

Center 128

Chapter 2 - Transportation



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2.0 TRANSPORTATION

2.1 Introduction

A traffic impact and access study has been conducted for the proposed Center 128 development, as described in Chapter 1, within Needham Crossing (formerly known as the New England Business Center) in Needham, MA. The site is shown on Figure 2-1.

This chapter addresses the transportation scope issued by MEPA for the three components which compose the Center 128 development. This traffic impact and access study is a complete update of the study included in the November 2014 SEIR.

Needham Crossing is located east of Route 128/I-95 between Highland Avenue and Kendrick Street in Needham. An inventory of the existing roadway and intersection conditions within the study area is presented. This is followed by trip generation calculations for the proposed redevelopment and an evaluation of future traffic operations with and without the Center 128 development.

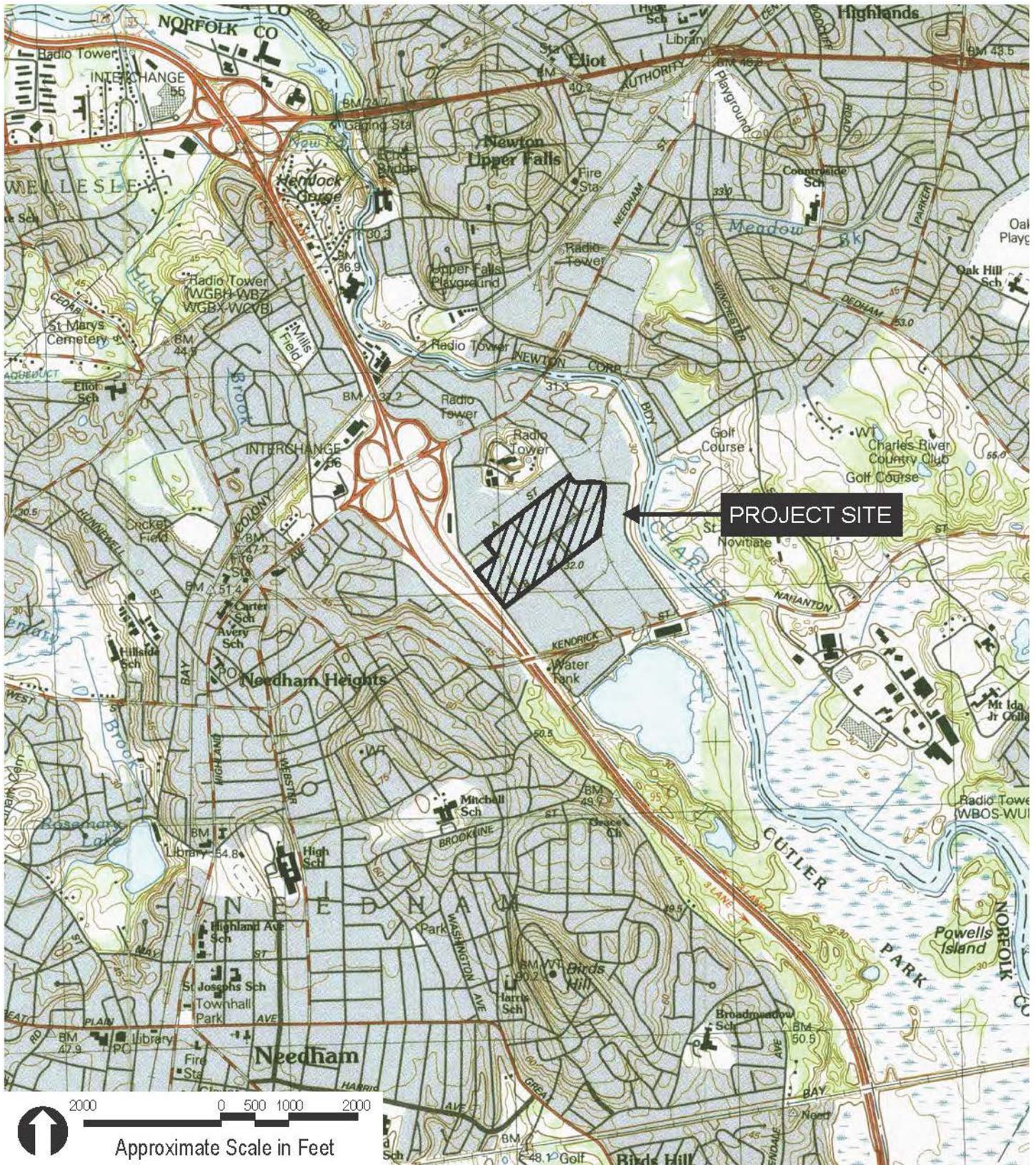
The traffic impact analysis was generally based on the current Transportation Impact Assessment (TIA) Guidelines (MassDOT, March 13, 2014).

2.1.1 Study Area

Center 128 is located within a commercial /office district. Major roadways in the site vicinity include Highland Avenue to the north, Route 128/I-95 to the west and Kendrick Street to the south. Figure 2-2 illustrates the site location in a broad context. Regional access to the site is available via Route 128/I-95 (which also carries Interstate 95 through the study area) at Highland Avenue. As illustrated in Figure 2-2, the study area for the traffic impact analysis includes the following five major intersections providing access to the New England Business Center:

- ◆ Highland Avenue at 1st Avenue
- ◆ Highland Avenue at 2nd Avenue
- ◆ Kendrick Street at 3rd Avenue
- ◆ Kendrick Street at 4th Avenue
- ◆ Kendrick Street at Hunting Road

The study area also includes the proposed site driveways and weaving maneuvers within the I-95/Highland Avenue interchange impacted by Center 128.



Center 128 Needham, Massachusetts



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2.1.2 Center 128 Development Description

The proposed Center 128 development is comprised of three components: Center 128 West, Center 128 East and the 2nd Avenue Residences as shown on Figure 2-3. As of early 2011, the Center 128 West site was occupied by 671 parking spaces and four commercial buildings (three office buildings totaling 152,906 square feet and a light industrial building of 99,223 square feet). The Center 128 West development, evaluated in the SEIR submitted in November 2014, includes 740,000 square feet of office space and a 128-room hotel and two parking structures. The hotel was completed and opened in 2013. The 288,346 square-foot office building located at the corner of 1st Avenue and B Street was recently completed and occupied by its tenant, TripAdvisor, in July 2015.

The Center 128 East site is currently developed with 514,992 square feet of office space and occupied by General Dynamics. The site will be redeveloped with 420,429 square feet of office space, 19,000 square feet of retail space, a 128 room hotel and surface parking areas.

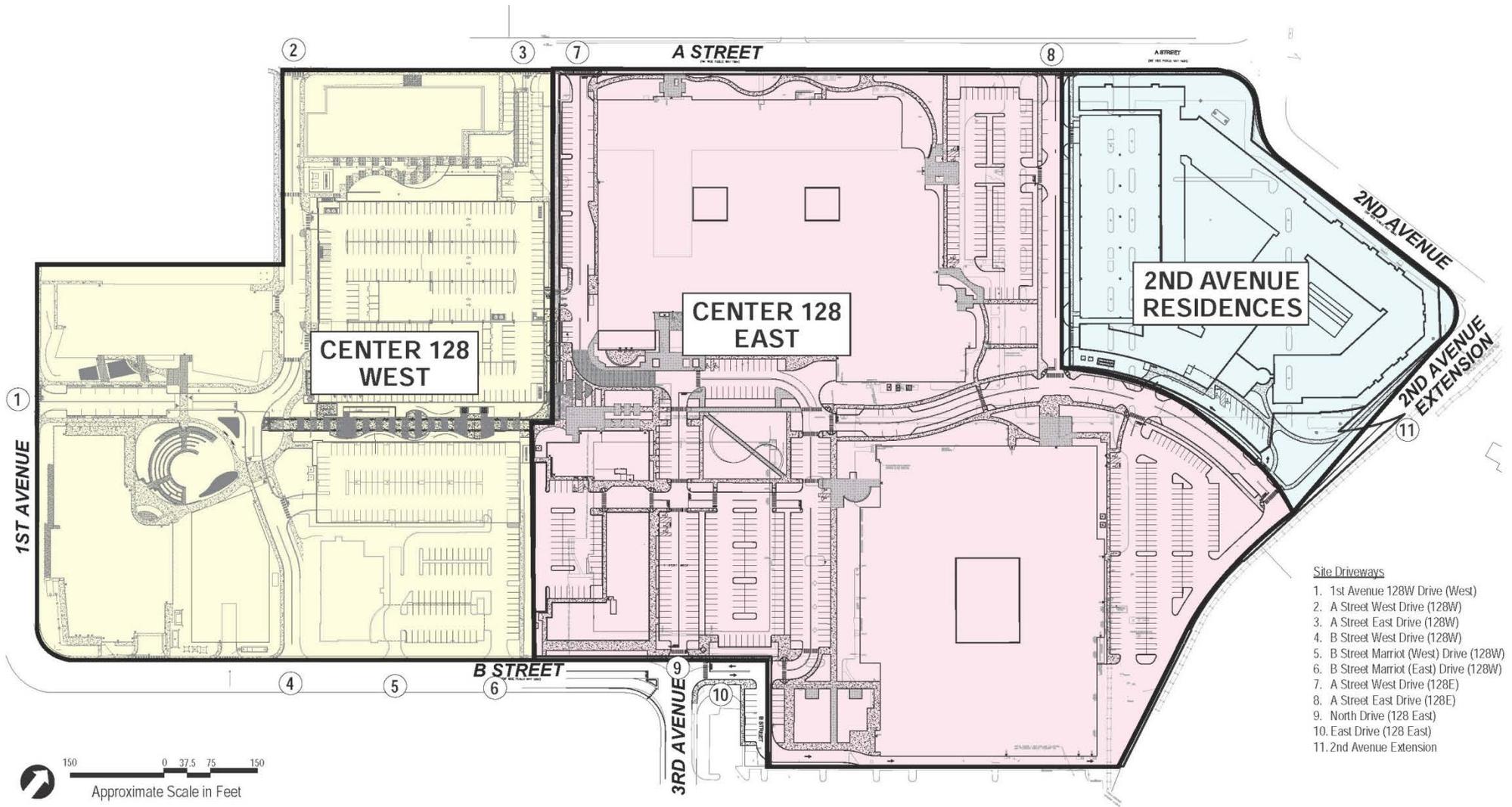
The 2nd Avenue Residences site is currently surface parking lots used by General Dynamics. It will be developed with 390 apartment units and structured parking.

In summary, Center 128 includes one existing and six proposed office buildings totaling 1,160,429 square feet, two 128-room hotels, 19,000 square feet of retail space and 390 residential units. The combination of the elements is expected to be complete by June 2019. Figure 2-4 presents the proposed overall site plan with buildings, parking garages, internal roadways and pedestrian accommodations.

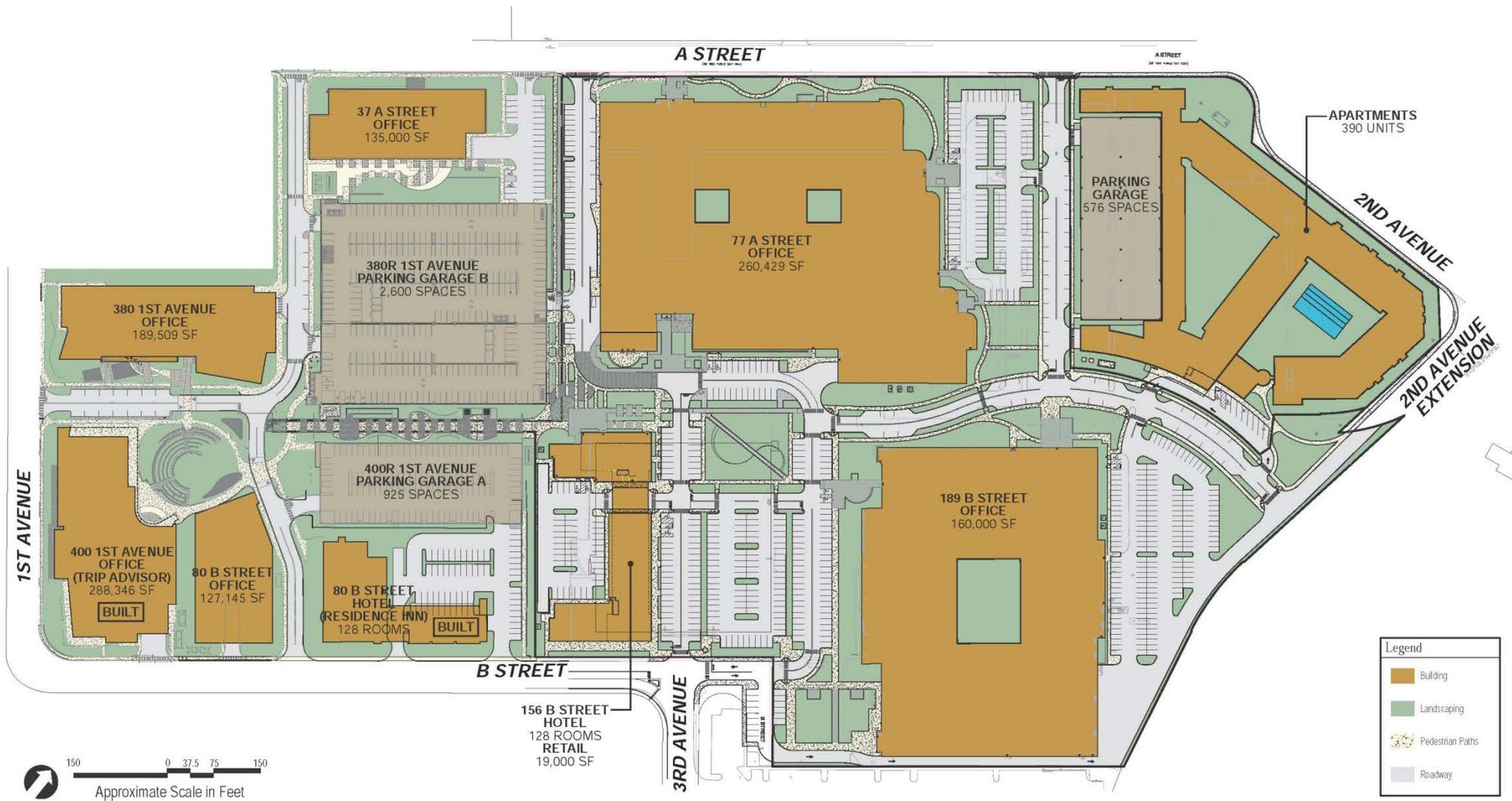
A total of 4,879 parking spaces will be provided on-site including two garages on the Center 128 West site (Garage 380 R: 2,600 spaces and Garage 400 R: 925 spaces), a 576-space parking garage on the 2nd Avenue Residence site and 778 surface parking spaces spread over the entirety of the development.

The overall redeveloped site will include 11 driveways which will provide access to the three major components of Center 128 including four driveways on A Street, five driveways along B Street, one driveway on 1st Avenue and an extension of 2nd Avenue into the site. Because of internal connections between Center 128 West, Center 128 East, and the 2nd Avenue Residences, and shared parking between Center 128 West and Center 128 East, each of these driveways could be used by vehicles entering/exiting any of the three components of Center 128.

Sidewalks are proposed in the vicinity of the site along 1st Avenue, 2nd Avenue, A Street and B Street. On site, sidewalks are proposed along the interior roadways with a system of walkways connecting buildings and parking areas. A detailed description and evaluation of the proposed site driveways is provided in Section 2.4.



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Center 128 Needham, Massachusetts

2.2 Existing Conditions

An evaluation of existing roadway geometrics, traffic controls, transit, bicycle and pedestrian accommodations, peak hour traffic volumes, and traffic crashes was conducted.

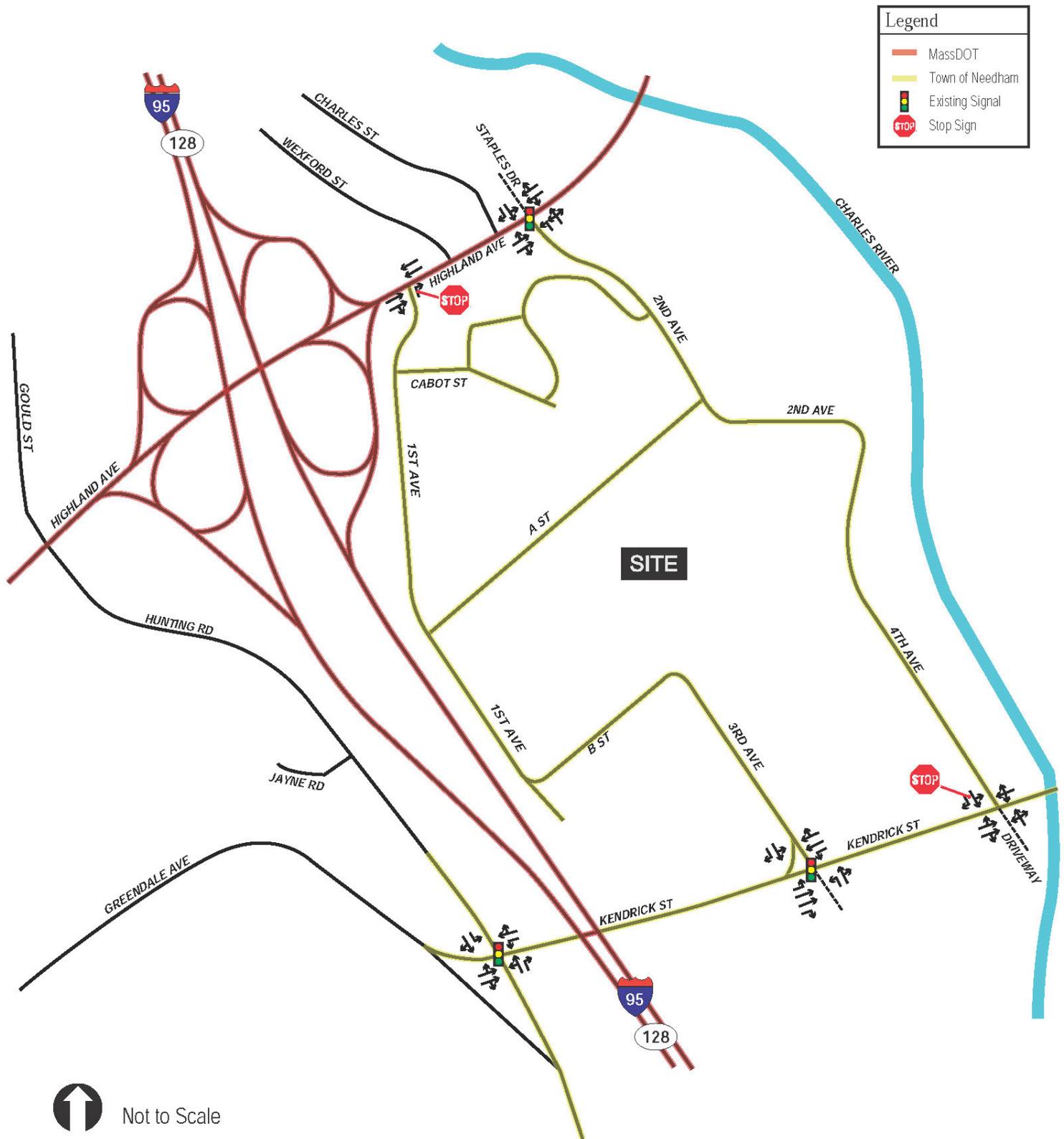
On-going construction activities along Kendrick Street by the Massachusetts Department of Transportation (MassDOT) has resulted in fluctuating conditions within the study area. To provide a basis on which to evaluate the total development's traffic impacts on the study area intersections, existing conditions prior to the disruptions along Kendrick Street have been assumed and are described below.

2.2.1 Roadway Geometry and Land Use Conditions

This section provides a brief description of the key highways and arterials roadways that serve the proposed Center 128 site. Summaries of lane configurations for each study area intersection, the location of existing traffic signals and roadway jurisdiction are shown on Figure 2-5 and reflect conditions prior to the commencement of construction activities along I-95 between Kendrick Street and Highland Avenue. Figure 2-6 provides a summary of the functional classification of the study roadways. Nearly all traffic is expected to use the regional roadway system to access the Center 128 site. The principal regional roadway serving the site environs is Route 128, which presently provides a connection to Highland Avenue and will provide a direct connection to Kendrick Street in the future. More minor roadways that intersect Highland Avenue and Kendrick Street are included in the study area. These roadways include Hunting Road, 1st Avenue, 2nd Avenue, 3rd Avenue, and 4th Avenue, A Street and B Street.

Highland Avenue. Within the study area, Highland Avenue is an arterial roadway that has a general east-west orientation. Highland Avenue has a four-lane cross-section, with two lanes in each direction from the bridge over Route 128 eastward to 2nd Avenue. It is median divided from the Route 128 bridge to a point approximately 200 feet east of 1st Avenue.

Approximately 200 feet east of 2nd Avenue, Highland Avenue drops to a two-lane cross section with one lane in each direction. This two-lane roadway crosses a bridge over the Charles River into the City of Newton where it becomes Needham Street. Land uses along Highland Avenue are primarily retail and commercial with a small residential neighborhood south of Highland Avenue near the Charles River. There is no posted speed limit in the vicinity of the site. Observed free-flow speeds are generally between 35 and 40 mph although congested conditions reduce the observed speeds during the morning and afternoon commuter peak periods. Highland Avenue is under the jurisdiction of MassDOT.



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Kendrick Street. Within the study area, Kendrick Street is a collector roadway that has a general east-west orientation. Prior to construction activities along the I-95 corridor, Kendrick Street had a four-lane cross-section with two lanes in each direction in the vicinity of Needham Crossing. To the east of 4th Avenue, Kendrick Street crosses the Charles River, and narrows to a two-lane cross-section although the pavement width is approximately 42 feet. Kendrick Street also has a two-lane cross-section to the west of Hunting Road. Land uses along Kendrick Street are primarily commercial on the east side of Route 128 and residential to the west of Route 128. There is no posted speed limit in the vicinity of the site. Observed free-flow speeds are generally between 35 and 40 mph. Kendrick Street is under Town of Needham jurisdiction within the study area.

Hunting Road. Within the study area Hunting Road is a collector roadway that has a general north-south orientation and a two-lane cross-section. There is no posted speed limit in the vicinity of the site. Land uses along Hunting Road are primarily residential. Hunting Road is under Town of Needham jurisdiction within the study area. Approximately 600 feet south of Kendrick Street, Hunting Road merges with Greendale Avenue.

1st Avenue. 1st Avenue is a local roadway that has a general north-south orientation. 1st Avenue extends from Highland Avenue south to B Street within Needham Crossing and has a two-lane cross-section with one lane in each direction. There is no posted speed limit. Land uses along 1st Avenue are primarily commercial. The average travel speed on 1st Avenue is approximately 29 mph northbound and 31 mph southbound.

2nd Avenue. Within the study area, 2nd Avenue is a local roadway that has a general north-south orientation. 2nd Avenue extends from Highland Avenue south to 4th Avenue and has a two-lane cross-section with one lane in each direction. There is no posted speed limit. On-street parking occurs on both sides of 2nd Avenue in the immediate vicinity of its intersection with A Street. Land uses along 2nd Avenue are primarily commercial. The average travel speed on 2nd Avenue is approximately 28 mph eastbound and 31 mph westbound.

At the intersection of A Street with 2nd Avenue sight lines for vehicles exiting from A Street to the north are obstructed both by large bushes located on the easterly side of the building located at 206 A Street (Needham Knowledge Beginnings) and by vehicles parked along the west side of 2nd Avenue.

3rd Avenue. Within the study area, 3rd Avenue is a local roadway with a general north-south orientation running from Kendrick Street north to B Street. 3rd Avenue has a two-lane cross-section, with one lane in each direction. On-street parking occurs on the east side of 3rd Avenue along its length. There is no posted speed limit. Land uses along 3rd Avenue are primarily commercial.

4th Avenue. 4th Avenue is a local roadway that has a general north-south orientation running from Kendrick Street north to 2nd Avenue. 4th Avenue has a two-lane cross-section with one lane in each direction. There is no posted speed limit. Land uses along 4th Avenue are primarily commercial.

A Street. A Street is a local roadway that has a general east-west orientation running from 1st Avenue east to 2nd Avenue. A Street has a two-lane cross-section with one lane in each direction. Parking occurs on both sides of A Street, although parking signs indicate that parking is not permitted along the south side of A Street from the existing General Dynamics westerly driveway to a point approximately 250 feet to the east. There is no posted speed limit. Land uses along A Street are primarily commercial. The average travel speed along A Street is approximately 33 mph in both travel directions.

B Street. B Street is a local roadway that has a general east-west orientation running from 1st Avenue east to 3rd Avenue. B Street has a two-lane cross-section with one lane in each direction. There is no posted speed limit. On-street parking occurs on the north side of B Street although it is signed for no parking. Land uses along B Street are primarily commercial. The average travel speed on B Street is approximately 23 mph in both travel directions.

2.2.2 Intersection Geometry and Traffic Control

This section describes the five principal study area intersections.

Highland Avenue/1st Avenue. Highland Avenue is intersected from the south by 1st Avenue, forming an unsignalized T-intersection. Highland Avenue is median-divided at this location so only the eastbound lanes of Highland Avenue are accessible to or from 1st Avenue. The Highland Avenue eastbound approach consists of a through lane and a through/right lane. The shared through/right lane is sufficiently wide (24 feet) to allow through moving vehicles to pass vehicles turning right onto 1st Avenue. The 1st Avenue northbound approach consists of a right turn lane, and is STOP controlled. A pedestrian crosswalk is provided across 1st Avenue (the southern leg) of the intersection. Land uses near the intersection are primarily retail and commercial.

Highland Avenue/2nd Avenue. Highland Avenue intersects 2nd Avenue and the driveway to a retail property (Staples) to form a signalized, four-way intersection. Both Highland Avenue approaches consists of a left/through lane and a through/right lane. The 2nd Avenue northbound approach consists of a left turn lane and a left/through/right lane. The retail driveway southbound approach consists of a left/through lane and a right turn lane. Pedestrian crosswalks are provided across the north, east, and south legs of the intersection. The signal has four phases: westbound movements, eastbound and westbound movements with concurrent, button-actuated pedestrian movements, southbound movements, and northbound movements with concurrent, button-actuated pedestrian movements. The surrounding land uses are primarily retail and commercial.

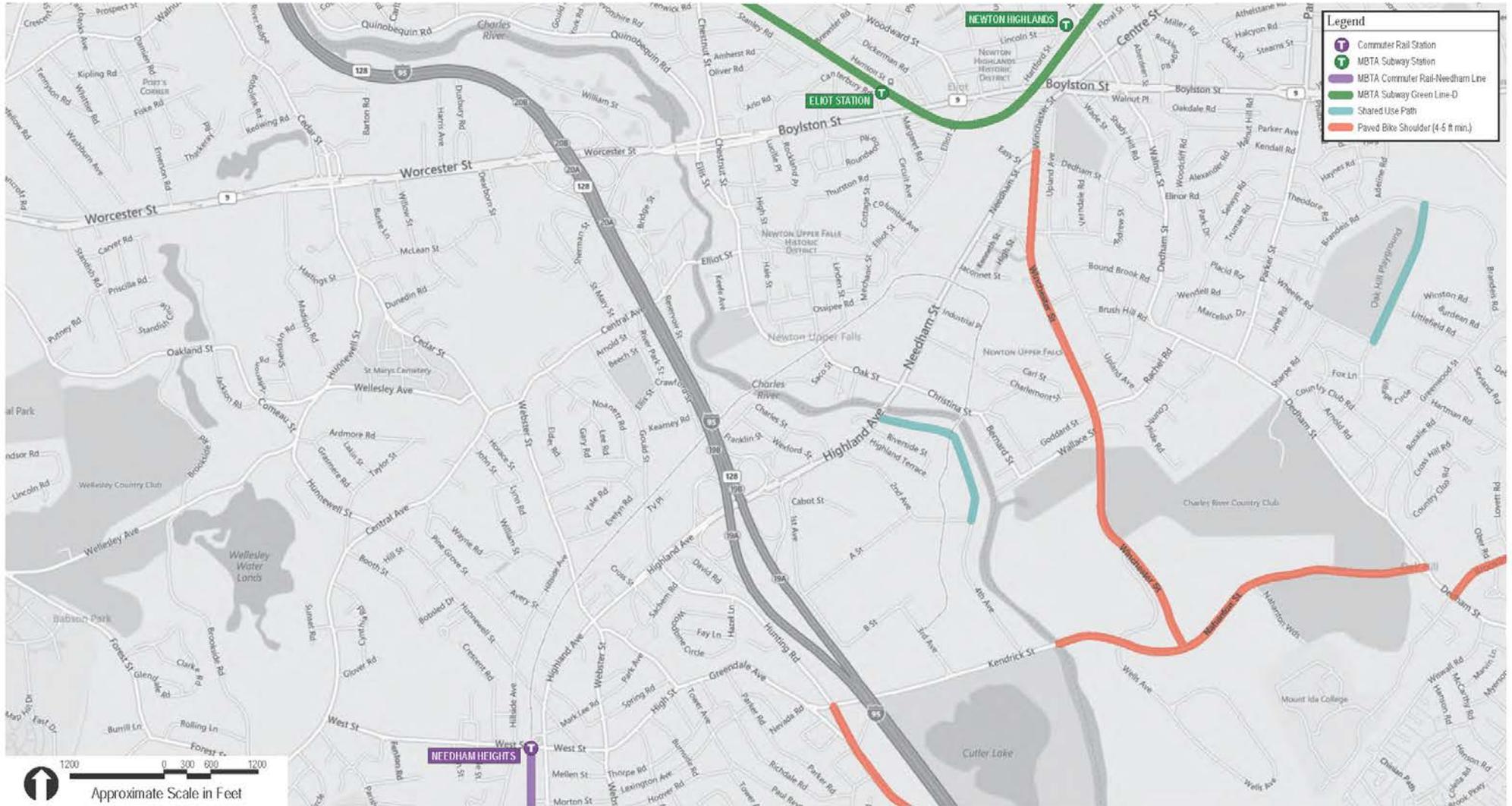
Kendrick Street/3rd Avenue. Kendrick Street intersects 3rd Avenue and an office driveway (Parametric) to form a signalized, four-way intersection. The Kendrick Street eastbound approach consists of a left turn lane, two through lanes, and a right turn lane. The Kendrick Street westbound approach consists of a left turn lane, a through lane, and a through/right lane. The office driveway northbound approach includes a left-turn lane and a through/right lane. The 3rd Avenue southbound approach provides a left/through lane and a channelized right-turn lane. Pedestrian crosswalks are provided across the north and east legs of the intersection. The signal has four phases: eastbound and westbound left turn movements, eastbound and westbound through/right movements, northbound movements, northbound and southbound movements and button-actuated pedestrian movements. The surrounding land uses are primarily commercial.

Kendrick Street/4th Avenue. Kendrick Street intersects 4th Avenue to form an unsignalized four-way intersection, with an office driveway forming the fourth leg. The Kendrick Street eastbound approach consists of a left/through lane and a through/right lane. The Kendrick Street westbound approach consists of a single lane. The office driveway northbound approach consists of a single lane. The 4th Avenue southbound approach consists of a left/through lane and a right-turn lane. The 4th Avenue approach is STOP controlled. There is no STOP sign at the office driveway approach but traffic is implicitly under STOP control. Land uses to the west of 4th Avenue on either side of Kendrick Street are primarily commercial. All land between 4th Avenue and the Charles River is undeveloped land maintained by the Massachusetts Department of Conservation and Recreation (DCR). This reservation continues to the south of Kendrick Street, east of the office drive.

Kendrick Street/Hunting Road. Kendrick Street intersects Hunting Road to form a signalized, four-way intersection. The Kendrick Street eastbound approach consists of a left-turn lane and a through/right lane. The Kendrick Street westbound approach consists of a left/through lane and a through/right lane. The Hunting Road northbound approach consists of a left/through lane and a channelized right-turn lane. The Hunting Road southbound approach consists of a left-turn lane and a through/right lane. Pedestrian crosswalks are provided across the north and west legs of the intersection. The signal has five phases: westbound and eastbound movements, westbound movements, northbound and southbound movements, southbound movements, and a button-actuated exclusive pedestrian phase. The surrounding land uses are primarily residential.

2.2.3 *Bicycle Accommodations*

Bicycle facilities were identified from data contained in the MassDOT's Bicycle Facility Inventory (BFI) and from visual inspection. Figure 2-7 depicts existing bicycle accommodations in the vicinity of the study area.



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In the vicinity of the Center 128 site bicycle accommodation is limited. Paved bicycle shoulders of four to five feet wide exist along segments of Greendale Avenue in Needham, Nahanton Street, Brookline Street and Winchester Street in Newton. A short shared use path (Blue Heron Trail) connects the 2nd Avenue/4th Avenue intersection to Highland Avenue following the west bank of the Charles River. Bicycle racks are located at the Needham Heights Commuter Rail Station and at the MBTA Green D-Line Elliot Street stop.

2.2.4 Pedestrian Accommodations

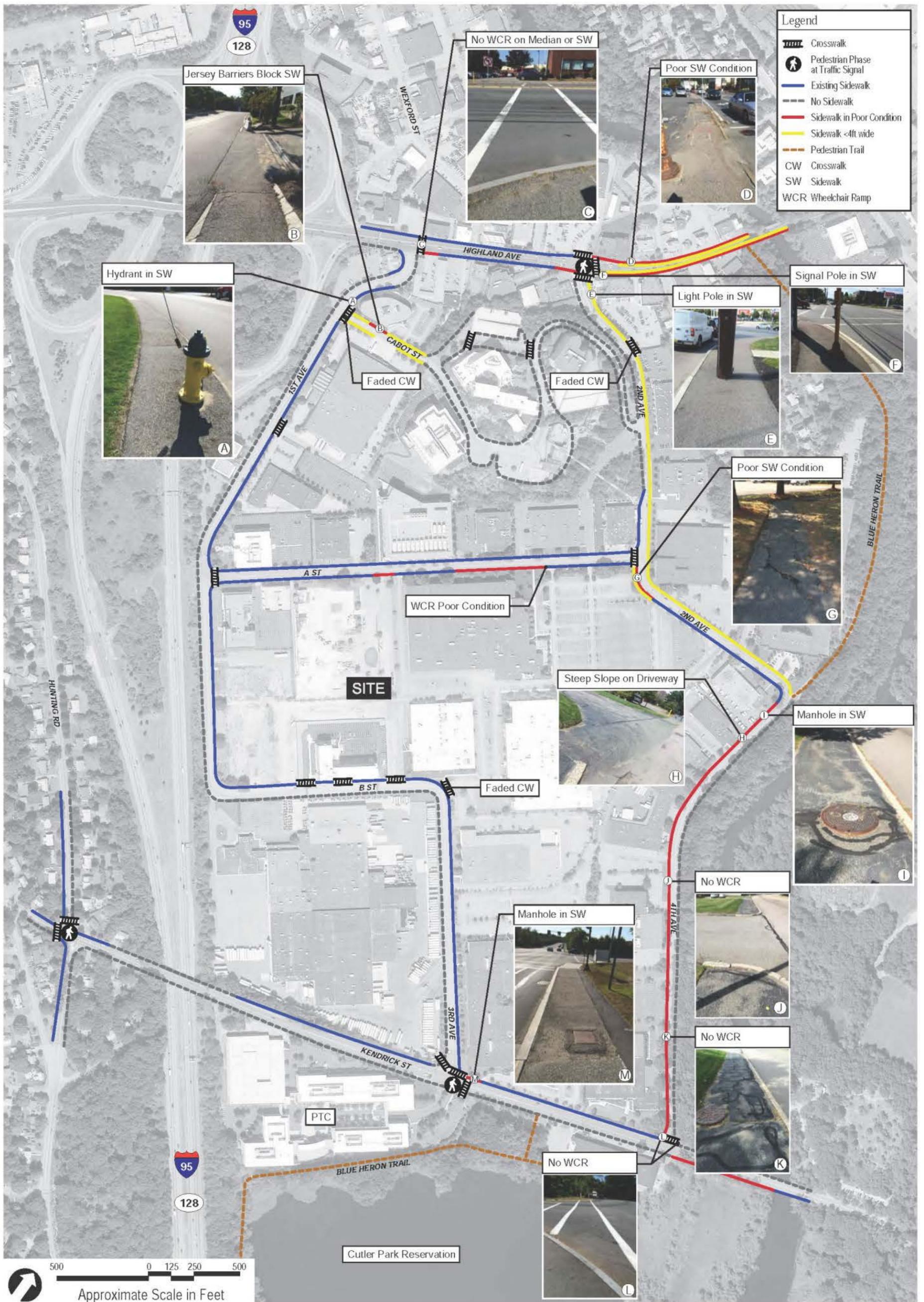
A visual survey of pedestrian accommodations within the study area was conducted in September 2014, the results of which are illustrated on Figure 2-8. The survey focused on the location and condition of sidewalks, crosswalks, wheelchair ramps and accommodations at traffic signals. In general, sidewalks are provided throughout the study area. On Highland Avenue, between 1st Avenue and the Charles River Bridge, sidewalks are located on both sides of the street.

Sidewalk conditions within the study area are generally good. However, the sidewalk on 4th Avenue is in poor condition, with broken or cracked pavement and stationary objects located within the sidewalk. On Highland Avenue, east of 1st Avenue, portions of the sidewalk are narrow and have segments with poor pavement with stationary objects blocking the sidewalk. Additionally, wheelchair ramps are not provided at most curb cuts.

Due to the nature of the development which consists of office, hotel and residential spaces, of particular interest are the pedestrian accommodations from Center 128 to retail establishments located along Highland Avenue and to the DCR Blue Heron Trail. A segment of the Blue Heron Trail connects the 2nd Avenue/4th Avenue intersection to Highland Avenue following the west bank of the Charles River. A longer portion of the Blue Heron Trail is located within the DCR Cutler Park Reservation located on the south side of Kendrick Street.

Access to Highland Avenue from the site is via three routes including: i) 1st Avenue, ii) A Street and 2nd Avenue and iii) A Street, 2nd Avenue and the Blue Heron Trail. The following briefly describes pedestrian accommodations along 1st Avenue, A Street and 2nd Avenue.

1st Avenue. The sidewalk located on the easterly side of 1st Avenue is generally in good condition. However, as 1st Avenue approaches Highland Avenue, the sidewalk ends due to a 230-foot long break in the curb allowing access to a parking lot. Sidewalk is provided on the westerly side of 1st Avenue in this area, but a connecting crosswalk is not provided. At the Highland Avenue/1st Avenue intersection, pedestrian accommodations are poor. There is not a crosswalk on the 1st Avenue approach and the existing Highland Avenue crosswalk does not provide handicap accommodations.



A Street. Sidewalk is provided on both sides of A Street and is generally in good condition. There is a warning sign which indicates the presence of a crosswalk located on the south side of A Street. However, no crosswalk is marked.

2nd Avenue. Sidewalks are located on both sides of 2nd Avenue. On the easterly side, a narrow sidewalk is provided along the entire length of the street. It is separated from the street by a grass strip and curb. On the westerly side of 2nd Avenue, sidewalk is provided from a point approximately 200 feet north of A Street to 4th Avenue. At the 2nd Avenue intersection with Highland Avenue, crosswalks are located on all approaches except on eastbound Highland Avenue. Concurrent, button-actuated pedestrian phases are provided at the intersection.

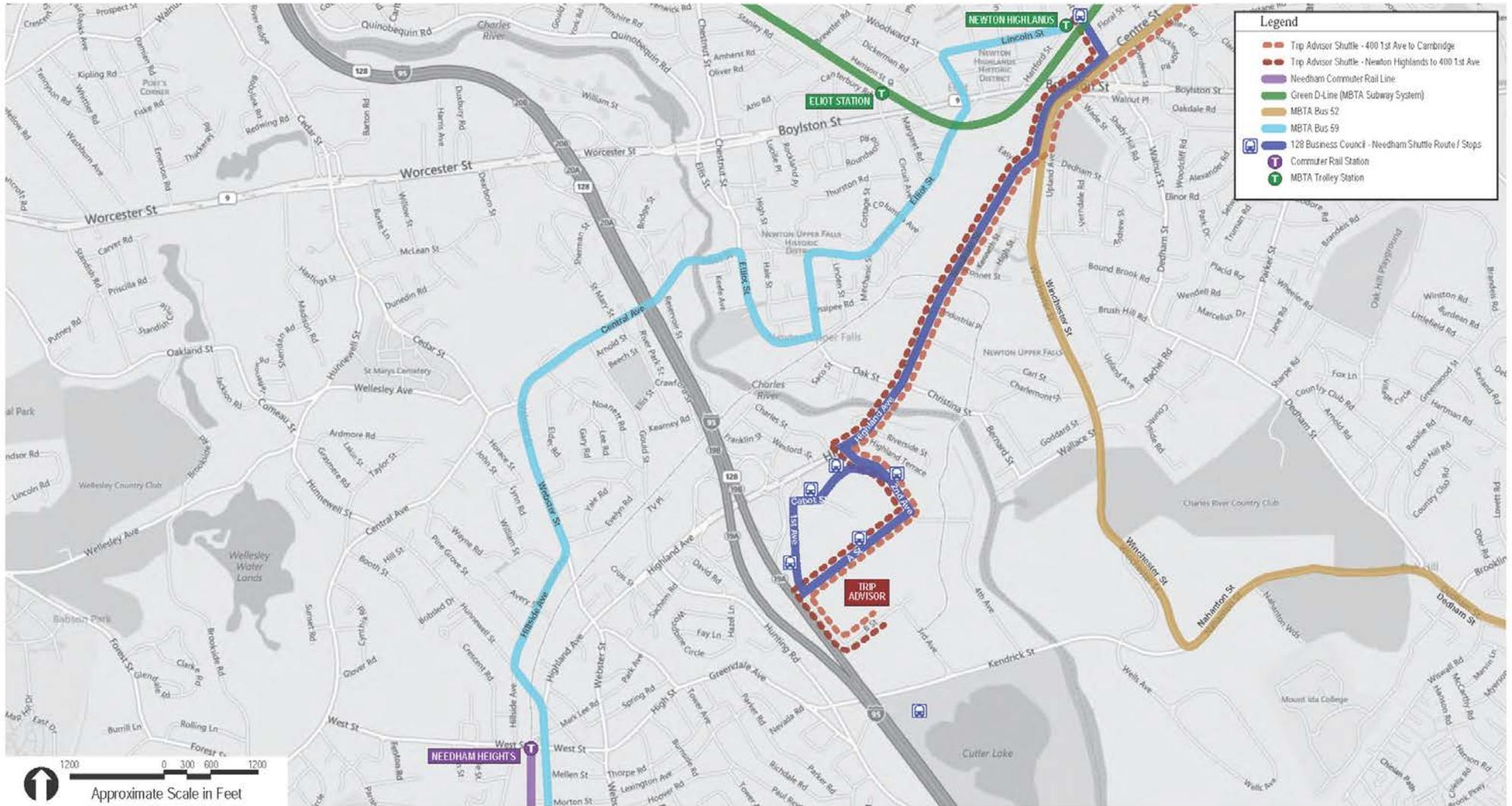
For pedestrians traveling from Center 128 to Cutler Park and the Blue Heron Trail located on the south side of Kendrick Street, sidewalk is located along the entire length of B Street and 3rd Avenue. At the signalized intersection of Kendrick Street/3rd Avenue crosswalks are located on the 3rd Avenue and westbound Kendrick Street approaches. A button-actuated pedestrian phase is provided at the intersection. As sidewalk is not provided along the south side of Kendrick Street, pedestrians would likely access Cutler Park via the PTC easterly parking lot located opposite 3rd Avenue. Otherwise, pedestrians would continue along the sidewalk on the north side of Kendrick Street, crossing Kendrick Street at the entrance to Cutler Park parking area.

2.2.5 Transit Accommodations

The study area is served by several forms of public and private transit services including the Massachusetts Bay Transit Authority (MBTA), 128 Business Council Transportation Management Association and TripAdvisor, through Local Motion, a private bus company. Transit accommodations in the vicinity of the study area shown on Figure 2-9 and described below. More detailed information regarding these services is provided in Attachment 2.A.

2.2.5.1 MBTA Commuter Rail

The MBTA Needham commuter rail line stops at the Needham Heights Station, approximately two miles west of Center 128 on Highland Avenue in Needham. The Needham line provides service to/from South Station and Back Bay in Boston. The weekday peak period train schedule is summarized in Table 2-1. Serving a reverse commute in the morning, three trains arrive at Needham Heights Station from Boston between 7:50 a.m. and 9:26 a.m. During the afternoon commuting hours three trains depart Needham Heights Station between 3:55 p.m. and 5:37 p.m. As these trains are reverse commute, bicycles are permitted to be carried on.



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Table 2-1 MBTA Peak Hour Commuter Rail Service at Needham Heights Station

Outbound (Boston to Needham)			Inbound (Needham to Boston)		
Train	Depart South Station	Arrive Needham Heights	Train	Depart Needham Heights	Arrive South Station
605	7:05 AM	7:50 AM	618	3:55 PM	4:35 PM
607	7:39 AM	8:22 AM	620	5:02 PM	5:45 PM
609	8:45 AM	9:26 AM	622	5:37 PM	6:17 PM

2.2.5.2 MBTA Green Line

The D Branch (Riverside) of the MBTA Green Line provides trolley line service between Park Street Station in Boston and Newton Highlands. The Newton Highlands stop is located approximately 1.6 miles north of Center 128. The trolley runs approximately every seven to eight minutes during peak commuting periods. Bicycles are not accommodated on the Green Line D branch.

2.2.5.3 MBTA Bus Routes

The study area is not serviced by the MBTA bus system. However, Center 128 is located approximately 1 mile, or a 20 minute walk, from bus stops which are serviced by Bus Route 52 (e) and Bus Route 59.

Bus Route 52 (e). South of the site, a bus stop is located near the intersection of Winchester Street/Nahanton Street in Newton. It is serviced by Bus Route 52. Bus Route 52 travels between the junction of Route 1/Washington Street at the Dedham Mall (southerly terminus) and Watertown Square (northerly terminus). It provides a stop in Newton Centre near the Green Line D Branch. Weekday peak period service at the Winchester Street/Nahanton Street bus stop is summarized in Table 2-2. No service is provided on weekends.

Table 2-2 Bus Route 52 (e)

	Morning Peak Period (Arrivals)	Afternoon Peak Period (Departures)
To/from the south (Dedham Mall)	None	4:52 p.m. 6:02 p.m.
To/from the north (Watertown Square)	8:50 a.m.	4:11 p.m. 5:07 p.m.

Bus Route 59. Approximately one mile northeast of the site, the MBTA bus stop located at the intersection of Oak Street/Chestnut Street in Newton is serviced by Bus Route 59. Bus Route 59 travels between the Needham Junction Commuter Rail Station (southerly terminus) and Watertown Square (northerly terminus). It stops at the Needham Junction Commuter Rail Station, the Needham Center Commuter Rail station, the Needham Heights Commuter Rail Station, the Newton Highlands Green Line Station and the Newtonville Commuter Rail Station (Framingham/Worcester Line). Peak period service at the Oak Street/Chestnut Street bus stop is summarized in Table 2-3.

Table 2-3 Bus Route 59

	Morning Peak Period (Arrivals)	Afternoon Peak Period (Departures)
To/from the south (Needham Junction)	7:08 a.m. 8:54 a.m.	3:56 p.m. 4:32 p.m. 5:04 p.m. 5:40 p.m.
To/from the north (Watertown Square)	6:54 a.m. 7:38 a.m. 8:16 a.m. 8:48 a.m.	3:58 p.m. 4:34 p.m. 5:09 p.m. 5:45 p.m.

Bicycles are permitted on MBTA buses when the bicycle can fit on the external bicycle rack.

2.2.5.4 128 Business Council Shuttle Bus Service

The 128 Business Council, the local transportation management association, operates a shuttle bus which connects Council members in the vicinity of Needham Crossing to the MBTA Newton Highlands Green D Line station. The shuttle operates from 6:30 a.m. to 9:20 a.m. and from 3:40 p.m. to 6:10 p.m. The shuttle buses run approximately every 45 minutes. The 128 Business Council estimates that two to five percent of Needham Crossing employees use the shuttle service as part of their commute to/from work.

2.2.5.5 TripAdvisor Shuttle Bus Service

TripAdvisor is expected to be one of the major tenants of Center 128 and currently occupies a building on the Center 128 West site. Working with Local Motion of Boston, a private bus company, TripAdvisor runs shuttle bus routes in the study area providing service between its new facility on 1st Avenue to the Newton Highlands Green Line station and Kendall and Central Squares in Cambridge. TripAdvisor indicates that approximately 23 percent of its employees utilize its shuttle bus service. The schedule for this service is provided in Attachment 2.A.

Newton Highlands Station to Needham Street. Connecting TripAdvisor’s office to the Green Line Station in Newton Highlands, this shuttle is run with approximately 20 to 25 minute headways. In the morning commuting period, the first shuttle bus departs from the Walnut Street bridge over the Newton Highlands station at 7:52 a.m. Service is provided every 18 to 23 minutes with the last shuttle leaving at 9:57 a.m. In the afternoon, the first shuttle leaves 1st Avenue at 4:30 p.m. running every 20 to 25 minutes until the last shuttle leaves at 6:45 p.m. On Friday afternoons, the last shuttle leaves from the 1st Avenue facility at 6:25 p.m.

Cambridge to Needham Street. Service between Kendall Square, Central Square and the TripAdvisor office is provided in the morning at approximately 7:30 a.m., 8:00 a.m., and 8:55 a.m. In the afternoon, shuttles depart from TripAdvisor at 5:30 p.m., 6:15 p.m. and 6:55 p.m. The shuttle bus stops in Cambridge are located near the inbound Kendall Square/MIT Red Line station on Main Street and in Central Square at the intersection of Green Street and Magazine Street.

2.2.6 Existing Traffic Volumes

Daily and peak hour traffic volumes were obtained to determine the 2015 traffic conditions at the study area intersections. Count data was obtained in January 2012, December 2013, June 2014 and June 2015 (at existing site driveways) and is provided in Attachment 2.B.

Daily Traffic Volumes. Daily traffic counts, performed with Automatic Traffic Recorders (ATRs), were conducted at four locations adjacent to the site including, 1st Avenue (south of A Street), 2nd Avenue (southeast of A Street), A Street (west of the General Dynamics center driveway) and B Street (west of 3rd Avenue). The data was obtained for a three day period from Thursday, June 4, 2015 to Saturday, June 7, 2015. The Thursday and Saturday daily volumes are summarized in Table 2-4.

Table 2-4 Daily Traffic Volumes

Roadway	Average Weekday	Saturday
1st Avenue south of A Street	5,000	1,800
2 nd Avenue southeast of A Street	9,300	5,200
A Street west of General Dynamics Center Driveway	4,200	1,300
B Street west of 3 rd Avenue	4,500	1,400

Peak Hour Traffic Volumes. Weekday morning and afternoon traffic volume data was obtained from the approved *Traffic Impact Study Center 128* (Tetra Tech, August 24, 2012) report for the Kendrick Street intersections and from MassDOT’s *Functional Design Report - Intersection Improvements at Highland Avenue and First Avenue* (FST, LLC, June 2014) for

the Highland Avenue intersections. The Saturday midday traffic volume data was obtained from the *Traffic Impact Study Fitness Club, 200 1st Avenue* (Tetra Tech, December 18, 2013) for the Kendrick Street and Highland Avenue intersections.

As documented in the *Center 128* report, traffic was counted at the Kendrick Street intersections from 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m. on Wednesday, January 18, 2012. Due to on-going construction along Kendrick Street, the January 2012 traffic volumes, adjusted to 2015 levels, will be used to establish existing conditions.

Traffic was counted at the intersections of Highland Avenue with 1st and 2nd Avenues as part of the *Functional Design Report* on Wednesday, June 4, 2014 from 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m.

Traffic was counted at the Highland Avenue and Kendrick Street intersections as part of the *Fitness Club* report on Saturday, December 7, 2013.

The factors used to adjust the count data are described below.

Annual Growth Adjustment. Several sets of traffic volume data were available for the study area intersections including traffic counts obtained by Tetra Tech in October 2007 and January 2012, and traffic counts obtained by FST in June 2014. These data sets were normalized to average annual conditions as described below and compared to understand annual growth within the study area. The following summarizes the results of the comparisons which are provided in Attachment 2.B.

- ◆ Traffic volumes, at the five study area intersections, conducted by Tetra Tech in October 2007 were compared to the January 2012 data. The data indicates that during this five year period, traffic increased at a rate of approximately one percent per year.
- ◆ Highland Avenue traffic volumes from the Tetra Tech report obtained in January 2012 were compared to the data obtained in June 2014. The data indicates that traffic along Highland Avenue has decreased by approximately seven percent per year over the past two years.
- ◆ The Town of Needham Planning Department was also contacted to determine if any significant development has occurred in the study area which may have increased traffic at the study area intersections over the past two years. The Planning Department indicated that the only project completed and occupied since 2012 was the Residences at Wingate, located on Highland Avenue, west of Route 128. An expansion of this project is currently proposed. Traffic associated with the expansion will be discussed in Section 2.3 Future Conditions.

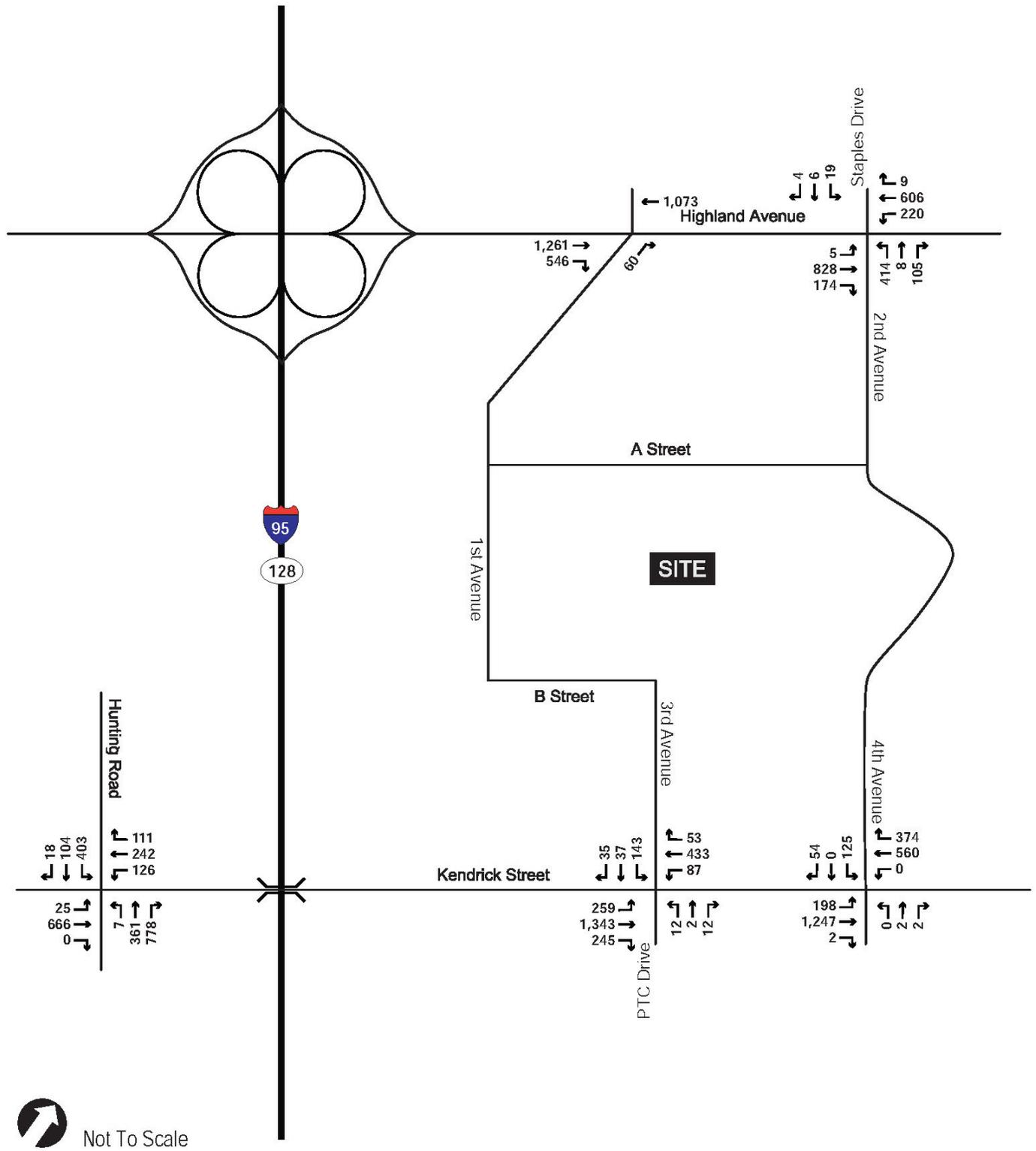
In light of this data, the January 2012 weekday traffic count data intersections was increased by a factor of 1.03 (one percent per year), the December 2013 traffic count data were grown by a factor of 1.02 (two percent per year) and the June 2014 traffic count data was grown by a factor of 1.01 (one percent per year) to estimate 2015 traffic volumes. The redevelopment of the former Filene's Basement site at 215 Needham Street was completed after the traffic counts were conducted at the Kendrick Street and Highland Avenue study intersections. Therefore, traffic associated with this project was added to the 2015 estimated traffic volumes based on ITE *Trip Generation* trip rates and existing traffic patterns.

Trips associated with the existing hotel located on the Center 128 West site were added to the Kendrick Street intersections as the count data at these locations was obtained before or shortly after the hotel was constructed and opened.

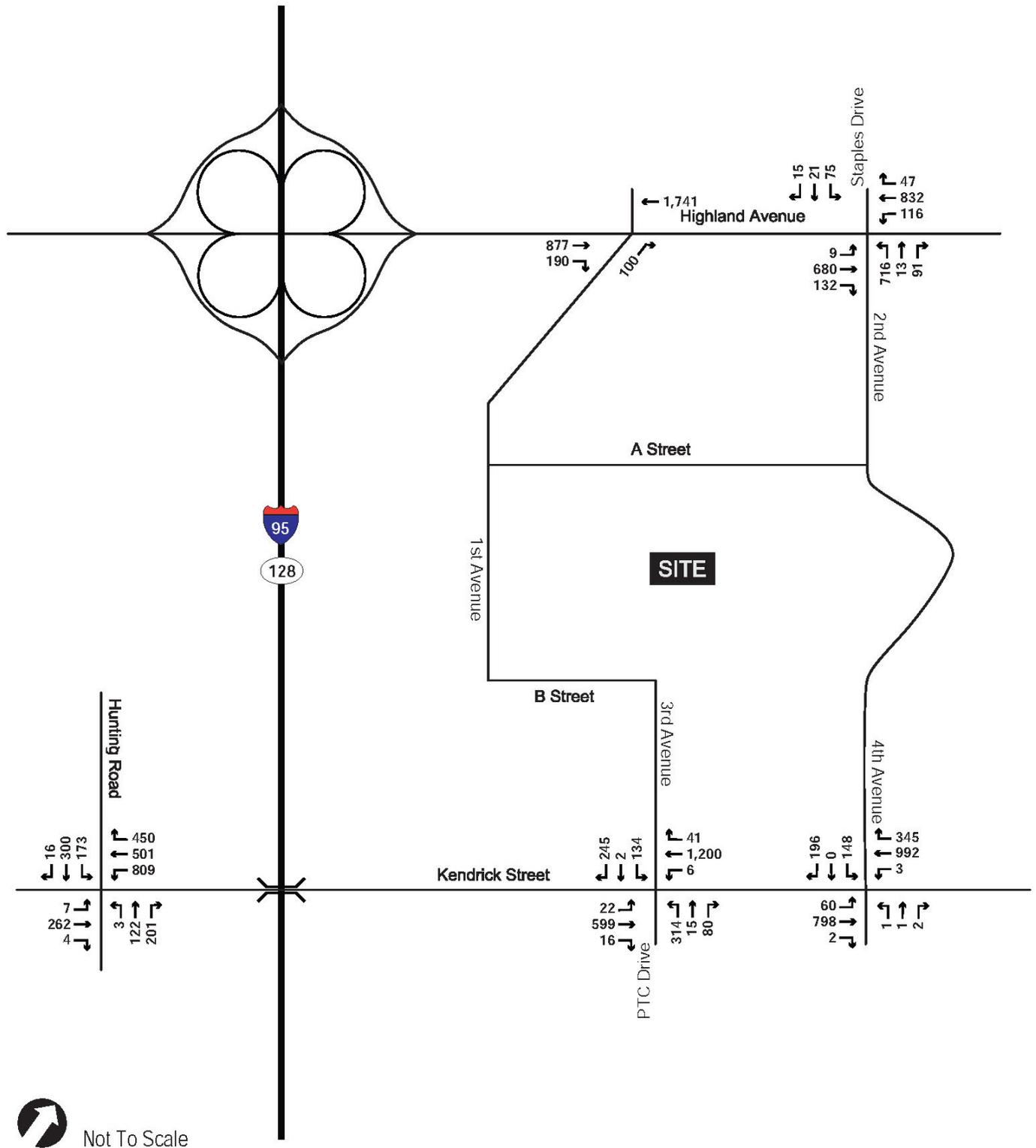
Average Annual Adjustments. MassDOT traffic volume data obtained in 2009 from permanent count station (#6161-SB) located on Route 128 in Needham indicates that January traffic volumes are approximately four percent lower than average annual volumes, June traffic volumes are approximately three percent higher than average annual volumes and December traffic volumes are one percent higher than average annual volumes. To provide a conservative analysis, the existing traffic volume data obtained in January at the Kendrick Street intersections was increased by four percent to reflect average annual conditions and the data obtained in June and December were not adjusted.

Figures 2-10, 2-11 and 2-12 depict the existing weekday morning, weekday afternoon and Saturday midday peak hour traffic volumes, respectively. The weekday peak hours generally occurred from 8:00 a.m. to 9:00 a.m. in the morning and from 4:45 p.m. to 5:45 p.m. in the afternoon. On Saturday, the peak hour generally occurred from 11:00 a.m. to 12:00 p.m.

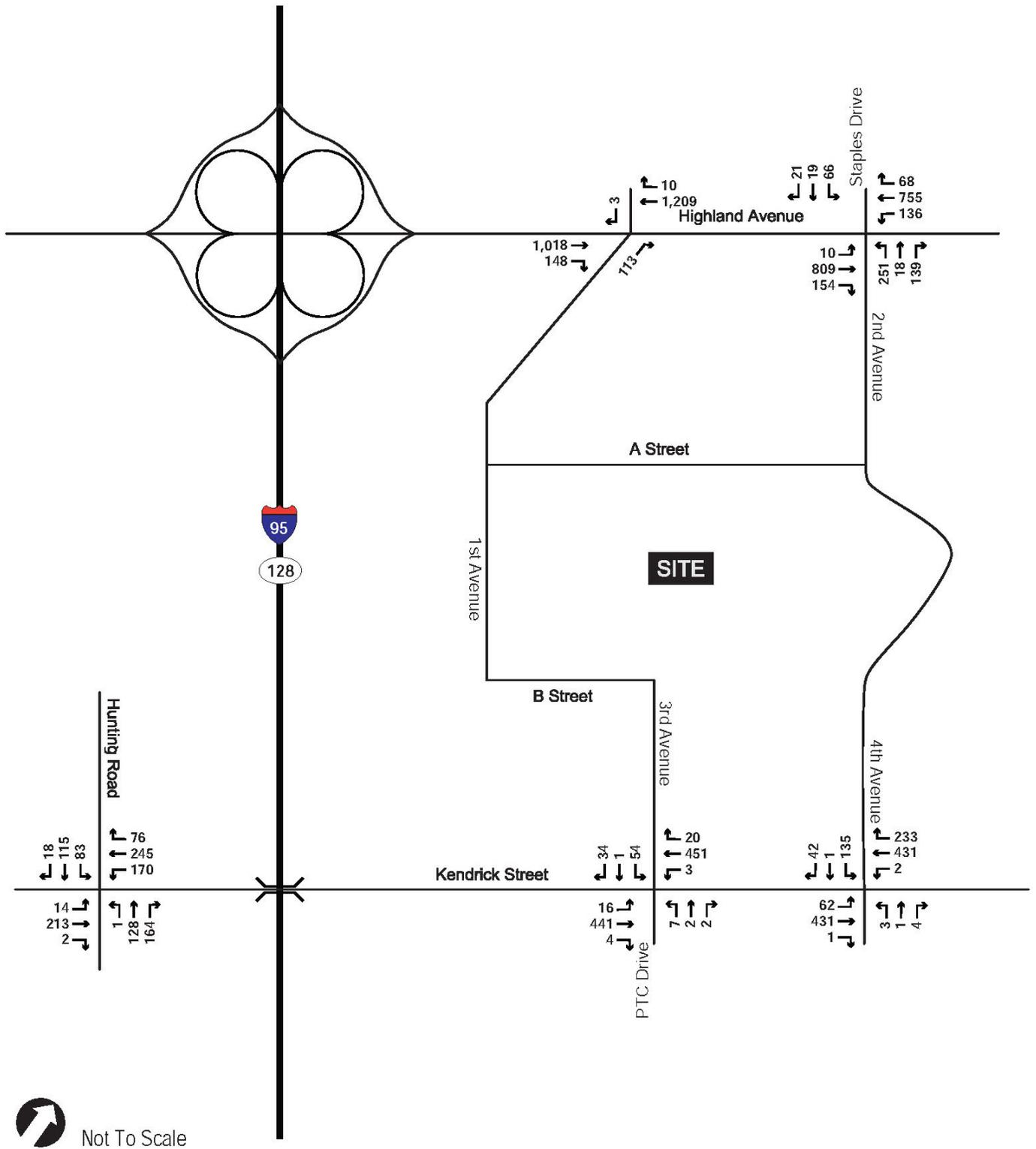
Morning, afternoon and Saturday midday peak hour pedestrian and bicycle volumes are shown on Figures 2-13, 2-14 and 2-15, respectively. As seen on the figures, the pedestrian and bicycle volumes at the study area intersections are generally low. The highest pedestrian levels occur at the Highland Avenue/2nd Avenue intersection where approximately 10, 20 and 30 pedestrians were observed during the morning peak hour, the afternoon peak hour and the Saturday midday peak hour, respectively. During the Saturday midday peak hour, 15 to 20 bicycles were observed at the Kendrick Street intersections.



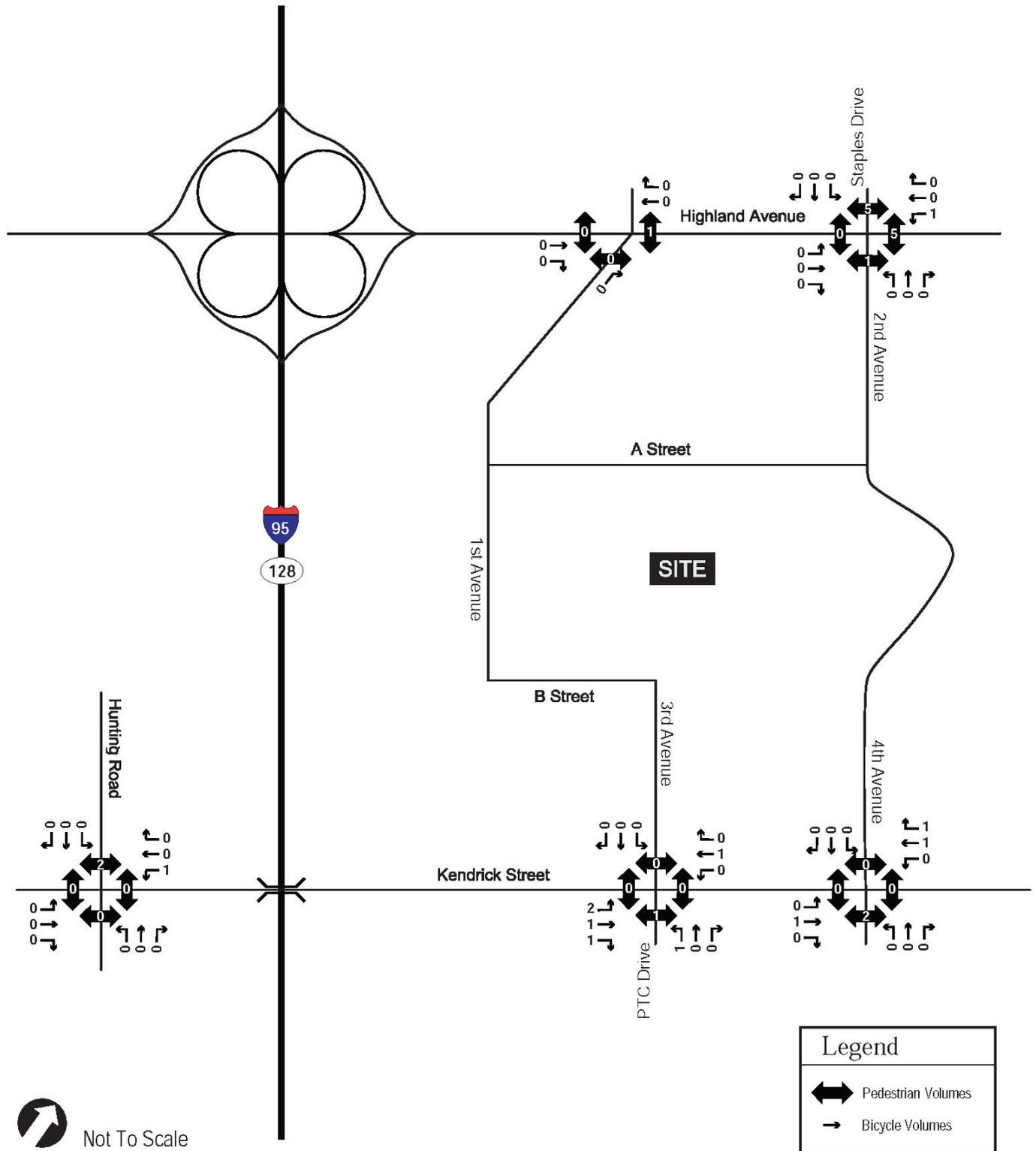
Center 128 Needham, Massachusetts



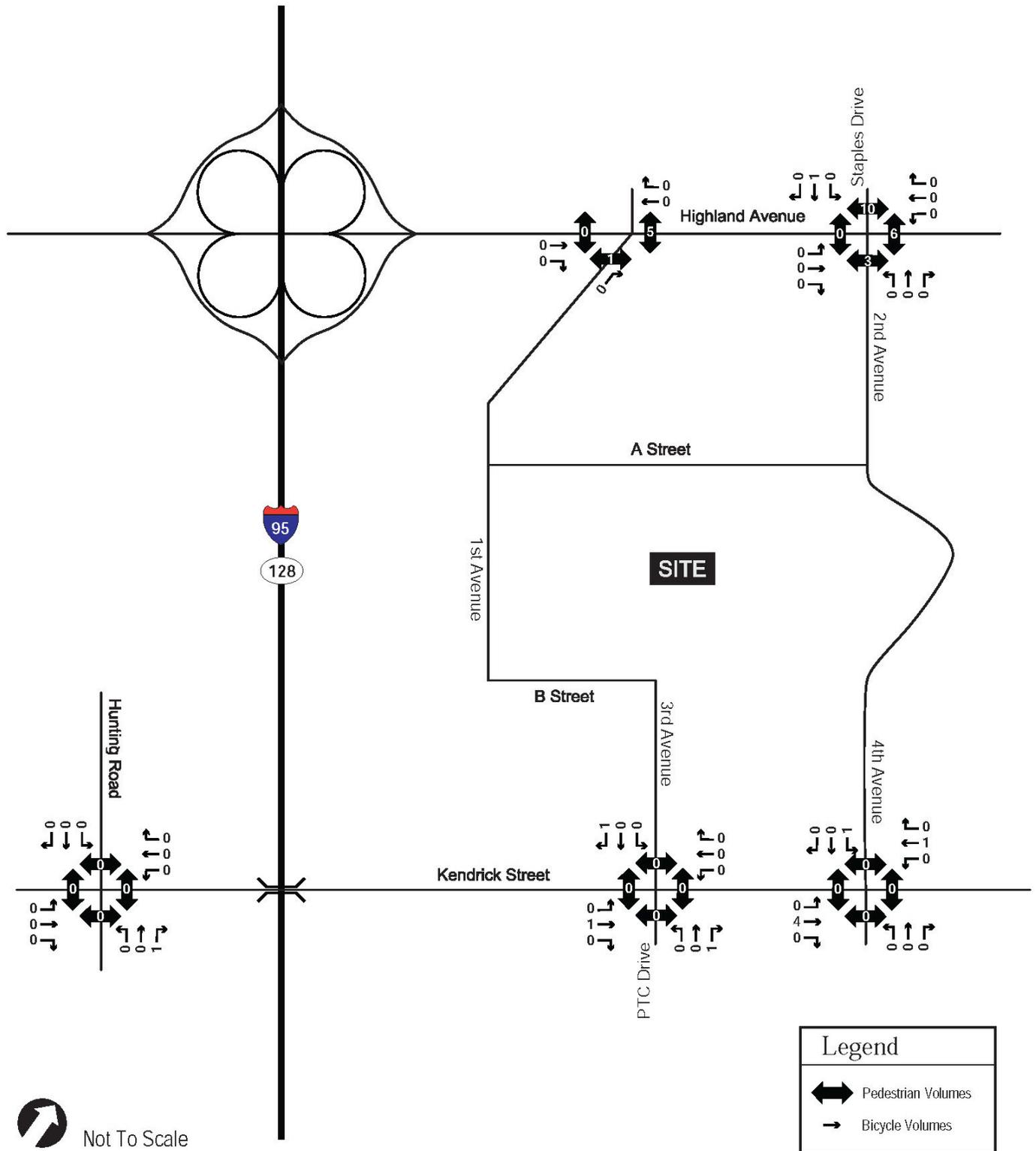
Center 128 Needham, Massachusetts



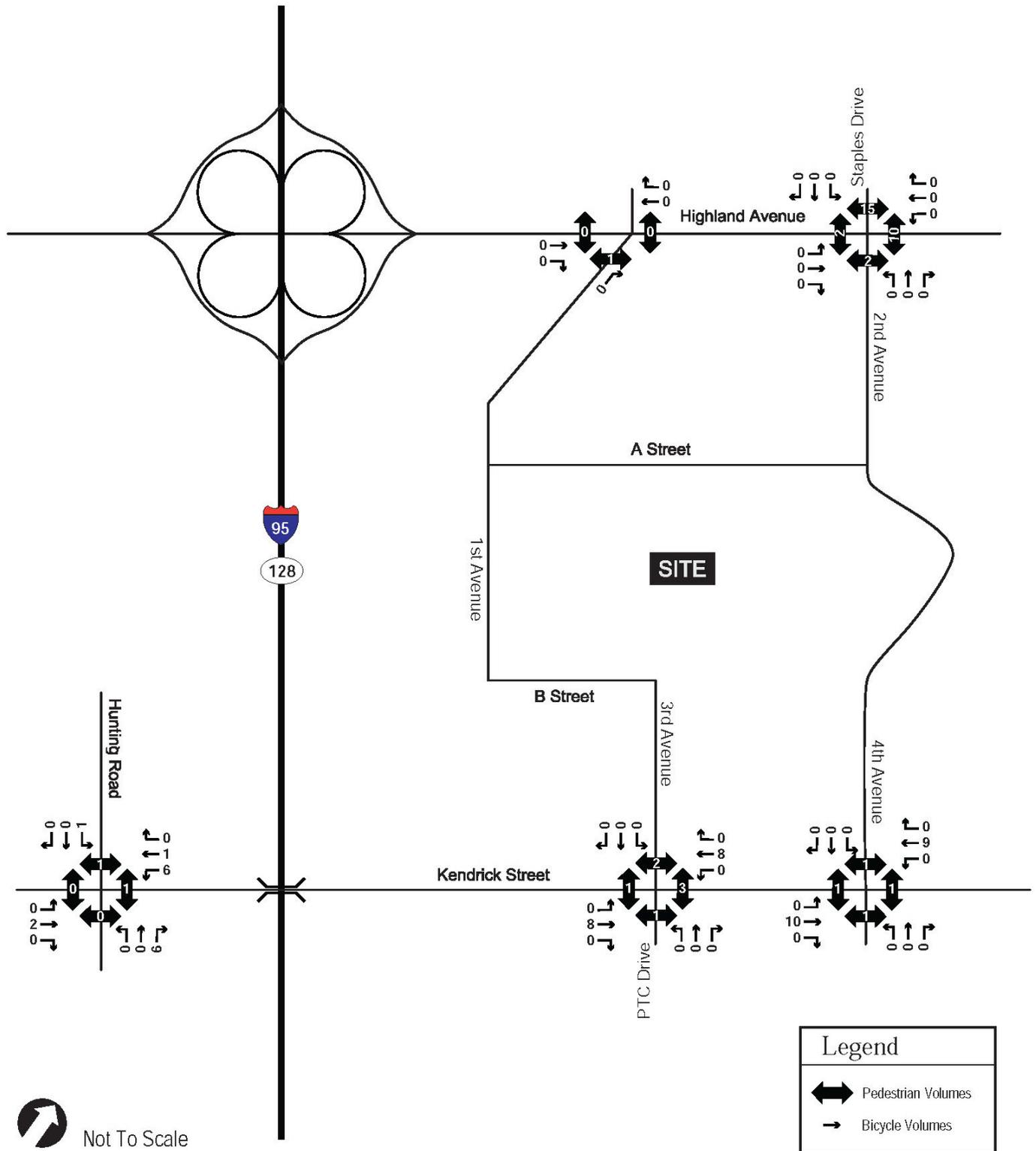
Center 128 Needham, Massachusetts



Center 128 Needham, Massachusetts



Center 128 Needham, Massachusetts



Center 128 Needham, Massachusetts

2.2.7 Existing Operating Conditions

Traffic conditions during the commuter peak hours were evaluated at the study area intersections. Existing peak hour traffic operations were determined by comparing observed volumes to calculated capacities as described in greater detail below.

2.2.7.1 Level of Service Criteria

Level of service (LOS) is a term used to describe the quality of the traffic flow on a roadway facility at a particular point in time. It is an aggregate measure of travel delay, travel speed, congestion, driver discomfort, convenience, and safety based on a comparison of roadway system capacity to roadway system travel demand. Operating levels of service are reported on a scale of A to F, with A representing the best operating conditions and F representing the worst. Depending upon the type of facility being analyzed, level of service A represents free-flow or uncongested conditions with little or no delay to motorists, while level of service F represents long delays with traffic demands sometimes exceeding roadway capacity.

The following sections describe the specific criteria used to evaluate operations of each facility type.

Intersections. Intersection operating levels of service are calculated following the methodologies defined in the 2000 *Highway Capacity Manual* for signalized and unsignalized intersections. For both signalized and unsignalized intersections, the operating LOS is based on travel delays. Delays can be measured in the field but generally are calculated as a function of traffic volume, peaking characteristic of traffic flow, percentage of heavy vehicles in the traffic stream, type of traffic control, number of travel lanes and lane use, intersection approach grades, pedestrian activity, and signal timing, phasing, and progression where applicable. The specific criteria applied per the 2000 *Highway Capacity Manual* are summarized in Table 2-5. The calculated average delay per vehicle for signalized intersections applies to all vehicles entering the intersection and under control of the traffic signal. For unsignalized intersections, it is assumed that through movements on the main street have the right-of-way and are not delayed by side street traffic. Consequently, the total delay values in Table 2-5 for unsignalized intersections apply only to the major street left-turn movements and the minor street intersection movements, which must yield to oncoming traffic.

For this study, the SYNCHRO 8.0 software was used to analyze peak hour operations at the study intersections. SYNCHRO 8.0 is a windows-based analysis tool that follows the procedures defined in the 2000 *Highway Capacity Manual*. Use of the 2000 Highway Capacity Manual (HCM) output from Synchro 8.0 was required for this analysis because the 2010 HCM methodology does not support intersections with exclusive pedestrian phasing, which are present within the study limits.

Table 2-5 Intersection Level of Service Criteria

Level of Service	Average Delay per Vehicle (Seconds)	
	Signalized Intersections	Unsignalized Intersections
A	≤10.0	≤10.0
B	10.1 to 20.0	10.1 to 15.0
C	20.1 to 35.0	15.1 to 25.0
D	35.1 to 55.0	25.1 to 35.0
E	55.1 to 80.0	35.1 to 50.0
F	> 80.0	> 50.0

Source: *Highway Capacity Manual*, Special Report 209, Third Edition, Transportation Research Board, National Research Council, Washington, DC, 2000.

Highway Weave Area. The LOS of a weave area is related to the density of vehicles within the weaving area. Density of the weaving area is determined by a series of equations based on the following information: volume ratio (the ratio of weaving vehicles to total vehicles in the section); total flow rate in the weaving area in passenger cars per hour; total number of lanes in the weaving area; and the length of the weaving area in feet. For example, high volume ratios and total flow rates combined with a short weaving area length will result in high vehicle density. Table 2-6 summarizes the relationship between vehicle density and the level of service in highway and low-speed (multilane and collector-distributor) weave areas. The Highway Capacity Software was used to perform the weave analyses.

Weaving analyses were conducted at the Route 128/Highland Avenue interchange under future conditions.

Table 2-6 Weaving Areas Level of Service Criteria

Level of Service	Density (passenger cars/mile/lane)	
	Highway Weaving Segment	Multilane and Collector-Distributor Weaving Segment
A	< 10.0	< 12.0
B	> 10.0 –20.0	> 12.0 –24.0
C	> 20.0 –28.0	> 24.0 –32.0
D	> 28.0 –35.0	> 32.0 –36.0
E	> 35.0 –43.0	> 36.0 –40.0
F	> 43.0	> 40.0

Source: *Highway Capacity Manual*, Transportation Research Board, National Research Council, Washington, DC, 2000.

2.2.7.2 Intersection Operating Conditions

The procedures described above were used to determine existing peak hour Levels of Service at the study area intersections. Table 2-7 presents the results of the 2015 existing conditions operations analysis. As shown in Table 2-7, the three signalized intersections in the study area generally operate at LOS C or D conditions. Kendrick Street at 3rd Avenue during the morning peak hour and Kendrick Street at Hunting Avenue during the afternoon peak hour operate at LOS E conditions.

Table 2-7 also shows mixed results for the unsignalized intersections in the study area. Level of Service B/C operations occur at the Highland Avenue / 1st Avenue intersection during all peak hours. The Kendrick Street and 4th Avenue intersection operates at LOS F during all peak hours. The LOS F condition is associated with long delays associated with turns from 4th Avenue. The longest delays are associated with left-turns from 4th Avenue southbound. Capacity analysis worksheets are included in Attachment 2.C.

2.2.8 Safety

A safety analysis was performed at the study area intersections to identify any possible safety issues. Crash data from the four most recent years available from MassDOT (2010 – 2013) were used for the analysis. The results of the crash analysis are provided in Attachment 2.D and summarized in Table 2-8, which provides a breakdown of crashes per year at each intersection, as well as the intersection crash rate.

The crash rate, which represents the number of crashes at the intersection per million entering vehicles, provides an indication of how the intersection compares with other similar intersections (signalized or unsignalized) within the region or the state. MassDOT calculates the average crash rate for intersections on a state-wide basis and for each of its six engineering districts. Needham is located within MassDOT District 6. The crash rates for all of the intersections are below the statewide and District 6 averages.

Angle and rear-end crashes accounted for 73 percent of all the study area crashes. The majority of crashes occurred during clear weather conditions, between 9:00 a.m. and 4:00 p.m. The most common crash severity among all the study area crashes was property damage (74 percent) and no fatalities were reported.

A crash involving a pedestrian occurred on March 28, 2011 at 7:25 a.m. at the intersection of Highland Avenue and First Avenue. No injuries resulted from this crash.

A review of the 2010 to 2012 MassDOT Top Crash Locations data indicates that none of the study area intersections were identified as a Top 200 Intersection Cluster or a Highway Safety Improvement Program (HSIP) Cluster location. However, the Highland Avenue/Wexford Street intersection, located east of 1st Avenue was a HSIP Cluster in 2010-2012.

Table 2-7 Existing Intersection Analysis Results

Location	Morning					Afternoon					Saturday				
	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C	Delay	LOS	50th Q	95th Q	V/C	Delay	LOS	50th Q	95th Q
Signalized Intersections															
Highland Ave./2nd Ave.															
Highland Ave. EB LTR	0.76	22	C	245	324	0.71	23	C	211	275	0.71	20	C	223	330
Highland Ave. WB LTR	1.01	27	C	165	#285	0.93	35	D	191	#315	0.92	30	C	165	#358
2nd Ave. L	0.83	43	D	178	#300	1.12	114	F	~321	#514	0.76	42	D	126	205
2nd Ave. LTR	0.66	31	C	144	223	0.96	64	E	255	#461	0.36	31	C	46	112
Driveway LT	0.42	38	D	19	38	0.96	102	F	79	#134	0.72	51	D	56	#119
Driveway R	0.00	36	D	0	0	0.01	37	D	0	0	0.02	36	D	0	0
Overall	0.84	28	C			0.99	51	D			0.86	28	C		
Kendrick St./3rd Ave.															
Kendrick St. EB L	*	**	F	~213	#454	0.21	50	D	14	46	0.14	24	C	3	21
Kendrick St. EB T	1.00	48	D	401	#773	0.40	20	C	124	271	0.28	9	A	24	111
Kendrick St. EB R	0.18	10	A	0	40	0.01	6	A	0	0	0.00	5	A	0	0
Kendrick St. WB L	0.59	43	D	53	118	0.33	59	E	4	19	0.13	27	C	1	8
Kendrick St. WB TR	0.39	19	B	101	186	0.96	49	D	438	#800	0.42	11	B	63	124
Driveway L	0.09	27	C	8	22	0.78	37	D	172	#319	0.05	16	B	2	8
Driveway TR	0.02	27	C	1	15	0.08	24	C	7	48	0.01	16	B	1	5
3rd Ave. LT	1.27	**	F	~127	#320	0.89	85	F	100	#252	0.49	23	C	17	46
3rd Ave. R	0.02	27	C	0	1	0.18	37	D	4	52	0.03	14	B	0	3
Overall	1.01	69	E			0.84	41	D			0.42	12	B		
Kendrick St./Hunting Rd.															
Kendrick St EB LTR	0.77	40	D	234	#445	0.84	60	E	104	173	0.47	20	B	37	70
Kendrick St. WB L	0.53	39	D	58	127	1.10	86	F	~502	#1068	0.38	11	B	43	77
Kendrick St. WB TR	0.52	25	C	183	344	1.05	67	E	618	#1306	0.52	12	B	88	142
Hunting Rd. NB LT	1.14	**	F	~290	#638	0.58	43	D	87	179	0.33	18	B	36	81
Hunting Rd. NB R	0.49	1	A	0	0	0.14	0	A	0	0	0.10	0	A	0	0
Hunting Rd. SB L	0.96	73	E	238	#606	0.55	36	D	104	193	0.18	10	B	18	43
Hunting Rd. SB TR	0.16	20	B	48	123	0.66	35	D	206	350	0.21	11	B	29	62
Overall	0.91	44	D			1.02	60	E			0.55	12	B		

Table 2-7 Existing Intersection Analysis Results (Continued)

Location	Morning					Afternoon					Saturday				
	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C	Delay	LOS	50th Q	95th Q	V/C	Delay	LOS	50th Q	95th Q
Unsignalized Intersections															
Highland Ave./1st Ave.															
1st Ave. R	0.19	16	C		18	0.23	14	B		21	0.26	15	B		25
Kendrick St./4th Ave															
Kendrick St. EB LTR	0.33	9	A		36	0.14	4	A		13	0.08	3	A		7
Kendrick St. WB LTR	0.00	0	A		0	0.00	0	A		0	0.00	0	A		0
Driveway LTR	0.75	**	F		47	*	**	F		***	0.12	29	D		10
4th Ave. LT	*	**	F		***	*	**	F		***	0.99	**	F		186
4th Ave. R	0.20	19	C		18	*	**	F		301	0.12	16	C		11

¹Delay = Average delay per vehicle (seconds) ²v/c = Volume to capacity ratio ³LOS = Level of Service
⁴50th percentile queue (feet) ⁵95th percentile queue (feet)
 *v/c exceeds 1.2, **delay exceeds 120 seconds
 ~ the approach is above capacity; 50th percentile queue could be longer # volume for the 95th percentile queue exceeds capacity

Table 2-8 Crash Data Summary from 2010 to 2013

Intersection	1st Ave. / Highland Ave.	2nd Ave. / Highland Ave.	3rd Ave. / Kendrick St.	4th Ave. / Kendrick St.	Hunting Rd. / Kendrick St.
2010	3	5	0	2	5
2011	4	6	3	6	5
2012	6	7	0	3	12
2013	6	9	1	4	4
Total	19	27	4	15	26
Angle	6	6	2	12	11
Rear-end	6	11	2	1	9
Head-on	0	0	0	1	4
Sideswipe	6	9	0	0	1
Single Vehicle	1	1	0	1	1
Unknown	0	0	0	0	0
Total	19	27	4	15	26

Table 2-8 Crash Data Summary from 2010 to 2013 (Continued)

Intersection	1st Ave. / Highland Ave.	2nd Ave. / Highland Ave.	3rd Ave. / Kendrick St.	4th Ave. / Kendrick St.	Hunting Rd. / Kendrick St.
Property	15	21	3	10	18
Injury	3	5	1	5	6
Fatality	0	0	0	0	0
Unknown	1	1	0	0	2
Total	19	27	4	15	26
Pedestrians	1	0	0	0	0
Bicyclists	0	0	0	0	0
Vehicles Only	18	27	4	15	26
Total	19	27	4	15	26
Clear	16	18	3	11	21
Cloudy	2	4	1	1	2
Rain	1	5	0	3	1
Snow	0	0	0	0	2
Sleet	0	0	0	0	0
Fog	0	0	0	0	0
Unknown	0	0	0	0	0
Total	19	27	4	15	26
7:00 am to 9:00 am	3	1	0	3	4
9:00 am to 4:00 pm	13	15	3	5	11
4:00 pm to 6:00 pm	3	5	1	5	4
6:00 pm to 7:00 am	0	6	0	2	7
Total	19	27	4	15	26
CRASH RATES					
Statewide Rate	0.60	0.80	0.80	0.60	0.80
District Rate	0.58	0.76	0.76	0.58	0.76
Intersection Rate	0.36	0.54	0.09	0.36	0.56

A Road Safety Audit (RSA) was conducted at the Highland Avenue/1st Avenue and Highland Avenue/Wexford Street intersections by MassDOT in March 2014. Safety deficiencies noted in the RSA at the Highland Avenue/1st Avenue intersection include:

- ◆ Vehicles unable to turn left from 1st Avenue onto Highland Avenue instead turn right onto Highland Avenue and either make an illegal U-turn at the end of the median island or use Wexford Street to reverse direction.
- ◆ The speed limit is not posted on Highland Avenue east of Route 128.
- ◆ The median island is not wide enough at 1st Street to provide pedestrian refuge.
- ◆ The Highland Avenue crosswalk is located on the east side of 1st Avenue. Vehicles turning right from 1st Avenue onto Highland Avenue need only to look left for oncoming traffic and may not expect pedestrians to their right.
- ◆ Wheelchair ramps are not provided at the Highland Avenue crosswalk.

2.3 Future Conditions

Existing traffic volumes in the study area were projected to the year 2022 to represent a seven-year planning horizon consistent with state requirements for traffic impact studies. Independent of Center 128, traffic volumes on the roadway network in 2022 will include existing traffic, traffic from other approved projects in the area, traffic generated by the previous use of the site, new traffic resulting from general background traffic growth and a redistribution of traffic resulting from the proposed interchange at Kendrick Street and improvements at the Highland Avenue/1st Avenue intersection. This constitutes the 2022 No-Build condition. Traffic anticipated as a result of the proposed development is added to the 2022 No-Build traffic flow networks to create the 2022 Build condition.

2.3.1 *Proposed Improvements*

Two roadway projects are currently under design or construction by the MassDOT which will enhance vehicular, bicycle and pedestrian access to Center 128. These include the Route 128 Add-A-Lane project and corridor improvements to Highland Avenue including a new traffic signal at the Highland Avenue/1st Avenue intersection. The Route 128 Add-A-Lane Project is intended to increase the capacity of Route 128 but to also provide new ramps to/from Route 128 at Kendrick Street. Currently, no transit improvements are proposed for the study area by the MBTA. The following provides a brief summary of proposed projects already planned or under construction, and their estimated completion dates.

2.3.1.1 Route 128 Add-A-Lane

MassDOT is widening Route 128 along Needham Crossing's western boundary. Referred to as the Route 128 Add-A-Lane Project, portions of this project are currently under construction. In the site vicinity, current plans call for new ramps at Kendrick Street. Full access between both travel directions on Route 128 and Kendrick Street east of Route 128 will be accommodated at the new interchange. West of Route 128 access to/from Kendrick Street at the interchange is limited to southbound Route 128.

Due to the proximity of the proposed Kendrick Street interchange to the existing interchange at Highland Avenue (less than one mile), collector-distributor roads (also known as CD roads) will be constructed along Route 128 northbound and southbound from a point north of the Highland Avenue ramps to Kendrick Street. Thus, the exchange of volumes (merging, diverging or weaving movements) to/from the ramps will occur along the CD roads not on mainline Route 128.

A new traffic signal will be installed at the proposed intersection of Kendrick Street with the Route 128 southbound ramps. The existing traffic signals on Kendrick Street at Hunting Road and 3rd Avenue will be retimed and coordinated with the new traffic signal at the southbound ramps.

The northbound approach at the Kendrick Street/3rd Avenue intersection will be restriped to include an exclusive left turn lane and a shared left/through/right turn lane.

The southeasterly corner of the Kendrick Street/Hunting Road intersection will be reconstructed and new crosswalks installed on the Hunting Road northbound approach.

Construction began in 2014 and completion of this project is scheduled for spring of 2019. The Route 128 northbound off-ramp and Route 128 southbound on-ramp at Kendrick Street are 'early action' items and are scheduled to be complete by December 2016.

As documented in the design report prepared for the project (*Function Design Report for the I-95/I-93 Transportation Improvement Project (Bridge V) Route 9/Highland Avenue/Kendrick Street Section* (McMahon, August 2010)), the traffic volumes used to design this project were based on counts and modeling conducted by the Central Transportation Planning Staff in 2003. Future condition peak hour traffic volumes were projected for two study years, 2017 and 2025, with the 2025 volumes accounting for full development of Needham Crossing, including Charles River Landing, and Wexford/Charles Industrial District in Needham (approximately 2.5 million square feet of development) and Avalon at Upper Falls and the Northland site in Newton.

The Add-A-Lane FDR assumed that several improvements would be made along the Kendrick Street corridor in conjunction with the expansion of Needham Crossing. These improvements which are not a part of the Add-A-Lane Project include:

- ◆ Installation of a traffic signal at the Kendrick Street/4th Avenue intersection.
- ◆ Installation of a second left turn lane on the eastbound Kendrick Street approach to 3rd Avenue.
- ◆ An additional westbound lane between 3rd Avenue and the Route 128 northbound on-ramp which would allow a free right turn from 3rd Avenue onto Kendrick Street.

2.3.1.2 Highland Avenue Corridor Project

MassDOT plans to reconstruct Highland Avenue from Webster Street, (west of Route 128), to the Charles River and Newton City line. As shown on the *Highland Avenue/Needham/Needham Street/Newton Bridge No. N04-002=N-12-002 Over the Charles River Corridor Project 25% Design Submittal* (Fay, Spofford & Thorndike, Inc., May 2014) prepared for that project, the cross section of Highland Avenue will be widened to include two vehicular lanes and a bicycle lane in each direction. At Riverside Street, Highland Avenue will taper back to three lanes. The cross section of Highland Avenue at the Charles River Bridge is designed to effectively provide two lanes eastbound (towards Newton) and one lane westbound (towards Needham).

Based on recent conversations with MassDOT, it is understood that the design of the Highland Avenue/2nd Avenue intersection was modified from the 25 percent design and will be reflected in the 75 percent design plans. The 75 percent design plans were not available when this document was prepared. The currently proposed lane configuration at the intersection includes dedicated left-turn lanes on both approaches of Highland Avenue, and on the westbound approach a single through lane. Although the 25 percent design plans included two westbound through lanes, right-of-way issues caused the reduction from two lanes to one lane. Second Avenue will include a left lane, shared left/through lane and an exclusive right turn lane. Signal equipment will be replaced, but the signal phasing is not expected to change.

The project includes opening the Highland Avenue median to allow a left turn movement from 1st Avenue onto Highland Avenue, traffic signal control of the resulting four-legged intersection and traffic signal coordination of the new traffic signal with the existing traffic signal controller at the Highland Avenue/2nd Avenue intersection. It is understood that this component of the project will not be constructed until the improvements at the I-95/Highland Avenue interchange are completed.

Funding for construction of the portion of the project between 1st Avenue and the Charles River Bridge has been obtained and construction is anticipated to begin by the summer of 2016.

2.3.1.3 Town of Needham Potential Roadway Improvements

In addition to improvements proposed for the study area by MassDOT, the Town of Needham is also considering improvements within the study area. As local mitigation for Center 128 West (740,000 square feet of office space and a 128 room hotel), a contribution of \$930,000 was made to the Town of Needham traffic improvement fund and a \$1,000,000 contribution was made to the New England Business Center Owner's Association to address traffic issues.

During the permitting process for Center 128 it was discussed that these funds could potentially be used for the improvements suggested in the Add-A-Lane Function Design Report:

- ◆ Installation of a traffic signal at the Kendrick Street/4th Avenue intersection.
- ◆ Installation of a second left turn lane on the eastbound Kendrick Street approach to 3rd Avenue.
- ◆ An additional westbound lane between 3rd Avenue and the Route 128 northbound on-ramp which would allow a free right turn from 3rd Avenue onto Kendrick Street.

It was also discussed that these funds could potentially be used to implement improvements at the Highland Avenue/2nd Avenue intersection. Of particular concern to the Town and the New England Business Center Owner's Association were traffic operations at the intersection for the time period when the first Center 128 West office buildings would be open prior to the completion of the Kendrick Street interchange (when volumes on 2nd Avenue would be expected to decrease).

Addressing this concern, the Town of Needham Engineering Department has used a portion of the Center 128 West mitigation to fund the design of interim improvements at the Highland Avenue/2nd Avenue intersection. The Town's design includes modifications to the 2nd Avenue approach (extending the existing left turn lane and adding a 125 foot long exclusive right turn), and signal timing modifications. No changes are proposed on Highland Avenue. It is understood that an Access Permit was granted for this project and the improvements are to be constructed sometime in 2015. These improvements are considered as interim improvements to the MassDOT Highland Avenue corridor improvements.

2.3.1.4 Transit Accommodations

Review of the MBTA Transit Project website indicates that no transit improvements are proposed for the study area.

TripAdvisor will continue to operate its shuttle bus services between its new location on 1st Avenue and Newton Highlands and Cambridge (Kendell Square and Central Square).

2.3.1.5 Bicycle Accommodations

Bicycle accommodations will be constructed on Kendrick Street as part of the Route 128 Add-A-Lane Project. Bicycle lanes (4-feet to 5-feet wide) will be provided on both sides of the street from Hunting Road to 3rd Avenue. It is expected that this work will be complete by 2019.

Bicycles lanes are also proposed as part of the Highland Avenue Corridor Project. Five-foot-wide bicycles lanes will be provided on both sides of the street through the study area.

2.3.1.6 Pedestrian Accommodations

As part of the Highland Avenue Corridor Project, sidewalks will be reconstructed on both sides of Highland Avenue.

Pedestrian accommodations at 1st Avenue will include crosswalks on the 1st Avenue and westbound Highland Avenue approaches. The new traffic signal system will have pedestrians crossing concurrently with vehicular traffic.

At the Highland Avenue/2nd Avenue intersection crosswalks will be provided on the 2nd Avenue, Highland Avenue westbound and the driveway (southbound) approaches. The new traffic signal system will have pedestrians crossing concurrently with vehicular traffic.

Sidewalks are also proposed on both sides of Highland Avenue as part of the improvements at the I-95/Highland Avenue interchange being constructed as part of the Route 128 Add-A-Lane Project.

2.3.1.7 Summary of Proposed Roadway, Transit, Bicycle and Pedestrian Projects

Based on scheduling information for each of these projects, provided by the MassDOT and the Town of Needham, it is assumed that the Route 128 Add-A-Lane Project and the Highland Avenue corridor projects (from 1st Avenue to the Charles River) will be complete by 2022.

Figure 2-16 provides a summary of the construction schedule for the various infrastructure projects proposed in the area as well as the major components of the buildings that comprise the Center 128 development. As seen in Figure 2-16, only the hotel and the 288,346 square-foot building (recently occupied by TripAdvisor) were completed and occupied prior to the “early action” items expected to be complete at Kendrick Street (the Route 128 northbound off-ramp and the Route 128 southbound on-ramp). For approximately 18 months, the office building will be occupied prior to the opening of the ramps. The remaining components of the Center 128 buildings are expected to be complete by June 2019 with the Add-A-Lane Project fully complete by Spring 2019.

Attachment 2.E contains available design plans for the roadway projects discussed above.

Location	Use	Size	2015				2016				2017				2018				2019	
			Jan. to Mar.	Apr. to Jun.	July to Sept.	Oct. to Dec.	Jan. to Mar.	Apr. to Jun.	July to Sept.	Oct. to Dec.	Jan. to Mar.	Apr. to Jun.	July to Sept.	Oct. to Dec.	Jan. to Mar.	Apr. to Jun.	July to Sept.	Oct. to Dec.	Jan. to Mar.	Apr. to Jun.
Center 128																				
Center 128 West: Hotel (Complete)	Hotel	128 rooms																		
Center 128 West: Trip Advisor	Office	288,346 s.f.																		
Center 128 East: 77A Street	Office Renovation	260,429 s.f.																		
Center 128 East: 156 B Street	Hotel	128 rooms																		
Center 128 East: 156 B Street	Retail	19,000 s.f.																		
2nd Avenue Residences	Apartments	390 units																		
Center 128 East: 189 B Street	Office Renovation	160,000 s.f.																		
Center 128 West: 37A Street	Office	135,000 s.f.																		
Center 128 West: Trip Advisor Expansion	Office	127,145 s.f.																		
Center 128 West: 380 1st Avenue	Office	189,509 s.f.																		
MassDOT Projects																				
Add A Lane - Early Action Items (Kendrick Street)																				
Add A Lane - Remaining Items (Complete by Spring 2019)																				
Highland Ave. (1st Ave to River) Corridor Improvements																				
Highland Ave./1st Avenue Improvements																				
Potential Town of Needham Projects																				
Highland Ave./2nd Ave. Interim Improvements																				
Kendrick St./3rd Ave. - EB LT Lane, Auxiliary WB Lane																				
Kendrick St./4th Ave. - Traffic Signal																				

Legend
Center 128 West
Center 128 East
2nd Avenue Residences
Infrastructure Improvements

Center 128 Needham, Massachusetts



Figure 2-16
Infrastructure Improvements and Construction Schedule

2.3.2 2022 No-Build Traffic Volumes

The 2022 No-Build peak hour traffic volumes will include the existing traffic volumes, traffic generated by the previous use of the site, traffic from other approved projects in the area, new traffic resulting from general background traffic growth and finally a redistribution of traffic resulting from the proposed interchange at Kendrick Street and the proposed improvements at the Highland Avenue/1st Avenue intersection.

2.3.2.1 Previous Use of the Site

Center 128 West. The site previously included 152,906 square feet of office space and 99,223 square feet of light industrial space. The buildings which comprised these uses were either vacated or demolished in 2011. Therefore, a credit for existing trips was taken. Based on trip rates obtained from the Institute of Transportation Engineers (ITE) publication *Trip Generation*, 9th Edition, 2012 - Land Use Code 710 (General Office) and Land Use Code 110 (General Light Industrial), the site previously generated approximately 297 a.m. peak hour trips, 346 p.m. peak hour trips and 80 Saturday midday peak hour trips. These trips were adjusted and assigned to the roadway network in accordance with the trip generation methodology and regional distribution for office space described in Section 2.0 of this report. The trips were assigned to the study intersections assuming the new interchange at Kendrick Street is not constructed and incorporated into the No-Build networks.

Center 128 East. The site currently includes 514,992 square feet of occupied office space. Therefore, a credit for existing trips was taken based on trip rates obtained from the Institute of Transportation Engineers (ITE) publication *Trip Generation*, 9th Edition, 2012 - Land Use Code 710 (General Office). When fully occupied, the site generated approximately 710 a.m. peak hour trips, 655 p.m. peak hour trips and 221 Saturday midday peak hour trips. Traffic volume data obtained in June 2015 at the site driveways indicates that the site currently generates 241 a.m. peak hour trips, 243 p.m. peak hour trips and 53 Saturday midday peak hour trips. The existing trips were removed from the study area roadway network and traffic estimated to be generated by the by-right use using trip rates from *Trip Generation* were assigned to the roadway network in accordance with the trip generation methodology and regional distribution for office space described in Section 2.3.3 of this report. The trips were assigned to the study intersections assuming the new interchange at Kendrick Street is not constructed and incorporated into the No-Build networks.

2.3.2.2 Site Specific Development

The planning departments of the towns of Needham and Newton were contacted to identify specific development proposals by others that may impact future traffic volumes within the study area. All projects noted by town's planning staff are summarized in Table 2-9 along with their common name, location, type, size and status. Table 2-9 also identifies projects for which a traffic study was prepared. If a traffic study was prepared, the trip generation

and distribution presented therein were used. If a study was not prepared, the project's traffic was estimated using appropriate trip-generation statistics from the publication *Trip Generation, 9th Edition*, (Institute of Transportation Engineers (ITE) 2012) and distributed through the study area based on the existing peak hour traffic patterns. Trip generation calculations and trip assignments for site specific development are provided in Attachment 2.F.

Table 2-9 Off-Site Development

Name		Location	Type	Size	Status	Include	Project Trip Source
Newton							
1	135 Wells Ave	135 Wells Ave.	40B Residential Development	334 units	Permitting process	Yes	Traffic Study
2	Bright Horizon Day Care	320 Needham St.	Day Care	11,000 sf	Approved	No ¹	
3	2 Wells Ave	2 Wells Ave.	Office Expansion	66,510 sf	In permitting	Yes	Traffic Study
4	145 Wells Ave	145 Wells Ave.	Day Care Play Facility	5,000 sf	Approved	No ¹	
5	180 Wells Ave	180 Wells Ave.	Office Expansion	60,565 sf	In permitting	Yes	Estimated ²
6	170 Needham St	170 Needham St.	Mixed Use	5,000 sf retail 50 seat restaurant	Under Construction	Yes	Estimated ²
7	180 Needham St	180 Needham St.	Mixed Use	105 seat restaurant	In permitting	Yes	Traffic Study
8	300 Needham St	300 Needham St.	Restaurant	120 seats	Phase 1 Completed	Yes	Estimated ²
9	Newton Technology Park	131-181 Needham St.	Mixed Use	55,056 sf office, 86,960 sf retail, 20,000 sf supermarket	In permitting	Yes	Traffic Study
Needham							
10	Wingate Senior Living Expansion	Highland Ave./ Gould St.	Senior Living bldg.	Adding 80 independent units	Approved	Yes	Traffic Study
11	Fitness Center	1 st Ave.	Fitness	31,000 s.f.	Approved	Yes	Traffic Study
12	Mews Residential	692 Greendale Ave.	40B Residential Development	300 units	In Litigation	Yes	Traffic Study
¹ Daycare center will be located within an existing office building and will occupy space previously used as office space. ² Peak hour trips based on trip rates from the Institute of Transportation Engineers (ITE) publication <i>Trip Generation, 9th Edition, 2012</i> .							

2.3.2.3 General Background Traffic Growth

To determine a growth rate for the seven year period between 2015 and 2022 a comparison of count data obtained from other traffic studies conducted in the area to the 2012 count data was performed. The comparison, summarized above in Section 2.2.6 (Existing Traffic Volumes) indicates that traffic volumes along Highland Avenue have decreased and only slightly increased on Kendrick Street in recent years.

Therefore, based on this data and that several projects are proposed in the vicinity of the study area, a 0.5 percent per year background growth rate was applied for seven years, representing a total increase of 3.6 percent.

2.3.2.4 Redistribution for Kendrick Street Interchange

The 2022 weekday morning and afternoon no-build peak hour traffic volumes were adjusted to account for the new Route 128/Kendrick Street interchange using traffic volume data obtained from the *Add-A-Lane Functional Design Report* (Add-A-Lane FDR) and the *West Street/High Street/Greendale Avenue Neighborhood Traffic Study* (McMahon, April 2013) (Neighborhood Study). The 2025 volumes reported in the FDR were established assuming full development of Needham Crossing, including Charles River Landing, and Wexford/Charles Industrial District in Needham (approximately 2.5 million square feet of development) and are considered as inclusive of traffic generated by Center 128. The 2017 volumes reported in the FDR are assumed to be more reflective of traffic levels prior to the addition of new traffic generated by Center 128.

The adjustments were developed based on the methodology summarized below and presented in Attachment 2.F.

1. The 2017 No-Build (without interchange) peak hour volumes depicted on Figure 14 of the Add-A-Lane FDR were subtracted from the 2017 Build (with interchange) peak hour volumes depicted on Figure 15 of the Add-A-Lane FDR to determine the 2017 Redistribution Volumes.
2. Estimated 2022 No-Build volumes were compared to the 2017 No-Build volumes reported in the Add-A-Lane FDR. The estimated 2022 No-Build volumes are approximately four percent lower than the 2017 No-Build volumes reported in the Add-A-Lane FDR. The 2017 Redistribution Volumes were reduced by four percent to estimate the redistribution appropriate for purposes of this study.
3. Adjustments to the Kendrick Street/Hunting Road intersection expected to occur as a result of the interchange and shown in Figures 9 and 10 of the Neighborhood Study are based on a comprehensive origin and destination study. These adjustments were also applied to the 2022 No-Build volumes.

4. The volumes used to adjust the 2022 No-Build peak hour traffic volumes, without the Kendrick Street interchange, to reflect conditions with the interchange, included the 2017 redistribution volumes (obtained from the Add-A-Lane FDR) reduced by four percent and the Neighborhood Study adjustments to the Kendrick Street/Hunting Road intersection. The resulting volumes were reviewed and additional modifications were made where the volume appeared unrealistic. A volume was considered unrealistic if when added to the 2022 No-Build volumes resulted in a very low volume or was not consistent with the Neighborhood Study peak hour volumes depicted in that study's Figures 11 and 12 (2025 Future Build Peak Hour Traffic Volumes).

For the Saturday peak hour, adjustment data was not provided in the Add-A-Lane FDR. Therefore, a ratio of the Saturday peak hour volume to the PM peak hour volume was calculated for each turning movement and applied to the PM redistribution values to estimate Saturday redistribution volumes appropriate for each turning movement.

2.3.2.5 Redistribution for Improvements at 1st Avenue

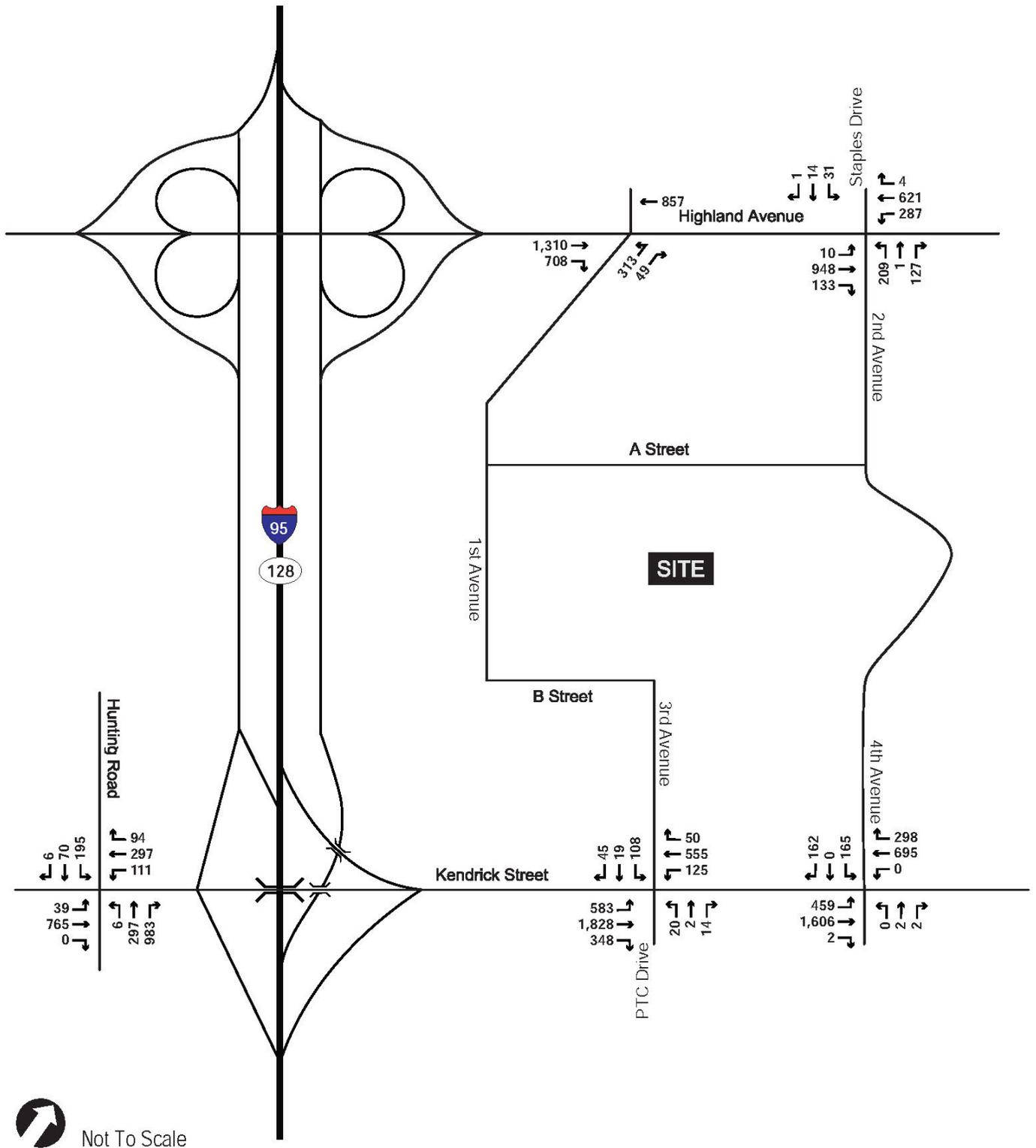
With the proposed improvements at 1st Avenue, a left turn will be permitted from 1st Avenue onto Highland Avenue. Therefore, a portion of vehicles turning left from 2nd Avenue onto Highland Avenue were redistributed onto 1st Avenue. In accordance with the *Functional Design Report Intersection Improvements at Highland Avenue at 1st Avenue Needham* (FST, June 2014), 60 percent of traffic estimated to turn left from 2nd Avenue onto Highland Avenue (313 vehicles in the morning peak hour, 530 vehicles in the afternoon peak hour and 150 vehicles in the Saturday midday peak hour) were redistributed onto 1st Avenue and would be expected to turn left from 1st Avenue onto Highland Avenue.

2.3.2.6 2022 No-Build Traffic Volumes

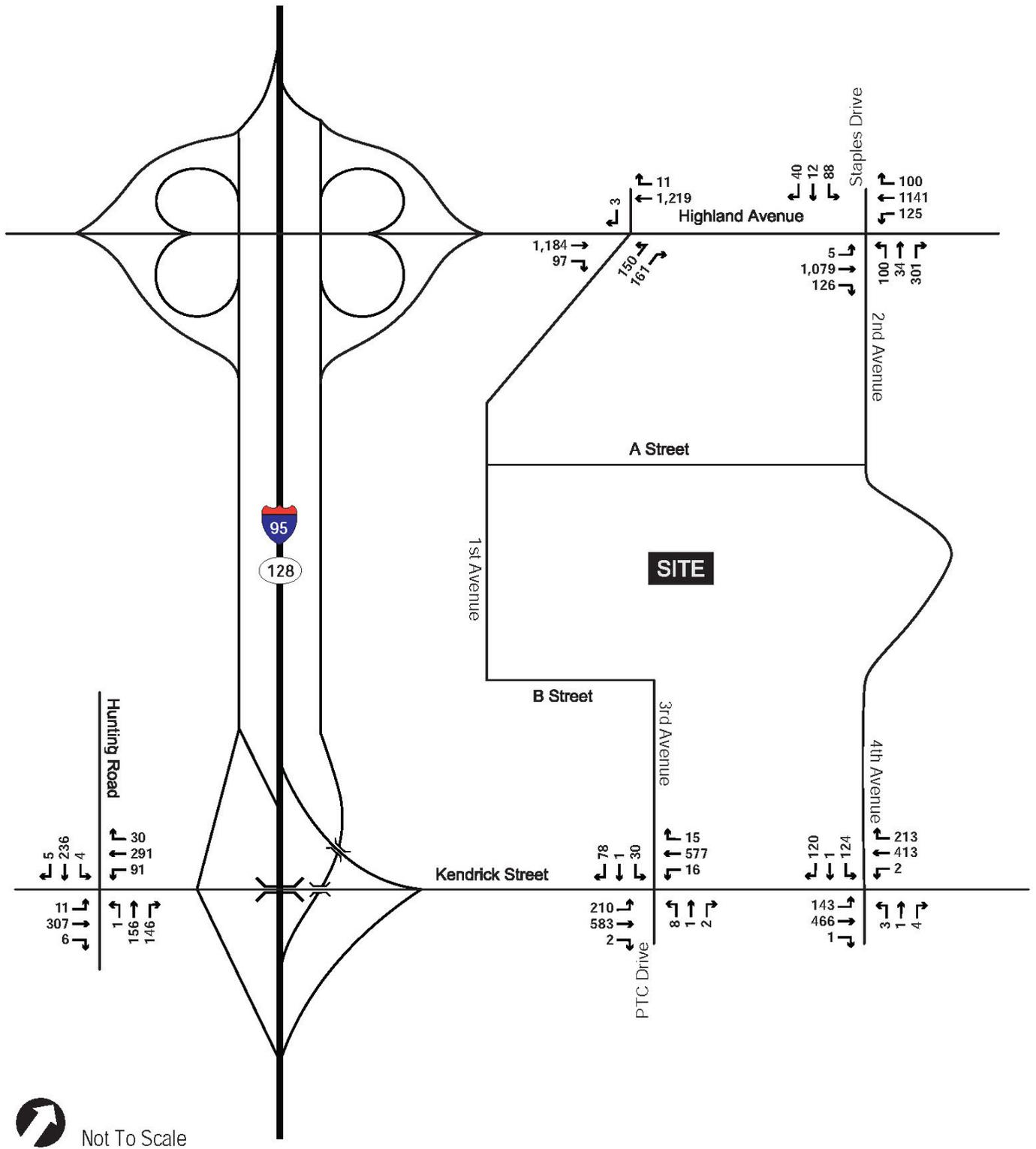
The 2022 No-Build peak hour traffic networks were estimated by increasing existing peak hour traffic volumes by a factor of 1.036, increased by trips generated by off-site development, increased by trips generated by "by-right" uses on the Center 128 site, and adjusted to account for the new Route 128 interchange at Kendrick Street and the improvements at 1st Avenue. The 2022 No-Build peak hour traffic volume networks are shown on Figures 2-17, 2-18 and 2-19.

2.3.3 Center 128 Traffic

Anticipated traffic volumes from the proposed Center 128 development were determined and assigned to the roadway network to develop the 2022 Build condition. The Build condition assumes full development of three components which comprise the site including Center 128 West, Center 128 East and the 2nd Avenue Residences. Procedures used to generate and assign trips to the roadway network are described below.



Center 128 Needham, Massachusetts



Center 128 Needham, Massachusetts

2.3.3.1 Center 128 Trip Generation

The trip generation for Center 128 was developed using appropriate trip-generation statistics from the publication *Trip Generation, 9th Edition*, (Institute of Transportation Engineers (ITE) 2012). Specifically, ITE Land Use Codes (LUCs) 220 Apartment, 310 Hotel, 710 General Office Building and 826 Specialty Retail were used to establish the unadjusted trips for the development. As the retail component of the development is only 19,000 square feet and is located within Needham Crossing, no credit for pass-by or diverted link trips were taken. Factors influencing the total trips generated by the mixed-use development include:

1. Travel Mode Selection
2. Internal Trips

The following sections detail the procedures used to apply these adjustments to the base traffic volume projections for Center 128. The detailed trip generation calculations are provided in Attachment 2.G.

Travel Mode Selection

Office. Based on data obtained from the 2010 American Community Survey (ACS) 5-year Summary File provided by the Central Transportation Planning Staff (CTPS), the mode share for employees who currently work in Needham is: 86.5 percent drive alone, 8.5 percent carpool, 1.7 percent use rapid transit/rail, 0.6 percent use buses, 2 percent walk, 0.1 percent bicycle and 0.6 percent use other modes.

The Proponent has joined the 128 Business Council and will participate in the 128 Business Council shuttle bus service which will provide a connection from the Center 128 site to the Newton Highland Green Line station during peak commuting periods. The 128 Business Council estimates that currently two to five percent of Needham Crossing employees currently use the shuttle bus service and that the ridership is expected to increase with new development in Needham Crossing.

TripAdvisor operates a shuttle bus service from their new location within the Center 128 West development to Cambridge (Kendall Square and Central Square) and to the Newton Highland Green Line station. TripAdvisor estimates that 23 percent of all employees currently use its shuttle bus service as part of their commute (see schedule in Attachment 2.A). Accordingly, it is assumed that the public transit mode share for new office trips would be slightly higher (approximately three percent versus two percent) than reported for the Town of Needham in the 2010 ACS Survey.

Based on the above, it is assumed that the peak period mode share for new office trips would be approximately 85.5 percent drive alone, 8.5 percent carpool, 2.7 percent rapid transit/rail, 0.6 percent buses, two percent walk, 0.1 percent bicycle and 0.6 percent use

other modes. Vehicle trips would represent approximately 89.75 percent (85.5 percent drive alone + 4.25 percent carpool) of the new trips generated by the proposed office space.

Residential. Based on data obtained from the 2010 American Community Survey 5-year Summary File provided by the Central Transportation Planning Staff (CTPS), the mode share for employees who live in Needham is: 80.5 percent drive alone, 4.8 percent carpool, 9.9 percent use rapid transit/rail, 0.7 percent bicycle, 3.8 percent walk and 0.3 percent use other modes.

Although a comprehensive transportation demand management plan is proposed for Center 128, it is conservatively assumed that the mode share for employees who live in Needham as reported in the ACS Survey is applicable to the residential component of Center 128. Vehicle trips would represent 82.9 percent (80.5 percent drive alone + 2.4 percent carpool) of the total trips generated by the proposed apartments.

Retail/Hotel. The mode share for the retail and hotel components of the development is assumed to be 100 percent drive alone.

Internal Trips

Estimates of internal trips for Center 128 were developed based on the methodology and internal capture trip rates contained in *NCHRP Report 864 Enhancing Internal Trip Capture Estimation for Mixed-Use Developments* (Transportation Research Board, 2011). The internal capture trip rates are based on data collected at mixed-use developments in Florida, Texas and Georgia. The internal trips were calculated using the NCHRP 684 Internal Trip Capture Estimation Tool Excel spreadsheet obtained from the ITE website. A credit for internal trips was not assumed for Saturday.

Center 128 West

As presented in the November 2014 SEIR prepared for this component of the development, the net trip generation increase for the Center 128 West site was determined by comparing trip estimates for the previous land uses on the site to trip estimates for the proposed land uses. Specifically, trip generation estimates for 152,906 square feet of office space and 99,223 square feet of industrial space were compared to the trip estimates for 740,000 square feet of office space and a 128-room hotel. However, the trip generation analysis presented in the SEIR did not account for non-auto or internal trips. Given the overall size of Center 128, adjustments to the total trips have been applied to account for non-auto modes and internal trips. With the adjustments to account for non-auto modes and internal trips, Center 128 West is expected to generate 4,146 new weekday daily vehicle trips of which 604 will occur during the morning peak hour and 567 will occur during the afternoon peak hour. On Saturdays, Center 128 West is expected to generate 2,250 new daily vehicle trips of which 331 will occur during the midday peak hour.

Tables 2-10A and 2-10B summarize the Center 128 West trip generation including total, auto, internal and external trips for each land use.

Center 128 East

The net trip generation increase for the Center 128 East site was determined by comparing trip estimates for the previous land use on the site to trip estimates for the proposed land uses. Specifically, trip generation estimates for 514,992 square feet of office space were compared to the trip estimates for the proposed 420,429 square feet of office space, 128-room hotel and 19,000 square feet of retail space. The net new trip generation represents new trips on the roadway network associated with the proposed development. Tables 2-11A and 2-11B summarize the Center 128 East trip generation including total, auto, internal and external trips for each land use. With the adjustments to account for non-auto modes and internal trips, Center 128 East is expected to generate 911 new weekday daily vehicle trips of which a net decrease of 67 trips will occur during the morning peak hour and an increase of 15 will occur during the afternoon peak hour. On Saturdays, Center 128 East is expected to generate 1,503 new daily vehicle trips of which 130 will occur during the midday peak hour.

2nd Avenue Residences

Table 2-12 summarizes the trip generation for the proposed 390 apartments including total, auto, internal and external trips. With the adjustments to account for non-auto modes and internal trips, the 2nd Avenue Residences are expected to generate 2,388 new weekday daily vehicle trips of which 158 will occur during the morning peak hour and 169 will occur during the afternoon peak hour. On Saturdays, the 2nd Avenue Residences are expected to generate 2,805 new daily vehicle trips of which 203 will occur during the midday peak hour.

Summary

Tables 2-13A and 2-13B summarize the trip generation for the Center 128 development. In total, Center 128 results in a net increase of 7,445 weekday daily vehicle trips of which 696 will occur during the morning peak hour and 752 will occur during the afternoon peak hour. On Saturday, Center 128 generates 6,558 new daily vehicle trips of which 664 will occur during the midday peak hour. Internal trips represent ten percent of the weekday morning peak hour trips and seven percent of weekday afternoon peak hour trips.

Applying the mode share portions Center 128's net new trips results in the transit, bus, bicycle and walk trips summarized in Table 2-14.

Table 2-10A Weekday Trip Generation Summary – Center 128 West

Weekday Daily	Size	Total			Auto Trips			Internal Trips			External Auto Trips				
		In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	740,000 sf	3,005	3,004	6,009	96.83%	2,910	2,909	5,819	0.56%	28	4	32	2,882	2,905	5,787
Hotel	128 rooms	386	386	772	100.00%	386	386	772	2.72%	2	19	21	384	367	751
Total		3,391	3,390	6,781		3,296	3,295	6,591		30	23	53	3,266	3,272	6,538
Existing															
Office	152,906sf	907	906	1,813	97.35%	883	882	1,765		0	0	0	883	882	1,765
Industrial	99,223 sf	320	319	639	98.21%	314	313	627		0	0	0	314	313	627
Total		1,227	1,225	2,452		1,197	1,195	2,392		0	0	0	1,197	1,195	2,392
Net New Project Trips		2,164	2,165	4,329		2,099	2,100	4,199		30	23	53	2,069	2,077	4,146
AM Peak Hour	Size	In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	740,000 sf	835	114	949	89.75%	749	102	851	3%	26	0	26	723	102	825
Hotel	128 rooms	40	28	68	100.00%	40	28	68	27%	0	19	19	40	9	49
Total		875	142	1,017		789	130	919		26	19	45	763	111	874
Existing															
Office	152,906 sf	237	32	269	90.75%	215	29	244		0	0	0	215	29	244
Industrial	99,223 sf	25	3	28	90.75%	23	3	26		0	0	0	23	3	26
Total		262	35	297		238	32	270		0	0	0	238	32	270
Net New Project Trips		613	107	720		551	98	649		26	19	45	525	79	604
PM Peak Hour	Size	In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	740,000 sf	154	753	907	89.75%	138	676	814	1%	3	4	7	135	672	807
Hotel	128 rooms	39	38	77	100.00%	39	38	77	3%	2	1	3	37	37	74
Total		193	791	984		177	714	891		5	5	10	172	709	881
Existing															
Office	152,906 sf	43	207	250	90.75%	39	188	227		0	0	0	39	188	227
Industrial	99,223 sf	12	84	96	90.75%	11	76	87		0	0	0	11	76	87
Total		55	291	346		50	264	314		0	0	0	50	264	314
Net New Project Trips		138	500	638		127	450	577		5	5	10	122	445	567

Source: *Trip Generation*, 9th Edition, (Institute of Transportation Engineers), Land Use Codes 110 Light Industrial, 310 Hotel and 710 General Office

Table 2-10B Saturday Trip Generation Summary – Center 128 West

Saturday Daily	Size	Total			Auto Trips			Internal Trips			External Auto Trips				
		In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	740,000 sf	910	910	1,820	100.00%	910	910	1,820	0%	0	0	0	910	910	1,820
Hotel	128 rooms	469	468	937	100.00%	469	468	937	0%	0	0	0	469	468	937
Total		1,379	1,378	2,757		1,379	1,378	2,757		0	0	0	1,379	1,378	2,757
Existing															
Office	152,906 sf	188	188	376	100.00%	188	188	376		0	0	0	188	188	376
Industrial	99,223 sf	66	65	131	100.00%	66	65	131		0	0	0	66	65	131
Total		254	253	507		254	253	507		0	0	0	254	253	507
Net New Project Trips		1,125	1,125	2,250		1,125	1,125	2,250		0	0	0	1,125	1,125	2,250
SAT Peak Hour	Size	In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	740,000 sf	172	146	318	100.00%	172	146	318	0%	0	0	0	172	146	318
Hotel	128 rooms	52	41	93	100.00%	52	41	93	0%	0	0	0	52	41	93
Total		224	187	411		224	187	411		0	0	0	224	187	411
Existing															
Office	152,906 sf	36	30	66	100.00%	36	30	66		0	0	0	36	30	66
Industrial	99,223 sf	7	7	14	100.00%	7	7	14		0	0	0	7	7	14
Total		43	37	80		43	37	80		0	0	0	43	37	80
Net New Project Trips		181	150	331		181	150	331		0	0	0	181	150	331

Source: *Trip Generation*, 9th Edition, (Institute of Transportation Engineers), Land Use Codes 110 Light Industrial, 310 Hotel and 710 General Office

Table 2-11A Weekday Trip Generation Summary – Center 128 East

Weekday Daily	Size	Total			Auto Trips			Internal Trips			External Auto Trips				
		In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	420,429 sf	1,955	1,955	3,910	96.98%	1,896	1,896	3,792	0.48%	16	3	19	1,880	1,893	3,773
Hotel	128 rooms	386	386	772	100.00%	386	386	772	2.72%	2	19	21	384	367	751
Retail	19,000 sf	421	421	842	100.00%	421	421	842	2.26%	6	13	19	415	408	823
Total		2,762	2,762	5,524		2,703	2,703	5,406		24	35	59	2,679	2,668	5,347
Existing															
Office	514,992 sf	2,281	2,281	4,562	97.23%	2,218	2,218	4,436		0	0	0	2,218	2,218	4,436
Net New Project Trips		481	481	962		485	485	970		24	35	59	461	450	911
AM Peak Hour	Size	In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	420,429 sf	532	72	604	89.75%	477	65	542	3%	14	0	14	463	65	528
Hotel	128 rooms	40	28	68	100.00%	40	28	68	27%	0	19	19	40	9	49
Retail	19,000 sf	0	0	0	100.00%	0	0	0		0	0	0	0	0	0
Total		572	100	672		517	93	610		14	19	33	503	74	577
Existing															
Office	514,992 sf	625	85	710	90.75%	567	77	644		0	0	0	567	77	644
Net New Project Trips		-53	15	-38		-50	16	-34		14	19	33	-64	-3	-67
PM Peak Hour	Size	In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	420,429 sf	93	456	549	89.75%	83	409	492	1%	1	3	4	82	406	488
Hotel	128 rooms	39	38	77	100.00%	39	38	77	3%	2	1	3	37	37	74
Retail	19,000 sf	29	38	67	100.00%	29	38	67	28%	6	13	19	23	25	48
Total		161	532	693		151	485	636		9	17	26	142	468	610
Existing															
Office	514,992 sf	111	544	655	90.75%	101	494	595		0	0	0	101	494	595
Net New Project Trips		50	-12	38		51	-9	41		9	17	26	41	-26	15

Source: *Trip Generation*, 9th Edition, (Institute of Transportation Engineers), Land Use Codes 310 Hotel, 710 General Office and 826 Specialty Retail.

Table 2-11B Saturday Trip Generation Summary – Center 128 East

Saturday Daily	Size	Total			Auto Trips			Internal Trips			External Auto Trips				
		In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	420,429 sf	517	517	1,034	100.00%	517	517	1,034	0%	0	0	0	517	517	1,034
Hotel	128 rooms	469	468	937	100.00%	469	468	937	0%	0	0	0	469	468	937
Retail	19,000 sf	400	399	799	100.00%	400	399	799	0%	0	0	0	400	399	799
Total		1,386	1,384	2,770		1,386	1,384	2,770		0	0	0	1,386	1,384	2,770
Existing															
Office	514,992 sf	634	633	1,267	100.00%	634	633	1,267		0	0	0	634	633	1,267
Net New Project Trips		752	751	1,503		752	751	1,503		0	0	0	752	751	1,503
Midday Peak Hour	Size	In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	420,429 sf	98	83	181	100.00%	98	83	181	0%	0	0	0	98	83	181
Hotel	128 rooms	52	41	93	100.00%	52	41	93	0%	0	0	0	52	41	93
Retail	19,000 sf	39	38	77	100.00%	39	38	77	0%	0	0	0	39	38	77
Total		189	162	351		189	162	351		0	0	0	189	162	351
Existing															
Office	514,992 sf	119	102	221	100.00%	119	102	221		0	0	0	119	102	221
Net New Project Trips		70	60	130		70	60	130		0	0	0	70	60	130

Source: *Trip Generation*, 9th Edition, (Institute of Transportation Engineers), Land Use Codes 310 Hotel, 710 General Office and 826 Specialty Retail.

Table 2-12 Trip Generation Summary – 2nd Avenue Residences

Weekday Daily	Total			Auto Trips			Internal Trips			External Auto Trips				
	In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Weekday Daily	1,244	1,243	2,487	97.06%	1,207	1,207	2,414	1%	15	11	26	1,192	1,196	2,388
AM Peak Hour	39	156	195	82.9%	32	129	161	2%	0	3	3	32	126	158
PM Peak Hour	151	81	232	82.9%	125	67	192	12%	15	8	23	110	59	169
Saturday Daily	1,403	1,402	2,805	100.0%	1,403	1,402	2,805	0%	0	0	0	1,403	1,402	2,805
Midday Peak Hour	110	93	203	100.0%	110	93	203	0%	0	0	0	110	93	203

Source: *Trip Generation*, 9th Edition, (Institute of Transportation Engineers), Land Use Code 220 Apartment

Table 2-13A Weekday Trip Generation Summary – Center 128

Weekday Daily	Size	Total			Auto Trips			Internal Trips			External Auto Trips				
		In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	1,160,429 sf	4,960	4,959	9,919	96.89%	4,806	4,805	9,611	0.53%	44	7	51	4,762	4,798	9,560
Hotel	256 rooms	772	772	1,544	100.00%	772	772	1,544	2.72%	4	38	42	768	734	1,502
Retail	19,000 sf	421	421	842	100.00%	421	421	842	2.26%	6	13	19	415	408	823
Residential	390 units	1,244	1,243	2,487	97.06%	1,207	1,207	2,414	1.08%	15	11	26	1,192	1,196	2,388
Total		7,397	7,395	14,792		7,206	7,205	14,411		69	69	138	7,137	7,136	14,273
Existing															
Office	667,898 sf	3,188	3,187	6,375	97.27%	3,101	3,100	6,201		0	0	0	3,101	3,100	6,201
Industrial	99,223 sf	320	319	639	98.21%	314	313	627		0	0	0	314	313	627
Total		3,508	3,506	7,014		3,415	3,413	6,828		0	0	0	3,415	3,413	6,828
Net New Project Trips		3,889	3,889	7,778		3,791	3,792	7,583		69	69	138	3,722	3,723	7,445
AM Peak Hour	Size	In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	1,160,429 sf	1,367	186	1,553	89.75%	1,226	167	1,393	3%	40	0	40	1,186	167	1,353
Hotel	256 rooms	80	56	136	100.00%	80	56	136	27%	0	37	37	80	19	99
Retail	19,000 sf	0	0	0		0	0	0		0	0	0	0	0	0
Residential	390 units	39	156	195	82.90%	32	129	161	2%	0	3	3	32	126	158
Total		1,486	398	1,884		1,338	352	1,690		40	40	80	1,298	312	1,610
Existing															
Office	667,898 sf	862	117	979	90.75%	782	106	888		0	0	0	782	106	888
Industrial	99,223 sf	25	3	28	90.75%	23	3	26		0	0	0	23	3	26
Total		887	120	1,007		805	109	914		0	0	0	805	109	914
Net New Project Trips		599	278	877		533	243	776		40	40	80	493	203	696
PM Peak Hour		In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	1,160,429 sf	247	1,209	1,456	89.75%	221	1,085	1,306	1%	4	7	11	217	1,078	1,295
Hotel	256 rooms	78	76	154	100.00%	78	76	154	3%	4	1	5	74	75	149
Retail	19,000 sf	29	38	67	100.00%	29	38	67	28%	6	13	19	23	25	48
Residential	390 units	151	81	232	82.90%	125	67	192	12%	15	8	23	110	59	169
Total		505	1,404	1,909		453	1,266	1,719		29	29	58	424	1,237	1,661
Existing															
Office	667,898 sf	154	751	905	90.75%	140	682	822		0	0	0	140	682	822
Industrial	99,223 sf	12	84	96	90.75%	11	76	87		0	0	0	11	76	87
Total		166	835	1,001		151	758	909		0	0	0	151	758	909
Net New Project Trips		339	569	908		302	508	810		29	29	58	273	479	752

Source: Trip Generation, 9th Edition, (Institute of Transportation Engineers), Land Use Codes 110 Light Industrial, 220 Apartment, 310 Hotel, 710 General Office and 826 Specialty Retail.

Table 2-13B Saturday Trip Generation Summary – Center 128

Saturday Daily	Size	Total			Auto Trips			Internal Trips			External Auto Trips				
		In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	1,160,429 sf	1,427	1,427	2,854	100.00%	1,427	1,427	2,854	0%	0	0	0	1,427	1,427	2,854
Hotel	256 rooms	938	936	1,874	100.00%	938	936	1,874	0%	0	0	0	938	936	1,874
Retail	19,000 sf	400	399	799	100.00%	400	399	799	0%	0	0	0	400	399	799
Residential	390 units	1,403	1,402	2,805	100.00%	1,403	1,402	2,805	0%	0	0	0	1,403	1,402	2,805
Total		4,168	4,164	8,332		4,168	4,164	8,332		0	0	0	4,168	4,164	8,332
Existing															
Office	667,898 sf	822	821	1,643	100.00%	822	821	1,643		0	0	0	822	821	1,643
Industrial	99,223 sf	66	65	131	100.00%	66	65	131		0	0	0	66	65	131
Total		888	886	1,774		888	886	1,774		0	0	0	888	886	1,774
Net New Project Trips		3,280	3,278	6,558		3,280	3,278	6,558		0	0	0	3,280	3,278	6,558
Midday Peak Hour	Size	In	Out	Total	Portion	In	Out	Total	Portion	In	Out	Total	In	Out	Total
Proposed															
Office	1,160,429 sf	270	229	499	100.00%	270	229	499	0%	0	0	0	270	229	499
Hotel	256 rooms	104	82	186	100.00%	104	82	186	0%	0	0	0	104	82	186
Retail	19,000 sf	39	38	77	100.00%	39	38	77	0%	0	0	0	39	38	77
Residential	390 units	110	93	203	100.00%	110	93	203	0%	0	0	0	110	93	203
Total		523	442	965		523	442	965		0	0	0	523	442	965
Existing															
Office	667,898 sf	155	132	287	100.00%	155	132	287		0	0	0	155	132	287
Industrial	99,223 sf	7	7	14	100.00%	7	7	14		0	0	0	7	7	14
Total		162	139	301		162	139	301		0	0	0	162	139	301
Net New Project Trips		361	303	664		361	303	664		0	0	0	361	303	664

Source: *Trip Generation*, 9th Edition, (Institute of Transportation Engineers), Land Use Codes 110 Light Industrial, 220 Apartment, 310 Hotel, 710 General Office and 826 Specialty Retail.

Table 2-14 Trip Generation by Mode Share

	Total Trips	Drive Alone	Carpool	Public Transit	Bus	Bicycle	Walk	Other
Residential Mode Share		80.5%	4.8%	9.9%	0.0%	0.7%	3.8%	0.3%
AM Peak Hour								
In	39	31	2	4	0	0	2	0
<u>Out</u>	<u>156</u>	<u>126</u>	<u>8</u>	<u>15</u>	<u>0</u>	<u>1</u>	<u>6</u>	<u>0</u>
Total	195	157	10	19	0	1	8	0
PM Peak Hour								
In	151	122	7	15	0	1	6	0
<u>Out</u>	<u>81</u>	<u>65</u>	<u>4</u>	<u>8</u>	<u>0</u>	<u>1</u>	<u>3</u>	<u>0</u>
Total	232	187	11	23	0	2	9	0
Office Mode Share		85.5%	8.5%	2.7%	0.6%	0.1%	2.0%	0.6%
AM Peak Hour¹								
In	480	410	41	13	3	1	10	2
<u>Out</u>	<u>66</u>	<u>56</u>	<u>6</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>1</u>
Total	546	466	47	15	3	1	11	3
PM Peak Hour¹								
In	81	69	7	2	1	0	1	1
<u>Out</u>	<u>374</u>	<u>320</u>	<u>32</u>	<u>10</u>	<u>2</u>	<u>0</u>	<u>8</u>	<u>2</u>
Total	455	389	39	12	3	0	9	3
Hotel/Retail Mode Share		100%	0%	0%	0%	0%	0%	0%
AM Peak Hour								
In	80	80	0	0	0	0	0	0
<u>Out</u>	<u>56</u>	<u>56</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	136	136	0	0	0	0	0	0
PM Peak Hour								
In	107	107	0	0	0	0	0	0
<u>Out</u>	<u>114</u>	<u>114</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	221	221	0	0	0	0	0	0
Total								
AM Peak Hour								
In	599	521	43	17	3	1	12	2
<u>Out</u>	<u>278</u>	<u>238</u>	<u>14</u>	<u>17</u>	<u>0</u>	<u>1</u>	<u>7</u>	<u>1</u>
Total	877	759	57	34	3	2	19	3
PM Peak Hour								
In	339	298	14	17	1	1	7	1
<u>Out</u>	<u>569</u>	<u>499</u>	<u>36</u>	<u>18</u>	<u>2</u>	<u>1</u>	<u>11</u>	<u>2</u>
Total	908	797	50	35	3	2	18	3

¹Total trips = Proposed office trips less existing office/industrial trips.

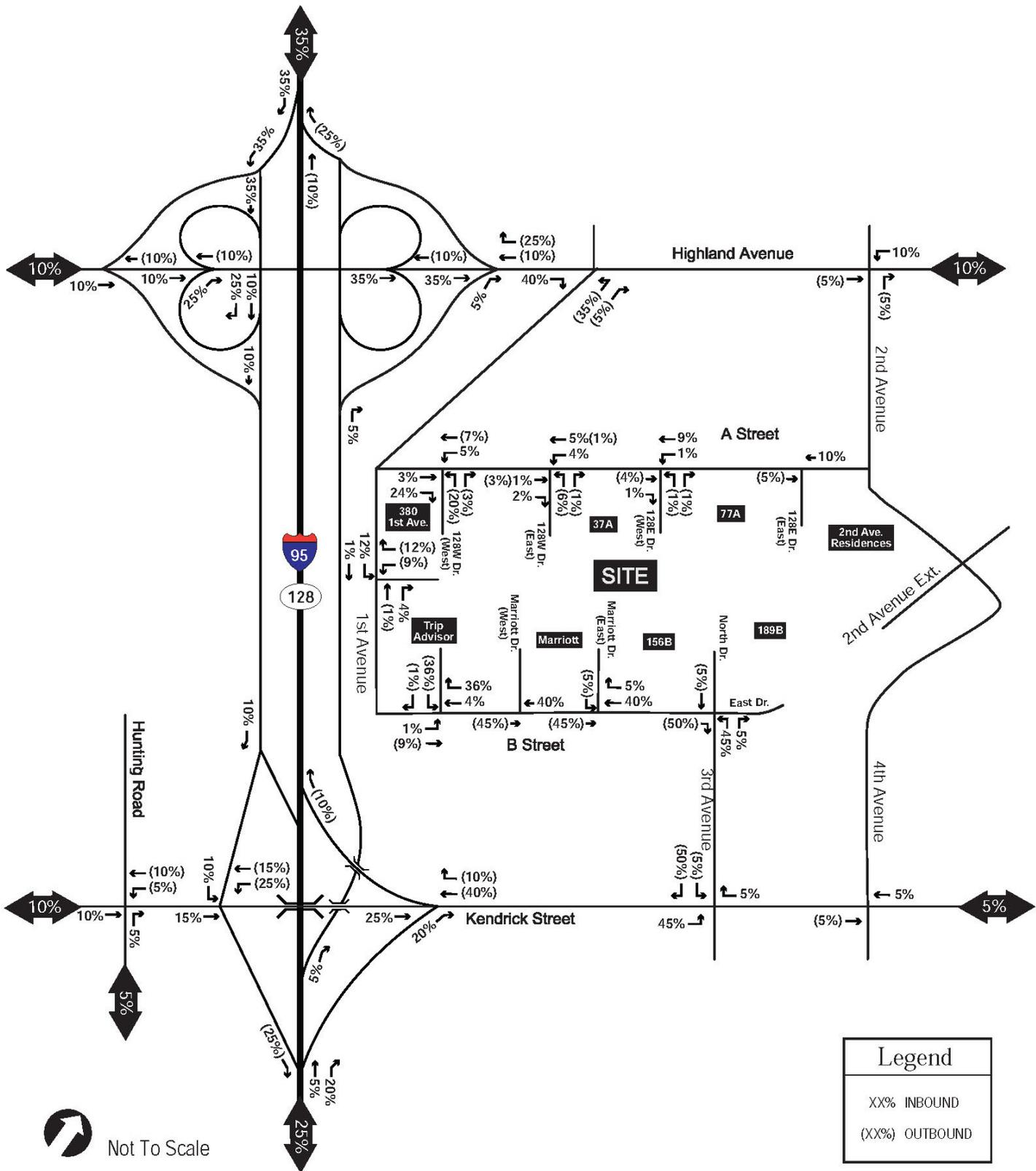
2.3.3.2 Trip Distribution

The distribution of office and hotel trips through the study area was based on an analysis of Journey to Work data for employees who work in Needham (available through the 2010 American Community Survey) and the roadway system serving the site. The analysis indicates 60 percent of the trips will arrive/depart via Route 128 (25 percent oriented to the south and 35 percent to the north), 20 percent will arrive/depart via Highland Avenue (ten percent to/from the east and 10 percent to/from the west) and 20 percent will arrive/depart via Kendrick Street (ten percent to/from the east and ten percent to/from the west). The Journey to Work data and distribution analysis is provided in Attachment 2.G. The distribution used to assign trips associated with the office buildings at Center 128 West, the hotel at Center 128 West, 77A office building on Center 128 East, 189B office building on Center 128 East and the hotel at Center 128 East are shown on Figures 2-20 through 2-24.

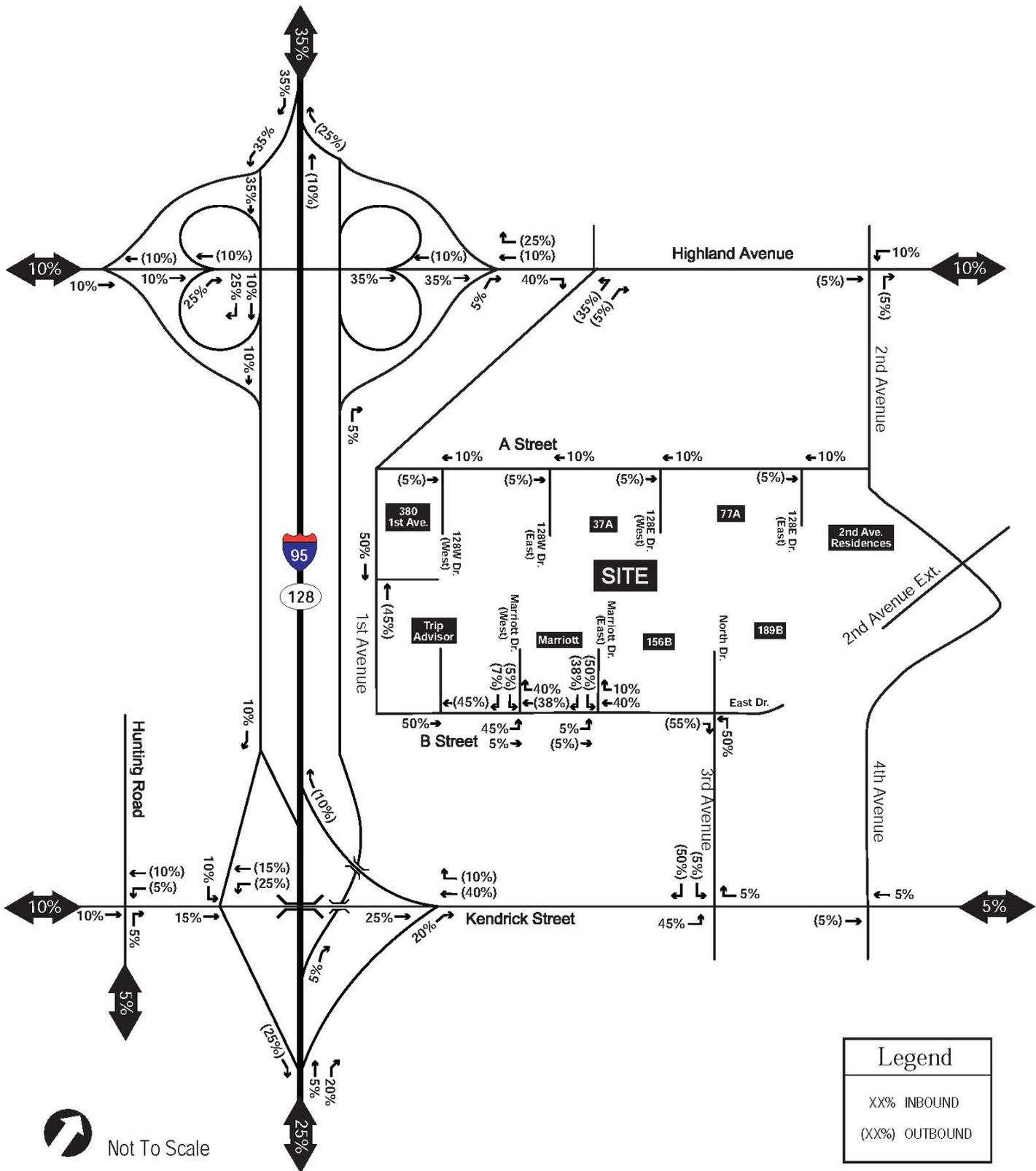
The distribution of residential trips through the study area was based on an analysis of Journey to Work data for employees who reside in Needham (available through the 2010 American Community Survey) and the roadway system serving the site. The analysis indicates 55 percent of the trips will arrive/depart via Route 128 (15 percent oriented to the south and 40 percent to the north), 27 percent will arrive/depart via Highland Avenue (12 percent to/from the east and 15 percent to/from the west) and 18 percent will arrive/depart via Kendrick Street (eight percent to/from the east and ten percent to/from the west). The Journey to Work data and distribution analysis is provided in Attachment 2.G. The distribution used to assign trips associated with the residential development is shown on Figure 2-25.

The distribution of retail trips through the study area was based on an analysis of area populations within a 30-minute drive time zone of the site (population data available through the 2013 American Community Survey). The analysis indicates 55 percent of the trips will arrive/depart via Route 128 (41 percent oriented to the south and 14 percent to the north), 21 percent will arrive/depart via Highland Avenue (15 percent to/from the east and six percent to/from the west) and 24 percent will arrive/depart via Kendrick Street (15 percent to/from the east and nine percent to/from the west). The Journey to Work data and distribution analysis is provided in Attachment 2.G. The distribution used to assign trips associated with the retail development on Center 128 East is shown on Figure 2-26.

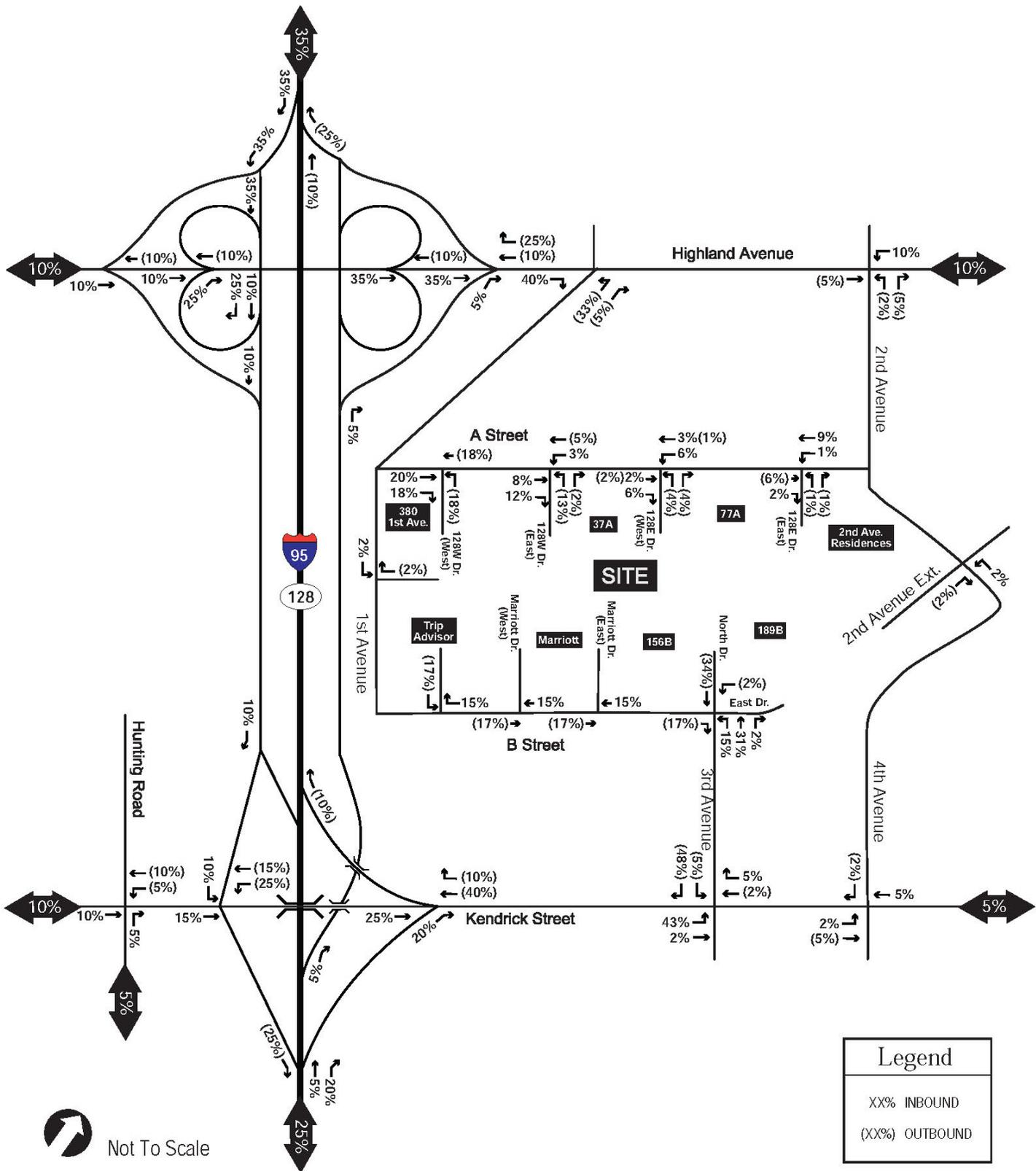
Using the trip distribution patterns shown on Figures 2-20 to 2-26, the net new trips shown in Tables 2-10, 2-11 and 2-12 were assigned to the 2022 No-Build roadway network. The development-related peak hour volumes are presented on Figures 2-27, 2-28 and 2-29 for the weekday morning, weekday afternoon and Saturday midday peak hours.



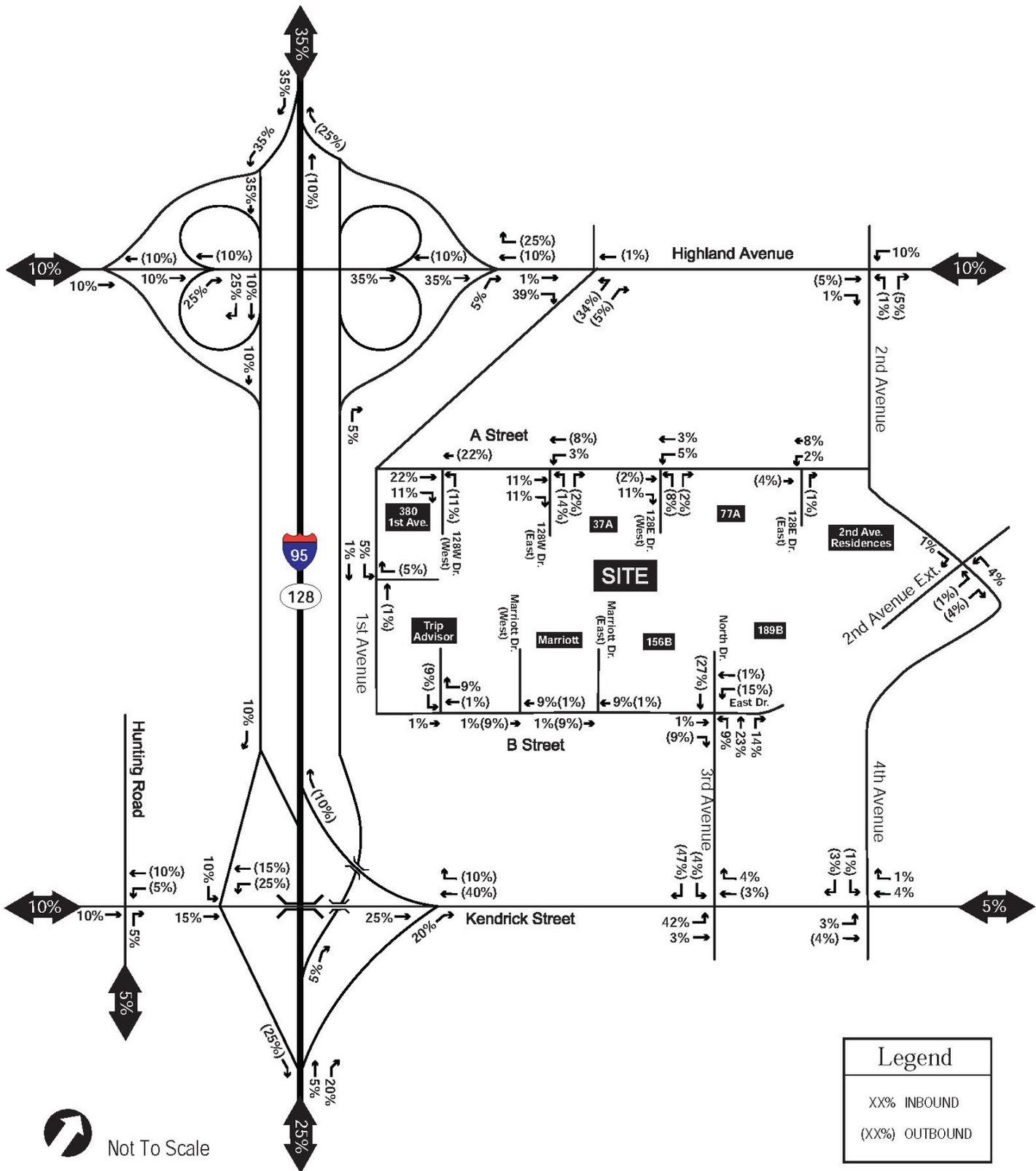
Center 128 Needham, Massachusetts



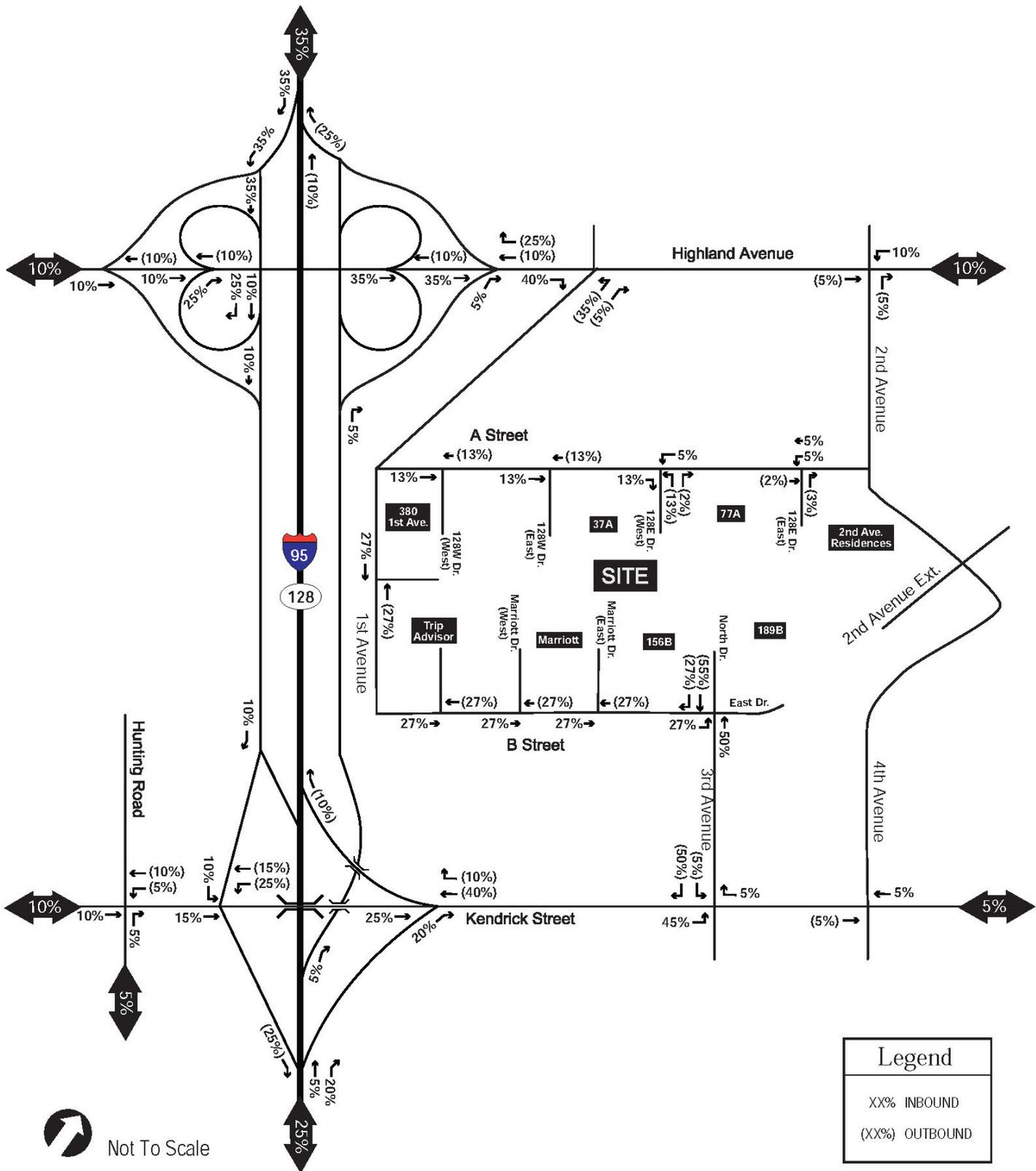
Center 128 Needham, Massachusetts



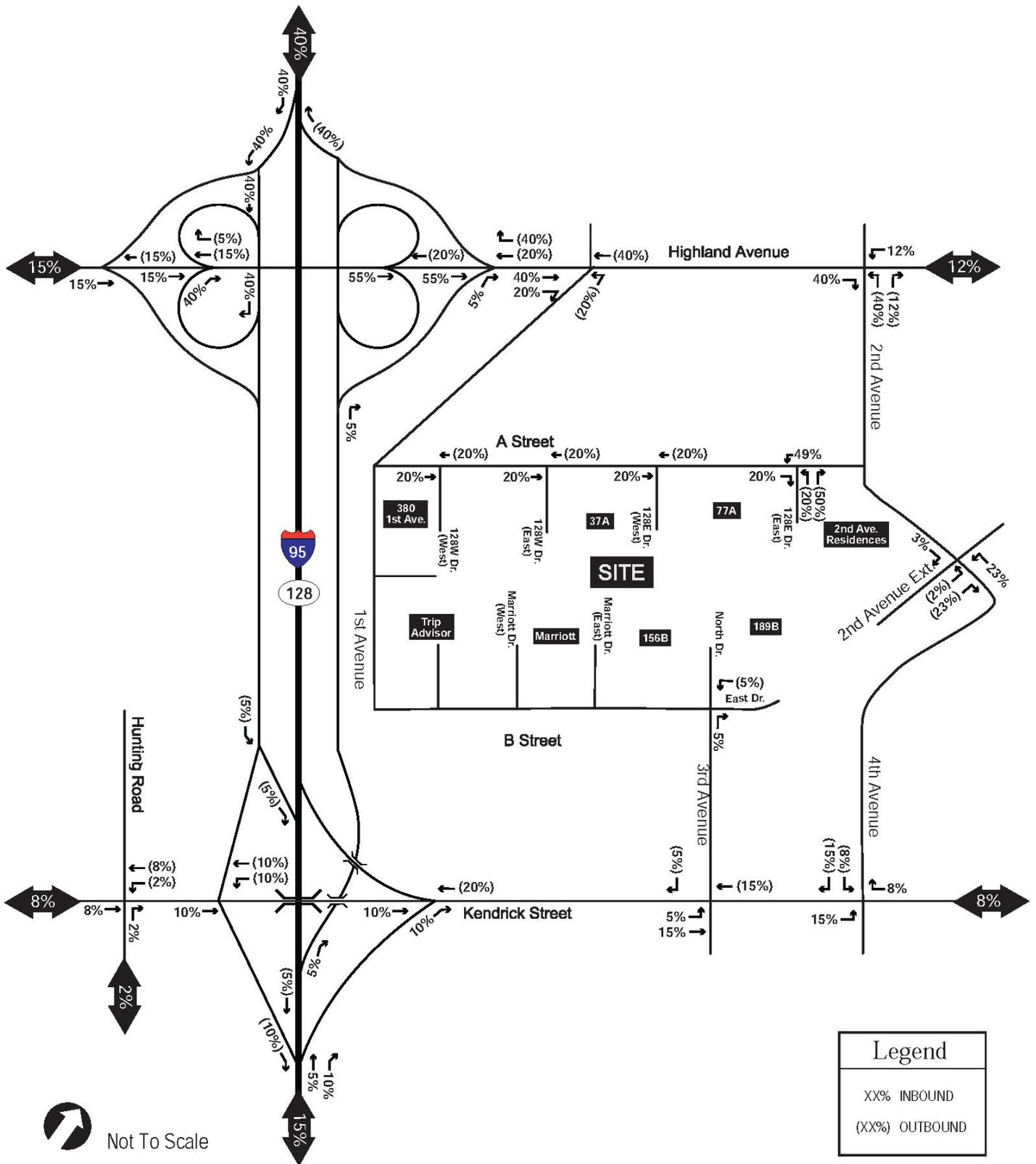
Center 128 Needham, Massachusetts



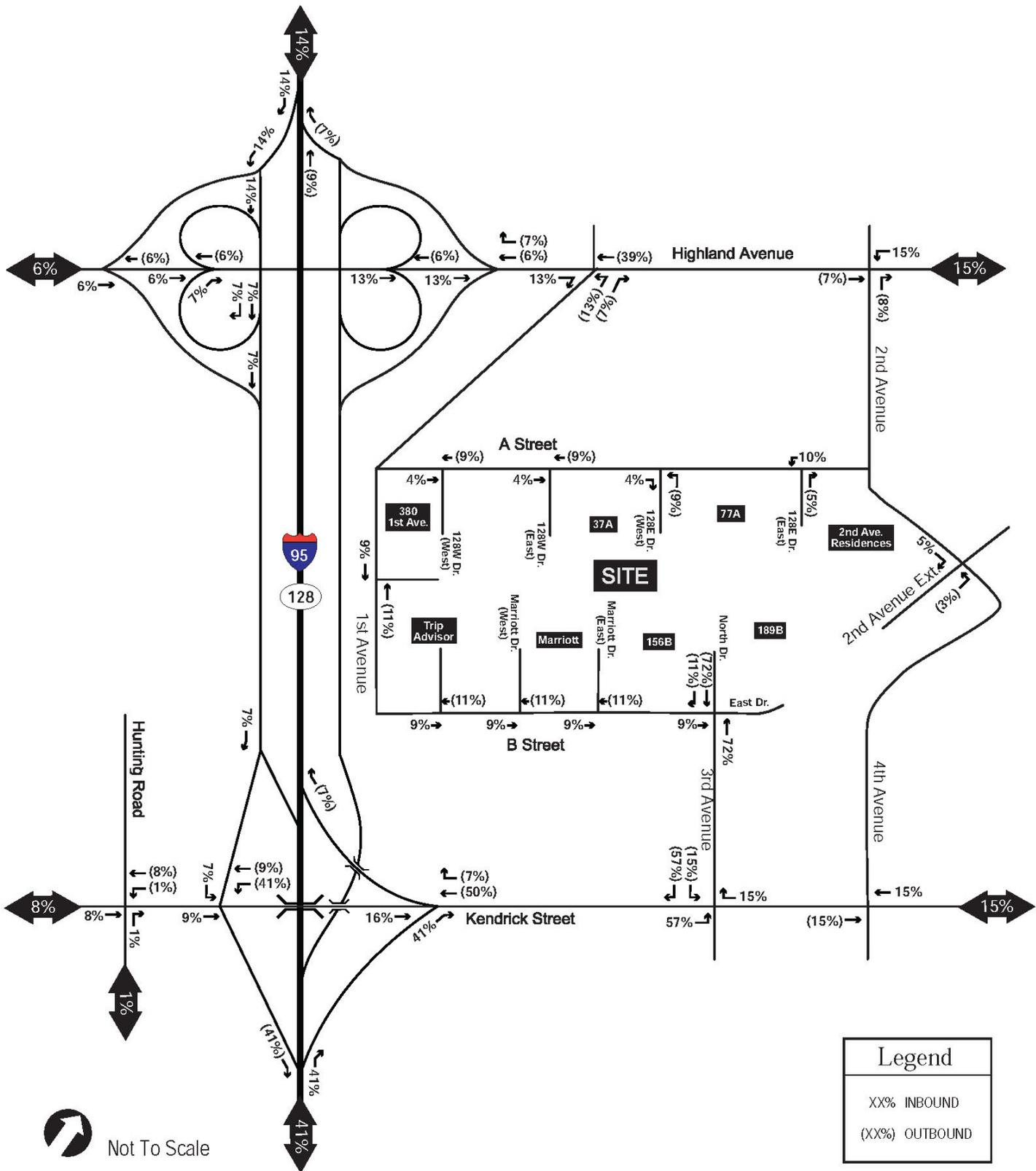
Center 128 Needham, Massachusetts



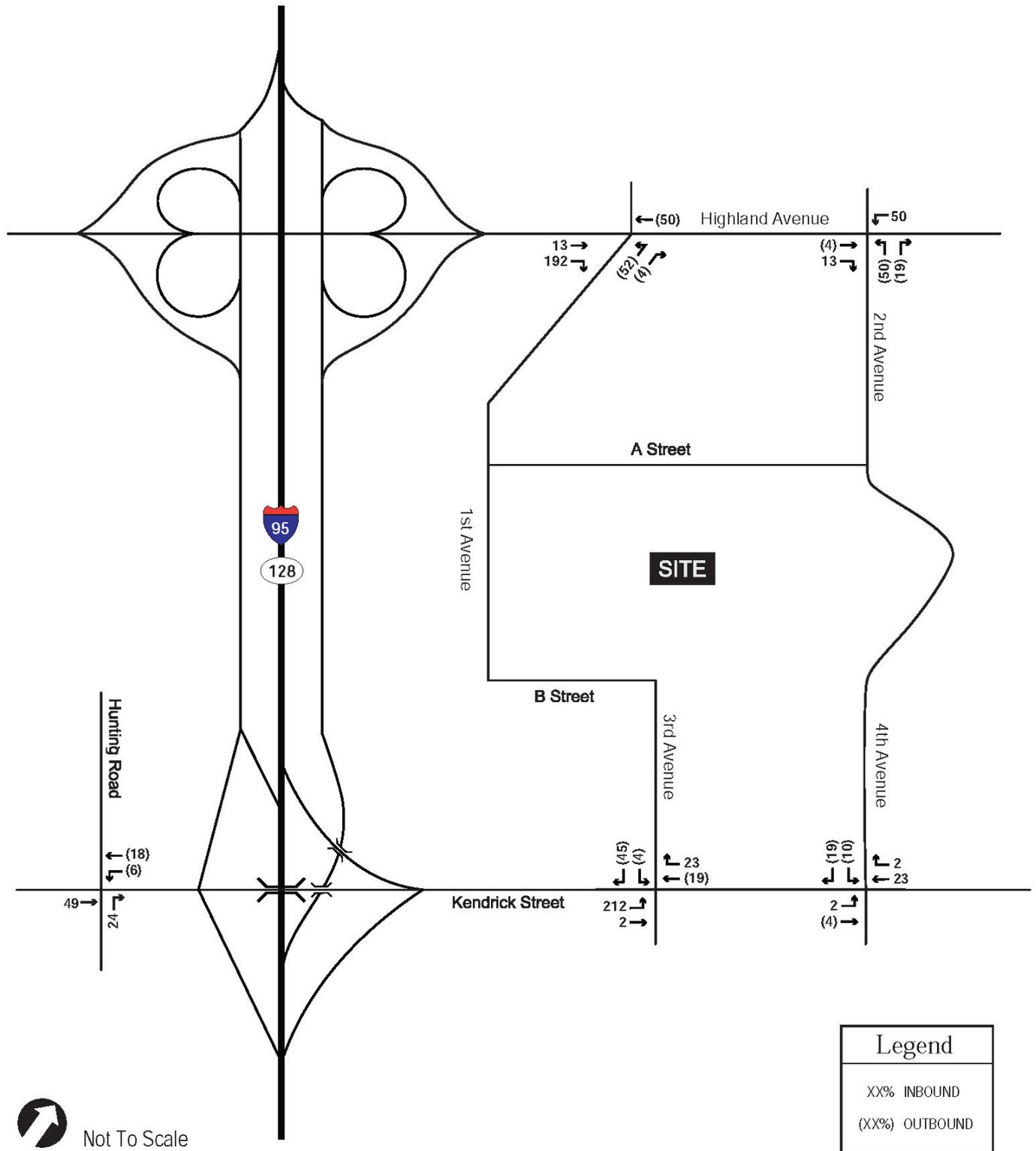
Center 128 Needham, Massachusetts



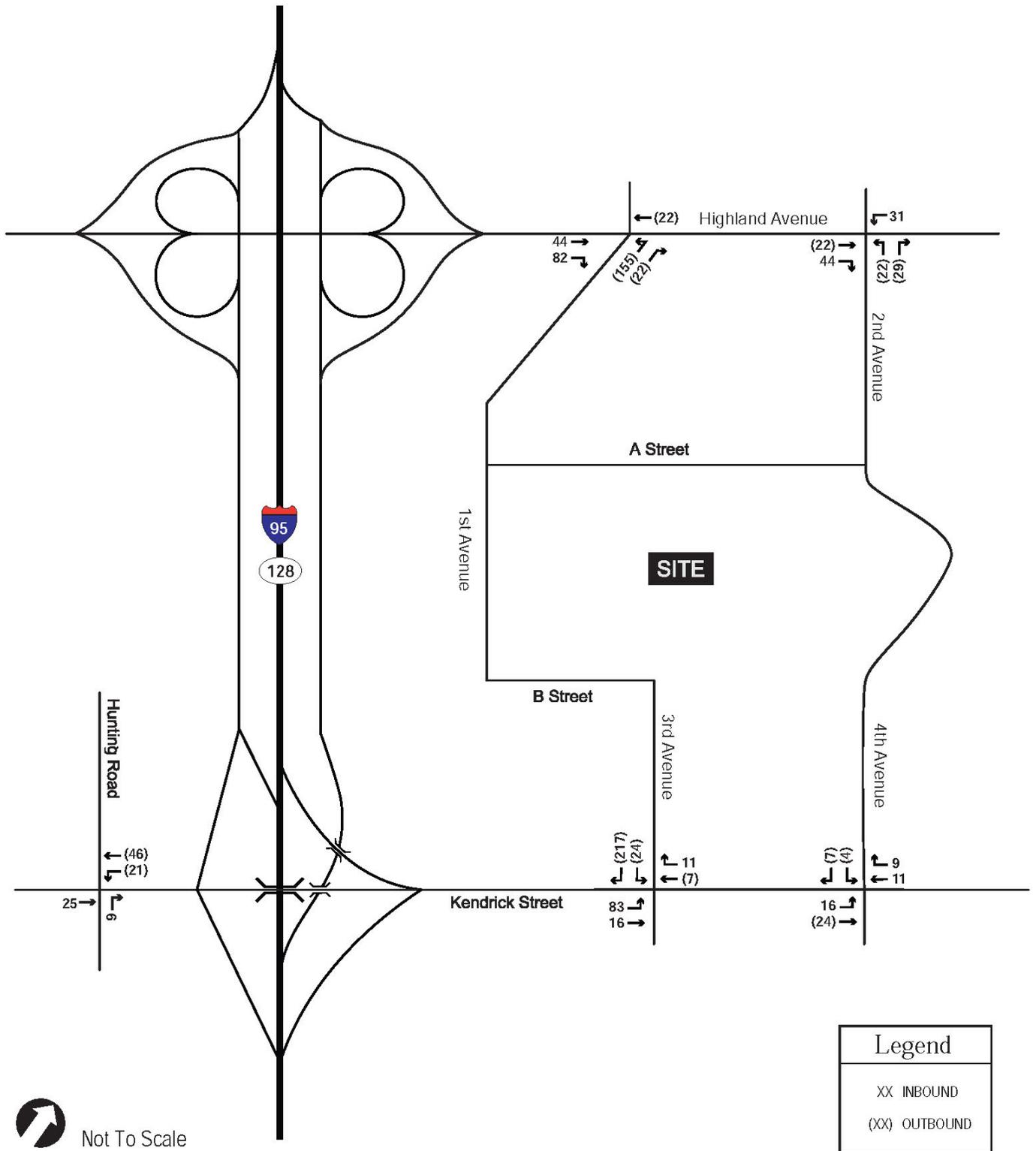
Center 128 Needham, Massachusetts



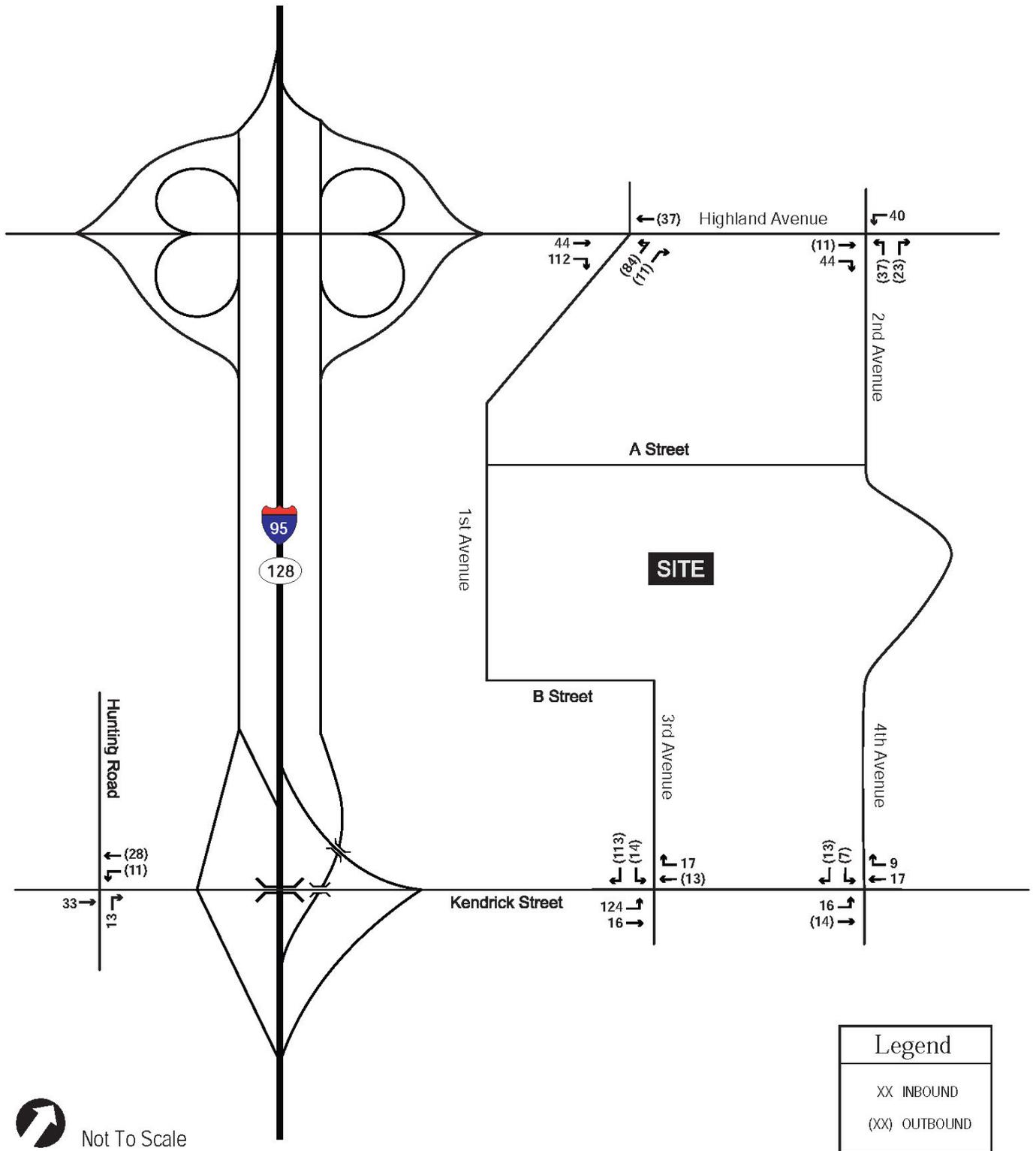
Center 128 Needham, Massachusetts



Center 128 Needham, Massachusetts



Center 128 Needham, Massachusetts



Center 128 Needham, Massachusetts

2.3.4 Build Traffic Volumes

The 2022 Build condition peak hour traffic volumes include the 2022 No-Build and Center 128 trips volumes and are depicted on Figures 2-30, 2-31 and 2-32.

2.3.5 Future Intersection Operating Conditions

Anticipated future roadway operating levels of service were calculated based on the projected 2022 No-Build and Build condition traffic flows and roadway conditions. Intersection geometry and traffic signal phasing and timing were obtained from MassDOT for the Route 128 Add-A-Lane Project and the Highland Avenue corridor improvements at 1st Avenue and 2nd Avenue (provided in Attachment 2.E) where available.

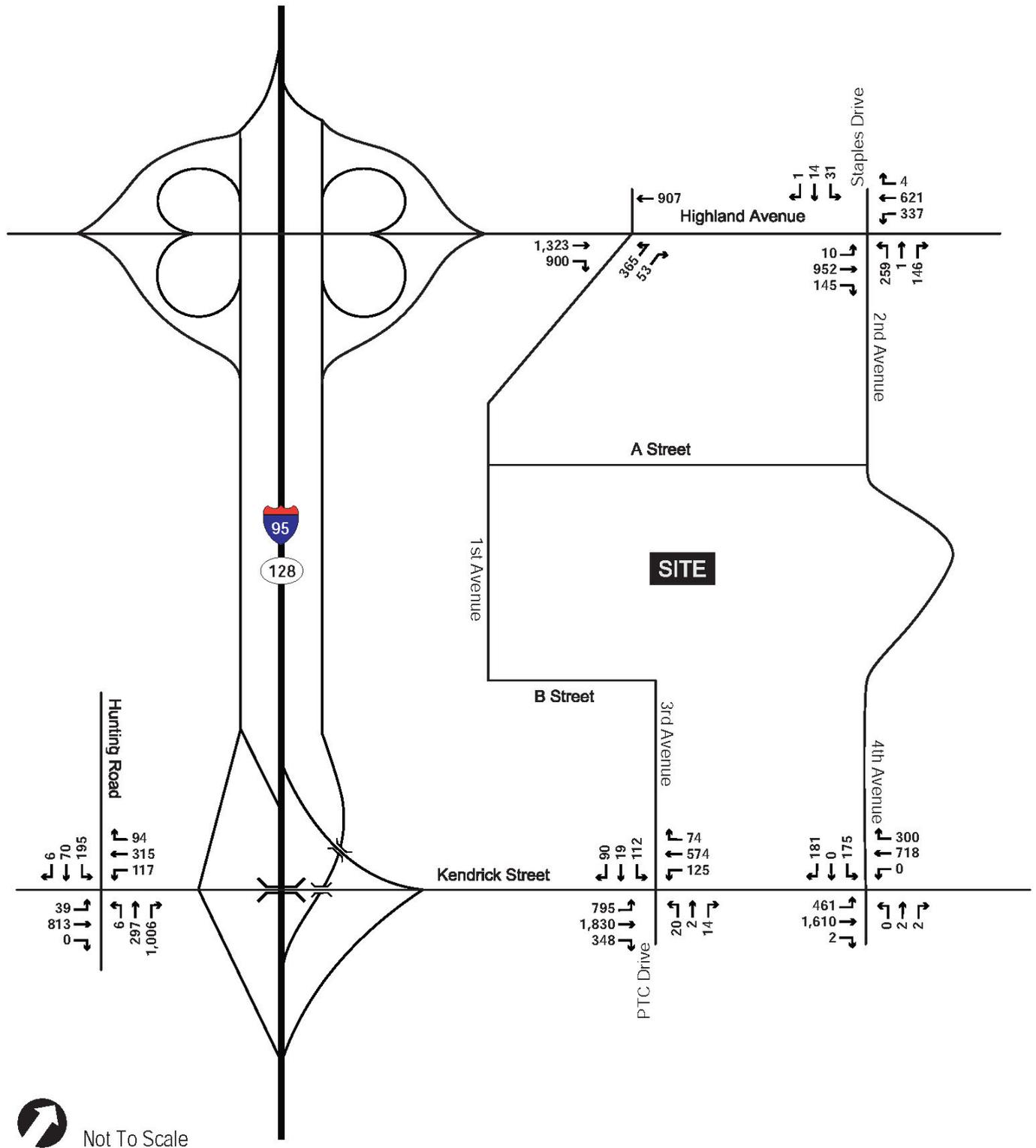
At the Highland Avenue/2nd Avenue intersection, the number of lanes on the westbound Highland Avenue approach and 2nd Avenue approach have changed since the submission of the 25 percent design plans. Thus, the signal timings shown on the 25 percent design plans are expected to be modified to reflect the new geometry. Optimal signal timings were assumed for the traffic signals at 1st and 2nd Avenues. The traffic signal at 1st Avenue is coordinated with the traffic signal at 2nd Avenue.

Tables 2-15, 2-16, 2-17 and 2-18 provide level of service analysis results for the morning, afternoon and Saturday peak hours under 2015 Existing, 2022 No-Build and 2022 Build conditions. The capacity analyses are provided in Attachment 2.H.

2015 Existing to 2022 No-Build. With a left turn allowed from 1st Avenue onto Highland Avenue, approximately 60 percent of traffic turning left from 2nd Avenue is expected to shift onto 1st Avenue. The intersections of Highland Avenue at 1st Avenue and 2nd Avenue will operate at overall LOS E or better during peak hours. With MassDOT's improvements at Highland Avenue/1st Avenue complete, traffic operations will generally improve along Highland Avenue during the peak hours.

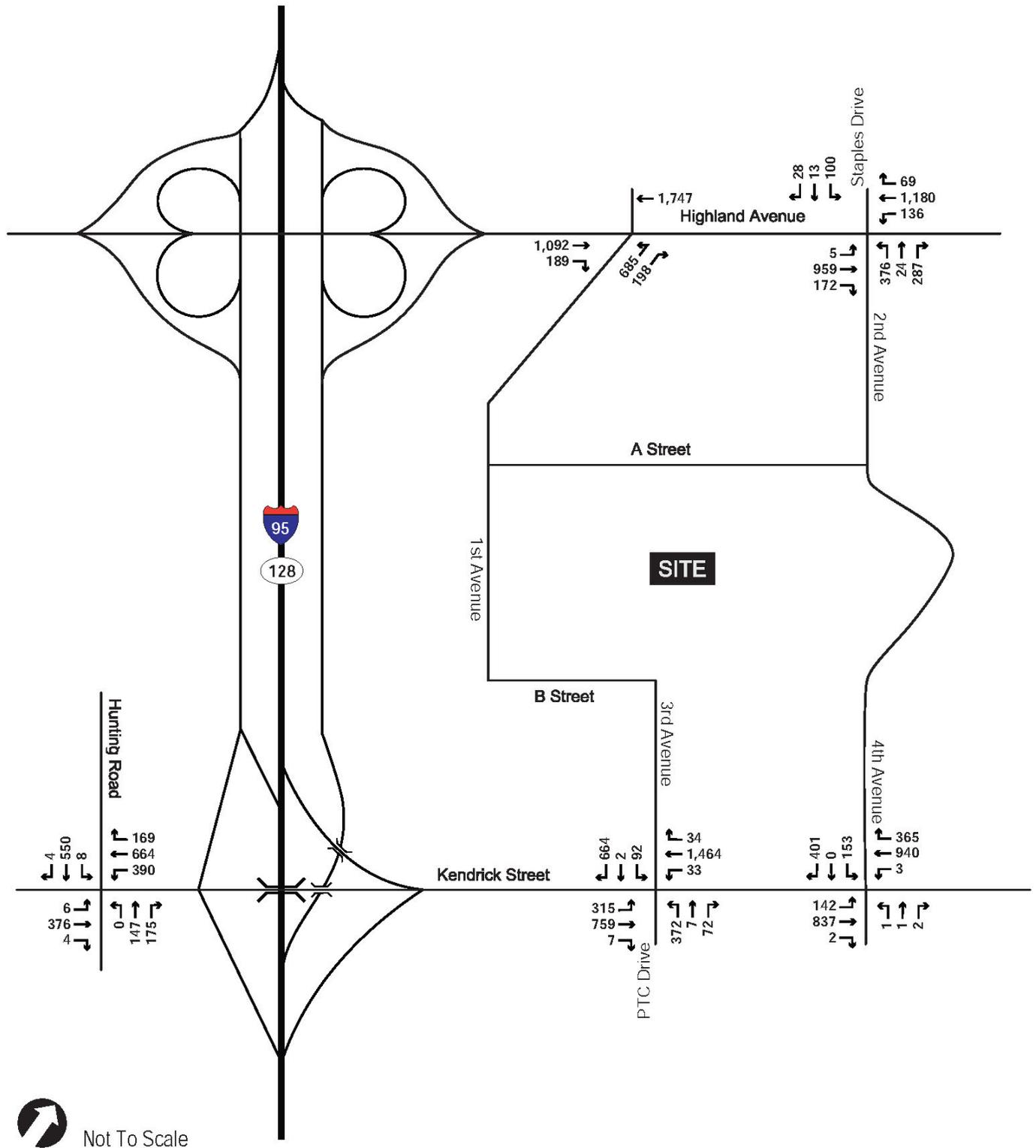
The exception is the Highland Avenue westbound through movements at 2nd Avenue which drop to LOS E/F operations during the afternoon and Saturday midday peak hours due to the conversion of the existing through/left-turn lane to a left only turn lane. The proposed signal at Highland Avenue/1st Avenue will operate at overall LOS D or better operations during peak hours. The queues on the eastbound approach to 1st Avenue will extend to and past the Route 128 northbound off-ramp. This condition was also noted in Functional Design Report prepared for the Highland Avenue/ 1st Avenue Project.

Due to significant traffic volume growth from the introduction of the nearby planned interchange with I-95 and planned development projects in the area, operations at the Kendrick Street/3rd Avenue intersection drop to overall LOS F operations during the

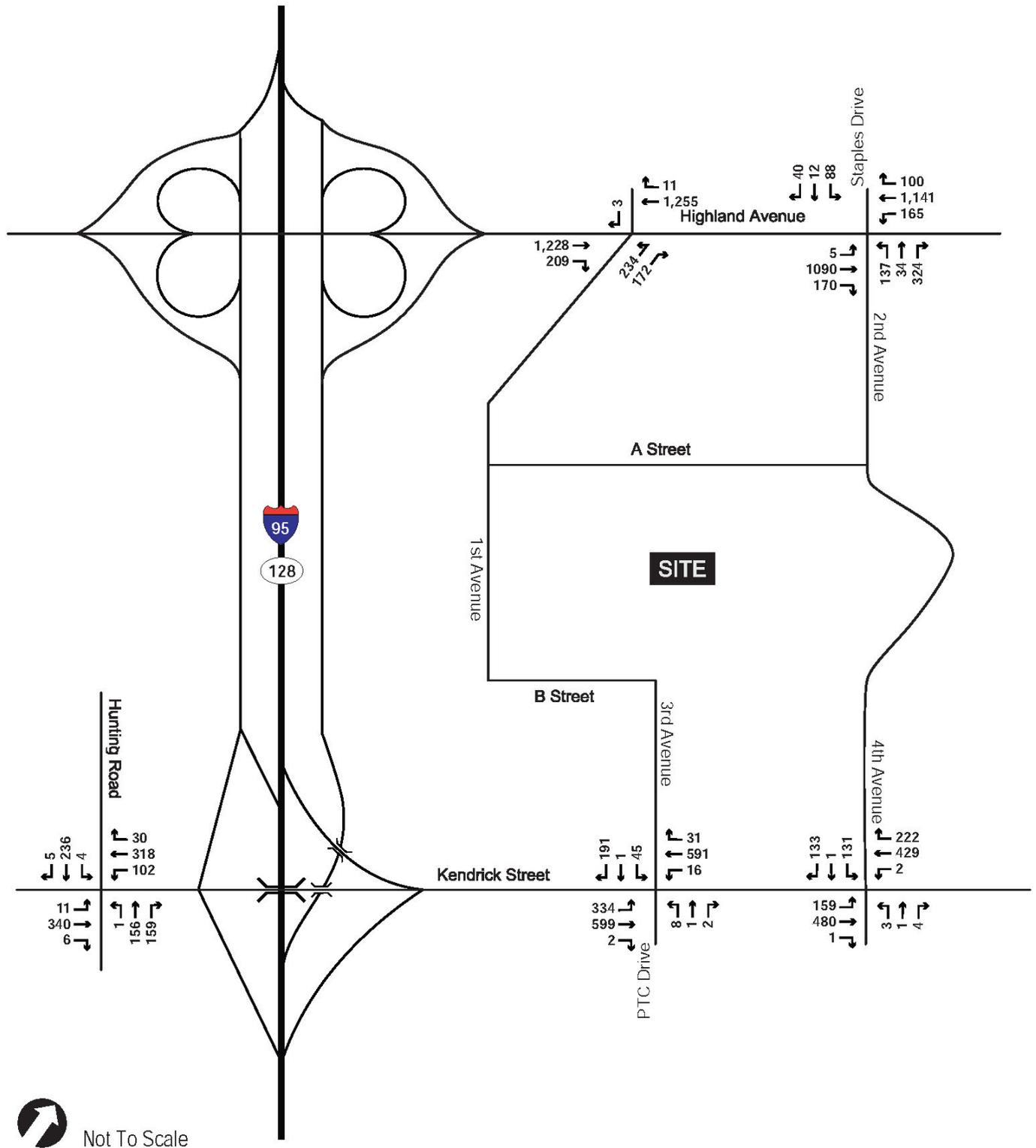


Not To Scale

Center 128 Needham, Massachusetts



Center 128 Needham, Massachusetts



Center 128 Needham, Massachusetts

weekday peak hours. 95th percentile queues in the Kendrick Street eastbound through lanes are expected to extend through the proposed interchange ramp during the morning peak hour. During the afternoon commuting period, the Kendrick Street westbound through lane 95th percentile queue will extend through the intersection with 4th Avenue. The Kendrick Street/3rd Avenue intersection will operate at overall LOS C operations during the Saturday midday peak hour,

Planned traffic signal coordination with the proposed I-95 interchange ramps along Kendrick Street, generally results in similar or improved overall operations at the Kendrick Street/Hunting Road intersection during the peak hours.

The Kendrick Street/4th Avenue unsignalized intersection will continue to operate at poor levels of service during peak periods, primarily due to the turns from 4th Avenue.

2022 No-Build to 2022 Build. Center 128 generally does not result in changes in overall level of service at the signalized study area intersections during the peak hours. Specific Center 128 related impacts to study area intersections during the morning, afternoon and Saturday midday peak hours include:

- ◆ **Highland Avenue/1st Avenue.** The overall level of service at the Highland Avenue/1st Avenue intersection will drop to LOS C during the morning peak hour and LOS E during the afternoon peak hour. The 1st Avenue left turn lane will operate at LOS E during the morning peak hour and the 95th percentile queue will increase by approximately 100 feet. In the afternoon peak hour, the 95th percentile queue in the 1st Avenue left-turn lane will increase by 310 feet.

In the morning, the 95th percentile queue length will increase by approximately 140 feet in the Highland Avenue eastbound right turn lane. On Saturdays, the 95th percentile queue in the Highland Avenue eastbound through lane will increase by approximately 120 feet during the midday peak hour.

- ◆ **Highland Avenue/2nd Avenue.** No change in overall peak hour level of service is anticipated at this intersection as a result of Center 128. Average and 95th percentile queue increases due to projects are generally expected to be one additional vehicle or less during peak hours. During the afternoon peak hour, queue increases are expected to be longer, particularly along the westbound through/right-turn lane which is expected to experience an increase of approximately 300 feet.

Kendrick Street/3rd Avenue. Center 128 traffic will add to the poor operating conditions expected by 2022 at the Kendrick Street/3rd Avenue intersection as a result of the new Kendrick Street interchange. Additionally, the average vehicle queue in the 3rd Avenue right turn lane is expected to increase by approximately 400 feet during the afternoon peak hour. The average and 95th percentile queues

along the Kendrick Street eastbound left turn lane are expected to increase by approximately 400 feet during the morning peak hour and 200 feet during the afternoon peak hour.

- ◆ **Kendrick Street/Hunting Road.** No change in overall levels of service are expected at the Kendrick Street/Hunting Street intersection during peak hours as a result of Center 128.
- ◆ **Kendrick Street/4th Avenue.** Center 128 will increase future weekday peak hour volumes by approximately two percent and will increase future Saturday midday peak hour volumes by approximately five percent. These minor increases will add to the poor peak hour operating conditions that occur under Existing and 2022 No-Build conditions.

2.3.6 *Future Intersection Operation Conditions with Optimal Signal Timings*

Traffic operations at the Kendrick Street signalized intersections were reanalyzed assuming optimal signal timings using the Synchro 8.0 optimization module. As the signal timings utilized for the Build condition analyses were obtained from recently prepared signal timing/phasing plans, as described above in Section 2.3.1, optimization did not significantly improve operations and in some cases provided worse operations. The results of the Build and Build with Optimal Timing analyses are summarized in Tables 2-15, 2-16 and 2-17. The analyses are provided in Attachment 2.H.

Table 2-15 Morning Peak Hour Capacity Analyses Summary – Signalized Locations

	2015 Existing					2022 No-Build					2022 Build					2022 Build (with optimal timings)				
	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵
Highland Ave./1st Ave.																				
Highland Ave. EB T						0.75	21	C	279	#778	0.79	23	C	308	#790					
Highland Ave. EB R						0.59	5	A	0	270	0.74	8	A	0	#412					
Highland Ave. WB TR						0.49	13	B	90	#356	0.55	14	B	90	#443					
1st Ave. L						0.83	51	D	213	309	0.89	56	E	250	#406				Not Applicable	
1st Ave. R						0.03	31	C	0	14	0.04	29	C	0	17					
Driveway LTR						-	-	-	-	-	-	-	-	-	-					
Overall						0.73	18	B			0.77	20	C							
Highland Ave./2nd Ave.																				
Highland Ave. EB L	--	--	--	--	--	0.04	5	A	5	m0	0.04	5	A	4	m0					
Highland Ave. EB LTR	0.76	22	C	245	324	--	--	--	--	--	--	--	--	--	--					
Highland Ave. EB TR	--	--	--	--	--	0.86	20	B	406	#526	0.94	28	C	~421	#538					
Highland Ave. WB L	--	--	--	--	--	0.73	31	C	129	#319	0.79	35	C	169	#398					
Highland Ave. WB LTR	1.01	27	C	165	#285	--	--	--	--	--	--	--	--	--	--					
Highland Ave. WB TR	--	--	--	--	--	0.61	14	B	231	444	0.62	15	B	245	444				Not Applicable	
2nd Ave. L	0.83	43	D	178	#300	0.55	44	D	77	123	0.64	47	D	96	149					
2nd Ave. LTR	0.66	31	C	144	223	--	--	--	--	--	--	--	--	--	--					
2nd Ave. LT	--	--	--	--	--	0.56	45	D	78	124	0.64	47	D	96	150					
2nd Ave. R	--	--	--	--	--	0.14	25	C	13	49	0.17	23	C	21	60					
Driveway LT	0.42	38	D	19	38	0.66	66	E	33	#81	0.66	66	E	33	#81					
Driveway R	0.00	36	D	0	0	0.00	48	D	0	0	0.00	48	D	0	0					
Overall	0.84	28	C			0.76	23	C			0.83	28	C							
Kendrick St./3rd Ave.																				
Kendrick St. EB L	*	**	F	~213	#454	0.86	35	C	423	#916	1.18	**	F	~820	#1335	1.12	100	F	~785	#1308
Kendrick St. EB T	1.00	48	D	401	#773	*	**	F	~1037	#1350	*	**	F	~1046	#1351	*	**	F	~1050	#1332
Kendrick St. EB R	0.18	10	A	0	40	0.32	16	B	49	30	0.33	16	B	48	31	0.33	10	B	18	30
Kendrick St. WB L	0.59	43	D	53	118	0.57	54	D	108	#283	0.57	54	D	108	#283	0.57	54	D	108	#283
Kendrick St. WB TR	0.39	19	B	101	186	*	**	F	~324	#449	*	**	F	~367	#495	*	**	F	~404	#532
Driveway L	0.09	27	C	8	22	0.23	59	E	16	47	0.23	59	E	16	47	0.23	59	E	16	47
Driveway TR	0.02	27	C	1	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Driveway LTR	--	--	--	--	--	0.06	59	E	3	31	0.06	59	E	3	31	0.06	59	E	3	31
3rd Ave. LT	*	**	F	~127	#320	0.65	59	E	111	#263	0.64	58	E	114	#274	0.64	58	E	114	#274
3rd Ave. R	0.02	27	C	0	1	0.03	11	B	0	0	0.07	11	B	0	30	0.07	10	A	0	28
Overall	1.01	69	E			1.01	**	F			1.09	**	F			1.10	**	F		
Kendrick St./Hunting Rd.																				
Kendrick St EB LTR	0.77	40	D	234	#445	0.67	34	C	287	#558	0.72	35	D	313	#611	0.73	36	D	303	466
Kendrick St. WB L	0.53	39	D	58	127	0.44	21	C	31	m85	0.49	25	C	37	m90	0.51	32	C	45	m92
Kendrick St. WB TR	0.52	25	C	183	344	0.46	9	A	56	m352	0.48	10	B	50	m354	0.48	12	B	91	m297
Hunting Rd. NB LT	1.14	**	F	~290	#638	0.83	63	E	269	351	0.83	63	E	269	351	0.83	62	E	257	#468
Hunting Rd. NB R	0.49	1	A	0	0	0.64	2	A	0	0	0.65	2	A	0	0	0.65	2	A	0	0
Hunting Rd. SB L	0.96	73	E	238	#606	0.73	56	E	125	#247	0.73	56	E	125	#247	0.70	53	D	129	#305
Hunting Rd. SB TR	0.16	20	B	48	123	0.13	29	C	43	81	0.13	29	C	43	81	0.12	29	C	44	93
Overall	0.91	44	D			0.81	23	C			0.83	24	C			0.83	25	C		

¹Delay = Average delay per vehicle (seconds) ²v/c = Volume to capacity ratio ³LOS = Level of Service ⁴50th percentile queue (feet) ⁵95th percentile queue (feet)
 *v/c exceeds 1.2, **delay exceeds 120 seconds
 ~ the approach is above capacity; 50th percentile queue could be longer # volume for the 95th percentile queue exceeds capacity, m metered by upstream signal

Table 2-16 Afternoon Peak Hour Capacity Analyses Summary – Signalized Locations

	2015 Existing					2022 No-Build					2022 Build					2022 Build (with optimal timings)						
	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵		
Highland Ave./1st Ave.																						
Highland Ave. EB T						0.60	21	C	254	540	0.62	21	C	271	574							
Highland Ave. EB R						0.09	2	A	0	28	0.15	2	A	0	43							
Highland Ave. WB TR						0.98	34	C	491	m#1004	0.99	36	D	508	m#1020							
1st Ave. L						1.19	**	F	~585	#813	1.54	**	F	~881	#1123							Not Applicable
1st Ave. R						0.25	37	D	50	118	0.34	38	D	78	154							
Driveway LTR						-	-	-	-	-	-	-	-	-	-							
Overall						1.00	47	D			1.12	77	E									
Highland Ave./2nd Ave.																						
Highland Ave. EB L	--	--	--	--	--	0.09	8	A	1	m1	0.09	9	A	1	m1							
Highland Ave. EB LTR	0.71	23	C	211	275	--	--	--	--	--	--	--	--	--	--							
Highland Ave. EB TR	--	--	--	--	--	0.61	10	A	344	68	0.65	12	B	383	86							
Highland Ave. WB L	--	--	--	--	--	0.40	13	B	33	59	0.58	17	B	44	#85							
Highland Ave. WB LTR	0.93	35	D	191	#315	--	--	--	--	--	--	--	--	--	--							
Highland Ave. WB TR	--	--	--	--	--	1.18	115	F	~1335	#1640	1.19	120	F	~1352	#1640							Not Applicable
2nd Ave. L	1.12	114	F	~321	#514	0.83	73	E	175	#266	0.85	75	E	186	#302							
2nd Ave. LTR	0.96	64	E	255	#461	--	--	--	--	--	--	--	--	--	--							
2nd Ave. LT	--	--	--	--	--	0.83	73	E	177	266	0.85	75	E	187	#300							
2nd Ave. R	--	--	--	--	--	0.65	51	D	139	238	0.77	58	E	172	#288							
Driveway LT	0.96	102	F	79	#134	*	**	F	~137	#266	*	**	F	~137	#266							
Driveway R	0.01	37	D	0	0	0.02	59	E	0	0	0.02	59	E	0	0							
Overall	0.99	51	D			1.13	72	E			1.14	73	E									
Kendrick St./3rd Ave.																						
Kendrick St. EB L	0.21	50	D	14	46	0.88	65	E	188	#401	*	**	F	~397	#574	*	**	F	~424	#621		
Kendrick St. EB T	0.40	20	C	124	271	0.59	32	C	293	387	0.67	38	D	324	395	0.67	48	D	337	408		
Kendrick St. EB R	0.01	6	A	0	0	0.01	9	A	0	m0	0.01	11	B	0	m0	0.01	11	B	0	m0		
Kendrick St. WB L	0.33	59	E	4	19	0.60	70	E	29	65	0.64	77	E	29	65	0.67	84	F	30	67		
Kendrick St. WB TR	0.96	49	D	438	#800	*	**	F	~981	#1123	*	**	F	~997	#1139	*	**	F	~1031	#1173		
Driveway L	0.78	37	D	172	#319	0.60	44	D	188	#508	0.60	44	D	188	#508	0.61	47	D	200	#490		
Driveway TR	0.08	24	C	7	48	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Driveway LTR	--	--	--	--	--	0.54	43	D	167	#466	0.54	43	D	167	#466	0.55	45	D	177	#446		
3rd Ave. LT	0.89	85	F	100	#252	0.47	55	E	60	113	0.42	51	D	73	#163	0.38	51	D	74	#171		
3rd Ave. R	0.18	37	D	4	52	0.40	35	D	46	174	0.87	56	E	264	#580	0.89	59	E	296	#642		
Overall	0.84	41	D			1.01	**	F			1.19	**	F			1.20	**	F				
Kendrick St./Hunting Rd.																						
Kendrick St EB LTR	0.84	60	E	104	173	0.58	45	D	127	207	0.60	44	D	135	218	0.61	47	D	143	227		
Kendrick St. WB L	1.10	86	F	~502	#1068	0.59	19	B	43	m197	0.64	23	C	79	m208	0.65	15	B	65	m132		
Kendrick St. WB TR	1.05	67	E	618	#1306	0.85	16	B	64	m587	0.90	22	C	633	m625	0.91	15	B	151	m666		
Hunting Rd. NB LT	0.58	43	D	87	179	0.33	39	D	103	192	0.33	39	D	103	192	0.32	39	D	106	198		
Hunting Rd. NB R	0.14	0	A	0	0	0.11	0	A	0	0	0.12	0	A	0	0	0.12	0	A	0	0		
Hunting Rd. SB L	0.55	36	D	104	193	0.03	34	C	5	19	0.03	34	C	5	19	0.03	34	C	5	20		
Hunting Rd. SB TR	0.66	35	D	206	350	1.02	86	F	~568	#795	1.02	86	F	~568	#795	0.98	76	E	~570	#799		
Overall	1.02	60	E			0.98	37	D			1.01	39	D			1.00	34	C				

¹Delay = Average delay per vehicle (seconds) ²v/c = Volume to capacity ratio ³LOS = Level of Service ⁴50th percentile queue (feet) ⁵95th percentile queue (feet)
 *v/c exceeds 1.2, **delay exceeds 120 seconds
 ~ the approach is above capacity; 50th percentile queue could be longer # volume for the 95th percentile queue exceeds capacity, m metered by upstream signal

Table 2-17 Saturday Midday Peak Hour Capacity Analyses Summary – Signalized Locations

	2015 Existing					2022 No-Build					2022 Build					2022 Build (with optimal timings)					
	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	
Highland Ave./1st Ave.																					
Highland Ave. EB T						0.51	8	A	162	347	0.57	12	B	227	468						
Highland Ave. EB R						0.08	1	A	0	9	0.17	2	A	0	15						
Highland Ave. WB TR						0.53	7	A	217	m139	0.59	8	A	185	m151						
1st Ave. L						0.74	65	E	134	202	0.80	63	E	208	279				Not Applicable		
1st Ave. R						0.11	50	D	0	64	0.12	44	D	0	59						
Driveway LTR						0.00	64	E	0	0	0.00	64	E	0	0						
Overall						0.56	13	B			0.63	15	B								
Highland Ave./2nd Ave.																					
Highland Ave. EB L	--	--	--	--	--	0.09	13	B	2	m2	0.09	12	B	2	m3						
Highland Ave. EB LTR	0.71	20	C	223	330	--	--	--	--	--	--	--	--	--	--						
Highland Ave. EB TR	--	--	--	--	--	0.72	21	C	421	228	0.75	19	B	451	198						
Highland Ave. WB L	--	--	--	--	--	0.39	14	B	29	#73	0.56	18	B	42	#154						
Highland Ave. WB LTR	0.92	30	C	165	#358	--	--	--	--	--	--	--	--	--	--						
Highland Ave. WB TR	--	--	--	--	--	1.10	78	E	~1127	#1631	1.11	82	F	~1218	#1631				Not Applicable		
2nd Ave. L	0.76	42	D	126	205	0.44	56	E	63	105	0.53	57	E	80	129						
2nd Ave. LTR	0.36	31	C	46	112	--	--	--	--	--	--	--	--	--	--						
2nd Ave. LT	--	--	--	--	--	0.44	56	E	64	106	0.53	57	E	82	130						
2nd Ave. R	--	--	--	--	--	0.76	55	D	184	296	0.83	62	E	208	327						
Driveway LT	0.72	51	D	56	#119	1.06	167	F	~100	#223	1.06	**	F	~100	#223						
Driveway R	0.02	36	D	0	0	0.03	58	E	0	0	0.03	58	E	0	0						
Overall	0.86	28	C			1.05	53	D			1.07	54	D								
Kendrick St./3rd Ave.																					
Kendrick St. EB L	0.14	24	C	3	21	0.68	37	D	125	#300	0.63	25	C	191	#508	0.63	24	C	194	#505	
Kendrick St. EB T	0.28	9	A	24	111	0.33	10	B	22	277	0.35	11	B	24	#288	0.35	13	B	35	#288	
Kendrick St. EB R	0.00	5	A	0	0	0.00	9	A	0	m0	0.00	10	A	0	m0	0.00	10	A	0	m0	
Kendrick St. WB L	0.13	27	C	1	8	0.36	49	D	10	32	0.36	49	D	10	32	0.36	49	D	10	32	
Kendrick St. WB TR	0.42	11	B	63	124	0.51	26	C	120	#361	1.02	80	E	167	#386	1.01	79	E	164	#411	
Driveway L	0.05	16	B	2	8	0.12	48	D	4	17	0.12	48	D	4	17	0.12	48	D	4	17	
Driveway TR	0.01	16	B	1	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Driveway LTR	--	--	--	--	--	0.09	48	D	2	15	0.09	48	D	2	15	0.09	48	D	2	15	
3rd Ave. LT	0.49	23	C	17	46	0.24	44	D	20	51	0.28	42	D	30	67	0.28	42	D	30	67	
3rd Ave. R	0.03	14	B	0	3	0.05	22	C	0	7	0.12	13	B	0	52	0.12	13	B	0	51	
Overall	0.42	12	B			0.48	22	C			0.62	39	D			0.62	39	D			
Kendrick St./Hunting Rd.																					
Kendrick St EB LTR	0.47	20	B	37	70	0.22	16	B	48	146	0.25	17	B	54	162	0.25	17	B	54	162	
Kendrick St. WB L	0.38	11	B	43	77	0.16	3	A	2	10	0.18	5	A	5	m24	0.18	3	A	4	m24	
Kendrick St. WB TR	0.52	12	B	88	142	0.32	4	A	6	324	0.35	6	A	15	345	0.35	4	A	15	346	
Hunting Rd. NB LT	0.33	18	B	36	81	0.53	39	D	99	165	0.53	39	D	99	165	0.53	39	D	99	165	
Hunting Rd. NB R	0.10	0	A	0	0	0.10	0	A	0	0	0.10	0	A	0	0	0.10	0	A	0	0	
Hunting Rd. SB L	0.18	10	B	18	43	0.02	33	C	2	10	0.02	33	C	2	10	0.02	33	C	2	10	
Hunting Rd. SB TR	0.21	11	B	29	62	0.58	35	D	159	209	0.58	35	D	159	209	0.58	35	D	159	209	
Overall	0.55	12	B			0.44	17	B			0.46	17	B			0.46	17	B			

¹Delay = Average delay per vehicle (seconds) ²v/c = Volume to capacity ratio ³LOS = Level of Service ⁴50th percentile queue (feet) ⁵95th percentile queue (feet)
 *v/c exceeds 1.2, **delay exceeds 120 seconds
 ~ the approach is above capacity; 50th percentile queue could be longer # volume for the 95th percentile queue exceeds capacity, m metered by upstream signal

Table 2-18 Unsignalized Intersection Capacity Analyses Summary

Location	Existing					No-Build					Build				
	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵
Morning Peak Hour															
Kendrick St./1st Ave.															
1st Ave. R	0.19	16	C		18	Intersection is Signalized									
Kendrick St./4th Ave															
Kendrick St. EB LT	0.33	9	A		36	0.78	27	D		185	0.80	30	D		199
Kendrick St. WB LT	0.00	0	A		0	0.00	0	A		0	0.00	0	A		0
Driveway LT/TH/RT	0.75	**	F		47	*	**	F		***	*	**	F		***
4th Ave. LT/TH	*	**	F		***	*	**	F		***	*	**	F		***
4th Ave. R	0.20	19	C		18	0.64	39	E		101	0.75	50	F		135
Afternoon Peak Hour															
Kendrick St./1st Ave.															
1st Ave. RT	0.23	14	B		21	Intersection is Signalized									
Kendrick St./4th Ave															
Kendrick St. EB LT	0.14	4	A		13	0.29	9	A		30	0.34	10	B		37
Kendrick St. WB LT	0.00	0	A		0	0.00	0	A		0	0.00	0	A		0
Driveway LT/TH/RT	*	**	F		***	*	**	F		***	*	**	F		***
4th Ave. LT/TH	*	**	F		***	*	**	F		***	*	**	F		***
4th Ave. R	*	**	F		301	*	**	F		895	*	**	F		930
Saturday Midday Peak Hour															
Kendrick St. /1st Ave.															
1st Ave. R	0.26	15	B		25	Intersection is Signalized									
Kendrick St./4th Ave															
Kendrick St. EB LT	0.08	3	A		7	0.17	5	A		15	0.19	5	A		18
Kendrick St. WB LT	0.00	0	A		0	0.00	0	A		0	0.00	0	A		0
Driveway LT/TH/RT	0.12	29	D		10	0.07	36	E		6	0.08	43	E		7
4th Ave. LT/TH	0.99	**	F		186	0.86	96	F		148	1.02	**	F		188
4th Ave. R	0.12	16	C		11	0.28	16	C		28	0.32	17	C		34

¹Delay = Average delay per vehicle (seconds) ²v/c = Volume to capacity ratio ³LOS = Level of Service
⁴50th percentile queue (feet) ⁵95th percentile queue (feet)
 *v/c exceeds 1.2, **delay exceeds 120 seconds
 ~ the approach is above capacity; 50th percentile queue could be longer # volume for the 95th percentile queue exceeds capacity

2.3.7 Route 128/I-95 Highland Avenue Interchange

MassDOT requested in its scoping document for the DSEIR that the Center 128’s impact to the weaving maneuvers within the Route 128/Highland Avenue interchange be performed. As MassDOT recently awarded the Route 128 Add-A-Lane construction contract which includes improvements to the Route 128/Highland Avenue interchange, weaving analyses were conducted only for the interchange with the proposed improvements.

A review of Figures 2-20 to 2-26 (Project Distributions) indicates that development generated traffic will impact two weaving maneuvers within the interchange. These include:

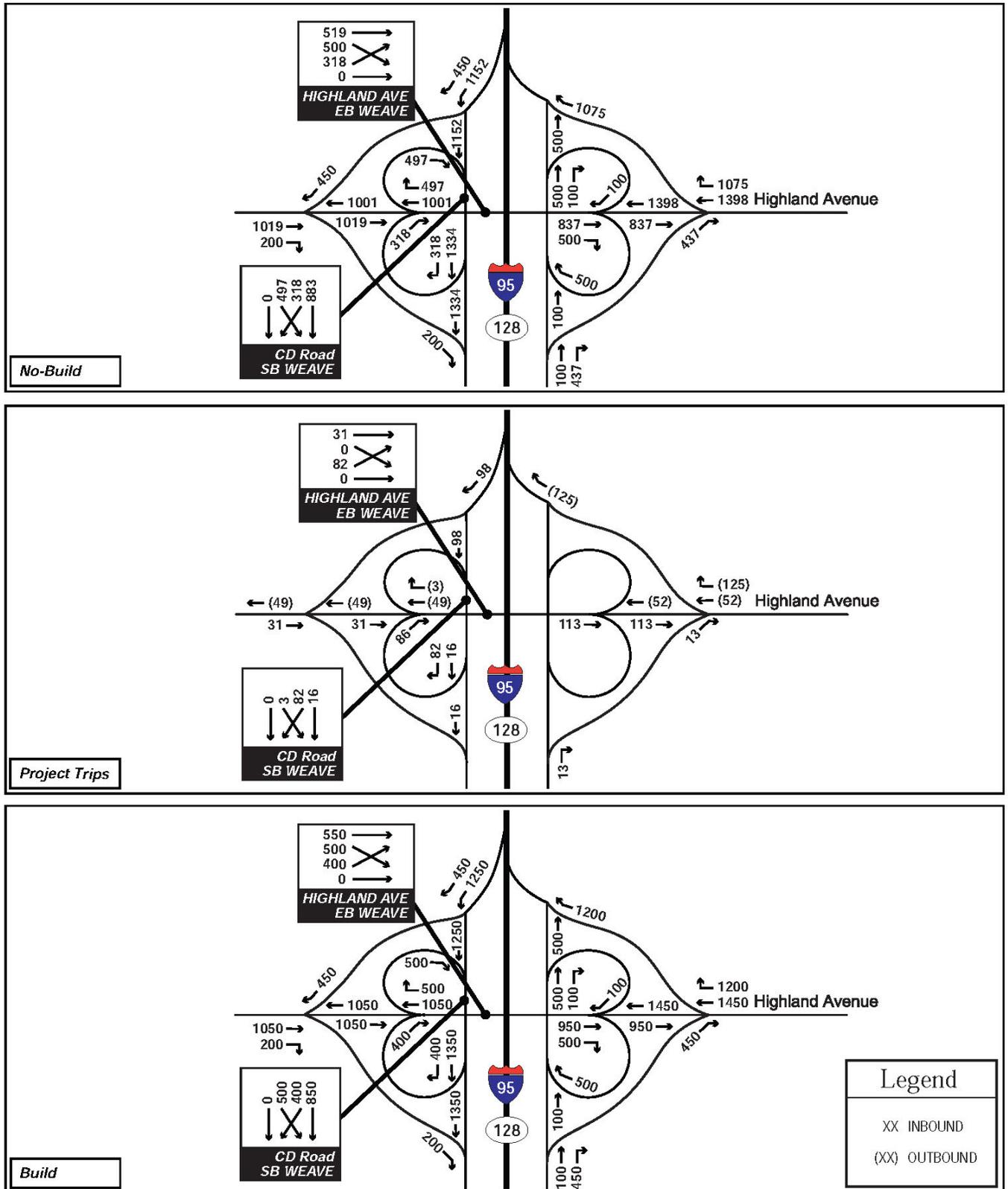
- ◆ the weave on the southbound collector-distributor (CD) road which occurs between the two loop ramps, and
- ◆ the weave on Highland Avenue eastbound which occurs between the two loop ramps.

The Route 128 Add-A-Lane design documents (provided in Attachment 2.E) indicate that the southbound CD road at Highland Avenue will consist of a single lane, widening to accommodate two lanes between the on and off loop ramps. Highland Avenue, in both directions, is designed with two lanes in each travel direction with a third lane provided between the off and on loop ramps.

To estimate weaving volumes for the analysis, morning and afternoon Build condition peak hour traffic volumes were obtained from the Route 128 Add-A-Lane FDR - Figure 12: 2025 Build Volumes. As discussed above in Section 2.3.1.1., the Build condition volumes reported in the FDR were established assuming full development of Needham Crossing, including Charles River Landing, and Wexford/Charles Industrial District in Needham (approximately 2.5 million sf of development) and are considered as inclusive of traffic generated by the Center 128 development.

To estimate the 2025 No-Build peak hour traffic volumes, the Center 128 trips assigned to the interchange were subtracted from the 2025 Build volumes. Figures 2-33 and 2-34 provide a summary of the 2025 No-Build, Center 128 trips and 2025 Build morning and afternoon peak hour traffic volumes through the Route 128/Highland Avenue interchange.

Weaving analyses were not conducted for the Saturday condition as the Add-A-Lane FDR did not provide estimates for 2025 Saturday peak hour volumes. It is noted that the traffic volumes on Highland Avenue, west of 1st Avenue estimated for the 2022 Build condition are approximately 20 percent lower during the Saturday peak hour than for the weekday afternoon peak hour. Therefore, it is likely that the weaving operations on Saturday would operate at similar or better levels of service than reported for the weekday afternoon peak hour. Capacity analyses results for the weaving analyses for the 2025 No-Build and Build conditions are summarized in Table 2-19. The capacity analyses reports are provided in Attachment 2.I.



Center 128 Needham, Massachusetts

Table 2-19 Weaving Analyses Summary

	Morning Peak Hour				Afternoon Peak Hour			
	No-Build		Build		No-Build		Build	
Location/Direction	Density ¹	LOS ²						
Highland Avenue (EB)								
From Route 128 SB On-Ramp to Route 128 NB Off-Ramp	21	B	23	B	12	A	13	B
Collector-Distributor Road (SB)								
From Highland Ave WB On-Ramp to Highland Ave EB Off-Ramp	28	C	32	C	22	B	23	B

¹ Density = Passenger cars per mile per lane, ² LOS = Level of Service

2.4 Site Driveways

The eleven site driveways which will provide access to/from the site were evaluated with respect to intersection capacity and safety. The driveways are shown on Figure 2-3.

2.4.1 Site Driveway Descriptions

The eleven driveways which will provide access to the three major components of Center 128 are briefly described below. It is noted that due to internal connections between Center 128 West, Center 128 East and the 2nd Avenue Residences and shared parking between Center 128 West and Center 128 East, each of these driveways could be used by vehicles entering/exiting any of the three site components.

2.4.1.1 Center 128 West Site Driveways

1. 1st Avenue Driveway. The driveway located on 1st Avenue has been constructed and was opened in July 2015. It provides a single lane in each direction, parking on both sides and is under STOP sign control. A crosswalk is located on the driveway.

2. A Street West Drive. The westerly Center 128 driveway on A Street is located approximately 350 feet east of 1st Avenue. It has been constructed and was opened in July 2015. The two lane driveway is unsignalized.

3. A Street East Drive. Located approximately 200 feet from the West driveway, the easterly Center 128 driveway on A Street is presently under construction. The two lane driveway will be unsignalized. Perpendicular parking spaces will be located along both sides of this driveway. A crosswalk will be provided on the driveway's approach to A Street.

4. B Street West Drive. The westerly Center 128 driveway on B Street is located approximately 180 feet east of B Street. It is constructed and was opened in July 2015. It provides a single lane in each direction. A crosswalk is located on the driveway's approach to B Street.

5. B Street Marriott (West) Drive. The center driveway on B Street has been built and crosses under the existing hotel. It consists of a single 22 foot wide lane which provides access to the drop off area in front of the hotel. A crosswalk is located on the driveway's approach to B Street.

6. B Street Marriott (East) Drive. The easterly driveway on B Street has been built and consists of two lanes. It currently provides access to the surface parking area located behind the hotel. When the site is fully developed it will provide access to/from Garage A. A crosswalk is located on the driveway's approach to B Street.

2.4.1.2 Center 128 East Site Driveways

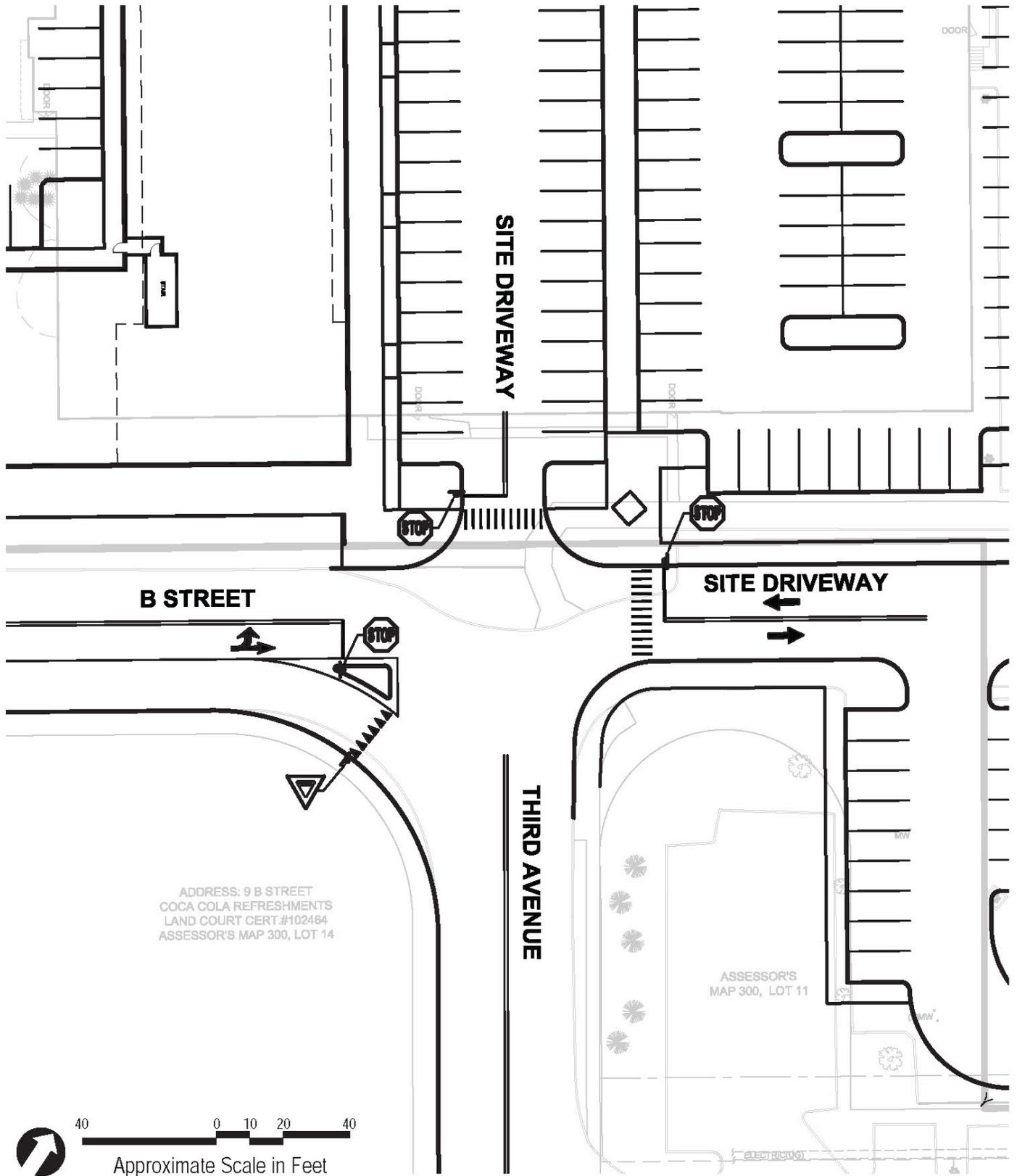
7. A Street West Drive. The Center 128 East westerly driveway on A Street is located in the same position as the existing General Dynamics driveway. It will consist of a travel lane in each direction with parking provided along both sides. A crosswalk is located on the driveway's approach to A Street.

8. A Street East Drive. The Center 128 East easterly driveway on A Street is located approximately 300 feet west of 2nd Avenue. The unsignalized driveway will consist of a travel lane in each direction with parking located on both sides. A crosswalk is located on the driveway's approach to A Street.

9. and 10. B Street/3rd Avenue North Drive and East Drive. Currently, 3rd Avenue curves around onto B Street with an existing site driveway intersecting the north side of the curve. With Center 128, the intersection will be reconfigured to a four-legged intersection with the site driveways forming the north and east legs of the intersection.

A conceptual design plan of the 3rd Avenue/B Street intersection is shown on Figure 2-35. As shown on the figure, the B Street approach would be marked with a left/through lane under STOP sign control and a channelized right turn lane under YIELD sign control. Both site driveways would be comprised of a single approach lane under Stop sign control. The 3rd Avenue approach would be designed with a shared left/through/right turn lane. This concept maintains the existing free flow condition for northbound 3rd Avenue approach.

11. 2nd Avenue Extension. South of A Street, the 2nd Avenue right-of-way includes a stub which extends approximately 250 feet towards the southwest ending at the Center 128 site. For purposes of this report, this segment of 2nd Avenue will be called 2nd Avenue Extension. Site access will be provided by a continuation of the 2nd Avenue Extension. The existing intersection of 2nd Avenue/2nd Avenue Extension is under local jurisdiction.



Center 128 Needham, Massachusetts

2.4.1.3 2nd Avenue Residences Site Access

Access to/from the 2nd Avenue Residences will be via the driveways described above for Center 128 West and Center 128 East. It is assumed that the Center 128 East easterly driveway on A Street and the continuation of the 2nd Avenue Extension will be the primary driveways for the 2nd Avenue Residences.

2.4.2 Safety Analysis

Stopping sight distance and intersection sight distance analyses were conducted at the Center 128's driveways in accordance with the methodology contained in A Policy on Geometric Design of Highways and Streets, 6th Edition, 2011, American Association of State and Highway Transportation Officials (AASHTO).

As the sight lines at the sight driveway were generally measured either before actual construction of the driveway or shortly after installation and prior to full development of recently installed trees and shrubs, it is assumed that all landscaping is designed and maintained so not to obstruct sight lines.

Travel speed measurements were taken in the vicinity of each site driveway. The data, provided in Attachment 2.B, was obtained for a three day period beginning Thursday, June 4, 2015. The speed data is necessary to determine if the measured sight lines are adequate.

2.4.2.1 Methodology and Description

Stopping Sight Distance (SSD)

Stopping sight distance (SSD) is the length of roadway ahead which is visible to the driver. The minimum sight distance available on a roadway should be sufficiently long enough to enable a vehicle to stop before reaching a stationary object in its path. SSD includes the length of roadway traveled during the perception and reaction time of a driver to an object in a road, and the distance traveled during braking. Stopping sight distance criteria are defined by AASHTO based on design speeds, anticipated driver behavior and vehicle performance, as well as physical roadway conditions.

Per AASHTO guidelines, the stopping sight lines are measured with an eye height 3.5 feet above the road surface. The distance at which a 2-foot tall object located in the road is visible is measured for each approach to the study location.

The stopping sight distance recommendation for the major road approach to the intersection is based on the measured 85th percentile travel speed and approach grade.

Intersection Sight Distance (ISD)

Intersection sight distance (ISD) is the length of roadway which is visible to a driver stopped on a minor road (or driveway) approach to an intersection. More specifically, AASHTO indicates that intersection sight distance should be long enough for drivers exiting a driveway to accelerate from a stop and complete the required maneuver without unduly interfering with traffic on the major street.

Per AASHTO guidelines, the intersection sight lines are measured on the minor approach with an eye height 3.5 feet above the road surface and 14.5 feet from the edge of traveled way on the major street. The distance at which a 3.5 foot tall vehicle is visible is measured.

The intersection sight distance for a left turn maneuver is based on the 85th percentile travel speeds on the major street and the approach grade on the minor street. The desirable sight distance exceeds the stopping sight distance. However, AASHTO indicates that “if the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions”. In other words, ISD can be at a minimum equal to SSD.

2.4.2.2 1st Avenue Driveway

In the vicinity of the site driveway, 1st Avenue has a straight alignment and an uphill grade as it approaches the driveway from the south. The 85th percentile travel speed on weekdays is 32 mph in the northbound direction and 34 mph in the southbound direction. For these speeds the desirable stopping sight lines are 240 feet from the north and the 215 feet from the south. The desirable intersection sight line to the north is 375 feet and to the south is 350 feet. The sight lines to/from the north exceed 500 feet and to/from the south are to/from 3rd Avenue or approximately 350 feet. However, on-street parking is allowed along the easterly side of 1st Avenue. Given the ample on-site parking supply, it is not anticipated that these on-street spaces would be used. However, if vehicles were to park on 1st Avenue in the vicinity of the driveway, sight lines would be reduced.

2.4.2.3 A Street Driveways

A Street has a straight and flat alignment with an 85th percentile travel speed on weekdays of 35 mph in both directions. For this speed, the desirable stopping sight line per AASHTO is 250 feet and the recommended intersection sight line is 390 feet. The stopping sight lines exceed 250 feet at all proposed driveways or is from either 1st Avenue or 2nd Avenue. Measured from a point 14.5 feet from the edge of travel way (per AASHTO), intersection sight lines are restricted by existing on-street parking. On-street parking is allowed and presently used on both sides of the entire length of A Street.

Sight lines are improved if a vehicle exiting the site driveway pulls forward onto A Street towards the travel way. It is noted that this condition currently exists on A Street and a review of MassDOT crash data indicates that no crashes have occurred which involved vehicles traveling on A Street and vehicles either entering or exiting from the existing site driveways.

2.4.2.4 B Street Driveways

B Street has a straight and flat alignment with an 85th percentile travel speed on weekdays of 27 mph in both directions. For this speed, the desirable stopping sight line per AASHTO is 170 feet and the recommended intersection sight line is 300 feet. The stopping sight lines exceed 170 feet or are from 3rd Avenue or 1st Avenue. Intersection sight lines exceed 300 feet or are to 3rd Avenue or 1st Avenue.

On-street parking is allowed along the northerly side of B Street from approximately 100 feet east of 1st Avenue to the existing westerly hotel driveway (approximately 325 feet west of 3rd Avenue). Given the ample on-site parking supply, it is not anticipated that these on-street spaces would be used. However, if vehicles were to park on B Street in the vicinity of the driveway, sight lines would be reduced.

2.4.2.5 Conclusion

It is suggested that the Proponent and the Town of Needham discuss the desirability of removing on-street parking in the vicinity of the site driveways to improve safety. At a minimum, a parking restriction of 25 feet on both sides of each driveway is suggested.

2.4.3 Site Driveway Operating Conditions

The Build condition traffic volumes at the site driveway intersections were estimated in order to provide a basis on which to conduct capacity analyses. The data which supports the development of the 2022 Build condition traffic volumes at the site driveways is provided in Attachment 2.J. The 2022 Build weekday morning, weekday afternoon and Saturday midday peak hour volumes include the following:

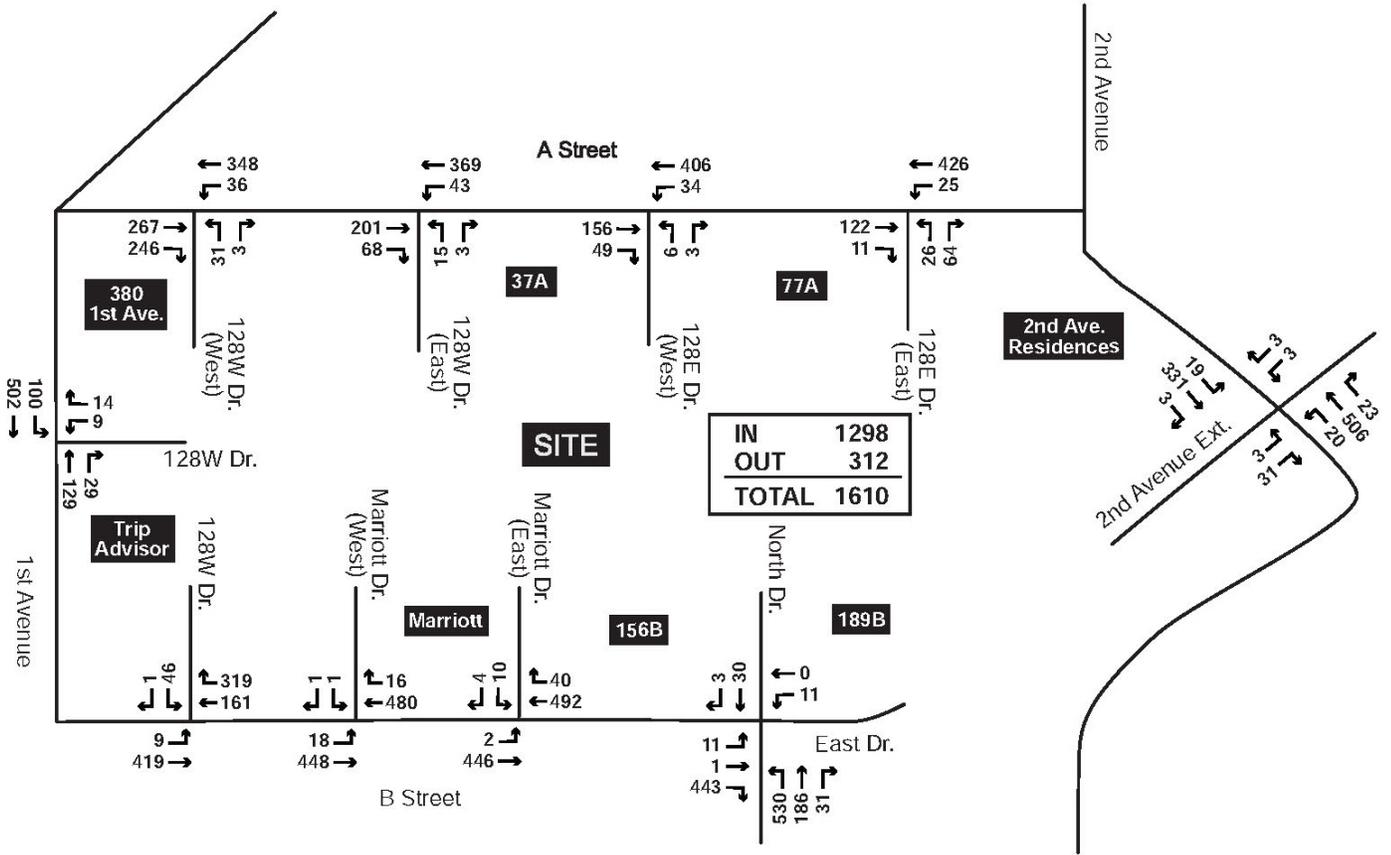
- ◆ Existing traffic volumes based on counts obtained on Thursday, June 4, 2015 and Saturday, June 6, 2015 (provided in Attachment 2.B).
- ◆ Increases associated with background growth in traffic.
- ◆ Traffic generated by off-site development listed in Section 2.3.2.2.
- ◆ Adjustments to account for Add-A-Lane.
- ◆ Adjustments to account for improvements at 1st Avenue.
- ◆ Removal of existing site (General Dynamics and hotel) generated trips.

- ◆ Increases generated by Center 128 including both by-right and new trips.

The weekday morning peak hour, weekday afternoon peak hour and Saturday midday peak hour 2022 Build condition volumes are shown on Figures 2-36, 2-37, and 2-38 respectively.

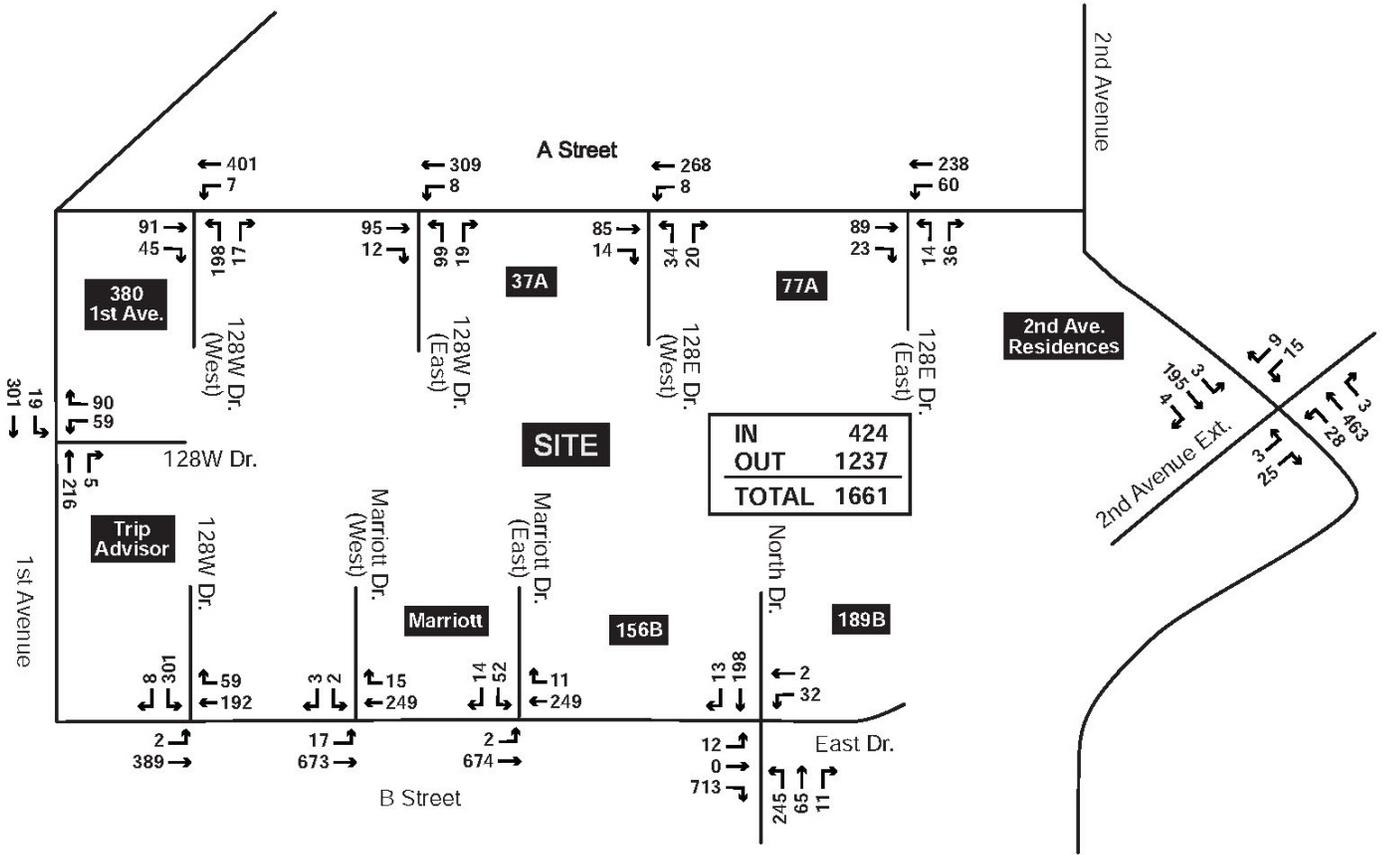
The intersection of B Street/3rd Avenue/North Drive/East Drive could not be analyzed using Synchro software due to the proposed traffic control of the intersection. As such, the intersection was modeled and analyzed using SimTraffic software.

Table 2-20 provides level of service analysis results for the weekday morning peak hour, weekday afternoon peak hour and Saturday midday peak hour 2022 Build condition at the site driveways. The driveway intersection analyses are provided in Attachment 2.J. With full occupancy of the site, the site driveways will operate at LOS D or better for all peak hours with one exception. The left turn movement from the Center 128 West driveway onto B Street during the afternoon peak hour will operate at LOS E conditions.



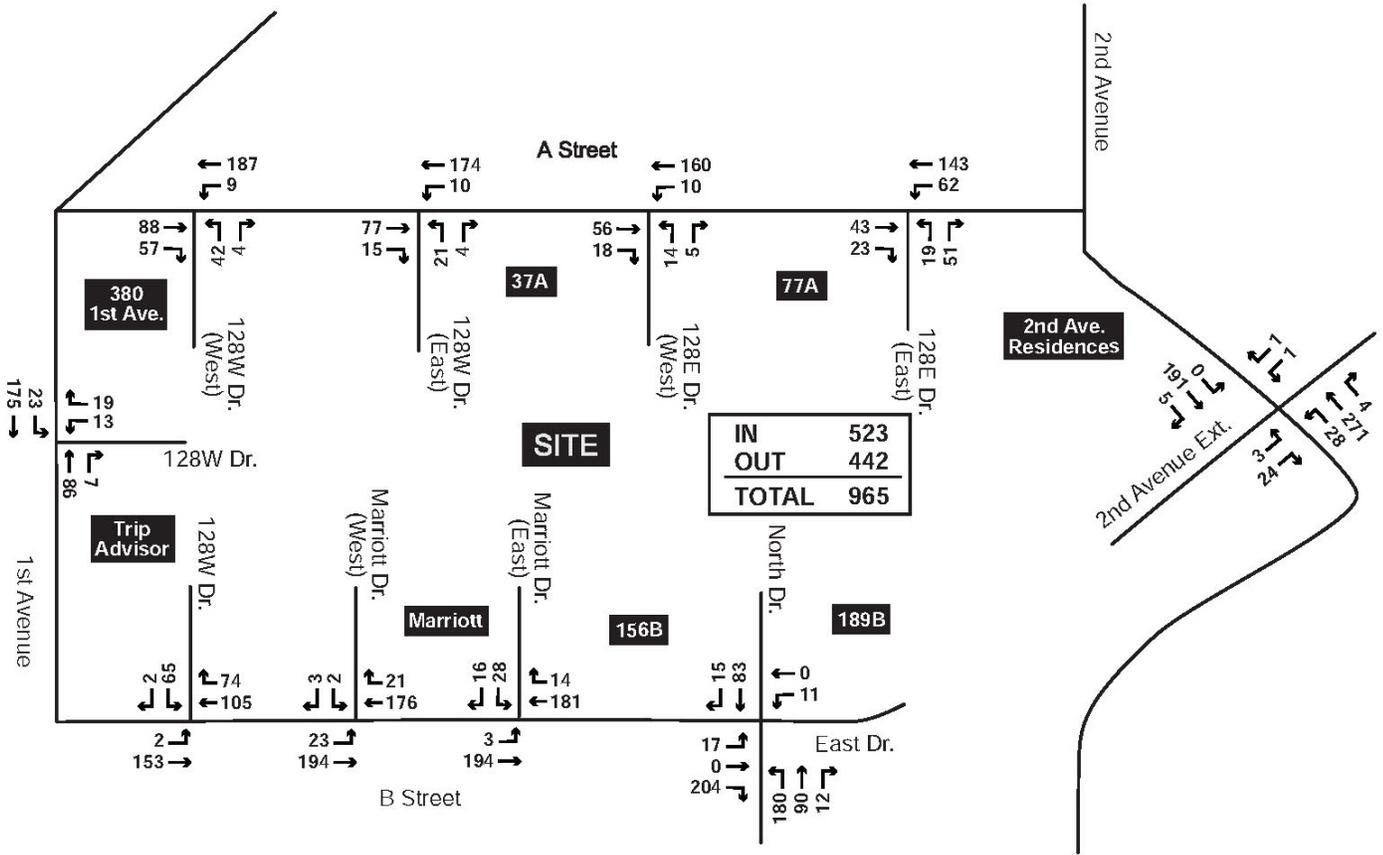
 Not To Scale

Center 128 Needham, Massachusetts



 Not To Scale

Center 128 Needham, Massachusetts



 Not To Scale

Center 128 Needham, Massachusetts

Table 2-20 Site Driveway Capacity Analysis Summary

Location	Morning				Afternoon				Saturday			
	V/C ¹	Delay ²	LOS ³	95th Q ⁴	V/C	Delay	LOS	95th Q	V/C	Delay	LOS	95th Q
128W (West) Dr./A St.												
A Street EB TR	0.33	0	A	0	0.09	0	A	0	0.09	0	A	0
A Street WB LT	0.04	1	A	3	0.01	0	A	0	0.01	1	A	1
Driveway NB LR	0.12	18	C	10	0.47	19	C	62	0.08	11	B	6
128W (East) Dr./A St.												
A Street EB TR	0.17	0	A	0	0.07	0	A	0	0.06	0	A	0
A Street WB LT	0.04	1	A	3	0.01	0	A	0	0.01	1	A	1
Driveway NB LR	0.05	14	B	4	0.22	13	B	20	0.04	10	B	3
128E (West) Dr./A St.												
A Street EB TR	0.13	0	A	0	0.06	0	A	0	0.05	0	A	0
A Street WB LT	0.03	1	A	2	0.01	0	A	0	0.01	1	A	1
Driveway NB LR	0.02	13	B	2	0.08	11	B	7	0.03	10	A	2
128E (East) Dr./A St.												
A Street EB TR	0.09	0	A	0	0.07	0	A	0	0.04	0	A	0
A Street WB LT	0.02	1	A	1	0.04	2	A	3	0.04	3	A	3
Driveway NB LR	0.14	11	B	12	0.07	10	B	6	0.09	10	A	7
First Ave./128W Dr.												
Driveway WB LR	0.05	13	B	4	0.26	13	B	26	0.04	10	A	3
First Ave. NB TR	0.10	0	A	0	0.14	0	A	0	0.06	0	A	0
First Ave. SB LT	0.08	2	A	6	0.02	1	A	1	0.02	1	A	1
B St/128W Dr.												
B St. EB LT	0.01	1	A	1	0.00	0	A	0	0.00	0	A	0
B St. WB TR	0.31	0	A	0	0.16	0	A	0	0.11	0	A	0
Driveway SB LR	0.15	17	C	13	0.78	38	E	171	0.11	11	B	9
B St./Marriott (West) Dr.												
B St. EB LT	0.02	1	A	2	0.01	1	A	1	0.02	1	A	1
B St. WB TR	0.32	0	A	0	0.17	0	A	0	0.13	0	A	0
Driveway SB LR	0.01	19	C	1	0.01	14	B	1	0.01	10	B	1
B St./Marriott (East) Dr.												
B St. EB LT	0.00	0	A	0	0.00	0	A	0	0.00	0	A	0
B St. WB TR	0.34	0	A	0	0.17	0	A	0	0.12	0	A	0
Driveway SB LR	0.05	18	C	4	0.23	20	C	22	0.07	11	B	6

Table 2-20 Site Driveway Capacity Analysis Summary (Continued)

Location	Morning				Afternoon				Saturday			
	V/C ¹	Delay ²	LOS ³	95th Q ⁴	V/C	Delay	LOS	95th Q	V/C	Delay	LOS	95th Q
B St./Third Ave./North Dr./East Dr⁵												
B St. EB LT		11	B	32		6	A	85		6	A	39
B St. EB R		2	A	107		14	B	187		1	A	53
East Dr. WB LTR		12	B	30		7	A	49		5	A	33
Third Ave. NB LTR		5	A	0		2	A	0		2	A	0
North Dr. SB LTR		9	A	50		8	A	89		6	A	55
2nd Ave. Ext./Second Ave.												
Second Ave. EB LTR	0.02	1	A	2	0.00	0	A	0	0.00	0	A	0
Second Ave. WB LTR	0.02	1	A	1	0.02	1	A	2	0.02	1	A	2
2 nd Ave. Ext. NB LTR	0.06	12	B	5	0.04	10	B	3	0.04	10	A	3
Driveway SB LTR	0.02	18	C	2	0.07	16	C	6	0.00	12	B	0

¹Delay = Average delay per vehicle (seconds) ²v/c = Volume to capacity ratio ³LOS = Level of Service
⁴95th percentile queue (feet) ⁵Results based on modeling using SimTraffic software.

2.5 Mitigation

Mitigation for Center 128 includes meeting all traffic related obligations to the Needham Planning Board related to the three components of the development, providing additional fair share funding to address operational deficiencies which currently exist or are expected with or without the development, implementing a comprehensive transportation demand management plan and conducting a traffic monitoring program.

Across the three components of Center 128, the contribution to new traffic generation varies significantly. Center 128 West was approved by the Town of Needham in 2012 and then by MEPA in 2014. Center 128 West replaced 252,129 square feet of existing office/industrial buildings. The “new” daily trips generated by Center 128 West accounts for 56 percent of the new daily vehicle trips generated by Center 128.

In contrast, Center 128 East is the replacement of the existing General Dynamics buildings totaling 514,992 square feet, with 420,429 square feet of office space, 19,000 square feet of retail space and a 128-room hotel. In large part, Center 128 East is purely a redevelopment project, as defined by MEPA, resulting in very few, if any, “new” vehicle trips. Under the analysis presented, Center 128 East accounts for just 12 percent of the new daily vehicle trips of the overall Center 128 development.

Finally, the 2nd Avenue Residences will generate 32 percent of the new daily vehicle trips generated by the overall Center 128 development.

To fully understand Center 128’s impact to the study are intersections during the critical weekday peak hours, a detailed summary of the estimated peak hour traffic volumes by intersection is provided in Table 2-21. Table 2-21 includes the total entering volumes for the 2022 No-Build condition (assuming Add-A-Lane and improvements at 1st Avenue),

Center 128 West new trips, Center 128 East new trips, 2nd Avenue Residence trips, total Center 128 trips and the 2022 Build volumes. As seen in table, new trips generated by Center 128 represents between two percent to nine percent of the total traffic volumes projected by 2022 for the study area intersections. The mitigation program presented below addresses Center 128’s contribution to future traffic levels.

Table 2-21 Traffic Volume Summary

Intersection	2022 No-Build	New Trips				2022 Build	Percent Project Trips
		Center 128 West	Center 128 East	2 nd Ave. Residence	Total		
Morning Peak Hour							
Highland Ave./1 st Ave.	3,237	242	-27	95	310	3,547	9%
Highland Ave./2 nd Ave.	2,386	61	-7	83	137	2,523	5%
Kendrick St./3 rd Ave.	3,698	307	-33	32	306	4,004	8%
Kendrick St./4 th Ave.	3,391	30	-6	36	60	3,451	2%
Kendrick St./Hunting Rd.	2,863	91	-10	16	97	2,960	3%
Afternoon Peak Hour							
Highland Ave./1 st Ave.	3,587	227	-4	102	325	3,912	8%
Highland Ave./2 nd Ave.	3,201	57	3	88	148	3,349	4%
Kendrick St./3 rd Ave.	3,463	306	17	34	357	3,820	9%
Kendrick St./4 th Ave.	2,777	28	3	39	70	2,847	2%
Kendrick St./Hunting Rd.	2,393	85	0	17	102	2,495	4%

2.5.1 Needham Planning Board Traffic Mitigation for Center 128 West

As required in the Board’s First Amended and Restated Decision issued for the Center 128 West component of the development on April 2, 2013, the Proponent has agreed to implement each of the conditions listed in the Planning Board’s Decision. Table 2-22 provides a summary of the conditions and the Proponent’s progress towards compliance. As required in the Decision, the Proponent has contributed to the Town of Needham \$1,005,000 in traffic mitigation funds, to be used to improve traffic operations in the vicinity of Needham Crossing and has contributed to Needham Crossing Owner’s Group \$1,100,000, also available to be used to improve intersections providing access to Needham Crossing.

The Town of Needham is currently constructing short-term improvements to the Highland Avenue/2nd Avenue intersection as noted in Section 2.3.1.3. The design and construction of this project, was funded through the Needham Crossing owner’s group by using a portion of the funds paid by the Proponent. The improvements include a right turn lane on Second Avenue and signal timing modifications.

Table 2-22 Needham Planning Board Traffic Mitigation Summary for Center 128 West

Condition (Summarized)	Status
3.16 Provide or make available shuttle service between the Center 128 buildings and public transportation stations during the hours of 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. Monday through Friday.	The Proponent has committed to joining the 128 Business Council TMA and to participate in its shuttle bus service.
3.17/3.20 (e) Working with the 128 Business Council Transportation Management Association and future building tenants, implement a Transportation Demand Management (TDM) Plan. Components of the TDM plan shall include provisions for Zipcar parking spaces, participation in the 128 Business Council TMA shuttle service, carpooling, transit usage and parking management. A copy of the TDM program shall be submitted to the Needham Planning Board for review and approval for compliance prior to the issuance of the occupancy permit for each phase of the development.	As noted in the proposed agreement provided in Attachment 2.K, the 128 Business Council TMA provides services to encourage carpooling and transit usage. A Transportation Demand Management plan was submitted to and approved by the Needham Planning Board for the 400 1 st Avenue TripAdvisor building. The parking management plan for Center 128 includes 54 preferential carpool/vanpool parking spaces, 248 low emitting/fuel efficient vehicle parking spaces and 16 Electric Vehicle Charging Stations.
3.18 Upon issuance of the building permit for the first office building to be constructed, the Proponent will contribute to the Town of Needham a Traffic Improvement Fee of \$930,000.	Done
3.19 Contribute to the Town of Needham an additional \$75,000 for use by the town to hire a traffic engineer to evaluate traffic measures that should be implemented to improve traffic conditions in the immediate area of the New England Business Center.	Done
3.20 (a) Contribute \$1,000,000 to the New England Business Center Owner’s Association, to be used to address traffic issues at the intersections serving the New England Business Center. \$100,000 of this contribution will be paid within 30 days of the expiration of the Special Permit appeals period and is anticipated to be used for the preliminary engineering of intersection improvements.	Done
3.20 (d) Provide a bike share program for the New England Business Center.	Done
3.20 (g) Contribute \$100,000 to the New England Business Center Owner’s Association to fund new ingress and egress signs for the New England Business Center.	This obligation will be met in accordance with the schedule outlined in the Decision.

2.5.2 Town of Needham Traffic Mitigation for Center 128 East

Site Development Plans for the Center 128 East component of Center 128 were submitted to the Town of Needham on July 24, 2015 and are currently under review by the Town. A Traffic Improvement Fee as described in the Zoning By-Law of the Town of Needham is not anticipated for this component of Center 128. Mitigation will include improvements to the 3rd Avenue/B Street intersection as shown on Figure 2-35.

2.5.3 Town of Needham Traffic Mitigation for 2nd Avenue Residences

As part of an overall mitigation program developed for the proposed 2nd Avenue residences, \$2,250,000 will be contributed to the Town of Needham to be used at the Town's discretion for infrastructure improvements to support the 2nd Avenue Residences. At this time a formal submission to the Town of Needham has not been made for the 2nd Avenue Residences. As such, this contribution is subject to the 2nd Avenue Residences achieving local approval.

2.5.4 Intersection Improvements

Based on projected traffic operations at the study area intersections for the 2022 peak hours and MassDOT's assumptions for improvements along Kendrick Street (by others) listed in the Route 128 Add-A-Lane Functional Design Report, it is suggested that the Town of Needham consider using a portion of its \$3,250,000 in mitigation funding as described above to monitor, design and construct improvements along Kendrick Street.

Intersection improvements suggested and described below for Kendrick Street were developed based on projected changes to traffic patterns documented in the Add-A-Lane Functional Design Report prepared in 2010, as well as minor increases in traffic levels associated with Center 128. It is recommended that traffic volumes on Kendrick Street be monitored after the new interchange is fully functional. The improvements suggested below for Kendrick Street at the 3rd Avenue and at 4th Avenue may need to be updated or revised to accommodate actual conditions once the interchange is complete.

It is also suggested that the Needham Crossing Owner's Group cooperate with the Town of Needham to contribute the funds remaining of the \$1,000,000 contribution to complete intersection improvements as described herein. It is noted that the April 2, 2013 Planning Board Decision states that "The \$1,000,000 shall be available for the association to use to address traffic and related issues that exist or which may exist in the future at any or all intersections in and around Needham Crossing as the Association shall deem advisable".

Minor improvements are also recommended for the Highland Avenue/1st Avenue and 2nd Avenue/A Street intersections.

2.5.4.1 Kendrick Street/3rd Avenue

With the new interchange on Kendrick Street traffic volumes at the Kendrick Street/3rd Avenue intersection are anticipated to increase. Based on data provided in the Route 128 Add-A-Lane Functional Design Report, it is estimated that by 2022 the interchange will increase peak hour traffic levels through the intersection by approximately 800 vehicles during the morning peak hour and by 600 vehicles during the afternoon peak hour.

In comparison, the new trips generated by Center 128 would increase the intersection's peak hour traffic volumes by approximately 300 trips during the morning peak hour and 350 trips during the afternoon peak hour. By 2022, the projected total entering volumes during peak hours is estimated at approximately 3,900 vehicles. Therefore, the Center 128 related new trips represent less than ten percent of the total traffic at the intersection.

Operating conditions predicted for the 2022 No-Build weekday peak hours at this intersection (with the additional traffic generated by the new interchange at I-95 on Kendrick Street) causes this intersection to operate at LOS F conditions with average and 95th percentile queues extending to the new northbound off-ramp. Center 128 will add to these poor operations.

Consistent with the recommendations proposed in the Route 128 Add-A-Lane Functional Design Report the following improvements are suggested for the Kendrick Street/3rd Avenue intersection:

- ◆ Install a second left turn lane on the eastbound Kendrick Street approach to 3rd Avenue.
- ◆ Install an additional westbound lane between 3rd Avenue and the Route 128 northbound on-ramp which would allow a free right turn from 3rd Avenue onto Kendrick Street.

It is also suggested that a pedestrian actuated signal be provided at the crosswalk located on the 3rd Avenue channelized right turn lane. The signal would show a green indication unless actuated by a pedestrian.

Figures 2-39a and 2-39b show a conceptual design of these improvements. These improvements would require additional state and town right-of-way along the north side Kendrick Street (west of 3rd Avenue), along the south side of Kendrick Street (east of 3rd Avenue) and along the west side of 3rd Avenue. With implementation of these improvements, the intersection would operate at LOS E conditions during weekday peak hours, which results in improved overall LOS and delays compared to the 2022 No-Build condition.

The improvements are warranted with or without Center 128. The town may decide to use a portion of its mitigation funds towards improvements at this location.

2.5.4.2 Kendrick Street/4th Avenue

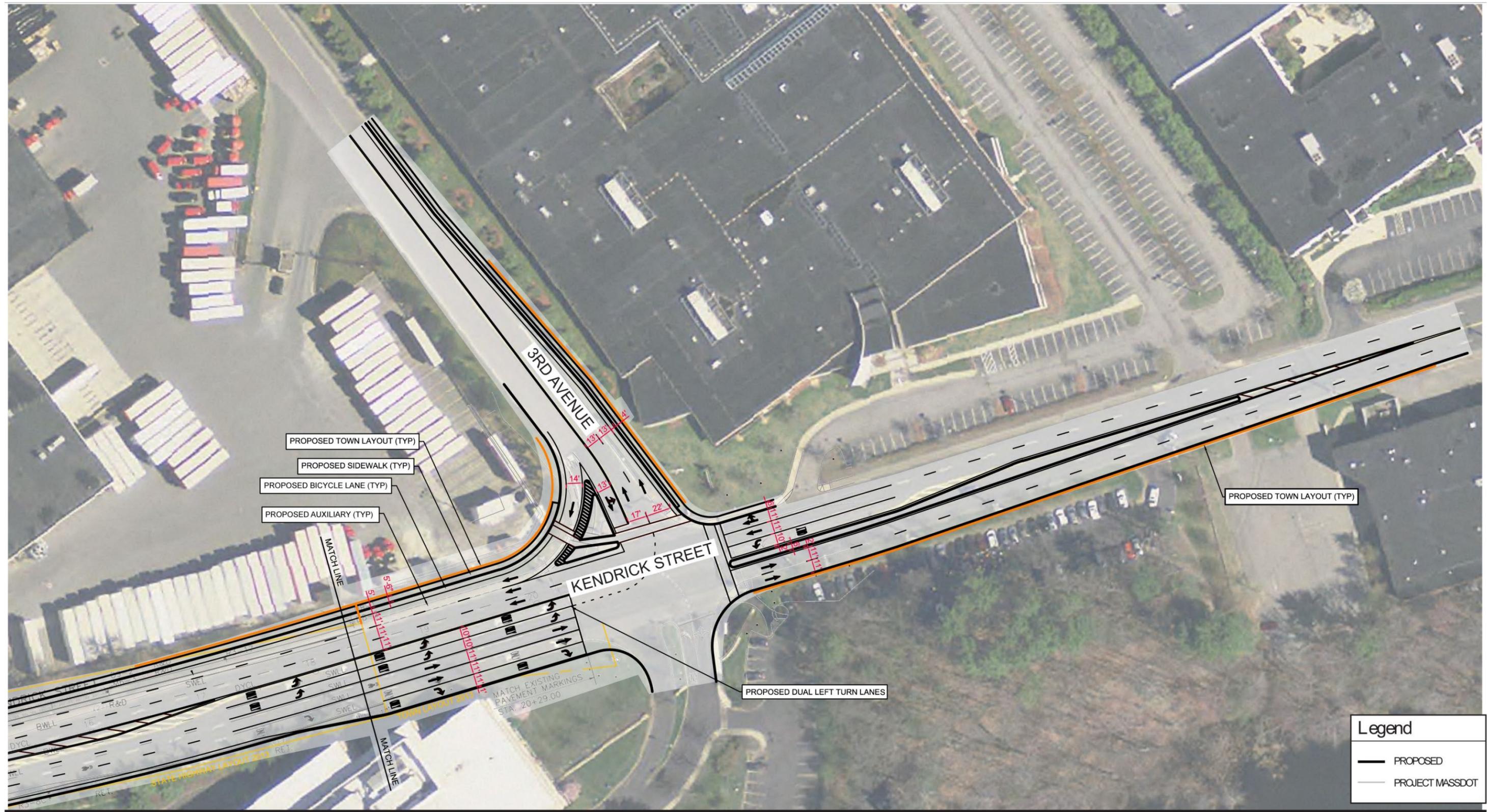
The unsignalized intersection of Kendrick Street/4th Avenue currently operates at LOS F conditions for the weekday peak hours and will continue to operate at poor levels of service in the future. It was recommended in the Route 128 Add-A-Lane Functional Design Report



Base Plan Source: PS + E, I-95/I-93 (Route 128) TIP-Bridge V, Needham, Wellesley, MassDOT; January 2014



Center 128 Needham, Massachusetts



Base Plan Source: PS + E, I-95/I-93 (Route 128) TIP-Bridge V, Needham, Wellesley, MassDOT; January 2014



Center 128 Needham, Massachusetts

that the intersection be put under traffic signal control. A traffic signal would significantly improve operations at this intersection, however geometric improvements may also be necessary.

The proposed Center 128 development is estimated to increase weekday peak hour volumes at this location by approximately two percent. The town may decide to use a portion of the \$3,250,000 mitigation funds towards improvements at this location, but with the understanding that the improvement mitigates poor operations caused primarily by existing traffic and increases attributed to the new interchange at Kendrick Street.

2.5.4.3 Highland Avenue at 1st Avenue and 2nd Avenue

Center 128 will increase the left-turn volume from 1st Avenue onto Highland Avenue during the afternoon peak hour by approximately 150 new trips from approximately 530 vehicles under No-Build conditions to 680 vehicles under Build conditions. As a result of the additional left-turning vehicles, the vehicle queue lengths in the left-turn lane are expected to increase. It is recommended that the current MassDOT design for the project, which includes a left-turn lane and a right-turn lane on the 1st Avenue approach, be modified to include a left-turn lane and a shared left/right-turn lane. This change would require modifications to the currently proposed traffic signal and a slight modification to the median island on Highland Avenue to accommodate large trucks.

With these improvements, the intersection would operate at overall LOS D or better during peak hours, consistent with operations under the No-Build condition. Although improvements are not proposed for Highland Avenue/2nd Avenue, the traffic signals at 1st Avenue and 2nd Avenue will be coordinated. Therefore, the signal timing at Highland Avenue/2nd Avenue would be adjusted to reflect the changes at 1st Avenue.

2.5.4.4 2nd Avenue at A Street

As noted above, sight line obstructions exist at the intersection of 2nd Avenue with A Street. The Town of Needham may want to discuss with the property owner at 206 A Street trimming the existing shrubs in front of the building and consider parking restrictions on the westerly side of 2nd Avenue, north of A Street to improve sight lines at the intersection.

2.5.4.5 Intersection Operating Conditions with Improvements

Tables 2-23, 2-24 and 2-25 provides a summary of operating conditions at the intersections for the 2022 No-Build and 2022 Build conditions without and with the recommended improvements. With implementation of the recommended improvements, the intersections would generally operate at similar or better conditions than predicted for the No-Build condition. The capacity analyses for the study intersection with the recommended improvements is provided in Attachment 2.L.

Table 2-23 Morning Peak Hour Intersection Capacity Analysis Results (with improvements)

Location	2022 No-Build					2022 Build					2022 Build (with improvements)				
	V/C ¹	Delay ²	LOS ³	50 th Q ⁴	95 th Q ⁵	V/C	Delay	LOS	50 th Q	95 th Q	V/C	Delay	LOS	50 th Q	95 th Q
Highland Ave/1st Ave															
Highland Ave. EB T	0.75	21	C	279	#778	0.79	23	C	308	#790	0.70	16	B	217	#676
Highland Ave. EB R	0.59	5	A	0	270	0.74	8	A	0	#412	0.75	8	A	0	#501
Highland Ave. WB TR	0.49	13	B	90	#356	0.55	14	B	90	#443	0.49	11	B	78	314
1st Ave. L	0.83	51	D	213	309	0.89	56	E	250	#406	0.76	48	D	146	#258
1st Ave. R	0.03	31	C	0	14	0.04	29	C	0	17	--	--	--	--	--
1 st Ave. L/R	--	--	--	--	--	--	--	--	--	--	0.53	38	D	83	168
Driveway LTR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Overall	0.73	18	B			0.77	20	C			0.71	16	B		
Highland Ave/2nd Ave															
Highland Ave. EB L	0.04	5	A	5	m0	0.04	5	A	4	m0	0.04	9	A	5	m1
Highland Ave. EB TR	0.86	20	B	406	#526	0.94	28	C	~421	#538	1.00	43	D	~445	#550
Highland Ave. WB L	0.73	31	C	129	#319	0.79	35	C	169	#398	0.78	33	C	157	#391
Highland Ave. WB TR	0.61	14	B	231	444	0.62	15	B	245	444	0.64	15	B	245	454
2nd Ave. L	0.55	44	D	77	123	0.64	47	D	96	149	0.62	44	D	91	141
2nd Ave. LT	0.56	45	D	78	124	0.64	47	D	96	150	0.62	44	D	91	143
2nd Ave. R	0.14	25	C	13	49	0.17	23	C	21	60	0.16	21	C	18	56
Driveway LT	0.66	66	E	33	#81	0.66	66	E	33	#81	0.58	52	D	31	69
Driveway R	0.00	48	D	0	0	0.00	48	D	0	0	0.00	45	D	0	0
Overall	0.76	23	C			0.83	28	C			0.84	34	C		
Kendrick St/3rd Ave															
Kendrick St. EB L	0.86	35	C	423	#916	1.18	**	F	~820	#1335	0.77	46	D	323	#678
Kendrick St. EB T	*	**	F	~1037	#1350	*	**	F	~1046	#1351	1.15	103	F	562	#1297
Kendrick St. EB R	0.32	16	B	49	30	0.33	16	B	48	31	0.34	12	B	37	159
Kendrick St. WB L	0.57	54	D	108	#283	0.57	54	D	108	#283	0.57	45	D	120	m#194
Kendrick St. WB TR	*	**	F	~324	#449	*	**	F	~367	#495	0.69	44	D	174	m245
Driveway L	0.23	59	E	16	47	0.23	59	E	16	47	0.23	59	E	16	47
Driveway LTR	0.06	59	E	3	31	0.06	59	E	3	31	0.06	59	E	3	31
3rd Ave. LT	0.65	59	E	111	#263	0.64	58	E	114	#274	1.36	273	F	~158	#297
3rd Ave. R	0.03	11	B	0	0	0.07	11	B	0	30	0.07	0	A	0	0
Overall	1.01	**	F			1.09	**	F			1.02	75	E		
Kendrick St/4th Ave															
Kendrick St EB L	--	--	--	--	--	--	--	--	--	--	0.98	48	D	434	m402
Kendrick St EB LTR	0.78	27	D		185	0.80	30	D		199					
Kendrick St EB TR	--	--	--	--	--	--	--	--	--	--	0.68	2	A	8	m34
Kendrick St. WB LT	--	--	--	--	--	--	--	--	--	--	0.99	66	E	607	#1011
Kendrick St. WB LTR	0.00	0	A		0	0.00	0	A		0					
Kendrick St. WB R	--	--	--	--	--	--	--	--	--	--	0.32	15	B	68	117
Driveway NB LTR	*	**	F		***	*	**	F		***	0.10	66	E	2	14
4 th Ave. SB LT	*	**	F		***	*	**	F		***	0.79	71	E	155	#255
4 th Ave. SB R	0.64	39	E		101	0.75	50	F		135	0.11	20	B	0	41
Overall											0.94	27	C		

¹Delay = Average delay per vehicle (seconds) ²v/c = Volume to capacity ratio ³LOS = Level of Service
⁴50th percentile queue (feet) ⁵95th percentile queue (feet) *v/c exceeds 1.2, **delay exceeds 120 seconds
~ the approach is above capacity; 50th percentile queue could be longer # volume for the 95th percentile queue exceeds capacity

Table 2-24 Afternoon Peak Hour Intersection Capacity Analysis Results (with improvements)

Location	2022 No-Build					2022 Build					2022 Build (with improvements)				
	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C	Delay	LOS	50th Q	95th Q	V/C	Delay	LOS	50th Q	95th Q
Highland Ave/1st Ave															
Highland Ave. EB T	0.60	21	C	254	540	0.62	21	C	271	574	0.65	24	C	297	#644
Highland Ave. EB R	0.09	2	A	0	28	0.15	2	A	0	43	0.15	2	A	0	43
Highland Ave. WB TR	0.98	34	C	491	m#1004	0.99	36	D	508	m#1020	1.04	53	D	579	m#1058
1st Ave. L	1.19	**	F	~585	#813	1.54	**	F	~881	#1123	0.98	80	E	429	#665
1st Ave. R	0.25	37	D	50	118	0.34	38	D	78	154	--	--	--	--	--
1 st Ave. L/R	--	--	--	--	--	--	--	--	--	--	0.89	61	E	347	#558
Driveway LTR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Overall	1.00	47	D			1.12	77	E			0.97	46	D		
Highland Ave/2nd Ave															
Highland Ave. EB L	0.09	8	A	1	m1	0.09	9	A	1	m1	0.09	8	A	1	m1
Highland Ave. EB TR	0.61	10	A	344	68	0.65	12	B	383	86	0.66	13	B	407	92
Highland Ave. WB L	0.40	13	B	33	59	0.58	17	B	44	#85	0.58	17	B	46	#80
Highland Ave. WB TR	1.18	115	F	~1335	#1640	1.19	120	F	~1352	#1640	1.20	**	F	~1366	#1646
2nd Ave. L	0.83	73	E	175	#266	0.85	75	E	186	#302	0.86	77	E	186	#308
2nd Ave. LT	0.83	73	E	177	266	0.85	75	E	187	#300	0.85	76	E	187	#305
2nd Ave. R	0.65	51	D	139	238	0.77	58	E	172	#288	0.76	57	E	173	#283
Driveway LT	*	**	F	~137	#266	*	**	F	~137	#266	1.19	**	F	~124	#254
Driveway R	0.02	59	E	0	0	0.02	59	E	0	0	0.02	58	E	0	0
Overall	1.13	72	E			1.14	73	E			1.14	73	E		
Kendrick St/3rd Ave															
Kendrick St. EB L	0.88	65	E	188	#401	*	**	F	~397	#574	0.64	56	E	146	#288
Kendrick St. EB T	0.59	32	C	293	387	0.67	38	D	324	395	0.43	20	B	121	387
Kendrick St. EB R	0.01	9	A	0	m0	0.01	11	B	0	m0	0.01	6	A	0	m0
Kendrick St. WB L	0.60	70	E	29	65	0.64	77	E	29	65	0.62	68	E	30	m42
Kendrick St. WB TR	*	**	F	~981	#1123	*	**	F	~997	#1139	1.11	94	F	552	#1099
Driveway L	0.60	44	D	188	#508	0.60	44	D	188	#508	*	**	F	~272	#452
Driveway LTR	0.54	43	D	167	#466	0.54	43	D	167	#466	1.10	**	F	~226	#408
3rd Ave. LT	0.47	55	E	60	113	0.42	51	D	73	#215	1.01	**	F	~89	#209
3rd Ave. R	0.40	35	D	46	174	0.87	56	E	264	#580	0.42	1	A	0	0
Overall	1.01	**	F			1.19	**	F			1.01	70	E		
Kendrick St/4th Ave															
Kendrick St EB L	--	--	--	--	--	--	--	--	--	--	0.75	64	E	131	m#199
Kendrick St EB LTR	0.29	9	A		30	0.34	10	B		37	--	--	--	--	--
Kendrick St EB TR	--	--	--	--	--	--	--	--	--	--	0.35	3	A	52	m63
Kendrick St. WB LT	--	--	--	--	--	--	--	--	--	--	0.95	42	D	684	#1270
Kendrick St. WB LTR	0.00	0	A		0	0.00	0	A		0	--	--	--	--	--
Kendrick St. WB R	--	--	--	--	--	--	--	--	--	--	0.28	6	A	13	31
Driveway NB LTR	*	**	F		***	*	**	F		***	0.13	67	E	2	14
4 th Ave. SB LT	*	**	F		***	*	**	F		***	0.62	56	E	133	197
4 th Ave. SB R	*	**	F		895	*	**	F		930	0.57	40	D	189	280
Overall											0.86	28	C		

¹Delay = Average delay per vehicle (seconds) ²v/c = Volume to capacity ratio ³LOS = Level of Service

⁴50th percentile queue (feet) ⁵95th percentile queue (feet) *v/c exceeds 1.2, **delay exceeds 120 seconds

~ the approach is above capacity; 50th percentile queue could be longer # volume for the 95th percentile queue exceeds capacity

Table 2-25 Saturday Peak Hour Intersection Capacity Analysis Results (with improvements)

Location	2022 No-Build					2022 Build					2022 Build (with improvements)				
	V/C ¹	Delay ²	LOS ³	50th Q ⁴	95th Q ⁵	V/C	Delay	LOS	50th Q	95th Q	V/C	Delay	LOS	50th Q	95th Q
Highland Ave/1st Ave															
Highland Ave. EB T	0.51	8	A	162	347	0.57	12	B	227	468	0.57	11	B	217	455
Highland Ave. EB R	0.08	1	A	0	9	0.17	2	A	0	15	0.17	2	A	0	15
Highland Ave. WB TR	0.53	7	A	217	m139	0.59	8	A	185	m151	0.58	7	A	178	m130
1st Ave. L	0.74	65	E	134	202	0.80	63	E	208	279	0.80	65	E	197	271
1st Ave. R	0.11	50	D	0	64	0.12	44	D	0	59	--	--	--	--	--
1 st Ave. L/R	--	--	--	--	--	--	--	--	--	--	0.22	46	D	18	88
Driveway LTR	0.00	64	E	0	0	0.00	64	E	0	0	0.00	64	E	0	0
Overall	0.56	13	B			0.63	15	B			0.62	15	B		
Highland Ave/2nd Ave															
Highland Ave. EB L	0.09	13	B	2	m2	0.09	12	B	2	m3	0.09	13	B	2	m2
Highland Ave. EB TR	0.72	21	C	421	228	0.75	19	B	451	198	0.75	20	B	455	209
Highland Ave. WB L	0.39	14	B	29	#73	0.56	18	B	42	#154	0.56	18	B	42	#154
Highland Ave. WB TR	1.10	78	E	~1127	#1631	1.11	82	F	~1218	#1631	1.11	82	F	~1218	#1631
2nd Ave. L	0.44	56	E	63	105	0.53	57	E	80	129	0.53	57	E	80	129
2nd Ave. LT	0.44	56	E	64	106	0.53	57	E	82	130	0.53	57	E	82	130
2nd Ave. R	0.76	55	D	184	296	0.83	62	E	208	327	0.83	62	E	208	327
Driveway LT	1.06	**	F	~100	#223	1.06	**	F	~100	#223	1.06	**	F	~100	#223
Driveway R	0.03	58	E	0	0	0.03	58	E	0	0	0.03	58	E	0	0
Overall	1.05	53	D			1.07	54	D			1.07	54	D		
Kendrick St/3rd Ave															
Kendrick St. EB L	0.68	37	D	125	#300	0.63	25	C	191	#508	0.76	49	D	119	#208
Kendrick St. EB T	0.33	10	B	22	277	0.35	11	B	24	#288	0.33	14	B	33	277
Kendrick St. EB R	0.00	8	A	0	m0	0.00	10	A	0	m0	0.00	6	A	0	m0
Kendrick St. WB L	0.36	49	D	10	32	0.36	49	D	10	32	0.36	51	D	11	m32
Kendrick St. WB TR	0.51	26	C	120	#361	1.02	80	E	167	#386	0.44	21	C	67	#330
Driveway L	0.12	48	D	4	17	0.12	48	D	4	17	0.12	48	D	4	17
Driveway LTR	0.09	48	D	2	15	0.09	48	D	2	15	0.09	48	D	2	15
3rd Ave. LT	0.24	44	D	20	51	0.28	42	D	30	67	0.51	47	D	31	70
3rd Ave. R	0.05	22	C	0	7	0.12	13	B	0	52	0.12	0	A	0	0
Overall	0.48	22	C			0.62	39	D			0.50	23	C		
Kendrick St/4th Ave															
Kendrick St EB L	--	--	--	--	--	--	--	--	--	--	0.65	36	D	106	190
Kendrick St EB LTR	0.17	5	A		15	0.19	5	A		18	--	--	--	--	--
Kendrick St EB TR	--	--	--	--	--	--	--	--	--	--	0.20	2	A	22	17
Kendrick St. WB LT	--	--	--	--	--	--	--	--	--	--	0.40	14	B	141	321
Kendrick St. WB LTR	0.00	0	A		0	0.00	0	A		0	--	--	--	--	--
Kendrick St. WB R	--	--	--	--	--	--	--	--	--	--	0.14	6	A	0	19
Driveway NB LTR	0.07	36	E		6	0.08	43	E		7	0.16	52	D	2	17
4 th Ave. SB LT	0.86	96	F		148	1.02	**	F		188	0.61	46	D	87	146
4 th Ave. SB R	0.28	16	C		28	0.32	17	C		34	0.08	24	C	0	36
Overall											0.47	15	B		

¹Delay = Average delay per vehicle (seconds) ²v/c = Volume to capacity ratio ³LOS = Level of Service

⁴50th percentile queue (feet) ⁵95th percentile queue (feet) *v/c exceeds 1.2, **delay exceeds 120 seconds

~ the approach is above capacity; 50th percentile queue could be longer # volume for the 95th percentile queue exceeds capacity

2.5.5 Pedestrian Improvements

2.5.5.1 On-Site Pedestrian Accommodations

Proposed sidewalks and walkways, as shown on Figure 2-4, will connect to existing sidewalks within Needham Crossing. Lighting will be provided on-site along walkways, adjacent to buildings and in all parking areas. Internal site pedestrian connections between office buildings, residential areas and the retail and hotel components of Center 128 will include walkways, sidewalks and pedestrian tables and crosswalks. Crosswalks are proposed on site driveways at their intersections with the roadway system within Needham Crossing.

2.5.5.2 Off-Site Pedestrian Accommodations

Center 128 includes approximately 2,500 feet of sidewalk reconstruction within Needham Crossing. As part of the recently completed Center 128 West hotel and 400 1st Avenue office building, 870 feet of sidewalk along 1st Avenue and B Street have already been reconstructed.

Approximately 1,025 feet of sidewalk along the westerly side of 2nd Avenue will also be reconstructed as part of the 2nd Avenue Residences work. As noted on Figure 2-8, this section of sidewalk is presently less than 4 feet wide and in poor condition.

It is recommended that the New England Business Center's Owner's Group consider using a portion of its mitigation funds to further enhance pedestrian accommodations within Needham Crossing. Based on the evaluation of existing pedestrian conditions with the park presented in this document, the following improvements are recommended:

- ◆ Widen the sidewalk along the easterly side of 2nd Avenue, which is typically less than 4-feet-wide, to a minimum width of 5 feet.
- ◆ Reconstruct all segments of sidewalks noted as in poor condition on Figure 2-8.
- ◆ Relocate all obstructions within existing sidewalk, as shown on Figure 2-8, to provide an unobstructed travel way.
- ◆ Provide a crosswalk on 1st Avenue, north of Cabot Street, to connect the sidewalks located on both sides of the street.
- ◆ Repaint all crosswalks within Needham Crossing.

2.5.6 *Transportation Demand Management Plan*

2.5.6.1 128 Business Council Transportation Management Association

The Proponent will join the 128 Business Council TMA and participate in the TMA's shuttle service for its office tenants. TripAdvisor will be exempt as they provide their own shuttle service. The Proponent and its tenants, through the 128 Business Council TMA, will provide access to a carpool matching database, provide a guaranteed ride home program, provide bike/walk information and offer on-site commuter events promoting alternative transportation modes.

The Proponent will facilitate communication between its tenants and the 128 Business Council TMA and will request its tenants to comply with the proposed Transportation Demand Management plan.

The Proponent will also consider working with the 128 Business Council TMA to provide shuttle service for future residents of Center 128.

2.5.6.2 MassRIDES

The Proponent will work with state's MassRIDES program to promote its carpool matching, NuRide and vanpool programs. Tenants of 2nd Avenue Residences will be provided information on the MassRIDES program with their rental agreement.

2.5.6.3 Parking Management

Parking Supply. Center 128 is currently designed with approximately 4,879 spaces including 778 surface parking spaces and 4,101 spaces in three parking garages. Table 2-26 provides a summary of the parking supply by each component of Center 128.

Table 2-26 Parking Supply

Site	380R Garage	400R Garage*	2nd Ave. Residence Garage	Surface	Total
Center 128 West	925	1,743		117	2,785
Center 128 East		857		652	1,509
2 nd Avenue Residences			576	9	585
Total	925	2,600	576	778	4,879

*Current assignment of spaces to meet local parking requirements. Garage 400R is located on Center 128 West.

It is anticipated that the separate owners of the components of Center 128 will reach an agreement to allow shared parking between the Center 128 West and Center 128 East sites. However, the 585 parking spaces on the 2nd Avenue Residences site will not be available for use by Center 128 West or Center 128 East office workers or hotel guests. Similarly, parking by 2nd Avenue residents will not be allowed at the Center 128 East or Center 128 West parking facilities.

Table 2-27 provides a summary of the various types of parking spaces which will be available to employees, hotel guests and residents. Approximately seven percent of the 4,879 parking spaces will be reserved for electric charging stations, carpool/vanpool and low emitting/fuel efficient spaces. It is estimated that the site will provide 54 preferential carpool/vanpool parking spaces, conveniently located near building entrances; 248 low emitting/fuel efficient vehicle parking spaces, located throughout the each parking facility; and 16 Electric Vehicle Charging Stations.

Table 2-27 Types of Parking Spaces

Type	380R Garage	400R Garage	2 nd Avenue Residence Garage	Surface	Total
Fuel Efficient Vehicle Spaces	48	130	30	40	248
Electric Vehicle Charging Station Spaces	4	8	4	0	16
Carpool/Vanpool Spaces	16	32	2	4	54
Other Spaces	857	2,430	540	734	4,561
Total	925	2,600	576	778	4,879

2nd Avenue Residence Parking Summary. Based on parking rate data provided in *Parking Generation* (Institute of Transportation Engineers, 4th Edition, 2010) for apartment units, the site's peak demand for parking is estimated at approximately 516 spaces. Local zoning requires 1.5 spaces per unit or 585 spaces. Thus, the site's parking supply of 585 spaces has been designed to meet the local requirements and exceeds the estimated demand based on ITE parking rates. It is currently anticipated that residents will be charged a fee for use of a parking space.

Center 128 East and Center 128 West Parking Summary. Based on parking rate data provided in *Parking Generation* (Institute of Transportation Engineers, 4th Edition, 2010) for office, hotels and shopping centers, the site's peak demand for parking is estimated at approximately 4,462 spaces (4,190 spaces for office employees, 223 spaces for hotel guests and 49 spaces for retail space). Therefore, as the combined Center 128 West and Center 128 East parking supply is 4,294 spaces, the site accommodates approximately 96 percent of the site's parking demand (4,294 parking supply/4,462 parking demand).

It is noted that shared parking will occur between the three uses proposed on the Center 128 West and Center 128 East sites. It is expected that office workers would either walk or bicycle to the retail area of the site which would reduce the parking demand at the retail site. Similarly, guests of the proposed two hotels with business at the sites' office buildings would likely walk reducing parking demand at the office buildings.

Local zoning requires that 4,215 spaces be provided for two sites (2,608 spaces for Center 128 West and 1,607 spaces for Center 128 East). The two sites are designed with a total of 4,294 spaces. Therefore, based on local zoning requirements, the combined sites provide 79 additional parking spaces. Parking demand calculations are provided in Attachment 2.K.

2.5.6.4 Transit

TripAdvisor will be one of the largest tenants within the 128 Center. They currently operate a shuttle bus service from their new location within the Center 128 development to Cambridge (Kendall Square and Central Square) and to the Newton Highland Green Line station. TripAdvisor estimates that 23 percent of all employees currently use its shuttle bus service as part of their commute (see schedule in Attachment 2.A).

Each residential and office building within Center 128 will provide a commuter information center and access to a commuter website. Maps and schedules for the MBTA commuter rail/subway/bus services, the 128 Business Council shuttle bus service and TripAdvisor shuttle bus service (where appropriate) will be posted in the commuter information center and on websites. Public transportation is currently promoted to hotel guests on the hotel's website which includes links to the MBTA subway and commuter rail services.

During the preparation of the SEIR, the manager of Service Planning at the MBTA was contacted in an effort to improve MBTA bus service in the area. Specifically, it was requested that the MBTA consider rerouting Bus Route 52 through the New England Business Center and increase peak hour service. A similar request was made for Bus Route 59. Although, the requests could not be considered by the MBTA at this time, the MBTA indicated that the requests would be kept in mind.

A follow-up e-mail and conversation with a senior planner at the MBTA, made during the preparation of this document, indicates that this situation has not changed. A copy of the MBTA correspondence is provided in Attachment 2.K.

2.5.6.5 Bicycle and Pedestrian Accommodations

Center 128 includes approximately 287 spaces for bicycle parking including interior and exterior bicycle storage. Bicycle racks will be located throughout the Center 128 site. Office workers will have access to on-site locker rooms/showers. Table 2-28 provides a summary of the number of available bicycle parking spaces provide for each component of the development.

Table 2-28 Bicycle Parking Supply

Type	Center 128 West	Center 128 East	2 nd Avenue Residences	Total
General Bicycle Parking Spaces	140 ¹	81	30 ²	251
Zagster Shared Bicycle Spaces	6 ³	6 ⁴	0	12
TripAdvisor Bicycle Spaces	24	0	0	24
Total	170	87	30	287

¹Includes 84 spaces provided by bicycle racks on-site and interior storage for 56 bicycles.

²Includes 9 spaces provided by bicycle racks on-site and interior storage for 21 bicycles.

³Existing shared bicycles.

⁴Possible future shared bicycles.

The Proponent, partnering with Zagster (a bicycle share company), currently provides six shared bicycles on-site which would be available to all tenants within Needham Crossing. Usage of these bicycles will be monitored, and if additional bicycles are needed, they will be provided. Additionally, TripAdvisor presently provides 24 shared bicycles for its employees. These bicycles are located in Garage 380R.

As the closest Hubway station is located 7 miles to the east in Jamaica Plain and Hubway stations are not provided in Needham or Newton, it is unlikely that a shared bicycle system would be used for commuter trips. However, on-site shared bicycles will be promoted as a means to reduce vehicle-trips associated with midday errands and to encourage midday exercise.

The site's driveways and internal roadways, designed as low speed facilities, will accommodate both automobiles and bicycles.

The site's proposed pedestrian accommodations, shown on Figure 2-4, were developed to encourage walking and provide connections to the existing sidewalks serving the site. Traffic calming measures such as pedestrian tables, marked crosswalks and non-linear roadway alignments are also incorporated into the design of site's driveway system.

2.5.6.6 Staggered Work Hours

The Proponent will encourage its tenants to implement flexible work hours to reduce peak hour employee vehicle trips.

2.5.6.7 On-Site Amenities

To reduce trips to/from the site, on-site amenities will be provided throughout Center 128. Fitness centers and cafés are programmed for several of the proposed office buildings and both hotels. A pool is provided at the existing hotel on Center 128 West and is proposed for the 2nd Avenue Residences. At the existing TripAdvisor building, additional on-site amenities include a fire pit, outdoor theater and gaming room.

2.5.6.8 Mode Share Goals

With implementation of the transportation demand management program discussed above and analysis of available mode share information for the tenants of Needham Crossing, mode share goals have been established for the office and residential components of Center 128.

The mode share goals for the residential component of Center 128 are based on U.S. Census data for residents of the Town of Needham. The Proponent will actively work with MassRIDES and the 128 Business Council to reduce the existing Drive Alone mode share of 80.5 percent.

For the office component of Center 128, a drive-alone mode share goal of 82 percent was established based on current mode share information available for the existing tenants of Needham Crossing (23 percent of TripAdvisor employees and two to five percent of other Needham Crossing employees use a shuttle bus to access public transit) and based on data from the U.S. Census. This reflects a 3.5 percent projected increase in the use of public transit from the 2.7 percent assumed in the trip generation analysis to 6.2 percent. Mode share goals for the residential and office components of the development are summarized in Table 2-29.

Table 2-29 Mode Share

	Drive Alone	Carpool	Public Transit	Bus	Bicycle	Walk	Other
Residential	80.5%	4.8%	9.9%	0.0%	0.7%	3.8%	0.3%
Office	82.0%	8.5%	6.2%	0.6%	0.1%	2.0%	0.6%

2.5.7 Traffic Monitoring Program

The Proponent will implement a Transportation Monitoring Program that will include manual counts of vehicles, bicycles and pedestrians entering/exiting to/from the site driveways. The counts will be conducted from 7:00 a.m. to 9:00 a.m. and from 4:00 p.m. to 6:00 p.m. on a typical workday. This data will be used to determine the Center 128 development's trip generation and mode share. The Proponent will also conduct transportation surveys in the lobbies of at least four office buildings and one residential building to further define the site's mode share. The survey would also include questions related to how the buildings managers could further improve alternative mode share. The monitoring program will begin one year after occupancy of the Phase I (Center 128 West hotel and 400 1st Avenue office building) components of Center 128 and will continue annually until two years after the final building is constructed.

A technical memorandum summarizing the results of the monitoring program, including a comparison to the trip generation and mode share estimated for Center 128, will be prepared annually and provided to the Town of Needham, MassDOT and the 128 Business Council TMA.