet operational needs of the Site and the adjacent roadways.

Key findings of the preliminary traffic assessment are as follows:

- *Existing Traffic Characteristics.* Lagrange Street, a minor arterial roadway in the study area, carries approximately 13,000 vehicles per day (vpd) with peak hour volumes ranging from approximately 955 vehicles per hour (vph) to 1,140 vph. Directional flow of traffic exhibits commuter trends (eastbound in the AM peak hour and westbound in the PM peak hour).

- *Safety Characteristics.* Safe stopping sight distance (SSD) is available for oncoming vehicles to detect, react and stop for vehicles exiting the proposed site driveway onto Lagrange Street based on the regulatory speed limit and ambient travel speeds. No immediate safety countermeasures are required at the study intersections based on historic crash data and trends.

- *Traffic Generation.* The proposed residential development is estimated to generate approximately 43 vehicle trips (9 entering and 34 exiting) during the weekday morning peak hour and 62 vehicle trips (40 entering and 22 exiting) during the weekday evening peak hour. These trips are estimated to be principally oriented to/from the east (85%) based on Journey to Work data. No reduction in site trips is taken as a result of available public transportation, despite data published by the US Census, which indicates approximately 24 percent of residents in the immediate study area utilize modes of transportation other than single-occupancy vehicles.

- *Adequate Roadway Capacity.* Adequate capacity is available along Lagrange Street and at study intersections to accommodate modest projected traffic increases for the proposed residential development. Unsignalized intersection operations are generally at LOS D or better which is supported by observed/measured delays for study intersections. No change in overall LOS at the study intersections expected as a result of the project. The mainline approaches to unsignalized intersections operate unimpeded at LOS A operations under existing and future year conditions.

- *Site Access.* Driveway and sidewalk improvements are identified and proposed by the Applicant to ensure efficient traffic operations are achieved, adequate sight lines are provided to meet or exceed recommended safety standards and that pedestrian features (sidewalks) are expanded to integrate the Site with the surrounding roadway system.

In summary, MDM finds that travel conditions in the site vicinity along Lagrange Street are generally unconstrained. Trip generation estimates based on ITE methodology trip generation for the development is estimated at approximately 43 vehicle-trips during the weekday morning peak hour and 62 vehicle-trips during the weekday evening peak hour. The proposed 80-unit residential development is not expected to have a material impact on the study area intersections and no change in traffic operations is anticipated. No material change in operations is anticipated along major public ways and at study intersections under future conditions due to the proposed apartment complex.

PROJECT DESCRIPTION

The Site comprises 14± acres located along Lagrange Street at the Kesseler Woods property bordering the Brookline Town line in Newton, Massachusetts. The Site currently consists of wooded area. The proximity of the Site in relation to the regional transportation system is shown in **Figure 1**. The Site was previously permitted in 2006 for the construction of 62 residential condominium units.

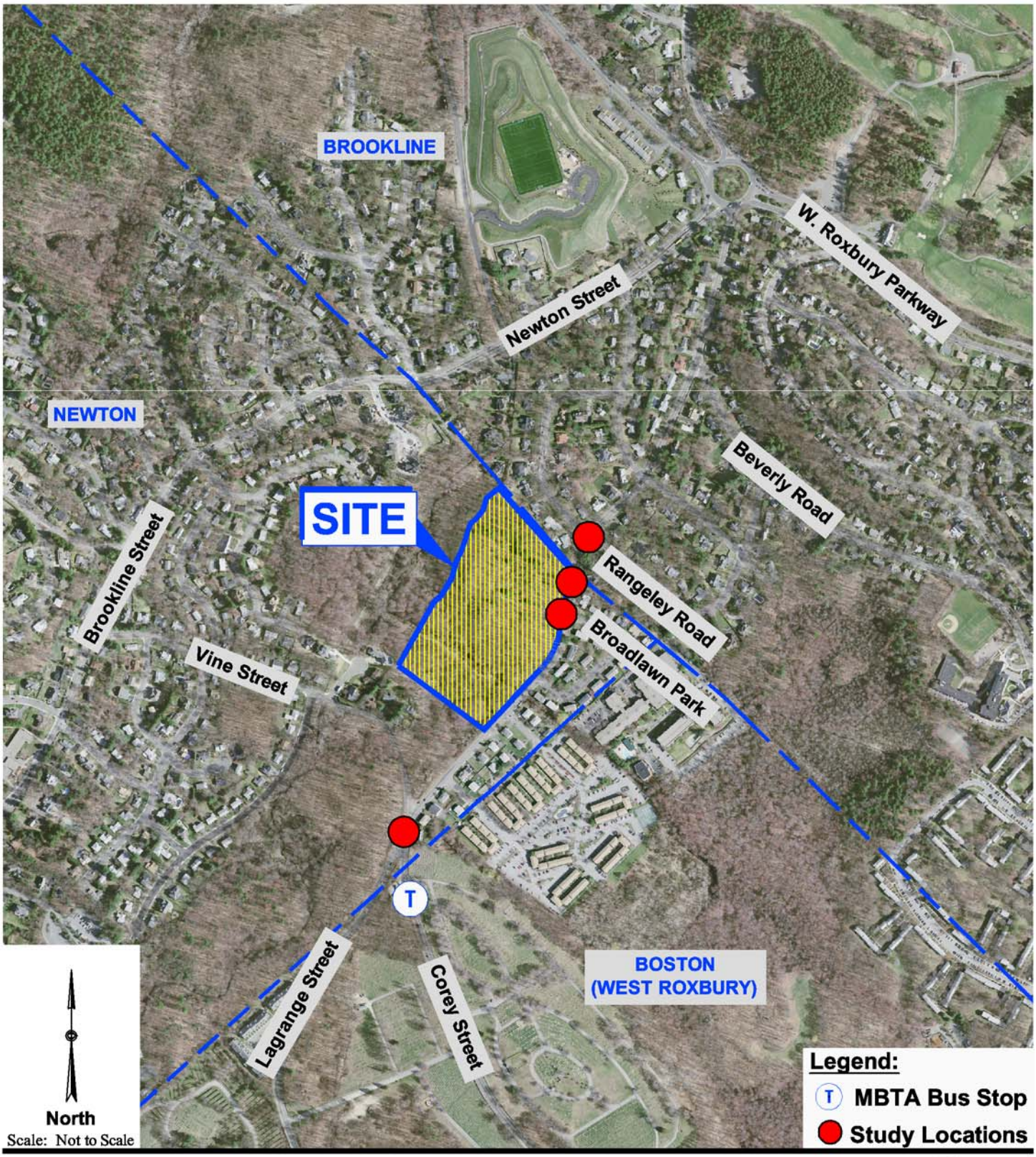

Figure 1

Site Location

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Dwg No. 765 TIAS.dwg

The proposed Site programming consists of constructing an apartment building with 80 units. On-Site parking is planned for 138 garage spaces and 22 surface spaces for a total of approximately 160 marked spaces. Planned Site access/egress will be provided by a single, full-access driveway along Lagrange Street between Broadlawn Park and the Brookline Town line. The preliminary Site layout plan prepared by Stantec is presented in **Figure 2**.

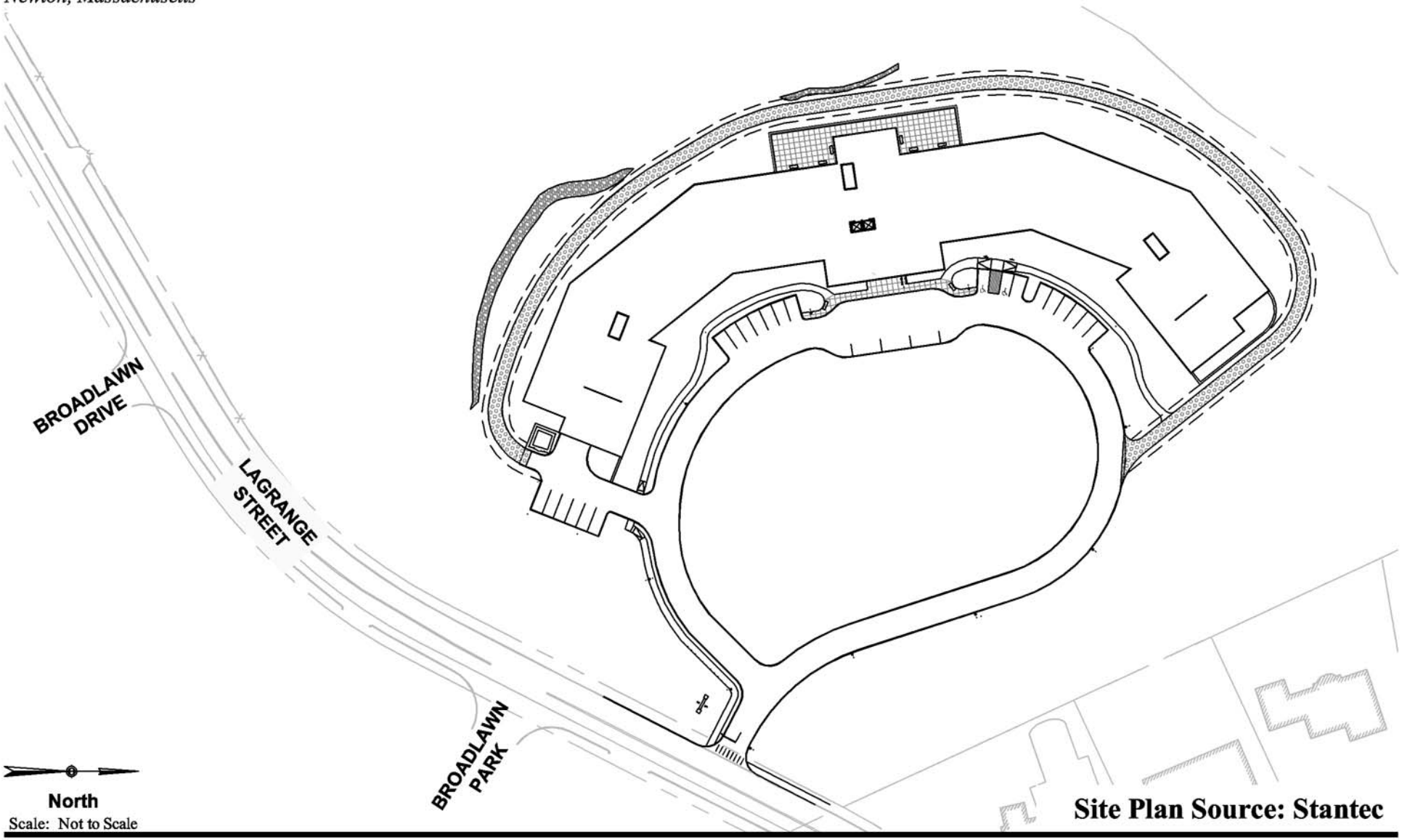
STUDY METHODOLOGY

This traffic impact assessment is conducted in accordance with industry standard traffic study guidelines and consists of several steps. The first step documents existing conditions in the transportation study area, including an inventory of roadway geometry, observed traffic volumes and safety characteristics. Next, future year traffic conditions are forecast that account for other planned area developments, normal area growth, and development-related traffic increases. The third step quantifies operating characteristics of study intersections. Specific attention is given to the incremental impacts of the proposed development. Finally, improvements are described that address specific development-related operational needs as required.

STUDY AREA

This TIA evaluates transportation characteristics of roadways and intersections that provide a primary means of access to the site, and that are likely to sustain a measurable level of traffic impact from the development. The study area includes the following unsignalized intersections located in Newton and Brookline, which are also identified in **Figure 1**:

- ☐ Lagrange Street at Corey Street/ Vine Street
- ☐ Lagrange Street at Rangeley Road
- ☐ Lagrange Street at Broadlawn Park
- ☐ Lagrange Street at Proposed Site Drive



Site Plan Source: Stantec

Figure 2

Preliminary Site Layout

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EXISTING TRAFFIC & SAFETY CHARACTERISTICS

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

Roadways

Lagrange Street

Lagrange Street is a roadway under local (Town) jurisdiction that is classified by the Massachusetts Department of Transportation (MassDOT) as an Urban Minor Arterial roadway. Lagrange Street provides a connection between Washington Street in Boston and Horace James Circle in Brookline. Locally, Lagrange Street connects Corey Street/ Vine Street the Newton Town/City lines with Brookline and Boston. Within the study area, sidewalks are provided along the southerly side of the roadway between Rangeley Road and Corey Street as well as the northerly side of the roadway within the Town of Brookline. Within the site vicinity, Lagrange Street has horizontal and vertical curves along the site frontage. One travel lane is provided in each direction separated by a double yellow centerline with a total roadway width of approximately 33 feet. The regulatory speed limit along Lagrange Street is 30 miles per hour (mph) within the study area. Land use along Lagrange Street is primarily residential.

Intersections

Lagrange Street at Vine Street / Corey Street

Lagrange Street meets Vine Street and Corey Street to form a four-way, unsignalized intersection in Newton. All approaches to the intersection provide a single, general-purpose travel lane in each direction. The Lagrange Street eastbound and westbound approaches each provide a channelized right-turn lane for vehicles turning right from either direction onto Vine Street and Corey Street. The Vine Street southbound approach and the Corey Street northbound approach operate under "STOP" sign control. At the intersection, sidewalks are provided along the southerly side of Lagrange Street east of Corey Street and along the westerly side of Corey Street south of Lagrange Street. A Massachusetts Bay Transportation Authority (MBTA) bus stop is located at the intersection for Bus #37. Land use at the intersection consists of residential homes and wooded area.

Lagrange Street at Rangeley Road

Lagrange Street meets Rangeley Road to form a four-way, unsignalized intersection in the Town of Brookline. Rangeley Road approaches from the north and south and provides a single, general-purpose travel lane in each direction. The Rangeley Road approaches operate under "STOP" sign control. Lagrange Street approaches from the east and west and provides a single, general-purpose travel lane in each direction. Sidewalks are provided on both sides of all the approaches. Land use at the intersection consists of single-family homes.

Lagrange Street at Broadlawn Park

Lagrange Street meets Gerry Road to form a "T"-type, unsignalized intersection. The Lagrange Street approaches provide a single, general-purpose travel lane in each direction. The Broadlawn Park approach provides a wide travel lane that operates under "STOP" control. Sidewalks are provided on both sides of Broadlawn Park and along the southerly side of Lagrange Street. Land use at the intersection consists of residential homes and wooded area.

Existing Traffic Data

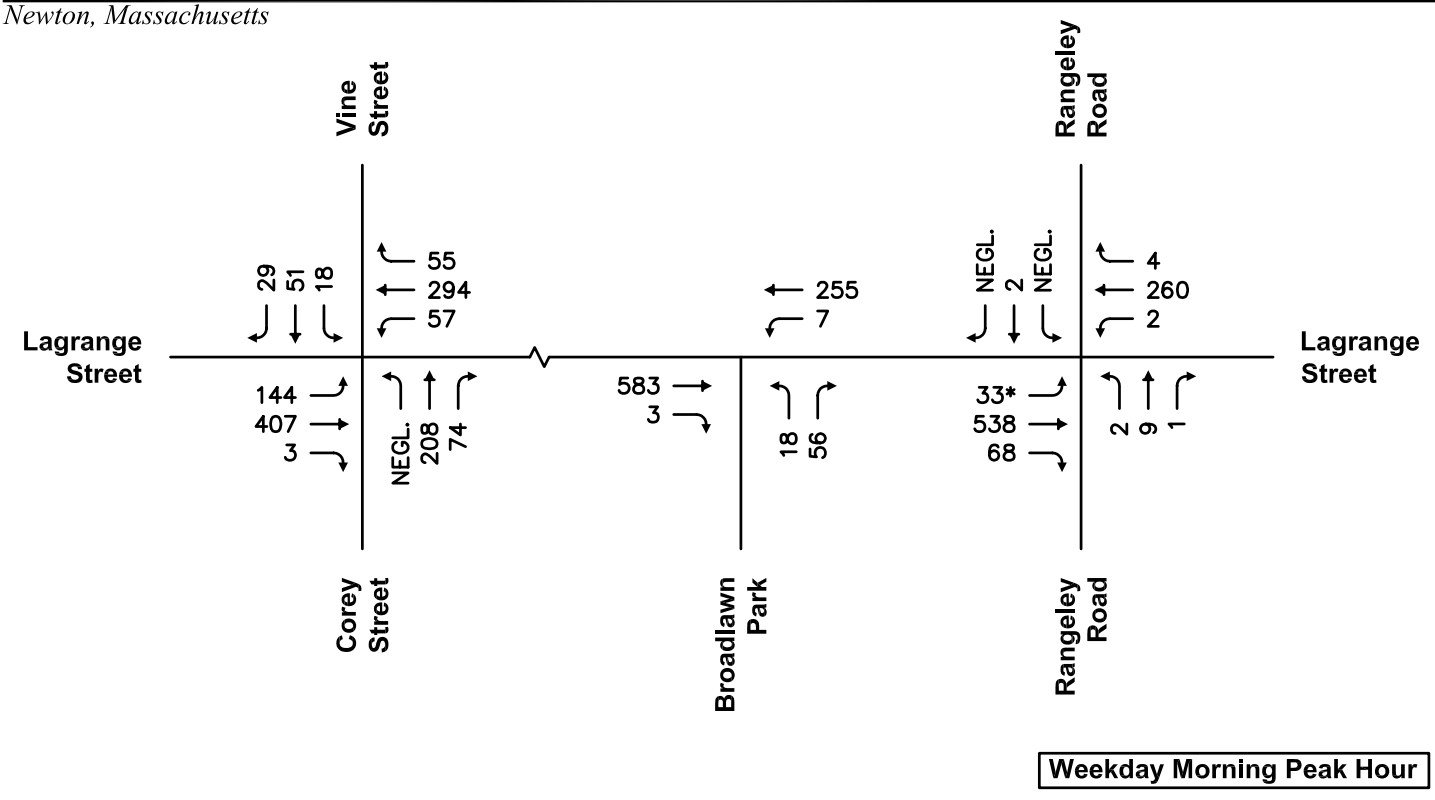
Traffic volume data were collected at the study intersections during the weekday morning (7:00 AM - 9:00 AM) and weekday evening (4:00 PM – 6:00 PM) periods to coincide with peak traffic activity of the proposed residential use and the adjacent streets. Traffic data used in this evaluation were collected in May and June 2014 and reflect typical area traffic conditions with schools in session. The months of May and June represent above-average traffic conditions based on review of MassDOT permanent count station data for the area. Therefore, as a conservative measure, no adjustment (reduction) to the observed traffic volumes was made to reflect average season conditions. Traffic count data and MassDOT permanent count station data are provided in the **Attachments.** The weekday morning and evening peak hour traffic volumes for the study intersections are shown in **Figure 3**.

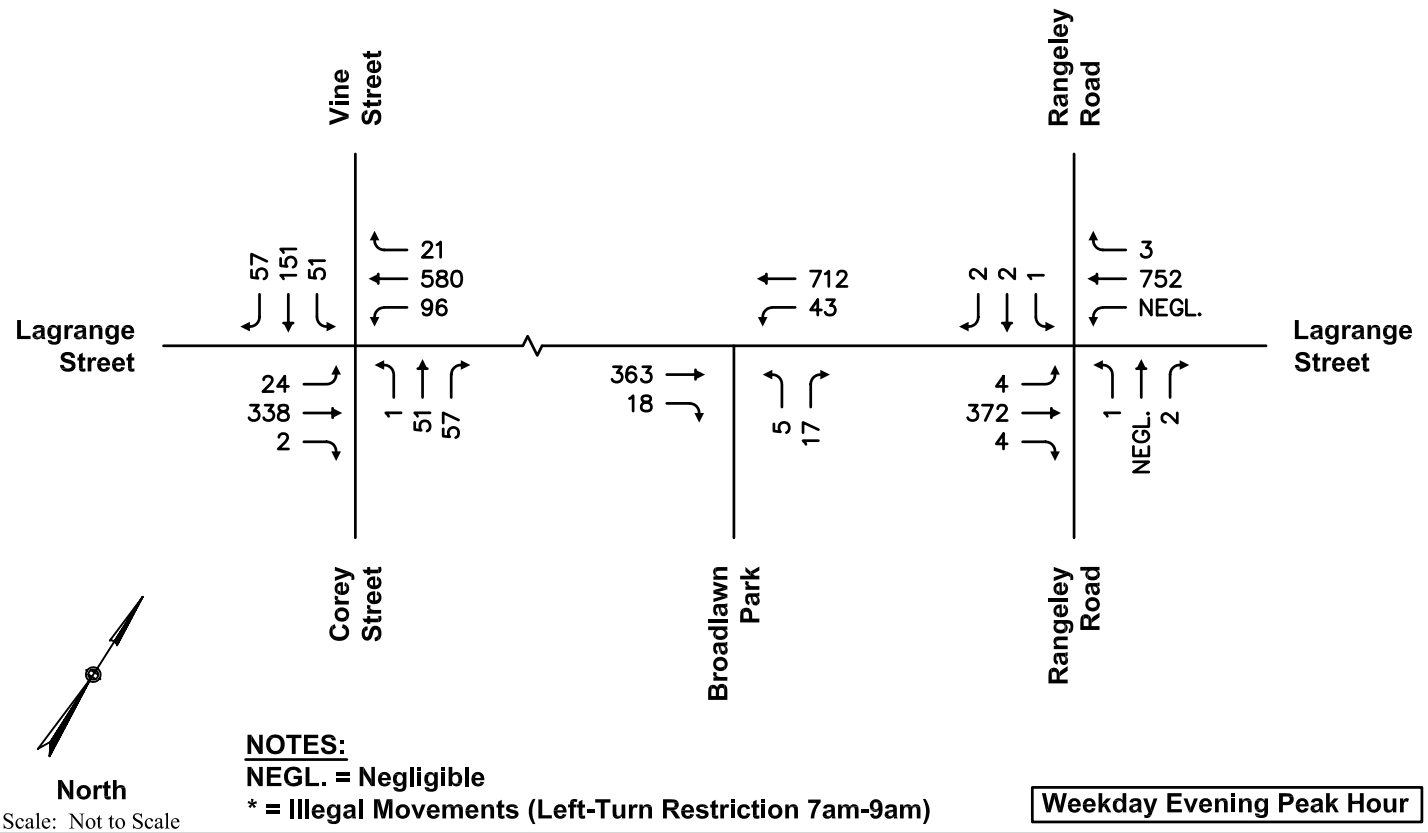
Daily traffic volumes along Lagrange Street in the site vicinity were obtained by mechanical methods using a radar-based traffic recorder. The results of the counts are summarized in **Table 1**, and are discussed below.

TABLE 1
EXISTING TRAFFIC VOLUME SUMMARY
LAGRANGE STREET (AT BROOKLINE TOWN LINE)

Time Period	Daily Volume (vpd)[1]	Percent Daily Traffic[2]	Peak Hour Volume (vph)[3]	Peak Flow Direction[4]	Peak Hour Directional Volume (vph)
Weekday Morning Peak Hour	12,895	7%	953	68% EB	651
Weekday Evening Peak Hour	12,895	9%	1,142	66% WB	759

[1]Two-way daily traffic expressed in vehicles per day without seasonal adjustment.
[2]The percent of daily traffic that occurs during the peak hour.
[3]Two-way peak-hour volume expressed in vehicles per hour.
[4]EB = Eastbound, WB = Westbound





North
Scale: Not to Scale

NOTES:
NEGL. = Negligible
*** = Illegal Movements (Left-Turn Restriction 7am-9am)**

Figure 3

2014 Existing Condition
Peak Hour Traffic Volumes

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As summarized in **Table 1,** the weekday daily traffic volume on Lagrange Street in the site vicinity is approximately 12,895 vehicles per day (vpd) on a weekday. Peak hour traffic flow on Lagrange Street ranges from approximately 953 vehicles per hour (vph) during the morning peak hour to 1,142 vph during the evening peak hour representing 7 to 9 percent of daily traffic flow. Vehicle flow is skewed towards the eastbound direction (towards Horace James Circle) during the weekday morning peak hour and in the westbound direction (away from Horace James Circle) during the weekday evening peak hour.

Comparison to Historical Traffic Volumes

Daily and peak hour traffic volumes were previously collected in the study area as part of prior permitting of the site. Daily traffic volumes were collected along Lagrange Street in the site vicinity in 2004 and 2006 and peak hour traffic volumes were collected at the Lagrange Street/Corey Street/Vine Street intersection in 2004 and 2008. **Table 2** summarizes the average daily and peak hour traffic volume conditions in the study area in 2004, 2006, 2008 and 2014. Count data and a graphical representation of the historical count data is provided in the **Attachments.**

TABLE 2
HISTORICAL TRAFFIC VOLUME COMPARISON[1]

	Traffic Volume			
Time Period	2004[2]	2006[3]	2008[4]	2014
Lagrange Street (near Brookline Town Line)				
Daily (24-Hour)	12,848	11,835	n/a[5]	12,508
Lagrange Street at Corey Street/Vine Street				
Weekday Morning Peak Hour	1,253	n/a	881	1,300
Weekday Evening Peak Hour	1,273	n/a	1,173	1,386

[1]Seasonal corrections applied to observed (raw) data to represent average monthly conditions. See **Attachments** for calculations.
[2]Source: *Kesseler Woods-Phase II, Proposed 62-Unit Condominium Development, Newton, Massachusetts,* prepared by Conley Associates, dated November 30, 2004.
[3]Source: *Kesseler Woods Outstanding Issues,* prepared by Conley Associates, dated June 2, 2006.
[4]Source: *Kesseler Woods Condominium Updated,* prepared by Conley Associates, dated June 23, 2008.
[5]n/a = not available

As shown in **Table 2,** average daily and peak hour traffic volumes along Lagrange Street in the study area observed in 2014 are generally consistent with the average traffic volumes observed in 2004 resulting in a less than 1 percent per year growth over the last 10 years. A decrease in daily and peak hour traffic in the study area occurred during the 2006 and 2008 count years, but returned back to 2004 traffic levels by 2014.

Intersection Crash History

In order to identify crash trends and safety characteristics for study area intersections, crash data were obtained from MassDOT for the City of Newton and Town of Brookline for the three-year period 2009 through 2011 (the most recent data currently available from MassDOT). Crash data for the study intersections is summarized in **Table 2** with detailed data provided in the **Attachments.**

Crash rates were calculated for the study area intersections as reported in **Table 2.** This rate quantifies the number of crashes per million entering vehicles. MassDOT has determined the official District 6 (which includes the Towns of Newton and Brookline) crash rate to be 0.58 for unsignalized intersections and 0.76 for signalized intersections. These rates represent MassDOT's "average" crash experience for District 6 communities and serves as a basis for comparing reported crash rates for the study intersections. Where calculated crash rates notably exceed the district average, some form of safety countermeasures may be warranted.

TABLE 2
INTERSECTION CRASH SUMMARY – MASSDOT
2009 THROUGH 2011[1]

Data Category	Lagrange Street at Rangeley Road	Lagrange Street at Broadlawn Park
Traffic Control	Unsignalized	Unsignalized
Crash Rate[2]	**0.07**	**0.14**
District 6 Avg[3]	0.58	0.58
Year:		
2009	1	1
2010	0	0
2011	0	1
Total	**1**	**2**
Type:		
Angle	0	1
Rear-End	0	0
Head-On	0	0
Sideswipe	0	0
Single Vehicle	1	1
Other/Unknown	0	0
Severity:		
P. Damage Only	0	0
Personal Injury	1	1
Fatality	0	0
Unknown	0	1
Conditions:		
Dry	0	1
Wet	0	1
Snow	1	0
Other	0	0
Time:		
7:00 to 9:00 AM	1	0
4:00 to 6:00 PM	0	1
Rest of Day	0	1

[1] Source: MassDOT Crash Database
[2] Crashes per million entering vehicles
[3] District 6 averages = 0.76 (signalized) and 0.58 (unsignalized)

As summarized in **Table 2**:

- *Lagrange Street/Rangeley Road.* There was one (1) reported crash at the Lagrange Street/ Rangeley Road unsignalized intersection during the three-year study period resulting in a crash rate of 0.07 which is well below the District 6 average of 0.58 for unsignalized intersections. The reported crash involved a single vehicle collision with a utility pole resulting in a non-fatal injury and occurring under snowy roadway conditions. The crash occurred during the weekday morning peak period. No fatalities or pedestrian-related incidents were reported at this location during the three-year study period.

- *Lagrange Street at Broadlawn Park.* A total of two (2) crashes were reported at the Lagrange Street/ Broadlawn Park unsignalized intersection during the three-year study period resulting in a crash rate of 0.14 which is well below the District 6 average of 0.58 for unsignalized intersections. Of the reported crashes, one (1) involved an angle-type collision and one (1) involved a single vehicle collision with a tree. One (1) of the crashes involved non-fatal injury and the other reported crash resulted in unknown severity. One (1) of the crashes occurred under dry roadway conditions and the other crash occurred under wet roadway conditions. One (1) of the reported crashes occurred during the weekday morning/evening peak periods. No fatalities or pedestrian-related incidents were reported at this location during the three-year study period.

- There were no reported crashes at the unsignalized intersection of Lagrange Street and Corey Street/ Vine Street during the three-year study period.

In summary, the study intersections all experienced crash rates well below the District 6 average and no immediate safety countermeasures are warranted based on the crash history at the study intersections.

Local Police Department Crash Records

In order to identify crash trends in more recent years, the MassDOT crash data was supplemented with local police crash records obtained from the Newton Police Department for the period covering January 1, 2011 through December 31, 2013. The same police crash data was also requested from the Brookline Police Department whose response indicates that the MassDOT data is appropriate for the Lagrange Street/Rangeley Road intersection. **Table 3** summarizes the police department crash data for the study intersections along Lagrange Street. The **Attachments** include crash rate calculations based on Newton Police Department crash records.

TABLE 3
INTERSECTION CRASH SUMMARY – NEWTON POLICE DEPARTMENT
JANUARY 1, 2011 THROUGH DECEMBER 31, 2013

Data Category	Lagrange Street at Corey Street/Vine Street	Lagrange Street at Broadlawn Park
Traffic Control	Unsignalized	Unsignalized
Crash Rate[2]	**0.17**	**0.14**
District 6 Avg[3]	0.58	0.58
Year:		
2011	0	1
2012	2	0
2013	1	1
Total	**3**	**2**
Type:		
Angle	3	0
Rear-End	0	0
Head-On	0	0
Sideswipe	0	0
Single Vehicle	0	2
Other/Unknown	0	0
Severity:		
P. Damage Only	1	0
Personal Injury	2	2
Fatality	0	0
Unknown	0	0
Conditions:		
Dry	3	2
Wet	0	0
Snow	0	0
Other	0	0
Time:		
7:00 to 9:00 AM	1	1
4:00 to 6:00 PM	0	0
Rest of Day	2	1

Source: City of Newton Police Department

[2]Crashes per million entering vehicles (MEV).

[3] District 6 averages = 0.76 (signalized) and 0.58 (unsignalized)

As summarized in **Table 3**:

- *Lagrange Street/Corey Street/Vine Street.* A total of three (3) crashes were reported a the unsignalized Lagrange Street/ Corey Street/ Vine Street intersection during the three-year study period resulting in a crash rate of 0.17 which is well below the District 6 average of 0.58 for unsignalized intersections. All of the reported crashes involved angle-type collisions and occurred under dry roadway conditions. Two (2) of the reported crashes resulted in non-fatal injuries and one (1) of the crashes resulted in property damage only. Only one (1) of the crashes occurred during the weekday morning/evening peak periods. No fatalities or pedestrian-related incidents were reported at this location during the three-year study period.

- *Lagrange Street at Broadlawn Park.* A total of two (2) crashes were reported at the Broadlawn Park unsignalized intersection during the three-year study period resulting in a crash rate of 0.14 which is well below the District 6 average of 0.58 for unsignalized intersections. Both of the reported crashes involved single vehicle collisions occurring under dry roadway conditions and resulting in non-fatal injuries. Only one (1) of the reported crashes occurred during the weekday morning/evening peak periods. No fatalities or pedestrian-related incidents were reported at this location during the three-year study period.

In summary, the study intersections experienced crash rates well below the District 6 average and no immediate safety countermeasures are warranted based on the crash history at the study intersections.

Measured Travel Speeds

Vehicle speeds were obtained for the Lagrange Street eastbound and westbound travel directions using a radar-based automatic traffic recorder (ATR) in May 2014. **Table 4** summarizes the regulatory posted speed and observed average and 85th percentile speeds for Lagrange Street adjacent to the Site. Field data are provided in the **Attachments**.

TABLE 4
SPEED STUDY RESULTS – LAGRANGE STREET

		Travel Speed	
Travel Direction	Posted Speed Limit	Average[1]	85th Percentile[2]
Eastbound	30	32	36
Westbound	30	33	37

[1] Arithmetic Mean.
[2] The speed at or below which 85 percent of the vehicles are traveling.

As summarized in **Table 4**, the mean (average) travel speed on Lagrange Street traveling eastbound is 32 mph and traveling westbound is 33 mph. The 85th percentile travel speed was observed to be 36 mph for the eastbound travel direction and 37 mph for the westbound travel direction. The observed travel speeds are higher than the posted (regulatory) speed limit of 30 mph on Lagrange Street in the study area.

Sight Line Evaluation

An evaluation of sight lines was conducted at the site driveway location providing access to the proposed residential building to ensure that minimum recommended sight lines are available at the proposed site driveway intersection with Lagrange Street. The evaluation documents sight lines under proposed conditions for vehicles as they relate to Lagrange Street with comparison to recommended guidelines.

The American Association of State Highway and Transportation Officials' (AASHTO) standards[1] reference two types of sight distance which are relevant at the proposed site driveway intersection along Lagrange Street: stopping sight distance (SSD) and intersection sight distance (ISD). Sight lines for critical vehicle movements at the site driveway intersections were compared to minimum SSD and ISD recommendations for the regulatory and observed speeds near the site.

Stopping Sight Distance

Sight distance is the length of roadway visible to the motorist to a fixed object. The minimum sight distance available on a roadway should be sufficiently long enough to enable a below-average operator, traveling at or near a regulatory speed limit, to stop safely before reaching a stationary object in its path, in this case, a vehicle exiting onto Lagrange Street. The SSD criteria are defined by AASHTO based on design and operating speeds, anticipated driver behavior and vehicle performance, as well as physical roadway conditions. SSD includes the length of roadway traveled during the perception and reaction time of a driver to an object, and the distance traveled during brake application on wet level pavement. Adjustment factors are applied to account for roadway grades when applicable.

SSD was estimated in the field using AASHTO standards for driver's eye (3.5 feet) and object height equivalent to the taillight height of a passenger car (2.0 feet) for the eastbound and westbound Lagrange Street approaches to the site driveway. **Table 5** presents a summary of the available SSD as they relate to Lagrange Street and AASHTO's recommended SSD based on posted and ambient travel speeds along Lagrange Street.

[1] *A policy on Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials (AASHTO), 2011.

TABLE 5
STOPPING SIGHT DISTANCE SUMMARY
LAGRANGE STREET APPROACHES TO SITE DRIVEWAY

Approach/ Travel Direction	Available SSD	AASHTO Recommended[1]		
		Posted Speed Limit[2]	Average Travel Speed[3]	85th Percentile Travel Speed[4]
Eastbound	290± Feet	190 Feet	205 Feet	245 Feet
Westbound	300± Feet	190 Feet	215 Feet	255 Feet

[1]Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet to object height of 2.0 feet.
[2]Regulatory posted speed = 30 mph
[3]Avg observed travel speeds = 32 mph EB and 33 mph WB
[4]85th percentile observed travel speeds = 36 mph EB and 37 mph WB

As summarized in **Table 5,** analysis results indicate that the existing available sight lines exceed AASHTO's recommended SSD criteria for both travel directions along Lagrange Street. Stopping sight distance calculations are provided in the **Attachments.**

Intersection Sight Distance

Clear sight lines provide sufficient sight distance for a stopped driver on a minor-road approach to depart from the intersection and enter or cross the major road. As stated under AASHTO's Intersection Sight Distance (ISD) considerations, "*...If the available sight distance for an entering ...vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to avoid collisions...To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road.*" AASHTO's ISD criteria are defined into several "cases". In this case, the proposed site driveway approach to Lagrange Street is proposed to be under STOP sign control and the ISD in question relates to the ability to turn left or turn right onto Lagrange Street.

Available ISD was estimated in the field using AASHTO standards for driver's eye (3.5 feet), object height (3.5 feet) and decision point (14.5 feet from the edge of travel lane) for the eastbound and westbound directions along Lagrange Street. **Table 6** presents a summary of the available ISD for the departure from the proposed site driveway and AASHTO's recommended ISD.

TABLE 6
INTERSECTION SIGHT DISTANCE SUMMARY
SITE DRIVEWAY DEPARTURE TO LAGRANGE STREET

Approach/ Travel Direction	Available SSD[2]	AASHTO Minimum[1]		
		Posted Speed Limit[3]	Average Travel Speed[4]	85th Percentile Travel Speed[5]
Looking East	>300 Feet	190 Feet	215 Feet	255 Feet
Looking West	>300 Feet	190 Feet	205 Feet	245 Feet

[1]Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet and an object height of 3.5 feet and adjustments for roadway grade if required. Minimum value as noted represents SSD per AASHTO guidance.
[2]Assumes clearing of on-site vegetation and re-grading.
[3]Regulatory posted speed = 30 mph
[4]Avg observed travel speeds = 32 mph EB and 33 mph WB
[5]85th percentile observed travel speeds = 36 mph EB and 37 mph WB

The results of the ISD analysis presented in **Table 6** indicate that the available ISD looking in both directions from the proposed site driveway onto Lagrange Street exceed the recommended minimum sight line requirements. MDM recommends that any new plantings (shrubs, bushes) or physical landscape features to be located within the driveway sight lines should also be maintained at a height of 2 feet or less to ensure unobstructed lines of sight.

ALTERNATE MODES OF TRANSPORTATION

Based on data published by the US Census, approximately 24 percent of residents in the immediate study area (US Census Tract 3739) utilize modes of transportation other than single-occupancy vehicles. US Census transportation mode data for the area are provided in the **Attachments**. Alternative transportation modes include, but are not limited to, using public transportation, walking, bicycling, carpooling, and working at home. Alternative modes of transportation are available to Lagrange Street residents and include MBTA Bus Routes 37 and 51 described as follows:

- **Route 37 – Baker & Vermont Street – Forest Hills Station:** This Route provides a connection to the "T" at the Orange Line (Forest Hills Station) with limited weekday service to the Lagrange Street/Corey Street intersection. The Route generally provides weekday service between 5:30 AM and 8:00 PM. Saturday service is generally provided between 5:30 AM and 8:00 PM. This Route does not currently operate on Sundays. Specific MBTA route and schedule information is provided in the **Attachments**.

- **Route 51 – Reservoir (Cleveland Circle) – Forest Hills Station:** This Route provides a connection to the "T" at the Green Line (Reservoir Station) and Orange Line (Forest Hills Station). The Route generally provides weekday service between 6:00 AM and 10:30 PM. Nearby service is provided at the Grove Street/Beverly Road intersection in Brookline and limited weekday service is provided at the Newton Street/Arlington Road intersection. Saturday service is generally provided between 6:00 AM and 10:00 PM. This Route does not currently operate on Sundays. Specific MBTA route and schedule information is provided in the **Attachments**.

- **Shuttle Service** – Chestnut Hill Realty (CHR), the parent entity of the Proponent, currently provides a shuttle service to its residents at nearby Hancock Village which transports passengers between Independence Drive and Reservoir Station (Cleveland Circle) during the weekday morning (6:00 AM to 9:00 AM) and evening (4:30 PM to 7:30 PM) commuter periods. The shuttle service runs every 20 minutes and experiences a rider-ship of approximately 3 to 8 passengers per trip. CHR will evaluate expanding this shuttle service to the proposed Kesseler Woods residential development based on demand. Inclusion of Kesseler Woods as part of the Hancock Village shuttle loop would provide the added benefit of Kesseler Woods resident access to two Zipcar vehicles provided at Hancock Village. Zipcar is a privately-owned company providing rental cars stationed at various locations throughout select cities allowing local residents (with membership) access to rental vehicles without the traditional rental car protocol. These vehicles can be rented by the hour or by the day and the rental fee typically includes gas, reserved parking, insurance (deductible applies) and a pre-determined mileage limit. Specific information is available on the Zipcar website.

In summary, the residents of the proposed development will have access to a variety of alternative modes of transportation. The proposed on-site sidewalk system and the existing sidewalk system in the surrounding neighborhood is extensive and provides access to nearby commercial establishments, public transportation and other area attractions. As a conservative measure, *no reduction in site trips* is taken as a result of available public transportation.

PROJECTED FUTURE TRAFFIC CONDITIONS

Evaluation of the proposed development impacts requires the establishment of a future analysis condition. This section estimates future roadway and traffic conditions with and without the proposed development. For this evaluation, a five-year planning horizon (year 2019) was selected consistent with standard-industry practice.

To determine the impact of site-generated traffic volumes on the roadway network under future conditions, Existing (Baseline) traffic volumes in the study area were projected to a future year condition. Traffic volumes on the roadway network at that time, in the absence of the development (that is, the No-Build condition), includes existing traffic, new traffic due to general background traffic growth, and traffic related to specific developments by others that are currently permitted or under review at the local and/or state level. Consideration of these factors resulted in the development of No-Build traffic volumes. Anticipated site-generated traffic volumes were then superimposed upon these No-Build traffic-flow networks to develop future Build conditions.

The following sections provide an overview of the future traffic volumes.

Background Growth

Background traffic includes demand generated by other planned developments in the area as well as demand increases caused by external factors. External factors are general increases in traffic not attributable to a specific development and are determined using historical data.

Nearby permanent count station data published by MassDOT indicates a declining (-0.3% per year) growth rate in recent years. On a local basis, recent and historical daily and hourly traffic count data collected along Independence Drive and Grove Street in Brookline for a nearby project[2] indicate minimal or declining growth ranging from -1.8% per year to less than +0.4% per year. Similarly, daily and peak hour traffic volume counts conducted along Lagrange Street for previous permitting[3] of the site indicate a yearly growth rate over a 10-year period of 1% or less. Therefore, for purposes of this evaluation and to present a conservative analysis, a 1 percent growth rate was used (approximate 5 percent increase over a 5-year horizon) which is higher than the 0.5 percent per year growth rate used in other recent area traffic studies. This growth rate is higher than historic rates, and as such, is also expected to account for any small fluctuation in hourly traffic as may occur from time to time in the study area and traffic associated with small vacancies or developments in the area. Background growth rate calculations are provided in the **Attachments.**

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[2] *Response to Comments – BETA Group, Inc., The Residences of South Brookline, Brookline, Massachusetts,* prepared by MDM Transportation Consultants, Inc., dated April 29, 2014.

[3] *Kesseler Woods-Phase II, Proposed 62-Unit Condominium Development, Newton, Massachusetts,* prepared by Conley Associates, dated November 30, 2004.

Based on discussion with City Planning staff and review of local and state (Massachusetts Environmental Policy Act) files, there are currently several permitted or proposed development projects in the area that may increase traffic at the study intersections:

- ***Center 128 Office Park:*** This planned office park to be located along Kendrick Street in Needham consists of the construction of approximately 740,000 sf of office space. Given the project's location relative to the study area, traffic associated with the Center 128 office park is expected to be reasonably accounted for in the conservative 1 percent per year growth rate.

- ***135 Wells Avenue 40B Residential Development***: This project, currently in the permitting process with the City of Newton, consists of demolishing an active 62,000± sf Boston Sports Club and constructing 334 residential apartments and 6,000± sf of co-work/café space at 135 Wells Avenue in Newton. The proposed project is expected to have negligible impact to the Lagrange Street study area based on the traffic impact and access study[4] submitted for the project.

- ***Chestnut Hill Shopping Center (The Street) Remaining Build-Out***: This project consists of the remaining build-out of the Chestnut Hill Shopping Center known as The Street Chestnut Hill. Remaining build-out includes the redevelopment of 33 Boylston Street in Newton. At the time the traffic counts were conducted, the redeveloped 64,000± sf retail/office/restaurant building at 33 Boylston Street was partially occupied. Based on the project's location relative to the study area, it is assumed that traffic associated with the remaining unoccupied space at 33 Boylston Street can be reasonably accounted for in the conservative 1 percent per year background growth rate.

- ***Chestnut Hill Square Residential Development***: This project consists of the remaining build-out of the large mixed-use development known as Chestnut Hill Square. Based on discussion with City Planning Staff, Chestnut Hill Square is complete except for up to 100 residential units which have been approved but are not yet constructed. The Wegman's grocery store component of the project was fully operational at the time the counts were conducted in May 2014. Traffic associated with the residential component of Chestnut Hill Square project was estimated using ITE standard rates and the residential trip distribution patterns presented in the traffic study prepared for the project[5]. The site-specific trip tracings are provided in the **Attachments**.

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[4] *Traffic Impact and Access Study, Proposed Residential Development, 135 Wells Avenue, Newton, Massachusetts,* prepared by Vanasse Hangen Brustlin, Inc., dated May 2014.

[5] *Supplemental Traffic Impact Assessment, Chestnut Hill Square – EEA No. 12928, Newton, Massachusetts,* prepared by Vanasse & Associates, Inc., dated August 12, 2010.

- ***Residences of South Brookline:*** This residential 40B project, currently in the permitting process with the Town of Brookline, consists of the construction of 184 apartment units at the existing Hancock Village apartment community in Brookline. Traffic associated with the 184-unit residential development is based on the Traffic Impact Assessment (TIA)[6] prepared for the project. The site-specific trip tracings are provided in the **Attachments**.

2019 No-Build Traffic Volume Networks

In summary, to account for future traffic growth in the study area future No-Build traffic volumes are developed by increasing the existing (baseline) volumes by approximately 5 percent (1 percent compounded annually over 5 years) and adding traffic associated with the remaining build-out of Chestnut Hill Square and the Residences of South Brookline project. The resulting No-Build traffic volumes are displayed in **Figure 4**.

Site Traffic

The trip generation estimates for the proposed residential development are provided for the weekday morning and weekday evening periods, which correspond to the critical weekday analysis periods for the proposed use and adjacent street traffic flow. New traffic generated by the project was estimated using trip rates published in ITE's *Trip Generation*[7] for the Land Use Code (LUC) that most closely reflects the characteristics of the residential use within the site. **Table 7** presents the trip-generation estimates for the proposed development based on ITE methodology.

As summarized in **Table 7**, the proposed development is estimated to generate approximately 43 vehicle trips (9 entering and 34 exiting) during the weekday morning peak hour and 62 vehicle trips (40 entering and 22 exiting) during the weekday evening peak hour. On a daily basis, the proposed residential use is estimated to generate approximately 608 vehicle trips on a weekday with 50 percent entering and exiting. Trip generation calculations are provided in the **Attachments**.

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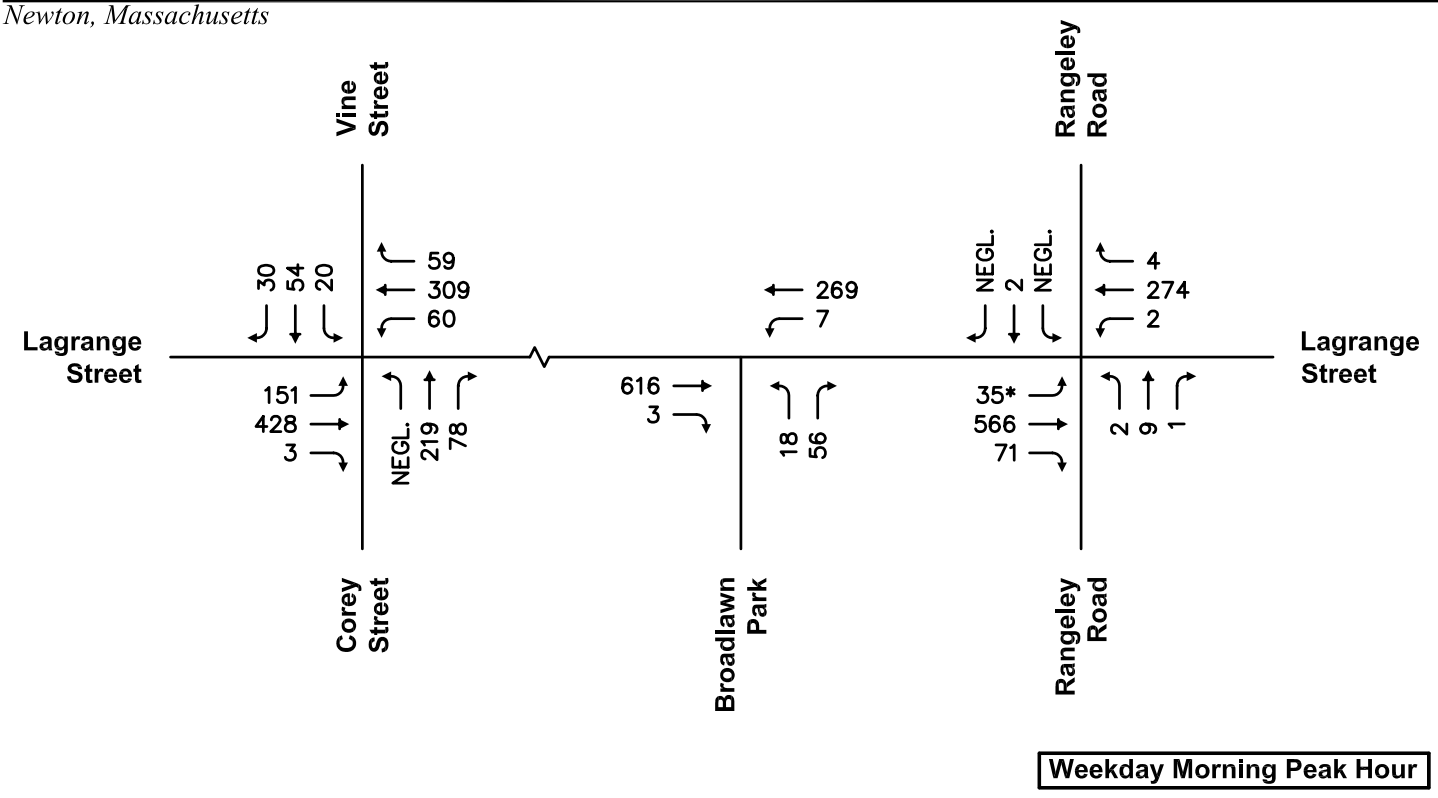
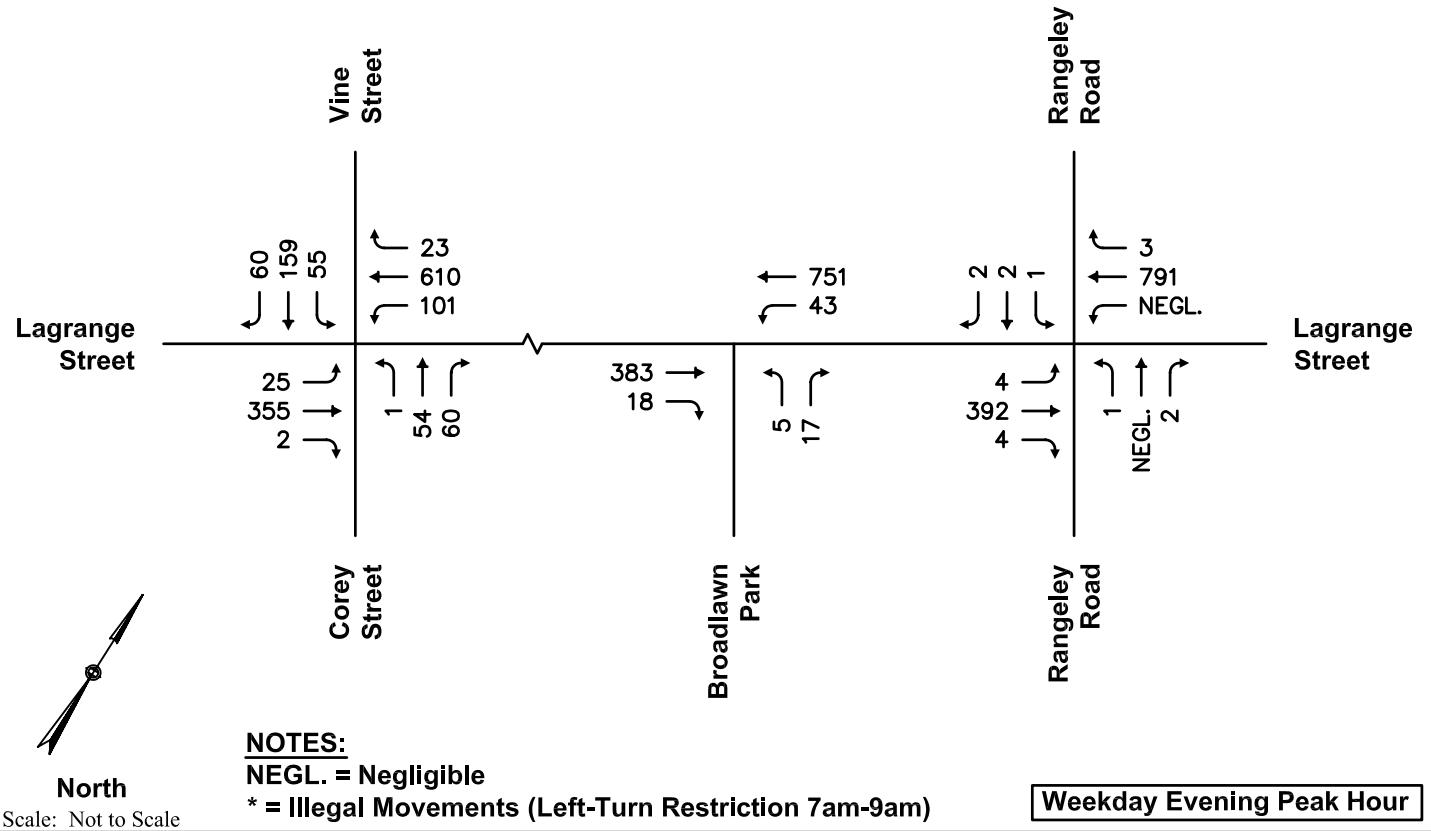
[6] *Traffic Impact Assessment, Proposed Residences of South Brookline – 40B, Brookline, Massachusetts,* prepared by MDM Transportation Consultants, Inc., dated July 1, 2014 (Revised July 17, 2014).

[7] *Trip Generation,* Ninth Edition; Institute of Transportation Engineers; Washington, DC; 2012.





North
Scale: Not to Scale

NOTES:
NEGL. = Negligible
*** = Illegal Movements (Left-Turn Restriction 7am-9am)**

Figure 4

MDM TRANSPORTATION CONSULTANTS, INC.
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2019 No-Build Condition Peak Hour Traffic Volumes

Date: June 2014
Dwg No. 765 TIAS.dwg

TABLE 7
TRIP-GENERATION SUMMARY

Period/Direction	ITE Basis Apartment Trips[1]
Weekday Morning Peak Hour	
Entering	9
Exiting	34
Total	43
Weekday Evening Peak Hour	
Entering	40
Exiting	22
Total	62
Weekday Daily	608

Source: ITE *Trip Generation,* Ninth Edition; 2012.
[1]Based on ITE LUC 220 (Apartment) applied to 80 units.

Trip Distribution

The distribution for projected traffic for the proposed expansion project is primarily based on Journey to Work data published by the US Census. The resulting trip distribution is presented in **Figure 5** with detailed calculations provided in the **Attachments.**

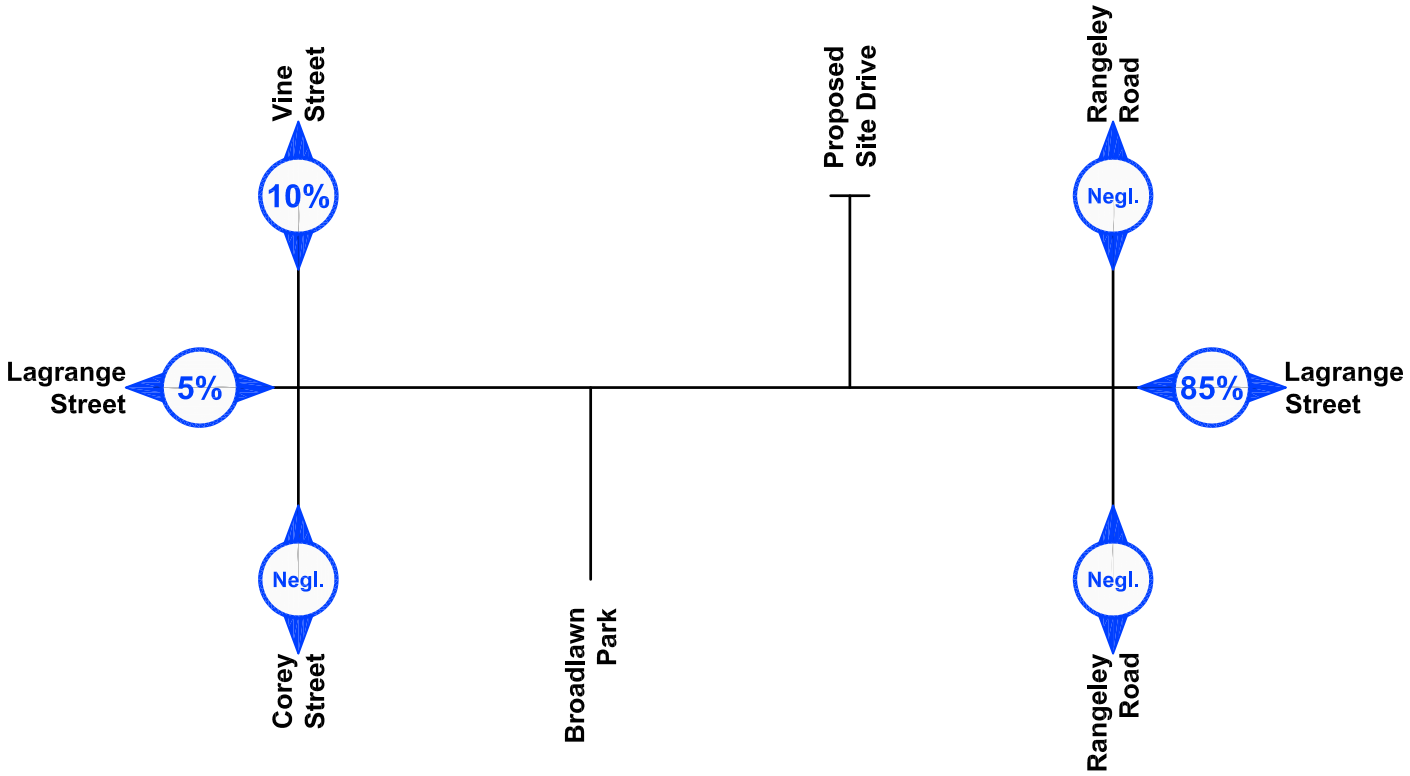
Figure 6 presents projected site-generated traffic volumes for the weekday morning and weekday evening peak hours for the proposed residential development based on the trip generation presented in **Table 7** and projected travel patterns presented in **Figure 5.**

2019 Build Traffic Conditions

2019 Build condition traffic volumes are derived by adding the traffic increases for the proposed residential apartments at the site to the 2019 No-Build conditions. The resulting Build traffic volumes used for analysis are shown in **Figure 7.**

OPERATIONS ANALYSIS

This section provides an overview of operational analysis methodology, an assessment of driveway operations under Existing (Baseline) and projected future No-Build and Build conditions and a summary of the vehicular queues at the signalized intersections.



North
Scale: Not to Scale

NOTES:
Negl. = Negligible

MDM TRANSPORTATION CONSULTANTS, INC.
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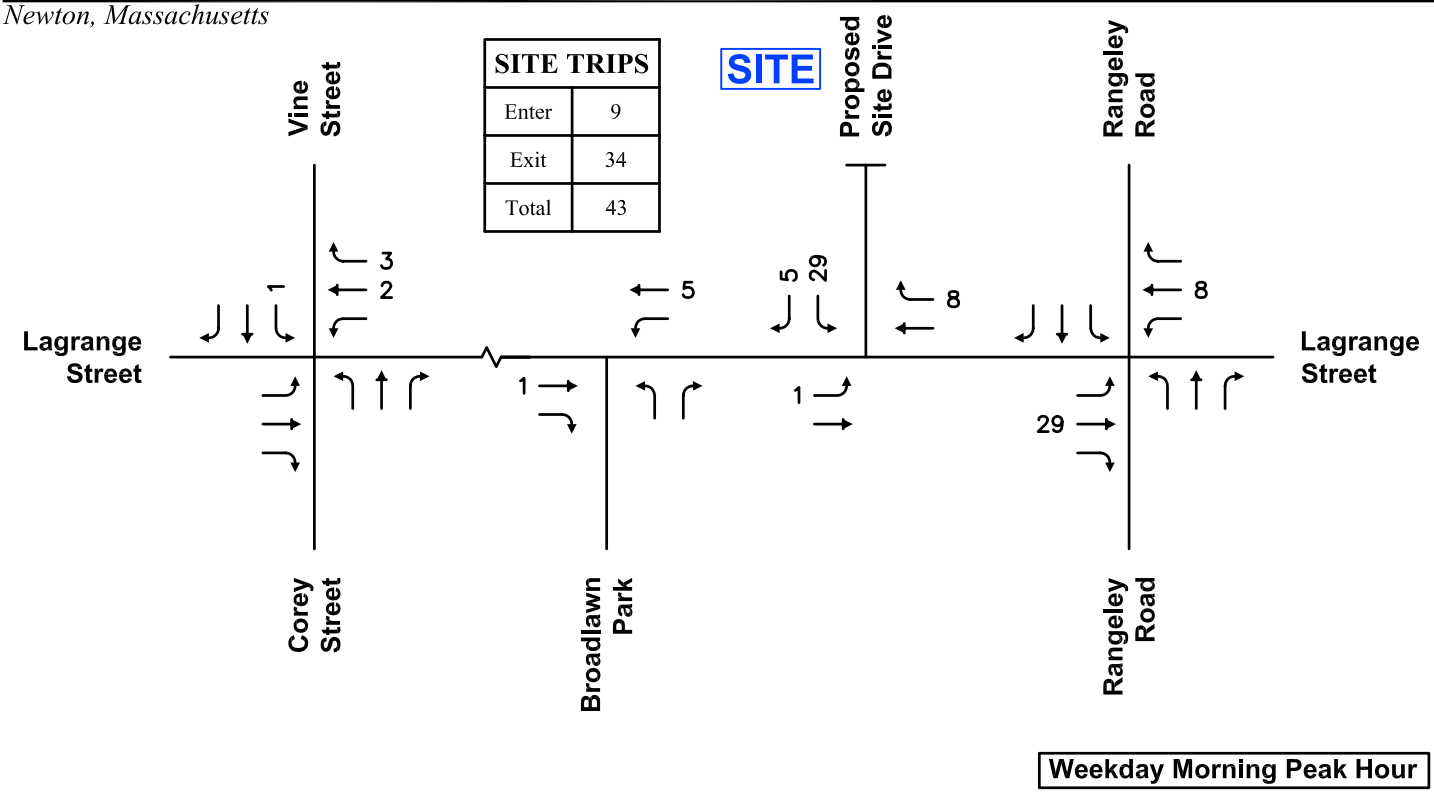
Figure 5

Trip Distribution

Date: June 2014
Dwg No. 765 TIAS.dwg



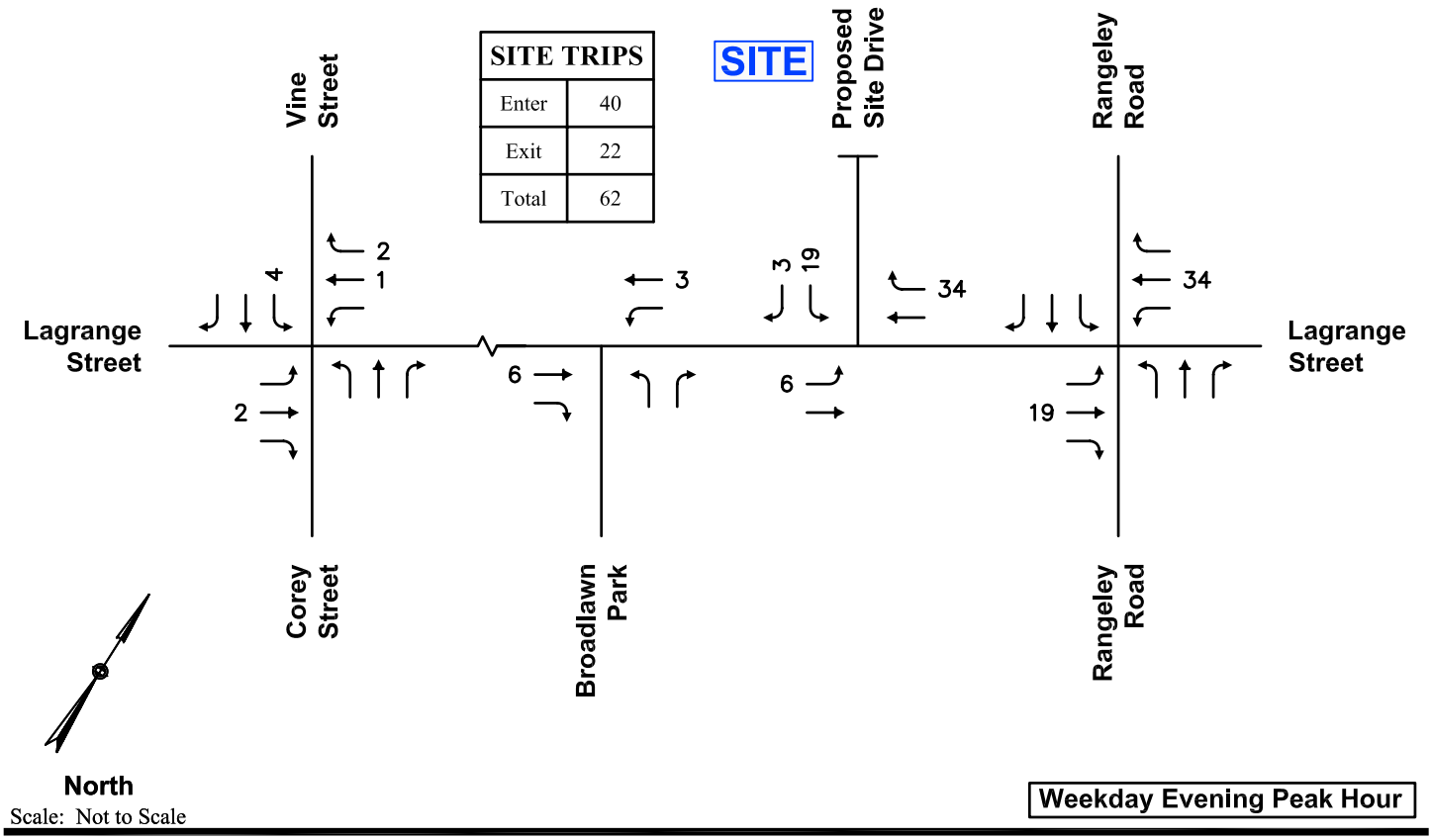


Figure 6

Site-Generated Trips

MDM TRANSPORTATION CONSULTANTS, INC.
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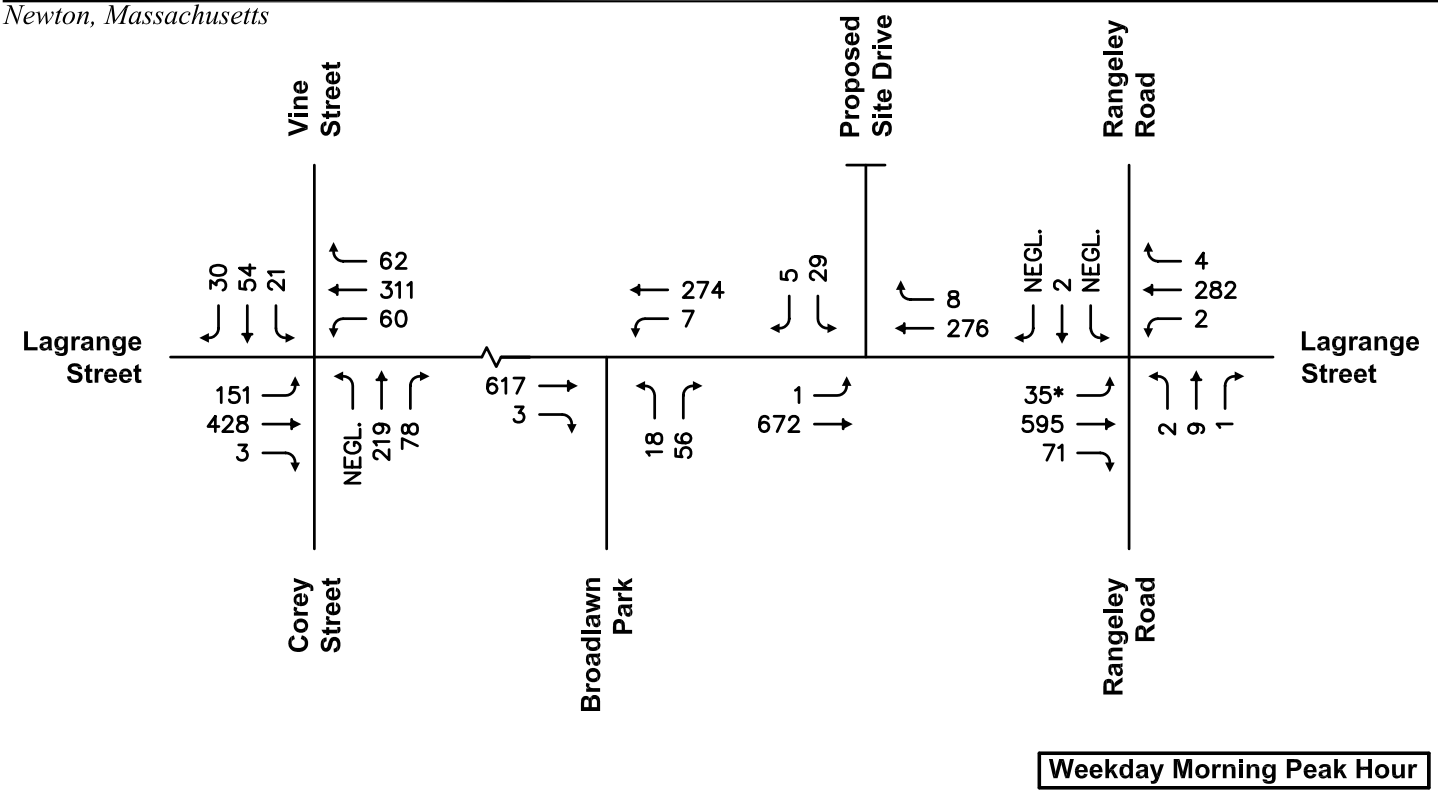
Date: June 2014
Dwg No. 765 TIAS.dwg



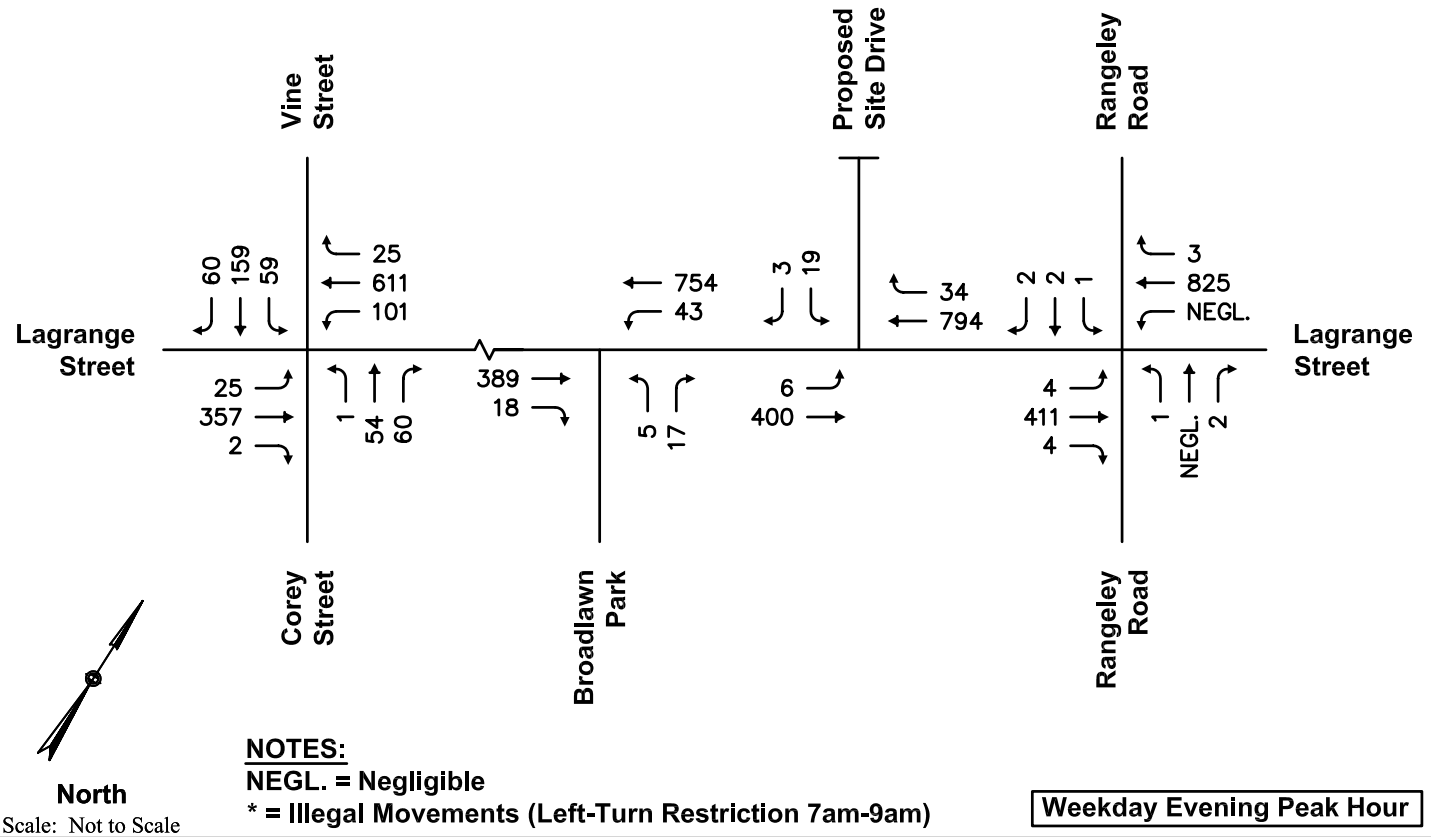


Figure 7

2019 Build Condition
Peak Hour Traffic Volumes

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

Date: June 2014
Dwg No. 765 TIAS.dwg

Analysis Methodology

Intersection capacity analyses are presented in this section for the Existing (Baseline), No-Build, and Build traffic-volume conditions. Capacity analyses, conducted in accordance with EEA/MassDOT guidelines, provide an index of how well the roadway facilities serve the traffic demands placed upon them.

Capacity analysis of intersections is developed using the Synchro® computer software, which implements the methods of the 2010 Highway Capacity Manual (HCM). The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service is defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements). The specific control delays and associated LOS designations are presented in the **Attachments**.

Analysis Results

Level-of-Service (LOS) analyses were conducted for the Existing (Baseline), No-Build, and Build conditions for the study intersections. The results of the intersection capacity are summarized below in **Table 9** and **Table 10**. Detailed analysis results are presented in the **Attachments**.

TABLE 9
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY MORNING PEAK HOUR

		2014 Existing (Baseline)			2019 No-Build			2019 Build		
Period	Approach	v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS	v/c	Delay	LOS
Lagrange Street at	Eastbound L	0.12	8	A	0.13	8	A	0.13	8	A
Corey Street / Vine Street	Westbound L	0.05	8	A	0.06	9	A	0.06	9	A
	Northbound	>1.0	>50	F	>1.0	>50	F	>1.0	>50	F
	Southbound	>1.0	>50	F	>1.0	>50	F	>1.0	>50	F
Lagrange Street at	Eastbound L	0.03	8	A	0.03	8	A	0.03	8	A
Rangeley Road	Westbound L	0.00	9	A	0.00	9	A	0.00	9	A
	Northbound	0.05	20	C	0.05	21	C	0.06	22	C
	Southbound	0.01	20	C	0.01	21	C	0.01	22	C
Lagrange Street at	Westbound L	0.01	9	A	0.01	9	A	0.01	9	A
Broadlawn Park	Northbound L	0.06	17	C	0.06	18	C	0.07	18	C
	Northbound R	0.12	13	B	0.12	14	B	0.12	14	B
Lagrange Street at	Eastbound L	n/a[4]	n/a	n/a	n/a	n/a	n/a	0.00	8	A
Proposed Site Drive	Southbound	n/a	n/a	n/a	n/a	n/a	n/a	0.12	19	C

[1]Volume-to-capacity ratio
[2]Average control delay per vehicle (in seconds)
[3]Level of service
[4]n/a = not applicable

TABLE 10
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY EVENING PEAK HOUR

		2014 Existing (Baseline)			2019 No-Build			2019 Build		
Period	Approach	v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS	v/c	Delay	LOS
Lagrange Street at	Eastbound L	0.03	9	A	0.03	9	A	0.03	9	A
Corey Street / Vine Street	Westbound L	0.09	8	A	0.09	8	A	0.09	8	A
	Northbound	>1.0	>50	F	>1.0	>50	F	>1.0	>50	F
	Southbound	>1.0	>50	F	>1.0	>50	F	>1.0	>50	F
Lagrange Street at	Eastbound L	0.01	9	A	0.01	9	A	0.01	10	A
Rangeley Road	Westbound L	0.00	<5	A	0.00	<5	A	0.00	<5	A
	Northbound	0.01	16	C	0.01	17	C	0.01	18	C
	Southbound	0.02	21	C	0.02	22	C	0.03	23	C
Lagrange Street at	Westbound L	0.04	8	A	0.04	8	A	0.04	8	A
Broadlawn Park	Northbound L	0.03	24	C	0.03	26	D	0.03	26	D
	Northbound R	0.03	11	B	0.03	11	B	0.03	11	B
Lagrange Street at	Eastbound L	n/a[4]	n/a	n/a	n/a	n/a	n/a	0.01	10	A
Proposed Site Drive	Southbound	n/a	n/a	n/a	n/a	n/a	n/a	0.11	25	C

[1]Volume-to-capacity ratio
[2]Average control delay per vehicle (in seconds)
[3]Level of service
[4]n/a = not applicable

As summarized in **Table 9** and **Table 10**:

- Operations along Lagrange Street at Corey Street/ Vine Street operate unimpeded at LOS A operations under all analysis scenarios; however, modeling shows longer delays for movements from the side streets. Field observations and measurements confirm that these modeled delays are conservatively high; actual delays experienced by vehicles at this intersection average less than 15 seconds as described in more detail in the following section (equivalent to LOS B or better opertations). Additional project traffic is not expected to notably impact operations at the intersection, which field measurements show operates below capacity and safety data shows is a below-average crash location.

- The proposed development is not expected to materially impact the nearby Lagrange Street/ Rangeley Road unsignalized intersection. No change in LOS is anticipated relative to No-Build conditions as a result of the proposed development. The intersection will operate below capacity at LOS C or better operations.

- Operational analysis of the unsignalized Lagrange Street/ Broadlawn Park intersection indicates the main line movements operate unimpeded at LOS A operations. Side street delays along the Broadlawn Park approach are expected to operate below capacity at LOS D or better with or without the proposed development. This operating condition is well within operating levels and delays typical of urban settings. Traffic due to the proposed residential development is expected to have negligible impact to the intersection with no change in level of service or delay anticipated during peak hours.

- Under future Build Conditions, the proposed site driveway along Lagrange Street will operate below capacity at LOS C during the weekday morning and weekday evening peak hours. The mainline movements along Lagrange Street are anticipated to operate unimpeded at LOS A operations.

The above analysis results are based on a conservatively high trip generation methodology for the project. Accordingly, actual site traffic impacts are likely to be lower than reported above.

Observed Intersection Delays

Field observations were made at the intersection of Lagrange Street and Corey Street/ Vine Street to determine actual average delays for vehicles turning onto Lagrange Street during the weekday morning and weekday evening peak hours. The observed delay data are presented in the **Appendix,** which were used to compare actual field conditions to those calculated using Synchro® modeling presented above.

Field measurements indicate that, on average, vehicles attempting to depart from the Corey Street approach onto Lagrange Street were delayed an average of 10 seconds during the morning peak hour and an average of 7 seconds during the evening peak hour, results that correlate to LOS A operations. Similarly, field measurements indicate that, on average, vehicles attempting to depart from the Vine Street approach onto Lagrange Street were delayed an average of 7 seconds during the morning peak hour and an average of 14 seconds during the evening peak hour, results that correlate to LOS A and LOS B operations, respectively. While vehicles are occasionally delayed by more than 50 seconds, observed average delay times are well below that value.

Along the northbound Corey Street approach to the intersection, the maximum number of vehicles queued at the intersection were 5 vehicles during the morning peak hour and 3 vehicles during the evening peak hour. Along the southbound Vine Street approach to the intersection, the maximum number of vehicles queued at the intersection were 3 vehicles during the morning peak hour and 7 vehicles during the evening peak hour.

When compared to the calculated delays in the capacity analysis results above, these measured average delay conditions indicate that the computer-based vehicle delay results provide an overly conservative analysis. Calculated average delays suggest the minor street approaches at the Lagrange Street at Corey Street/Vine Street intersection operates at LOS F during the morning and evening peak hours; observed average delays are significantly lower and correspond to LOS B or better conditions. This finding suggests that ample capacity exists at the study area intersection of Lagrange Street and Corey Street/Vine Street to support the anticipated traffic generated by the site (one additional vehicle trip every 5 to 10 minutes). A comparison of calculated versus observed vehicle delays is presented in **Table 11**.

TABLE 11
AVERAGE VEHICLE DELAY COMPARISON

Intersection/ Period	Calculated Delay (seconds)	LOS	Actual Delay (seconds)	LOS
Corey Street departure to Lagrange Street				
Weekday Morning Peak Hour	>50	F	10	A
Weekday Evening Peak Hour	>50	F	7	A
Vine Street departure to Lagrange Street				
Weekday Morning Peak Hour	>50	F	7	A
Weekday Evening Peak Hour	>50	F	14	B

In summary, the proposed development is expected to have a minimal impact on the study area intersections as there will be no change in level of service and delay increases of 1 second or less during peak hours under future conditions due to the proposed residential development. In general, adequate capacity is available under future Build conditions to accommodate the site use.

SITE ACCESS/CIRCULATION

The site has been designed to include a 20-foot wide main driveway in accordance with local design standards. The curb radii and on-site circulation aisles are adequate to provide access and egress for emergency apparatus (Ladder Truck) with no significant impact to on-site parking. AutoTurn® analysis figures for the emergency apparatus and service vehicle types are provided in the **Attachments**.

CONCLUSIONS AND RECOMMENDATIONS

In summary, MDM finds that travel conditions in the site vicinity along Lagrange Street are generally unconstrained. Trip generation estimates based on ITE methodology trip generation for the development is estimated at approximately 43 vehicle-trips during the weekday morning peak hour and 62 vehicle-trips during the weekday evening peak hour. The proposed 80-unit residential development is not expected to have a material impact on the study area intersections and no change in traffic operations is anticipated. No material change in operations is anticipated along major public ways and at study intersections under future conditions due to the proposed apartment complex. MDM recommends the following access-related improvements aimed at enhancing traffic operations and/or travel safety:

- The site driveway along Lagrange Street is proposed to be 20-feet wide and will include a "STOP" sign (R1-1), STOP line pavement markings and crosswalk on the driveway approach to Lagrange Street. The final design of the roadway should accommodate passenger cars, delivery traffic, and emergency apparatus as needed.

- Sidewalks are proposed connecting the main building entrance to Lagrange Street. The Applicant proposes to construct a sidewalk along the northerly side of Lagrange Street. MDM recommends that this sidewalk connect to the existing sidewalk along the northerly side of Lagrange Street in Brookline subject to consultation and approval of the City of Newton and/or the Town of Brookline as needed. MDM also recommends that all proposed sidewalk be ADA-compliant.

- Any new plantings (shrubs, bushes) and structures (walls, fences, etc.) should be maintained at a height of 2 feet or less within the sight lines in vicinity of the site driveway to provide unobstructed sight lines.

Additionally, CHR plans to evaluate the inclusion of the proposed Kesseler Woods residential development in their existing shuttle service that transports Hancock Village residents between Independence Drive and Reservoir Station (Cleveland Circle) during weekday morning and weekday evening commuter periods. The inclusion of Kesseler Woods in this shuttle service would provide the added benefit of Kesseler Woods resident access to two Zipcar vehicles provided at Hancock Village.