EXPANDED PROJECT NOTIFICATION FORM

The Boston Garden

Submitted to:
Boston Redevelopment Authority
One City Hall Square
Boston, MA 02201

Submitted by:
Boston Properties Limited Partnership
800 Boylston Street, 19th Floor
Boston, MA 02199

and

Boston Garden Development Corporation
TD Garden
100 Legends Way
Boston, MA 02114

Prepared by:
Epsilon Associates, Inc.
3 Clock Tower Place, Suite 250
Maynard, MA 01754

In Association with:
Elkus Manfredi Architects
Goodwin Procter LLP
GZA GeoEnvironmental, Inc.
Vanasse and Associates, Inc.
Vanasse Hangen Brustlin, Inc.

September 6, 2013

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ASSOCIATES INC.

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Chapter 1.0

General Information

1.0 GENERAL INFORMATION

1.1 Introduction

Boston Properties Limited Partnership and Boston Garden Development Corp. (together, the "Proponent") propose the redevelopment of the vacant site at 80 Causeway Street previously occupied by the Boston Garden and adjacent to the TD Garden which opened in 1995 (the "Project site"). The Proponent is proposing a development on the Project site that includes approximately 1,870,000 square feet (sf) of mixed uses on an expansion of TD Garden, a new prominent entrance to the TD Garden and North Station, new connections between Causeway Street, North Station, TD Garden and the Massachusetts Bay Transportation Authority (MBTA) Green and Orange Lines and new parking (the "Project").

The Project site is part of a larger redevelopment area that has a permitting history dating back over several decades starting with area merchants in the 1960s, with a focus by the Boston Redevelopment Authority (BRA) starting in the late 1970s. Several phases of the public/private development efforts for the North Station/Boston Garden area have already been completed, including the underground MBTA parking garage; relocation of the MBTA Green Line; creation of the underground rapid transit station serving both the MBTA Orange and Green Lines; extension of the MBTA North Station commuter rail platforms; construction of a new passenger waiting area and ticketing facility and construction of the new arena, known as the TD Garden. Another phase of the development, consisting of a residential project known as the Nashua Street Residences, is expected to begin construction soon. The proposed Project will be the final piece of the redevelopment of the area conceived in the 1970s and 1980s.

The Project will serve as a gateway to Boston for those accessing the City by car from Interstate 93 or local roadways, or by public transportation and Amtrak at North Station. In return, the Project's tenants, residents and visitors will benefit from its adjacency to North Station, with easy access throughout Boston via the MBTA Green and Orange Lines, and to the greater metropolitan area via the Commuter Rail lines, and to New Hampshire and Maine on Amtrak.

This Expanded Project Notification Form (PNF) is being submitted to the BRA to initiate review of the Project under Article 80B, Large Project Review, of the Boston Zoning Code.

1.2 Project Identification

Address/Location:	80 Causeway Street
Proponent:	Boston Properties Limited Partnership 800 Boylston Street, 19th Floor Boston, MA 02199 (617) 236-3300 Michael Cantalupa Rick DeAngelis Kevin Sheehan
	Boston Garden Development Corp. TD Garden 100 Legends Way Boston, MA 02114 (617) 624-3051 Chris Maher
Architect:	Elkus Manfredi Architects 300 A Street Boston, MA 02210 (617) 426-1300 David Manfredi Steven Dube
Legal Counsel:	Goodwin Procter LLP Exchange Place, 53 State Street Boston, MA 02109 (617) 570-1000 Martin Healy Randi Eisner
Permitting Consultant:	Epsilon Associates, Inc. 3 Clock Tower Place, Suite 250 Maynard, MA 01754 (978) 897-7100 Peggy Briggs Geoff Starsiak

Transportation Consultant:	Vanasse & Associates, Inc. 10 New England Business Center Drive, Suite 314 Andover, MA 01810 (978) 474-8800 Jeffrey Dirk
Civil Engineer:	Vanasse Hangen Brustlin, Inc. 99 High Street, 10th Floor Boston, MA 02110 (617) 728-7777 Howard Moshier
Geotechnical Consultant:	GZA GeoEnvironmental, Inc. 249 Vanderbilt Avenue Norwood, MA 02062 (781) 278-3700 Terese Kwiatkowski
Sustainability Consultant:	The Green Engineer Inc 50 Beharrell Street Concord, MA 01742 (978) 369-8978 Chris Schaffner
Community Outreach:	Exclusive Real Estate 10 Derne Street Boston, MA 02114 (617) 263-1157 Harry Collings

1.3 Project Summary

The Project site is an approximately 2.8-acre parcel, mostly used for surface parking, that is bounded by Causeway Street to the south, TD Garden to the north, the pedestrian connection from Causeway Street to the TD Garden and North Station to the west and Interstate 93 to the east. The proposed Project includes approximately 1,870,000 sf anticipated to contain residential, hotel, office, flex office and retail uses, as well as an expansion of TD Garden and new connections between Causeway Street, North Station, TD Garden and the MBTA Green and Orange Lines, as more particularly described in Chapter 2. The Project will also include new parking in a below-grade garage. Chapter 2 includes additional information on the Project program.

1.4 Public Benefits

This long awaited Project will develop the vacant site currently used for parking along Causeway Street into a vibrant, mixed-use development that will further activate the area, especially during the times when the adjacent TD Garden is not in use. The Project will create new housing, jobs, and tax revenues for the City of Boston.

Other benefits from the Project to the neighborhood and the City of Boston will include but are not limited to:

Urban Design Benefits

- Creating a more prominent and convenient entrance to North Station and TD Garden from Causeway Street via the atrium hall described in Chapter 2.
- Creating a new, weather-protected pedestrian connection between the MBTA Orange and Green Lines to the Commuter Rail and Amtrak.
- Infilling a vacant site in a growing neighborhood of Boston, and creating of a new, attractive gateway to the City of Boston.
- Activating the TD Garden/North Station area with a vibrant, mixed-use development with a focus on the site as a sports and entertainment hub.
- Maximizing ground floor retail opportunities for businesses to serve the needs of local residents in and around the Project site, while minimizing the impacts of loading activity by placing loading docks internally on the site.
- Improving the streetscape on Causeway Street with an enhanced walkable, pedestrian-friendly environment.
- Filling in a missing link within the West End neighborhood.

Economic Benefits

- Generating significant new real estate, retail, and hotel related tax revenues for the City of Boston.
- Providing new affordable housing units consistent with the Mayor's executive order relative to affordable housing and the BRA's inclusionary development policy.
- Creating approximately 2,000 construction jobs and 5,000 permanent jobs in the City of Boston.
- Contributing approximately $9,000,000 in housing linkage funds and approximately $1,800,000 in jobs linkage funds in accordance with the provisions of Section 80B-7 of the Boston Zoning Code.
- Providing additional day care opportunities within the neighborhood.

Environmental Benefits

- Utilizing sustainable design and green building features to promote energy conservation, and to comply with the provisions of Article 37 of the Boston Zoning Code.
- Improving stormwater runoff from the site by replacing a surface parking lot with new development, a portion of which will include a green roof.
- Developing in an area with appropriate capacity to support the Project.
- Creating approximately 497 new residential units proximate to public transportation, jobs, and services.
- Furthering the principles of Smart Growth by the development of high density housing and mixed-use project next to public transport, as well as adjacent to Lovejoy Wharf, a future water taxi location.
- Improved visual environment, public spaces, pedestrian connections and street crossings.

1.5 Legal Information

1.5.1 Legal Judgments Adverse to the Proposed Project

The Proponent is not aware of any legal judgments or actions pending concerning the Project or Project site.

1.5.2 History of Tax Arrears on Property

The Proponent owns no real estate in Boston on which real estate tax payments are in arrears.

1.5.3 Evidence of Site Control

Boston Garden Development Corp. acquired fee title to the portion of the Project site commonly referred to as the "Old Garden Site" by deed dated June 27, 2013 from Delaware North Companies, Inc. - Boston, formerly known as New Boston Garden Corporation, recorded with Suffolk County Registry of Deeds in Book 51706, Page 307. 120 Nashua Street, LLC, an affiliate of Boston Garden Development Corp. acquired fee title to Legend's Way, a portion of the Project site, by deed dated June 6, 2012 from the MBTA, recorded with Suffolk County Registry of Deeds in Book 49634, Page 226. Boston Garden Development Corp. and Boston Properties Limited Partnership have entered into a Letter of Intent dated May 30, 2013 to develop the Project site.

1.5.4 Public Easements

The Project is subject to the following easements:

- Superplatform Access Easement (Book 18192, Page 131) (easement to MBTA to construct and maintain an Access Structure on the Project site leading from the Orange Line/Green Line platform at North Station);
- Green Line Easement (Book 18192, Page 122) (easement to MBTA to construct and maintain a tunnel under the Project site for the Green Line);
- Encroachment Easement (Book 49634, Page 245) (easement to allow the Access Structure and Green Line tunnel to encroach on the Project site; easement to allow drainage easement to encroach on the Project site);
- Public passageway over Parcel D1, now or formerly owned by the BRA (Book 10280, Page 282);
- Relocation of Cross Platform Access Easement (Book 41333, Page 332) (relocates Cross Platform Access Easement to MBTA (Book 18192, Page 140) for pedestrian access to and from Causeway Street to and from TD Garden to the public passageway over Parcel D1, which is located adjacent to the Project site; and relocates passenger waiting area and ticketing facility to TD Garden);
- MBTA reserved ground and subsurface rights in Legend's Way (Book 18192, Page 156);
- Easements included in the New Boston Garden Master Cooperation Agreement by and among MBTA and New Boston Garden Corp. and Garden Corporation;
- Ramp currently under construction on Legend's Way for entrance to and exit from the North Station Parking Garage that is located underground, adjacent to the Project site; and
- City of Boston Sewer Easement (shown on 1992 subdivision plan to be located under Legend's Way as shown on Plan 1754).

1.6 Public Participation

The Proponent has communicated with the following organizations regarding the Project: West End Civic Association, West End Council, West End Place Association, West End Community Center, Strada Residents Association, Downtown North Association, North End Chamber of Commerce, North End Residents Association, and North End Waterfront Council. In addition to these groups, the Proponent has met with public agencies and public officials, including the following interested parties: City Councilor Mike Ross, City Councilor Sal Lamattina, State Representative Aaron Michlewitz, State Representative Jay Livingstone, State Senator Anthony Petruccelli, and Nicole Leo from the Mayor's office.

Chapter 2.0

Project Description

2.0 PROJECT DESCRIPTION

2.1 Project Site

The Project site is an approximately 2.8-acre vacant parcel on the former site of the original Boston Garden before the arena's demolition in 1998. Most of the site is currently being utilized as a paved surface parking lot with access directly from Causeway Street, while a portion of the site includes a section of the pedestrian connection from Causeway Street to North Station and the TD Garden. The site is bounded by Causeway Street to the south, the TD Garden to the north, the pedestrian connection from Causeway Street to the TD Garden and North Station to the west and Interstate 93 to the east. A ramp is currently under construction on the eastern side of the site to connect Causeway Street to the parking garage under North Station and TD Garden. See Figure 2-1 for an aerial locus map of the Project site. Figures 2-2 and 2-3 present photos of the existing conditions in the area in and around the Project site.

2.1.1 Site and Permitting History

2.1.1.1 Background Information

The Project site is part of a larger redevelopment area that has a permitting history dating back over several decades. Planning efforts for the redevelopment of the North Station area began as early as 1960 by area merchants. By 1977, the BRA had become a leading proponent for economic redevelopment within the North Station area and was responsible for the preparation of numerous studies and reports for various development alternatives. One of the reports, the "North Station Final Project Report, Application for Project Execution, submitted to Executive Office of Communities and Development, Commonwealth of Massachusetts" led to the adoption, in August of 1980, of the North Station Urban Renewal Plan (the "Urban Renewal Plan"). The planning and design objectives of the Urban Renewal Plan included the development of a program of uses, including office space (1,000,000 sf), retail commercial space (200,000 sf), and parking (1,500 spaces) within Sub-Area I, which includes the Project site.

In 1985, the City issued a request for proposals in the form of a document entitled, "Design Development Guidelines: Nashua Street Parking Lot, North Station, City of Boston Public Facilities Department" (the "RFP"). This document requested proposals for a multi-use development on the City-owned Nashua Street parking lot at North Station, including a new or substantially renovated arena, office and retail space, a hotel, housing, and parking. A few years later, in 1989, the BRA adopted Article 39 of the Boston Zoning Code, which established the zoning for the North Station Economic Development Area (EDA).

Three separate development proposals were submitted to the City in response to the RFP, but none were acceptable to the City. In 1987, New Boston Garden Corporation (NBGC) submitted its own development proposal to the City in response to the RFP. In June of

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The Boston Garden Boston, Massachusetts

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Figure 2-1
Aerial Locus Map

Site View Down Canal Street

Site View From Canal Street & Causeway Street

Site View West Down Causeway Street

Site View East Down Causeway Street

1988, NBGC received notice of the City's intent to grant NBGC tentative designation to redevelop Boston Garden/North Station. In January 1989, a Memorandum of Agreement (MOA) was reached between the City, the BRA, and NBGC establishing the terms and conditions of the development program. The MOA permitted NBGC to construct a new arena on City-owned air rights behind the old Boston Garden and to develop a total of 2,300,000 sf of commercial space on the site of the old Boston Garden and adjacent parcels. In February of 1989, a MOA was reached between NBGC and the MBTA, the owners of the commuter rail facilities at North Station. Together, these two agreements provided that NBGC, the City, the BRA, and the MBTA would cooperate in the development efforts for the North Station/Boston Garden area as part of a unique public and private partnership, including construction of a new arena in air rights over the MBTA's North Station commuter rail facilities and underground parking garage.

As described in the Draft Project Impact Report / Draft Environmental Impact Report (DPIR/DEIR) for the redevelopment of the Boston Garden/North Station, the area was proposed to include the construction of a new multi-purpose arena near the existing Boston Garden site, a commercial component of three buildings containing 2,300,000 sf of office and retail space, a public concourse containing a minimum of 16,000 sf, and an underground parking garage for 1,100 vehicles (the "Original Proposal"). Several phases of the public/private development efforts for the North Station/Boston Garden area have already been completed, including (i) construction of the underground MBTA parking garage, which contains parking for 1,275 vehicles; (ii) relocation of the MBTA Green Line; (iii) creation of a new underground rapid transit station serving both the MBTA Orange and Green Lines; (iv) extension of the MBTA North Station commuter rail platforms; (v) construction of the 16,000 sf public concourse; and (vi) construction of the TD Garden (the "New Arena"). Another phase of the development, consisting of a residential project known as the "Nashua Street Residences", is expected to begin construction soon. The final phase, consisting of the proposed Project, will complete the City's vision for the Boston Garden/North Station area, and create long-awaited synergies with the New Arena and North Station, and with Causeway Street, that will combine to make the heart of this district a vibrant and exciting place to live, work, visit and shop.

In addition to the developments described above, several significant roadway improvements have been made in and around the North Station/Boston Garden area. These improvements include the redesign of Nashua Street to accommodate traffic from the MBTA Garage, reconstruction of Merrimac Street, and the depression of the Central Artery. Note that environmental review of the Central Artery/Tunnel project included, as part of the expected background growth, a program similar to the Original Proposal described above, thereby leading to a roadway design which could accommodate traffic from a large scale development on the Project site.

2.1.1.2 Development Review/Permitting History

The New Arena and the Nashua Street Residences projects have undergone extensive review under Article 80 of the Boston Zoning Code and MEPA. Highlights of the permitting history are set forth below:

1. Review of the New Arena

A DPIR/DEIR for the Original Proposal was submitted to the BRA and MEPA in October 1990. The BRA issued a Preliminary Adequacy Determination scoping further study in a Final Project Impact Report (FPIR) for the New Arena portion of the Project, and allowed the detailed environmental study of the commercial development, which included two office buildings, a third office or hotel building, a retail base, and a six level underground parking garage (the "Proposed Commercial Component"), to be deferred until the balance of the project was more defined. An FPIR was submitted to the BRA for the New Arena on August 13, 1992, and an Adequacy Determination was issued by the BRA on September 28, 1992 for the New Arena portion of the project only.

Similarly, a request for a Phase I waiver was submitted to the Executive Office of Environmental Affairs (now the Executive Office of Energy and Environmental Affairs [EEA]) in October 1990, in association with the DPIR/DEIR for the project, to permit the New Arena portion of the project to proceed while allowing the detailed environmental study of the Proposed Commercial Component to be deferred. EEA issued the Final Record of Decision for the New Boston Garden on January 3, 1991, allowing the New Arena to be built as a replacement for the existing Boston Garden. Environmental study of the Proposed Commercial Component was deferred until the remainder of the development was proposed for construction.

2. Review of the Nashua Street Residences Project

In 2003, NBGC decided to pursue the development of a residential building on a parcel of land bounded by Nashua Street to the west, Partners HealthCare property to the north, the New Arena/North Station to the east and the Thomas P. O'Neill Federal Building to the south (the "Nashua Street Site"). Following meetings with both the BRA and MEPA, it was determined that the BRA and MEPA files for the New Arena and the Proposed Commercial Component would be closed and new filings would be made just for the residential project. Review of the "Nashua Street Residences" underwent an extensive public review process under Article 80 of the Boston Zoning Code, including review of a PNF filed on April 2, 2004 and a joint DPIR/DEIR filed on October 15, 2004. The BRA Board voted on April 7, 2005 to authorize the Director to issue a Preliminary Adequacy Determination for the Nashua Street Residences, which was issued by the Director on May 5, 2005. A Notice of

Project Change (NPC) was filed with the BRA on May 25, 2006, which requested the conversion of proposed rental apartment units into condominium units and an increase in the number of parking spaces. The NPC was approved by the BRA Board on August 10, 2006.

Nashua Street Residences also underwent an extensive review process under MEPA, including review of an Environmental Notification Form (ENF) filed on April 15, 2004, a joint DPIR/DEIR filed on October 15, 2004, and a Final Environmental Impact Report (FEIR) filed on February 15, 2005. A MEPA Certificate on the FEIR was issued on April 1, 2005. An Advisory Opinion was issued resulting in no finding, no Lapse of Time under the MEPA regulations as of December 14, 2010.

In 2012, NBGC entered into an agreement to sell the Nashua Street Site to AvalonBay Communities, Inc. ("AvalonBay"). An NPC was filed by AvalonBay on November 16, 2012, and the BRA Board voted to waive further review of the project on February 14, 2013.

On January 31, 2013, AvalonBay submitted an NPC to MEPA requesting an increase in square footage from 572,071 sf to 636,551 sf, as well as an increase of 140 units and decrease of 25 parking spaces. On March 8, 2013, it was determined that no further MEPA review was required.

2.2 Proposed Development

2.2.1 Description

This long awaited Project will develop the vacant site currently used for parking along Causeway Street into a vibrant, mixed-use development that will further activate the area, especially during the times when the adjacent TD Garden is not in use.

The Project is a mixed-use development of approximately 1,870,000 sf with retail, restaurants, office, hotel, and residences. The Project includes a 40,000 sf expansion of TD Garden as well as new connections from Causeway Street, North Station, TD Garden and the MBTA Green and Orange Lines as more particularly described below.

Table 2-1 presents the Project program.

Table 2-1 Project Program

Project Element	Approximate Dimension
Residential	560,000 sf / 497 units
Hotel	200,000 sf / 306 keys
Flex Office	142,000 sf
Office	668,000 sf
Retail/Restaurant	235,000 sf
TD Garden Expansion	40,000 sf
Atrium Hall	25,000 sf
Total Square Footage	**1,870,000 sf**
Parking	800 spaces
Height (according to Boston Zoning Code)	600 feet

The site is divided into two blocks: the base of the west block has one retail level below grade and four levels above grade, and the east block has retail below grade, two levels of retail and four levels of flex office above grade for include approximately 235,000 sf of retail space and 142,000 sf of flex office space. Major retail tenants may include a grocery store and pharmacy on the lower level, in line retail uses at street level, full service restaurants on the second level, and a cinema on the upper levels. See Figures 2-4 through 2-7 for floor plans. The new entrance to the TD Garden is comprised on an atrium hall which includes several passageways that facilitate the movement of Project patrons and members of the public into and through the Project site. Comprising approximately 25,000 sf, this atrium hall includes a multilevel entrance off Causeway Street that draws visitors and commuters through all of the new commercial activities approaching the TD Garden and North Station, and a weather protected passageway below grade that brings visitors traveling on the Orange and Green Lines into the Project or through it on their way to the TD Garden or North Station. The north side of the retail base will include an approximately 40,000 sf expansion on levels 3-7 of the TD Garden for expanded concessions and elevator lobbies. The roof of the base podium will include a residential amenity space.

Above the retail base will be three new towers. On the west side of the site will be a residential tower with approximately 497 units. On the east side of the site will be an office tower with approximately 668,000 sf. In the middle will be the third tower, containing a hotel with approximately 306 rooms. See Figure 2-8. The development will include a four-level below-grade parking facility for approximately 800 vehicles, which will be integrated with the existing garage under North Station and TD Garden.

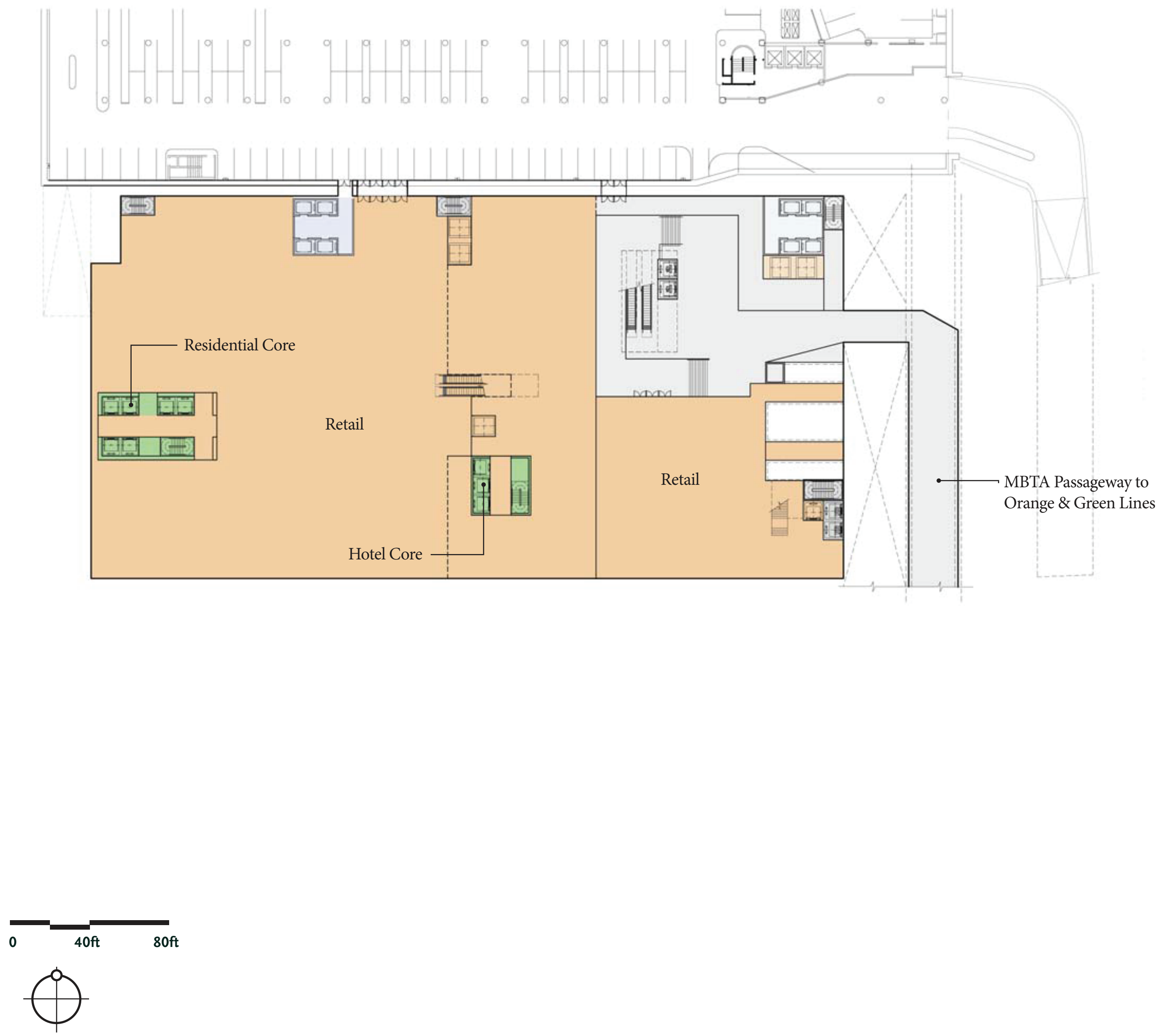


Figure 2-4

Basement Level Plan

Figure 2-5

Ground Floor Plan

Figure 2-6
Second Floor Plan

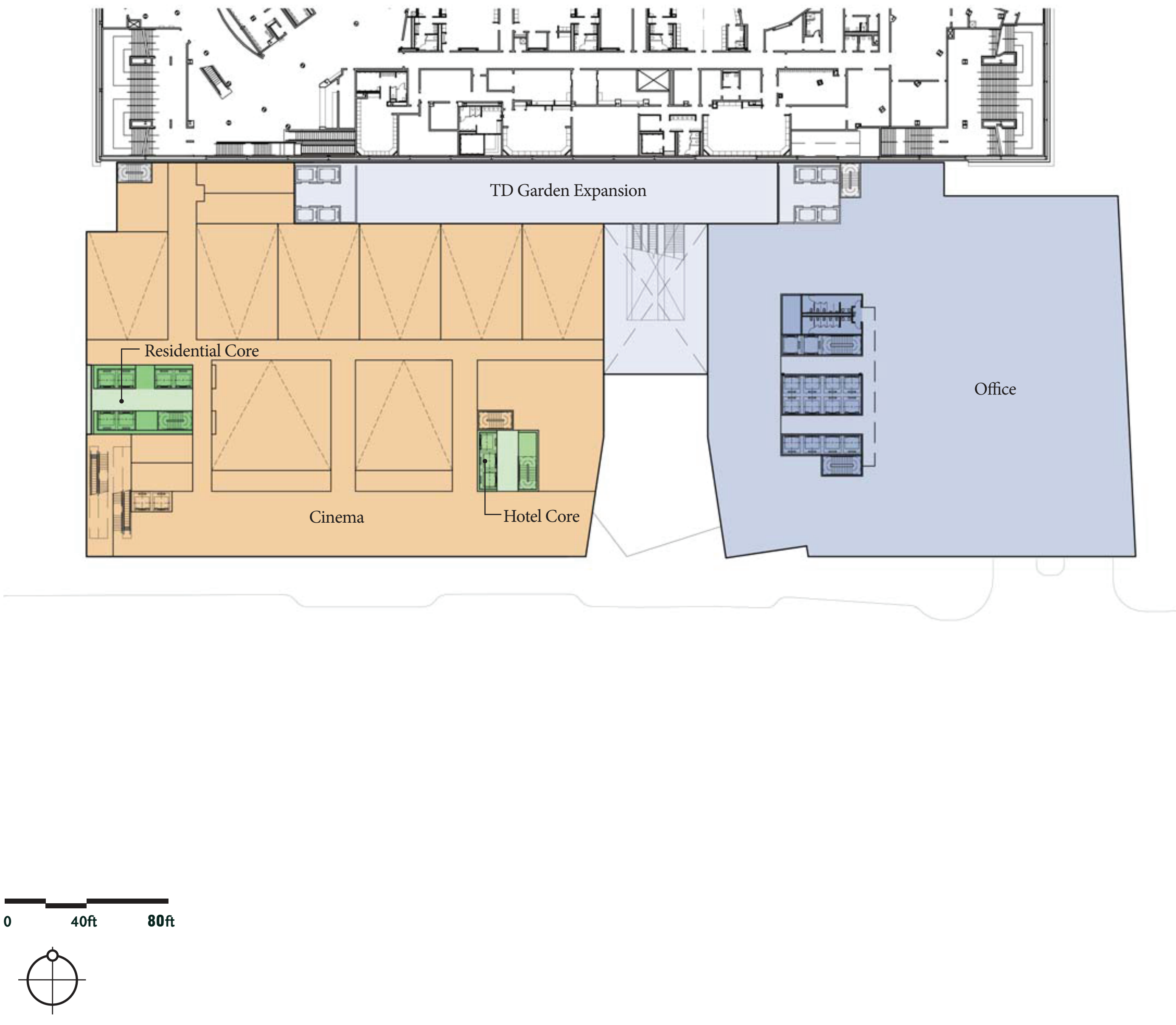
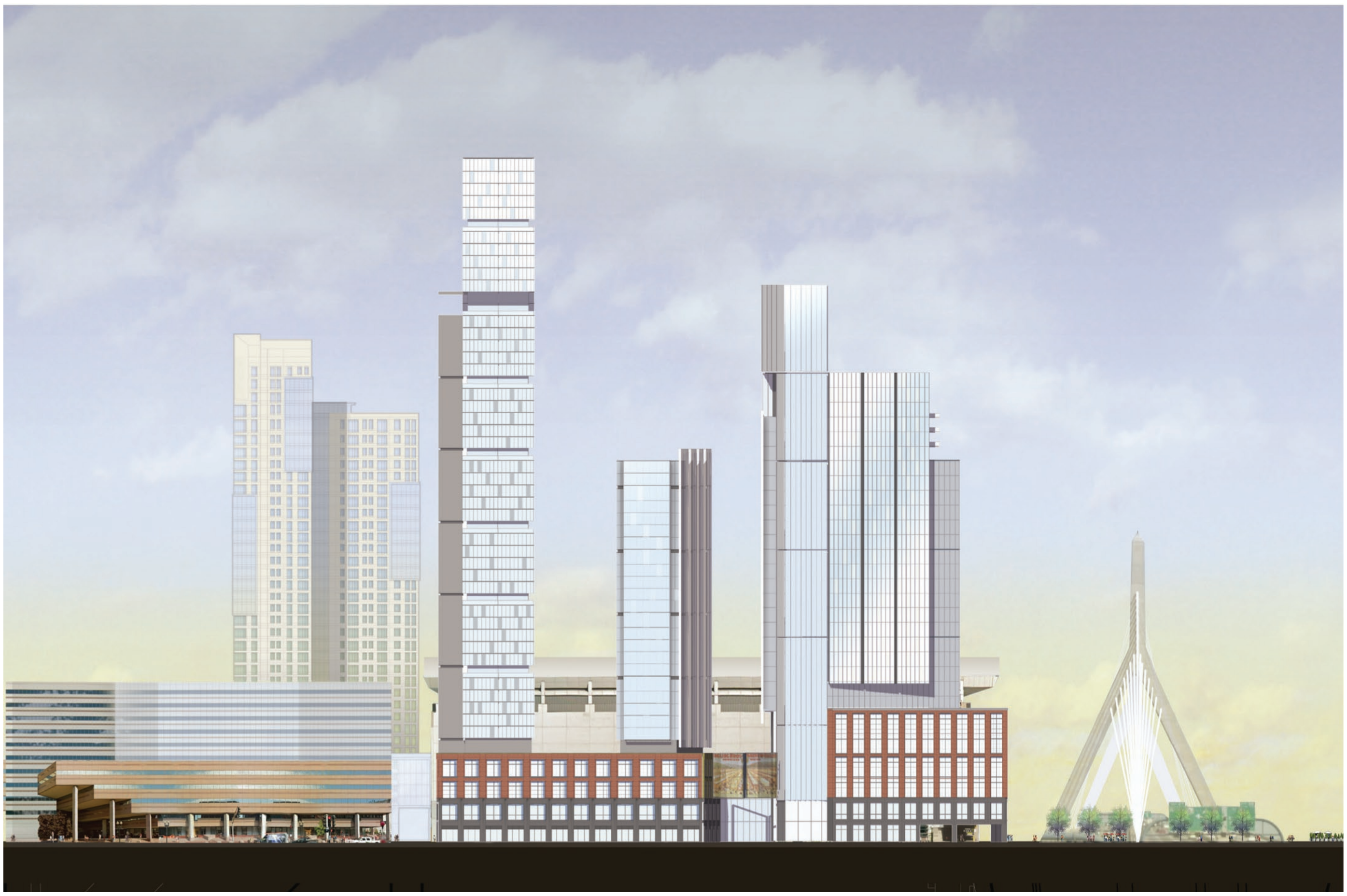


Figure 2-7

Third Floor Plan



The Boston Garden Boston, Massachusetts

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Figure 2-8

Causeway Street Elevation

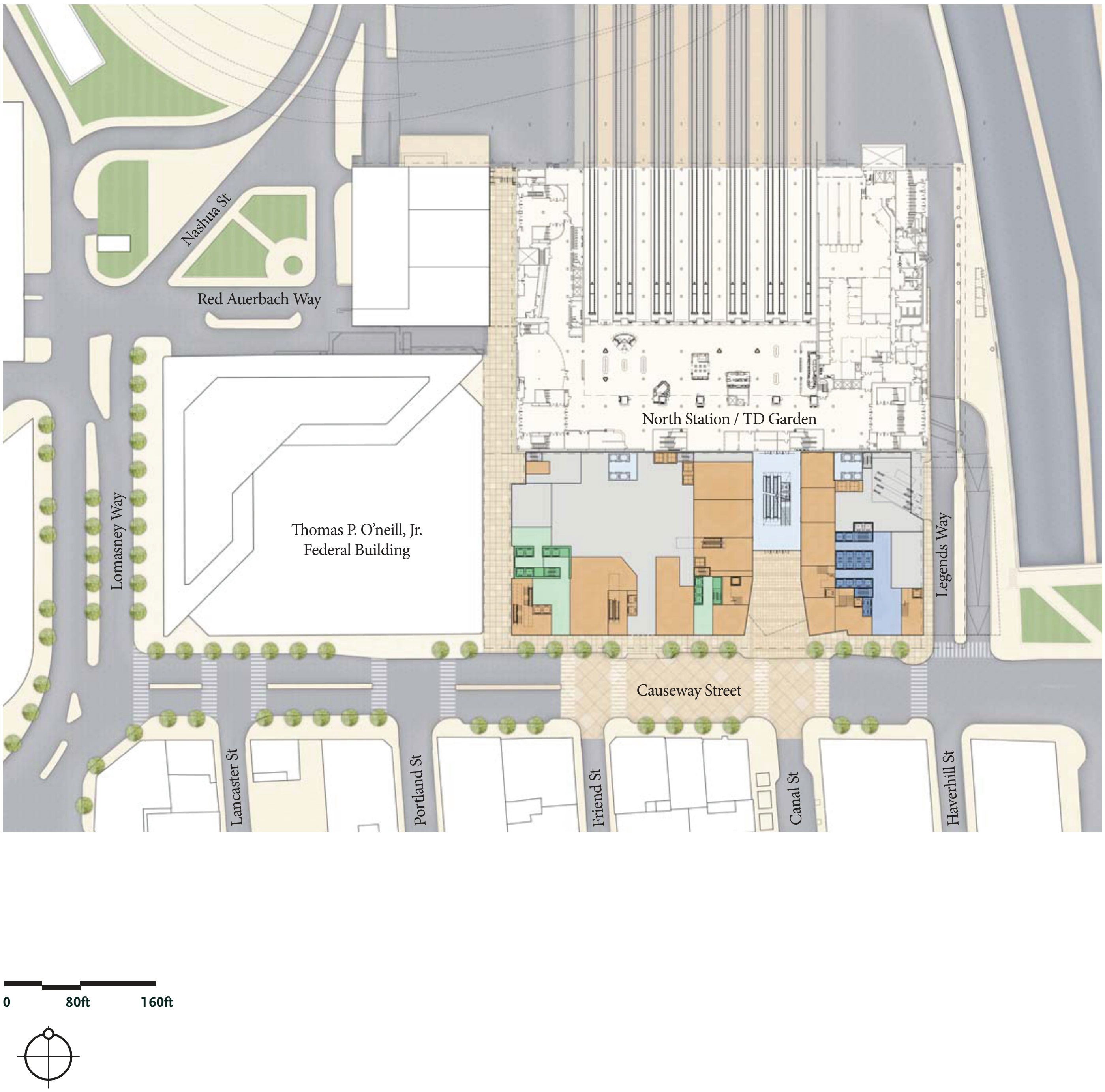
The massing of the Project will be broken up along Causeway Street into two separate "blocks" on either side of the atrium hall. The atrium hall will continue the pedestrian route from Canal Street to the north, extending the pedestrian experience from the new developments and transportation grid in the Bulfinch Triangle to North Station. See Figure 2-9 for a site plan. The atrium hall will be open to the public seven days a week during hours of subway operation. The location of the atrium hall will provide a visual connection from the Project site toward Haymarket. The Project will further connect to its surroundings with the design of the podium that will take into consideration the history of the Bulfinch Triangle in regard to materiality and composition, relating to the Project's historic and contemporary neighbors.

In addition to the activity created by the atrium hall, Causeway Street will be activated with ground level retail, entrances to upper and lower level retail, and entrances to the office, hotel, and residential towers. The ground and second levels further enhance the urban experience at the street level with large areas of glass that will display the activity within the building. The facade of the atrium hall will be visually permeable. A plaza space in front of the atrium hall will mediate between the indoor pedestrian traffic of the atrium hall and the pedestrian traffic on the street. This plaza will provide an atmosphere conducive to a variety of different scaled interactions, including travelers entering the city for the first time, a person meeting friends for lunch or shopping, or a large game-day rally.

Although the primary entry to North Station and TD Garden will be through the new atrium hall, the pedestrian passage to the west of the Project site will continue to serve as a secondary entry to North Station and TD Garden, and will connect to the proposed Nashua Street Residences. Figure 2-10 presents the primary pedestrian and train access routes. This passage will have a combination of building service and retail activity and/or residential lobby space at the base of the proposed building. The east portion of the ground level of the Project will provide covered access to the existing TD Garden loading area, as well as the new ramp to access the existing parking garage below North Station.

An interior loading area will be provided for both the east and west portions of the Project. The west loading entrance occurs on Causeway Street between retail tenants and serves the west retail block and the residential and hotel towers, while the east loading entrance services the east retail block and office tower, and occurs on Legends Way along the existing service access to the TD Garden.

As part of the Project, the developer will undertake streetscape improvements around the building structure along Causeway Street. These improvements will include new sidewalks with granite curbs, new street lights, new street furniture, and new street trees.



The Boston Garden **Boston, Massachusetts**

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Figure 2-9

Site Plan

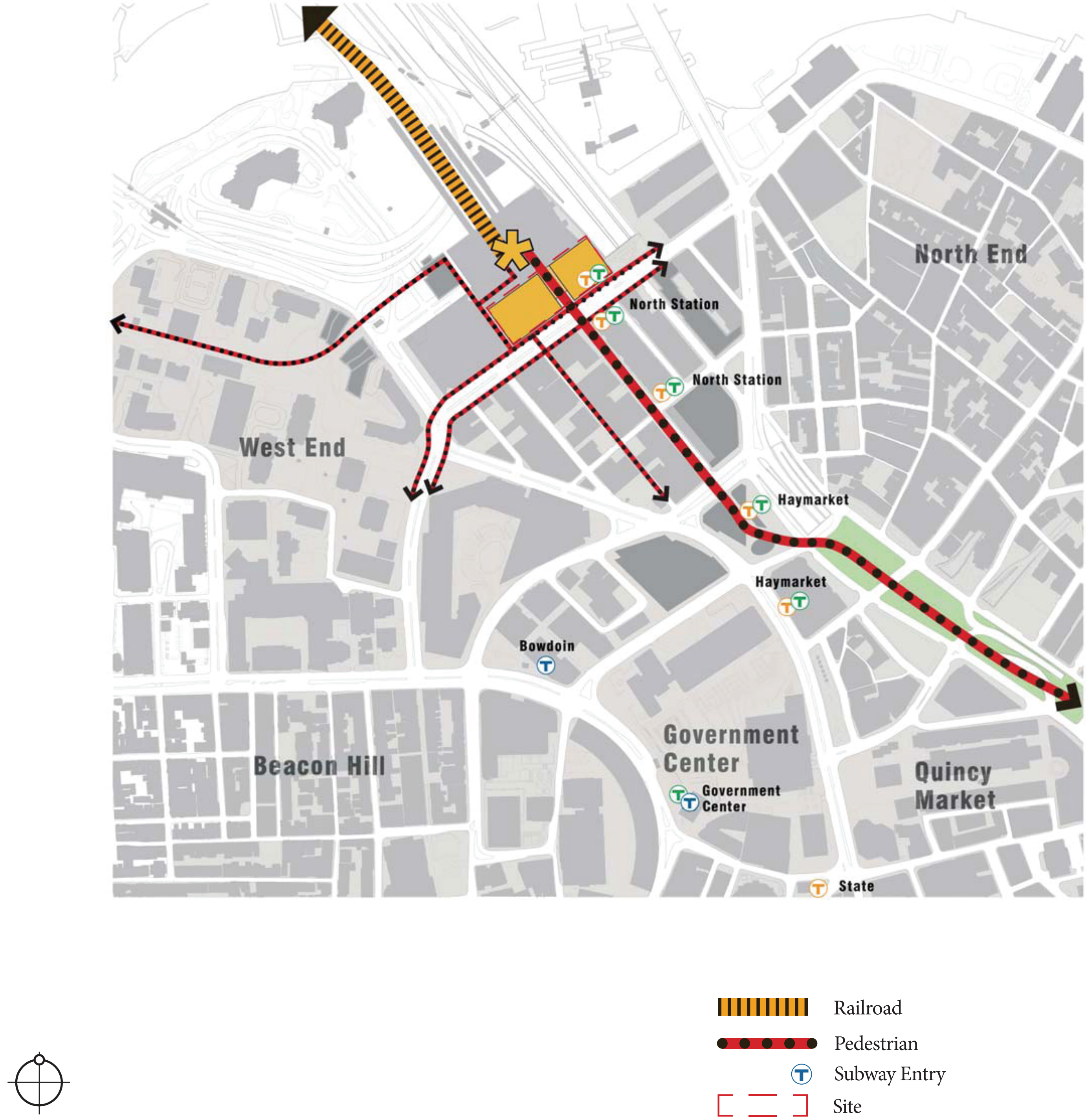

Figure 2-10
Primary Pedestrian and Train Access

2.2.1.1 Parking and Access

The development will include a four-level below-grade parking facility for approximately 800 vehicles, which will be integrated with the existing garage under North Station and TD Garden. The existing garage is leased to Boston Garden Development Corp. pursuant to a long term lease, and both the existing and new garage expansion will operate as a unified garage. A ramp connecting Causeway Street to the existing garage is currently under construction, and access to and egress from the new expansion will be via the two entrances and exits to and from the existing garage.

The Project represents the completion of the overall redevelopment of North Station and the former Boston Garden site that was contemplated as a part of the 1980 Urban Renewal Plan for the North Station Economic Development Area, and was reflected in the traffic volume projections that formed the basis of the constructed elements of the Central Artery/Tunnel (CA/T) project and the Bulfinch Triangle surface street network. As such, the planned and constructed transportation system that serves the North Station area presents the central elements to support this transit-oriented development. Additional enhancements to Causeway Street to support access to the Project site and to integrate the Project into the pedestrian environment will be developed, including the expansion and rehabilitation of the sidewalk infrastructure along the Project frontage in the context of the City's Crossroads Initiative for Causeway Street, which will be a central piece of the Project's improvement program.

The Project has also been designed to be integrated into the event traffic management plan that is coordinated with the Boston Transportation Department (BTD), the Boston Police Department and the Massachusetts State Police for event conditions at TD Garden.

2.3 City of Boston Zoning

A summary of the provisions of the Boston Zoning Code (the "Zoning Code") that are applicable to the Project is set forth below.

Zoning Districts

According to the map entitled, "Map 1B North Station Economic Development Area," effective September 19, 2003 (the "Zoning Map"), the Project site is located in the New Boston Garden Development Area of the North Station Economic Development Area. The Zoning Map also indicates that the property is located in an area where Planned Development Areas may be permitted. The Project site is located within the Restricted Parking Overlay District, but is not located within the Groundwater Conservation Overlay District.

Permitted Uses

The Project site is subject to Article 39-12.2 of the Zoning Code, pursuant to which office, residential, retail and hotel uses are allowed as of right.

Dimensional Regulations

Pursuant to § 39-6 of the Zoning Code, the Project is subject to a height limit of 400 feet and an FAR of 11, but the Project is not subject to any other dimensional requirements under the Zoning Code. Certain portions of the Project are expected to exceed the maximum height limit of 400 feet, and the Project as a whole is expected to exceed the maximum FAR of 11. Therefore, the Proponent will be seeking permission to deviate from these requirements. Final building design will dictate whether the Proponent will seek additional deviations from the street wall continuity, street wall height, and skyplane setback requirements of § 39-13.

Inclusion of Day Care Facilities

Under § 39-12 of the Zoning Code, any proposed project having a gross floor area, not including the floor area devoted to Residential Uses, which equal or exceeds 100,000 sf, shall devote to day care facilities an amount of floor area equal to at least the amount listed in Table A of § 39-12. The day care facilities may be created on-site or elsewhere in the neighborhood.

Off-Street Parking

The Project site is located within the Restricted Parking Overlay District. Under Article 3-1A(c) of the Zoning Code, any non-residential parking within the Restricted Parking Overlay District requires a conditional use permit from the Board of Appeal. According to § 23-4, off-street parking is not required for retail or office uses in the Restricted Parking Overlay District.

In addition, residential uses require 0.4 off-street parking spaces per dwelling unit, and the Proponent anticipates requesting a deviation from this requirement to provide fewer than the required number of residential off-street spaces. The Proponent may also request a deviation from the parking space design standards of § 23-9.

Off-Street Loading

According to § 39-16 of the Zoning Code, the provision and design of off-street loading facilities for the use of any structure or land that is subject to Large Project Review (Article 80B of the Zoning Code) shall be determined through such review. The number and design of off-street loading facilities will be determined via that review process.

Signs and Wireless Communication Equipment

Article 11 of the Zoning Code establishes requirements for signs. The Proponent will be seeking permission to deviate from these requirements and to establish signage for the area subject to BRA design review. Likewise, Article 86 of the Zoning Code establishes requirements for wireless communication equipment. The Proponent will be seeking to locate wireless communication equipment on the rooftops, subject to BRA design review.

121A Project

The Proponent has determined that the first phase of the Project will not be feasible without governmental intervention in the form of tax relief provided by a 121A determination. Therefore, the Proponent intends to seek approval from the BRA for the Project to be a 121A Project. As part of approving a project under 121A, the BRA has the authority to grant permissions which will be required for the Project under the Boston Zoning Code and other City ordinances.

2.4 Anticipated Permits

The table below provides a preliminary list of local and federal permits and approvals that are anticipated to be required for the Project. It is possible that only some of these permits or actions will be required, or that additional permits or actions will be required.

The Project is currently under review by the Massachusetts Environmental Policy Act (MEPA) Office of the Executive Office of Energy and Environmental Affairs. An Environmental Notification Form (ENF) was filed with the MEPA Office on May 15, 2013. A Draft Environmental Impact Report will be filed with the MEPA Office in the near future.

Table 2-2 List of Anticipated Permits and Approvals

AGENCY	Permit / Approval
Local	
Boston Redevelopment Authority	Article 80B Large Project Review Planned Development Area Review (if applicable) Design Review
Either Boston Zoning Commission or Boston Zoning Board of Appeal	Establish Planned Development Area (if applicable) Zoning Relief (if applicable)
Boston Civic Design Commission	Design Review
Boston Transportation Department	Transportation Access Plan Agreement Construction Management Plan

Table 2-2 List of Anticipated Permits and Approvals (Continued)

AGENCY	Permit / Approval
Local	
Boston Water and Sewer Commission	Water and sewer connection/discharge permits Temporary Construction Dewatering Permit (if required) Cross-connection permit (if required) Site Plan Review
Public Works Department	Curb cut permits (if applicable)
Public Safety Commission	Permit to erect and maintain parking structure
Committee on Licenses/Fire Department	Garage Permit Permit for Storage of Inflammables Fire Safety Permits
Public Improvement Commission	Improvements within public streets or sidewalks Maintenance Agreement Street discontinuances (if applicable) Curb Cuts (if applicable)
Boston Air Pollution Control Commission	Parking Freeze Permit for non-exempt parking spaces included in the Project
Boston Parks Commission	Approval for erection or alteration of a building within 100 feet of a park (if applicable)
Inspectional Services Department	Demolition, Foundation, Building and Occupancy Permits
State	
Boston Redevelopment Authority	121A Approval Minor Modification of North Station Urban Renewal Plan
Executive Office of Energy and Environmental Affairs	MEPA review
Massachusetts Historical Commission	Determination of No Adverse Effect on Historic Properties
Massachusetts Department of Transportation	Highway Access Permit (if applicable) or confirmation that no Highway Access Permit required Licenses to Enter
Executive Office of Transportation and Construction	Approval for building permit on land on or adjacent to railroad corridor
Department of Environmental Protection, Division of Water Pollution Control	Sewer Connection/Extension Permit
Department of Environmental Protection, Division of Air Quality Control	Comprehensive Plan Approval Fossil Fuel Utilization Permit

Table 2-2 List of Anticipated Permits and Approvals (Continued)

AGENCY	Permit / Approval
State	
Massachusetts Water Resources Authority	Temporary Construction Dewatering Discharge Permit (if required) Sewer Use Discharge Permit for discharge of Industrial Waste (if applicable)
Massachusetts Bay Transportation Authority	Approval under existing easements and agreements (if required) Licenses to Enter
Federal	
Federal Aviation Administration	Determination of No Hazard to Air Navigation (for building and crane)
U.S. Environmental Protection Agency	NPDES Notice of Intent for Construction (if required)

2.5 Schedule

The Project is anticipated to be completed in separate phases. The first phase, which includes the retail podium, the atrium hall, expansion of the TD Garden, hotel tower and parking garage, is anticipated to commence in the third quarter of 2014 with completion by the first quarter of 2017. The residential tower and office tower will be constructed in subsequent phases to occur after phase one with construction schedules of approximately 24 to 36 months. The residential tower and office tower may be completed as one phase or as separate phases.

Chapter 3.0

Transportation Component

3.0 TRANSPORTATION COMPONENT

3.1 Introduction

Vanasse & Associates, Inc. (VAI) has conducted a Traffic Impact and Access Study (TIAS) in conjunction with this Expanded PNF to determine the potential impacts on the transportation infrastructure associated with the construction of the Project as described in Chapter 2. This study evaluates the following specific areas as they relate to the Project: i) access requirements; ii) potential off-site improvements; and iii) safety considerations; and identifies and analyzes existing and future conditions, both with and without the Project, on the transportation infrastructure serving the Project site.

This study presents a comprehensive assessment of all elements of the transportation infrastructure serving the Project site and the Bulfinch Triangle, North End and West End neighborhoods. The study area evaluated as a part of this assessment includes all major roadways and intersections that are expected to convey traffic to the Project site, and includes 17 intersections located along Causeway Street, North Washington Street, Merrimack Street, Nashua Street, New Chardon Street, and Lomasney Way, as well as the entirety of the Bulfinch Triangle street network. This expansive study area, determined through consultation with the Boston Transportation Department (BTD), allows for a full evaluation of the transportation system serving the Project site, both at present and with planned future development in the area. Further, the extent of the study area allows for the development of a transportation improvement program that is designed to incorporate a balanced approach to improving traffic flow, public transportation access, and accessibility for pedestrians and bicyclists. These goals have been advanced as part of the transportation improvement program developed for the Project.

3.1.1 Project Impact Summary

The Project is projected to result in 7,034 new automobile trips (two-way, 24-hour volume) on an average weekday, with 6,970 transit trips and 19,352 pedestrian/bicycle trips. During the weekday morning peak hour, the Project is predicted to generate 474 new automobile trips, 516 transit trips and 983 pedestrian/bicycle trips. During the weekday evening peak hour, the Project is predicted to generate 661 new automobile trips, 768 transit trips and 2,019 pedestrian/bicycle trips. On a Saturday, the Project is predicted to generate approximately 9,218 new automobile trips (again, two-way, 24-hour volume), with 13,762 transit trips and 13,566 pedestrian/bicycle trips. During the Saturday midday peak hour, the Project is predicted to generate 654 new automobile trips (356 vehicles entering and 298 exiting), 663 transit trips and 2,076 pedestrian/bicycle trips.

As a result of the analyses presented herein, a comprehensive transportation improvement program has been developed for the Project that has been designed to: i) address the potential impact of the Project on the transportation infrastructure; ii) encourage the use of alternative modes of transportation for those accessing the Project; and iii) address transportation infrastructure deficiencies identified as a part of this study or by the City.

The planned improvements encompass the following general elements:

- Traffic signal improvements, including timing, phasing and coordination plan enhancements both pre- and post-occupancy of the Project;
- Sidewalk and streetscape improvements along the Project site frontage on Causeway Street consistent with, and expanding upon, the City's Causeway Street Crossroads Initiative;
- Pedestrian and bicycle access and safety improvements;
- Advancement of a comprehensive Transportation Demand Management (TDM) program to include specific elements designed to encourage the use of public transportation services, car and vanpooling, and pedestrian and bicycle use;
- Implementation of a detailed Construction Management Plan (CMP) that is designed to reduce impacts during the construction phase of the Project; and
- Integration of a traffic monitoring and reporting program that will be used to document the trip characteristics of the Project under operating conditions, and allow for adjustments to the elements of the TDM program or associated aspects of the transportation improvement program as necessary.

The implementation of the identified improvements will serve to provide additional capacity and enhancements to the transportation system and facilitate access to the Project site in a safe and efficient manner.

3.1.2 Project Description

The Project will entail the construction of a mixed-use, transit-oriented development on the site of the former Boston Garden located at 80 Causeway Street in Boston, Massachusetts, that will consist of the following primary components: an approximately 497 unit residential building; an approximately 306 key/room hotel; approximately 810,000 sf office space consisting of 142,000 sf of low-rise flex office space and 668,000 sf of high-rise office tower space; approximately 235,000 sf of retail/restaurant space which may include a neighborhood grocery store; an approximately 40,000 sf expansion for expanded concession and elevator lobbies within the TD Garden; and an approximately 25,000 sf atrium hall to the North Station commuter rail station that includes the inclusion of the existing headhouse to the MBTA Orange and Green Line portion of North Station into the development. The Project site encompasses approximately 2.8 acres of primarily paved land that accommodates parking for up to 193 vehicles and is bounded by the TD Garden to the north; Causeway Street to the south; Legends Way and I-93 to the east; and Lowell Way (pedestrian right-of-way) to the west. Figure 3-1 depicts the Project site location in relation to the existing roadway network.

The Project represents the fulfillment of the overall redevelopment of North Station and the former Boston Garden site that was contemplated as a part of the 1980 Urban Renewal Plan for the North Station Economic Development Area, and was reflected in the traffic volume projections that formed the basis of the constructed elements of the Central Artery/Tunnel (CA/T) project and the Bulfinch Triangle surface street network. As such, the planned and constructed transportation system that serves the North Station area presents the central elements to support this transit oriented development project.

Vehicular access to the Project site will be provided by way of the driveways serving the TD Garden located off Causeway Street and Nashua Street/Cotting Street, with curbside pick-up/drop-off to be provided in designated areas along Causeway Street. Parking for the Project will be provided by way of the existing parking facility situated beneath the TD Garden which contains approximately 1,275 parking spaces, and a planned expansion of the parking garage beneath the Project site to provide an additional approximately 800 parking spaces (2,075 spaces total at the completion of the Project).

3.1.3 Study Methodology

This study was prepared in consultation with the City of Boston; was performed in accordance with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs (EEA)/MassDOT Guidelines for Environmental Impact Report/ Environmental Impact Statement Traffic Impact Assessments (TIAs), and the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports; and was conducted in three distinct stages.

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

In the second stage of the study, future conditions were projected and analyzed. Specific travel demand forecasts for the Project were assessed along with future demands due to expected growth independent of the Project. A 15-year time horizon was selected for analyses consistent with the planned build-out and occupancy of the Project and other major development projects within the study area. The future conditions analysis conducted in stage two identifies existing or projected future capacity, safety, and site access issues.

The Boston Garden Boston, Massachusetts

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Figure 3-1
Site Location Map

The third stage of the study presents and evaluates measures to address the projected impact of the Project on the transportation infrastructure as identified in stage two of the study, and to facilitate safe and efficient access to the Project site.

3.2 Existing Conditions

A comprehensive field inventory of the study area roadways and intersections was conducted in June, July and October 2011, and updated in July and August 2013. The field investigation consisted of an inventory of existing roadway geometrics; pedestrian and bicycle facilities; on and off-street parking; public transportation services; traffic volumes; and operating characteristics; as well as posted speed limits and land use information within the study area.

3.2.1 Study Area

The study area assessed for the Project is consistent with that which was identified in initial consultation meetings with BTD and as described in the May 2013 ENF filed with the MEPA Office for the Project, and was selected to contain the major roadways providing access to the Project site including: Causeway Street, North Washington Street, Merrimack Street, Nashua Street, New Chardon Street, and Lomasney Way; as well as 17 major intersections located along these roadways and within the Bulfinch Triangle street network, through which Project-related traffic will travel. The 17 study intersections, as shown in Figure 3-2, are:

1. Causeway Street/Staniford Street/Merrimac Street/Lomasney Way (Lowell Square)
2. Causeway Street/Lancaster Street
3. Causeway Street/Portland Street
4. Causeway Street/Friend Street
5. Causeway Street/Canal Street
6. Causeway Street/Haverhill Street/Legends Way
7. Causeway Street/Beverly Street
8. Causeway Street/Medford Street
9. Causeway Street/North Washington Street/Commercial Street (Keany Square)
10. Valenti Way/Canal Street
11. Valenti Way/Haverhill Street
12. Valenti Way/Beverly Street
13. Valenti Way/North Washington Street/Thatcher Street
14. North Washington Street/Beverly Street
15. Lomasney Way/Nashua Street
16. Martha Road/Nashua Street
17. Merrimac Street/New Chardon Street

The Boston Garden **Boston, Massachusetts**

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Figure 3-2
Study Area Map

3.2.2 Geometry

A field inventory of the study area roadways, intersection geometrics, pedestrian accommodations and bicycle facilities was conducted in July and August 2013 and is summarized in the following sections.

3.2.2.1 Roadways

Causeway Street – Causeway Street is a four to six-lane (two to three lanes per direction), urban minor arterial roadway (MassDOT Function Classification) that is under City jurisdiction and traverses a general northeast-southwest direction between Lomasney Way and North Washington Street. Sidewalks are provided continuously along both sides of Causeway Street with on-street parking accommodated in designated areas along the south side between Portland Street and Canal Street, and along the north side between Canal Street and Friend Street. MBTA bus stops are provided along both sides of Causeway Street at its intersection with Canal Street. The headhouse to the MBTA Green Line/Orange Line portion of North Station is located on the northwest corner of the intersection of Causeway Street at Haverhill Street and Legends Way, with North Station on the MBTA Commuter Rail system located along the north side of Causeway Street. At present formal bicycle accommodations are not provided along Causeway Street; however, the City of Boston is undertaking a redesign of Causeway Street as a part of the City's Crossroads Initiative (discussed in Section 3.3) that includes the addition of bicycle lanes or shared travel lane designation ("sharrows") along Causeway Street, as well as sidewalk extensions and widening and streetscape improvements. Land use along Causeway Street consists of the Project site, the TD Garden, the Garden Garage, residential and commercial properties, Portal Park, the O'Neill Federal Building, and areas of open space.

North Washington Street – North Washington Street is a four to six-lane (two to three lanes per direction), urban principal arterial roadway that is under City jurisdiction and traverses a general north-south direction between Haymarket Square (New Chardon Street) and City Square. Sidewalks are provided along both sides of North Washington Street with on-street parking provided in designated areas along one or both sides of the roadway south of Causeway Street/Commercial Street. MBTA bus stops are provided at Valenti Way and at Commercial Street/Causeway Street. Formal bicycle facilities are not currently provided along North Washington Street. Land use along North Washington Street consists of residential and commercial properties, and areas of open space as a part of the Rose Kennedy Greenway.

Merrimac Street – Merrimac Street is a four lane (two lanes per direction), median divided, urban minor arterial roadway that is under City jurisdiction and traverses a general northwest-southeast direction between Staniford Street/Causeway Street and New Chardon Street. Sidewalks are provided along both sides of Merrimac Street with on-street parking provided in designated areas along one or both sides of the roadway south of Staniford

Street/Causeway Street. Formal bicycle facilities are not currently provided along Merrimac Street. Land use along Merrimac Street consists of residential and commercial properties, and the Suffolk County Probate and Family Court.

Nashua Street – Nashua Street is a four lane (two lanes per direction), urban principal arterial roadway under City jurisdiction that traverses a circuitous northwest-southeast direction between Lomasney Way/Martha Road and Leverett Circle. Sidewalks are provided along both sides of Nashua Street with on-street parking provided in designated areas along one or both sides of the roadway south of the previous Spaulding Rehabilitation Hospital and the Suffolk County Jail. Formal bicycle facilities are not currently provided along Nashua Street. Land use along Nashua Street consists of residential and commercial properties, the Suffolk County Jail, and areas of open space as a part of the Nashua Street Park and the West End Park.

Lomasney Way – Lomasney Way is a six lane (three lanes per direction), urban principal arterial roadway under City jurisdiction that traverses a general northwest-southeast direction between Nashua Street/Martha Road and Causeway Street. Sidewalks are provided along both sides of Lomasney Way with on-street parking prohibited. Formal bicycle facilities are not currently provided along Lomasney Way. Land use along Lomasney Way consists of residential and commercial properties, the TD Garden, the Garden Garage, the O'Neill Federal Building, the West End Museum and areas of open space as a part of the West End Park.

New Chardon Street – New Chardon Street is a six lane (three lanes per direction), median divided, urban principal arterial roadway under City jurisdiction that traverses a general northeast-southwest direction between Merrimac Street and North Washington Street. Sidewalks are provided along both sides of New Chardon Street with on-street parking prohibited. Formal bicycle facilities are not currently provided along New Chardon Street. Land use along New Chardon Street consists of residential and commercial properties, the Suffolk County Probate and Family Court, the Government Center parking garage, Haymarket Station on the MBTA Orange Line and supporting bus lines, and areas of open space as a part of the Rose Kennedy Greenway.

3.2.2.2 Intersections

Table 3.2-1 and Figure 3-3 summarize lane use, traffic control, pedestrian and bicycle accommodations and other existing features at the study area intersections as observed in July and August 2013.

Table 3.2-1 Study Area Intersection Description

Intersection	Traffic Control Type[a]	Pedestrian Accommodations? (Yes/No/Description)	Bicycle Accommodations? (Yes/No/ Description)	Bus Stop? (Yes/No and Location)	On-Street Parking? (Yes/No/ Location)	Loading Zone? (Yes/No/ Location)	Other Defining Feature
Causeway Street/Staniford Street/Merrimac Street/Lomasney Way	TS	Yes – sidewalks, crosswalks, and traffic signal equipment/phasing provided	Yes - Detection	No	Yes – both sides of Merrimac Street and Staniford Street	No	
Causeway Street/Lancaster Street	NC	Yes – sidewalks and crosswalk across Lancaster Street	No	No	Yes – both sides of Lancaster Street	No	Lancaster Street is one-way southbound
Causeway Street/Portland Street	TS	Yes – sidewalks, crosswalks, and traffic signal equipment/phasing provided	No	No	Yes – south side of Causeway Street east of intersection and metered parking on Portland Street	No	Portland Street is one-way northbound
Causeway Street/Friend Street	NC	Yes – sidewalks and crosswalks provided	No	No	Yes – south side of Causeway Street	No	Friend Street is one-way southbound
Causeway Street/Canal Street	S	Yes – sidewalks and crosswalks provided	No	No	Yes – south side of Causeway Street and both sides of Canal Street	No	Canal Street is one-way northbound
Causeway Street/Haverhill Street/Legends Way	TS	Yes – sidewalks, crosswalks, and traffic signal equipment/phasing provided	No	Yes – northwest and southeast corners	No	No	Haverhill Street is one-way northbound

[a]See notes at end of table.

Table 3.2-1 Study Area Intersection Description (Continued)

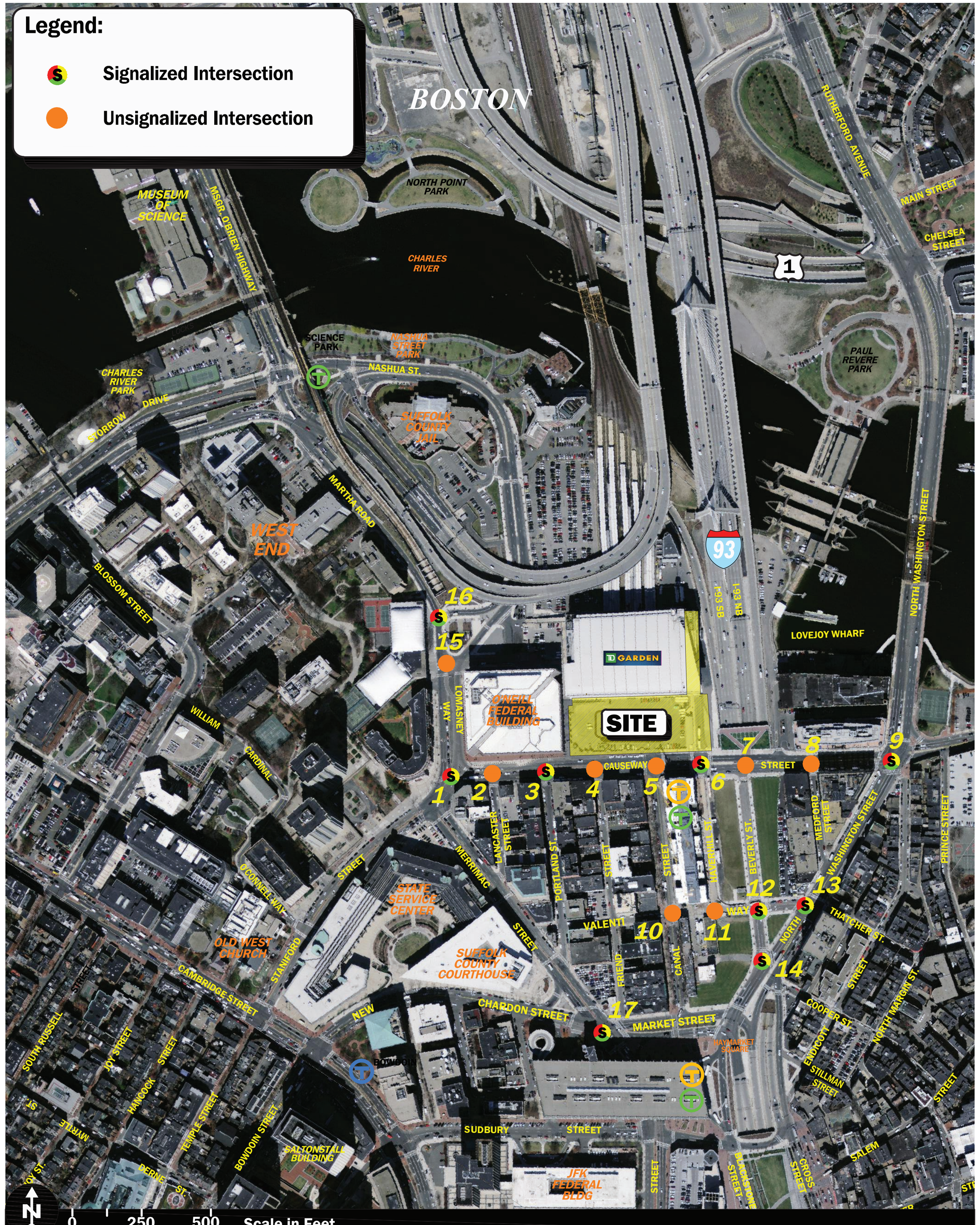
Intersection	Traffic Control Type[a]	Pedestrian Accommodations? (Yes/No/Description)	Bicycle Accommodations? (Yes/No/ Description)	Bus Stop? (Yes/No and Location)	On-Street Parking? (Yes/No/ Location)	Loading Zone? (Yes/No/ Location)	Other Defining Feature
Causeway Street/Beverly Street	NC	Yes – sidewalks and crosswalks provided	No	No	No	No	Beverly Street is one-way southbound
Causeway Street/Medford Street	S	Yes – sidewalks and crosswalks provided	No	No	Yes – both sides of Medford Street	No	Medford Street is one-way northbound
Causeway Street/North Washington Street/Commercial Street	TS	Yes – sidewalks, crosswalks, and traffic signal equipment/phasing provided	No	Yes – northeast corner	Yes – both sides of North Washington Street south of intersection	No	
Valenti Way/Canal Street	S	Yes – sidewalks and crosswalks provided	No	No	Yes – both sides of Canal Street	No	Valenti Way is one-way westbound east of the intersection and one-way eastbound to the west; Canal Street is one-way northbound
Valenti Way/Haverhill Street	NC	Yes – sidewalks and crosswalk provided	No	No	No	No	Valenti Way is one-way westbound and Haverhill Street is one-way northbound
Valenti Way/Beverly Street	TS	Yes – sidewalks, crosswalks, and traffic signal equipment/phasing provided	No	No	No	No	Valenti Way is one-way westbound and Beverly Street is one-way southbound
Valenti Way/North Washington Street/Thatcher Street	TS	Yes – sidewalks, crosswalks, and traffic signal equipment/phasing provided	No	Yes – southeast corner	Yes – east side of North Washington Street	No	

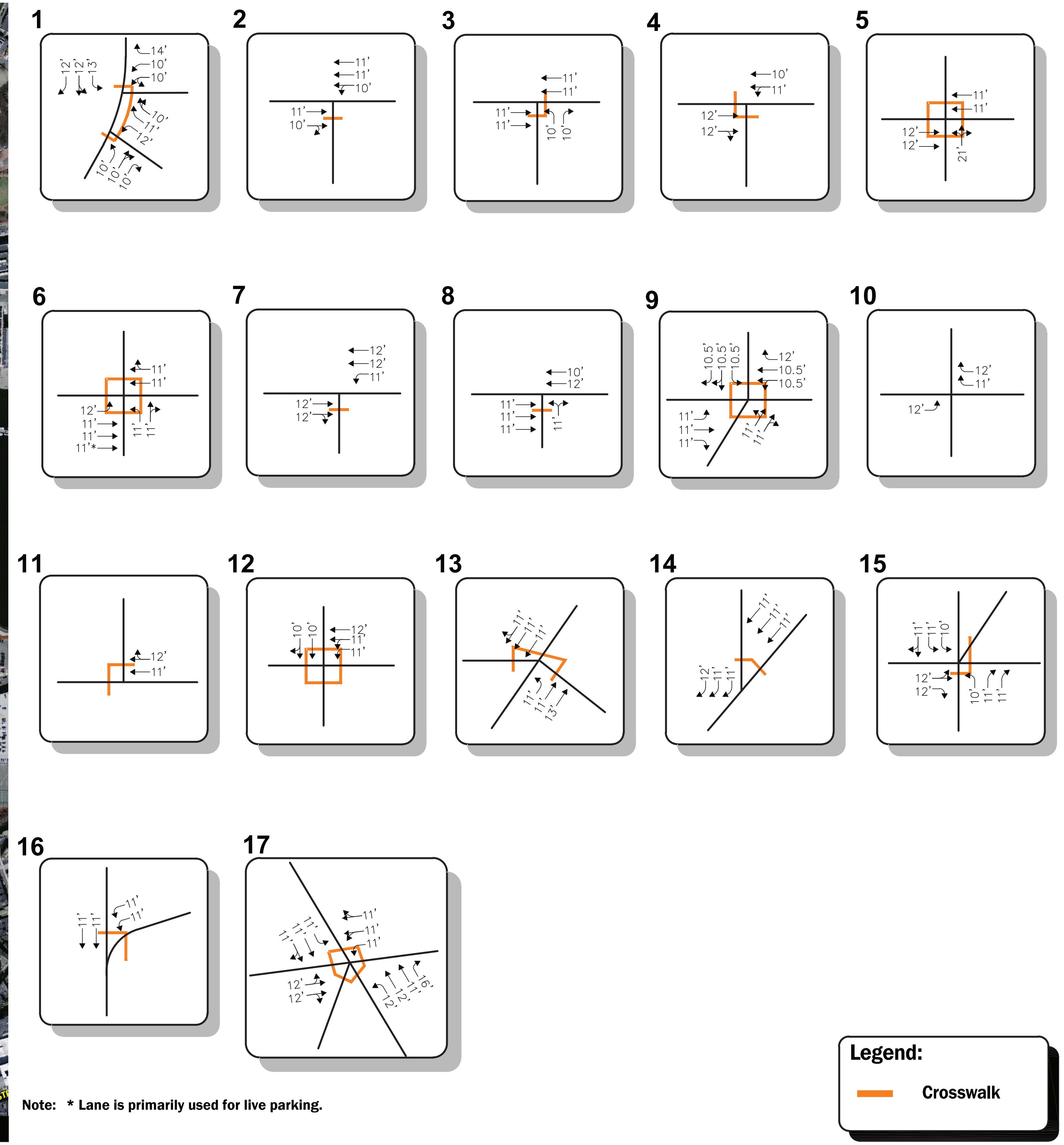
[a]See notes at end of table.

Table 3.2-1 Study Area Intersection Description (Continued)

Intersection	Traffic Control Type[a]	Pedestrian Accommodations? (Yes/No/Description)	Bicycle Accommodations? (Yes/No/ Description)	Bus Stop? (Yes/No and Location)	On-Street Parking? (Yes/No/ Location)	Loading Zone? (Yes/No/ Location)	Other Defining Feature
North Washington Street/Beverly Street	TS	Yes – sidewalks, crosswalks, and traffic signal equipment/phasing provided	No	No	No	No	North Washington Street is median divided
Lomasney Way/Nashua Street	S	Yes – sidewalks and crosswalk provided	No	No	Yes – west side of Lomasney Street south of intersection	No	
Nashua Street/Martha Road	TS	Yes – sidewalks, crosswalks, and traffic signal equipment/phasing provided	No	No	No	No	
Merrimac Street/New Chardon Street	TS	Yes – sidewalks, crosswalks, and traffic signal equipment/phasing provided	No	No	No	No	

[a]TS = traffic signal; F = flashing beacon; P = pedestrian signal; S = STOP-sign control; Y = Yield-sign control; R = rotary/roundabout; NC = no control present.





Note: * Lane is primarily used for live parking.

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Figure 3-3
Intersection Lane Use

3.2.3 Traffic Volumes

To determine existing traffic-volume demands and flow patterns within the study area, manual turning movement counts (TMCs) and vehicle classification counts were completed in June, July and October 2011, and in July 2013. The TMCs were conducted at the study intersections during the weekday morning (7:00 to 9:00 a.m.), weekday evening (4:00 to 6:00 p.m.) and Saturday midday (11:00 a.m. to 2:00 p.m.) peak periods, the peak traffic volume hours for both the Project and the adjacent roadways.

Seasonal Adjustments

In order to evaluate the potential for seasonal fluctuation of traffic volumes within the study area, MassDOT weekday seasonal factors for Group 6 roadways (urban arterials, collectors and rural arterials, the MassDOT functional classification for the study area roadways) were reviewed.[1] Based on a review of this data, it was determined that traffic volumes for the months of June, July and October are approximately 10.0, 8.0, and 7.0 percent above average-month conditions, respectively. In order to provide a conservative (above average) analysis scenario, the traffic volumes collected as a part of this study were not adjusted downward to average-month conditions. The 2013 Existing weekday morning, weekday evening and Saturday midday peak-hour traffic volumes are depicted on Figures 3-4, 3-5 and 3-6, respectively.

A review of the peak-period traffic counts indicates that the weekday morning peak hour generally occurs between 8:00 and 9:00 a.m., the weekday evening peak hour generally occurs between 5:00 and 6:00 p.m., and the Saturday midday peak hour generally occurs between 1:00 and 2:00 p.m.

3.2.4 Pedestrian and Bicycle Facilities

A comprehensive field inventory of pedestrian and bicycle facilities was performed in June, July and October 2011, and July and August 2013. The field inventory consisted of a review of the location of sidewalks and pedestrian crossing locations along the study roadways and at the study intersections, as well as the location of existing and planned future bicycle facilities. Pedestrian and bicycle counts were conducted at each of the study intersections during weekday morning (7:00 to 9:00 a.m.), weekday evening (4:00 to 6:00 p.m.) and Saturday midday (11:00 a.m. to 2:00 p.m.) peak periods. Additional information regarding pedestrian and bicycle facilities within the City of Boston and the study area is provided in Appendix B.

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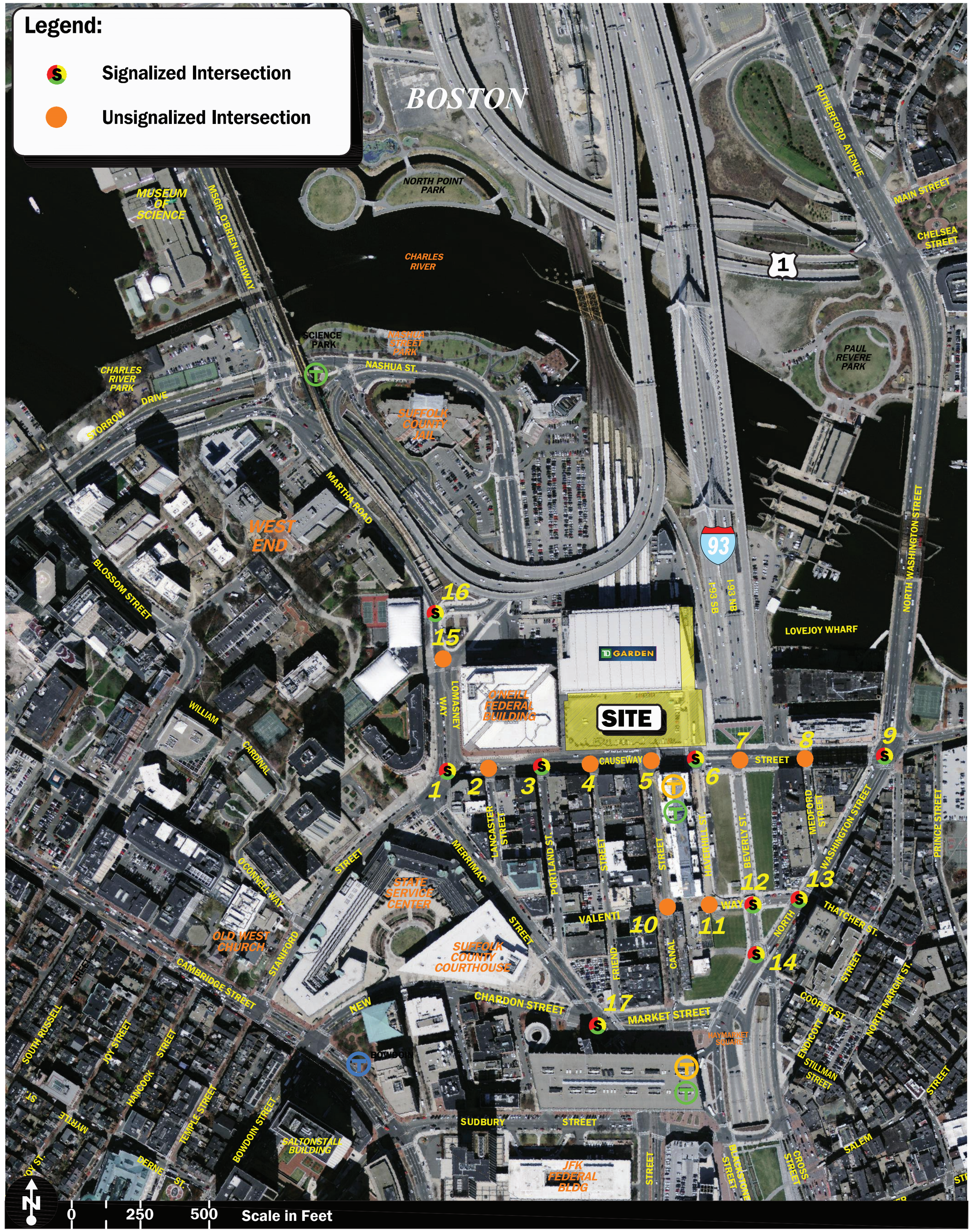
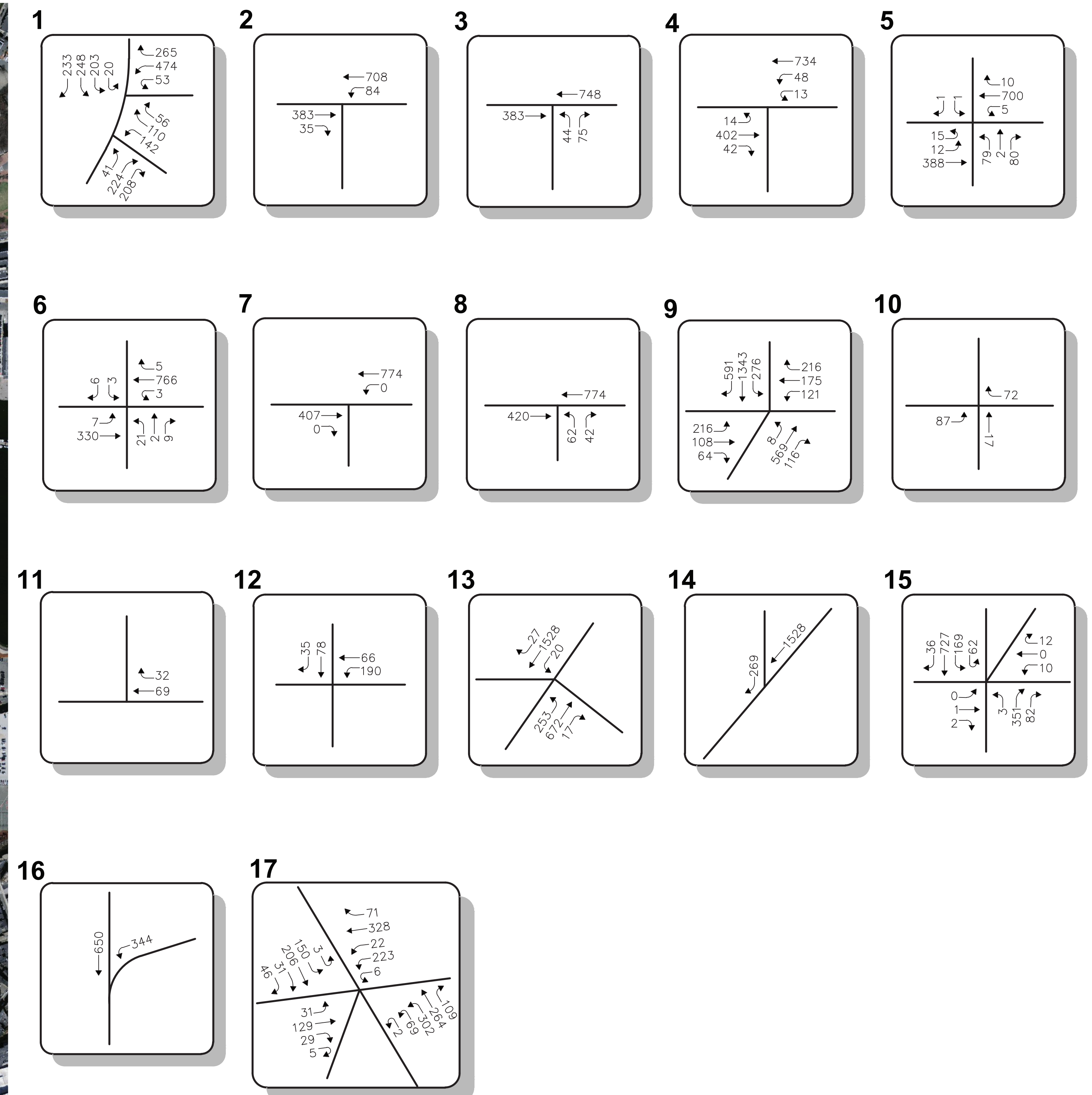
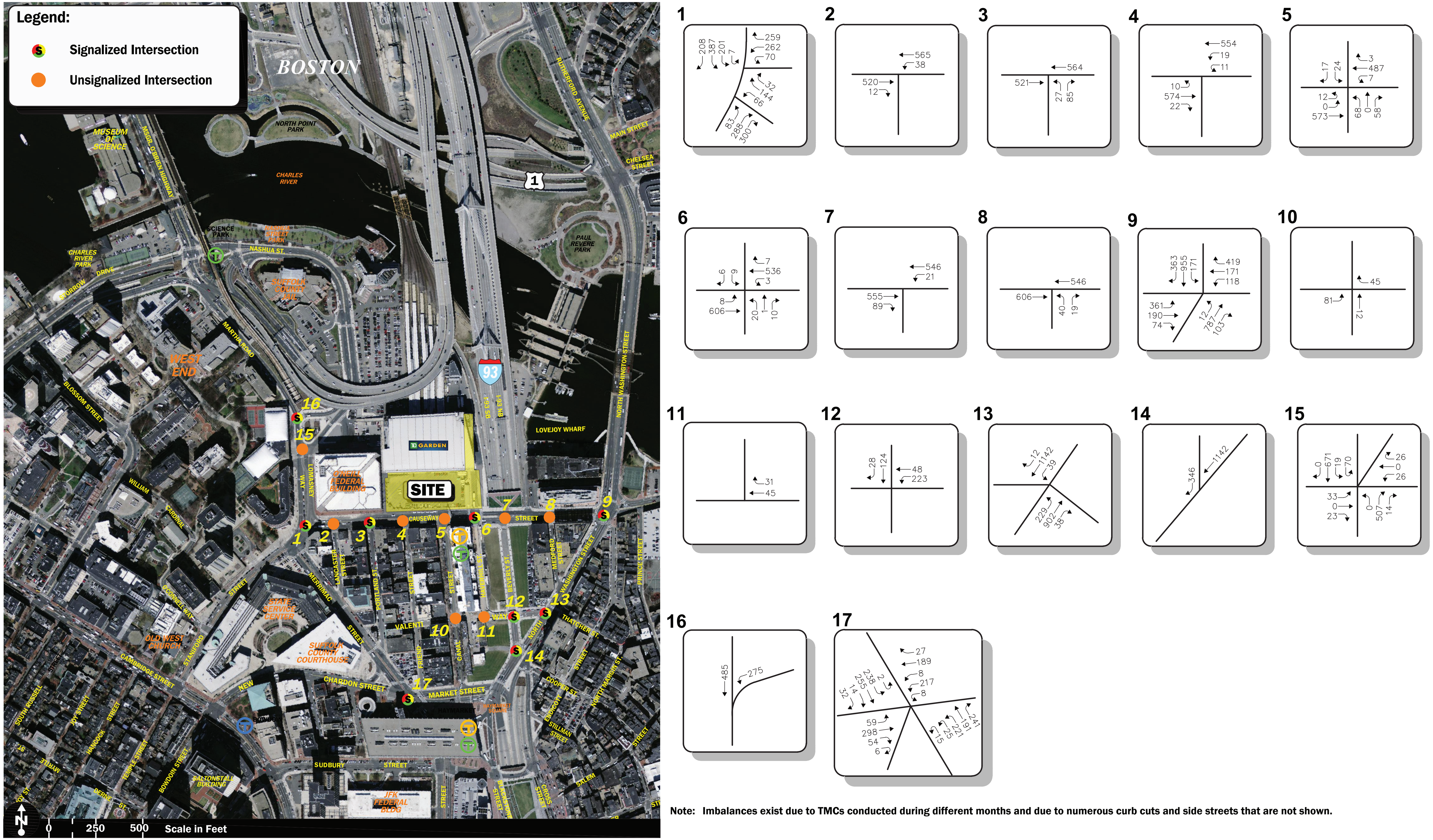
[1] MassDOT Traffic Volumes for the Commonwealth of Massachusetts; 2007 Weekday Seasonal Factors, Group 6 – Urban Arterials, Collectors and Rural Arterials.





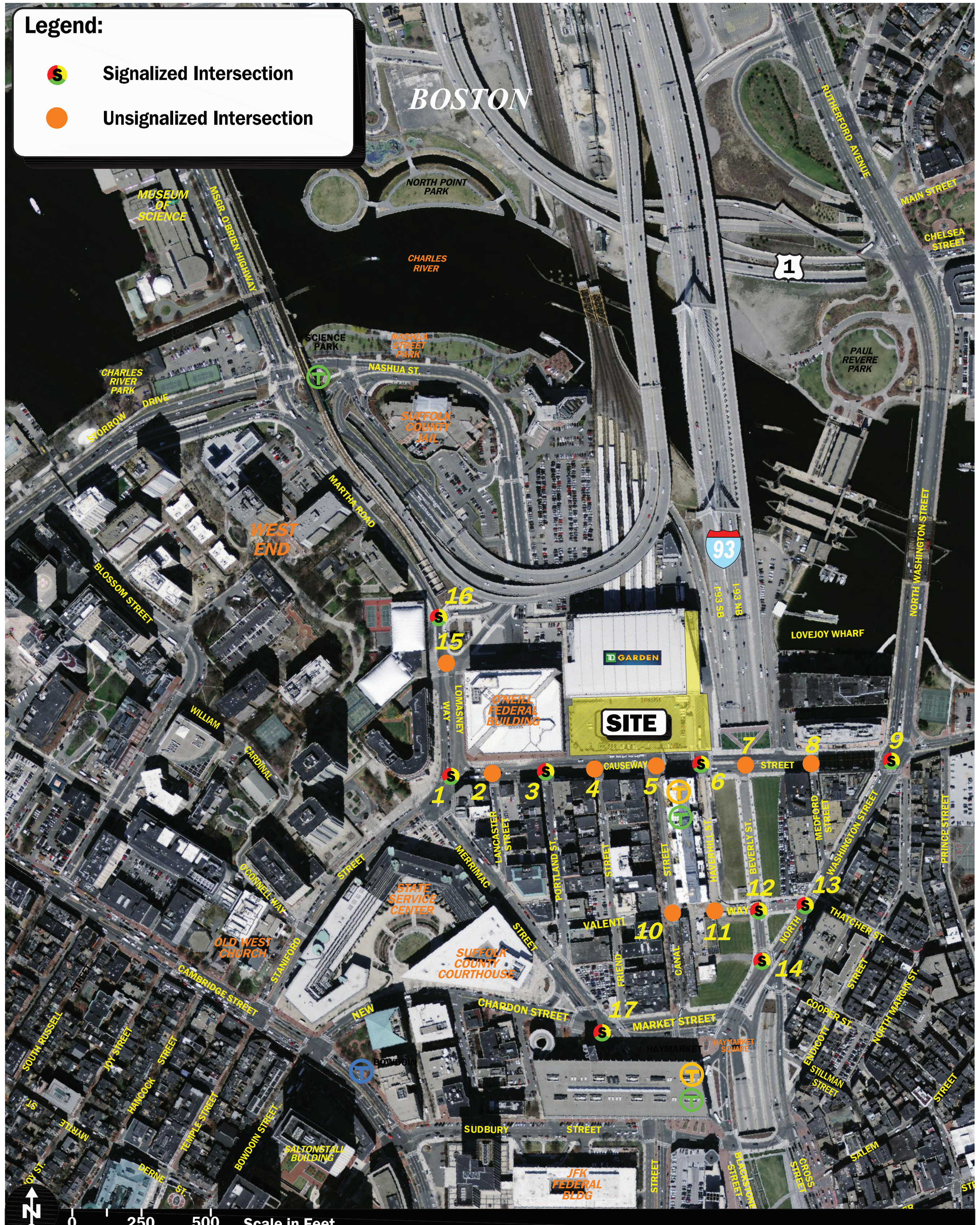
Note: Imbalances exist due to TMCs conducted during different months and due to numerous curb cuts and side streets that are not shown.

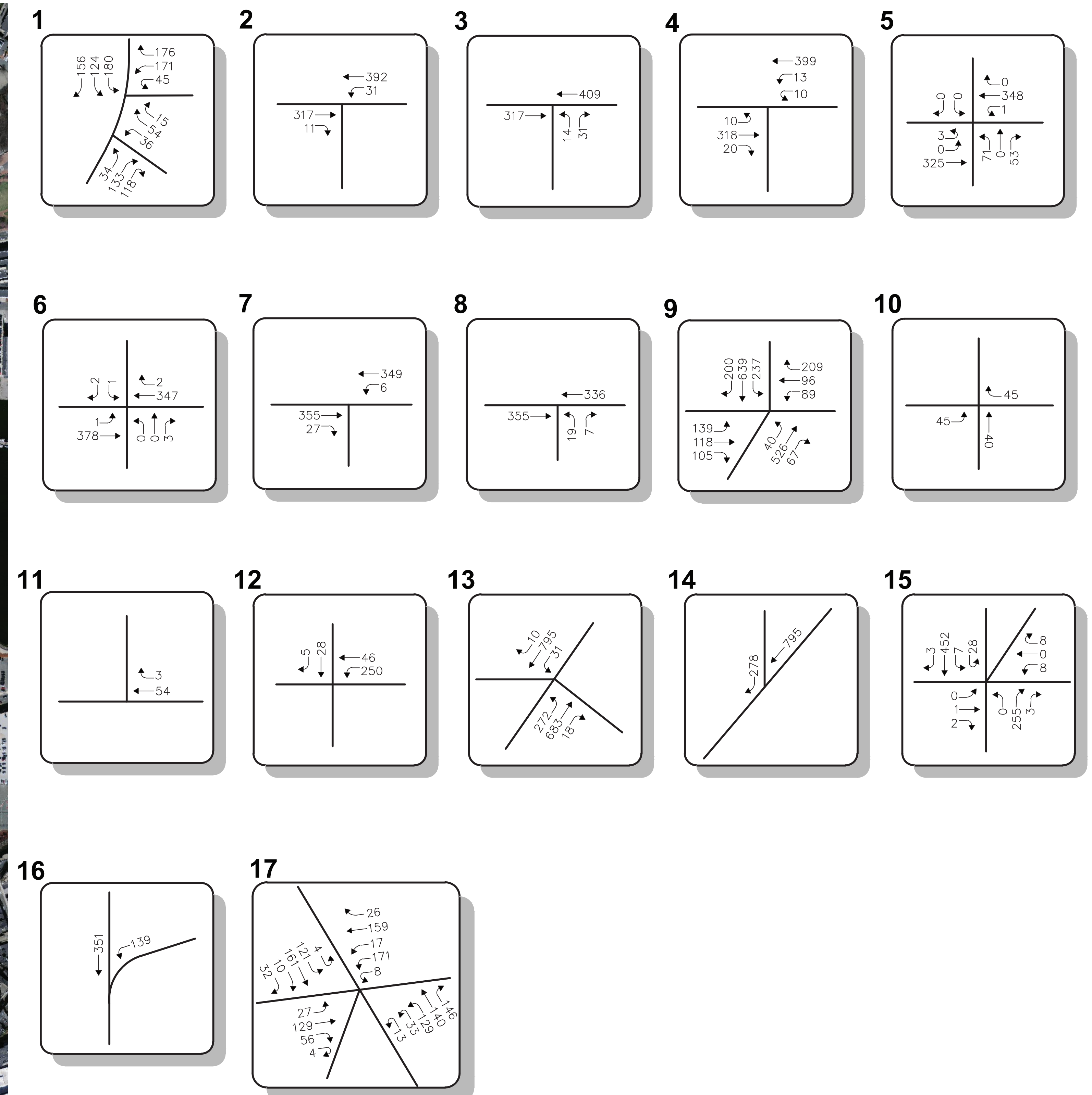


Note: Imbalances exist due to TMCs conducted during different months and due to numerous curb cuts and side streets that are not shown.

Figure 3-5

2013 Existing Weekday Evening Peak Hour Traffic Volumes





Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Figure 3-6

2013 Existing Saturday Midday Peak Hour Traffic Volumes

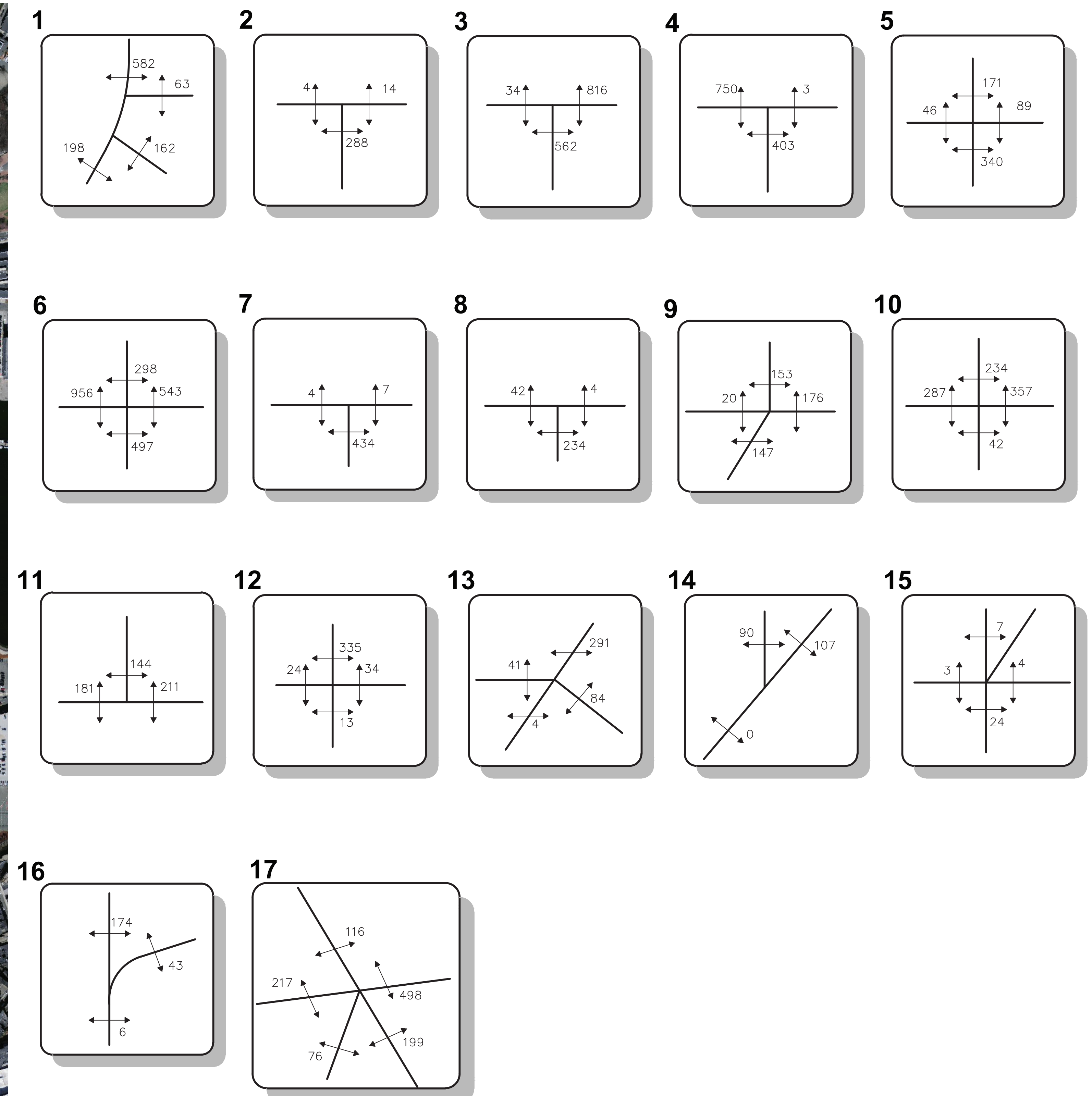
3.2.4.1 Pedestrian Facilities

Sidewalks are generally provided along both sides of the study area roadways that are accompanied by marked crosswalks, with pedestrian traffic signal equipment and phasing provided at the signalized intersections. Crosswalks are provided at a number of unsignalized intersections along Causeway Street, including at Friend Street and Canal Street, along Merrimac Street at Lancaster Street and Portland Street, and along Nashua Street at Lomasney Way and between the island areas separating north and southbound Nashua Street and Red Auerbach Way (behind the O'Neill Federal Building). In addition, the Dr. Paul Dudley White multiuse path (pedestrians and bicyclists) traverses both sides of the Charles River between Newton and the North End neighborhood in Boston, with connections to the pathway located behind the TD Garden. At present, the pathway along the south side of the Charles River terminates on both sides of the MBTA Commuter Rail tracks. Several alternatives have been evaluated to complete the missing segment of the pathway which entail crossing both the Charles River and the MBTA tracks. In conjunction with the Project, the Proponent has committed to working with the City of Boston, the Department of Conservation and Recreation (DCR), the MBTA and WalkBoston to advance the completion of the missing segment of the pathway along the south side of the Charles River to include developing a defined link between the Project site and the pathway.

Figures 3-7, 3-8 and 3-9 depict the 2013 Existing weekday morning, weekday evening, and Saturday midday peak hour pedestrian volumes, respectively. The largest numbers of pedestrian crossings for each peak period were observed at the Causeway Street/Haverhill Street intersection during the weekday morning peak-hour, with 956 pedestrians crossing Causeway Street; at the Causeway Street/Friend Street intersection during the weekday evening peak-hour with 997 pedestrians crossing Causeway Street; and at the Causeway Street/North Washington Street/Commercial Street intersection during the Saturday midday peak-hour with 376 pedestrians crossing Commercial Street.

3.2.4.2 Bicycle Facilities

At present, formal bicycle accommodations are not provided along the study area roadways. In conjunction with the City's Causeway Street Crossroads Initiative, bicycle accommodations are planned along both sides of Causeway Street between North Washington Street and Lomasney Way by way of either a bicycle lane or shared travel lane designation ("sharrows"). As described previously, the Dr. Paul Dudley White multiuse path (pedestrians and bicyclists) traverses both sides of the Charles River between Newton and the North End Neighborhood in Boston, but is discontinuous along the south side at the MBTA Commuter Rail tracks. As stated previously, the Proponent has committed to working with the City of Boston, the DCR, the MBTA and WalkBoston to advance the completion of the missing segment of the pathway along the south side of the Charles River to include developing a defined link between the Project site and the pathway.



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

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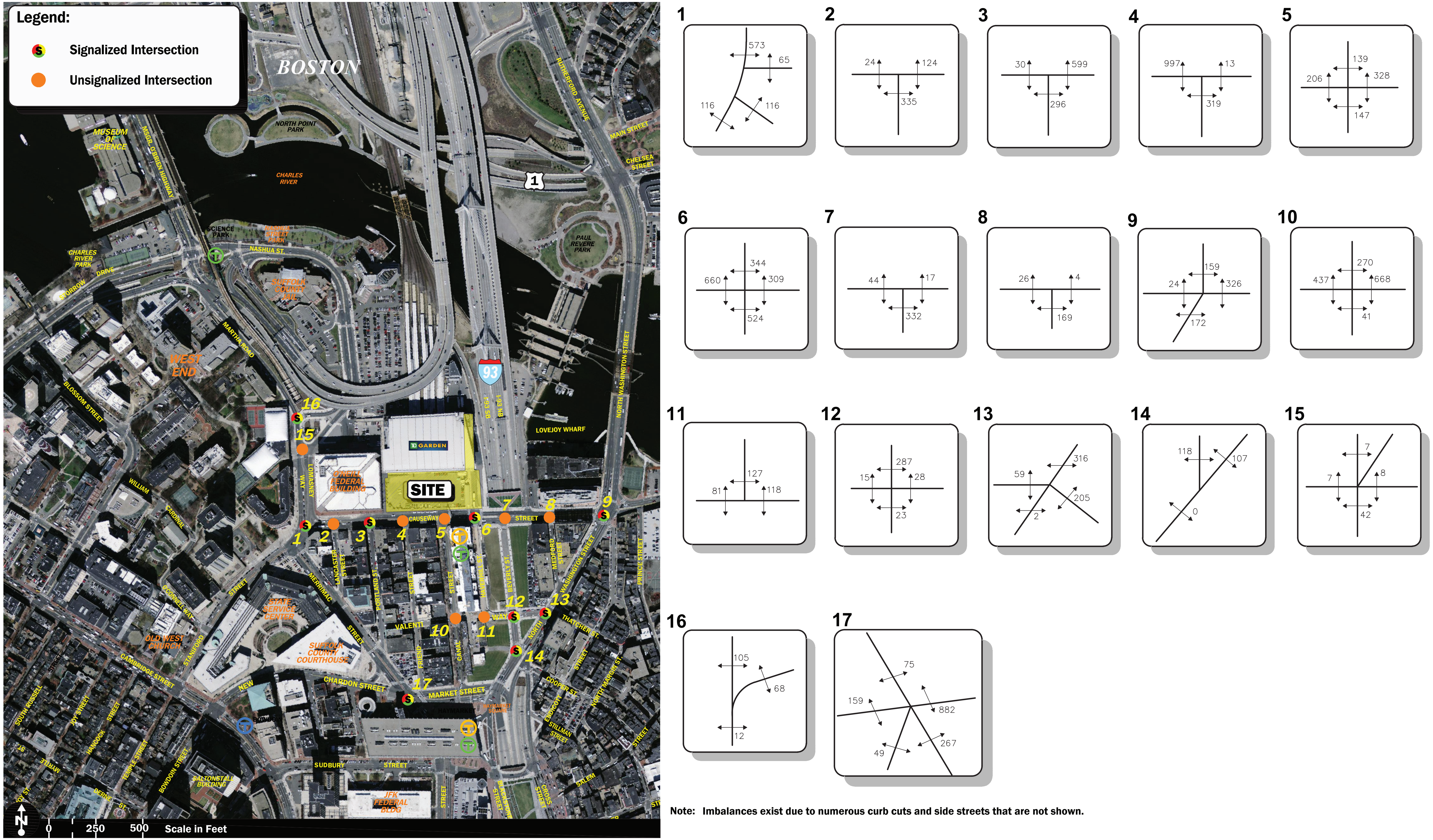
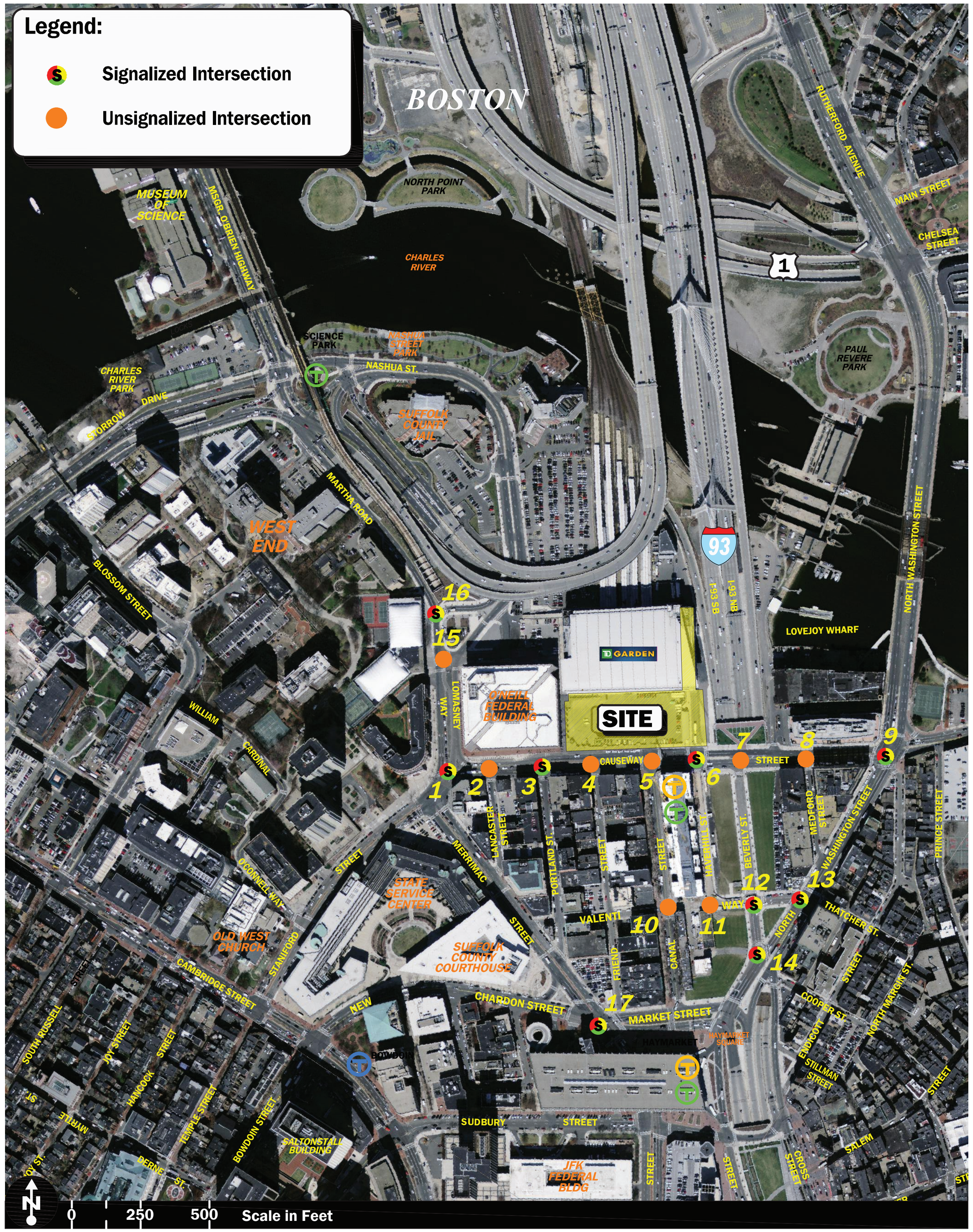
Figure 3-7
2013 Existing Weekday Morning Peak Hour Pedestrian Volumes

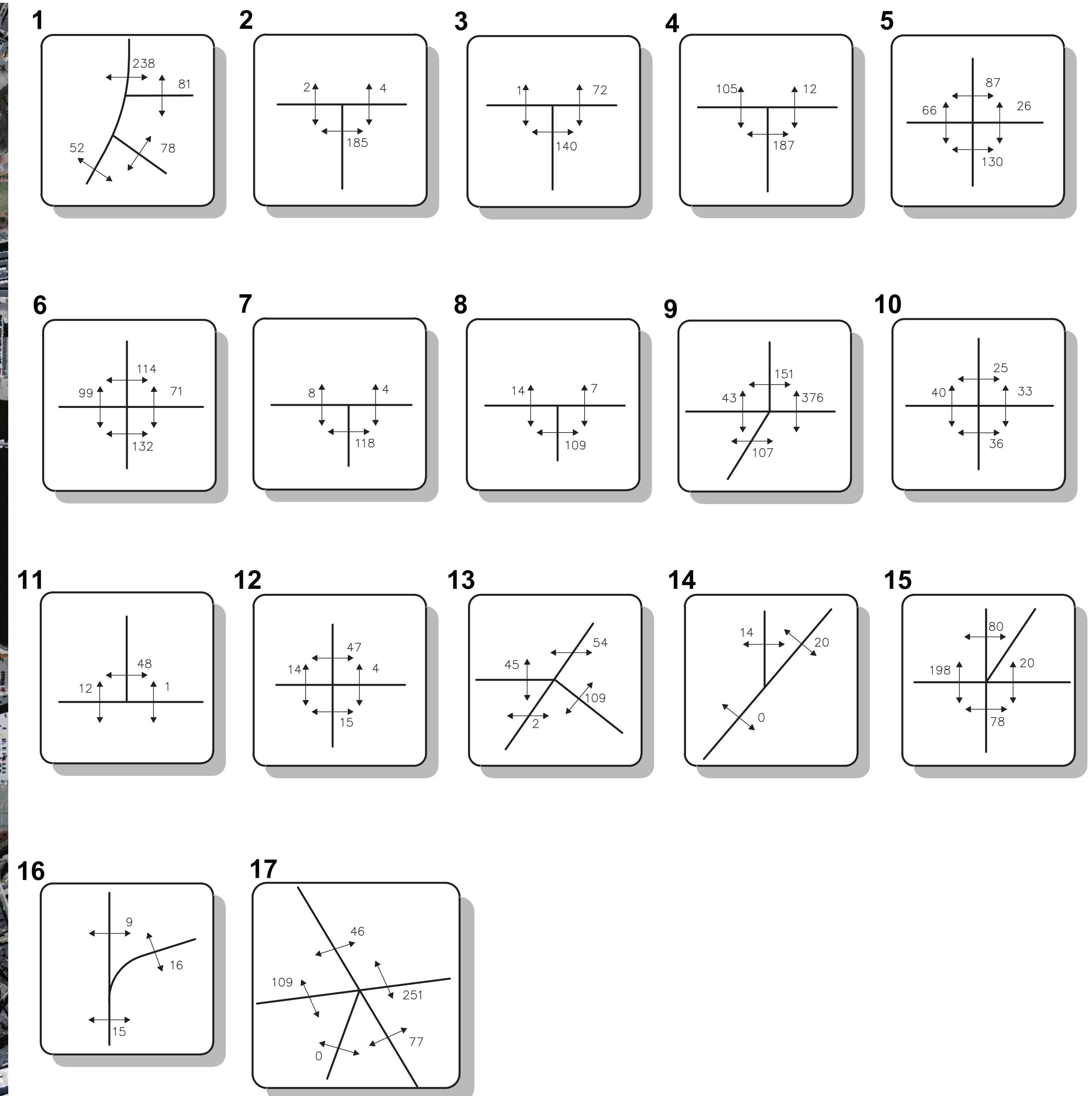


Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Figure 3-8

2013 Existing Weekday Evening Peak Hour Pedestrian Volumes





Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

The Hubway bike sharing program was introduced in the City of Boston in July 2011 and included 600 bicycles at 60 stations located throughout the City. Since its introduction, the program has expanded to include over 108 stations and in excess of 1,000 bicycles, with the service area extended to Brookline, Cambridge and Somerville. One of the most active Hubway stations is located at North Station, just outside of the TD Garden at Portal Park. The current Hubway configuration at North Station provides docking for 53 bicycles, and is replenished on a regular basis.

Figures 3-10, 3-11 and 3-12 depict the 2013 existing weekday morning, weekday evening, and Saturday midday peak hour bicycle volumes, respectively. The largest volume of bicyclists were observed travelling along Lomasney Way and Causeway Street during the peak hours.

3.2.5 Public Transportation

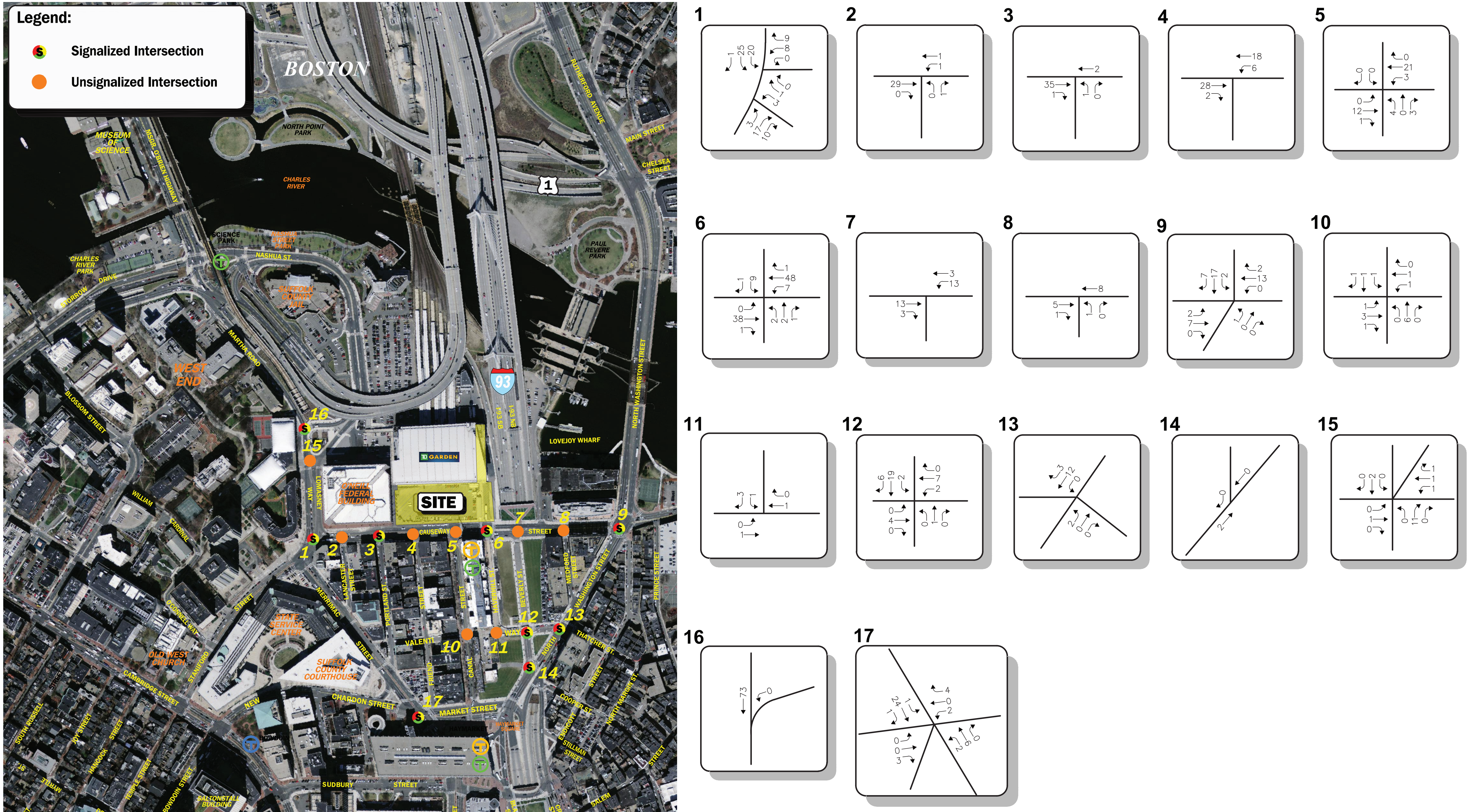
The Project site is situated at the northern hub of the MBTA Commuter Rail system at North Station, and is served by a number of public transportation services, including bus service and subway service via both the Orange and Green Lines. The Orange Line/Green Line North Station headhouse is located on the northwest corner of the Causeway Street/Legends Way intersection and immediately adjacent to the Project site. In addition, Haymarket Station, which serves as the northern MBTA bus terminal and is located on the Orange and Green Lines, is located within a 5-6 minute walking distance of the Project site off New Chardon Street, or is one stop south of the Project site on either the Orange Line or Green Line. Figure 3-13 depicts the available public transportation services in the area. The following sections describe the available public transportation services within the study area that serve the Project site, with detailed system maps, schedules and fare information provided in Appendix B.

3.2.5.1 Bus Service

The MBTA operates the following six public bus routes within the study area:

- *Route 4: North Station – Tide Street* – via World Trade Center.
- *Route 92: Assembly Square Mall - Downtown* – via Main Street.
- *Route 93: Sullivan Square Station - Downtown* – via Bunker Hill Street.
- *Route 111: Woodlawn or Broadway & Park Avenue – Haymarket Station* – via Mystic River/Tobin Bridge.
- *Route 426: Central Square, Lynn – Haymarket Station* – via Cliftondale Square.
- *Route 428*: *Oaklandvale – Haymarket Station* – via Granada Heights.

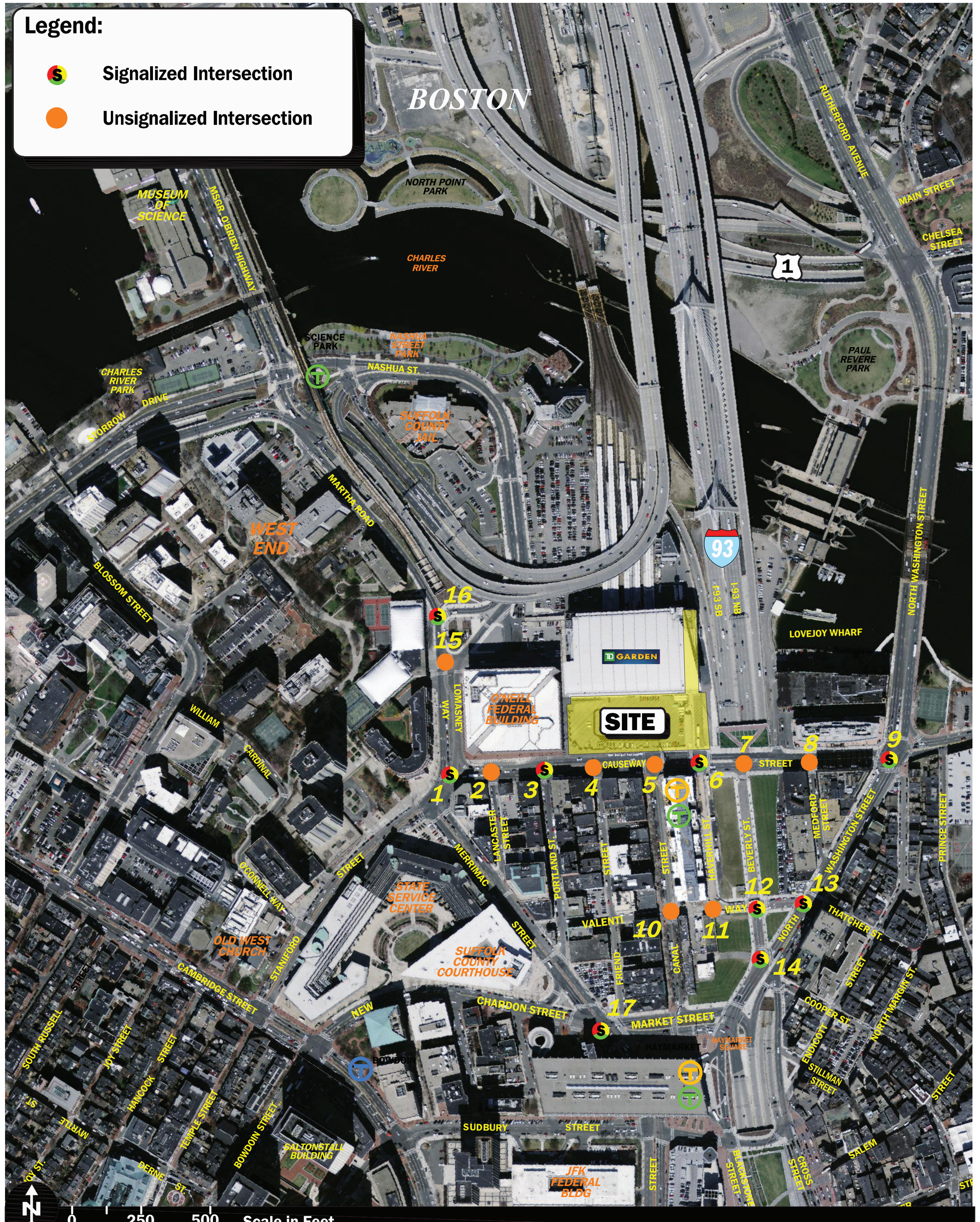
Table 3.2-2 summarizes the MBTA bus service capacity and ridership information as provided by the Central Transportation Planning Staff (CTPS) for the six public buses serving the study area, and indicates reserve capacity is available to accommodate additional passenger loadings associated with the Project.

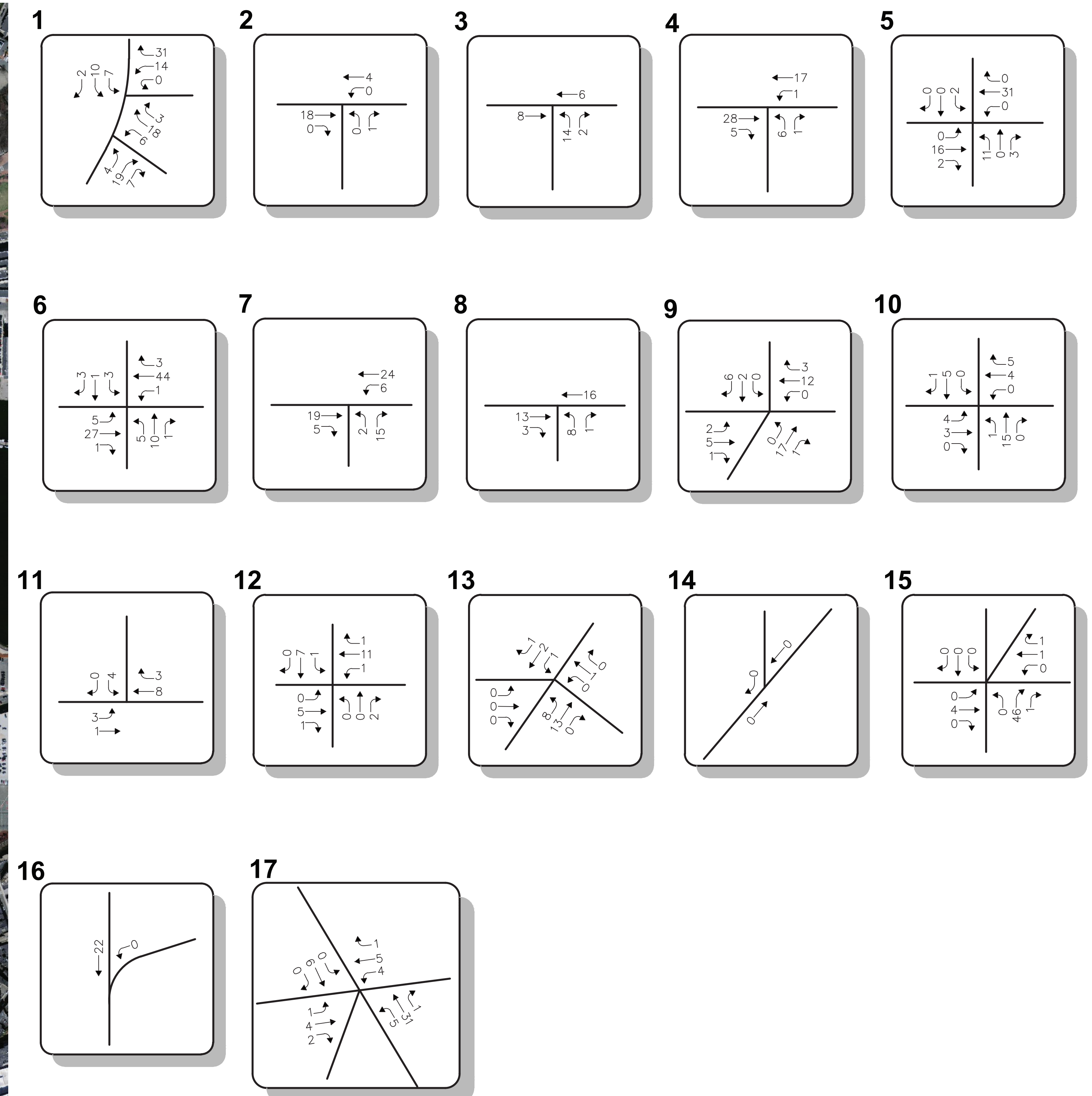


Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Figure 3-10

2013 Existing Weekday Morning Peak Hour Bicycle Volumes





Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

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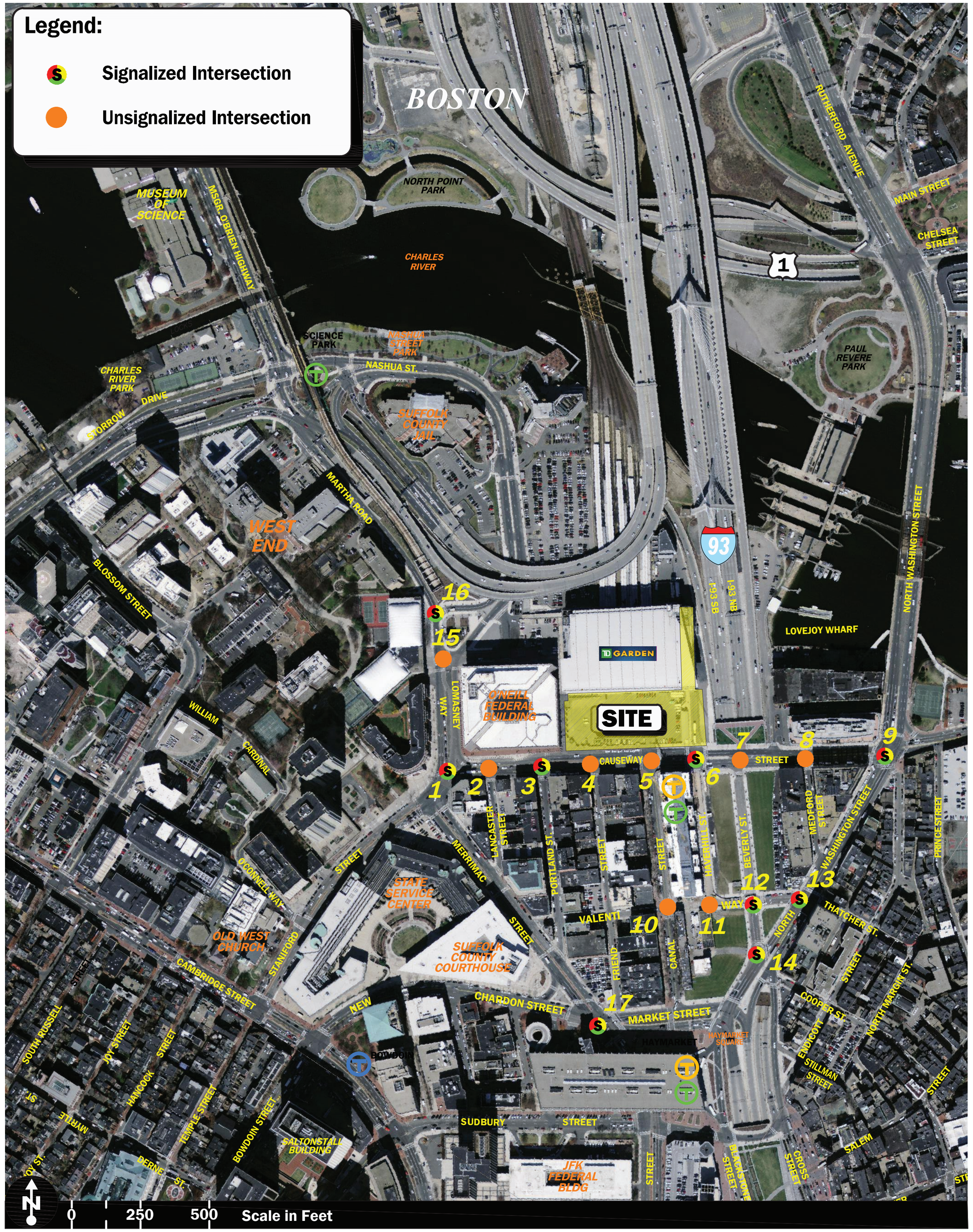
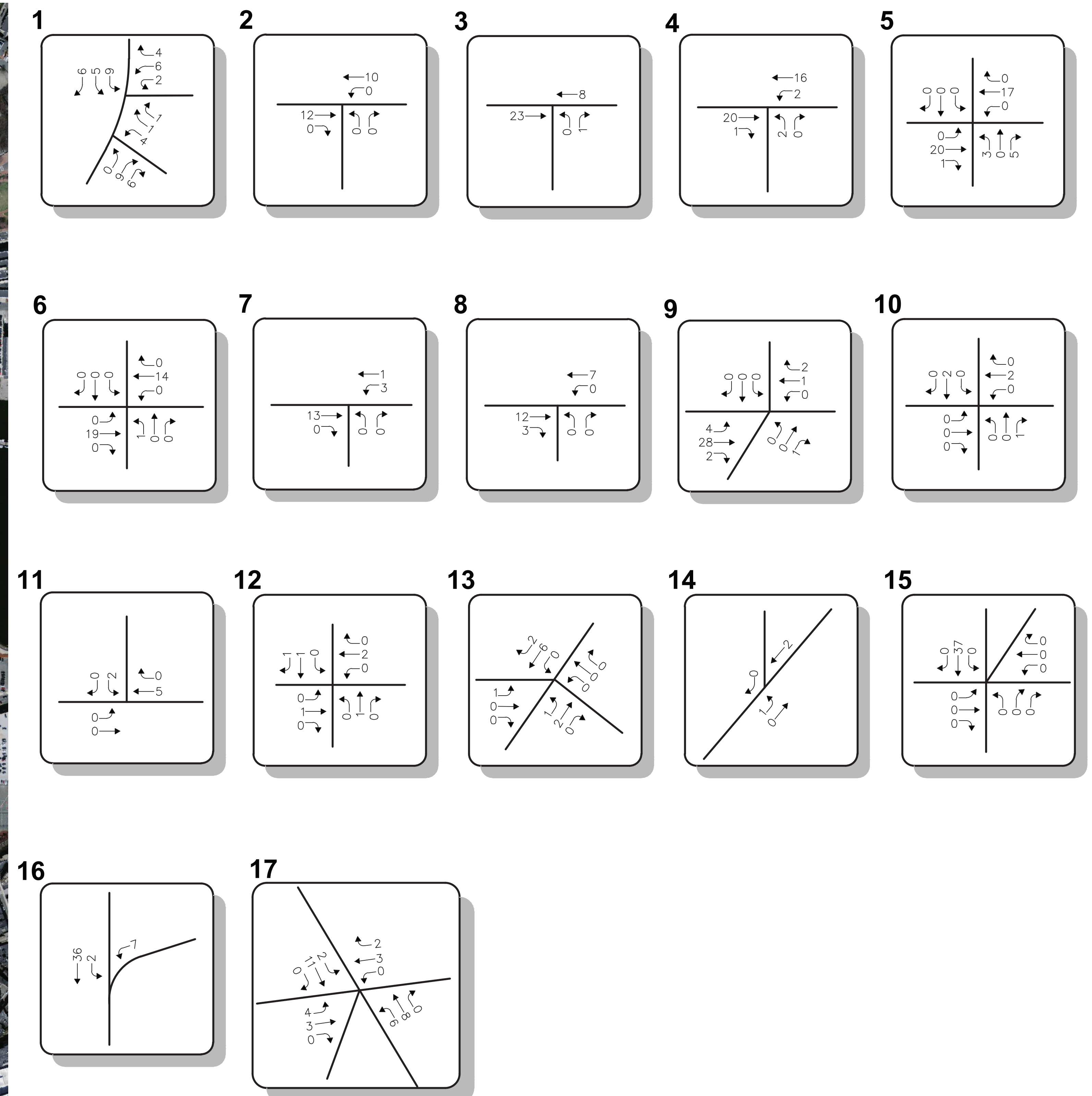
Figure 3-11
2013 Existing Weekday Evening Peak Hour Bicycle Volumes





Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

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Figure 3-12
2013 Existing Saturday Midday Peak Hour Bicycle Volumes

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Figure 3-13
Public Transportation Map

Table 3.2-2 MBTA Bus Service and Capacity

		Weekday Morning Peak Period			Weekday Evening Peak Period		
Bus Route Number	Bus Route	Peak PeriodHeadway (minutes)	Ridership[a] (Inbound and Outbound Total)	Maximum Load Capacity[b] (Inbound and Outbound Total)	Peak Period Headway (minutes)	Ridership[a] (Inbound and Outbound Total)	Maximum Load Capacity[b] (Inbound and Outbound Total)
4	North Station – Tide Street	13	226	1,216	20	170	912
92	Assembly Square Mall – Downtown	15	324	1,064	15	335	1,216
93	Sullivan Square Station – Downtown	7	1,191	2,280	8	1,069	2,204
111	Woodlawn or Broadway & Park Avenue – Haymarket Station	3-6	1,578	2,356	3-6	2,426	3,420
426	Central Square, Lynn – Haymarket Station	30	304	836	30	403	988
428	Oaklandvale – Haymarket Station	40	60	152	34	78	152

Source: MBTA/CTPS.

[a]Ridership for a two-hour peak period (7:00 to 9:00 a.m. and 4:00 to 6:00 p.m.)

[b]Passenger capacity for a two-hour peak period (7:00 to 9:00 a.m. and 4:00 to 6:00 p.m.). Maximum load capacity is equal to 76 passengers.

3.2.5.2 Subway Service

The Project site and the immediate study area is served by MBTA subway service provided by way of both the Orange and Green Lines. The Orange Line/Green Line North Station headhouse is located on the northwest corner of the Causeway Street/Legends Way intersection, and will be incorporated into the Project providing a direct, weather protected connection between the northern hub of the MBTA Commuter Rail system at North Station and the subway system. Connections to the MBTA Blue Line can be made at State or Government Center Stations from the Orange Line and Green Line, respectively, and to the Red Line at Downtown Crossing from the Orange Line or Park Street Station from the Green Line.

Table 3.2-3 summarizes the service capacity and ridership information for the Orange and Green Lines at North Station, and indicates reserve capacity is available to accommodate additional passenger loadings associated with the Project.

Table 3.2-3 MBTA North Station Orange and Green Line Service and Capacity

				Ridership in Passengers	
Subway Line	Peak Period Headway (Minutes)	Policy Load Capacity (Passengers)	Crush Load Capacity (Passengers)	Weekday Morning Peak-Period	Weekday Evening Peak-Period
Orange Line:	4 – 5 mins.				
Inbound		6,681	11,424	13,634	5,140
Outbound		6,681	11,424	4,911	11,860
Total		13,362	22,848	18,545	17,000
Green Line:	5 -7 mins.				
Inbound		3,131	8,339	3,810	2,394
Outbound		3,131	8,339	1,505	2,621
Total		6,262	16,678	5,315	5,015

Source: MBTA/CTPS.
[a]Ridership for a two-hour peak period (7:00 to 9:00 AM and 4:00 to 6:00 PM).
[b]Passenger capacity for a two-hour peak period (7:00 to 9:00 AM and 4:00 to 6:00 PM).

3.2.5.3 Commuter Rail Service

As stated previously, the Project site is located at the northern hub of the MBTA Commuter Rail system at North Station, which is served by four of the 12 MBTA Commuter Rail lines:

- Newburyport/Rockport
- Haverhill
- Lowell
- Fitchburg

Table 3.2-4 summarizes the service capacity and ridership information for the four Commuter Rail Lines that serve North Station. As shown, within the two-hour commuter service period, it was noted that there are trains that currently operate over their service capacity resulting in passengers standing or finding other accommodations within the train. However, reserve capacity is afforded within the overall Commuter Rail system serving North Station to accommodate additional ridership, with passengers shifting to either an earlier or later train as work schedules permit.

Table 3.2-4 MBTA North Station Commuter Rail Service and Capacity

	Weekday Morning Peak Period		Weekday Evening Peak Period	
Commuter Rail Line	Ridership[a]	Maximum Load Capacity[b]	Ridership[a]	Maximum Load Capacity[b]
Newburyport/Rockland:				
Inbound	5,436	5,600	333	5,600
Outbound	405	5,600	4,890	5,600
Total	5,841	11,200	5,223	11,200
Haverhill:				
Inbound	2,834	2,240	98	1,680
Outbound	109	2,240	2,374	1,680
Total	2,943	4,480	2,472	3,360
Lowell:				
Inbound	3,953	2,520	323	2,940
Outbound	236	2,520	3,329	2,940
Total	4,189	5,040	3,652	5,880
Fitchburg:				
Inbound	2,858	2,100	554	2,100
Outbound	569	2,100	2,543	2,100
Total	3,427	4,200	3,097	4,200

Source: CTPS counts, Spring 2012.
[a]Ridership for a two-hour peak period (7:00 to 9:00 a.m. and 4:00 to 6:00 p.m.).
[b]Passenger capacity for a two-hour peak period (7:00 to 9:00 a.m. and 4:00 to 6:00 p.m.).

3.2.6 Parking

To assess the availability of parking proximate to the Project site, an inventory of public parking located within an approximate 0.25-mile radius of the Project site was completed in August 2013. The inventory included all publicly available parking located on-street or within surface lots or garages. Table 3.2-5 summarizes the inventory of available public parking spaces within the study area.

Table 3.2-5 Existing Public Parking Supply

Type of Parking Space	Number of Spaces
On-Street Parking:	
Unregulated/Metered Spaces	52
Weekday Morning/Evening Peak Period Restricted	20
Spaces[a]	166
Weekday 2-Hour Parking Limit Spaces	2
Parking Permitted After 6:00 p.m. on Weekdays Spaces	3
Handicapped Spaces	42
Resident Permit Parking 8:00 p.m. to 8:00 a.m.	
	588
Surface Lots:	
Garages:	1,275
North Station Garage	650
Garden Garage	2,310
Government Center Garage	
TOTAL	5,168

[a]No parking between 7:00 and 9:30 a.m. and 4:00 and 6:00 p.m.

Parking for the Project will be provided by way of the existing parking facility situated beneath the TD Garden which contains approximately 1,275 parking spaces, and a planned expansion of the parking garage beneath the Project site to provide an additional approximately 800 parking spaces (2,075 spaces total at the completion of the Project). As can be seen in Table 3.2-5, excluding the additional 800 parking spaces that will be constructed as a part of the Project, there are in excess of 5,000 parking spaces that are available within a reasonable walking distance of the Project site.

3.3 Future Conditions

Existing conditions in the study area were projected to the year 2028, which reflects a 15-year planning horizon consistent with the planned build-out and occupancy of the Project and other major development projects within the study area. Independent of the Project, conditions on the transportation system in the year 2028 under No Build conditions are influenced by changes in the transportation system resulting from: i) specific development projects by others; ii) population and demographic shifts; and iii) capital investments made by the local, state and/or federal government or private interests. Anticipated Project-generated trips superimposed upon the 2028 No Build condition transportation network reflect 2028 Build conditions with the Project.

3.3.1 *Future Growth*

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

An alternative procedure identifies the location and type of planned development, estimates the trips that are to be generated, and assigns the resultant values to the area transportation network. This procedure produces a more realistic estimate of growth for local conditions; however, the drawback of this procedure is that potential growth in population and development external to the study area would not be accounted for in the projections.

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

3.3.1.1 Specific Developments by Others

BTD and the BRA were contacted in order to determine if there were any projects planned within the study area that would have an impact on future conditions at the study intersections. Based on these discussions, the following projects were identified for inclusion in this study:

- ***121-127 Portland Street.*** This project consists of the addition of 54 loft dwelling units and 42 parking spaces to the existing six-story building located at 121-127 Portland Street.
- ***Lovejoy Wharf, 160 North Washington Street.*** This project consists of the reuse and rehabilitation of the existing 336,335 sf Hoffman Building located at 160 North Washington Street to include approximately 187,187 sf of office space and approximately 20,543 sf of commercial space, including an approximately 300-seat restaurant, as well as the restoration of the wharf.
- ***Massachusetts General Hospital (MGH) Institutional Master Plan Building for the 3rd Century.*** This project consists of the continued build-out of the MGH master planned development to include a 150 bed addition to the hospital facility.
- ***Garden Garage Redevelopment.*** This project consists of the redevelopment of the Garden Garage located off Lomasney Way and Martha Road to include two new buildings on the site. The west building (tower) would include approximately 190 residential apartment units and approximately 3,000 sf of ground-floor retail space. The east building would include approximately 310 residential apartment units. In addition, the existing 650-space above ground parking garage would be replaced with an approximately 850-space underground parking facility.

- ***Nashua Street Residences.*** This project consists of the construction of an approximately 503-unit residential building with approximately 3,575 sf of retail space and approximately 219 parking spaces to be located off Nashua Street and adjacent to the TD Garden.
- ***One Canal Street.*** This project consists of the construction of approximately 280 residential apartments and approximately 15,000 sf of retail space to be located at One Canal Street.
- ***Simpson Housing (The Victor).*** This project consists of the construction of approximately 284 residential units and approximately 14,910 sf of ground-floor retail space with approximately 142 parking spaces to be located off Beverly Street.
- ***The Merano.*** This project consists of the construction of a mixed-use project encompassing approximately 491,700 sf of gross floor area, including approximately 248,000 sf of residential apartments (approximately 230 units), an approximately 210 key hotel of approximately 149,000 sf, approximately 13,000 sf of restaurant use on the ground floor and 4,700 sf of retail uses on the ground floor. to be located between Beverly Street and Medford Street. The project will also include approximately 184 parking spaces that will be located on two levels above grade.
- ***Suffolk University Expansion.*** This project entails the demolition of the former Metropolitan District Commission Building and its replacement with an eight-story, approximately 112,000 sf building that will include classrooms, studios for art students and gallery space. Traffic volumes associated with this project within the study area are expected to be relatively minor and were assumed to be accounted for in the general background growth rate.
- ***North Bennet Street School.*** This project consists of the redevelopment of two City owned buildings located at 130-140 Richmond Street and 152 North Street in the North End neighborhood to accommodate the North Bennet Street School. The current North Bennet Street School building will be reused by the City as expansion space for the Eliot School. The rehabilitation of the 152 North Street building will include an approximately 4,000 sf expansion of the existing structure. Traffic volumes associated with this project within the study area are expected to be relatively minor given the high proportion of transit and pedestrian trips, and were assumed to be accounted for in the general background growth rate.
- ***One Broomfield Street.*** This project consists of the construction of an approximately 250-unit residential building to be located at One Broomfield Street. Traffic volumes associated with this project within the study area are expected to be relatively minor and were assumed to be accounted for in the general background growth rate.

- ***Millennium Tower and Burnham Building (former Filene's site).*** This project consists of the construction of a mixed-use development that will include approximately 600 residential units, between approximately 125,000 and 218,000 sf of office space, and between approximately 122,000 and 231,000 sf of retail space to include a health club and restaurant. The project also includes the construction of approximately 550 parking spaces, approximately 250 of which would be available to the public. Traffic volumes associated with this project within the study area are expected to be relatively minor and were assumed to be accounted for in the general background growth rate.
- ***Government Center Garage Redevelopment.*** This project consists of the redevelopment of the Government Center Garage to include: approximately 651 apartment units; approximately 120 residential condominium units; an approximately 204-room hotel; approximately 82,500 sf of retail/restaurant space (37,602 sf existing and 44,898 sf new); and approximately 1,303,300 sf of office space (256,532 sf existing and 1,046,768 sf new). In order to accommodate the redevelopment, the number of parking spaces within the existing parking garage will be reduced by approximately 1,151.

Traffic volumes associated with the above projects were obtained from their respective traffic study or were developed using trip-generation statistics published by the Institute of Transportation Engineers (ITE)[2] for the appropriate land use(s) and then distributed onto the study area roadway network based on existing traffic patterns. No other projects were identified at this time that are expected to impact future traffic volumes within the study area beyond the general background traffic growth rate.

3.3.1.2 General Background Traffic Growth

Traffic-volume data and historic traffic counts in the area were reviewed in order to determine general traffic growth trends. Based on a review of this data, it was determined that traffic volumes within the City of Boston have remained relatively stable over the past 10 years (i.e., none or nominal growth). In order to account for future traffic growth and presently unforeseen development within the study area, a 0.25 percent per year compounded annual background traffic growth rate was used for the short-term traffic volume projections (five-year, or 2013 through 2018) recognizing the number of known specific development projects by others whose trip generation were included in the future condition traffic volume projections, with a higher 0.5 percent per year compounded annual background traffic growth rate used for the long-range projections (2018 through 2028).

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2 *Trip Generation,* 9th Edition; Institute of Transportation Engineers; Washington, DC; 2012.

3.3.1.3 Planned Roadway Improvements

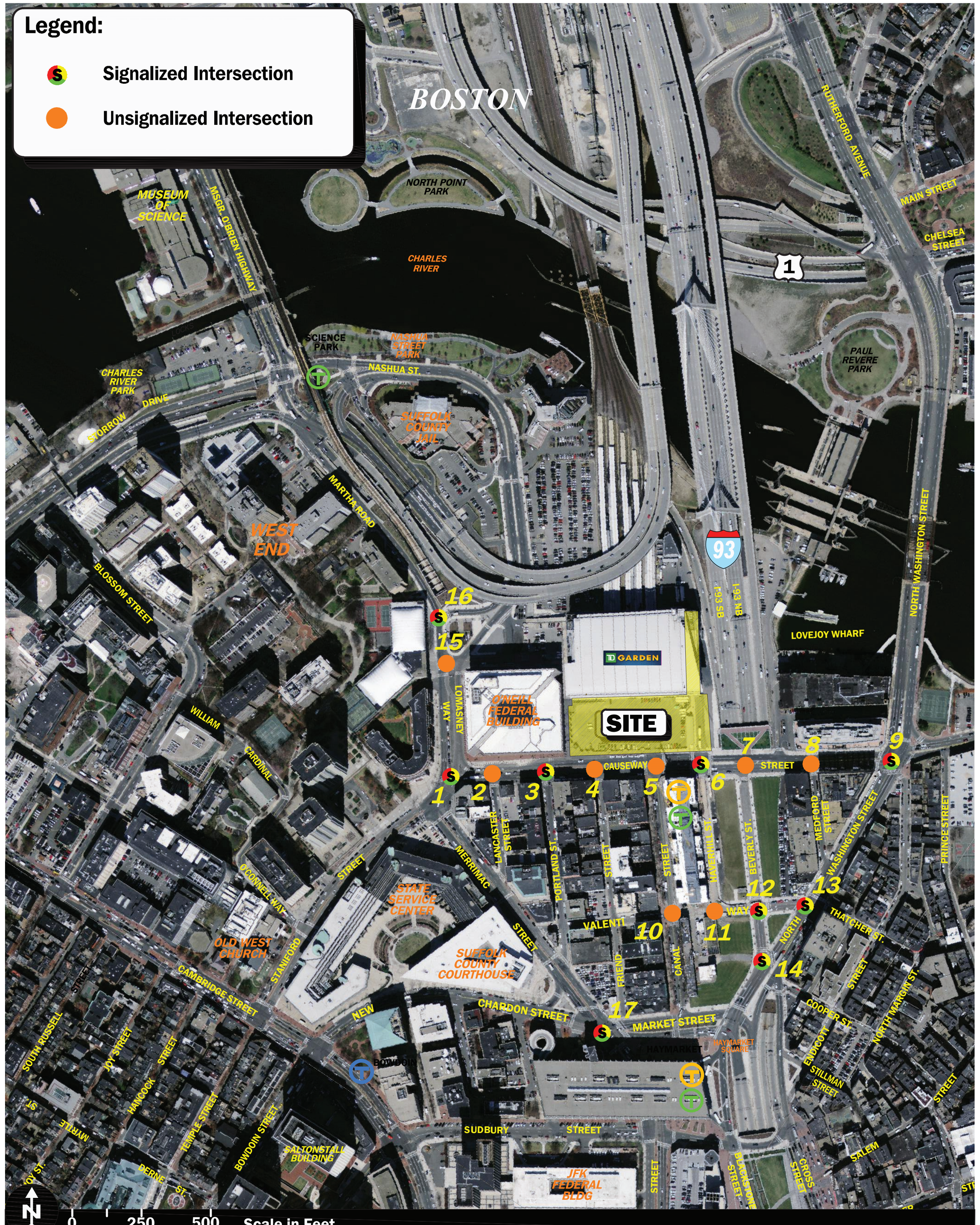
The BTD and the BRA were consulted in order to determine if there were any planned roadway improvement projects expected to be completed within the study area. Based on this consultation, the following roadway improvement projects were identified:

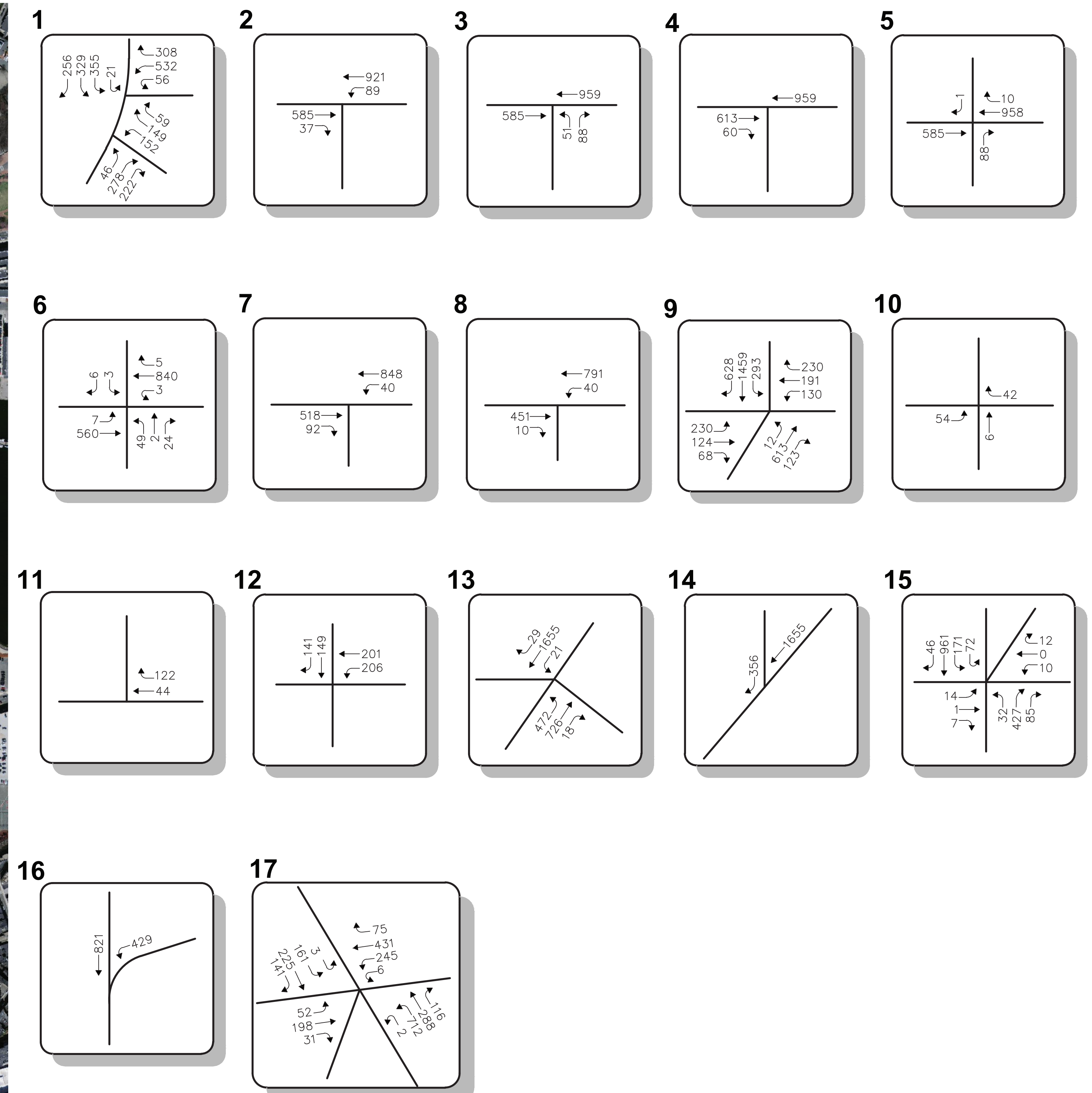
- *Causeway Street Crossroads Initiative* – The Causeway Street Crossroads Initiative is being undertaken by the City of Boston in partnership with the Massachusetts Department of Transportation (MassDOT) and will entail the reconstruction of Causeway Street between North Washington Street (Keany Square) and Lomasney Way (Lowell Square) with the goals of transforming the corridor into a pedestrian-oriented boulevard and an anchor for the Bulfinch Triangle business and entertainment district, and reconnecting the West End and North End neighborhoods. The planned design will improve traffic operations and safety through the replacement and upgrade of signs, pavement markings and traffic signal equipment; will provide significant upgrades to existing bicycle accommodations through the introduction of bicycle lanes or shared travel lane designation ("sharrows"); and will improve pedestrian amenities and convenience through wider sidewalks, curbline bump-outs to reduce crossing distances, and the introduction of a raised median to allow crossings to be made in two stages. These improvements were assumed to be complete by 2028, the horizon year of this study, and are reflected in the No Build and Build condition analyses.
- *North Washington Street Bridge (Charlestown Bridge) Rehabilitation* – The City of Boston is undertaking the rehabilitation of the North Washington Street bridge (a.k.a. Charlestown Bridge) over the Charles River to include the replacement of the existing concrete deck slabs and sidewalks with lightweight reinforced concrete and replacement of all deteriorated structural steel. In addition, the existing structure will be repainted, and improved signs and pavement markings will be installed. This project is being funded through the 2016 State Transportation Improvement Program (STIP), and is expected to commence in the Winter of 2015.

No other roadway improvement projects aside from routine maintenance activities were identified to be planned within the study area at this time.

3.3.1.4 No Build Traffic Volumes

The 2028 No Build condition peak-hour traffic-volume networks were developed by increasing the 2013 Existing peak-hour traffic volumes by 0.25 percent per year between 2013 and 2018 (five years) and by 0.5 percent per year between 2018 and 2028 (10 years), and then superimposing the peak-hour traffic volumes expected to be generated by the previously identified specific development projects by others. The resulting 2028 No Build condition weekday morning, weekday evening and Saturday midday peak-hour traffic-volume networks are shown on Figures 3-14, 3-15 and 3-16, respectively.





Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

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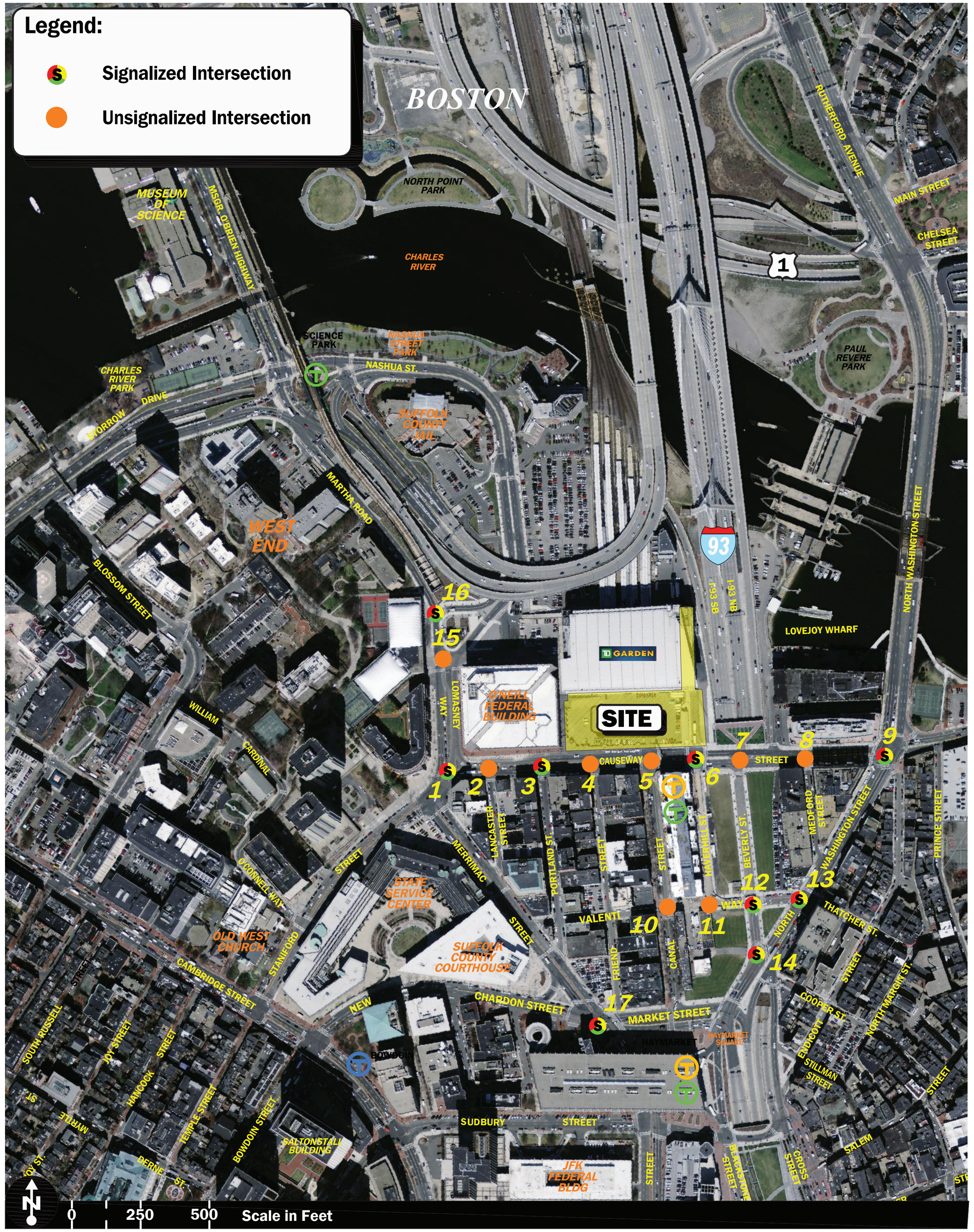
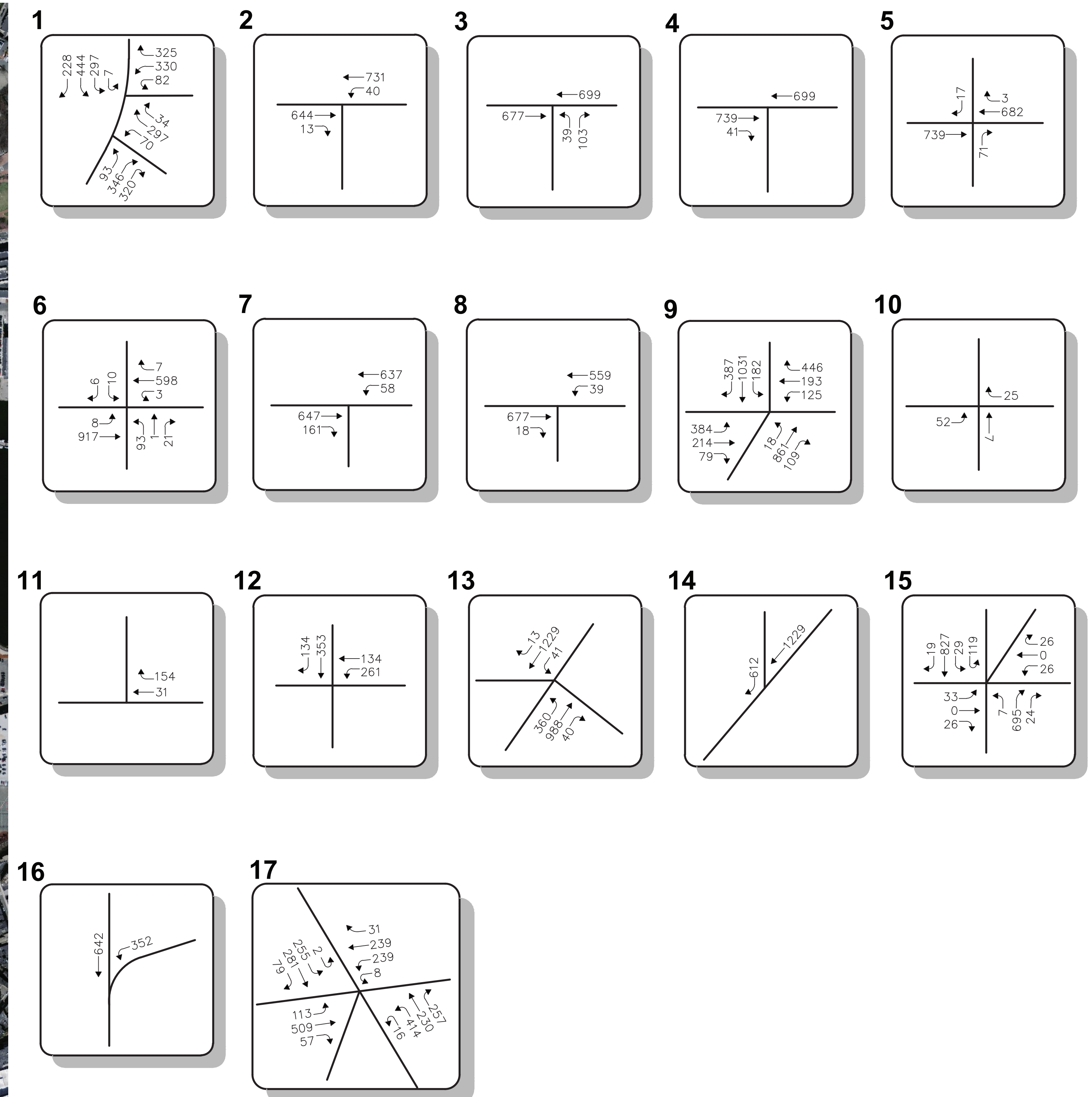
Figure 3-14
2028 No-Build Weekday Morning Peak Hour Traffic Volumes





Note: Imbalances exist due to TMCs conducted during different months and due to numerous curb cuts and side streets that are not shown.

Figure 3-15

2028 No-Build Weekday Evening Peak Hour Traffic Volumes

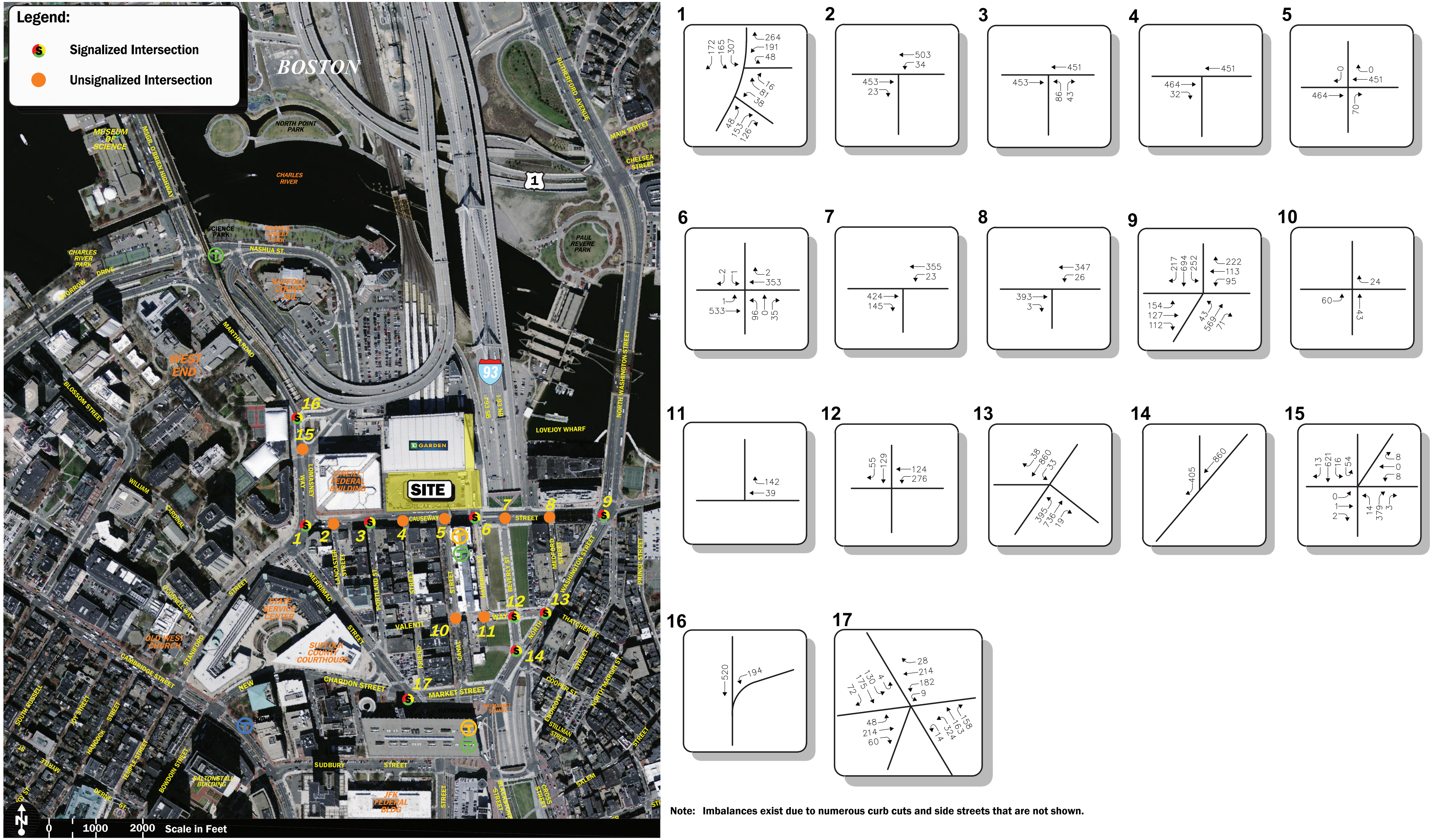


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Figure 3-16

2028 No-Build Saturday Midday Peak Hour Traffic Volumes

3.3.1.5 No Build Pedestrian Volumes

The future 2028 No Build condition pedestrian volume networks were developed by applying a 0.5 percent per year compounded annual growth rate to the 2013 Existing peak-hour pedestrian volumes, consistent with the methodology used for developing the future condition traffic volume networks beyond 2018. The resulting 2028 No Build weekday morning, weekday evening and Saturday midday peak-hour pedestrian-volume networks are shown on Figures 3-17, 3-18 and 3-19, respectively.

3.3.2 Project-Generated Trips

Design year (2028 Build) automobile, pedestrian/bicycle and public transportation trips for the study area were determined by estimating the trip characteristics of the Project and assigning these volumes on the transportation system. The following sections describe the procedures used to develop Build conditions (with the Project) within the study area.

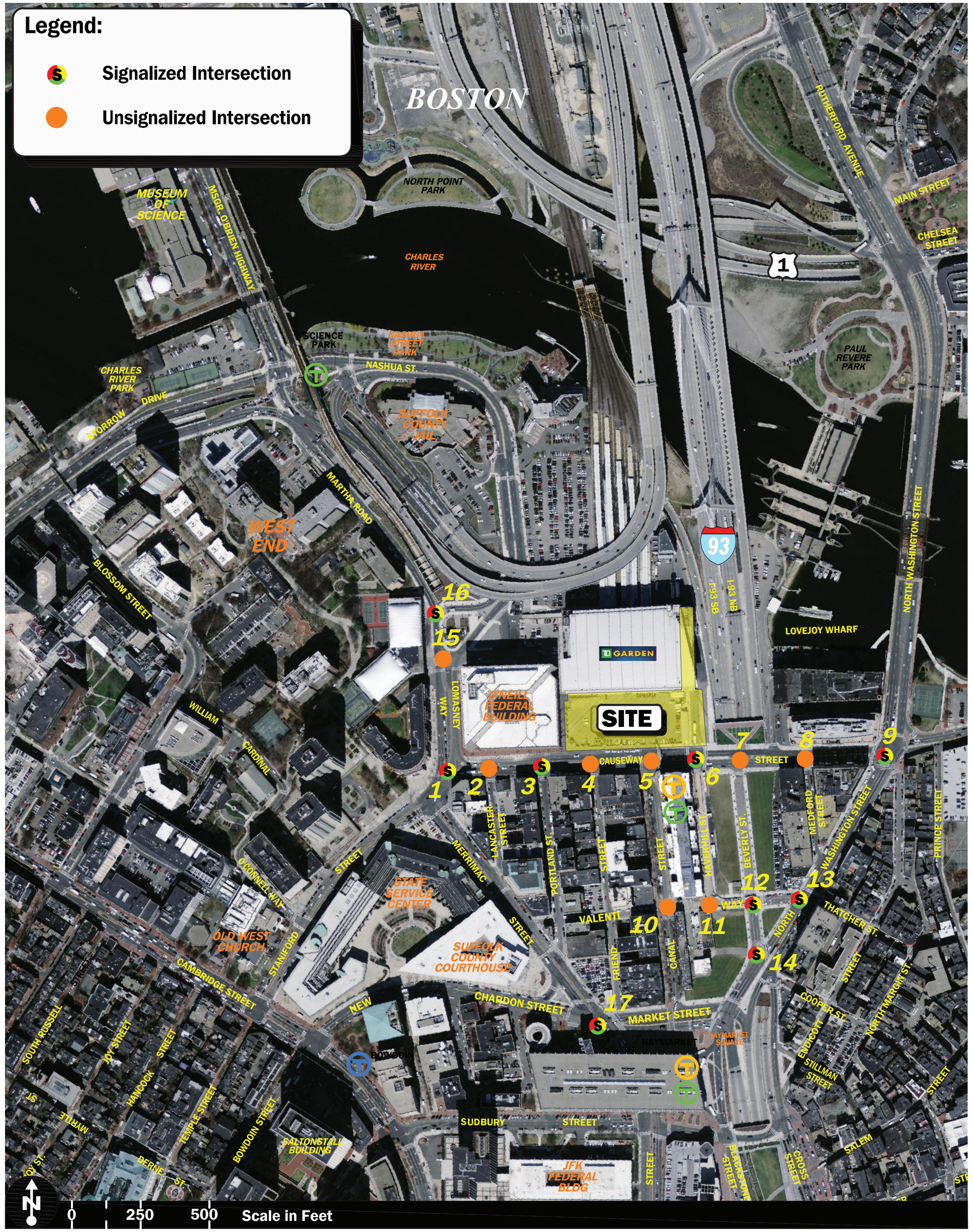
3.3.2.1 Methodology

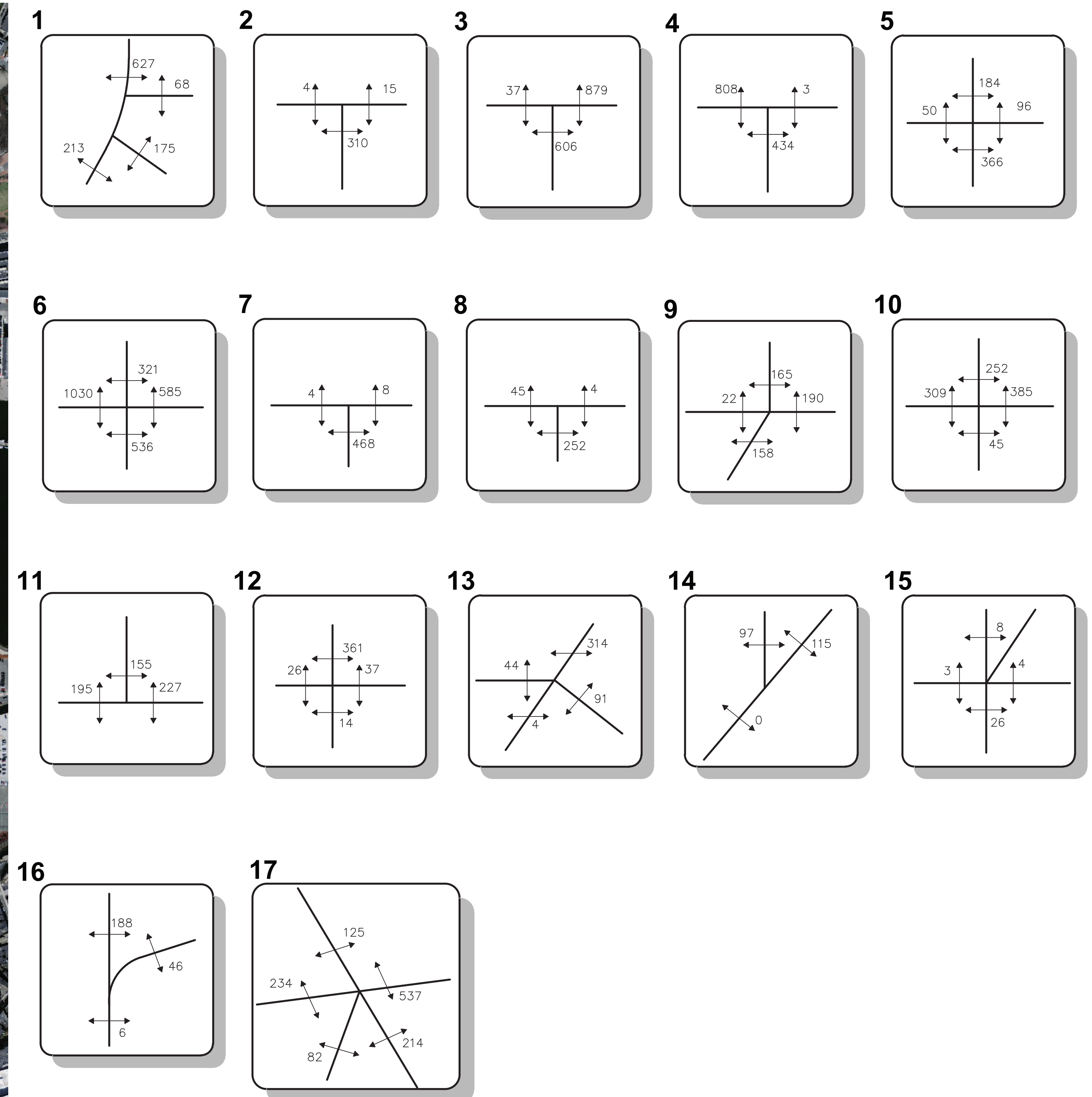
As described previously, the Project includes the construction of a mixed-use, transit-oriented development with residential, office, hotel and retail uses. The Project also includes an expansion of service and circulation areas within the TD Garden and an approximately 25,000 sf atrium hall. The TD Garden expansion and atrium hall are not expected to result in a material increase in trips within the study area over existing conditions.

In order to develop the base trip characteristics of the Project, trip-generation statistics published by the ITE[3] for similar land uses as those proposed were used. ITE Land Use Codes (LUCs) 222, *High-Rise Apartment*; 310, *Hotel*; 710, *General Office Building*; 820, *Shopping Center*; and 850, *Supermarket*; were used to develop the base trip estimates for the Project. For the purpose of this analysis and in order to provide conservative (high) trip projections for the Project, it was assumed that a neighborhood grocery store (approximately 45,000 sf) would be advanced as a part of the retail component of the development.

Given the availability of public transportation to the Project site (bus and Commuter Rail) and the extensive sidewalk network that links the Project site to Downtown Boston, the Bulfinch Triangle, and the North and West End neighborhoods, it is expected that a significant portion of the trips generated by the Project will be made by public transportation or will include pedestrian/bicycle trips. In order to disseminate the ITE trip characteristics of the Project, which are expressed in vehicle trips, to the modes of travel

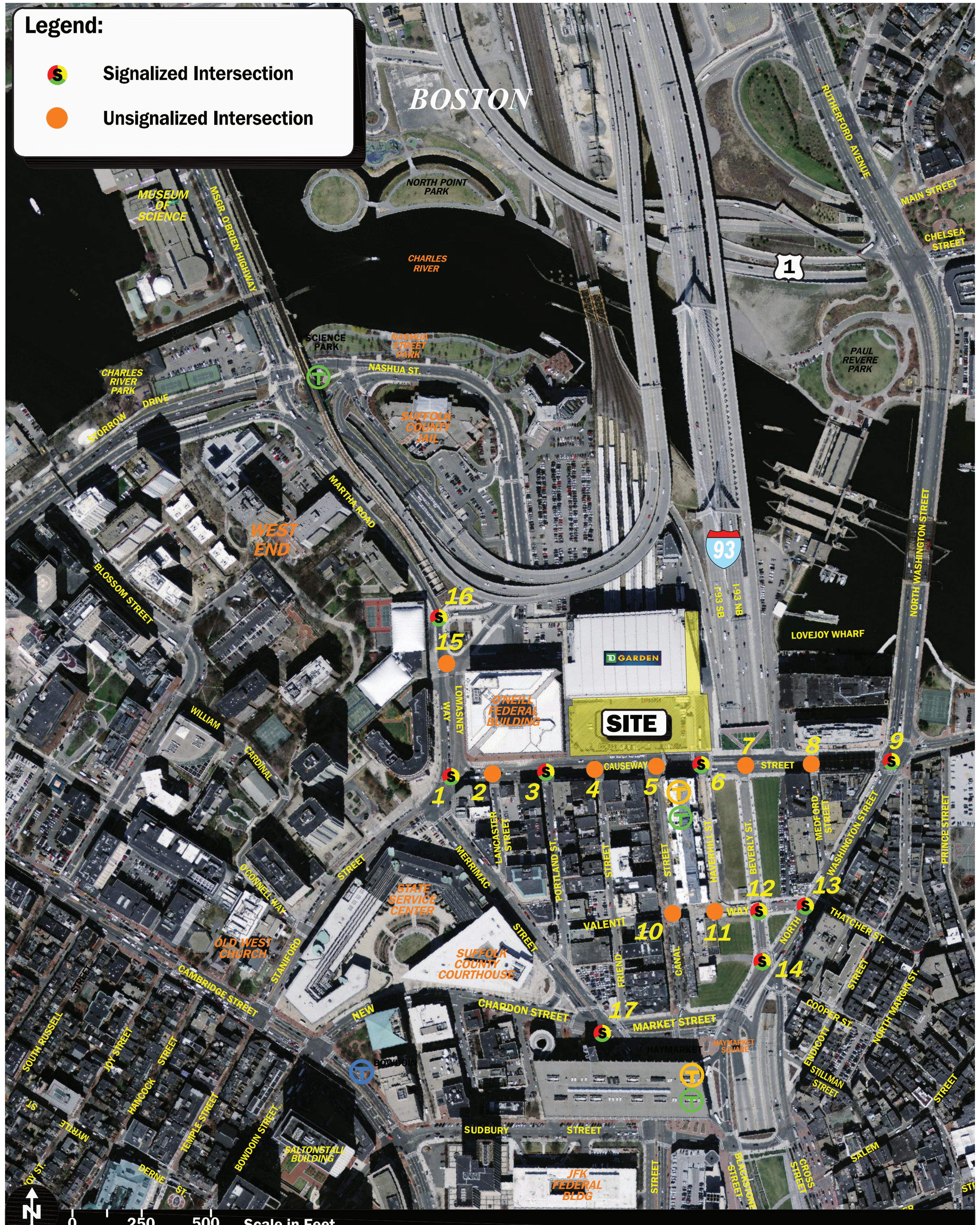
[3] Ibid.

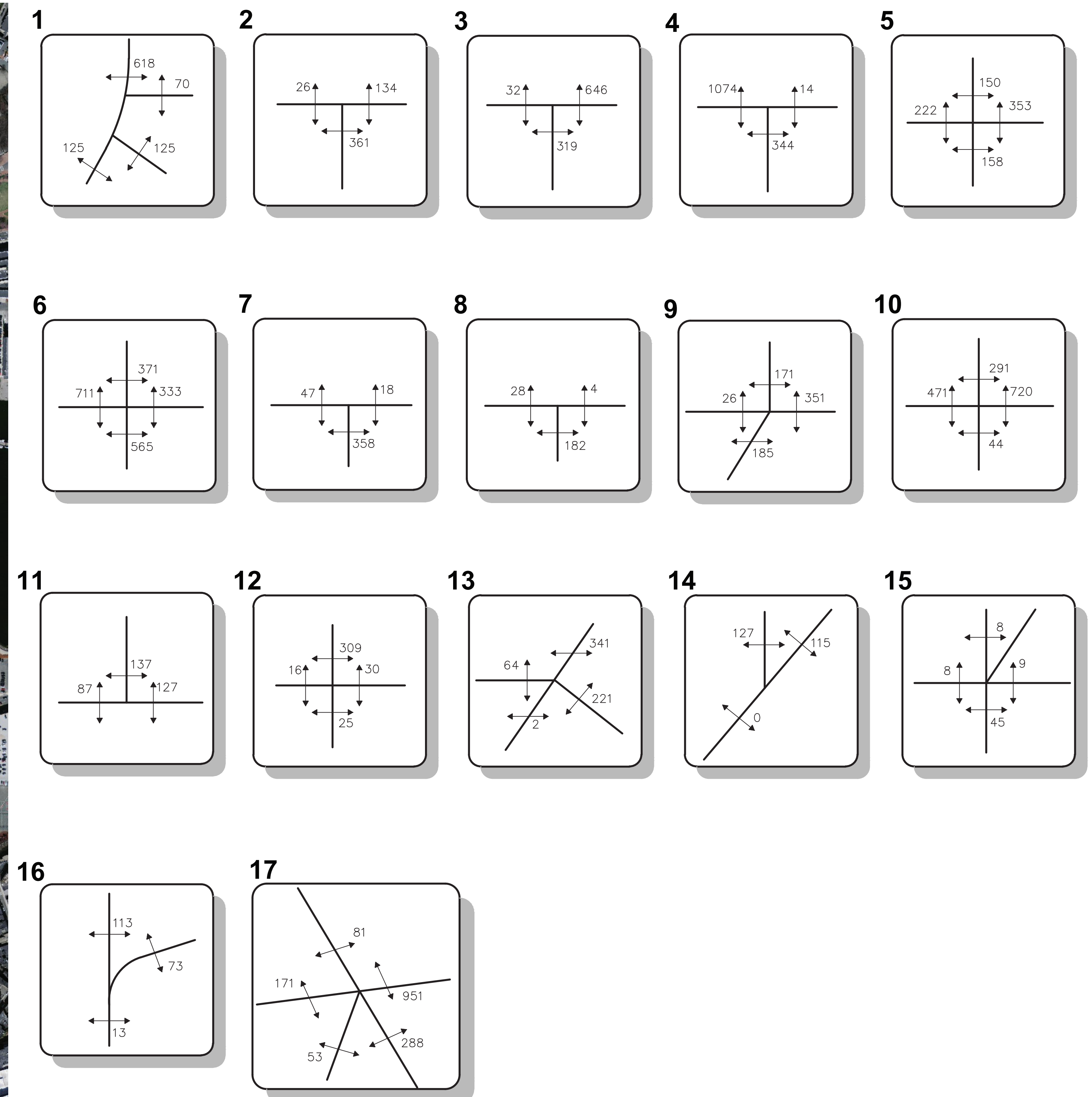




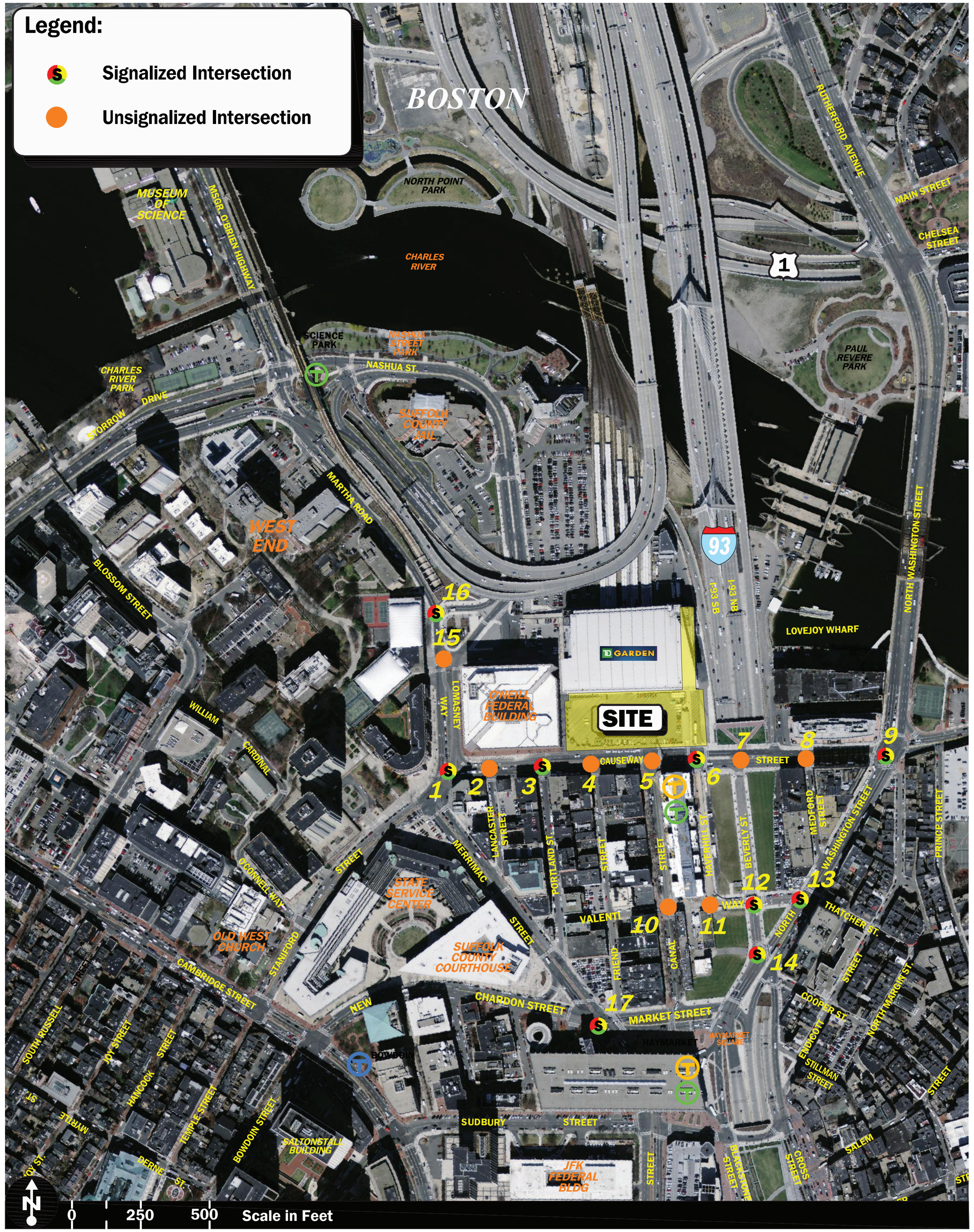
Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

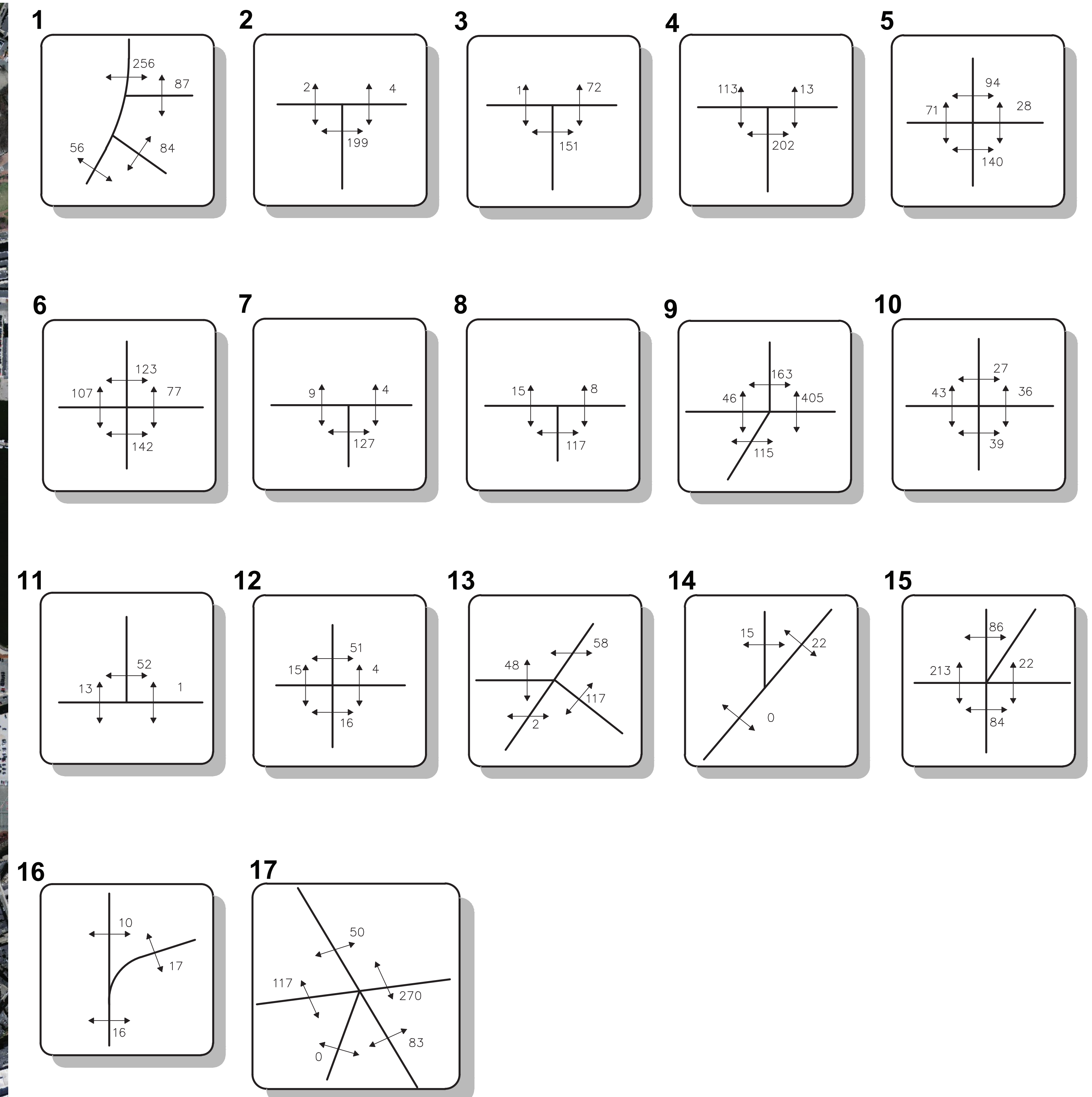
Figure 3-17
2028 No-Build Weekday Morning Peak Hour Pedestrian Volumes





Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.





Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

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Figure 3-19

2028 No-Build Saturday Midday Peak Hour Pedestrian Volumes that will be available to the Project (automobile, public transportation and pedestrian/bicycle), vehicle occupancy ratios (VORs) obtained from recent development projects in the area and travel mode data obtained from BTD were reviewed. Table 3.3-1 summarizes the VOR and travel mode data used for the individual components of the Project.

3.3.2.2 Pass-By Trips

Not all of the automobile trips expected to be generated by the Project will consist of new trips on the roadway network. A portion of the trips generated by the retail/restaurant/grocery components of the Project will consist of pass-by trips, or vehicles traveling along Causeway Street for other purposes that will patronize the Project in conjunction with their trip and then continue on to their original destination. Based on statistics published by the ITE,[4] on average, 34 percent of the trips generated by a retail use (shopping center) and 36 percent of the trips generated by a grocery store (supermarket) may consist of pass-by trips. In order to provide a conservative (high) analysis scenario, and in accordance with state standards for the preparation of TIAs, a more conservative 25 percent pass-by trip rate was applied to the automobile trips associated with the retail/restaurant/grocery components of the Project.

3.3.2.3 Internal Capture Trips

Given the mix of uses to be integrated into the Project, it is expected that a portion of the trips associated with the Project will remain internal to the development, such as a resident of the Project or employee of the office building that patronizes one of the retail uses, restaurants or the grocery component of the development. This interaction between uses within a mixed-use development is not accounted for when the trip generation calculations are performed on an individual land use basis. In order to account for this interaction, an overall internal capture trip rate of 10 percent was used for the Project.

Table 3.3-2 summarizes the anticipated trip characteristics of the Project using the above methodology, with the trip-generation calculations for the individual components of the Project provided in Appendix B.

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4 Ibid.

Table 3.3-1 Travel Mode Split and Vehicle Occupancy Ratio[a]

	Mode of Travel															
	Automobile (Percent)					Transit (Percent)					Pedestrian/Bicycle (Percent)					
Land Use	Weekday Daily	AM Peak Hour	PM Peak Hour	Saturday Daily	Saturday Midday Peak Hour	Weekday Daily	AM Peak Hour	PM Peak Hour	Saturday Daily	Saturday Midday Peak Hour	Weekday Daily	AM Peak Hour	PM Peak Hour	Saturday Daily	Saturday Midday Peak Hour	VOR (Persons per Vehicle)
Residential:																
Entering	31	17	17	32	24	15	15	13	15	16	54	68	70	53	60	1.2
Exiting	31	17	17	32	20	15	13	15	15	15	54	70	68	53	65	1.2
Office:																
Entering	43	38	38	43	49	30	32	29	30	26	27	30	33	27	25	1.1
Exiting	43	38	38	43	43	30	29	32	30	30	27	33	30	27	27	1.1
Hotel:																
Entering	31	27	26	43	32	15	16	14	30	15	54	57	60	27	53	1.8
Exiting	31	26	27	43	32	15	14	16	30	15	54	60	57	27	53	1.8
Retail/Grocery:																
Entering	31	27	26	43	32	15	16	14	30	15	54	57	60	27	53	1.8
Exiting	31	26	27	43	32	15	14	16	30	15	54	60	57	27	53	1.8

[a]Source: *Bulfinch Triangle Project,* EEA#14194; Boston, Massachusetts, Epsilon Associates, Inc. et al; July 2008.

The Merano, Project Notification Form; Boston, Massachusetts, Epsilon Associates, Inc. et al; June 2008 and NPC filed in 2011.

One Canal, Project Notification Form; Boston, Massachusetts, Epsilon Associates, Inc. et al; October 2011.

Table 3.3-2 Project Trip-Generation Summary – Full Build-Out

Time Period/Direction	ITE Trips	Person Trips: Total Person Trips	Person Trips: Automobile Trips	Person Trips: Transit Trips	Person Trips: Pedestrian/ Bicycle Trips	Vehicle Trips: (A) Automobile Trips	Vehicle Trips: (B) Pass-By Trips	Vehicle Trips: (C = A - B) Total New Vehicle Trips
Average Weekday Daily:								
Entering	12,541	19,689	6,528	3,485	9,676	4,066	549	3,517
Exiting	12,541	19,689	6,528	3,485	9,676	4,066	549	3,517
Total	25,082	39,378	13,056	6,970	19,352	8,132	1,098	7,034
Weekday Morning Peak Hour:								
Entering	1,238	1,579	532	411	636	406	11	395
Exiting	428	617	165	105	347	90	11	79
Total	1,666	2,196	697	516	983	496	22	474
Weekday Evening Peak Hour:								
Entering	997	1,614	431	253	930	247	43	204
Exiting	1,631	2,323	719	515	1,089	500	43	457
Total	2,628	3,937	1,150	768	2,019	747	86	661
Saturday Daily:								
Entering	13,960	23,685	10,021	6,881	6,783	5,727	1,118	4,609
Exiting	13,960	23,685	10,021	6,881	6,783	5,727	1,118	4,609
Total	27,920	47,370	20,042	13,762	13,566	11,454	2,236	9,218
Saturday Midday Peak Hour:								
Entering	1,300	2,145	711	346	1,088	425	69	356
Exiting	1,162	1,931	626	317	988	367	69	298
Total	2,462	4,076	1,337	663	2,076	792	138	654

3.3.2.4 Project-Generated Trip Summary

As can be seen in Table 3.3-2, at full build-out, the Project is projected to result in 7,034 new automobile trips (3,517 vehicles entering and 3,517 exiting) on an average weekday, with 6,970 transit trips and 19,352 pedestrian/bicycle trips. During the weekday morning peak hour, the Project is projected to generate 474 new automobile trips (395 vehicles entering and 79 exiting), with 516 transit trips and 983 pedestrian/bicycle trips. During the weekday evening peak hour, the Project is projected to generate 661 new automobile trips (204 vehicles entering and 457 exiting), with 768 transit trips and 2,019 pedestrian/bicycle trips. On a Saturday, the Project is projected to generate approximately 9,218 new automobile trips (4,609 vehicles entering and 4,609 exiting), with 13,762 transit trips and 13,566 pedestrian/bicycle trips. During the Saturday midday peak hour, the Project is projected to generate 654 new automobile trips (356 vehicles entering and 298 exiting), with 663 transit trips and 2,076 pedestrian/bicycle trips.

3.3.2.5 Vehicle Trip Distribution and Assignment

The directional distribution of automobile trips to and from the Project site was determined based on a review of existing travel patterns within the study area and the roadway network serving the Project site. Separate trip distribution patterns were developed for the residential and commercial components of the Project, as the origin and destination of the trips associated with these uses will be distinct. The general trip distribution for the Project is summarized in Table 3.3-3, with the detailed trip distribution patterns graphically depicted on Figures 3-20 and 3-21. The additional automobile trips expected to be generated by the Project were assigned on the study area roadway network as shown on Figures 3-22, 3-23 and 3-24 for the weekday morning, weekday evening and Saturday midday peak hours, respectively.

Table 3.3-3 Vehicle Trip Distribution Summary

Roadway	Direction (To/From Site)	Commercial Component To/From Site (Percent)	Residential Component To/From Site (Percent)
I-93/Route 1	North	26	5
I-93/Callahan/Sumner Tunnels	South	35	1
Storrow Drive	West	10	29
North Washington Street (local)	North	6	5
Commercial Street (local)	East	5	5
Cambridge Street (local)	West	11	20
Congress Street (local)	South	2	20
Cross Street/Surface Road (local)	South	3	10
O'Brien Highway (local)	North	2	5
Total		**100**	**100**

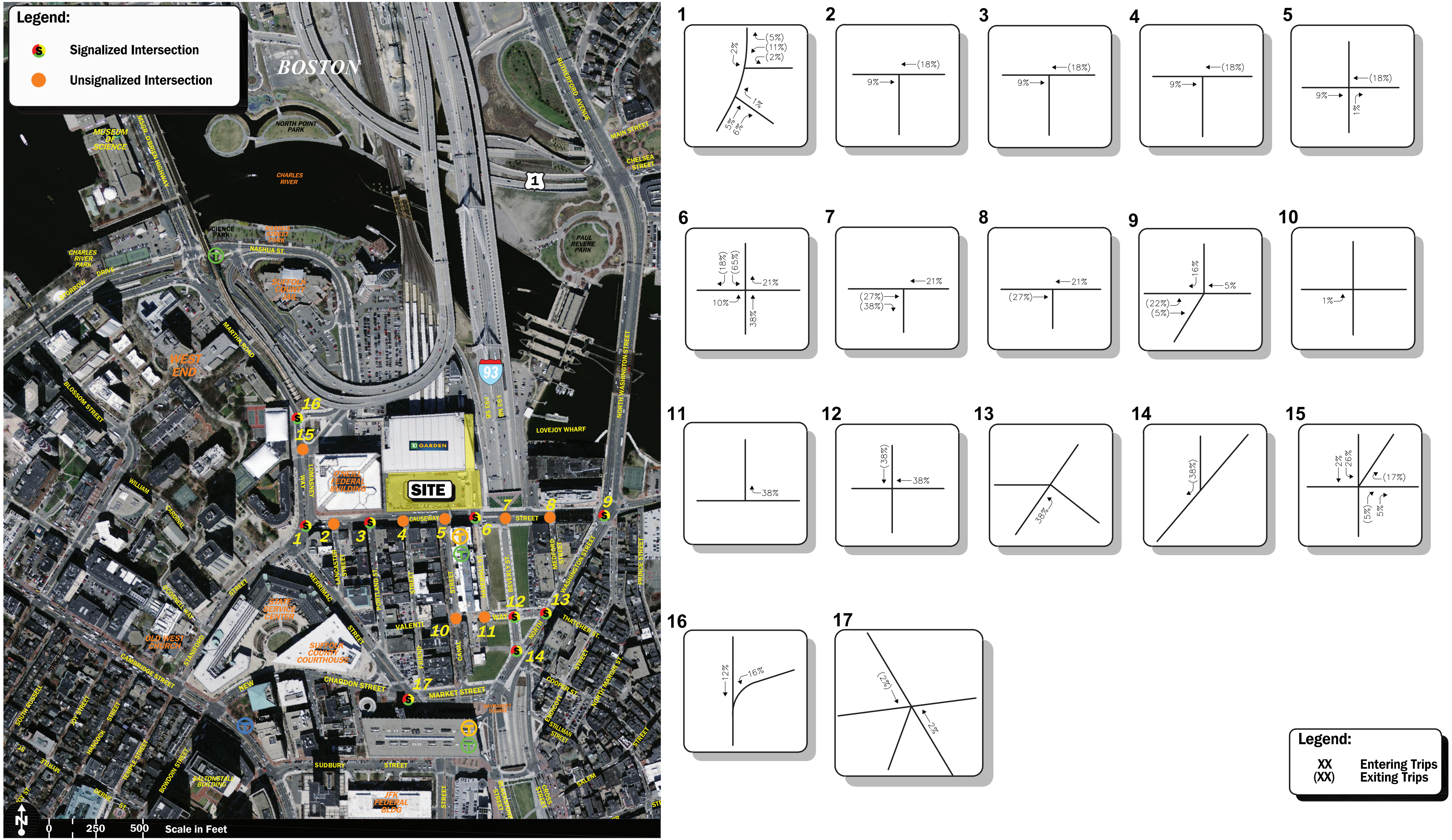

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Figure 3-20
Trip Distribution Map, Commercial Component

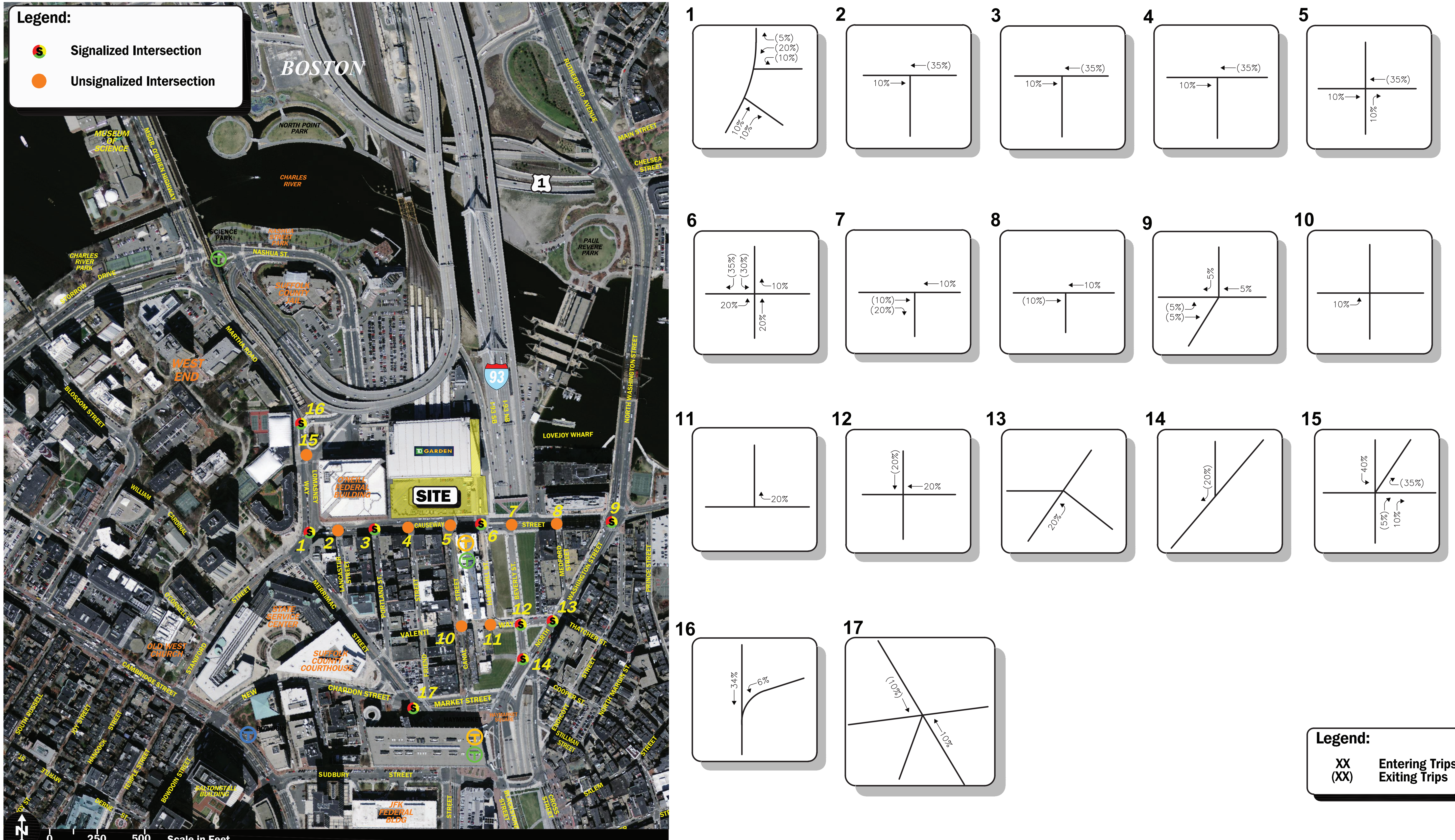

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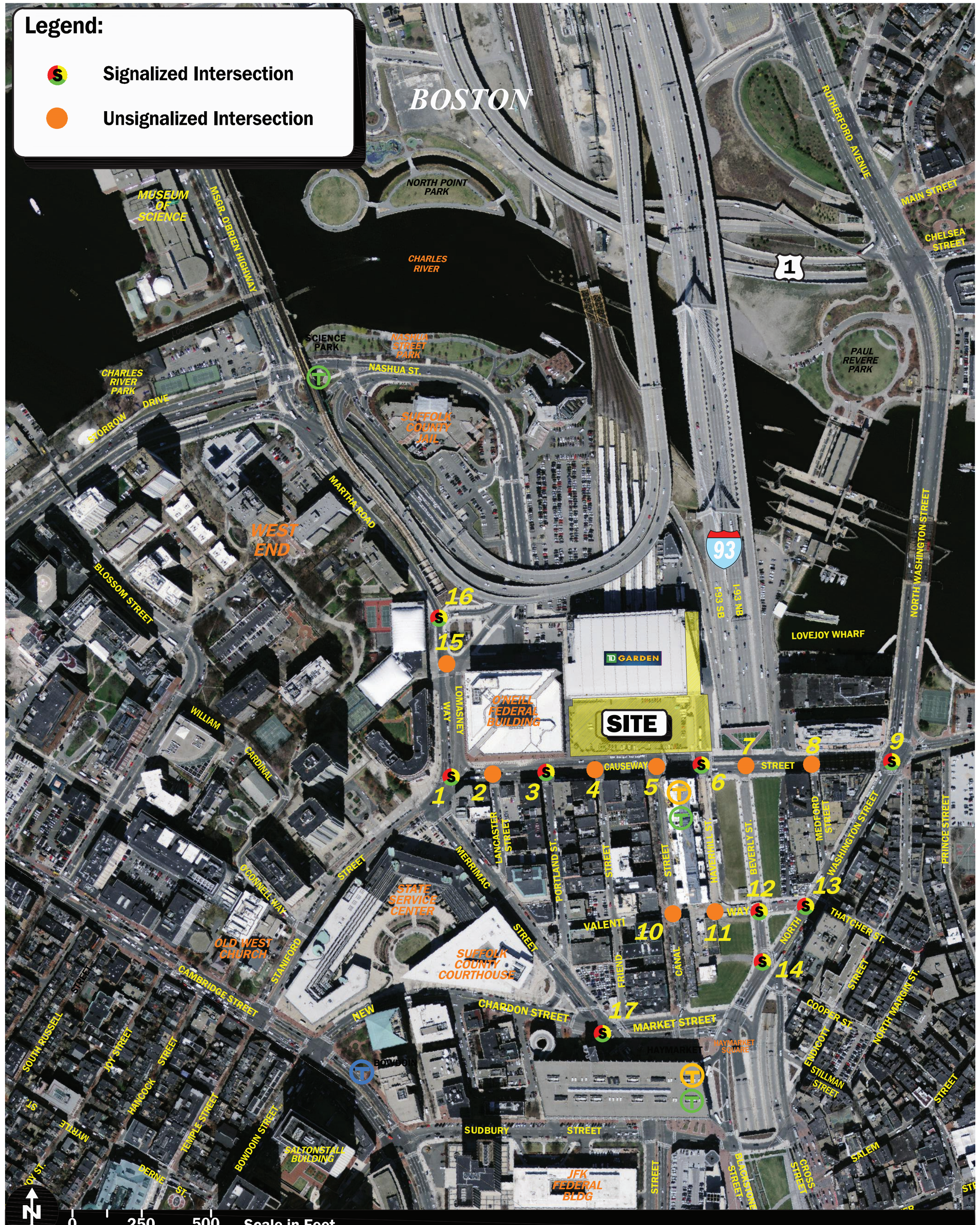
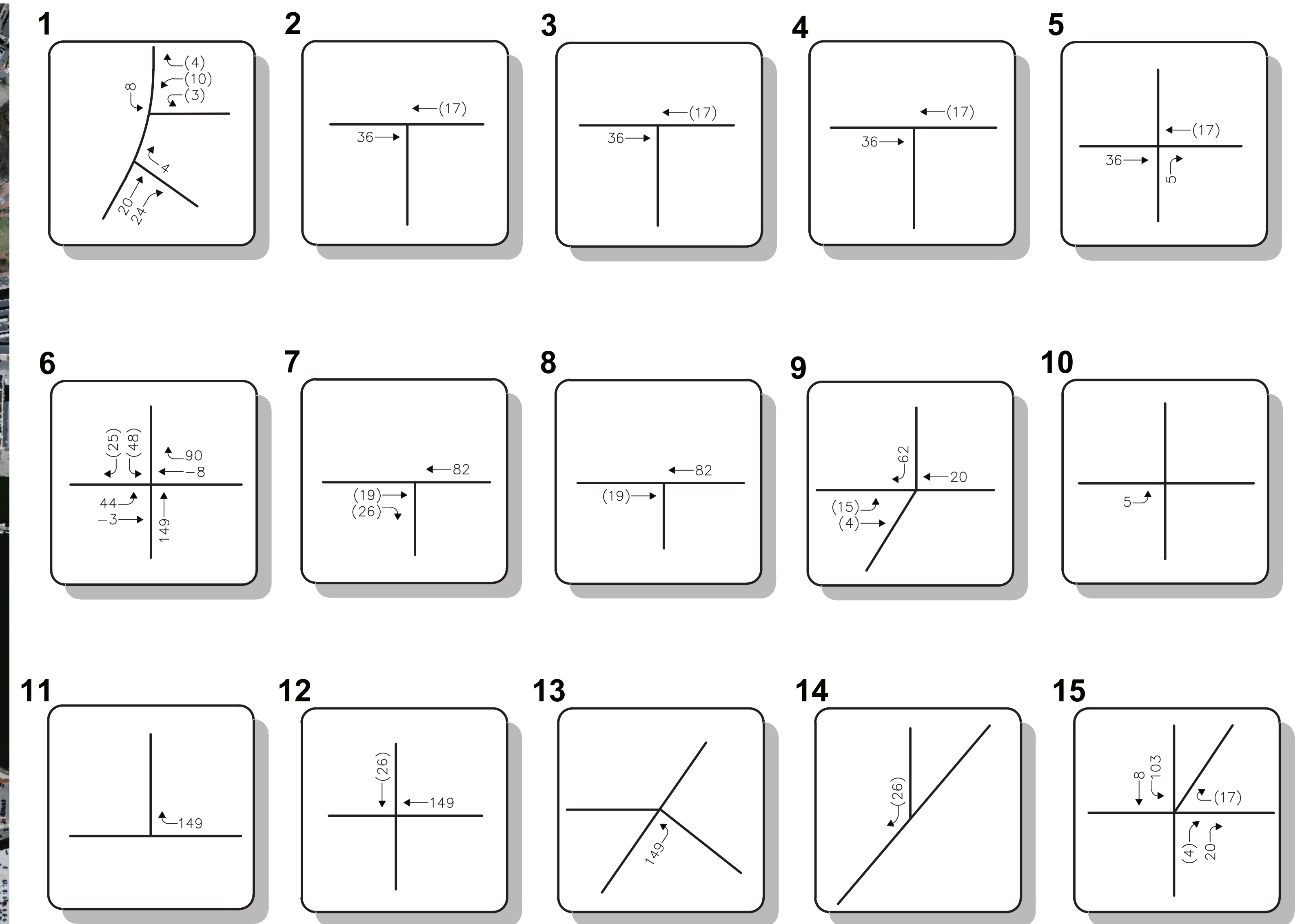
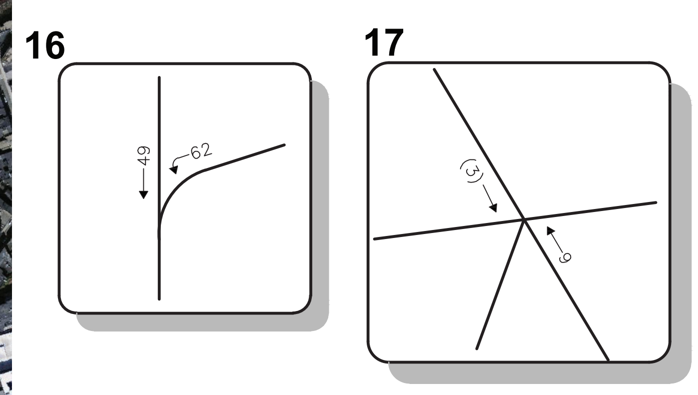
Figure 3-21
Trip Distribution Map, Residential Component







SITE

	New Trips	Pass-By Trips	Total Trips
In	395	11	406
Out	79	11	90
Total	474	22	496

Legend:
XX Entering Trips
(XX) Exiting Trips

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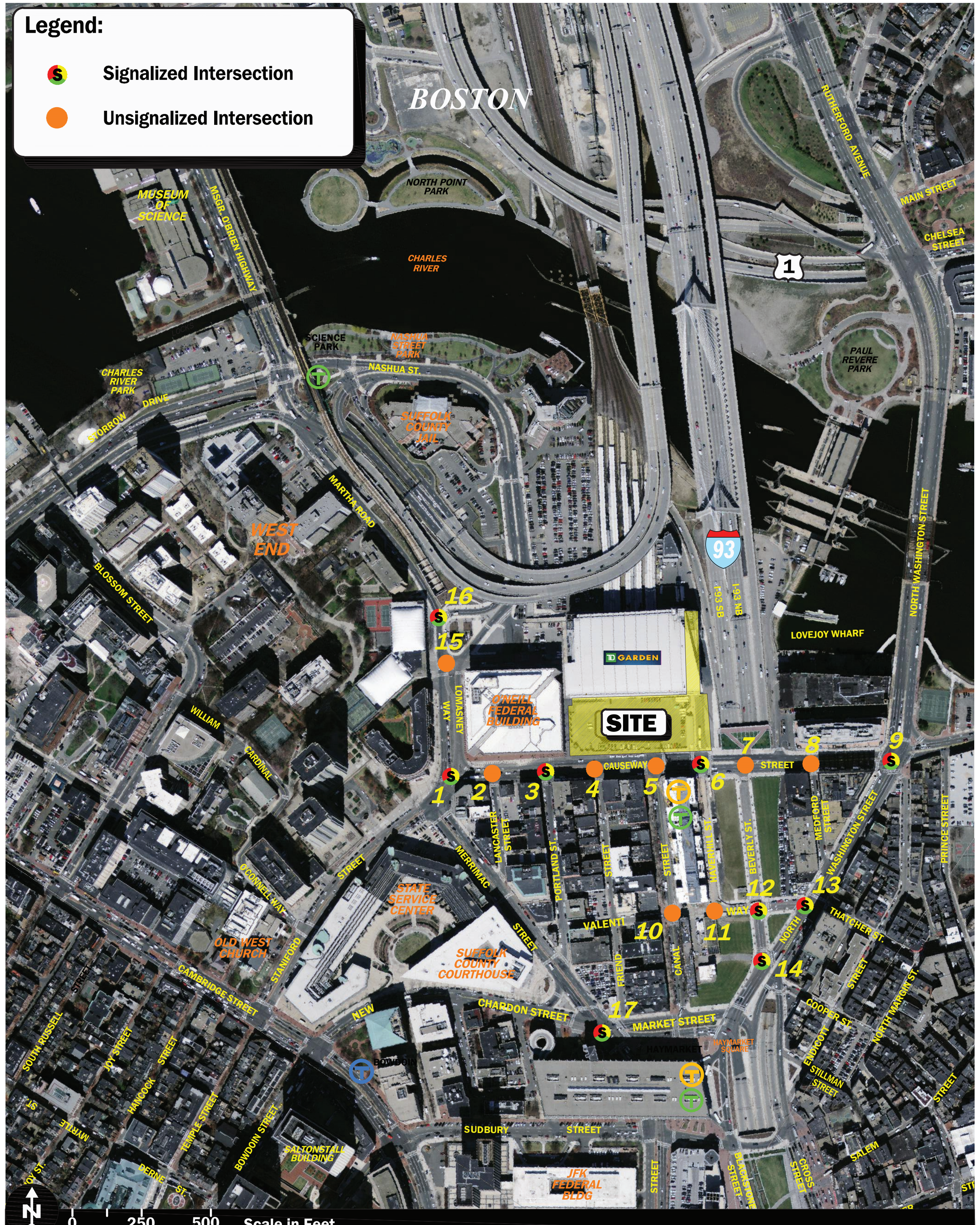
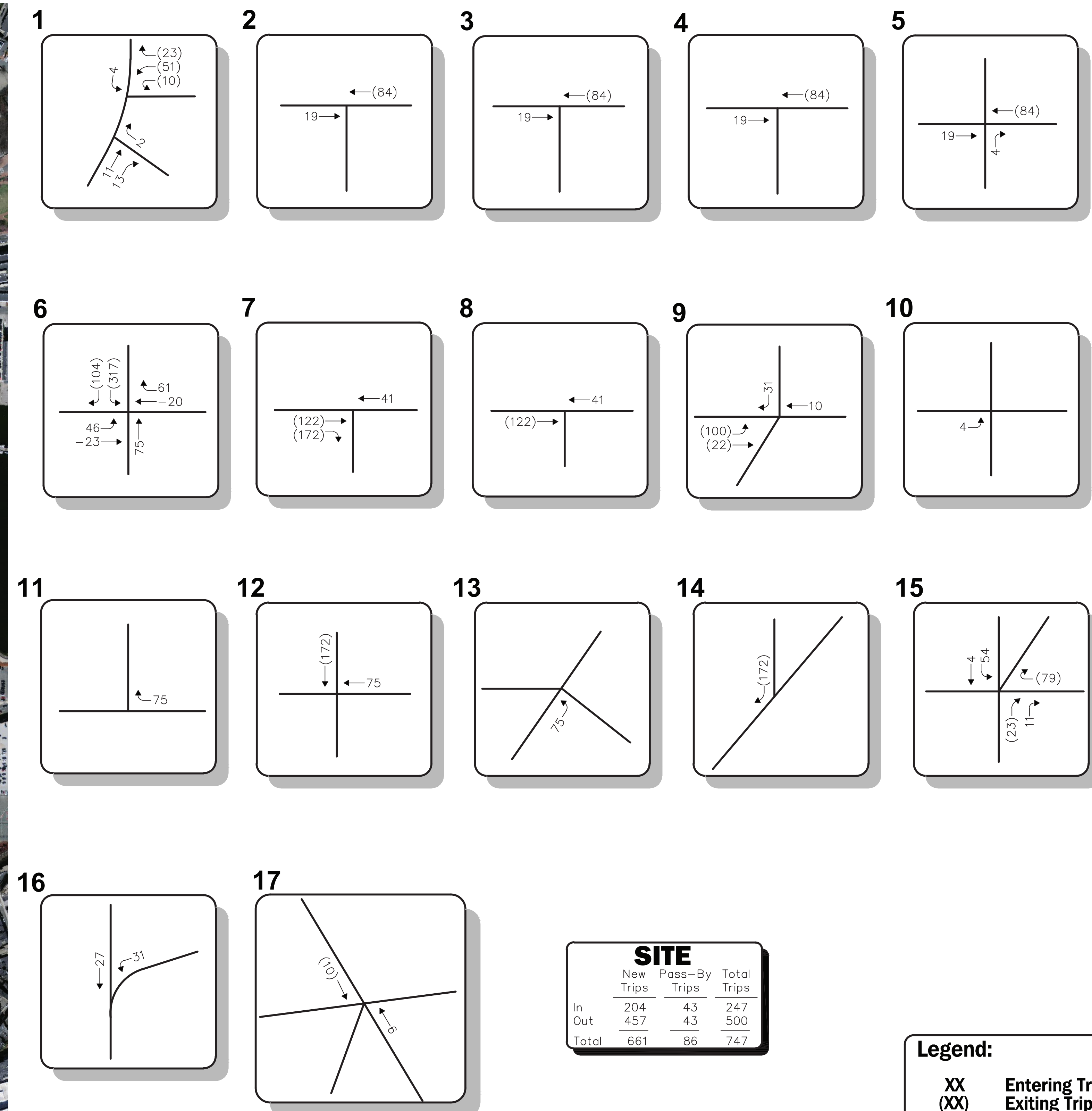
Figure 3-22
Project-Generated Weekday Morning Peak Hour Traffic Volumes





SITE	New Trips	Pass-By Trips	Total Trips
In	204	43	247
Out	457	43	500
Total	661	86	747

Legend:

XX Entering Trips
(XX) Exiting Trips

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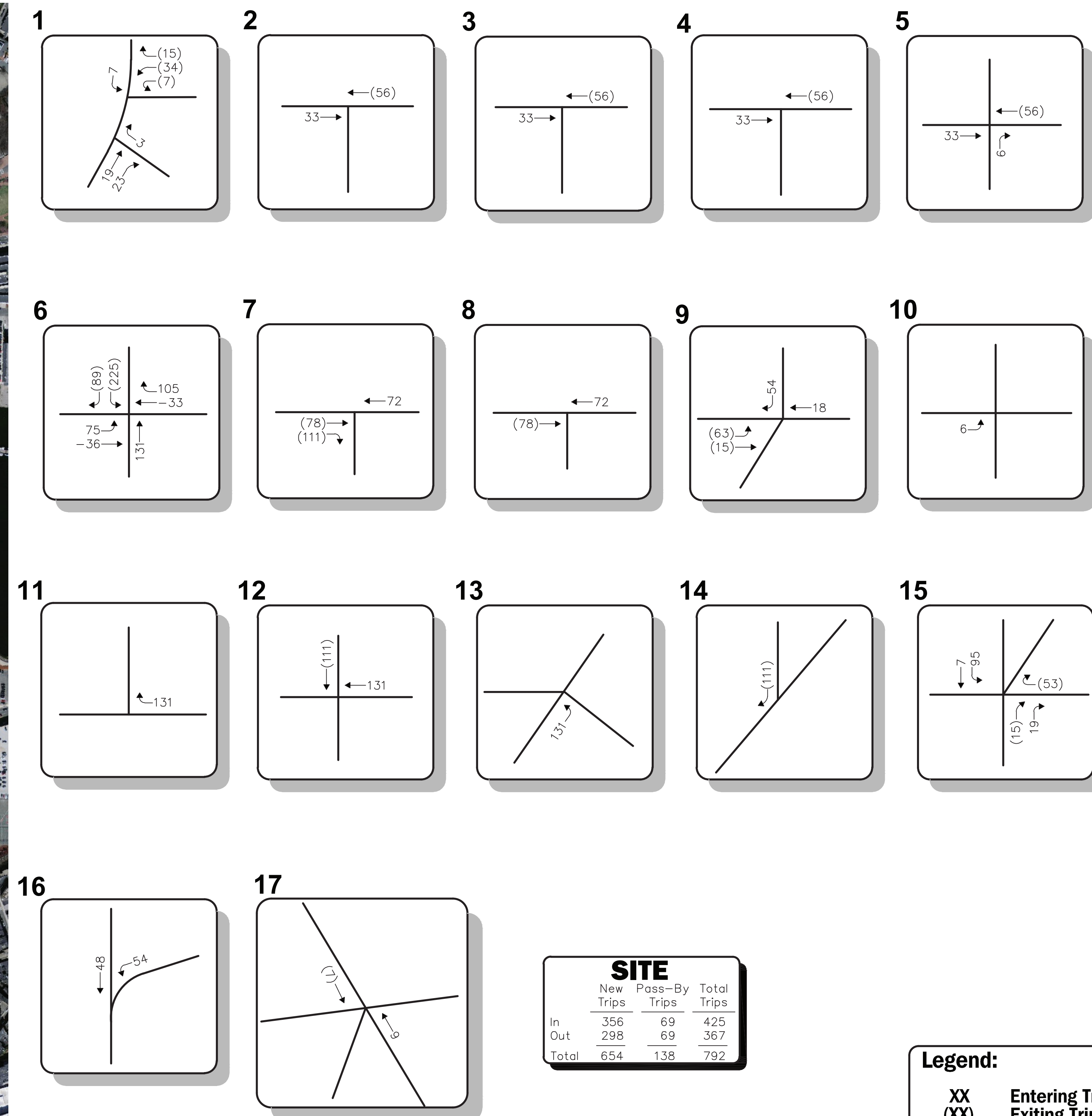
Figure 3-23

Project-Generated Weekday Evening Peak Hour Traffic Volumes



SITE

	New Trips	Pass-By Trips	Total Trips
In	356	69	425
Out	298	69	367
Total	654	138	792

Legend:
XX Entering Trips
(XX) Exiting Trips

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Figure 3-24
Project-Generated Saturday Midday Peak Hour Traffic Volumes

3.3.2.6 Pedestrian Trip Distribution and Assignment

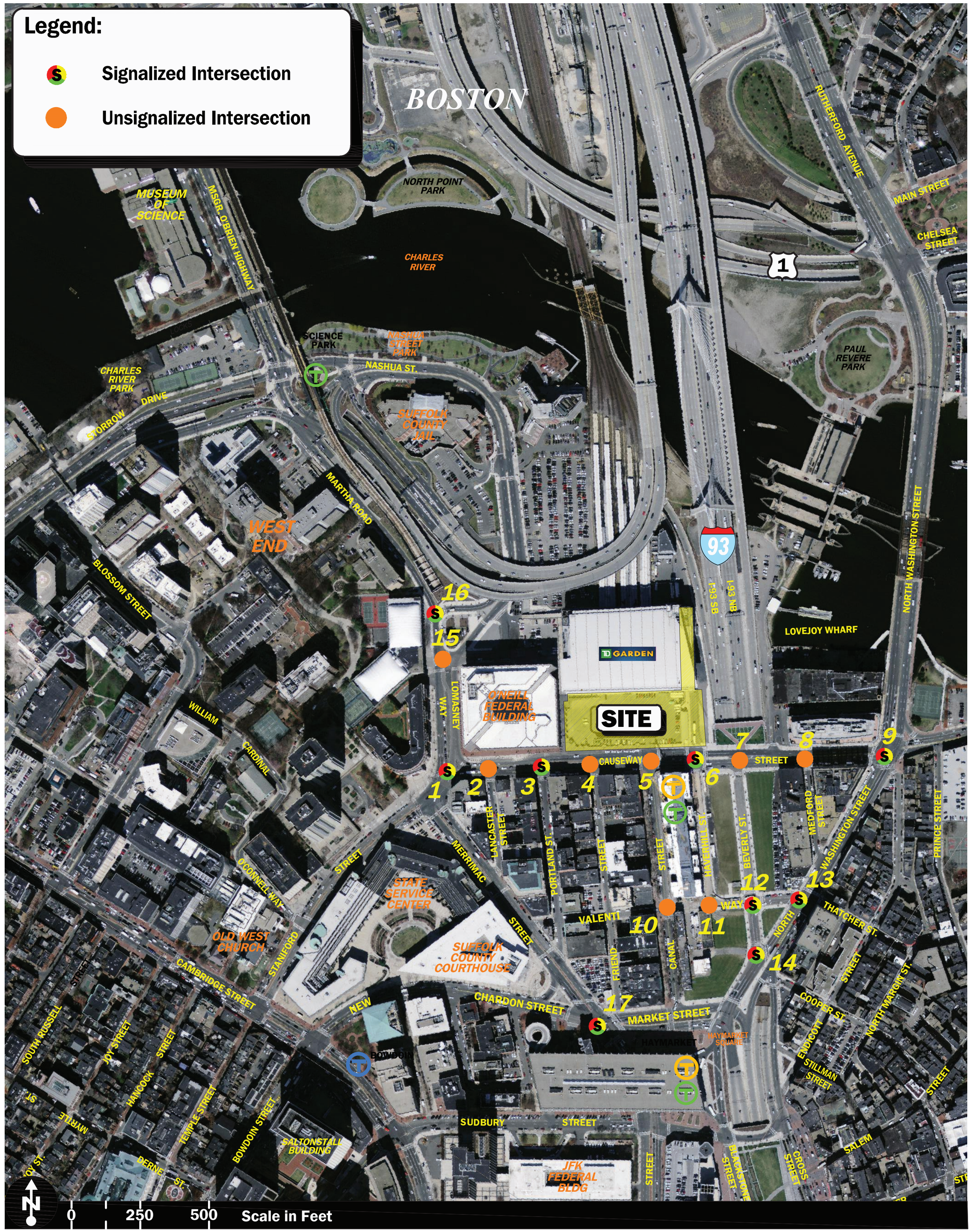
The distribution of pedestrian trips to and from the Project was developed assuming that the primary trip generation area for pedestrian trips would encompass the neighborhood areas located proximate to the Project site, including the Bulfinch Triangle, the North End and West End neighborhoods, and extending toward Beacon Hill and Charlestown. The general pedestrian trip distribution for the Project was developed based on a review of existing pedestrian volumes and patterns along Causeway Street and was then refined based on a review of pedestrian volumes entering and exiting the study area from the surrounding neighborhoods. The additional pedestrian trips expected to be generated by the Project were assigned on the study area pedestrian network as shown on Figures 3-25, 3-26 and 3-27 for the weekday morning, weekday evening and Saturday midday peak hours, respectively.

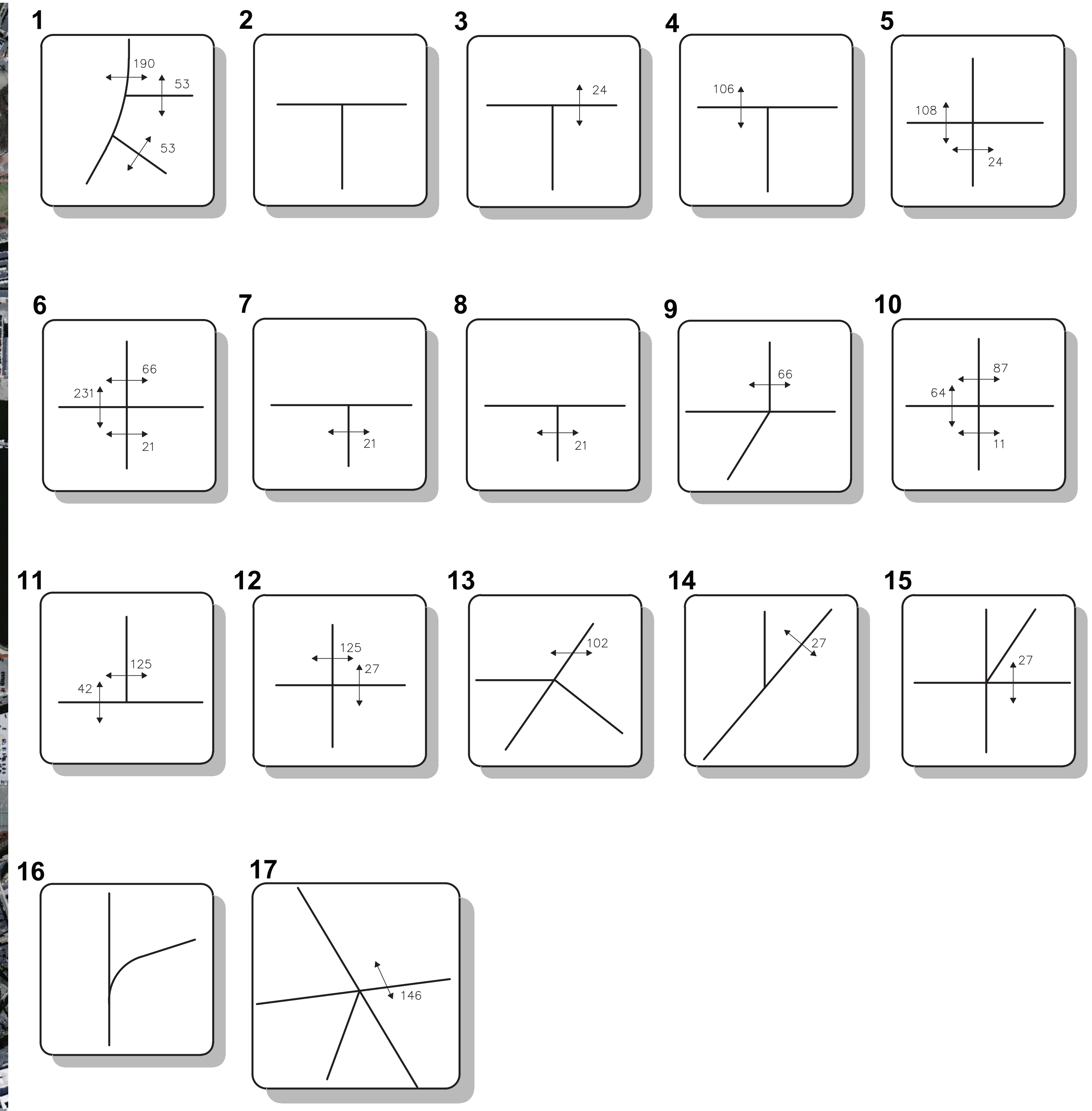
3.3.3 Future Build Condition

3.3.3.1 Build Traffic Volumes

The 2028 Build condition traffic volumes were developed by adding the anticipated Project-generated automobile trips to the respective 2028 No Build condition peak-hour traffic volumes. The resulting 2028 Build condition weekday morning, weekday evening and Saturday midday peak-hour traffic-volume networks are graphically depicted on Figure 3-28, 3-29 and 3-30, respectively.

A summary of peak-hour projected traffic-volume increases external to the immediate study area that are the subject of this assessment are shown in Table 3.3-4. These volumes are based on the expected increases from the Project. As shown in Table 3.3-4, peak-hour traffic-volume increases external to the immediate study area are anticipated to range from 0.7 to 19.2 percent, with vehicle increases ranging from 12 to 247 vehicles.

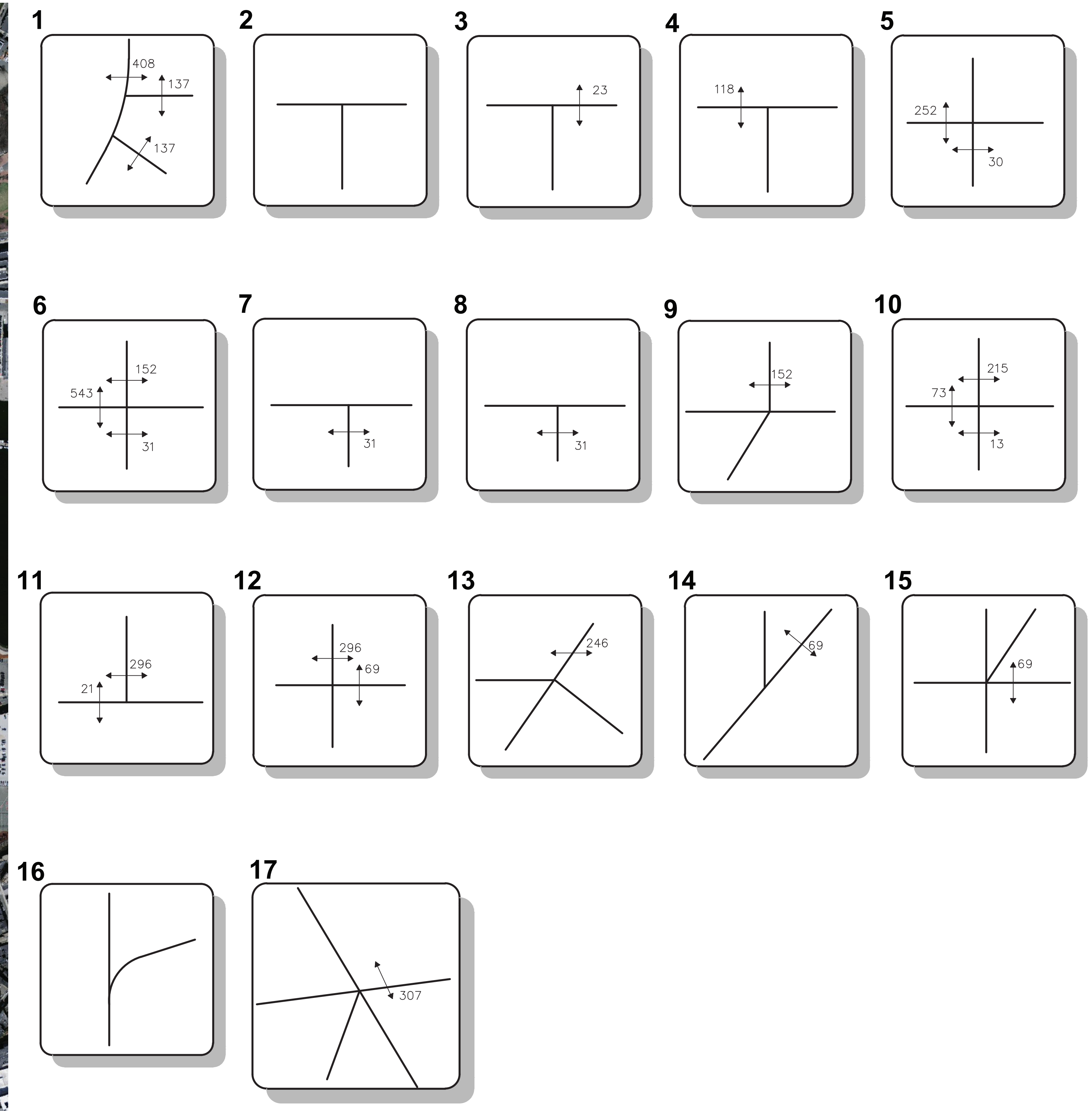




Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

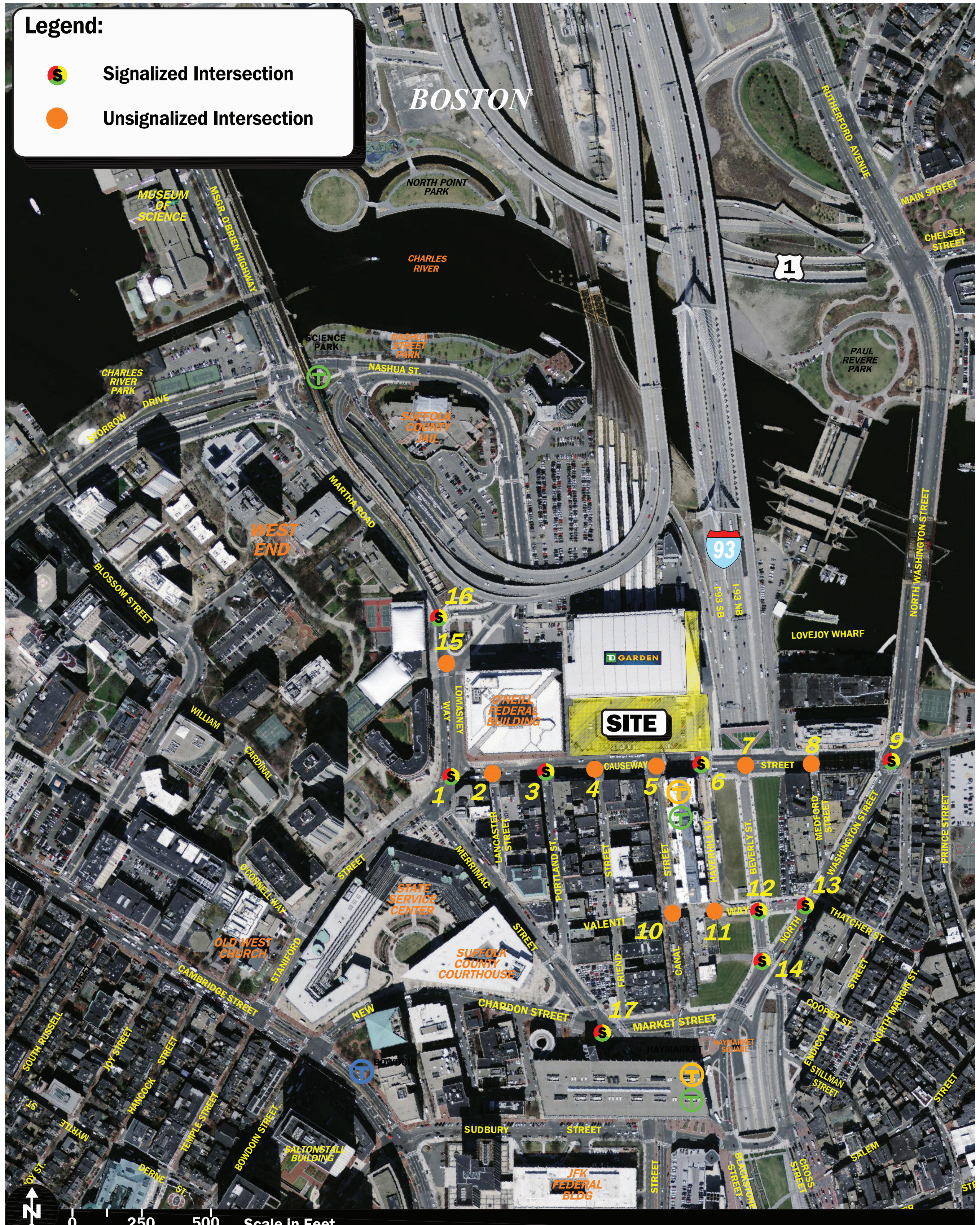
Figure 3-25

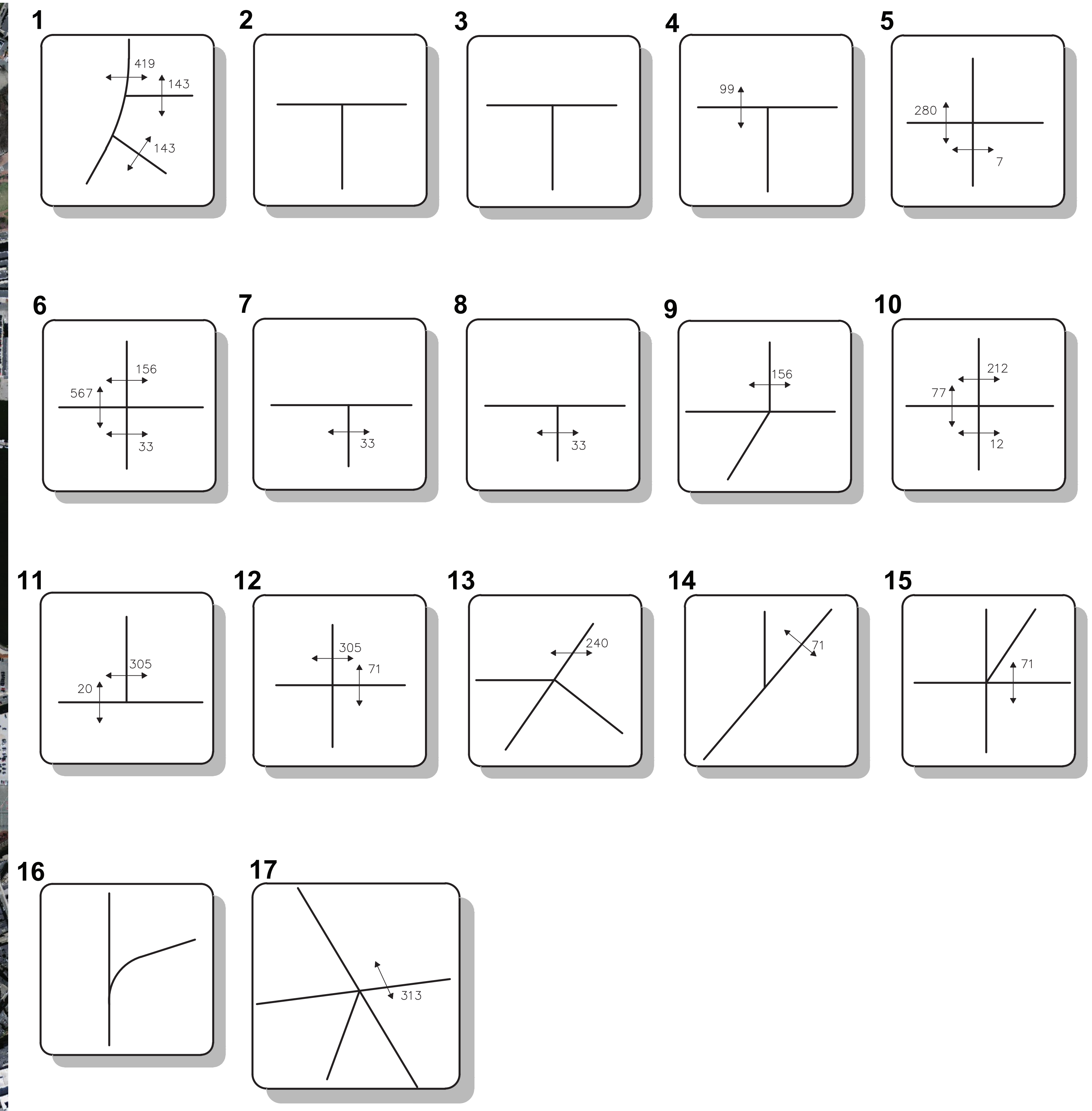
Project-Generated Weekday Morning Peak Hour Pedestrian Volumes



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Figure 3-26
Project-Generated Weekday Evening Peak Hour Pedestrian Volumes

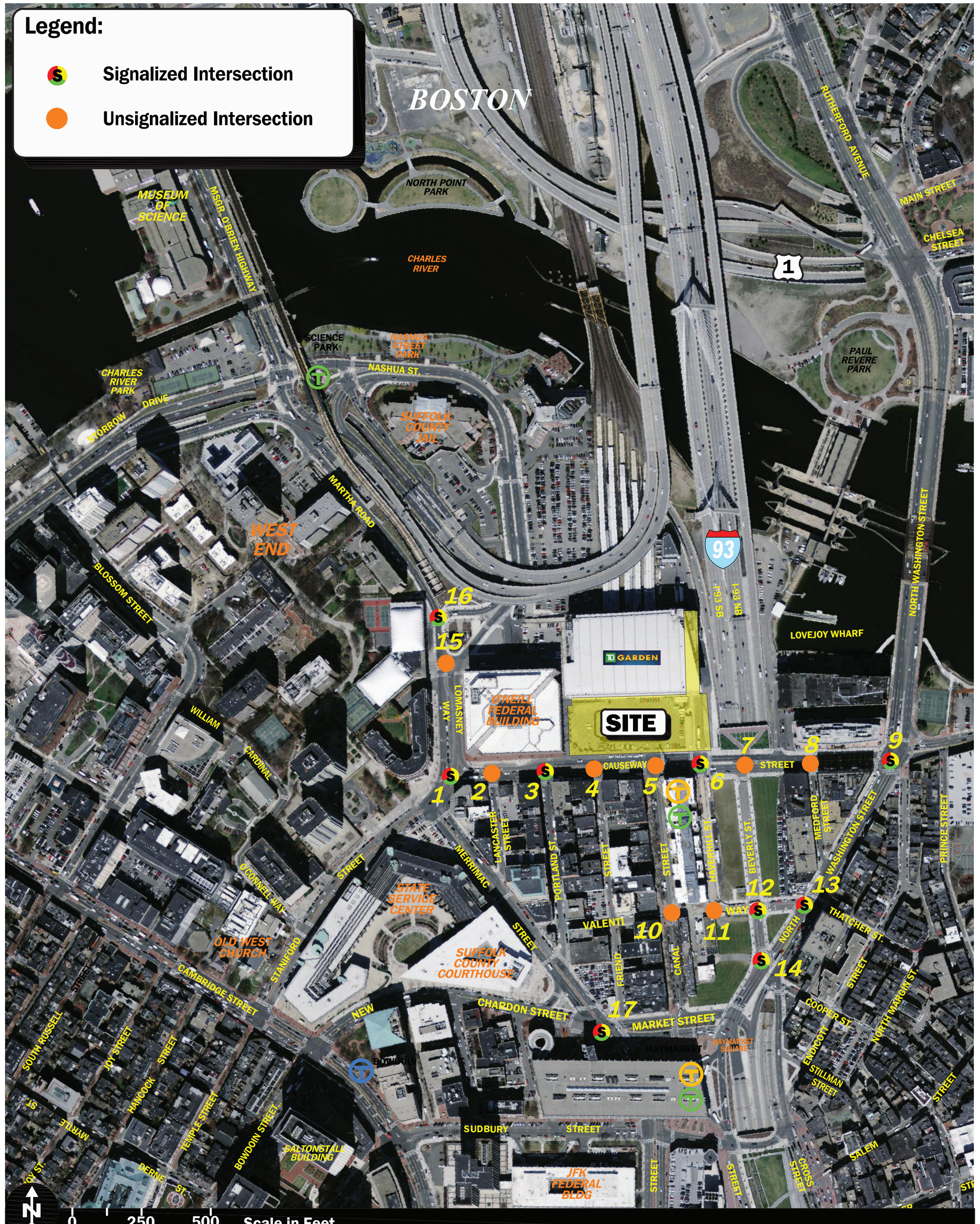


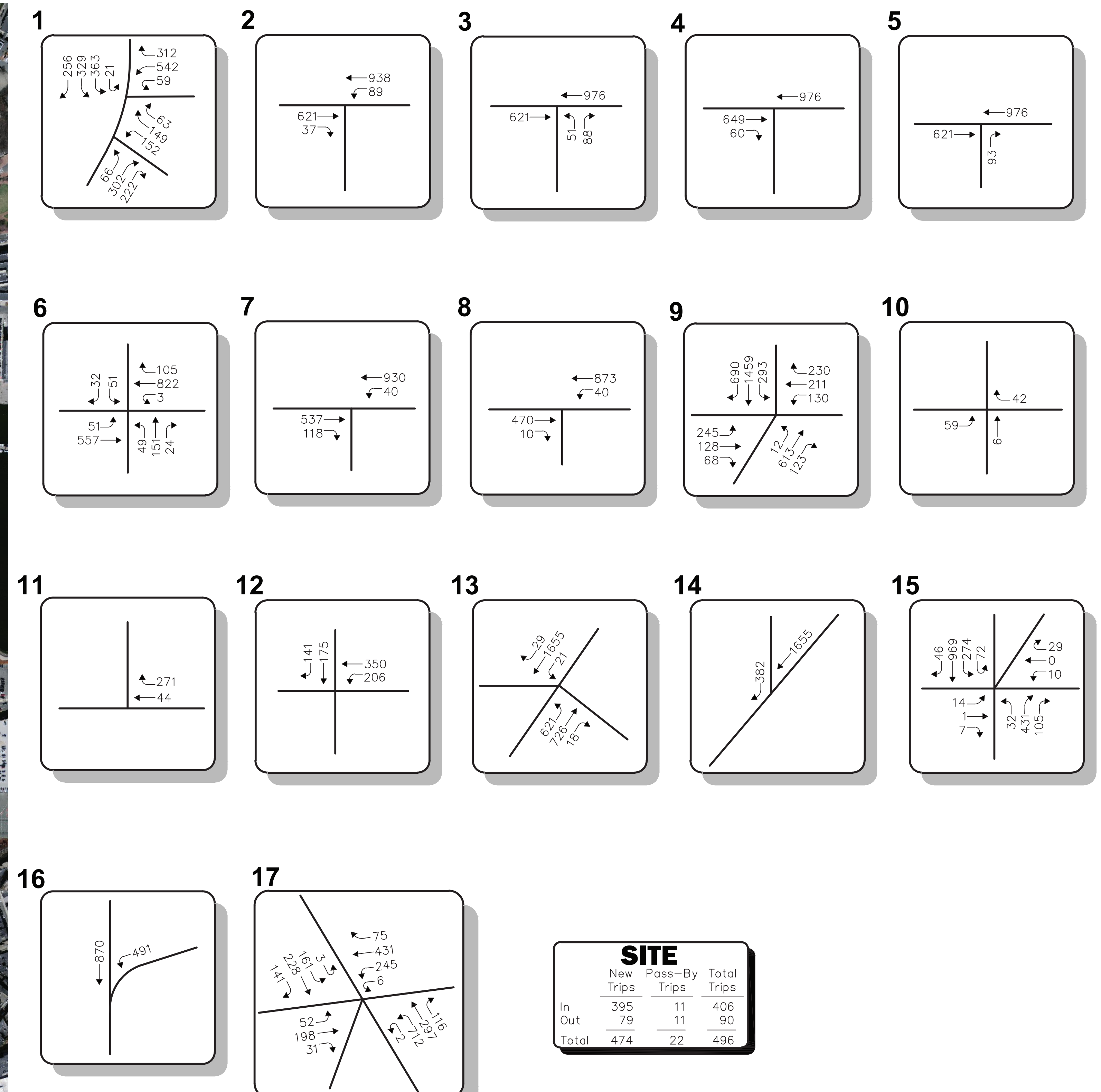


Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Figure 3-27

Project-Generated Saturday Midday Peak Hour Pedestrian Volumes





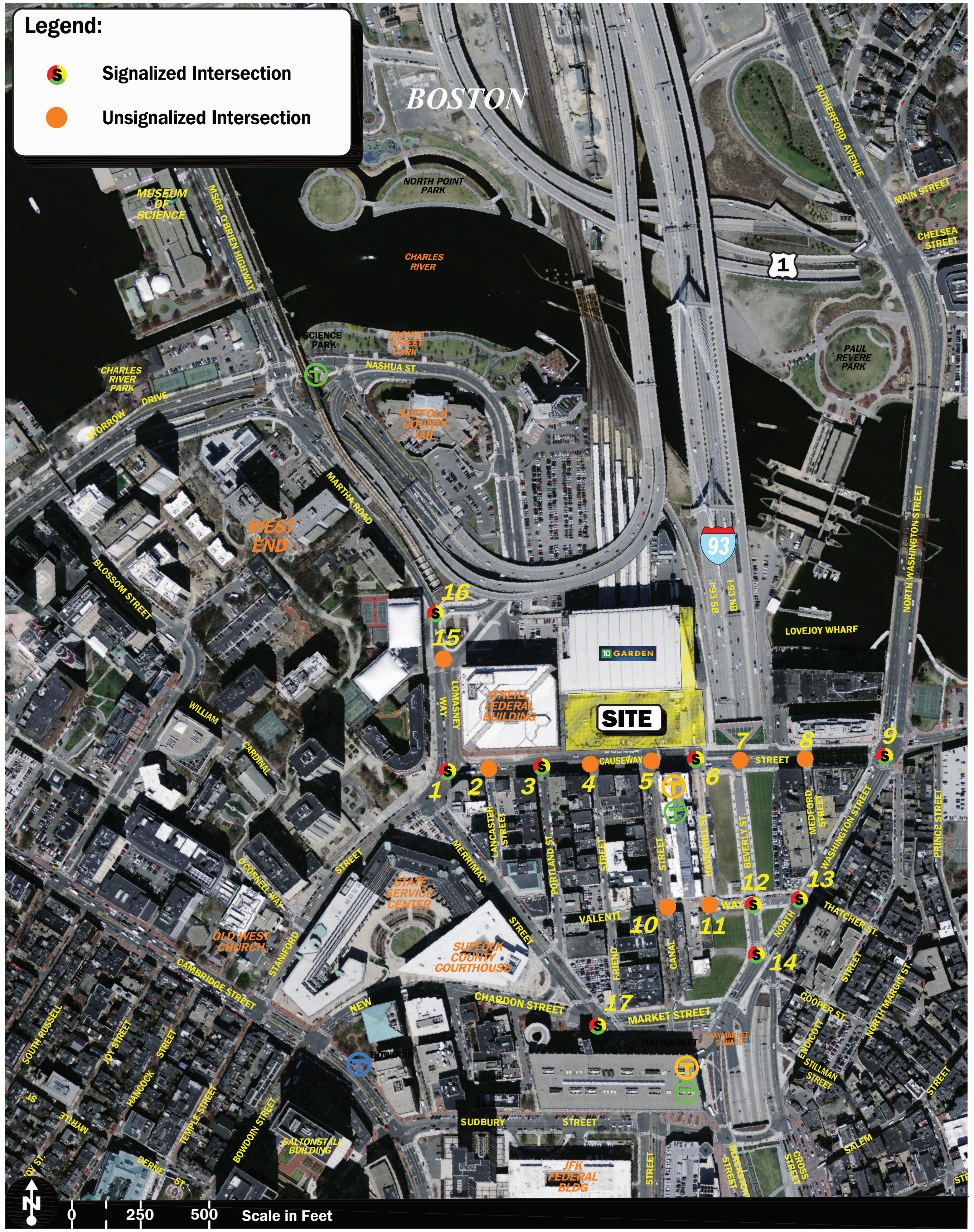
SITE

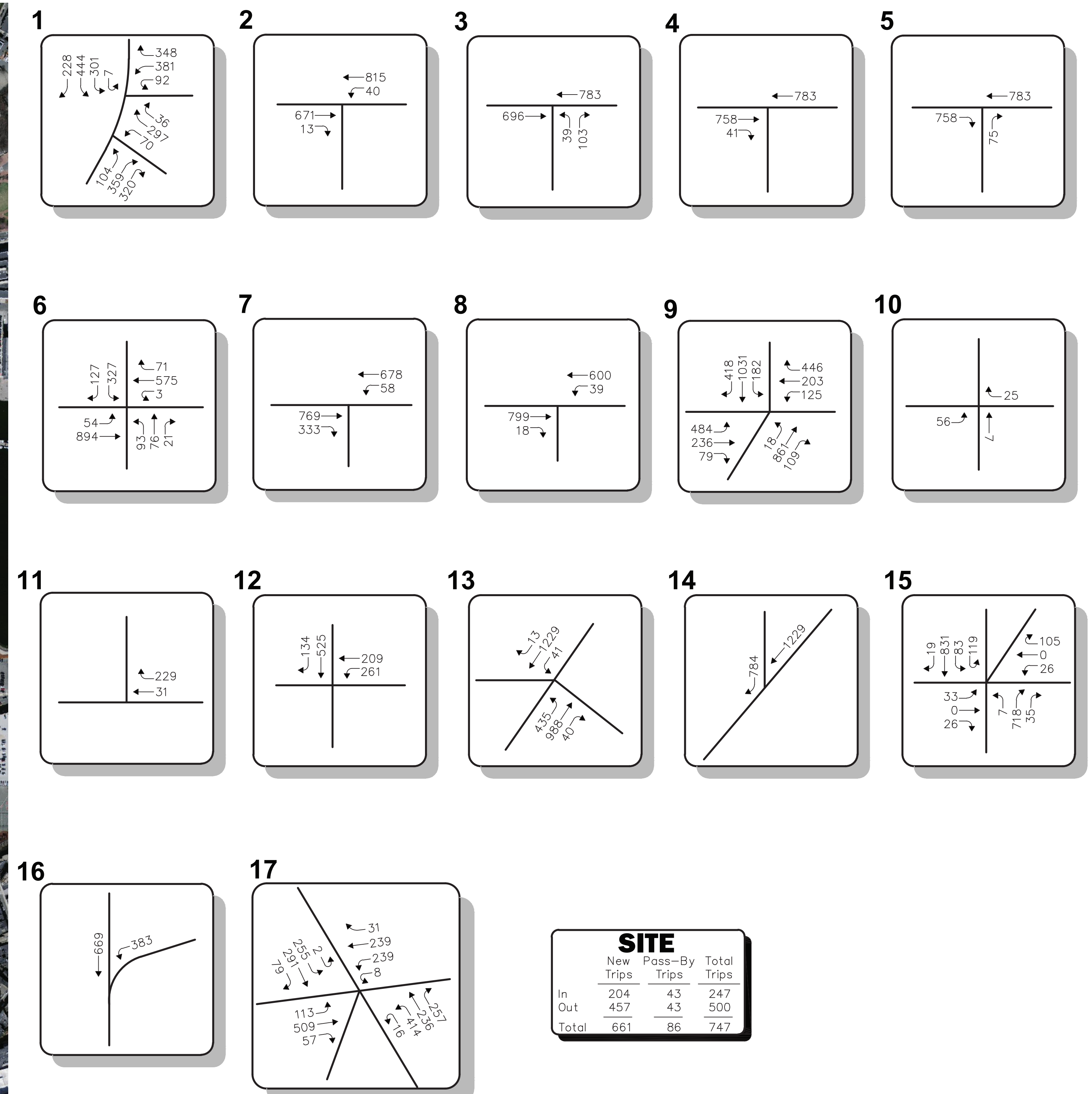
	New Trips	Pass-By Trips	Total Trips
In	395	11	406
Out	79	11	90
Total	474	22	496

Note: Imbalances exist due to TMCs conducted during different months and due to numerous curb cuts and side streets that are not shown.

Figure 3-28

2028 Build Weekday Morning Peak Hour Traffic Volumes





Note: Imbalances exist due to TMCs conducted during different months and due to numerous curb cuts and side streets that are not shown.

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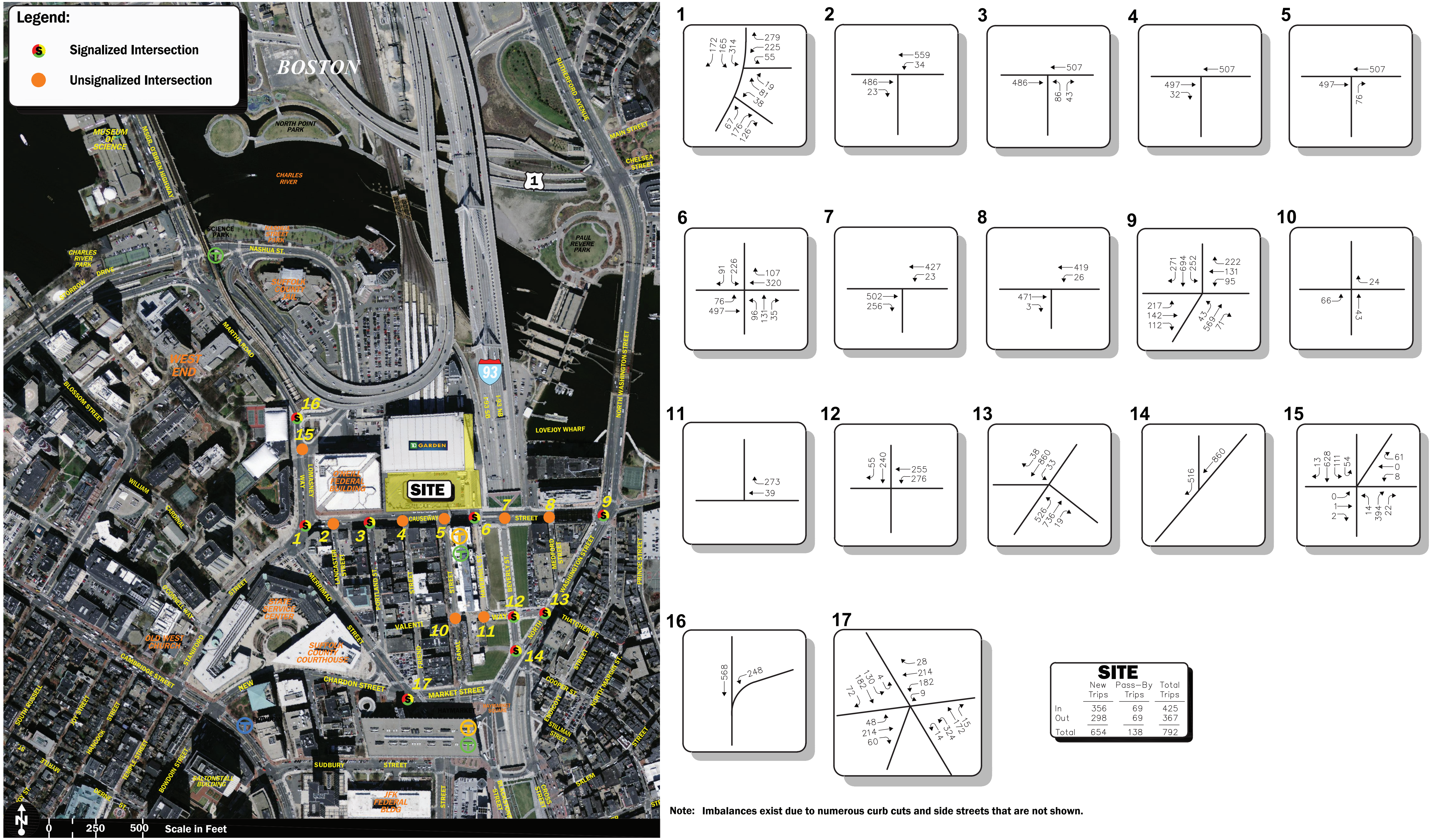
Figure 3-29
2028 Build Weekday Evening Peak Hour Traffic Volumes



SITE

	New Trips	Pass-By Trips	Total Trips
In	356	69	425
Out	298	69	367
Total	654	138	792

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

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Figure 3-30

2028 Build Saturday Midday Peak Hour Traffic Volumes

Table 3.3-4 Peak Hour Traffic Volume Increases External Roadway Links

Location/Peak Hour	2013 Existing	2028 No Build	2028 Build	Volume Increase Over No Build	Percent Increase Over No Build
North Washington Street, north of Causeway Street					
Weekday Morning	3,211	3,453	3,530	77	2.2
Weekday Evening	3,056	3,291	3,422	131	4.0
Saturday Midday	1,950	2,108	2,225	117	5.6
North Washington Street, south of Valenti Way					
Weekday Morning	2,739	3,227	3,402	175	5.4
Weekday Evening	2,657	3,229	3,476	247	7.6
Saturday Midday	2,046	2,415	2,657	242	10.0
Nashua Street, north of Lomasney Way					
Weekday Morning	769	954	1,037	83	8.7
Weekday Evening	911	1,225	1,358	133	10.9
Saturday Midday	430	635	757	122	19.2
Merrimac Street, south of Market Street					
Weekday Morning	1,204	1,619	1,631	12	0.7
Weekday Evening	1,219	1,494	1,510	16	1.1
Saturday Midday	849	933	949	16	1.7
Staniford Street, west of Merrimac Street					
Weekday Morning	1,322	1,486	1,540	54	3.6
Weekday Evening	1,207	1,387	1,462	75	5.4
Saturday Midday	648	728	804	76	10.4
Commercial Street, west of North Washington					
Street	1,012	1,091	1,115	24	2.2
Weekday Morning	1,172	1,269	1,301	32	2.5
Weekday Evening	816	880	913	33	3.8
Saturday Midday					

3.3.3.2 Build Pedestrian Volumes

Similar to the Build condition traffic-volume networks, the 2028 Build condition peak-hour pedestrian volume networks were developed by adding the anticipated peak-hour Project-generated pedestrian volumes to the 2028 No Build pedestrian volumes. The resulting 2028 Build condition weekday morning, weekday evening, and Saturday midday peak-hour pedestrian-volume networks are graphically depicted on Figures 3-31, 3-32 and 3-33, respectively.

3.4 Transportation System Operations Analysis

Measuring existing and future vehicle, pedestrian, bicycle and transit volumes quantifies flow within the study area. To assess the quality of operation of the transportation system, roadway, pedestrian facility and transit capacities were evaluated, as well as vehicle queuing at the study intersections, under Existing, No Build, and Build conditions. Capacity analyses provide an indication of how well the transportation system serves the demands placed upon the system, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

3.4.1 Intersection Capacity Analysis

3.4.1.1 Methodology

Levels of Service - A primary result of capacity analyses is the assignment of level of service (LOS) to traffic facilities under various traffic-flow conditions.[5] The concept of level of service is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A LOS definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience and safety.

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

Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of levels of service, depending on the time of day, day of week, or period of year.

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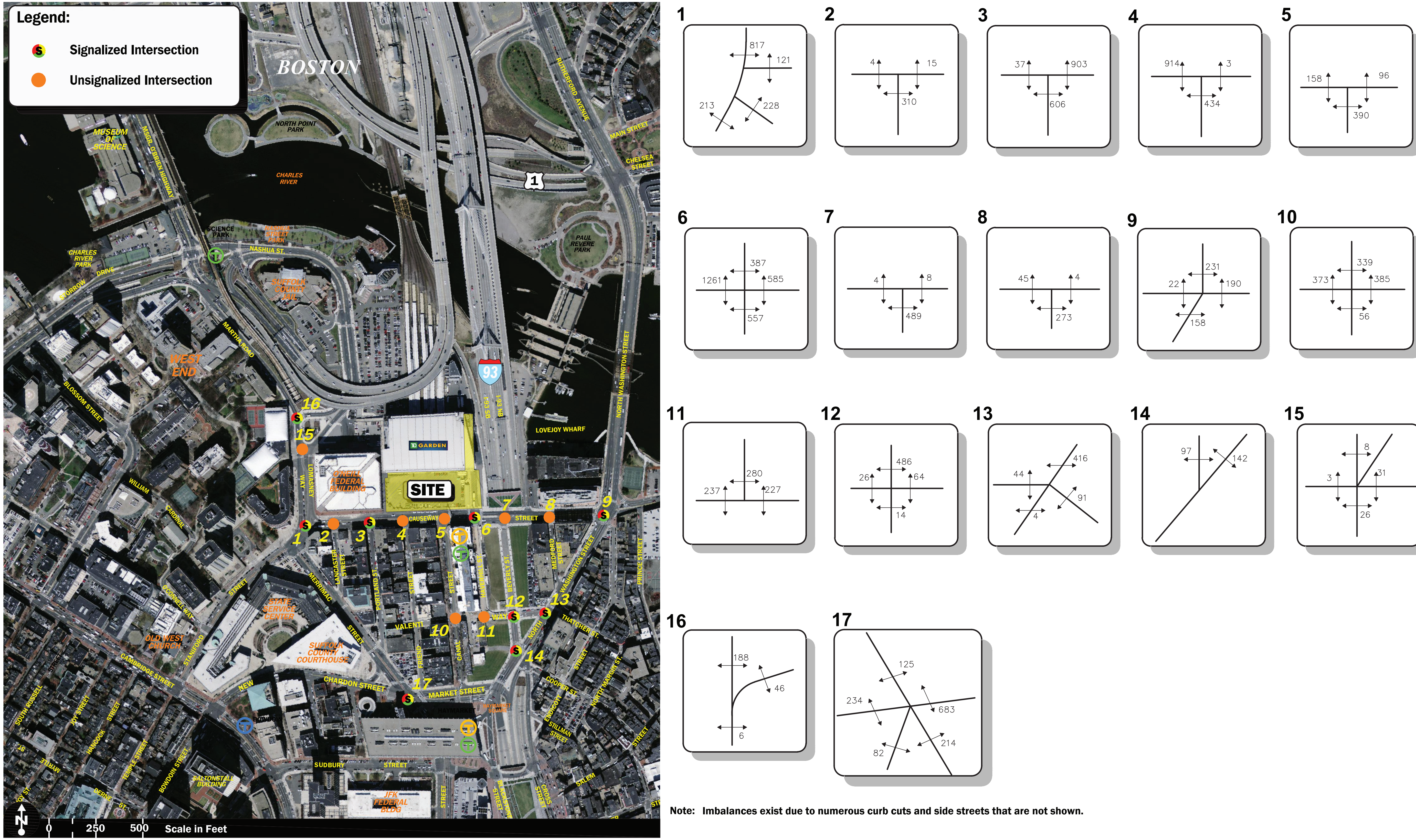
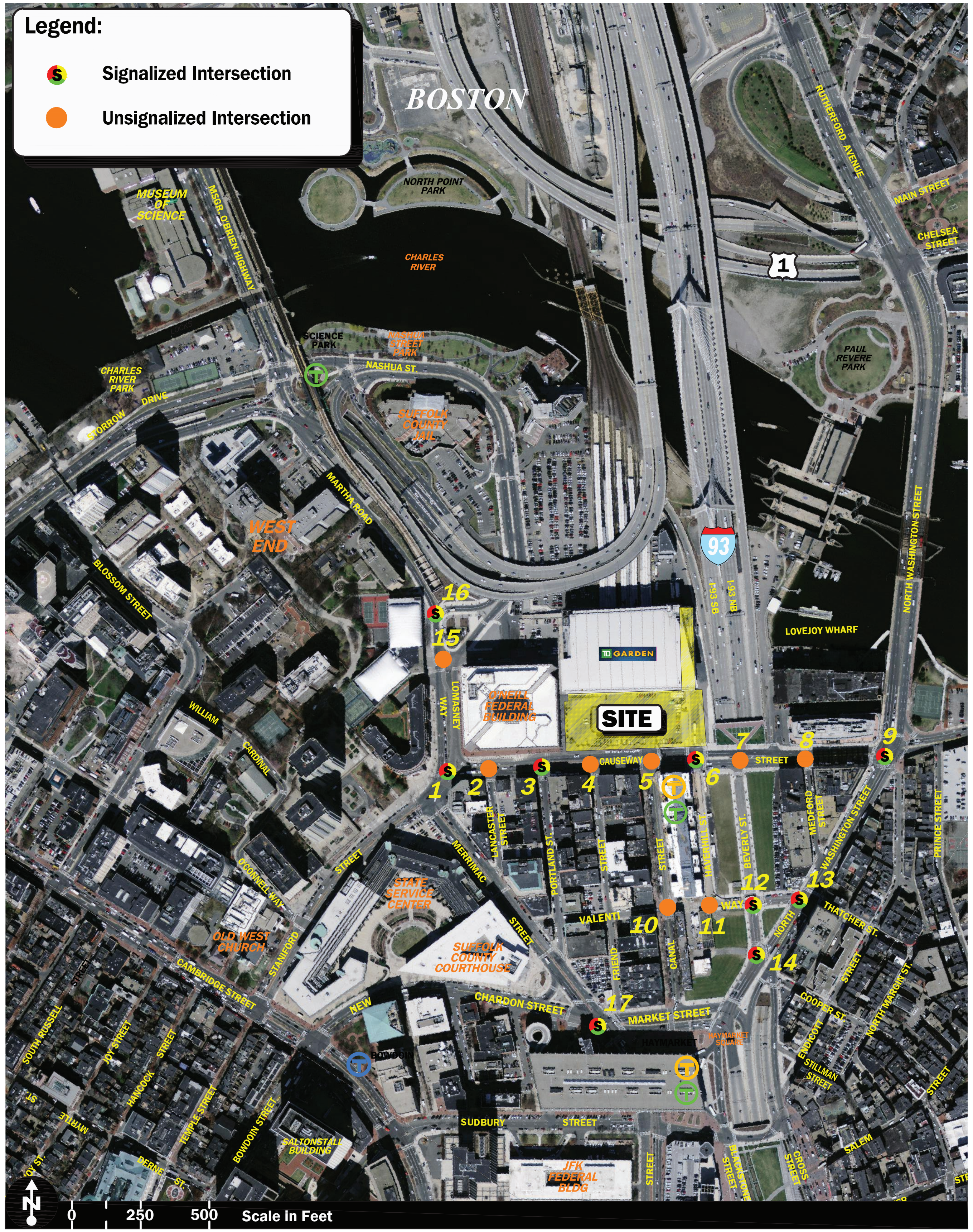
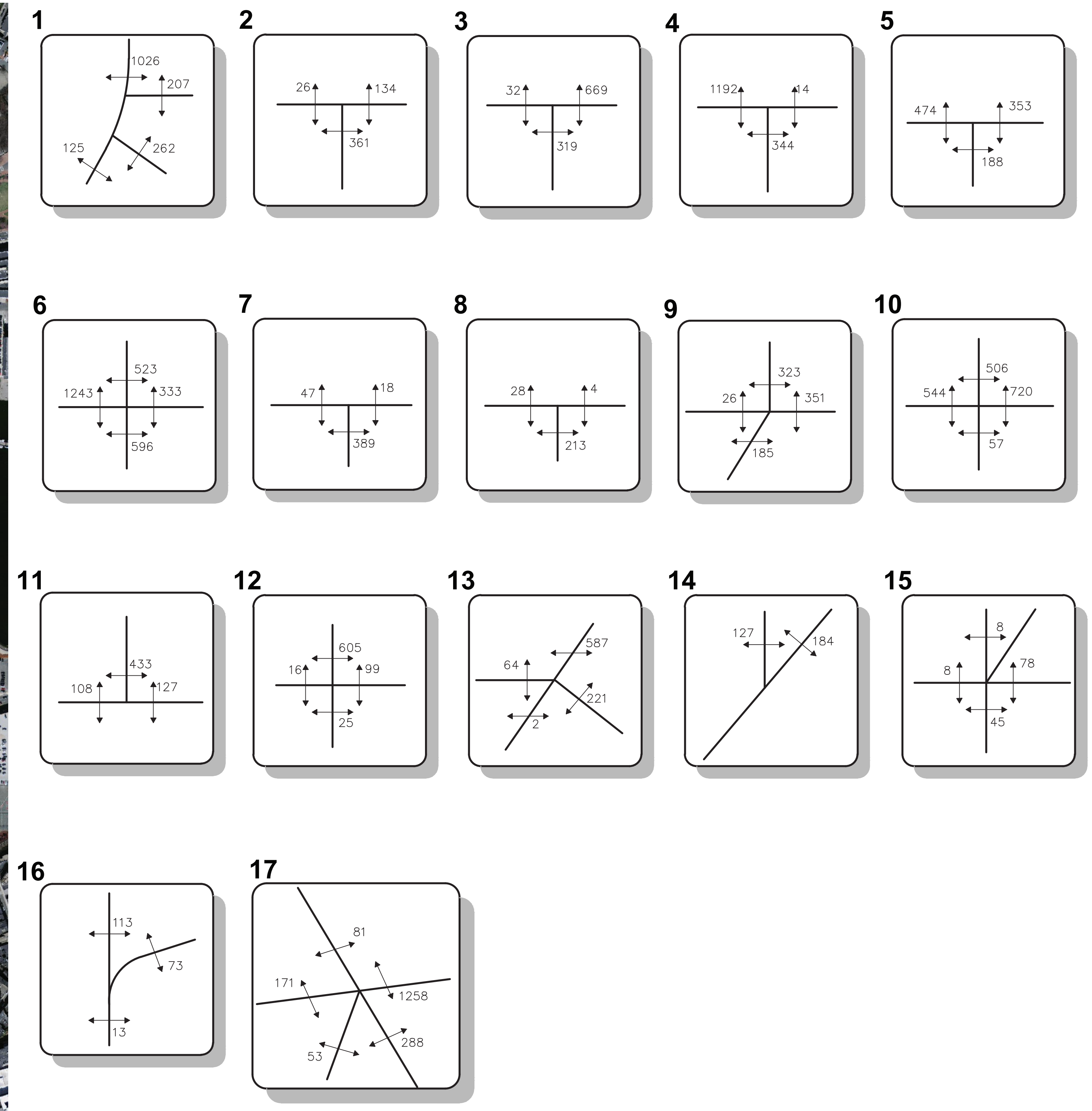
[5] The capacity analysis methodology is based on the concepts and procedures presented in the *Highway Capacity Manual;* Transportation Research Board; Washington, DC; 2000.



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.





Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

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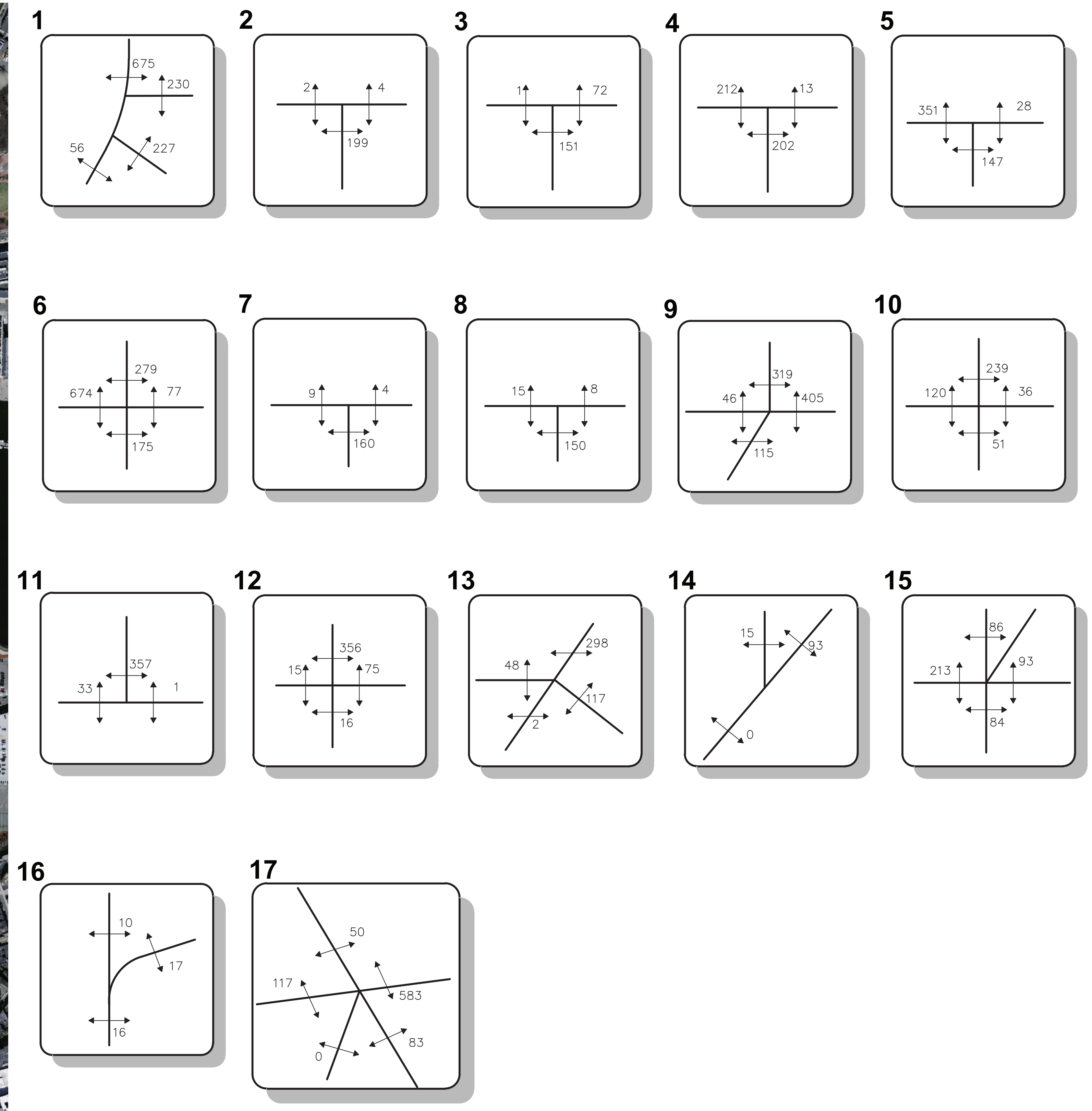
Figure 3-32

2028 Build Weekday Evening Peak Hour Pedestrian Volumes



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

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Figure 3-33

2028 Build Saturday Midday Peak Hour Pedestrian Volumes

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

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

Levels of service for signalized intersections are calculated using the operational analysis methodology of the 2000 *Highway Capacity Manual*. This method assesses the effects of signal type, timing, phasing, and progression; vehicle mix; and geometrics on delay. LOS designations are based on the criterion of control or signal delay per vehicle. Control or signal delay is a measure of driver discomfort, frustration, and fuel consumption, and includes initial deceleration delay approaching the traffic signal, queue move-up time, stopped delay and final acceleration delay. Table 3.4-1 summarizes the relationship between LOS and control delay. The tabulated control delay criterion may be applied in assigning LOS designations to individual lane groups, to individual intersection approaches, or to entire intersections.

Table 3.4-1 Level of Service Criteria for Signalized Intersections

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

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

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

The levels of service of unsignalized intersections are determined by application of a procedure described in the 2000 *Highway Capacity Manual*. LOS is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and STOP signs. Control delay includes the effects of initial deceleration delay approaching a STOP sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for LOS at unsignalized intersections are also given in the 2000 *Highway Capacity Manual*. Table 3.4-2 summarizes the relationship between LOS and average control delay for unsignalized intersections.

Table 3.4-2 Level of Service Criteria for Unsignalized Intersections

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

Vehicle Queue Analysis - Vehicle queue analyses are a direct measurement of an intersection's ability to process vehicles under various traffic control and volume scenarios and lane use arrangements. The vehicle queue analysis was performed using the Synchro™ intersection capacity analysis software which is based upon the methodology and procedures presented in the 2000 *Highway Capacity Manual*. The Synchro™ vehicle queue analysis methodology is a simulation based model which reports the number of vehicles that experience a delay of six seconds or more at an intersection. For signalized intersections, Synchro™ reports both the average (50th percentile) and the 95th percentile vehicle queue. For unsignalized intersections, Synchro™ reports the 95th percentile vehicle queue; however, for all-way STOP-control intersections, Synchro™ does not report vehicle queues and it is necessary to use the associated SimTraffic™ traffic model to obtain vehicle queue data. Vehicle queue lengths are a function of the capacity of the movement under study and the volume of traffic being processed by the intersection during the analysis period. The 95th percentile vehicle queue is the vehicle queue length that will be exceeded only five percent of the time, or approximately three minutes out of sixty minutes during the peak one hour of the day (during the remaining fifty-seven minutes, the vehicle queue length will be less than the 95th percentile queue length).

3.4.1.2 Analysis Results

LOS and vehicle queue analyses were conducted for 2013 Existing, 2028 No Build, and 2028 Build conditions for the intersections within the study area. The results of the intersection capacity and vehicle queue analyses are summarized for the signalized and unsignalized study intersections in Tables 3.4-3 and 3.4-4, respectively, and are described in the following sections. The detailed analysis results are presented in Appendix B.

3.4.1.3 Signalized Intersections

The addition of Project-related traffic to the signalized study area intersections is predicted to result in a change in the overall LOS at only two of the nine intersections studied between the No Build and Build conditions. Five of the nine signalized intersections were found to be generally operating at LOS D or better during the peak hours under all analysis conditions, which is considered acceptable in an urban environment. The following is a summary of the analysis results for the signalized intersections that were found to be operating at or over their design capacity (defined as LOS E or F), or where the addition of Project-related traffic was found to result in a degradation in operating conditions below LOS D (generally defined as the limit of “acceptable” traffic operations).

Causeway Street at Staniford Street, Lomasney Way and Merrimac Street – This signalized intersection was found to be operating over its design capacity (LOS F) under 2013 Existing conditions during the weekday morning peak-hour and projected to operate at or over its design capacity (LOS E or F, respectively) during the weekday morning, weekday evening and Saturday midday peak hours under 2028 No Build conditions with the planned improvements associated with the City’s Causeway Street Crossroads Initiative and independent of the Project. The addition of Project-related traffic to the intersection is not projected to result in a significant increase in the overall utilization of the intersection capacity (i.e., volume-to-capacity (v/c) ratio) over No Build conditions; however, overall operating conditions are predicted to continue at LOS E or F during the peak periods under 2028 Build conditions.

Causeway Street at Haverhill Street – This signalized intersection was found to be operating at an overall LOS A under 2013 Existing conditions during the weekday morning, weekday evening and Saturday midday peak hours, and predicted to degrade slightly to LOS B/C conditions during the peak hours under 2028 No Build conditions with the planned improvements associated with the City's Causeway Street Crossroads Initiative and independent of the Project. The addition of Project-related traffic to the intersection is predicted to result in a degradation in overall intersection operations from LOS B to LOS E during the weekday morning peak-hour, from LOS C to LOS F during the weekday evening peak-hour, and from LOS B to LOS D during the Saturday midday peak-hour under 2028 Build conditions.

Causeway Street at North Washington Street and Commercial Street– This signalized intersection was found to be operating over its design capacity (LOS F) under 2013 Existing conditions during both the weekday morning and evening peak hours, and at LOS D during the Saturday midday peak-hour. Under 2028 No Build conditions, overall operating conditions at the intersection are predicted at LOS F during the weekday morning, weekday evening and Saturday midday peak hours with the planned improvements associated with the City's Causeway Street Crossroads Initiative and independent of the Project. The addition of Project-related traffic to the intersection is not projected to result in a significant increase in the overall utilization of the intersection capacity (i.e., volume-to-capacity (v/c) ratio) over No Build conditions; however, overall operating conditions are predicted to continue at LOS F during the peak periods under 2028 Build conditions.

Table 3.4-3 Signalized Intersection Level of Service and Vehicle Queue Summary

	2013 Existing				2028 No Build				2028 Build			
Signalized Intersection/Peak Hour/Movement	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	V/C	Delay	LOS	Queue Avg./95th	V/C	Delay	LOS	Queue Avg./95th
1. Causeway Street at Staniford Street, Lomasney Way and Merrimac Street												
Weekday Morning:												
Staniford Street EB LT	0.78	76.3	E	1/4	0.23	44.3	D	2/3	0.33	45.1	D	2/4
Staniford Street EB LT/TH	0.93	70.7	E	7/11	1.32	>80.0	F	13/21	1.43	>80.0	F	15/23
Staniford Street EB RT	0.16	20.2	C	0/2	0.19	44.0	D	0/3	0.19	44.0	D	0/3
Causeway Street WB LT/TH	1.63	>80.0	F	11/15	0.91	56.3	E	12/17	0.95	62.1	E	13/18
Causeway Street WB RT	0.54	20.2	C	7/9	0.72	44.4	D	8/11	0.72	43.8	D	8/11
Merrimac Street NB LT	0.69	43.4	D	4/6	0.67	53.2	D	5/9	0.67	53.2	D	5/9
Merrimac Street NB TH/RT	0.42	33.8	C	3/5	0.95	>80.0	F	7/14	0.97	>80.0	F	7/14
Merrimac Street NB RT	0.33	32.7	C	2/3	--	--	--	--	--	--	--	--
Lomasney Way SB LT	0.91	71.4	E	6/11	0.88	56.3	E	12/17	0.88	56.6	E	12/18
Lomasney Way SB TH/RT	0.75	43.1	D	7/11	0.72	42.0	D	10/15	0.71	41.1	D	10/15
Lomasney Way SB RT	0.75	44.9	D	6/11	0.67	39.9	D	8/12	0.66	39.4	D	8/12
Overall	**1.03**	**>80.0**	**F**	--	**0.98**	**69.7**	**E**	--	**1.02**	**77.2**	**E**	--
Weekday Evening:												
Staniford Street EB LT	0.62	40.1	D	2/5	0.46	46.4	D	3/6	0.52	47.1	D	4/6
Staniford Street EB LT/TH	0.92	66.0	E	9/15	1.63	>80.0	F	18/26	1.69	>80.0	F	17/27
Staniford Street EB RT	0.35	24.2	C	0/2	1.08	>80.0	F	0/8	1.08	>80.0	F	0/8
Causeway Street WB LT/TH	1.15	70.2	E	6/9	0.77	58.1	E	5/8	0.88	67.2	E	6/12
Causeway Street WB RT	0.41	33.7	C	7/11	0.76	63.6	E	11/16	0.81	64.4	E	12/18
Merrimac Street NB LT	0.50	42.4	D	3/3	0.24	41.3	D	2/4	0.24	41.3	D	2/4
Merrimac Street NB TH/RT	0.49	39.1	D	4/7	1.20	>80.0	F	14/21	1.21	>80.0	F	14/22
Merrimac Street NB RT	0.24	34.2	C	2/2	---	--	--	--	--	--	--	--
Lomasney Way SB LT	0.81	59.4	E	6/11	0.71	41.3	D	9/14	0.72	41.9	D	10/14
Lomasney Way SB TH/RT	0.92	65.8	E	13/22	0.96	71.9	E	16/25	0.96	71.9	E	16/25
Lomasney Way SB RT	0.62	43.3	D	7/10	0.57	36.3	D	7/11	0.57	36.3	D	7/11
Overall	**0.88**	**50.8**	**D**	--	**1.09**	**>80.0**	**F**	--	**1.13**	**>80.0**	**F**	--
Saturday Midday:												
Staniford Street EB LT	0.36	34.7	C	1/2	0.21	30.8	C	1/3	0.30	31.4	C	2/3
Staniford Street EB LT/TH	0.63	39.3	D	4/6	0.59	35.4	D	4/7	0.67	38.7	D	5/8
Staniford Street EB RT	0.13	25.6	C	0/2	0.32	32.1	C	0/4	0.32	32.1	C	0/4
Causeway Street WB LT/TH	0.79	43.8	D	4/5	0.36	19.1	B	3/3	0.42	18.7	B	2/3
Causeway Street WB RT	0.31	28.8	C	5/7	1.00	>80.0	F	7/14	1.06	>80.0	F	8/15
Merrimac Street NB LT	0.26	37.5	D	1/2	0.13	30.4	C	1/2	0.13	30.4	C	1/2
Merrimac Street NB TH/RT	0.19	29.6	C	2/3	0.36	32.0	C	--	0.37	32.2	C	3/5
Merrimac Street NB RT	0.07	28.2	C	1/1	--	--	--	2/4	--	--	--	--
Lomasney Way SB LT	0.56	37.2	D	5/8	1.14	>80.0	F	9/17	1.18	>80.0	F	9/17
Lomasney Way SB TH/RT	0.32	23.5	C	3/6	0.69	40.7	D	5/10	0.70	40.9	D	5/10
Lomasney Way SB RT	0.31	23.6	C	3/5	0.69	41.5	D	4/9	0.69	41.7	D	4/9
Overall	**0.51**	**32.8**	**C**	--	**0.58**	**61.9**	**E**	--	**0.63**	**67.3**	**E**	--

See notes at end of table.

Table 3.4-3 Signalized Intersection Level of Service and Vehicle Queue Summary (Continued)

	2013 Existing				2028 No Build				2028 Build			
Signalized Intersection/Peak Hour/Movement	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	V/C	Delay	LOS	Queue Avg./95th	V/C	Delay	LOS	Queue Avg./95th
3. Causeway Street at Portland Street												
Weekday Morning:												
Causeway Street EB TH	0.23	13.1	B	4/5	0.29	2.8	A	3/3	0.30	2.8	A	3/3
Causeway Street WB TH	0.44	9.7	A	6/8	0.46	4.8	A	5/6	0.47	4.8	A	5/6
Portland Street NB LT	0.39	37.6	D	2/3	0.28	46.3	D	2/4	0.28	46.3	D	2/4
Portland Street NB RT	0.07	35.7	D	0/2	0.08	44.8	D	0/2	0.08	44.8	D	0/2
Overall	**0.43**	**13.6**	**B**	--	**0.43**	**7.4**	**A**	--	**0.44**	**7.4**	**A**	--
Weekday Evening:												
Causeway Street EB TH	0.31	20.5	C	8/10	0.32	4.5	A	3/4	0.33	4.6	A	3/4
Causeway Street WB TH	0.37	9.1	A	5/5	0.34	17.9	B	11/14	0.38	14.6	B	11/13
Portland Street NB LT	0.31	42.1	D	1/2	0.23	46.0	D	1/3	0.23	46.0	D	1/3
Portland Street NB RT	0.09	40.8	D	0/2	0.09	44.8	D	0/2	0.09	44.8	D	0/2
Overall	**0.36**	**17.4**	**B**	--	**0.32**	**14.5**	**B**	--	**0.36**	**14.9**	**B**	--
Saturday Midday:												
Causeway Street EB TH	0.20	14.3	B	5/7	0.23	5.7	A	4/4	0.25	5.5	A	4/4
Causeway Street WB TH	0.24	7.4	A	3/3	0.24	6.4	A	2/7	0.27	7.8	A	4/6
Portland Street NB LT	0.16	36.4	D	1/1	0.36	32.1	C	2/4	0.36	32.1	C	2/4
Portland Street NB RT	0.04	35.8	D	0/1	0.04	29.8	C	0/1	0.04	29.8	C	0/1
Overall	**0.23**	**12.9**	**B**	--	**0.26**	**9.2**	**A**	--	**0.29**	**9.5**	**A**	--

See notes at end of table.

Table 3.4-3 Signalized Intersection Level of Service and Vehicle Queue Summary (Continued)

	2013 Existing				2028 No Build				2028 Build			
Signalized Intersection/Peak Hour/Movement	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	V/C	Delay	LOS	Queue Avg./95th	V/C	Delay	LOS	Queue Avg./95th
6. Causeway Street at Haverhill Street												
Weekday Morning:												
Causeway Street EB LT	0.05	2.0	A	0/0	--	--	--	--	--	--	--	--
Causeway Street EB LT/TH	--	--	--	--	0.43	6.4	A	2/6	0.69	17.3	B	5/10
Causeway Street EB TH	0.22	2.2	A	1/2	--	--	--	--	--	--	--	--
Causeway Street WB TH/RT	0.42	3.1	A	2/5	0.75	21.0	C	7/19	1.15	>80.0	F	16/21
Haverhill Street NB LT	0.44	35.3	D	1/1	0.54	41.3	D	1/3	0.34	33.6	C	1/3
Haverhill Street NB TH/RT	0.04	32.5	C	0/1	0.03	36.1	D	0/1	0.68	40.8	D	4/7
Legends Way SB LT/TH/RT	0.11	32.9	C	0/1	0.13	43.6	D	0/1	0.60	43.8	D	2/4
Overall	**0.42**	**4.5**	**A**	--	**0.64**	**16.5**	**B**	--	**0.89**	**67.7**	**E**	--
Weekday Evening:												
Causeway Street EB LT	0.06	0.6	A	0/0	--	--	--	--	--	--	--	--
Causeway Street EB LT/TH	--	--	--	--	0.66	12.2	B	5/16	1.33	>80.0	F	24/30
Causeway Street EB TH	0.37	2.0	A	1/1	--	--	--	--	--	--	--	--
Causeway Street WB TH/RT	0.36	2.5	A	2/3	0.88	52.3	D	10/13	0.87	49.2	D	11/15
Haverhill Street NB LT	0.47	45.6	D	1/2	0.83	>80.0	F	3/7	0.59	54.4	D	3/5
Haverhill Street NB TH/RT	0.04	46.8	D	0/0	0.02	44.5	D	0/1	0.55	52.4	D	3/5
Legends Way SB LT/TH/RT	0.15	42.5	D	1/2	0.22	57.4	E	1/2	0.88	52.6	D	14/24
Overall	**0.38**	**4.3**	**A**	--	**0.75**	**31.7**	**C**	--	**1.06**	**>80.0**	**F**	--
Saturday Midday:												
Causeway Street EB LT	0.00	0.1	A	0/0	--	--	--	--	--	--	--	--
Causeway Street EB LT/TH	--	--	--	--	0.38	8.2	A	5/7	0.70	29.2	C	7/9
Causeway Street EB TH	0.21	1.0	A	1/1	--	--	--	--	--	--	--	--
Causeway Street WB TH/RT	0.19	1.1	A	0/2	0.35	15.5	B	3/6	0.60	29.2	C	4/7
Haverhill Street NB LT	0.00	0.0	A	0/0	0.60	61.7	E	3/5	0.41	52.5	D	3/4
Haverhill Street NB TH/RT	0.01	41.5	D	0/0	0.03	35.7	D	0/0	0.64	59.2	E	4/6
Legends Way SB LT/TH/RT	0.06	41.7	D	0/1	0.03	42.7	D	0/1	0.94	66.4	E	8/17
Overall	**0.20**	**1.9**	**A**	--	**0.40**	**16.8**	**B**	--	**0.75**	**41.2**	**D**	--

See notes at end of table.

Table 3.4-3 Signalized Intersection Level of Service and Vehicle Queue Summary (Continued)

Signalized Intersection/Peak Hour/Movement	2013 Existing				2028 No Build				2028 Build			
	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	V/C	Delay	LOS	Queue Avg./95th	V/C	Delay	LOS	Queue Avg./95th
9. Causeway Street at North Washington Street												
Weekday Morning:	0.76	75.6	E	7/10	0.43	51.9	D	5/7	0.45	51.6	D	5/7
Causeway Street EB LT	0.73	66.7	E	6/8	--	--	--	--	--	--	--	--
Causeway Street EB LT/TH/RT	--	--	--	--	0.71	62.2	E	7/13	0.71	61.2	E	8/13
Causeway Street EB TH/RT	0.80	72.4	E	7/9	0.76	67.1	E	7/9	0.79	68.9	E	8/10
Causeway Street WB LT/TH	0.25	21.0	C	3/6	0.31	26.8	C	2/3	0.32	27.4	C	2/4
Causeway Street WB RT	1.83	>80.0	F	27/29	1.90	>80.0	F	26/31	1.90	>80.0	F	26/31
North Washington Street NB LT/TH/RT	0.37	13.6	B	7/8	0.75	55.0	D	12/17	0.77	57.6	E	12/17
North Washington Street SB LT	--	--	--	--	1.00	55.6	E	35/40	1.01	60.3	E	35/40
North Washington Street SB TH	0.85	26.2	C	28/33	--	--	--	--	--	--	--	--
North Washington Street SB TH/RT	0.85	30.5	C	22/28	0.73	14.5	B	15/23	0.80	18.4	B	18/29
North Washington Street SB RT	**1.13**	**>80.0**	**F**	--	**1.15**	**>80.0**	**F**	--	**1.18**	**>80.0**	**F**	--
Overall												
Weekday Evening:	0.93	>80.0	F	11/18	0.72	59.8	E	8/11	0.91	77.6	E	11/15
Causeway Street EB LT	0.90	78.3	E	10/12	--	--	--	--	--	--	--	--
Causeway Street EB LT/TH/RT	--	--	--	--	1.12	>80.0	F	15/23	1.21	>80.0	F	16/25
Causeway Street EB TH/RT	0.76	68.3	E	7/8	0.65	59.0	E	7/9	0.67	59.4	E	7/10
Causeway Street WB LT/TH	0.73	43.8	D	14/20	0.85	53.7	D	10/15	0.87	55.1	E	10/16
Causeway Street WB RT	1.63	>80.0	F	29/34	2.02	>80.0	F	35/40	2.02	>80.0	F	35/40
North Washington Street NB LT/TH/RT	0.22	15.2	B	4/6	0.64	57.5	E	7/11	0.64	57.5	E	7/11
North Washington Street SB LT	--	--	--	--	0.73	27.9	C	17/21	0.73	27.9	C	17/21
North Washington Street SB TH	0.63	21.4	C	15/18	--	--	--	--	--	--	--	--
North Washington Street SB TH/RT	0.60	21.4	C	11/16	0.51	14.2	B	9/10	0.56	15.2	B	10/12
North Washington Street SB RT	**1.11**	**>80.0**	**F**	--	**1.31**	**>80.0**	**F**	--	**1.34**	**>80.0**	**F**	--
Overall												
Saturday Midday:	0.69	63.2	E	5/8	0.26	48.9	D	3/5	0.37	50.6	D	4/6
Causeway Street EB LT	0.52	54.4	D	3/5	--	--	--	--	--	--	--	--
Causeway Street EB LT/TH/RT	--	--	--	--	0.86	78.9	E	9/17	0.92	>80.0	F	10/18
Causeway Street EB TH/RT	0.54	54.2	D	4/5	0.57	62.5	E	5/7	0.61	63.1	E	5/7
Causeway Street WB LT/TH	0.26	31.5	C	2/3	0.32	40.4	D	2/4	0.39	41.1	D	3/5
Causeway Street WB RT	1.13	>80.0	F	17/22	1.29	>80.0	F	20/25	1.29	>80.0	F	20/25
North Washington Street NB LT/TH/RT	0.27	11.3	B	4/7	1.05	>80.0	F	12/19	1.05	>80.0	F	12/19
North Washington Street SB LT	--	--	--	--	0.45	18.5	B	9/11	0.45	18.5	B	9/11
North Washington Street SB TH	0.37	12.2	B	6/9	--	--	--	--	--	--	--	--
North Washington Street SB TH/RT	0.31	11.7	B	4/7	0.34	17.4	B	5/8	0.43	18.8	B	7/10
North Washington Street SB RT	**0.82**	**51.9**	**D**	--	**1.04**	**>80.0**	**F**	--	**1.05**	**>80.0**	**F**	--
Overall												

See notes at end of table.

Table 3.4-3 Signalized Intersection Level of Service and Vehicle Queue Summary (Continued)

	2013 Existing				2028 No Build				2028 Build			
Signalized Intersection/Peak Hour/Movement	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	V/C	Delay	LOS	Queue Avg./95th	V/C	Delay	LOS	Queue Avg./95th
12. Valenti Way at Beverly Street												
Weekday Morning:												
Valenti Way WB LT	0.08	0.1	A	0/0	0.11	0.0	A	0/0	0.15	0.0	A	0/0
Valenti Way WB LT/TH	0.07	0.0	A	0/0	0.12	0.0	A	0/0	0.16	0.1	A	0/0
Beverly Street SB TH/RT	0.40	43.5	D	1/3	0.63	44.9	D	2/4	0.66	45.3	D	3/4
Overall	**0.11**	**13.4**	**B**	--	**0.19**	**18.7**	**B**	--	**0.23**	**16.5**	**B**	--
Weekday Evening:												
Valenti Way WB LT	0.10	0.1	A	0/0	0.10	17.7	B	1/2	0.12	56.4	E	4/4
Valenti Way WB LT/TH	0.08	0.0	A	0/0	0.12	7.2	A	1/2	0.18	18.9	B	5/5
Beverly Street SB TH/RT	0.52	51.5	D	2/3	0.79	41.9	D	6/8	0.71	29.9	C	8/9
Overall	**0.15**	**16.2**	**B**	--	**0.29**	**27.9**	**C**	--	**0.38**	**30.4**	**C**	--
Saturday Midday:												
Valenti Way WB LT	0.09	13.0	B	1/2	0.10	20.9	C	1/1	0.13	31.7	C	2/2
Valenti Way WB LT/TH	0.06	7.7	A	1/1	0.11	10.5	B	2/2	0.15	10.4	B	3/3
Beverly Street SB TH/RT	0.21	55.1	E	1/1	0.45	55.0	D	2/4	0.62	43.8	D	4/5
Overall	**0.10**	**15.0**	**B**	--	**0.15**	**27.0**	**C**	--	**0.23**	**27.1**	**C**	--
13. North Washington Street at Valenti Way and Thatcher Street												
Weekday Morning:												
North Washington Street NB LT	0.80	46.0	D	7/10	1.34	>80.0	F	17/25	1.76	>80.0	F	26/35
North Washington Street NB TH/RT	0.72	14.6	B	11/20	0.77	17.4	B	13/20	0.77	17.4	B	13/20
North Washington Street SB LT/TH/RT	0.83	16.7	B	14/24	0.98	32.0	C	22/31	0.98	32.0	C	22/31
Overall	**0.82**	**19.3**	**B**	--	**1.08**	**56.2**	**E**	--	**1.20**	**>80.0**	**F**	--
Weekday Evening:												
North Washington Street NB LT	0.87	58.7	E	7/11	1.19	>80.0	F	12/20	1.44	>80.0	F	17/25
North Washington Street NB TH/RT	0.96	31.8	C	22/37	1.01	44.4	D	27/40	1.01	44.4	D	27/40
North Washington Street SB LT/TH/RT	0.92	22.9	C	14/20	0.88	19.4	B	13/20	0.88	19.4	B	13/20
Overall	**0.94**	**30.1**	**C**	--	**1.05**	**46.8**	**D**	--	**1.11**	**66.0**	**E**	--
Saturday Midday:												
North Washington Street NB LT	0.84	46.7	D	7/12	1.10	>80.0	F	12/19	1.47	>80.0	F	18/26
North Washington Street NB TH/RT	0.74	14.2	B	11/15	0.74	14.5	B	11/17	0.74	14.5	B	11/17
North Washington Street SB LT/TH/RT	0.49	8.1	A	5/7	0.54	8.9	A	6/8	0.54	8.9	A	6/8
Overall	**0.77**	**16.5**	**B**	--	**0.84**	**30.2**	**C**	--	**0.94**	**70.4**	**E**	--

See notes at end of table.

Table 3.4-3 Signalized Intersection Level of Service and Vehicle Queue Summary (Continued)

Signalized Intersection/Peak Hour/Movement	2013 Existing				2028 No Build				2028 Build			
	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	V/C	Delay	LOS	Queue Avg./95th	V/C	Delay	LOS	Queue Avg./95th
14. North Washington Street at Beverly Street												
Weekday Morning:												
Beverly Street SB RT	0.25	12.1	B	1/2	0.33	23.9	C	4/4	0.35	22.8	C	4/4
North Washington Street SWB TH	0.73	9.1	A	11/11	0.83	33.8	C	16/16	0.83	33.8	C	16/16
Overall	**0.51**	**9.6**	**A**	--	**0.61**	**32.0**	**C**	--	**0.62**	**32.1**	**C**	--
Weekday Evening:												
Beverly Street SB RT	0.31	24.7	C	3/4	0.49	27.6	C	8/10	0.62	28.7	C	11/13
North Washington Street SWB TH	0.62	19.1	B	5/6	0.68	28.1	C	14/16	0.68	28.1	C	14/16
Overall	**0.46**	**20.5**	**C**	--	**0.58**	**28.0**	**C**	--	**0.65**	**28.4**	**C**	--
Saturday Midday:												
Beverly Street SB RT	0.21	20.3	C	4/5	0.29	18.6	B	5/6	0.37	19.0	B	6/8
North Washington Street SWB TH	0.46	34.6	C	8/9	0.50	36.0	D	8/10	0.50	36.0	D	8/10
Overall	**0.33**	**30.8**	**C**	--	**0.39**	**30.4**	**C**	--	**0.43**	**30.6**	**C**	--
16. Martha Road at Nashua Street												
Weekday Morning:												
Nashua Street WB LT	0.24	17.5	B	1/2	0.49	17.2	B	2/3	0.55	16.8	B	2/3
Martha Road SB TH	0.36	4.4	A	2/3	0.48	6.3	A	3/5	0.54	7.6	A	3/6
Overall	**0.33**	**8.9**	**A**	--	**0.48**	**10.0**	**B**	--	**0.54**	**10.9**	**B**	--
Weekday Evening:												
Nashua Street WB LT	0.12	17.2	B	0/1	0.26	17.5	B	1/2	0.34	17.4	B	1/2
Martha Road SB TH	0.30	4.0	A	2/2	0.35	4.5	A	2/3	0.37	4.9	A	2/4
Overall	**0.26**	**9.0**	**A**	--	**0.33**	**9.1**	**A**	--	**0.36**	**9.4**	**A**	--
Saturday Midday:												
Nashua Street WB LT	0.05	18.3	B	0/0	0.07	18.4	B	0/0	0.09	17.2	B	0/1
Martha Road SB TH	0.20	3.0	A	1/1	0.26	3.2	A	1/2	0.30	4.0	A	2/2
Overall	**0.17**	**7.2**	**A**	--	**0.23**	**7.3**	**A**	--	**0.26**	**8.0**	**A**	--

See notes at end of table.

Table 3.4-3 Signalized Intersection Level of Service and Vehicle Queue Summary (Continued)

Signalized Intersection/Peak Hour/Movement	2013 Existing V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	2028 No Build V/C	Delay	LOS	Queue Avg./95th	2028 Build V/C	Delay	LOS	Queue Avg./95th
17. New Chardon Street at Merrimac Street and Congress Street												
Weekday Morning:												
New Chardon Street EB LT/TH/RT	0.60	41.7	D	3/5	0.68	43.9	D	4/6	0.68	43.9	D	4/6
New Chardon Street WB LT	0.82	54.9	D	6/11	0.91	67.8	E	7/13	0.91	67.8	E	7/13
New Chardon Street WB LT/TH/RT	0.82	45.7	D	7/9	0.80	43.9	D	7/10	0.80	43.9	D	7/10
Congress Street NB LT	0.57	34.1	C	6/11	0.97	71.4	E	12/21	0.97	71.4	E	12/21
Congress Street NB LT/TH	0.59	31.7	C	6/9	0.92	43.7	D	10/15	0.93	44.6	D	10/16
Congress Street NB RT	0.15	10.5	B	2/3	0.14	10.8	B	2/3	0.14	10.8	B	2/3
Merrimac Street SB LT/TH/RT	0.67	40.7	D	4/5	0.71	41.3	D	5/6	0.71	41.5	D	5/6
Overall	**0.66**	**38.8**	**D**	--	**0.85**	**47.8**	**D**	--	**0.85**	**48.1**	**D**	--
Weekday Evening:												
New Chardon Street EB LT/TH/RT	1.02	>80.0	F	9/10	0.98	64.4	E	10/15	0.98	64.4	E	10/15
New Chardon Street WB LT	0.78	54.3	D	5/8	1.15	>80.0	F	8/15	1.15	>80.0	F	8/15
New Chardon Street WB LT/TH/RT	0.80	47.7	D	6/6	0.53	38.4	D	4/6	0.53	38.4	D	4/6
Congress Street NB LT	0.49	33.2	C	5/8	0.74	49.4	D	6/12	0.75	50.4	D	7/12
Congress Street NB LT/TH	0.49	31.2	C	5/5	0.75	43.1	D	7/9	0.75	43.6	D	7/9
Congress Street NB RT	0.35	14.9	B	5/6	0.38	18.6	B	5/8	0.38	18.7	B	5/8
Merrimac Street SB LT/TH/RT	0.92	41.5	D	6/7	0.89	45.2	D	6/8	0.88	45.7	D	6/8
Overall	**0.73**	**47.2**	**D**	--	**0.91**	**55.8**	**E**	--	**0.91**	**56.1**	**E**	--
Saturday Midday:												
New Chardon Street EB LT/TH/RT	0.60	36.3	D	4/4	0.66	37.7	D	4/6	0.66	37.7	D	4/6
New Chardon Street WB LT	0.77	52.0	D	4/7	0.80	50.4	D	5/9	0.80	50.4	D	5/9
New Chardon Street WB LT/TH/RT	0.78	44.8	D	5/5	0.43	32.5	C	3/4	0.43	32.5	C	3/4
Congress Street NB LT	0.30	22.6	C	3/6	0.43	27.7	C	4/7	0.44	27.9	C	4/7
Congress Street NB LT/TH	0.30	21.9	C	3/4	0.42	25.8	C	4/6	0.43	26.2	C	4/6
Congress Street NB RT	0.20	10.3	B	2/4	0.02	9.3	A	0/1	0.02	9.4	A	0/1
Merrimac Street SB LT/TH/RT	0.56	36.1	D	3/4	0.58	35.9	D	3/4	0.58	35.9	D	3/4
Overall	**0.50**	**33.2**	**C**	--	**0.59**	**34.3**	**C**	--	**0.59**	**34.4**	**C**	--

[a]Volume-to-capacity ratio
[b]Control (signal) delay per vehicle in seconds
[c]Level of Service
[d]Queue length in vehicles
[e]95th percentile queue is metered by upstream signal
EB = eastbound; WB = westbound; NB = northbound; SB = southbound; LT = left-turning movements; TH = through movements; RT = right-turning movements

Table 3.4-4 Unsignalized Intersection Level of Service and Vehicle Queue Summary

	2013 Existing				2028 No Build				2028 Build			
Unsignalized Intersection/Peak Hour/Movement	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
2. Causeway Street at Lancaster Street												
Weekday Morning:												
Causeway Street EB TH/RT	418	0.0	A	0	622	0.0	A	0	658	0.0	A	0
Causeway Street WB LT/TH	792	4.4	A	1	1,010	4.7	A	1	1,027	4.8	A	1
Weekday Evening:												
Causeway Street EB TH/RT	532	0.0	A	0	657	0.0	A	0	684	0.0	A	0
Causeway Street WB LT/TH	603	2.9	A	0	771	2.9	A	1	855	2.9	A	1
Saturday Midday:												
Causeway Street EB TH/RT	328	0.0	A	0	476	0.0	A	0	509	0.0	A	0
Causeway Street WB LT/TH	423	2.8	A	0	537	2.8	A	0	593	2.8	A	0
4. Causeway Street at Friend Street												
Weekday Morning:												
Causeway Street EB TH/RT	458	0.0	A	0	673	0.0	A	0	709	0.0	A	0
Causeway Street WB LT/TH	795	2.2	A	1	--	--	--	--	--	--	--	--
Causeway Street WB TH	--	--	--	--	959	0.0	A	0	976	0.0	A	0
Weekday Evening:												
Causeway Street EB TH/RT	606	0.0	A	0	780	0.0	A	0	788	0.0	A	0
Causeway Street WB LT/TH	584	1.6	A	0	--	--	--	--	--	--	--	--
Causeway Street WB TH	--	--	--	--	699	0.0	A	0	783	0.0	A	0
Saturday Midday:												
Causeway Street EB TH/RT	348	0.0	A	0	496	0.0	A	0	529	0.0	A	0
Causeway Street WB LT/TH	422	1.4	A	0	--	--	--	--	--	--	--	--
Causeway Street WB TH	--	--	--	--	451	0.0	A	0	507	0.0	A	0

See notes at end of table.

Table 3.4-4 Unsignalized Intersection Level of Service and Vehicle Queue Summary (Continued)

Unsignalized Intersection/Peak Hour/Movement	2013 Existing				2028 No Build				2028 Build			
	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
5. Causeway Street at Canal Street												
Weekday Morning:												
Causeway Street EB LT/TH	415	1.9	A	0	--	--	--	--	--	--	--	--
Causeway Street EB TH	--	--	--	--	585	0.0	A	0	621	0.0	A	0
Causeway Street EB LT/TH/RT	715	0.2	A	0	--	--	--	--	--	--	--	--
Causeway Street EB TH/RT	--	--	--	--	968	0.0	A	0	976	0.0	A	0
Canal Street NB LT/TH/RT	161	26.4	D	3	--	--	--	--	--	--	--	--
Canal Street NB RT	--	--	--	--	88	11.1	B	1	93	11.3	B	1
Parking Lot driveway SB LT/RT	2	21.1	C	0	--	--	--	--	--	--	--	--
Parking Lot driveway SB RT	--	--	--	--	1	9.5	A	0	--	--	--	--
Weekday Evening:												
Causeway Street EB LT/TH	585	0.6	A	0	--	--	--	--	--	--	--	--
Causeway Street EB TH	--	--	--	--	739	0.0	A	0	758	0.0	A	0
Causeway Street EB LT/TH/RT	497	0.3	A	0	--	--	--	--	--	--	--	--
Causeway Street EB TH/RT	--	--	--	--	685	0.0	A	0	783	0.0	A	0
Canal Street NB LT/TH/RT	126	26.1	D	3	--	--	--	--	--	--	--	--
Canal Street NB RT	--	--	--	--	71	11.4	B	1	75	11.5	B	1
Parking Lot driveway SB LT/RT	41	21.9	C	2	--	--	--	--	--	--	--	--
Parking Lot driveway SB RT	--	--	--	--	17	9.4	A	0	--	--	--	--
Saturday Midday:												
Causeway Street EB LT/TH	328	0.2	A	0	--	--	--	--	--	--	--	--
Causeway Street EB TH	--	--	--	--	464	0.0	A	0	497	0.0	A	0
Causeway Street EB LT/TH/RT	349	0.1	A	0	--	--	--	--	--	--	--	--
Causeway Street EB TH/RT	--	--	--	--	451	0.0	A	0	507	0.0	A	0
Canal Street NB LT/TH/RT	124	13.9	B	1	--	--	--	--	--	--	--	--
Canal Street NB RT	--	--	--	--	70	10.2	B	1	76	10.4	B	1
Parking Lot driveway SB LT/RT	0	0.0	A	0	--	--	--	--	--	--	--	--
Parking Lot driveway SB RT	--	--	--	--	0	0.0	A	0	--	--	--	--

See notes at end of table.

Table 3.4-4 Unsignalized Intersection Level of Service and Vehicle Queue Summary (Continued)

Unsignalized Intersection/Peak Hour/Movement	2013 Existing				2028 No Build				2028 Build			
	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
7. Causeway Street at Beverly Street												
Weekday Morning:												
Causeway Street EB TH/RT	407	0.0	A	0	610	0.0	A	0	655	0.0	A	0
Causeway Street WB LT	0	0.0	A	0	--	--	--	--	--	--	--	--
Causeway Street WB TH	680	0.0	A	0	--	--	--	--	--	--	--	--
Causeway Street WB LT/TH	--	--	--	--	888	1.6	A	0	970	1.6	A	0
Weekday Evening:												
Causeway Street EB TH/RT	644	0.0	A	0	808	0.0	A	0	1,102	0.0	A	0
Causeway Street WB LT	21	9.8	A	0	--	--	--	--	--	--	--	--
Causeway Street WB TH	546	0.0	A	0	--	--	--	--	--	--	--	--
Causeway Street WB LT/TH	--	--	--	--	695	3.4	A	1	736	4.6	A	1
Saturday Midday:												
Causeway Street EB TH/RT	382	0.0	A	0	569	0.0	A	0	758	0.0	A	0
Causeway Street WB LT	6	8.6	A	0	--	--	--	--	--	--	--	--
Causeway Street WB TH	349	0.0	A	0	--	--	--	--	--	--	--	--
Causeway Street WB LT/TH	--	--	--	--	378	1.8	A	0	450	1.8	A	0
8. Causeway Street at Medford Street												
Weekday Morning:												
Causeway Street EB TH	420	0.0	A	0	--	--	--	--	--	--	--	--
Causeway Street EB TH/RT	--	--	--	--	461	0.0	A	0	480	0.0	A	0
Causeway Street WB LT/TH	--	--	--	--	831	1.5	A	0	913	1.5	A	0
Causeway Street WB TH	774	0.0	A	0	--	--	--	--	--	--	--	--
Medford Street NB LT/RT	104	18.8	C	2	--	--	--	--	--	--	--	--
Weekday Evening:												
Causeway Street EB TH	606	0.0	A	0	--	--	--	--	--	--	--	--
Causeway Street EB TH/RT	--	--	--	--	695	0.0	A	0	817	0.0	A	0
Causeway Street WB LT/TH	--	--	--	--	598	2.1	A	0	639	2.1	A	0
Causeway Street WB TH	546	0.0	A	0	--	--	--	--	--	--	--	--
Medford Street NB LT/RT	59	20.0	C	1	--	--	--	--	--	--	--	--
Saturday Midday:												
Causeway Street EB TH	355	0.0	A	0	--	--	--	--	--	--	--	--
Causeway Street EB TH/RT	--	--	--	--	396	0.0	A	0	474	0.0	A	0
Causeway Street WB LT/TH	--	--	--	--	373	1.7	A	0	445	1.7	A	0
Causeway Street WB TH	336	0.0	A	0	--	--	--	--	--	--	--	--
Medford Street NB LT/RT	26	12.4	B	1	--	--	--	--	--	--	--	--

See notes at end of table.

Table 3.4-4 Unsignalized Intersection Level of Service and Vehicle Queue Summary (Continued)

Unsignalized Intersection/Peak Hour/Movement	2013 Existing				2028 No Build				2028 Build			
	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
10. Valenti Way at Canal Street												
Weekday Morning:												
Valenti Way EB LT	87	10.2	B	1	54	9.3	A	1	59	9.3	A	1
Valenti Way WB RT	72	8.6	A	0	42	8.4	A	0	42	8.4	A	0
Canal Street NB TH	17	8.6	A	0	9	8.4	A	0	9	8.4	A	0
Weekday Evening:												
Valenti Way EB LT	81	9.7	A	1	52	9.0	A	1	56	9.0	A	1
Valenti Way WB RT	45	8.5	A	0	25	8.4	A	0	25	8.4	A	0
Canal Street NB TH	12	8.5	A	0	7	8.4	A	0	7	8.4	A	0
Saturday Midday:												
Valenti Way EB LT	45	9.8	A	1	60	9.3	A	1	66	9.3	A	1
Valenti Way WB RT	45	8.6	A	0	24	8.5	A	0	24	8.5	A	0
Canal Street NB TH	40	8.6	A	0	43	8.5	A	0	43	8.5	A	0
11. Valenti Way at Haverhill Street												
Weekday Morning:												
Valenti Way EB TH/RT	101	0.0	A	0	166	0.0	A	0	315	0.0	A	0
Weekday Evening:												
Valenti Way EB TH/RT	76	0.0	A	0	185	0.0	A	0	260	0.0	A	0
Saturday Midday:												
Valenti Way EB TH/RT	57	0.0	A	0	181	0.0	A	0	312	0.0	A	0

See notes at end of table.

Table 3.4-4 Unsignalized Intersection Level of Service and Vehicle Queue Summary (Continued)

Unsignalized Intersection/Peak Hour/Movement	2013 Existing Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	2028 No Build Demand	Delay	LOS	Queue 95th	2028 Build Demand	Delay	LOS	Queue 95th
15. Lomasney Way at Nashua Street and the North Station Garage												
Weekday Morning:												
North Station Garage EB TH/RT	3	30.3	D	0	22	>50.0	F	3	22	>50.0	F	4
Nashua Street NB LT	3	9.5	A	0	32	11.0	B	0	32	11.1	B	0
Nashua Street NB TH/RT	433	0.0	A	0	512	0.0	A	0	536	0.0	A	0
Lomasney Way SB LT	231	9.4	A	1	243	9.9	A	1	346	11.0	B	2
Lomasney Way SB TH/RT	763	0.0	A	0	1,007	0.0	A	0	1,015	0.0	A	0
Weekday Evening:												
North Station Garage EB TH/RT	56	>50.0	F	4	59	>50.0	F	5	59	>50.0	F	6
Nashua Street NB LT	0	0.0	A	0	7	9.9	A	0	7	9.9	A	0
Nashua Street NB TH/RT	521	0.0	A	0	719	0.0	A	0	753	0.0	A	0
Lomasney Way SB LT	89	9.6	A	1	148	10.7	B	1	202	11.6	B	2
Lomasney Way SB TH/RT	671	0.0	A	0	846	0.0	A	0	850	0.0	A	0
Saturday Midday:												
North Station Garage EB TH/RT	3	12.7	B	0	3	16.4	C	0	3	21.1	C	0
Nashua Street NB LT	0	0.0	A	0	14	9.0	A	0	14	9.0	A	0
Nashua Street NB TH/RT	258	0.0	A	0	382	0.0	A	0	414	0.0	A	0
Lomasney Way SB LT	35	7.9	A	0	70	8.3	A	1	165	8.8	A	1
Lomasney Way SB TH/RT	455	0.0	A	0	634	0.0	A	0	641	0.0	A	0

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

North Washington Street at Valenti Way and Thatcher Street – This signalized intersection was found to be operating at an overall LOS B under 2013 Existing conditions during the weekday morning and Saturday midday peak hours, and at LOS C during the weekday evening peak-hour. Under 2028 No Build conditions, overall operating conditions at the intersection are predicted to degrade to LOS E during the weekday morning peak-hour, to LOS D during the weekday evening peak-hour, and to LOS C during the Saturday midday peak-hour independent of the Project. The addition of Project-related traffic to the intersection is projected to result in a degradation in overall intersection operations from LOS E to LOS F during the weekday morning peak-hour, from LOS D to LOS E during the weekday evening peak-hour, and from LOS C to LOS E during the Saturday midday peak-hour under 2028 Build conditions.

New Charon Street at Merrimac Street and Congress Street – This signalized intersection was found to be operating at an overall LOS D under 2013 Existing conditions during the weekday morning and evening peak hours, and at LOS C during the Saturday midday peak hour conditions. The weekday evening peak hour conditions are predicted to only degrade slightly to LOS E under 2028 No Build conditions independent of the Project. The addition of Project-related traffic to the intersection is not predicted to result in a degradation in overall intersection operations over 2028 No Build conditions.

3.4.1.4 Unsignalized Intersections

The addition of Project-related traffic to the unsignalized study area intersections was not shown to result in a change in the overall LOS over anticipated future conditions without the Project (i.e., No Build conditions). Only one of the eight unsignalized study intersections was found to have a movement that was operating below a LOS D independent of the Project.

Lomasney Way at Nashua Street and the North Station Garage – Exiting movements from the North Station Garage to Nashua Street were shown to operate at LOS D during the weekday morning peak-hour, at LOS F during the weekday evening peak-hour, and at LOS B during the Saturday midday peak-hour under 2013 Existing conditions. Under 2028 No-Build and 2028 Build conditions, the exit movement from the North Station Garage is predicted to operate under LOS F conditions during both the weekday morning and evening peak-hours, and at LOS C during the Saturday midday peak-hour as a result of the large volume of conflicting traffic travelling along Nashua Street; however, the residual vehicle queue within the garage is predicted to be between 0 and 6 vehicles and can be contained within the garage without impeding access or circulation. All movements at Nashua Street are predicted to operate at LOS A during the peak periods with minimal vehicle queuing (0 to 2 vehicles) under all analysis conditions.

3.4.2 Pedestrian Impact Analysis

3.4.2.1 Introduction

A LOS analysis at intersection crossings was conducted under Existing, No Build, and Build conditions in order to assess Project-related impacts on the pedestrian infrastructure.

3.4.2.2 Methodology

In order to analyze the quality of service provided to pedestrians, a pedestrian facility analysis was conducted using the methodologies described in the 2010 *Highway Capacity Manual*.[6] The concept of LOS for pedestrian facilities is similar to that discussed previously for signalized and unsignalized intersections, and is evaluated separately for each crosswalk and intersection corner. A five step evaluation process is used to determine the pedestrian LOS as follows:

1. Determine street corner circulation area;
2. Determine crosswalk circulation area;
3. Determine pedestrian delay;
4. Determine pedestrian LOS score for intersection; and
5. Determine overall LOS.

This five step approach allows for a holistic definition of the pedestrian experience at an intersection between the initial wait on the corner to the crossing within the crosswalk. Aggregating the LOS score for each of these experiences results in an overall pedestrian LOS score for an intersection.

Six levels of service scores are defined for pedestrian facilities and are a measure of the pedestrian's experience as it relates to pedestrian density, crossing delay, crossing distance and perceived exposure to traffic. They are given letter designations from "A" to "F", with LOS A representing the "best" crossing conditions and LOS F representing the "worst" crossing conditions. Table 3.4-5 summarizes the relationship between LOS and the perceived LOS score for pedestrian facilities at signalized intersections.

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[6] *Highway Capacity Manual;* Transportation Research Board; Washington, DC; 2010.

Table 3.4-5 Pedestrian Level of Service Criteria at Signalized Intersections[a]

Level of Service	LOS Score (Seconds)
A	≤ 2.00
B	> 2.00 to 2.75
C	> 2.75 to 3.50
D	> 3.50 to 4.25
E	> 4.25 to 5.00
F	> 5.00

[a]Source: *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010; Exhibit 18-5.

For two-way Stop-controlled intersections, the pedestrian LOS is related to the average pedestrian delay associated with pedestrian crossings, and follows a six step evaluation procedure as follows:

1. Identify two-stage crossings (i.e., locations were a median refuge island is available);
2. Determine critical headway;
3. Estimate probability of a delayed crossing;
4. Calculate average delay to wait for adequate gap;
5. Estimate delay reduction due to yielding vehicles; and
6. Calculate average pedestrian delay and determine the LOS.

Table 3.4-6 summarizes the relationship between LOS and average pedestrian delay (control delay) for pedestrian facilities at two-way Stop-controlled intersections.

Table 3.4-6 Pedestrian Level of Service Criteria at Two-Way Stop-Controlled Intersections[a]

Level of Service	Control Delay (Seconds per Pedestrian)
A	≤ 5
B	> 5 to 10
C	> 10 to 20
D	> 20 to 30
E	> 30 to 45
F	> 45

[a]Source: *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010; Exhibit 19-2.

The *Highway Capacity Manual* does not provide a definition for pedestrian LOS at all-way Stop-controlled intersections, but does provide general guidance to determine the potential pedestrian delay that may be incurred as a result of intersection geometry, traffic volumes and pedestrian demand. The nature of the operation of all-way Stop-controlled intersections implies that, depending on driver behavior, pedestrian crossing delay should be less than that experienced at a similar intersection that is under two-way Stop-control.

3.4.2.3 Analysis Results

Pedestrian LOS analyses were conducted for 2013 Existing, 2028 No Build and 2028 Build conditions for the pedestrian crossings within the study area located along the Causeway Street corridor given that pedestrian activity (and impacts) associated with the Project will be concentrated and therefore more pronounced at the crossings serving Causeway Street. The results of the analyses are summarized for the signalized and unsignalized study intersections in Tables 3.4-7 and 3.4-8, respectively. The detailed analysis results are presented in Appendix B.

As shown in Table 3.4-7, the signalized pedestrian crossings along Causeway Street at both Portland Street and Haverhill Street/Legends Way were shown to operate at a pedestrian LOS C or better, with minimal impacts as a result of the addition of Project-related pedestrian activity (minor degradation from pedestrian LOS B to C during the weekday evening and Saturday midday peak hours for the Causeway Street crossings at Haverhill Street/Legends Way). As a part of the Project, the pedestrian phase timings along the Causeway Street corridor will be reviewed and adjusted as necessary to accommodate the increased pedestrian activity associated with the Project.

As shown in Table 3.4-8, the unsignalized crossings of Causeway Street at both Friend Street and Canal Street, crossings which currently serve upward of 1,000 pedestrians per hour during the weekday peak hours and are the most direct pedestrian paths to the North Station Commuter Rail terminal, operate at a pedestrian LOS F during the peak hours independent of the Project. That being said, under actual operating conditions, pedestrians cross these locations in a platoon when a gap in traffic is afforded in at least one direction on Causeway Street. This platooned crossing results in less pedestrian delay than predicted by the analysis model under actual operating conditions. In conjunction with the reconstruction of the Causeway Street corridor as a part of the City's Causeway Street Crossroads Initiative, additional enhancements to the unsignalized pedestrian crossings along Causeway Street are planned, including the introduction of a raised median, the installation of raised intersections and provision of both wider sidewalks and curbline extensions. These features will improve pedestrian accessibility to North Station, the Bulfinch Triangle and the Project site.

Table 3.4-7 Pedestrian Level of Service Summary Signalized Intersections

	2013 Existing			2028 No Build			2028 Build		
Intersection/Time Period/Crossing Path	Demand[a]	LOS Score[b]	LOS[c]	Demand	LOS Score	LOS	Demand	LOS Score	LOS
3. Causeway Street at Portland Street									
Weekday Morning:									
Crossing Causeway Street (east)	816	2.47	B	879	2.61	B	903	2.62	B
Crossing Causeway Street (west)	34	2.46	B	37	2.68	B	37	2.69	B
Crossing Portland Street (south)	562	1.76	A	606	1.78	A	606	1.78	A
Weekday Evening:									
Crossing Causeway Street (east)	599	2.47	B	646	2.57	B	669	2.59	B
Crossing Causeway Street (west)	30	2.45	B	32	2.61	B	32	2.64	B
Crossing Portland Street (south)	296	1.76	A	319	1.79	A	319	1.79	A
Saturday Midday:									
Crossing Causeway Street (east)	72	2.35	B	72	2.40	B	72	2.42	B
Crossing Causeway Street (west)	1	2.34	B	1	2.54	B	1	2.57	B
Crossing Portland Street (south)	140	1.73	A	151	1.77	A	151	1.77	A
6. Causeway Street at Haverhill Street and Legends Way									
Weekday Morning:									
Crossing Causeway Street (east)	543	2.56	B	585	2.54	B	585	2.65	B
Crossing Causeway Street (west)	956	2.59	B	1,030	2.62	B	1,261	2.63	B
Crossing Legends Way (north)	298	1.74	A	321	1.73	A	387	1.95	A
Crossing Haverhill Street (south)	497	1.72	A	536	1.74	A	557	1.80	A
Weekday Evening:									
Crossing Causeway Street (east)	309	2.59	B	333	2.60	B	333	3.19	C
Crossing Causeway Street (west)	660	2.61	B	711	2.75	B	1,243	2.78	C
Crossing Legends Way (north)	344	1.77	A	371	1.75	A	523	2.08	B
Crossing Haverhill Street (south)	524	1.73	A	565	1.77	A	596	1.80	A
Saturday Midday:									
Crossing Causeway Street (east)	71	2.47	B	77	2.40	B	77	2.81	C
Crossing Causeway Street (west)	99	2.46	B	107	2.56	B	674	2.58	B
Crossing Legends Way (north)	114	1.72	A	123	1.72	A	279	2.09	B
Crossing Haverhill Street (south)	132	1.71	A	142	1.76	A	175	1.82	A

[a]Demand in pedestrians per hour.

[b]Seconds.

[c]Level-of-service.

Table 3.4-8 Pedestrian Level of Service Summary Unsignalized Intersections

	2013 Existing			2028 No Build			2028 Build		
Intersection/Time Period/Crossing Path	Demand[a]	Delay[b]	LOS[c]	Demand	Delay	LOS	Demand	Delay	LOS
4. Causeway Street at Friend Street									
Weekday Morning:									
Crossing Causeway Street (east)	3	>45.0	F	3	>45.0	F	3	>45.0	F
Crossing Causeway Street (west)	750	>45.0	F	808	>45.0	F	914	>45.0	F
Crossing Friend Street (south)	403	1.9	A	434	1.2	A	434	1.2	A
Weekday Evening:									
Crossing Causeway Street (east)	13	>45.0	F	14	>45.0	F	14	>45.0	F
Crossing Causeway Street (west)	997	>45.0	F	1,074	>45.0	F	1,192	>45.0	F
Crossing Friend Street (south)	319	0.8	A	344	0.8	A	344	0.8	A
Saturday Midday:									
Crossing Causeway Street (east)	12	>45.0	F	13	>45.0	F	13	>45.0	F
Crossing Causeway Street (west)	105	>45.0	F	113	>45.0	F	212	>45.0	F
Crossing Friend Street (south)	187	0.6	A	202	0.6	A	202	0.6	A
5. Causeway Street at Canal Street									
Weekday Morning:									
Crossing Causeway Street (east)									
Crossing Causeway Street (west)	89	>45.0	F	96	>45.0	F	96	>45.0	F
Crossing parking lot driveway (north)	46	>45.0	F	50	>45.0	F	158	>45.0	F
Crossing Canal Street (south)	171	0.5	A	184	1.8	A	--	--	--
Weekday Evening:	340	3.6	A	366	0.2	A	390	1.9	A
Crossing Causeway Street (east)									
Crossing Causeway Street (west)	328	>45.0	F	353	>45.0	F	353	>45.0	F
Crossing parking lot driveway (north)	206	>45.0	F	222	>45.0	F	474	>45.0	F
Crossing Canal Street (south)	139	2.7	A	150	1.4	A	--	--	--
Saturday Midday:	147	0.9	A	158	0.4	A	188	1.5	A
Crossing Causeway Street (east)									
Crossing Causeway Street (west)	26	>45.0	F	28	>45.0	F	28	>45.0	F
Crossing parking lot driveway (north)	66	>45.0	F	71	>45.0	F	351	>45.0	F
Crossing Canal Street (south)	87	0.0	A	0	0.0	A	--	--	--
	130	2.7	A	70	2.7	A	147	2.7	A

[a]Demand in pedestrians per hour.

[b]Average delay per pedestrian.

[c]Level-of-service.

3.4.3 Public Transportation Impact Analysis

Under the 2028 Build conditions, the additional weekday peak-hour transit trips expected to be generated by the Project (516 trips during the weekday morning peak hour and 768 trips during the weekday evening peak hour) were distributed to each of the public transportation modes operated by the MBTA serving the Project site and the study area (six bus routes, four Commuter Rail lines, and the Orange and Green Lines) based on ridership information provided by the CTPS. Weekend conditions are not typically a critical transit analysis period as additional reserve capacity is available with the exception of special event operations or holiday scheduling, circumstances under which Project-related transit trips would likely be reduced as well. Table 3.4-9 summarizes the assignment of weekday Project-related transit trips to the various public transportation services available within the study area and to the Project site.

Based on the peak period transit capacity and ridership information provided by the CTPS and documented in Section 3.2.5 above, sufficient capacity exists within the overall public transportation system serving the study area and the Project site to accommodate the additional ridership associated with the Project. It was noted that there are trains on the Commuter Rail system serving North Station that currently operate over their service capacity resulting in passengers standing or finding other accommodations within the train. The limited additional ridership within the Commuter Rail system expected to result from the Project during these time periods (42 or fewer total passengers) is not expected to appreciably degrade these conditions. It is likely that, absent the addition of capacity to the system, passengers will alter their commuting times to select an earlier or later train to avoid peak passenger service times.

Table 3.4-9 Public Transportation Trip Assignment

	Project Ridership in Passengers	
Mode/Route	Weekday Morning Peak-Hour	Weekday Evening Peak-Hour
Bus:		
Route 4	5	7
Route 92	3	15
Route 93	5	4
Route 111	10	4
Route 426	3	8
Route 428	0	0

Table 3.4-9 Public Transportation Trip Assignment (Continued)

	Project Ridership in Passengers	
Mode/Route	Weekday Morning Peak-Hour	Weekday Evening Peak-Hour
Subway:		
Orange Line:		
Inbound	74	148
Outbound	107	121
Total	181	269
Green Line:		
Inbound	68	214
Outbound	164	132
Total	232	346
Commuter Rail:		
Newburyport/Rockport:		
Inbound	22	14
Outbound	6	28
Total	28	42
Haverhill:		
Inbound	11	7
Outbound	3	14
Total	14	21
Lowell:		
Inbound	15	9
Outbound	4	19
Total	19	28
Fitchburg:		
Inbound	13	8
Outbound	3	16
Total	16	24

3.4.4 Parking Allocation

Parking for the Project will be provided by way of an expansion of the existing North Station parking garage to accommodate an additional approximately 800 parking spaces to be located beneath the Project site.

The proposed parking supply is within the recommended BTD parking goals for the Bulfinch Triangle area, and represents a sufficiently constrained parking supply recognizing the location of the Project at the northern hub of the MBTA Commuter Rail system and the transit-oriented nature of the development. Further, providing a constrained parking supply in combination with an aggressive Transportation Demand Management (TDM) program with appropriate inducements will encourage and reinforce the use of the many available alternative modes of transportation to the Project site, including MBTA Commuter Rail, subway and bus service, and walking and bicycling.

As documented in Section 3.2.6 and Table 3.2-5, over 5,000 public parking spaces are located within a five-minute walking distance of the Project site, including 1,275 spaces in the adjacent North Station Garage, to accommodate area-wide parking demands, particularly when an event is scheduled at the TD Garden. Note that the Project will include the addition of 450 public parking spaces, included in the total 800 new spaces, which will allow the flexibility to provide shared parking between different uses, as well as accommodate public parking for access to the TD Garden and the city and regional transportation system.

3.4.5 Loading/Delivery Impacts

Primary loading and delivery activities associated with the Project will occur in two designated off-street loading areas: one situated off Causeway Street between Friend Street and Canal Street, and the second located off Legends Way. Both loading dock areas are enclosed and are located internal to the structures that will occupy the Project site. The Causeway Street loading area has been designed to accommodate the turning and maneuvering requirements of a large tractor semi-trailer combination (WB-50 design vehicle) internal to the loading dock area (i.e., no maneuvering required within Causeway Street or the sidewalk area along the Project site frontage). Smaller delivery vehicles, including single-unit trucks (SU-30 design vehicle), trash/recycling vehicles (SU-40 design vehicle), and small tractor semi-trailer combinations (up to a WB-50 design vehicle), can be accommodated within either of the two loading areas. Assuming the neighborhood grocery store development scenario (most intensive development scenario with respect to trip-generation and truck traffic), the Project could be expected to receive five deliveries per day by way of large tractor semi-trailer combinations (WB-50), with approximately 50 deliveries per day by smaller trucks, including USPS, UPS, FedEx, food suppliers, office supplies, linen/laundry, etc.

In addition to the two off-street loading areas described above, short-term loading and passenger drop-off/pick-up activities will occur curbside along Causeway Street in defined areas to be developed in consultation with BTD and consistent with the curbside allocation for the Project site defined as a part of the City's Causeway Street Crossroads Initiative.

3.5 Transportation Improvement Program

The previous sections of this assessment have quantified and evaluated in detail the impact of the Project on the transportation infrastructure. This section presents a summary of Project-related improvements that are designed to: 1) address existing deficiencies identified as a part of this assessment; 2) minimize the impact of the Project on the transportation system and proximate neighborhood areas; and 3) provide safe and efficient access to the Project site.

3.5.1 Recommendations

The Proponent is committed to the implementation of a comprehensive transportation improvement program that is designed to reduce the impact of the planned development on the transportation infrastructure. The major elements of the improvement program can be separated into three primary categories: i) Project site access accommodations; ii) off-site improvements; and iii) Transportation Demand Management (TDM) measures. In addition, the framework of a construction traffic and parking management plan have also been developed for the Project. The elements of the planned transportation improvement program are discussed in detail in the following sections, with Table 3.5-1 summarizing the improved operating conditions (LOS and vehicle queuing) resulting from the recommended improvements where applicable.

3.5.1.1 Project Site Access

Access to the Project site will be provided by way of the driveways serving the TD Garden located off Causeway Street and Nashua Street/Cotting Street, with curbside pick-up/drop-off to be provided in designated areas along Causeway Street. Primary loading and delivery activities associated with the Project will occur in two designated off-street loading areas: one situated off Causeway Street between Friend Street and Canal Street, and the second located off Legends Way. Both loading dock areas are enclosed and are located internal to the structures that will occupy the Project site. The Causeway Street loading area has been designed to accommodate the turning and maneuvering requirements of a large tractor semi-trailer combination (WB-50 design vehicle) internal to the loading dock area (i.e., no maneuvering required within Causeway Street or the sidewalk area along the Project site frontage). The following recommendations are made relative to the access drives serving the Project site:

- The Causeway Street access to the Project site should be maintained under traffic signal control and an optimal traffic signal timing, phasing and coordination plan should be developed to accommodate the additional traffic demands associated with the Project and in consideration of pedestrian and bicycle accommodations and service levels.

- Consideration should be given to providing a dedicated left-turn lane on the Causeway Street eastbound approach to the Haverhill Street/Legends Way/North Station Garage intersection as a part of the redesign of Causeway Street in the context of the City's Causeway Street Crossroads Initiative.
- The driveway serving the loading dock area off Causeway Street should be designed as a pan-type driveway so that the sidewalk is maintained at a consistent grade along Causeway Street. Audible and visual pedestrian warning devices should be installed at the driveway to warn pedestrians of vehicles that may be exiting the loading area.
- Vehicles exiting the Project and the North Station Garage onto Nashua Street should continue to be placed under STOP-sign control.
- Centerline pavement markings, where provided, shall consist of a double-yellow line in accordance with the centerline pavement marking standards of the *Manual on Uniform Traffic Control Devices* (MUTCD).[7]
- All signs and other pavement markings to be installed within the development shall conform to the applicable standards of the MUTCD.
- Signs, landscaping and other features to be installed adjacent to the Project site driveways should be designed and maintained so as not to restrict lines of sight to or from the driveways for vehicles, pedestrians or bicyclists.

3.5.1.2 Off-Site

Causeway Street Corridor- The Proponent will assist the City in the advancement of the reconstruction of Causeway Street between Lomasney Way/Merrimac Street and North Washington Street as envisioned as a part of the City's Causeway Street Crossroads Initiative. These efforts will include the reconstruction of the sidewalk along the Project site frontage on Causeway Street to include finishes, street trees and furnishings consistent with the Crossroads Project. These improvements will be coordinated with the City of Boston and will be completed commensurate with the build-out of the Project subject to receipt of all necessary rights, permits and approvals.

Causeway Street Traffic Signal System - The Proponent will design and implement an optimal traffic signal timing, phasing and coordination plan along the Causeway Street corridor in order to accommodate the additional traffic, pedestrian and bicycle demands associated with the Project. These improvements will include the installation of all necessary hardware and appurtenances as may be required to provide a fully functional coordinated traffic signal system with pedestrian and bicycle accommodations (i.e., push

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

buttons, signal indications, phasing, detection and signs, as appropriate), including the connection to the central computer system located at the BTD Tech Center (Boston City Hall). The following intersections will be a part of this coordinated system:

- Causeway Street at Staniford Street, Lomasney Way and Merrimac Street;
- Causeway Street at Portland Street;
- Causeway Street at Haverhill Street; and
- Causeway Street at North Washington Street and Commercial Street.

As shown in Table 3.5-1, with the implementation of these improvements, in general, overall traffic operations at these intersections are predicted to improve over or to be maintained at No Build conditions, with reduced overall motorist delay and/or an improvement in the ability of the intersection to process traffic in an efficient manner (reduced volume-to-capacity ratio). The Causeway Street/Staniford Street/Lomasney Way/Merrimac Street (Lowell Square) and Causeway Street/North Washington Street/Commercial Street (Keany Square) intersections will continue to operate at an overall LOS E or F with the recommended improvements, conditions that will occur with or without the Project.

The Proponent will design and implement these improvements prior to the issuance of the first Certificate of Occupancy for the Project subject to receipt of all necessary rights, permits and approvals as may be necessary to implement the improvements. In addition, the improved timing, phasing and coordination plan will be revisited within one-year of initial occupancy of the Project site and will be further adjusted as may be necessary to accommodate the actual traffic demands and traffic patterns resulting from the Project.

North Washington Street at Valenti Way and Thatcher Street - The Proponent will design and implement an optimal traffic signal timing plan for the intersection of North Washington Street at Valenti Way and Thatcher Street in order to accommodate the additional traffic, pedestrian and bicycle demands associated with the Project. These improvements will include the installation of all necessary hardware and appurtenances as may be required to provide a fully functional traffic signal system with pedestrian and bicycle accommodations (i.e., push buttons, signal indications, phasing, detection and signs, as appropriate), including the connection to the central computer system located at the BTD Tech Center.

As shown in Table 3.5-1, with the implementation of these improvements, overall motorist delays at the intersection are predicted to be reduced over 2028 No Build conditions without the improvements. The Proponent will design and implement these improvements prior to the issuance of the first Certificate of Occupancy for the Project subject to receipt of all necessary rights, permits and approvals as may be necessary to implement the improvements. In addition, the improved timing and phasing plan will be revisited within one-year of initial occupancy of the Project site, and will be further adjusted as may be necessary to accommodate the actual traffic demands and traffic patterns resulting from the Project.

New Chardon Street at Merrimac Street and Congress Street - The Proponent will design and implement an optimal traffic signal timing plan for the intersection of New Chardon Street at Merrimac Street and Congress Street in order to accommodate the additional traffic, pedestrian and bicycle demands associated with the Project. These improvements will include the installation of all necessary hardware and appurtenances as may be required to provide a fully functional traffic signal system with pedestrian and bicycle accommodations (i.e., push buttons, signal indications, phasing, detection and signs, as appropriate), including the connection to the central computer system located at the BTD Tech Center.

As shown in Table 3.5-1, with the implementation of these improvements, overall motorist delays at the intersection are predicted to be reduced or generally maintained over 2028 No Build conditions. The Proponent will design and implement these improvements prior to the issuance of the first Certificate of Occupancy for the Project subject to receipt of all necessary rights, permits and approvals as may be necessary to implement the improvements. In addition, the improved timing and phasing plan will be revisited within one-year of initial occupancy of the Project site and will be further adjusted as may be necessary to accommodate the actual traffic demands and traffic patterns resulting from the Project.

3.1.5.3 Transportation Demand Management Program

Introduction

The Project site is ideally situated at the northern hub of the MBTA Commuter Rail system with access to multiple bus lines and subway service on both the Orange and Green Lines to facilitate opportunities to reduce vehicle trips and encourage the use of alternative modes of travel. As detailed herein, the Project includes an expansion of the North Station Commuter Rail concourse area and has been designed to integrate the MBTA's North Station Orange and Green Line Station into the Project, providing a direct, weather-protected link between the Commuter Rail, the Orange and Green Lines, and the Project. Further, North Station is the location of one of the most active Hubway bicycle rental stations in the City, offering opportunities to expand the service to accommodate increased demands associated with the Project.

The following pedestrian and bicycle improvements/accommodations, TDM measures, and trip reduction strategies are proposed with the goal of further minimizing the Project's overall impact.

Pedestrian Improvements

As part of the Project, the Proponent will define and enhance pedestrian facilities as follows:

- Reconstruct sidewalks along the Project site frontage on Causeway Street consistent with and expanding upon the pedestrian improvements contemplated as a part of the City's Causeway Street Crossroads Initiative.
- Street lighting will be provided around the building perimeter and along Causeway Street.
- Full handicapped access will be provided on-site, including elevators and ramps for barrier-free access.
- Sidewalks will be constructed so as to be flush with all driveways and garage entrances.
- Pedestrian warning devices (signs, voice and light devices, mirrors, etc.) will be provided at all garage driveways for pedestrian safety.

In addition, the Proponent will work with the City of Boston, the Department of Conservation and Recreation (DCR), the MBTA and WalkBoston to advance the completion of the missing segment of the Dr. Paul Dudley White multiuse path along the south side of the Charles River, which currently terminates on both sides of the MBTA Commuter Rail tracks behind the TD Garden. This effort will include developing a defined link between the Project site and the pathway.

Bicycle Accommodations

The Project will include provision of safe, secure, weather protected bicycle racks and/or storage lockers within the Project site. Signs will be provided at appropriate locations within the Project site directing bicyclists to the bicycle storage facilities. Short-term bicycle parking will be provided at appropriate locations along Causeway Street defined in consultation with BTD and the BRA, and consistent with the street furniture space allocation developed as a part of the City's Causeway Street Crossroads Initiative. In addition, all traffic signals to be modified in conjunction with the Project will include bicycle detection and associated signs and pavement markings, if and to the extent feasible and appropriate.

Traffic Reduction Strategies

In order to reduce single occupant vehicle (SOV) travel to the Project site and encourage the use of alternative modes of transportation to reach the planned development, the following traffic reduction strategies will be implemented in conjunction with the Project:

- An on-site Transportation Coordinator will be assigned;

- Join the A Better City Transportation Management Association (TMA);
- Coordinate with MassRIDES through the A Better City TMA to provide commuter services to employees of the Project;
- Through the A Better City TMA, make available information regarding public transportation services, maps, schedules and fare information to employees, residents and guests of the Project;
- Promote the use of public transportation to hotel guests and employees in website based materials including links to the appropriate home pages of the MBTA and MassRIDES;
- Provide at least four car sharing (ZipCar or similar service) parking spaces within the parking garage;
- Provide at least two carpool/vanpool designated parking spaces within the parking garage;
- Provide at least two designated parking spaces for alternatively fueled vehicles within the parking garage;
- Provide at least two electric vehicle charging stations within the parking garage;
- Participate in the MBTA Corporate T-Pass Program to the extent practical and as allowable pursuant to corporate policies;
- Offer a "guaranteed-ride-home" to all employees that car/vanpool or that use public transportation as provided through the A Better City TMA;
- Through the A Better City TMA, provide a periodic newsletter or bulletin summarizing transit, ridesharing, bicycling, alternative work schedules and other travel options;
- Promote bicycle use as an alternative to SOV travel by providing promotional material on bicycle commuting and bicycle safety, and offer incentives for bicycle use; and
- Encourage employees to participate in MassRIDES' NuRide program which rewards employees that choose to walk, bicycle, carpool, vanpool or that use public transportation.

In addition, an annual employee survey and traffic monitoring program will be implemented through the A Better City TMA (discussion follows) that will be used to document the effectiveness of the traffic reduction program.

Alternative Work Schedules

Flexible working hours allow employees to choose their own starting and finishing times by establishing a required core time such as 9:00 a.m. to 4:00 p.m.; which allows employees to vary work schedules and reduces peak-hour demand. Project tenants will evaluate the feasibility of implementing a flextime policy and/or telecommuting for clerical/office employees in order to reduce peak-hour traffic demands.

On-Site Banking/Direct Deposit

Project tenants will be encouraged to offer employees the option of direct deposit of paychecks in order to reduce off-site trips and the overall volume of employee traffic.

3.1.5.4 Construction Management Plan (CMP)

An important component of the transportation improvement program is an effective series of measures designed to minimize traffic flow and safety impacts during the Project's construction phase. Summarized below are several measures which the Proponent and the general contractor will undertake during the construction phase of the Project.

- The Proponent will coordinate with BTD regarding all transportation-related construction impacts of the Project.
- Prior to the implementation of any planned construction activities within the public right-of-way, the contractor will submit to BTD for review and approval a traffic and pedestrian management plan.
- The general contractor will join the A Better City TMA in order to coordinate trip reduction strategies during the construction phase of the Project.
- The general contractor, through the A Better City TMA, will implement a car/vanpool program in order to reduce construction-related traffic and parking demands associated with the Project.
- The general contractor will be encouraged to offer subsidies to workers that use public transportation to be used toward the purchase of MBTA "Charlie Cards". Employees that participate in the program would also be eligible for the "guaranteed-ride-home" program through the A Better City TMA.
- Designated truck routes will be established to govern how trucks access the Project site. The goal of this commitment is to have construction trucks use only the regional highway system (I-93) and to avoid using residential city streets to the extent practical. Construction contracts for the Project will include notification of this provision and contain explicit language prohibiting travel over the North Washington Street (Charlestown) Bridge or along DCR parkways where truck traffic is prohibited.

- Secure fencing and sidewalk staging protection will be provided in areas affected by the construction to protect nearby pedestrian and vehicular traffic. Gate entrances into the construction area(s) will be determined jointly with BTD.
- Secure on-site storage will be provided for tools and equipment in an effort to minimize construction-related vehicle trips to the site.
- Full or partial street closures will be avoided to the extent possible. Should a partial street closure be necessary in order to off-load construction materials and/or complete construction-related activities, the closure will be limited to off-peak periods as defined by the BTD so as to minimize the impact on vehicular and pedestrian flow. Police details will be utilized as required by the BTD.
- During construction activities, as required by BTD, a police detail will be placed on-site within the sidewalk/street area to control pedestrian, bicycle and construction vehicle conflicts.
- Construction worker parking will be prohibited along Causeway Street and on-street areas within the Bulfinch Triangle and the North End and West End neighborhoods. Construction contracts for the Project will include notification of this prohibition.

3.1.5.5 Loading and Deliveries

The Project has been designed to accommodate all loading and delivery functions on-site in enclosed areas in a safe and efficient manner. The loading areas will be managed by the building management team, and signs will be posted in the loading areas informing drivers of the five-minute idle time. Two loading areas are planned as a part of the Project and located internal to the proposed building: one situated off Causeway Street and a second located off Legends Way. In addition to the two off-street loading areas, short-term loading and passenger drop-off/pick-up activities will occur curbside along Causeway Street in defined areas to be developed in consultation with BTD and consistent with the curbside allocation for the Project site defined as a part of the City's Causeway Street Crossroads Initiative.

3.1.5.6 Traffic Monitoring Program

The Proponent, by and through the A Better City TMA, will conduct a post-development traffic monitoring and employee survey program in order to evaluate the success, and to refine the elements, of the TDM program. The monitoring program will include obtaining traffic volume information at the driveways serving the Project site and an employee, resident and hotel guest survey of commuting modes. The results of the annual monitoring program will be provided to the BRA, BTD and MassDOT. The monitoring program will commence upon full completion and occupancy of the Project and will continue for a period of two-years thereafter.

3.5.2 Conclusion

With implementation of the elements of the transportation improvement program described in the previous section, the Project can be accommodated within the confines of the transportation system in a safe and efficient manner. The Proponent will formalize the commitments to mitigation as a part of the City of Boston Transportation Access Plan Agreement (TAPA) to ensure that proper Project mitigation will be implemented as may be required to accommodate the Project and commensurate with the planned build-out and occupancy of the development.

Table 3.5-1 Mitigated Signalized Intersection Level of Service and Vehicle Queue Summary

	2028 No Build				2028 Build				2028 Build with Mitigation			
Signalized Intersection/Peak Hour/Movement	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	V/C	Delay	LOS	Queue Avg./95th	V/C	Delay	LOS	Queue Avg./95th
1. Causeway Street at Staniford Street, Lomasney Way and Merrimac Street												
Weekday Morning:												
Staniford Street EB LT	0.23	44.3	D	2/3	0.33	45.1	D	2/4	0.25	39.8	D	2/4
Staniford Street EB LT/TH	1.32	>80.0	F	13/21	1.43	>80.0	F	15/23	1.09	>80.0	F	12/16
Staniford Street EB RT	0.19	44.0	D	0/3	0.19	44.0	D	0/3	0.19	39.2	D	0/3
Causeway Street WB LT/TH	0.91	56.3	E	12/17	0.95	62.1	E	13/18	0.96	65.3	E	11/16
Causeway Street WB RT	0.72	44.4	D	8/11	0.72	43.8	D	8/11	0.80	46.9	D	8/13
Merrimac Street NB LT	0.67	53.2	D	5/9	0.67	53.2	D	5/9	0.75	61.7	E	5/10
Merrimac Street NB TH/RT	0.95	>80.0	F	7/14	0.97	>80.0	F	7/14	1.08	>80.0	F	8/15
Merrimac Street NB RT	--	--	--	--	--	--	--	--	--	--	--	--
Lomasney Way SB LT	0.88	56.3	E	12/17	0.88	56.6	E	12/18	0.93	68.2	E	12/19
Lomasney Way SB TH/RT	0.72	42.0	D	10/15	0.71	41.1	D	10/15	0.79	49.1	D	11/17
Lomasney Way SB RT	0.67	39.9	D	8/12	0.66	39.4	D	8/12	0.73	45.7	D	8/13
Overall	**0.98**	**69.7**	**E**	--	**1.02**	**77.2**	**E**	--	**1.00**	**68.9**	**E**	--
Weekday Evening:												
Staniford Street EB LT	0.46	46.4	D	3/6	0.52	47.1	D	4/6	0.36	40.2	D	3/6
Staniford Street EB LT/TH	1.63	>80.0	F	18/26	1.69	>80.0	F	17/27	1.17	>80.0	F	17/23
Staniford Street EB RT	1.08	>80.0	F	0/8	1.08	>80.0	F	0/8	1.08	>80.0	F	0/8
Causeway Street WB LT/TH	0.77	58.1	E	5/8	0.88	67.2	E	6/12	0.86	62.7	E	6/12
Causeway Street WB RT	0.76	63.6	E	11/16	0.81	64.4	E	12/18	1.06	>80.0	F	13/21
Merrimac Street NB LT	0.24	41.3	D	2/4	0.24	41.3	D	2/4	0.23	40.4	D	2/4
Merrimac Street NB TH/RT	1.20	>80.0	F	14/21	1.21	>80.0	F	14/22	1.16	>80.0	F	14/21
Merrimac Street NB RT	---	--	--	--	--	--	--	--	--	--	--	--
Lomasney Way SB LT	0.71	41.3	D	9/14	0.72	41.9	D	10/14	0.94	77.6	E	11/18
Lomasney Way SB TH/RT	0.96	71.9	E	16/25	0.96	71.9	E	16/25	1.20	>80.0	F	18/27
Lomasney Way SB RT	0.57	36.3	D	7/11	0.57	36.3	D	7/11	0.71	47.5	D	7/11
Overall	**1.09**	**>80.0**	**F**	--	**1.13**	**>80.0**	**F**	--	**1.10**	**>80.0**	**F**	--
Saturday Midday:												
Staniford Street EB LT	0.21	30.8	C	1/3	0.30	31.4	C	2/3	0.30	31.4	C	2/3
Staniford Street EB LT/TH	0.59	35.4	D	4/7	0.67	38.7	D	5/8	0.67	38.7	D	5/8
Staniford Street EB RT	0.32	32.1	C	0/4	0.32	32.1	C	0/4	0.32	32.1	C	0/4
Causeway Street WB LT/TH	0.36	19.1	B	3/3	0.42	18.7	B	2/3	0.42	12.2	B	1/2
Causeway Street WB RT	1.00	>80.0	F	7/14	1.06	>80.0	F	8/15	1.06	>80.0	F	8/15
Merrimac Street NB LT	0.13	30.4	C	1/2	0.13	30.4	C	1/2	0.13	30.4	C	1/2
Merrimac Street NB TH/RT	0.36	32.0	C	--	0.37	32.2	C	3/5	0.37	32.2	C	3/4
Merrimac Street NB RT	--	--	--	2/4	--	--	--	--	--	--	--	--
Lomasney Way SB LT	1.14	>80.0	F	9/17	1.18	>80.0	F	9/17	1.18	>80.0	F	9/17
Lomasney Way SB TH/RT	0.69	40.7	D	5/10	0.70	40.9	D	5/10	0.70	40.9	D	5/10
Lomasney Way SB RT	0.69	41.5	D	4/9	0.69	41.7	D	4/9	0.69	41.7	D	4/9
Overall	**0.58**	**61.9**	**E**	--	**0.63**	**67.3**	**E**	--	**0.63**	**66.4**	**E**	--

See notes at end of table.

Table 3.5-1 Mitigated Signalized Intersection Level of Service and Vehicle Queue Summary (Continued)

	2028 No Build				2028 Build				2028 Build with Mitigation			
Signalized Intersection/Peak Hour/Movement	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	V/C	Delay	LOS	Queue Avg./95th	V/C	Delay	LOS	Queue Avg./95th
6. Causeway Street at Haverhill Street												
Weekday Morning:												
Causeway Street EB LT	--	--	--	--	--	--	--	--	0.27	12.3	B	1/2
Causeway Street EB LT/TH	0.43	6.4	A	2/6	0.69	17.3	B	5/10	--	--	--	--
Causeway Street EB TH	--	--	--	--	--	--	--	--	0.47	10.7	B	5/7
Causeway Street WB TH/RT	0.75	21.0	C	7/19	1.15	>80.0	F	16/21	1.00	53.7	D	13/18
Haverhill Street NB LT	0.54	41.3	D	1/3	0.34	33.6	C	1/3	0.35	33.9	C	1/3
Haverhill Street NB TH/RT	0.03	36.1	D	0/1	0.68	40.8	D	4/7	0.71	41.9	D	4/7
Accolon Way SB LT/RT	0.13	43.6	D	0/1	0.60	43.8	D	2/4	0.69	46.1	D	2/5
Overall	**0.64**	**16.5**	**B**	--	**0.89**	**67.7**	**E**	--	**0.83**	**37.6**	**D**	--
Weekday Evening:												
Causeway Street EB LT	--	--	--	--	--	--	--	--	0.23	26.4	C	2/3
Causeway Street EB LT/TH	0.66	12.2	B	5/16	1.33	>80.0	F	24/30	--	--	--	--
Causeway Street EB TH	--	--	--	--	--	--	--	--	0.93	53.4	D	18/22
Causeway Street WB TH/RT	0.88	52.3	D	10/13	0.87	49.2	D	11/15	0.77	38.9	D	10/13
Haverhill Street NB LT	0.83	>80.0	F	3/7	0.59	54.4	D	3/5	0.59	54.4	D	3/5
Haverhill Street NB TH/RT	0.02	44.5	D	0/1	0.55	52.4	D	3/5	0.55	52.4	D	3/5
Accolon Way SB LT/RT	0.22	57.4	E	1/2	0.88	52.6	D	14/24	0.99	79.9	E	15/27
Overall	**0.75**	**31.7**	**C**	--	**1.06**	**>80.0**	**F**	--	**0.92**	**53.9**	**D**	--
Saturday Midday:												
Causeway Street EB LT	--	--	--	--	--	--	--	--	0.21	17.5	B	2/3
Causeway Street EB LT/TH	0.38	8.2	A	5/7	0.70	29.2	C	7/9	--	--	--	--
Causeway Street EB TH	--	--	--	--	--	--	--	--	0.50	18.6	B	5/9
Causeway Street WB TH/RT	0.35	15.5	B	3/6	0.60	29.2	C	4/7	0.66	33.1	C	5/8
Haverhill Street NB LT	0.60	61.7	E	3/5	0.41	52.5	D	3/4	0.43	49.8	D	3/4
Haverhill Street NB TH/RT	0.03	35.7	D	0/0	0.64	59.2	E	4/6	0.68	58.2	E	4/6
Accolon Way SB LT/RT	0.03	42.7	D	0/1	0.94	66.4	E	8/17	0.83	46.2	D	7/12
Overall	**0.40**	**16.8**	**B**	--	**0.75**	**41.2**	**D**	--	**0.70**	**34.1**	**C**	--

See notes at end of table.

Table 3.5-1 Mitigated Signalized Intersection Level of Service and Vehicle Queue Summary (Continued)

	2028 No Build				2028 Build				2028 Build with Mitigation			
Signalized Intersection/Peak Hour/Movement	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	V/C	Delay	LOS	Queue Avg./95th	V/C	Delay	LOS	Queue Avg./95th
9. Causeway Street at North Washington Street												
Weekday Morning:												
Causeway Street EB LT	0.43	51.9	D	5/7	0.45	51.6	D	5/7	0.50	54.8	D	5/7
Causeway Street EB TH/RT	0.71	62.2	E	7/13	0.71	61.2	E	8/13	0.80	73.8	E	8/14
Causeway Street WB LT/TH	0.76	67.1	E	7/9	0.79	68.9	E	8/10	0.80	70.2	E	8/10
Causeway Street WB RT	0.31	26.8	C	2/3	0.32	27.4	C	2/4	0.42	39.2	D	4/6
North Washington Street NB LT/TH/RT	1.90	>80.0	F	26/31	1.90	>80.0	F	26/31	1.17	>80.0	F	20/26
North Washington Street SB LT	0.75	55.0	D	12/17	0.77	57.6	E	12/17	1.25	>80.0	F	16/24
North Washington Street SB TH	1.00	55.6	E	35/40	1.01	60.3	E	35/40	0.97	45.6	D	31/39
North Washington Street SB RT	0.73	14.5	B	15/23	0.80	18.4	B	18/29	0.98	56.2	E	28/41
Overall	**1.15**	**>80.0**	**F**	--	**1.18**	**>80.0**	**F**	--	**1.09**	**78.4**	**E**	--
Weekday Evening:												
Causeway Street EB LT	0.72	59.8	E	8/11	0.91	77.6	E	11/15	0.90	74.5	E	11/15
Causeway Street EB TH/RT	1.12	>80.0	F	15/23	1.21	>80.0	F	16/25	1.19	>80.0	F	16/24
Causeway Street WB LT/TH	0.65	59.0	E	7/9	0.67	59.4	E	7/10	0.68	60.2	E	7/10
Causeway Street WB RT	0.85	53.7	D	10/15	0.87	55.1	E	10/16	0.93	70.1	E	11/20
North Washington Street NB LT/TH/RT	2.02	>80.0	F	35/40	2.02	>80.0	F	35/40	1.84	>80.0	F	34/39
North Washington Street SB LT	0.64	57.5	E	7/11	0.64	57.5	E	7/11	0.73	66.7	E	8/12
North Washington Street SB TH	0.73	27.9	C	17/21	0.73	27.9	C	17/21	0.73	27.9	C	17/21
North Washington Street SB RT	0.51	14.2	B	9/10	0.56	15.2	B	10/12	0.62	21.6	C	11/16
Overall	**1.31**	**>80.0**	**F**	--	**1.34**	**>80.0**	**F**	--	**1.33**	**>80.0**	**F**	--
Saturday Midday:												
Causeway Street EB LT	0.26	48.9	D	3/5	0.37	50.6	D	4/6	0.50	46.5	D	4/5
Causeway Street EB TH/RT	0.86	78.9	E	9/17	0.92	>80.0	F	10/18	1.21	>80.0	F	10/17
Causeway Street WB LT/TH	0.57	62.5	E	5/7	0.61	63.1	E	5/7	0.51	46.6	D	4/6
Causeway Street WB RT	0.32	40.4	D	2/4	0.39	41.1	D	3/5	0.39	32.1	C	3/5
North Washington Street NB LT/TH/RT	1.29	>80.0	F	20/25	1.29	>80.0	F	20/25	1.18	>80.0	F	15/20
North Washington Street SB LT	1.05	>80.0	F	12/19	1.05	>80.0	F	12/19	1.15	>80.0	F	10/17
North Washington Street SB TH	0.45	18.5	B	9/11	0.45	18.5	B	9/11	0.44	14.1	B	7/9
North Washington Street SB RT	0.34	17.4	B	5/8	0.43	18.8	B	7/10	0.45	16.8	B	6/9
Overall	**1.04**	**>80.0**	**F**	--	**1.05**	**>80.0**	**F**	--	**1.06**	**77.2**	**E**	--

See notes at end of table.

Table 3.5-1 Mitigated Signalized Intersection Level of Service and Vehicle Queue Summary (Continued)

	2028 No Build				2028 Build				2028 Build with Mitigation			
Signalized Intersection/Peak Hour/Movement	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	V/C	Delay	LOS	Queue Avg./95th	V/C	Delay	LOS	Queue Avg./95th
13. North Washington Street at Valenti Way and Thatcher Street												
Weekday Morning:												
North Washington Street NB LT	1.34	>80.0	F	17/25	1.76	>80.0	F	26/35	--	--	--	--
North Washington Street NB TH/RT	0.77	17.4	B	13/20	0.77	17.4	B	13/20	--	--	--	--
North Washington Street SB LT/TH/RT	0.98	32.0	C	22/31	0.98	32.0	C	22/31	--	--	--	--
Overall	**1.08**	**56.2**	E	--	**1.20**	**>80.0**	**F**	--	--	--	--	--
Weekday Evening:												
North Washington Street NB LT	1.19	>80.0	F	12/20	1.44	>80.0	F	17/25	1.38	>80.0	F	16/24
North Washington Street NB TH/RT	1.01	44.4	D	27/40	1.01	44.4	D	27/40	1.02	48.8	D	31/41
North Washington Street SB LT/TH/RT	0.88	19.4	B	13/20	0.88	19.4	B	13/20	0.91	23.0	C	14/23
Overall	**1.05**	**46.8**	**D**	--	**1.11**	**66.0**	**E**	--	**1.11**	**64.9**	**E**	--
Saturday Midday:												
North Washington Street NB LT	1.10	>80.0	F	12/19	1.47	>80.0	F	18/26	0.97	57.5	E	13/21
North Washington Street NB TH/RT	0.74	14.5	B	11/17	0.74	14.5	B	11/17	0.92	34.2	C	17/27
North Washington Street SB LT/TH/RT	0.54	8.9	A	6/8	0.54	8.9	A	6/8	0.76	20.4	C	9/13
Overall	**0.84**	**30.2**	**C**	--	**0.94**	**70.4**	**E**	--	**0.94**	**33.9**	**C**	--

See notes at end of table.

Table 3.5-1 Mitigated Signalized Intersection Level of Service and Vehicle Queue Summary (Continued)

	2028 No Build				2028 Build				2028 Build with Mitigation			
Signalized Intersection/Peak Hour/Movement	V/C[a]	Delay[b]	LOS[c]	Queue[d] Avg/95th	V/C	Delay	LOS	Queue Avg./95th	V/C	Delay	LOS	Queue Avg./95th
17. New Chardon Street and Market Street at Merrimac Street and Congress Street												
Weekday Morning:												
New Chardon Street EB LT/TH/RT	0.68	43.9	D	4/6	0.68	43.9	D	4/6	--	--	--	--
Market Street WB LT	0.91	67.8	E	7/13	0.91	67.8	E	7/13	--	--	--	--
Market Street WB LT/TH/RT	0.80	43.9	D	7/10	0.80	43.9	D	7/10	--	--	--	--
Congress Street NB LT	0.97	71.4	E	12/21	0.97	71.4	E	12/21	--	--	--	--
Congress Street NB LT/TH	0.92	43.7	D	10/15	0.93	44.6	D	10/16	--	--	--	--
Congress Street NB RT	0.14	10.8	B	2/3	0.14	10.8	B	2/3	--	--	--	--
Merrimac Street SB LT/TH/RT	0.71	41.3	D	5/6	0.71	41.5	D	5/6	--	--	--	--
Overall	**0.85**	**47.8**	**D**	--	**0.85**	**48.1**	**D**	--	--	--	--	--
Weekday Evening:												
New Chardon Street EB LT/TH/RT	0.98	64.4	E	10/15	0.98	64.4	E	10/15	0.98	64.4	E	10/15
Market Street WB LT	1.15	>80.0	F	8/15	1.15	>80.0	F	8/15	1.02	>80.0	F	8/14
Market Street WB LT/TH/RT	0.53	38.4	D	4/6	0.53	38.4	D	4/6	0.48	36.3	D	4/5
Congress Street NB LT	0.74	49.4	D	6/12	0.75	50.4	D	7/12	0.77	52.3	D	7/12
Congress Street NB LT/TH	0.75	43.1	D	7/9	0.75	43.6	D	7/9	0.77	44.9	D	7/9
Congress Street NB RT	0.38	18.6	B	5/8	0.38	18.7	B	5/8	0.37	17.7	B	5/7
Merrimac Street SB LT/TH/RT	0.89	45.2	D	6/8	0.88	45.7	D	6/8	0.95	54.2	D	6/9
Overall	**0.91**	**55.8**	**E**	--	**0.91**	**56.1**	**E**	--	**0.91**	**54.2**	**D**	--
Saturday Midday:												
New Chardon Street EB LT/TH/RT	0.66	37.7	D	4/6	0.66	37.7	D	4/6	--	--	--	--
Market Street WB LT	0.80	50.4	D	5/9	0.80	50.4	D	5/9	--	--	--	--
Market Street WB LT/TH/RT	0.43	32.5	C	3/4	0.43	32.5	C	3/4	--	--	--	--
Congress Street NB LT	0.43	27.7	C	4/7	0.44	27.9	C	4/7	--	--	--	--
Congress Street NB LT/TH	0.42	25.8	C	4/6	0.43	26.2	C	4/6	--	--	--	--
Congress Street NB RT	0.02	9.3	A	0/1	0.02	9.4	A	0/1	--	--	--	--
Merrimac Street SB LT/TH/RT	0.58	35.9	D	3/4	0.58	35.9	D	3/4	--	--	--	--
Overall	**0.59**	**34.3**	**C**	--	**0.59**	**34.4**	**C**	--	--	--	--	--

[a]Volume-to-capacity ratio
[b]Control (signal) delay per vehicle in seconds
[c]Level of Service
[d]Queue length in vehicles
[e]95th percentile queue is metered by upstream signal
EB = eastbound; WB = westbound; NB = northbound; SB = southbound; LT = left-turning movements; TH = through movements; RT = right-turning movements

Chapter 4.0

Environmental Review Component

4.0 ENVIRONMENTAL REVIEW COMPONENT

4.1 Wind

4.1.1 Introduction

A pedestrian wind study was conducted for the proposed Project which involved wind simulations on a 1:400 scale model of the proposed building and surroundings. These simulations were then conducted in one of RWDI's boundary-layer wind tunnels at Dunstable, Bedforshire, U.K., for the purpose of quantifying local wind speed conditions and comparing to appropriate criteria for gauging wind comfort in pedestrian areas. The model was constructed based on information provided by the Project team. The criteria recommended by the BRA were used in this study.

The existing conditions in the Project area are windy and are predicted to remain that way in the future. The results of the wind study show that the Project site generally saw improved wind conditions with the Project, while some areas, especially to the east, saw some degradation in wind conditions. Conditions south of the Project site generally remained the same or improved.

4.1.2 Overview

Major buildings, especially those that protrude above their surroundings, often cause increased local wind speeds at the pedestrian level. Typically, wind speeds increase with elevation above the ground surface, and taller buildings intercept these faster winds and deflect them down to the pedestrian level. The funneling of wind through gaps between buildings and the acceleration of wind around corners of buildings may also cause increases in wind speed. Conversely, if a building is surrounded by others of equivalent height, it may be protected from the prevailing upper-level winds, resulting in no significant changes to the local pedestrian-level wind environment. The most effective way to assess potential pedestrian-level wind impacts around a proposed new building is to conduct scale model tests in a wind tunnel.

The consideration of wind in planning outdoor activity areas is important since high winds in an area tend to deter pedestrian use. For example, winds should be light or relatively light in areas where people would be sitting, such as outdoor cafes or playgrounds. For bus stops and other locations where people would be standing, somewhat higher winds can be tolerated. For frequently used sidewalks, where people are primarily walking, stronger winds are acceptable. For infrequently used areas, the wind comfort criteria can be relaxed even further. The actual effects of wind can range from pedestrian inconvenience, due to the blowing of dust and other loose material in a moderate breeze, to severe difficulty with walking due to the wind forces on the pedestrian.

4.1.3 Methodology

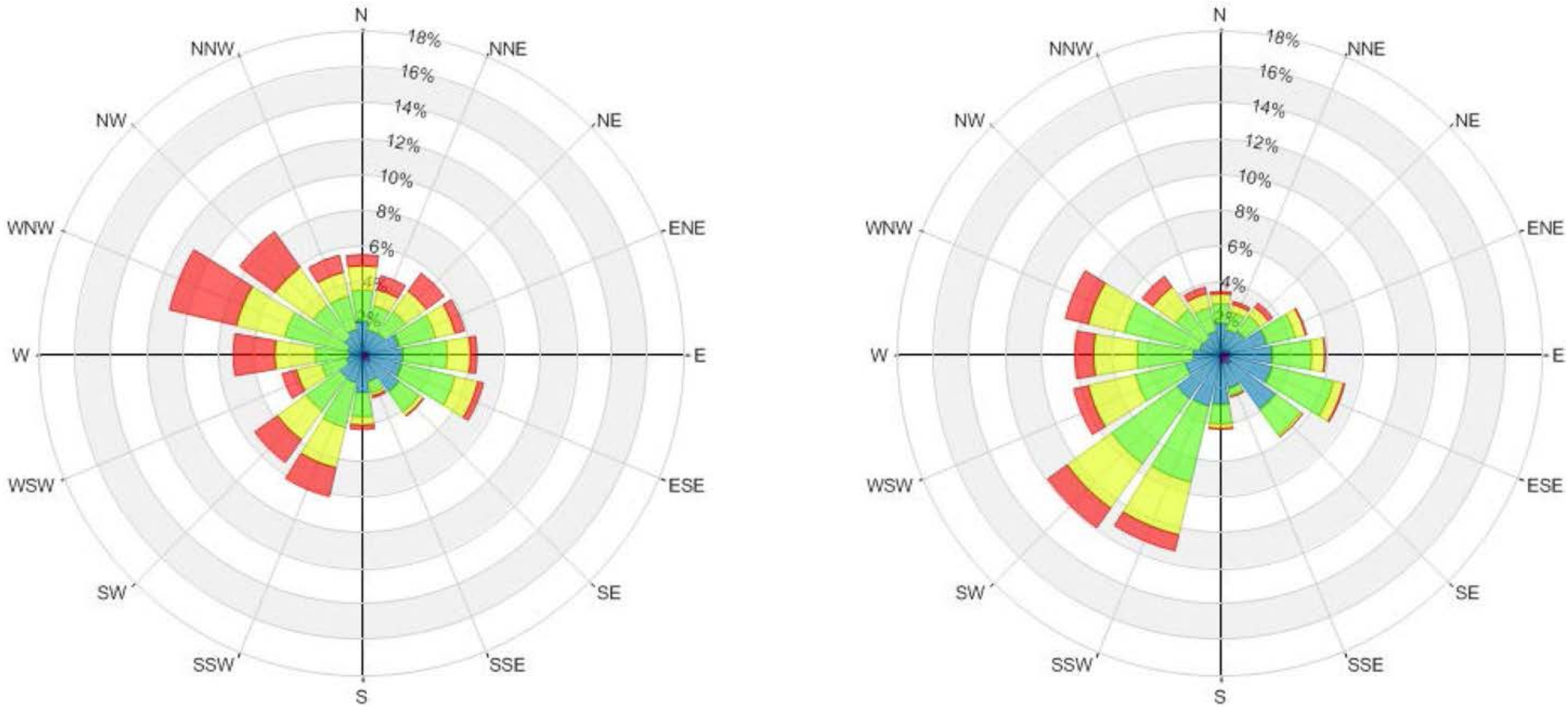
Information concerning the site and surroundings was derived from: information on surrounding buildings and terrain; and site plans and elevations of the Project provided by the design team. The following configurations were simulated:

- No Build – this configuration includes all existing buildings and future surrounding developments (developments proposed and not yet completed or under construction);

- Full Build – this configuration includes the proposed Project and all existing and future surrounding developments (developments proposed and not yet completed or under construction).

The wind tunnel model included the proposed development and all relevant surrounding buildings and topography within a 1,600-foot radius of the Project site. The mean speed profile and turbulence of the natural wind approaching the modeled area were also simulated in RWDI's boundary layer wind tunnel. The scale model was equipped with 121 specially designed wind speed sensors that were connected to the wind tunnel's data acquisition system to record the mean and fluctuating components of wind speed at a full-scale height of five feet above grade in pedestrian areas throughout the study area. The location of the 121 sensors was determined in coordination with the BRA. Wind speeds were measured for 36 wind directions, in 10 degree increments, starting from true north. The measurements at each sensor location were recorded in the form of ratios of local mean and gust speeds to the reference wind speed in the free stream above the model. The results were then combined with long-term meteorological data, recorded during the years 1981 to 2011 at Boston's Logan International Airport, in order to predict full scale wind conditions. The analysis was performed separately for each of the four seasons and for the entire year.

Figures 4.1-1 to 4.1-3 present "wind roses", summarizing the annual and seasonal wind climates in the Boston area, based on the data from Logan International Airport. The wind roses, in Figures 4.1-1 and 4.1-2, are based on all observed wind readings for the given season. The left-hand side wind rose in Figure 4.1-1, for example, summarizes the spring (March, April, and May) wind data. In general, the prevailing winds are from the west northwest, northwest, west and southwest. In the case of strong winds, however, the most common wind direction is northwest and west. On an annual basis (Figure 4.1-3) the most common wind directions are those between southwest and northwest. These are also the dominant directions for strong winds.



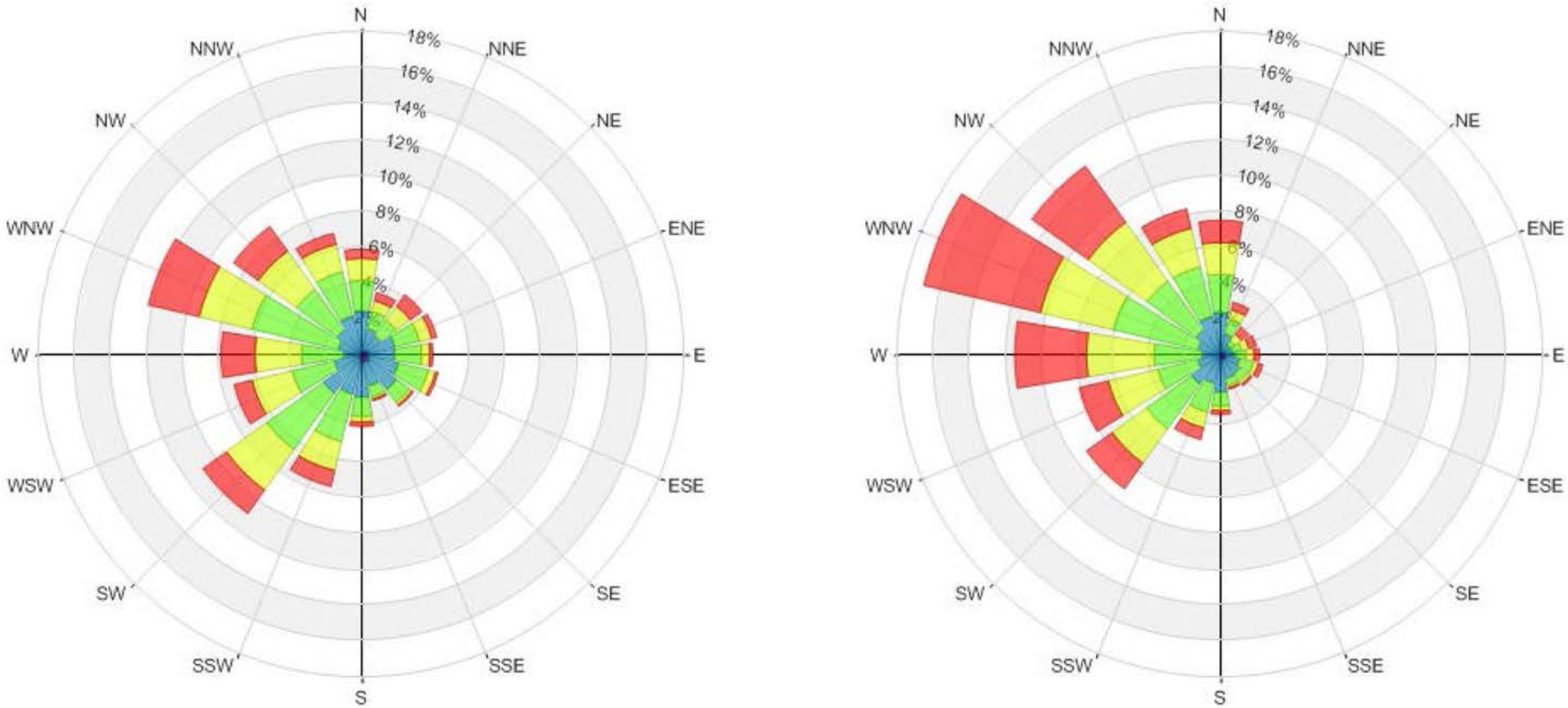
Spring
(March - May)

Summer
(June - August)

Wind Speed (mph)	Probability (%) Spring	Probability (%) Summer
Calm	1.7	1.8
1-5	3.5	4.6
6-10	22.5	30.3
11-15	31.5	36.4
16-20	23.0	19.5
>20	17.8	7.4

Figure 4.1-1

Directional Distribution (%) of Winds (Blowing From) Boston Logan International Airport (1981 – 2011)



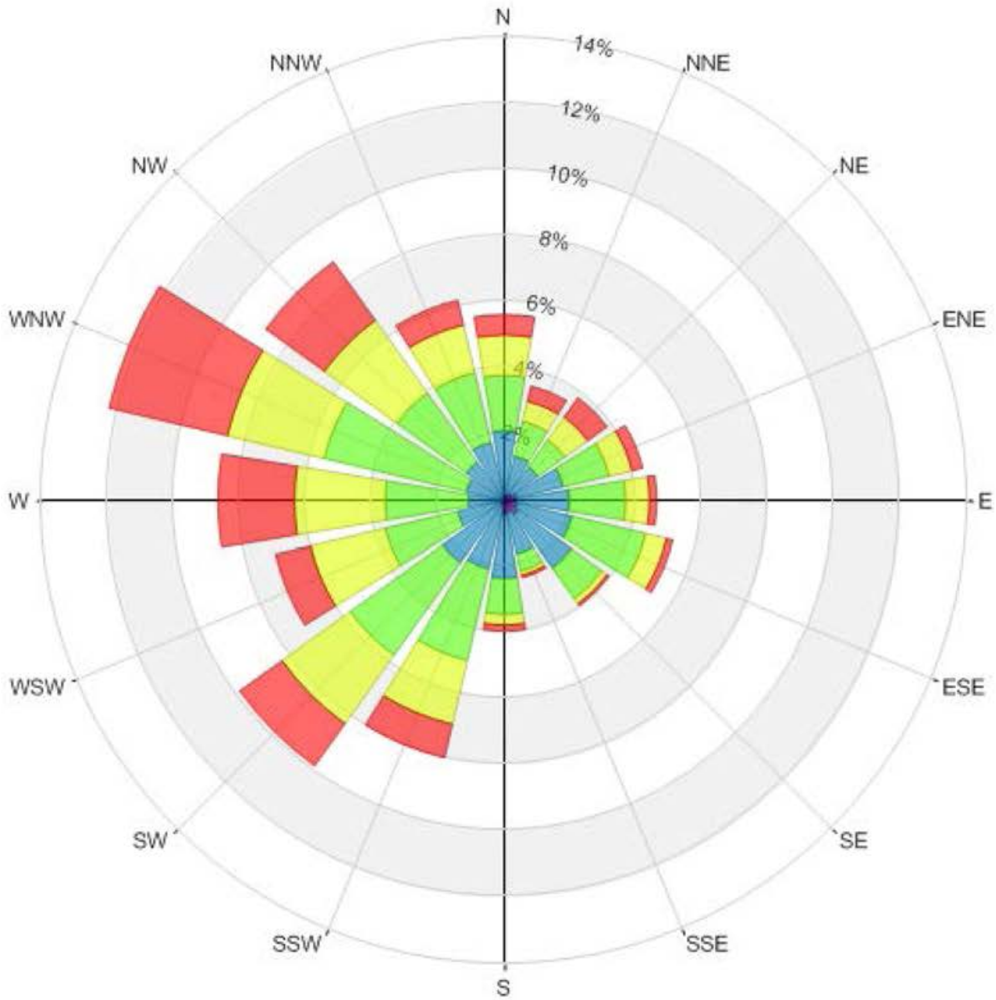
Fall
(September - November)

Winter
(December - February)

Wind Speed (mph)	Probability (%) Fall	Probability (%) Winter
Calm	1.9	1.5
1-5	4.1	3.0
6-10	26.3	19.8
11-15	32.7	27.7
16-20	21.4	24.6
>20	13.5	23.4

Figure 4.1-2

Directional Distribution (%) of Winds (Blowing From) Boston Logan International Airport (1981 – 2011)



Annual Winds

Wind Speed (mph)	Probability (%)
Calm	1.7
1-5	3.8
6-10	24.7
11-15	32.1
16-20	22.1
>20	15.5

Figure 4.1-3

Directional Distribution (%) of Winds (Blowing From) Boston Logan International Airport (1981 – 2011)

This study involved state-of-the-art measurement and analysis techniques to predict wind conditions at the study site. Nevertheless, some uncertainty remains in predicting wind comfort, and this must be kept in mind. For example, the sensation of comfort among individuals can be quite variable. Variations in age, individual health, clothing, and other human factors can change a particular response of an individual. The comfort limits used in this report represent an average for the total population. Also, unforeseen changes in the Project area, such as the construction or removal of buildings, can affect the conditions experienced at the site. Finally, the prediction of wind speeds is necessarily a statistical procedure. The wind speeds reported are for the frequency of occurrence stated (one percent of the time). Higher wind speeds will occur, but on a less frequent basis.

4.1.4 Pedestrian Wind Comfort Criteria

The BRA has adopted two standards for assessing the relative wind comfort of pedestrians. First, the BRA wind design guidance criterion states that an effective gust velocity (hourly mean wind speed +1.5 times the root-mean-square wind speed) of 31 mph should not be exceeded more than one percent of the time. The second set of criteria used by the BRA to determine the acceptability of specific locations is based on the work of Melbourne[1]. This set of criteria is used to determine the relative level of pedestrian wind comfort for activities such as sitting, standing, or walking. The criteria are expressed in terms of benchmarks for the one-hour mean wind speed exceeded one percent of the time (i.e., the 99-percentile mean wind speed). They are provided in Table 4.1-1 below.

Table 4.1-1 Boston Redevelopment Authority Mean Wind Criteria*

Level of Comfort	Wind Speed
Dangerous	> 27 mph
Uncomfortable for Walking	>19 and ≤27 mph
Comfortable for Walking	>15 and ≤19 mph
Comfortable for Standing	>12 and ≤15 mph
Comfortable for Sitting	<12 mph

* Applicable to the hourly mean wind speed exceeded one percent of the time.

The wind climate found in a typical downtown location in Boston is generally comfortable for the pedestrian use of sidewalks and thoroughfares, and meets the BRA effective gust velocity criterion of 31 mph. However, without any mitigation measures, this wind climate is likely to be frequently uncomfortable for more passive activities such as sitting.

1 Melbourne, W.H., 1978, "Criteria for Environmental Wind Conditions", Journal of Industrial Aerodynamics, 3 (1978) 241 - 249.

4.1.5 Test Results

Appendix C presents the mean and effective gust wind speeds for each season as well as annually. Figures 4.1-4 through 4.1-7 graphically depict the mean and effective gust wind conditions at each wind measurement location based on the annual winds. Typically, the summer and fall winds tend to be more comfortable than the annual winds, while the winter and spring winds are less comfortable than the annual winds. The following summary of pedestrian wind comfort is based on the annual winds for each configuration tested, except where noted below in the text.

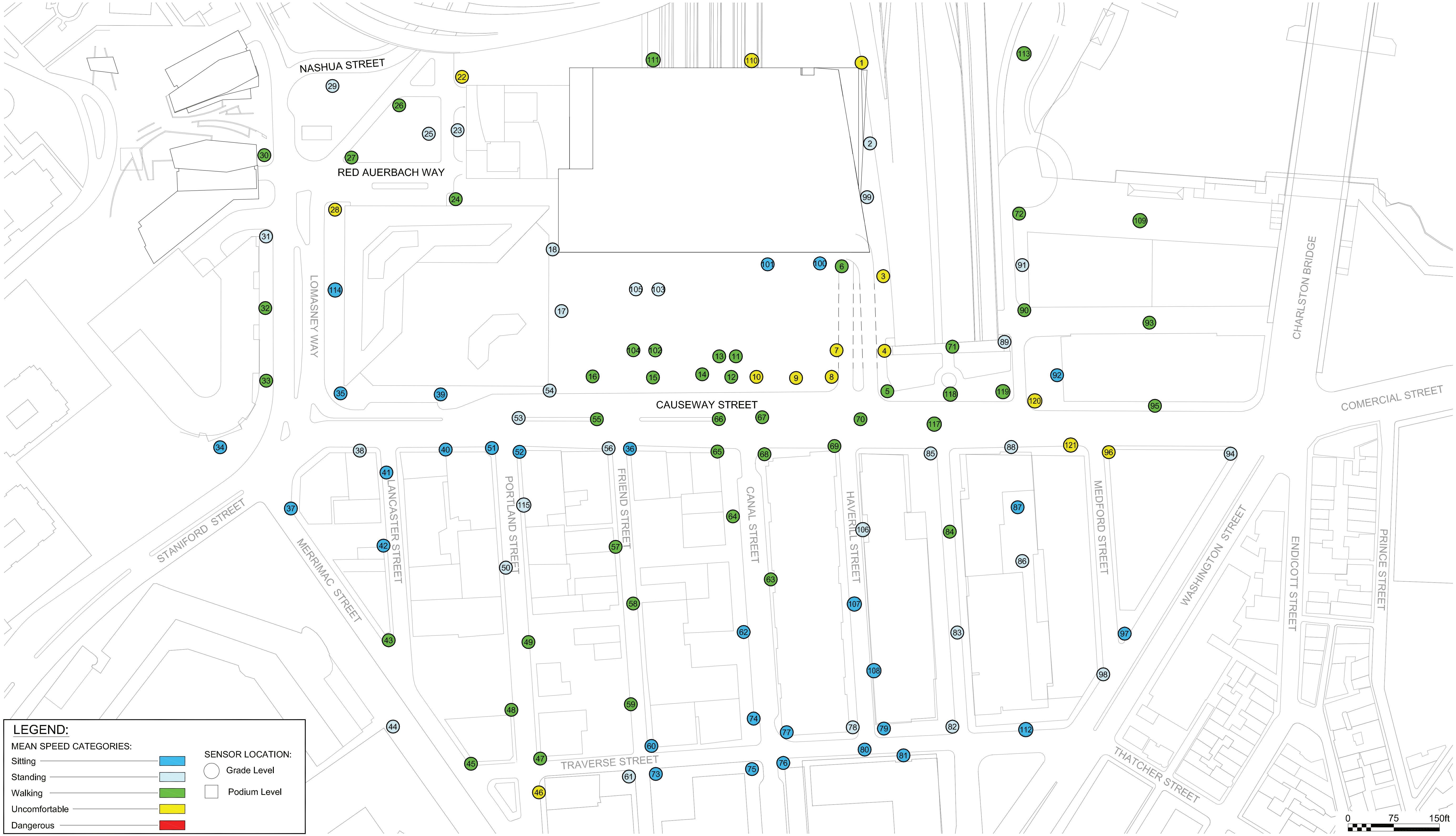
A total of 121 sensors were used in the model. The data from Sensors 19-21 were not applicable for the two configurations tested as these sensors are located within the footprint of the future structure. The placement of wind measurement locations was based on RWDI's experience and the understanding of pedestrian usage of the site and in coordination with the BRA.

Generally, wind conditions suitable for walking are appropriate for sidewalks, walkways and parking lots; wind speeds comfortable for standing are preferred for building entrances where pedestrians are more apt to linger; and lower wind speeds comfortable for sitting or standing are desired for outdoor amenity spaces.

4.1.5.1 No Build – Existing and Future Surroundings

On an annual basis on the Project site, mean wind speeds comfortable for walking or better were predicted (2 through 18, 54 and 99 through 105 in Figure 4.1-4). Locations 3, 4, and 7 through 10 resulted in conditions uncomfortable for walking. Most off-site locations (1, 19 through 53, 55 through 98 and 106 through 121) were predicted to have mean wind speeds that were generally comfortable for walking or better on an annual basis (see Figure 4.1-4). Mean wind speeds uncomfortable for walking were detected at Locations 1, 22, 28, 46, 96, 110, 120 and 121 on an annual basis. Locations 1, 22 and 28 exceeded the effective gust criterion on an annual basis in the No Build configuration (Figure 4.1-6).

The No Build configuration indicates that with both the existing and future surrounding buildings in place, conditions in the area will be windy without the proposed Project in place. It can therefore be expected that when a proposed building, regardless of its height, is placed in this environment, uncomfortable wind conditions may still occur on an annual basis at certain locations, such as exposed building corners and at off-site locations.



The Boston Garden **Boston, Massachusetts**

Figure 4.1-4

Pedestrian Wind Comfort Conditions - No Build with Existing and Future Surroundings, Annual

The Boston Garden **Boston, Massachusetts**

Figure 4.1-5

Pedestrian Wind Comfort Conditions - Full Build with Existing and Future Surroundings, Annual

The Boston Garden Boston, Massachusetts

RWDI

Figure 4.1-6

Pedestrian Wind Safety Conditions - No Build with Existing and Future Surroundings, Annual

The Boston Garden **Boston, Massachusetts**

Figure 4.1-7

Pedestrian Wind Safety Conditions - Full Build with Existing and Future Surroundings, Annual

4.1.5.2 Build – Existing and Future Surroundings

On-Site Entrances, Sidewalks and Podium (Locations 2-18, 54 and 99-103)

Wind conditions were generally similar in the No Build and Build conditions. Four locations (Locations 3, 7, 9 and 10) had wind conditions that improved from uncomfortable for walking to comfortable for walking or better. In addition, four locations adjacent to the Project at the entrance to the atrium hall improved to comfortable for standing. On an annual basis, the mean wind speeds on-site were comfortable for walking or better, with the exception of six locations situated at building corners or areas of channeling winds (Locations 4, 5, 6, 8, 54 and 102 in Figure 4.1-5) where wind conditions uncomfortable for walking were predicted. Two of the locations were already uncomfortable for walking in the No Build configuration (Locations 4 and 8), while four locations (5, 6, 54 and 102) worsened to uncomfortable for walking. Location 6 is proposed to include a loading area with little pedestrian activity. Location 102 will have minimal pedestrian activity, as the area will be used for mechanical and possibly rooftop amenity space. The roof of the podium will be accessible by residents only, and the Project team is considering measures to improve wind conditions, if determined necessary. All on-site locations met the effective gust criterion on an annual basis, with the exception of Location 102 at the podium level (Figure 4.1-7). The Project team will study measures to further improve wind conditions, as necessary.

Off-Site Areas (Locations 1, 19-53, 55-98 and 106-121)

Wind conditions in off-site areas were generally comfortable for walking or better, similar to the No Build conditions. Seven locations identified as uncomfortable for walking in the No Build configuration did not change with the Project in place (Locations 1, 22, 28, 96, 110, 120 and 121). Additional locations with winds uncomfortable for walking on an annual basis with the Project included Locations 24, 26, 32, 55, 69 through 71, 84, 89, 90, and 117 through 119 (Figure 4.1-5). The Project team will study measures to improve these wind conditions as the Project design progresses. Wind conditions on Portland Street and Friend Street between Causeway Street and Traverse Street were improved on an annual basis, with Location 46 improving from uncomfortable to comfortable for walking.

As per the effective gust criterion, six locations (1, 22, 28, 69, 96 and 118 in Figure 4.1-7) exceeded the criterion on an annual basis. Locations 1, 22 and 28 also exceeded the criterion on an annual basis for the No Build configuration. The Project team will study measures to improve the wind conditions in these areas as the design progresses. Measures could include wind screens or additional landscaping.

4.1.6 Conclusions

The No Build configuration shows that with both the existing and future surrounding buildings in place, conditions in the area will be windy even without the proposed Project in place. It can therefore be expected that when a proposed building, regardless of its height, is placed in this environment, uncomfortable wind conditions may still occur on an annual basis at certain locations, such as exposed building corners and at off-site locations.

The majority of the locations remained the same or suitable for walking or better from the No Build configuration to the Full Build configuration. On the Project site, four locations worsened to uncomfortable for walking from comfortable for walking or better, while four locations improved from uncomfortable for walking to comfortable for walking or better. Locations in front of the atrium hall improved from the No Build configuration. Off-site, some locations directly to the east of the Project site worsened. The Project team will consider measures to improve these conditions as the design progresses. South of the Project, wind conditions on Portland Street and Friend Street improved from the No Build configuration.

4.2 Shadow

4.2.1 Introduction and Methodology

A shadow impact analysis was conducted to investigate shadow impacts from the Project during three time periods (9:00 a.m., 12:00 noon, and 3:00 p.m.) during the summer solstice (June 21), autumnal equinox (September 21), vernal equinox (March 21), and the winter solstice (December 21). In addition, shadow studies were conducted for the 6:00 p.m. time period during the summer solstice and autumnal equinox.

The shadow analysis presents the existing shadow and new shadow that would be created by the proposed Project, illustrating the incremental impact of the Project. The analysis focuses on nearby open spaces, sidewalks and bus stops adjacent to and in the vicinity of the Project site. Shadows have been determined using the applicable Altitude and Azimuth data for Boston. Figures showing the net new shadow from the Project are provided in Figures 4.2-1 to 4.2-14 at the end of this section.

The shadow impact analysis shows that new shadow will be cast onto the surrounding streets and sidewalks during the time periods studied. New shadow will be cast onto Portal Park, which is immediately to the east of the Project site, during the afternoon time periods studied. During four separate time periods, Lovejoy Wharf, West End Park, Paul Revere Park and Langone Park each had limited new shadow.

4.2.2 Vernal Equinox (March 21)

At 9:00 a.m. during the vernal equinox, new shadow from the Project will be cast to the northwest onto a portion of Nashua Street and its eastern and western sidewalks, as well as rooftops and the parking lot south of the former Spaulding Rehabilitation Hospital building. No new shadow will be cast onto nearby bus stops or open spaces.

At 12:00 p.m., new shadow will be cast to the north onto a portion of Interstate 93, as well as a minor portion of Portal Park. No new shadow will be cast onto nearby bus stops or other open spaces.

At 3:00 p.m., new shadow will be cast to the northeast onto a portion of Interstate 93, a portion of Beverly Street, a small portion of Lovejoy Wharf and onto Portal Park. No new shadow will be cast onto nearby bus stops.

4.2.3 Summer Solstice (June 21)

At 9:00 a.m. during the vernal equinox, new shadow from the Project will be cast to the northwest onto a portion of Nashua Street and its eastern and western sidewalks, a portion of Lomasney Way and its eastern and western sidewalks, and a portion of Martha Road and its northern and southern sidewalks. New shadow will extend the existing shadow onto the West End Park. No new shadow will be cast onto nearby bus stops.

At 12:00 p.m., new shadow will be cast to the north and will mostly be cast onto the Project site and the TD Garden roof. A sliver of new shadow will be cast onto Portal Park. No new shadow will be cast onto nearby bus stops.

At 3:00 p.m., new shadow will be cast to the east onto a portion of Causeway Street and its northern sidewalk, as well as onto Portal Park. New shadow will be cast onto the bus stop in front of the site on Causeway Street.

At 6:00 p.m., new shadow will be cast to the northeast onto a portion of Causeway Street and its northern and southern sidewalks, a minor portion of Friend Street and its eastern and western sidewalk, a minor portion of Beverly Street and its eastern and western sidewalks, minimal areas of North Washington Street and its eastern sidewalk, and Thatcher and Cooper Streets. No new shadow will be cast onto nearby bus stops or open spaces.

4.2.4 Autumnal Equinox (September 21)

At 9:00 a.m., new shadow from the Project will be cast to the northwest onto a portion of the Interstate 93/Storrow Drive ramp and the parking lot to the south of the former Spaulding Rehabilitation Hospital building. No new shadow will be cast onto nearby bus stops or open spaces.

At 12:00 p.m., new shadow will be cast to the north onto a portion of Interstate 93, as well as a small portion of Portal Park. No new shadow will be cast onto nearby bus stops.

At 3:00 p.m., new shadow will be cast to the northeast onto a portion of Interstate 93, a portion of Beverly Street and its eastern and western sidewalks, and onto Lovejoy Place.

New shadow will also be cast onto Portal Park. No new shadow will be cast onto nearby bus stops.

At 6:00 p.m., most of the area is under existing shadow. New shadow will generally be limited to rooftops to the east of the Project site, with the exception of new shadow on a portion of Burroughs Wharf and Boston Inner Harbor. No new shadow will be cast onto nearby bus stops or other open spaces.

4.2.5 Winter Solstice (December 21)

The winter solstice creates the least favorable conditions for sunlight in New England. The sun angle during the winter is lower than in any other season, causing the shadows in urban areas to elongate and be cast onto large portions of the surrounding area.

At 9:00 a.m., new shadow from the Project will be cast to the northwest onto a portion of the parking lot south of the former Spaulding Rehabilitation Hospital building, the Interstate 93/Storrow Drive ramp, and onto a portion of the Charles River just to the east of the ramp and between the ramp and the Leonard P. Zakim Bunker Hill Memorial Bridge. No new shadow will be cast onto nearby bus stops or open spaces.

At 12:00 p.m., new shadow will be cast to the northeast onto a portion of Interstate 93 and the Zakim Bridge, onto a portion of the Charles River and a minor portion of Paul Revere Park. No new shadow will be cast onto nearby bus stops.

At 3:00 p.m., new shadow will be cast to the east onto a sliver of the Charlestown Bridge, and will extend existing shadow on a small portion of Portal Park. New shadow will be cast onto Boston Inner Harbor and a minor portion of Langone Park. No new shadow will be cast onto nearby bus stops.

4.2.5 Conclusions

The shadow impact analysis looked at net new shadow created by the Project during 14 time periods. The analysis shows that new shadow will generally fall on nearby buildings and surrounding streets and sidewalks. Since Portal Park is immediately to the east of the site, new shadow will be cast onto it during the afternoon hours (seven of the 14 time periods studied). New shadow on other nearby open spaces will be limited to a minor portion of Lovejoy Wharf on March 21 at 3:00 p.m., West End Park on June 21 at 9:00 a.m., a portion of Burroughs Wharf on September 21 at 6:00 p.m., a minor portion of Paul Revere Park on December 21 at 12:00 p.m. and a minor portion of Langone Park on December 21 at 3:00 p.m. The bus stop on Causeway Street in front of the site will have new shadow on one time period, June 21 at 3:00 p.m.

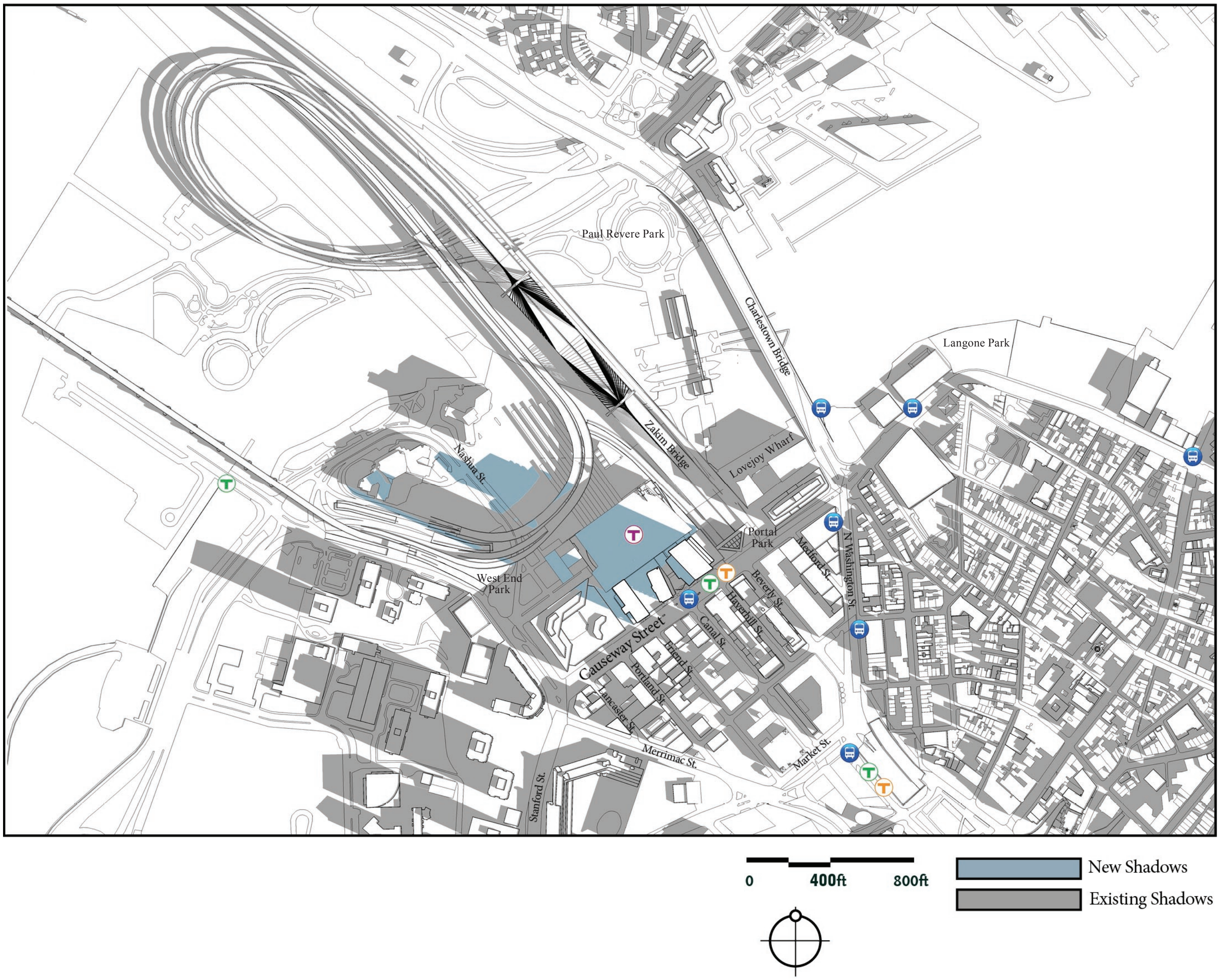
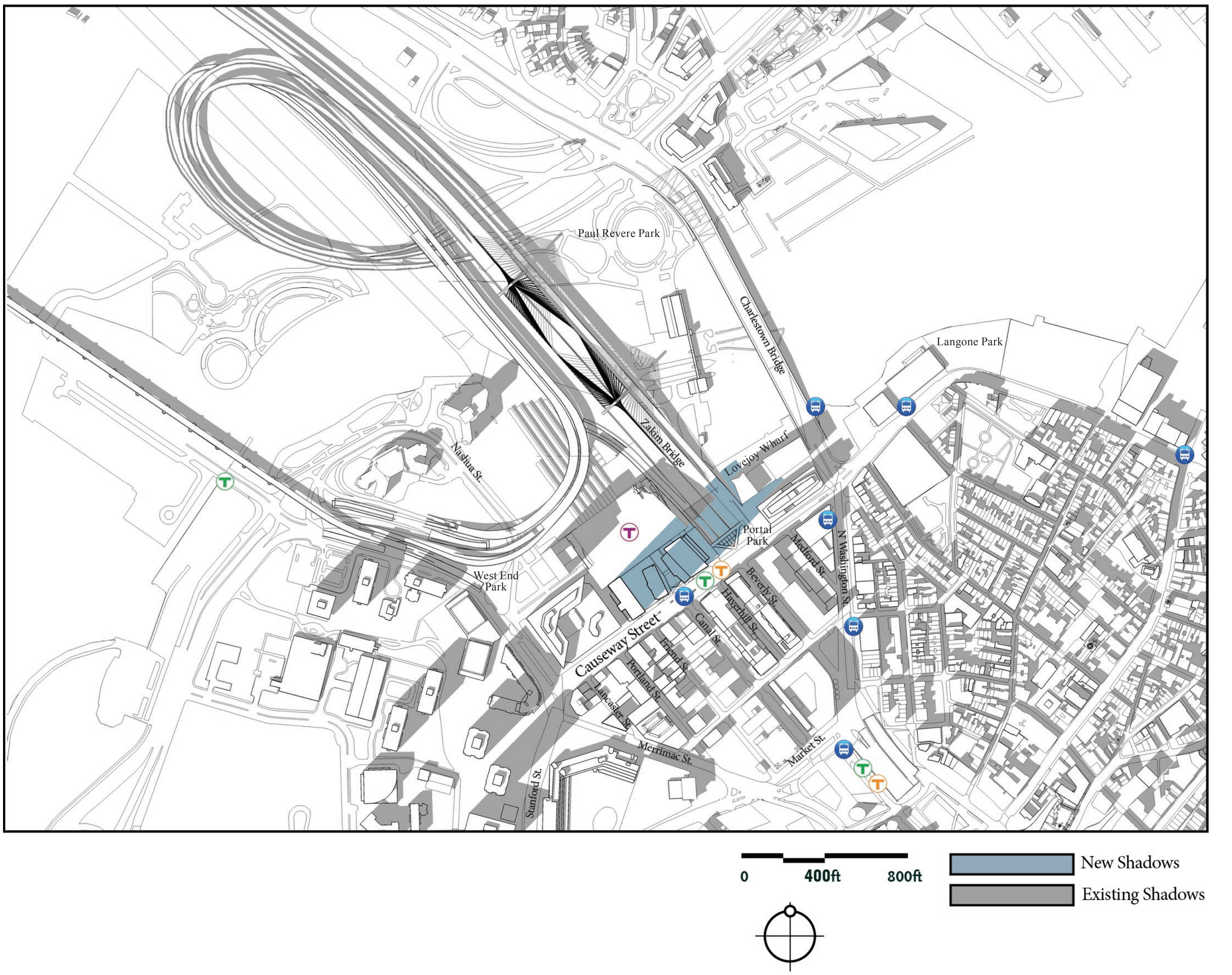


Figure 4.2-1

Shadow Studies: March 21, 9 am

Figure 4.2-2

Shadow Studies: March 21, 12 pm



The Boston Garden   Boston, Massachusetts

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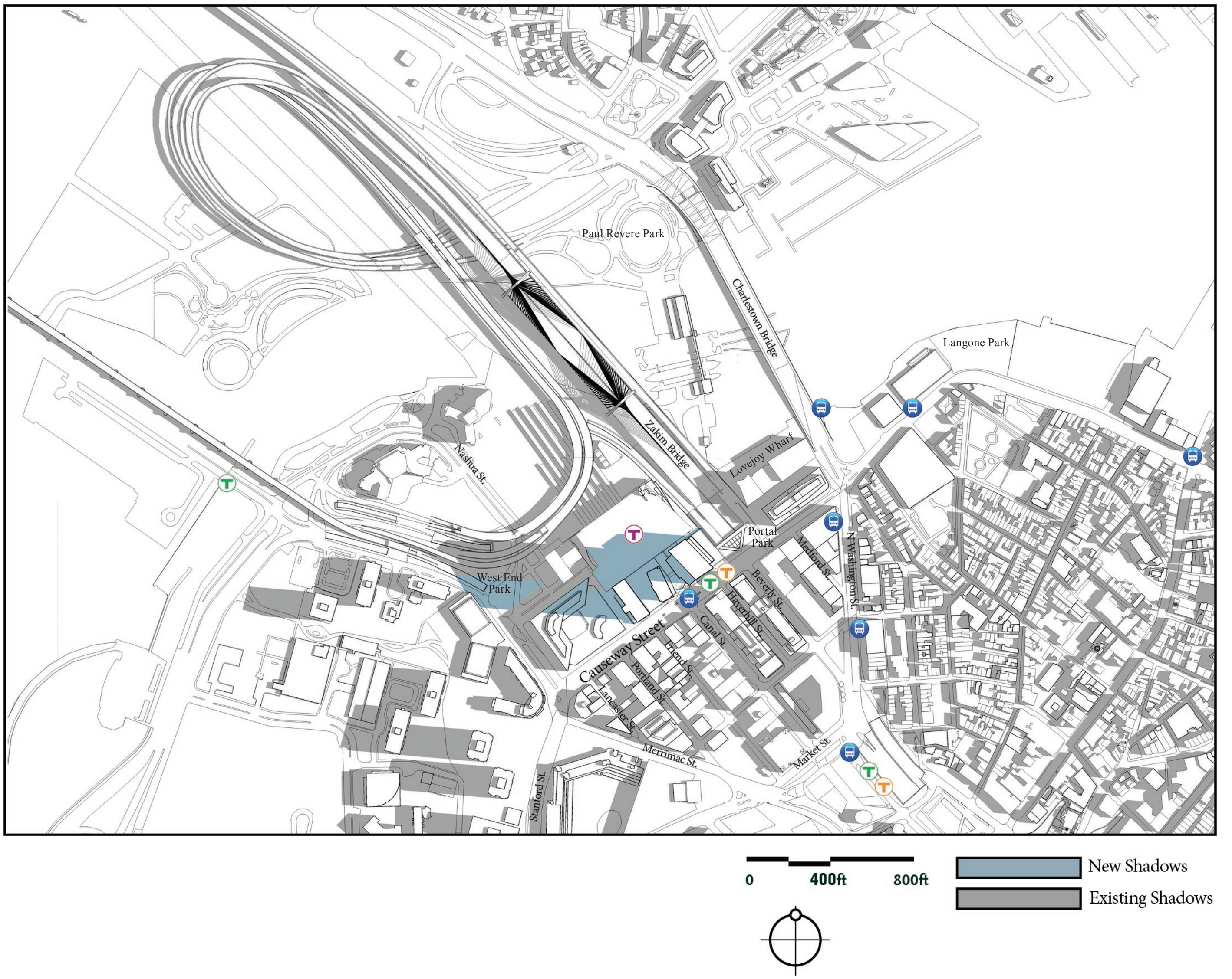
Figure 4.2-3

Shadow Studies: March 21, 3 pm



The Boston Garden **Boston, Massachusetts**

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Figure 4.2-4

Shadow Studies: June 21, 9 am

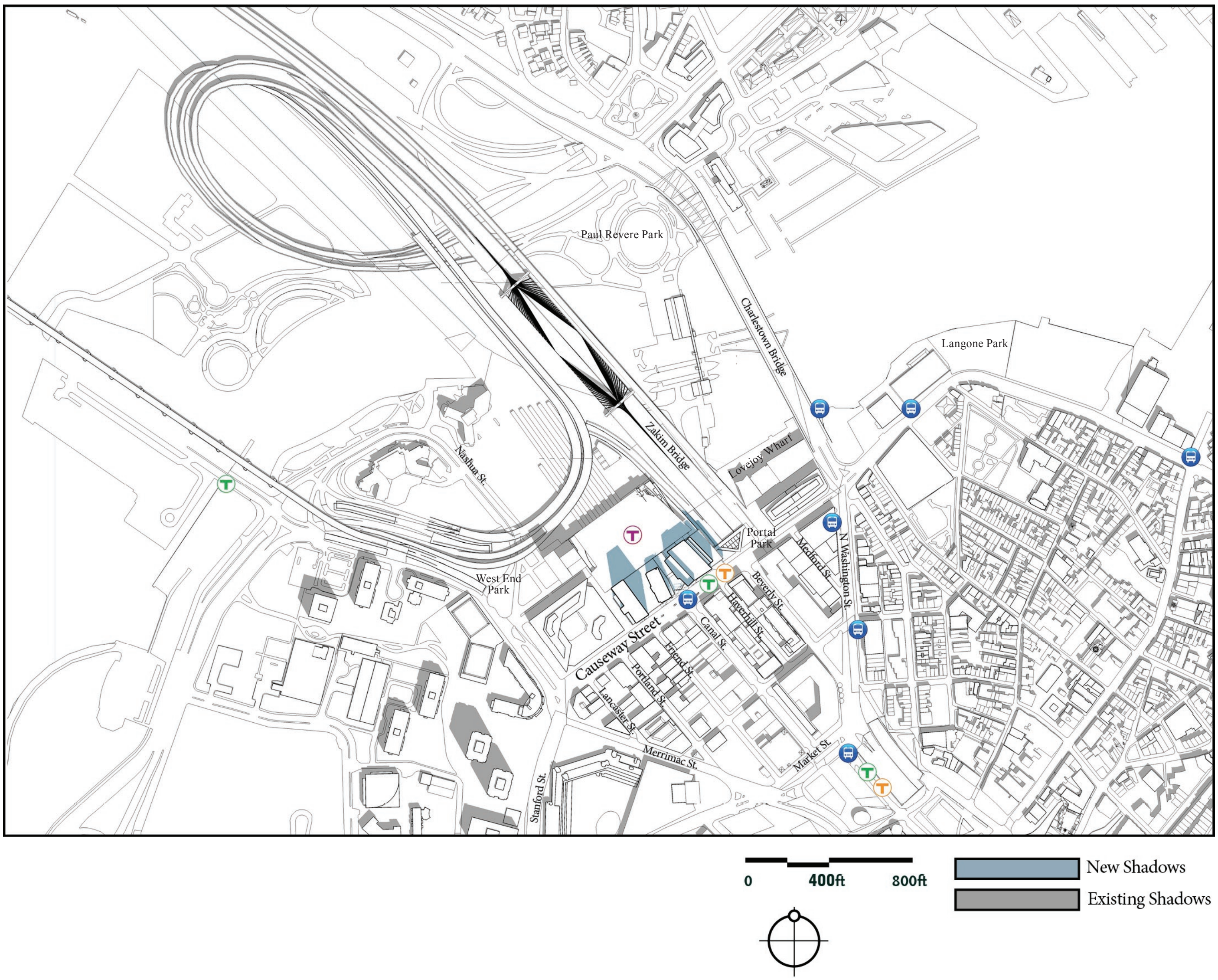
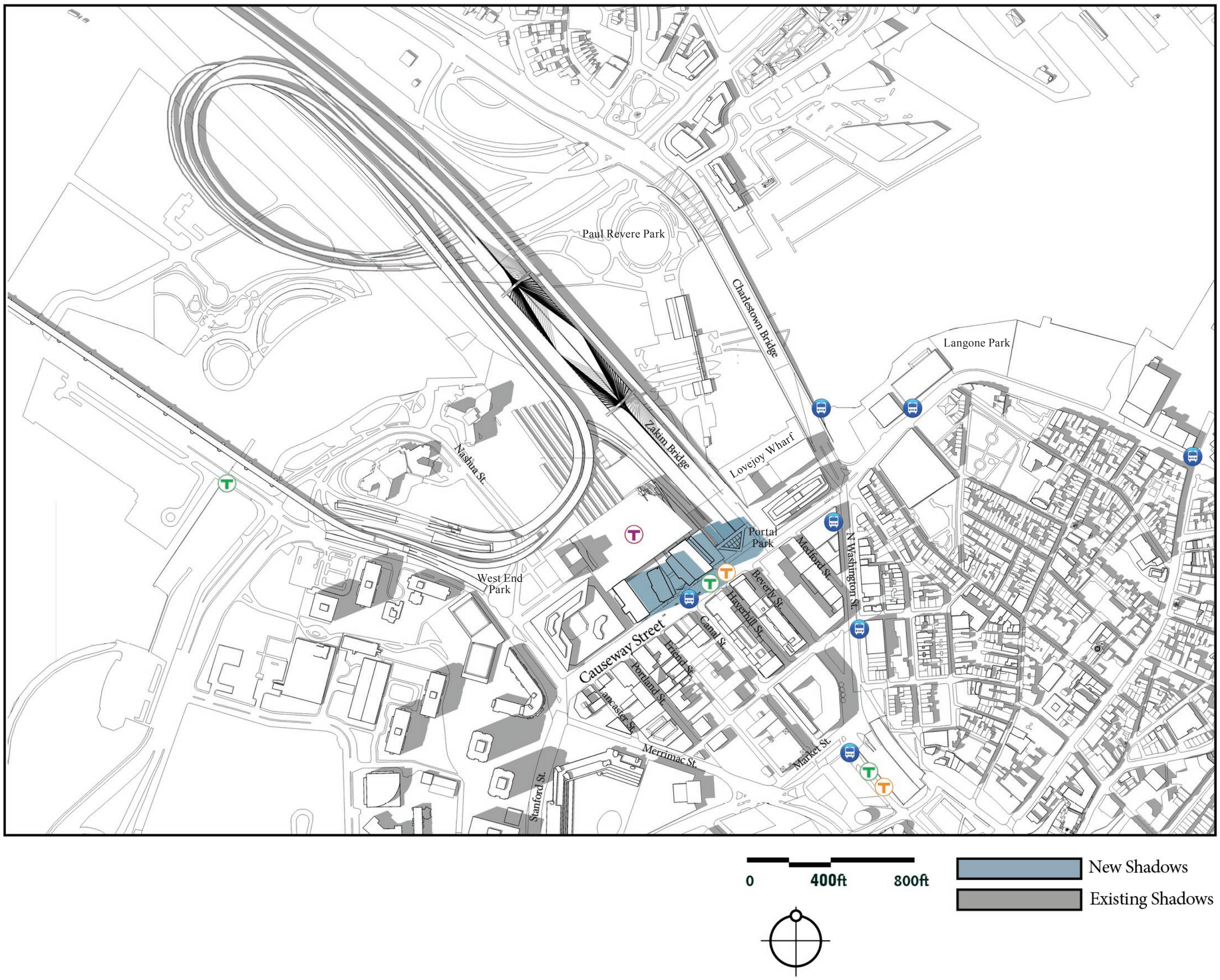


Figure 4.2-5

Shadow Studies: June 21, 12 pm



The Boston Garden **Boston, Massachusetts**

Figure 4.2-6

Shadow Studies: June 21, 3 pm

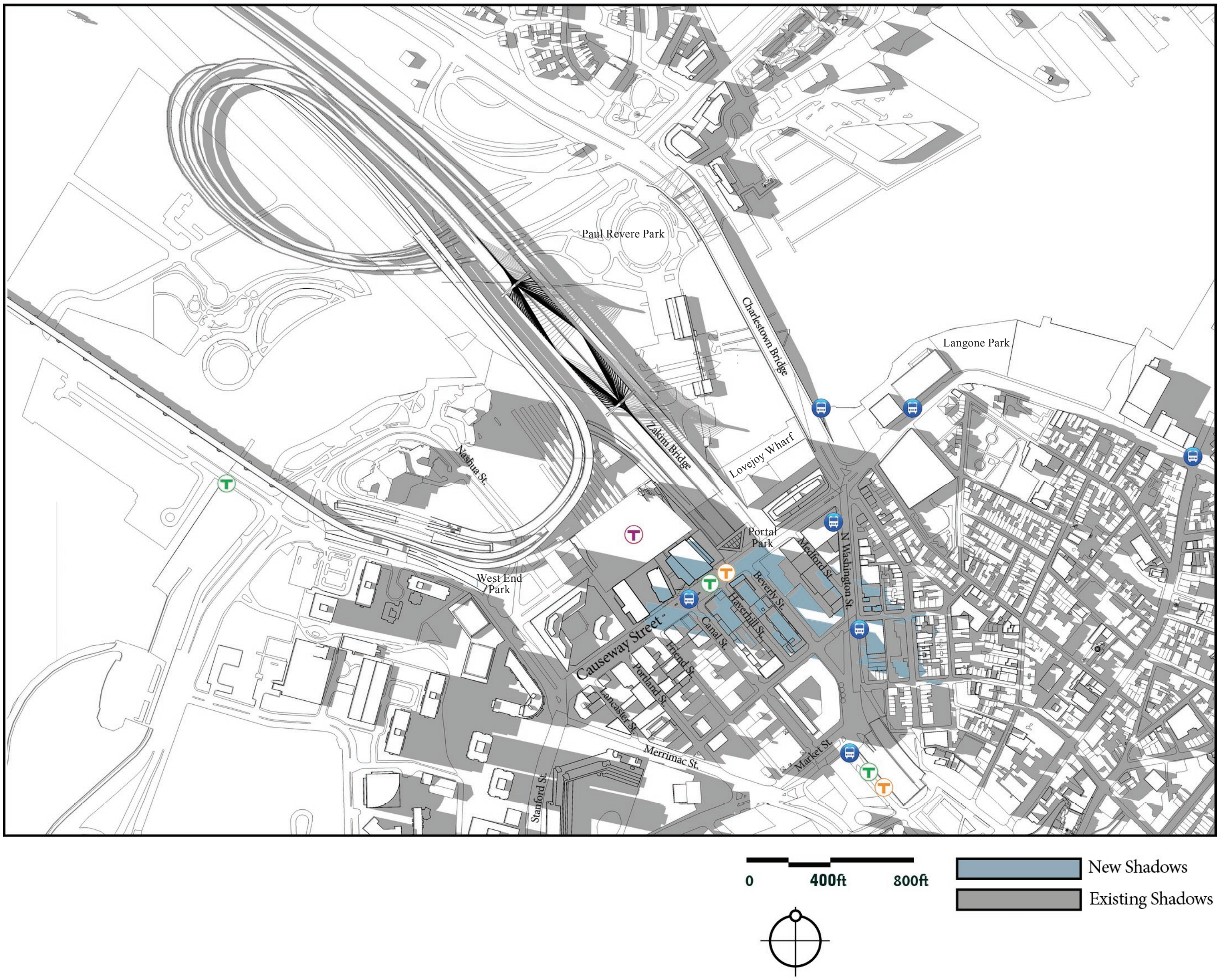


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Figure 4.2-7

Shadow Studies: June 21, 6 pm

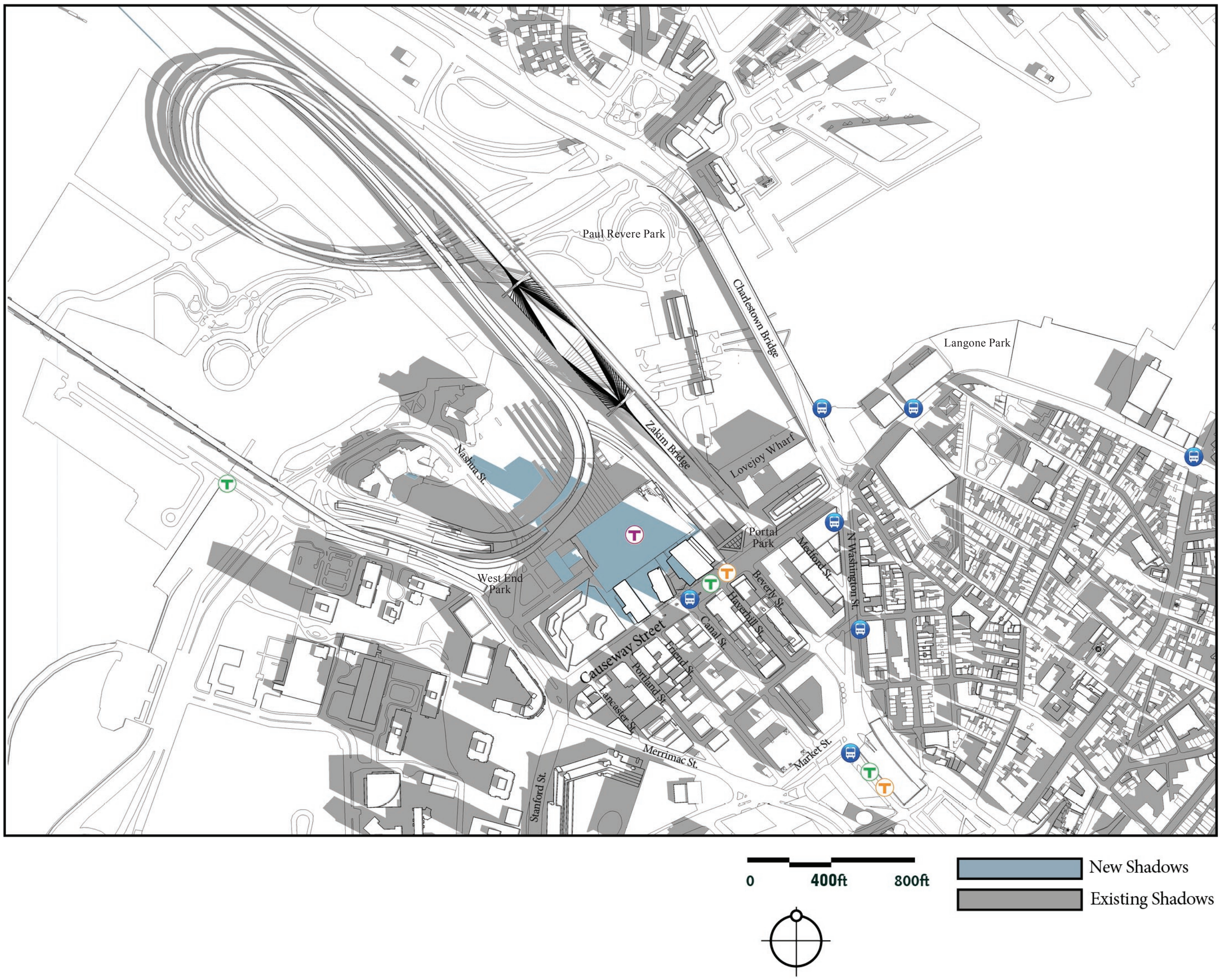

Figure 4.2-8

Shadow Studies: September 21, 9 am

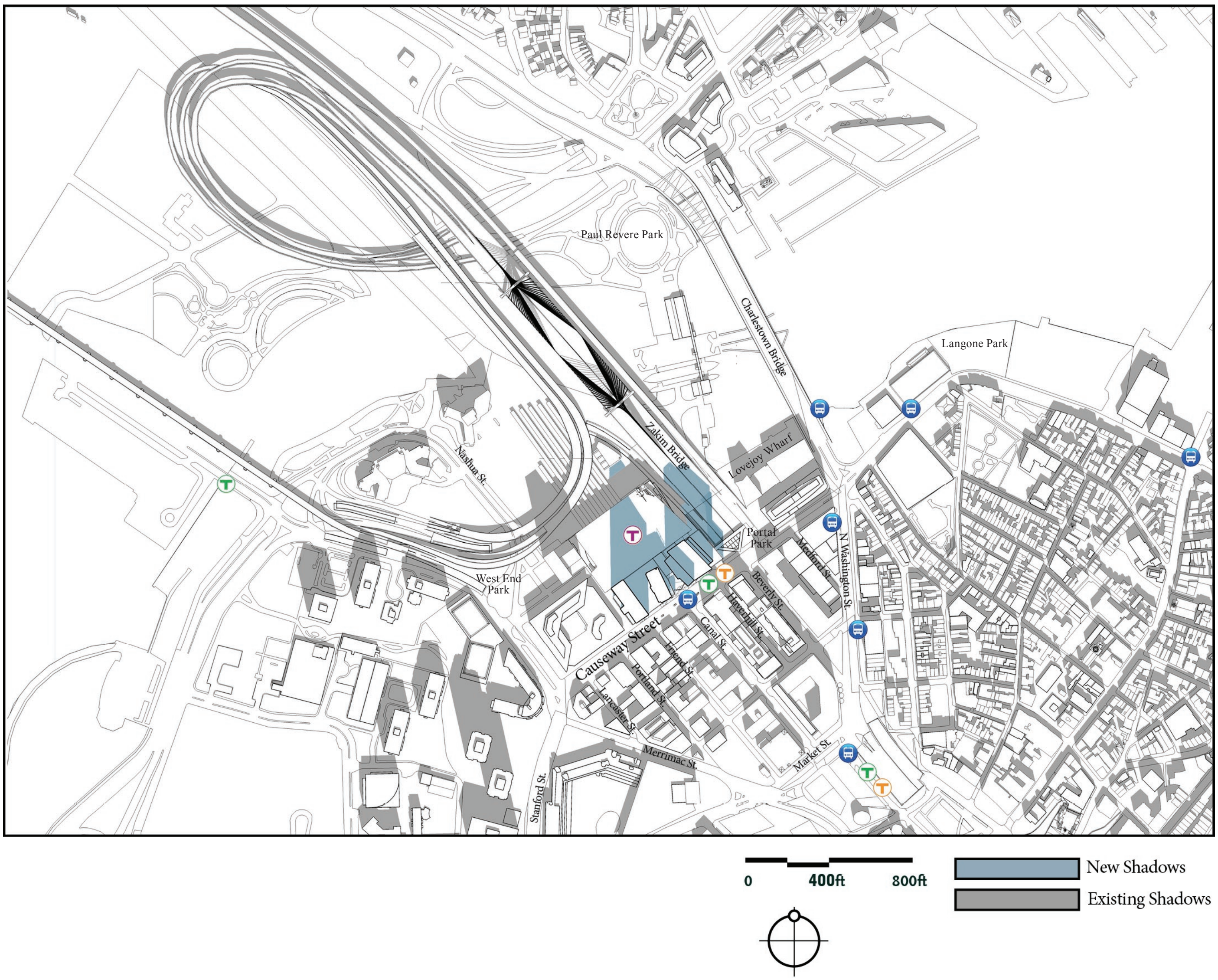

Figure 4.2-9

Shadow Studies: September 21, 12 pm

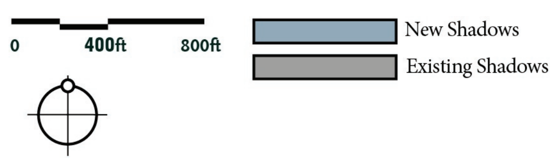

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Figure 4.2-10

Shadow Studies: September 21, 3 pm

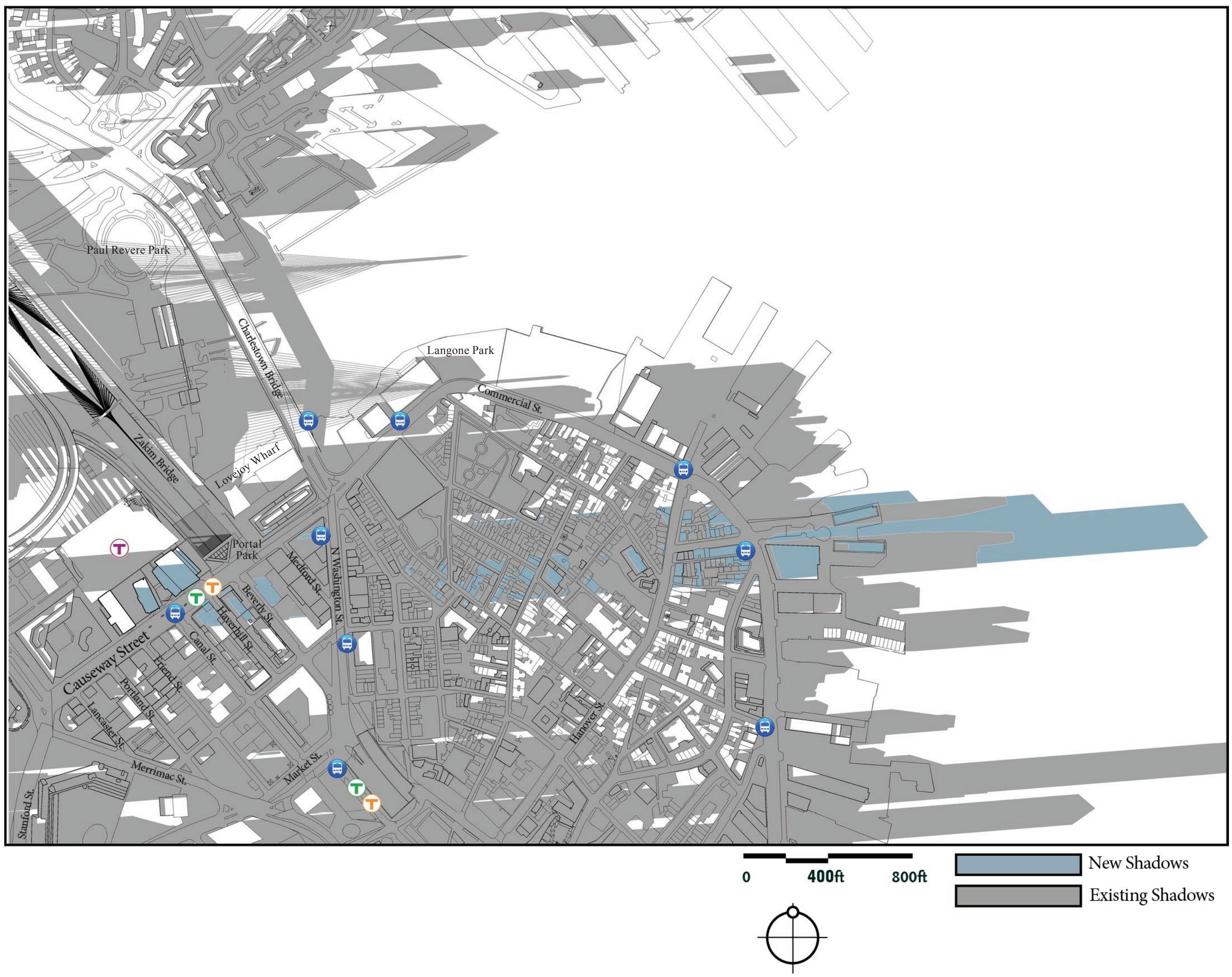
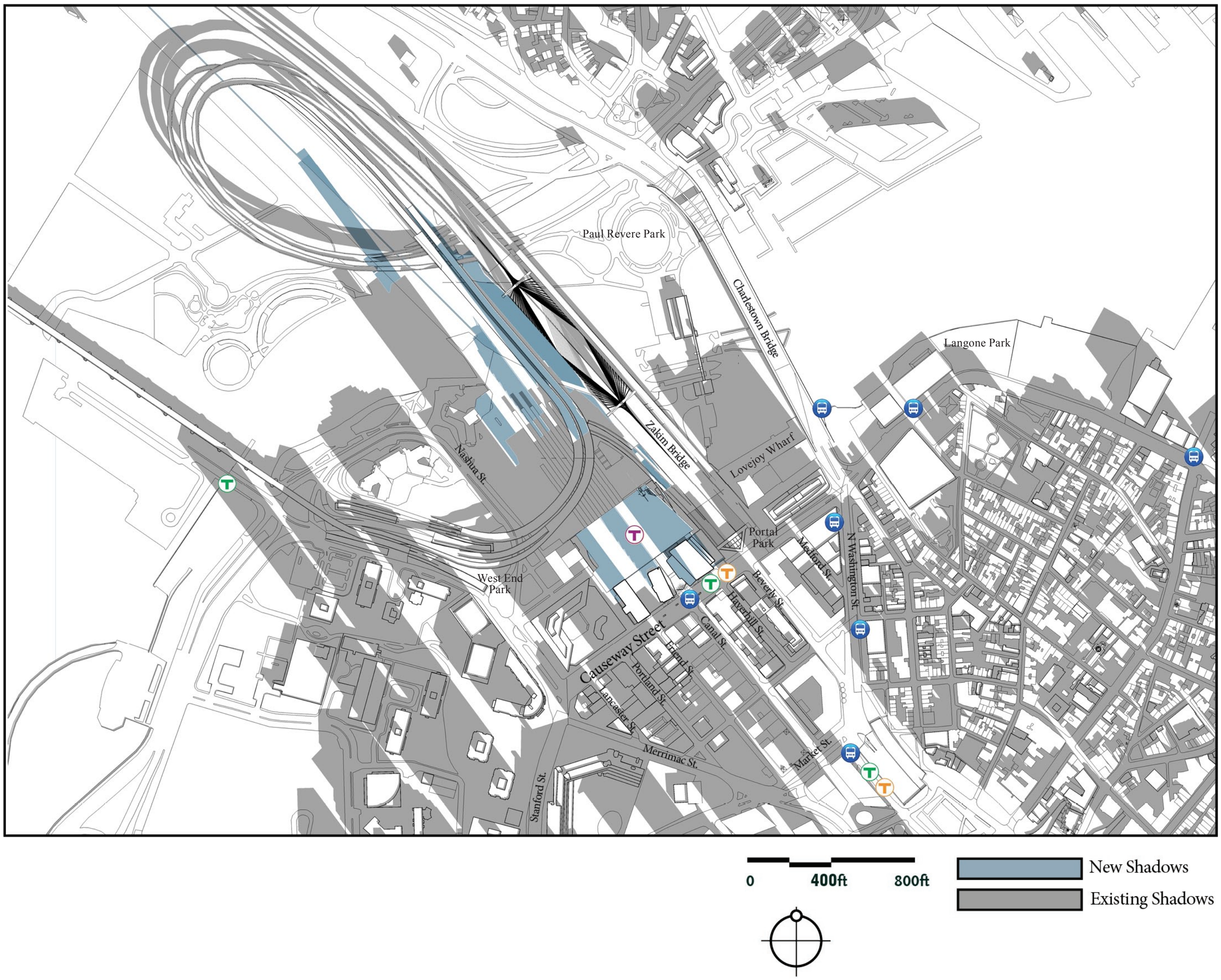


Figure 4.2-11

Shadow Studies: September 21, 6 pm



The Boston Garden   Boston, Massachusetts

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Figure 4.2-12

Shadow Studies: December 21, 9 am

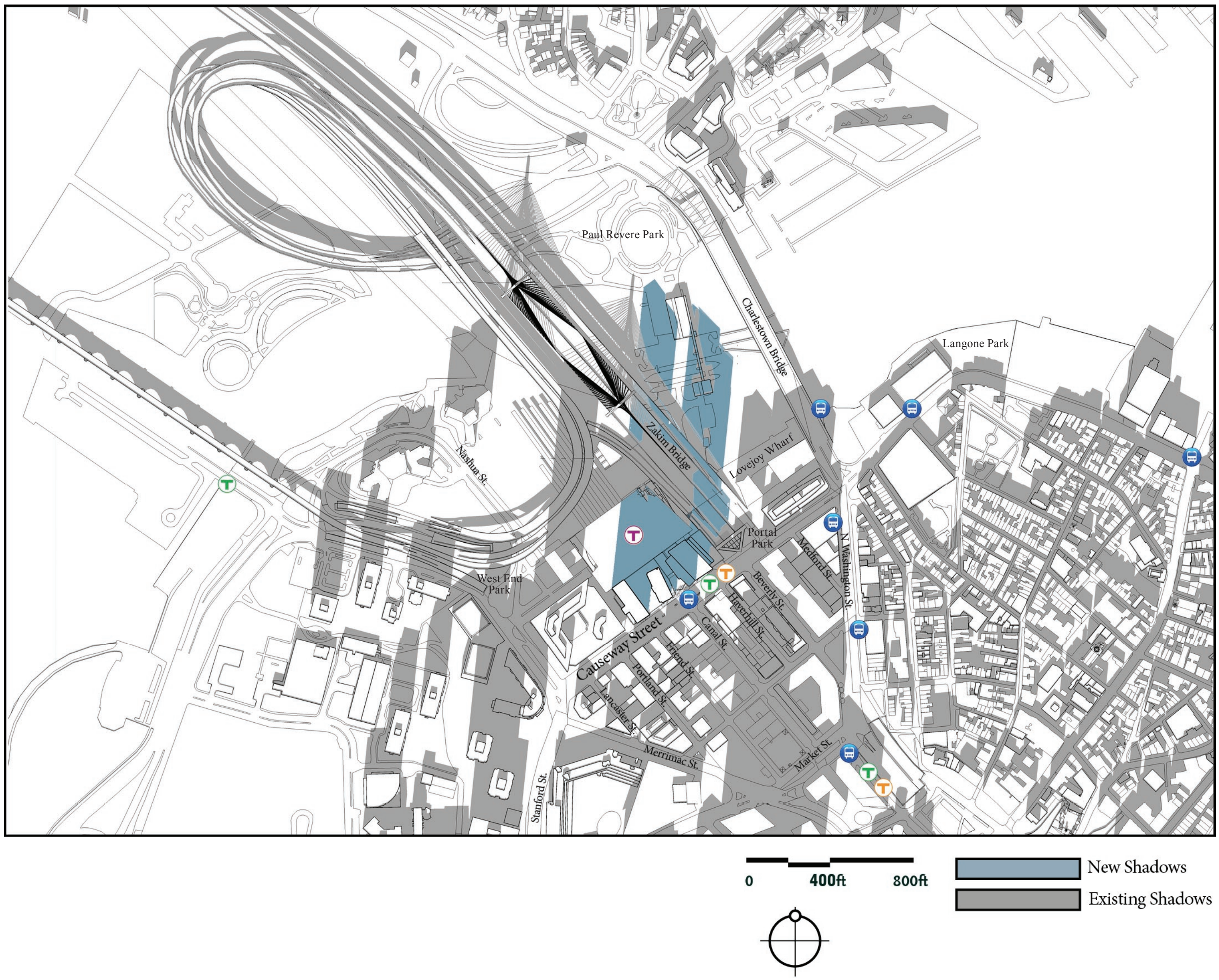

Figure 4.2-13

Shadow Studies: December 21, 12 pm

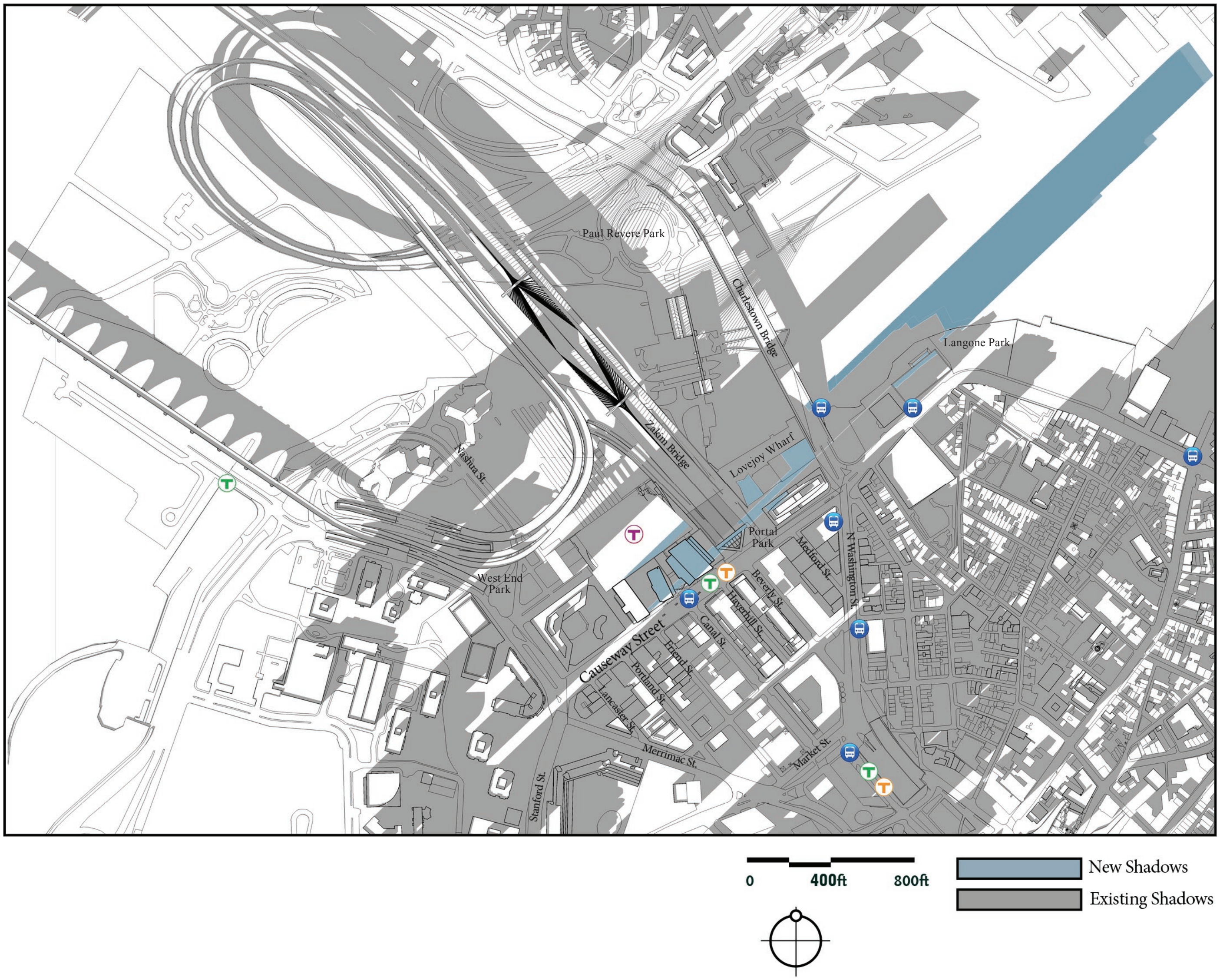

Figure 4.2-14

Shadow Studies: December 21, 3 pm

4.3 Daylight

4.3.1 Introduction

The purpose of the daylight analysis is to estimate the extent to which a proposed project will affect the amount of daylight reaching the streets and the sidewalks in the immediate vicinity of a project site. The daylight analysis for the Project considers the existing and proposed conditions, as well as typical daylight obstruction values of the surrounding area.

Because the Project site is currently undeveloped, the proposed Project will inherently increase daylight obstruction; however, the resulting conditions will be typical of the area and other urban areas, and will be minimized by the width of Causeway Street and the spaces between the three towers.

4.3.2 Methodology

The daylight analysis was performed using the Boston Redevelopment Authority Daylight Analysis (BRADA) computer program[2]. This program measures the percentage of "sky dome" that is obstructed by a project and is a useful tool in evaluating the net change in obstruction from existing to build conditions at a specific site.

Using BRADA, a silhouette view of the building is taken at ground level from the middle of the adjacent city streets or pedestrian ways centered on the proposed building. The façade of the building facing the viewpoint, including heights, setbacks, corners and other features, is plotted onto a base map using lateral and elevation angles. The two-dimensional base map generated by BRADA represents a figure of the building in the "sky dome" from the viewpoint chosen. The BRADA program calculates the percentage of daylight that will be obstructed on a scale of 0 to 100 percent based on the width of the view, the distance between the viewpoint and the building, and the massing and setbacks incorporated into the design of the building; the lower the number, the lower the percentage of obstruction of daylight from any given viewpoint.

The analysis compares three conditions: Existing Condition; Proposed Condition; and the context of the area. Although the Project site is undeveloped, there is existing daylight obstruction caused by the TD Garden behind the Project.

One viewpoint was chosen on Causeway Street to evaluate the daylight obstruction for the existing and proposed conditions, as it is the only public street abutting the site. Three area context viewpoints were considered in order to provide a basis of comparison to existing conditions in the surrounding area. The viewpoint and area context viewpoints were taken in the following locations and are shown on Figure 4.3-1.

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2 Method developed by Harvey Bryan and Susan Stuebing, computer program developed by Ronald Fergle, Massachusetts Institute of Technology, Cambridge, MA, September 1984.

- **Viewpoint 1:** View from Causeway Street facing northwest toward the Project site.
- **Area Context Viewpoint AC1:** View from Friend Street facing northeast toward the building at 225 Friend Street.
- **Area Context Viewpoint AC2:** View from Canal Street facing northeast toward the building at 101 Canal Street.
- **Area Context Viewpoint AC3:** View from Lomasney Way facing southwest toward the building at 150 Staniford Street.

4.3.3 Results

The results for each viewpoint are described in Table 4.3-1. Figures 4.3-2 and 4.3-3 illustrate the BRADA results for each analysis.

Table 4.3-1 Daylight Obstruction Values

Viewpoint Locations		Existing Conditions	Proposed Conditions
Viewpoint 1	View from Causeway Street facing northwest toward the Project site	23.4%	52.7%
Area Context Points			
AC1	View from Friend Street facing northeast toward the building at 225 Friend Street	86.9%	N/A
AC2	View from Canal Street facing northeast toward the building at 101 Canal Street	72.5%	N/A
AC3	View from Lomasney Way facing southwest toward the building at 150 Staniford Street	66.2%	N/A

Causeway Street – Viewpoint 1

Causeway Street runs along the southeastern edge of the Project site. Viewpoint 1 was taken from the center of Causeway Street facing northwest toward the Project site. The existing daylight obstruction value, caused by the TD Garden behind the Project, is 23.4%. The development of the Project will result in a daylight obstruction value of 52.7%, which is consistent with, or lower than, other buildings in the area, including the Area Context buildings. The relatively low daylight obstruction value is due to the spaces between the towers that allow for a view of the sky above the podium building.

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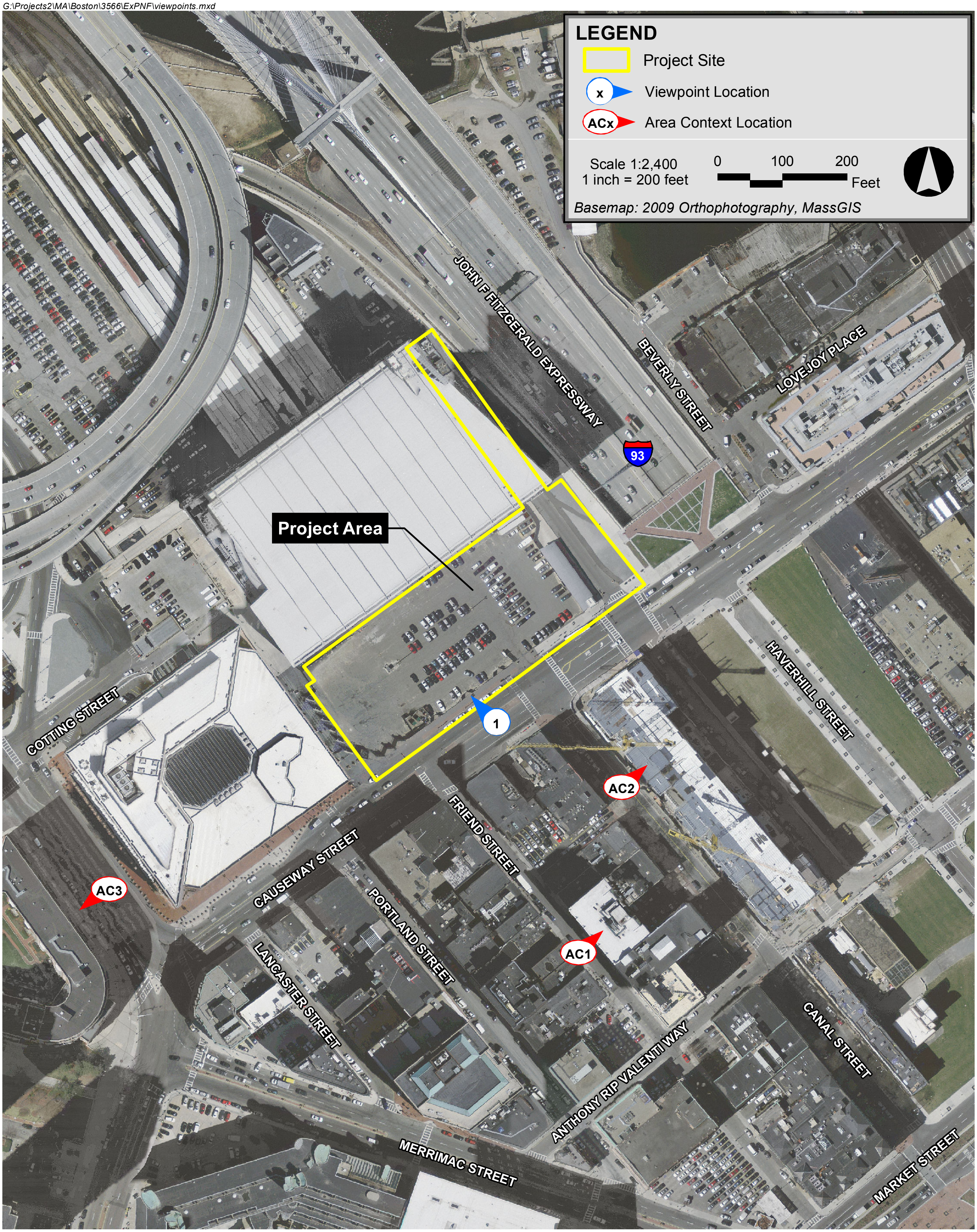


The Boston Garden **Boston, Massachusetts**

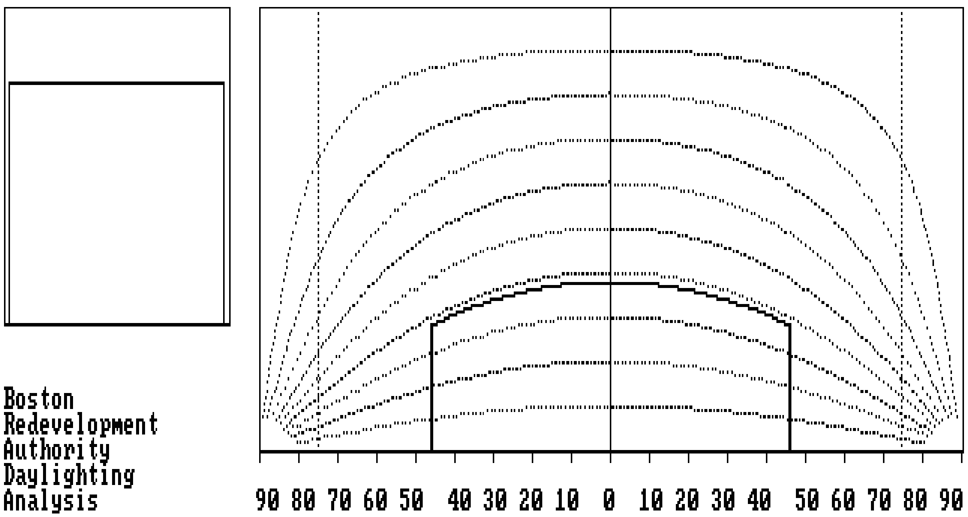
Epsilon ASSOCIATES INC.

Figure 4.3-1

Viewpoint and Area Context Locations

Existing Condition

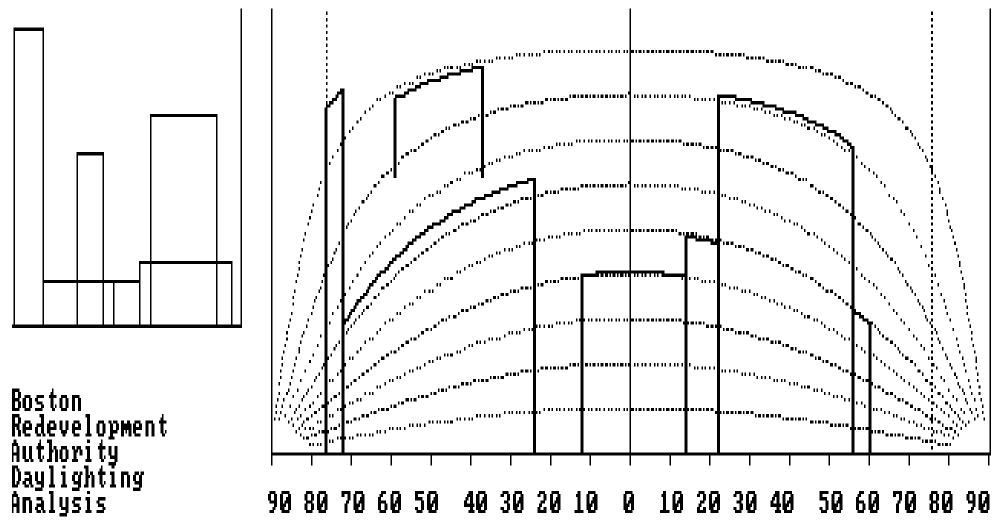
Viewpoint 1: View from Causeway Street facing northwest toward the Project site



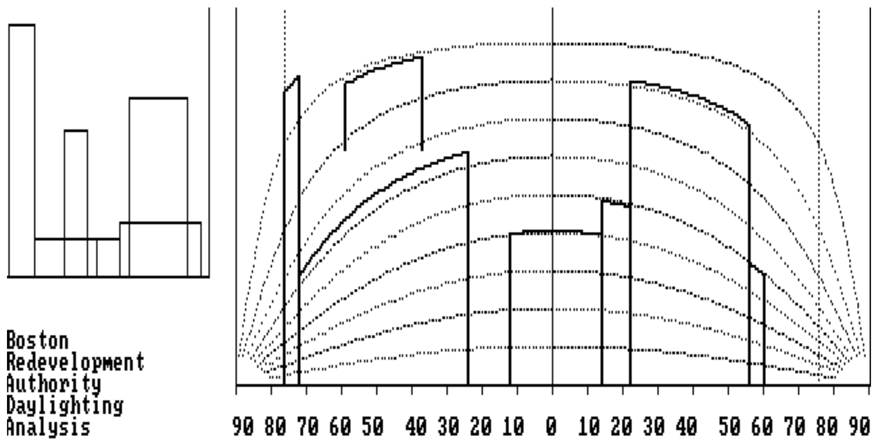
Obstruction of daylight by the building is 23.4 %

Proposed Condition

Viewpoint 1: View from Causeway Street facing northwest toward the Project site

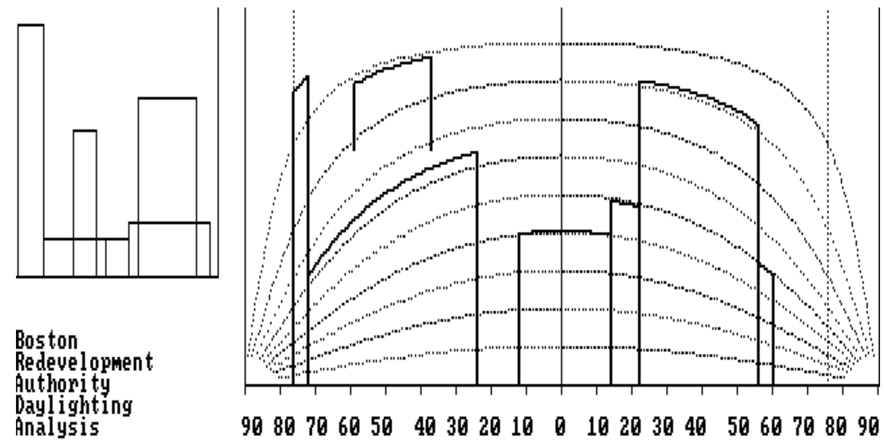


Obstruction of daylight by the building is 52.7 %



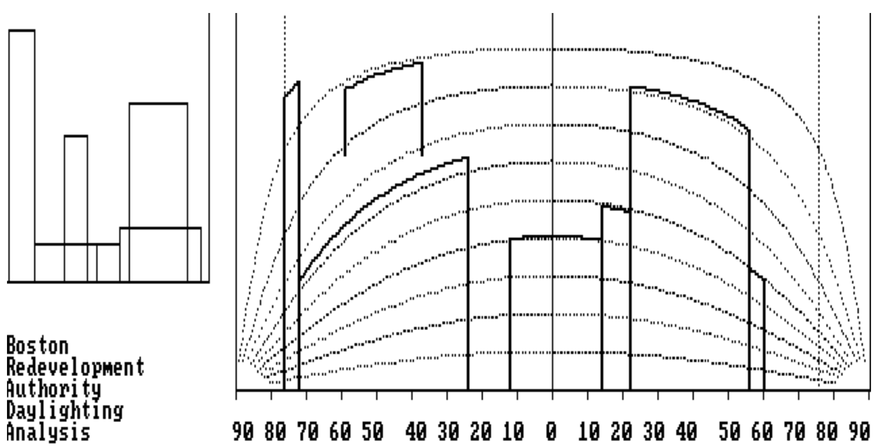
Obstruction of daylight by the building is 52.7 %

AC1: View from Friend Street facing northeast toward the building at 225 Friend Street



Obstruction of daylight by the building is 52.7 %

AC3: View from Lomasney Way facing southwest toward the building at 150 Staniford Street



Obstruction of daylight by the building is 52.7 %

AC2: View from Canal Street facing northeast toward the building at 101 Canal Street

Area Context Views

The Project area currently consists of a mix of mid-rise and high-rise towers with retail on the ground floor. To provide a larger context for comparison of daylight conditions, obstruction values were calculated for the three Area Context Viewpoints described above and shown on Figure 4.3-1. The daylight obstruction values ranged from 66.2% for AC3 to 86.9% for AC1. Daylight obstruction values for the Project are consistent with, or lower than, the Area Context values.

4.3.4 Conclusions

The daylight analysis conducted for the Project describes proposed daylight obstruction conditions at the Project site, as well as existing conditions in the surrounding area. The results of the BRADA analysis indicate that while the development of the Project will inherently result in increased daylight obstruction over existing conditions, the resulting conditions will be similar to, or less than, the daylight obstruction values within the surrounding area, and typical of densely built urban areas.

4.4 Solar Glare

It is not anticipated that the Project will include the use of reflective glass or other reflective materials on the building facades that would result in adverse impacts from reflected solar glare from the Project.

4.5 Air Quality

4.5.1 Introduction

It is expected that the majority of stationary sources (boilers, engines, etc) would be subject to the Massachusetts Department of Environmental Protection's (MassDEP's) Environmental Results Program. Thus, any air quality impacts would be mitigated by this program and air impact analyses would be done at the time of permitting.

An air quality analysis was conducted to determine the impact of pollutant emissions from mobile source emissions generated by the Project.

A microscale analysis is typically performed to evaluate the potential air quality impacts of carbon monoxide (CO) due to traffic flow around the Project area. The impacts were added to monitored background values and compared to the Federal National Ambient Air Quality Standards (NAAQS). The standards were developed by the United States Environmental Protection Agency (EPA) to protect the human health against adverse health effects with a margin of safety.

The modeling methodology was developed in accordance with the latest MassDEP modeling policies and federal modeling guidelines.[3] The air quality analysis results show that CO concentrations at all receptors studied are well under NAAQS thresholds.

Modeling assumptions and backup data for results presented in this section are provided in Appendix D.

4.5.2 Microscale Analysis

A microscale analysis is used to determine the effect on air quality of the increase in traffic generated by a project. A microscale analysis is typically required for a project at intersections where 1) project traffic would impact intersections or roadway links currently operating at Level of Service (LOS) D, E, or F or would cause LOS to decline to D, E, or F; 2) project traffic would increase traffic volumes on nearby roadways by 10% or more (unless the increase in traffic volume is less than 100 vehicles per hour); or, 3) project will generate 3,000 or more new average daily trips on roadways providing access to a single location.[4] The microscale analysis involves modeling of carbon monoxide (CO) emissions from vehicles idling at and traveling through signalized intersections. Predicted ambient concentrations of CO for the Build and No Build cases are compared with federal and state ambient air quality standards for CO.

The microscale analysis typically examines breathing-level (1.8 meter) CO impacts due to traffic queues in the immediate vicinity of a project. CO is used in microscale studies to indicate roadway pollutant levels since it is the most abundant pollutant emitted by motor vehicles and can result in so-called "hot spot" (high concentration) locations around congested intersections. NAAQS have been established by the EPA for CO to protect the public health (known as primary standards). These standards do not allow ambient CO concentrations to exceed 35 parts per million (ppm) for a one-hour averaging period and 9 ppm for an eight-hour averaging period, more than once per year at any location. The widespread use of CO catalysts on late-model vehicles has reduced the occurrences of CO hot spots. Air quality modeling techniques (computer simulation programs) are typically used to predict CO levels for both existing and future conditions to evaluate compliance of the roadways with the standards. The analysis followed the procedure outlined in EPA's intersection modeling guidance.[5]

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[3] 40 CFR 51 Appendix W, Guideline on Air Quality Models, 70 FR 68228, Nov. 9, 2005

[4] BRA, Development Review Guidelines, 2006.

[5] U.S. EPA, Guideline for Modeling Carbon Monoxide from Roadway Intersections; EPA-454/R-92-005, November 1992.

The microscale analysis has been conducted using the latest versions of EPA MOBILE6.2 and CAL3QHC to estimate CO concentrations at sidewalk receptor locations.

Existing (2013) and future year (2028) emission factor data calculated from the MOBILE6.2 model, along with traffic data, were input into the CAL3QHC program to determine CO concentrations due to traffic flowing through the selected intersections.

Existing background values of CO at the nearest monitor location in Kenmore Square were obtained from MassDEP. CAL3QHC and AERMOD results were then added to background CO values of 1.9 ppm (one-hour) and 1.5 ppm (eight-hour), as provided by MassDEP, to determine total air quality impacts due to the Project. This value was compared to the NAAQS for CO of 35 ppm (one-hour) and 9 ppm (eight-hour).

4.5.2.1 Intersection Selection

An analysis of the seventeen intersections from the traffic study was conducted (see Chapter 3). Of these seventeen, nine are signalized. The modeling guidance identifies the following steps to determine the intersections to be modeled.

- Rank the top twenty intersections by traffic volumes
- Calculate the LOS for each intersection
- Rank the intersections by volume
- Rank the intersections by LOS
- Model the top three intersections based on worst LOS and the top three intersections based on the highest traffic volumes

The top three intersections for both criteria (LOS and volumes) are identical. Therefore, only three intersections were modeled:

- Causeway Street, Merrimac Street, Staniford Street and Lomasney Way;
- Causeway Street, Commercial Street, and North Washington Street; and,
- Valenti Way and North Washington Street.

The traffic volumes and LOS calculations provided in Chapter 3 form the basis of evaluating the traffic data versus the microscale thresholds.

4.5.2.2 Emissions Calculations (MOBILE6.2)

The EPA MOBILE6.2 computer program was used to estimate motor vehicle emission factors on the roadway network. Emission factors calculated by the MOBILE6.2 model are based on motor vehicle operations typical of daily periods. The Commonwealth's statewide annual Inspection and Maintenance program was included, as well as the state specific vehicle age registration distribution. The input files for MOBILE6.2 for the existing (2013) and build year (2028) are provided by MassDEP. As is typical, minor edits to the files were necessary to allow the program to output emission factors for the various speeds used in the analysis.

The current version of MOBILE6.2 does not explicitly calculate idle emissions. However, idle emissions can be obtained from a vehicle speed of 2.5 miles per hour (mph) (the lowest speed MOBILE6 will model). The resulting emission rate given (in grams/mile) is then multiplied by 2.5 mph to estimate idle emissions (in grams/hour). Moving emissions are calculated based on actual speeds at which free-flowing vehicles travel through the intersections. A speed of 30 mph is used for all free-flow traffic. Speeds of 10 and 15 mph were used for right (and U-turns, if necessary) and left turns, respectively.

Winter CO emission factors are typically higher than summer. Therefore, winter vehicular emission factors were conservatively used in the microscale analysis.

4.5.2.3 Receptors and Meteorology Inputs

Sets of up to 250 receptors were placed in the vicinity of each of the modeled intersections. Receptors extended approximately 500 feet on the sidewalks along the roadways approaching the intersection. The roadway links and receptor locations of the modeled intersections are presented in Figures 4.5-1 through 4.5-3.

For the CAL3QHC model, limited meteorological inputs are required. Following EPA guidance[6], a wind speed of one meter per second (m/s), stability class D (4), and a mixing height of 1,000 meters was used. To account for the intersection geometry, wind directions from 0° to 350°, every 10°, were selected. A surface roughness length of 321 cm was selected.[7]

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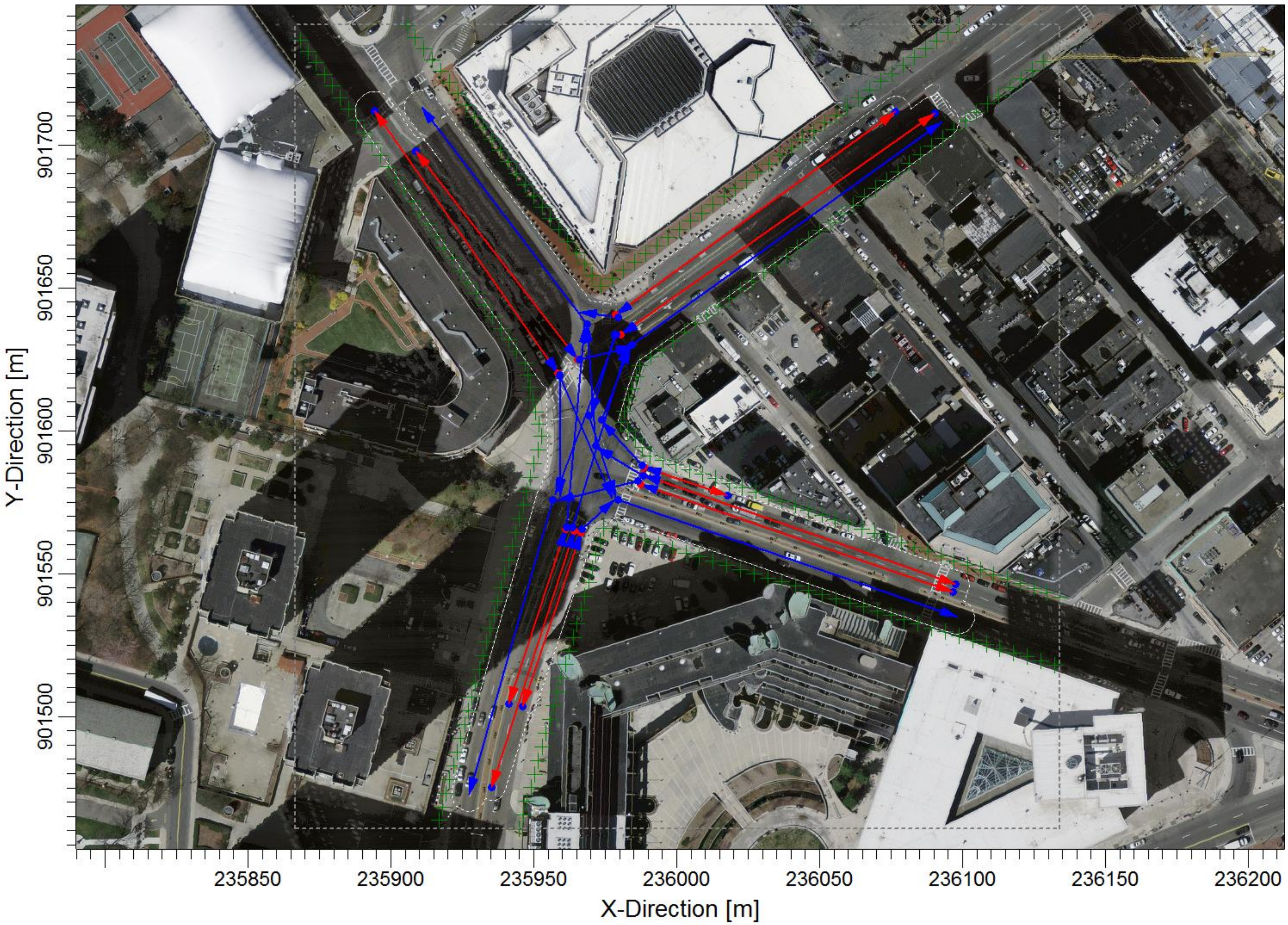
6 U.S. EPA, *Guideline for Modeling Carbon Monoxide from Roadway Intersections.* EPA-454/R-92-005, November 1992.

7 U.S. EPA, *User's Guide for CAL3QHC Version 2: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections.* EPA –454/R-92-006 (Revised), September 1995

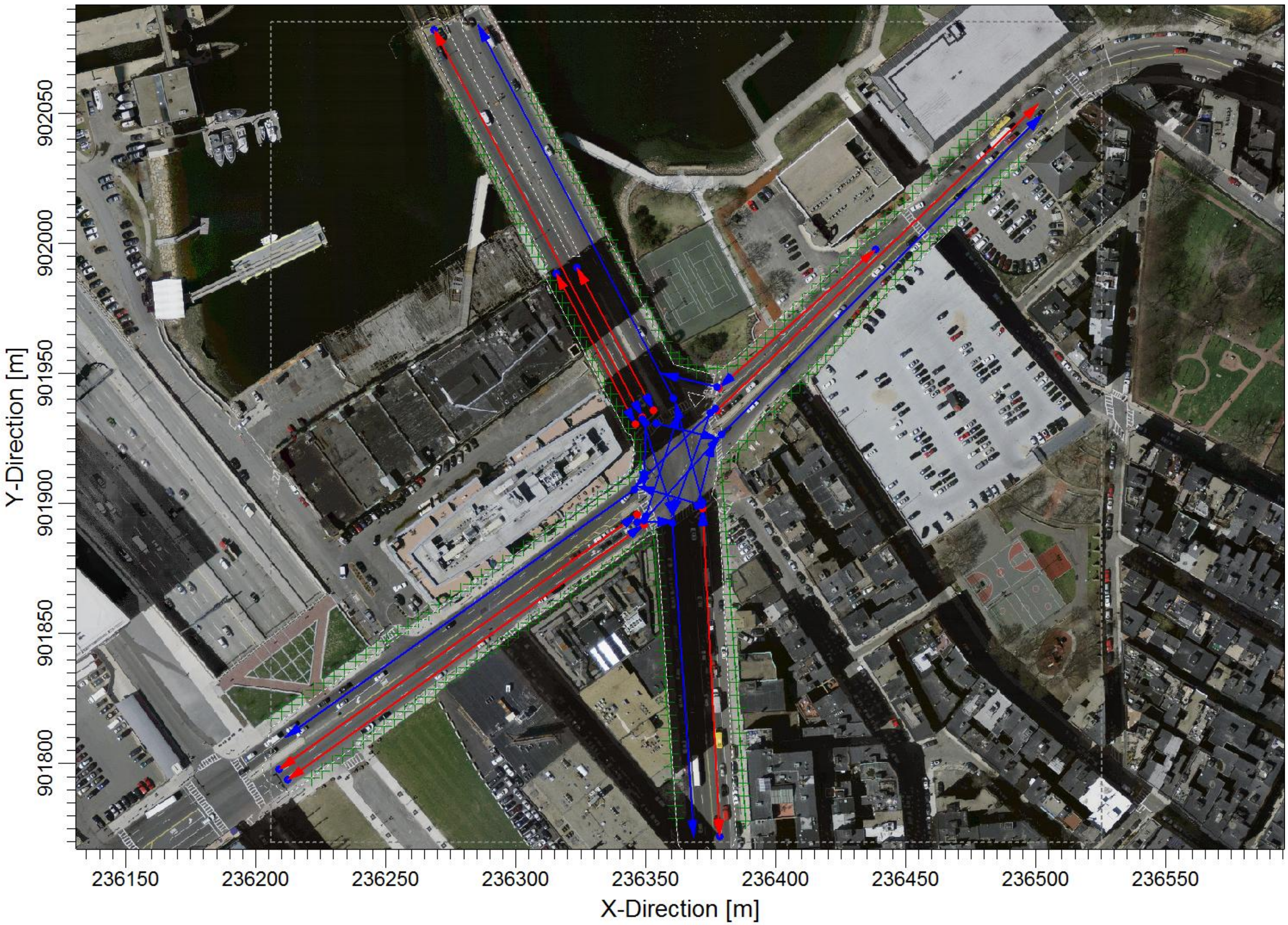


The Boston Garden **Boston, Massachusetts**

Epsilon ASSOCIATES INC.

Figure 4.5-1

Link and Receptor Locations for CAL3QHC modeling of Intersection 1: Causeway, Staniford, Merrimac Streets & Lomasney Way

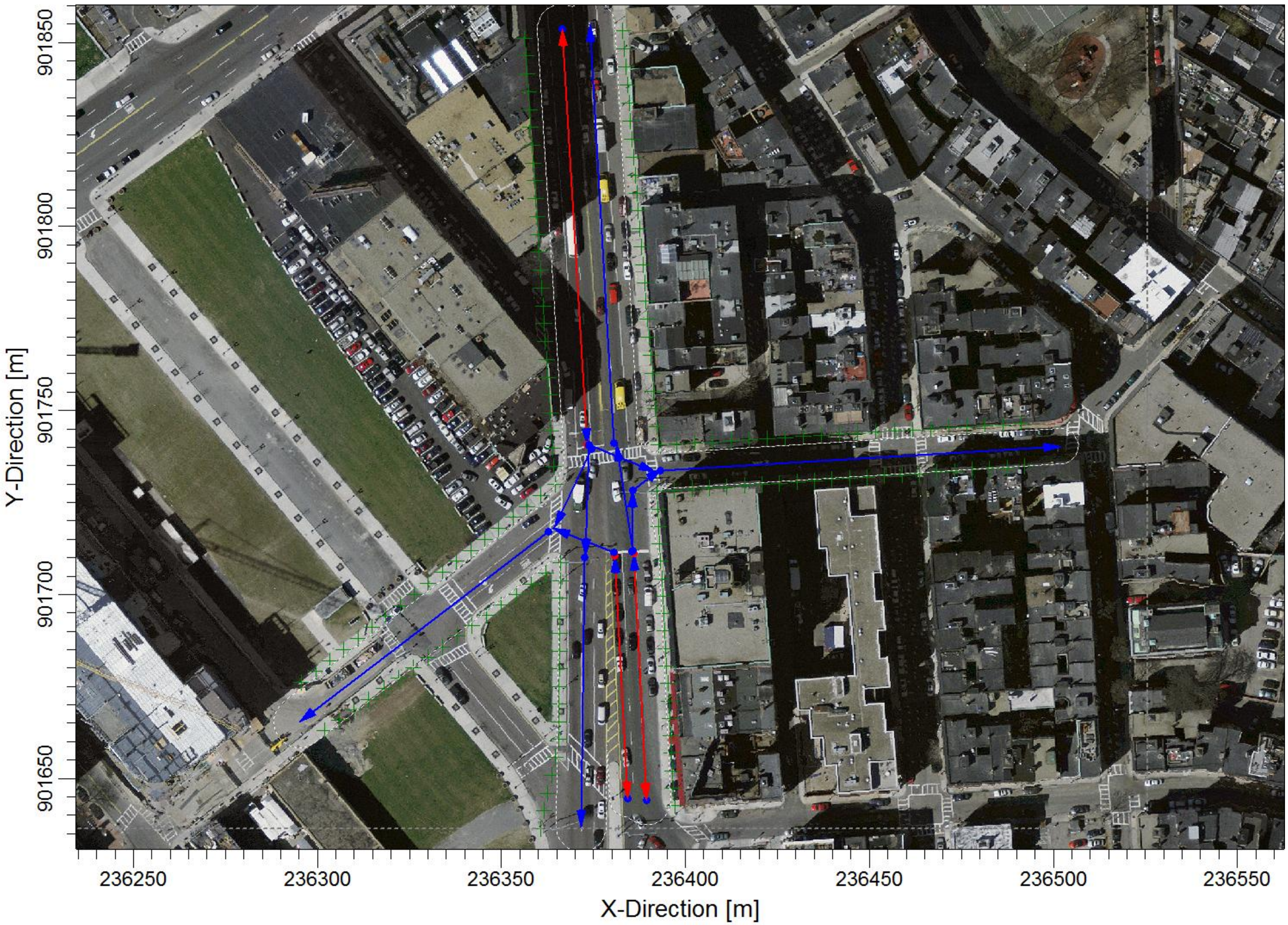


The Boston Garden **Boston, Massachusetts**

Epsilon ASSOCIATES INC.

Figure 4.5-2

Link and Receptor Locations for CAL3QHC modeling of Intersection 9: Causeway, Commercial, & N.. Washington Streets



The Boston Garden **Boston, Massachusetts**

Figure 4.5-3

Link and Receptor Locations for CAL3QHC modeling of Intersection 13: Valenti Way and N. Washington Street

4.5.2.4 Impact Calculations

Modeling was performed at the selected intersections for all cases identified in the traffic analysis (2013 Existing, and 2028 No Build, Build, and Mitigated Build for a.m., p.m., and Saturday peak hours). The CAL3QHC model predicts one-hour concentrations using queue links at intersections, worst-case meteorological conditions, and traffic input data (including signal cycle length, red time, and approach conditions). The one-hour concentrations were scaled by a factor of 0.7 to estimate eight-hour concentrations.[8] The CAL3QHC methodology was based on EPA CO modeling guidance. Signal timings were provided directly from the traffic modeling runs. The CAL3QHC input parameters are also described in Appendix D.

4.5.2.5 Background Concentrations

To estimate background pollutant levels representative of the area, the most recent air quality monitor data reported by MassDEP in their Annual Air Quality Reports was obtained for 2007 to 2012. MassDEP guidance specifies the use of the latest three years of available monitoring data from within 10 kilometers of the Project site. Since some pollutants are no longer monitored, data prior to the most recent three years is used.

The closest monitor is located at 174 North Street in Boston with others at One City Square in Charlestown, and at Kenmore Square, in Boston. A summary of the background air quality concentrations are presented in Table 4.5-1. All observed concentrations are currently in compliance with applicable NAAQS.

Background CO concentrations were determined from the closest available monitoring stations to the Project site. For use in the microscale analysis, background concentrations of CO in ppm were required. The corresponding maximum background concentrations in ppm were 1.9 ppm for one-hour and 1.5 ppm for eight-hour CO.

Table 4.5-1 Observed Ambient Air Quality Concentrations and Selected Background Levels

Pollutant	Averaging Time	2010	2011	2012	Background Concentration (μg/m³)	NAAQS	Location
SO_2 [1,7,8]	1-Hour	69.9	127.4	41.1	127.4	195	KEN
	3-Hour	88.4	62.4	49.4	88.4	365	KEN
	24-Hour	21.8	31.5	15.6	31.5	1,300	KEN
	Annual	5.8	6.1	4.9	6.1	80	KEN

8 U.S. EPA, Screening Procedures for Estimating the Air Quality Impact of Stationary Sources; EPA-454/R-92-019, October 1992

Table 4.5-1 Observed Ambient Air Quality Concentrations and Selected Background Levels (Continued)

Pollutant	Averaging Time	2010	2011	2012	Background Concentration (µg/m³)	NAAQS	Location
PM-10	24-Hour	32	39	41	41.0	150	CTY
	Annual	15.1	15.9	16.8	16.8	50	CTY
PM-2.5	24-Hour [4]	24.8	23.9	20.9	23.2	35	NTH
	Annual [5]	10.03	10.32	9.47	9.9	15	NTH
NO_2 [3]	1-Hour [6]	119	141	120	140.8	188	KEN
	Annual	36	38	36	38.3	100	KEN
CO [2]	1-Hour	2166	1710	1596	2166	40,000	KEN
	8-Hour	1710	1482	1254	1710	10,000	KEN

From 2007-2012 MassDEP Annual Data Summaries

KEN = Kenmore Sq. Boston; CTY = 1 City Sq. Boston, NTH = 174 North St. Boston

[1] SO_2 reported in ppm or ppb. Converted to $\mu g/m^3$ using factor of 1 ppm = 2600 $\mu g/m^3$.

[2] CO reported in ppm or ppb. Converted to $\mu g/m^3$ using factor of 1 ppm = 1140 $\mu g/m^3$.

[3] NO_2 reported in ppm or ppb. Converted to $\mu g/m^3$ using factor of 1 ppm = 1880 $\mu g/m^3$.

[4] Background level for 24-hour PM-2.5 is the average concentration of the 98th percentile for three years.

[5] Background level for annual PM-2.5 is the average for three years.

[6] Maximum annual one-hour concentrations.

[7] The 24-hour and Annual standards were revoked by EPA on June 22, 2010, Federal Register 75-119, p. 35520.

[8] The 2010 & 2011 SO_2 three-hour value is not reported. Years 2007-2009 used instead.

4.5.3 Results

4.5.3.1 Microscale Analysis

The results of the maximum one-hour predicted CO concentrations from CAL3QHC are provided in Tables 4.5-2 through 4.5-5 for the 2013 and 2028 scenarios. Eight-hour average concentrations are calculated by multiplying the maximum one-hour concentrations by a factor of 0.7.[9]

The results of the one-hour and eight-hour maximum modeled CO ground-level concentrations from CAL3QHC were added to EPA supplied background levels for comparison to the NAAQS. These values represent the highest potential concentrations at the intersection as they are predicted during the simultaneous occurrence of "defined" worst case meteorology. The highest one-hour traffic-related concentration predicted in the area of the Project, for the modeled conditions (2.8 ppm) plus background (1.9 ppm) is 4.7

[9] U.S. EPA, Screening Procedures for Estimating the Air Quality Impact of Stationary Sources; EPA-454/R-92-019, October 1992

ppm. The highest eight-hour traffic-related concentration predicted in the area of the Project for the modeled conditions (2.0 ppm) plus background (1.5 ppm) is 3.5 ppm. Both concentrations are well below the one-hour NAAQS of 35 ppm and the eight-hour NAAQS of 9 ppm.

It would be expected that any other mitigation measures implemented to improve traffic flow at any of the modeled intersections would result in further improved air quality conditions.

4.5.4 Conclusions

Using conservative estimates, the CO concentrations at the nearest receptors including impacts from the intersection, plus monitored background values, are well under the CO NAAQS thresholds for the peak traffic periods studied. It would be concluded that off-peak hours would also produce concentrations well below NAAQS.

Table 4.5-2 Summary of Microscale Modeling Analysis (No Build 2028)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
One-Hour					
Causeway Street, Staniford Street, Merrimac Street & Lomasney Way	AM	1.2	1.9	3.1	35
	PM	1.1	1.9	3.0	35
	SA	0.9	1.9	2.8	35
Causeway Street, Commercial Street & North Washington Street	AM	2.7	1.9	4.6	35
	PM	2.5	1.9	4.4	35
	SA	2.0	1.9	3.9	35
Valenti Way & North Washington Street	AM	1.2	1.9	3.1	35
	PM	1.1	1.9	3.0	35
	SA	0.9	1.9	2.8	35

Table 4.5-2 Summary of Microscale Modeling Analysis (No Build 2028) (Continued)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
Eight-Hour					
Causeway Street, Staniford Street, Merrimac Street & Lomasney Way	AM	0.8	1.5	2.3	9
	PM	0.8	1.5	3.1	9
	SA	0.6	1.5	2.1	9
Causeway Street, Commercial Street & North Washington Street	AM	1.9	1.5	3.4	9
	PM	1.8	1.5	3.3	9
	SA	1.4	1.5	2.9	9
Valenti Way & North Washington Street	AM	0.8	1.5	2.3	9
	PM	0.8	1.5	2.3	9
	SA	0.6	1.5	2.1	9

Notes:
CAL3QHC eight-hour impacts were conservatively obtained by multiplying one-hour impacts by a screening factor of 0.7.

Table 4.5-3 Summary of Microscale Modeling Analysis (Build 2028)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
One-Hour					
Causeway Street, Staniford Street, Merrimac Street & Lomasney Way	AM	1.2	1.9	3.1	35
	PM	1.2	1.9	3.1	35
	SA	0.9	1.9	2.8	35
Causeway Street, Commercial Street & North Washington Street	AM	2.8	1.9	4.7	35
	PM	2.5	1.9	4.4	35
	SA	2.0	1.9	3.9	35

Table 4.5-3 Summary of Microscale Modeling Analysis (Build 2028) (Continued)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
Valenti Way & North Washington Street	AM	1.3	1.9	3.2	35
	PM	1.2	1.9	3.1	35
	SA	1.0	1.9	2.9	35
Eight-Hour					
Causeway Street, Staniford Street, Merrimac Street & Lomasney Way	AM	0.8	1.5	2.3	9
	PM	0.8	1.5	3.1	9
	SA	0.6	1.5	2.1	9
Causeway Street, Commercial Street & North Washington Street	AM	2.0	1.5	3.5	9
	PM	1.8	1.5	3.3	9
	SA	1.4	1.5	2.9	9
Valenti Way & North Washington Street	AM	0.9	1.5	2.4	9
	PM	0.8	1.5	2.3	9
	SA	0.7	1.5	2.2	9

Notes:
CAL3QHC eight-hour impacts were conservatively obtained by multiplying one-hour impacts by a screening factor of 0.7.

Table 4.5-4 Summary of Microscale Modeling Analysis (Mitigated Build 2028)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
One-Hour					
Causeway Street, Staniford Street, Merrimac Street & Lomasney Way	AM	1.2	1.9	3.1	35
	PM	1.2	1.9	3.1	35
	SA	0.9	1.9	2.8	35

Table 4.5-4 Summary of Microscale Modeling Analysis (Mitigated Build 2028) (Continued)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
Causeway Street, Commercial Street & North Washington Street	AM	2.8	1.9	4.7	35
	PM	2.5	1.9	4.4	35
	SA	2.0	1.9	3.9	35
Valenti Way & North Washington Street	AM	1.3	1.9	3.2	35
	PM	1.3	1.9	3.2	35
	SA	1.0	1.9	2.9	35
Eight-Hour					
Causeway Street, Staniford Street, Merrimac Street & Lomasney Way	AM	0.8	1.5	2.3	9
	PM	0.8	1.5	3.1	9
	SA	0.6	1.5	2.1	9
Causeway Street, Commercial Street & North Washington Street	AM	2.0	1.5	3.5	9
	PM	1.8	1.5	3.3	9
	SA	1.4	1.5	2.9	9
Valenti Way & North Washington Street	AM	0.9	1.5	2.4	9
	PM	0.9	1.5	2.4	9
	SA	0.7	1.5	2.2	9

Notes:
CAL3QHC eight-hour impacts were conservatively obtained by multiplying one-hour impacts by a screening factor of 0.7.

4.6 Stormwater/Water Quality

Please see Chapter 8 for a discussion of stormwater and water quality.

4.7 Flood Hazard Zones/Wetlands

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map for this area (25025C0081G) shows that the FEMA Flood Zone Designation for the Project site is Zone X, "Areas determined to be outside the 0.2% annual chance floodplain."

The Project site does not contain wetlands.

4.8 Geotechnical/Groundwater

This section describes the geotechnical conditions relating to the construction of the Project and discusses the potential impacts that excavation and foundation construction may have on existing adjacent structures.

4.8.1 Existing Conditions

The site is located in the North Station area which was created by filling in the Charles River estuary north of Causeway Street in the early 1800s. The proposed building site occupies the footprint of the former Boston Garden, which was constructed in the late 1920s. The former building was supported on cast-in-place concrete (Simplex) piles with a slab-on-grade.

In the early 1970s, the Orange Line tunnel was constructed immediately adjacent to the east side of the existing Boston Garden below Accolon Way (now known as Legends Way). The Orange Line tunnel was constructed using an internally braced steel sheetpile earth support system. The east end of the Boston Garden was underpinned using jacked-in-place steel pipe piles to facilitate construction of the tunnel.

In the 1990s, the existing TD Garden was constructed as an air-rights structure above the five-level below-grade parking garage. The garage construction included slurry walls used as temporary support as well as the walls of the permanent structure, and internal load bearing elements were installed to provide interior column support.

In the early 2000s, the elevated Green Line structure and surface stations were razed and a new below-grade station and platform was constructed along the east side of the footprint of the former Boston Garden. Excavation for the station and platform was completed using slurry walls and internal bracing.

The site is relatively flat and paved, and is currently used as a parking lot for TD Garden employees. Portions of foundations, including underground vaults, from the former structure were left in place following demolition of the Boston Garden in 1998. Historical records also indicate an abandoned approximately four-foot wide sewer line passing through the middle of the site in a north to south direction.

4.8.2 Subsurface Conditions

The generalized subsurface conditions at the site, in descending order from ground surface based on available boring data, consist of miscellaneous fill, organic soils, glacial till and bedrock. Some of the borings encountered a silty sand/sand and gravel layer and/or silty clay layer above the glacial till. The fill is generally granular and contains varying amounts of sand, gravel, silt, cinders and fragments of brick, wood, shells, and miscellaneous building rubble, which are typical of fill conditions in Boston. The organic soils and silty clay are compressible and are susceptible to settlement due to groundwater drawdown. Bedrock is Cambridge Argillite, with localized intrusions of diabase and basalt. The Argillite is typically weathered and fractured at the top.

4.8.3 Groundwater

Groundwater levels at the site generally range between approximately 7 and 11 feet below existing ground surface. Fluctuations in the groundwater occur mainly due to rainfall, temperature, and other seasonal changes. Tidal fluctuations in the groundwater are not expected because the Charles River locks and dam maintain a fairly constant elevation of the river.

Based on measured piezometric levels in the glacial till and bedrock during construction of the TD Garden and MBTA garage, and the nearby Central Artery/Tunnel project, the piezometric levels in the glacial till and bedrock are typically depressed relative to groundwater levels in the fill.

4.8.4 Foundation Support and Below Grade Construction

An excavation support system is required to support the sides of the excavation and to limit ground movements that could impact adjacent structures, streets and utilities. To support the required excavation that is anticipated to extend up to 65 feet below existing grade, it is anticipated that a relatively rigid support system will be installed (i.e. concrete diaphragm walls constructed using slurry methods – slurry walls).

The slurry walls will be installed into the bedrock to provide adequate stability for earth support as well as to provide a groundwater cut-off. Groundwater levels in the fill and organic soils should be maintained during construction to limit settlement associated with consolidation of the organic and silty clay layers, and also to limit downdrag on timber piles that support some of the older structures near the site in the Bulfinch Triangle. Decay of the tops of timber piles is also a concern if the groundwater levels in the fill and organic soils are lowered such that the top of timber piles are exposed. It is anticipated that groundwater will be controlled during construction primarily by pumping from relief wells installed in the glacial till and bedrock. Upon completion of construction, it is anticipated that the foundation for the permanent structure will be designed to resist hydrostatic uplift pressure.

It is anticipated that interior building columns will be supported on drilled shaft foundations. The sequence of construction will determine the timing of installation of the drilled shafts, but it is anticipated that the shafts will be installed immediately following installation of the slurry walls and prior to performing excavation to final subgrade.

Prior to installation of the slurry walls and drilled shaft foundations, pre-excavation will be required to remove the former pile caps from foundations that supported the former Boston Garden. The existing pile foundations can be removed as excavation progresses to final subgrade. New foundation elements will be located to avoid conflict with existing below-grade structures, including the Green Line tunnel, station and platform; TD Garden and MBTA garage and garage ramp; and the Orange Line tunnel.

It is anticipated that construction methods will be similar to that used to construct the TD Garden, which utilized a "top-down" construction technique. "Top-down" construction provides many benefits because it limits ground movements (settlement) and lowering of groundwater levels in areas surrounding the construction site. This method of construction allows the erection of the superstructure while simultaneously constructing the building substructure. This shortens the construction schedule, eliminates the need for tiebacks for wall support, and reduces noise and dust. "Top-down" involves construction of the slurry walls and drilled shaft foundations first, followed by installation of the ground floor slab. Erection of the superstructure can then begin simultaneously with excavation down for below-grade levels.

4.8.5 Construction Monitoring Program

Since excavation for the Project is located adjacent to existing structures and active utilities and streets, a geotechnical instrumentation and monitoring program will be required. The purpose of the program is to establish baseline data prior to construction and then during construction to monitor the performance of the excavation support system and evaluate the effects of construction on:

- ♦ Groundwater levels in the fill and organics and piezometric levels in the glacial till and bedrock,
- ♦ Adjacent buildings, and
- ♦ Streets, sidewalks, and utilities surrounding the excavation that must remain active during and following construction

There are a number of instruments and techniques available to monitor construction. A program will be selected based on site geology and proposed construction methods and sequencing. Instruments will be selected to monitor performance of the earth support system, ground movements, horizontal and vertical building movement, vibrations, water levels and pore pressures. Such instruments could include observation wells, piezometers, surface reference points, building reference points, vibration monitors, and inclinometers. The wells and piezometers will be installed outside the excavation to monitor groundwater levels adjacent to the excavation at adjacent structures. We will coordinate the locations of the wells and piezometers with the Boston Groundwater Trust, who already have several wells near the Project site. Inclinometers will be installed adjacent to the earth support system to monitor for lateral soil and wall movement. The instruments will be installed prior to excavation to establish baseline data and then read periodically throughout construction to monitor geotechnical conditions during construction. A program of response actions will be developed to mitigate ground movements or lowering of groundwater levels that may adversely affect surrounding structures. Response values for the instruments will be developed and incorporated into the Project specifications so that the contractor can be prepared to implement remedial measures should the response values be reached. The Project will coordinate with MBTA, BWSC, Boston Groundwater Trust, area land and utility owners, and City of Boston in the implementation of the geotechnical monitoring program.

4.9 Solid and Hazardous Waste

4.9.1 Hazardous Waste

4.9.1.1 Existing Conditions

The proposed development is located in the North Station area, an urbanized area of Boston. The site is bounded by Causeway Street to the south, the General Services Administration (GSA) Building to the west, the existing TD Garden to the north and the existing MBTA Orange Line tunnel and Central/Artery to the east. The site is relatively flat, paved, and is currently used as employee parking. It is anticipated that debris from demolition of the Boston Garden and the existing foundations (cast-in-place concrete (Simplex) piles) and pile caps are present below grade.

4.9.1.2 Regulatory Review

Based on a review of the MassDEP Searchable Sites Database (updated through July 9, 2013), five releases of oil or hazardous materials have been reported at the property listed as 150 Causeway Street and/or as the Boston Garden or TD Banknorth Garden, as summarized in Table 4.9-1

Table 4.9-1 Hazardous Materials Reported

MassDEP Release Tracking Number (RTN)	Site Address/ Name	Notification Date; Reporting Category	Current Status/ Status Date	Comments
3-10179	150 Causeway St./ Adj. to Boston Garden & MBTA Station	10/12/93; 2-hour	Class A-2 RAO, 6/30/00	Release of 60 gallons of No. 2 fuel oil
3-18960	Causeway St./ Old Boston Garden	11/10/99; 120-day	Class A-3 RAO, 6/10/05	PAHs in soil
3-19557	Causeway St./ Old Boston Garden Brown Fill	5/17/00; 120-day	RAO, 6/10/05	PAHs in soil; RTN 3-19557 linked to RTN 3-18960

Table 4.9-1 Hazardous Materials Reported (Continued)

MassDEP Release Tracking Number (RTN)	Site Address/ Name	Notification Date; Reporting Category	Current Status/ Status Date	Comments
3-26309	Causeway Street/TD Bank North Garden	10/18/06; 2-hour	Class A-1 RAO; 12/22/06	Release of 20 gallons of hydraulic oil
3-26308	150 Causeway St./North Sta. Track 7 Motor Oil Release	10/18/06; 2-hour	Class A-2 RAO, 2/16/07	Release of 100 gallons of motor oil from locomotive

Three of these Release Tracking Numbers (RTNs) are related to discrete releases of petroleum products. Class A-1 or Class A-2 Response Action Outcomes, indicating that a Permanent Solution has been achieved, have been issued for these three releases, and no Activity and Use Limitations (AULs), ongoing monitoring or treatment, or other follow-up activities are required.

RTNs 3-18960 and 3-19557 pertain to the detection of polynuclear aromatic hydrocarbons (PAHs) and metals in fill materials at the site. PAHs, which are byproducts of the combustion of fuel and metals are common constituents of historic urban fill. Reportable concentrations of oil and hazardous material were not detected in groundwater samples collected from the site. RTNs 3-18906 and 3-19557 were linked in accordance with the provisions of the Massachusetts Contingency Plan (MCP), and a single Class A-3 RAO was issued for them on June 10, 2005. The Class A-3 RAO is dependent on the implementation of an AUL, a deed notice prohibiting certain activities on the site (e.g., residential use, the growing of food crops).

The MCP specifies that post-RAO soil management activities at a site with an AUL must be carried out as a Release Abatement Measure. One post-RAO RAM has already been completed at this site: landscaping improvements made in late 2009 involved the management of site soils. Excavation activities carried out in conjunction with the construction of a building foundation at this site would also require the filing of a RAM Plan, a RAM Completion Report, and, if necessary, RAM status reports. A Health and Safety Plan and a Soil Management Plan would be prepared as part of the RAM Plan. A suite of disposal analyses, generally at a frequency of one for every 500 cubic yards, will be required by whatever facility receives the soils excavated from this (or any) site.

Whether an AUL will still be necessary following building foundation construction will depend on the extent of excavation. If PAH-contaminated historic fill is left on the site within 15 feet of the ground surface—either outside the footprint of the building or beneath the building slab—then the AUL will need to be maintained. If, on the other hand, all contaminated fill within 15 feet of the ground surface is removed during construction, then the AUL could be removed.

4.9.2 Solid Waste

The Project will generate solid waste typical of residential, office, hotel and retail uses. Solid waste is expected to include wastepaper, cardboard, glass bottles and food. Recyclable materials will be recycled through a program implemented by building management. The Project will generate approximately 3,100 tons of solid waste per year.

With the exception of household hazardous wastes typical of mixed-use developments (e.g., cleaning fluids and paint), the Project will not involve the generation, use, transportation, storage, release, or disposal of potentially hazardous materials.

The Proponent will work with tenants to implement recycling programs for tenant solid waste, and will aim to reduce office waste by up to 50%. Vendors and restaurant tenants will be encouraged to incorporate responsible waste management practices. Cooking oil will be recycled. If feasible, "single stream" recycling will be incorporated into the Project, which allows all paper fibers and containers to be mixed together instead of being sorted into separate commodities. Single stream recycling collects more types of recycled materials and results in more recycling because there is no need to separate different types of materials.

4.9.3 Organic Waste

The Proponent will work closely with vendors and tenants to promote composting. It is anticipated that composting will be facilitated with dedicated areas to store waste, clean the barrels, and simplify the removal. Technology will be installed to put compost into a processor that makes the end product more manageable. The Proponent will investigate the use of organic waste as an onsite energy source.

4.10 Noise

4.10.1 Introduction

A sound level assessment conducted by Epsilon Associates, Inc. (Epsilon) included a baseline sound monitoring program to measure existing sound levels in the vicinity of the Project site, computer modeling to predict operational sound levels from mechanical equipment associated with the Project, and a comparison of future Project sound levels to applicable noise regulations, including the City of Boston Zoning District Noise Standards and the MassDEP Noise Policy.

This analysis, which is consistent with BRA requirements for noise studies, indicates that predicted noise levels from the Project with appropriate noise controls will comply with both state and local regulations.

4.10.2 Noise Terminology

There are several ways in which sound (noise) levels are measured and quantified, all of which use the logarithmic decibel (dB) scale. The following section defines the noise terminology used in this analysis.

The decibel scale is logarithmic to accommodate the wide range of sound intensities observed in the environment. A property of the decibel scale is that the sound pressure levels of two distinct sounds are not purely additive. For example, if a sound of 50 dB is added to another sound of 50 dB, the total is only a three-decibel increase (53 dB), not a doubling (100 dB). Thus, every three-decibel change in sound level represents a doubling or halving of sound energy. Related to this is the fact that a change in sound level of less than three dB is generally imperceptible to the human ear.

Another property of the decibel scale is that if one source of noise is 10 dB (or more) louder than another source, then the total combined sound level is simply that of the louder source (i.e., the quieter source contributes negligibly to the overall sound level). For example, a source of sound at 60 dB plus another source at 47 dB is 60 dB.

The sound level meter used to measure noise is a standardized instrument.[10] It contains "weighting networks" to adjust the frequency response of the instrument to approximate that of the human ear under various conditions. One network is the A-weighting network (there are also B- and C-weighting networks), which most closely approximates how the human ear responds to sound as a function of frequency, and is the accepted scale used for community sound level measurements. Sounds are frequently reported as detected with the A-weighting network of the sound level meter, in dBA. A-weighted sound levels emphasize the middle frequencies (i.e., middle pitched—around 1,000 Hertz sounds), and de-emphasize lower- and higher-frequencies.

Because the sounds in our environment vary with time, they cannot simply be represented with a single number. In fact, there are several methods used for quantifying variable sounds which are commonly reported in community noise assessments, as defined below.

- L_{eq}, the equivalent level, in dBA, is the level of a hypothetical steady sound that would have the same energy (i.e., the same time-averaged mean square sound pressure) as the actual fluctuating sound observed.

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[10] *American National Standard Specification for Sound Level Meters*, ANSI S1.4-1983, published by the Standards Secretariat of the Acoustical Society of America, Melville, NY.

- L_{90} is the sound level, in dBA, exceeded 90 percent of the time in a given measurement period. The L_{90}, or residual sound level, is close to the lowest sound level observed when there are no obvious nearby intermittent noise sources.

- L_{50} is the median sound level, in dBA, exceeded 50 percent of the time in a given measurement period.

- L_{10} is the sound level, in dBA, exceeded only 10 percent of the time in a given measurement period. The L_{10}, or intrusive sound level, is close to the maximum sound level observed due to occasional louder intermittent noises, like those from passing motor vehicles.

- L_{max} is the maximum instantaneous sound level observed in a given measurement period.

By employing various noise metrics, it is possible to separate prevailing, steady sounds (the L_{90}) from occasional louder sounds (L_{10}) in the noise environment. This analysis treats all noise sources from the Project as though the emissions will be steady and continuous, described most accurately by the L_{90} exceedance level.

In the design of noise controls, which do not function quite like the human ear, it is important to understand the frequency spectrum of the noise source of interest. The spectra of noises are usually stated in terms of octave-band sound pressure levels, in dB, with the octave frequency bands being those established by standard. To facilitate the noise-control design process, the estimates of noise levels in this analysis are also presented in terms of octave-band sound pressure levels.

4.10.3 Noise Regulations and Criteria

The primary set of regulations relating to the potential increase in noise levels is the City of Boston Zoning District Noise Standards (City of Boston Code – Ordinances: Section 16–26 Unreasonable Noise and City of Boston Air Pollution Control Commission Regulations for the Control of Noise in the City of Boston). Results of the baseline ambient sound level survey and the modeled Project sound levels were compared to the City of Boston Zoning District Noise Standards. Separate regulations within the Standards provide criteria to control different types of noise. Regulation 2 is applicable to the effects of the Project, as completed, and is considered in this noise study. Table 4.10-1 includes the Zoning District Standards.

Table 4.10-1 City of Boston Zoning District Noise Standards, Maximum Allowable Sound Pressure Levels

Octave-band Center	Residential Zoning District		Residential-Industrial Zoning District		Business Zoning District	Industrial Zoning District
Frequency (Hz)	Daytime (dB)	All Other Times (dB)	Daytime (dB)	All Other Times (dB)	Anytime (dB)	Anytime (dB)
32	76	68	79	72	79	83
63	75	67	78	71	78	82
125	69	61	73	65	73	77
250	62	52	68	57	68	73
500	56	46	62	51	62	67
1000	50	40	56	45	56	61
2000	45	33	51	39	51	57
4000	40	28	47	34	47	53
8000	38	26	44	32	44	50
A-Weighted (dBA)	**60**	**50**	**65**	**55**	**65**	**70**

Notes:
1. Noise standards are extracted from Regulation 2.5, City of Boston Air Pollution Control Commission, "Regulations for the Control of Noise in the City of Boston", adopted December 17, 1976.
2. All standards apply at the property line of the receiving property.
3. dB and dBA based on a reference sound pressure of 20 micropascals.
4. 'Daytime' refers to the period between 7:00 a.m. and 6:00 p.m. daily, excluding Sunday.

Additionally, MassDEP has the authority to regulate noise under 310 CMR 7.10, which is part of the Commonwealth's air pollution control regulations. According to MassDEP, "unnecessary" noise is considered an air contaminant and thus prohibited by 310 CMR 7.10. MassDEP administers this regulation through Noise Policy DAQC 90-001 which limits a source to a 10-dBA increase above the L_{90} ambient sound level measured at the Project property line and at the nearest residences. The MassDEP policy further prohibits "pure tone" conditions where the sound pressure level in one octave-band is three dB or more greater than the sound levels in each of two adjacent bands.

4.10.4 Existing Conditions

A background noise level survey was conducted to characterize the existing "baseline" acoustical environment in the vicinity of the Project, located within the North End neighborhood of Boston, Massachusetts. Existing noise sources in the vicinity of the Project site currently include: vehicular traffic along local roadways; birds; wind noise; light leaf rustle; aircraft flyovers; pedestrian conversation and foot traffic; mechanical equipment located on the surrounding buildings; roadway construction; and the general noises of the City.

4.10.4.1 Noise Monitoring Methodology

Sound level measurements were made on Tuesday, July 30, 2013 during the daytime (10:00 a.m. to 1:00 p.m.) and on Thursday, July 25, 2013 during nighttime hours (12:00 a.m. to 3:00 a.m.). Since noise impacts from the Project on the community will be highest when background noise levels are the lowest, the study was designed to measure community noise levels under conditions typical of a "quiet period" for the area. Daytime measurements were scheduled to avoid peak traffic conditions. All measurements were 20 minutes in duration.

Sound levels were measured at publicly accessible locations at a height of five feet (1.5 meters) above ground level, under low wind conditions, and with dry roadway surfaces. Wind speed measurements were made with a Davis Instruments TurboMeter electronic wind speed indicator, and temperature and humidity measurements were made using a General Tools digital psychrometer. Unofficial observations about meteorology or land use in the community were made solely to characterize the existing sound levels in the area and to estimate the noise sensitivity at properties near the Project site.

4.10.4.2 Noise Monitoring Locations

The selection of the noise monitoring locations was based upon a review of zoning and land use in the Project area. Five noise monitoring locations were selected as representative sites to obtain a sampling of the ambient baseline noise environment. These measurement locations are depicted on Figure 4.10-1 and described below.

- Location ST-1 was located at the northwest corner of the Archstone Avenir Apartments along Causeway Street. This location was selected to represent sound levels at residential receptors along Causeway Street immediately southeast of the Project.

- Location ST-2 was located on the southern sidewalk of Thatcher Street to the west of Endicott Street. This location was selected to represent sound levels at residential receptors within the neighborhood to the east of the Project.

- Location ST-3 was located on the northern sidewalk of Causeway Street across from Medford Street. This location was selected to represent sound levels at residential receptors to the immediate northeast of the Project.

- Location ST-4 was located at the western corner of the intersection of Causeway Street, Lomasney Street, and Staniford Street. This location was selected to represent sound levels at residential receptors at 150 Staniford Street and those located west of the Project.

- Location ST-5 was located on the western sidewalk of Nashua Street directly east of the Suffolk County Jail and southwest of the previous Spaulding Rehabilitation Hospital. This location was selected to represent sound levels at residential receptors to the north of the Project.

4.10.4.3 Noise Monitoring Equipment

A Casella Model CEL-593 sound level meter equipped with a CEL-527 Type I Preamplifier, a CEL-250 half-inch electret microphone, and manufacturer-provided windscreen was used to collect background sound pressure level data. This instrumentation meets the "Type 1 - Precision" requirements set forth in American National Standards Institute (ANSI) S1.4 for acoustical measuring devices. The measurement equipment was calibrated in the field before and after the surveys with a Casella CEL-110/1 acoustical calibrator which meets the standards of IEC 942 Class 1L and ANSI S1.40-1984. Statistical descriptors (L_{eq}, L_{90}, etc.) were calculated for each 20-minute sampling period, with octave-band sound levels corresponding to the same data set processed for the broadband levels.

4.10.4.4 Measures Background Noise Levels

Baseline noise monitoring results are presented in Table 4.10-2, and summarized below:

- The daytime residual background (L_{90} dBA) measurements ranged from 58 to 68 dBA;

- The nighttime residual background (L_{90} dBA) measurements ranged from 54 to 60 dBA;

- The daytime equivalent level (L_{eq} dBA) measurements ranged from 64 to 81 dBA;

- The nighttime equivalent level (L_{eq} dBA) measurements ranged from 58 to 69 dBA;

Table 4.10-2 Summary of Measured Background Noise Levels

Location	Period	Start Time	L_{eq}	L_{max}	L_{10}	L_{50}	L_{90}	L_{90} Sound Pressure Level by Octave-Band								
								32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz
			dBA	dBA	dBA	dBA	dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
ST-1	Day	10:53 AM	72	93	74	71	66	69	71	68	66	63	62	58	51	42
ST-2	Day	12:19 PM	64	89	67	61	58	63	63	58	56	55	53	49	43	33
ST-3	Day	10:23 AM	81	103	76	71	68	70	72	69	64	63	66	61	51	40
ST-4	Day	11:18 AM	70	90	72	67	64	74	72	71	63	60	59	57	50	42
ST-5	Day	11:44 AM	70	89	72	69	67	70	76	76	64	61	62	57	47	33
ST-1	Night	12:01 AM	69	87	72	62	59	63	63	60	56	54	56	51	40	29
ST-2	Night	12:42 AM	58	85	59	55	54	55	57	54	52	51	50	46	39	30
ST-3	Night	1:15 AM	65	79	68	63	60	57	61	58	56	55	57	52	41	26
ST-4	Night	1:51 AM	66	85	65	57	56	59	61	59	55	53	51	46	37	—
ST-5	Night	2:30 AM*	66	86	68	61	59	71	67	62	58	55	56	51	43	33

*Roadway construction activities occurred during nighttime measurement period.

Weather Conditions:

	Date	Temp	RH	Sky	Wind
Daytime	Tuesday, July 30, 2013	86.5 °F	37%	clear/sunny	1-5 mph NE
Nighttime	Thursday, July 25, 2013	67.6 °F	52%	partly cloudy	0-6 mph variable

Monitoring Equipment Used:

	Manufacturer	Model	S/N
Sound Level Meter	Casella	CEL-593	3/0162197
Microphone	Casella	CEL-250	6259
Preamp	Casella	CEL-527	3/1152208
Calibrator	Casella	CEL-110/1	16028

4.10.5 Future Conditions

4.10.5.1 Overview of Potential Project Noise Sources

The primary sources of continuous sound exterior to the Project will include ventilation, cooling, and emergency power noise sources, located predominantly on the upper rooftops and fifth floor mechanical rooms, with the exception of exhaust fans related to parking garage ventilation.

The residential building is anticipated to include three cooling towers, two chillers, and three energy recovery units located on the upper roof, along with two chillers, one energy recovery unit, and one emergency generator located in the fifth floor mechanical room with a louvered wall along the western façade. The podium building is anticipated to include three cooling towers, four chillers, and an emergency generator located on the upper roof. The hotel building is anticipated to include two cooling towers and one energy recovery unit located on the upper roof, along with two chillers and an emergency generator located in the fifth floor mechanical room with louvered walls along the northern and southern façades. The office building is anticipated to include six cooling towers, six chillers, one ventilation air unit, and one emergency generator located on the upper roof. Eight garage inlet and eight garage exhaust fans (two per level per shaft) are anticipated to vent air from the below-grade parking garage through a total of two at-grade plenums.

Other secondary noise sources, such as domestic hot water heaters, boilers, and pumps will either be enclosed within the building interior, or are assumed to have sound levels 10 dBA lower than the primary sources of noise, and were not considered in this analysis to contribute significantly to the overall sound level. Ventilation fans proposed for the rooftop will be much smaller in size and were not anticipated to be a significant source of noise.

All emergency diesel generators will be located at roof level or in louvered fifth floor mechanical penthouses within dedicated enclosures. It is assumed that these generators will only operate during the day for brief, routine testing when background sound levels will be higher, or during an emergency interruption of the electrical grid when other rooftop mechanical equipment will not be operating.

Mitigation will be applied to sources as needed to ensure compliance with the applicable noise regulations. The noise control features assumed in this analysis, as described in Table 4.10-4, were acoustical louvers on the fifth floor mechanical room wall openings and garage supply/exhaust plenums, generator enclosures, and a critical-grade generator exhaust silencers.

A tabular summary of the modeled mechanical equipment proposed for the Project is presented below in Table 4.10-3a. Sound power level data for each unit, as provided by the manufacturer or calculated from provided sound pressure level data, is presented in

Table 4.10-3b. Sound power levels of those units for which data was not provided were assumed based on data for similar or representative equipment. The approximate locations of the mechanical equipment were provided by the Project team in a preliminary roof plan.

Table 4.10-3-a Modeled Noise Sources

Noise Source	Quantity	Anticipated Location	Size/Capacity per Unit
Cooling Tower	14	Residential Roof (x3), Retail Roof (x3) Hotel Roof (x2), Office Roof (x6)	~300 Ton
Chiller	16	Residential Roof (x2), Residential 5th Floor (x2), Retail Roof (x4), Hotel 5th Floor (x2), Office Roof (x6)	600 Ton
Energy Recovery Unit	4	Residential Roof (x2), Residential 5th Floor (x1), Hotel Roof (x1)	22,000 CFM
Garage Intake Fan	8	At-Grade Plenum	12,000 CFM
Garage Exhaust Fan	8	At-Grade Plenum	12,000 CFM
Ventilation Air Unit	1	Office Roof (x1)	55,000 CFM
Emergency Generator	5	Residential 5th Floor (x1), Hotel 5th Floor (x1), Retail Roof (x1), Office Roof (x1), Tennant Roof (x1)	800 kW

Table 4.10-3-b Modeled Sound Power Levels per Unit

Noise Source	Broadband	32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
	dBA	dB	dB	dB	dB	dB	dB	dB	dB	dB
Cooling Tower[1]	93	101	101	98	90	89	88	84	82	81
Chiller[2]	95	80	80	83	83	83	83	84	92	85
Energy Recovery Unit[3]	95	90	90	92	98	91	89	86	83	80
Garage Intake Fan[4]	90	77	77	86	91	88	84	81	78	69
Garage Exhaust Fan[5]	92	84	84	84	87	89	88	84	80	69
Ventilation Air Unit[6]	85	109	96	89	92	78	73	65	67	62
Emergency Generator - Mechanical (Enclosed)[7]	111	115	115	116	108	106	104	104	104	98
Emergency Generator - Exhaust (Open)[8]	118	82	82	108	118	114	113	112	103	84

Notes:

1. Evapco Model UT-19-911 314 ton, Single-Cell with Super Low Sound Fan
2. Carrier Evergreen 600 Ton 19XRV Chiller, Model 19XRV5051446LCH64
3. AAON 4212-25 Axial Fan Outlet
4. Greenheck QEI-22-I Mixed Flow Fan, 12,000 CFM, Inlet
5. Greenheck QEI-22-I Mixed Flow Fan, 12,000 CFM, Outlet
6. Ecotron RK+-500-HW-C-H-ACCUi, 2"insulation
7. Caterpillar C27DE37 Standby Diesel Generator Set, 800kW, WP Canopy
8. Caterpillar C27DE37 Standby Diesel Generator Set, 800kW, Open Exhaust

Table 4.10-4 Attenuation Values Used for Noise Modeling (dB)

Noise Control	Noise Source	Noise Reduction (dB) per Octave-band Center Frequency (Hz)								
		32	63	125	250	500	1000	2000	4000	8000
Exhaust Silencer[1]	Emergency Generator Exhausts	-	20	35	35	27	20	20	22	22
Acoustical Louvers[2]	Garage Fan Plenums	-	15	14	15	19	30	31	29	29
Acoustical Louvers[3]	5th Floor Mechanical Rooms	-	9	8	9	13	24	25	23	23

Notes:

1. JB Series Critical Grade Silencer (JB-18)
2. Safe Air Dowco Model UFD-12 Acoustical Louver, Noise Reduction
3. Safe Air Dowco Model UFD-12 Acoustical Louver, Transmission Loss

4.10.5.2 Noise Modeling Methodology

Noise impacts from mechanical equipment associated with the Project were predicted using Cadna/A noise calculation software (DataKustik Corporation, 2005). This software, which uses the ISO 9613-2 international standard for sound propagation (Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation), offers a refined set of computations accounting for local topography, ground attenuation, drop-off with distance, barrier shielding, diffraction around building edges, reflection off building facades, and atmospheric absorption of sound from multiple noise sources.

An initial analysis considered all of the mechanical equipment without the emergency generator running, to simulate typical nighttime operating conditions at nearby receptors. A second analysis combined the mechanical equipment and the emergency generator, to reflect worse-case daytime conditions during brief, routine, testing of the generator when ambient levels are higher.

4.10.5.3 Noise Modeling Results

Ten modeling locations with a height of 1.5 meters above-grade were included in both analyses, consisting of nearby residential and commercial locations, and were evaluated against the applicable daytime or nighttime background sound levels and noise limits. Figure 4.10-1 shows the locations of each modeled receptor as well as the monitoring locations selected for background measurements.

In both scenarios, the predicted future sound levels (Project + background) are well below the MassDEP criteria of 10 dBA over the measured background L_{90} sound levels at all sensitive receptor locations. This evaluation, with and without the emergency generator, is presented in Tables 4.10-5a and b, respectively. The Project's mechanical equipment is not expected to create or exacerbate any "pure-tone" conditions as defined by MassDEP when combined with existing background sound levels at these locations. Predicted sound levels combining Project and background sources are shown with and without the emergency generator in Tables 4.10-6a and b, respectively. Additionally, modeled sound levels from Project equipment are within the most stringent broadband and octave-band residential zoning limits for the City of Boston at the closest residential receptors and also meet the business and industrial limits where applicable. This evaluation is presented with and without the emergency generator in Tables 4.10-7a and b, respectively.

Table 4.10-5a MassDEP Compliance Evaluation (*With* Emergency Generator)

Receptor ID	Land Use	Representative Background ID	Evaluation Period	Measured Background Noise Level	Modeled Project-Only Noise Level	Combined Project + Background Noise Level	Project Impact[1]	Meets MassDEP Noise Policy?
				dBA	dBA	dBA	dBA	
R1	Residential	ST-5	Day	67	45	67	0	YES
R2	Residential	ST-5	Day	67	45	67	0	YES
R3	Residential	ST-3	Day	68	44	68	0	YES
R4	Residential	ST-3	Day	68	46	68	0	YES
R5	Residential	ST-2	Day	58	43	58	0	YES
R6	Residential	ST-1	Day	66	53	66	0	YES
R7	Residential	ST-2	Day	58	45	58	0	YES
R8	Residential	ST-1	Day	66	52	66	0	YES
R9	Residential	ST-4	Day	64	45	64	0	YES
R10	Residential	ST-4	Day	64	43	64	0	YES

1. Calculation of increase over background performed using data rounded to nearest whole decibel

Table 4.10-5b MassDEP Compliance Evaluation (*Without* Emergency Generator)

Receptor ID	Land Use	Representative Background ID	Evaluation Period	Measured Background Noise Level	Modeled Project-Only Noise Level	Combined Project + Background Noise Level	Project Impact[1]	Meets MassDEP Noise Policy?
				dBA	dBA	dBA	dBA	
R1	Residential	ST-5	Night	59	40	59	0	YES
R2	Residential	ST-5	Night	59	38	59	0	YES
R3	Residential	ST-3	Night	60	32	60	0	YES
R4	Residential	ST-3	Night	60	40	60	0	YES
R5	Residential	ST-2	Night	54	41	54	0	YES
R6	Residential	ST-1	Night	59	44	59	0	YES
R7	Residential	ST-2	Night	54	40	54	0	YES
R8	Residential	ST-1	Night	59	41	59	0	YES
R9	Residential	ST-4	Night	56	35	56	0	YES
R10	Residential	ST-4	Night	56	37	56	0	YES

[1] Calculation of increase over background performed using data rounded to nearest whole decibel

Table 4.10-6a MassDEP "Pure Tone" Evaluation: Combined Project + Background Levels (*With* Emergency Generator)

Receptor ID	Land Use	Period	dBA	32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
				dB	dB	dB	dB	dB	dB	dB	dB	dB
R1	Residential	Day	67	70	76	76	64	61	62	57	47	33
R2	Residential	Day	67	70	76	76	64	61	62	57	47	33
R3	Residential	Day	68	70	72	69	64	63	66	61	51	40
R4	Residential	Day	68	71	72	69	64	63	66	61	51	40
R5	Residential	Day	58	64	64	59	56	55	53	49	43	33
R6	Residential	Day	66	71	72	69	66	63	62	58	51	42
R7	Residential	Day	58	65	64	60	56	55	53	49	43	33
R8	Residential	Day	66	71	72	69	66	63	62	58	51	42
R9	Residential	Day	64	74	72	71	63	60	59	57	50	42
R10	Residential	Day	64	74	72	71	63	60	59	57	50	42

Table 4.10-6b MassDEP "Pure Tone" Evaluation: Combined Project + Background Levels (*Without* Emergency Generator)

Receptor ID	Land Use	Period	dBA	32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
				dB	dB	dB	dB	dB	dB	dB	dB	dB
R1	Residential	Night	59	71	67	62	58	55	56	51	43	33
R2	Residential	Night	59	71	67	62	58	55	56	51	43	33
R3	Residential	Night	60	58	**61**	58	56	55	57	52	41	26
R4	Residential	Night	60	59	61	58	56	55	57	52	41	26
R5	Residential	Night	54	57	58	55	52	51	50	46	39	30
R6	Residential	Night	59	64	63	60	57	54	56	51	40	29
R7	Residential	Night	54	57	58	55	52	51	50	46	39	30
R8	Residential	Night	59	63	63	60	56	54	56	51	40	29
R9	Residential	Night	56	59	61	59	55	53	51	46	37	N/A
R10	Residential	Night	56	59	61	59	55	53	51	46	37	N/A

*Highlighted cell represents MassDEP "pure tone" already present in measured background levels without Project contribution.

Table 4.10-7a City of Boston Compliance Evaluation: Project-Only Modeling Results (*With* Emergency Generator)

Receptor ID		Land Use	Period	dBA	32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
					dB	dB	dB	dB	dB	dB	dB	dB	dB
R1		Residential	Day	45	55	54	53	46	42	39	34	25	0
R2		Residential	Day	45	56	54	54	47	42	38	34	24	0
R3		Residential	Day	44	60	57	55	46	40	35	32	28	6
R4		Residential	Day	46	61	58	57	49	42	36	33	29	6
R5		Residential	Day	43	56	55	52	44	40	37	32	24	0
R6		Residential	Day	53	67	62	64	56	50	39	37	36	24
R7		Residential	Day	45	60	56	55	47	43	37	33	28	9
R8		Residential	Day	52	68	63	64	55	49	38	36	35	22
R9		Residential	Day	45	60	56	57	48	42	32	29	26	3
R10		Residential	Day	43	58	54	54	45	39	32	29	22	0
City of Boston Noise Limits	Residential		Day	60	76	75	69	62	56	50	45	40	38
			Night	50	68	67	61	52	46	40	33	28	26
	Residential/Industrial		Day	65	79	78	73	68	62	56	51	47	44
			Night	55	72	71	65	57	51	45	39	34	32
	Business		Day	65	79	78	73	68	62	56	51	47	44
			Night	65	79	78	73	68	62	56	51	47	44
	Industrial		Day	70	83	82	77	73	67	61	57	53	50
			Night	70	83	82	77	73	67	61	57	53	50

Table 4.10-7b City of Boston Compliance Evaluation: Project-Only Modeling Results (*Without* Emergency Generator)

Receptor ID		Land Use	Period	dBA	32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
					dB	dB	dB	dB	dB	dB	dB	dB	dB
R1		Residential	Night	40	50	49	46	39	36	37	31	20	0
R2		Residential	Night	38	49	48	45	38	35	34	27	18	0
R3		Residential	Night	32	51	46	41	34	29	26	21	20	0
R4		Residential	Night	40	54	51	47	44	37	33	27	22	0
R5		Residential	Night	41	53	51	48	41	38	36	30	22	0
R6		Residential	Night	44	54	51	48	50	42	32	27	28	15
R7		Residential	Night	40	53	51	47	41	37	35	29	24	5
R8		Residential	Night	41	53	51	47	46	37	30	25	27	13
R9		Residential	Night	35	50	47	43	40	32	26	19	18	0
R10		Residential	Night	37	49	48	45	39	34	31	25	16	0
City of Boston Noise Limits	Residential		Day	60	76	75	69	62	56	50	45	40	38
			Night	50	68	67	61	52	46	40	33	28	26
	Residential/Industrial		Day	65	79	78	73	68	62	56	51	47	44
			Night	55	72	71	65	57	51	45	39	34	32
	Business		Day	65	79	78	73	68	62	56	51	47	44
			Night	65	79	78	73	68	62	56	51	47	44
	Industrial		Day	70	83	82	77	73	67	61	57	53	50
			Night	70	83	82	77	73	67	61	57	53	50

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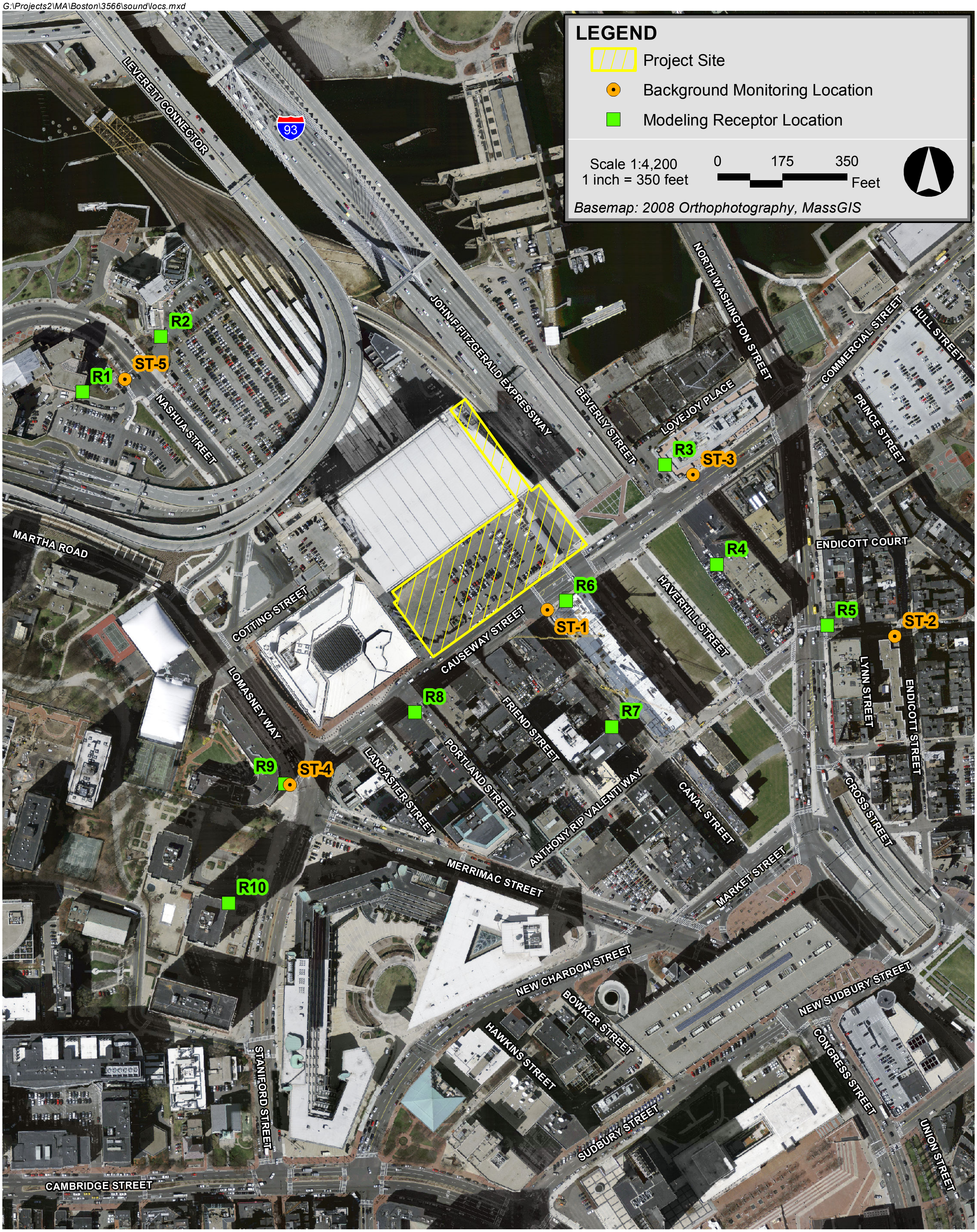

The Boston Garden   Boston, Massachusetts

Epsilon ASSOCIATES INC.

Figure 4.10-1

Noise Monitoring and Modeling Locations

4.10.6 Conclusions

Baseline noise levels were measured in the vicinity of the Project site and were compared to predicted noise levels based on information provided by the manufacturers of representative mechanical equipment or estimated from the equipment's capacity. With appropriate mitigation (as described in Section 4.10.5.1), the Project is not expected to introduce significant outdoor mechanical equipment noise into the surrounding community.

Results of the analysis indicate that noise levels from the Project at the nearest receptors will be well below the City of Boston Noise Zoning requirements based on land use, and will comply with MassDEP A-weighted and tonal noise limits. The results presented in Section 4.10.5.3 indicate that the Project is not anticipated to impact the existing acoustical environment.

At this time, the mechanical equipment and noise controls are conceptual in nature and, during the final design phase of the Project, will be specified to meet the applicable City of Boston and MassDEP noise limits. Additional mitigation may include the selection of quieter units, acoustical louvers, screening walls, mufflers, or equipment enclosures, as needed.

4.11 Construction

4.11.1 Introduction

A Construction Management Plan (CMP) in compliance with the City's Construction Management Program will be submitted to the BTD once final plans are developed and the construction schedule is fixed. The construction contractor will be required to comply with the details and conditions of the approved CMP.

Proper pre-planning with the City and neighborhood will be essential to the successful construction of the Project. Construction methodologies which ensure public safety and protect nearby residences and businesses will be employed. The CMP will include routing plans for trucking and deliveries, plans for the protection of existing utilities, and control of noise and dust.

During the construction phase of the Project, the Proponent will provide the name, telephone number and address of a contact person to communicate with on issues related to the construction. The construction contact will be responsible for responding to the questions/comments/complaints of the residents of the nearby area.

The Proponent intends to follow the guidelines of the City of Boston and the MassDEP, which direct the evaluation and mitigation of construction impacts.

4.11.2 Construction Methodology/Public Safety

Construction methodologies that ensure public safety and protect nearby tenants will be employed. Techniques such as barricades and signage will be used. Construction management and scheduling will minimize impacts on the surrounding environment and will include plans for construction worker commuting and parking, routing plans for trucking and deliveries, and the control of noise and dust.

As the design of the Project progresses, the Proponent will meet with BTD to discuss the specific location of barricades, the need for lane closures, pedestrian walkways, and truck queuing areas. Secure fencing, signage and covered walkways will be used, as necessary, to ensure the safety and efficiency of all pedestrian and vehicular traffic flows. In addition, sidewalk areas and walkways near construction activities will be well marked and lighted to protect pedestrians and ensure their safety. Public safety for pedestrians on abutting sidewalks will also include covered pedestrian walkways when appropriate. If required by BTD and the Boston Police Department, police details will be provided to facilitate traffic flow. These measures will be incorporated into the CMP which will be submitted to BTD for approval prior to the commencement of construction work.

4.11.3 Construction Schedule

The Proponent anticipates that the Project will commence in the third quarter of 2014 and construction of the first phase will finish approximately around the first quarter of 2017. Future phases will have similar construction durations of 24-36 months.

Typical construction hours will be from 7:00 a.m. to 6:00 p.m., Monday through Friday, with most shifts ordinarily ending at 3:30 p.m. No substantial sound-generating activity will occur before 7:00 a.m. If longer hours, additional shifts, or Saturday work is required, the construction manager will place a work permit request to the Boston Air Pollution Control Commission and BTD in advance. Notification would occur during normal business hours, Monday through Friday. It is noted that some activities such as finishing activities could run beyond 6:00 p.m. to ensure the structural integrity of the finished product; certain components must be completed in a single pour, and placement of concrete cannot be interrupted.

4.11.4 Construction Staging/Access

Access to the site and construction staging areas will be provided in the CMP.

Although specific construction and staging details have not been finalized, the Proponent and its construction management consultant will work to ensure that staging areas will be located to minimize impacts to pedestrian and vehicular flow. Secure fencing and barricades will be used to isolate construction areas from pedestrian traffic adjacent to the site. Construction procedures will be designed to meet all Occupational Safety and Health Administration (OSHA) safety standards for specific site construction activities.

4.11.5 Construction Mitigation

The Proponent will follow City and MassDEP guidelines which will direct the evaluation and mitigation of construction impacts. As part of this process, the Proponent and construction team will evaluate the Commonwealth's Clean Air Construction Initiative.

The CMP, to be submitted to BTD for review and approval prior to issuance of a building permit, will include detailed information on specific construction mitigation measures and construction methodologies to minimize impacts to abutters and the local community. The CMP will also define truck routes which will help in minimizing the impact of trucks on City and neighborhood streets.

"Don't Dump - Drains to Charles River" plaques will be installed at storm drains that are replaced or installed as part of the Project.

4.11.6 Construction Employment and Worker Transportation

The number of workers required during the construction period will vary. It is anticipated that approximately 2,000 construction jobs will be created over the length of construction. The Proponent will make reasonable good-faith efforts to have at least 50% of the total employee work hours be for Boston residents, at least 25% of total employee work hours be for minorities and at least 10% of the total employee work hours be for women. The Proponent will enter into a jobs agreement with the City of Boston.

To reduce vehicle trips to and from the construction site, minimal construction worker parking will be available at the site, and all workers will be strongly encouraged to use public transportation and ridesharing options. The general contractor will work aggressively to ensure that construction workers are well informed of the public transportation options serving the area. Space on-site will be made available for workers' supplies and tools so they do not have to be brought to the site each day.

4.11.7 Construction Truck Routes and Deliveries

Truck traffic will vary throughout the construction period, depending on the activity. The construction team will manage deliveries to the site during morning and afternoon peak hours in a manner that minimizes disruption to traffic flow on adjacent streets. Construction truck routes to and from the site for contractor personnel, supplies, materials, and removal of excavations required for the development will be coordinated with BTD. Traffic logistics and routing will be planned to minimize community impacts. Truck access during construction will be determined by BTD as part of the CMP. These routes will be mandated as a part of all subcontractors' contracts for the development. The construction team will provide subcontractors and vendors with Construction Vehicle & Delivery Truck Route Brochures in advance of construction activity.

"No Idling" signs will be included at the loading, delivery, pick-up and drop-off areas.

4.11.8 Construction Air Quality

Impacts associated with construction activities may generate fugitive dust, which will result in localized increases in airborne particulate levels. Fugitive dust emissions from construction activities will depend on such factors as the properties of the emitting surfaces (e.g., moisture content, and volume of spoils), meteorological variables, and construction practices employed.

To reduce emissions of fugitive dust and minimize impacts on the local environment, the construction work will adhere to a number of strictly enforced mitigation measures. These measures may include the following:

- Using wetting agents regularly to control and suppress dust that may come from the construction materials;
- Fully covering all trucks used for transportation of construction debris;
- Removing construction debris from each site regularly as needed;
- Monitoring actual construction practices to ensure that unnecessary transfers and mechanical disturbances of loose materials are minimized and to ensure that any emissions of dust are negligible;
- Providing a wheel wash at all exits from the construction areas; and
- Cleaning streets and sidewalks periodically to minimize dust accumulations.

4.11.9 Construction Noise

The Proponent is committed to mitigating noise impacts from the construction of the Project. Increased community sound levels, however, are an inherent consequence of construction activities. Construction work will comply with the requirements of the City of Boston Noise Ordinance. Every reasonable effort will be made to minimize the noise impact of construction activities.

Mitigation measures are expected to include:

- Instituting a proactive program to ensure compliance with the City of Boston noise limitation policy;
- Using appropriate mufflers on all equipment and ongoing maintenance of intake and exhaust mufflers;
- Muffling enclosures on continuously running equipment, such as air compressors and welding generators;

- Replacing specific construction operations and techniques by less noisy ones where feasible;
- Selecting the quietest of alternative items of equipment where feasible;
- Scheduling equipment operations to keep average noise levels low, to synchronize the noisiest operations with times of highest ambient levels, and to maintain relatively uniform noise levels;
- Turning off idling equipment; and
- Locating noisy equipment at locations that protect sensitive locations by shielding or distance.

4.11.10 Construction Vibration

All means and methods for performing work at the site will be evaluated for potential vibration impacts on adjoining property, utilities, and adjacent existing structures. Acceptable vibration criteria will be established prior to construction, and vibration will be monitored, if required, during construction to ensure compliance with the agreed-upon standard.

4.11.11 Construction Waste

The Proponent will take an active role with regard to the reprocessing and recycling of construction waste. The disposal contract will include specific requirements that will ensure that construction procedures allow for the necessary segregation, reprocessing, reuse and recycling of materials when possible. The Construction Manager will endeavor to divert as much demolition debris and construction waste from area landfills as possible, with a goal to achieve 75% diversion. For those materials that cannot be recycled, solid waste will be transported in covered trucks to an approved solid waste facility, per MassDEP Regulations for Solid Waste Facilities, 310 CMR 16.00. This requirement will be specified in the disposal contract. Construction will be conducted so that materials that may be recycled are segregated from those materials not recyclable to enable disposal at an approved solid waste facility.

4.11.12 Protection of Utilities

Existing public and private infrastructure located within the public right-of-way will be protected during construction. The installation of proposed utilities within the public way will be in accordance with the MWRA, BWSC, Boston Public Works, Dig Safe, and the governing utility company requirements. All necessary permits will be obtained before the commencement of the specific utility installation. Specific methods for constructing proposed utilities where they are near to, or connect with, existing water, sewer and drain facilities will be reviewed by BWSC as part of its site plan review process.

4.11.13 Rodent Control

A rodent extermination certificate will be filed with the building permit application for the Project. Rodent inspection monitoring and treatment will be carried out before, during, and at the completion of all construction work for each phase of the Project, in compliance with the City's requirements.

4.11.14 Wildlife Habitat

The Project site is currently developed and in an established urban neighborhood. There are no wildlife habitats in or adjacent to the Project site.

Chapter 5.0

Sustainable Design and Climate Change Preparedness

5.0 SUSTAINABLE DESIGN AND CLIMATE CHANGE PREPAREDNESS

5.1 Green Building

The Proponent is committed to developing a project that is sustainably designed and energy efficient with interior environments that are healthy for the residents, employees and visitors. As required under Article 37 of the Boston Zoning Code, projects that are subject to Article 80B, Large Project Review, shall be Leadership in Energy and Environmental Design (LEED) certifiable. The Project will use the LEED CS v2009 to show compliance with Article 37. The LEED rating system tracks the sustainable features of a project by achieving points in the following eight categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation in Design Process and the additional Regional Priority Credits.

The following is a detailed credit-by-credit analysis of the Project team's approach for achieving LEED-CS v2009 at the "Certifiable" level. The Project is anticipating reaching the Certified certification level by targeting 44 credit points. There are a number of additional credit points, listed in italics below, which are still under consideration and will be decided as the design develops and engineering assumptions are substantiated. The LEED-CS v2009 checklist is included at the end of this section.

Sustainable Sites

The Project site is in Boston's West End neighborhood adjacent to one of the City's main transportation hubs, North Station. The proposed site plan will incorporate low-impact site features that will properly capture and infiltrate stormwater to improve groundwater levels and help to mitigate the negative impacts on historic wood pile foundations found in the area. Hardscape and roofing materials will be selected to minimize contribution to the urban heat island effect. Alternative transportation strategies will be employed to reduce pollution impacts from automobile use.

The proposed Project earns points for Site Selection, Development Density, Alternative Transportation options, Stormwater Design, Heat Island Effect, as well as Tenant Design and Construction Guidelines. The Proponent strongly supports public transportation and a number of parking spaces will be designated to alternative transportation options. All parking will be located below grade and there will be preferred parking for low-emitting and fuel efficient vehicles and electric vehicle charging stations. Bicycle storage will also be provided.

Green roofs, light colored and high-albedo roofs will be employed to reduce solar heat gain and the heat island effect. Stormwater from the roofs and open spaces will be collected and managed.

Comprehensive tenant design and construction guidelines will encourage any future tenant in implementing sustainable practices.

Prerequisite 1: Construction Activity Pollution Prevention. The construction manager will submit and implement an Erosion and Sedimentation Control (ESC) Plan for construction activities related to the demolition of existing conditions and the construction of the new development specific to this Project. The ESC Plan will conform to the erosion and sedimentation requirements of the 2012 EPA Construction General Permit and specific municipal requirements for the City of Boston.

Credit 1: Site Selection. The Project site is located on a previously developed parking lot in a dense neighborhood situated adjacent to the TD Garden and North Station.

Credit 2: Development Density and Community Connectivity. The Project site is located in an urban-core area, with a surrounding community that includes many local amenities within walking distance. The Project will also meet the requirements of Exemplary Performance for Development Density of the surrounding neighborhood to earn an Innovation Credit.

Credit 3: Brownfield Redevelopment. The Project site will be tested to determine if it contains contaminated soils or existing building components. If it does, a remediation plan will be established and implemented on site. Contaminated materials will be properly removed and disposed of following all local, state and federal guidelines and regulations.

Credit 4.1: Alternative Transportation, Public Transportation Access. There are several MBTA bus and MBTA/Amtrak rail routes that stop at the adjacent North Station and Haymarket Station. The Project will meet the exemplary performance requirements to earn an Innovation Credit.

Credit 4.2: Alternative Transportation, Bicycle Storage & Changing Rooms. Exterior bike storage locations for visitors and employees are anticipated to be incorporated into the site design. The Project is also exploring the option to include showering facilities for employee occupants.

Credit 4.3: Alternative Transportation, Low-Emitting & Fuel-Efficient Vehicles. Parking will be accommodated for the Project and will include designated preferred parking spaces for low-emitting, fuel efficient vehicles. Additionally, the Project will include electric vehicle charging stations within the parking garage.

Credit 4.4: Alternative Transportation Parking Capacity. The quantity of available parking spaces provided for the Project may not exceed the quantity required by the local zoning regulations, and an alternative transportation plan for residential occupants is being considered by the Project team.

Credit 6.1: Stormwater Design, Quantity Control. The City of Boston has requirements for collection and dispersal of stormwater. Improved absorptive landscaped areas may be designed to help mitigate stormwater runoff from the Project site. The Project team is aiming to reduce the total stormwater runoff for a one and two-year storm design.

Credit 6.2: Stormwater Design, Quality Control. A combination of natural and structural BMP measures will be used to reduce the suspended solids and phosphorus content of the site stormwater runoff. BMP measures may include rain gardens, water quality inlets, and grit chambers. Site stormwater run-off will be captured and treated to the extent possible prior to release.

Credit 7.1: Heat Island Effect, Non-Roof. The Project's parking will be located in an underground garage. The Project will achieve this credit, as well as the exemplary performance credit.

Credit 7.2: Heat Island Effect, Roof. The roofs will be a high albedo membrane roof product with a minimum SRI value of 78, which will cover a minimum of 75% of the Project's total roof area.

Credit 8: Light Pollution Reduction. The Project team is exploring designs for a reduction of the exterior site lighting trespass at the Project boundary, as well as the automation of interior lighting to optimize daily use of the lighting fixtures within interior spaces.

Credit 9: Tenant Design and Construction Guidelines. A set of Design & Construction Guidelines will be developed and available for the tenants that highlight the Project's sustainable features and will provide guidance on how to make sustainable choices in tenant improvement projects.

Water Efficiency

The Project will specify low-flow and high efficiency plumbing fixtures to reduce the amount of potable water used throughout the building. The landscape design will use regionally appropriate, drought tolerant, indigenous plants. There will be a high efficiency irrigation system, if necessary, to support the vegetation.

Prerequisite 1: Water Use Reduction, 20% Reduction. Through the specification of low-flow and high efficiency plumbing fixtures, the Project will implement water use reduction strategies that use, at a minimum, 20% less potable water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements. The Project will target an overall potable water use savings of 30% from the calculated baseline use. *A higher goal of 35% may be possible depending on the final fixture selection for Water Use Reduction by the Project team.*

Credit 1: Water Efficient Landscaping. The Project is aiming to include at least 5% of the total site area as vegetated, landscaped area. The landscape design will incorporate native and adaptive plant materials and, if required, the design of the irrigation system will target a 50% reduction in potable water use when compared to a mid-summer baseline.

Credit 3: Water Use Reduction. Through the specification of low-flow and high efficiency plumbing fixtures, the Project will implement water use reduction strategies that will target an overall potable water use savings of 30% from the calculated baseline use. *A higher goal of 35% may be possible depending on the final fixture selection for Water Use Reduction by the Project team.*

Energy and Atmosphere

The building systems will be designed to optimize energy performance and reduce energy consumption. The design will include high efficiency building systems. No chlorofluorocarbon (CFC) based refrigerants will be used in order to avoid ozone depletion in the atmosphere. The team will explore the feasibility of onsite renewable technologies. At a minimum, the building will be designed to be "solar ready" to ease future photo-voltaic installations.

Attention will be paid to the interior lighting control systems in all base building occupied areas, and tenant guidelines will encourage tenants to also employ an interior lighting control system, which can include occupancy sensors and using less power per square foot than a customary office environment.

The Proponent will engage a Commissioning Agent during the design phase to review the proposed design and ultimately confirm the building systems are installed and function as intended and desired.

Prerequisite 1: Fundamental Commissioning of the Building Energy Systems. A Commissioning Agent, (CxA) will be engaged by the owner for purposes of providing basic commissioning services for the building energy related systems including HVAC & R, lighting, and domestic hot water systems. The CxA will verify the building systems are installed, calibrated and perform to the Project requirements and the Project team's basis of design.

Prerequisite 2: Minimum Energy Performance. The building performance rating will demonstrate a minimum of a 20% improvement in energy use when compared to a baseline building performance as calculated using the rating method in Appendix G of ANSI/ASHREA/IESNA Standard 90.1-2007. This requirement will be met by selecting efficient mechanical equipment. Additionally, an improved building envelope design and efficient lighting will be required to achieve this minimum. The team will develop a whole building energy model to demonstrate the expected performance rating of the designed building systems.

Prerequisite 3: Fundamental Refrigerant Management. The specifications for refrigerants used in the building HVAC & R systems will NOT permit the use of CFC-based refrigerants. The proposed design of the HVAC &R systems will achieve the prerequisite, and compliant selections of any walk-in freezers/coolers (installed by restaurant tenants) will be required.

Credit 1: Optimize Energy Performance. The building performance rating will demonstrate a minimum of a 20% improvement in energy use when compared to a baseline building performance as calculated using the rating method in Appendix G of ANSI/ASHREA/IESNA Standard 90.1-2007. *The Project team will target a higher goal for the Project of at least a 26% improvement in energy use, based on initial design intent.*

Credit 3: Enhanced Commissioning. The team will engage a third-party CxA during the Design Development phase. The CxA's role will include, at minimum, a review of the owner's Project requirements, creating, distributing and implementing a commissioning plan, and performing a design review of the Project documents.

Credit 4: Enhanced Refrigerant Management. Long-life high efficiency mechanical equipment will be specified for the HVAC systems, and the refrigerants specified for the systems will have low Ozone-depletion and global warming potentials. Credit achievement is based on the final equipment selection and the calculated amount of refrigerant in the systems.

Credit 5.1: Measurement and Verification, Base Building. The Proponent will establish an ENERGY STAR Portfolio Manager account to enable the USGBC to review whole building energy and water use for five years after occupancy. *The Project team is exploring further submetering and the development of a Measurement & Verification system.*

Credit 5.2: Measurement and Verification, Tenant Submetering. The Project team is exploring submetering capacity requirements and the development guidelines for tenants to develop a Measurement & Verification plan.

Credit 6: Green Power. The Proponent is exploring purchase of 'green power' for a two-year renewable energy contract to provide a minimum of 35% of the building's electricity from renewable sources.

Materials and Resources

A demolition and construction waste management plan will be implemented during construction of the Project to divert at least 75% of waste material from landfills. Building materials will be selected that contain recycled and regional content to reduce use of virgin materials and energy use associated with transportation while supporting local economies. Building-occupant waste recycling will be encouraged through the use of a building recycling program and facility.

Prerequisite 1: Storage and Collection of Recyclables. Storage of collected recyclables will be accommodated within the Project design. Occupants will have a dedicated area to bring their recyclables for storage and collection. Recyclables will be collected by a contracted waste management company on a regular basis.

Credits 2.1 and 2.2: Construction Waste Management. The specification will require that prior to the start of construction, the construction management team develop and implement a Construction Waste Management plan for waste generation on site. The construction manager will endeavor to divert as much demolition debris and construction waste from area landfills as possible, with a goal to achieve 75% diversion.

Credits 4.1: Recycled Content 10% (post-consumer & ½ pre-consumer). The Project specifications will require certain materials to include pre- and/or post-consumer recycled content. During construction, materials and products submittals will include documentation of the percentage of pre-/post-consumer recycled content. The construction manager will track the recycled content with a Project goal to achieve 10% recycled-content materials based on overall Project materials costs.

Credits 4.2: Recycled Content 20% (post-consumer & ½ pre-consumer). The construction manager will track the recycled content for each material with a Project target to achieve 20% recycled-content materials based on overall Project materials costs.

Credit 5.1: Regional Materials, 10% Extracted, Processed and Manufactured Regionally. The Project specifications will indicate materials be extracted, harvested, recovered and manufactured within a 500-mile radius of the Project site. The Project has established a target for 10% of the materials and products installed to be regional materials. The construction manager will track the submitted and installed materials and products with a goal to achieve the 10% threshold based on overall Project materials costs.

Credits 5.2: Recycled Content 20% Extracted, Processed and Manufactured Regionally. The construction manager will track the regional materials with a Project target to achieve 20% regional materials based on overall Project materials costs.

Credits 7: Certified Wood. The Project team is exploring the cost and availability of FSC certified wood. The construction manager will track all wood materials installed on the Project, as well as invoicing documentation for all FSC certified products installed on the Project.

Indoor Environmental Quality

The comfort and well-being of the building occupants will be paramount in regard to air quality, access to daylight and outside views. An indoor air quality management plan will be implemented during construction to enhance the well-being of construction workers and to promote a better indoor environment for building occupants. Low-emitting materials, finishes, adhesives and sealants, will be employed throughout the building to reduce the quantity of indoor air contaminants and promote the comfort and well-being of installers and building occupants.

Prerequisite 1: Minimum IAQ Performance. The building mechanical systems will be designed to meet or exceed the requirements of ASHRAE Standard 62.1-2007 sections 4 through 7 and/or applicable building codes. Any naturally ventilated spaces will comply with the applicable portions of ASHRAE 62.1 as well.

Prerequisite 2: Environmental Tobacco Smoke (ETS) Control. The public spaces and common areas within the building will be non-smoking. Additionally, smoking will be prohibited within 25 feet of all building openings and air intakes.

Credit 1: Outdoor Air Delivery Monitoring. The HVAC design intends to include permanent monitoring systems to ensure that ventilation systems maintain design minimum requirements through the use of airflow monitoring stations and CO_2 sensors. Final achievement of the credit is dependent upon HVAC design development.

Credit 2: Increased Ventilation. The Project team is exploring the design to increase the ventilation rates to a 30% higher volume than ASHRAE 62.1-2007. Achievement will be dependent on the final design of the ventilation systems and reviewing potential energy use penalties.

Credit 3: Construction IAQ Management Plan, During Construction. The specifications will require the construction manager to develop an Indoor Air Quality Management Plan for the construction and pre-occupancy phases of the Project to meet/exceed the recommended Control Measures of the SMACNA IAQ Guidelines for Occupied Buildings Under Construction 2nd Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3).

Credits 4.1: Low-Emitting Materials, Adhesives & Sealants. The specifications will include requirements for adhesives and sealants to meet low VOC criteria for adhesives and sealants. The construction manager will be required to track all products used to ensure compliance.

Credits 4.2: Low-Emitting Materials, Paints and Coatings. The specifications will include requirements for paints and coatings to meet low VOC criteria for paints and coatings. The construction manager will be required to track all products used to ensure compliance.

Credits 4.3: Low-Emitting Materials, Flooring Systems. The specifications will include requirements for hard surface flooring materials to be Floor Score certified, and carpet systems will endeavor to comply with the Carpet and Rug Institute Green Label program. The construction manager will be required to track all products used to ensure compliance.

Credit 4.4: Low-Emitting Materials, Composite Wood and Agrifiber Products. The Project will research the scope of composite wood on the Project, and attempt to specify and install composite wood and agrifiber products that contain no added urea-formaldehyde. The construction manager may use only compliant composite wood materials.

Credit 5: Indoor Chemical and Pollutant Source Control. The Project team will design to minimize and control the entry of pollutants into the building and to contain chemical use areas. The achievement of this credit will be dependent on the extent of chemical use areas within the Project and the ventilation design attributed to these spaces.

Credit 7: Thermal Comfort, Design. The Project HVAC system design will be in compliance with ASHRAE 55 for all tenant spaces, as well as provide the flexibility for tenant fit-out extensions of the mechanical systems to meet the ASHRAE 55 requirements for thermal comfort.

Credit 8.2: Daylight and Views, Views for 90% of the spaces. It is the intent of the design to provide ample glazing along the perimeter allowing for views for at least 90% of the tenant spaces.

Innovation & Design Processes

The team has identified several possible ID credits listed below, (limited to five ID credits total):

Exemplary Performance for SSc2.2. The Project site is located in a densely developed urban area.

Exemplary Performance for SSc4.1. The Project site is located on several bus routes and rail lines with a frequency of service that includes over 200 transit rides per day.

Exemplary Performance for SSc7.1. The Project site is locating 100% of parking underground with a compliant surface.

Building as an Educational Tool. The Project will explore implementation of two public outreach programs to inform the public about the sustainable design features incorporated into the apartment building Project.

Green Housekeeping/Operations. The owner may use green cleaning products and equipment in the common areas and provide a package for residents explaining the 'green living' components of the Project.

Credit 2 LEED Accredited Professional. A LEED AP will provide administrative services to oversee the LEED credit documentation process.

Regional Priority Credits

Regional Priority Credits, (RPC) are established LEED credits designated by the USGBC to have priority for a particular area of the country. When a Project team achieves one of the designated RPCs, an additional credit is awarded to the Project. RPCs applicable to the 02114 zip code include: SSc3, SSc6.1, SSc7.1, SSc7.2, EAc2(1%) and MRc1.1(75%). This Project anticipates two RPCs for SSc7.1-Heat Island Effect, Non-Roof and SSc7.2 Heat Island Effect, Roof. *Two additional RPCs are possible at the current status of the design: SSc3 Brownfield Redevelopment and SSc6.1 Stormwater Design, Quantity Control.*

Boston Green Building Credits

The Boston Green Building Credits were established in Appendix A of Article 37 as Boston-specific credits that can contribute a point towards a Project's LEED "Certifiable" point total. One point may be awarded for each of the following four categories: Modern Grid; Historic Preservation; Groundwater Recharge; and Modern Mobility.

Modern Grid. The Project does not anticipate qualifying for this credit.

Historic Preservation. The Project is not eligible for this credit since it is a new construction project.

Groundwater Recharge. The team will explore whether or not the proposed Project can provide 50% greater recharge than required under Article 32-6.

Modern Mobility. The team will explore Transportation Demand Management options available and appropriate for the Project.

LEED v3 for Core and Shell Development 2009
Project Scorecard

Project Name: Boston Garden
Project Address: Boston, MA

TOTALS

Yes	?	No
44	38	28

Yes	?	No		Sustainable Sites	28
18	8	2			
Y			Prereq 1	**Construction Activity Pollution Prevention**	Required
1			Credit 1	**Site Selection**	1
5			Credit 2	**Development Density & Community Connectivity**	5
	1		Credit 3	**Brownfield Redevelopment**	1
6			Credit 4.1	**Alternative Transportation,** Public Transportation Access	6
	2		Credit 4.2	**Alternative Transportation,** Bicycle Storage & Changing Room	2
3			Credit 4.3	**Alternative Transportation,** Low-Emitting & Fuel-Efficient Vehic	3
	2		Credit 4.4	**Alternative Transportation,** Parking Capacity	2
		1	Credit 5.1	**Site Development,** Protect or Restore Habitat	1
		1	Credit 5.2	**Site Development,** Maximize Open Space	1
	1		Credit 6.1	**Stormwater Design,** Quantity Control	1
	1		Credit 6.2	**Stormwater Design,** Quality Control	1
1			Credit 7.1	**Heat Island Effect,** Non-Roof	1
1			Credit 7.2	**Heat Island Effect,** Roof	1
	1		Credit 8	**Light Pollution Reduction**	1
1			Credit 9	**Tenant Design and Construction Guidelines**	1

Yes	?	No		Water Efficiency	10
2	5	3			
Y			Prereq 1	**Water Use Reduction, 20%** Reduction	Required
	4		Credit 1	**Water Efficient Landscaping**	2 to 4
				M Reduce Water Use by 50%	2
				M No Potable Water use for Irrigation	4
		2	Credit 2	**Innovative Wastewater Technologies** *** RP	2
2	1	1	Credit 3	**Water Use Reduction**	2 to 4
				Y 30% Reduction	2
				M 35% Reduction	3
				N 40% Reduction	4

Yes	?	No		Energy & Atmosphere	37
10	12	15			
Y			Prereq 1	**Fundamental Commissioning of the Building Energy Systen**	Required
Y			Prereq 2	**Minimum Energy Performance**	Required
Y			Prereq 3	**Fundamental Refrigerant Management**	Required
7	3	11	Credit 1	**Optimize Energy Performance**	3 to 21
				Y 12% New Buildings or 8% Existing Building Renovations	3
				Y 14% New Buildings or 10% Existing Building Renovations	4
				Y 16% New Buildings or 12% Existing Building Renovations	5
				Y 18% New Buildings or 14% Existing Building Renovations	6
				Y 20% New Buildings or 16% Existing Building Renovations	7
				M 22% New Buildings or 18% Existing Building Renovations	8
				M 24% New Buildings or 20% Existing Building Renovations	9
				M 26% New Buildings or 22% Existing Building Renovations	10
				N 28% New Buildings or 24% Existing Building Renovations	11
				N 30% New Buildings or 26% Existing Building Renovations	12
				N 32% New Buildings or 28% Existing Building Renovations	13
				N 34% New Buildings or 30% Existing Building Renovations	14
				N 36% New Buildings or 32% Existing Building Renovations	15
				N 38% New Buildings or 34% Existing Building Renovations	16
				N 40% New Buildings or 36% Existing Building Renovations	17
				N 40% New Buildings or 36% Existing Building Renovations	16
				N 40% New Buildings or 36% Existing Building Renovations	17
				N 40% New Buildings or 36% Existing Building Renovations	18
				N 42% New Buildings or 38% Existing Building Renovations	18
				N 44% New Buildings or 40% Existing Building Renovations	19
				N 46% New Buildings or 42% Existing Building Renovations	20
				N 48% New Buildings or 44% Existing Building Renovations	21
		4	Credit 2	**On-Site Renewable Energy** 1% Renewable Energy use	4
2			Credit 3	**Enhanced Commissioning**	2
	2		Credit 4	**Enhanced Refrigerant Management**	2
1	2		Credit 5.1	**Measurement & Verification:** Base Building	3
	3		Credit 5.2	**Measurement & Verification:** Tenant Submetering	3
	2		Credit 6	**Green Power**	2

Yes	?	No			
4	3	6		**Materials & Resources**	13
Y			Prereq 1	**Storage & Collection of Recyclables**	Required
		5	Credit 1	**Building Reuse**	1 to 5
				N Reuse 25% of Existing Walls, Floors & Roof	1
				N Reuse 33% of Existing Walls, Floors & Roof	2
				N Reuse 42% of Existing Walls, Floors & Roof	3
				N Reuse 50% of Existing Walls, Floors & Roof	4
				N Reuse 75% of Existing Walls, Floors & Roof	5
2			Credit 2	**Construction Waste Management**	1 to 2
				Y Divert 50% from Disposal	1
				Y Divert 75% from Disposal	2
		1	Credit 3	**Materials Reuse,** (5%)	1
1	1		Credit 4	**Recycled Content**	1 to 2
				Y 10% (post-consumer + ½ pre-consumer)	1
				M 20% (post-consumer + ½ pre-consumer)	2
1	1		Credit 5	**Regional Materials, 10%** Extracted, Processed & Manufactured Re(	1 to 2
				Y 10% Extracted, Processed & Manufactured Regionally	1
				M 20% Extracted, Processed & Manufactured Regionally	2
	1		Credit 7	**Certified Wood**	1

Yes	?	No			
5	5	2		**Indoor Environmental Quality**	12
Y			Prereq 1	**Minimum IAQ Performance**	Required
Y			Prereq 2	**Environmental Tobacco Smoke (ETS) Control**	Required
	1		Credit 1	**Outdoor Air Delivery Monitoring**	1
	1		Credit 2	**Increased Ventilation**	1
1			Credit 3	**Construction IAQ Management Plan,** During Construction	1
1			Credit 4.1	**Low-Emitting Materials,** Adhesives & Sealants	1
1			Credit 4.2	**Low-Emitting Materials,** Paints & Coatings	1
1			Credit 4.3	**Low-Emitting Materials,** Flooring Systems	1
	1		Credit 4.4	**Low-Emitting Materials,** Composite Wood & Agrifiber Products	1
	1		Credit 5	**Indoor Chemical & Pollutant Source Control**	1
		1	Credit 6	**Controllability of Systems,** Thermal Comfort	1
1			Credit 7	**Thermal Comfort,** Design	1
		1	Credit 8.1	**Daylight & Views,** Daylight 75% of Spaces	1
	1		Credit 8.2	**Daylight & Views,** Views for 90% of Spaces	1

Yes	?	No			
3	3	0		**Innovation & Design Process**	6
1			Credit 1.1	**ID - Exemplary Performance in SSc4.1**	1
1			Credit 1.2	**ID - Exemplary Performance in SSc7.1**	1
	1		Credit 1.3	**ID - Pending Strategy**	1
	1		Credit 1.4	**ID - Pending Strategy**	1
	1		Credit 1.5	**ID - Pending Strategy**	1
1			Credit 2	**LEED® Accredited Professional**	1

Yes	?	No			
2	2	0		**Regional Priority Credits**	4
1			Credit 1.1	**Regional Priority for 02114:** SSc3, SSc6.1, SSc7.1, SSc7.2, EAc2 (1%), MRc1.1	1
1			Credit 1.2	**Regional Priority for 02118:** SSc3, SSc6.1, SSc7.1, SSc7.2, EAc2 (1%), MRc1.1	1
	1		Credit 1.3	**Regional Priority for 02118:** SSc3, SSc6.1, SSc7.1, SSc7.2, EAc2 (1%), MRc1.1	1
	1		Credit 1.4	**Regional Priority for 02118:** SSc3, SSc6.1, SSc7.1, SSc7.2, EAc2 (1%), MRc1.1	1

Yes	?	No		
44	38	28	**Project Totals (Certification Estimates)**	110

Certified: 40-49 points, **Silver:** 50-59 points, **Gold:** 60-79 points, **Platinum:** 80+ points

5.2 Climate Change Preparedness

The City's interest in adapting to climate change has been manifested by the Mayor's Executive Order Relative to Climate Change in Boston, and the recent convening of the Mayor's Climate Action Leadership Committee. In general, the proposed Project team examined the following areas of concern related to climate change: sea level rise, drought conditions, and increased number of high-heat days and higher cost of energy.

The BRA recently began asking project proponents to complete an on-line questionnaire regarding their project's climate change preparedness. A copy of the completed questionnaire is included in Appendix E. Given the preliminary level of design, the responses are also preliminary and may be updated as the Project design progresses.

Sea Level Rise

According to the Intergovernmental Panel on Climate Change (IPCC), if the sea level continues to rise at the current rate, the sea level in Massachusetts as a whole will rise by one foot by the year 2100. However, using a high emissions scenario, sea level rise could reach six feet[1]. According to The Boston Harbor Association's Sea Level Rise Maps, the Project site would not be impacted by a rise in sea level of up to five feet. However, updates in the floodplain delineation due to climate change may change the classification of the Project site. The Project has taken measures to reduce risk to extreme weather events that could lead to flooding, as described below in the section on Weather Conditions.

Weather Conditions

As a result of climate change, the Northeast is expected to experience more frequent and intense storms. To mitigate this, the Project intends to take measures to minimize stormwater runoff and protect its mechanical equipment. These measures include:

- Decreasing stormwater runoff from the two-year 24-hour design storm;
- Incorporating a green roof;
- Locating critical mechanical and electrical equipment at the highest elevation possible to prevent exposure to flood waters;
- Locating the emergency generators on rooftops;

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[1] IPCC (Intergovernmental Panel on Climate Change), 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Avery, M. Tignor, and H. L. Miller (eds.)]. Cambridge University Press, Cambridge, UK, and New York, 996 pp.

- Locating the electrical substation at grade on a pad, above the predicted high water line;
- The lower parking garage levels will be able to be inundated during extreme storms;
- Water reuse and collection tanks will be incorporated; and
- As design progresses, the Project team will consider strategies to prevent water penetration at lower levels.

Drought Conditions

Under the high emissions scenario, the occurrence of droughts lasting one to three months could go up by as much as 75% over existing conditions by the end of the century[2]. To minimize the Projects susceptibility to drought conditions, the landscape design is anticipated to incorporate native and adaptive plant materials and, if required, the design of the irrigation system will target a 50% reduction in potable water use when compared to a mid-summer baseline. The Project will also incorporate low-flow fixtures to conserve the use of potable water. The Project is considering a water collection system and grey water reuse.

High Heat Days and Cost of Energy

The IPCC has predicted that in Massachusetts, the number of days with temperatures greater than 90°F will increase from the current five to twenty days annually, to thirty to sixty days annually. The Project design will incorporate a number of measures to minimize the impact of high temperature events, including:

- Operable windows, or vents, where possible to allow for natural ventilation;
- High albedo roof tops and green roofs to minimize the heat island effect; and
- New street trees to shade the sidewalks adjacent to the site.

Energy modeling for the Project has not yet been completed; however, as indicated on the LEED Checklist, the Proponent will strive to reduce the Project's overall energy demand and GHG emissions that contribute to global warming. The Project's proposed TDM program described in Section 3.1.5.3 will also help to lessen fossil fuel consumption.

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[22] Hayhoe, K., C. P. Wake, T. G. Huntington, L. Luo, M. D. Schwartz, J. Sheffield, E. Wood, B. Anderson, J. Bradbury, A. Degaetano, T. J. Troy, and D. Wolfe, 2006. Past and Future Changes in Climate and Hydrological Indicators in the U.S. Northeast. Climate Dynamics 28:381-407, DOI 10.1007. Online at: www.northeastclimateimpacts.org/pdf/tech/hayhoe_et_al_climate_dynamics_2006.pdf.

Chapter 6.0

Urban Design

6.0 URBAN DESIGN

6.1 Introduction

The Project entails the redevelopment of the old Boston Garden site on Causeway Street between the Rose Kennedy Greenway and the Thomas P. O'Neill, Jr., Federal Building. Located at the northern edge of the Bulfinch Triangle, the site terminates the northern end of the Canal Street axis and will have a visual connection to Haymarket Square at the other end of Canal Street.

The site has been underutilized in its function as a surface parking lot since the demolition of the old Boston Garden, and is poised to become a hub of activity within the neighborhood. With approximately 2.8 acres of developable land and a direct connection to one of the City's three major mass transit hubs, the location is supported by a robust transportation infrastructure providing access throughout Boston, the metropolitan area and other locations within New England.

The redevelopment of the site is occurring in the context of several nearby projects that are either recently completed, or are planned for construction in the next few years. In aggregate, these projects will transform the district into a vibrant mixed-use neighborhood with housing, entertainment and commercial uses that create a live, work, and play environment.

6.2 Historic Context

The site's history is rich in civic accommodation as it has been a major northern portal into the City since the opening of the North Union Station railroad depot in 1893. The transportation hub grew with the introduction of the Boston Elevated Railway and elevated Green Line. These elevated transit structures and the nearby elevated Central Artery filled the public realm with structures and created a dark and unwelcoming experience for pedestrians.

The old Boston Garden and the old North Station below it persevered until the new Boston Garden (now TD Garden) was completed in 1995. Shortly thereafter, the demolition of the elevated subway lines and the completion of the Big Dig have transformed the gritty, industrial character of Causeway Street into an urban crossroad that connects the West End and North End neighborhoods.

6.3 Vision

The design proposal for the Project requires an architecture that is responsive to both broader and local contexts. From a distance, the Project marks the northern portal to the City, while also terminating the Canal Street view corridor from the south.

Along the street, strong urban streetwalls define the public edge and are lined with active uses that engage pedestrians. Streetscape enhancements include sidewalk improvements and street furniture that reinforce the identity of the district, while providing amenities in the public realm.

The Project also presents an opportunity to enhance pedestrian access to North Station and the TD Garden with a new entrance on Causeway Street on axis with Canal Street and a new atrium hall. The new entrance is acknowledged with a bold architectural and graphic composition.

6.4 Design Principles

To realize the Project's urban design objectives, three primary Design Principles have been established to organize the urban design strategy:

1) Canal Street has been restored as the major pedestrian connection through the Bulfinch Triangle, and the alignment of Canal Street establishes the location of the atrium hall into North Station and the definition of two distinct blocks.

2) The infill of these blocks presents the opportunity to create active streetscape along Causeway Street, the atrium hall, and the O'Neill Federal Building.

3) North Station is both a portal into the City and the edge of the urban grid. The configuration of towers will signal the edge of the grid and transition to the suburban geometries.

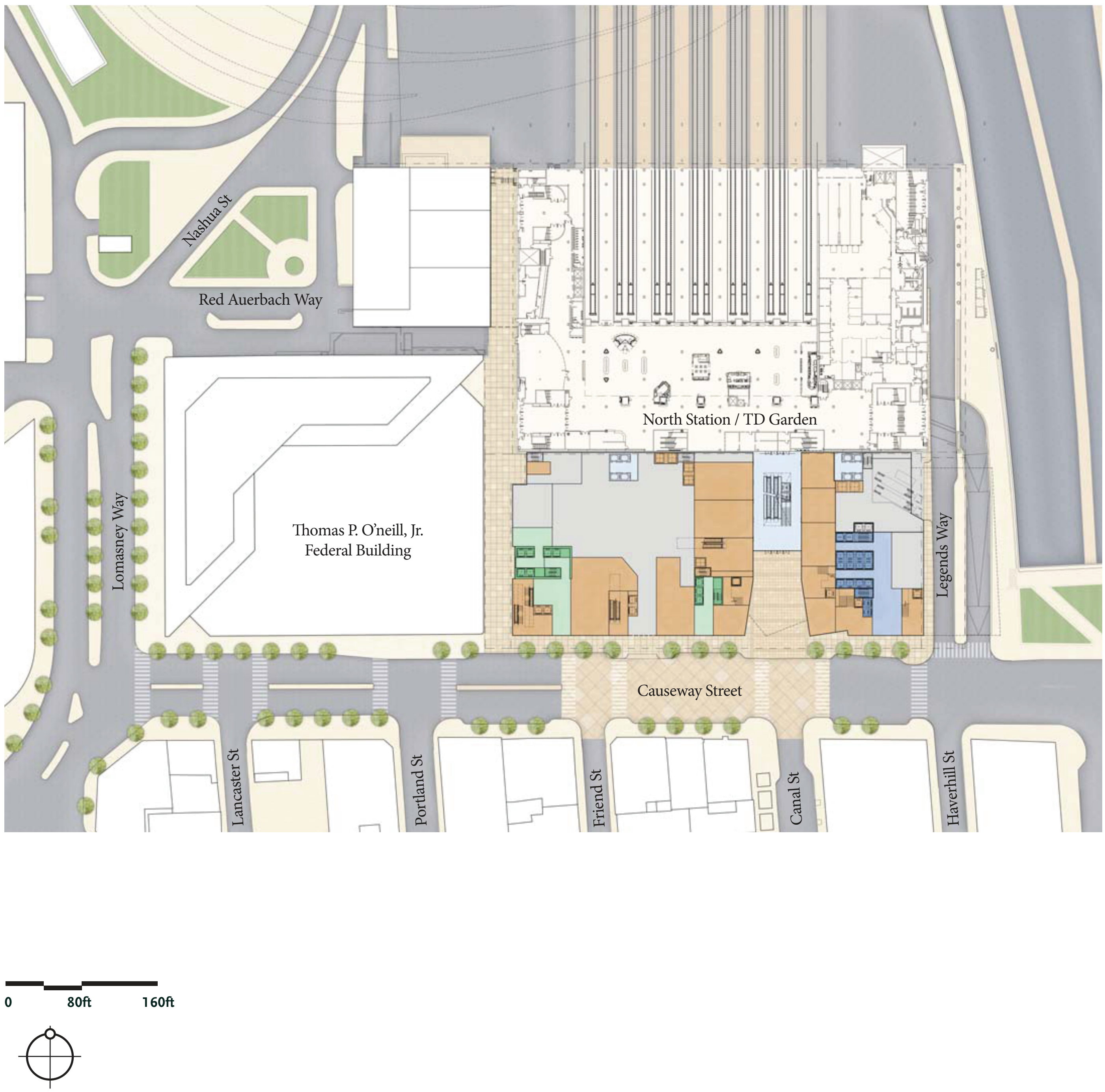
The massing approach subscribes to the first design principle by creating two distinct blocks that frame the Canal Street axis, while creating an atrium hall that becomes the new public entrance to North Station, which also connects the Commuter Rail and Amtrak platforms to the Green and Orange Lines, and the TD Garden. See Figure 6-1.

The second design principle is fulfilled by restoring the streetwall along Causeway Street with active uses and enhancing the public realm with site furnishings and sidewalk improvements. Collectively, these improvements reinforce the urban fabric while promoting place-making and bringing identity to the neighborhood.

The third design principle is realized in the alignment of vertical tower elements that frame the atrium hall and signal the disruption of the grid. The angled geometry distinctly departs from the urban grid in the Bulfinch Triangle to recognize this edge condition. See Figure 6-2.

6.5 Building Form and Articulation

At the street, the blocks respond in massing to the scale of the surrounding Bulfinch Triangle buildings. See Figures 6-3 through 6-5 for renderings of the Project.



The Boston Garden Boston, Massachusetts

ELKUS | MANFREDI ARCHITECTS

Figure 6-1

Site Plan

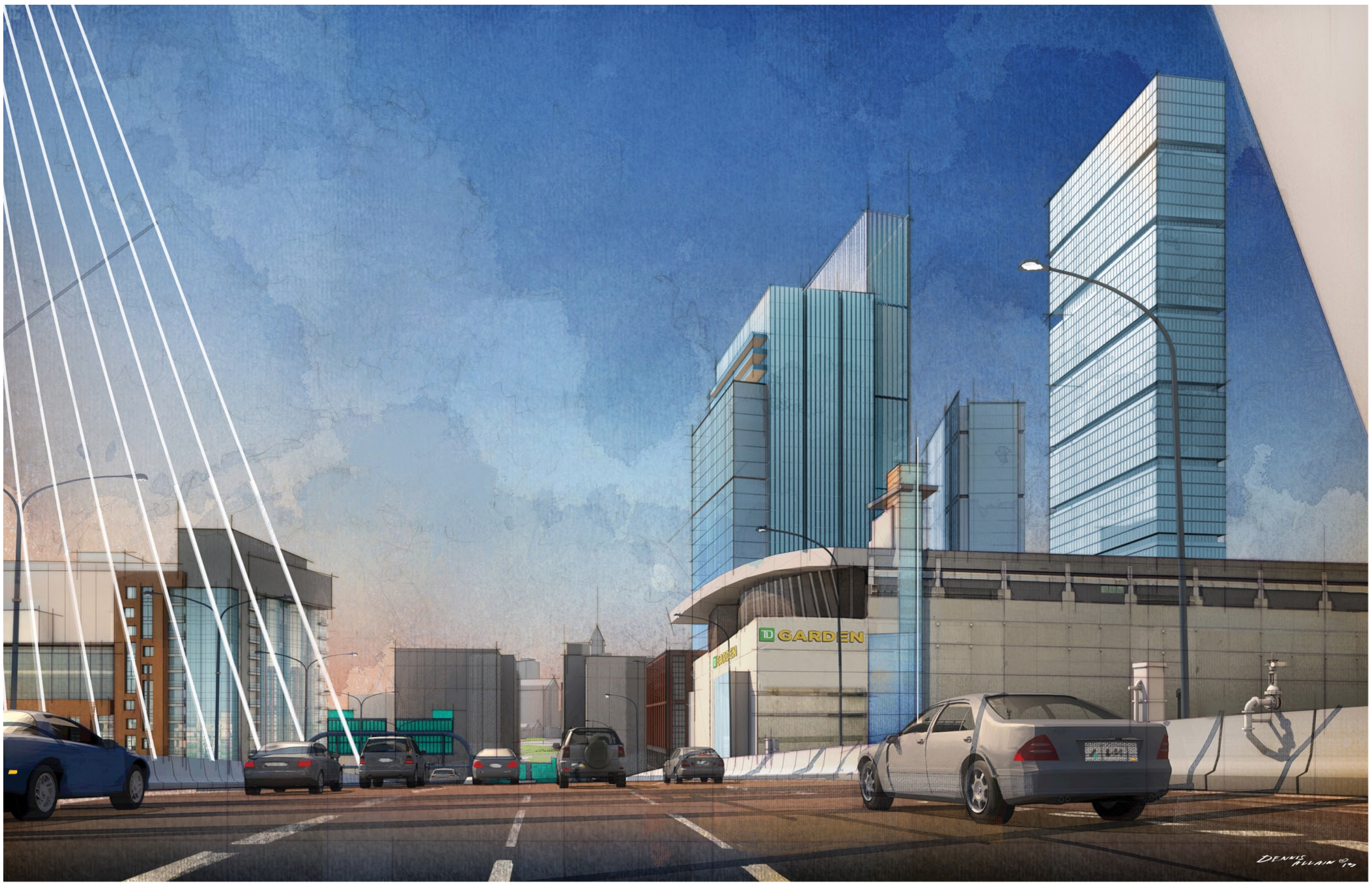
The Boston Garden   Boston, Massachusetts

ELKUS | MANFREDI
ARCHITECTS

Figure 6-2
Typical Tower Floor Plan

Figure 6-3
Causeway Street Perspective

Figure 6-4
Canal Street Perspective



The Boston Garden Boston, Massachusetts

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Figure 6-5
Zakim Bridge Perspective

The west block has a masonry base with retail uses on the lower through third levels. The masonry volume is punctuated by retail storefronts on each level that respond individually to the tenant's identity and provide diversity in the facade. On the eastern edge of the base, the walls are angled as they return to the new atrium hall to recognize the Canal Street axis while creating a wider throat to the entrance. Above the retail base, two towers rise: residential and hotel. See Figure 6-6.

On the western edge of the site, a slender glass and metal residential tower rises to approximately 600 feet. Its rectangular shape is aligned with the orthogonal geometry of the base and is punctuated by a vertical metal clad bar on the western façade. This vertical bar element contains the core for the lower portion of the building. The bar resolves itself at a reveal near the top of the building to signal the transition between the apartments and condominiums while creating a break in the composition that recognizes the top of the building.

On the eastern portion of the west block, a glass and metal hotel tower rises to approximately 320 feet. Its rectangular geometry is angled to align with the base, and the eastern façade is articulated with a projecting glass plane.

The east block has a masonry base with two floors of retail and flexible office uses above. Above the base, a glass and metal office building rises to approximately 420 feet. At the southwest corner of the block, the masonry volume is pulled away, and a vertical glass frame from the office building geometry extends to the ground. The frame extends above the roof and transitions to a vertically slotted façade expression to accentuate the verticality of the geometry while creating resolution for the top of the building.

The angled geometry on each side of the Canal Street axis, and the alignment of vertical elements on the towers framing the atrium hall, reinforce the civic character of the new entrance to North Station and TD Garden while breaking from the urban grid in the Bulfinch Triangle.

6.6 Building Entrances, Service, and Parking

The urban streetwall along Causeway Street is activated by entrances to retail, residential, hotel, and office uses. Retail use continues around the corner along Legends Way and along the passageway adjacent to the O'Neill Federal Building to line these passageways with active uses that engage pedestrians. The building entrances for each use are distinctly expressed using architectural elements such as awnings, canopies, signage, and unique storefront designs. All building entrances incorporate vision glass as the predominant material. Most of the large retail spaces in the lower and upper levels have entrances with storefronts on the ground level with vertical circulation.

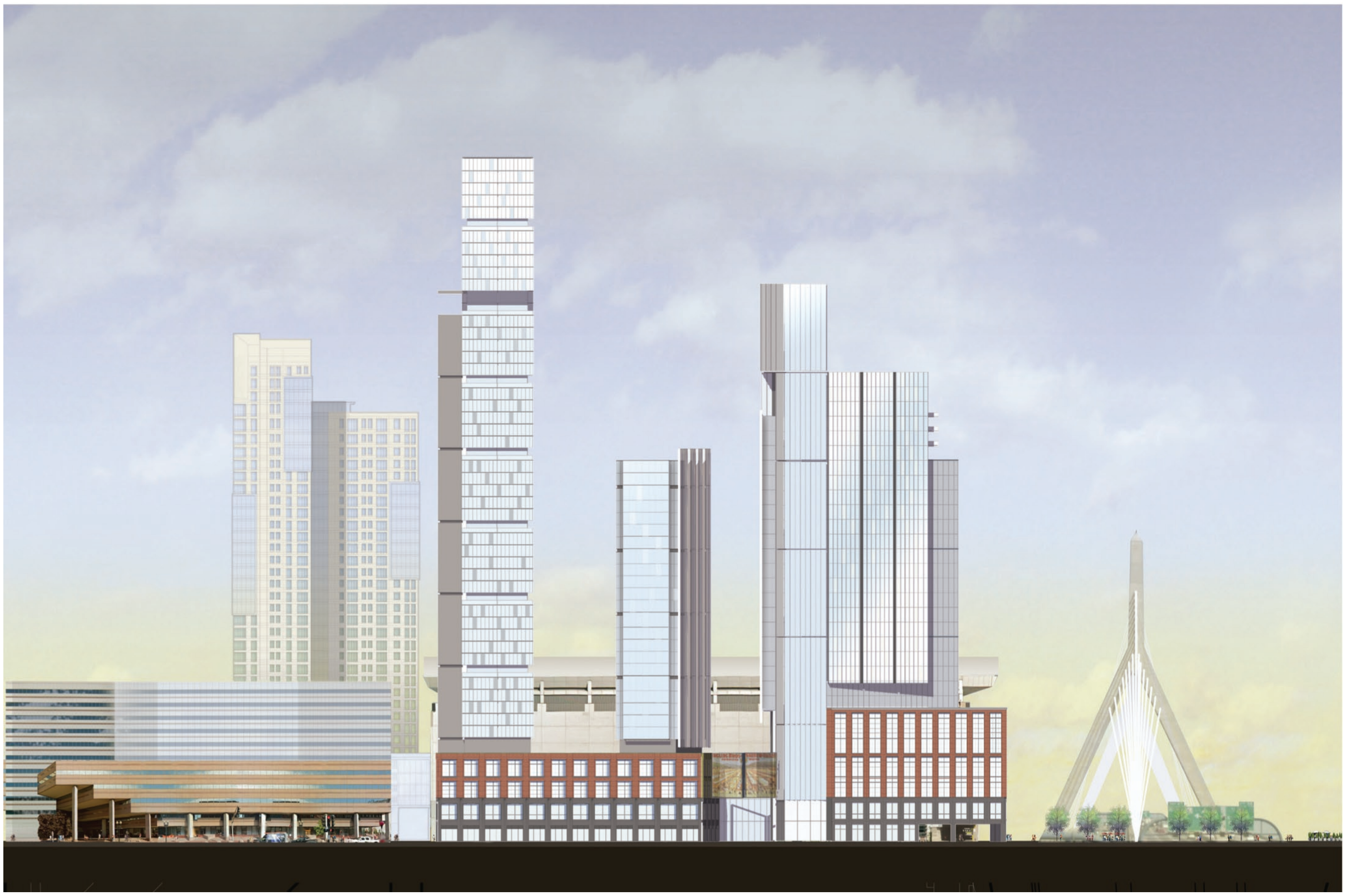

Figure 6-6

Causeway Street Elevation

The Project is serviced by two loading docks: one in the west block and one in the east block. The west block loading is accessed by a curb cut on Causeway Street. The opening to the loading is recessed from the streetwall and is as narrow as possible to minimize its presence on the street. The east block loading area is accessed via Legends Way and is located adjacent to the TD Garden.

All parking is located below grade and is accessed from the existing parking garage, which has access and egress via Nashua Street. A new garage access ramp on Causeway Street is under construction and will be operational prior to the completion of this Project.

6.7 Phasing

The Project is expected to be developed in phases as described in Section 2.5.

Chapter 7.0

Historic and Archaeological Resources

7.0 HISTORIC AND ARCHAEOLOGICAL RESOURCES

7.1 Buildings on the Project Site

There are no historic resources listed on the State or National Registers of Historic Places or included in the Inventory of Historic and Archaeological Assets of the Commonwealth within the Project site.

7.2 Historic Resources in the Project Vicinity

The Project will have no direct effects on historic or archaeological resources. Several historic resources listed in the State and National Registers of Historic Places and included in the Inventory are located within the vicinity of the Project site that may be indirectly affected by the Project.

Table 7-1 lists State and National Register-listed properties and historic districts located within a quarter mile radius of the Project Site. Figure 7-1 at the end of this chapter identifies the locations of these properties and historic districts.

Table 7-1 State and National Register-Listed Properties and Historic Districts

Map Key to Figure	Historic Resource	Address
State and National Register-listed Properties		
A	Bulfinch Triangle Historic District	Canal, Causeway, Friend, Lancaster, Lowell Square, Merrimack, Portland and Traverse Streets
B	North Terminal Garage	600 Commercial Street
Properties included in the *Inventory of Historic and Archaeological Assets of the Commonwealth*		
1	Causeway/North Washington Street Area	Causeway and North Washington Streets
2	North End Area	Roughly the waterfront to North Washington to Central Artery to Clinton Street to Atlantic Avenue
3	Charlestown Bridge	North Washington to Rutherford Avenue over Charles River
4	Lindeman Center	15-25 Staniford Street
5	35, 43-45 Hawkins Street	
6	25 New Chardon Street	
7	15 New Chardon Street	
8	40 Hawkins Street	

7.3 Impacts to Historic Resources

Several historic resources listed in the State and National Registers of Historic Places and included in the Inventory are located within the vicinity of the Project site. Any potential effects to historic resources will be limited to indirect effects associated with shadow and design within the setting of nearby historic properties.

7.3.1 Visual Impacts

The proposed new construction will restore the street wall along Causeway Street creating a more vibrant pedestrian experience along the edge of the Bulfinch Triangle Historic District. The creation of the atrium hall at the base of the building will serve as a visual connection between the new construction and Canal Street within the Bulfinch Triangle Historic District. The building will feature a three to five-story base, or podium, which will be visually distinct from the tower sections of the Project. By architecturally distinguishing this lower portion of the building, it will more directly relate to the nearby historic buildings within the adjacent historic district and Causeway/North Washington Street Area. The lower floors will include the use of masonry and architectural metals. The large rectangular window openings proposed along these lower levels will directly relate to the regimented appearance of the fenestration patterns in the nearby historic buildings. The upper floors will be divided into three high-rise glass and metal tower components including two 20-story towers and one 45-story tower. By separating these tower sections, the overall massing of the proposed new construction is divided, creating a more vibrant streetscape and the visibility of the sky from the pedestrian level.

7.3.2 Shadow Impacts

New shadow cast on historic resources is limited to late afternoon and evening periods. New shadow is cast on the North Washington/Causeway Streets Area at 3:00 p.m. on the vernal equinox. The shadow extends into the North End Area at 6:00 p.m. during the same period; however, most of the area is already in shadow. At 6:00 p.m. on the summer solstice, new shadow is cast on the Bulfinch Triangle Historic District, the west side of the Washington/Causeway Streets Area, and a small section of the North End Area. On the autumnal equinox, the new shadow is limited to the 3:00 p.m. period where shadow falls on the northern end of the Causeway/North Washington Streets Area. By 6:00 p.m., some new shadow is cast on the roofs of buildings in the North End Area, however, much of this Area is already in shadow at this time. At 3:00 p.m. on the winter solstice, new shadow is cast on the rooftops of buildings at the north end of the North Washington/Causeway Streets Area. During this period, much of the Area is already in shadow. Due to the overall density and proximity of buildings, throughout the year much of the area is in shadow when new shadow created by the Project is cast on historic resources. As a result, new shadow cast by the Project is unlikely to affect historic resources.

7.4 Archaeological Resources

No previously identified archaeological resources are located within the Project site. The Project site is located on previously disturbed land. Due to the prior disturbance, no impacts to archaeological resources are anticipated.

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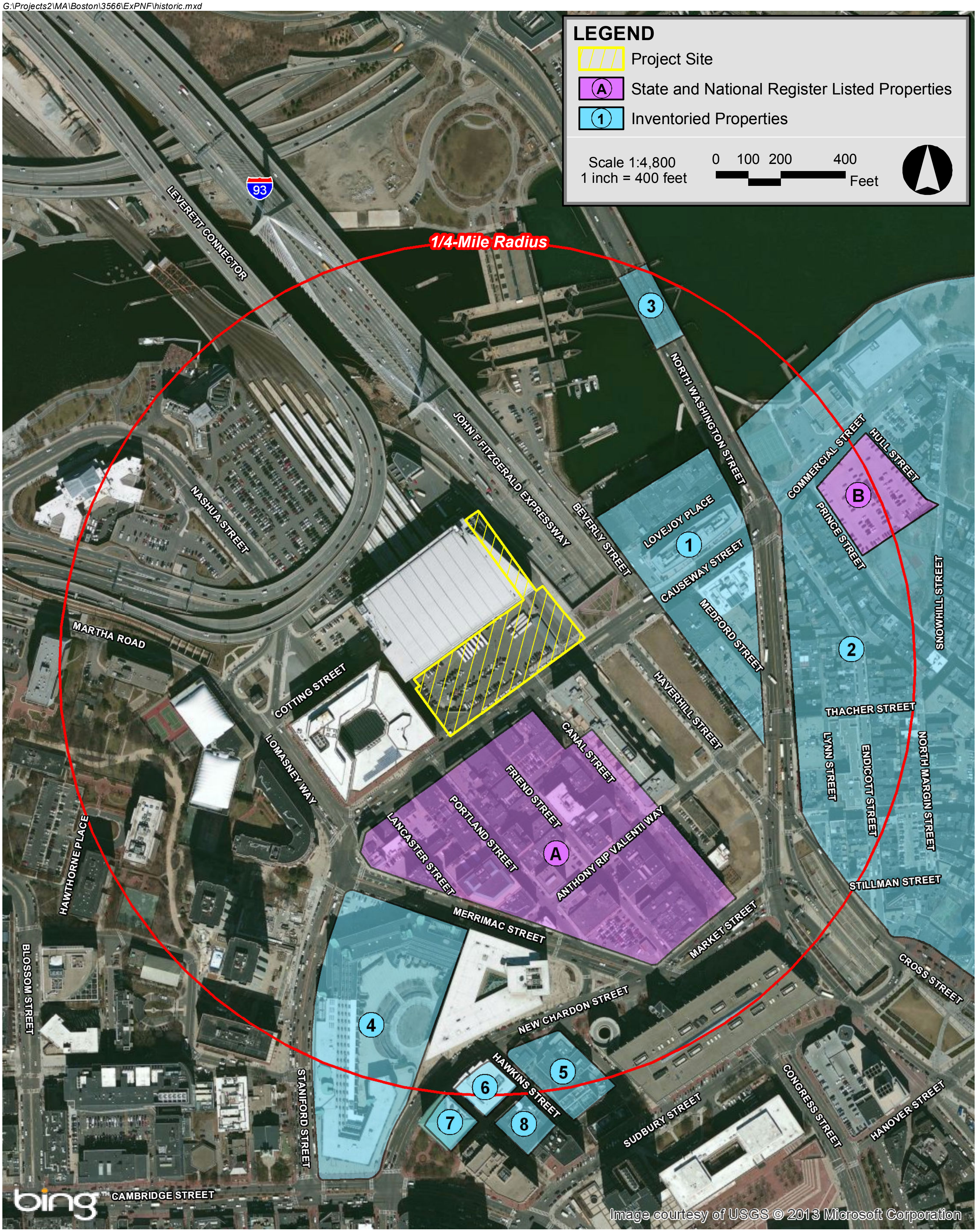


The Boston Garden **Boston, Massachusetts**

Epsilon ASSOCIATES INC.

Figure 7-1
Historic Resources

Chapter 8.0

Infrastructure

8.0 INFRASTRUCTURE

This section identifies the infrastructure needs of the Project and describes the systems that will support the Project. The Project will use the existing water, sewer, electrical and natural gas systems available in public streets adjacent to the Project site. These systems include those owned or managed by the Boston Water and Sewer Commission (BWSC), private utility companies, and on-site infrastructure systems. Research and coordination with utility providers indicates that these services are available at the site frontage. All system availabilities will be further defined through coordination with the utility providers as the Project design progresses. Figure 8-1 at the end of this chapter shows the existing sewer and water lines as well as other utilities that serve the Project site.

8.1 Wastewater

8.1.1 Existing Sewer System

Local sanitary sewer service is provided by BWSC via a 24-inch sanitary sewer located in Causeway Street, which connects to the West Side Interceptor. The sanitary sewer system eventually discharges to the Deer Island Treatment Plant for treatment and disposal.

8.1.2 Project-Generated Sanitary Sewer Flow

In total, the Project will generate an estimated 226,680 gallons per day (gpd) of new wastewater flows as shown in Table 8-1. The rates were calculated using the Massachusetts State Environmental Code (310 CMR 15.000). The Project will require a Sewer Connection Permit from MassDEP. The existing 24-inch sanitary sewer in front of the Project site has a flowing full capacity of 4,635,016 gpd, far in excess of the anticipated Project flows.

Table 8-1 Projected Sanitary Sewer Flows

Building	Use	Quantity	Flow Rate (gpd)	Sewage Generation (gpd)
New Project-Related Sewage Generation				
Hotel	Hotel	200,000 sf – 306	110/room	33,660
Retail	Retail	235,000 sf	50/1,000 sf	11,750
Flex Office	Office	142,000 sf	75/1,000 sf	10,650
Restaurant	Restaurant	100,000 sf – 2,000	20/seat	40,000
TD Garden		40,000 sf	No additional flow	0
Public Passage		25,000 sf	No additional flow	0

Table 8-1 Projected Sanitary Sewer Flows (Continued)

Building	Use	Quantity	Flow Rate (gpd)	Sewage Generation (gpd)
Residential	Residential	732 bdrm	110/bdrm	80,520
Office	Office	668,000 sf	75/1,000 sf	50,100
Total New Project – Related Sewage Generation				**226,680**

8.1.3 Sanitary Sewer Connection

Sanitary sewer connections for the Project are to be on Causeway Street. The 24-inch sanitary sewer is available along the frontage and should be available at numerous locations. At least three sanitary sewer connections are anticipated for the Project. The number and size of these connections will be confirmed as each design phase advances. The connections will be included in BWSC Site Plan Approval filings.

The Proponent will coordinate with BWSC on the design and capacity for proposed connections to their sewer systems. In addition, the Proponent will submit a General Service Application and site plan to the BWSC for review as Project design progresses.

8.2 Water System

8.2.1 Existing Water Service

Domestic and fire protection water supply at the Project site is provided by BWSC via a 16-inch Southern Low (SL) service main in Causeway Street and a 12-inch Southern High (SH) service main in Causeway Street. There are a number of existing hydrants along Causeway Street. As the project design progresses, the Proponent will seek input from the Boston Fire Department concerning any changes to hydrant locations.

8.2.2 Anticipated Water Consumption

Domestic water demand is based on estimated sewage generation with an added factor of 10 percent for consumption, system losses and other use. Based upon sewage generation rates outlined in the MassDEP Sewer Connection and Extension Regulations, 310 CMR 15.203.f, the Project will require approximately 250,000 gpd.

8.2.3 Proposed Water Service

Domestic water and fire protection connections will be provided via the 16-inch and 12-inch mains. The larger mains provide local area supply and capacity for the system as a whole. Multiple domestic water and fire protection water connections are anticipated for the Project. The number and sizes of the water connections will be confirmed as each design phase advances.

The domestic and fire protection water service connections required by the Project will meet the applicable City and State codes and standards, including cross-connection backflow prevention. Compliance with the standards for the domestic water system service connection will be reviewed as part of BWSC's Site Plan Review process. This review includes, but is not limited to, sizing of domestic water and fire protection services, calculation of meter sizing, backflow prevention design, and location of hydrants and siamese connections that conform to BWSC and Boston Fire Department requirements.

8.2.4 Water Supply Conservation and Mitigation Measures

As discussed in the stormwater section below and sustainability section of this report (Chapter 5, Sustainable Design), the Proponent will be actively exploring means to reduce domestic water demand, including the harvesting of rain water for mechanical uses and irrigation, and the careful selection of plumbing fixtures. The Project will implement water use reduction strategies that will target an overall potable water use savings of 30% from the calculated baseline use (calculated per LEED requirements).

8.3 Storm Drainage System

8.3.1 Existing Storm Drainage System

The Project is located in a densely developed area consisting primarily of impervious rooftops and impervious paved surfaces. BWSC owns and maintains an extensive system of catch basins, manholes and drain pipes in the area immediately adjacent to the Project site. This system of pipes, catch basins and manholes drains to specific areas within the Charles River Watershed.

Local storm drainage service is provided by BWSC via an 18-inch storm drain located in Causeway Street, which connects to a 36-inch x 60-inch storm drain, and a 36-inch x 60-inch storm drain located in Causeway Street, which connects to Combined Sewer Outfall (CSO) 049.

The storm drainage system serving the Project site drains primarily to the Charles River via Combined Sewer Outfall (CSO) 049 near the Nashua Street Jail.

8.3.2 Proposed Storm Drainage System

Targeting the treatment of the first inch of stormwater runoff per BWSC requirements, equivalent to an estimated volume of 7,730 cubic feet, the Project is exploring the use of stormwater control measures, as follows:

- Subsurface infiltration systems – the Proponent is considering the use of sub-grade, precast concrete infiltration systems, designed to detain and infiltrate stormwater runoff from impervious surfaces. These systems will reduce stormwater flows to the outfall.

- Rainwater harvesting – the Proponent is considering the harvesting of roof runoff for use in mechanical make-up water and irrigation. These systems will reduce stormwater flows to the outfall.

- Proprietary treatment devices – proprietary filter devices (i.e. JellyFish, Vortechnics, etc.) may also be used as a method to improve stormwater quality. These devices improve stormwater quality.

- Green roofs – the Proponent is evaluating the provision of green roof areas on certain roofs. If green roof areas are identified and feasible, they will improve stormwater quality.

The Project's preliminary design includes approximately 6,600 cubic feet of water to be infiltrated through subsurface infiltration systems and approximately 1,130 cubic feet of rain water to be harvested for mechanical make-up water and irrigation. Both of these measures will reduce or eliminate nutrients from stormwater in a manner consistent with current BWSC requirements.

In addition, the implementation of the above potential stormwater control measures will reduce the amount of stormwater inflow to the combined sewer outfall into the Charles River. The Proponent intends to implement measures to avoid increasing CSO discharges and compromising CSO control goals. Proposed stormwater management controls will be established in compliance with BWSC standards.

Given that, under existing conditions, the Project site is virtually impervious, the Project is not expected to result in the introduction of any additional peak flows, volumes, pollutants or sediments that would potentially impact the receiving waters of the BWSC's stormwater drainage system. As currently contemplated, the Project is expected to reduce peak flows, reducing the impact on the City's stormwater system. The existing discharge rate will be reduced, or met, as a result of the improvements associated with the Project. The quantities shown below are representative of pre-development and maximum post-development discharge rates. The implementation of potential rainwater harvesting tanks and infiltration systems will help achieve these numbers for the Project. The assumed time of concentration used to determine the values was five minutes, though the final design may increase the time of concentration, further reducing post-development discharge rates.

Table 8-2 Stormwater Discharge Rates

Site	Event (yr)	Pre-development and Maximum Post-Development Discharge Rate (cfs)
Project Site	2	6.75
	10	9.77
	25	11.70
	100	14.07

Multiple storm drain connections are anticipated for the Project, but the number and sizes of the storm drain connections will be confirmed as each design phase advances.

The existing 36-inch x 60-inch storm drain in front of the Project site has a flowing full capacity of 23.3 cfs. As the Project is expected to reduce runoff rates and volumes, the Project is expected to have a beneficial impact on the stormwater system.

8.4 Electrical Service

NSTAR operates underground electric systems in Causeway Street. The total electrical demand associated with the Project is estimated at 19,072 kW. As the design of the Project progresses, the Proponent and NSTAR will coordinate the final design and installation of electrical service.

8.5 Telecommunications Systems

The Proponent will select private telecommunications companies to provide telephone, cable and data services. There are several potential candidates with substantial downtown Boston networks capable of providing service, and there are numerous duct bank systems in the streets abutting the Project site.

Comcast, one of the private telecommunications companies that have duct bank systems near the Project vicinity, has existing service located in Portland Street and Lomasney Way. Comcast has plans in the near future to extend their duct bank system into Causeway Street from Portland Street. Telecommunication service could be potentially provided by the existing system in Lomasney Way or new system in Causeway Street.

Upon selection of a provider or providers, the Proponent will coordinate service connection locations and obtain appropriate approvals.

8.6 Gas Systems

Gas service at the Project site is provided by National Grid in Causeway Street. National Grid has an existing 12-inch gas main that could service the Project. Depending on the source of energy selected for the Project, the total net new natural gas demand for the Project could be approximately 62,000 cubic feet per hour (CFH). As the Project progresses, the Proponent will coordinate with National Grid to further define the service requirements. Should the Proponent elect to use steam as an energy source, natural gas demand would be reduced.

Steam service at the Project site is provided by Veolia via a 12-inch supply in Causeway Street. Depending on the source of energy selected for the Project, the total net new steam demand for the Project could be approximately 56,364 pounds per hour. As the Project progresses, the Proponent will coordinate with Veolia to further define the service requirements. Should the Proponent elect to use steam as an energy source, natural gas demand would be reduced.

8.7 Utility Protection During Construction

The contractor will notify utility companies and call "Call Before You Dig" prior to any excavation within the site. During construction, infrastructure will be protected using sheeting and shoring, temporary relocations, and construction staging as required. The contractor will be required to coordinate all protection measures, temporary supports, and temporary shutdowns of all utilities with the appropriate utility owners and/or agencies. The contractor will also be required to provide adequate notification to the utility owner prior to any work commencing on their utility. Also, in the event a utility cannot be maintained in service during switch over to a temporary or permanent system, the contractor will be required to coordinate the shutdown with the utility owners and Project abutters to minimize impacts and inconveniences.

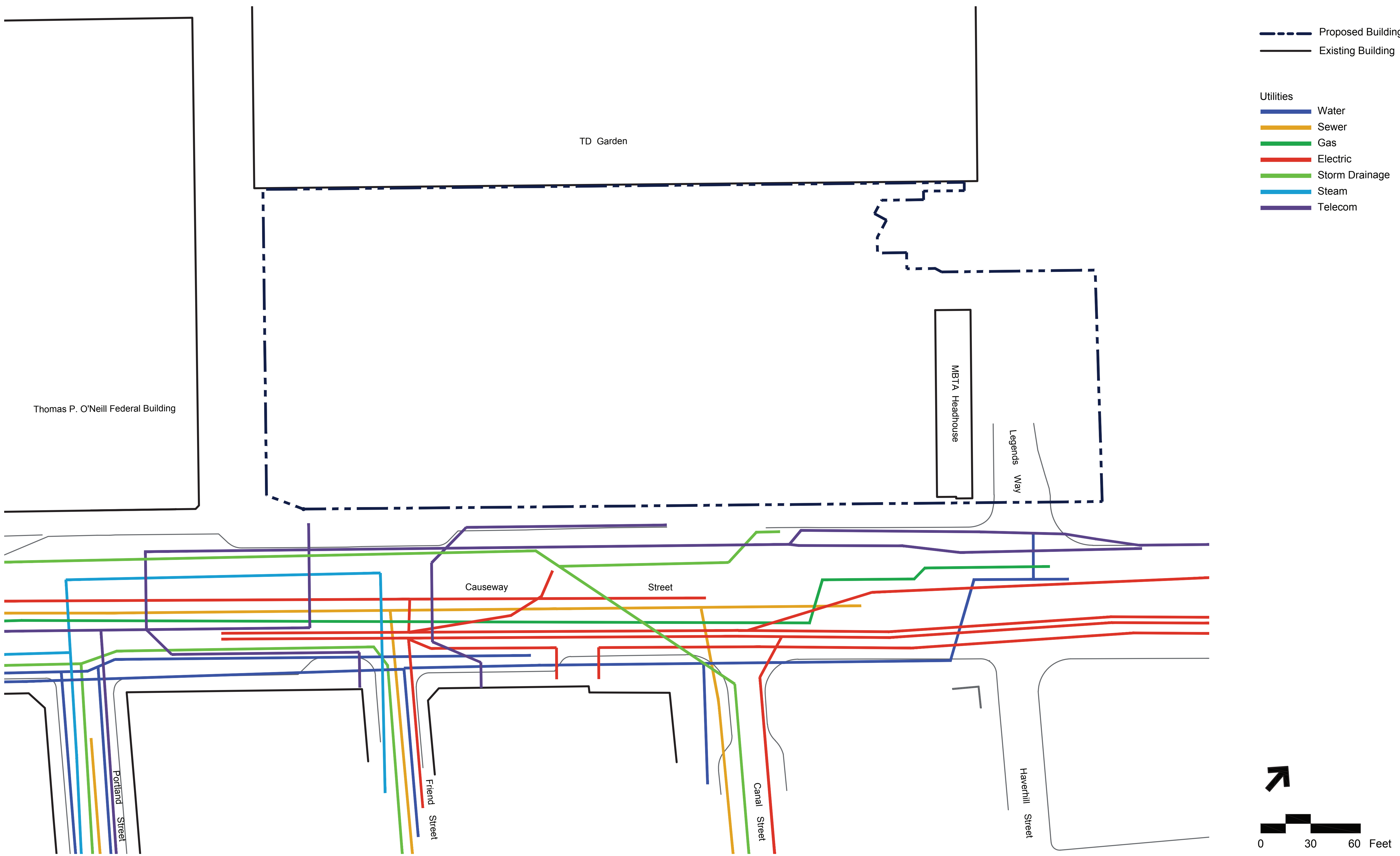


Figure 8-1
Existing Utilities

Chapter 9.0

Coordination with other Governmental Agencies

9.0 COORDINATION WITH OTHER GOVERNMENTAL AGENCIES

9.1 Architectural Access Board Requirements

The Project will comply with the requirements of the Massachusetts Architectural Access Board and will be designated to comply with the standards of the Americans with Disabilities Act.

9.2 Massachusetts Environmental Policy Act (MEPA)

The Project is currently being reviewed under the Massachusetts Environmental Policy Act (MEPA). An Environmental Notification Form (ENF) was submitted to the MEPA Office on May 15, 2013. The Secretary of the Office of Energy and Environmental Affairs issued a Certificate on the ENF on June 21, 2013 requiring an Environmental Impact Report. A Draft Environmental Impact Report will be submitted to the MEPA Office in the near future.

9.3 Massachusetts Historical Commission

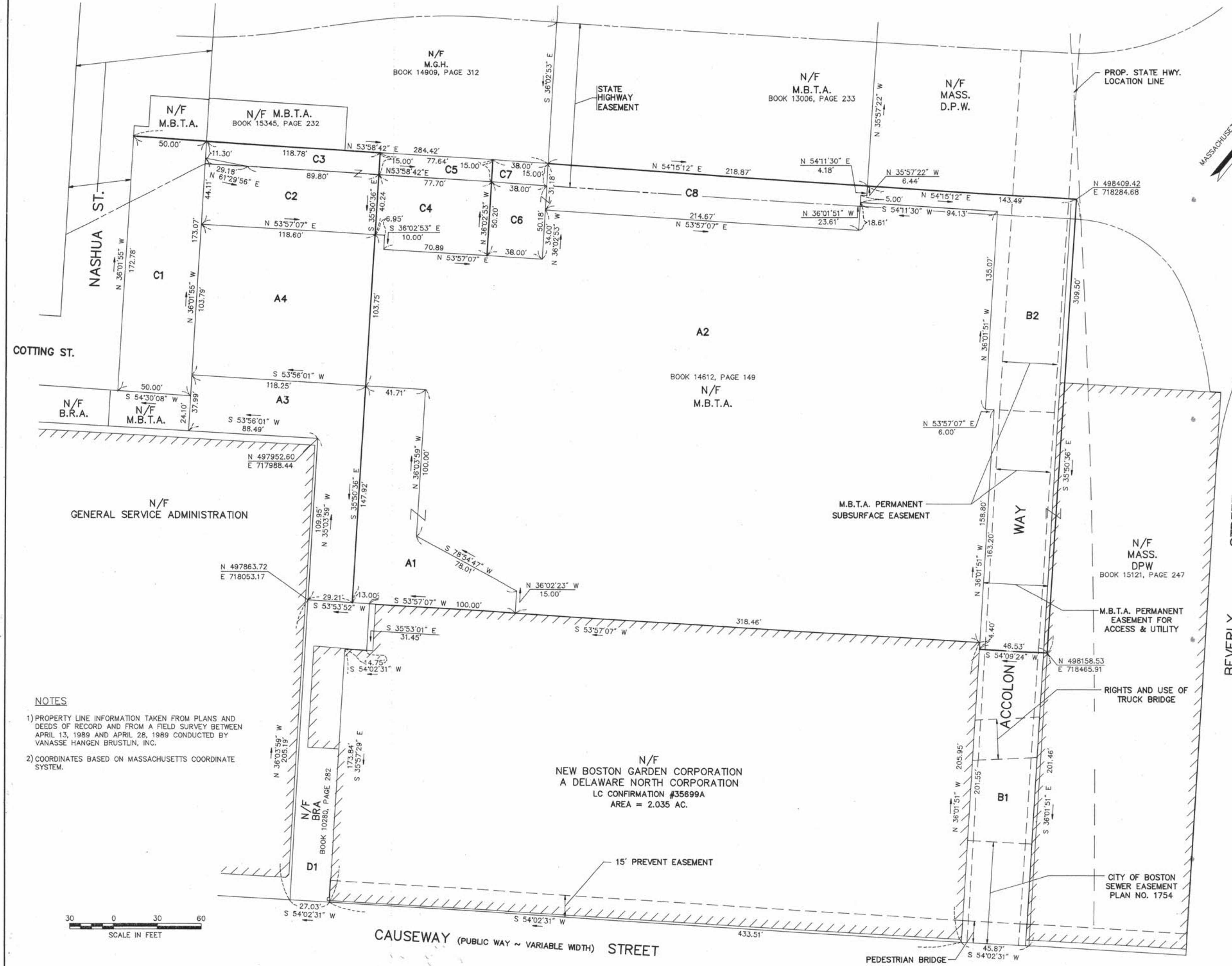
The MHC is reviewing the Project through the MEPA process.

9.4 Boston Civic Design Commission

The Project will comply with the provisions of Article 28 of the Boston Zoning Code. This PNF will be submitted to the Boston Civic Design Commission by the BRA as part of the Article 80 process.

Appendix A

Site Survey



FOR REGISTRY USE ONLY

NOTES

1) PROPERTY LINE INFORMATION TAKEN FROM PLANS AND DEEDS OF RECORD AND FROM A FIELD SURVEY BETWEEN APRIL 13, 1989 AND APRIL 28, 1989 CONDUCTED BY VANASSE HANGEN BRUSTLIN, INC.

2) COORDINATES BASED ON MASSACHUSETTS COORDINATE SYSTEM.

PARCELS A1, A2, A3 & A4 LAND NOW OR FORMERLY OWNED BY M.B.T.A.

A1	8,437 S.F.	SUBJECT TO RIGHTS OF CITY OF BOSTON
A2	107,536 S.F.	
A3	7,725 S.F.	
A4	12,289 S.F.	
TOTAL=135,987 S.F.		

PARCELS B1 & B2 LAND NOW OR FORMERLY OWNED BY M.D.P.W.

B1	9,310 S.F.	
B2	16,484 S.F.	SUBJECT TO THE STATE HIGHWAY EASEMENT
TOTAL=25,794 S.F.		

PARCELS C1, C2, C3, C4, C5, C6, C7 & C8 LAND NOW OR FORMERLY OWNED BY THE M.B.T.A.

C1	8,637 S.F.	SUBJECT TO THE STATE HIGHWAY EASEMENT
C2	4,833 S.F.	
C3	1,726 S.F.	SUBJECT TO THE STATE HIGHWAY EASEMENT AND RIGHTS OF M.G.H.
C4	3,836 S.F.	
C5	1,165 S.F.	SUBJECT TO THE STATE HIGHWAY EASEMENT AND RIGHTS OF M.G.H.
C6	1,908 S.F.	
C7	570 S.F.	SUBJECT TO THE STATE HIGHWAY EASEMENT AND RIGHTS OF M.G.H.
C8	6,600 S.F.	SUBJECT TO THE STATE HIGHWAY EASEMENT
TOTAL=29,275 S.F.		

PARCEL D1 LAND NOW OR FORMERLY B.R.A.

D1	6,051 S.F.
TOTAL=6,051 S.F.	

CERTIFICATION

I CERTIFY THAT THIS PLAN WAS PREPARED IN ACCORDANCE WITH THE RULES AND REGULATIONS OF THE REGISTERS OF DEEDS.

COMMONWEALTH OF MASSACHUSETTS JAMES L. DIORIO No. 32092 PROFESSIONAL LAND SURVEYOR

James L. Diorio — 10-20-92

PROFESSIONAL LAND SURVEYOR — DATE

SUBDIVISION PLAN OF LAND
IN
BOSTON, MASS.
PREPARED FOR
NEW BOSTON GARDEN CORPORATION

SCALE 1"=30' SEPTEMBER 15, 1992
REVISED: OCT. 20, 1992

PREPARED BY: VANASSE HANGEN BRUSTLIN, INC.
Consulting Engineers & Planners
101 Walnut Street Watertown, MA.

2250SUB.DWG

A3, A4, C1, C2 & C3 = 35,210

Appendix B

Transportation Appendix

Available Upon Request

Appendix C

Wind Appendix

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
1	A	Spring	27		Uncomfortable	37		Unacceptable
		Summer	21		Uncomfortable	29		Acceptable
		Fall	25		Uncomfortable	34		Unacceptable
		Winter	30		Dangerous	41		Unacceptable
		Annual	27		Uncomfortable	36		Unacceptable
	B	Spring	27		Uncomfortable	38		Unacceptable
		Summer	21		Uncomfortable	29		Acceptable
		Fall	25		Uncomfortable	35		Unacceptable
		Winter	30		Dangerous	41		Unacceptable
		Annual	27		Uncomfortable	37		Unacceptable
2	A	Spring	13		Standing	20		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
	B	Spring	14		Standing	20		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
3	A	Spring	24		Uncomfortable	32		Unacceptable
		Summer	18		Walking	25		Acceptable
		Fall	22		Uncomfortable	30		Acceptable
		Winter	25		Uncomfortable	33		Unacceptable
		Annual	23		Uncomfortable	31		Acceptable
	B	Spring	15	-38%	Standing	23	-28%	Acceptable
		Summer	12	-33%	Sitting	18	-28%	Acceptable
		Fall	14	-36%	Standing	21	-30%	Acceptable
		Winter	16	-36%	Walking	24	-27%	Acceptable
		Annual	15	-35%	Standing	22	-29%	Acceptable
4	A	Spring	21		Uncomfortable	31		Acceptable
		Summer	16		Walking	23		Acceptable
		Fall	20		Uncomfortable	28		Acceptable
		Winter	22		Uncomfortable	31		Acceptable
		Annual	20		Uncomfortable	29		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	22		Uncomfortable	29		Acceptable
		Summer	17		Walking	23		Acceptable
		Fall	20		Uncomfortable	27		Acceptable
		Winter	23		Uncomfortable	30		Acceptable
		Annual	21		Uncomfortable	28		Acceptable
5	A	Spring	18		Walking	27		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	17		Walking	25		Acceptable
		Winter	20		Uncomfortable	30		Acceptable
		Annual	18		Walking	27		Acceptable
	B	Spring	22	+22%	Uncomfortable	29		Acceptable
		Summer	17	+21%	Walking	23		Acceptable
		Fall	20	+18%	Uncomfortable	28	+12%	Acceptable
		Winter	23	+15%	Uncomfortable	31		Acceptable
		Annual	21	+17%	Uncomfortable	28		Acceptable
6	A	Spring	21		Uncomfortable	29		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	19		Walking	27		Acceptable
		Winter	20		Uncomfortable	28		Acceptable
		Annual	19		Walking	27		Acceptable
	B	Spring	21		Uncomfortable	29		Acceptable
		Summer	17	+13%	Walking	23		Acceptable
		Fall	20		Uncomfortable	28		Acceptable
		Winter	23	+15%	Uncomfortable	32	+14%	Unacceptable
		Annual	20		Uncomfortable	29		Acceptable
7	A	Spring	23		Uncomfortable	31		Acceptable
		Summer	17		Walking	23		Acceptable
		Fall	21		Uncomfortable	29		Acceptable
		Winter	23		Uncomfortable	32		Unacceptable
		Annual	21		Uncomfortable	29		Acceptable
	B	Spring	20	-13%	Uncomfortable	26	-16%	Acceptable
		Summer	15	-12%	Standing	19	-17%	Acceptable
		Fall	18	-14%	Walking	23	-21%	Acceptable
		Winter	19	-17%	Walking	25	-22%	Acceptable
		Annual	18	-14%	Walking	24	-17%	Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
8	A	Spring	20		Uncomfortable	29		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	19		Walking	27		Acceptable
		Winter	21		Uncomfortable	31		Acceptable
		Annual	20		Uncomfortable	28		Acceptable
	B	Spring	25	+25%	Uncomfortable	31		Acceptable
		Summer	18	+20%	Walking	23		Acceptable
		Fall	22	+16%	Uncomfortable	28		Acceptable
		Winter	24	+14%	Uncomfortable	30		Acceptable
		Annual	22		Uncomfortable	28		Acceptable
9	A	Spring	22		Uncomfortable	30		Acceptable
		Summer	16		Walking	23		Acceptable
		Fall	20		Uncomfortable	28		Acceptable
		Winter	22		Uncomfortable	32		Unacceptable
		Annual	21		Uncomfortable	29		Acceptable
	B	Spring	16	-27%	Walking	23	-23%	Acceptable
		Summer	13	-19%	Standing	19	-17%	Acceptable
		Fall	15	-25%	Standing	22	-21%	Acceptable
		Winter	17	-23%	Walking	24	-25%	Acceptable
		Annual	16	-24%	Walking	23	-21%	Acceptable
10	A	Spring	20		Uncomfortable	29		Acceptable
		Summer	16		Walking	23		Acceptable
		Fall	19		Walking	27		Acceptable
		Winter	21		Uncomfortable	30		Acceptable
		Annual	20		Uncomfortable	28		Acceptable
	B	Spring	12	-40%	Sitting	19	-34%	Acceptable
		Summer	10	-38%	Sitting	15	-35%	Acceptable
		Fall	12	-37%	Sitting	18	-33%	Acceptable
		Winter	13	-38%	Standing	20	-33%	Acceptable
		Annual	12	-40%	Sitting	19	-32%	Acceptable
11	A	Spring	19		Walking	28		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	21		Uncomfortable	29		Acceptable
		Annual	19		Walking	27		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

<u>Configurations</u>

A – No Build
B – Build

<u>Mean Wind Speed Criteria</u>

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

<u>Effective Gust Criteria</u>

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	14	-26%	Standing	22	-21%	Acceptable
		Summer	12	-20%	Sitting	18	-18%	Acceptable
		Fall	13	-28%	Standing	21	-19%	Acceptable
		Winter	14	-33%	Standing	22	-24%	Acceptable
		Annual	14	-26%	Standing	21	-22%	Acceptable
12	A	Spring	19		Walking	28		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	20		Uncomfortable	29		Acceptable
		Annual	19		Walking	27		Acceptable
	B	Spring	16	-16%	Walking	23	-18%	Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	15	-17%	Standing	23	-12%	Acceptable
		Winter	16	-20%	Walking	24	-17%	Acceptable
		Annual	15	-21%	Standing	23	-15%	Acceptable
13	A	Spring	19		Walking	27		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	20		Uncomfortable	29		Acceptable
		Annual	19		Walking	27		Acceptable
	B	Spring	0	-100%	Sitting	0	-100%	Acceptable
		Summer	0	-100%	Sitting	0	-100%	Acceptable
		Fall	0	-100%	Sitting	0	-100%	Acceptable
		Winter	0	-100%	Sitting	0	-100%	Acceptable
		Annual	0	-100%	Sitting	0	-100%	Acceptable
14	A	Spring	19		Walking	27		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	20		Uncomfortable	29		Acceptable
		Annual	18		Walking	27		Acceptable
	B	Spring	14	-26%	Standing	22	-19%	Acceptable
		Summer	12	-20%	Sitting	18	-18%	Acceptable
		Fall	13	-28%	Standing	21	-19%	Acceptable
		Winter	15	-25%	Standing	22	-24%	Acceptable
		Annual	14	-22%	Standing	21	-22%	Acceptable

Notes:
1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
15	A	Spring	17		Walking	26		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	16		Walking	25		Acceptable
		Winter	19		Walking	28		Acceptable
		Annual	17		Walking	26		Acceptable
	B	Spring	15	-12%	Standing	23	-12%	Acceptable
		Summer	12	-14%	Sitting	19		Acceptable
		Fall	14	-12%	Standing	22	-12%	Acceptable
		Winter	16	-16%	Walking	24	-14%	Acceptable
		Annual	15	-12%	Standing	22	-15%	Acceptable
16	A	Spring	17		Walking	25		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	20		Uncomfortable	28		Acceptable
		Annual	17		Walking	25		Acceptable
	B	Spring	19	+12%	Walking	28	+12%	Acceptable
		Summer	16	+14%	Walking	25	+25%	Acceptable
		Fall	18	+12%	Walking	27	+12%	Acceptable
		Winter	19		Walking	29		Acceptable
		Annual	18		Walking	27		Acceptable
17	A	Spring	13		Standing	20		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	13		Standing	19		Acceptable
	B	Spring	13		Standing	20		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
18	A	Spring	16		Walking	23		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	15		Standing	21		Acceptable
		Winter	16		Walking	23		Acceptable
		Annual	15		Standing	21		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

<u>Configurations</u>

A – No Build
B – Build

<u>Mean Wind Speed Criteria</u>

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

<u>Effective Gust Criteria</u>

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	11	-31%	Sitting	18	-22%	Acceptable
		Summer	10	-17%	Sitting	15	-12%	Acceptable
		Fall	11	-27%	Sitting	17	-19%	Acceptable
		Winter	12	-25%	Sitting	19	-17%	Acceptable
		Annual	11	-27%	Sitting	17	-19%	Acceptable
19	A	Spring	6		Sitting	9		Acceptable
		Summer	5		Sitting	7		Acceptable
		Fall	6		Sitting	8		Acceptable
		Winter	6		Sitting	9		Acceptable
		Annual	6		Sitting	9		Acceptable
	B	Spring	0	-100%	Sitting	0	-100%	Acceptable
		Summer	0	-100%	Sitting	0	-100%	Acceptable
		Fall	0	-100%	Sitting	0	-100%	Acceptable
		Winter	0	-100%	Sitting	0	-100%	Acceptable
		Annual	0	-100%	Sitting	0	-100%	Acceptable
20	A	Spring	6		Sitting	9		Acceptable
		Summer	5		Sitting	7		Acceptable
		Fall	6		Sitting	8		Acceptable
		Winter	6		Sitting	9		Acceptable
		Annual	6		Sitting	8		Acceptable
	B	Spring	0	-100%	Sitting	0	-100%	Acceptable
		Summer	0	-100%	Sitting	0	-100%	Acceptable
		Fall	0	-100%	Sitting	0	-100%	Acceptable
		Winter	0	-100%	Sitting	0	-100%	Acceptable
		Annual	0	-100%	Sitting	0	-100%	Acceptable
21	A	Spring	6		Sitting	9		Acceptable
		Summer	5		Sitting	7		Acceptable
		Fall	6		Sitting	9		Acceptable
		Winter	7		Sitting	10		Acceptable
		Annual	6		Sitting	9		Acceptable
	B	Spring	15	+150%	Standing	22	+144%	Acceptable
		Summer	12	+140%	Sitting	17	+143%	Acceptable
		Fall	14	+133%	Standing	20	+122%	Acceptable
		Winter	15	+114%	Standing	23	+130%	Acceptable
		Annual	14	+133%	Standing	21	+133%	Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

CONSULTING ENGINEERS & SCIENTISTS

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
22	A	Spring	24		Uncomfortable	33		Unacceptable
		Summer	19		Walking	26		Acceptable
		Fall	22		Uncomfortable	31		Acceptable
		Winter	25		Uncomfortable	35		Unacceptable
		Annual	23		Uncomfortable	32		Unacceptable
	B	Spring	25		Uncomfortable	33		Unacceptable
		Summer	20		Uncomfortable	26		Acceptable
		Fall	23		Uncomfortable	31		Acceptable
		Winter	27		Uncomfortable	35		Unacceptable
		Annual	24		Uncomfortable	32		Unacceptable
23	A	Spring	14		Standing	23		Acceptable
		Summer	12		Sitting	19		Acceptable
		Fall	14		Standing	22		Acceptable
		Winter	15		Standing	25		Acceptable
		Annual	14		Standing	23		Acceptable
	B	Spring	15		Standing	24		Acceptable
		Summer	12		Sitting	19		Acceptable
		Fall	14		Standing	22		Acceptable
		Winter	15		Standing	25		Acceptable
		Annual	14		Standing	23		Acceptable
24	A	Spring	17		Walking	24		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	19		Walking	26		Acceptable
		Annual	17		Walking	24		Acceptable
	B	Spring	23	+35%	Uncomfortable	30	+25%	Acceptable
		Summer	18	+38%	Walking	24	+26%	Acceptable
		Fall	22	+38%	Uncomfortable	29	+26%	Acceptable
		Winter	25	+32%	Uncomfortable	33	+27%	Unacceptable
		Annual	23	+35%	Uncomfortable	30	+25%	Acceptable
25	A	Spring	15		Standing	22		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	13		Standing	21		Acceptable
		Winter	15		Standing	23		Acceptable
		Annual	14		Standing	22		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

<u>Configurations</u>

A – No Build
B – Build

<u>Mean Wind Speed Criteria</u>

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

<u>Effective Gust Criteria</u>

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	13	-13%	Standing	21		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	12		Sitting	20		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	21		Acceptable
26	A	Spring	20		Uncomfortable	29		Acceptable
		Summer	16		Walking	24		Acceptable
		Fall	19		Walking	28		Acceptable
		Winter	21		Uncomfortable	31		Acceptable
		Annual	19		Walking	28		Acceptable
	B	Spring	22		Uncomfortable	31		Acceptable
		Summer	18	+12%	Walking	26		Acceptable
		Fall	21	+11%	Uncomfortable	30		Acceptable
		Winter	23		Uncomfortable	33		Unacceptable
		Annual	21	+11%	Uncomfortable	31	+11%	Acceptable
27	A	Spring	18		Walking	26		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	17		Walking	24		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	18		Walking	25		Acceptable
	B	Spring	19		Walking	28		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	20		Uncomfortable	29		Acceptable
		Annual	19		Walking	27		Acceptable
28	A	Spring	24		Uncomfortable	34		Unacceptable
		Summer	19		Walking	27		Acceptable
		Fall	22		Uncomfortable	31		Acceptable
		Winter	26		Uncomfortable	36		Unacceptable
		Annual	23		Uncomfortable	33		Unacceptable
	B	Spring	25		Uncomfortable	34		Unacceptable
		Summer	20		Uncomfortable	27		Acceptable
		Fall	23		Uncomfortable	32		Unacceptable
		Winter	27		Uncomfortable	37		Unacceptable
		Annual	24		Uncomfortable	34		Unacceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
29	A	Spring	14		Standing	21		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	14		Standing	21		Acceptable
	B	Spring	14		Standing	21		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
30	A	Spring	17		Walking	25		Acceptable
		Summer	13		Standing	20		Acceptable
		Fall	15		Standing	24		Acceptable
		Winter	17		Walking	26		Acceptable
		Annual	16		Walking	24		Acceptable
	B	Spring	6	-65%	Sitting	9	-64%	Acceptable
		Summer	5	-62%	Sitting	7	-65%	Acceptable
		Fall	6	-60%	Sitting	8	-67%	Acceptable
		Winter	6	-65%	Sitting	9	-65%	Acceptable
		Annual	6	-62%	Sitting	9	-62%	Acceptable
31	A	Spring	15		Standing	23		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	14		Standing	21		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	15		Standing	22		Acceptable
	B	Spring	15		Standing	23		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	14		Standing	21		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	15		Standing	22		Acceptable
32	A	Spring	19		Walking	27		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	17		Walking	25		Acceptable
		Winter	20		Uncomfortable	30		Acceptable
		Annual	18		Walking	27		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

<u>Configurations</u>

A – No Build
B – Build

<u>Mean Wind Speed Criteria</u>

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

<u>Effective Gust Criteria</u>

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	21	+11%	Uncomfortable	30	+11%	Acceptable
		Summer	16		Walking	24		Acceptable
		Fall	19	+12%	Walking	28	+12%	Acceptable
		Winter	22		Uncomfortable	32		Unacceptable
		Annual	20	+11%	Uncomfortable	29		Acceptable
33	A	Spring	17		Walking	25		Acceptable
		Summer	13		Standing	20		Acceptable
		Fall	15		Standing	23		Acceptable
		Winter	18		Walking	27		Acceptable
		Annual	16		Walking	24		Acceptable
	B	Spring	18		Walking	27		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	16		Walking	25		Acceptable
		Winter	19		Walking	28		Acceptable
		Annual	17		Walking	26		Acceptable
34	A	Spring	10		Sitting	16		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	10		Sitting	16		Acceptable
		Winter	10		Sitting	17		Acceptable
		Annual	10		Sitting	16		Acceptable
	B	Spring	10		Sitting	16		Acceptable
		Summer	8	-11%	Sitting	13		Acceptable
		Fall	9		Sitting	15		Acceptable
		Winter	10		Sitting	16		Acceptable
		Annual	9		Sitting	15		Acceptable
35	A	Spring	13		Standing	19		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	12		Sitting	19		Acceptable
	B	Spring	18	+38%	Walking	25	+32%	Acceptable
		Summer	14	+40%	Standing	20	+33%	Acceptable
		Fall	16	+33%	Walking	23	+21%	Acceptable
		Winter	18	+29%	Walking	26	+24%	Acceptable
		Annual	17	+42%	Walking	24	+26%	Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
36	A	Spring	12		Sitting	20		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	11		Sitting	19		Acceptable
		Winter	13		Standing	21		Acceptable
		Annual	12		Sitting	19		Acceptable
	B	Spring	16	+33%	Walking	22		Acceptable
		Summer	13	+30%	Standing	19	+19%	Acceptable
		Fall	14	+27%	Standing	21	+11%	Acceptable
		Winter	16	+23%	Walking	23		Acceptable
		Annual	15	+25%	Standing	21	+11%	Acceptable
37	A	Spring	12		Sitting	20		Acceptable
		Summer	10		Sitting	17		Acceptable
		Fall	12		Sitting	20		Acceptable
		Winter	13		Standing	21		Acceptable
		Annual	12		Sitting	20		Acceptable
	B	Spring	13		Standing	20		Acceptable
		Summer	10		Sitting	17		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
38	A	Spring	13		Standing	21		Acceptable
		Summer	10		Sitting	17		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
	B	Spring	15	+15%	Standing	22		Acceptable
		Summer	12	+20%	Sitting	17		Acceptable
		Fall	14	+17%	Standing	21	+11%	Acceptable
		Winter	15		Standing	23		Acceptable
		Annual	14		Standing	21		Acceptable
39	A	Spring	11		Sitting	17		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	11		Sitting	17		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	15	+36%	Standing	21	+24%	Acceptable
		Summer	12	+33%	Sitting	17	+21%	Acceptable
		Fall	13	+18%	Standing	19	+12%	Acceptable
		Winter	15	+25%	Standing	21	+11%	Acceptable
		Annual	14	+27%	Standing	20	+18%	Acceptable
40	A	Spring	12		Sitting	19		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	12		Sitting	19		Acceptable
	B	Spring	13		Standing	18		Acceptable
		Summer	10		Sitting	14		Acceptable
		Fall	12		Sitting	17		Acceptable
		Winter	14		Standing	20		Acceptable
		Annual	12		Sitting	18		Acceptable
41	A	Spring	11		Sitting	18		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	12		Sitting	18		Acceptable
		Annual	11		Sitting	17		Acceptable
	B	Spring	10		Sitting	16	-11%	Acceptable
		Summer	8	-20%	Sitting	13	-13%	Acceptable
		Fall	10		Sitting	15	-12%	Acceptable
		Winter	11		Sitting	17		Acceptable
		Annual	10		Sitting	16		Acceptable
42	A	Spring	12		Sitting	19		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	11		Sitting	18		Acceptable
		Winter	12		Sitting	20		Acceptable
		Annual	11		Sitting	18		Acceptable
	B	Spring	11		Sitting	16	-16%	Acceptable
		Summer	8	-20%	Sitting	13	-13%	Acceptable
		Fall	10		Sitting	16	-11%	Acceptable
		Winter	11		Sitting	17	-15%	Acceptable
		Annual	10		Sitting	16	-11%	Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

<u>Configurations</u>

A – No Build
B – Build

<u>Mean Wind Speed Criteria</u>

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

<u>Effective Gust Criteria</u>

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
43	A	Spring	16		Walking	24		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	15		Standing	23		Acceptable
		Winter	17		Walking	26		Acceptable
		Annual	16		Walking	24		Acceptable
	B	Spring	14	-12%	Standing	20	-17%	Acceptable
		Summer	11	-21%	Sitting	16	-20%	Acceptable
		Fall	13	-13%	Standing	19	-17%	Acceptable
		Winter	14	-18%	Standing	20	-23%	Acceptable
		Annual	13	-19%	Standing	19	-21%	Acceptable
44	A	Spring	15		Standing	22		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	14		Standing	20		Acceptable
	B	Spring	14		Standing	19	-14%	Acceptable
		Summer	10	-17%	Sitting	15	-17%	Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	13		Standing	19		Acceptable
		Annual	12	-14%	Sitting	18		Acceptable
45	A	Spring	19		Walking	27		Acceptable
		Summer	15		Standing	23		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	17		Walking	25		Acceptable
	B	Spring	18		Walking	25		Acceptable
		Summer	14		Standing	20	-13%	Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	17		Walking	24		Acceptable
		Annual	16		Walking	23		Acceptable
46	A	Spring	22		Uncomfortable	30		Acceptable
		Summer	20		Uncomfortable	26		Acceptable
		Fall	20		Uncomfortable	27		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	21		Uncomfortable	27		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting: ≤ 12 mph
Comfortable for Standing: > 12 and ≤ 15 mph
Comfortable for Walking: > 15 and ≤ 19 mph
Uncomfortable for Walking: > 19 and ≤ 27 mph
Dangerous Conditions: > 27 mph

Effective Gust Criteria

Acceptable: ≤ 31 mph
Unacceptable: > 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	18	-18%	Walking	26	-13%	Acceptable
		Summer	16	-20%	Walking	22	-15%	Acceptable
		Fall	16	-20%	Walking	24	-11%	Acceptable
		Winter	16	-16%	Walking	24	-11%	Acceptable
		Annual	17	-19%	Walking	24	-11%	Acceptable
47	A	Spring	17		Walking	24		Acceptable
		Summer	15		Standing	21		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	16		Walking	22		Acceptable
	B	Spring	15	-12%	Standing	22		Acceptable
		Summer	13	-13%	Standing	19		Acceptable
		Fall	13	-13%	Standing	21		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	14	-12%	Standing	21		Acceptable
48	A	Spring	20		Uncomfortable	27		Acceptable
		Summer	18		Walking	24		Acceptable
		Fall	18		Walking	24		Acceptable
		Winter	17		Walking	23		Acceptable
		Annual	18		Walking	25		Acceptable
	B	Spring	15	-25%	Standing	22	-19%	Acceptable
		Summer	13	-28%	Standing	19	-21%	Acceptable
		Fall	14	-22%	Standing	20	-17%	Acceptable
		Winter	14	-18%	Standing	20	-13%	Acceptable
		Annual	14	-22%	Standing	21	-16%	Acceptable
49	A	Spring	18		Walking	26		Acceptable
		Summer	17		Walking	23		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	15		Standing	23		Acceptable
		Annual	17		Walking	24		Acceptable
	B	Spring	13	-28%	Standing	20	-23%	Acceptable
		Summer	10	-41%	Sitting	16	-30%	Acceptable
		Fall	12	-25%	Sitting	18	-22%	Acceptable
		Winter	14		Standing	20	-13%	Acceptable
		Annual	12	-29%	Sitting	19	-21%	Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
50	A	Spring	15		Standing	23		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	14		Standing	21		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	14		Standing	22		Acceptable
	B	Spring	14		Standing	20	-13%	Acceptable
		Summer	10	-29%	Sitting	15	-25%	Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	19	-14%	Acceptable
51	A	Spring	12		Sitting	18		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	12		Sitting	17		Acceptable
		Winter	13		Standing	19		Acceptable
		Annual	12		Sitting	18		Acceptable
	B	Spring	13		Standing	19		Acceptable
		Summer	10	+11%	Sitting	15		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	13		Standing	19		Acceptable
		Annual	12		Sitting	18		Acceptable
52	A	Spring	10		Sitting	16		Acceptable
		Summer	8		Sitting	12		Acceptable
		Fall	9		Sitting	15		Acceptable
		Winter	10		Sitting	17		Acceptable
		Annual	9		Sitting	16		Acceptable
	B	Spring	15	+50%	Standing	23	+44%	Acceptable
		Summer	13	+62%	Standing	20	+67%	Acceptable
		Fall	14	+56%	Standing	21	+40%	Acceptable
		Winter	14	+40%	Standing	23	+35%	Acceptable
		Annual	14	+56%	Standing	22	+38%	Acceptable
53	A	Spring	14		Standing	22		Acceptable
		Summer	11		Sitting	18		Acceptable
		Fall	14		Standing	21		Acceptable
		Winter	16		Walking	25		Acceptable
		Annual	14		Standing	22		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

<u>Configurations</u>

A – No Build
B – Build

<u>Mean Wind Speed Criteria</u>

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

<u>Effective Gust Criteria</u>

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	15		Standing	22		Acceptable
		Summer	13	+18%	Standing	19		Acceptable
		Fall	14		Standing	21		Acceptable
		Winter	15		Standing	23		Acceptable
		Annual	15		Standing	22		Acceptable
54	A	Spring	15		Standing	21		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	15		Standing	23		Acceptable
		Annual	14		Standing	21		Acceptable
	B	Spring	21	+40%	Uncomfortable	29	+38%	Acceptable
		Summer	18	+50%	Walking	24	+41%	Acceptable
		Fall	20	+43%	Uncomfortable	28	+40%	Acceptable
		Winter	22	+47%	Uncomfortable	30	+30%	Acceptable
		Annual	20	+43%	Uncomfortable	28	+33%	Acceptable
55	A	Spring	17		Walking	26		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	16		Walking	25		Acceptable
		Winter	19		Walking	29		Acceptable
		Annual	17		Walking	26		Acceptable
	B	Spring	21	+24%	Uncomfortable	29	+12%	Acceptable
		Summer	17	+21%	Walking	24	+14%	Acceptable
		Fall	20	+25%	Uncomfortable	27		Acceptable
		Winter	21	+11%	Uncomfortable	30		Acceptable
		Annual	20	+18%	Uncomfortable	28		Acceptable
56	A	Spring	15		Standing	23		Acceptable
		Summer	12		Sitting	19		Acceptable
		Fall	14		Standing	22		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	15		Standing	23		Acceptable
	B	Spring	17	+13%	Walking	24		Acceptable
		Summer	14	+17%	Standing	21	+11%	Acceptable
		Fall	16	+14%	Walking	23		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	24		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

<u>Configurations</u>

A – No Build
B – Build

<u>Mean Wind Speed Criteria</u>

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

<u>Effective Gust Criteria</u>

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
57	A	Spring	17		Walking	25		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	15		Standing	23		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	16		Walking	24		Acceptable
	B	Spring	14	-18%	Standing	22	-12%	Acceptable
		Summer	12	-20%	Sitting	19	-14%	Acceptable
		Fall	13	-13%	Standing	21		Acceptable
		Winter	15		Standing	23		Acceptable
		Annual	14	-12%	Standing	21	-12%	Acceptable
58	A	Spring	17		Walking	26		Acceptable
		Summer	15		Standing	23		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	15		Standing	24		Acceptable
		Annual	16		Walking	24		Acceptable
	B	Spring	13	-24%	Standing	22	-15%	Acceptable
		Summer	12	-20%	Sitting	19	-17%	Acceptable
		Fall	12	-25%	Sitting	20	-17%	Acceptable
		Winter	13	-13%	Standing	20	-17%	Acceptable
		Annual	13	-19%	Standing	20	-17%	Acceptable
59	A	Spring	17		Walking	26		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	16		Walking	25		Acceptable
		Annual	16		Walking	24		Acceptable
	B	Spring	16		Walking	24		Acceptable
		Summer	13	-13%	Standing	21		Acceptable
		Fall	15		Standing	23		Acceptable
		Winter	16		Walking	25		Acceptable
		Annual	15		Standing	23		Acceptable
60	A	Spring	13		Standing	20		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	19		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	13		Standing	21		Acceptable
		Summer	11		Sitting	18		Acceptable
		Fall	12		Sitting	20		Acceptable
		Winter	13		Standing	21		Acceptable
		Annual	13		Standing	20		Acceptable
61	A	Spring	14		Standing	22		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	21		Acceptable
	B	Spring	16	+14%	Walking	23		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	14		Standing	21		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	15	+15%	Standing	21		Acceptable
62	A	Spring	12		Sitting	19		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	11		Sitting	18		Acceptable
		Winter	12		Sitting	20		Acceptable
		Annual	12		Sitting	18		Acceptable
	B	Spring	17	+42%	Walking	25	+32%	Acceptable
		Summer	13	+30%	Standing	19	+19%	Acceptable
		Fall	16	+45%	Walking	23	+28%	Acceptable
		Winter	17	+42%	Walking	25	+25%	Acceptable
		Annual	16	+33%	Walking	24	+33%	Acceptable
63	A	Spring	16		Walking	25		Acceptable
		Summer	13		Standing	20		Acceptable
		Fall	15		Standing	24		Acceptable
		Winter	17		Walking	27		Acceptable
		Annual	16		Walking	25		Acceptable
	B	Spring	13	-19%	Standing	20	-20%	Acceptable
		Summer	10	-23%	Sitting	16	-20%	Acceptable
		Fall	12	-20%	Sitting	19	-21%	Acceptable
		Winter	13	-24%	Standing	20	-26%	Acceptable
		Annual	12	-25%	Sitting	19	-24%	Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations	Mean Wind Speed Criteria		Effective Gust Criteria	
A – No Build	Comfortable for Sitting:	≤ 12 mph	Acceptable:	≤ 31 mph
B – Build	Comfortable for Standing:	> 12 and ≤ 15 mph	Unacceptable:	> 31 mph
	Comfortable for Walking:	> 15 and ≤ 19 mph		
	Uncomfortable for Walking:	> 19 and ≤ 27 mph		
	Dangerous Conditions:	> 27 mph		

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
64	A	Spring	17		Walking	25		Acceptable
		Summer	13		Standing	20		Acceptable
		Fall	15		Standing	23		Acceptable
		Winter	17		Walking	26		Acceptable
		Annual	16		Walking	24		Acceptable
	B	Spring	16		Walking	23		Acceptable
		Summer	13		Standing	18		Acceptable
		Fall	14		Standing	20	-13%	Acceptable
		Winter	15	-12%	Standing	22	-15%	Acceptable
		Annual	14	-12%	Standing	21	-12%	Acceptable
65	A	Spring	19		Walking	29		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	18		Walking	27		Acceptable
		Winter	20		Uncomfortable	30		Acceptable
		Annual	18		Walking	28		Acceptable
	B	Spring	18		Walking	28		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	17		Walking	25		Acceptable
		Winter	18		Walking	27		Acceptable
		Annual	17		Walking	26		Acceptable
66	A	Spring	19		Walking	28		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	20		Uncomfortable	30		Acceptable
		Annual	19		Walking	27		Acceptable
	B	Spring	18		Walking	27		Acceptable
		Summer	14		Standing	22		Acceptable
		Fall	17		Walking	26		Acceptable
		Winter	18		Walking	28		Acceptable
		Annual	17	-11%	Walking	26		Acceptable
67	A	Spring	20		Uncomfortable	29		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	18		Walking	27		Acceptable
		Winter	21		Uncomfortable	30		Acceptable
		Annual	19		Walking	28		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	17	-15%	Walking	27		Acceptable
		Summer	13	-13%	Standing	20		Acceptable
		Fall	16	-11%	Walking	25		Acceptable
		Winter	18	-14%	Walking	27		Acceptable
		Annual	16	-16%	Walking	25	-11%	Acceptable
68	A	Spring	17		Walking	26		Acceptable
		Summer	13		Standing	21		Acceptable
		Fall	16		Walking	25		Acceptable
		Winter	18		Walking	28		Acceptable
		Annual	16		Walking	26		Acceptable
	B	Spring	20	+18%	Uncomfortable	29	+12%	Acceptable
		Summer	15	+15%	Standing	22		Acceptable
		Fall	18	+12%	Walking	26		Acceptable
		Winter	20	+11%	Uncomfortable	29		Acceptable
		Annual	19	+19%	Walking	27		Acceptable
69	A	Spring	20		Uncomfortable	30		Acceptable
		Summer	15		Standing	23		Acceptable
		Fall	18		Walking	27		Acceptable
		Winter	22		Uncomfortable	33		Unacceptable
		Annual	19		Walking	29		Acceptable
	B	Spring	26	+30%	Uncomfortable	34	+13%	Unacceptable
		Summer	20	+33%	Uncomfortable	27	+17%	Acceptable
		Fall	24	+33%	Uncomfortable	32	+19%	Unacceptable
		Winter	28	+27%	Dangerous	37	+12%	Unacceptable
		Annual	25	+32%	Uncomfortable	34	+17%	Unacceptable
70	A	Spring	18		Walking	27		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	17		Walking	25		Acceptable
		Winter	20		Uncomfortable	29		Acceptable
		Annual	18		Walking	26		Acceptable
	B	Spring	21	+17%	Uncomfortable	28		Acceptable
		Summer	16	+14%	Walking	22		Acceptable
		Fall	19	+12%	Walking	26		Acceptable
		Winter	21		Uncomfortable	28		Acceptable
		Annual	20	+11%	Uncomfortable	27		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
71	A	Spring	16		Walking	25		Acceptable
		Summer	12		Sitting	19		Acceptable
		Fall	15		Standing	24		Acceptable
		Winter	17		Walking	28		Acceptable
		Annual	16		Walking	25		Acceptable
	B	Spring	22	+38%	Uncomfortable	31	+24%	Acceptable
		Summer	17	+42%	Walking	24	+26%	Acceptable
		Fall	21	+40%	Uncomfortable	29	+21%	Acceptable
		Winter	25	+47%	Uncomfortable	34	+21%	Unacceptable
		Annual	22	+38%	Uncomfortable	31	+24%	Acceptable
72	A	Spring	19		Walking	27		Acceptable
		Summer	16		Walking	21		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	20		Uncomfortable	28		Acceptable
		Annual	19		Walking	26		Acceptable
	B	Spring	19		Walking	27		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	17		Walking	25		Acceptable
		Winter	20		Uncomfortable	28		Acceptable
		Annual	18		Walking	26		Acceptable
73	A	Spring	13		Standing	21		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	12		Sitting	20		Acceptable
		Annual	12		Sitting	20		Acceptable
	B	Spring	13		Standing	21		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	13		Standing	20		Acceptable
74	A	Spring	11		Sitting	17		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	11		Sitting	16		Acceptable
		Winter	12		Sitting	18		Acceptable
		Annual	11		Sitting	17		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

<u>Configurations</u>

A – No Build
B – Build

<u>Mean Wind Speed Criteria</u>

Comfortable for Sitting: ≤ 12 mph
Comfortable for Standing: > 12 and ≤ 15 mph
Comfortable for Walking: > 15 and ≤ 19 mph
Uncomfortable for Walking: > 19 and ≤ 27 mph
Dangerous Conditions: > 27 mph

<u>Effective Gust Criteria</u>

Acceptable: ≤ 31 mph
Unacceptable: > 31 mph

CONSULTING ENGINEERS & SCIENTISTS

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	13	+18%	Standing	19	+12%	Acceptable
		Summer	10	+11%	Sitting	15		Acceptable
		Fall	12		Sitting	18	+12%	Acceptable
		Winter	13		Standing	20	+11%	Acceptable
		Annual	12		Sitting	18		Acceptable
75	A	Spring	12		Sitting	20		Acceptable
		Summer	10		Sitting	17		Acceptable
		Fall	11		Sitting	18		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	11		Sitting	19		Acceptable
	B	Spring	12		Sitting	19		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	11		Sitting	18		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	11		Sitting	18		Acceptable
76	A	Spring	12		Sitting	19		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	11		Sitting	18		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	19		Acceptable
	B	Spring	12		Sitting	18		Acceptable
		Summer	9		Sitting	15		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	11		Sitting	18		Acceptable
77	A	Spring	11		Sitting	18		Acceptable
		Summer	9		Sitting	15		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	12		Sitting	20		Acceptable
		Annual	11		Sitting	18		Acceptable
	B	Spring	14	+27%	Standing	21	+17%	Acceptable
		Summer	11	+22%	Sitting	17	+13%	Acceptable
		Fall	13	+18%	Standing	20	+18%	Acceptable
		Winter	15	+25%	Standing	23	+15%	Acceptable
		Annual	14	+27%	Standing	21	+17%	Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
78	A	Spring	14		Standing	20		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	20		Acceptable
	B	Spring	15		Standing	21		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	16	+14%	Walking	23		Acceptable
		Annual	15	+15%	Standing	21		Acceptable
79	A	Spring	13		Standing	20		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	13		Standing	21		Acceptable
		Annual	12		Sitting	19		Acceptable
	B	Spring	13		Standing	19		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	18		Acceptable
80	A	Spring	12		Sitting	19		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	19		Acceptable
	B	Spring	12		Sitting	18		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	11		Sitting	18		Acceptable
81	A	Spring	12		Sitting	19		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	12		Sitting	18		Acceptable

Notes:
1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

<u>Configurations</u>

A – No Build
B – Build

<u>Mean Wind Speed Criteria</u>

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

<u>Effective Gust Criteria</u>

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	11		Sitting	18		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	12		Sitting	18		Acceptable
		Annual	11		Sitting	17		Acceptable
82	A	Spring	16		Walking	23		Acceptable
		Summer	13		Standing	18		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	15		Standing	22		Acceptable
	B	Spring	16		Walking	23		Acceptable
		Summer	13		Standing	18		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	15		Standing	23		Acceptable
83	A	Spring	15		Standing	21		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	16		Walking	23		Acceptable
		Annual	15		Standing	21		Acceptable
	B	Spring	15		Standing	21		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	14		Standing	20		Acceptable
84	A	Spring	17		Walking	24		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	18		Walking	26		Acceptable
		Annual	17		Walking	24		Acceptable
	B	Spring	22	+29%	Uncomfortable	30	+25%	Acceptable
		Summer	17	+31%	Walking	23	+21%	Acceptable
		Fall	20	+25%	Uncomfortable	27	+17%	Acceptable
		Winter	23	+28%	Uncomfortable	32	+23%	Unacceptable
		Annual	21	+24%	Uncomfortable	29	+21%	Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
85	A	Spring	14		Standing	22		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	15		Standing	24		Acceptable
		Annual	14		Standing	21		Acceptable
	B	Spring	18	+29%	Walking	25	+14%	Acceptable
		Summer	14	+27%	Standing	19	+12%	Acceptable
		Fall	17	+31%	Walking	24	+20%	Acceptable
		Winter	20	+33%	Uncomfortable	28	+17%	Acceptable
		Annual	18	+29%	Walking	25	+19%	Acceptable
86	A	Spring	13		Standing	19		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	13		Standing	17		Acceptable
		Winter	14		Standing	20		Acceptable
		Annual	13		Standing	18		Acceptable
	B	Spring	14		Standing	19		Acceptable
		Summer	11		Sitting	15		Acceptable
		Fall	13		Standing	18		Acceptable
		Winter	14		Standing	20		Acceptable
		Annual	13		Standing	18		Acceptable
87	A	Spring	8		Sitting	11		Acceptable
		Summer	6		Sitting	9		Acceptable
		Fall	7		Sitting	11		Acceptable
		Winter	8		Sitting	12		Acceptable
		Annual	8		Sitting	11		Acceptable
	B	Spring	7	-12%	Sitting	11		Acceptable
		Summer	6		Sitting	8	-11%	Acceptable
		Fall	7		Sitting	10		Acceptable
		Winter	7	-12%	Sitting	11		Acceptable
		Annual	7	-12%	Sitting	10		Acceptable
88	A	Spring	16		Walking	22		Acceptable
		Summer	13		Standing	18		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	15		Standing	21		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

<u>Configurations</u>

A – No Build
B – Build

<u>Mean Wind Speed Criteria</u>

Comfortable for Sitting: ≤ 12 mph
Comfortable for Standing: > 12 and ≤ 15 mph
Comfortable for Walking: > 15 and ≤ 19 mph
Uncomfortable for Walking: > 19 and ≤ 27 mph
Dangerous Conditions: > 27 mph

<u>Effective Gust Criteria</u>

Acceptable: ≤ 31 mph
Unacceptable: > 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	15		Standing	23		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	13		Standing	21		Acceptable
		Winter	15		Standing	24		Acceptable
		Annual	14		Standing	22		Acceptable
89	A	Spring	14		Standing	22		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	13		Standing	21		Acceptable
		Winter	15		Standing	24		Acceptable
		Annual	14		Standing	22		Acceptable
	B	Spring	21	+50%	Uncomfortable	30	+36%	Acceptable
		Summer	17	+55%	Walking	23	+35%	Acceptable
		Fall	20	+54%	Uncomfortable	28	+33%	Acceptable
		Winter	24	+60%	Uncomfortable	33	+38%	Unacceptable
		Annual	21	+50%	Uncomfortable	29	+32%	Acceptable
90	A	Spring	18		Walking	26		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	19		Walking	28		Acceptable
		Annual	17		Walking	26		Acceptable
	B	Spring	20	+11%	Uncomfortable	29	+12%	Acceptable
		Summer	16	+14%	Walking	23	+15%	Acceptable
		Fall	19	+19%	Walking	27	+12%	Acceptable
		Winter	22	+16%	Uncomfortable	31	+11%	Acceptable
		Annual	20	+18%	Uncomfortable	29	+12%	Acceptable
91	A	Spring	14		Standing	20		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	14		Standing	20		Acceptable
	B	Spring	17	+21%	Walking	25	+25%	Acceptable
		Summer	14	+27%	Standing	20	+25%	Acceptable
		Fall	16	+23%	Walking	24	+26%	Acceptable
		Winter	19	+27%	Walking	27	+23%	Acceptable
		Annual	17	+21%	Walking	25	+25%	Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
92	A	Spring	10		Sitting	16		Acceptable
		Summer	8		Sitting	13		Acceptable
		Fall	10		Sitting	16		Acceptable
		Winter	11		Sitting	17		Acceptable
		Annual	10		Sitting	16		Acceptable
	B	Spring	11		Sitting	19	+19%	Acceptable
		Summer	9	+12%	Sitting	15	+15%	Acceptable
		Fall	11		Sitting	18	+12%	Acceptable
		Winter	13	+18%	Standing	21	+24%	Acceptable
		Annual	11		Sitting	19	+19%	Acceptable
93	A	Spring	18		Walking	25		Acceptable
		Summer	15		Standing	20		Acceptable
		Fall	16		Walking	22		Acceptable
		Winter	18		Walking	25		Acceptable
		Annual	17		Walking	23		Acceptable
	B	Spring	18		Walking	26		Acceptable
		Summer	15		Standing	21		Acceptable
		Fall	17		Walking	24		Acceptable
		Winter	18		Walking	26		Acceptable
		Annual	17		Walking	24		Acceptable
94	A	Spring	15		Standing	23		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	14		Standing	21		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	15		Standing	22		Acceptable
	B	Spring	17	+13%	Walking	25		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	16	+14%	Walking	23		Acceptable
		Winter	18	+12%	Walking	26		Acceptable
		Annual	16		Walking	24		Acceptable
95	A	Spring	18		Walking	25		Acceptable
		Summer	14		Standing	19		Acceptable
		Fall	17		Walking	23		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	17		Walking	25		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	18		Walking	26		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	17		Walking	24		Acceptable
		Winter	19		Walking	28		Acceptable
		Annual	17		Walking	25		Acceptable
96	A	Spring	21		Uncomfortable	30		Acceptable
		Summer	17		Walking	23		Acceptable
		Fall	20		Uncomfortable	27		Acceptable
		Winter	23		Uncomfortable	32		Unacceptable
		Annual	21		Uncomfortable	29		Acceptable
	B	Spring	27	+29%	Uncomfortable	37	+23%	Unacceptable
		Summer	21	+24%	Uncomfortable	29	+26%	Acceptable
		Fall	25	+25%	Uncomfortable	34	+26%	Unacceptable
		Winter	30	+30%	Dangerous	40	+25%	Unacceptable
		Annual	27	+29%	Uncomfortable	36	+24%	Unacceptable
97	A	Spring	10		Sitting	16		Acceptable
		Summer	7		Sitting	12		Acceptable
		Fall	9		Sitting	15		Acceptable
		Winter	10		Sitting	17		Acceptable
		Annual	9		Sitting	15		Acceptable
	B	Spring	9		Sitting	15		Acceptable
		Summer	7		Sitting	12		Acceptable
		Fall	8	-11%	Sitting	14		Acceptable
		Winter	10		Sitting	16		Acceptable
		Annual	9		Sitting	14		Acceptable
98	A	Spring	15		Standing	24		Acceptable
		Summer	11		Sitting	18		Acceptable
		Fall	13		Standing	21		Acceptable
		Winter	16		Walking	26		Acceptable
		Annual	14		Standing	23		Acceptable
	B	Spring	18	+20%	Walking	29	+21%	Acceptable
		Summer	13	+18%	Standing	22	+22%	Acceptable
		Fall	16	+23%	Walking	27	+29%	Acceptable
		Winter	19	+19%	Walking	32	+23%	Unacceptable
		Annual	17	+21%	Walking	29	+26%	Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

<u>Configurations</u>

A – No Build
B – Build

<u>Mean Wind Speed Criteria</u>

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

<u>Effective Gust Criteria</u>

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
99	A	Spring	13		Standing	20		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
	B	Spring	11	-15%	Sitting	18		Acceptable
		Summer	9		Sitting	15		Acceptable
		Fall	11		Sitting	17	-11%	Acceptable
		Winter	12	-14%	Sitting	19	-14%	Acceptable
		Annual	11	-15%	Sitting	18		Acceptable
100	A	Spring	12		Sitting	19		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	11		Sitting	18		Acceptable
		Winter	12		Sitting	18		Acceptable
		Annual	11		Sitting	18		Acceptable
	B	Spring	9	-25%	Sitting	14	-26%	Acceptable
		Summer	7	-30%	Sitting	11	-31%	Acceptable
		Fall	8	-27%	Sitting	13	-28%	Acceptable
		Winter	10	-17%	Sitting	15	-17%	Acceptable
		Annual	9	-18%	Sitting	14	-22%	Acceptable
101	A	Spring	12		Sitting	18		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	11		Sitting	18		Acceptable
		Annual	11		Sitting	17		Acceptable
	B	Spring	15	+25%	Standing	25	+39%	Acceptable
		Summer	13	+44%	Standing	20	+43%	Acceptable
		Fall	14	+27%	Standing	23	+35%	Acceptable
		Winter	15	+36%	Standing	26	+44%	Acceptable
		Annual	15	+36%	Standing	24	+41%	Acceptable
102	A	Spring	16		Walking	24		Acceptable
		Summer	13		Standing	20		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	18		Walking	26		Acceptable
		Annual	16		Walking	24		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	24	+50%	Uncomfortable	35	+46%	Unacceptable
		Summer	20	+54%	Uncomfortable	28	+40%	Acceptable
		Fall	22	+38%	Uncomfortable	32	+33%	Unacceptable
		Winter	24	+33%	Uncomfortable	34	+31%	Unacceptable
		Annual	23	+44%	Uncomfortable	33	+38%	Unacceptable
103	A	Spring	14		Standing	21		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
	B	Spring	20	+43%	Uncomfortable	29	+38%	Acceptable
		Summer	15	+36%	Standing	22	+29%	Acceptable
		Fall	18	+38%	Walking	27	+35%	Acceptable
		Winter	19	+27%	Walking	28	+27%	Acceptable
		Annual	18	+38%	Walking	27	+35%	Acceptable
104	A	Spring	17		Walking	25		Acceptable
		Summer	13		Standing	20		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	18		Walking	27		Acceptable
		Annual	16		Walking	24		Acceptable
	B	DATA NOT AVAILABLE						
		DATA NOT AVAILABLE						
		DATA NOT AVAILABLE						
		DATA NOT AVAILABLE						
		DATA NOT AVAILABLE						
105	A	Spring	13		Standing	20		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
	B	DATA NOT AVAILABLE						
		DATA NOT AVAILABLE						
		DATA NOT AVAILABLE						
		DATA NOT AVAILABLE						
		DATA NOT AVAILABLE						

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

<u>Configurations</u>

A – No Build
B – Build

<u>Mean Wind Speed Criteria</u>

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

<u>Effective Gust Criteria</u>

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
106	A	Spring	14		Standing	21		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	14		Standing	20		Acceptable
	B	Spring	14		Standing	21		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
107	A	Spring	10		Sitting	16		Acceptable
		Summer	8		Sitting	13		Acceptable
		Fall	10		Sitting	15		Acceptable
		Winter	11		Sitting	16		Acceptable
		Annual	10		Sitting	15		Acceptable
	B	Spring	12	+20%	Sitting	19	+19%	Acceptable
		Summer	9	+12%	Sitting	14		Acceptable
		Fall	11		Sitting	17	+13%	Acceptable
		Winter	12		Sitting	18	+12%	Acceptable
		Annual	11		Sitting	17	+13%	Acceptable
108	A	Spring	9		Sitting	15		Acceptable
		Summer	8		Sitting	12		Acceptable
		Fall	9		Sitting	14		Acceptable
		Winter	10		Sitting	16		Acceptable
		Annual	9		Sitting	14		Acceptable
	B	Spring	13	+44%	Standing	19	+27%	Acceptable
		Summer	10	+25%	Sitting	16	+33%	Acceptable
		Fall	12	+33%	Sitting	18	+29%	Acceptable
		Winter	15	+50%	Standing	22	+38%	Acceptable
		Annual	13	+44%	Standing	19	+36%	Acceptable
109	A	Spring	17		Walking	27		Acceptable
		Summer	13		Standing	21		Acceptable
		Fall	16		Walking	25		Acceptable
		Winter	19		Walking	30		Acceptable
		Annual	17		Walking	27		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	19	+12%	Walking	29		Acceptable
		Summer	15	+15%	Standing	22		Acceptable
		Fall	17		Walking	27		Acceptable
		Winter	21	+11%	Uncomfortable	32		Unacceptable
		Annual	19	+12%	Walking	29		Acceptable
110	A	Spring	21		Uncomfortable	31		Acceptable
		Summer	16		Walking	24		Acceptable
		Fall	20		Uncomfortable	29		Acceptable
		Winter	24		Uncomfortable	35		Unacceptable
		Annual	21		Uncomfortable	31		Acceptable
	B	Spring	21		Uncomfortable	31		Acceptable
		Summer	16		Walking	24		Acceptable
		Fall	19		Walking	29		Acceptable
		Winter	23		Uncomfortable	35		Unacceptable
		Annual	21		Uncomfortable	31		Acceptable
111	A	Spring	18		Walking	26		Acceptable
		Summer	13		Standing	20		Acceptable
		Fall	16		Walking	25		Acceptable
		Winter	19		Walking	29		Acceptable
		Annual	17		Walking	26		Acceptable
	B	Spring	18		Walking	27		Acceptable
		Summer	13		Standing	20		Acceptable
		Fall	16		Walking	25		Acceptable
		Winter	19		Walking	29		Acceptable
		Annual	17		Walking	26		Acceptable
112	A	Spring	13		Standing	20		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	12		Sitting	18		Acceptable
	B	Spring	15	+15%	Standing	23	+15%	Acceptable
		Summer	12	+20%	Sitting	18	+20%	Acceptable
		Fall	14	+17%	Standing	22	+22%	Acceptable
		Winter	16	+33%	Walking	25	+32%	Acceptable
		Annual	14	+17%	Standing	23	+28%	Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations	Mean Wind Speed Criteria		Effective Gust Criteria	
A – No Build	Comfortable for Sitting:	≤ 12 mph	Acceptable:	≤ 31 mph
B – Build	Comfortable for Standing:	> 12 and ≤ 15 mph	Unacceptable:	> 31 mph
	Comfortable for Walking:	> 15 and ≤ 19 mph		
	Uncomfortable for Walking:	> 19 and ≤ 27 mph		
	Dangerous Conditions:	> 27 mph		

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
113	A	Spring	17		Walking	25		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	17		Walking	24		Acceptable
	B	Spring	17		Walking	25		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	17		Walking	24		Acceptable
114	A	Spring	10		Sitting	17		Acceptable
		Summer	8		Sitting	14		Acceptable
		Fall	10		Sitting	16		Acceptable
		Winter	11		Sitting	18		Acceptable
		Annual	10		Sitting	16		Acceptable
	B	Spring	11		Sitting	17		Acceptable
		Summer	8		Sitting	13		Acceptable
		Fall	10		Sitting	16		Acceptable
		Winter	11		Sitting	18		Acceptable
		Annual	10		Sitting	16		Acceptable
115	A	Spring	13		Standing	20		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	19		Acceptable
	B	Spring	17	+31%	Walking	23	+15%	Acceptable
		Summer	12	+20%	Sitting	17	+13%	Acceptable
		Fall	15	+25%	Standing	21	+17%	Acceptable
		Winter	16	+14%	Walking	23		Acceptable
		Annual	15	+15%	Standing	21	+11%	Acceptable
116	A	Spring	13		Standing	20		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	19		Acceptable

Notes:
1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	11	-15%	Sitting	18		Acceptable
		Summer	9	-18%	Sitting	14	-12%	Acceptable
		Fall	11		Sitting	17	-11%	Acceptable
		Winter	11	-21%	Sitting	18	-18%	Acceptable
		Annual	11	-15%	Sitting	17	-11%	Acceptable
117	A	Spring	18		Walking	29		Acceptable
		Summer	14		Standing	22		Acceptable
		Fall	17		Walking	27		Acceptable
		Winter	20		Uncomfortable	32		Unacceptable
		Annual	18		Walking	29		Acceptable
	B	Spring	23	+28%	Uncomfortable	32	+10%	Unacceptable
		Summer	18	+29%	Walking	24		Acceptable
		Fall	22	+29%	Uncomfortable	30	+11%	Acceptable
		Winter	25	+25%	Uncomfortable	35		Unacceptable
		Annual	23	+28%	Uncomfortable	31		Acceptable
118	A	Spring	16		Walking	25		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	15		Standing	24		Acceptable
		Winter	17		Walking	28		Acceptable
		Annual	16		Walking	25		Acceptable
	B	Spring	23	+44%	Uncomfortable	33	+32%	Unacceptable
		Summer	18	+38%	Walking	25	+32%	Acceptable
		Fall	22	+47%	Uncomfortable	31	+29%	Acceptable
		Winter	26	+53%	Uncomfortable	36	+29%	Unacceptable
		Annual	23	+44%	Uncomfortable	33	+32%	Unacceptable
119	A	Spring	19		Walking	27		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	17		Walking	25		Acceptable
		Winter	19		Walking	28		Acceptable
		Annual	17		Walking	26		Acceptable
	B	Spring	20		Uncomfortable	30	+11%	Acceptable
		Summer	16		Walking	23		Acceptable
		Fall	19	+12%	Walking	28	+12%	Acceptable
		Winter	22	+16%	Uncomfortable	33	+18%	Unacceptable
		Annual	20	+18%	Uncomfortable	29	+12%	Acceptable

Notes:
1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

Configurations

A – No Build
B – Build

Mean Wind Speed Criteria

Comfortable for Sitting: ≤ 12 mph
Comfortable for Standing: > 12 and ≤ 15 mph
Comfortable for Walking: > 15 and ≤ 19 mph
Uncomfortable for Walking: > 19 and ≤ 27 mph
Dangerous Conditions: > 27 mph

Effective Gust Criteria

Acceptable: ≤ 31 mph
Unacceptable: > 31 mph

Table 1: Pedestrian Wind Comfort and Safety Categories - Multiple Seasons

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
120	A	Spring	20		Uncomfortable	28		Acceptable
		Summer	16		Walking	22		Acceptable
		Fall	19		Walking	26		Acceptable
		Winter	21		Uncomfortable	30		Acceptable
		Annual	20		Uncomfortable	27		Acceptable
	B	Spring	21		Uncomfortable	30		Acceptable
		Summer	17		Walking	24		Acceptable
		Fall	20		Uncomfortable	29	+12%	Acceptable
		Winter	23		Uncomfortable	33		Unacceptable
		Annual	21		Uncomfortable	30	+11%	Acceptable
121	A	Spring	23		Uncomfortable	31		Acceptable
		Summer	18		Walking	25		Acceptable
		Fall	21		Uncomfortable	29		Acceptable
		Winter	25		Uncomfortable	34		Unacceptable
		Annual	23		Uncomfortable	31		Acceptable
	B	Spring	22		Uncomfortable	31		Acceptable
		Summer	18		Walking	25		Acceptable
		Fall	21		Uncomfortable	30		Acceptable
		Winter	24		Uncomfortable	34		Unacceptable
		Annual	22		Uncomfortable	31		Acceptable

Notes: 1) Wind speeds are for a 1% probability of exceedance; and,
2) % Change is based on comparison with Configuration A and only those that are greater than 10% are listed.

<u>Configurations</u>

A – No Build
B – Build

<u>Mean Wind Speed Criteria</u>

Comfortable for Sitting:	≤ 12 mph
Comfortable for Standing:	> 12 and ≤ 15 mph
Comfortable for Walking:	> 15 and ≤ 19 mph
Uncomfortable for Walking:	> 19 and ≤ 27 mph
Dangerous Conditions:	> 27 mph

<u>Effective Gust Criteria</u>

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

Appendix D

Air Quality Appendix

AIR QUALITY APPENDIX

Introduction

This Air Quality Appendix provides modeling assumptions and backup for results presented in Section 4.5 of the report. Included within this documentation is a brief description of the methodology employed along with pertinent calculations and data used in the emissions and dispersion calculations supporting the microscale air quality analyses.

Motor Vehicle Emissions

The EPA MOBILE6.2 computer program generated motor vehicle emissions used in the mobile source CAL3QHC modeling. The model input parameters were provided by MassDEP. Emission rates were derived for 2017 for speed limits of 2.5, 10, 15, and 30 mph for use in the microscale analyses.

CAL3QHC

For the intersections studied, the CAL3QHC model was applied to calculate CO concentrations at sensitive receptor locations using emission rates derived in MOBILE6.2. The intersection's queue links and free flow links were input to the model along with sensitive receptors at all locations nearby each intersection. The meteorological assumptions input into the model were a 1.0 meter per second wind speed, Pasquill-Gifford Class D stability combined with a mixing height of 1000 meters. For each direction, the full range of wind directions at 10 degree intervals was examined. In addition, a surface roughness (z_0) of 321 cm was used for the intersections. Idle emission rates for queue links were based on 2.5 mph emission rates derived in MOBILE6.2 and converted from grams per mile to grams per hour. Emission rates for speeds of 10, 15, and 30 mph were used for right turn, left turn, and free flow links, respectively.

Boston Properties New Boston Garden
Calculation of Microscale Modeling Emission Factors
Summary of MOBILE6 Output

Carbon Monoxide Only

Queues	Idle
Free Flow	30 mph
Right Turns	10 mph
Left Turns	15 mph

Winter	**2013**	**2028**	**Units**
Idle	48.058	44.988	g/hr
2.5 mph	19.223	17.995	g/mile
10 mph	10.408	10.127	g/mile
15 mph	9.367	9.205	g/mile
30 mph	8.371	8.334	g/mile

Note: Winter CO emission factors are higher than Summer and are conservatively used

Boston Properties New Boston Garden Development
Background Concentrations

Background Concentrations								
POLLUTANT	AVERAGING TIME	2010	2011	2012	Units	ppm to $\mu g/m^3$ Conversion Factor	Background Concentration ($\mu g/m^3$)	Location
SO_2 (1)(7)	1-Hour	0.0269	0.049	0.0158	ppm	2600	127.4	Kenmore Sq., Boston
	3-Hour (8)	0.034	0.024	0.019	ppm	2600	88.4	Kenmore Sq., Boston
	24-Hour	0.0084	0.0121	0.006	ppm	2600	31.5	Kenmore Sq., Boston
	Annual	0.00224	0.00236	0.00187	ppm	2600	6.1	Kenmore Sq., Boston
PM-10	24-Hour	32	39	41	$\mu g/m^3$	1	41.0	One City Sq. Boston
	Annual	15.1	15.9	16.8	$\mu g/m^3$	1	16.8	One City Sq. Boston
PM-2.5	24-Hour (4)	24.8	23.9	20.9	$\mu g/m^3$	1	23.2	174 North St., Boston
	Annual (5)	10.03	10.32	9.47	$\mu g/m^3$	1	9.9	174 North St., Boston
NO_2 (3)	1-Hour (6)	0.0635	0.0749	0.064	ppm	1880	140.8	Kenmore Sq., Boston
	Annual	0.0191	0.02036	0.0191	ppm	1880	38.3	Kenmore Sq., Boston
CO (2)	1-Hour	1.9	1.5	1.4	ppm	1140	2166	Kenmore Sq., Boston
	8-Hour	1.5	1.3	1.1	ppm	1140	1710	Kenmore Sq., Boston

From 2007-2012 MassDEP Annual Data Summaries
KEN = Kenmore Sq. Boston; CTY = 1 City Sq. Boston, NTH = 174 North St. Boston
[1] SO_2 reported in ppm or ppb. Converted to $\mu g/m^3$ using factor of 1 ppm = 2600 $\mu g/m^3$.
[2] CO reported in ppm or ppb. Converted to $\mu g/m^3$ using factor of 1 ppm = 1140 $\mu g/m^3$.
[3] NO_2 reported in ppm or ppb. Converted to $\mu g/m^3$ using factor of 1 ppm = 1880 $\mu g/m^3$.
[4] Background level for 24-hour PM-2.5 is the average concentration of the 98th percentile for three years.
[5] Background level for annual PM-2.5 is the average for three years.
[6] Maximum annual 1-hr concentrations.
[7] The 24-hour and Annual standards were revoked by EPA on June 22, 2010, Federal Register 75-119, p. 35520.
[8] The 2010 - 2012 SO_2 3-hr value is not reported. Years 2007-2009 used instead.

Boston Property New Boston Garden Development

Intersections (Signalized and *Unsignalized*)	2013 Existing Weekday AM Peak			2013 Existing Weekday PM Peak			2013 Existing Saturday Midday Peak		
	LOS RANK	COMB. RANK	Traffic Volume RANK	LOS RANK	COMB. RANK	Traffic Volume RANK	LOS RANK	COMB. RANK	Traffic Volume RANK
1: Causeway Street & Lomasney Way	1	4	3	2	5	3	2	5	3
2: Causeway Street & Lancaster Street	7	18	11	8	21	13	8	17	9
3: Causeway Street & Portland Street	5	14	9	6	17	11	5	12	7
4: Causeway Street & Friend Street	7	17	10	8	20	12	8	16	8
5: Causeway Street & Canal Street	7	15	8	8	15	7	8	14	6
6: Causeway Street & Haverhill Street	7	19	12	8	18	10	8	20	12
7: Causeway Street & Beverly Street	7	20	13	8	16	8	8	19	11
8: Causeway Street & Medford Street	7	14	7	8	16	8	8	21	13
9: Causeway Street & N Washington St.	2	3	1	1	2	1	1	2	1
10: Valenti Way & Canal Street	7	23	16	8	24	16	8	24	16
11: Valenti Way & Haverhill St	7	24	17	8	25	17	8	25	17
12: Valenti Way & Beverly Street	5	20	15	6	21	15	5	20	15
13: Valenti Way & N Washington St.	4	6	2	4	6	2	5	7	2
14: Beverly Street & N Washington St.	7	11	4	4	9	5	2	6	4
15: Nashua StlGarden Garage & Lomasney Way	7	13	6	8	14	6	8	17	9
16: Nashua Street & Lomasney Way	7	21	14	8	22	14	8	22	14
17: New Chardon St & Merrimac Street	2	7	5	2	6	4	2	7	5

Boston Property New Boston Garden Development

Intersections (Signalized and *Unsignalized*)	2028 No-Build Weekday AM Peak LOS RANK	COMB. RANK	Traffic Volume RANK	2028 No-Build Weekday PM Peak LOS RANK	COMB. RANK	Traffic Volume RANK	2028 No-Build Saturday Midday Peak LOS RANK	COMB. RANK	Traffic Volume RANK
1: Causeway Street & Lomasney Way	2	5	3	1	3	2	2	6	4
2: Causeway Street & Lancaster Street	9	18	9	9	21	12	8	17	9
3: Causeway Street & Portland Street	9	16	7	8	16	8	8	15	7
4: Causeway Street & Friend Street	9	18	9	9	20	11	8	19	11
5: Causeway Street & Canal Street	9	17	8	9	18	9	8	18	10
6: Causeway Street & Haverhill Street	6	17	11	5	12	7	7	15	8
7: Causeway Street & Beverly Street	9	21	12	9	19	10	8	19	11
8: Causeway Street & Medford Street	9	22	13	9	22	13	8	21	13
9: Causeway Street & N Washington St.	1	2	1	1	2	1	1	2	1
10: Valenti Way & Canal Street	9	26	17	9	26	17	8	25	17
11: Valenti Way & Haverhill St	9	25	16	9	25	16	8	24	16
12: Valenti Way & Beverly Street	6	21	15	5	20	15	3	18	15
13: Valenti Way & N Washington St.	2	4	2	4	8	4	3	5	2
14: Beverly Street & N Washington St.	5	10	5	5	10	5	3	8	5
15: Nashua StlGarden Garage & Lomasney Way	9	15	6	9	15	6	8	14	6
16: Nashua Street & Lomasney Way	6	20	14	9	23	14	8	22	14
17: New Chardon St & Merrimac Street	4	8	4	3	6	3	3	6	3

Boston Property New Boston Garden Development

Intersections (Signalized and *Unsignalized*)	2028 Build Weekday AM Peak LOS RANK	2028 Build Weekday AM Peak COMB. RANK	2028 Build Weekday AM Peak Traffic Volume RANK	2028 Build Weekday PM Peak LOS RANK	2028 Build Weekday PM Peak COMB. RANK	2028 Build Weekday PM Peak Traffic Volume RANK	2028 Build Saturday Midday Peak LOS RANK	2028 Build Saturday Midday Peak COMB. RANK	2028 Build Saturday Midday Peak Traffic Volume RANK
1: Causeway Street & Lomasney Way	3	6	3	1	3	2	2	5	3
2: Causeway Street & Lancaster Street	10	20	10	10	22	12	8	18	10
3: Causeway Street & Portland Street	10	18	8	9	18	9	8	17	9
4: Causeway Street & Friend Street	10	20	10	10	21	11	8	20	12
5: Causeway Street & Canal Street	10	19	9	10	20	10	8	19	11
6: Causeway Street & Haverhill Street	3	10	7	1	6	5	4	9	5
7: Causeway Street & Beverly Street	7	19	12	6	14	8	8	16	8
8: Causeway Street & Medford Street	10	23	13	10	23	13	8	21	13
9: Causeway Street & N Washington St.	1	2	1	1	2	1	1	2	1
10: Valenti Way & Canal Street	10	27	17	10	27	17	8	25	17
11: Valenti Way & Haverhill St	10	26	16	10	26	16	8	24	16
12: Valenti Way & Beverly Street	7	22	15	6	20	14	5	19	14
13: Valenti Way & N Washington St.	1	3	2	4	7	3	2	4	2
14: Beverly Street & N Washington St.	6	11	5	6	12	6	5	11	6
15: Nashua StlGarden Garage & Lomasney Way	10	16	6	10	17	7	8	15	7
16: Nashua Street & Lomasney Way	7	21	14	10	25	15	8	23	15
17: New Chardon St & Merrimac Street	5	9	4	4	7	3	5	9	4

Boston Property New Boston Garden Development

Intersections (Signalized and *Unsignalized*)	2028 Build Mitigated Weekday AM Peak			2028 Build Mitigated Weekday PM Peak			2028 Build Mitigated Saturday Midday Peak		
	LOS RANK	COMB. RANK	Traffic Volume RANK	LOS RANK	COMB. RANK	Traffic Volume RANK	LOS RANK	COMB. RANK	Traffic Volume RANK
1: Causeway Street & Lomasney Way	2	5	3	1	3	2	2	5	3
2: Causeway Street & Lancaster Street	10	20	10	10	22	12	9	19	10
3: Causeway Street & Portland Street	10	18	8	9	18	9	8	17	9
4: Causeway Street & Friend Street	10	20	10	10	21	11	9	21	12
5: Causeway Street & Canal Street	10	19	9	10	20	10	9	20	11
6: Causeway Street & Haverhill Street	4	11	7	4	9	5	3	8	5
7: Causeway Street & Beverly Street	7	19	12	6	14	8	9	17	8
8: Causeway Street & Medford Street	10	23	13	10	23	13	9	22	13
9: Causeway Street & N Washington St.	2	3	1	1	2	1	1	2	1
10: Valenti Way & Canal Street	10	27	17	10	27	17	9	26	17
11: Valenti Way & Haverhill St	10	26	16	10	26	16	9	25	16
12: Valenti Way & Beverly Street	7	22	15	6	20	14	3	17	14
13: Valenti Way & N Washington St.	1	3	2	3	6	3	3	5	2
14: Beverly Street & N Washington St.	6	11	5	6	12	6	3	9	6
15: Nashua StlGarden Garage & Lomasney Way	10	16	6	10	17	7	9	16	7
16: Nashua Street & Lomasney Way	7	21	14	10	25	15	9	24	15
17: New Chardon St & Merrimac Street	4	8	4	4	7	3	3	7	4

Boston Property New Boston Garden Development

Intersections (Signalized and *Unsignalized*)	All Modeled Cases: Worst 3 By LOS	Worst 3 By Volume	Overall
1: Causeway Street & Lomasney Way	21	34	55
2: Causeway Street & Lancaster Street	106	127	233
3: Causeway Street & Portland Street	95	101	196
4: Causeway Street & Friend Street	106	127	233
5: Causeway Street & Canal Street	106	108	214
6: Causeway Street & Haverhill Street	60	94	154
7: Causeway Street & Beverly Street	92	121	213
8: Causeway Street & Medford Street	106	145	251
9: Causeway Street & N Washington St.	14	12	26
10: Valenti Way & Canal Street	106	201	307
11: Valenti Way & Haverhill St	106	195	301
12: Valenti Way & Beverly Street	64	176	240
13: Valenti Way & N Washington St.	36	28	64
14: Beverly Street & N Washington St.	58	62	120
15: Nashua StlGarden Garage & Lomasney Way	106	79	185
16: Nashua Street & Lomasney Way	97	172	269
17: New Chardon St & Merrimac Street	41	46	87

Due to excessive size CAL3QHC, and MOBILE6.2 input and output files are available on digital media upon request.

Appendix E

Climate Change Preparedness Questionnaire

Boston Climate Change Preparedness Questionnaire

2. Project Information

1. Project Name and Location

Project Name : The Boston Garden
Project Address : 80 Causeway Street

2. Project Contact:

Name : Kevin Sheehan
Company : Boston Properties
Email Address : tmoked@epsilonassociates.com
Phone Number : 617-236-3300
Title : Senior Project Manager

3. Project Contact:

Name : Kevin Sheehan
Company : Boston Properties
Email Address : tmoked@epsilonassociates.com
Phone Number : 617-236-3300
Title : Senior Project Manager

4. Team Description:

Owner / Developer : Boston Properties Limited Partnership/Boston Garden Development Corp.
Architect : Elkus/Manfredi Architects
Engineer (building systems) : Cosentini
Sustainability / LEED : Elkus/Manfredi Architects
Permitting : Epsilon Associates, Inc.

3. New Page

5. Is this project a:

Phased, multi-building project

6. At what phase is this project?

PNF Submitted

4. Phased, multi-building project

7. Project Identification

Name of phased, multi-building project : Boston Garden
Number of phases : 3
Primary address : 80 Causeway Street
Additional addresses : none

5. Single building project

Project Identification:

6. Master Plan

Project Identification

7. Institutional Master Plan

Project Identification

8. Building Classification and Description

8. Building Uses - check all appropriate uses:

Retail
Residential - Multi-unit, Four plus
Office

9. Building First Floor Uses - list all:

Retail, Lobby

10. Construction Type – select most appropriate type:

Steel Frame

11. Building Size: do not include commas

Site Area (Square Feet) : 2.8 Acres
Building Area (Square Feet) : 1,870,000
Building Height (Feet) : 600
Number of Stories (Floors) : 45
First Floor Elevation (feet above sea level)(Boston City Base Elev.)(Ft.) : 13
Number of below grade levels : 5

9. Green Building

12. Which LEED Rating System(s) has or will your project use (by area for projects using multiple rating systems):

	Rating System
Primary Use	LEED 2009 for Core & Shell
Secondary Use	
Additional Uses	

13. What are the projected LEED Rating System Outcome(s):

	Rating System
Primary Use	Certified
Secondary Use	
Additional Uses	

14. Is or will the Project Register with the US Green Building Council

Yes

15. Is or will the Project Seek US Green Building Council Certification:

Yes

10. Higher Temperatures and Heat Waves - Analysis and General Strategies

16. Analysis Sources:

17. What time span of Climate Change was considered:

None

18. Analysis Conditions:

What Low Temperature will be used for project planning (degrees) : 12.4
What High Temperature will be used for project planning (degrees) : 87.6

19. What Extreme Heat Event characteristics will be used for project planning:

Peak High (degrees) : 87 design degree day 1% of the time

20. What measures will the project employ to reduce urban heat-island effect:

High reflective paving materials
High reflective roof materials
Vegetated roof materials
Other: Structured parking

21. Will the project be able to manage hotter and more humid summers without increasing its electrical load; if so how?

No

22. Will the building remain operable without utility power for an extended period; if so for how long and by what strategies?

If Yes, for how long (days) and describe strategies: Generator backup for essential building function only. Depends on outdoor conditions but about one day.

11. High Temperatures and Heat Waves - Active and Passive Strategies

23. What will be the overall energy performance of the project or building (percentage above code)

20%

24. How will project energy performance be determined

Whole Building Energy Model

25. What specific measures will the project employ to reduce building energy consumption

High performance lighting
Building day lighting
EnergyStar equipment / appliances

26. What specific measures will the project employ to reduce building energy demands on the utilities and infrastructure

Describe any added measures: On site renewable energy is being explored

27. Will the project employ Smart Grid Infrastructure and / or Systems

No

28. Describe any non-mechanical strategies that will support building functionality and use during an extended interruption(s) of utility services and infrastructure

High performance building envelop

29. List the R values for building envelope elements:

Roof : 30
Walls : 15.6
Floors / Slab : 0.73
Foundation / Basement : 1.14
Windows : 0.4

12. Sea-Level Rise and Storms – location analysis and description

30. Location Description:

Site Elevation - low point (feet above sea level)(Boston City Base Elev.)(Ft.) : 13
Site Elevation - high point (feet above sea level)(Boston City Base Elev.)(Ft.) : 18

31. Location Classification - is the site or building located in any of the following:

	Yes	No
Coastal Zone		X
Velocity Zone		X
Flood Zone		X
Area Prone to Flooding		X

32. Are updates in the floodplain delineation due to climate change likely to change the classification of the site or building location:

Yes

33. What is the project or building proximity to nearest Coastal, Velocity or Flood Zone or Area Prone to Flooding (horizontal distance in feet)

50 ft

13. Sea-Level Rise and Storms – analysis and general strategies

34. Analysis Sources:

35. What time span of Climate Change and Rising Sea-Levels was considered:

50 Years

36. How were impacts from higher sea levels and more frequent and extreme storm events analyzed:

Sea-Level Rise (change in feet) : Should not be impacted

14. Sea-Level Rise and Storms - Building Flood Proofing

37. Will the building remain occupiable without utility power during a period of extended inundation:

No

38. Will the proposed ground floor be raised in response to Sea Level Rise:

If Yes, to what elevation above the 100 year flood plain (Boston City Base Elev.)(Ft.):

39. Will the proposed ground floor be raised in response to Sea Level Rise:

40. Will lower building levels be constructed in a manner to prevent water penetration:

No

41. Describe measures and strategies intended to ensure the integrity of critical building systems during a flood or severe storm event:

None
Describe any other measure or strategies: See section 5 of PNF

42. Were the differing effects of fresh water and salt water flooding considered:

No

43. Will the project site and building(s) be accessible during periods of inundation or limited circulation and / or access to transportation:

44. Describe any additional Building Floor Proofing strategies?

15. Sea-Level Rise and Storms - Building Resiliency and Adaptability

45. Will the building be able to withstand severe storm impacts and endure temporary inundation

No

46. Will the building include additional structural capacity and or building systems to accommodate future on-site renewable and or clean energy sources; if so what:

No

47. Can the site and building be reasonably modified to increase Building Flood Proofing; if so how:

No

48. Describe any additional Building Resiliency and Adaptability strategies: