TRANSPORTATION IMPACT ASSESSMENT

BETH ISRAEL DEACONESS HOSPITAL EXPANSION
NEEDHAM, MASSACHUSETTS

Prepared for:

Beth Israel Deaconess Hospital- Needham, Inc.
Needham, MA

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EXECUTIVE SUMMARY

Vanasse & Associates, Inc. (VAI) has completed a detailed assessment of the potential impacts on the transportation infrastructure associated with the proposed Beth Israel Deaconess Hospital-Needham, Inc. expansion in Needham, Massachusetts. This assessment has been completed in accordance with State and Town standards and those 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:

- The Project is expected to generate approximately 35 new vehicle trips (22 vehicles entering and 13 exiting) during the weekday morning peak hour and 35 new vehicle trips (13 vehicles entering and 22 exiting) during the weekday evening peak hour;

- A review of accident data researched from MassDOT indicates that area intersections experience accident rates below state averages indicating safe operations.

- The Project will result in minimal increase in delays and queuing in the study area.

- The closing of the South Lot Lincoln Street driveway will reduce traffic along Lincoln Street.

- Effective managed parking at both on-site and off-site locations will continue to provide adequate parking while reducing the impacts in the immediate area of the hospital.

RECOMMENDATIONS

The following is recommended as a result of this study to maintain acceptable traffic and parking conditions in the vicinity of the hospital.

Site Access

In order to minimize the project impact and reduce traffic within the Lincoln Street neighborhood, it is recommended that the South Lot Lincoln Street driveway be closed. As per Section 3.6.8 of the Zoning By-Laws, closing of this driveway is consistent with the maintenance

of the suburban, residential character off all predominantly residential streets and portions of streets nearby the premises. The project impacts are minimized along School, Lincoln, Grant, Warren, Pleasant and Kimball Streets. Since 1998, the hospital has relocated the emergency room and entrance from Lincoln Street, modified and now closed the South Lot driveway at Lincoln Street and under the current plan, also closed the 111 Lincoln Street driveways providing access to 26 parking spaces which accommodated the Needham Pediatrics practice at 111 Lincoln Street. The purchase of 111 Lincoln Street by the Hospital, the relocation of the Needham Pediatrics practice, the decision to raze the 111 Lincoln Street building that had vehicular access from Lincoln Street and replacing it with a building where vehicular traffic to that site is directed to the Hospital parking area via Chestnut Street and not through the predominately residential street nearby the premises, have and will contribute to less traffic on those streets, consistent with the provisions of Section 3.6.8 of the Zoning By-Law.

Transportation Demand Management Measures

Bus service provided by the MBTA is provided along Chestnut Street with a bus stop located at the intersection of Chestnut Street and Oak Street. It is recommended that information regarding public transportation options be made available to employees and patients of the Hospital in an effort to reduce the overall number of automobile trips in the area and to integrate the project into the available transportation resources.

Parking

The hospital will continue to effectively manage the on-site and off-site parking. With past expansions of both on-site parking and use of the off-site lots, there has been a clear improvement to the on-site parking availability. In 2014, the hospital implemented a parking sticker program to more effectively manage on-site parking. This program, plus initiation of on-site security (24-hour) has resulted in more efficient use of the parking. As a result of these successful measures, the use of the on-site gates can be eliminated.

The hospital is under discussions for off-site parking of up to 35-50 additional parking spaces.

Traffic Signal Optimization

Prior to full occupancy of the proposed addition, traffic signal timings will be reviewed by the applicant's traffic engineer at the Chestnut Street intersections with School Street and Oak Street, and implement changes, if recommended by him.

CONCLUSIONS

An analysis of traffic operations at the study area intersections indicates that all of the study area intersections currently operate and will continue to operate at level-of-service (LOS) D or better during the peak periods and the project will not have a significant impact on motorist delays and vehicle queuing over Existing and No-Build conditions.

An analysis of projected parking demand indicates that sufficient parking will exist based on actual usage, projected usage and the increased parking supply.

With implementation of the above recommendations, safe and efficient access will be provided to the project site and the project can be constructed with minimal impact on the roadway system.

INTRODUCTION

Vanasse & Associates, Inc. (VAI) has conducted a Transportation Impact Assessment (TIA) to identify the potential traffic impacts associated with the proposed expansion of the Beth Israel Deaconess Hospital (the "Hospital") located off of Chestnut Street in Needham, Massachusetts. This study identifies and analyzes existing traffic conditions and future traffic conditions both with and without the project, and reviews access requirements, projected parking demand, potential off-site improvements, and safety considerations.

PROJECT DESCRIPTION

The existing Hospital campus consists of 156,075 square feet (sf) of floor area. The proposed expansion will consist of the construction of a new Ambulatory Care Center, which will be approximately 37,076 sf, resulting in a total of approximately 193,171 sf total hospital floor area. The existing 111 Lincoln Street building will be removed and the property will be consolidated with 148 Chestnut Street. The new building and the main hospital will be linked by a connector allowing for easy and safe passage for patients and providers between the buildings. It is currently planned that the new building will provide clinical space to be occupied by several of the existing clinics currently residing in the main hospital building. These clinics include, but are not limited to, Cardiology, Orthopedics, Endoscopy, and Meeting Rooms. Currently, there are five principal parking lots on the Hospital campus: the North Parking Lot, the South Parking Lot, the Parking Deck, the Chestnut Place Lot and the Delivery Lot. Existing access/egress driveways to the parking lots via School Street and Chestnut Street will remain unchanged. The South Parking Lot driveway onto Lincoln Street will be closed. The Hospital will continue to accommodate additional employee parking in the Hospital Chestnut Place Parking Lot located off of Chestnut Place, at 73 Chestnut Street (6 spaces), at one of the municipal lots (24 spaces) and at an off-site location in Dedham. Figure 1 shows the site location in relation to the local roadway network.

STUDY METHODOLOGY

This study was prepared in accordance with state guidelines for the preparation of Traffic Impact Assessments (TIAs), and was conducted in three distinct stages. The first stage involved an assessment of existing traffic conditions in the study area and included an inventory of roadway geometrics and parking supply, observations of traffic flow, and collection of peak-period traffic counts and parking demand.

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 from the current year was selected for analyses consistent with state guidelines for the preparation of TIAs. The traffic analysis conducted in stage two identifies existing or projected future roadway capacity, traffic safety, and site access issues, and parking supply and demand analysis.

The third stage of the study presents and evaluates measures to address traffic and safety issues, access and egress requirements, and proposals to mitigate project-related roadway impacts.

EXISTING CONDITIONS

A comprehensive field inventory of existing conditions on the study area roadways was conducted in March 2017. The field investigation consisted of an inventory of existing roadway geometrics; pedestrian and bicycle facilities; public transportation services; traffic volumes; parking supply and demand; and operating characteristics; as well as posted speed limits and land use information within the study area. The study area for the project is listed below and graphically depicted in Figure 2.

1. Chestnut Street at School Street
2. Chestnut Street at Ambulance Entrance
3. Chestnut Street at Oak Street and the South Parking Lot driveway
4. Chestnut Street at Chestnut Place
5. Chestnut Place at the Hospital Chestnut Place Parking Lot
6. School Street at the Hospital North Parking Lot/Police Station driveway
7. School Street at Hospital Garage
8. School Street at Lincoln Street
9. Lincoln Street at the Delivery Driveway
10. Lincoln Street at the Hospital Drop-Off Driveways
11. Lincoln Street at the Hospital South Parking Lot driveway

The following describes the study area roadway and intersections. Figure 3 summarizes existing lane use and travel lane widths at the study area intersections.

GEOMETRY

Roadways

Chestnut Street

The study section of Chestnut Street is a two-lane, urban minor arterial under local jurisdiction that has a general north-south alignment and connects Route 135 and the Town center in the north to Dedham Street in the south. Chestnut Street generally provides two 18 to 19-foot wide travel lanes separated by a double-yellow centerline with additional travel lanes provided at major intersections. Within the study area, sidewalks exist on both sides of the street, with crosswalks

provided at signalized intersections. Land uses along Chestnut Street consist of the Hospital, small retail stores, office, and residential uses.

School Street

School Street is a two-lane roadway under local jurisdiction that has a general east-west alignment and connects Chestnut Street in the west to Route 135 in the east. School Street generally provides one travel lane per direction, separated by a double-yellow centerline. Within the study area, sidewalks exist on both sides of the street, with crosswalks provided at major intersections. Land use along School Street consists of the Hospital, public parking, the police station and residential uses.

Lincoln Street

Lincoln Street is a two-lane roadway under local jurisdiction that has a general north-south alignment. Lincoln Street is generally 23 to 24 feet wide, providing one travel lane per direction with no marked centerline. Within the study area, sidewalks exist on both sides of the street, with crosswalks provided at major intersections. Land use along Lincoln Street consists of the Hospital, residential uses, and the Briarwood Nursing Home.

Intersections

Chestnut Street at School Street

School Street intersects Chestnut Street from the east to form this three-legged, signalized intersection. The Chestnut Street northbound approach consists of one 10-foot wide left-turn lane and a 13-foot wide through/right-turn lane with a 1-foot wide shoulder. The Chestnut Street southbound approach consists of one 10-foot wide left-turn lane and a 12-foot wide through lane with a 1-foot wide shoulder. The directions of travel along Chestnut Street are separated by a double-yellow centerline. The School Street westbound approach consists of a 10-foot wide left-turn/through lane and a 12-foot wide right-turn lane. The directions of travel along School Street are separated by a double-yellow centerline. Sidewalks exist along all sides of the intersection, with crosswalks provided across the north and east legs. The traffic signal operates in a three-phase, fully-actuated mode, with a lagging southbound phase provided. An exclusive pedestrian phase is provided upon pushbutton activation. The traffic signal at this intersection is coordinated with the traffic signal at Oak Street. Land use in the vicinity of the intersection consists of the police station, the Hospital and commercial uses.

Chestnut Street at the Hospital Ambulance Entrance

The ambulance entrance driveway intersects Chestnut Street from the east to form this three-legged, unsignalized intersection. The Chestnut Street northbound and southbound approaches consist of an 18-foot wide general-purpose travel lane with the directions of travel separated by a double-yellow centerline. The ambulance entrance driveway is 18 feet wide accommodating eastbound travel only (vehicles exiting Chestnut Street). Sidewalks exist along both sides of Chestnut Street. Land use in the vicinity of the intersection consists of the Hospital and commercial uses.

Chestnut Street at Oak Street and the Hospital South Parking Lot

The South Parking Lot driveway and Oak Street intersect Chestnut Street from the east and west, respectively, to form this four-legged, signalized intersection. The Chestnut Street northbound approach consists of a 10-foot wide left-turn lane and a 10-foot wide through/right-turn lane. The Chestnut Street southbound approach consists of a 10-foot wide left-turn/through lane and a 10-foot wide right-turn lane. The directions of travel along Chestnut Street are separated by a double-yellow centerline. The Oak Street eastbound approach consists of an 11-foot wide general-purpose lane. The directions of travel along Oak Street are separated by a double-yellow centerline. The South Parking Lot driveway is gated and accommodates 12-foot wide entering and exiting travel lanes. Sidewalks exist along all sides of the intersection, with crosswalks provided across all legs. The traffic signal operates in a three-phase, fully-actuated mode, with a leading northbound phase provided. An exclusive pedestrian phase is provided upon pushbutton activation. The traffic signal at this intersection is coordinated with the traffic signal at School Street. Land use in the vicinity of the intersection consists of the Hospital and commercial uses. A bus stop is located on the southeast corner of the intersection.

Chestnut Street at Chestnut Place

Chestnut Place intersects Chestnut Street from the east and west to form this four-legged, unsignalized intersection. The Chestnut Street northbound and southbound approaches consist of one 19 to 23-foot wide general-purpose travel lane with directions of travel separated by a double-yellow centerline. Chestnut Place is approximately 25 feet wide, accommodating two-way travel. A full-access commercial driveway providing access to restaurants, including a Dunkin' Donuts, is located opposite Chestnut Place. A sidewalk exists along all sides of the intersection. Land use in the vicinity of the intersection consists of commercial uses and a parking lot for the Hospital employees.

Chestnut Place at the Hospital Employee Parking Lot

Access to the Hospital Chestnut Place Parking Lot is provided via two 10 to 13-foot wide full-access driveways that intersect the north side of Chestnut Place. Chestnut Place is a 25-foot wide roadway with no marked centerline, accommodating two-way travel. A sidewalk exists along both sides of Chestnut Place. Land use in the vicinity of the intersection consists of commercial uses and the parking lot.

School Street at the Hospital North Parking Lot and Police Station Driveway

The police station driveway and the North Parking Lot driveway intersect School Street from the north and south, respectively, to form this four-legged unsignalized intersection. The School Street eastbound approach provides one 14-foot wide general-purpose travel lane with a 1-foot wide shoulder. The School Street westbound approach provides two 10 to 12-foot wide travel lanes with a 1-foot wide shoulder. The directions of travel along School Street are separated by a double-yellow centerline. The North Parking Lot driveway is gated and accommodates 12-foot wide entering and exiting travel lanes. The police station driveway is 18 feet wide and accommodates exiting vehicles only. A sidewalk exists along both sides of School Street. Land use in the vicinity of the intersection consists of the Hospital and the Needham Police Station.

School Street at the Hospital Garage

The Hospital Garage driveway intersects School Street from the south to form this three-legged unsignalized intersection. The School Street eastbound approach provides one 13-foot wide general-purpose travel lane with a 1-foot wide shoulder. The School Street westbound approach provides one 12-foot wide travel lane with a 1-foot wide shoulder. The directions of travel along School Street are separated by a double-yellow centerline. The Hospital Garage driveway is accommodates 11-foot wide entering and exiting travel lanes. A sidewalk exists along both sides of School Street. Land use in the vicinity of the intersection consists of the Hospital.

School Street at Lincoln Street

Lincoln Street intersects School Street from the north and south to form this four-legged intersection under all-way STOP control. The School Street eastbound approach provides one 13-foot wide general purpose travel lane, with on-street parking. The School Street westbound approach provides one 12-foot wide general purpose travel lane. Lincoln Street is a 23 to 24-foot wide roadway accommodating one travel lane per direction with no marked centerline or edge lines provided. Sidewalks exist along all sides of the intersection, with crosswalks provided across all legs. Land use in the vicinity of the intersection consists of the Hospital, the Tobin After-School facility, and residential homes.

Lincoln Street at the Hospital Delivery Driveway

The delivery driveways intersect Lincoln Street from the west to form this three-legged, unsignalized intersection. Lincoln Street is a 23-foot wide roadway accommodating two-way travel with no marked centerline or edge lines provided. The delivery driveway is approximately 40 feet wide, accommodating two-way travel. Sidewalks exist along both sides of Lincoln Street. Land use in the vicinity of the intersection consists of the Hospital and residential homes.

Lincoln Street at the Hospital Driveways

The hospital driveways intersect Lincoln Street from the west to form these two, three-legged, unsignalized intersections. Lincoln Street is a 23-foot wide roadway accommodating two-way travel with no marked centerline or edge lines provided. The driveway is a one-way circular roadway which connects to Lincoln Street on both ends. Sidewalks exist along all sides of this intersection. Land use in the vicinity of the intersection consists of the Hospital and residential homes.

Lincoln Street at the Hospital South Parking Lot Driveway

The South Parking Lot driveway intersects Lincoln Street from the west to form this three-legged, unsignalized intersection. Lincoln Street is a 23-foot wide roadway accommodating two-way travel with no marked centerline or edge lines provided. The South Parking Lot driveway is gated and accommodates 12-foot wide entering and exiting travel lanes. Sidewalks exist along both sides of Lincoln Street. Land use in the vicinity of the intersection consists of the Hospital and residential homes.

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 March 2017. The ATR counts were conducted on Chestnut Street 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 weekday afternoon (3:00 to 6:00 PM) peak period manual TMCs performed at the study intersections.

Seasonal Variation

In order to evaluate the potential for seasonal fluctuation of traffic volumes within the study area, MassDOT count stations were reviewed. Based on a review of this data, it was determined that traffic volumes for the month of March are approximately 12 percent below average-month conditions. In order to provide an average analysis scenario, the March traffic counts were adjusted upward accordingly. The 2017 Existing traffic volumes are summarized in Table 1 and graphically depicted on Figures 4 and 5 for the weekday morning and evening peak hours, respectively.

A review of the peak-period traffic counts indicate that the weekday morning peak hour within the study area generally occurs between 7:15 and 8:15 AM, with the evening peak hour generally occurring between 3:45 and 4:45 PM.

Table 1
EXISTING ROADWAY TRAFFIC-VOLUME SUMMARY

		Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
Location	Daily Volume (vpd)[a]	Volume (vph)[b]	Percent of Daily Traffic[c]	Predominant Flow	Volume (vph)	Percent of Daily Traffic	Predominant Flow
Chestnut Street, south of Chestnut Place	11,400	853	7.5	66% NB	981	8.6	59% SB

[a]Two-way daily traffic expressed in vehicles per day; from ATR Counts March 2017.
[b] Manual turning movement counts conducted in March 2017.
[c]The percent of daily traffic that occurs during the peak hour.
NB = northbound, SB = southbound

As can be seen in Table 1, Chestnut Street was found to accommodate approximately 11,400 vehicles per day (vpd) with 853 vehicles per hour (vph) during the weekday morning school peak hour and 981 vph during the weekday afternoon school peak hour. Directional traffic during the weekday morning is in the northbound direction and during the weekday evening is in the southbound direction.

PEDESTRIAN AND BICYCLE FACILITIES

A comprehensive field inventory of pedestrian and bicycle facilities within the study area was undertaken in March 2017. 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 bicycle facilities. In general, sidewalks are provided along the study area roadways. Crosswalks are provided at the all-way STOP-controlled intersection of School Street and Lincoln Street, as well as at the signalized intersections of Chestnut Street at School Street and Chestnut Street at Oak Street, along with pedestrian traffic signal equipment and phasing.

There are no formal existing bicycle facilities that were identified within the immediate study area; however, the traffic signal system at the signalized study intersections includes bicycle detection.

PUBLIC TRANSPORTATION

Public transportation services are provided within the study area by the Massachusetts Bay Transportation Authority (MBTA). The MBTA operates Bus Route 59, Needham Junction – Watertown Square via Newtonville, with a bus stop located on Chestnut Street at the intersection of Oak Street. . The bus service inbound (Needham Junction to Watertown Square via Newtonville) is provided Monday through Friday from approximately 6:00 AM to 7:50 PM operating every 35 minutes, Saturday from approximately 7:05 AM to 7:05 PM and Sunday from 7:50 AM to 6:20 PM both operating every 1 hour and 30 minutes. The bus service outbound (Watertown Square via Newtonville to Needham Junction) is provided Monday through Friday from approximately 6:05 AM to 7:00 PM operating every 35 minutes, Saturday from approximately 6:20 AM to 6:20 PM and Sunday from 7:05 AM to 5:35 PM both operating every 1 hour and 30 minutes.

The MBTA provides Commuter Rail service to South Station in Boston on the Needham Line (Zone 2), with Needham Junction Station located approximately 0.3 miles away to the hospital. The service is provided on weekday and Saturdays between approximately 6:00 AM to 8:00 PM.

In addition to MBTA services, the hospital shuttles employees from St. John of Damascus Orthodox at 300 West Street in Dedham to and from the hospital. Table 2 presents the employee shuttle schedule to and from Dedham.

Table 2
BID NEEDHAM SHUTTLE SCHEDULE

Morning (Departs Church)	Afternoon (Departs ED)
6:05 AM	**1:05 PM**
6:20 AM	**1:20 PM**
6:35 AM	**1:35 PM**
6:42 AM	**1:50 PM**
6:50 AM	**2:05 PM**
6:57 AM	**2:20 PM**
7:05 AM	**2:35 PM**
7:12 AM	**2:50 PM**
7:20 AM	**3:05 PM**
7:27 AM	**3:20 PM**
7:35 AM	**3:35 PM**
7:42 AM	**3:50 PM**
7:50 AM	**4:05 PM**
7:57 AM	**4:20 PM**
8:05 AM	**4:35 PM**
8:20 AM	**4:50 PM**
8:35 AM	**5:05 PM**
8:50 AM	**5:20 PM**
9:05 AM	**5:35 PM**
9:20 AM	**5:50 PM**
9:35 AM	**6:05 PM**
9:50 AM	**6:20 PM**
10:05 AM	**6:35 PM**
10:20 AM	**6:50 PM**
10:35 AM	**7:05 PM**
10:50 AM	**7:20 PM**
ON-CALL UNTIL 12:00 PM[1]	**7:35 PM** **7:50 PM**
***Driver takes his lunch break from 12:30 PM to 1 PM**	**8:05 PM ON CALL UNTIL 8:30 PM**

[1] Shuttle will run every 15 min except for "on-call" time; Shuttle Number - 781-453-3601

Any new parking lots outside of Needham will also include shuttle service.

MOTOR VEHICLE CRASH DATA

Motor vehicle crash data for the study area intersections were obtained from the MassDOT database research periods 2010 through 2014, the most recent five-year period for which data is available. Motor vehicle crash data was reviewed to determine crash trends in the study area. A summary of the data is provided in Table 3.

Table 3
MOTOR-VEHICLE CRASH DATA SUMMARY[a]

Scenario	Chestnut St/ School St	Chestnut St/ Oak St	School St/ Lincoln St	School St/ North Parking Lot
Year:				
2010	1	2	0	0
2011	1	1	1	0
2012	1	2	0	0
2013	1	4	1	1
2014	2	1	1	0
Total	6	10	3	1
Average	1.20	2.00	0.60	0.20
Crash Rate[b]	0.25	0.38	0.24	0.09
Significant[c]	No	No	No	No
Type:				
Angle	2	4	2	0
Rear-End	2	4	0	1
Head-On	1	0	0	0
Single Vehicle	1	0	0	0
Sideswipe	0	2	1	0
Pedestrian	0	0	0	0
Unknown	0	1	0	0
Total	6	10	3	1
Pavement Conditions				
Dry	4	10	3	0
Wet	2	0	0	0
Snow	0	0	0	1
Icy	0	0	0	0
Other	0	0	0	0
Unknown	0	0	0	0
Total	6	10	3	1
Severity:				
Property Only	5	9	2	1
Injury Accident	1	1	1	0
Fatal Accident	0	0	0	0
Other	0	0	0	0
Total	6	10	3	1

[a]Source: MassDOT. [b]Average accident over five-year period.
[b]Crash rate per million entering vehicles (mev).
[c]Signalized intersections are significant if rate 0.76 crashes per million entering vehicles (mev) and unsignalized intersections are significant if rate 0.58 crashes per mev for locations within District 6.

As can be seen in Table 3, the study area intersections were found to have averaged less than two reported motor vehicle crashes per year over the five-year review period. The signalized intersection of Chestnut Street at Oak Street was found to have experienced 10 motor vehicle crashes over the five-year review period, the majority of which involved property damage only (9 out of 10); occurred under dry roadway conditions (10 out of 10); and were classified as either angle and rear-end collisions (8 out of 10). All of the study intersections were found to have a motor vehicle crash rate below the MassDOT average for a signalized or unsignalized intersection, as appropriate, for the MassDOT Highway Division District in which the project is located (District 6). No fatal motor vehicle crashes were reported at the study area intersections over the five-year review period.

FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2024, which reflects a seven-year planning horizon from the current year consistent with State traffic study guidelines. Independent of the project, traffic volumes on the roadway network in the year 2024 under No-Build conditions include all existing traffic and new traffic resulting from background traffic growth. Anticipated project-generated traffic volumes superimposed upon this 2024 No-Build traffic network reflect the 2024 Build conditions with the project.

BACKGROUND TRAFFIC GROWTH

Traffic growth on area roadways is a function of the expected land development in the immediate area, as well as the surrounding region. Several methods are 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 inter-sections.

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 produces a more realistic estimate of growth for local traffic. However, the drawback of this procedure is that the potential growth in population and development external to the study area would not be accounted for in the traffic projections.

To provide a conservative analysis framework, both procedures were used.

General Background Traffic Growth

To present a conservative analysis scenario and to be consistent with the traffic study[1] previously conducted for the Hospital, a 1.0 percent per year compounded annual growth rate was used to account for general background traffic growth.

[1]Ibid 1.

Specific Development by Others

The Town of Needham Planning Department was contacted to identify any specific background developments that would have an impact on the traffic operating conditions within the study area by the 2024 design year. Based on these discussions, no projects were identified at this time that would impact future traffic volumes within the study area beyond the general background traffic growth rate.

Roadway Improvement Projects

The Town of Needham Planning Department was contacted to identify any planned roadway improvement projects that would have an impact on the traffic operating conditions within the study area by the 2024 design year. Based on these discussions, no roadway improvements were identified at this time that would impact future traffic volumes within the study area beyond the general roadway maintenance.

No-Build Traffic Volumes

The 2024 No-Build weekday morning and weekday evening peak-hour traffic-volume networks were developed by applying a compounded 1.0 percent annual growth rate to the existing 2017 peak-hour traffic volumes. The resulting 2024 No-Build weekday morning and evening peak-hour traffic-volume networks are shown on Figures 6 and 7, respectively.

SITE-GENERATED TRAFFIC

The proposed project involves expanding the Hospital from 156,075 sf to 193,075 sf, a 37,000 sf increase in space. To develop the traffic characteristics of the Project, trip-generation statistics published by the ITE[2] for Land Use Code (LUC) 610, *Hospital*, was used. In order to estimate the number of new trips to be generated by the expansion, the increase in trips generated from the existing square footage to the proposed square footage was calculated. Table 4 summarizes the anticipated traffic characteristics of the project.

[2]Ibid 2.

Table 4
TRIP-GENERATION SUMMARY

Time Period/Direction	On-Site Existing Trips[a]	Off-Site Existing Trips[b]	New Trips[c]	Total Trips
Weekday Morning Peak Hour:				
Entering	134	11	22	167
Exiting	53	4	13	70
Total	187	15	35	237
Weekday Evening Peak Hour:				
Entering	68	6	13	87
Exiting	118	38	22	178
Total	186	44	35	265

[a]Based on TMCs conducted in March 2017.
[b]Based on trip-rate developed for Chestnut Place Parking Lot, applied to all off-site lots.
[c]Based on ITE LUC 610, Hospital.

As can be seen in Table 4, the proposed expansion is expected to generate approximately 35 new vehicle trips (22 vehicles entering and 13 exiting) during the weekday morning peak hour and 35 new vehicle trips (13 vehicles entering and 22 exiting) during the weekday evening peak hour.

TRIP DISTRIBUTION AND ASSIGNMENT

The directional distribution of new project generated trips to and from the Hospital is expected to follow existing travel patterns at the site driveways and study area intersections. The general trip distribution for the project is summarized in Table 5 and graphically depicted on Figure 8. The weekday morning and evening peak-hour traffic volumes expected to be generated by the project were assigned on the study area roadway network as shown on Figures 9 and 10, respectively.

Table 5
TRIP-DISTRIBUTION SUMMARY

Roadway	Direction (To/From)	Percent
Chestnut Street	North	35
Chestnut Street	South	20
School Street	East	25
Lincoln Street	North	5
Lincoln Street	South	5
Oak Street	West	10
Total		100

FUTURE TRAFFIC VOLUMES – BUILD CONDITION

The 2024 Build condition networks consist of the 2024 No-Build traffic volumes with the anticipated site-generated traffic added to them. The 2024 Build weekday morning and weekday evening peak-hour traffic-volume networks are graphically depicted on Figures 11 and 12, respectively.

A summary of peak-hour projected traffic-volume increases are shown in Table 6. These volumes are based on the expected increases from the project.

Table 6
PEAK-HOUR TRAFFIC-VOLUME INCREASES

Location/Peak Hour	2024 No-Build	2024 Build	Volume Increase	Percent Increase
Chestnut Street, north of School Street:				
Weekday Morning	739	752	13	1.8
Weekday Evening	877	890	13	1.5
Chestnut Street, south of Chestnut Place:				
Weekday Morning	913	919	6	0.7
Weekday Evening	1,050	1,056	6	0.6
Lincoln Street, north of School Street:				
Weekday Morning	73	75	2	2.7
Weekday Evening	104	106	2	1.9
Lincoln Street, south of the South Parking Lot:				
Weekday Morning	78	80	2	2.6
Weekday Evening	91	93	2	2.2
School Street, east of Lincoln Street:				
Weekday Morning	477	486	9	1.9
Weekday Evening	554	563	9	1.6
Oak Street, west of Chestnut Street:				
Weekday Morning	448	451	3	0.7
Weekday Evening	417	420	3	0.7

As shown in Table 6, it is expected that the project will result in relatively small increases on area roadways. Project-related traffic-volume increases are anticipated to range from 2 to 13 vehicles during the peak periods, with percent increases ranging from 0.6 to 2.7 percent.

TRAFFIC OPERATIONS ANALYSIS

Measuring existing and future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity analyses were conducted under Existing, No-Build and Build traffic-volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them.

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.[3] 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.

[3]The capacity analysis methodology is based on the concepts and procedures presented in the *Highway Capacity Manual;* Transportation Research Board; Washington, DC; 2000.

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 2000 *Highway Capacity Manual.*[4] 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 effects 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 2000 *Highway Capacity Manual*. Table 7 summarizes the relationship between level of service and average control delay.

Table 7
LEVEL-OF-SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS[a]

Level of Service	Average Control Delay (Seconds Per Vehicle)
A	≤ 10.0
B	10.1 to 15.0
C	15.1 to 25.0
D	25.1 to 35.0
E	35.1 to 50.0
F	>50.0

[a]Source: *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2000; page 17-2.

[4]*Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2000.

Signalized Intersections

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

- *LOS A* describes operations with very low control delay; most vehicles do not stop at all.
- *LOS B* describes operations with relatively low control delay. However, more vehicles stop than LOS A.
- *LOS C* describes operations with higher control delays. Individual cycle failures may begin to appear. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
- *LOS D* describes operations with control delay in the range where the influence of congestion becomes more noticeable. Many vehicles stop and individual cycle failures are noticeable.
- *LOS E* describes operations with high control delay values. Individual cycle failures are frequent occurrences.
- *LOS F* describes operations with high control delay values that often occur with over-saturation. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Levels of service for signalized intersections are calculated using the operational analysis methodology of the 2000 *Highway Capacity Manual*. This method assesses the effects of signal type, timing, phasing, and progression; vehicle mix; and geometrics on delay. Level-of-service designations are based on the criterion of control or signal delay per vehicle. Control or signal delay is a measure of driver discomfort, frustration, and fuel consumption, and includes initial deceleration delay approaching the traffic signal, queue move-up time, stopped delay and final acceleration delay. Table 8 summarizes the relationship between level of service and control delay. The tabulated control delay criterion may be applied in assigning level-of-service designations to individual lane groups, to individual intersection approaches, or to entire intersections.

Table 8
LEVEL-OF-SERVICE CRITERIA
FOR SIGNALIZED INTERSECTIONS[a]

Level of Service	Control (Signal) Delay Per Vehicle (Seconds)
A	≤10.0
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	>80.0

[a]Source: *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2000; page 16-2.

ANALYSIS RESULTS

Level-of-service analyses were conducted for 2017 Existing, 2024 No-Build and 2024 Build conditions for the intersections within the study area. The results of the intersection capacity analyses are summarized for unsignalized and signalized intersections in Tables 8 and 9, respectively, with the detailed analysis results presented in the Appendix.

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

Unsignalized Intersections

Chestnut Street at the Ambulance Entrance Driveway

Under all conditions, the critical movement at this unsignalized intersection (left-turns from Chestnut Street southbound) was shown to operate at LOS A during both the weekday morning and evening peak hours.

Chestnut Street at Chestnut Place

Under all conditions, the critical movements at this unsignalized intersection (all movements from Chestnut Place eastbound) were shown to operate at LOS C during the weekday morning peak hour and at LOS D during the weekday evening peak hour.

Chestnut Place at the Hospital Chestnut Place Parking Lot Driveway

Under all conditions, the critical movements at this unsignalized intersection (left-turns/right-turns from Chestnut Place Parking Lot southbound) were shown to operate at LOS A during both the weekday morning and evening peak hours.

School Street at the Hospital North Parking Lot and Police Station Driveway

Under all conditions, the critical movements at this unsignalized intersection (all movements from Hospital North Parking Lot) were shown to operate at LOS B during both the weekday morning and evening peak hours.

School Street at the Hospital Garage Drive

Under all conditions, the critical movements at this unsignalized intersection (all movements from Hospital Garage Drive) were shown to operate at LOS B during both the weekday morning and evening peak hours.

School Street at Lincoln Street

Under all conditions, all approaches were shown to operate at LOS B or better during both the weekday morning and weekday evening peak hours.

Table 9
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE SUMMARY

	2017 Existing				2024 No-Build				2024 Build			
Unsignalized Intersection/Critical Movement/ Peak Hour	Demand[a]	Delay[b]	LOS[c]	Queue[d]	Demand	Delay	LOS	Queue	Demand	Delay	LOS	
Chestnut Street at the Ambulance Entrance												
Chestnut Street SB LT												
Weekday Morning	1	0.0	A	0	1	0.0	A	0	1	0.0	A	0
Weekday Evening	1	0.0	A	0	1	0.0	A	0	1	0.0	A	0
Chestnut Street at Chestnut Place												
Chestnut Place EB LT/TH/RT												
Weekday Morning	13	16.6	C	4	14	17.0	C	4	14	17.2	C	4
Weekday Evening	64	25.7	D	40	68	27.9	D	46	68	28.3	D	47
Chestnut Place at the Hospital Chestnut Place Parking Lot												
Hospital Parking Lot SB LT/RT												
Weekday Morning	2	8.6	A	0	2	8.6	A	0	2	8.6	A	0
Weekday Evening	18	9.1	A	3	18	9.1	A	2	18	9.1	A	2
School Street at the Hospital North Parking Lot												
Hospital North Parking Lot NB LT/TH/RT												
Weekday Morning	29	11.3	B	5	29	11.5	B	4	33	12.0	B	5
Weekday Evening	38	11.4	B	7	38	11.3	B	7	44	11.8	B	8
School Street at the Garage Drive												
Garage Drive NB LT /RT												
Weekday Morning	1	10.1	B	0	1	10.3	B	0	8	11.0	B	4
Weekday Evening	11	11.7	B	2	11	11.8	B	2	24	11.8	B	5
School Street at Lincoln Street												
Weekday Morning												
School Street EB	234	11.2	B	--	251	11.9	B	--	257	12.2	B	--
School Street WB	254	9.9	A	--	272	10.4	B	--	278	10.5	B	--
Lincoln Street NB	22	8.6	A	--	24	8.7	A	--	27	8.9	A	--
Lincoln Street SB	23	8.5	A	--	25	8.6	A	--	26	8.6	A	--
Weekday Evening												
School Street EB	281	12.3	B	--	302	13.5	B	--	311	14.1	B	--
School Street WB	232	10.4	B	--	250	11.0	B	--	253	11.2	B	--
Lincoln Street NB	44	8.8	A	--	47	9.1	A	--	50	9.3	A	--
Lincoln Street SB	52	8.8	A	--	56	9.1	A	--	57	9.1	A	--
Lincoln Street at the Hospital Delivery Drive												
Hospital Delivery Drive EB LT/RT												
Weekday Morning	1	9.9	A	0	1	9.9	A	0	1	9.9	A	0
Weekday Evening	1	8.7	A	0	1	8.7	A	0	1	8.7	A	0
Lincoln Street at Hospital Drop-Off Entrance												
Lincoln Street NB LT												
Weekday Morning	0	0.0	A	0	0	0.0	A	0	0	0.0	A	0
Weekday Evening	0	0.0	A	0	0	0.0	A	0	0	0.0	A	0
Lincoln Street at Hospital Drop-Off Exit												
Drop-Off Exit Driveway EB LT/RT												
Weekday Morning	0	0.0	A	0	0	0.0	A	0	0	0.0	A	0
Weekday Evening	0	0.0	A	0	0	0.0	A	0	0	0.0	A	0
Lincoln Street at the Hospital South Parking Lot												
Hospital South Parking Lot EB LT/RT												
Weekday Morning	0	0.0	A	0	0	0.0	A	0	--	--	--	--
Weekday Evening	0	0.0	A	0	0	0.0	A	0	--	--	--	--

[a]Demand in vehicles per hour.
[b]Average control delay per vehicle (in seconds).
[c]Level-of-Service.
[d]Queue Length (in feet).
NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

Table 10
SIGNALIZED INTERSECTION LEVEL-OF-SERVICE SUMMARY

	2017 Existing				2024 No-Build				2024 Build			
Signalized Intersection/Peak Hour	V/C[a]	Delay[b]	LOS[c]	Queue[d]	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Chestnut Street at School Street												
Weekday Morning												
Private Driveway EB LT/TH/RT	0.00	0.0	A	0/0	0.00	0.0	A	0/0	0.00	0.0	A	0/0
School Street WB LT/TH	0.86	67.1	E	104/211	0.90	73.8	E	113/230	0.90	73.8	E	113/230
School Street WB RT	0.13	28.6	C	25/52	0.14	28.4	C	26/55	0.15	28.5	C	29/59
Chestnut Street NB LT	0.01	7.7	A	1/ 2	0.01	7.8	A	1/ 2	0.01	7.8	A	1/ 2
Chestnut Street NB TH/RT	0.75	17.7	B	327/633	0.72	15.3	B	94/693	0.72	15.3	B	95/692
Chestnut Street SB LT	0.17	21.4	C	6/36	0.16	19.8	B	6/37	0.18	20.2	C	7/42
Chestnut Street SB TH/RT	0.18	6.2	A	24/113	0.18	6.4	A	25/119	0.18	6.4	A	25/119
Overall	**0.68**	**23.3**	**C**	--	**0.67**	**23.4**	**C**	--	**0.67**	**23.4**	**C**	--
Weekday Evening												
Private Driveway EB LT/TH/RT	0.00	0.0	A	0/0	0.00	0.0	A	0/0	0.0	0.0	A	0/0
School Street WB LT/TH	0.83	56.6	E	97/201	0.84	57.5	E	99/213	0.85	58.6	E	100/216
School Street WB RT	0.15	24.2	C	27/56	0.16	24.2	C	27/59	0.17	24.3	C	30/63
Chestnut Street NB LT	0.02	7.5	A	1/ 4	0.01	6.8	A	1/3	0.01	7.0	A	1/3
Chestnut Street NB TH/RT	0.58	14.7	B	159/501	0.61	14.6	B	168/538	0.61	15.1	B	173/540
Chestnut Street SB LT	0.15	14.8	B	7/42	0.16	15.9	B	7/44	0.18	16.1	B	8/48
Chestnut Street SB TH/RT	0.40	8.2	A	63/259	0.40	8.3	A	64/278	0.40	8.3	A	64/278
Overall	**0.59**	**18.8**	**B**	--	**0.61**	**19.0**	**B**	--	**0.62**	**19.4**	**B**	--
Chestnut Street at Oak Street and Hospital South Parking Lot												
Weekday Morning												
Oak Street EB LT/TH/RT	0.75	34.8	C	167/189	0.73	30.9	C	173/205	0.73	30.7	C	175/208
Hospital Parking Lot WB LT/TH/RT	0.02	21.2	C	3/21	0.02	18.9	B	2/21	0.02	18.8	B	3/24
Chestnut Street NB LT	0.21	13.3	B	36/78	0.23	15.7	B	40/82	0.23	15.9	B	40/82
Chestnut Street NB TH/RT	0.60	18.8	B	199/351	0.66	22.4	C	222/381	0.67	22.8	C	223/384
Chestnut Street SB LT/TH	0.25	17.1	B	26/131	0.32	19.5	B	30/136	0.33	19.8	B	30/136
Chestnut Street SB RT	0.05	55.9	E	0/16	0.06	56.9	E	0/19	0.06	57.9	E	0/19
Overall	**0.66**	**24.9**	**C**	--	**0.68**	**26.0**	**C**	--	**0.69**	**26.2**	**C**	--
Weekday Evening												
Oak Street EB LT/TH/RT	0.57	35.8	D	57/125	0.59	36.0	D	60/134	0.60	36.3	D	61/136
Hospital Parking Lot WB LT/TH/RT	0.16	30.5	C	13/20	0.16	30.3	C	13/20	0.19	30.4	C	16/23
Chestnut Street NB LT	0.16	11.3	B	8/50	0.17	11.4	B	10/53	0.17	11.6	B	10/53
Chestnut Street NB TH/RT	0.35	6.7	A	54/236	0.37	7.0	A	61/257	0.37	7.1	A	61/259
Chestnut Street SB LT/TH	0.57	12.5	B	95/485	0.57	12.5	B	94/505	0.57	12.5	B	95/507
Chestnut Street SB RT	0.07	27.7	C	0/28	0.06	28.9	C	0/30	0.06	29.0	C	0/30
Overall	**0.53**	**16.9**	**B**	--	**0.54**	**17.0**	**B**	--	**0.54**	**17.2**	**B**	--

[a]Volume-to-capacity ratio.
[b]Control (signal) delay per vehicle in seconds.
[c]Level-of-Service.
[d]Queue Length (in feet).

Lincoln Street at the Hospital Delivery Driveway

Under all conditions, the critical movements at this unsignalized intersection (all movements from Hospital Delivery Driveway) were shown to operate at LOS A during both the weekday morning and evening peak hours.

Lincoln Street at the Hospital Drop-Off Entrance Driveway

Under all conditions, the critical movements at this unsignalized intersection (all movements from Hospital Drop-Off Entrance) were shown to operate at LOS A during both the weekday morning and evening peak hours.

Lincoln Street at the Hospital Drop-Off Exit Driveway

Under all conditions, the critical movements at this unsignalized intersection (all movements from Hospital Drop-Off Exit) were shown to operate at LOS A during both the weekday morning and evening peak hours.

Lincoln Street at the Hospital South Parking Lot Driveway

Under Existing and No-Build conditions, the critical movements at this unsignalized intersection (all movements from Hospital South Parking Lot Driveway) were shown to operate at LOS A during both the weekday morning and evening peak hours. Under Build conditions, this driveway is closed.

Signalized Intersections

Chestnut Street at School Street

Under all conditions, overall operations at this signalized intersection were shown to operate at LOS C during the weekday morning peak hour and at LOS B during the weekday evening peak hour.

Chestnut Street at Oak Street and the Hospital South Parking Lot Driveway

Under all conditions, overall operations at this signalized intersection were shown to operate at LOS C during the weekday morning peak hour and at LOS B during the weekday evening peak hour.

PARKING ANALYSIS

EXISTING PARKING SUPPLY

The existing parking supply for the Hospital consists of 313 "on-site" spaces and 150 off-site spaces for a total of 463 parking spaces. There are three principal parking lots on the Hospital campus: the North Parking Lot, the South Parking Lot and the Parking Deck. "On-site" employee parking is provided at the Hospital Chestnut Place Parking Lot, located at 237 Chestnut Street in addition to the delivery lot. Additional employee parking is provided in the off-site lots which include a Church Lot in Dedham, Needham City Spots, and 73 Chestnut Street Lot (6 spaces). The Hospital also presently utilizes 10 parking spaces at 20 Junction Street (the VFW lot) for additional back-up supply on a temporary basis (one year lease). A summary of the parking supply is shown in Table 11.

Table 11
EXISTING HOSPITAL PARKING SUPPLY

Location	Capacity	Access
"ON-SITE" Lots:		
South Parking Lot	96	Chestnut Street, Lincoln Street
North Parking Lot	59	Chestnut Street, School Street
Chestnut Place Parking Lot	68	Chestnut Place
Parking Deck	82	School Street
Delivery Lot (86 School Street)	8	Lincoln Street
Total	313	
Leased Off-Site Lots:		
73 Chestnut Street	6	Chestnut Street
Church Lot	110	West Street, Dedham
Needham City Spots	24	Needham
VFW Lot (temporary)	10	Junction Street
Total	150	
Total (including off-site leased spaces)	**463**	

EXISTING PARKING DEMAND

In order to determine the peak parking demand at the Hospital, a 10-hour parking accumulation survey was conducted on Wednesday, April 26, 2017 between the hours of 5:00 AM and 7:00 PM in one-hour intervals at the five of the on-site parking lots listed in Table 10, which are graphically depicted in Figure 13. The overall peak parking demand was observed to occur at 12:00 PM and 1:00 PM. The results for the peak parking demand is summarized in Table 12 and graphically depicted on Figure 14. The observed hourly parking demand from 5:00 AM to 7:00 PM is summarized in Table 13 and graphically depicted on Figure 15.

Table 12
EXISTING PEAK PARKING DEMAND – ON-SITE ONLY

		Overall Peak 12:00 PM[a]		Parking Lot Peaks (Non-Coincident)		
Location	Capacity	Spaces Occupied	Percent Occupied	Time	Spaces Occupied	Percent Occupied
North Parking Lot	59	54	97%	2:00 PM	56	95%
South Parking Lot	96	83	86%	3:00 PM	88	92%
Parking Deck	82	55	67%	1:00 PM	63	77%
Chestnut Place Lot	68	60	88%	10:00 AM	63	93%
Delivery Area	8	3	38%	7:00 AM[a]	4	50%
Total	313	255	81%	--	--	--

[a]Overall Peak occurs at 12:00 PM and 1:00 PM.
[b]Peaks at 4 vehicles at multiple times throughout the day (7:00 AM, 8:00 AM and 9:00 AM).

In addition to the 255 on-site parking demand, there are a total of 150 additional spaces off-site with a peak 12-noon demand of 123 parking spaces. Combining both on-site and off-site, there are a total of 85 vacant parking spaces during the peak 12:00-noon period.

Table 13
OBSERVED EXISTING HOSPITAL PARKING UTILIZATION[a]

Time	South Lot	North Lot	Chestnut Place		Parking Deck	Delivery Area	Total
Available Spaces	96	59	68		82	8	360
5:00 AM	15	29	44		4	1	93
6:00 AM	22	33	49		7	2	113
7:00 AM	38	33	55		23	4	153
8:00 AM	59	40	59		43	4	205
9:00 AM	80	49	46		49	4	228
10:00 AM	73	51	63		59	3	249
11:00 AM	70	49	60		56	3	238
12:00 PM	83	54	60		55	3	255
1:00 PM	81	52	56		63	3	255
2:00 PM	87	56	41		61	0	245
3:00 PM	88	50	29		44	0	211
4:00 PM	64	41	19		27	0	151
5:00 PM	61	51	8		20	0	140
6:00 PM	65	35	9		16	0	125
7:00 PM	58	34	11		10	0	113

Source: Parking counts conducted April 26, 2017.

As can be seen from Tables 12 and 13 the peak parking for the Hospital campus took place at 12:00 PM and 1:00 PM with a total of 255 parking spaces occupied, which is 81 percent occupancy. Peak parking times at each study parking lot varied, with the South Parking Lot peaking at 3:00 PM, the North Parking Lot peaking at 2:00 PM, the Parking Deck peaking at 1:00 PM, the Chestnut Place Lot peaking at 10:00 AM, and the Delivery Area peaking from 7:00 – 9:00 AM. Overall, the hospital's successful use of off-site parking lots is evident by the excess parking available at peak times.

PROPOSED PARKING SUPPLY

Off-Site Lot - Under Negotiation

The hospital is under discussion for off-site parking for 35-50 parking spaces. Those employees will be shuttled similar to the Dedham Church Lot.

South Parking Lot

The South Parking Lot will be modified with a slight loss of parking to 78 spaces.

VFW Parking Lot

Use of this lot is temporary and will be terminated in the future.

Town By-Law Analysis

The Town By-Law specifies the required parking for a hospital campus based upon the number of beds (0.5/spaces/bed), full-time equivalent employees (0.5 spaces/employee) and square footage (2.5 spaces/1,000 sf) of Clinical facilities at the facility. The parking analysis is presented in Table 14 for the future expanded hospital condition.

Table 14
HOSPITAL PARKING REQUIREMENTS
NEEDHAM BY-LAW

		Existing		New		Total	
Use	Rate	Number	Spaces Required	Number	Spaces Required	Number	Spaces Required
Employees	0.5/employee	275	137.5	31	15.5	306	153
Beds	0.5/bed	58	29	15	7.5	73	36.5
Clinic Space	2.5/ksf	80,150	200.4	18,470	46.2	98,620	246.55
Required			367[1]		70[1]		437[1]

[1]Rounded up..

As shown, the Hospital Campus requires a parking supply of 437 parking spaces, which represents an increased requirement of 70 spaces.

FUTURE SUPPLY AND DEMAND ANALYSIS

A summary of the existing and future parking supply and demand is summarized Table 15.

Table 15
PARKING SUPPLY AND DEMAND ANALYSIS

	Supply		
	Existing Conditions	Campus Changes	Future Conditions
Supply			
On-Site			
South Parking Lot	96	-18	78
North Parking Lot	59	--	59
Parking Deck	82	--	82
Chestnut Place	68	--	68
Delivery Area	8	--	8
Sub-Total	313	-18	295
Off-Site			
73 Chestnut Street	6	--	6
Church Lot	110	--	110
City Spots	24	--	24
New Off-Site	0	+50	35[1]
VFW Lot	10	-10	0
Sub-Total	150	+40	190
Total	463	+22	**470**

[1]New off-site lot to accommodate 35 parking spaces.

As shown in Table 15, the peak parking demand is conservatively expected to increase by approximately 70 spaces as a result of the proposed changes. The total Hospital Campus on-site and off-site lots will provide a total of 470 parking spaces with existing demand of 255 on-site, 123 off-site, plus 70 new demand result in a total demand of 448 spaces. During the peak times the parking lots are projected to operate at approximately 95 percent of capacity indicating that sufficient parking will exist.

CONCLUSIONS AND RECOMMENDATIONS

Vanasse & Associates, Inc. (VAI) has completed a detailed assessment of the potential impacts on the transportation infrastructure associated with the proposed Beth Israel Deaconess Hospital-Needham, Inc. expansion in Needham, Massachusetts. This assessment has been completed in accordance with State and Town standards and those 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:

- The Project is expected to generate approximately 35 new vehicle trips (22 vehicles entering and 13 exiting) during the weekday morning peak hour and 35 new vehicle trips (13 vehicles entering and 22 exiting) during the weekday evening peak hour;

- A review of accident data researched from MassDOT indicates that area intersections experience accident rates below state averages indicating safe operations.

- The Project will result in minimal increase in delays and queuing in the study area.

- The closing of the South Lot Lincoln Street driveway will reduce traffic along Lincoln Street.

- Effective managed parking at both on-site and off-site locations will continue to provide adequate parking while reducing the impacts in the immediate area of the hospital.

RECOMMENDATIONS

The following is recommended as a result of this study to maintain acceptable traffic and parking conditions in the vicinity of the hospital.

Site Access

In order to minimize the project impact and reduce traffic within the Lincoln Street neighborhood, it is recommended that the South Lot Lincoln Street driveway be closed. As per Section 3.6.8 of the Zoning By-Laws, closing of this driveway is consistent with the maintenance of the suburban, residential character off all predominantly residential streets and portions of streets nearby the

premises. The project impacts are minimized along School, Lincoln, Grant, Warren, Pleasant and Kimball Streets. Since 1998, the hospital has relocated the emergency room and entrance from Lincoln Street, modified and now closed the South Lot driveway at Lincoln Street and under the current plan, also closed the 111 Lincoln Street driveways providing access to 26 parking spaces which accommodated the Needham Pediatrics practice at 111 Lincoln Street. The purchase of 111 Lincoln Street by the Hospital, the relocation of the Needham Pediatrics practice, the decision to raze the 111 Lincoln Street building that had vehicular access from Lincoln Street and replacing it with a building where vehicular traffic to that site is directed to the Hospital parking area via Chestnut Street and not through the predominately residential street nearby the premises, have and will contribute to less traffic on those streets, consistent with the provisions of Section 3.6.8 of the Zoning By-Law.

Transportation Demand Management Measures

Bus service provided by the MBTA is provided along Chestnut Street with a bus stop located at the intersection of Chestnut Street and Oak Street. It is recommended that information regarding public transportation options be made available to employees and patients of the Hospital in an effort to reduce the overall number of automobile trips in the area and to integrate the project into the available transportation resources.

Parking

The hospital will continue to effectively manage the on-site and off-site parking. With past expansions of both on-site parking and use of the off-site lots, there has been a clear improvement to the on-site parking availability. In 2014, the hospital implemented a parking sticker program to more effectively manage on-site parking. This program, plus initiation of on-site security (24-hour) has resulted in more efficient use of the parking. As a result of these successful measures, the use of the on-site gates can be eliminated.

The hospital is under discussions for off-site parking of up to 35-50 additional parking spaces.

Traffic Signal Optimization

Prior to full occupancy of the proposed addition, traffic signal timings will be reviewed by the applicant's traffic engineer at the Chestnut Street intersections with School Street and Oak Street, and implement changes, if recommended by him.

CONCLUSIONS

An analysis of traffic operations at the study area intersections indicates that all of the study area intersections currently operate and will continue to operate at level-of-service (LOS) D or better during the peak periods and the project will not have a significant impact on motorist delays and vehicle queuing over Existing and No-Build conditions.

An analysis of projected parking demand indicates that sufficient parking will exist based on actual usage, projected usage and the increased parking supply.

With implementation of the above recommendations, safe and efficient access will be provided to the project site and the project can be constructed with minimal impact on the roadway system.