EXPANDED PROJECT NOTIFICATION FORM

2 Charlesgate West

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

Submitted by:
Trans National Properties, Charlesgate West Associates Limited Partnership, and Charlesgate Condo LLC
2 Charlesgate West
Boston, MA 02115

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

In Association with:
KIG Real Estate Advisors
KPD Advisors
Elkus Manfredi Architects
Carol R. Johnson Associates,
Mel Shuman Law
Howard Stein Hudson
Nitsch Engineering
Cosentini Associates
McPhail Associates, LLC

September 9, 2016

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ASSOCIATES INC.

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Chapter 1.0

Project Summary

1.0 PROJECT SUMMARY

1.1 Project Overview

Trans National Properties, Charlesgate West Associates Limited Partnership, and Charlesgate Condo LLC (collectively, the Proponent), propose to redevelop the approximately 0.47-acre site at 2 Charlesgate West in the Fenway neighborhood of Boston (the Project site). The site currently comprises three existing buildings, which will be demolished and replaced with a 29-story, 344,000 square-foot (sf) residential tower, with ground-floor restaurant and office space. It will include approximately 295 residential units, which will be a mix of rental and ownership units. Trans National Properties intends to occupy the office space. The Project will also include approximately 186 parking spaces.

The Proponent has maintained its headquarters at the Project site since 1976, and, as longstanding members of the Fenway community, they look forward to improving the neighborhood with what will be a transformative Project. The Project site is one of two gateway sites in the Fenway Neighborhood District designated as such under Section 66-31 of the Boston Zoning Code. The designation is intended to encourage "the development of architecturally-distinctive civic landmarks at major entrances to the Fenway neighborhood". The Project has been designed to meet this high standard. It will replace an undistinguished, nondescript building with an iconic landmark that will serve as an eastern gateway to the Fenway neighborhood (see Figure 1-1).

In addition to the creation of an iconic architectural landmark, the Proponent also proposes to make significant improvements to the open space and streetscapes adjacent to the Project site. These improvements are designed to make the area an attractive complement to the Fens park system, and to enhance pedestrian routes in the area by providing a safer, more accessible and pleasant environment. The Project will activate and enliven the Ipswich Street corridor through the introduction of a new restaurant and through the proposed installation of new lighting and art work in the area beneath the Charlesgate overpass, which will be done in collaboration with Artists for Humanity, the Boston Art Academy and MassDOT. The Project will also help to meet Mayor Walsh's housing goals by creating much needed housing, including new affordable housing, in a neighborhood with great demand.

Because the proposed Project exceeds 50,000 square feet of gross floor area, the Project is subject to the requirements of Large Project Review pursuant to Article 80 of the Boston Zoning Code (the Code). Based on the comprehensive approach to addressing potential impacts and mitigation equivalent to the level normally presented in a Draft Project Impact Report (DPIR) presented herein, the Boston Redevelopment Authority (BRA), after reviewing public and agency comments on this expanded PNF and any further responses to comments made by the Project team, may potentially issue a Scoping Determination Waiving Further Review pursuant to the Article 80B process.

2 Charlesgate West **Boston, Massachusetts**

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Figure 1-1

View from Boylston Street facing Northwest toward the Project

1.2 Development Team

Address/Location: 2 Charlesgate West

Developer:
Trans National Properties, Charlesgate West Associates Limited Partnership, and Charlesgate Condo LLC
2 Charlesgate West
Boston, MA 02115
(617) 638-3312

Developer/Advisor:
KIG Real Estate Advisors
1199 Beacon Street, #3
Brookline, MA 02446
(973) 224-7774
Justin D. Krebs

Development Manager:
KPD Advisors
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Medway, MA 02053
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Kevin Daly

Architect:
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25 Drydock Avenue
Boston, MA 02210
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Brian Roessler AIA, LEED AP

Landscape Architect:
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(617) 896-2500 Christopher M. Jones, ASLA

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Melvin R. Shuman

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3 Clock Tower Place, Suite 250
Maynard, MA 01754
(978) 897-7100
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Talya Moked

Transportation and Parking Consultant:
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Elizabeth Peart, P.E.

Civil Engineer:
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John Schmid, PE
Ryan M. Gordon, EIT

MEP Engineer:
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Robert Leber

Geotechnical Consultant:
McPhail Associates, LLC
2269 Massachusetts Avenue
Cambridge, MA 02140
(617) 868-1420
Jonathan W. Patch, P.E.

1.3 Public Benefits

The proposed Project will generate myriad public benefits for the surrounding neighborhoods and the City of Boston as a whole, both during construction and on an ongoing basis upon completion. These public benefits fall into two general categories, Urban Design/Public Realm and Economic/Community Benefits as outlined below.

Urban Design and Public Realm Benefits

- The Project will replace a featureless, nondescript building with a new building that will celebrate and mark the neighborhood with an architecturally significant asset.
- The Project will enliven the surrounding streetscapes with new residents and active restaurant uses.
- The Project will make significant improvements along the Boylston and Ipswich Street corridors. On Ipswich Street, the Proponent is proposing to collaborate with Artists for Humanity, the Boston Art Academy and MassDOT on a project to install new lighting and art work in the area beneath the Charlesgate overpass. On Boylston Street, the Project includes significant new landscaping and pedestrian improvements.
- The Project will replace an older and relatively energy inefficient building with a new building featuring environmentally sustainable green architecture. The Project will comply with Article 37 of the Boston Zoning Code by being Leadership in Energy and Environmental Design (LEED) certifiable; anticipated at the Silver level.

Economic and Community Benefits

- In keeping with Mayor Walsh's goal of adding significant new housing in the city, the Project will create approximately 295 new residential units, including both ownership and rental housing, in close proximity to public transit.
- The Project will create new affordable housing units consistent with the BRA's December 2015 Inclusionary Development Policy. The Proponent is committed to including at least 50% of the required affordable housing units on-site. The Proponent is also pursuing the creation of all the affordable units within the Fenway neighborhood, and is working with the Fenway Community Development Corporation and the community to determine the best approach for the remaining affordable units with the goal of creating more affordable units off-site than would be produced if all affordable units are provided on-site.
- The Project will create approximately $3,500,000 in new annual real estate tax revenues for the City of Boston.
- The Project will create approximately 1,600 construction jobs and approximately 150 new permanent jobs.

1.4 Preliminary Project Schedule

Construction is anticipated to begin in the second quarter of 2017 and will occur over approximately 24-30 months.

1.5 Consistency with Zoning

The Project site is located in the North Boylston Street Neighborhood Shopping Subdistrict of Boston's Fenway Neighborhood District, which is governed principally by Article 66 of the Code. The Project site is also part of each of the North Boylston Gateway Development Area Overlay District, the Restricted Parking Overlay District and the Groundwater Conservation Overlay District (GCOD), and is located partially in the Greenbelt Protection Overlay District (GPOD). Where Article 66 conflicts with the rest of the Code, the provisions of Article 66 govern. Figure 2-1 identifies the Project site.

Multi-family dwelling use above the first story, restaurant use in the basement and first floor, office use and accessory parking are permitted as of right under the Code. As currently contemplated, the Project will be 29 stories with a zoning height not to exceed 340 feet. The proposed total square feet of gross floor area for purposes of calculating the floor area ratio (FAR) in accordance with the Code is approximately 344,000 square feet resulting in a floor area ratio (FAR) for the Project of approximately 16.9.

Since the height and FAR exceed that which is currently permitted, the Project will require relief from the provisions of the Code for height and FAR. In addition, the Project will require zoning relief from applicable parking requirements under the Code. Since the site is located in the GCOD, a conditional use permit for construction of the Project will be required to comply with Article 32 of the Code. Since a portion of the site is located in the GPOD, a conditional use permit for construction of the Project will be on required to comply with Article 29 of the Code. In addition, the Project is subject to demolition delay under Article 85 of the Code since the existing building is over fifty (50) years old.

Article 80 Review Process and Zoning

The proposed Project is subject to review by the BRA pursuant to Article 80B, Large Project Review of the Code. The Project will require variances and conditional use permits from the Board of Appeal as described above. Depending upon the final program for the Project, additional variances or conditional use permits may be required.

1.6 Legal Information

1.6.1 Legal Judgments Adverse to the Proposed Project

The Proponent is not aware of any legal judgments in effect or legal actions pending that would prevent the Proponent from undertaking the Project.

1.6.2 History of Tax Arrears on Property Owned in Boston by the Proponent

No portion of the Project Site is in tax arrears to the City of Boston.

1.6.3 Site Control/ Public Easements

Steven B. Belkin, as Trustee of Charlesgate West Realty Trust, acquired fee simple title to the property known as 2 and 6 Charlesgate West, Boston, Massachusetts in 1975 and the adjacent property known as 1161 Boylston Street in 1996. The combined property is known as 2 Charlesgate West (the Project site). There are no public easements encumbering the site, but the property is subject to various utility easements and rights benefitting abutters. A site survey is included in Appendix A.

1.7 Regulatory Controls and Permits

Table 1-1 presents a preliminary list of local, state, and federal permits and approvals that may be required for the proposed Project. The list is based on current information about the proposed Project and is subject to change as the design of the Project advances. Some of the permits listed may not be required, while there may be others not listed that will be needed.

Table 1-1 Preliminary List of Permits and Approvals

Agency Name	Permit / Approval
Federal	
U.S. Environmental Protection Agency	Coverage under NPDES Construction General Permit; Coverage under NPDES Remediation General Permit (as required)
Federal Aviation Administration	Determination of No Hazard to Air Navigation
State	
Department of Environmental Protection, Division of Air Quality Control	Fossil Fuel Utilization permit (as required); Notice of Demolition/Construction
Department of Conservation and Recreation (DCR)	Coordination Agreement
Massachusetts Water Resources Authority	Construction Dewatering Permit
Massachusetts Historical Commission	Determination of Effect on Historic Resources
Local	
Boston Redevelopment Authority	Article 80B Large Project Review; Cooperation Agreement; Affordable Housing Agreement
Office of Jobs and Community Service Memorandum of Understanding;	Memorandum of Understanding; First Source Agreement
Boston Employment Commission	Boston Residents Construction Employment Plan
Board of Appeal	Zoning Variances and Conditional Use Permits
Boston Civic Design Commission	Design Review
Boston Landmarks Commission	Article 85 Demolition Delay Review
Boston Parks and Recreation Commission	Review of Project
Boston Transportation Department	Transportation Access Plan Agreement; Construction Management Plan; Street and Sidewalk Occupation Permits; Tieback/Earth Retention Permit
Boston Water and Sewer Commission	Sewer Use Discharge Permit; Site Plan Approval; Construction Dewatering Permit; Sewer Extension/ Connection Permit; Stormwater Connection

Table 1-1 Preliminary List of Permits and Approvals (Continued)

Agency Name	Permit / Approval
Public Improvement Commission	Specific Repair Plan; Permit/Agreement for Temporary Earth Retention Systems, Tie-Back Systems and Temporary Support of Subsurface Construction (as required); Permit for sign, awning, hood, canopy or marquee, etc.; Street Layout (all as required)
Boston Public Works Department	Curb Cut Permit(s); Street Opening Permit; Street/Sidewalk Occupancy Permit (as required)
Boston Air Pollution Control Commission	Parking Freeze Permit/Exemption
Public Safety Commission Committee on Licenses	Permit to Erect and Maintain Garage; Flammable Storage License
Boston Inspectional Services Department	Demolition Permits; Building Permits; Certificate of Occupancy

Chapter 2.0

Project Description

2.0 PROJECT DESCRIPTION

This chapter describes the Project in detail, including its site and proposed building program.

2.1 Surrounding Neighborhood

The Project site is in the Fenway neighborhood. Fenway Park and the numerous restaurants along Lansdowne Street are to the west, and the Emerald Necklace is to the southeast. To the southwest of the site is the Boylston Street corridor, a rapidly growing area with multiple projects recently completed, under construction, or in development. The Project site is located on one of two gateway sites in the Fenway Neighborhood District under Section 66-31 of the Boston Zoning Code which is intended to encourage "the development of architecturally-distinctive civic landmarks at major entrances to the Fenway neighborhood".

2.2 Project Description

2.2.1 Project Site

The Project site is approximately 0.47-acres, and is bounded by Ipswich Street to the north, landscaped open space and Charlesgate West to the east, Private Alley 938 to the west, and 1163 Boylston Street to the south. The greenspace and mature plantings located between the Project site and Charlesgate West are owned by the Massachusetts Department of Conservation and Recreation (DCR). The site currently comprises three existing buildings: 2 Charlesgate West Trans National building, a six-story commercial building constructed in 1963; 6 Charlesgate West, a two-story commercial block constructed in 1954; and 1161 Boylston Street, a one-story office block and warehouse constructed in 1955. In total, the site currently contains approximately 52,000 sf of office space. See Figure 2-1 for an aerial locus map of the Project site, and Figures 2-2 through 2-4 for images of the existing conditions on and around the Project site.

The site is within a quarter mile of the Massachusetts Bay Transportation Authority (MBTA) Green Line at Kenmore Station, and within one half mile of the commuter rail at Yawkey Station. The site is also near several bus stops, Zipcar® sites, and Hubway® bike sharing stations. This proximity to public transit makes the area an ideal location for transit-oriented development.

2.2.2 Proposed Development

The Project, as shown in Table 2-1, is an approximately 344,000 sf, 29--story residential building that includes approximately 295 residential units with a mix of rental and ownership units, approximately 10,000 sf of restaurant space, and approximately 7,500 sf of office space. Trans National Properties will occupy the office space, and will remain an active member of the community. The Project will include approximately 186 attended parking spaces, partially below-grade and partially above-grade on the fourth and fifth floors.

G:\Projects2\MA\Boston\4404\PNF\aerial.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

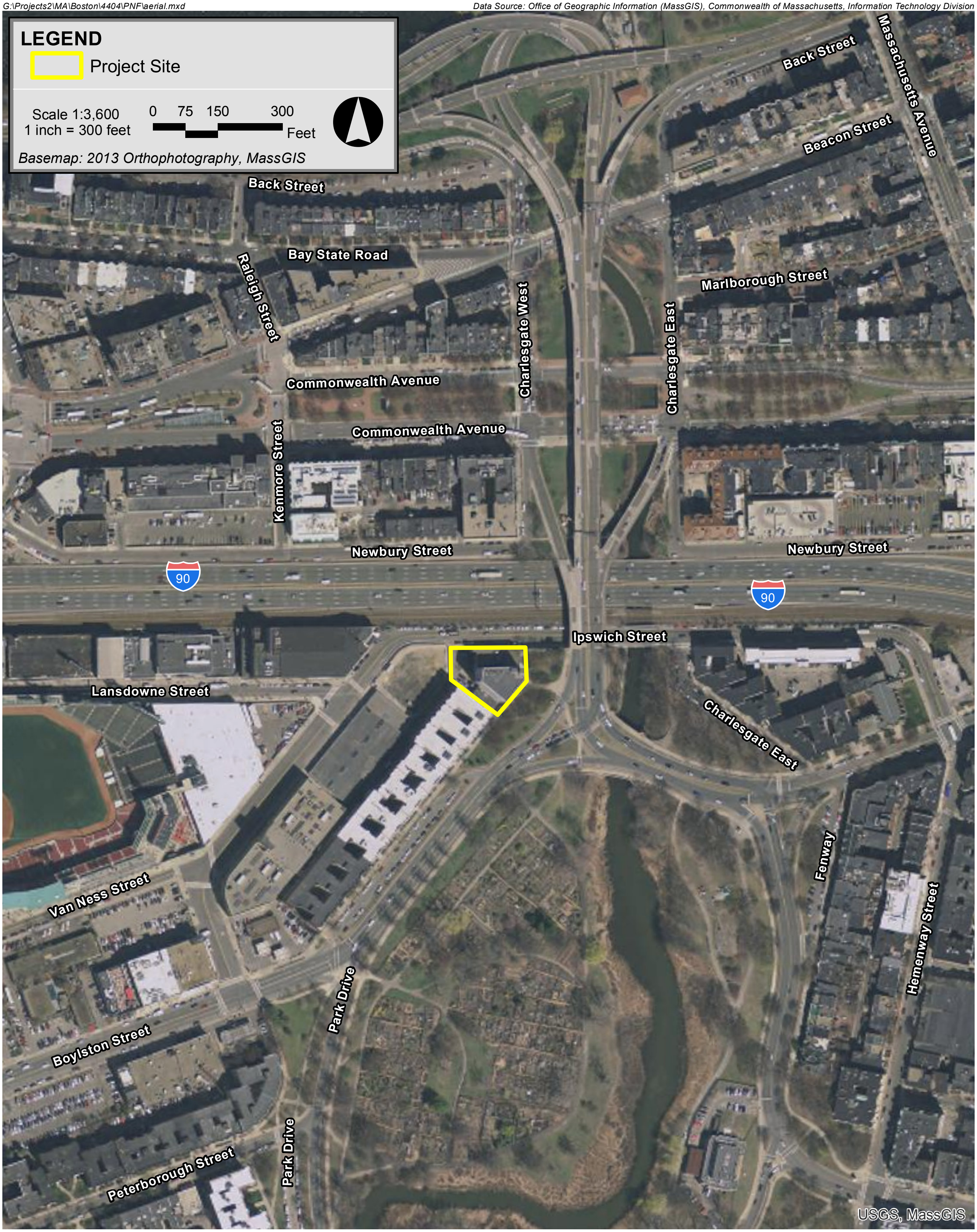

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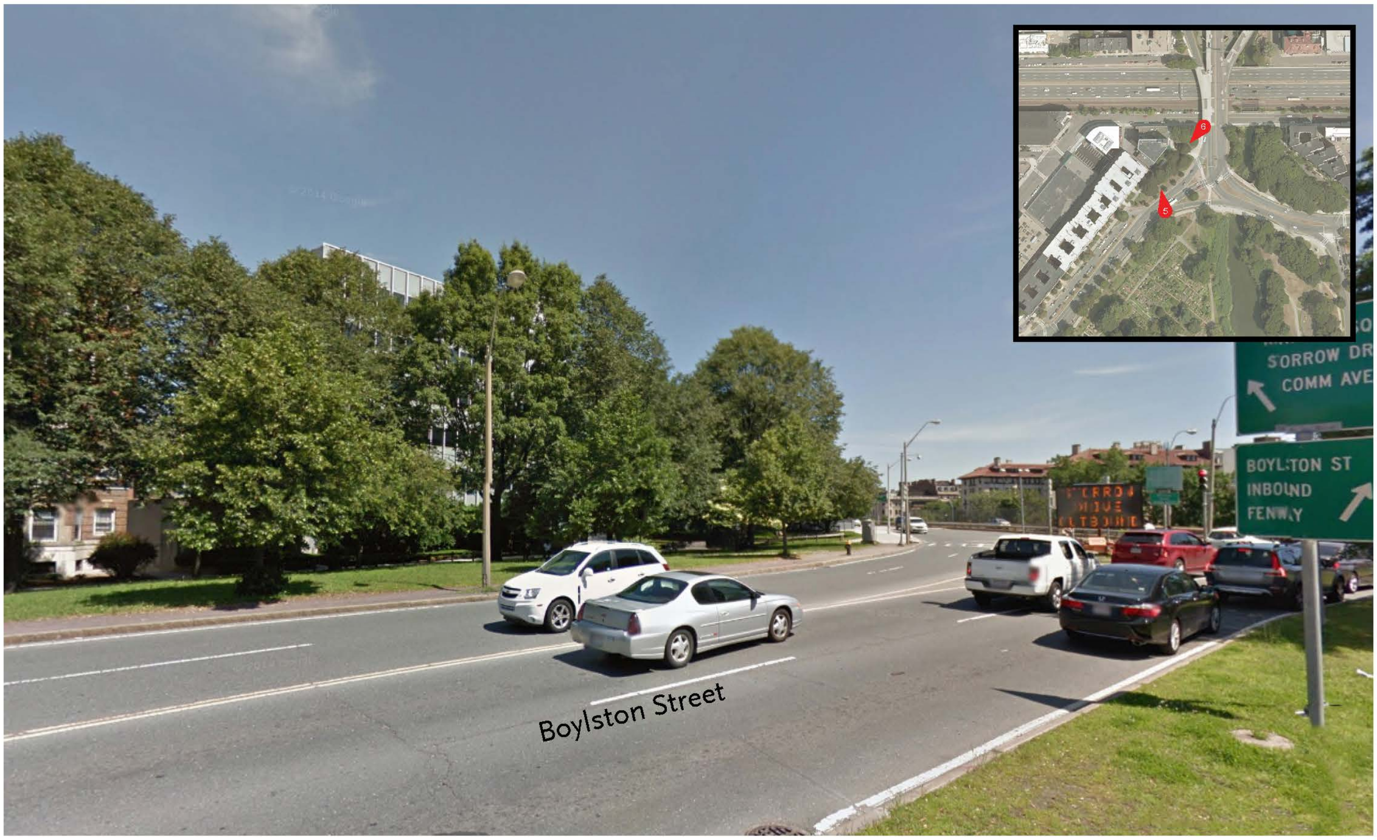
Figure 2-1

Aerial Locus Map



5 - Boylston Street looking North

6 - Charlesgate Street looking Southwest

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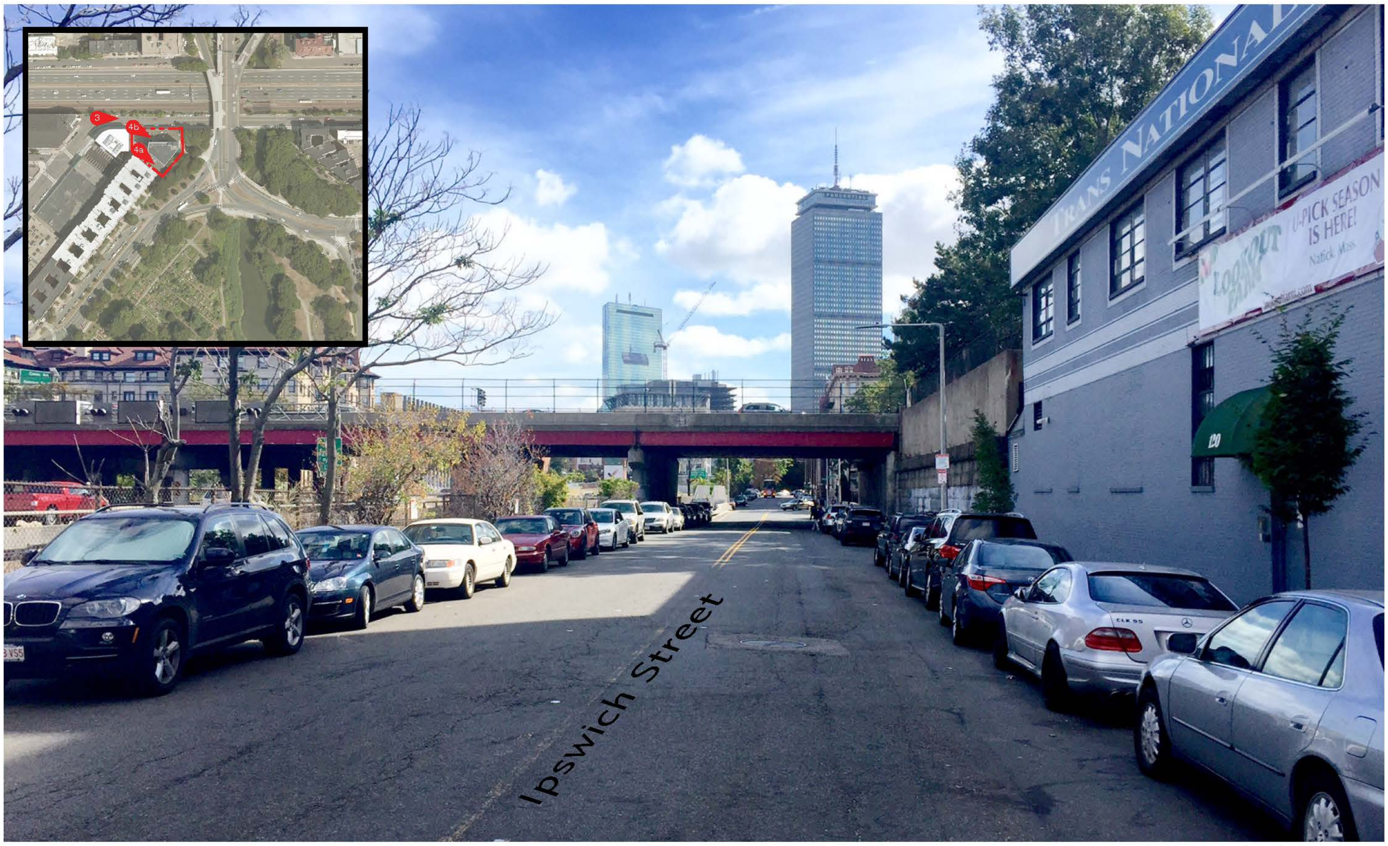
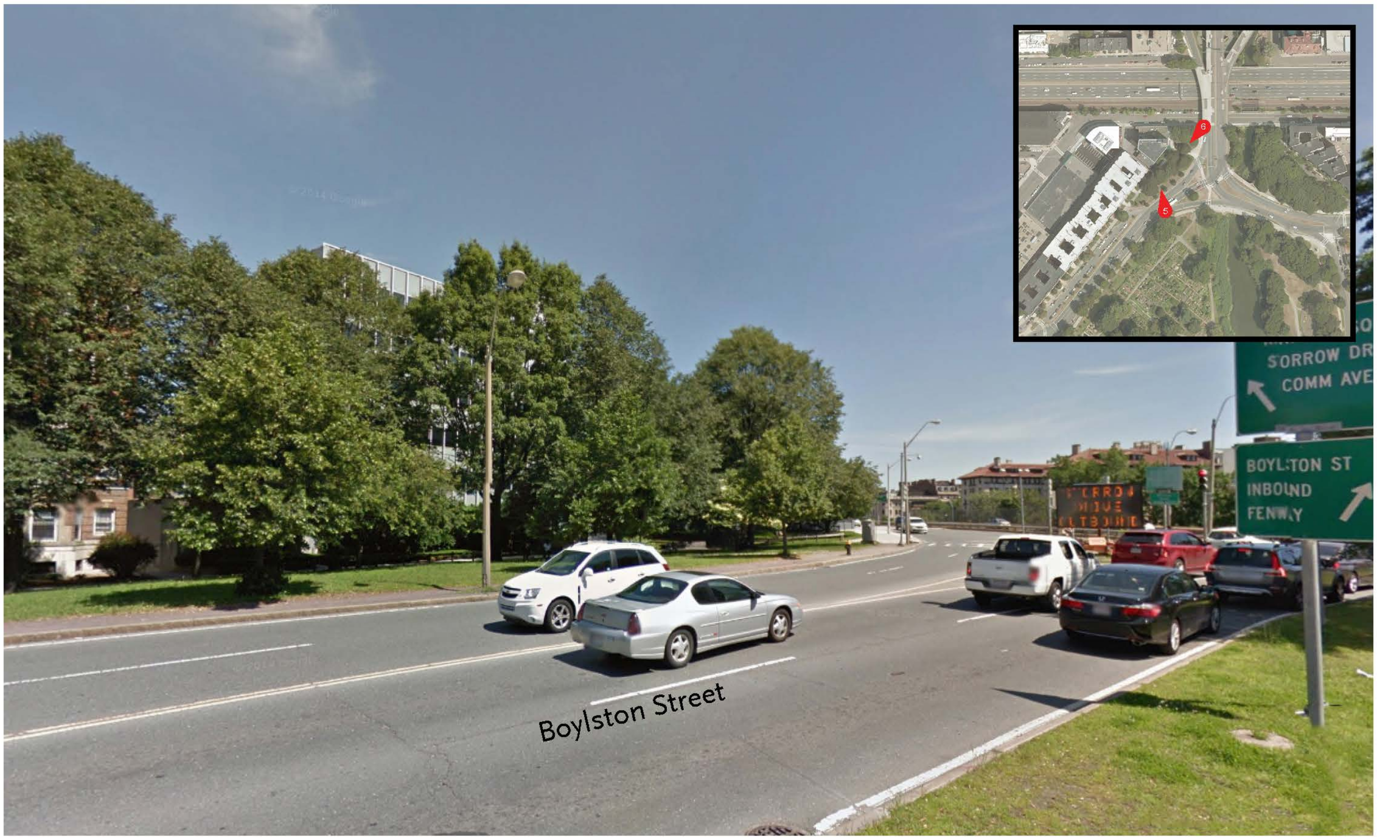


3 - Ipswich Street looking East

4 - Private Alley 938

Figure 2-3
Existing Conditions



5 - Boylston Street looking North

6 - Charlesgate Street looking Southwest

Figure 2-4

Existing Conditions

The residential units will be a variety of sizes to meet a number of different needs, including studios, 1-bedroom, 2-bedroom, and 3-bedroom units. Levels 5 and 19 will include residential amenities such as a fitness center, show kitchen, dining room, library and landscaped outdoor terraces with outdoor grills and dining space. The building will include both rental apartments and residential condominiums, with the condominium floors located above the rental floors. Secure bicycle storage for residents (one per residential unit) will be included within the building. Figures 2-5 through 2-19 present site plans, floor plans, sections and elevations.

Table 2-1 Project Program

Project Element	Approximate Dimension
Restaurant	10,000 sf
Office	7,500 sf
Shared Residential Space	16,000 sf
Rental Apartments	174,500 sf/173 units
Condominiums	136,000 sf/122 units
Total Gross Square Footage (GSF)	**344,000 sf**
Parking	186 spaces
Zoning Height	340 ft/ 29 stories
Parcel Area	20,343 sf
FAR	16.9

The Project will provide residential entries on both Ipswich and Boylston Streets. While Ipswich Street serves as the primary vehicular access to three levels of attended parking, much of its street frontage is glazed and activated by lobbies serving the residents, office tenants, and restaurant guests. Upgrades to Ipswich Street, new lighting, street furnishings, and plantings will improve the pedestrian environment. In addition, the Proponent is proposing to collaborate with Artists for Humanity, the Boston Art Academy and MassDOT on a Project to install new lighting and art work in the area beneath the Charlesgate overpass.

On Boylston Street, the building is separated from the Bowker (aka Charlesgate) Overpass ramps and Boylston Street by approximately one half acre of DCR land. A remnant of the former Charlesgate West overpass, the opportunity to integrate this land with the neighboring and historic Back Bay Fens will be studied as the Project advances. Beyond this landscaped space are entrances to both the apartment and condominium portions of the tower, a dining terrace and entry to the proposed restaurant and accessory retail, and an existing stair leading down to the private alley and Ipswich Street that will be upgraded and expanded.

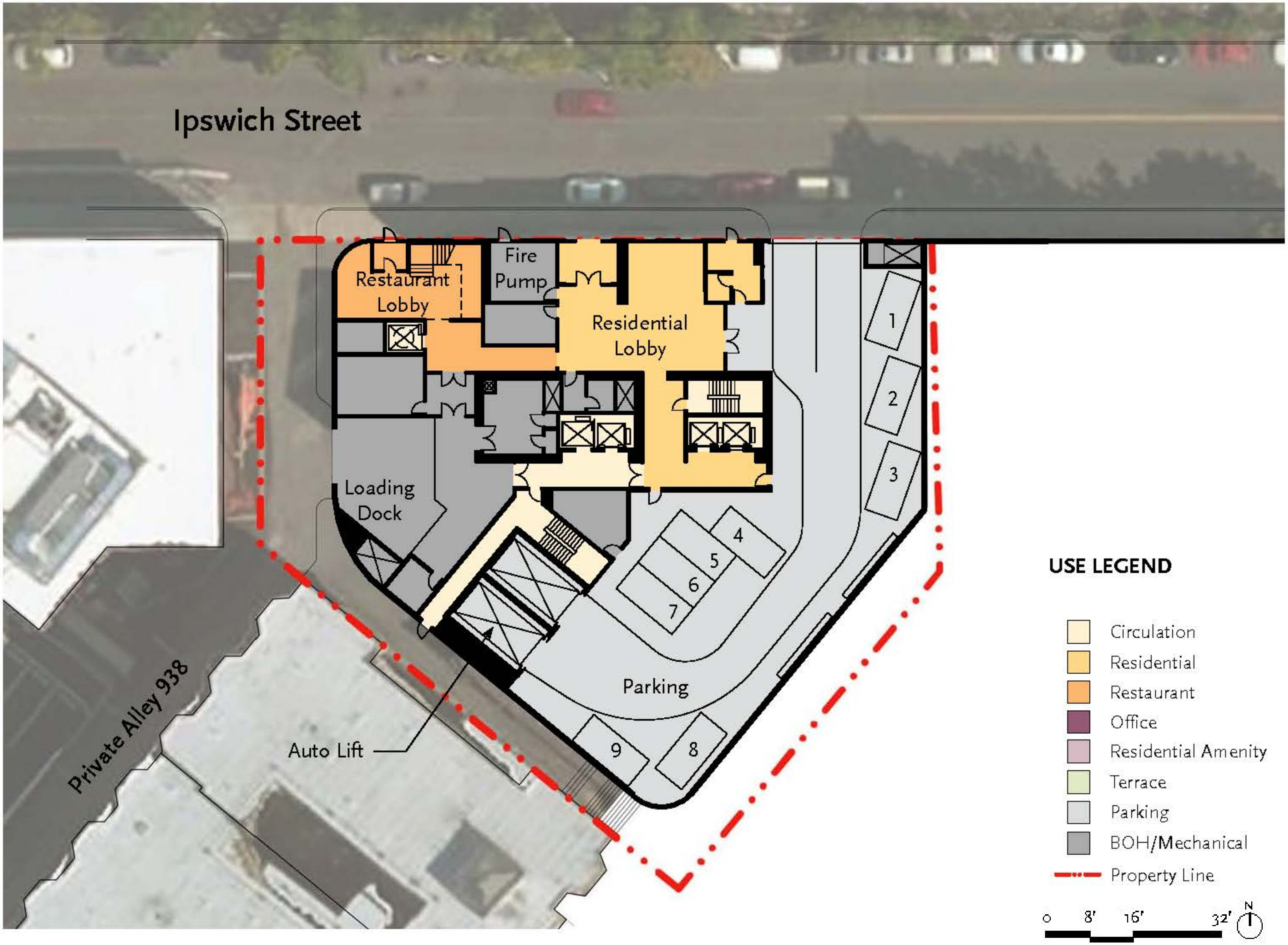


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Figure 2-5

Level 1 - Ipswich Street Ground Floor Plan

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Figure 2-6

Level 2 - Boylston Street Ground Floor Plan

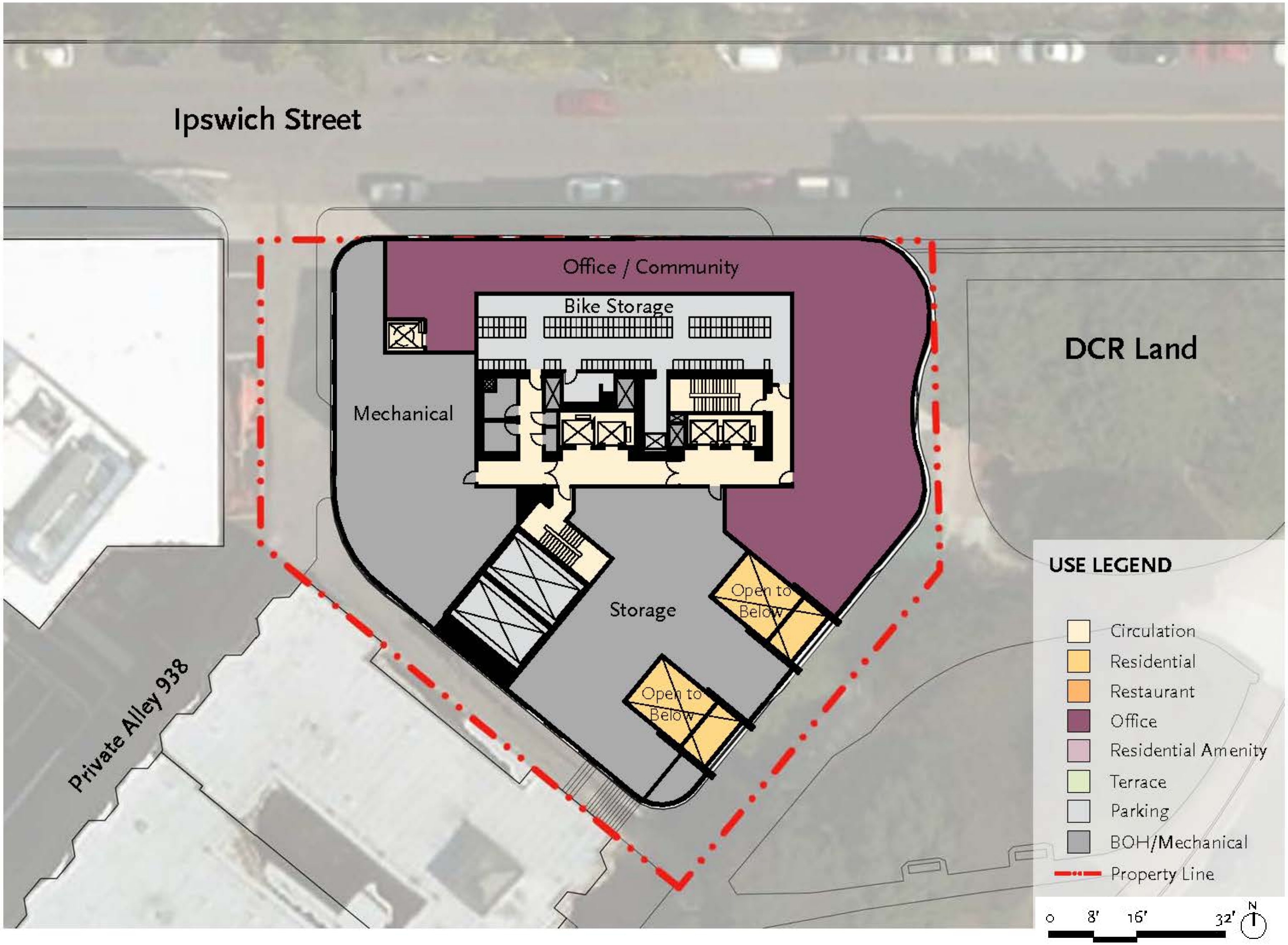

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Figure 2-7

Third Floor Plan

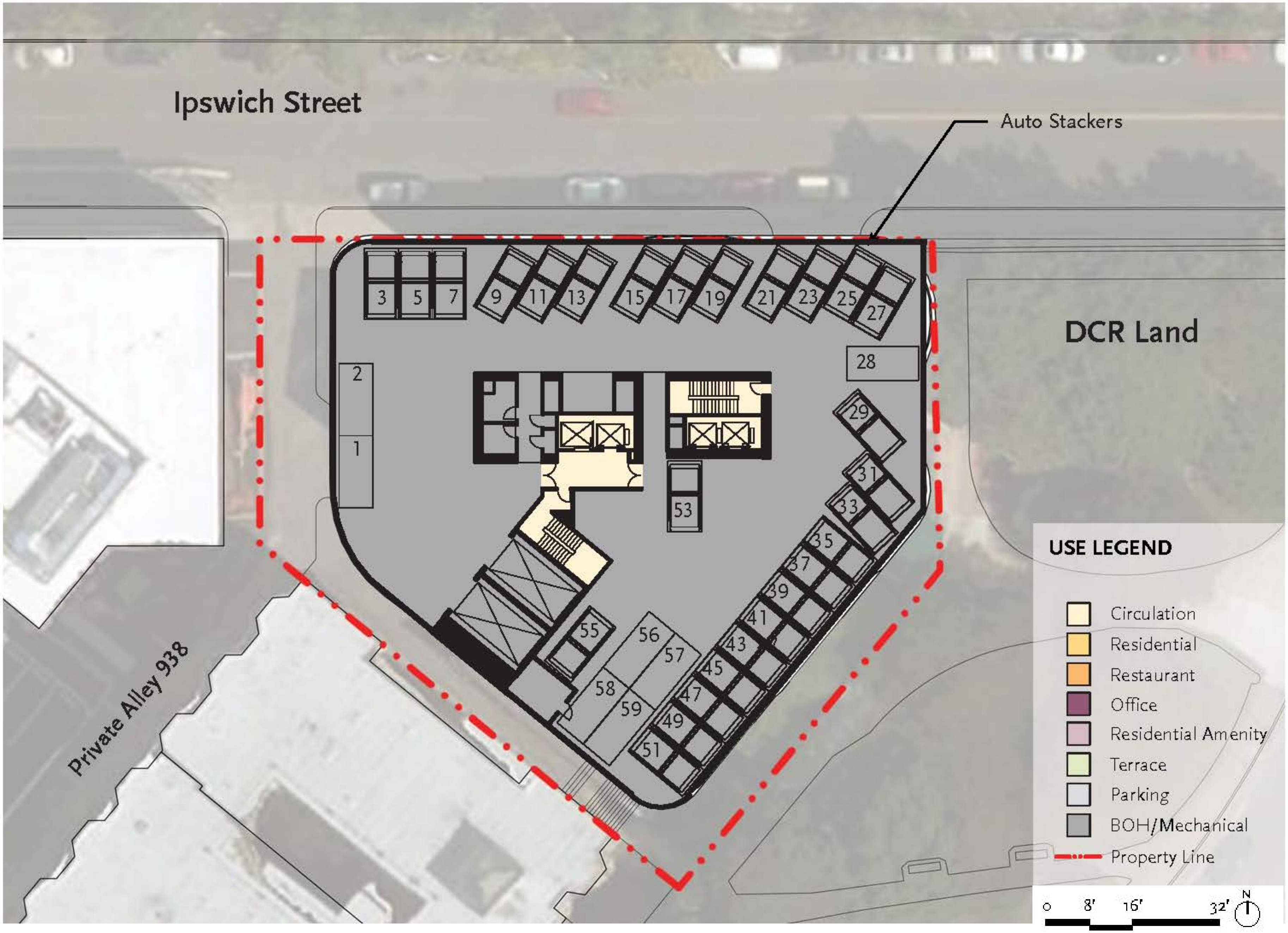

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Figure 2-8

Parking Plan (Level 1 Below Grade, Levels 4 and 5)

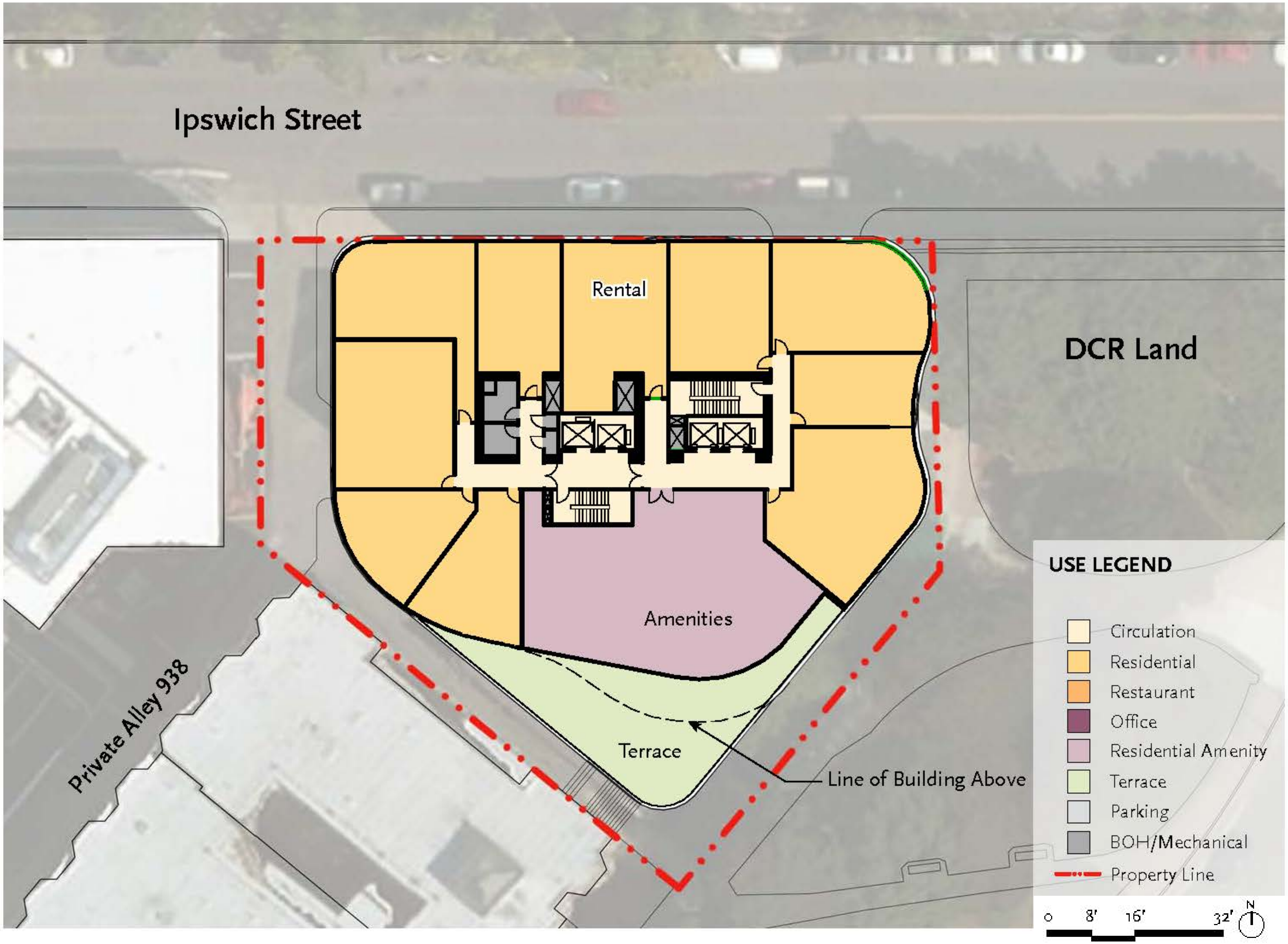

Figure 2-9

Level 6 Floor Plan

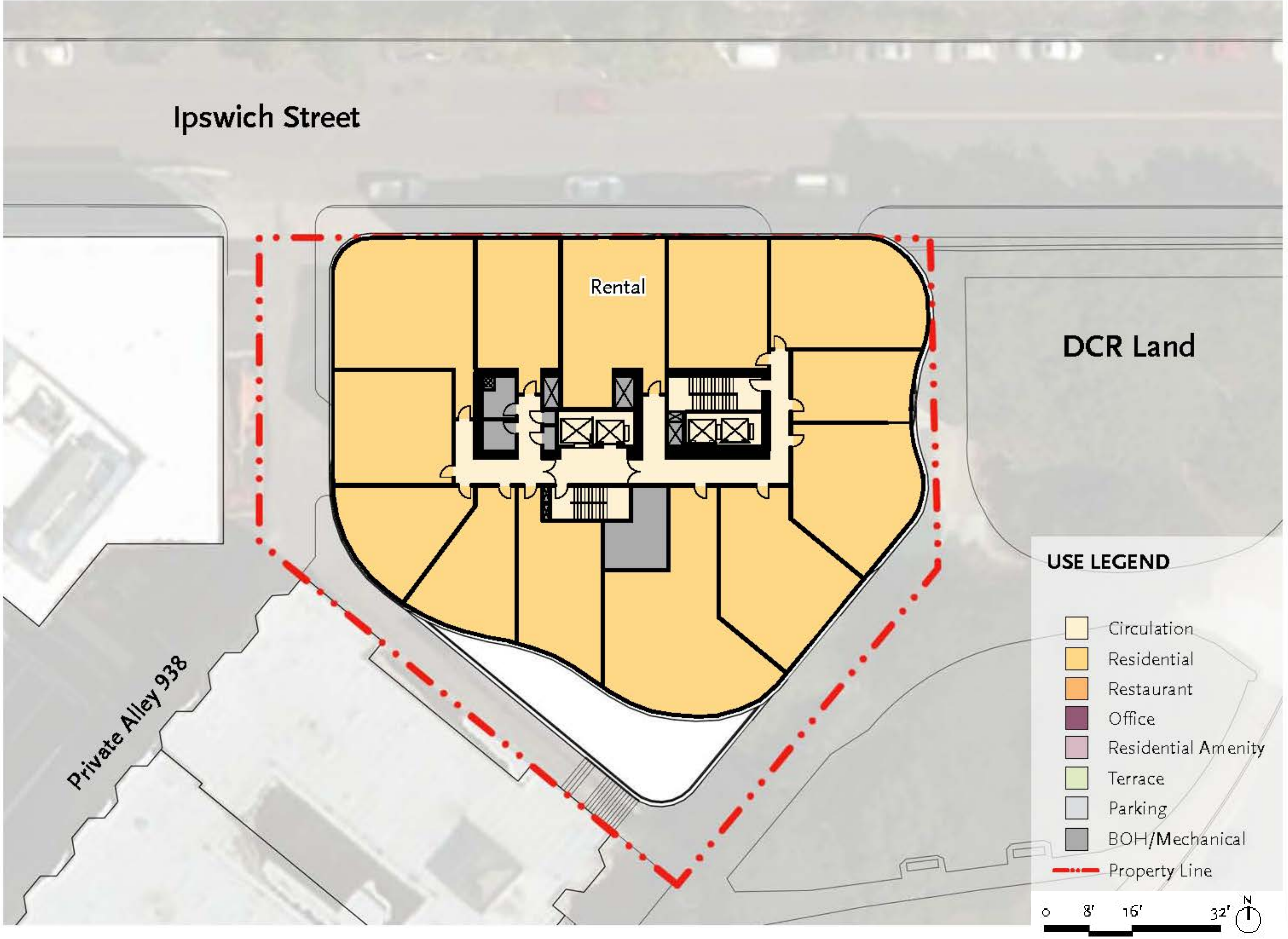

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Figure 2-10

Levels 7-13 Floor Plan

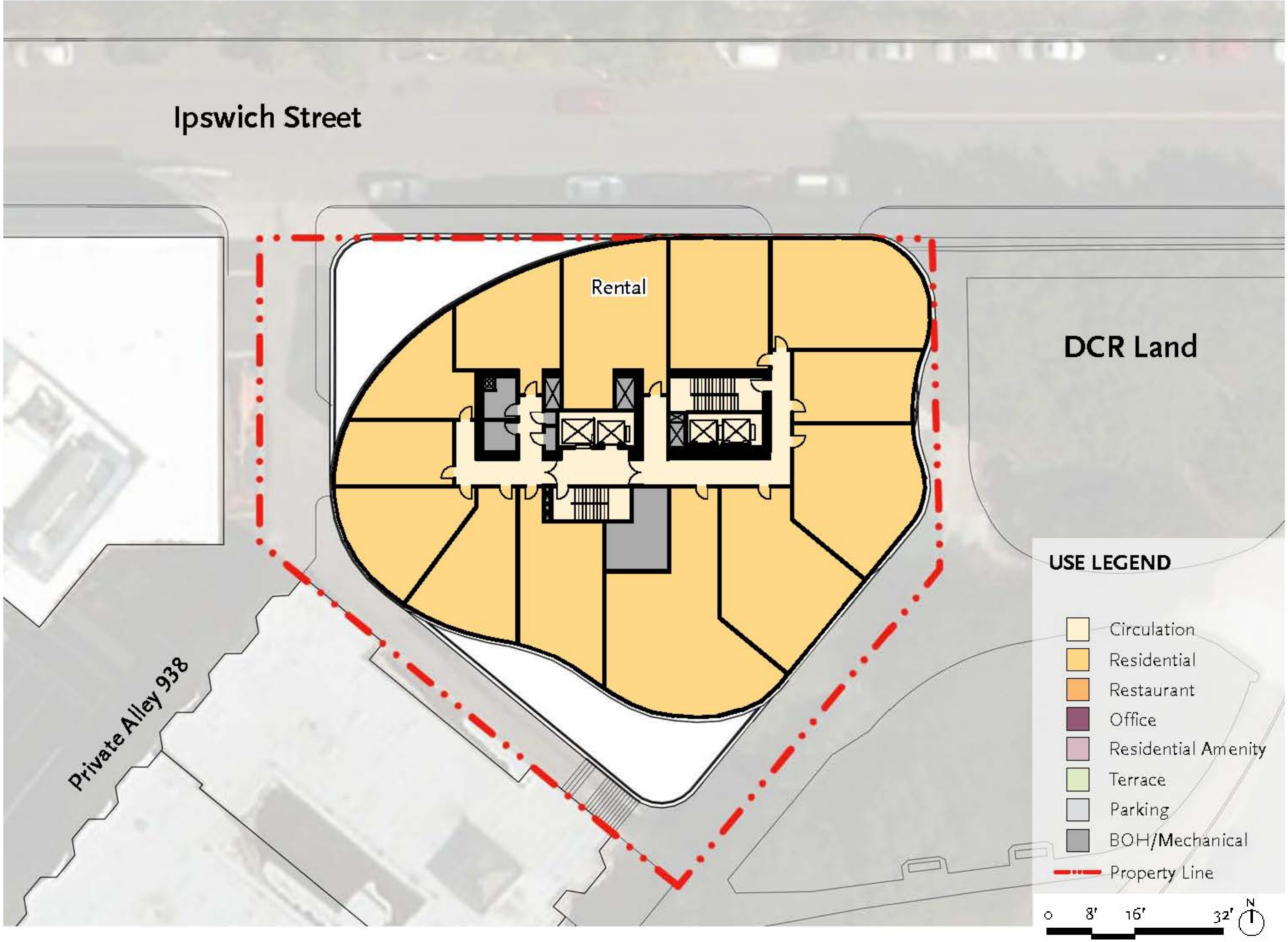

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Figure 2-11

Levels 14-18 Floor Plan)

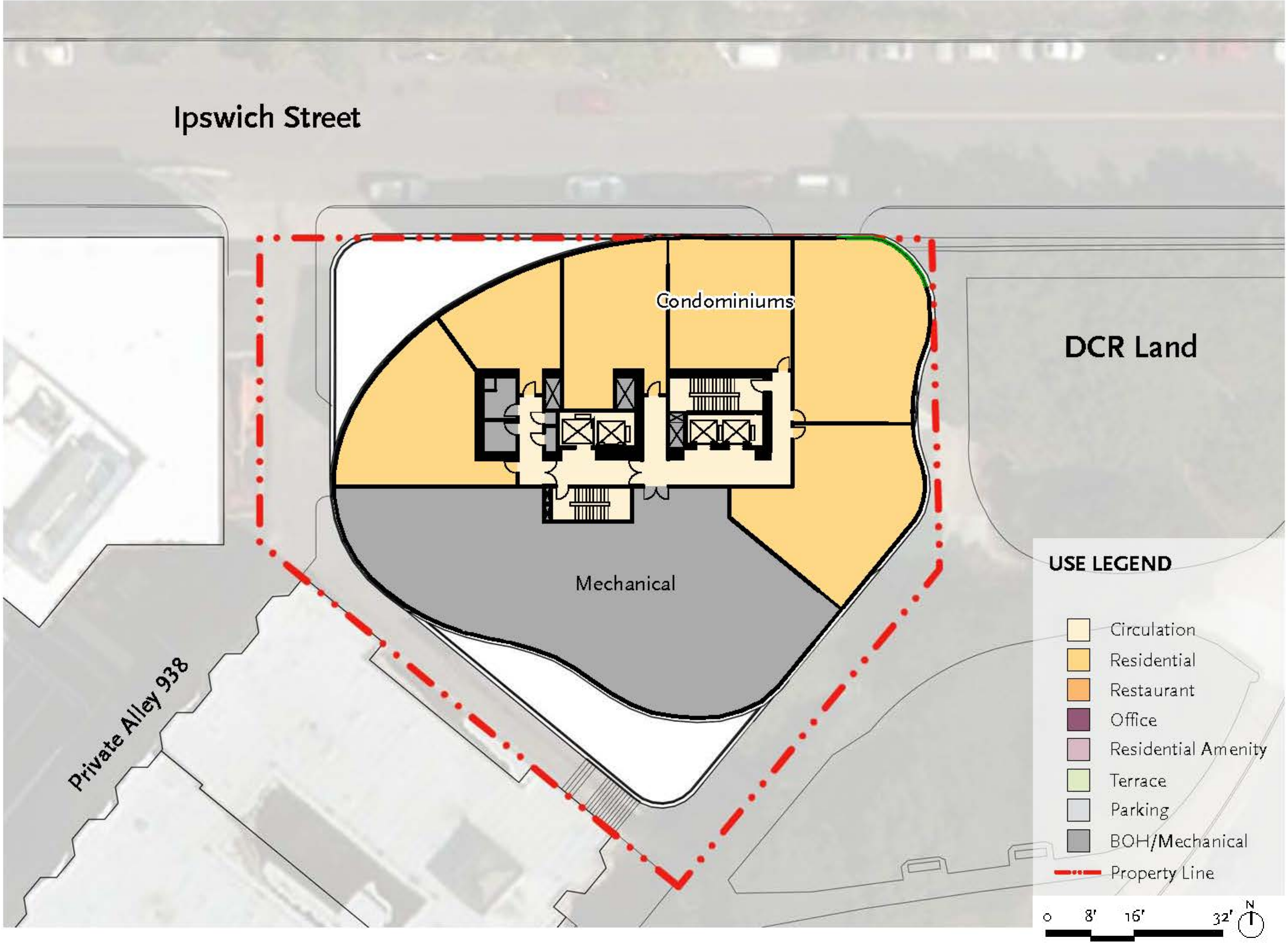

Figure 2-12

Level 19 Floor Plan

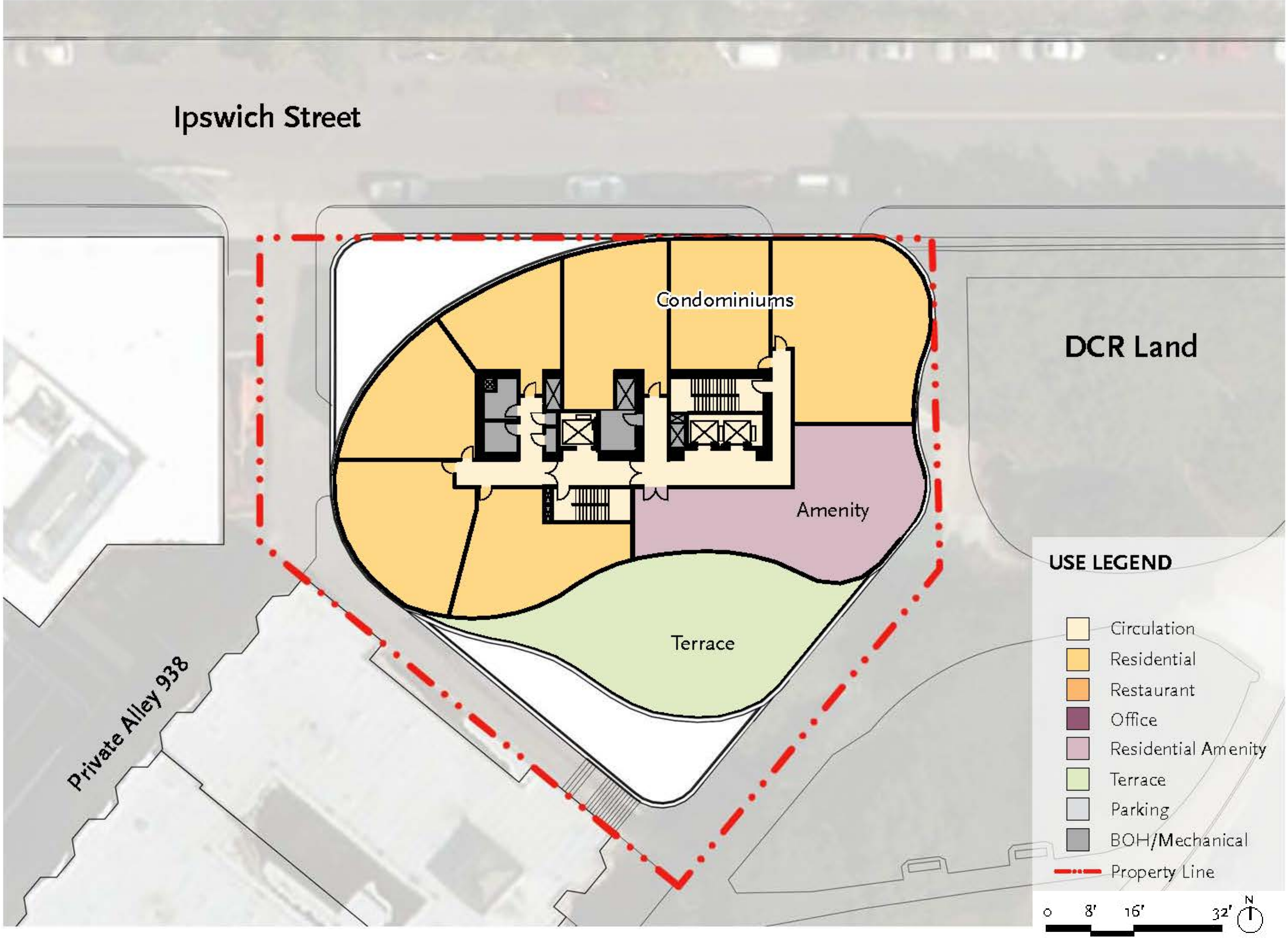

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Figure 2-13

Level 20 Floor Plan

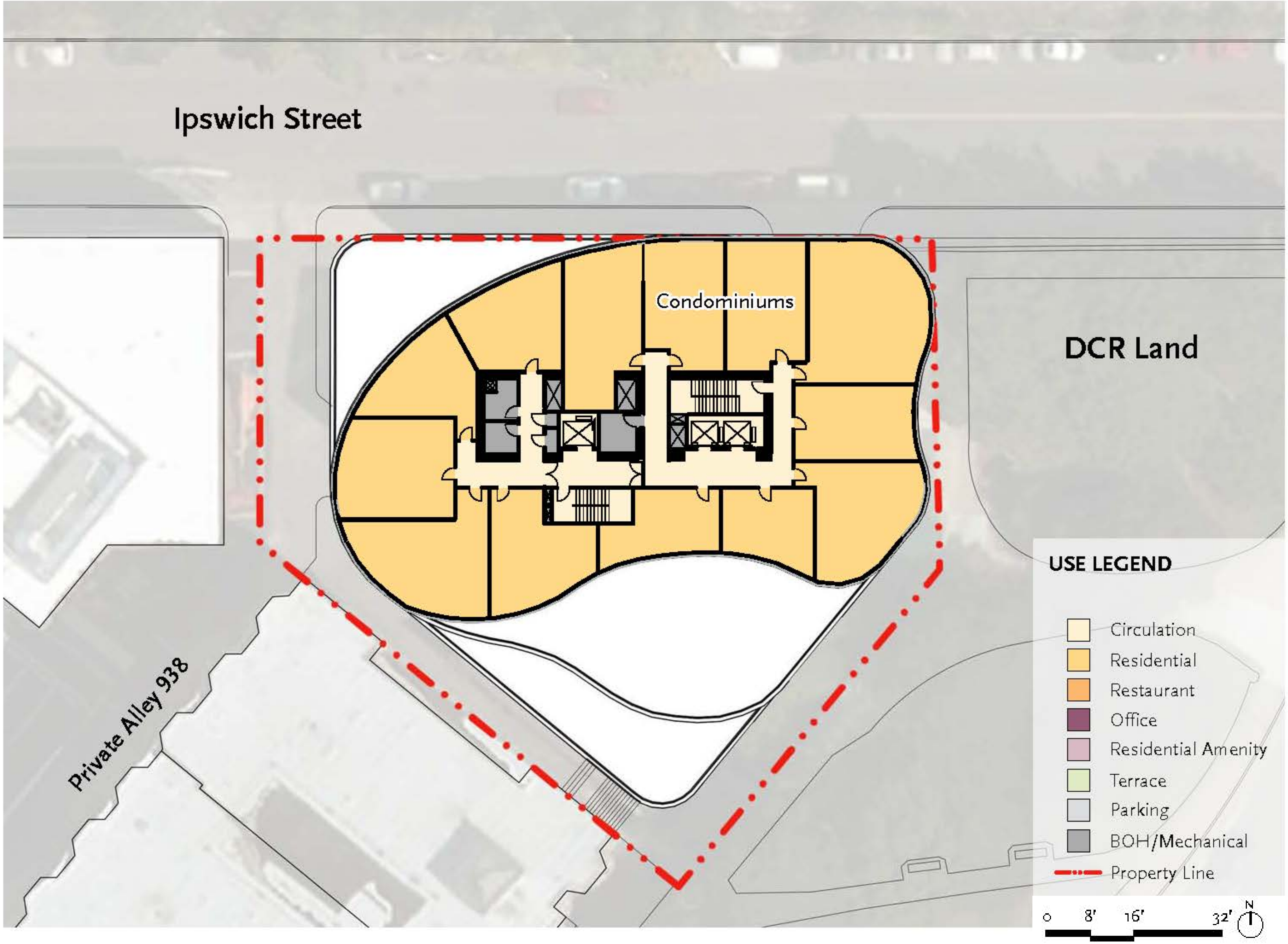

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Figure 2-14

Levels 21-29 Floor Plan

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Figure 2-15
Section

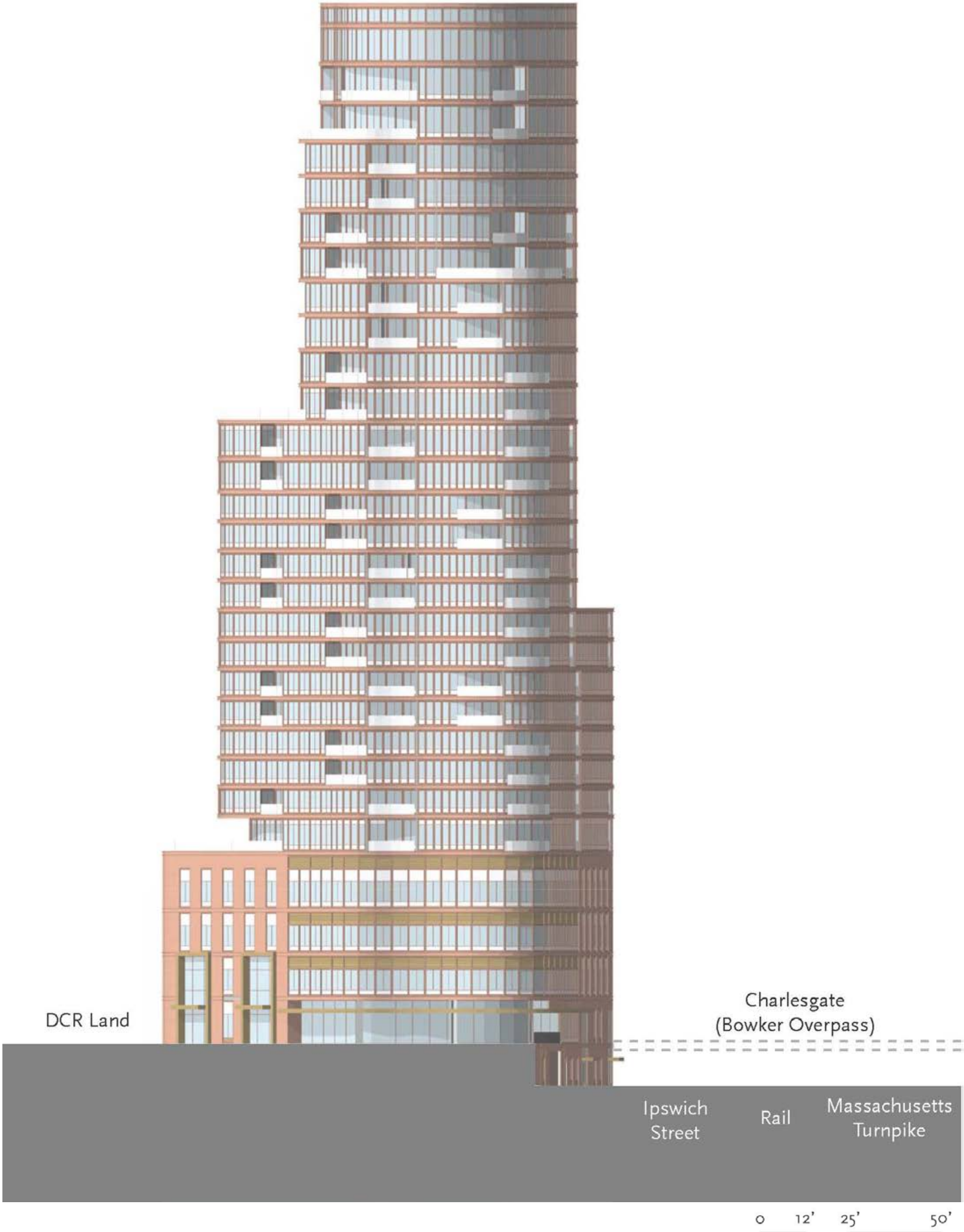

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Figure 2-16
East Elevation

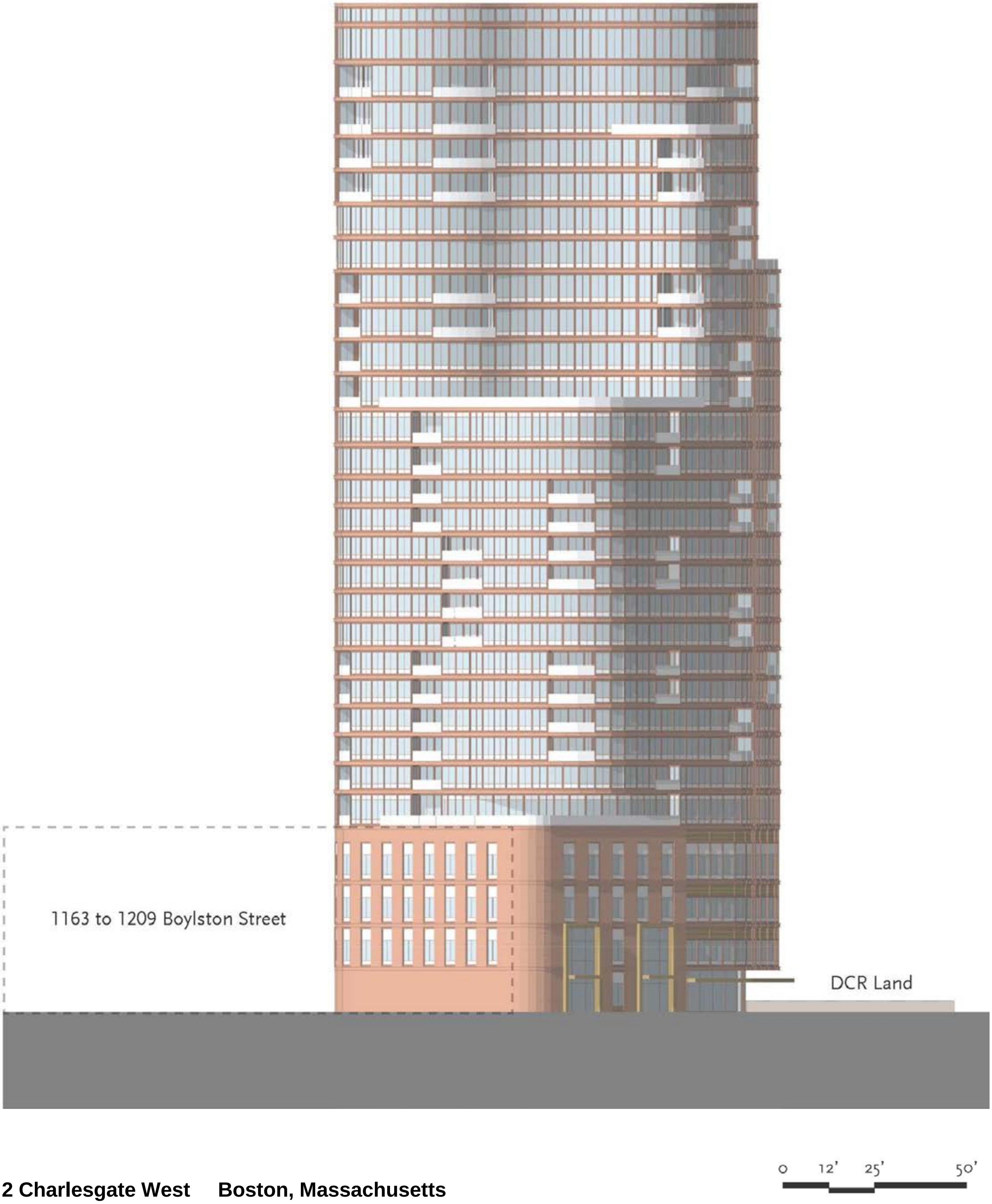

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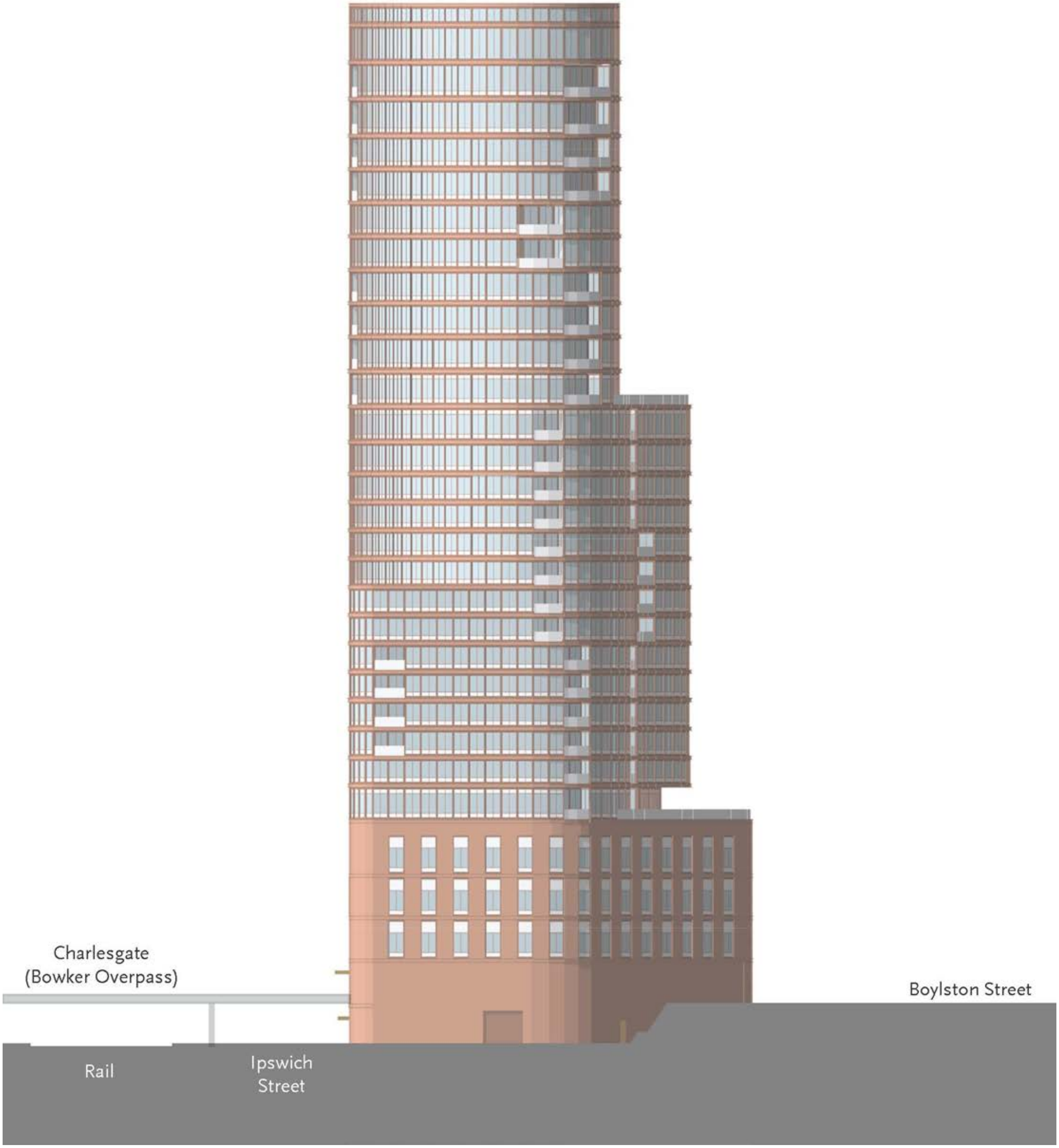
Figure 2-17
South Elevation



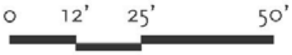


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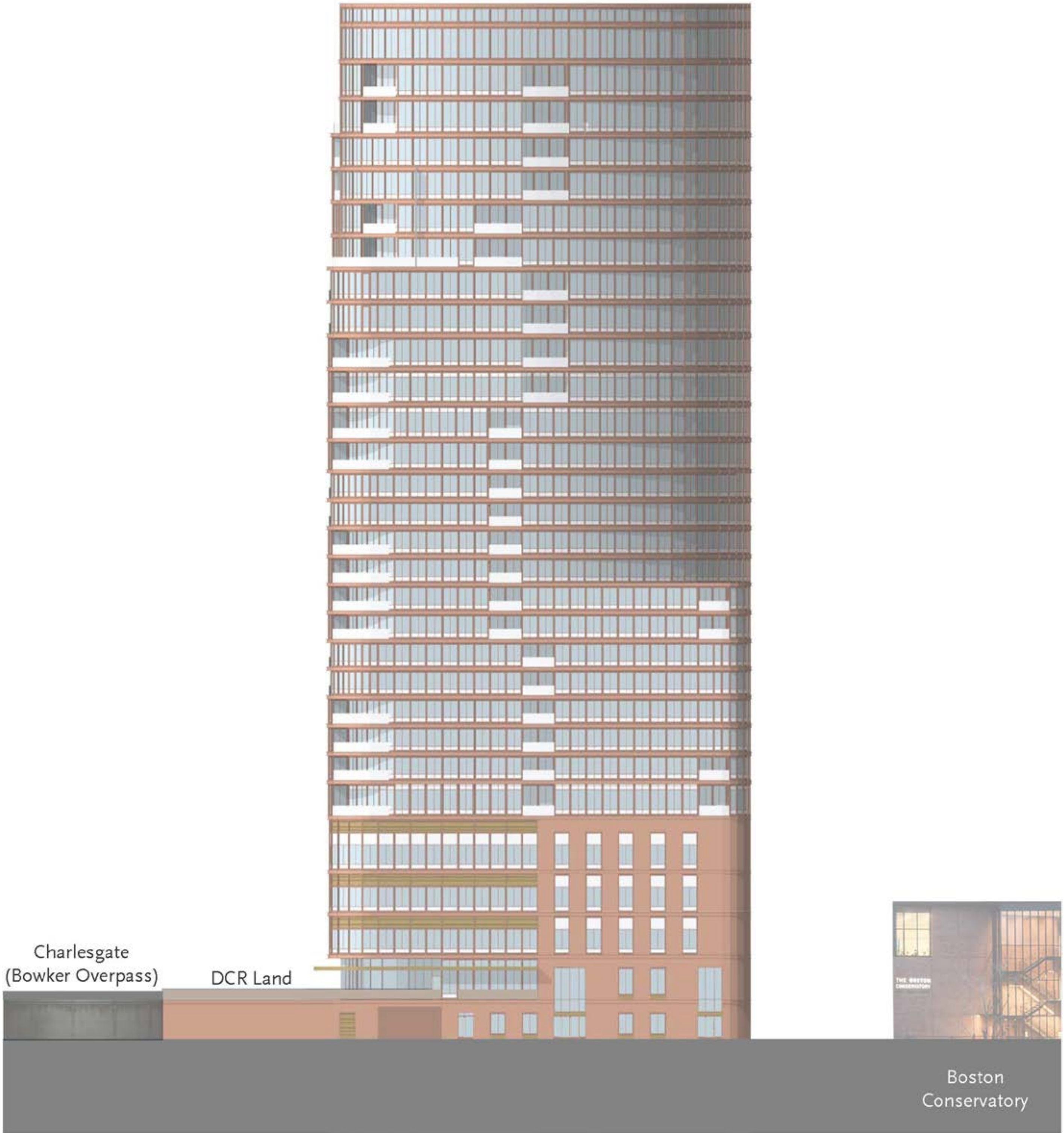
Figure 2-18
West Elevation



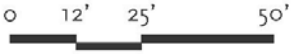


Figure 2-19
North Elevation

Chapter 3.0

Transportation Component

3.0 TRANSPORTATION

3.1 Introduction

Howard Stein Hudson (HSH) has conducted an evaluation of the transportation impacts of the Project. In accordance with the City of Boston's Transportation Access Plan Guidelines, this section describes roadway, pedestrian, bicycle, and public transportation conditions; parking and loading; and transportation demand management (TDM) strategies for the Project.

3.1.1 Project Description

The Project site currently consists of an office building with approximately 51,840 square feet (sf). The Project includes demolition of the existing on-site structure and construction of a new 29-story residential building, with a small amount of office space and a restaurant on the Boylston Street ground level. Parking for the uses on site will be provided in a garage at the basement, third, and fourth levels. The summary of Project uses is shown in Table 3-1.

Table 3-1 Project Program

Land Use	Quantity
Residential Apartments Condominiums	Approx. 173 units Approx. 122 units
Restaurant	Approx. 10,000 sf
Office	Approx. 7,500 sf
Parking	Approx. 186 spaces

3.1.2 Study Area

The study area, shown in Figure 3-1, includes the following ten intersections:

- Boylston Street/Ipswich Street/Hemenway Street (signalized);
- Boylston Street/Fenway/Charlesgate East (signalized);
- Boylston Street/Bowker Overpass (signalized);
- Boylston Street/Park Drive (signalized);
- Boylston Street/Ipswich Street (signalized);
- Boylston Street/Boylston Street (unsignalized);

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HOWARD STEIN HUDSON
Engineers + Planners

Figure 3-1

Study Area Intersection

- Boylston Street/Van Ness Street (unsignalized);
- Ipswich Street/Lansdowne Street (unsignalized);
- Ipswich Street/Private Alley 938 (unsignalized); and
- Ipswich Street/Charlesgate East (unsignalized).

3.1.3 Study Methodology

This transportation study and supporting analyses follow BTD guidelines, as outlined below.

- The Existing (2016) Condition analysis includes an inventory of the existing transportation conditions such as traffic characteristics, parking, curb usage, transit, pedestrian circulation, bicycle facilities, loading, and site conditions. Existing counts for vehicles, bicycles, and pedestrians were collected at the study area intersections. A traffic data collection effort forms the basis for the transportation analysis conducted as part of this evaluation.
- The future transportation conditions analysis evaluates potential transportation impacts associated with the Project. Long-term impacts are evaluated for the year 2021, a future horizon of five years.
- The No-Build (2021) Condition includes general background traffic growth, traffic growth associated with specific developments (not including this Project), and nearby planned transportation improvements.
- The Build (2021) Condition includes a net increase in traffic volume due to the addition of Project-generated trip estimates to the traffic volumes developed as part of the No-Build (2021) Condition analysis. Expected roadway, parking, transit, pedestrian, and bicycle accommodations, as well as loading capabilities and deficiencies, are identified.

The final part of the transportation study identifies measures to mitigate Project-related impacts and to address any traffic, pedestrian, bicycle, transit, safety, or construction related issues that are necessary to accommodate the Project.

An evaluation of short-term traffic impacts associated with construction activities is provided.

3.1.4 Summary of Impacts

The redevelopment of the proposed Project will have relatively minor traffic impacts to study area intersections, primarily because of the residential nature of the Project. Residential developments generate far fewer trips per square foot than comparably sized office or retail developments and do not produce a large proportion of daily trips during commuter travel periods, thereby minimizing the Project's impact during peak hours. Key transportation characteristics of the Project and analysis results include:

- During the a.m. peak hour, the Project will generate 11 entering vehicle trips and 17 exiting vehicle trips and, during the p.m. peak hour, the Project will generate 26 entering trips and 18 exiting trips. These additional vehicle trips will not affect traffic operations at the ten study area intersections.

- When arriving at the Project, residents will use Ipswich Street to access the site driveway. Once inside, drivers will stop and leave their vehicles with a garage attendant, who will take the vehicle to the attendant-operated vehicle elevators. Garage attendants will also retrieve vehicles from the garage for residents when they depart. The staging of vehicles waiting to be picked-up by residents or serviced by the garage elevators will occur in nine designated spaces within the internal drop-off/pick-up area. All vehicles will exit onto Ipswich Street via the site driveway.

- The Project will provide on-site parking for residents and a limited number of spaces for office tenants, with approximately 180 spaces for residents and six spaces for office use. Garage parking will be located at the basement level and third and fourth levels. On-site parking will be provided for condominium units at about 0.90 space/units. For apartment units, parking will be provided at about 0.35 space/unit. Many residents will not own an automobile, and instead will rely on taxicabs, or other vehicle transport services, such as Uber or Zipcar to make any trips requiring a vehicle.

- In accordance with the City of Boston's Bicycle Guidelines, and to encourage bicycling as an alternative travel mode, the Proponent will provide secure bicycle storage capacity for residents and employees. Secure, residential bicycle storage capacity will be provided for 295 bicycles (one per unit) and will be provided in a separate bicycle storage room on the third floor. Tenants using the bicycle room will enter the site via the Ipswich Street driveway and then walk their bicycle to the elevators. Bicycle racks for visitor use will be provided near primary entrances. The design team will continue to explore alternative access points and storage options.

- The Project will have one loading bay, which will be accessed via Private Alley 938. Deliveries and move-in/move-out activity will occur at the loading area and be managed by an on-site transportation coordinator. As today, trash pick-up will occur along the alley.

- The Proponent is committed to implementing Transportation Demand Management (TDM) measures to reduce residents' dependence on automobiles. TDM measures to be undertaken by the Proponent include: promoting transit services in marketing and orientation materials, providing adequate secure bicycle storage, and designating an on-site transportation coordinator.

- A Transportation Access Plan Agreement (TAPA) will be entered into between the Proponent and BTD and set forth the specific TDM measures and agreements between the Proponent and the City of Boston.

3.2 Existing Condition

This section includes descriptions of existing study area roadway geometries, intersection traffic control, peak-hour vehicular and pedestrian volumes, average daily traffic volumes, public transportation availability, parking, curb usage, and loading conditions.

3.2.1 Existing Roadway Conditions

The study area includes the following roadways, which are categorized according to the Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning functional classifications:

Ipswich Street is a two-way roadway classified as a local road under BTD jurisdiction that runs east-west from Boylston Street (west) to Boylston Street (east), where it terminates at Hemenway Street. In the vicinity of the site, most on-street parking is designated for resident permit parking. Sidewalks are provided on both sides of the roadway.

Boylston Street is a two-way roadway classified as a principal artery under BTD jurisdiction to the west and an urban principal arterial under Department of Conservation and Recreation (DCR) jurisdiction to the east. Boylston Street runs east-west from Brookline Avenue in the Fens to Washington Street, where it becomes Essex Street, terminating at Atlantic Avenue. Within the study area, the roadway is a two-way street with two lanes in each direction. In the vicinity of the site, on-street parking and loading activity is provided along both sides of the roadway when possible. Sideways are provided on both sides of the roadway.

Charlesgate is a two-way, two lane roadway classified as a principal artery under MassDOT jurisdiction and runs in a predominately north-south direction between Storrow Drive to the north and Boylston Street to the south. Over I-90, it is known as the Bowker Overpass. Near the site, parking is restricted on both sides of the roadway. Sidewalks are provided on both sides of the roadway.

Charlesgate East is a one-way northbound, one lane roadway classified as a local roadway under BTD jurisdiction. In the vicinity of the site, on-street parking is available on the left side of the roadway and resident permit parking only on the right side of the roadway. Sidewalks are only provided on the east side of the roadway.

Park Drive is a one-way southbound, two lane roadway classified as a principal arterial between Boylston Street and Peterborough Street and an urban principal arterial between Peterborough Street and Brookline Avenue, under DCR jurisdiction. In the vicinity of the site, parking is restricted to residents only. Sidewalks are provided on both sides of the street within the study area.

The Fenway is a one-way northbound, two lane roadway classified as a principal arterial between Boylston Street and Agassiz Road and an urban principal arterial between Agassiz Road and Brookline Avenue, under DCR jurisdiction. In the study area, on-street parking is provided along the right side of the roadway when possible and is resident permit parking only. Sidewalks are provided on both sides of the street within the study area.

Hemenway Street is a one-way northbound, one lane roadway between Westland Avenue and Boylston Street. From Westland Avenue to Forsyth Way, Hemenway is a two-way, one lane roadway in each direction. Hemenway is classified as an urban minor arterial under BTD jurisdiction. In the vicinity of the site, on-street parking is restricted to residents only with some metered parking. Sidewalks are provided on both sides of the street.

Van Ness Street is a two-way, two lane roadway classified as a local roadway under BTD jurisdiction and runs in a predominately east-west direction between Ipswich Street to the east and Kilmarnock Street to the west. In the vicinity of the site, limited metered-parking is available. Sidewalks are provided on both sides of the street within the study area.

Lansdowne Street is a one-way eastbound, one lane roadway between Brookline Avenue and Ipswich Street, classified as a local road under BTD jurisdiction. In the vicinity of the site, on-street parking and loading activity is provided along both sides of the roadway when possible. Sidewalks are provided along both sides of the roadway.

Private Alley 938 is a two-way, one lane roadway classified as a local road under BTD jurisdiction and runs in a predominately north-south direction between Ipswich to the north and Boylston Street to the south. In the vicinity of the site, parking is restricted to commercial vehicles only. Sidewalks are not provided along this private alley.

3.2.2 Existing Intersection Conditions

Existing conditions at the study area intersections are described below.

Boylston Street/Hemenway Street/Ipswich Street is a four-leg, signalized intersection with four approaches. The Boylston Street eastbound approach consists of one shared left-turn/ through lane and one through lane. The Boylston Street westbound approach consists of one through lane and one shared through/right-turn lane. The Hemenway Street northbound approach consists of one shared left/through/right lane. The Ipswich Street southbound approach consists of a shared left/right turn lane. Sidewalks are provided along all approaches. Crosswalks, wheelchair ramps, and pedestrian signal equipment are provided across all approaches to the intersection. On-street parking is permitted along the west and east side of Boylston Street.

Boylston Street/The Fenway/Charlesgate East is a four-leg, signalized intersection with three approaches. The Boylston Street eastbound approach consists of two through lanes and one channelized right-turn lane. The Boylston Street westbound approach consists of two through lanes and one right-turn only lane. The Fenway northbound approach consists of two through lanes and one channelized right-turn lane. Sidewalks are provided along all approaches. Crosswalks, wheelchair ramps, and pedestrian signal equipment are provided across all approaches to the intersection. Parking is not permitted along all approaches.

Boylston Street/Bowker Overpass is a five-leg, signalized intersection with three approaches. Boylston Street makes up the northwest and northeast approaches, and Charlesgate makes up the southbound approach. The Boylston Street northwest approach consists of two through only lanes. The Boylston Street northeast approach consists of two through only lanes and one channelized right turn only, heading east. The Charlesgate southbound approach consists of two through only lanes and two right-turn lanes.

Currently, the Bowker Overpass is undergoing construction. The partial rehabilitation consists of replacing the overpass's decks and parapets, retrofit pin and hanger joints, and making steel repairs. At this time, construction is in Phase 4 (the last phase), where two inbound lanes are open and one outbound lane is open.

Sidewalks are provided along all approaches. Crosswalks, wheelchair ramps, and pedestrian signal equipment are provided across all approaches to the intersection. Parking is prohibited along all three approaches.

Boylston Street/Park Drive is a three-leg, signalized intersection with two approaches. The Boylston Street eastbound approach consists of two through only lanes and a channelized right-turn lane. The Boylston Street westbound consists of one shared left-turn/through lane and one through only lane. Sidewalks are provided along all approaches. Crosswalks, wheelchair ramps, and pedestrian signal equipment are provided across all approaches to the intersection. Parking is prohibited along the two approaches.

Boylston Street/Ipswich Street/is a three-leg, signalized intersection with three approaches. The Boylston Street eastbound approach consists of one shared left-turn/through lane and one through lane. The Boylston Street westbound approach consists of one through lane and one shared through/right-turn lane. The Ipswich Street southbound approach consists of a shared left/right lane. Sidewalks are provided along all approaches. Crosswalks, wheelchair ramps, and pedestrian signal equipment are provided across all approaches to the intersection. On-street parking is permitted on the west side of Boylston Street. Parking is not permitted along the other two approaches.

Boylston Street/Boylston Street (Carriage Road) is a two-leg, unsignalized intersection with two approaches. The Boylston Street eastbound consists of one shared left/thru lane and a through lane. The Boylston Street westbound consists of one through lane and a shared thru/right lane. Sidewalks are provided along all approaches. However, crosswalks and wheelchair ramps are not provided across all approaches to the intersection. Parking is prohibited along the two approaches.

Ipswich Street/Van Ness Street is a three-leg, unsignalized intersection with three approaches. The Van Ness Street eastbound consists of a shared left/right lane. The Ipswich Street northbound and southbound consists of a shared left/right lane. Sidewalks are provided along all approaches. Crosswalks and wheelchair ramps are provided across all three approaches to the intersection. Limited on-street parking is permitted on the east side of Ipswich Street northbound for school employees only.

Ipswich Street/Lansdowne Street is a three-leg, unsignalized intersection with three approaches. The Lansdowne eastbound consists of one shared left/right lane. Both the Ipswich Street northeast and southbound approaches consist of one through lane in each direction. Sidewalks are provided along all approaches. Crosswalks and wheelchair ramps are provided across all approaches to the intersection. On-street parking is permitted on the west side of Lansdowne Street. Resident permit parking is provided on the north side of Ipswich Street and handicapped parking is provided on the south side of Ipswich Street.

Ipswich Street/Private Alley 938 is a three-leg, unsignalized intersection with three approaches. The Ipswich Street eastbound approach consists of one shared through/right-turn lane. The Ipswich Street westbound approach consists of one shared left-turn/through lane. The Private Alley 938 northbound approach consists of one shared left/right lane. Sidewalks are provided along the right side of Ipswich Street only. Crosswalks and wheelchair ramps are not provided across any of the approaches to the intersection. Parking is permitted along both sides of Ipswich Street for residents only.

Ipswich Street/Charlesgate East is a three-leg, unsignalized intersection with three approaches. The Ipswich Street eastbound and westbound approaches consist of one through lane in each direction. The Charlesgate East northbound approach consists of one shared left/right lane. Sidewalks are provided along the right side of Ipswich Street only and on both sides of Charlesgate East. Crosswalks and wheelchair ramps are only provided on the Charlesgate East approach. On-Street parking is permitted along all approaches.

3.2.3 Existing Traffic Data

Traffic volume data was collected at the ten study area intersections on February 4, 2016. Turning Movement Counts (TMCs) and vehicle classification counts were conducted during the weekday a.m. and weekday p.m. peak periods (7:00 – 9:00 a.m. and 4:00 – 6:00 p.m., respectively). The traffic classification counts included car, heavy vehicle, pedestrian, and bicycle movements. The detailed traffic counts are provided in Appendix B.

To account for seasonal variation in traffic volumes throughout the year, data provided by MassDOT was reviewed. The most recent (2011) MassDOT Weekday Seasonal Factors were used to determine the need for seasonal adjustments to the February 2016 TMCs. The seasonal adjustment factor for roadways similar to the study area (Group 6) is 1.01 for February. This indicates that average month traffic volumes are approximately one percent higher than the traffic volumes that were collected. Therefore, the traffic counts were adjusted upward to reflect average month conditions and provide a conservatively high analysis consistent with the peak season traffic volumes. The MassDOT 2011 Weekday Seasonal Factors table is provided in Appendix B.

3.2.4 Existing Vehicular Traffic Volumes

The existing traffic volumes were used to develop the Existing (2016) Condition traffic volumes. The Existing (2016) weekday a.m. Peak Hour and weekday p.m. Peak Hour traffic volumes are shown in Figure 3-2 and Figure 3-3, respectively.

3.2.5 Existing (2016) Condition Traffic Operations Analysis

The criterion for evaluating traffic operations is level of service (LOS), which is determined by assessing average delay experienced by vehicles at intersections and along intersection approaches. Trafficware's Synchro (version 9) software package was used to calculate average delay and associated LOS at the study area intersections. This software is based on the traffic operational analysis methodology of the Transportation Research Board's 2000 Highway Capacity Manual (HCM).

LOS designations are based on average delay per vehicle for all vehicles entering an intersection. Table 3-2 displays the intersection LOS criteria, where LOS A indicates the most favorable condition, with minimum traffic delay, while LOS F represents the worst condition. LOS D or better is typically considered acceptable in an urban area, such as Fenway/Kenmore neighborhood. However, LOS E or F is often typical for a stop-controlled minor street that intersects a major roadway.

Table 3-2 Vehicle Level of Service Criteria

Level of Service	Average Stopped Delay (sec/veh)	
	Signalized Intersections	Unsignalized Intersections
A	≤10	≤10
B	>10 and ≤20	>10 and ≤15
C	>20 and ≤35	>15 and ≤25
D	>35 and ≤55	>25 and ≤35
E	>55 and ≤80	>35 and ≤50
F	>80	>50

Source: 2000 Highway Capacity Manual, Transportation Research Board.

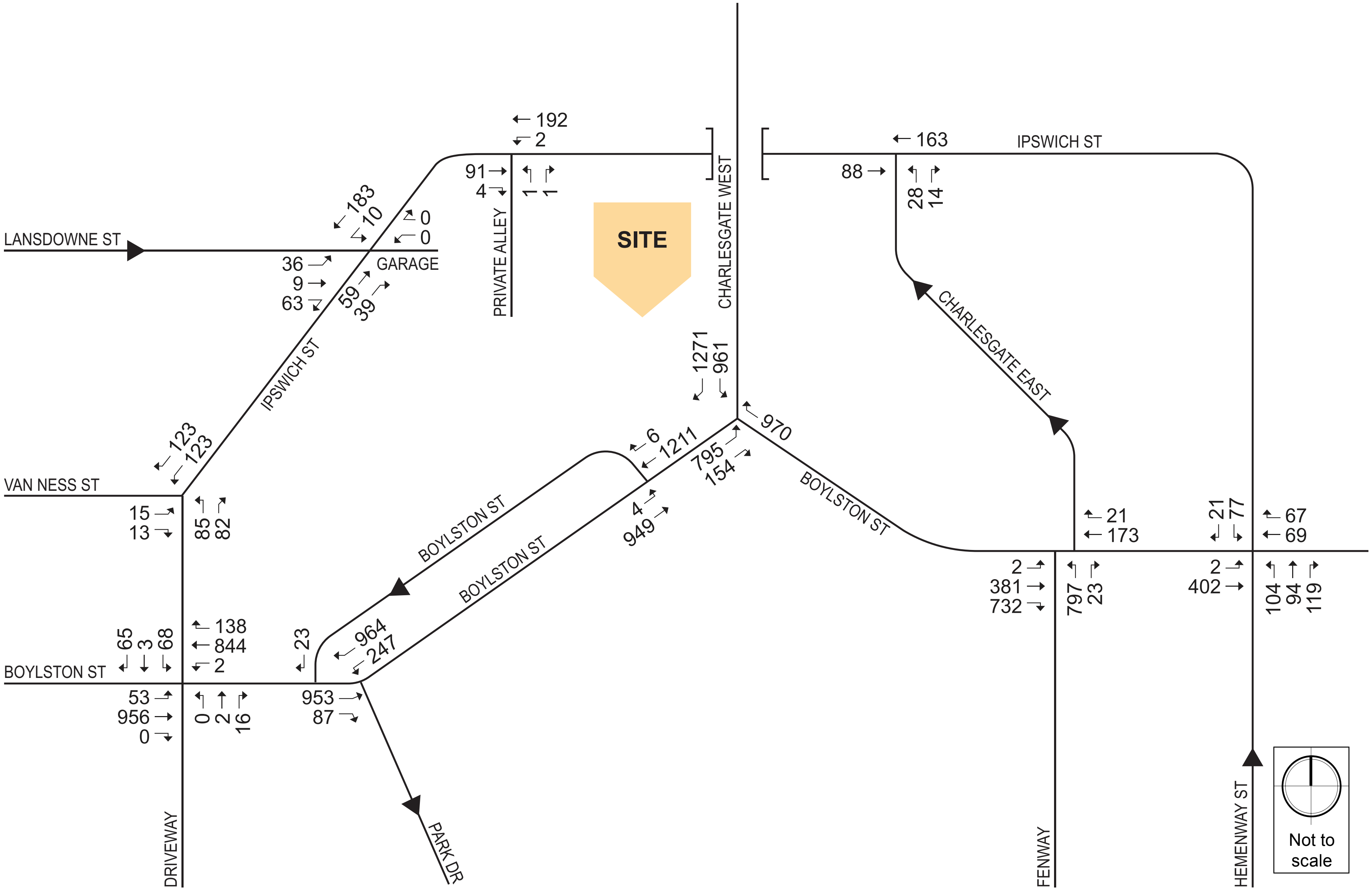

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Figure 3-2

Existing (2016) Condition Traffic Volumes, Weekday a.m. Peak Hour

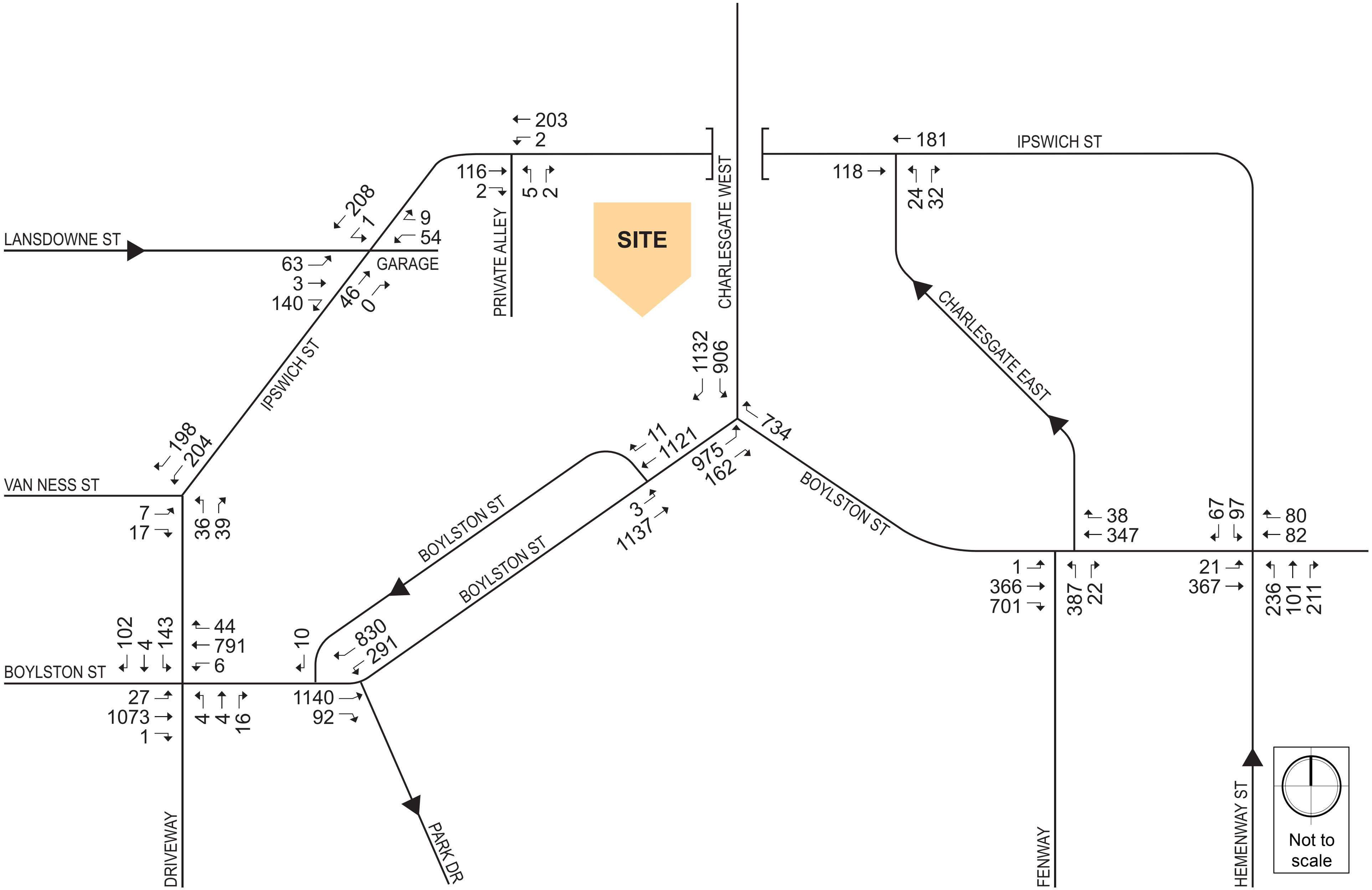

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Figure 3-3

Existing (2016) Condition Traffic Volumes, Weekday p.m. Peak Hour

In addition to delay and LOS, the operational capacity and vehicular queues are calculated and used to further quantify traffic operations at intersections. The following describes these other calculated measures.

In addition to delay and LOS, the estimated operational capacity and queue lengths, as described below, further quantify traffic operations at intersections.

- The volume-to-capacity (v/c) ratio is a measure of congestion at an intersection approach. A v/c ratio below one indicates that the intersection approach has adequate capacity to process the arriving traffic volumes over the course of an hour. A v/c ratio of one or greater indicates that the traffic volume on the intersection approach exceeds capacity.
- The 50th percentile queue length, measured in feet, represents the maximum queue length during a cycle of the traffic signal with typical entering traffic volumes.
- The 95th percentile queue, measured in feet, denotes the farthest extent of the vehicle queue (to the last stopped vehicle) upstream from the stop line. This maximum queue occurs five percent, or less, of the time during the peak hour and typically does not develop during off-peak hours. Because volumes fluctuate throughout the hour, the 95th percentile queue represents what can be considered a "worst case" condition. Queues at an intersection are generally below the 95th percentile length throughout most of the peak hour. It is also unlikely that 95th percentile queues for each approach to an intersection occur simultaneously.

Tables 3-3 and 3-4 summarize the Existing (2016) Condition capacity analysis for the study area intersections during the a.m. and p.m. peak hours, respectively. The detailed analysis sheets are provided in Appendix B.

As shown in Table 3-3 and Table 3-4, under the Existing (2016) Condition, all signalized intersections operate at LOS D or better. Two movements, as discussed below, operate below LOS D.

- The signalized intersection of **Boylston Street/Park Drive** operates at LOS D during both the a.m. and p.m. peak hours. The Boylston Street westbound left/thru | thru approach operates at LOS E during the a.m. peak hour and at LOS F during the p.m. peak hour.
- The signalized intersection of **Boylston Street/Ipswich Street/Sunoco Driveway** operates at LOS D during both the a.m. and p.m. peak hours. The Boylston Street westbound left/thru | thru/right approach operates at LOS E during both the a.m. and p.m. peak hours.

Table 3-3 Existing (2016) Condition Capacity Analysis Summary, a.m. Peak Hour

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	*95th percentile*
Signalized Intersections					
Boylston Street/Hemenway Street/ Ipswich Street	**C**	**20.1**	-	-	-
Boylston Street EB left/thru | thru	A	3.5	0.25	22	47
Boylston Street WB thru/right	A	5.1	0.16	16	49
Hemenway Street NB left/thru/right	D	44.9	0.79	182	262
Ipswich Street SB left	D	41.7	0.53	52	85
Ipswich Street SB right	A	9.3	0.06	0	16
Boylston Street/Fenway/Charlesgate East	**B**	**10.5**	-	-	-
Boylston Street EB left/thru | thru/right	A	5.4	0.67	0	32
Boylston Street EB right	A	0.9	0.34	0	m3
Boylston Street WB thru | thru/right	B	11.1	0.17	36	50
Fenway NB left | left	B	19.5	0.58	201	252
Fenway NB right	A	3.4	0.20	0	0
Boylston Street/Bowker Overpass	**C**	**25.2**	-	-	-
Boylston Street EB left | left	B	18.7	0.54	180	235
Boylston Street EB right	B	14.8	0.21	55	95
Boylston Street WB right | right	D	53.2	0.98	392	#505
Bowker Overpass SB left | left	C	31.4	0.78	275	355
Bowker Overpass SB right | right	A	1.2	0.55	0	14
Boylston Street/Park Drive	**D**	**46.7**	-	-	-
Boylston Street EB thru | thru	B	19.0	0.72	126	252
Boylston Street EB right	A	3.0	0.14	0	m15
Boylston Street WB left/thru | thru	E	73.7	0.79	274	343
Boylston Street/Ipswich Street/Sunoco Driveway	**D**	**42.2**	-	-	-
Boylston Street EB left/thru | thru/right	B	13.9	0.66	207	286
Boylston Street WB left/thru | thru/right	E	75.6	0.51	281	348
Sunoco Driveway NB right	A	0.0	0.02	0	0
Ipswich Street SB left/thru/right	C	31.0	0.58	63	101
Unsignalized Intersections					
Boylston Street/Boylston Street	-	-	-	-	-
Boylston Street EB left/thru | thru	A	0.1	0.40	-	1
Boylston Street WB thru | thru/right	A	0.0	0.48	-	0

Table 3-3 Existing (2016) Condition Capacity Analysis Summary, a.m. Peak Hour (Continued)

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	*95th percentile*
Unsignalized Intersections					
Ipswich Street/Van Ness Street	-	-	-	-	-
Van Ness Street EB left/right	B	11.5	0.07	-	5
Ipswich Street SB left/right	A	0.0	0.18	-	0
Ipswich Street NWB left/right	A	4.5	0.08	-	6
Ipswich Street/Lansdowne Street/ Garage Driveway	-	-	-	-	-
Lansdowne Street EB left/thru/right	B	11.5	0.18	-	17
Garage Driveway WB left/right	A	0.0	0.00	-	0
Ipswich Street NB thru/right	A	0.0	0.07	-	0
Ipswich Street SB left/thru	A	0.4	0.01	-	1
Ipswich Street/Private Alley 938	-	-	-	-	-
Ipswich Street EB thru/right	A	0.0	0.07	-	0
Ipswich Street WB left/thru	A	0.1	0.00	-	0
Private Alley NB left/right	A	9.7	0.01	-	0
Ipswich Street/Charlesgate East	-	-	-	-	-
Ipswich Street EB thru	A	0.0	0.07	-	0
Ipswich Street WB thru	A	0.0	0.12	-	0
Charlesgate East left/right	B	10.2	0.06	-	5

Grey shading indicates LOS E or F.

~ 50th percentile volume exceeds capacity. Queue shown is maximum after two cycles.

\# 95th percentile volume exceeds capacity. Queue shown is maximum after two cycles.

m Volumes for 95th percentile queue is metered by upstream signal.

Table 3-4 Existing (2016) Condition Capacity Analysis Summary, p.m. Peak Hour

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	*95th percentile*
Signalized Intersections					
Boylston Street/Hemenway Street/ Ipswich Street	**C**	**27.5**	-	-	-
Boylston Street EB left/thru | thru	B	14.3	0.30	143	192
Boylston Street WB thru/right	B	12.4	0.28	50	87
Hemenway Street NB left/thru/right	D	45.0	0.91	305	#518
Ipswich Street SB left	C	27.8	0.40	54	92
Ipswich Street SB right	A	6.9	0.13	4	m27

Table 3-4 Existing (2016) Condition Capacity Analysis Summary, p.m. Peak Hour (Continued)

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	*95th percentile*
Signalized Intersections					
Boylston Street/Fenway/Charlesgate East	**B**	**11.5**	-	-	-
Boylston Street EB left/thru | thru/right	B	12.3	0.67	225	m247
Boylston Street EB right	A	0.4	0.31	0	m0
Boylston Street WB thru | thru/right	B	18.2	0.44	98	110
Fenway NB left | left	B	12.5	0.28	79	95
Fenway NB right	A	3.7	0.21	0	0
Boylston Street/Bowker Overpass	**C**	**24.2**	-	-	-
Boylston Street EB left | left	B	15.9	0.60	279	356
Boylston Street EB right	A	9.0	0.19	54	m83
Boylston Street WB right | right	D	43.1	0.84	251	#296
Bowker Overpass SB left | left	D	49.8	0.94	304	#431
Bowker Overpass SB right | right	A	1.2	0.54	0	14
Boylston Street/Park Drive	**D**	**46.5**	-	-	-
Boylston Street EB thru | thru	B	11.8	0.68	280	285
Boylston Street EB right	A	0.3	0.12	0	m0
Boylston Street WB left/thru | thru	F	>80.0	0.88	371	#482
Boylston Street/Ipswich Street/Sunoco Driveway	**D**	**42.8**	-	-	-
Boylston Street EB left/thru | thru/right	B	15.2	0.62	236	301
Boylston Street WB left/thru | thru/right	E	77.0	0.50	347	390
Sunoco Driveway NB right	A	0.0	0.02	0	0
Ipswich Street SB left/thru/right	D	41.2	0.69	139	m223
Unsignalized Intersections					
Boylston Street/Boylston Street	-	-	-	-	-
Boylston Street EB left/thru | thru	A	0.1	0.49	-	0
Boylston Street WB thru | thru/right	A	0.0	0.47	-	0
Ipswich Street/Van Ness Street	-	-	-	-	-
Van Ness Street EB left/right	B	11.0	0.05	-	4
Ipswich Street SB left/right	A	0.0	0.28	-	0
Ipswich Street NWB left/right	A	4.2	0.04	-	3

Table 3-4 Existing (2016) Condition Capacity Analysis Summary, p.m. Peak Hour (Continued)

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	*95th percentile*
Unsignalized Intersections					
Ipswich Street/Lansdowne Street/ Garage Driveway	-	-	-	-	-
Lansdowne Street EB left/thru/right	B	12.6	0.35	-	40
Garage Driveway WB left/right	C	15.5	0.20	-	19
Ipswich Street NB thru/right	A	0.0	0.03	-	0
Ipswich Street SB left/thru	A	0.0	0.00	-	0
Ipswich Street/Private Alley 938	-	-	-	-	-
Ipswich Street EB thru/right	A	0.0	0.10	-	0
Ipswich Street WB left/thru	A	0.1	0.00	-	0
Private Alley NB left/right	B	10.5	0.02	-	2
Ipswich Street/Charlesgate East	-	-	-	-	-
Ipswich Street EB thru	A	0.0	0.08	-	0
Ipswich Street WB thru	A	0.0	0.12	-	0
Charlesgate East left/right	B	10.0	0.09	-	7

Grey shading indicates LOS E or F.
~ 50th percentile volume exceeds capacity. Queue shown is maximum after two cycles.
# 95th percentile volume exceeds capacity. Queue shown is maximum after two cycles.
m Volumes for 95th percentile queue is metered by upstream signal.

3.2.6 Parking

An inventory of the on-street and off-street parking in the vicinity of the Project was collected. On-street parking near the site, as shown in Figure 3-4, consists of predominately commercial parking and no-parking or metered parking.

There are more than 2,354 public parking spaces within about one-quarter mile, or a five-minute walk, from the Project site. Of these, approximately 818 are found in parking lots and 1,536 are in garages. Public surface lots and garages within a quarter-mile of the Project Site are shown in Figure 3-5.

A summary of all parking lots and garages are shown in Table 3-5.

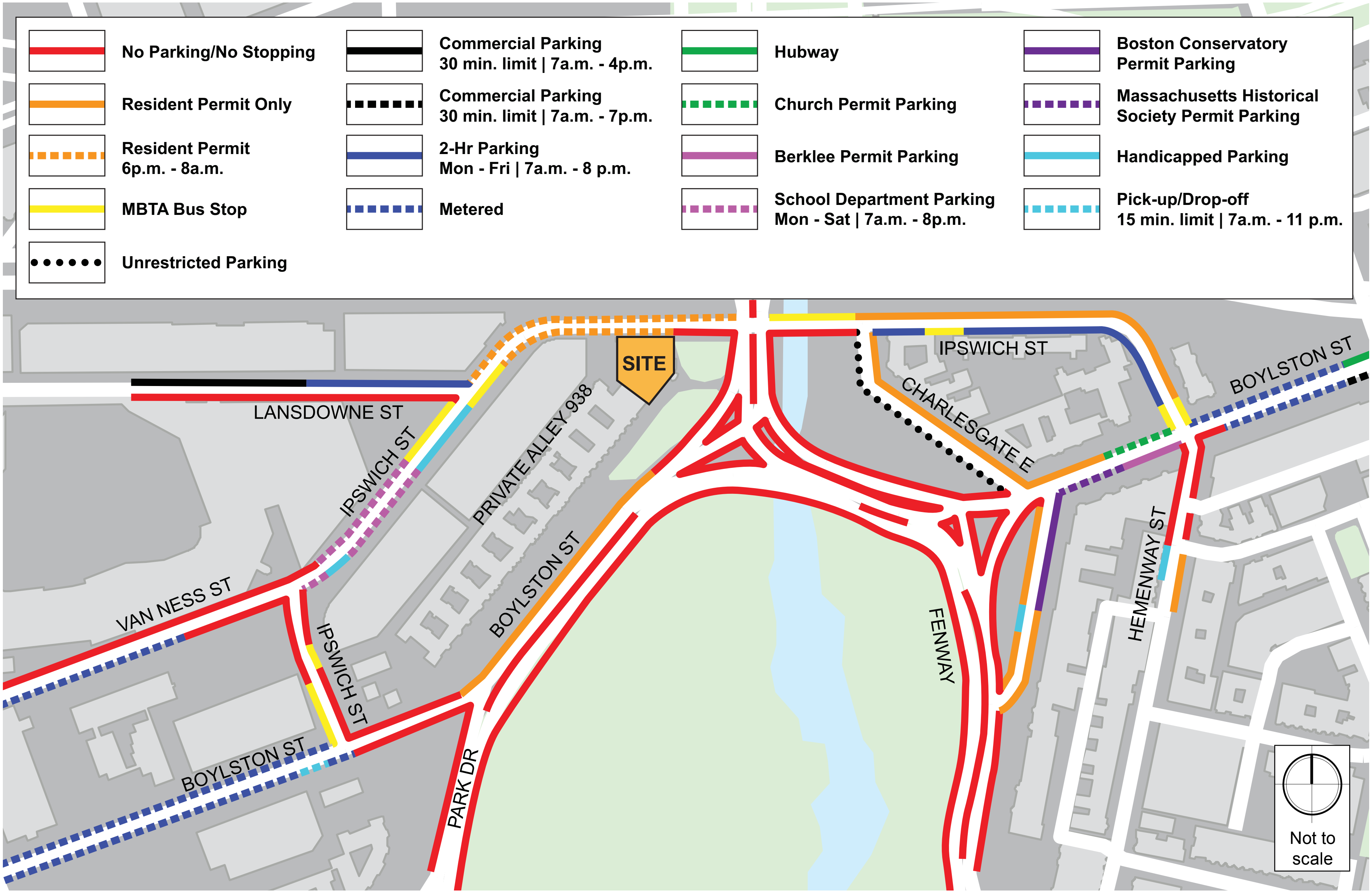

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Figure 3-4

Existing On-Street Parking

Lot
X Garage

NOTE: Locations are Keyed to Table 3-2

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Figure 3-5
Existing Off-Street Parking

Table 3-5 Off-street Parking Lots and Garages within a Quarter-Mile of the Site

Map ID	Facility	Capacity	Map ID	Facility	Capacity
Parking Garages			**Parking Lots**		
A	Westland Avenue Garage	307	1	Fenway Shell Station Lot	78
B	Ipswich Street Garage	150	2	1081 Boylston Street Lot	28
C	Somerset Garage	500	3	Swan Lot	140
D	1330 Boylston Street	200	4	Stanhope Parking Lot	42
E	Lansdowne Street Garage	285	5	Yawkey Way Lot	150
F	Fenway Garage	94	6	Harvard Club of Boston Lot	105
G	Patriot Haviland St. Garage	100	7	Kenmore Lot	250
			8	105 Van Ness Lot	25
Parking Garages Subtotal		**1,636**	**Parking Lots Subtotal**		**818**
Total Public Parking Spaces = 2,454					

3.2.7 Car Sharing Services

Car sharing enables easy access to short-term vehicular transportation. Vehicles are rented on an hourly or daily basis, and all vehicle costs (gas, maintenance, insurance, and parking) are included in the rental fee. Vehicles are checked out for a specific time period and returned to their designated location.

Zipcar is the primary company in the Boston car sharing market. There are currently nine Zipcar locations within about a half-mile walk of the site. The nearby car sharing locations are shown in Figure 3-6.

3.2.8 Existing Bicycle Volumes and Accommodations

In recent years, bicycle use has increased dramatically throughout the City of Boston. The City's "Bike Routes of Boston" map assigns a level of difficulty to many Boston streets. Study area streets and their associated level are presented below:

- Beginner routes are suitable for all riders including children, and people with no on-road experience. The City of Boston's "Bike Routes of Boston" map indicates that Ipswich Street and Hemenway Street are designated as beginner routes.

- Intermediate routes are suitable for riders with some on-road experience. Park Drive is designate as intermediate route.

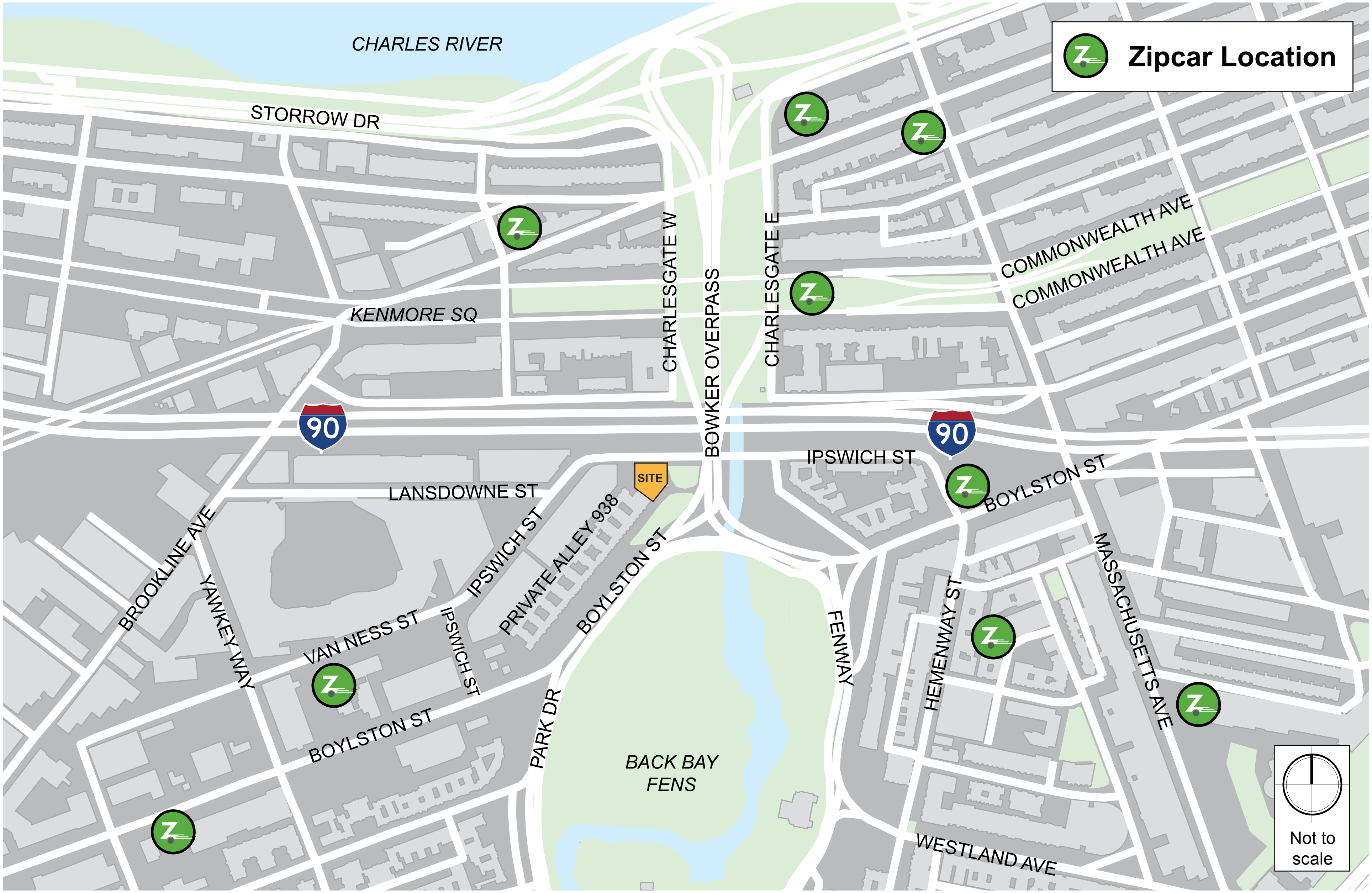

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Figure 3-6

Existing Car Sharing Locations

- Advanced routes are suitable for experienced and traffic-confident cyclists. Traffic volumes and/or speeds can be high. Boylston Street is designated as an advanced route.

Bicycle counts were conducted concurrent with the vehicular TMCs, and are presented in Figure 3-7. As shown in the figure, bicycle volumes are heaviest along Boylston Street during the peak periods. Note, though, that TMCs were collected in March, when bicycle travel may be affected by cold weather.

The site is also located in proximity to several bicycle sharing stations provided by Hubway. Hubway is the bicycle sharing system in the Boston area, which was launched in 2011 and consists of over 140 stations and 1,300 bicycles. The nearest Hubway station is located near the intersection of Massachusetts Avenue and Boylston Street. As shown Figure 3-8, eight Hubway stations are located near the Project Site.

3.2.9 Existing Pedestrian Volumes and Accommodations

In general, sidewalks are provided along all roadways and are in good condition. Crosswalks are provided at all study area intersections. Pedestrian signal equipment is provided at all five of the signalized study area intersections.

To determine the level of pedestrian activity within the study area, pedestrian counts were conducted concurrent with the TMCs at the study area intersection and are presented in Figure 3-9.

To understand how pedestrian activity changes with Red Sox home games at Fenway , the City requested that additional pedestrian counts be collected in the study area along Ipswich Street near the Project site. Pedestrian counts were collected on Thursday, June 2, when no Red Sox game was scheduled, and on Friday, June 3 with a Red Sox game that started at 7:05 p.m.

On both days, activity was observed between 4:00 p.m. and 8:00 p.m., a period that overlaps with the p.m. peak hour of traffic (generally 5:00 - 6:00 p.m.) and captures pre-game pedestrian activity. Between April and early October, home Red Sox games occur on about 40 percent of weekdays (primarily evening games). No Red Sox games occur during the other six months of the year.

Table 3-6 summarizes the afternoon/early evening hourly pedestrian volumes along Ipswich Street.

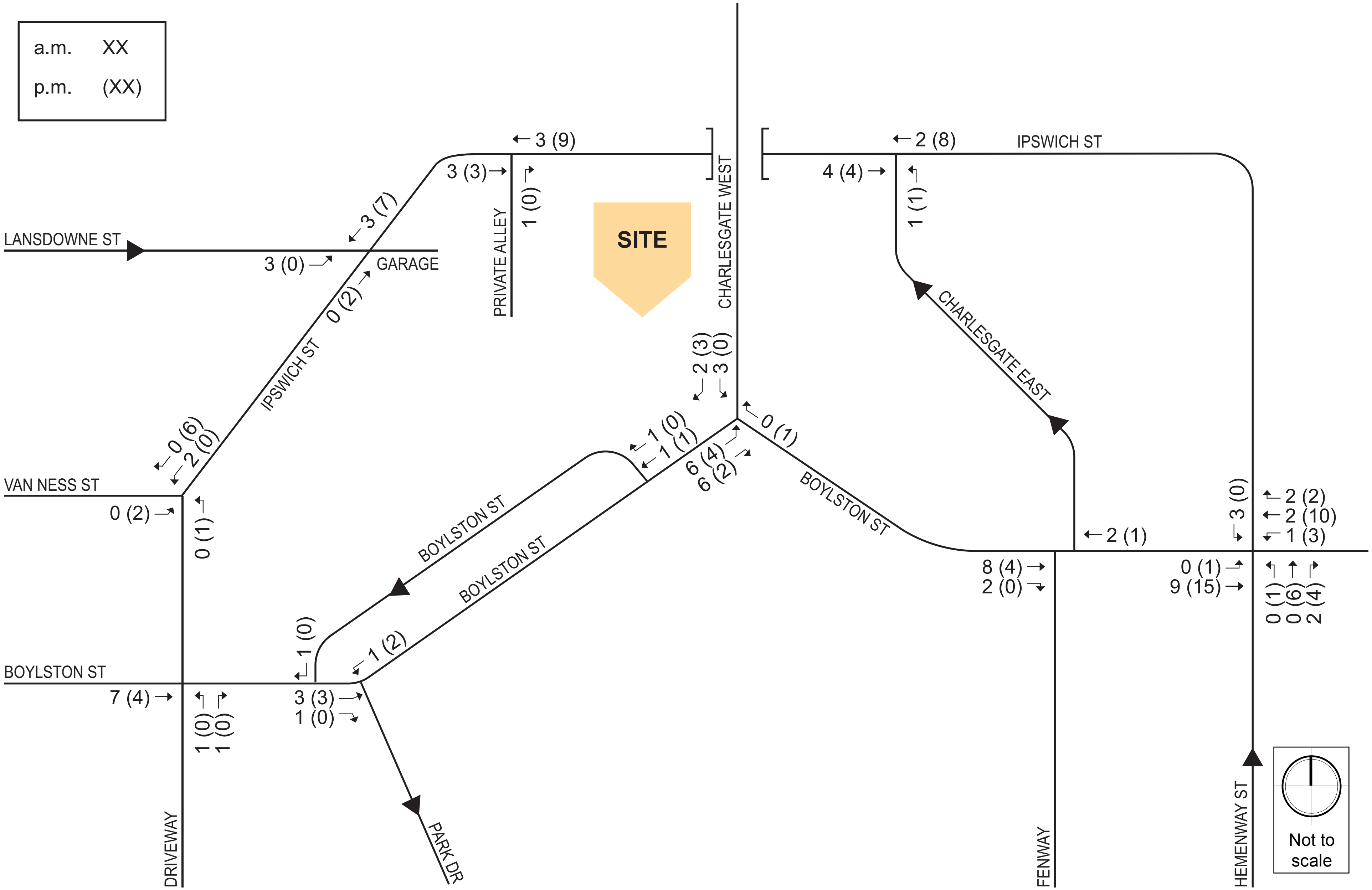

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Figure 3-7

Existing (2016) Condition Bicycle Volumes, a.m. and p.m. Peak Hours

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Figure 3-8
Existing Bicycle Sharing Locations

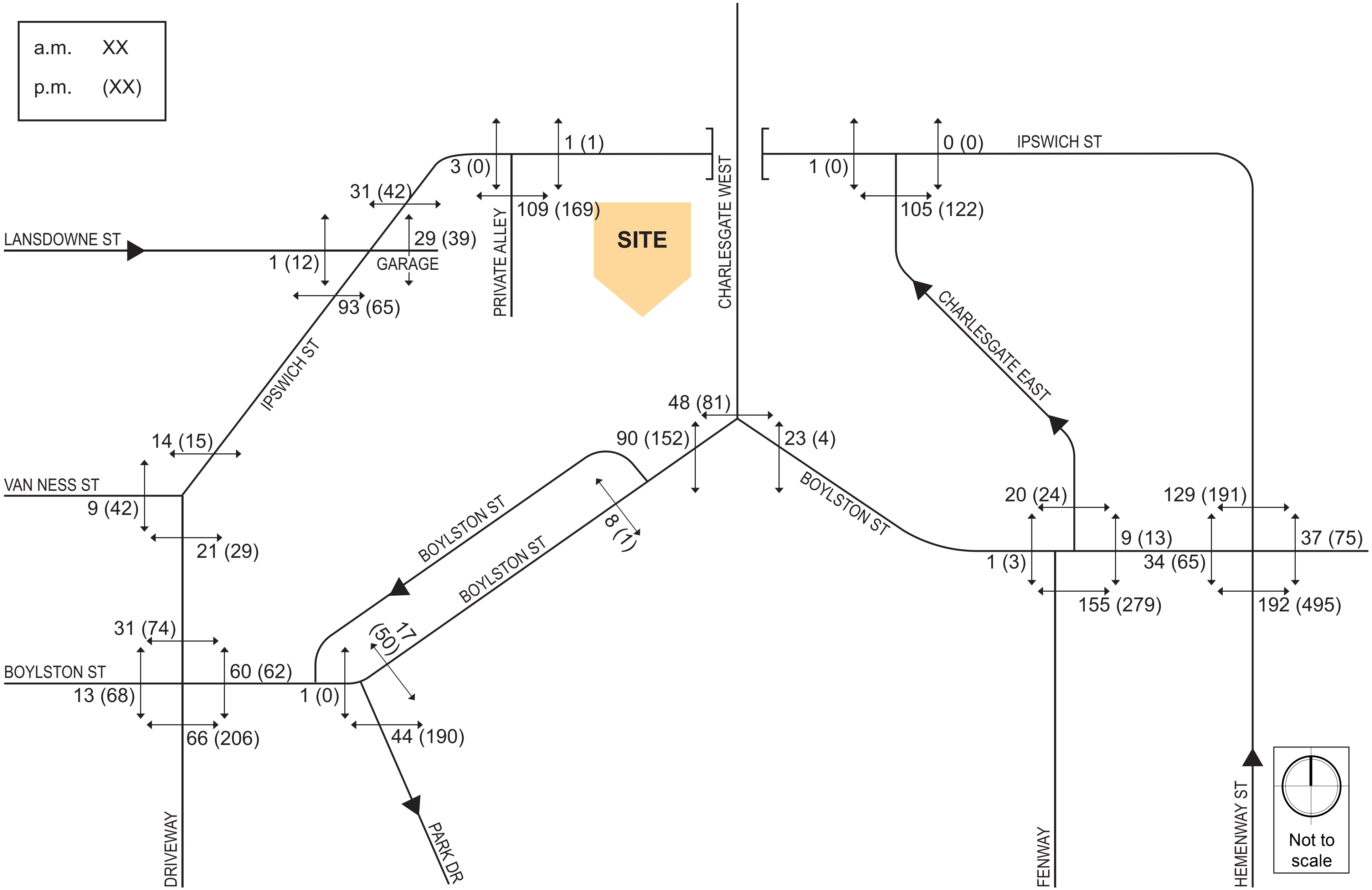

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Figure 3-9

Existing (2016) Pedestrian Volumes, a.m. and p.m. Peak Hours

Table 3-6 Pedestrian Volumes on Ipswich Street

Time period/ Direction [1]	Without Red Sox Game	With Red Sox Game	Difference
4:00 – 5:00 p.m.			
Westbound	78	312	234
Eastbound	155	69	-86
5:00 – 6:00 p.m.			
Westbound	82	754	672
Eastbound	107	71	-36
6:00 – 7:00 p.m.			
Westbound	100	1,536	1,436
Eastbound	45	86	41
7:00 – 8:00 p.m.			
Westbound	94	680	586
Eastbound	52	92	40

[1] Westbound - toward Fenway Park
Eastbound - toward Charlesgate East

Before a game, pedestrian volumes are higher along Ipswich Street, particularly between 6:00 – 7:00 p.m., as people walk from Charlesgate East and points further east toward the ballpark.

3.2.10 Existing Public Transportation Services

The site is in the Fenway/Kenmore neighborhood of Boston with many public transportation options. The site is within one-half mile of the MBTA Green Line Stations at Hynes and Kenmore Square and the Yawkey Station on the Framingham/Worcester Commuter Rail Line. Additionally, the MBTA operates seven bus routes in close proximity to the Project.

Nearby public transportation services are mapped in Figure 3-10 and listed in Table 3-7 below.

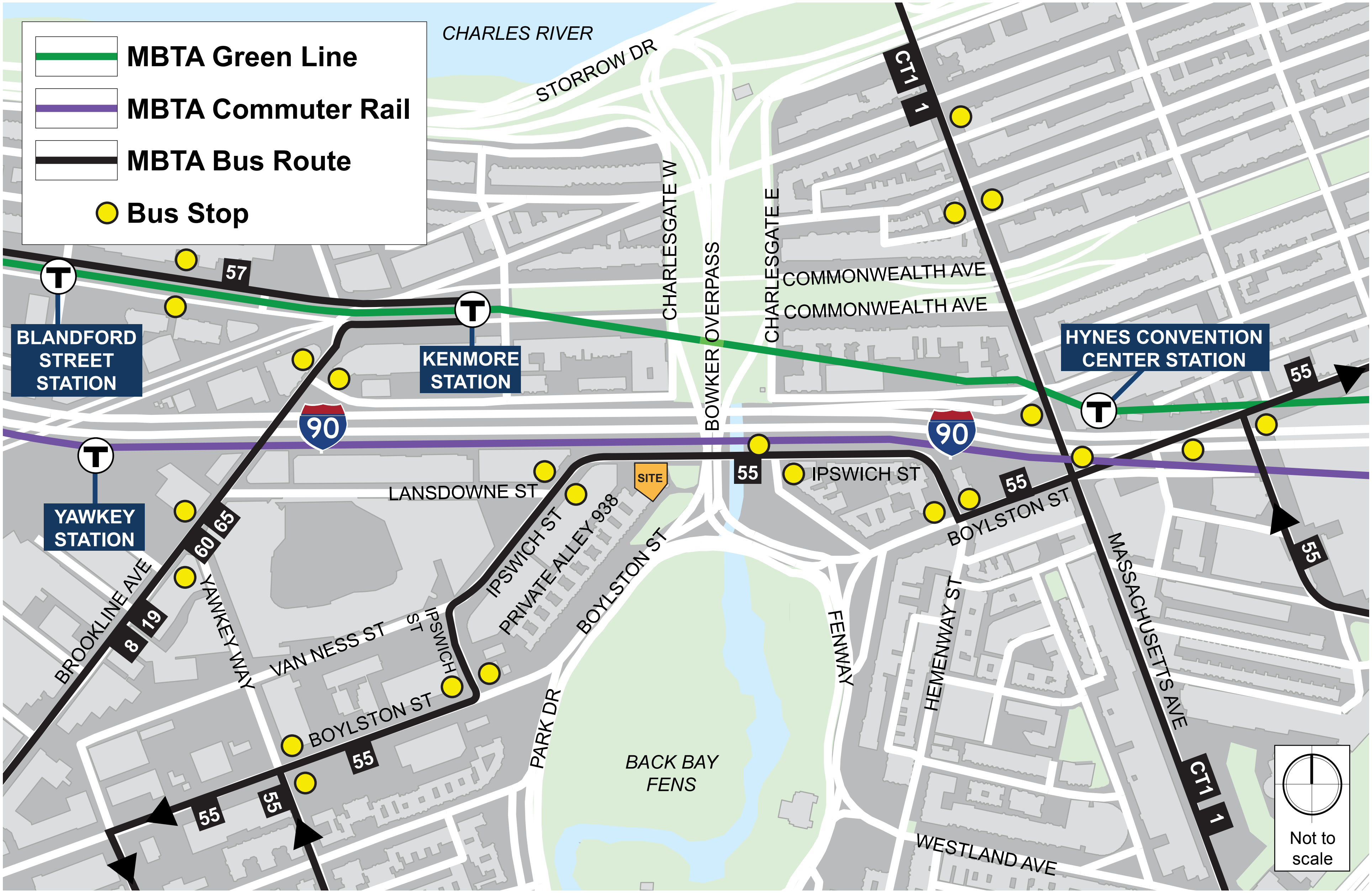

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Figure 3-10
Public Transportation

Table 3-7 Existing Public Transportation Services

Transit Service	Description	Rush-hour Headway (minutes)*
Subway		
Green Line	"B" Branch – Boston College – Park Street Station	6
	"C" Branch – Cleveland Circle – North Station	6
	"D" Branch – Riverside – Park Street Station	6
Commuter Rail		
Purple Line	Yawkey Station – Framingham/Worcester Line	30
Bus Routes		
CT1	Central Square Cambridge – BU Medical Campus/Boston Medical Center	20
1	Harvard/Holyoke Street – Dudley Station	12-15
8	Harbor Point/UMass - Kenmore via BU Medical Center & Dudley Station	14-15
19	Fields Corner Sta. - Kenmore or Ruggles Sta. via Grove Hall & Dudley Station	14
55	Jersey & Queensberry Streets – Copley Square or Park & Tremont Streets	15
60	Chestnut Hill - Kenmore via Brookline Village & Cypress St.	20-30
65	Brighton Ctr - Kenmore via Washington St., Brookline Village & Brookline Ave.	12

* Headway is the time between buses/trains.

3.3 No-Build (2021) Condition

The No-Build (2021) Condition reflects a future scenario that incorporates anticipated traffic volume changes associated with background traffic growth independent of any specific project, traffic associated with other planned specific developments, and planned infrastructure improvements that will affect travel patterns throughout the study area.

3.3.1 Background Traffic Growth

The methodology to account for generic future background traffic growth, independent of this Project, may be affected by changes in demographics, smaller scale development projects, or projects unforeseen at this time. Based on a review of recent and historic traffic data collected recently and to account for any additional unforeseen traffic growth, a traffic growth rate of one-half percent per year, compounded annually, was used.

3.3.2 Specific Development Traffic Growth

Traffic volumes associated with larger or nearby development projects can affect traffic patterns within the study area under future conditions. Four such projects, listed below and mapped in Figure 3-11, were specifically accounted for in the traffic volumes for future scenarios.

Parcel 7 Air Rights – This project includes four new buildings ranging in height from seven to 23 stories, containing 480,000 sf of retail and office uses and residential space above. The project will include approximately 500 residential apartments including 10 percent on-site affordable units and five percent off-site affordable housing contribution. The project has been approved by the BRA.

1350 Boylston Street – This project includes approximately 196,500 sf anticipated to contain approximately 7,050 sf of ground retail and restaurant space, and approximately 240 rental apartments. All parking will be located in a below-grade garage with approximately 105 spaces. Currently, this project is under construction.

The Point– This project includes a new residential tower with retail space, totaling 390,460 sf. The project will include approximately 350 residential units and 20,000 sf of retail space. Construction began in spring 2015 and is expected to be completed by fall 2017.

Landmark Center 2013 – This project consists of the addition of multiple building elements within the existing Landmark Center Property. The original building will be kept in place. The new buildings will consist of office, retail, and residential uses. The project will include up to 600 residential units, approximately 110,000 sf of retail space, approximately 75,000 sf of grocery space, and approximately 15,000 sf of office space.

The existing above-ground structured parking and surface spaces will be replaced by a new underground parking garage, providing up to 1,500 striped spaces. This project has been approved by the BRA.

3.3.3 Proposed Infrastructure Improvements

On-going repairs to the Bowker Overpass were assumed to be complete under the No-Build Condition.

3.3.4 No-Build Traffic Volumes

The 0.5 percent per year annual growth rate, compounded annually, was applied to the Existing (2016) Condition traffic volumes, then the traffic volumes associated with the background development projects listed above were added to develop the No-Build (2021) Condition traffic volumes. The No-Build (2021) weekday morning and evening peak hour traffic volumes are shown on Figure 3-12 and Figure 3-13, respectively.

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Figure 3-11
Area Development Projects

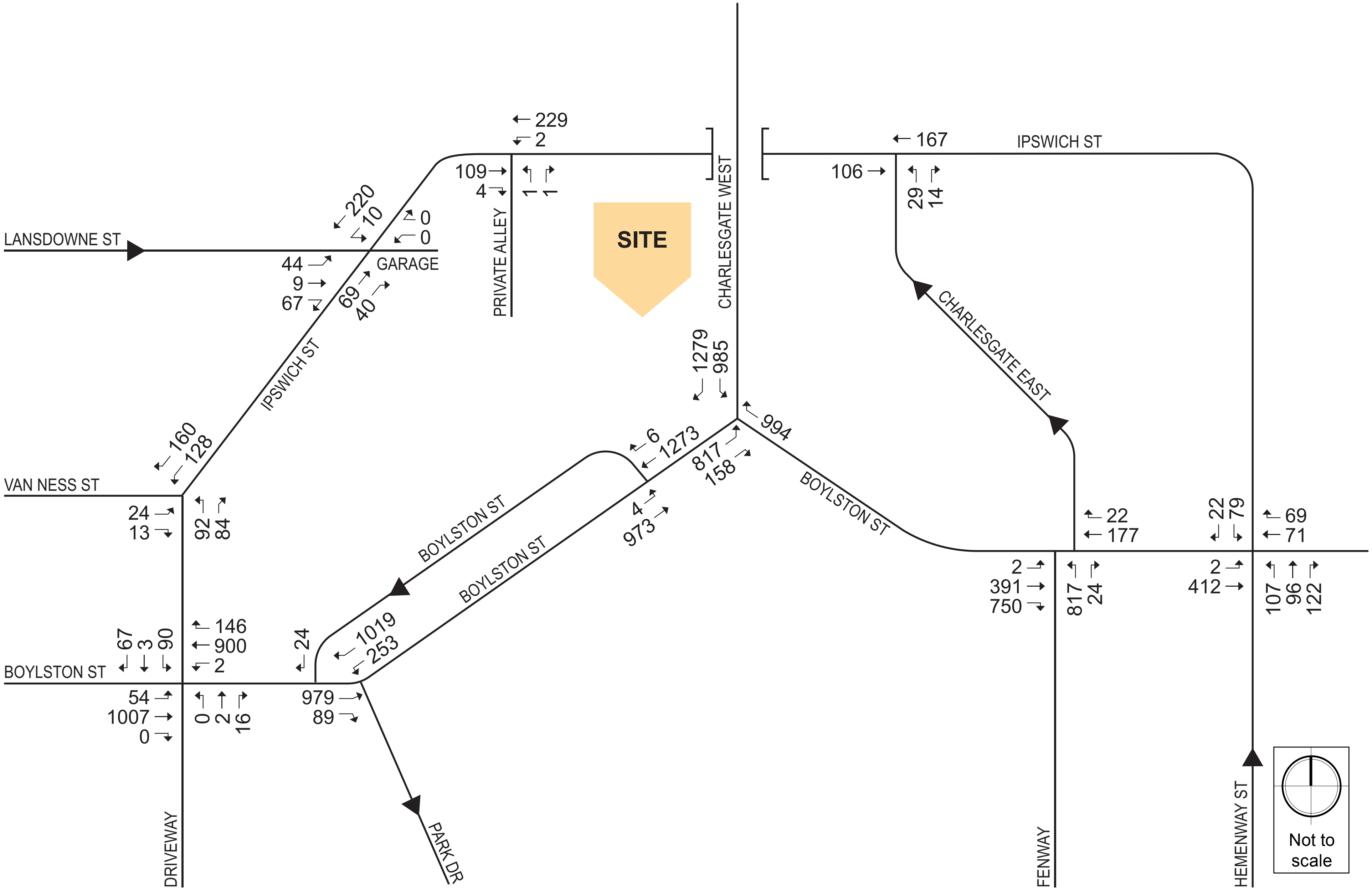

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Figure 3-12

No-Build (2021) Condition Traffic Volumes, Weekday a.m. Peak Hour

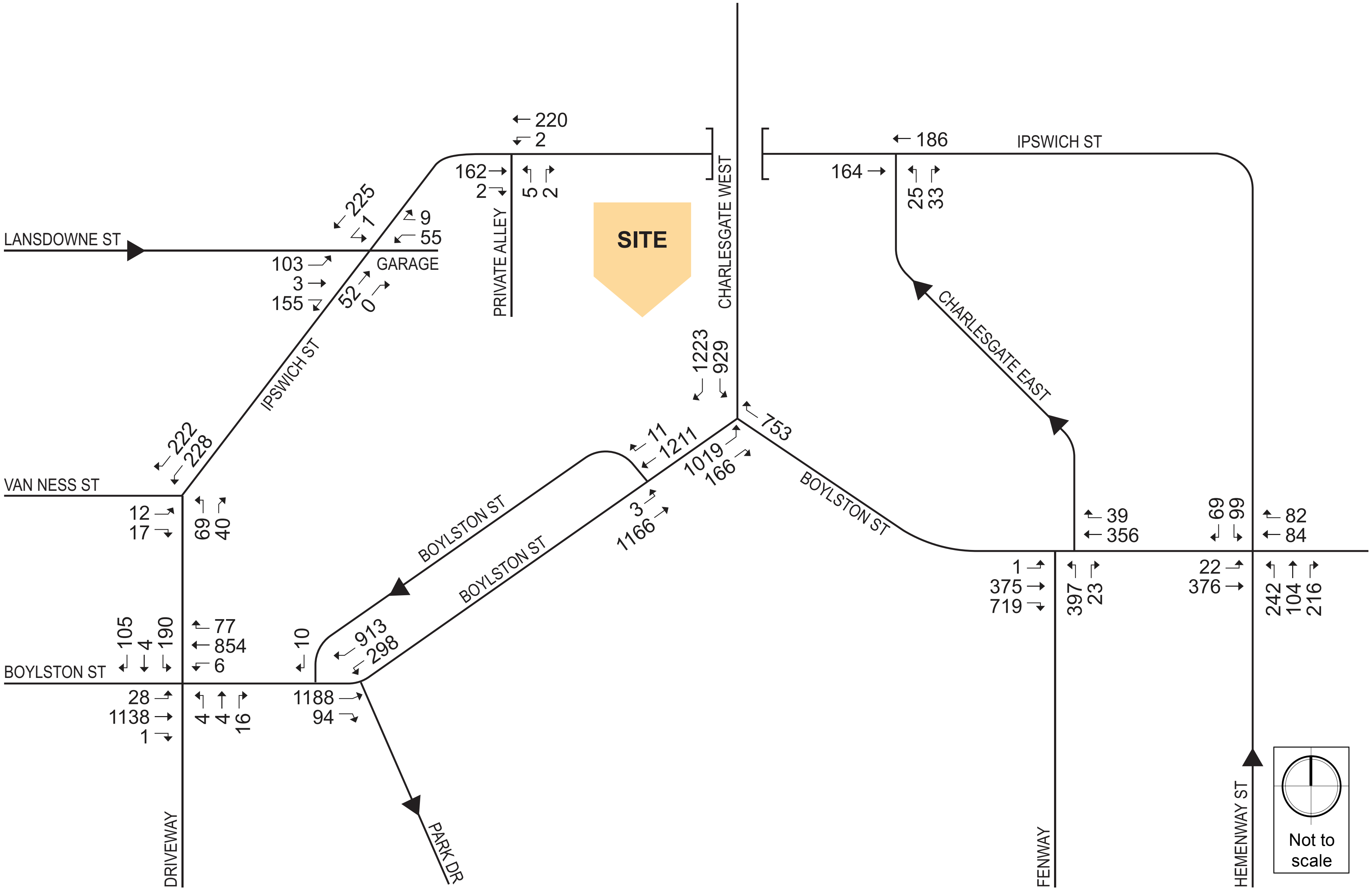

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Figure 3-13

No-Build (2021) Condition Traffic Volumes, Weekday p.m. Peak Hour

3.3.5 No-Build (2021) Condition Traffic Operations Analysis

The No-Build (2021) Condition analysis uses the same methodology as the Existing (2016) Condition capacity analysis. Table 3-8 and Table 3-9 present the No-Build (2021) Condition operations analysis for the a.m. and p.m. peak hours, respectively. The shaded cells in the tables indicate a projected decrease in LOS between the Existing (2016) Condition and the No-Build (2021) Condition to below LOS D. The detailed analysis sheets are provided in Appendix B.

As compared to the Existing Condition, only one change in level of service, as described below, would occur at the study intersections:

- While the overall intersection of **Boylston Street/Bowker Overpass** would continue to operate at LOS C during each peak hour, the operation of the Boylston Street westbound right movement would decrease from LOS D to LOS E during the a.m. peak hour.

Table 3-8 No-Build (2021) Condition, Capacity Analysis Summary, a.m. Peak Hour

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	*95th percentile*
Signalized Intersections					
Boylston Street/Hemenway Street/ Ipswich Street	**C**	**20.4**	**-**	**-**	**-**
Boylston Street EB left/thru | thru	A	3.7	0.26	23	52
Boylston Street WB thru/right	A	5.2	0.17	17	50
Hemenway Street NB left/thru/right	D	45.6	0.81	187	271
Ipswich Street SB left	D	42.0	0.54	54	88
Ipswich Street SB right	A	9.2	0.07	0	16
Boylston Street/Fenway/Charlesgate East	**B**	**10.8**	**-**	**-**	**-**
Boylston Street EB left/thru | thru/right	A	6.0	0.69	0	43
Boylston Street EB right	A	1.0	0.35	0	m5
Boylston Street WB thru | thru/right	B	11.0	0.17	36	50
Fenway NB left | left	B	19.8	0.59	208	261
Fenway NB right	A	3.5	0.21	0	0
Boylston Street/Bowker Overpass	**C**	**27.4**	**-**	**-**	**-**
Boylston Street EB left | left	B	18.9	0.55	187	243
Boylston Street EB right	B	14.9	0.21	57	97
Boylston Street WB right | right	E	61.4	>1.00	~410	#532
Bowker Overpass SB left | left	C	32.2	0.80	285	367
Bowker Overpass SB right | right	A	1.3	0.58	0	14

Table 3-8 No-Build (2021) Condition, Capacity Analysis Summary, a.m. Peak Hour (Continued)

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	*95th percentile*
Signalized Intersections					
Boylston Street/Park Drive	**D**	**48.8**	**-**	**-**	**-**
Boylston Street EB thru | thru	C	21.8	0.74	171	298
Boylston Street EB right	A	4.4	0.14	0	m19
Boylston Street WB left/thru | thru	E	74.7	0.82	288	370
Boylston Street/Ipswich Street/Sunoco Driveway	**D**	**44.4**	**-**	**-**	**-**
Boylston Street EB left/thru | thru/right	B	16.1	0.72	229	344
Boylston Street WB left/thru | thru/right	E	76.6	0.55	302	372
Sunoco Driveway NB right	A	0.0	0.02	0	0
Ipswich Street SB left/thru/right	D	37.6	0.66	87	122
Unsignalized Intersections					
Boylston Street/Boylston Street	**-**	**-**	**-**	**-**	**-**
Boylston Street EB left/thru | thru	A	0.1	0.41	-	1
Boylston Street WB thru | thru/right	A	0.0	0.51	-	0
Ipswich Street/Van Ness Street	**-**	**-**	**-**	**-**	**-**
Van Ness Street EB left/right	B	12.6	0.10	-	8
Ipswich Street SB left/right	A	0.0	0.21	-	0
Ipswich Street NWB left/right	A	4.7	0.09	-	7
Ipswich Street/Lansdowne Street/ Garage Driveway	-	-	-	-	-
Lansdowne Street EB left/thru/right	B	12.3	0.22	-	21
Garage Driveway WB left/right	A	0.0	0.00	-	0
Ipswich Street NB thru/right	A	0.0	0.08	-	0
Ipswich Street SB left/thru	A	0.4	0.01	-	1
Ipswich Street/Private Alley 938	-	-	-	-	-
Ipswich Street EB thru/right	A	0.0	0.08	-	0
Ipswich Street WB left/thru	A	0.1	0.00	-	0
Private Alley NB left/right	B	10.0	0.01	-	0
Ipswich Street/Charlesgate East	-	-	-	-	-
Ipswich Street EB thru	A	0.0	0.08	-	0
Ipswich Street WB thru	A	0.0	0.12	-	0
Charlesgate East left/right	B	10.4	0.07	-	5

Grey shading indicates a decrease into LOS E or F from the Existing (2016) Condition.
~ 50th percentile volume exceeds capacity. Queue shown is maximum after two cycles.
\# 95th percentile volume exceeds capacity. Queue shown is maximum after two cycles.
m Volumes for 95th percentile queue is metered by upstream signal.

Table 3-9 No-Build (2021) Condition, Capacity Analysis Summary, p.m. Peak Hour

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	*95th percentile*
Signalized Intersections					
Boylston Street/Hemenway Street/ Ipswich Street	**C**	**28.2**	**-**	**-**	**-**
Boylston Street EB left/thru | thru	B	14.5	0.31	147	194
Boylston Street WB thru/right	B	12.6	0.29	51	90
Hemenway Street NB left/thru/right	D	46.5	0.92	318	#538
Ipswich Street SB left	C	27.5	0.40	54	m92
Ipswich Street SB right	A	6.5	0.13	4	m26
Boylston Street/Fenway/Charlesgate East	**B**	**11.6**	**-**	**-**	**-**
Boylston Street EB left/thru | thru/right	B	12.5	0.69	231	m248
Boylston Street EB right	A	0.4	0.31	0	m0
Boylston Street WB thru | thru/right	B	18.3	0.45	101	113
Fenway NB left | left	B	12.6	0.29	82	97
Fenway NB right	A	3.9	0.22	0	0
Boylston Street/Bowker Overpass	**C**	**25.5**	**-**	**-**	**-**
Boylston Street EB left | left	B	16.4	0.63	301	382
Boylston Street EB right	A	8.9	0.19	54	m81
Boylston Street WB right | right	D	46.3	0.88	265	#325
Bowker Overpass SB left | left	D	53.7	0.96	315	#448
Bowker Overpass SB right | right	A	1.3	0.58	0	14
Boylston Street/Park Drive	**D**	**50.1**	**-**	**-**	**-**
Boylston Street EB thru | thru	B	12.9	0.71	296	302
Boylston Street EB right	A	0.3	0.12	0	m1
Boylston Street WB left/thru | thru	F	90.4	0.95	418	#571
Boylston Street/Ipswich Street/Sunoco Driveway	**D**	**45.6**	**-**	**-**	**-**
Boylston Street EB left/thru | thru/right	B	16.3	0.66	261	334
Boylston Street WB left/thru | thru/right	E	77.6	0.56	386	m411
Sunoco Driveway NB right	A	0.0	0.02	0	0
Ipswich Street SB left/thru/right	D	52.4	0.83	185	m#315
Unsignalized Intersections					
Boylston Street/Boylston Street	**-**	**-**	**-**	**-**	**-**
Boylston Street EB left/thru | thru	A	0.1	0.50	-	0
Boylston Street WB thru | thru/right	A	0.0	0.51	-	0

Table 3-9 No-Build (2021) Condition, Capacity Analysis Summary, p.m. Peak Hour (Continued)

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	*95th percentile*
Unsignalized Intersections					
Ipswich Street/Van Ness Street	-	-	-	-	-
Van Ness Street EB left/right	B	12.2	0.07	-	6
Ipswich Street SB left/right	A	0.0	0.31	-	0
Ipswich Street NWB left/right	A	5.8	0.08	-	6
Ipswich Street/Lansdowne Street/ Garage Driveway	-	-	-	-	-
Lansdowne Street EB left/thru/right	B	14.7	0.47	-	63
Garage Driveway WB left/right	C	17.0	0.23	-	22
Ipswich Street NB thru/right	A	0.0	0.04	-	0
Ipswich Street SB left/thru	A	0.0	0.00	-	0
Ipswich Street/Private Alley 938	-	-	-	-	-
Ipswich Street EB thru/right	A	0.0	0.13	-	0
Ipswich Street WB left/thru	A	0.1	0.00	-	0
Private Alley NB left/right	B	11.1	0.02	-	2
Ipswich Street/Charlesgate East	-	-	-	-	-
Ipswich Street EB thru	A	0.0	0.12	-	0
Ipswich Street WB thru	A	0.0	0.12	-	0
Charlesgate East left/right	B	10.5	0.10	-	8

Grey shading indicates a decrease into LOS E or F from the Existing (2016) Condition.
~ 50th percentile volume exceeds capacity. Queue shown is maximum after two cycles.
\# 95th percentile volume exceeds capacity. Queue shown is maximum after two cycles.
m Volumes for 95th percentile queue is metered by upstream signal.

3.4 Build (2021) Condition

The Project includes demolition of the existing on-site structure and construction of a new 29-story residential building. The Project will include ground and second floor restaurant and office space of approximately 10,000 sf and 7,500 sf, respectively. Approximately 186 parking spaces will be provided in in a garage at the ground, basement, third and fourth levels.

3.4.1 Site Access and Vehicle Circulation

Site plans for the Ipswich Street level and Boylston Street level are shown in Figure 3-14A and Figure 3-14B, respectively. Due to the topography of the site, Boylston Street is one level higher than Ipswich Street.

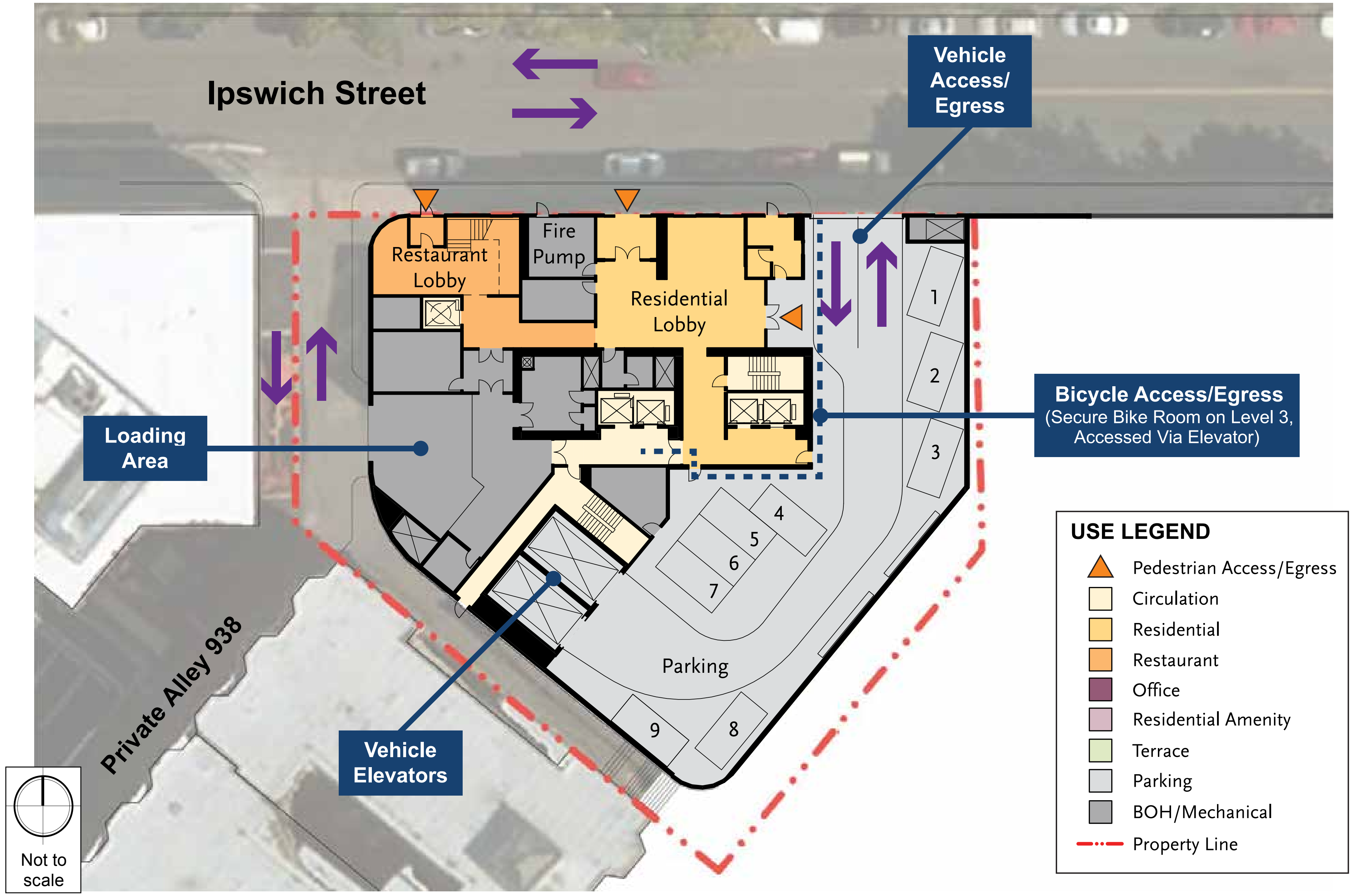

Figure 3-14A

Site Plan Ipswich Street Level

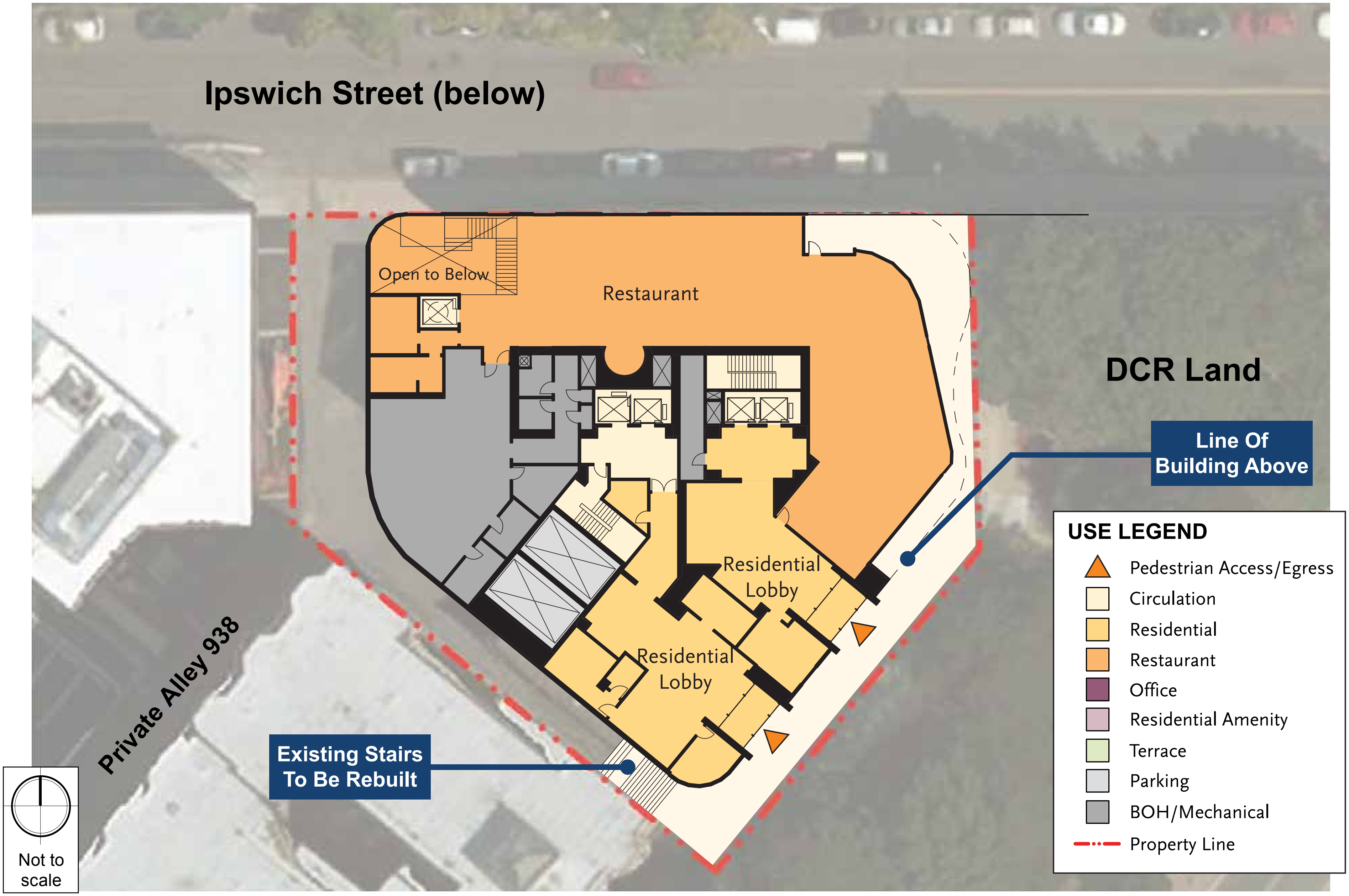

Figure 3-14B

Site Plan Boylston Street Level

All vehicles entering and exiting the Project parking garage will use the two-way driveway on Ipswich Street. When arriving, drivers will stop and leave their vehicles with a garage attendant, who will take the vehicle to the attendant-operated vehicle elevators. Garage parking will be located on the basement, third, and fourth levels. Garage attendants will also retrieve vehicles from the garage for residents when they depart. The staging of vehicles waiting to be picked-up by residents or serviced by the garage elevators will occur in nine designated spaces within the internal drop-off/pick-up area.

Pedestrians will be able to enter/exit the building at both the Ipswich Street level and the Boylston Street level.

Tenants using the bicycle room will enter the site via the vehicle access/egress driveway on Ipswich Street and walk their bicycle to the elevators. The design team will continue to explore alternative access points and storage options.

3.4.2 Loading and Service Accommodations

As shown in Figure 3-14A, loading and servicing for the Project will be provided in an internal loading area accessed via Private Alley 938 at the Ipswich Street level. At the existing building today, loading activity occurs at approximately the same location. Delivery vehicles will back into the loading area and then exit via Private Alley 938 to Ipswich Street.

As a residential project, the proposed Project is expected to have a relatively low number of daily deliveries, associated primarily with regular US mail, Fed-Ex/UPS, dry cleaning, food (take-out/ groceries), and trash collection/recycling. Move-in/move-out activity will occur at the loading area.

3.4.3 Trip Generation Methodology

Determining the future trip generation of the Project is a complex, multi-step process that produces an estimate of vehicle trips, transit trips, and walk/bicycle trips associated with a proposed development and a specific land use program. A project's location and proximity to different travel modes determines how people will travel to and from a site.

To estimate the number of trips expected to be generated by the Project, data published by the Institute of Transportation Engineers (ITE) in the Trip Generation Manual were used. ITE provides data to estimate the total number of unadjusted vehicular trips associated with the Project. In an urban setting well-served by transit, adjustments are necessary to account for other travel mode shares such as walking, bicycling, and transit.

When assessing a site with existing, active land uses, it is standard practice to estimate existing trips and subtract those trips from the projected future new trips. The result of this process yields "net new" trips that become the basis for traffic analysis and allows the study team to "take credit" for existing trip activity. Although the existing buildings on site contain active office space, no reduction has been applied to future trips. This approach yields the most conservative (higher impact) analysis results.

To estimate the unadjusted number of vehicular trips for the Project, the following ITE land use code (LUCs) was used:

Land Use Code 222 – High Rise Apartment. High rise apartments (rental dwelling units) are units located in rental buildings that have more than 10 levels (floors) and most likely have one or more elevators. Calculations of the number of trips use ITE's average rate per dwelling units.

Land Use Code 232 – High Rise Residential Condominium. High-rise residential condominiums/townhouses are defined as units located in a building that has three or more floors with condominium residential units. Calculations of the number of trips use ITE's average rate per dwelling units.

Land Use Code 710 – General Office. The most appropriate ITE code for the Project's office space is General Office, reflecting a place where one or more tenants perform professional services. Calculations of the number of trips use ITE's average rate per 1,000 sf.

Land Use Code 931 – Quality Restaurant. Quality restaurant is defined as a high quality, full service eating establishment with typical duration of stay of at least one hour. Quality restaurants typically do not serve breakfast and some do not serve lunch; however, they all serve dinner. Most quality restaurants include a lounge or bar facility with alcoholic beverages. Calculations of the number of trips use ITE's average rate per 1,000 sf.

3.4.4 Travel Mode Share

The BTD publishes vehicle, transit, and travel mode shares specific to each area of Boston. The Project site is located within BTD Area 4. The unadjusted vehicular trips were converted to person trips by using vehicle occupancy rates published by the Federal Highway Administration (FHWA)[1]. The person trips were then distributed to different modes according to the mode shares shown in Table 3-10.

3.4.5 Project Trip Generation

The mode share percentages shown in Table 3-10 were applied to the number of person trips to develop walk/bicycle, transit, and vehicle trip generation estimates. The trip generation for the Project by mode is shown in Table 3-11. The detailed trip generation information is provided in Appendix B.

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[1] Summary of Travel Trends: 2009 National Household Travel Survey; FHWA; Washington, D.C.; June 2011.

Since completion of the Build Condition traffic analysis (presented later in this chapter), the building design progressed and the planned retail/restaurant space has increased from 7,945 sf to 10,000 sf and the planned office space decreased from 10,475 sf to 7,500 sf. The trips shown in Table 3-11 reflect the earlier plan. With these changes to land use, the associated number of projected peak hour vehicle trips decrease from 28 to 26 during the a.m. peak hour and remain the same at 44 during the p.m. peak hour. Because the change is minor, the traffic analysis has not been updated and is still considered reflective of future conditions. The detailed trip generation worksheets for each land use plan are provided in Appendix B.

As shown in Table 3-11, the Project is expected to generate 1,654 pedestrian trips, 548 transit trips, and 554 vehicle trips throughout the day. During the a.m. peak hour, the Project is expected to generate 79 pedestrian trips (22 in and 57 out), 27 transit trips (12 in and 15 out), and 28 vehicle trips (11 in and 17 out). During the p.m. peak hour, the Project is expected to generate 154 pedestrian trips (99 in and 55 out), 47 transit trips (23 in and 24 out), and 44 vehicle trips (26 in and 18 out).

3.4.6 Trip Distribution

The trip distribution identifies the various travel paths for vehicles associated with the Project. Trip distribution patterns for the Project were based on BTD's origin-destination data for Area 4 and trip distribution patterns presented in traffic studies for nearby projects. The trip distribution patterns for the Project are illustrated in Figure 3-15 and Figure 3-16, for entering and exiting vehicles, respectively.

Table 3-10 Travel Mode Shares

Land Use		*Walk/Bicycle Share (5)*	*Transit Share (%)*	*Auto Share (%)*	*Vehicle Occupancy Rate*
Daily					
Residential – Apartments	In	57	19	24	1.13
	Out	57	19	24	1.13
Residential – Condos	In	57	19	24	1.13
	Out	57	19	24	1.13
Restaurant	In	55	16	29	2.10
	Out	55	16	29	2.10
Office	In	24	32	44	1.13
	Out	24	32	44	1.13

Table 3-10 Travel Mode Shares (Continued)

Land Use		*Walk/Bicycle Share (5)*	*Transit Share (%)*	*Auto Share (%)*	*Vehicle Occupancy Rate*
a.m. Peak Hour					
Residential – Apartments	In	59	22	19	1.13
	Out	64	15	21	1.13
Residential – Condos	In	59	22	19	1.13
	Out	64	15	21	1.13
Restaurant	In	57	19	24	2.10
	Out	61	13	26	2.10
Office	In	25	38	37	1.13
	Out	29	28	43	1.13
p.m. Peak Hour					
Residential – Apartments	In	64	15	21	1.13
	Out	59	22	19	1.13
Residential – Condos	In	64	15	21	1.13
	Out	59	22	19	1.13
Restaurant	In	61	13	26	2.10
	Out	57	19	24	2.10
Office	In	29	28	43	1.13
	Out	25	38	37	1.13

Table 3-11 Project Trip Generation

Land Use		*Walk/Bicycle Trips*	*Transit Trips*	*Vehicle Trips*
Daily				
Residential - Apartments	In	234	78	87
	Out	234	78	87
Residential – Condominiums	In	164	55	61
	Out	164	55	61
Restaurant	In	413	120	104
	Out	413	120	104
Office	In	16	21	25
	Out	16	21	25
Total	In	827	274	277
	Out	827	274	277

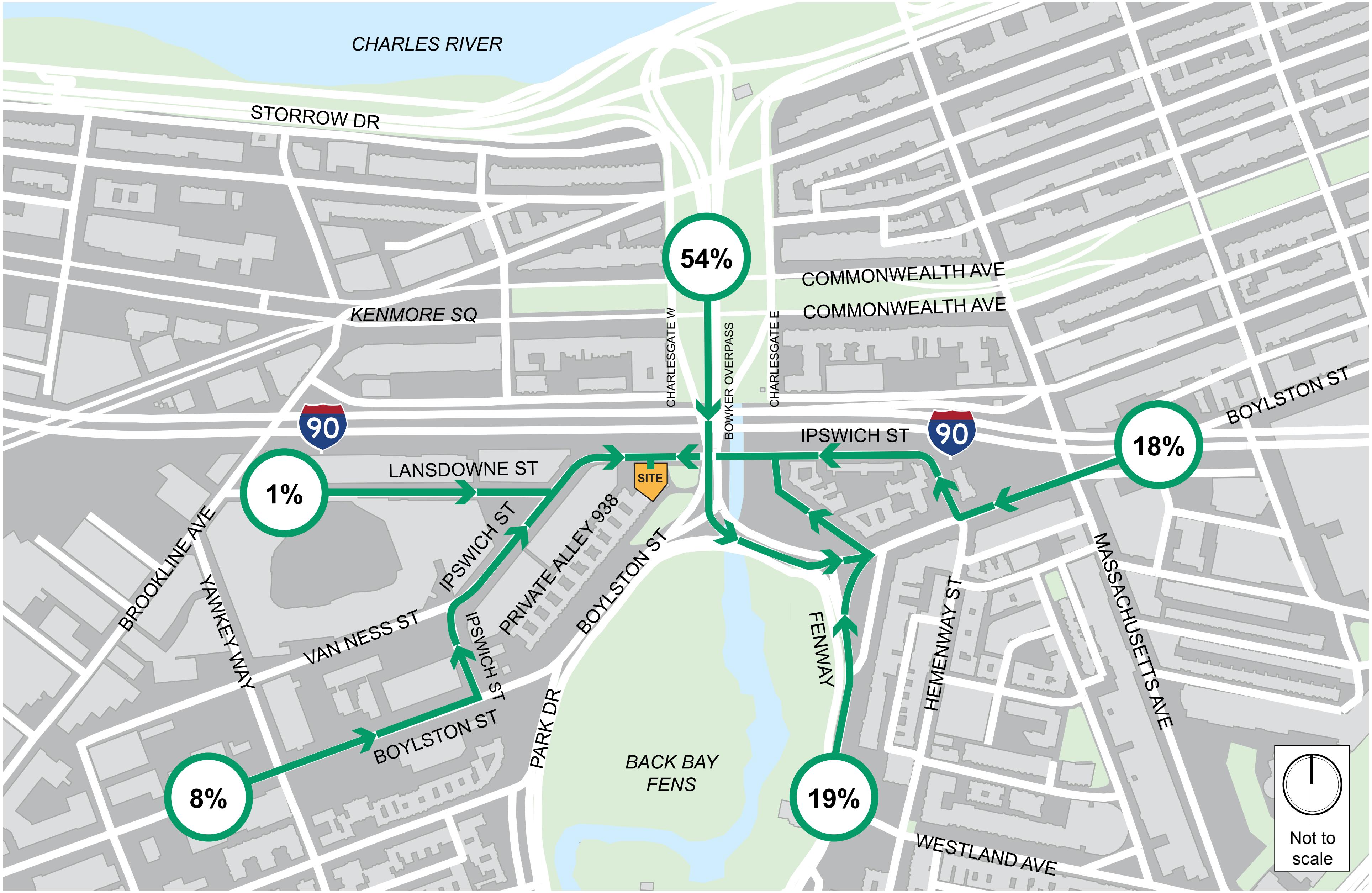
Table 3-11 Project Trip Generation (Continued)

Land Use		*Walk/Bicycle Trips*	*Transit Trips*	*Vehicle Trips*
a.m. Peak Hour				
Residential - Apartments	In	9	3	3
	Out	28	7	8
Residential – Condominiums	In	5	2	2
	Out	24	6	7
Restaurant	In	4	1	1
	Out	4	1	1
Office	In	4	6	5
	Out	1	1	1
Total	In	22	12	11
	Out	57	15	17
p.m. Peak Hour				
Residential - Apartments	In	27	6	8
	Out	16	6	4
Residential – Condominiums	In	20	5	6
	Out	12	4	4
Restaurant	In	51	11	10
	Out	8	23	5
Office	In	1	1	1
	Out	4	6	5
Total	In	99	23	26
	Out	55	24	18

3.4.7 Build Traffic Volumes

The vehicle trips were distributed through the study area roadway network. The Project-generated trips for the a.m. and p.m. peak hours are shown in Figures 3-17 and 3-18, respectively.

The trip assignments from the Project were added to the No-Build (2021) Condition volumes to develop the Build (2021) Condition traffic volumes. The Build (2021) Condition a.m. and p.m. peak hour traffic volumes are shown on Figures 3-19 and 3-20, respectively.



2 Charlesgate West **Boston, Massachusetts**

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Figure 3-15
Entering Vehicle Trip Distribution

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Figure 3-16
Exiting Vehicle Trip Distribution

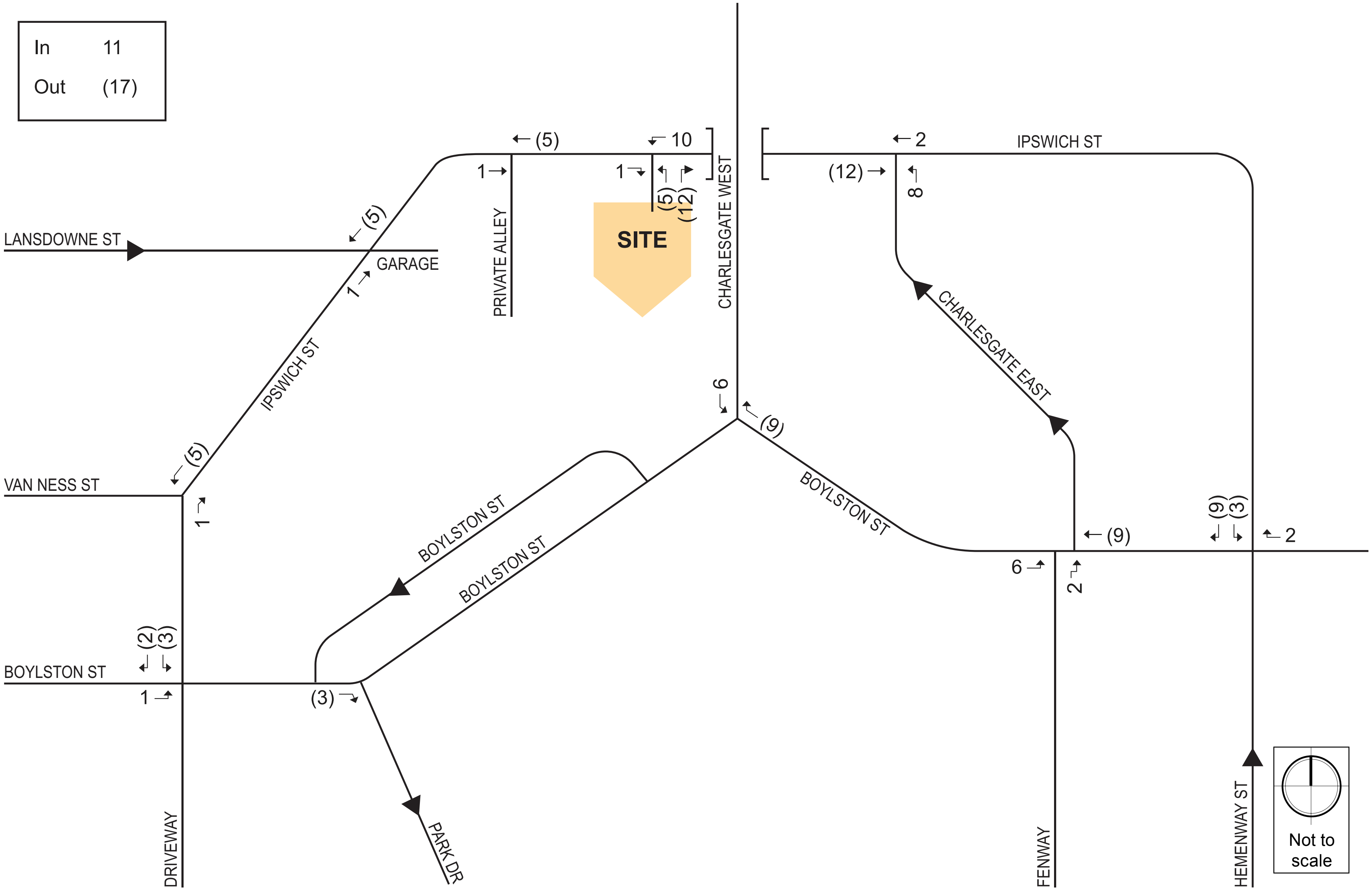

Figure 3-17

Project-generated Vehicle Trips, Weekday a.m. Peak Hour

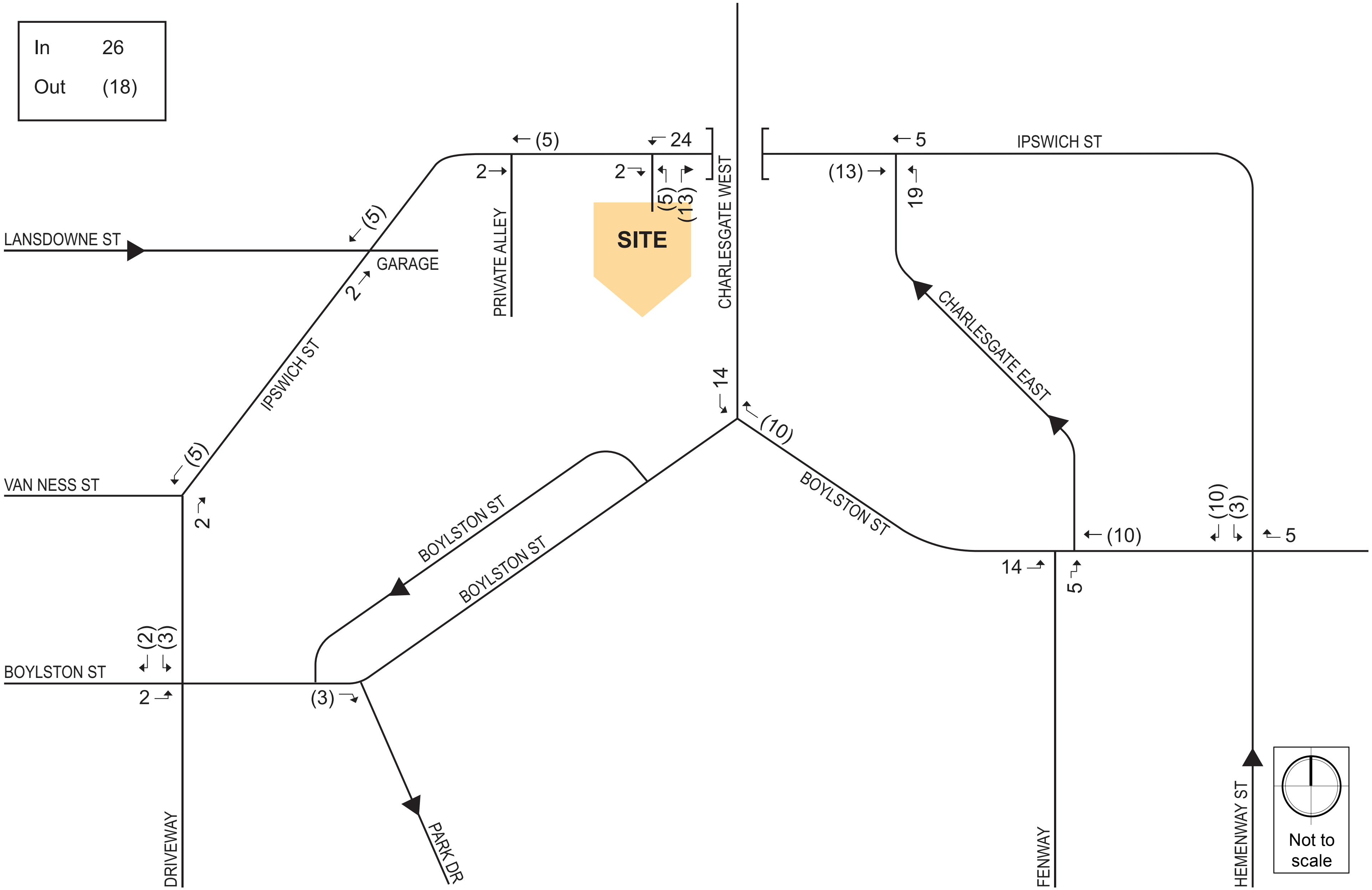

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Figure 3-18

Project-generated Vehicle Trips, Weekday p.m. Peak Hour

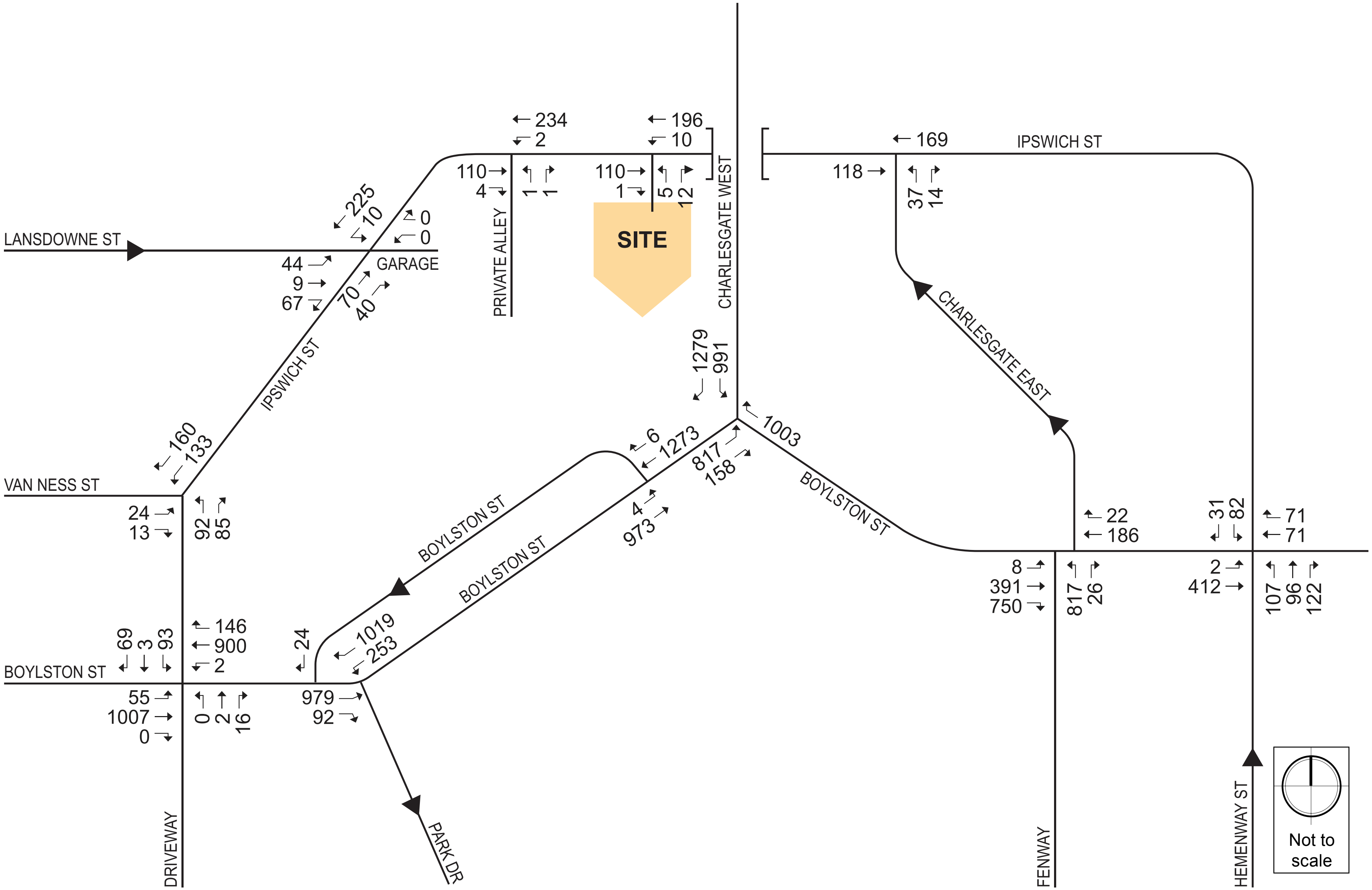

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Figure 3-19

Build (2021) Condition Traffic Volumes, Weekday a.m. Peak Hour

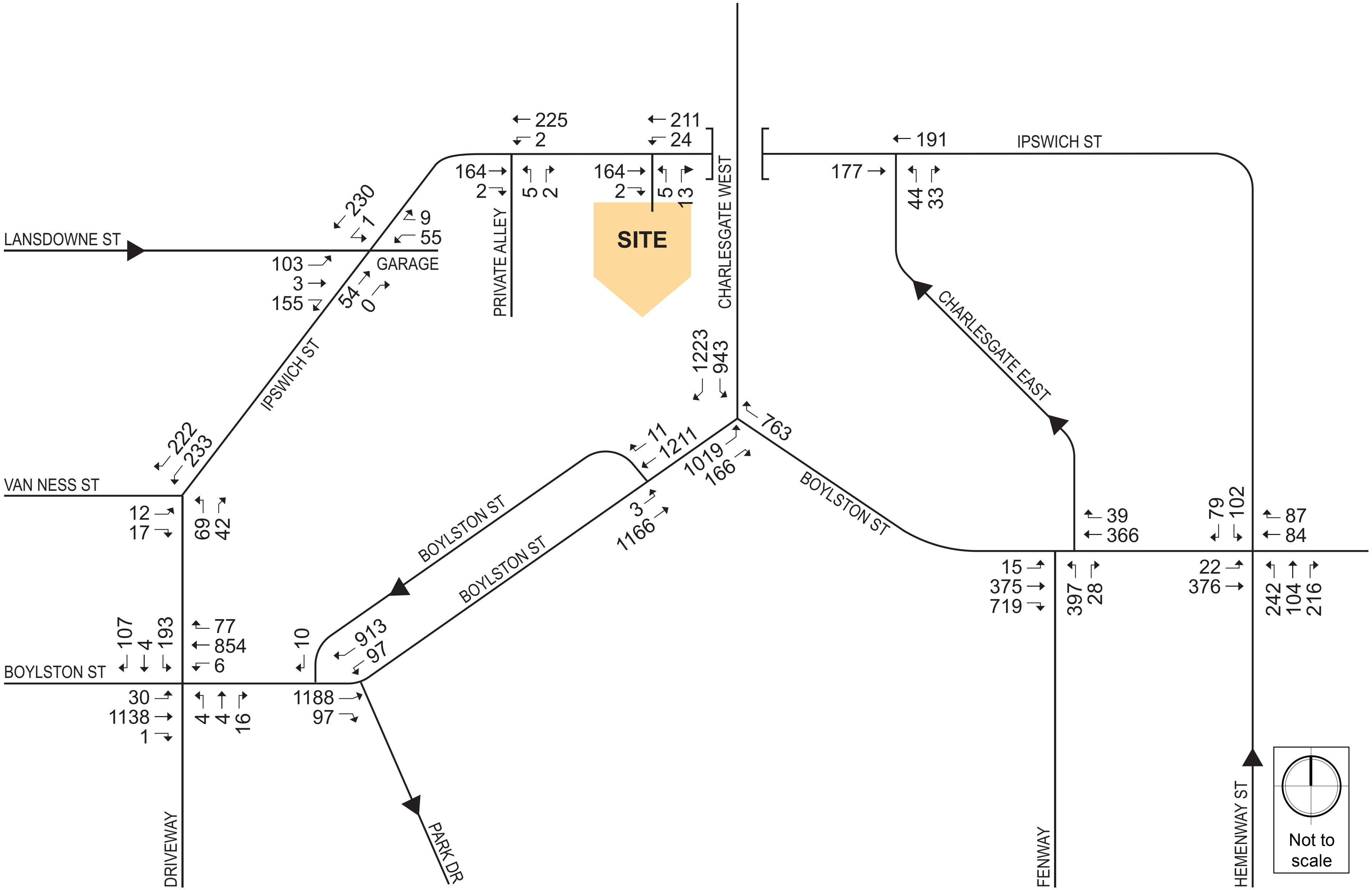

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Figure 3-20

Build (2021) Condition Traffic Volumes, Weekday p.m. Peak Hour

3.4.8 Build Condition Traffic Operations Analysis

The Build (2021) Condition analysis uses the same methodology as the Existing (2016) Condition and No-Build (2021) Condition analysis. Table 3-12 and Table 3-13 present the Build (2021) Condition capacity analysis for the a.m. and p.m. peak hours, respectively.

The shaded cells in the tables indicate a projected decrease in LOS between the No-Build (2021) Condition to and the Build (2021) Condition to below LOS D. The detailed analysis sheets are provided in Appendix B.

During the a.m. peak hour, all intersections and individual approaches would operate at the same level of service as the No-Build (2021) Condition.

During the p.m. peak hour, each intersection and individual approaches would operate at the same level of service as the No-Build (2021) Condition, with the exception of Bowker Overpass southbound through movement at the Boylston Street/Bowker Overpass intersection. While this movement would worsen from LOS D to LOS E, the change in average delay is minimal, becoming 56.6 seconds under Build Conditions compared to 53.7 seconds under No-Build Conditions. This change is considered minor and the overall intersection would continue to operate at LOS C.

Overall, these results indicate that the additional vehicle trips generated by the Project will not affect traffic operations at the ten study area intersections.

Table 3-12 Build (2021) Condition, Capacity Analysis Summary, a.m. Peak Hour

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	95th percentile
Signalized Intersections					
Boylston Street/Hemenway Street/ Ipswich Street	**C**	**20.2**	**-**	**-**	**-**
Boylston Street EB left/thru | thru	A	3.7	0.26	23	53
Boylston Street WB thru/right	A	5.2	0.17	17	50
Hemenway Street NB left/thru/right	D	45.1	0.80	184	271
Ipswich Street SB left	D	42.5	0.55	55	90
Ipswich Street SB right	A	8.2	0.09	0	18
Boylston Street/Fenway/Charlesgate East	**B**	**10.9**	**-**	**-**	**-**
Boylston Street EB left/thru | thru/right	A	6.2	0.70	0	47
Boylston Street EB right	A	1.1	0.35	0	m6
Boylston Street WB thru | thru/right	B	11.5	0.18	39	55
Fenway NB left | left	B	19.8	0.59	208	261
Fenway NB right	A	4.0	0.23	0	0

Table 3-12 Build (2021) Condition, Capacity Analysis Summary, a.m. Peak Hour (Continued)

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	95th percentile
Signalized Intersections					
Boylston Street/Bowker Overpass	**C**	**28.1**	-	-	-
Boylston Street EB left | left	B	18.9	0.55	187	243
Boylston Street EB right	B	14.9	0.21	57	97
Boylston Street WB right | right	E	63.7	>1.00	~411	#539
Bowker Overpass SB left | left	C	32.5	0.80	288	371
Bowker Overpass SB right | right	A	1.3	0.58	0	14
Boylston Street/Park Drive	**D**	**49.0**	-	-	-
Boylston Street EB thru | thru	C	22.2	0.74	171	304
Boylston Street EB right	A	4.5	0.15	0	m18
Boylston Street WB left/thru | thru	E	74.7	0.82	288	370
Boylston Street/Ipswich Street/Sunoco Driveway	**D**	**44.8**	-	-	-
Boylston Street EB left/thru | thru/right	B	16.7	0.73	233	353
Boylston Street WB left/thru | thru/right	E	76.8	0.55	308	372
Sunoco Driveway NB right	A	0.0	0.02	0	0
Ipswich Street SB left/thru/right	D	38.7	0.67	91	126
Unsignalized Intersections					
Boylston Street/Boylston Street	-	-	-	-	-
Boylston Street EB left/thru | thru	A	0.1	0.41	-	1
Boylston Street WB thru | thru/right	A	0.0	0.51	-	0
Ipswich Street/Van Ness Street	-	-	-	-	-
Van Ness Street EB left/right	B	12.7	0.10	-	8
Ipswich Street SB left/right	A	0.0	0.22	-	0
Ipswich Street NWB left/right	A	4.7	0.09	-	7
Ipswich Street/Lansdowne Street/ Garage Driveway	-	-	-	-	-
Lansdowne Street EB left/thru/right	B	12.4	0.22	-	21
Garage Driveway WB left/right	A	0.0	0.00	-	0
Ipswich Street NB thru/right	A	0.0	0.08	-	0
Ipswich Street SB left/thru	A	0.4	0.01	-	1
Ipswich Street/Private Alley 938	-	-	-	-	-
Ipswich Street EB thru/right	A	0.0	0.08	-	0
Ipswich Street WB left/thru	A	0.1	0.00	-	0
Private Alley NB left/right	B	10.1	0.01	-	0

Table 3-12 Build (2021) Condition, Capacity Analysis Summary, a.m. Peak Hour (Continued)

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	95th percentile
Unsignalized Intersections					
Ipswich Street/Charlesgate East	**-**	**-**	**-**	**-**	**-**
Ipswich Street EB thru	A	0.0	0.09	-	0
Ipswich Street WB thru	A	0.0	0.12	-	0
Charlesgate East left/right	B	10.7	0.08	-	7

Grey shading indicates a decrease of LOS E or F from the No-Build (2021) Condition.

~ 50th percentile volume exceeds capacity. Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity. Queue shown is maximum after two cycles.

m Volumes for 95th percentile queue is metered by upstream signal.

Table 3-13 Build (2021) Condition, Capacity Analysis Summary, p.m. Peak Hour

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	95th percentile
Signalized Intersections					
Boylston Street/Hemenway Street/ Ipswich Street	**C**	**27.6**	**-**	**-**	**-**
Boylston Street EB left/thru | thru	B	14.1	0.31	147	184
Boylston Street WB thru/right	B	12.6	0.30	52	92
Hemenway Street NB left/thru/right	D	46.1	0.92	318	#538
Ipswich Street SB left	C	27.9	0.41	56	m95
Ipswich Street SB right	A	6.4	0.15	5	m28
Boylston Street/Fenway/Charlesgate East	**B**	**12.0**	**-**	**-**	**-**
Boylston Street EB left/thru | thru/right	B	13.2	0.72	237	m251
Boylston Street EB right	A	0.3	0.31	0	m0
Boylston Street WB thru | thru/right	B	18.6	0.46	105	118
Fenway NB left | left	B	12.6	0.29	82	97
Fenway NB right	A	4.9	0.27	0	0
Boylston Street/Bowker Overpass	**C**	**26.6**	**-**	**-**	**-**
Boylston Street EB left | left	B	16.4	0.63	301	382
Boylston Street EB right	A	8.9	0.19	54	m81
Boylston Street WB right | right	D	47.7	0.89	271	#337
Bowker Overpass SB left | left	E	56.6	0.97	323	#460
Bowker Overpass SB right | right	A	1.3	0.58	0	14

Table 3-13 Build (2021) Condition, Capacity Analysis Summary, p.m. Peak Hour (Continued)

Intersection/Approach	LOS	Delay (seconds)	V/C Ratio	*Queue Length (ft)*	
				50th percentile	95th percentile
Signalized Intersections					
Boylston Street/Park Drive	**D**	**50.0**	-	-	-
Boylston Street EB thru | thru	B	12.9	0.71	290	299
Boylston Street EB right	A	0.4	0.12	0	m1
Boylston Street WB left/thru | thru	F	90.4	0.95	418	#571
Boylston Street/Ipswich Street/Sunoco Driveway	**D**	**45.9**	-	-	-
Boylston Street EB left/thru | thru/right	B	16.5	0.67	263	336
Boylston Street WB left/thru | thru/right	E	77.6	0.56	386	m411
Sunoco Driveway NB right	A	0.0	0.02	0	0
Ipswich Street SB left/thru/right	D	54.0	0.84	190	m#325
Unsignalized Intersections					
Boylston Street/Boylston Street	-	-	-	-	-
Boylston Street EB left/thru | thru	A	0.1	0.50	-	0
Boylston Street WB thru | thru/right	A	0.0	0.51	-	0
Ipswich Street/Van Ness Street	-	-	-	-	-
Van Ness Street EB left/right	B	12.3	0.07	-	6
Ipswich Street SB left/right	A	0.0	0.32	-	0
Ipswich Street NWB left/right	A	5.7	0.08	-	6
Ipswich Street/Lansdowne Street/ Garage Driveway	-	-	-	-	-
Lansdowne Street EB left/thru/right	B	14.8	0.48	-	64
Garage Driveway WB left/right	C	17.2	0.23	-	22
Ipswich Street NB thru/right	A	0.0	0.04	-	0
Ipswich Street SB left/thru	A	0.0	0.00	-	0
Ipswich Street/Private Alley 938	-	-	-	-	-
Ipswich Street EB thru/right	A	0.0	0.14	-	0
Ipswich Street WB left/thru	A	0.1	0.00	-	0
Private Alley NB left/right	B	11.1	0.02	-	2
Ipswich Street/Charlesgate East	-	-	-	-	-
Ipswich Street EB thru	A	0.0	0.13	-	0
Ipswich Street WB thru	A	0.0	0.12	-	0
Charlesgate East left/right	B	11.2	0.14	-	12

Grey shading indicates a decrease of LOS E or F from the No-Build (2021) Condition.

~ 50th percentile volume exceeds capacity. Queue shown is maximum after two cycles.

\# 95th percentile volume exceeds capacity. Queue shown is maximum after two cycles.

M Volumes for 95th percentile queue is metered by upstream signal.

3.4.9 Parking

The Project will provide on-site parking for residents and a limited number of spaces for office tenants, with approximately 180 spaces for residents and six spaces for office use. Per BTD parking guidelines published in 2001, the maximum residential parking ratio for in this area is 0.75 spaces per unit. However, HSH has conducted parking supply and demand surveys and observations at existing residential buildings throughout Boston in recent years that indicate demand is often less than 0.5 spaces per unit.

For this Project, on-site parking will be provided for condominium units at about 0.90 space/units. For apartment units, parking will be provided at about 0.35 space/unit. Therefore, about 65 percent of rental units will not be provided with on-site parking. These residents will likely not own an automobile, and instead will rely on taxicabs, or other vehicle transport services, such as Uber or Zipcar to make any trips requiring a vehicle.

3.4.10 Bicycle Accommodations

In accordance with BTD guidelines, the Proponent will provide 295 secure/covered bicycle parking spaces for residents (one per residential unit) and six for office and restaurant employees (0.3 spaces per 1,000 sf). Outdoor bicycle racks with capacity for at least four bicycles will be provided. The secure bicycle spaces will be provided in a separate bicycle storage room on the third floor. Tenants using the bicycle room will enter the site via the vehicle access/egress driveway on Ipswich Street and walk their bicycle to the elevators. The design team will continue to explore alternative access points and storage options.

Bicycle racks will be provided near primary entrances. Bicycle racks, signs, and parking areas will conform to BTD standards.

3.5 Transportation Demand Management

The Proponent is committed to implementing Transportation Demand Management (TDM) measures to reduce dependence on autos. Because the Project is primarily residential, its trip generation is already lower than that of an office or retail use project. TDM will be facilitated by the nature and location of the proposed Project. The Proponent is committed to implementing a TDM program that supports the City's efforts to reduce dependency on the automobile by encouraging travelers to use alternatives to driving alone, especially during peak time periods, through the following TDM commitments listed below:

- Limited Parking: The Project will have approximately 180 parking spaces for residents. With 295 residential units, the Project's resulting parking ratio rate will be about 0.61 spaces per unit.

- Public Transportation:
    - Include language in new commercial tenant leases to encourage tenants to promote public transportation and consider subsidizing employee use of public transit.
    - Orientation Packets: The Proponent will provide orientation packets to new tenants containing information on available transportation choices, including transit routes/schedules and nearby vehicle sharing and bicycle sharing locations. On-site management will work with residents and tenants as they move in to help facilitate transportation for new arrivals.
- Bicycle Spaces: Secure bicycle storage will be made available to tenants and visitors to encourage bicycling as an alternative mode of transportation. The secure bicycle spaces will be provided in a separate bicycle storage room on the third floor. In accordance with BTD guidelines, the Proponent will provide 295 secure/covered bicycle parking spaces (one per residential unit) for residents and six spaces for employees. Bicycle racks, signs, and parking areas will conform to BTD standards and be sited in safe, secure locations.
- Transportation Coordinator: The Proponent will designate a transportation coordinator to oversee transportation issues, including parking, service, and loading and deliveries, and will work with residents as they move in to raise awareness of public transportation, bicycling, and walking opportunities;
- A Transportation Access Plan Agreement (TAPA) will be entered into between the Proponent and BTD. The TAPA will codify the specific measures and agreements between the Proponent and the City of Boston.

3.6 Transportation Mitigation Measures

While the traffic impacts associated with the new trips are minimal, the Proponent will continue to work with the City of Boston to create a Project that efficiently serves vehicle trips, improves the pedestrian environment, and encourages transit and bicycle use.

The Proponent is responsible for preparation of the Transportation Access Plan Agreement (TAPA), a formal legal agreement between the Proponent and the BTD. The TAPA formalizes the findings of the transportation study, mitigation commitments, elements of access and physical design, travel demand management measures, and any other responsibilities that are agreed to by both the Proponent and the BTD. Because the TAPA must incorporate the results of the technical analysis, it must be executed after these other processes have been completed. The proposed measures listed above and any additional transportation improvements to be undertaken as part of this Project will be defined and documented in the TAPA.

The Proponent will also produce a Construction Management Plan (CMP) for review and approval by BTD. The CMP will detail the schedule, staging, parking, delivery, and other associated impacts of the construction of the Project.

3.7 Evaluation of Short-term Construction Impacts

Most construction activities will be accommodated within the current site boundaries. Details of the overall construction schedule, working hours, number of construction workers, worker transportation and parking, number of construction vehicles, and routes will be addressed in detail in a Construction Management Plan to be filed with BTD in accordance with the City's transportation maintenance plan requirements.

To minimize transportation impacts during the construction period, the following measures will be considered for the Construction Management Plan:

- Limited construction worker parking on-site;
- Encouragement of worker carpooling;
- Consideration of a subsidy for MBTA passes for full-time employees; and
- Providing secure spaces on-site for workers' supplies and tools so they do not have to be brought to the site each day.

The Construction Management Plan to be executed with the City prior to commencement of construction will document all committed measures.

Chapter 4.0

Environmental Review Component

4.0 ENVIRONMENTAL PROTECTION COMPONENT

4.1 Pedestrian Level Winds

4.1.1 Introduction

A pedestrian wind study was conducted on the proposed Project by Rowan Williams Davies & Irwin Inc. (RWDI) to assess the effect of the proposed Project on local conditions in pedestrian areas around the study site and provide recommendations for minimizing adverse effects. The study involved wind simulations on a 1:400 scale model of the proposed building and surroundings. These simulations were then conducted in RWDI's boundary-layer wind tunnel at Guelph, Ontario, for the purpose of quantifying local wind speed conditions and comparing to appropriate criteria for gauging wind comfort in pedestrian areas. The criteria recommended by the Boston Redevelopment Authority (BRA) were used in this study. The present report describes the methods and presents the results of the wind tunnel simulations.

Wind conditions at most locations studied are predicted to remain comfortable for walking or better. However, at some locations around the building perimeter, along Ipswich Street, and to the east of the Project site, wind conditions are expected to be uncomfortable. As the design progresses, potential mitigation measures to improve wind conditions at these locations will be studied and implemented.

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 site photographs; information on surrounding buildings and terrain; and site plans and elevations of the proposed Project provided by the design team. The following configurations were simulated:

- No Build Configuration: includes existing site and all existing and approved surrounding buildings; and
- Build Configuration: includes the proposed Project and all existing and approved surroundings.

As shown in Figures 4.1-1 through 4.1-2, the wind tunnel model included the proposed Project and all relevant surrounding buildings and topography within a 1,600-foot radius of the study site. The mean speed profile and turbulence of the natural wind approaching the modelled area were also simulated in RWDI's boundary layer wind tunnel. The scale model was equipped with 133 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 5 feet above grade in pedestrian areas throughout the study site. 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 1991 to 2015 at Boston 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 4.1-3 through 4.1-5 present "wind roses", summarizing the seasonal and annual wind climates in the Boston area, based on the data from Logan Airport. The first wind rose in Figure 4.1-3, for example, summarizes the spring (March, April, and May) wind data. In general, the prevailing winds at this time of year are from the west northwest, northwest, west, southwest and south-southwest. In the case of strong winds (speeds greater than 20 mph, red bands), however, the most common wind directions are northeast and west-northwest.

On an annual basis (Figure 4.1-5) the most common wind directions are those between south-southwest and northwest. Winds from the east and east-southeast are also relatively common. In the case of strong winds, northeast and west-northwest are the dominant wind directions.

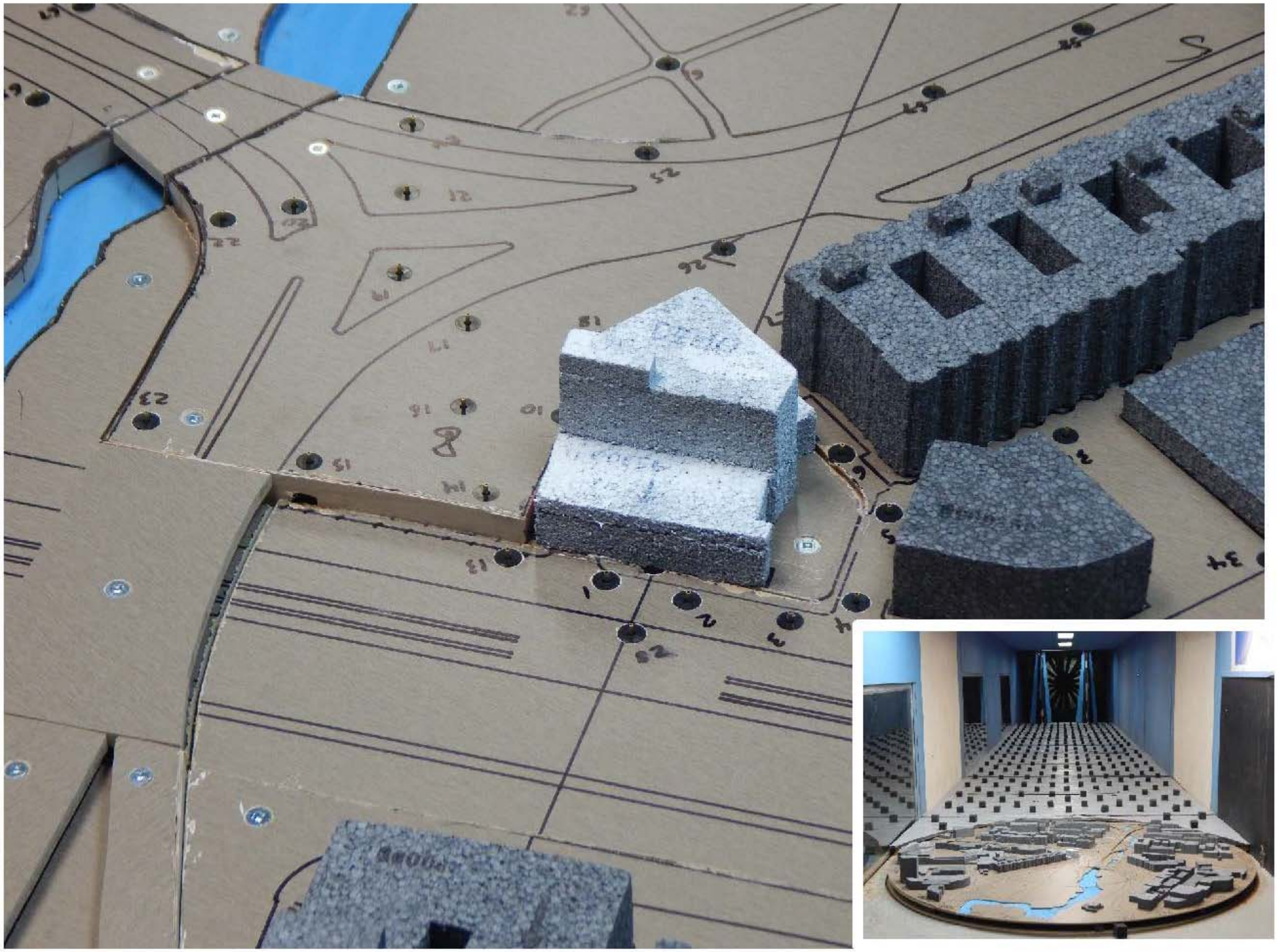


Figure 4.1-1

Wind Tunnel Study Model – No Build

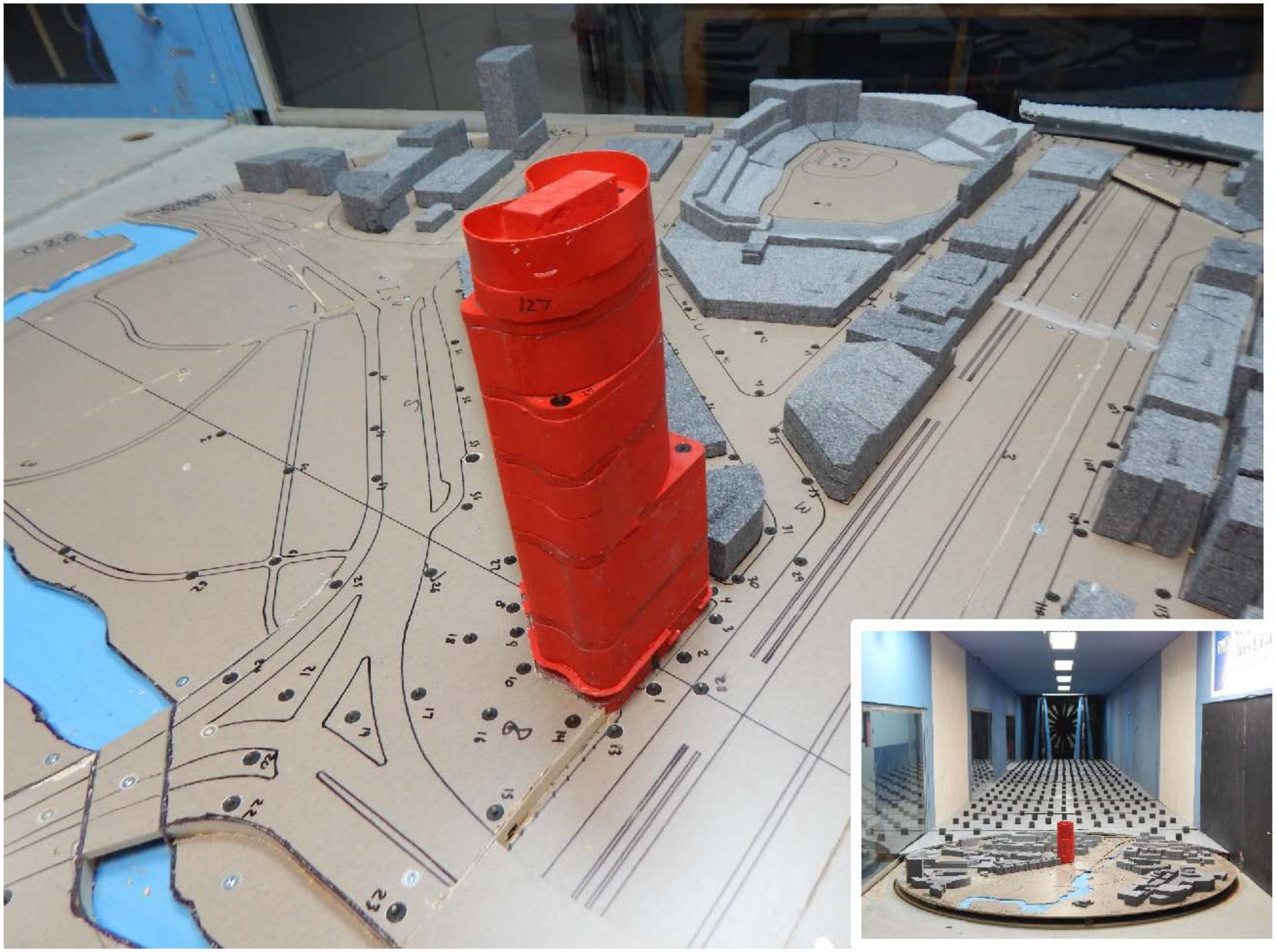
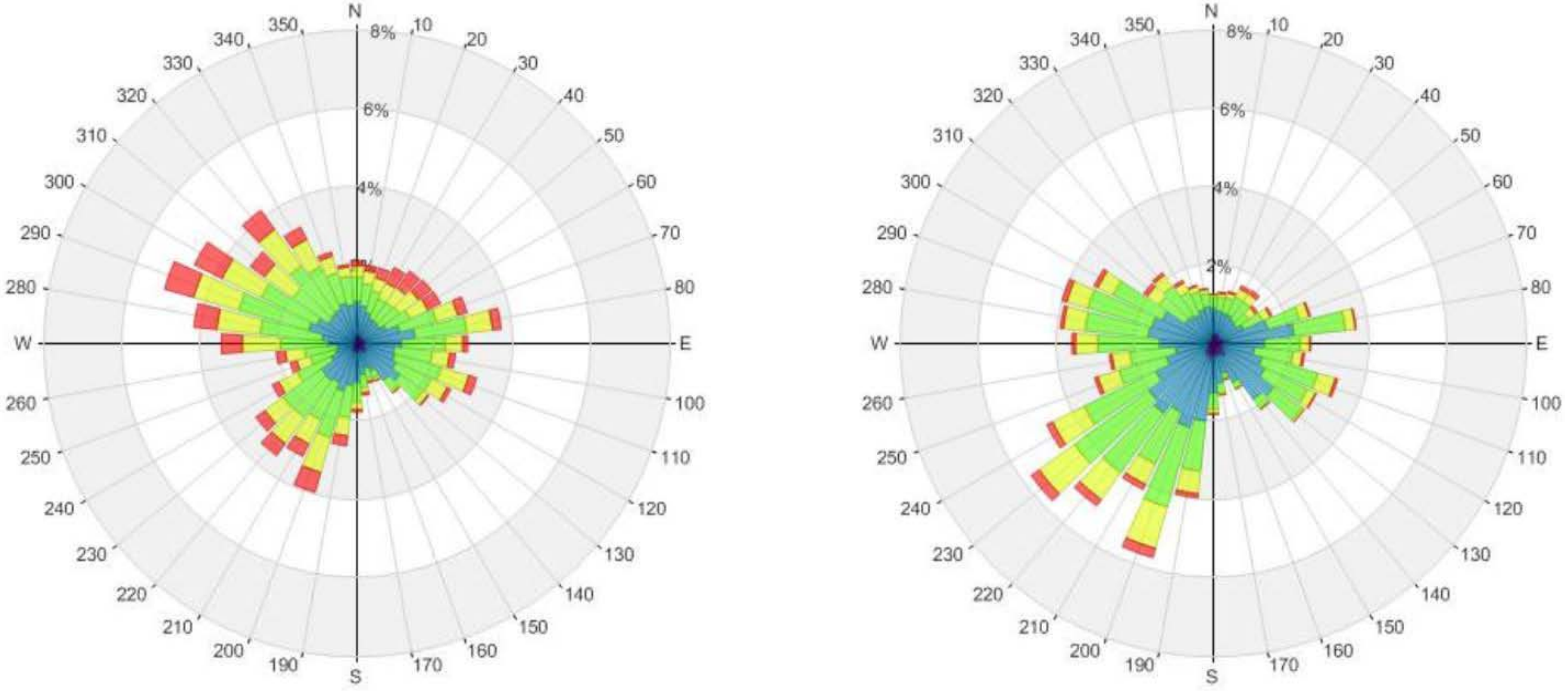


Figure 4.1-2

Wind Tunnel Study Model – Build



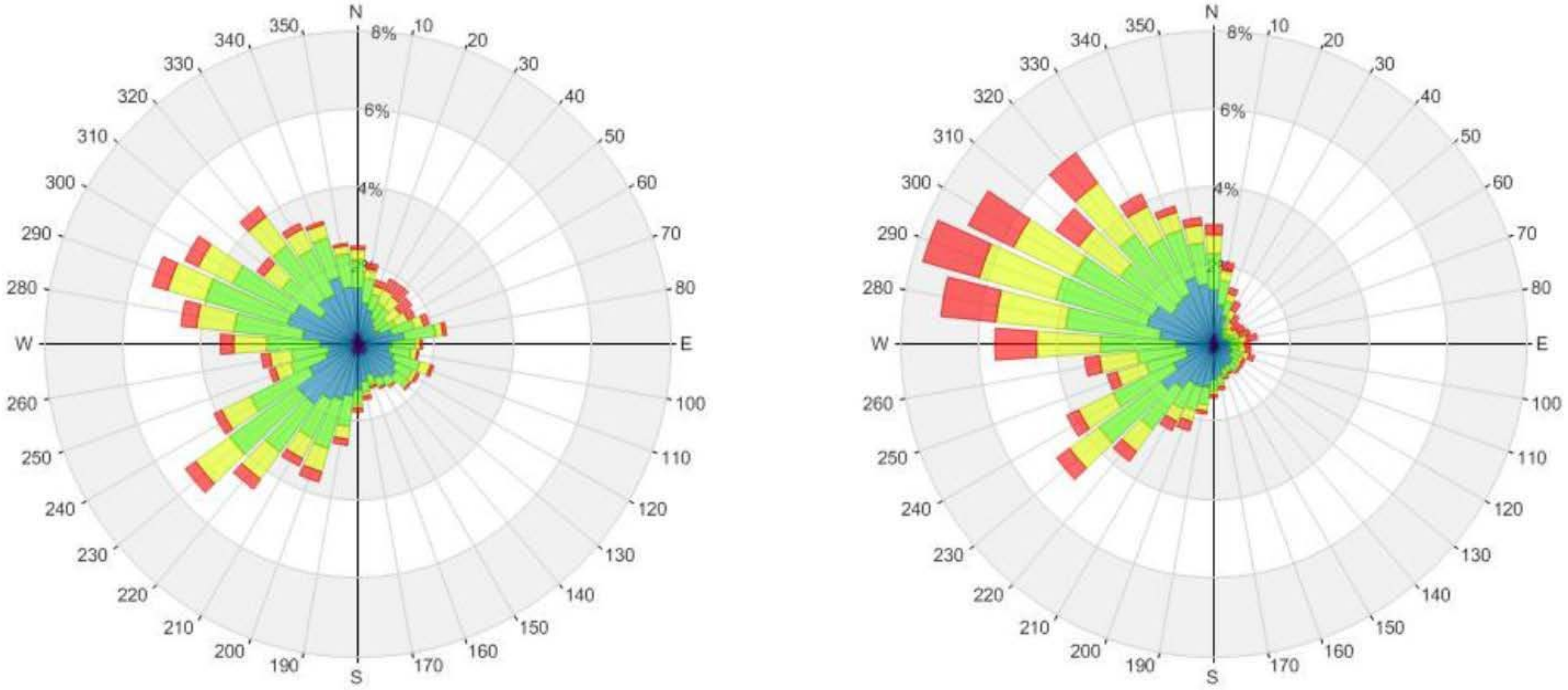
Spring
(March - May)

Summer
(June - August)

	Wind Speed (mph)	Probability (%) Spring	Probability (%) Summer
	Calm	2.4	2.7
🟪	1-5	6.4	8.9
🟦	6-10	28.5	38.1
🟩	11-15	32.9	35.1
🟨	16-20	19.7	12.6
🟥	>20	10.2	2.7

Figure 4.1-3

Directional Distribution (%) of Winds (Blowing From) Boston Logan International Airport (1991-2015)



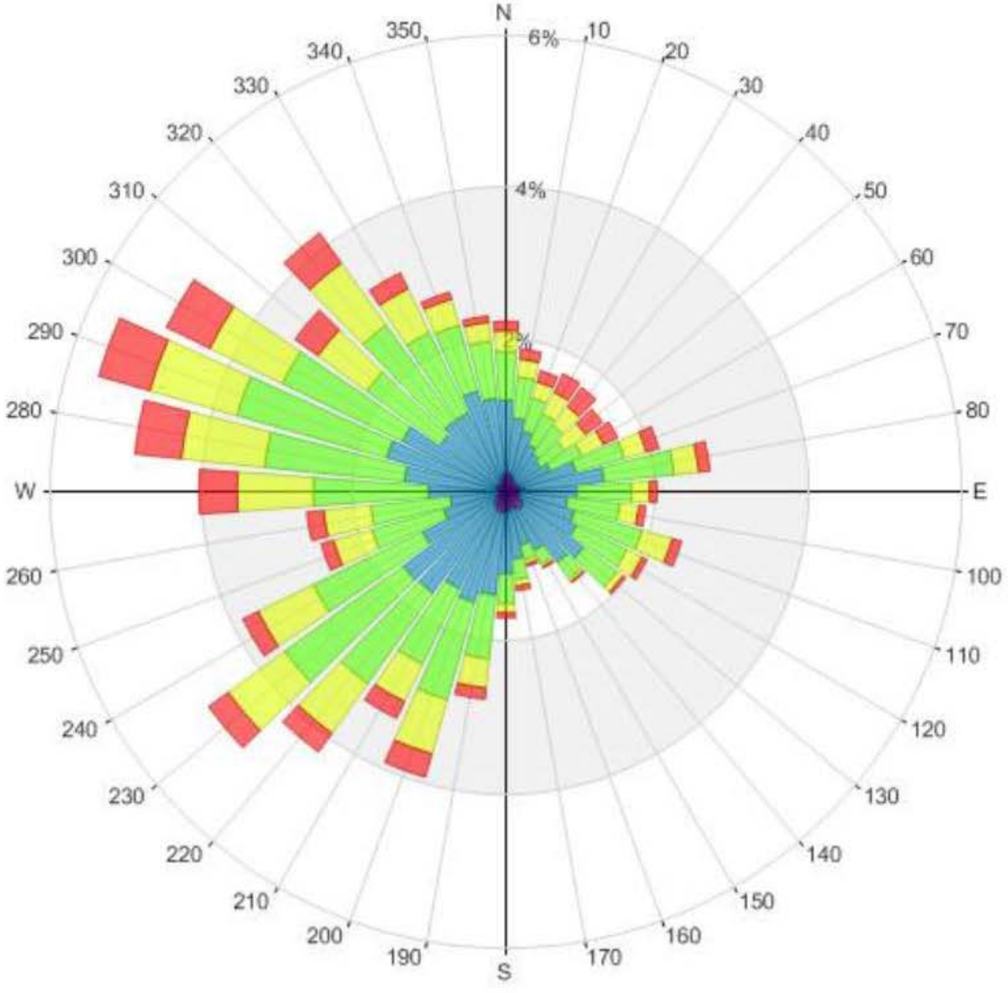
Fall
(September - November)

Winter
(December - February)

	Wind Speed (mph)	Probability (%) Fall	Probability (%) Winter
	Calm	2.9	2.3
🟪	1-5	8.0	6.2
🟦	6-10	34.3	27.5
🟩	11-15	32.8	31.1
🟨	16-20	15.3	20.1
🟥	>20	6.7	12.8

Figure 4.1-4

Directional Distribution (%) of Winds (Blowing From) Boston Logan International Airport (1991-2015)



Annual Winds

	Wind Speed (mph)	Probability (%)
	Calm	2.5
🟪	1-5	7.4
🟦	6-10	32.1
🟩	11-15	33.0
🟨	16-20	16.9
🟥	>20	8.1

Figure 4.1-5

Directional Distribution (%) of Winds (Blowing From) Boston Logan International Airport (1991-2015)

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 shown 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

Table 1 in Appendix C presents the mean and effective gust wind speeds for each season as well as annually. Figures 4.1-6 through 4.1-9 graphically depict the 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 mean speeds are based on the annual winds for each configuration tested, except where noted below in the text.

4.1.5.1 No-Build Configuration

As shown in Figure 4.1-6, all locations are expected to be suitable for walking or better annually in the vicinity of the Project site under the No Build configuration with the exception of Location 89, where the annual mean wind speed is 1 mph above the comfort threshold.

The effective gust criterion is expected to be met seasonally and annually at all locations for the No Build configuration (Figure 4.1-8).

4.1.5.2 Build Configuration

Entrances and Building Perimeter (Locations 1 through 13)

A mean speed categorization of walking is considered appropriate for sidewalks. Lower wind speeds conducive to standing are preferred at building entrances. The mean speeds anticipated at entrance Locations 1 and 2 are conducive to conditions comfortable for standing. These conditions are considered appropriate. Conditions comfortable for walking are expected at entrance Locations 8 and 9, and uncomfortable conditions are predicted at entrance Locations 3 and 10 (Figure 4.1-7). These conditions are higher than desired for entrance areas, and the Proponent is currently exploring mitigation measures such as vertical porous wind screens (8 – 10 ft tall, 70-80% solid) placed perpendicular to the façades on both sides of doorways, the use of landscaping incorporating coniferous/marcescent trees which retain their foliage in the winter, and/or recessed entrance ways to avoid direct interaction with strong winds. Alternatively, a colonnaded arcade may be designed along the base of the tower to provide a sheltered route for pedestrians on windy days. The efficacy of these mitigation measures will be tested through additional wind tunnel testing and after further discussion and design with RWDI's design team.

Wind speeds at the remaining locations along the perimeter of the Project site are expected to increase to uncomfortable with the addition of the proposed Project (Figure 4.1-7).

The effective gust criterion was met annually at most locations in the immediate perimeter of the development with the exception of Locations 4, 5, 7 and 11 (Figure 4.1-9).

Figure 4.1-6

Pedestrian Wind Conditions – Mean Speed – No-Build

2 Charlesgate West Boston, Massachusetts

Figure 4.1-7

Pedestrian Wind Conditions – Mean Speed – Build

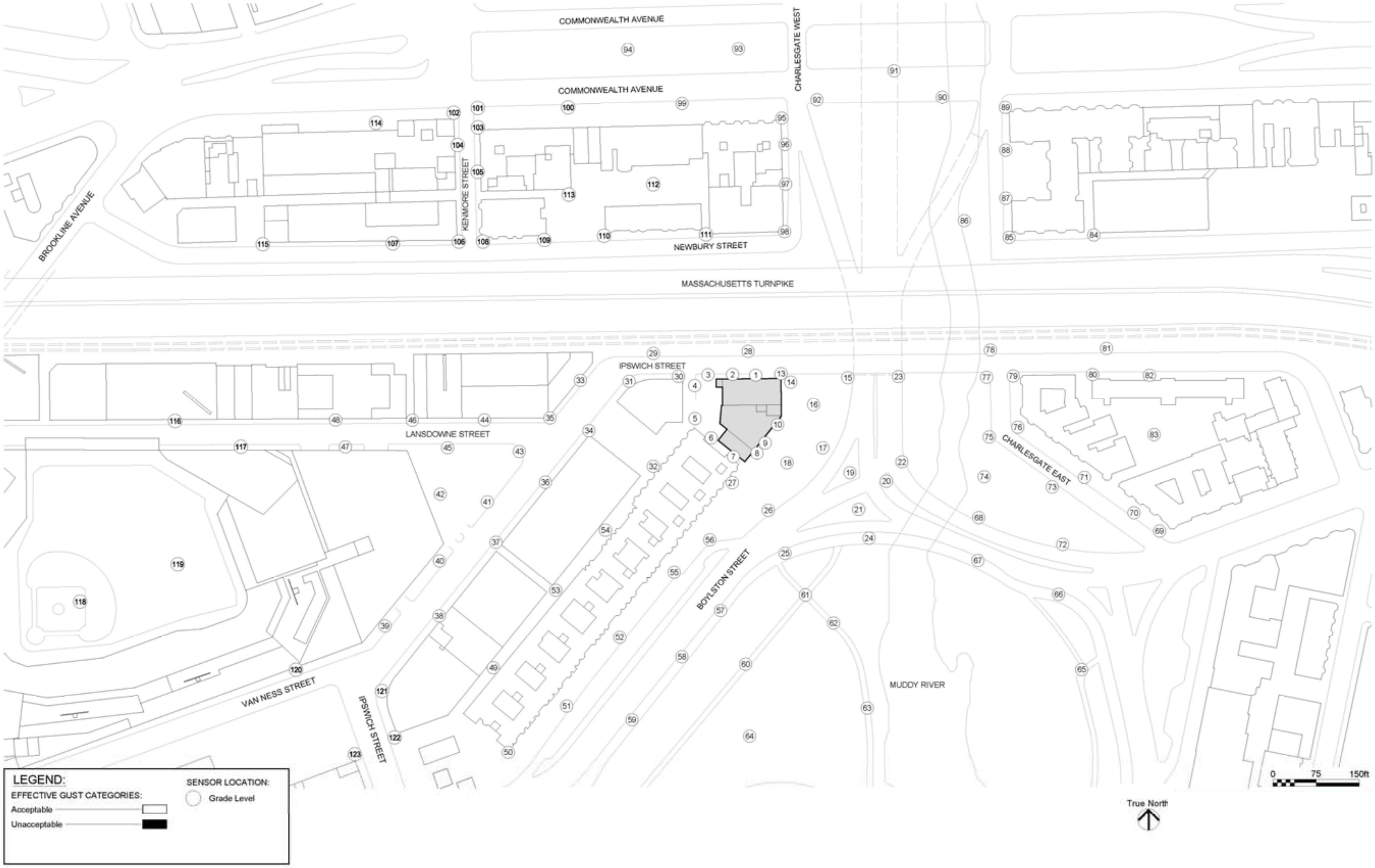


Figure 4.1-8

Pedestrian Wind Conditions – Effective Gust Speed – No-Build

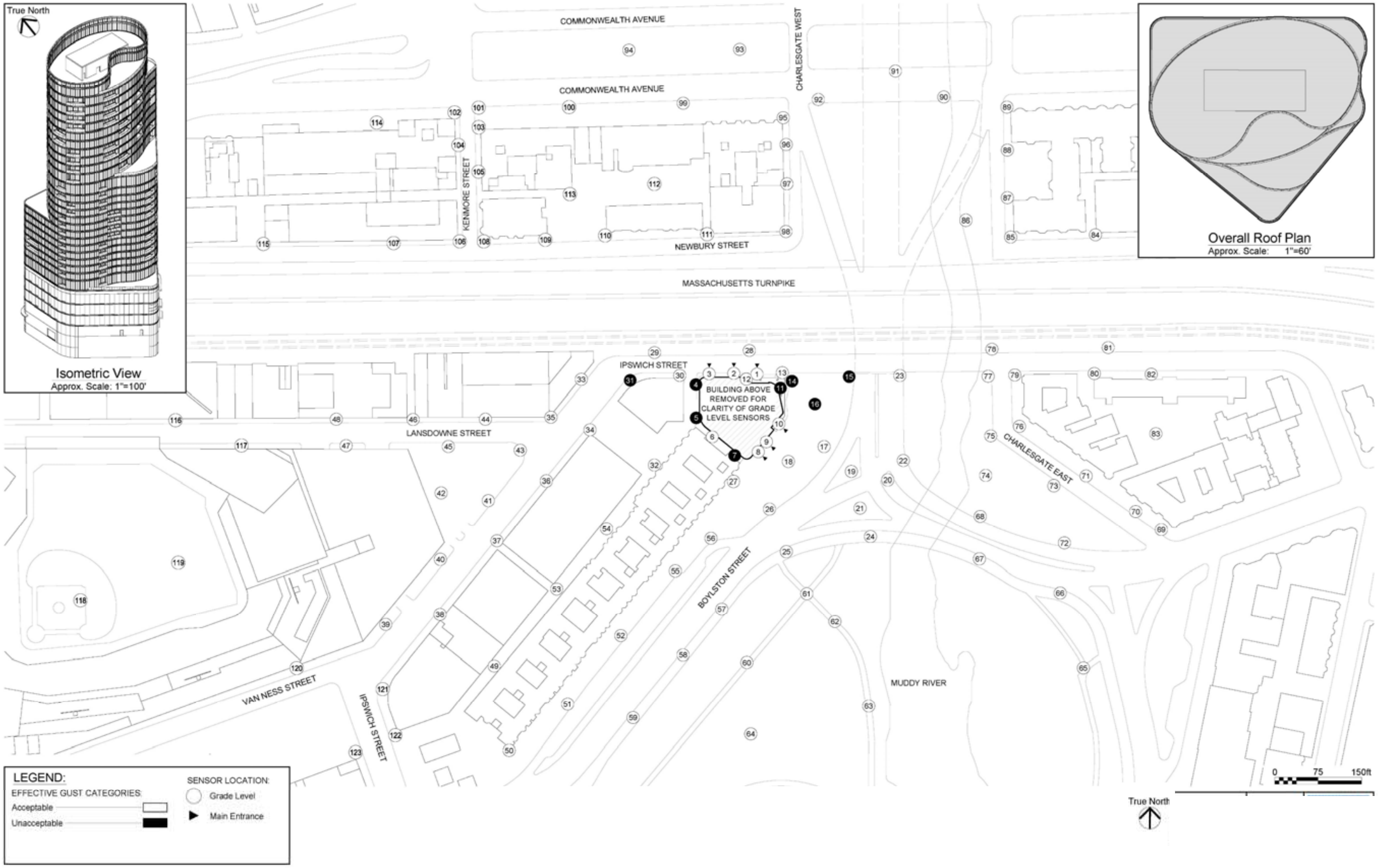


Figure 4.1-9

Pedestrian Wind Conditions – Effective Gust Speed – No-Build

Off-Site Walkways

Wind conditions around the Project site are expected to be comfortable for walking or better on an annual basis with the exception of uncomfortable conditions arising at Locations 14 through 19, 23, 76 and 79. The existing uncomfortable conditions remain at Location 89. Most of the wind speed increases occur in the area between the Project and Charlesgate East, and to the west of the Project site along Ipswich Street. Mitigation to these off-site areas would be difficult, unless coniferous/marcescent trees and/or wind screens are allowed in the park area and along sidewalks.

Most locations around the Project site are expected to meet the effective gust criterion annually with the exception of Locations 14, 15, 16 and 31 (Figure 4.1-9).

4.1.6 Conclusions

Wind conditions at most locations studied are predicted to remain comfortable for walking or better. However, at some locations around the building perimeter, along Ipswich Street, and to the east of the Project site, wind conditions are expected to be uncomfortable. Based on these, the following mitigation measures will be examined initially, with the understanding that additional mitigation may be required. The exact nature and configuration of mitigation will be confirmed through quantitative tests.

- Vertical porous wind screens (8–10 ft tall, 70-80% solid) placed perpendicular to the façades at the sides of entrances to the proposed Project, recessed entrances or a colonnaded arcade;

- Landscaping incorporating coniferous/marcescent trees and/or wind screens in the open space to the east of the site and along the Ipswich Street sidewalks, if feasible; and

- Tall guardrails (8-10 ft) around the perimeter of all terrace spaces, plus trellises/canopies.

4.2 Shadow Impacts

4.2.1 Introduction and Methodology

A shadow impact analysis was conducted to assess potential shadow impacts from the Project. The study looked at the following four times of the year:

1. Spring Equinox (March 21) at 9:00 a.m., 12:00 p.m., and 3:00 p.m.
2. Summer Solstice (June 21) at 9:00 a.m., 12:00 p.m., 3:00 p.m. and 6:00 p.m.
3. Autumnal Equinox (September 21) at 9:00 a.m., 12:00 p.m., 3:00 p.m. and 6:00 p.m.
4. Winter Solstice at 9:00 a.m., 12:00 p.m., and 3:00 p.m.

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. It should be noted that the model used for the analysis does not include trees, which can block new shadow from the proposed buildings during much of the year during certain time periods. 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.

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 Ipswich Street and its sidewalks, across the Massachusetts Turnpike, onto Newbury Street and its sidewalks, and onto a small portion of Kenmore Street and its sidewalks. No new shadow will be cast onto nearby bus stops or open spaces.

At 12:00 p.m., new shadow from the Project will be cast to the north onto Ipswich Street and its sidewalks, across the Massachusetts Turnpike, and onto Newbury Street and its sidewalks. No new shadow will be cast onto nearby bus stops or open spaces.

At 3:00 p.m., new shadow from the Project will be cast to the northeast onto Ipswich Street and its sidewalks, across the Massachusetts Turnpike, and onto a portion of the Bowker Overpass. New shadow will be cast onto a small portion of Charlesgate Park adjacent to the Overpass. No new shadow will be cast onto nearby bus stops or other open spaces.

4.2.3 Summer Solstice (June 21)

At 9:00 a.m. during the summer solstice, new shadow from the Project will be cast to the west onto a portion of Ipswich Street and its sidewalks. New shadow will be cast onto the Ipswich Street at Landsdowne Street Bus stop. No new shadow will be cast onto nearby open spaces.

At 12:00 p.m., new shadow from the Project will be cast to the north onto Ipswich Street and its sidewalks, and onto a portion of the Massachusetts Turnpike. No new shadow will be cast onto nearby bus stops or open spaces.

At 3:00 p.m., new shadow from the Project will be cast to the northeast onto Ipswich Street and its sidewalks, and onto a portion of the Bowker Overpass. New shadow will be cast onto a portion of the open space adjacent to the eastern edge of the Project site. No new shadow will be cast onto nearby bus stops or other open spaces.

At 6:00 p.m., new shadow from the Project will be cast to the southeast onto Charlesgate West and its sidewalks, and onto Charlesgate East and its sidewalks. New shadow will be cast onto portions of the open space to the east of the Project site. No new shadow will be cast onto bus stops or other open spaces.

4.2.4 Autumnal Equinox (September 21)

At 9:00 a.m. during the autumnal equinox, new shadow from the Project will be cast to the northwest onto Ipswich Street and its sidewalks, across the Massachusetts Turnpike, onto Newbury Street and its sidewalks and onto a portion of Kenmore Street and its sidewalks. No new shadow will be cast onto nearby bus stops or open spaces.

At 12:00 p.m., new shadow from the Project will be cast to the north onto Ipswich Street and its sidewalks, across the Massachusetts Turnpike, and onto Newbury Street and its sidewalks. No new shadow will be cast onto nearby bus stops or open spaces.

At 3:00 p.m., new shadow from the Project will be cast to the northeast onto Ipswich Street and its sidewalks, across the Massachusetts Turnpike, and onto a portion of the Bowker Overpass. New shadow will be cast onto a small portion of Charlesgate Park adjacent to the Overpass, and onto a small portion of the open space adjacent to the eastern edge of the Project site. No new shadow will be cast onto nearby bus stops or other open spaces.

At 6:00 p.m., new shadow from the Project will be cast to the east onto a portion of Charlesgate, a small portion of Charlesgate East, onto Ipswich Street and its sidewalks, across a portion of the Massachusetts Turnpike, and onto Massachusetts Avenue and its sidewalks. New shadow will be cast onto a portion of the open space adjacent to the eastern edge of the Project site, and onto the Ipswich Street at Charlesgate East bus stop.

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.

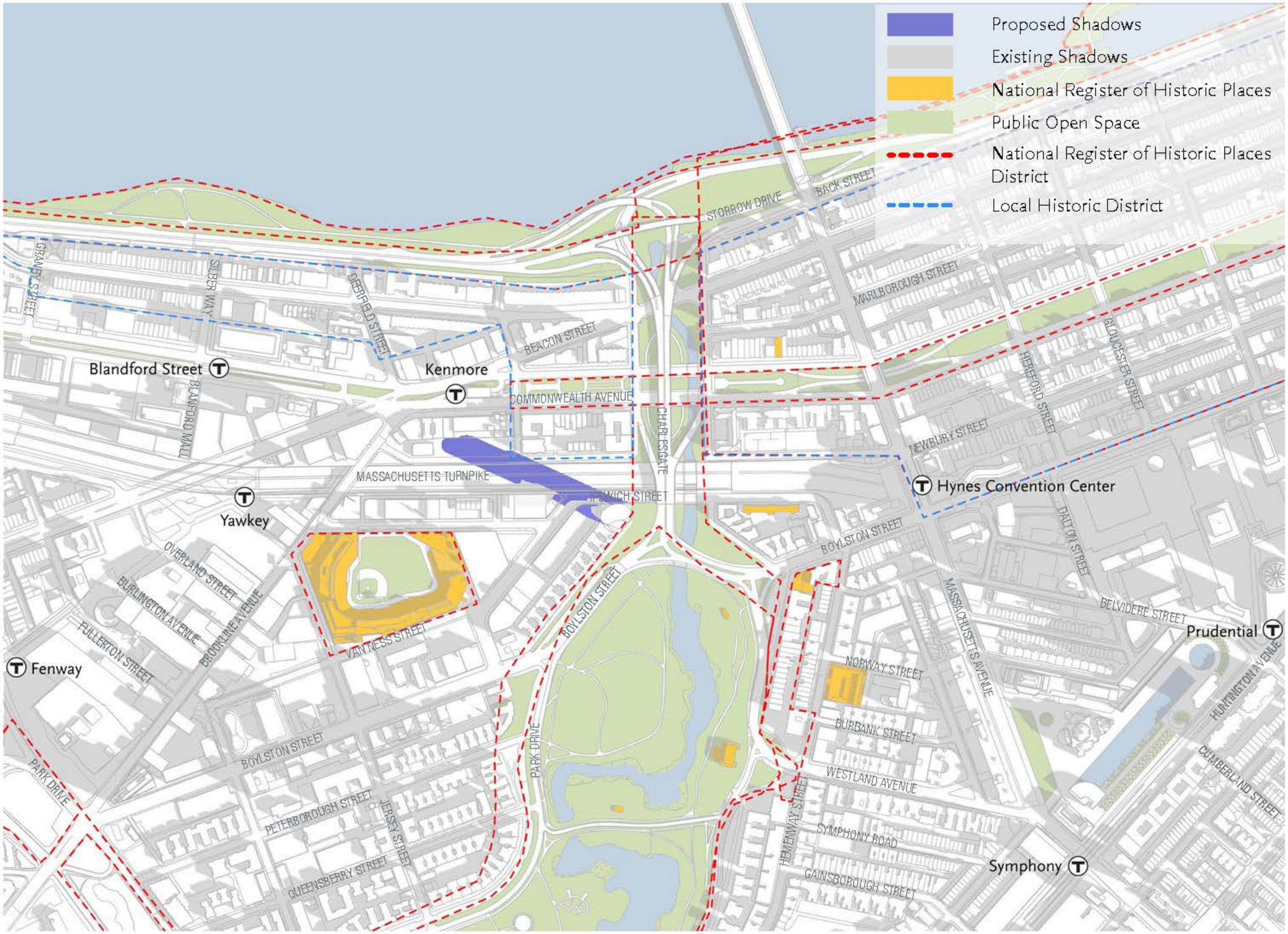
At 9:00 a.m., during the winter solstice, new shadow from the Project will be cast to the northwest onto a small portion of Ipswich Street, across the Massachusetts Turnpike, onto Newbury Street and its sidewalks, and small portions of Commonwealth Avenue and Beacon Street and their sidewalks. New shadow will be cast onto a very small portion of the Commonwealth Avenue Mall. No new shadow will be cast onto bus stops or other open spaces.

At 12:00 p.m., new shadow from the Project will be cast to the north onto a small portion of Ipswich Street, across the Massachusetts Turnpike, onto Newbury Street and its sidewalks, onto Commonwealth Avenue and its sidewalks, and onto Charlesgate West and its sidewalks. New shadow will be cast onto a portion of the Commonwealth Avenue Mall, and onto portions of Charlesgate Park. No new shadow will be cast onto nearby bus stops or other open spaces.

At 3:00 p.m., new shadow from the Project will be cast to the northeast across a portion of the Massachusetts Turnpike onto the Bowker Overpass, onto Charlesgate East and its sidewalks, and onto a small portion of Commonwealth Avenue. New shadow will be cast onto a small portion of the Commonwealth Avenue Mall. No new shadow will be cast onto bus stops or other open spaces.

4.2.6 Conclusions

The shadow impact analysis looked at net new shadow created by the Project during fourteen time periods. The Project will cast new shadow on the open space adjacent to the eastern edge of the Project site during four of the time periods studied (June 21 at 3:00 p.m., June 21 at 6:00 p.m., September 21 at 3:00 p.m., and September 21 at 6:00 p.m.), onto Charlesgate Park during three of the time periods studied (March 21 at 3:00 p.m., September 21 at 3:00 p.m., and December 21 at 12:00 p.m.) and onto small portions of the Commonwealth Avenue Mall only during the December time periods. New shadow will be cast onto the Ipswich Street at Landsdowne Street Bus stop during one time period (June 21 at 9:00 a.m., and onto the Ipswich Street at Charlesgate East during one time period (September 21 at 6:00 p.m.)



2 Charlesgate West **Boston, Massachusetts**

Figure 4.2-1

Shadow Study: March 21, 9:00 a.m.

Figure 4.2-2

Shadow Study: March 21, 12:00 p.m.

2 Charlesgate West Boston, Massachusetts

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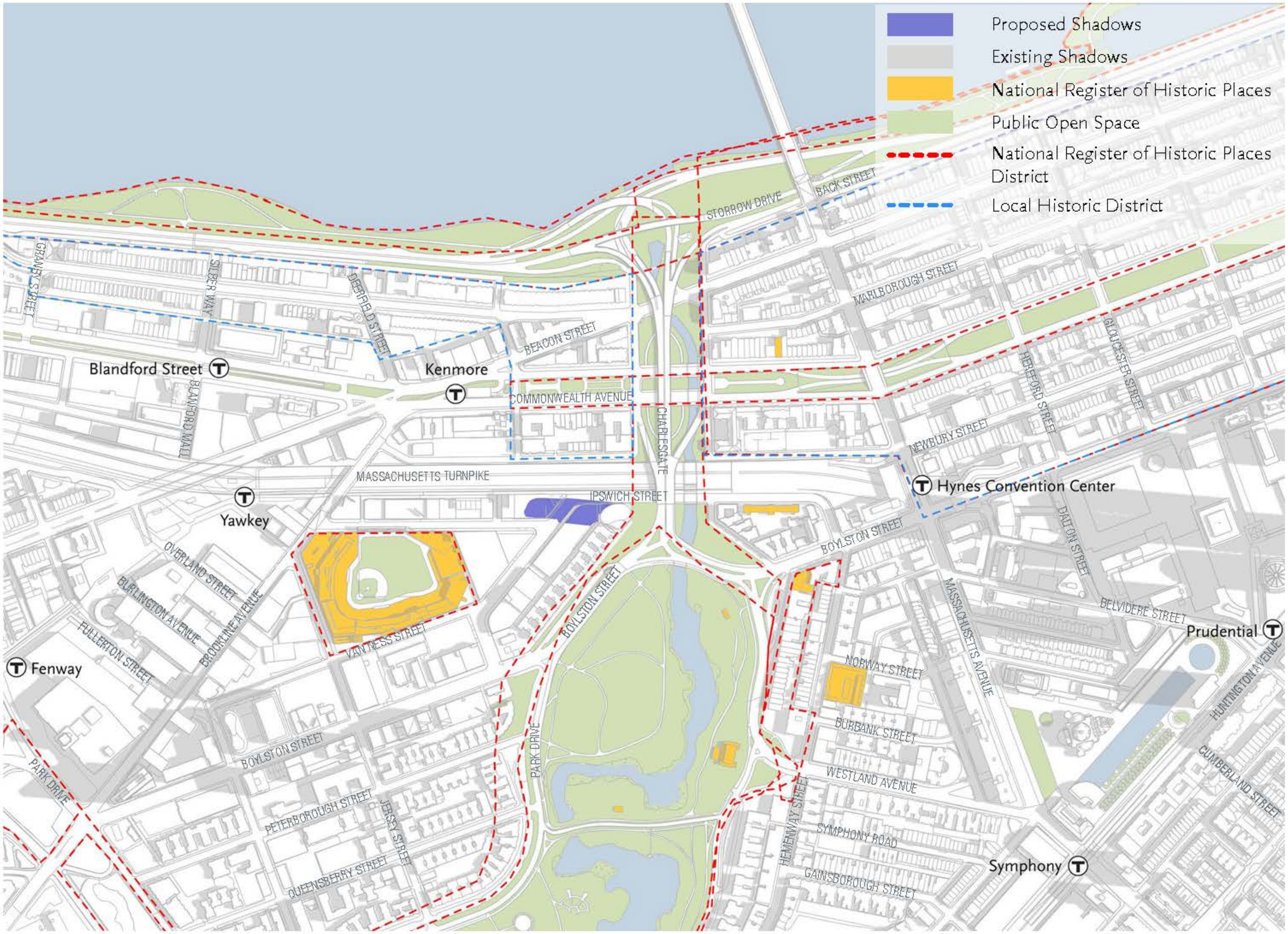
Figure 4.2-3

Shadow Study: March 21, 3:00 p.m.



2 Charlesgate West Boston, Massachusetts

ELKUS | MANFREDI
ARCHITECTS

Figure 4.2-4

Shadow Study: June 21, 9:00 a.m.

2 Charlesgate West Boston, Massachusetts

Figure 4.2-5

Shadow Study: June 21, 12:00 p.m.

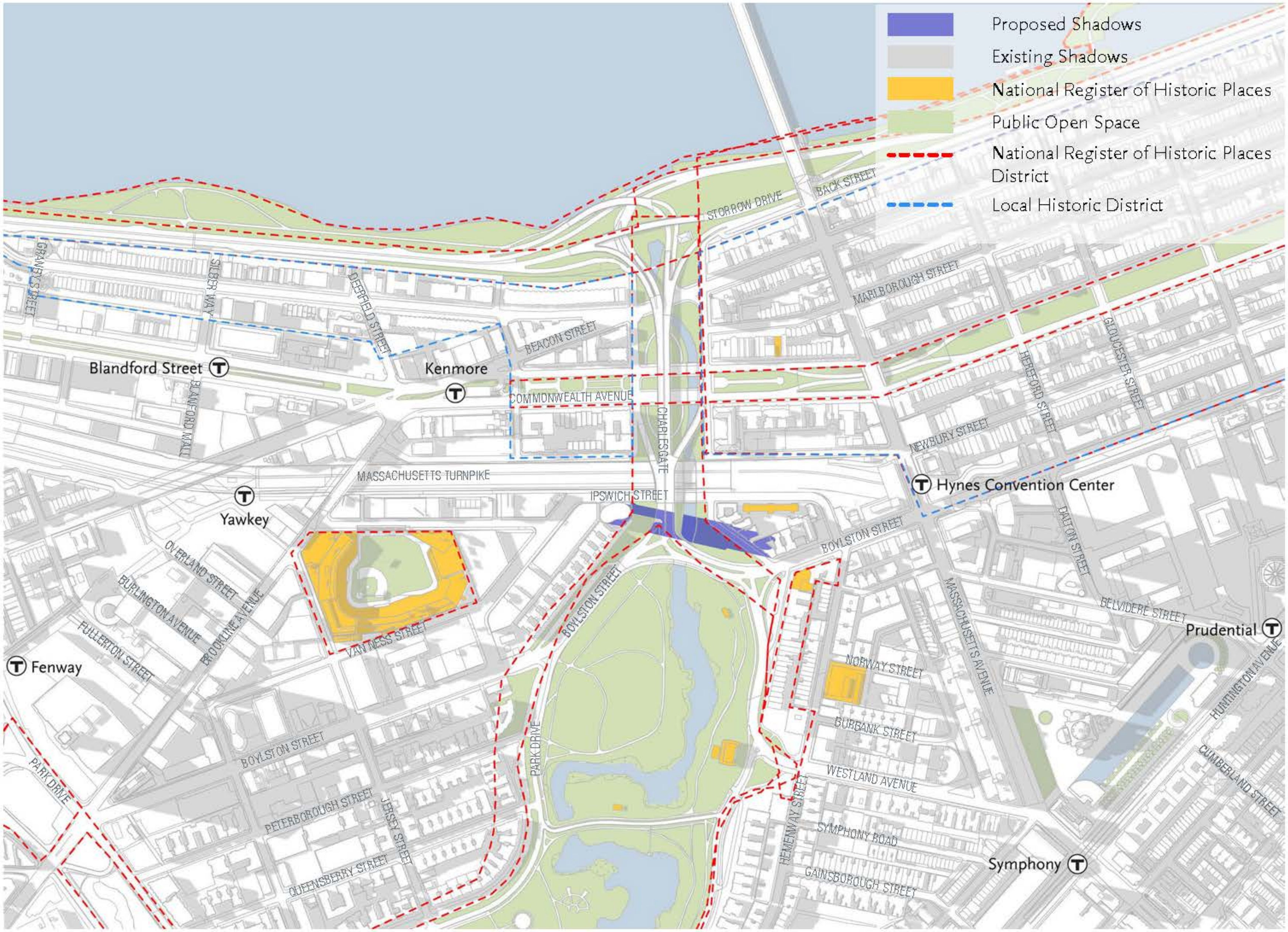
ELKUS | MANFREDI
ARCHITECTS

2 Charlesgate West **Boston, Massachusetts**

ELKUS | MANFREDI ARCHITECTS

Figure 4.2-6

Shadow Study: June 21, 3:00 p.m.

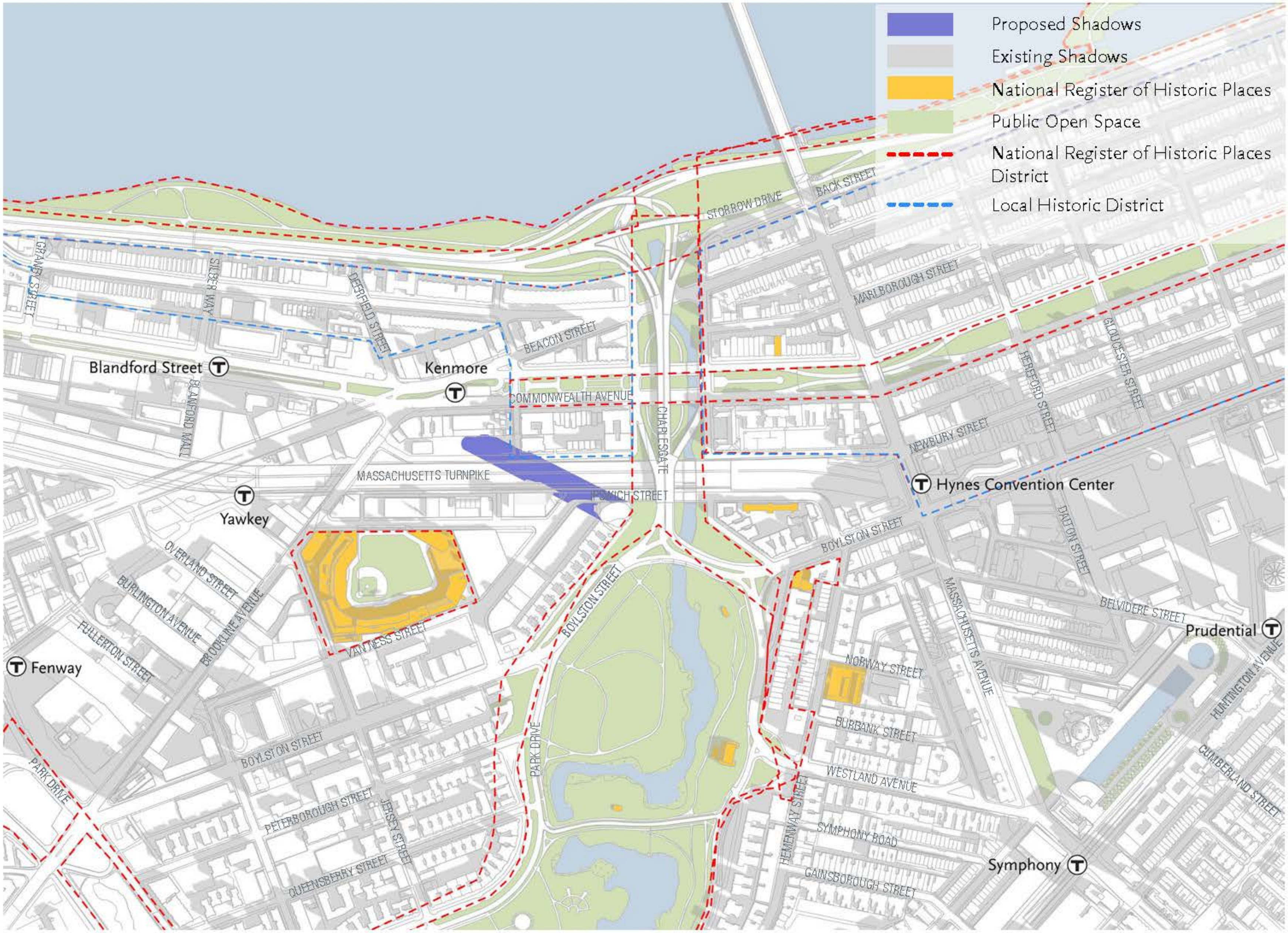


2 Charlesgate West Boston, Massachusetts

ELKUS | MANFREDI ARCHITECTS

Figure 4.2-7

Shadow Study: June 21, 6:00 p.m.



2 Charlesgate West Boston, Massachusetts

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Figure 4.2-8

Shadow Study: September 21, 9:00 a.m.

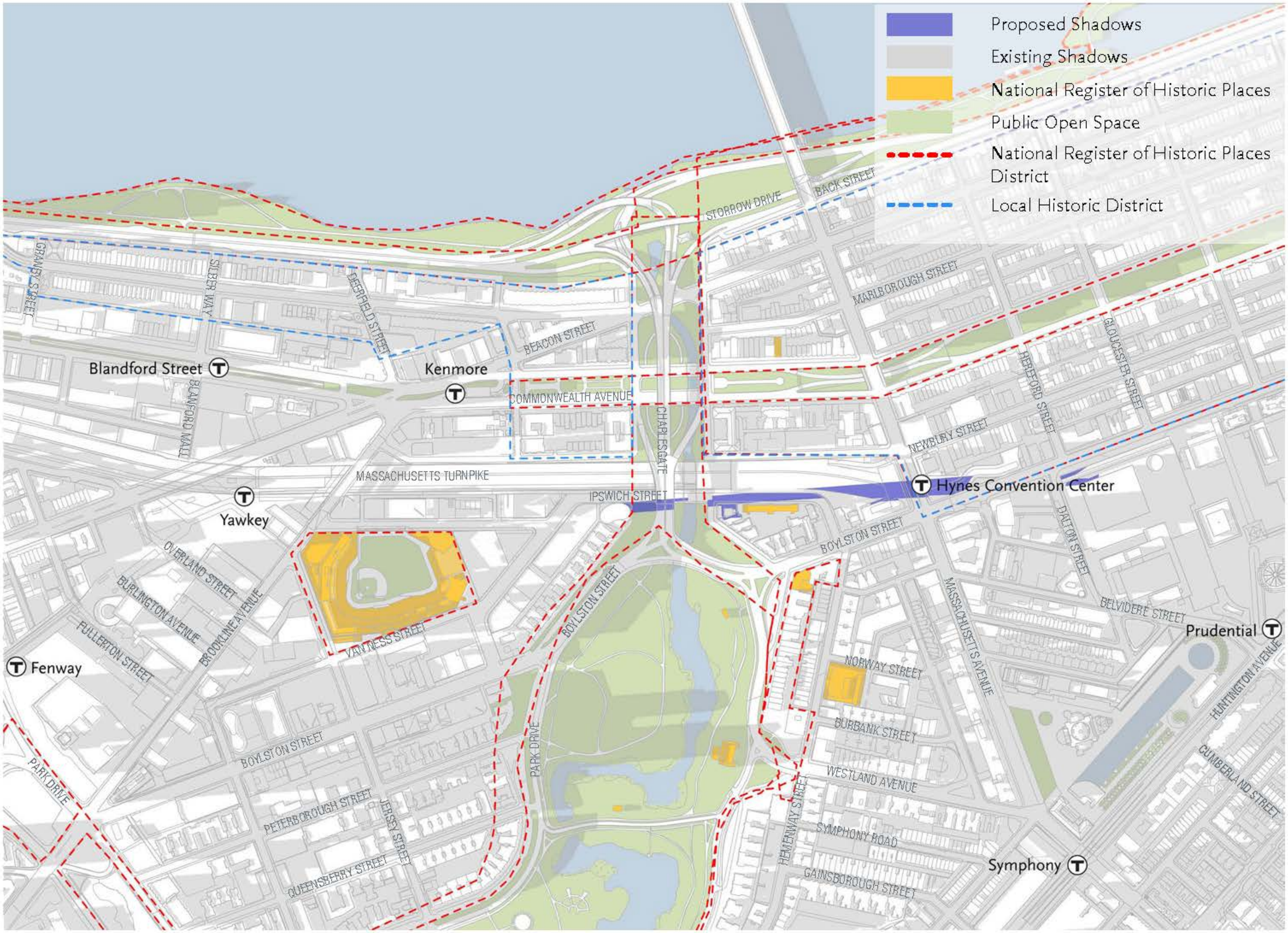
Figure 4.2-9

Shadow Study: September 21, 12:00 p.m.

2 Charlesgate West Boston, Massachusetts

Figure 4.2-10

Shadow Study: September 21, 3:00 p.m.



2 Charlesgate West **Boston, Massachusetts**

ELKUS | MANFREDI ARCHITECTS

Figure 4.2-11

Shadow Study: September 21, 6:00 p.m.

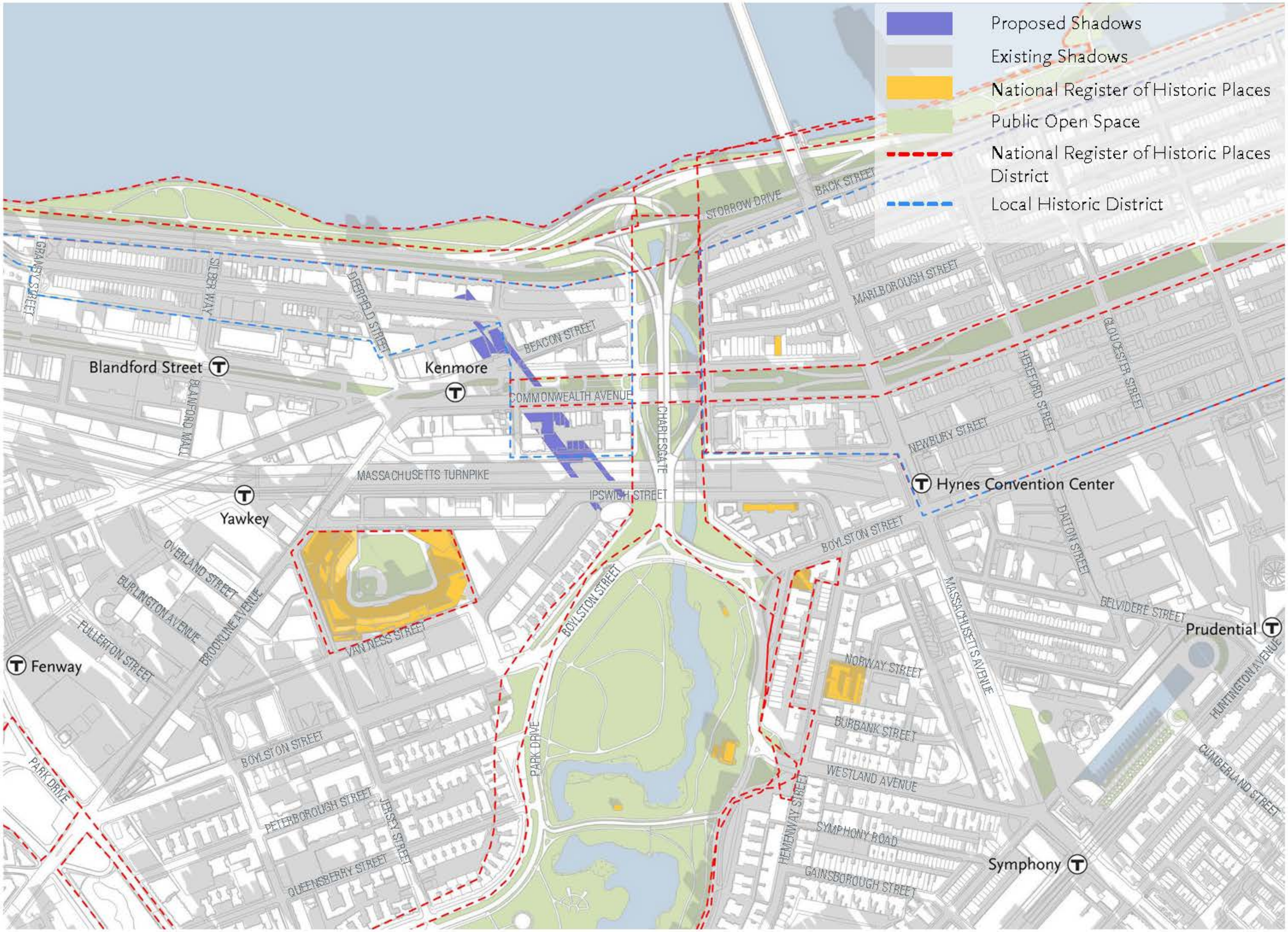


Figure 4.2-12

Shadow Study: December 21, 9:00 a.m.

Figure 4.2-13

Shadow Study: December 21, 12:00 p.m.

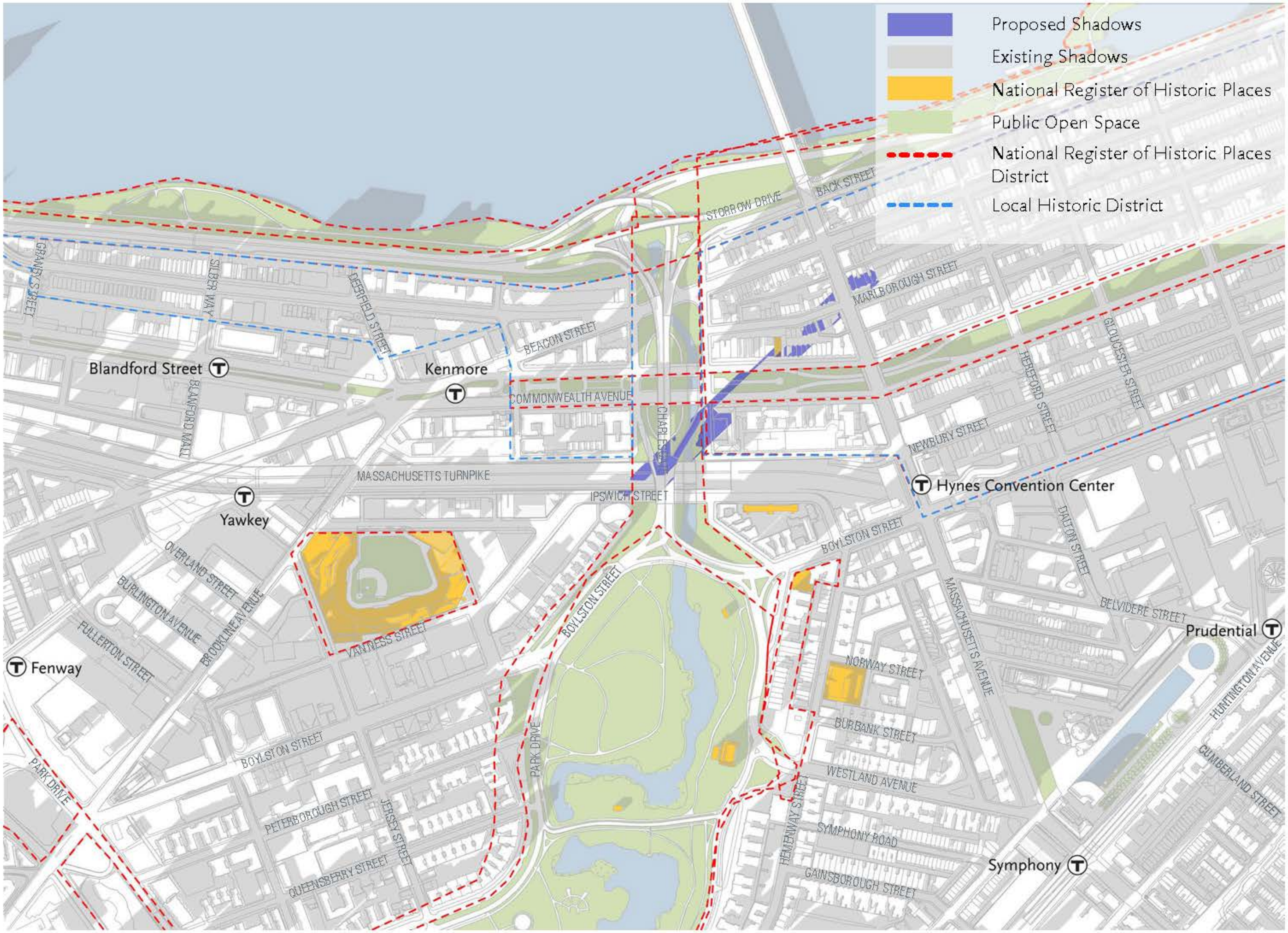


Figure 4.2-14

Shadow Study: December 21, 3:00 p.m.

4.3 Daylight Analysis

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.

Because the Project site currently consists of a low-rise building, the proposed Project will increase daylight obstruction; however, the resulting conditions will be typical of urban areas.

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 2-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 Conditions; Proposed Conditions; and the context of the area.

Two viewpoints were chosen to evaluate the daylight obstruction for the Existing and Proposed Conditions, one from Ipswich Street, and one from Charlesgate West. Two area context points 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.

---

[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 Ipswich Street facing south toward the Project site
- **Viewpoint 2:** View from Charlesgate West facing northwest toward the Project site
- **Area Context Viewpoint AC1:** View from Ipswich Street facing south toward the building at 132 Ipswich Street
- **Area Context Viewpoint AC2:** View from Boylston Street facing southeast toward the building at 1330 Boylston Street

4.3.3 Results

The results for each viewpoint are described in Table 4.3-1. Figures 4.3-2 through 4.3-4 illustrate the BRADA results for each analysis.

Table 4.3-1 Daylight Analysis Results

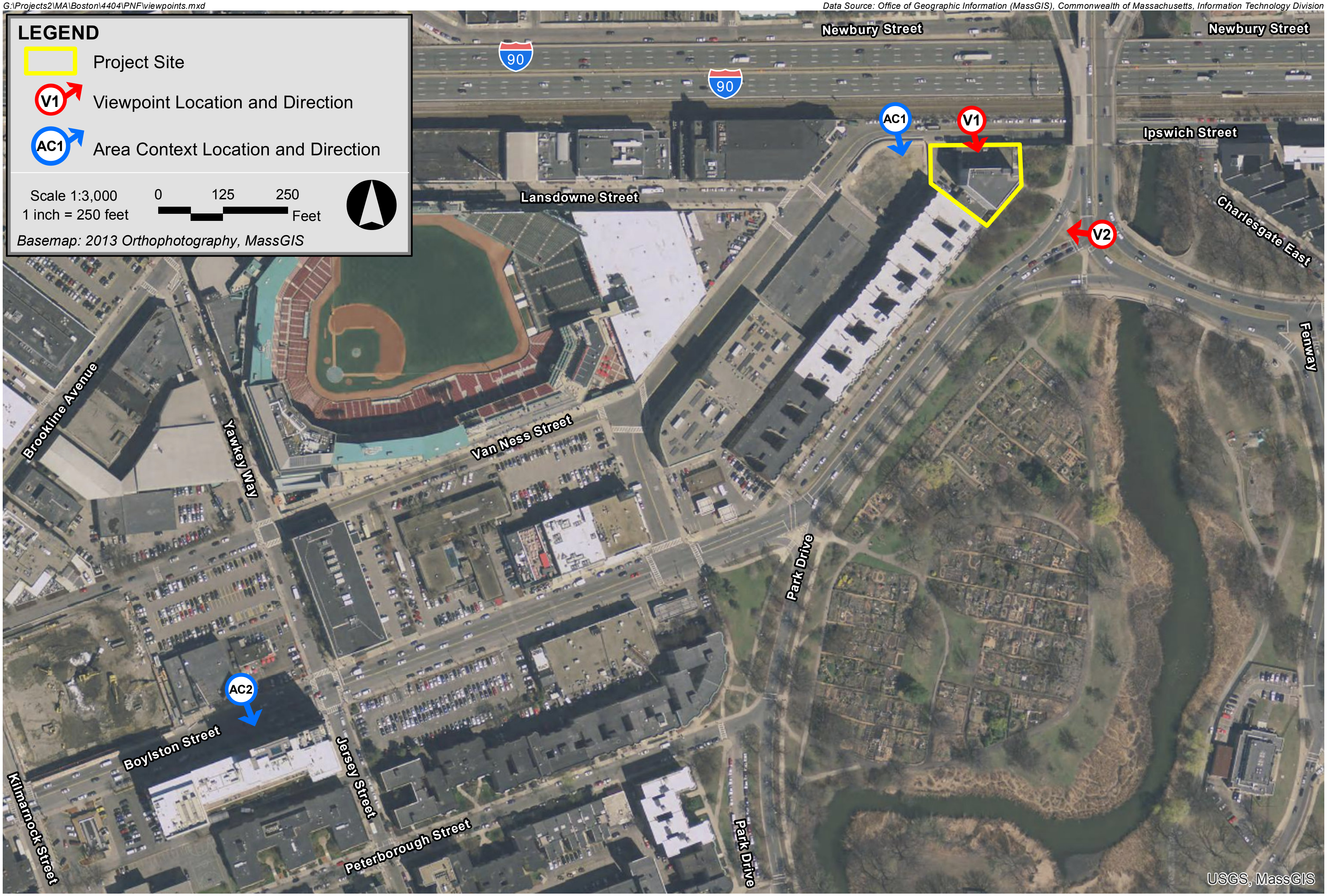
Viewpoint Locations		Existing Conditions	Proposed Conditions
Viewpoint 1	View from Ipswich Street facing south toward the Project site	43.8%	85.1%
Viewpoint 2	View from Charlesgate West facing northwest toward the Project site	8.7%	27.5%
Area Context Points			
AC1	View from Ipswich Street facing south toward the building at 132 Ipswich Street	65.2%	N/A
AC2	View from Boylston Street facing southeast toward the building at 1330 Boylston Street	76.8%	N/A

Ipswich Street – Viewpoint 1

Ipswich Street runs along the northern edge of the Project site. Viewpoint 1 was taken from the center of Ipswich Street looking directly south toward the Project site. The portion of the existing building that runs along Ipswich Street is only two stories, and has an existing daylight obstruction of 43.8 percent. The development of the Project will increase the daylight obstruction value to 85.1 percent. While this is slightly higher than the Area Context buildings, the daylight obstruction value is typical of urban areas and is similar to other development projects being constructed in the Fenway area.

G:\Projects2\MA\Boston\4404\PNF\viewpoints.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



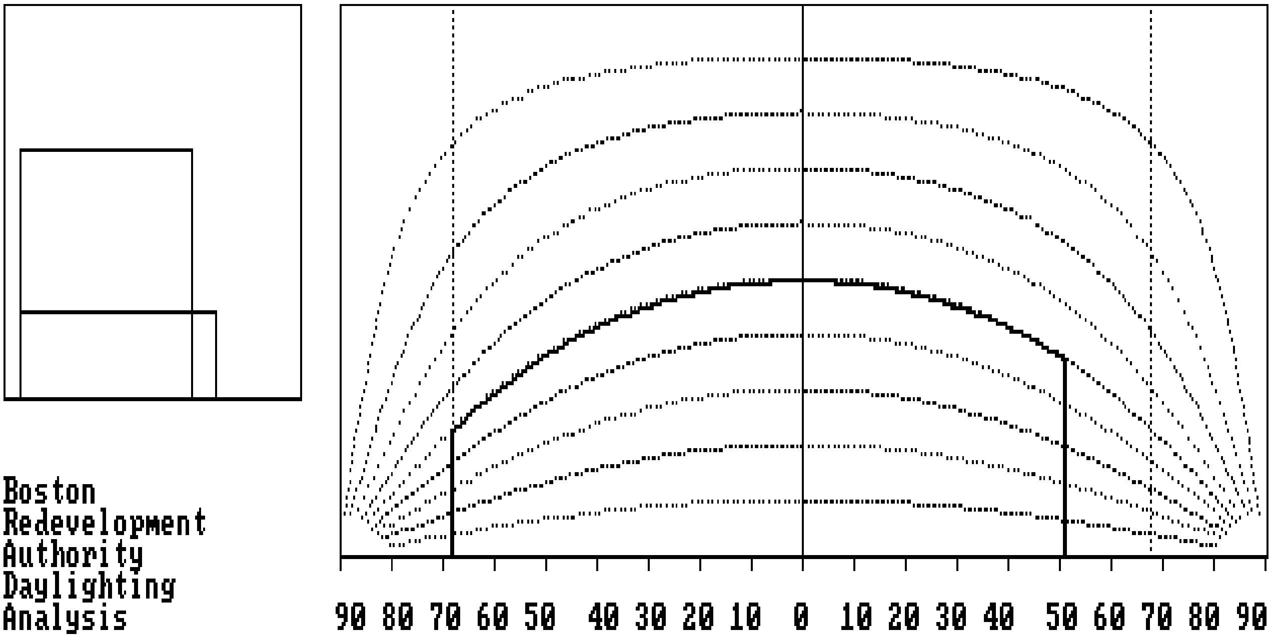
2 Charlesgate West Boston, Massachusetts

Epsilon ASSOCIATES INC.

Figure 4.3-1

Viewpoint and Area Context Locations

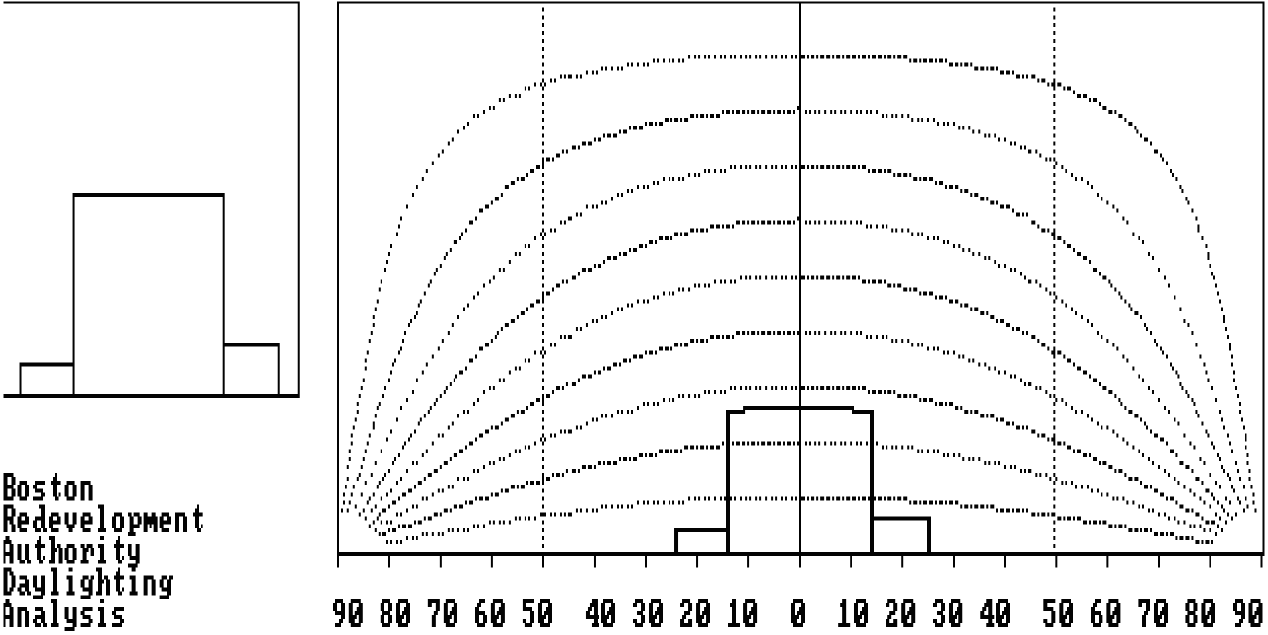
Viewpoint 1: View from Ipswich Street facing south toward the Project site



Boston
Redevelopment
Authority
Daylighting
Analysis

Obstruction of daylight by the building is 43.8 %

Viewpoint 2:View from Charlesgate West facing northwest toward the Project site

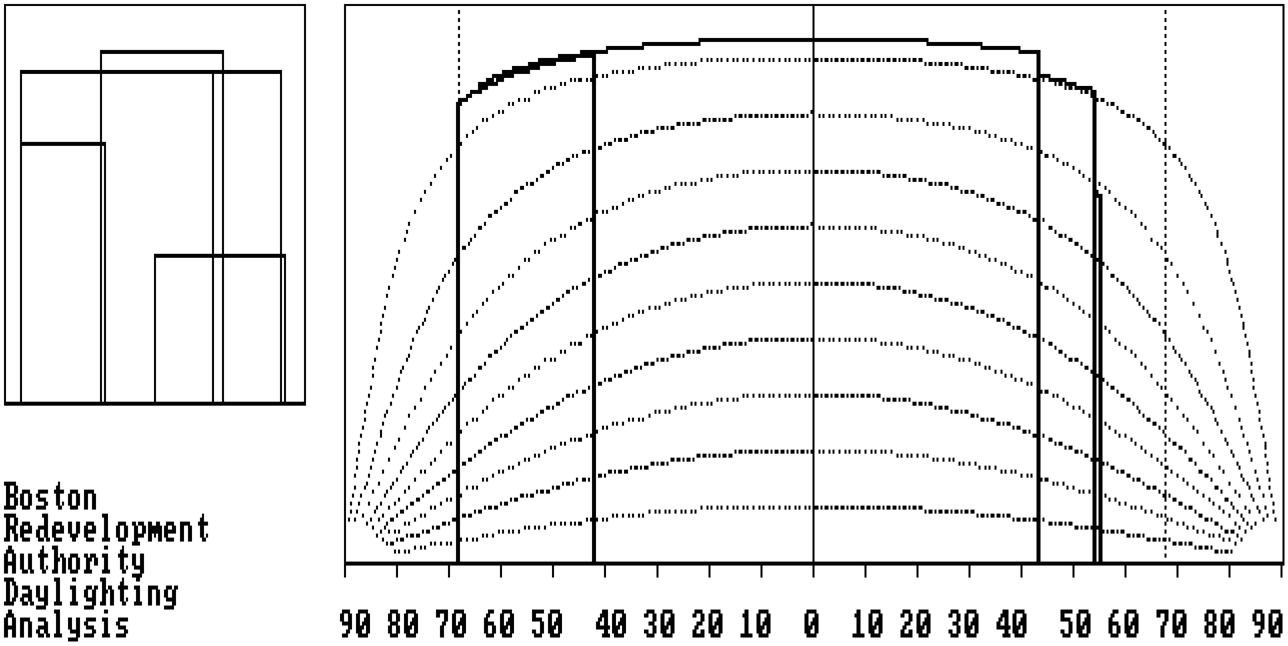


Boston
Redevelopment
Authority
Daylighting
Analysis

Obstruction of daylight by the building is 8.7 %

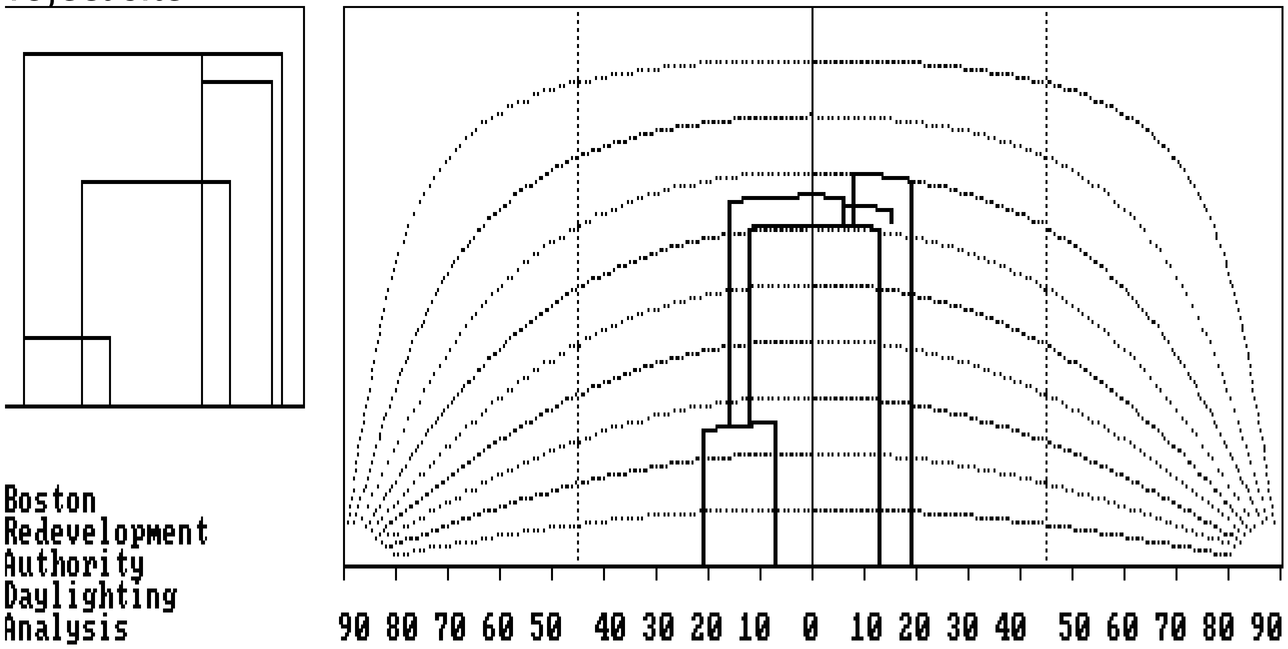
Figure 4.3-2
Existing Conditions

Viewpoint 1: View from Ipswich Street facing south toward the Project site



Obstruction of daylight by the building is 85.1 %

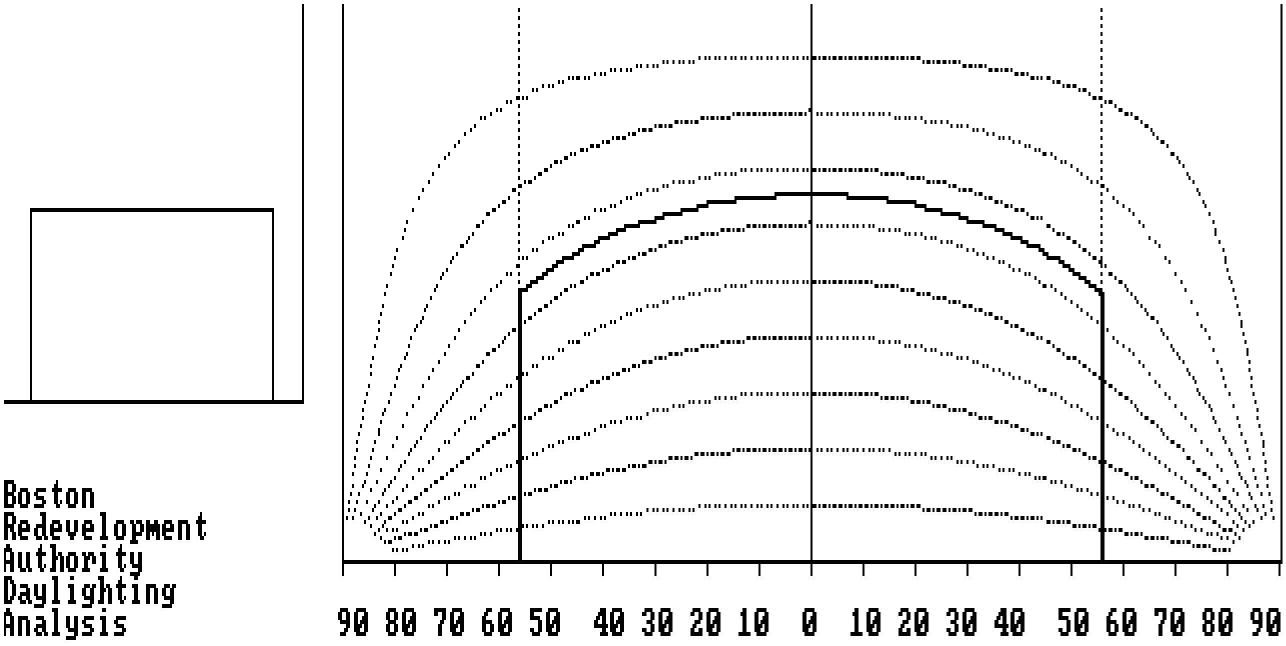
Viewpoint 2:View from Charlesgate West facing northwest toward the Project site



Obstruction of daylight by the building is 27.5 %

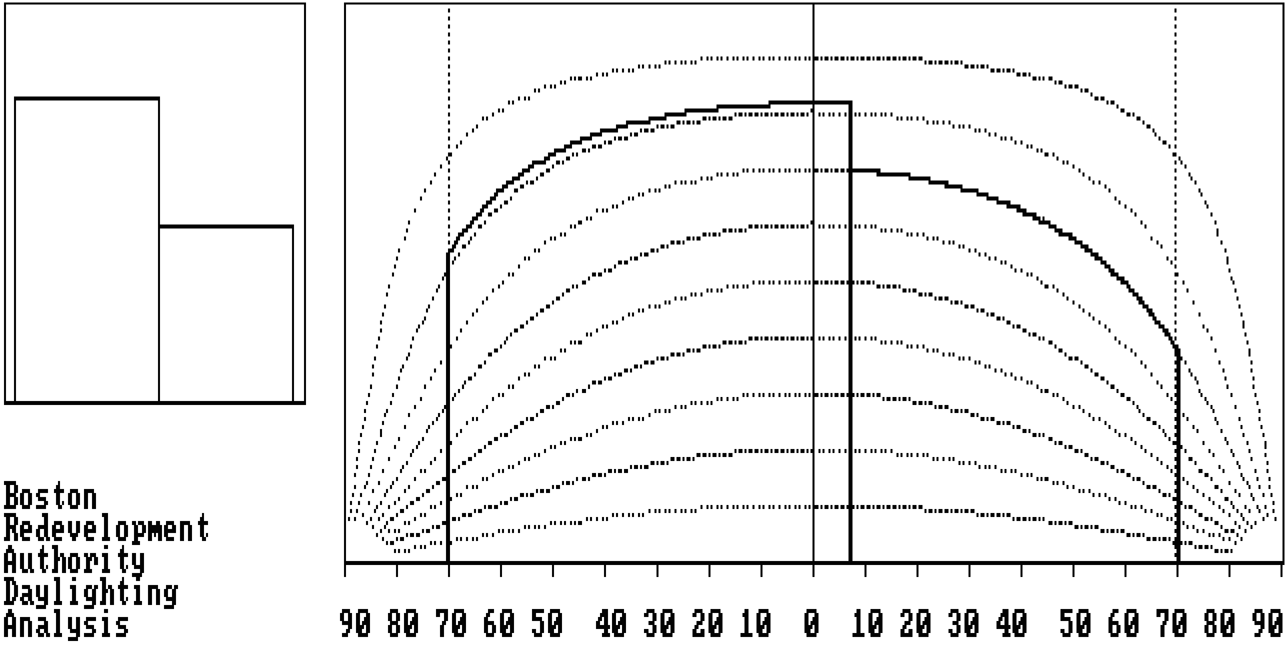
Figure 4.3-3
Proposed Conditions

Area Context Viewpoint AC1: View from Ipswich Street facing south toward the building at 132 Ipswich Street



Obstruction of daylight by the building is 65.2 %

Area Context Viewpoint AC2: View from Boylston Street facing southeast toward the building at 1330 Boylston Street



Obstruction of daylight by the building is 76.8 %

Charlesgate West – Viewpoint 2

Charlesgate West runs along the eastern edge of the Project site. Viewpoint 1 was taken from the center of Charlesgate West looking directly northwest toward the Project site. The Project site is buffered from the street at this viewpoint by landscaped green space. The development of the Project will increase the daylight obstruction value from 8.7 percent to 27.5 percent. While this is an increase of existing conditions, the daylight obstruction value is much lower than other buildings in the area due to the green space between the site and the street.

Area Context Views

The Project area currently consists of a mix of low-rise, mid-rise and high-rise residential towers, and low-rise commercial buildings. However, as noted in section 2.1, this is a rapidly growing area with several large projects either in construction or under review by the BRA. To provide a larger context for comparison of daylight conditions, obstruction values were calculated for the two Area Context Viewpoints described above and shown on Figure 4.3-1. The daylight obstruction values ranged from 65.2 percent for AC1 to 76.7 percent for AC2.

4.3.4 Conclusions

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

4.4 Solar Glare

RWDI has been retained to investigate the impact that solar reflections emanating from the Project will have on the surrounding urban realm. A preliminary set of simulations was conducted to determine peak reflection intensities and the frequency of occurrence of reflections for a broad area around the development. This served to identify areas which may experience high intensity or very frequent reflections. The selected receptor locations, as shown in Figure 4.4-1, were chosen to understand in detail how reflections from the building may impact drivers, pedestrians, and building facades.

The results of the solar glare analysis are summarized below, and the details results are included as Appendix D.

- People that are standing on the roof deck of the mechanical penthouse level (receptor P18) are predicted to experience high thermal impacts caused by the concave-shaped section of the top levels of the building's southern facade.

However, this area will only be accessible to maintenance staff. The Proponent will maintain this area in a manner that will mitigate potential risks.

- No other points at a pedestrian height will exceed thermal exposure criteria.
- No significant thermal impacts are expected to occur on the façade receptors (receptors F11-F14).
- Moderate levels of visual impact fall on the pedestrian receptors during frequent, short duration reflections. However, these reflections cause some visual nuisance only to viewers looking directly at the building.
- Drivers travelling in some locations in the vicinity of the Project will experience an increased level of visual glare impact. Many of these impacts are not expected to alter a driver's current experience as the sun will already be in the driver's line of sight. Some reflections could cause distraction to the drivers as the sun falls out of the driver' field of view. However, most of the reflections are brief and last from 2 to 10 minutes in duration.
- Thermal and visual impacts are not anticipated within Fenway Park.

As the design progresses, the Project team will explore mitigation options to further minimize thermal and visual impacts to drivers and pedestrians.

4.5 Air Quality Analysis

An air quality analysis has been conducted to determine the impact of pollutant emissions from mobile sources generated by the Project. Specifically, a microscale analysis was performed to evaluate the potential air quality impacts of carbon monoxide (CO) resulting from traffic flow around the Project area. Any new stationary sources will be reviewed by the Massachusetts Department of Environmental Protection (MassDEP) during permitting under the Environmental Results Program (ERP).

4.5.1 National Ambient Air Quality Standards and Background Concentrations

Background air quality concentrations and federal air quality standards were utilized to conduct the above air quality impact analyses. Federal National Ambient Air Quality Standards (NAAQS) were developed by US Environmental Protection Agency (EPA) to protect the human health against adverse health effects with a margin of safety. The modeling methodologies were developed in accordance with the latest Massachusetts

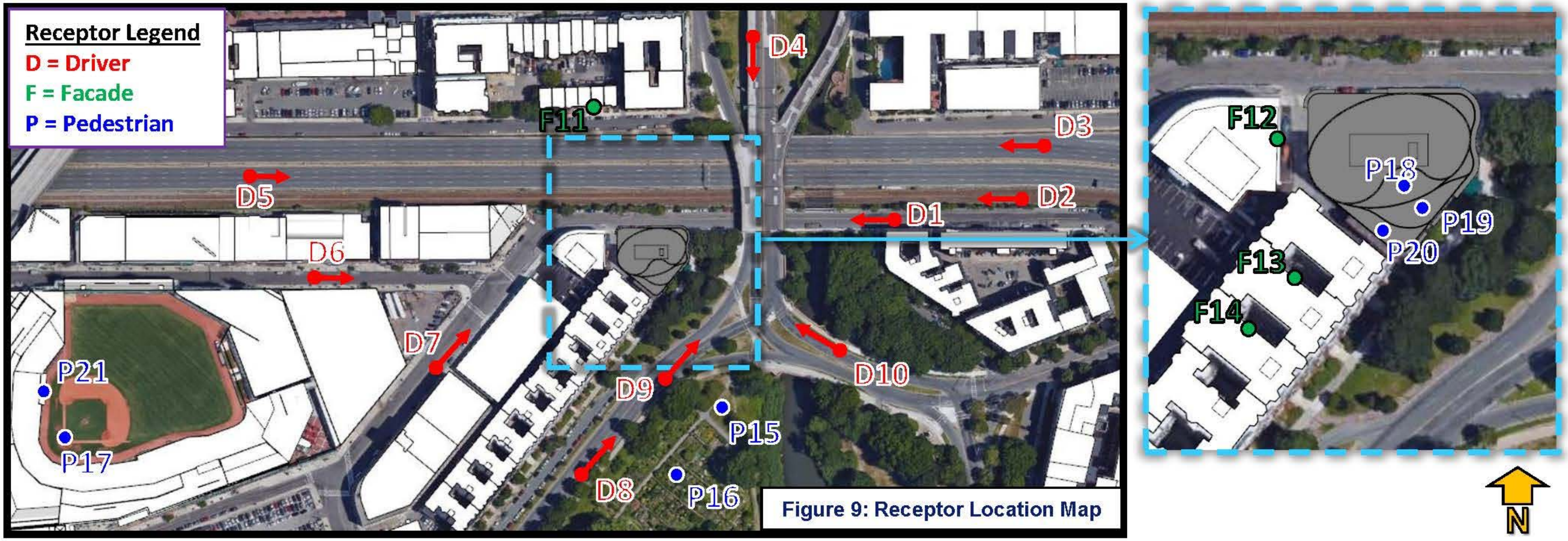


Figure 9: Receptor Location Map

Receptor Number	Receptor Description	Receptor Number	Receptor Description
D1	Drivers travelling west along Ipswich St.	**D10**	Drivers travelling northwest along Boylston St.
D2	Train drivers travelling west	**F11**	Facade of building to the north of development
D3	Drivers travelling west along Massachusetts Turnpike	**F12**	Facade of the Boston Conservatory building
D4	Drivers travelling south along Charlesgate St.	**F13-F14**	Facade of buildings to the southwest of development
D5	Drivers travelling east along Massachusetts Turnpike	**P15-P16**	Pedestrians in Fenway Victory Gardens
D6	Drivers travelling east along Lansdowne St.	**P17**	Baseball players standing at home plate in Fenway Park
D7	Drivers travelling northeast along Ipswich St.	**P18-P20**	Pedestrians standing on the exposed roof decks of the Charlesgate tower
D8-D9	Drivers travelling northeast along Boylston St.	**P21**	Baseball players standing in the third base dugout in Fenway Park

Figure 4.4-1

Solar Glare Analysis Receptor Locations

Department of Environmental Protection (MassDEP) modeling policies and Federal modeling guidelines.[3] The following sections outline the NAAQS standards and detail the sources of background air quality data.

4.5.1.1 National Ambient Air Quality Standards

The 1970 Clean Air Act was enacted by the US Congress to protect the health and welfare of the public from the adverse effects of air pollution. As required by the Clean Air Act, EPA promulgated National Ambient Air Quality Standards (NAAQS) for the following criteria pollutants: nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (PM) (PM10 and PM2.5), carbon monoxide (CO), ozone (O_3), and lead (Pb). The NAAQS are listed in Table 3.5-1. Massachusetts Ambient Air Quality Standards (MAAQS) are codified in 310 CMR 6.04, and generally follow the NAAQS but are not identical (highlighted in bold in Table 4.5-1).

NAAQS specify concentration levels for various averaging times and include both "primary" and "secondary" standards. Primary standards are intended to protect human health, whereas secondary standards are intended to protect public welfare from any known or anticipated adverse effects associated with the presence of air pollutants, such as damage to vegetation. The more stringent of the primary or secondary standards were applied when comparing to the modeling results for this Project.

A one-hour NO_2 standard was promulgated on January 22, 2010 to protect public health, including the health of sensitive populations (e.g., people with asthma, children, and the elderly). The final rule for the new hourly NO_2 NAAQS was published in the Federal Register on February 9, 2010 and became effective on April 12, 2010. The form of this standard is the three-year average of the 98th percentile of the daily maximum one-hour concentrations.

Similarly, a one-hour SO_2 standard was promulgated on June 2, 2010 to protect public health, including the health of sensitive populations (e.g., people with asthma, children, and the elderly). The final rule for the new hourly SO_2 NAAQS was published in the Federal Register on June 22, 2010 and became effective on August 23, 2010. The form of this standard is the three-year average of the 99th percentile of the daily maximum one-hour concentrations.

The inhalable particulate (PM10) NAAQS were promulgated on July 1, 1987 at the federal level with the intent of replacing the existing standards limiting ambient levels of Total Suspended Particulate (TSP). In 2006, the annual PM10 standard was revoked. However it remains codified in 310 CMR 6.00. EPA also promulgated a Fine Particulate (PM2.5)

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

NAAQS, effective December 2006, with an annual standard of 15 μg/m^3 and the 24-hour standard of 35 micrograms per cubic meter (μg/m^3). The annual standard has since been strengthened to 12 μg/m^3 (in 2012).

The NAAQS also reflect various durations of exposure. The non-probabilistic short-term periods (24 hours or less) refer to exposure levels not to be exceeded more than once a year. Long-term periods refer to limits that cannot be exceeded for exposure averaged over three months or longer.

Table 4.5-1 National (NAAQS) and Massachusetts (MAAQS) Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS (μg/m^3)		MAAQS (μg/m^3)	
		Primary	Secondary	Primary	Secondary
NO_2	Annual (1)	100	Same	100	Same
	1-hour (2)	**188**	None	**None**	None
SO_2	Annual (1)(9)	80	None	80	None
	24-hour (3)(9)	365	None	365	None
	3-hour (3)	None	1300	None	1300
	1-hour (4)	**196**	None	**None**	None
$PM_{2.5}$	Annual (1)	**12**	**15**	**None**	**None**
	24-hour (5)	**35**	**Same**	**None**	**None**
PM_{10}	Annual (1)(6)	**None**	None	**50**	Same
	24-hour (3)(7)	150	Same	150	Same
CO	8-hour (3)	10,000	Same	10,000	Same
	1-hour (3)	40,000	Same	40,000	Same
Ozone	8-hour (8)	**147**	Same	**235**	Same
Pb	3-month (1)	1.5	Same	1.5	Same

(1) Not to be exceeded

(2) 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years

(3) Not to be exceeded more than once per year.

(4) 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years

(5) 98th percentile, averaged over 3 years

(6) EPA revoked the annual PM_{10} NAAQS in 2006.

(7) Not to be exceeded more than once per year on average over 3 years

(8) Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years.

(9) EPA revoked the annual and 24-hour SO_2 NAAQS in 2010. However they remain in effect until one year after the area's initial attainment designation, unless designated as "nontattinmentl".

Source: http://www.epa.gov/ttn/naaqs/criteria.html and 310 CMR 6.04

4.5.1.2 Background Concentrations

To estimate background pollutant levels representative of the area, the most recent air quality monitor data reported by the MassDEP in their Annual Air Quality Reports was obtained for 2012 to 2014. The 3-hour and 24-hour SO_2 values are no longer reported in the annual reports. Data for these pollutant and averaging time combinations were obtained from the U.S. EPA's AirData website.

The Clean Air Act allows for one exceedance per year of the CO and SO_2 short-term NAAQS per year. The highest second-high accounts for the one exceedance. Annual NAAQS are never to be exceeded. The 24-hour PM-10 standard is not to be exceeded more than once per year on average over three years. To attain the 24-hour PM-2.5 standard, the three-year average of the 98th percentile of 24-hour concentrations must not exceed 35 μg/m^3. For annual PM-2.5 averages, the average of the highest yearly observations was used as the background concentration. A new 1-hr NO_2 standard was recently promulgated. To attain this standard, the 3-year average of the 98th percentile of the maximum daily 1-hour concentrations must not exceed 188 μg/m^3.

Background concentrations were determined from the closest available monitoring stations to the proposed development. All pollutants are not monitored at every station, so data from multiple locations are necessary. The closest monitor is at Kenmore Square in Boston, roughly 0.25 miles north of the Project site. However this site does not sample for lead or ozone. The next closest site that samples for these is at Harrison Avenue, roughly 1.3 miles south-southeast of the Project. A summary of the background air quality concentrations are presented in Table 4.5-2.

Table 4.5-2 Observed Ambient Air Quality Concentrations and Selected Background Levels

Pollutant	Averaging Time	2012	2013	2014	Background Concentration (μg/m^3)	NAAQS	Percent of NAAQS
SO_2 (1)(6)	1-Hour (5)	34.6	32.0	25.4	30.7	196.0	16
	3-Hour	27.8	36.4	24.6	36.4	1300.0	3
	24-Hour	14.1	15.7	13.1	15.7	365.0	4
	Annual	4.9	2.7	2.5	4.9	80.0	6
PM-10	24-Hour	28	50	53	53.0	150.0	35
	Annual	15.8	19.3	15.0	19.3	50.0	39
PM-2.5	24-Hour (5)	22.1	17.5	14.6	18.1	35.0	52
	Annual (5)	9.0	8.0	6.1	7.7	12.0	64
NO_2 (3)	1-Hour (5)	92.12	92.12	92.12	92.1	188.0	49
	Annual	35.9	33.4	32.3	35.9	100.0	36

Table 4.5-2 Observed Ambient Air Quality Concentrations and Selected Background Levels (Continued)

Pollutant	Averaging Time	2012	2013	2014	Background Concentration ($\mu g/m^3$)	NAAQS	Percent of NAAQS
CO (2)	1-Hour	1489.8	1489.8	1489.8	1489.8	40000.0	4
	8-Hour	1260.6	1146.0	1260.6	1260.6	10000.0	13
Ozone (4)	8-Hour	121.7	115.8	106.0	121.7	147.0	83
Lead	Rolling 3-Month	0.014	0.007	0.014	0.014	0.15	9

Notes:
From 2012-2014 EPA's AirData Website
(1) SO_2 reported ppb. Converted to μg/m3 using factor of 1 ppm = 2.62 μg/m3.
(2) CO reported in ppm. Converted to μg/m3 using factor of 1 ppm = 1146 μg/m3.
(3) NO_2 reported in ppb. Converted to μg/m3 using factor of 1 ppm = 1.88 μg/m3.
(4) O_3 reported in ppm. Converted to μg/m3 using factor of 1 ppm = 1963 μg/m3.
(5) Background level is the average concentration of the three years.
(6) The 24-hour and Annual standards were revoked by EPA on June 22, 2010, Federal Register 75-119, p. 35520.

Air quality in the vicinity of the Project site is generally good, with all local background concentrations found to be well below the NAAQS.

For use in the microscale analysis, background concentrations of CO in ppm were required. The corresponding maximum background concentrations in ppm were 1.3 ppm (1,490 $\mu g/m^3$) for one-hour and 1.1 ppm (1,261 $\mu g/m^3$) for eight-hour CO.

4.5.2 Methodology

The BRA typically requests an analysis of the effect on air quality of the increase in traffic generated by projects subject to Large Project Review. This "microscale" analysis is typically required for any intersection (including garage entrances/exits) where 1) Project traffic would impact intersections or roadway links currently operating at 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 percent or more (unless the increase in traffic volume is less than 100 vehicles per hour); or, 3) the Project will generate 3,000 or more new average daily trips on roadways providing access to a single location. The microscale analysis involves modeling of carbon monoxide (CO) emissions from vehicles idling at and traveling through signaled 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 ground-level 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. The NAAQS 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 current vehicles has reduced the occurrences of CO hotspots. 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 for the Project followed the procedure outlined in U.S. EPA's intersection modeling guidance.[4]

The microscale analysis has been conducted using the latest versions of EPA's MOVES and CAL3QHC programs to estimate CO concentrations at sidewalk receptor locations.

Baseline (2016) and future year (2021) emission factor data calculated from the MOVES 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 at Kenmore Square were obtained from MassDEP. CAL3QHC results were then added to background CO values of 1.3 ppm (one-hour) and 1.1 ppm (eight-hour), as provided by MassDEP, to determine total air quality impacts due to the Project. These values were compared to the NAAQS for CO of 35 ppm (one-hour) and 9 ppm (eight-hour).

The modeling methodology was developed in accordance with the latest MassDEP modeling policies and Federal modeling guidelines.[5]

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

Intersection Selection

Only two signalized intersections included in the traffic study meet the conditions for requiring a microscale analysis as described at the start of Section 4.5.2. They are the intersection of Park Drive and Boylston Street and the intersection of Ipswich Street and Boylston Street The traffic volumes and LOS calculations provided in Chapter 3 form the basis of evaluating the traffic data versus the microscale thresholds.

Microscale modeling was performed for the intersections based on the aforementioned methodology. The 2016 Existing conditions, and the 2021 No Build and Build conditions were each evaluated for both morning (a.m.) and afternoon (p.m.) peak.

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

[5] 40 CFR 51 Appendix W, Guideline on Air Quality Models, 70 FR 68228, Nov. 9, 2005

Emissions Calculations (MOVES)

The EPA MOVES computer program was used to estimate motor vehicle emission factors on the roadway network. Emission factors calculated by the MOVES model are based on motor vehicle operations typical of daily periods. The Commonwealth's statewide annual Inspection and Maintenance (I&M) program was included, as well as the county specific vehicle age registration distribution, fleet mix, meteorology, and other inputs. The inputs for MOVES for the existing (2016) and build year (2021) are provided by MassDEP.

All link types for the modeled intersection were input into MOVES. Idle emission factors are obtained from factors for a link average speed of 0 miles per hour (mph). Moving emissions are calculated based on speeds at which free-flowing vehicles travel through the intersection as stated in traffic modeling (SYNCHRO) reports. 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. Roadway emissions factors were obtained from MOVES using EPA guidance.[6]

Winter CO emission factors are typically higher than summer. Therefore, January weekday emission factors were conservatively used in the microscale analyses.

Receptors & Meteorology Inputs

Sets of up to roughly 90 receptors were placed in the vicinity of the modeled intersections. Receptors extended approximately 300 feet on the sidewalks along the roadways approaching the intersections. The roadway links and receptor locations of the modeled intersections are presented in Figure 4.5-1 and Figure 4.5-2.

For the CAL3QHC model, limited meteorological inputs are required. Following EPA guidance[7], a wind speed of one meter per second, stability class D (4), and a mixing height of 1,000 meters were used. To account for the intersection geometry, wind directions from 0° to 350°, every 10° were selected. A surface roughness length of 321 centimeters was selected.[8]

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[6] U.S. EPA, 2010. Using MOVES in Project-Level Carbon Monoxide Analyses. EPA-420-B-10-041

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

[8] 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.

2 Charlesgate West **Boston, Massachusetts**

Figure 4.5-1

Link and Receptor Locations for CAL3QHC modeling of Intersection of Park Drive & Boylston Street

2 Charlesgate West **Boston, Massachusetts**

Figure 4.5-2

Link and Receptor Locations for CAL3QHC modeling of Intersection of Ipswich Street and Boylston Street

Impact Calculations (CAL3QHC)

The CAL3QHC model predicts one-hour concentrations using queue-links at intersections, worst-case meteorological conditions, and traffic input data. The one-hour concentrations were scaled by a factor of 0.9 to estimate eight-hour concentrations.[9] The CAL3QHC methodology was based on EPA CO modeling guidance. Signal timings were provided directly from the traffic modeling outputs.

4.5.3 Air Quality Results

The results of the maximum one-hour predicted CO concentrations from CAL3QHC are provided in Tables 4.5-3 through 4.5-5 for the 2016 and 2021 scenarios. Eight-hour average concentrations are calculated by multiplying the maximum one-hour concentrations by a factor of 0.9.[10]

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 (0.4 ppm) plus background (1.3 ppm) is 1.7 ppm for the existing conditions at the both intersections. The highest eight-hour traffic-related concentration predicted in the area of the Project for the modeled conditions (0.4 ppm) plus background (1.1 ppm) is 1.5 ppm for the same locations and scenarios. All concentrations are well below the one-hour NAAQS of 35 ppm and the eight-hour NAAQS of 9 ppm.

4.5.4 Conclusions

Results of the microscale analysis show that all predicted CO concentrations are well below one-hour and eight-hour NAAQS. Therefore, it can be concluded that the increased traffic from the project will not result in any significant adverse air quality impacts.

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[9] U.S. EPA, AERSCREEN User's Guide; EPA-454/B-11-001, March 2011.

[10] U.S. EPA, AERSCREEN User's Guide; EPA-454/B-11-001, March 2011.

Table 4.5-3 Summary of Microscale Modeling Analysis (Existing 2016)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
1-Hour					
Park Drive & Boylston Street	AM	0.4	1.3	1.7	35
	PM	0.4	1.3	1.7	35
Ipswich Street & Boylston Street	AM	0.4	1.3	1.7	35
	PM	0.3	1.3	1.6	35
8-Hour					
Park Drive & Boylston Street	AM	0.4	1.1	1.5	9
	PM	0.4	1.1	1.5	9
Ipswich Street & Boylston Street	AM	0.4	1.1	1.5	9
	PM	0.3	1.1	1.4	9

Notes: CAL3QHC eight-hour impacts were conservatively obtained by multiplying one-hour impacts by a screening factor of 0.9.

Table 4.5-4 Summary of Microscale Modeling Analysis (No-Build 2021)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
1-Hour					
Park Drive & Boylston Street	AM	0.3	1.3	1.6	35
	PM	0.3	1.3	1.6	35
Ipswich Street & Boylston Street	AM	0.2	1.3	1.5	35
	PM	0.2	1.3	1.5	35

Table 4.5-4 Summary of Microscale Modeling Analysis (No-Build 2021) (continued)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
8-Hour					
Park Drive & Boylston Street	AM	0.3	1.1	1.4	9
	PM	0.3	1.1	1.4	9
Ipswich Street & Boylston Street	AM	0.2	1.1	1.3	9
	PM	0.2	1.1	1.3	9

Notes: CAL3QHC eight-hour impacts were conservatively obtained by multiplying one-hour impacts by a screening factor of 0.9.

Table 4.5-5 Summary of Microscale Modeling Analysis (Build 2021)

Intersection	Peak	CAL3QHC Modeled CO Impacts (ppm)	Monitored Background Concentration (ppm)	Total CO Impacts (ppm)	NAAQS (ppm)
1-Hour					
Park Drive & Boylston Street	AM	0.3	1.3	1.6	35
	PM	0.3	1.3	1.6	35
Ipswich Street & Boylston Street	AM	0.3	1.3	1.6	35
	PM	0.3	1.3	1.6	35
8-Hour					
Park Drive & Boylston Street	AM	0.3	1.1	1.4	9
	PM	0.3	1.1	1.4	9
Ipswich Street & Boylston Street	AM	0.3	1.1	1.4	9
	PM	0.3	1.1	1.4	9

Notes: CAL3QHC eight-hour impacts were conservatively obtained by multiplying one-hour impacts by a screening factor of 0.9.

4.6 Solid and Hazardous Waste

4.6.1 Hazardous Waste

The Project site is not the location of any DEP MCP disposal sites. An Environmental Site Assessment was completed for the subject site during September 2008. Specific tasks completed included a visual inspection of the subject site and surrounding properties for the presence of oil or hazardous materials (OHM), a review of historical information regarding the subject property, a review of federal and state databases and municipal files regarding the use, storage or release of OHM on or near the subject property. In summary, the assessment did not indicate the presence of Recognized Environmental Conditions (RECs) with respect to the subject property. An updated assessment will be undertaken as part of the Project.

Asphalt pavement, brick, and concrete (ABC) rubble generated from demolition of site driveways, parking areas and buildings will be handled in accordance with applicable Massachusetts Department of Environmental Protection (DEP) solid waste policies. The proposed Projects' disposal contracts will include specific provisions for the segregation, reprocessing, reuse, and/or recycling of building materials and demolition debris. Those materials that cannot be reused on-site will be transported in covered trucks to an approved solid waste facility per applicable DEP solid waste policies.

Abatement and disposal of hazardous materials (or hazardous waste), if encountered, will be performed under the provisions of MGL c21/2C, OSHA, and the Massachusetts Contingency Plan (MCP) by specialty contractors experienced and licensed in handling materials of this nature.

Construction of the proposed building and site improvements will require excavation and off-site disposal of an unknown quantity of excess soil. The Proponent will retain a Licensed Site Professional (LSP) to manage the environmental aspects of the Project, including proper management and/or disposal of soil encountered during construction. Disposal of excess excavated soil will be conducted in accordance with the current policies of the DEP. Chemical testing of soil samples will be performed as needed to reuse/dispose of the soils off-site depending on the acceptance criteria of specific facilities. The soils transported off site will be legally reused/disposed in accordance with the Massachusetts Contingency Plan (MCP) and other regulatory requirements. Disposal of materials will be tracked via Material Shipping Records, Bills of Lading and/or other methods, as required to ensure their proper and legal disposal.

In addition, procurement of temporary groundwater dewatering discharge permits from the Environmental Protection Agency (EPA), Massachusetts Department of Environmental Protection (DEP), Boston Water and Sewer Commission, and/or Massachusetts Water

Resources Authority (MWRA) will be required for pumping and discharge of site groundwater from within the temporary excavation support system to be installed prior to excavation.

4.6.2 Operation Solid and Hazardous Waste Generation

The Project will generate solid waste typical of residential and restaurant 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 355 tons of solid waste per year.

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

4.6.3 Recycling

A dedicated recyclables storage and collection program will facilitate the reduction of waste generated by building occupants that is hauled to and disposed of in landfills. The recycling program will be fully developed in accordance with LEED standards as described in Chapter 5.

4.7 Noise Impacts

4.7.1 Introduction

Epsilon Associates, Inc. conducted a sound level assessment which included a baseline sound monitoring program to measure existing sound levels in the vicinity of the Project, computer modeling to predict operational sound levels from proposed mechanical equipment, and a comparison of future Project sound levels to applicable City of Boston Zoning District Noise Standards.

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

4.7.2 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. 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.

A sound level meter (SLM) that is used to measure noise is a standardized instrument. It contains "weighting networks" to adjust the frequency response of the instrument to approximate that of the human ear under various circumstances. Frequencies more specifically characterize sound and are presented in the unit of Hertz (Hz). The most commonly used frequency-weighting network is the A-weighting network because it most closely approximates how the human ear responds to sound at various frequencies, and is the accepted scale used for community sound level measurements. A-weighted sound levels emphasize middle frequency sounds (i.e., middle pitched – around 1,000 Hz), and de-emphasize low and high frequency sounds. A-weighted sound levels are reported in A-weighted decibels designated as "dBA".

Because sounds in the environment vary with time, they cannot simply be represented with a single number. Thus several methods are 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.

- 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-bands being those established by standard (American National Standards Institute [ANSI] S1.11, 1986). 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. Octave-band measurements and modeling are used in assessing compliance with the City of Boston noise regulations.

4.7.3 Noise Regulations and Criteria

The City of Boston has both a noise ordinance and noise regulations. Chapter 16 §26 of the Boston Municipal Code sets the general standard for noise that is unreasonable or excessive: louder than 50 dBA between the hours of 11:00 p.m. and 7:00 a.m., or louder than 70 dBA at all other hours. The Boston Air Pollution Control Commission (APCC) has adopted regulations based on the city's ordinance - "Regulations for the Control of Noise in the City of Boston", which distinguish among residential, business, and industrial districts in the city. In particular, APCC Regulation 2 is applicable to the sounds from the proposed Project and is considered in this noise study.

Table 4.7-1 below presents the "Zoning District Noise Standards" contained in Regulation 2.5 of the APCC "Regulations for the Control of Noise in the City of Boston," adopted December 17, 1976. These maximum allowable sound pressure levels apply at the property line of the receiving property. The "Residential Zoning District" limits apply to any lot located within a residential zoning district or to any residential use located in another zone except an Industrial Zoning District, according to Regulation 2.2. Similarly, per Regulation 2.3, business limits apply to any lot located within a business zoning district not in residential or institutional use.

Table 4.7-1 City 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 from Regulation 2.5 "Zoning District Noise Standards", 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 pressure of 20 micropascals. 4. Daytime refers to the period between 7:00 a.m. and 6:00 p.m. daily, except Sunday.					

4.7.4 Existing Conditions

A background noise level survey was conducted to characterize the existing "baseline" acoustical environment in the vicinity of the Project. Existing noise sources in the vicinity of the Project site include: vehicle traffic along local roadways including: I-90, Charlesgate, Boylston Street, Ipswich Street, and Newbury Street, emergency sirens, mechanical equipment, pedestrian foot traffic, and birds.

4.7.4.1 Noise Monitoring Methodology

Sound level measurements were made on Wednesday, July 13, 2016 during the daytime (10:00 a.m. to 1:30 p.m.) and on Thursday, July 14, 2016 during nighttime hours (12:00 a.m. to 2:00 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.

4.7.4.2 Noise Monitoring Locations

Four representative noise monitoring locations were selected based upon a review of zoning and land use in the Project area. These measurement locations are depicted on Figure 4.7-1 and described below.

- **Location ST-1** is on the southern sidewalk of Newbury Street on the north side of I-90, representative of the residential receptors to the direct north of the Project along Newbury Street.

- **Location ST-2** is outside of #52 Charlesgate East, representative of the residential receptors to the east of the Project along Charlesgate East.

- **Location ST-3** is on the corner of The Boston Conservatory (#132 Ipswich Street) immediately west of the Project.

- **Location ST-4** is at 1161 Boylston Street, representative of the residential receptors immediately south of the Project.

4.7.4.3 Noise Monitoring Equipment

A Larson Davis Model 831 sound level meter equipped with a PRM831 Type I Preamplifier, a 377B20 half-inch 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 ANSI S1.4 for acoustical measuring devices. The measurement equipment was calibrated in the field before and after the surveys with a Larson Davis CAL200 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 sampling period, with octave-band sound levels corresponding to the same data set processed for the broadband levels.

4.7.4.4 Measured Background Noise Levels

Baseline noise monitoring results are presented in Table 4.7-2, and summarized below:

- The daytime residual background (L_{90} dBA) measurements ranged from 59 to 73 dBA;
- The nighttime residual background (L_{90} dBA) measurements ranged from 51 to 62 dBA;
- The daytime equivalent level (L_{eq} dBA) measurements ranged from 64 to 75 dBA;
- The nighttime equivalent level (L_{eq} dBA) measurements ranged from 56 to 69 dBA;

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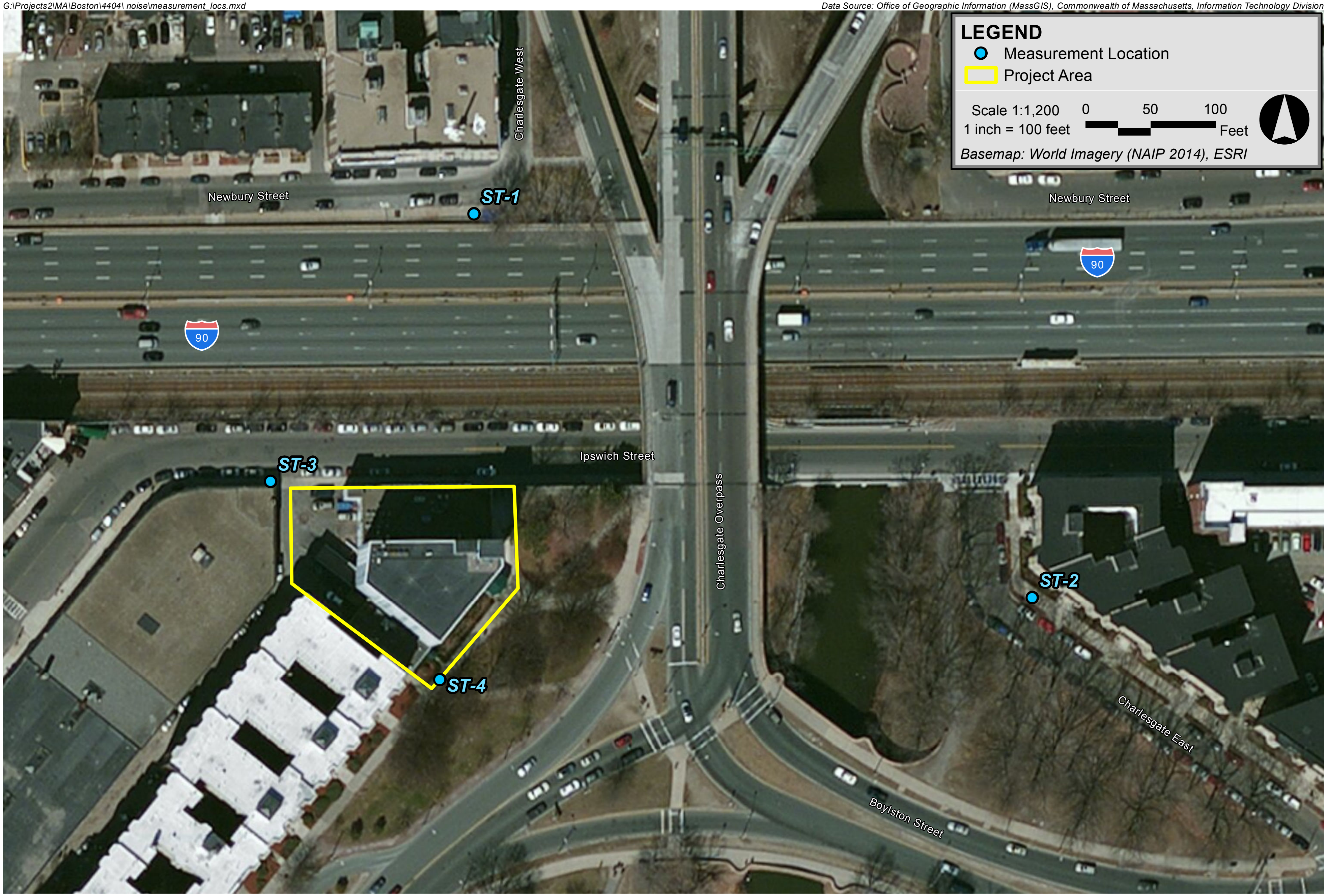
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



2 Charlesgate West Boston, Massachusetts

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Figure 4.7-1

Noise Measurement Locations

Table 4.7-2 Summary of Measured Background Noise Levels – July 13, 2016 (Daytime) & July 14, 2016 (Nighttime)

Location	Period	Start Time	L_{eq}	L_{max}	L_{10}	L_{50}	L_{90}	L_{90} Sound Pressure Levels by Octave-Band								
								31.5 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	10:20 AM	75	83	77	75	73	70	70	67	63	64	70	67	57	47
ST-2	Day	10:52 AM	64	70	66	64	63	66	65	61	56	55	60	55	45	34
ST-3	Day	11:20 AM	71	85	72	70	68	68	69	65	60	61	65	60	50	39
ST-4	Day	12:51 PM	67	88	65	61	59	66	65	61	57	52	55	51	44	33
ST-1	Night	12:05 AM	69	85	71	67	62	67	64	58	55	54	58	55	45	31
ST-2	Night	12:34 AM	61	81	61	57	54	64	60	56	52	50	50	45	38	27
ST-3	Night	1:01 AM	64	85	66	61	56	60	63	58	52	50	53	48	38	25
ST-4	Night	1:25 AM	56	69	58	54	51	59	58	55	51	47	47	43	35	27

Weather Conditions:

	Date	Temp	RH	Sky	Wind
Daytime	Wednesday, July 13, 2016	98 °F	42%	Clear	E @ 1 mph
Nighttime	Thursday, July 14, 2016	72 °F	63%	Clear	W @ 2 mph

Monitoring Equipment Used:

	Manufacturer	Model	S/N
Sound Level Meter	Larson Davis	LD831	3753
Microphone	Larson Davis	377B20	142956
Preamp	Larson Davis	PRM831	029564
Calibrator	Larson Davis	Cal200	7147

4.7.5 Future Conditions

4.7.5.1 Overview of Potential Project Noise Sources

The primary sources of continuous sound exterior to the proposed Project will consist of ventilation, heating, cooling, and emergency power noise sources. Multiple noise sources will be located on the rooftop. In addition, there will be multiple discharges and intakes along the facades of the mechanical space on the 18th floor. The discharges for the garage exhaust fans, intakes and exhausts for two air handling units, and the scrubber exhaust will be located along the northern façade of the building.

Table 4.7-3 provides an anticipated list of the major sources of sound. Sound power levels used in the acoustical modeling of each piece of equipment are presented in Table 4.7-4. The manufacturer's specification sheets which included sound power levels for each piece of equipment were provided by Cosentini Associates except for the emergency generator and air handling units (AHUs). The sound power levels for the components of the emergency generator were calculated using the sound pressure levels for a similar unit and sound power levels for a comparable AHU were modeled.

The Project includes various noise-control measures that are necessary to achieve compliance with the applicable noise regulations. As the design progresses, specifications for mechanical equipment may change; however, appropriate measures will be taken to ensure compliance with the City Noise Standards. Mitigation in the form of acoustical louvers will be installed for all garage fans, all intakes and exhausts for energy recovery units located within the building, all intakes and exhausts for all AHUs located within the building, and the scrubber exhaust. Rooftop equipment will be located within an "equipment well" which will have structural walls serving as noise barriers. The emergency generator sound levels will be controlled using an enclosure with an exhaust silencer. To further limit impacts from the standby generator, its required periodic, routine testing will be conducted during daytime hours, when background sound levels are highest. A summary of the noise mitigation proposed for the Project is presented in Table 4.7-5.

Table 4.7-3 Modeled Noise Sources

Noise Source	Quantity	Approximate Location[1]	Size/Capacity per Unit
Roof Dryer Fan	10	Roof (elevation: 361')	1,065 CFM
Cooling Tower	8 cells	Roof (elevation: 361')	68,230 CFM
Amenity Air Handling Unit	1	Roof (elevation: 361')	10,000 CFM
Energy Recovery Unit	2	Mechanical Floor (elevation: 233')	23,500 / 17,550 CFM
Air Handling Unit	1	Mechanical Floor (elevation: 233')	3,000 CFM
Garage Exhaust Fan	2	Northern Façade (elevation: 21')	8,965 CFM
Garage Exhaust Fan	2	Northern Façade (elevation: 31')	8,965 CFM
Air Handling Unit	2	Northern Façade (elevation: 31')	10,000 CFM
Scrubber Exhaust	1	Northern Façade (elevation: 31')	3,325 CFM
Emergency Generator	1	Roof (elevation: 361')	700 kW

Table 4.7-4 Modeled Sound Power Levels per Noise Source

Noise Source	Broadband (dBA)	Sound Level (dB) per Octave Band Center Frequency (Hz)								
		31.5	63	125	250	500	1k	2k	4k	8k
Roof Dryer Fan[1]	78	85[10]	85	84	77	74	73	70	67	67
Cooling Tower[2]	99	102[10]	102	101	102	97	93	86	81	78
Amenity Air Handling Unit Intake and Casing[3]	84	94[10]	94	87	76	80	77	77	76	70
Amenity Air Handling Unit Exhaust[3]	92	96[10]	96	92	88	90	88	83	77	70
Energy Recovery Unit Intake[4]	98	89[10]	89	93	97	97	93	88	84	80
Energy Recovery Unit Exhaust[4]	89	81[10]	81	86	95	86	80	78	74	72
10,000 CFM Air Handling Unit Intake[5]	77	92[10]	92	81	71	75	70	70	66	60
10,000 CFM Air Handling Unit Exhaust[5]	92	96[10]	96	92	88	90	88	83	77	70
Garage Exhaust Fan[6]	75	82[10]	82	76	73	74	70	67	60	50
Scrubber Exhaust[7]	87	88[10]	88	87	85	81	84	79	75	69
Emergency Generator – Mechanical[8]	116	108[10]	108	113	112	111	113	109	105	100
Emergency Generator – Exhaust[8]	121	85[10]	85	111	121	117	116	115	106	87
3,000 CFM Air Handling Unit Intake[9]	77	92[10]	92	81	71	75	70	70	66	60
3,000 CFM Air Handling Unit Exhaust[9]	92	96[10]	96	92	88	90	88	83	77	70

Notes:

Sound power levels do not include mitigation identified in Table 3.10-5.

1. Greenheck GB-141HP-7 1,065 CFM fan
2. Baltimore Aircoil Company, Inc. New Series 3000 XES3E-8518-05K
3. Trane 10,000 CFM AHU
4. Innovent ERU
5. Trane 10,000 CFM AHU
6. Greenheck QEI-30-I-20 8,965 CFM fan
7. Greenheck QEI-15-II-50 3,325 CFM fan
8. Caterpillar 750 kw generator (assumed to be a comparable to unit proposed)
9. Trane 10,000 CFM AHU (conservative estimate)
10. No data provided by manufacturer. Octave band sound level assumed to be equal to dB level in 63 Hz band.

Table 4.7-5 Attenuation Values Applied to Mitigate Each Noise Source

Noise Source	Form of Mitigation	Sound Level (dB) per Octave Band Center Frequency (Hz)								
		31.5	63	125	250	500	1k	2k	4k	8k
Energy Recovery Unit Intake	Acoustical Louver[1]	0[6]	6	12	15	21	24	27	25	20
Energy Recovery Unit Exhaust	Acoustical Louver[2]	0[6]	6	6	8	10	14	18	16	15
10,000 CFM Air Handling Unit Intake	Acoustical Louver[2]	0[6]	6	6	8	10	14	18	16	15
10,000 CFM Air Handling Unit Exhaust	Acoustical Louver[2]	0[6]	6	6	8	10	14	18	16	15
Garage Exhaust Fan	Acoustical Louver[3]	0[6]	5	4	5	6	9	13	14	13
Scrubber Exhaust	Acoustical Louver[2]	0[6]	6	6	8	10	14	18	16	15
Emergency Generator – Mechanical	Enclosure[4]	5[6]	10	12	14	24	32	40	42	44
Emergency Generator – Exhaust	Silencer[5]	7[6]	15	34	31	30	20	20	20	20
3,000 CFM Air Handling Unit Intake	Acoustical Louver[2]	0[6]	6	6	8	10	14	18	16	15
3,000 CFM Air Handling Unit Exhaust	Acoustical Louver[2]	0[6]	6	6	8	10	14	18	16	15

Notes:

1. IAC Noishield Model 2R acoustic louver.
2. IAC Slimshield Model SL-6 acoustic louver.
3. IAC Slimshield Model SL-4 acoustic louver.
4. Pritchard Brown enclosure.
5. Silex JB-12 silencer.
6. Estimated sound level reduction.

4.7.5.2 Noise Modeling Methodology

The noise impacts associated with the Project were predicted at the nearest receptors using the Cadna/A noise calculation software developed by DataKustik GmbH. This software uses the ISO 9613-2 international standard for sound propagation (Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation). The benefits of this software are a more refined set of computations due to the inclusion of topography, ground attenuation, multiple building reflections, drop-off with distance, and atmospheric absorption. The Cadna/A software allows for octave band calculation of noise from multiple noise sources, as well as computation of diffraction around building edges.

4.7.5.3 Future Sound Levels – Nighttime

The analysis of sound levels at night considered all of the mechanical equipment without the emergency generator running, to simulate typical nighttime operating conditions at nearby receptors. Five modeling locations were included in the analysis. Locations A through D are similar to measurement Locations 1 through 4. One additional modeling location, E, was added for additional residential use in the vicinity of the Project. The modeling receptors are depicted in Figure 4.7-2. The predicted exterior Project-only sound levels range from 36 to 54 dBA at nearby receptors and from 36 to 45 dBA at modeled residential locations. The City of Boston Residential limits have been applied to locations A, B, D, and E. Since Location C (Boston Conservatory) is not a nighttime noise sensitive area, is in a Business Zone, and existing sound levels are already above the residential limits, the Business limits have been applied. Predicted sound levels from Project-related equipment are within the broadband and octave-band nighttime limits under the City Noise Standards at the modeling locations. The evaluation is presented in Table 4.7-6.

Table 4.7-6 Comparison of Future Predicted Project-Only Nighttime Sound Levels to the City of Boston Limits

Modeling Location ID	Zoning	Broadband (dBA)	Sound Level (dB) per Octave Band Center Frequency (Hz)								
			31.5	63	125	250	500	1k	2k	4k	8k
A	Residential	44	61	55	51	45	44	38	29	23	11
B	Residential	36	53	47	42	41	33	25	17	11	-2
C	Business	54	70	64	60	55	54	48	39	35	28
D	Residential	45	59	54	50	51	43	36	28	23	16
E	Residential	45	60	53	49	49	44	37	29	23	14
City of Boston Limits	Residential	50	68	67	61	52	46	40	33	28	26
City of Boston Limits	Business	65	79	78	73	68	62	56	51	47	44

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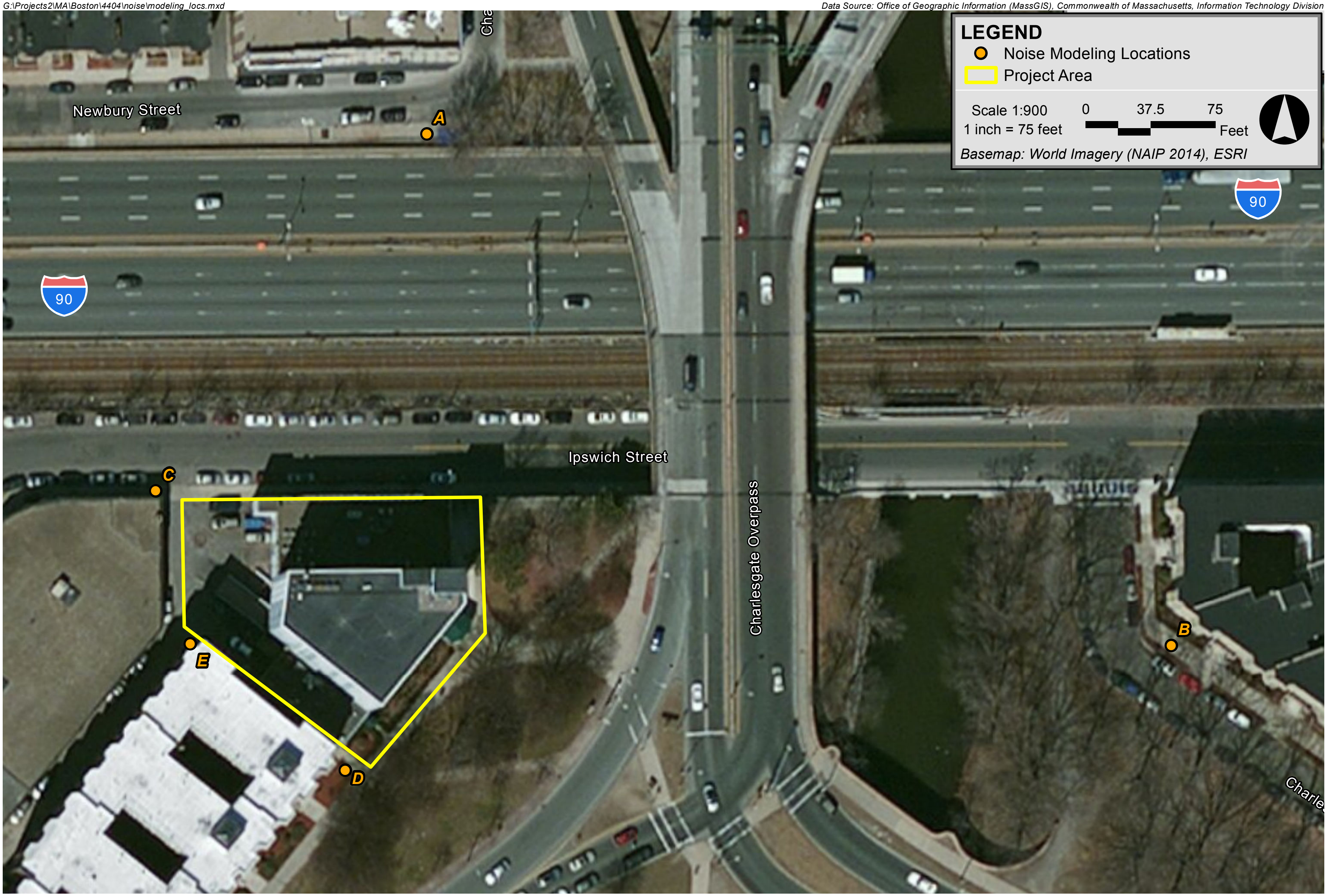
Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



2 Charlesgate West **Boston, Massachusetts**

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Figure 4.7-2

Noise Modeling Locations

4.7.5.4 Future Sound Levels – Daytime

As noted above, the emergency generator will only operate during the day for brief, routine testing when the background sound levels are high, or during an interruption of power from the electrical grid. A second analysis combined noise from the Project's mechanical equipment and its emergency generator to reflect worst-case conditions. The sound levels were calculated at the same receptors as in the nighttime analysis, and then were evaluated against daytime limits. The predicted exterior Project-only daytime sound levels range from 36 to 54 dBA at nearby receptors. Predicted sound levels from Project-related equipment are within the daytime broadband and octave-band limits under the City Noise Standards at each of the modeling locations. This evaluation is presented in Table 4.7-7.

Table 4.7-7 Comparison of Future Predicted Project-Only Daytime Sound Levels to City Noise Standards

Modeling Location ID	Zoning	Broadband (dBA)	Sound Level (dB) per Octave Band Center Frequency (Hz)								
			31.5	63	125	250	500	1k	2k	4k	8k
A	Residential	45	61	55	51	45	44	38	30	23	11
B	Residential	36	53	47	42	41	33	26	20	12	-2
C	Business	54	70	64	60	55	54	48	40	35	28
D	Residential	45	59	54	50	51	43	36	28	23	16
E	Residential	45	60	54	49	49	44	38	31	24	14
City of Boston Limits	Residential	60	76	75	69	62	56	50	45	40	38
City of Boston Limits	Business	65	79	78	73	68	62	56	51	47	44

4.7.6 Conclusions

Baseline noise levels were measured in the vicinity of the proposed Project during the day and at night. At these and additional locations, future Project-only sound levels were calculated based on information provided by the manufacturers of the expected mechanical equipment. Project-only sound levels were compared to applicable limits.

Predicted mechanical equipment noise levels from the proposed Project at each receptor location, taking into account attenuation due to distance, structures, and noise-control measures, will be at or below the octave-band requirements of City Noise Standards. The predicted sound levels from Project-related equipment, as modeled, are expected to remain below 50 dBA at residences; therefore, within the nighttime residential zoning limits for the City of Boston at the nearest residential receptors. The results indicate that the proposed Project can operate without significant impact on the existing acoustical environment.

At this time, while the mechanical equipment (type and location) and noise controls have been refined, they are still conceptual in nature. During the final design phase of the Proposed Project, mechanical equipment and noise controls will be specified and designed to meet the applicable broadband limit and the corresponding octave-band limits of the City Noise Standards.

4.8 Stormwater/ Water Quality

Please see Section 8.4 for a discussion of the proposed stormwater system.

4.9 Flood Hazard Zones/ Wetlands

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for the site located in the City of Boston - Community Panel Number 25025C0077J indicates the FEMA Flood Zone Designations for the site area. The map shows that the Project is located in a Zone X, "Areas determined to be outside the 0.2 percent annual chance floodplain."

The site does not contain wetlands.

4.10 Geotechnical Impacts

This section includes a description of subsurface soil and groundwater conditions at the Project site, planned below-grade construction activities, and mitigation measures for protecting adjacent structures and maintaining groundwater levels in the Project's vicinity during foundation and below-grade construction.

4.10.1 Site Conditions

The Project site, is currently occupied by three buildings and a paved parking lot.

The paved portion of the Project site is relatively level at about El. +16, Boston City Base Datum (BCB). Information on the existing site and abutting buildings is listed in Table 4.10-1 below:

Table 4.10-1 Existing Site Buildings

Building	Presumed Foundation	Other Information
2 Charlesgate West	Concrete-filled steel pipe piles supported on glacial till or bedrock.	Constructed 1963; 6-stories above grade; two below-grade basement levels.
6 Charlesgate West and 1161 Boylston Street	Presumed to be on wood piles; length and cut-off not known.	Constructed Unknown; 1-story above grade; one below grade basement level.

4.10.2 Subsurface Soil and Bedrock Conditions

Based on available subsurface data, the general Project site subsurface profile is listed below in Table 4.10-2, in order of increasing depth below ground surface.

Table 4.10-2 Subsurface Soil and Bedrock Conditions

Generalized Subsurface Strata	Approximate Thickness (Feet)
Miscellaneous Fill	14 to 195
Organic Deposits	18.5 to 27
Marine Clay	55 to 63
Glacial Till	7 to 11

4.10.3 Groundwater

Groundwater level measurements obtained in observation wells installed at the Project site at different times during the past approximately 24 years have ranged from about El. +7.6 to El. +8.3 BCB (depth below ground surface of about 7.2 to 7.9 feet). Groundwater level measurements obtained between 2006 and 2016 from nearby off-property observation wells monitored by the Boston Groundwater Trust (BGwT) range from about El. +5 to El. +7 BCB.

Groundwater levels in the area could be influenced by leakage into and out of sewers, storm drains and other below grade structures, as well as environmental factors such as precipitation, season, and temperature.

4.10.4 Proposed Conditions

The foundation construction will include the installation of deep end-bearing piles and/or rock-socketed drilled shafts to support the proposed building. The foundation piles will be driven into the glacial till deposit and/or bedrock at a depth of about 100 to 120 feet below the existing ground surface. The rock-socketed drilled shafts will be drilled into bedrock to total depths of about 160 feet below the existing ground surface. Vibrations associated with pile driving will be monitored continuously.

The Project may include below-grade levels which are benched into the site, with two levels below-grade on the Charlesgate West side of the site and one level below-grade on the Ipswich Street side of the site. Construction of the foundations and below-grade parking structure will require excavation depths anticipated to be up to 31 feet below the Boylston Street ground surface (approximately El. 0 BCB). The below-grade levels will be waterproofed.

The excavation will be conducted within an engineered lateral earth support system, such as a slurry wall or steel sheet pile wall system, which will be designed to provide excavation support, limit ground movements outside the excavation to protect adjacent facilities, and maintain groundwater levels outside the excavation by creating a groundwater "cutoff" between the excavation and the surrounding area. The lateral earth support system will be designed to be installed/sealed into the clay stratum to isolate the excavation and future below-grade garage from the groundwater table. Due to the depth of excavation, the lateral earth support system will be supported by an internal bracing system or external bracing system such as tiebacks. Installation of the temporary excavation support wall, if installed in the Public Way, and the installation of tiebacks below adjacent roadways will require approval from the City of Boston Public Improvements Commission (PIC). Pre-excavation will be performed along the building perimeter to remove obstructions prior to installing the excavation support system.

Temporary dewatering will be required inside the excavation during excavation and foundation construction to remove "free" water from the soils to be excavated as well as precipitation. The essentially watertight excavation support wall will prevent withdrawal of groundwater from outside the excavation. In the unlikely event that leakage occurs through the walls, it will be promptly sealed by grouting of the wall.

A temporary construction dewatering permit will be obtained from governing agencies prior to discharge of dewatering effluent from the Project site. Testing of the effluent will be conducted prior to and during discharge to confirm compliance with all permit requirements.

4.10.5 Groundwater Conservation Overlay District

The Project site is within the Groundwater Conservation Overlay District (GCOD) which is governed by Article 32 of the City of Boston Zoning Code. The Project will comply with the standards and requirements set forth in Article 32 of the Code. The Proponent will obtain a written determination from the Boston Water and Sewer Commission (BWSC) as to whether the Project meets the standards and requirements of Article 32. In addition, the Proponent will demonstrate that the Project meets the requirements of Section 32-6 of the Code by obtaining a stamped certification from the Massachusetts registered engineer that the requirements of Section 32-6 of the Code are met. The Proponent will provide both a copy of the written determination from BWSC and a copy of the stamped certification from a Massachusetts registered engineer to the BRA and the Boston Groundwater Trust prior to the issuance of a Certificate of Consistency. As such, the Project will be deemed to be in compliance with Article 32 of the Code and will not need a conditional use permit from the Board of Appeal for Article 32 purposes.

The Proponent is committed to working with the BGwT and neighborhood to ensure that the Project has no adverse impact on nearby groundwater levels.

4.11 Construction Impacts

4.11.1 Introduction

A Construction Management Plan (CMP) in compliance with the City's Construction Management Program will be submitted to the Boston Transportation Department (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. Techniques such as barricades, walkways and signage will be used. 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 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 may be employed 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 construction in the second quarter of 2017 and last for approximately 24-30 months.

Typical construction hours will be from 7:00 am to 6:00 pm, Monday through Friday, with most shifts ordinarily ending at 3:30 pm. No substantial sound-generating activity will occur before 7:00 am. 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 should occur during normal business hours, Monday through Friday. It is noted that some activities such as finishing activities could run beyond 6:00 pm 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.

A CMP will be submitted to BTD for review and approval prior to issuance of a Building Permit. The CMP 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 1,600 construction jobs will be created over the length of construction. The Proponent will make reasonable good-faith efforts to have at least 50 percent of the total employee work hours be for Boston residents, at least 25 percent of total employee work hours be for minorities and at least 10 percent of the total employee work hours be for women. The Proponent will enter into jobs agreements 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 contractors 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 the 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

Short-term air quality impacts from fugitive dust may be expected during demolition, excavation and the early phases of construction. Plans for controlling fugitive dust during demolition, excavation and construction include mechanical street sweeping, wetting portions of the site during periods of high wind, and careful removal of debris by covered trucks. The construction contract will provide for a number of strictly enforced measures to be used by contractors to reduce potential emissions and minimize impacts, pursuant to this Article 80 approval. These measures are expected to include:

- Using wetting agents on areas of exposed soil on a scheduled basis;
- Using covered trucks;

- Minimizing spoils on the construction site;
- Monitoring of actual construction practices to ensure that unnecessary transfers and mechanical disturbances of loose materials are minimized;
- Minimizing storage of debris on the site; and
- Periodic street and sidewalk cleaning with water 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. 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. Demolition activities will comply with MassDEP Solid Waste and Air Pollution Control regulations, pursuant to M.G.L. Chapter 40, Section 54.

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 each 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 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 Sustainable Design

Trans National Properties is committed to developing projects that are 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 LEED NC v2009 to show compliance with Article 37. There are seven categories in the LEED certification guidelines: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation in Design Process and the additional Regional Priority Credits.

This Project is targeting several credits which span the seven categories and is anticipating reaching LEED Silver certification by targeting 53 credit points. There are many additional credit points, listed in italics below, which are still under consideration. It may be determined that some of the credits under consideration may not be attainable. The preliminary LEED checklist is included at the end of this section. Please note that this is an initial credit checklist and applicable credits may change as the building design advances.

The following is a detailed credit-by-credit analysis of the project team's approach for achieving a LEED-NC v2009 Silver certified building.

Sustainable Sites

The Project site is in the Fenway neighborhood close to public transportation including multiple MBTA subway stops, including the Hynes Convention Center and Kenmore Green line stations and the Yawkey Commuter rail station. The Project will incorporate low-impact site features that will properly capture and infiltrate stormwater to improve groundwater levels. Alternative transportation strategies will be employed to reduce pollution impacts from automobile use, and all parking will be located under cover to minimize contribution to heat island effect from parking lot areas.

The Project earns points for Site Selection, Development Density, Brownfield Redevelopment, Alternative Transportation options, as well as Heat Island Effect. The Proponent strongly supports public transportation and a number of parking spaces will be designated to recharging of electric vehicles. All parking will be located within the primary structure, below the tower's main program and bicycle storage and changing rooms will be provided for all occupants.

<u>Prerequisite 1 - Construction Activity Pollution Prevention:</u> The Construction Manager will submit and implement an Erosion and Sedimentation Control (ESC) Plan for construction activities related to the demolition of existing buildings and the construction of the new

building specific to this Project. The ESC Plan will conform to the erosion and sedimentation requirements of the 2012 EPA Construction General Permit in order to comply with this LEED prerequisite.

Credit 1 - Site Selection: The Project site is located on a previously developed parcel in Boston's Fenway neighborhood, situated along Charlesgate West as well as Ipswich Street.

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 existing building located on the Project site will be tested to confirm it contains hazardous materials within the existing building components, including asbestos. 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 subway routes and a commuter rail line that all stop within a one-half mile walking distance from the Project site and travel in high frequency. 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 and base building locker room/shower facilities for visitors and employees will be incorporated into the design, as well as covered and secure bike storage for residential occupants.

Credit 4.3 - Alternative Transportation, Low-Emitting & Fuel-Efficient Vehicles: Parking will be fully attended for the Project and will include designated spaces for electric vehicle charging stations, which will be accompanied by dedicated charging infrastructure.

Credit 4.4 - Alternative Transportation Parking Capacity: The quantity of available parking spaces provided for the Project will 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. Infrastructure and support programs to facilitate shared vehicle use by residents are being considered by building management.

Credit 5.2 - Site Development, Maximize Open Space: The occupiable roof areas will be designed with ample vegetation for occupants. The design team is aiming to provide sufficient vegetation area to meet the minimum requirements of this credit. Achievement of this credit will be dependent upon calculations from the final square footage of vegetation area provided on the Project site.

Credit 6.1 - Stormwater Design, Quantity Control: The City of Boston has requirements for collection and recharge of stormwater. Stormwater collection systems will be designed to help mitigate runoff from the Project site and recharge a portion within groundwater recharge wells on-site. The Project team is aiming to reduce the total stormwater runoff for a one and two-year storm design; calculations during design will determine whether these strategies will meet the specific requirements for this LEED credit.

Credit 6.2 - Stormwater Design, Quality Control: The installation of a groundwater recharge system for stormwater will reduce the suspended solids and phosphorus content of the site stormwater recharge on-site. Calculations during design will determine whether these systems will meet the specific requirements for this credit.

Credit 7.1 - Heat Island Effect, Non-Roof: All of the on-site parking is located undercover within the site area of the Project. The Project is aiming to meet the exemplary performance requirement with 100 percent of the total parking provided undercover.

Credit 7.2 - Heat Island Effect, Roof: The Project team will specify high albedo surface materials with a minimum SRI value of 78 and provide vegetated roof areas for a minimum of 75 percent of the Project's total roof area, excluding area covered by rooftop mechanical systems.

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.

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 exterior vegetation will be comprised of regionally appropriate, drought tolerant, indigenous plants. There will be a high efficiency irrigation system, if necessary, for the installed vegetation among roof deck areas.

Prerequisite 1 - Water Use Reduction, 20 percent Reduction and 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 use, at a minimum, 20 percent 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 percent from the calculated baseline use. A higher goal of 35 percent will be considered depending on the final fixture selection for Water Use Reduction by the Project team.

Credit 1 - Water Efficient Landscaping: The exterior vegetation will incorporate native and adaptive plant materials and, if required, the design of the irrigation system will target a 50 percent reduction in potable water use when compared to a mid-summer baseline.

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. The team will engage a building commissioning agent to ensure the proper installation and operation of 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 back of house and amenity/common areas. The design will include high-performance strategies for the building envelope, in-unit lighting, appliances, and low-flow plumbing fixtures to reduce Domestic Hot Water demand.

The HVAC design includes high-performing Water Source Heat Pumps, Condensing boilers, efficient heat reject systems, and energy recovery dedicated outdoor air units. The team is also analyzing the feasibility of on-site co-generation systems.

The building owner 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. A systems manual and training protocol will be developed through the Commissioning Agent to ensure the proper use and maintenance of the building systems post-occupancy.

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 building owner’s Project requirements and the Project team’s basis of design.

Prerequisite 2 - Minimum Energy Performance and Credit 1 - Optimize Energy Performance: The building’s energy performance will meet the minimum requirements of EAp2. For EAc1, the design, at minimum, is expected to show a 16 percent energy cost savings when compared to a baseline building based on ASHRAE Standard 90.1-2007 Appendix G methodology. 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. *The Project team will target a higher goal for the Project of at least a 20 percent improvement in energy cost savings, based on initial design intent.*

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 systems will achieve the prerequisite.

Credit 3 - Enhanced Commissioning: The team will engage a third party Commissioning Agent (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 5 - Measurement and Verification: The owner 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 development of a full Measurement & Verification plan and implementation.*

Credit 6 - Green Power: The owner is exploring purchase of 'green power' for a 2-year renewable energy contract to provide a minimum of 35 percent 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 percent 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 on each residential floor. Building management will have scheduled recyclable collection times where staff will collect and transfer each floors recyclables to the central storage location to await pickup. 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 prepare and submit a Construction Waste Management plan which will be implemented 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 percent diversion.

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

<u>Credits 4.2 - Recycled Content 20 percent (post-consumer & ½ pre-consumer):</u> The Construction Manager shall track the recycled content for each material with a project target to achieve 20 percent recycled-content materials based on overall project materials costs.

<u>Credit 5.1 - Regional Materials, 10 percent Extracted, Processed and Manufactured Regionally:</u> The project specifications will indicate materials to be extracted, harvested, recovered and manufactured within a 500-mile radius of the job site. The Project has established a target for 10 percent 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 ten percent threshold based on overall Project materials costs.

<u>Credits 5.2 - Recycled Content 20 percent Extracted, Processed and Manufactured Regionally:</u> The Construction Manager will track the regional materials with a project target to achieve 20 percent regional materials based on overall project materials costs.

<u>Credits 7 - Certified Wood:</u> 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.

<u>Prerequisite 1 - Minimum IAQ Performance:</u> 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.

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

Credit 2 - Increased Ventilation: The Project team is exploring the design to increase the ventilation rates to 30 percent higher volume than ASHRAE 62.1-2007. Achievement will be dependent on the final design of the ventilation systems.

Credit 3.1 - 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).

Credit 3.2 - Construction IAQ Management Plan, Before Occupancy: The Project team is exploring options to comply with the flush-out or IAQ Testing requirements within this credit for the Project.

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

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

Credit 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 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 specify and install composite wood and agrifiber products that contain no added urea-formaldehyde. The Construction Manager will 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 Project team will install entryway systems at all primary entrances to the building, covering a minimum of ten feet in the direction of travel. The team will provide deck-to-deck partitions, self-closing door hardware, and negative pressurization within all chemical use areas in the Project. The team will specify a minimum MERV rating of 13 for all supply air intakes.

Credit 6.1 - Controllability of Systems, Lighting: The Project team will design to provide lighting controls to occupants within all multi-occupant amenity spaces, as well as provide individual lighting controls to a minimum of 90 percent of occupants within individually occupied spaces and units. Switched receptacles will be utilized to ensure lighting options within units are provided.

Credit 6.2 - Controllability of Systems, Thermal Comfort: The Project team will design to provide thermal controls to occupants within all multi-occupant amenity spaces, as well as provide units with individual controls to comfortably surpass the minimum of 50 percent of occupants with control access. Thermostats will be positioned to provide access for occupants to control the thermal comfort of these regularly occupied spaces.

Credit 7.1 - Thermal Comfort, Design: The Project HVAC system design shall be in compliance with ASHRAE 55 for all tenant units, as well as provide the flexibility for tenant fit-out extensions of the mechanical systems to meet the ASHRAE 55 requirements for thermal comfort. Compliance with this credit will be dependent on the final systems design and comparative calculations.

Credit 8.1 - Daylight and Views, Daylight Access for 75 percent of spaces: It is the intent of the design to provide ample glazing along the perimeter, maximizing the availability of daylight within these spaces. Compliance with this credit will be dependent on the final calculations based on the final floor plan layouts.

Credit 8.2 - Daylight and Views, Views for 90 percent of the spaces: It is the intent of the design to provide ample glazing along the perimeter allowing for views for at least 90 percent of the regularly occupied spaces within the units and amenity spaces, as well as encourage this design intent within tenant spaces.

Innovation & Design Processes

The team has identified five possible ID credits listed below (limited to 5 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 within a ½ mile walking distance of several subway 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 all of the parking undercover with a compliant surface.

Low Mercury Lighting: The Project will explore design options to significantly reduce the use of mercury-containing lamps, and implement purchasing preference to low-mercury containing fluorescent lamps, when applicable.

Green Housekeeping/Operations: The owner will consider options to implement a policy requiring that cleaning staff use green cleaning products and equipment in the common areas and provide a package for residents explaining the 'green living' components of the Project.

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 Project.

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 02215 zip code include: SSc3, SSc6.1, SSc7.1, SSc7.2, EAc2(one percent) and MRc1.1(75 percent). This Project anticipates three RPC for SSc3-Brownfield Redevelopment; SSc7.1-Heat Island Effect, Non-Roof; and SSc7.2-Heat Island Effect, Roof. *One additional RPC is being considered: SSc6.1 Stormwater Design, Quantity Control and EAc2, On-site Renewable Energy.*

5.2 Climate Change Preparedness

5.2.1 Introduction

Projects subject to Large Project Review are required to complete the Climate Change Preparedness Checklist. Climate change conditions considered include higher maximum and mean temperatures, more frequent and longer extreme heat events, more frequent and longer droughts, more severe rainfall events, and increased wind events. Due to the Project's location, the Project site is not considered susceptible to the impacts of a reasonably-assumed sea level rise. It is also unlikely to experience extreme flooding in the case of large storms.

The expected life of the Project is anticipated to be approximately 50 years. Therefore, the Proponent planned for climate change conditions projected to 50 years into the future. A copy of the completed checklist 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.

5.2.2 Extreme Heat Events

The Intergovernmental Panel on Climate Change (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[1]. The Project design will incorporate a number of measures to minimize the impact of high temperature events, including:

- Installing operable windows where possible;
- Using sun shading and high performance glazing;
- Using Energy Recovery Ventilation to reduce cooling loads; and
- Specifying high reflective paving materials, high albedo roof tops and green roofs to minimize the heat island effect.

5.2.3 Rain Events

As a result of climate change, the Northeast is expected to experience more frequent and intense storms. To mitigate this, the Proponent will take measures to minimize stormwater runoff and protect the Project's mechanical equipment. The Project will be designed to reduce the existing peak rates and volumes of stormwater runoff from the site, and promote runoff recharge to the greatest extent practicable.

5.2.4 Drought Conditions

Under the high emissions scenario, the occurrence of droughts lasting one to three months could go up by as much as 75 percent over existing conditions by the end of the century. To minimize the Project's susceptibility to drought conditions, water conservation fixtures will be included in the design, including aeration fixtures and appliances that will be chosen for water conservation qualities. In public areas, sensor operated faucets and toilets will be installed.

5.3 Energy Systems

The Project team has evaluated the feasibility of including solar photovoltaic and solar hot water systems with the Project. However, the Project roof area is limited due to the small size and mechanical equipment space needs, making both of these systems infeasible.

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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.

However, the building will be designed to be "solar ready" to ease future photo-voltaic installations. If building integrated solar photovoltaic becomes more economically feasible, the Proponent will study the potential to add such a system.

The Project team is currently investigating the overall impact level of a Combined Heat and Power system for use within the Project. The Project may include a 75-100 kW system if it is determined that the system would be sized appropriately to serve more than ten percent of the buildings energy use.

LEED for New Construction and Major Renovation v2009
Project Scorecard

Project Name: Two Charlesgate Residential Tower
Project Address: 2 Charlesgate West, Boston, MA 02110
Date of Review: August 9th 2016

LEED Goal: Silver Certifiable

Phase	Yes	?	No			
	21	4	1		**Sustainable Sites**	**26**
C	Y			Prereq 1	**Construction Activity Pollution Prevention**	Required
D	1			Credit 1	**Site Selection**	1
D	5			Credit 2	**Development Density & Community Connectivity**	5
D	1			Credit 3	**Brownfield Redevelopment**	1
D	6			Credit 4.1	**Alternative Transportation,** Public Transportation Access	6
D	1			Credit 4.2	**Alternative Transportation,** Bicycle Storage & Changing Rooms	1
D	3			Credit 4.3	**Alternative Transportation,** Low-Emitting & Fuel-Efficient Vehicles	3
D	2			Credit 4.4	**Alternative Transportation,** Parking Capacity	2
C			1	Credit 5.1	**Site Development,** Protect or Restore Habitat	1
D		1		Credit 5.2	**Site Development,** Maximize Open Space	1
D		1		Credit 6.1	**Stormwater Design,** Quantity Control	1
D		1		Credit 6.2	**Stormwater Design,** Quality Control	1
C	1			Credit 7.1	**Heat Island Effect,** Non-Roof	1
D	1			Credit 7.2	**Heat Island Effect,** Roof	1
D		1		Credit 8	**Light Pollution Reduction**	1

	Yes	?	No			
	4	1	5		**Water Efficiency**	**10**
D	Y			Prereq 1	**Water Use Reduction, 20%** Reduction	Required
D	2		2	Credit 1	**Water Efficient Landscaping**	4
D			2	Credit 2	**Innovative Wastewater Technologies**	2
D	2	1	1	Credit 3	**Water Use Reduction**	2 to 4
					☒ 30% Reduction	2
					☐ 35% Reduction	3
					☐ 40% Reduction	4

	Yes	?	No			
	6	7	22		**Energy & Atmosphere**	**35**
C	Y			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
D	Y			Prereq 2	**Minimum Energy Performance**	Required
D	Y			Prereq 3	**Fundamental Refrigerant Management**	Required
D	3	2	14	Credit 1	**Optimize Energy Performance**	1 to 19
					☐ 12% New Buildings or 8% Existing Building Renovations	1
					☐ 14% New Buildings or 10% Existing Building Renovations	2
					☒ 16% New Buildings or 12% Existing Building Renovations	3
					☐ 18% New Buildings or 14% Existing Building Renovations	4
					☐ 20% New Buildings or 16% Existing Building Renovations	5
D		1	6	Credit 2	**On-Site Renewable Energy**	1 to 7

					☐ 1% Renewable Energy	1
C	2			Credit 3	**Enhanced Commissioning**	2
D			2	Credit 4	**Enhanced Refrigerant Management**	2
C	1	2		Credit 5	**Measurement & Verification**	3
C		2		Credit 6	**Green Power**	2

	Yes	?	No			
	4	3	7		**Materials & Resources**	14
D	Y			Prereq 1	**Storage & Collection of Recyclables**	Required
C			3	Credit 1.1	**Building Reuse - Maintain Existing Walls, Floors, and Roof**	1 to 3
C			1	Credit 1.2	**Building Reuse - Maintain 50% of Interior Non-Structural Elements**	1
C	1			Credit 2.1	**Construction Waste Management,** Divert 50% from Disposal	1
C	1			Credit 2.2	**Construction Waste Management,** Divert 75% from Disposal	1
C			1	Credit 3.1	**Materials Reuse, 5%**	1
C			1	Credit 3.2	**Materials Reuse,10%**	1
C	1			Credit 4.1	**Recycled Content, 10%** (post-consumer + ½ pre-consumer)	1
C		1		Credit 4.2	**Recycled Content, 20%** (post-consumer + ½ pre-consumer)	1
C	1			Credit 5.1	**Regional Materials, 10%** Extracted, Processed & Manufactured Regionally	1
C		1		Credit 5.2	**Regional Materials, 20%** Extracted, Processed & Manufactured Regionally	1
C			1	Credit 6	**Rapidly Renewable Materials**	1
C		1		Credit 7	**Certified Wood**	1

	Yes	?	No			
	9	4	2		**Indoor Environmental Quality**	15
D	Y			Prereq 1	**Minimum IAQ Performance**	Required
D	Y			Prereq 2	**Environmental Tobacco Smoke (ETS) Control**	Required
D			1	Credit 1	**Outdoor Air Delivery Monitoring**	1
D		1		Credit 2	**Increased Ventilation**	1
C	1			Credit 3.1	**Construction IAQ Management Plan,** During Construction	1
C		1		Credit 3.2	**Construction IAQ Management Plan,** Before Occupancy	1
C	1			Credit 4.1	**Low-Emitting Materials,** Adhesives & Sealants	1
C	1			Credit 4.2	**Low-Emitting Materials,** Paints & Coatings	1
C	1			Credit 4.3	**Low-Emitting Materials,** Flooring Systems	1
C	1			Credit 4.4	**Low-Emitting Materials,** Composite Wood & Agrifiber Products	1
D	1			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
D	1			Credit 6.1	**Controllability of Systems,** Lighting	1
D	1			Credit 6.2	**Controllability of Systems,** Thermal Comfort	1
D		1		Credit 7.1	**Thermal Comfort,** Design	1
D			1	Credit 7.2	**Thermal Comfort,** Verification	1
D		1		Credit 8.1	**Daylight & Views,** Daylight 75% of Spaces	1
D	1			Credit 8.2	**Daylight & Views,** Views for 90% of Spaces	1

	Yes	?	No			
	6	0	0		**Innovation & Design Process**	6
D	1			Credit 1.1	**Innovation in Design: EP - SSc2**	1
D	1			Credit 1.2	**Innovation in Design: EP - SSc4.1**	1
D	1			Credit 1.3	**Innovation in Design: EP - SSc7.1**	1
D	1			Credit 1.4	**Innovation in Design: Low Mercury Lighting**	1
C	1			Credit 1.5	**Innovation in Design: Green Cleaning Policy**	1

D	1			Credit 2	**LEED® Accredited Professional**	1

Yes	?	No			
3	0	1	**Regional Priority Credits**		**4**
			02215: SSc3, SSc6.1, SSc7.1, SSc7.2, EAc2 (1%), MRc1.1 (75%)		
1			Credit 1.1	**Regional Priority Credit: SSc3**	1
1			Credit 1.2	**Regional Priority Credit: SSc7.1**	1
1			Credit 1.3	**Regional Priority Credit: SSc7.2**	1
		1	Credit 1.4	**Regional Priority Credit: MRc1.1**	1

Yes	?	No		
53	19	38	**Project Totals (Certification Estimates)**	**110**

Not Certified

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

Chapter 6.0

Urban Design

6.0 URBAN DESIGN

At the intersection of the Fenway and Back Bay neighborhoods, and at the link between Commonwealth Avenue Mall and the Fens, 2 Charlesgate West responds in its massing and form to influences from many directions. Designated as the North Boylston Gateway Development Area in the Fenway Neighborhood District (Article 66), the mixed-use tower is an "architecturally-distinctive civic landmark" not only for the Fenway neighborhood but for the Back Bay and the City of Boston.

On Boylston Street, spiraling terraces step up the tower beginning at an elevation that complements the abutting apartment block. A pair of significant terraces, at heights similar to the Boston University buildings lining the Mass Pike and the neighboring developments along Boylston Street near Fenway Park, forms the next two steps. The building concludes at a height identical to Pierce Boston, the other Gateway designated building in the Fenway Neighborhood District (see Figure 6-1).

Inspired by the historic brownstones with their crafted brick and stone fronts with bay and bow windows, 2 Charlesgate West meets the pedestrian realm at both Ipswich and Boylston Streets in a contextually-sensitive way. Drawing inspiration from the stonework of the nearby Boylston Street 'Richardson Bridge' (1883) and the remains of the Charlesgate West abutment directly adjacent to the site, a wall of highly articulated and rusticated brownstone defines the Ipswich Street façade (see Figure 6-2). This "heavy" wall becomes more refined as it rises to Boylston Street and ultimately terminates at an elevation sympathetic to both the apartment block on Boylston Street and many neighbors across the Mass Pike along Commonwealth Avenue. The brownstone continues in bands of floor to ceiling glass in the tower above.

2 Charlesgate West welcomes its residents, their guests, and the neighborhood at both Ipswich and Boylston Streets. While Ipswich Street serves as the primary vehicular access to three levels of attended parking, much of its street frontage is glazed and activated by lobbies serving the residents, office tenants, and restaurant guests. The Project proposes to invest in upgrades to Ipswich Street along the MBTA/Mass Pike fence line and the sidewalk on its side of the street, from the private alley immediately to the west of the site to the corner of Ipswich and Charlesgate East. New lighting, street furnishings, planting and art installations on the fence and Bowker Overpass, along with an expanded sidewalk and upgraded path leading to Boylston Street near Charlesgate East are opportunities to be developed as the Project advances (see Figure 6-3).

The Boylston Street pedestrian realm is unique in that the building is separated from the Bowker Overpass ramps and Boylston Street by approximately a half-acre of DCR land. A remnant of the former Charlesgate West overpass, the opportunity to integrate this land with the neighboring and historic Back Bay Fens is to be studied as the Project advances. Beyond this landscape lie formal and distinct entrances to both the apartment and condominium portions of the tower, a dining terrace and entry to the proposed restaurant and accessory retail, and an existing stair leading down to the private alley and Ipswich Street that will be upgraded and expanded.

Above the Ipswich and Boylston lobby levels, the stone and glass podium contains one floor of office, mechanical and storage for the residents, and two of the three floors of parking. Critical infrastructure is raised above possible flood levels and is oriented toward the private alley to maximize opportunities for day lit, habitable space with the best views. The parking floors are double high, allowing in the short term for stacked vehicle storage and in the long term for possible repurposing to additional office or dwelling space.

The residential tower is divided roughly in half, with the lower portion housing a shared amenity space on the roof of the podium and 173 rental units. A mid-tower mechanical space marks the transition to the condominium floors, with a private amenity area and terrace on the roof of the mid-tower mechanical space below. Balconies are provided in many of the units and are distributed along the façade to enhance views and to define the architectural features of the building. The building is capped by a vertically enclosed penthouse offering the potential for a small PV array and/or roof deck area for residents to enjoy 270 degree views to Cambridge and Boston.

Embraced by historic landscapes and structures, at a significant inflection point where two neighborhoods meet, 2 Charlesgate West aspires to be an iconic addition to the Boston skyline and the neighborhoods that surround it (see Figure 6-4).

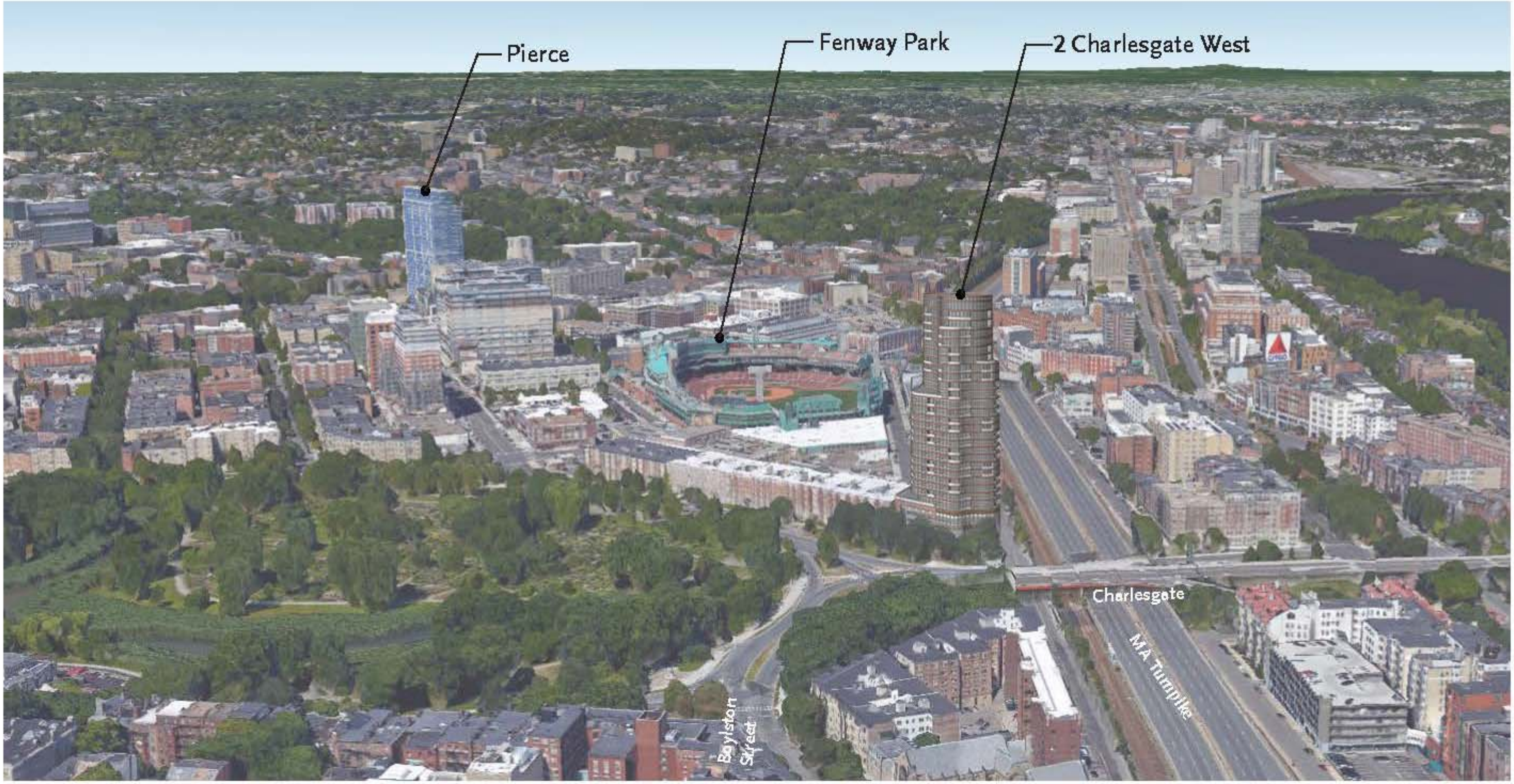


Figure 6-1

View from the East

Figure 6-2

View from Ipswich Street

Figure 6-3

View from Ipswich Street facing the Bowker Overpass

Figure 6-4

View from the Mass Pike facing East

Chapter 7.0

Historic and Archaeological Resources

7.0 HISTORIC AND ARCHAEOLOGICAL RESOURCES

The Historic and Archaeological Resources section describes the historic and archaeological resources within and in the vicinity of the Project site.

7.1 Project Site

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

The Project site is bounded by Ipswich Street to the north, Charlesgate West to the east, private alley 938 to the west, and 1163 Boylston to south. The greenspace and mature plantings located between the Project site and Charlesgate West is owned by DCR. This land is not part of the National Register Listed Olmstead Park System Emerald Necklace or Back Bay Fens. The DCR land was previously Charles Gate West roadway before modification to and construction of the new overpass and intersection in the mid-1960s. The DCR Land has been maintained by Trans National Properties for over 20 years under an Adopt-A-Lot Agreement signed with MDC in 2001 (and transferred to DCR).

The Project site is an approximately 20,325 sf parcel including the 2 Charlesgate West Trans National building, a six-story commercial building constructed in 1963; 6 Charlesgate West, a two-story commercial block constructed in 1954; and 1161 Boylston Street, a one-story office block and warehouse constructed in 1955.

2 Charlesgate West

Building permits indicate that 2 Charlesgate West was designed by Robert Goodoak and Associates for Charlesgate West Associates. The load bearing concrete building was originally designed as a 5-story block with two basement levels below the first floor, but was constructed as a 6-story block with two basement levels at a cost of $560,000. The two basement levels were and are still used for car parking. In the 1980s, a new entry was constructed and included a concrete ramp and concrete masonry walls. A new rubber membrane roof was installed in 2010. The interior of the building has been modified over time as the occupancy has changed.

6 Charlesgate West

The 2-story load bearing concrete building was designed by Sidney Kalin for Elpanco Incorporated. Building permits indicate that the building was constructed to house a sales and service organization. The building was constructed at a cost of $98,000. In 1978, the limestone facing on the building was removed and replaced with 32 gauge metal panels.

1161 Boylston Street

Like 6 Charlesgate West to the north, the one-story office and warehouse block at 1161 Boylston Street was designed by Sidney Kalin for Elpanco Incorporated. Building permits indicate that the building was constructed as a Dictaphone warehouse and office. The load bearing concrete building was constructed at a cost of $30,000.

7.2 Historic Resources Within the Vicinity of the Project Site

The Project site is located within and in the vicinity of several historic resources listed in the State and National Registers of Historic Places or included in the Inventory of Historic and Archaeological Assets of the Commonwealth. Table 7-1 identifies these resources within one-quarter mile of the Project Site and corresponds to resources depicted in Figure 7-1.

Table 7-1 Historic Resources in the Vicinity of the Project Site

No.	Historic Resource	Address	Designation*
	Charles River Basin	Follows the banks of the Charles River in Boston, Cambridge, Watertown, and Newton.	NRDIS
	Back Bay Architectural District	Roughly bounded by Back St., Embankment Rd. and Arlington St., Boylston St. and Charlesgate East	LHD
	Back Bay Historic District	Roughly bounded by Arlington, Providence, St. James, Exeter, and Boylston Streets, Charlesgate East, and the Charles River	NRDIS
	Commonwealth Avenue Mall	Extends ten blocks from Arlington Street to Kenmore Square connecting the Public Garden to the Fens	NRDIS, LHD, LL
	Bay State Road Back Bay Architectural Conservation District	Following Bay State Road and roughly bounded by Back Street, Charlesgate West, Newbury Street, and Grant Street	LHD
	Back Bay Fens	Roughly bound by Brookline Avenue, Park Drive, Boylston Street, and Fenway	NRDIS, LL
	Olmstead Park	Roughly bound by Brookline Avenue, Park Drive, Boylston Street, and Fenway	NRDIS

Table 7-1 Historic Resources in the Vicinity of the Project Site (continued)

No.	Historic Resource	Address	Designation*
	Fenway-Boylston Street Historic District	Roughly bound by Boylston Street, Fenway, Westland Avenue, and Hemenway St.	NRDIS
	Kenmore Square	Roughly bounded by Beacon Street, Commonwealth Avenue, and Deerfield Street	NRIND, NRDIS, NHL, LL
	Charles River Esplanade	Roughly bounded by Boston University Bridge, Storrow Drive, Embankment Road, Monsignor O'Brien Highway and the Charles River.	NRDIS, LL
1	Fenway Park	Roughly bounded by Brookline Avenue, Yawkey Way, Van Ness Street and Lansdowne St.	NRIND
2	John R. Smith Building	64-78 Brookline Ave.	NRIND
3	Fenway Park Rooftop Structures	416-426 Boylston St.	NRDIS, LL
4	Frederick Ayers Mansion	395 Commonwealth Ave.	NRDIS, LHD, NHL
5	Tommy Leonard Bridge	Massachusetts Ave.	NRDIS, LHD, LL
6	Leif Ericsson Statue	Commonwealth Ave.	NRDIS, LHD, LL
7	Fenway Studios Building	30 Ipswich St.	NRIND, NHL
8	Boylston Street Bridge	Boylston Street	NRIND, LL
9	John Boyle O'Reily Memorial	Boylston Street	NRIND, LL
10	Massachusetts Historical Society Building	1154 Boylston Street	NRDIS, NRIND, NHL
11	Mother's Rest Childrens Playground	Boylston Street	NRDIS, LL
12	Back Bay Fens Victory Garden	Park Dr.	NRIND, LL
13	The New Riding Club	52 Hemenway St.	NRIND
14	Boston Fire Alarm Headquarters Building	The Fenway	NRDIS, LL
15	Agassiz Road Gate House	Agassiz Road	NRDIS, LL
16	Agassiz Road Bridge	Agassiz Road	NRDIS, LL

*Designation Legend

NRIND	Individually listed on the National Register of Historic Places
NRDIS	National Register of Historic Places historic district
NRDOE	Determined eligible for inclusion in the National Register of Historic Places
NHL	National Historic Landmark
LHD	Local Historic District
LL	Local Landmark

G:\Projects2\MA\Boston\4404\historic.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

2 Charlesgate West Boston, Massachusetts

Epsilon ASSOCIATES INC.

Figure 7-1

Historic Resources

7.3 Archaeological Resources Within the Project Site

A review of Massachusetts Historical Commission's online archaeological base maps was conducted on June 21, 2016. It found no known archeological sites within the Project site or the immediate vicinity.

7.4 Potential Impacts to Historic Resources

7.4.1 Demolition of Existing Buildings

The proposed Project will require the demolition of the three existing buildings within the Project site. None of the buildings are listed or have been found to be eligible for listing on the National Register of Historic Places. Additionally, all of the buildings have had some level of alteration, such as 6 Charlesgate West, which had all of its limestone facing removed and replaced with 32 gauge metal panels in 1978. The Boston Landmarks Commission (BLC) will be afforded the opportunity to review the proposed demolition through the Article 85 Demolition Delay review process.

7.4.2 Urban Design

The Project is an approximately 344,000 sf, approximately 340-foot tall, 295-unit residential building that also includes 10,000 sf of restaurant space and 7,500 sf of office space. The new building will have varied elevations with different setbacks and elements that are characteristic and complementing of the nearby buildings and neighborhoods.

The Project is located in one of two gateway sites in the Fenway Neighborhood District under Section 66-31 of the Boston Zoning Code, which is intended to encourage "the development of architecturally-distinctive civic landmarks at major entrances to the Fenway neighborhood." The Project has been designed to meet this high standard by providing an iconic landmark to serve as a gateway to the Fenway neighborhood approaching from the east. The Project has been designed to take into consideration the historic characteristics of the surrounding buildings and neighborhoods, but is executed in a manner that clearly reads as new. The introduction of ground floor commercial space and street improvements along Ipswich Street will enhance the pedestrian experience.

7.4.3 Visual Impacts to Historic Resources

The Project is within the Fenway-Kenmore neighborhood of Boston, home to multiple properties listed on the State and National Registers of Historic Places. Several listed properties are located in the immediate vicinity of the Project site including, but not limited to, the Boylston Street Bridge, Fenway Studios (also a National Historic Landmark), and Fenway Park.

The proposed building has a 5-story base and a 24-story tower. The base is similar in height to other buildings in the area, keeping a consistent streetwall within large ground floor storefront windows and multi-light upper story windows similar to the surrounding buildings. The slender tower is designed to be set back from the base and has a much narrower frame than is typical of other tall buildings in Boston.

While the Project is within the viewshed of a number of nearby historic properties due to its height, the mass of the building is minimized by its small frame and terraced levels. The entrances on the east and north elevations will scale down the building to street level, while maintaining a sense of depth from the sidewalk. The proposed Project is in keeping with the architectural character of the surrounding neighborhood.

7.4.4 Shadow Impacts to Historic Resources

Shadow impacts to the historic resources will be mitigated by the presence of other multistory buildings already casting shadows in the area. As illustrated in the shadow study diagrams (Figures 4.2-1 to 4.2-14), during isolated time periods the Project will cast minimal net new shadow on areas within the Bay State Road-Back Bay Local Historic District, the Back Bay Architectural District, and the Olmstead Park System along a portion of Charlesgate and Boylston Street.

New shadow on historic resources is limited to new shadow at 12:00 p.m. and 3:00 p.m. on March 21, 3:00 p.m. on June 21, 12:00 p.m. and 6:00 p.m. on September 21, and 9:00 a.m., 12:00 p.m. and 6:00 p.m. on December 21. However, new shadow will be minimized by the existing shadow cast from other multi-story buildings in the area as well as the thin frame of the proposed tower. Most historic resources will only have a moving narrow band of new shadow cast upon them and only at an isolated time. Net new shadow created by the Project will have no significant impacts on historic resources.

7.4.5 Wind Impacts to Historic Resources

The Project entails the construction of a new building which will result in localized changes in wind conditions. Within the surrounding area, wind condition at pedestrian level will both improve and degrade in small measures depending upon the location. Wind conditions at most locations studied are predicted to remain comfortable for walking or better. However, at some locations around the building perimeter, along Ipswich Street, and to the east of the Project site, wind conditions are expected to be uncomfortable. The Project is unlikely to affect the setting of nearby historic properties.

7.5 Consistency with Other Historic Reviews

7.5.1 Boston Landmarks Commission Article 80 Review

The submission of this PNF initiates review of the Project by the BLC under the City's Article 80 Review process.

7.5.2 Boston Landmarks Commission Article 85 Review

The proposed demolition of the existing buildings on the Project site, including 2 Charlesgate West, 6 Charlesgate West, and 1161 Boylston Street will be subject to review by the Boston Landmarks Commission under Article 85 of the Boston Zoning Code. An Article 85 Application for each property will be submitted to the BLC.

7.5.3 Massachusetts Historical Commission

The MHC has review authority over projects requiring state funding, licensing, permitting and/or approvals that may have direct or indirect impacts to properties listed in the State Register of Historic Places. If a state permit is required for the Project, the MHC review process will be initiated through the filing of an MHC Project Notification Form as prescribed in MHC's governing regulations.

Chapter 8.0

Infrastructure

8.0 INFRASTRUCTURE SYSTEMS COMPONENT

8.1 Introduction

The Infrastructure Systems Component outlines the existing utilities surrounding the Project site, the connections required to provide service to the Project, and any impacts on the existing utility systems that may result from the construction of the Project. The following utility systems are discussed herein:

- Sewer;
- Domestic water;
- Fire protection;
- Drainage;
- Natural gas;
- Electricity; and
- Telecommunications.

The Project site is approximately 0.5-acres and is bounded by Ipswich Street to the north, landscaped open space and Charlesgate West to the east, Private Alley 938 to the west, and 1163 Boylston Street to the south. The existing site comprises three connected buildings with an alley and parking area in the back. The proposed Project includes the demolition of the existing buildings, and construction of a new 29-story residential building with an underground garage.

8.2 Wastewater

8.2.1 Existing Sewer System

The Boston Water and Sewer Commission (BWSC) owns and maintains the sewer system that services the City of Boston. The BWSC sewer system connects to the Massachusetts Water Resources Authority (MWRA) interceptors for conveyance, treatment, and disposal through the MWRA Deer Island Wastewater Treatment Plant. There are BWSC sanitary sewer mains near the Project site.

There is a BWSC 18-inch by 15-inch BWSC sanitary sewer main in Ipswich Street that begins just west of the west side property line in Ipswich Street and runs adjacent to the 132 Ipswich Street building. There is also an 18-inch by 15-inch BWSC sanitary sewer main in Private Alley 938 that begins just south of Project site.

The 18-inch by 15-inch BWSC sanitary sewer main west of the Project site in Ipswich Street flows westerly, and connects to a 30-inch by 36-inch BWSC sanitary sewer main in Ipswich Street. The 18-inch by 15-inch BWSC sanitary sewer main in Private Alley 938 flows southerly, increases to an 18-inch by 20-inch sewer main, and connects to the 30-inch by 36-inch BWSC sanitary sewer main in Ipswich Street. The 30-inch by 36-inch BWSC sanitary sewer main connects to an MWRA sewer main and is ultimately directed to the Deer Island Wastewater Treatment Plan for treatment and disposal. The existing BWSC sanitary sewer system is shown in Figure 8-1.

Record plans indicate that there are several existing building sewer services that appear to connect to the manhole at the end of the 18-inch by 15-inch BWSC sanitary sewer main in Private Alley 938, although the available record plans do not show exact building connection locations. Additionally, there are additional sewer easements in the Project site. The Proponent will work with BWSC to determine what is located within the existing sewer easements and what BWSC will require in order to build over the existing sewer easements.

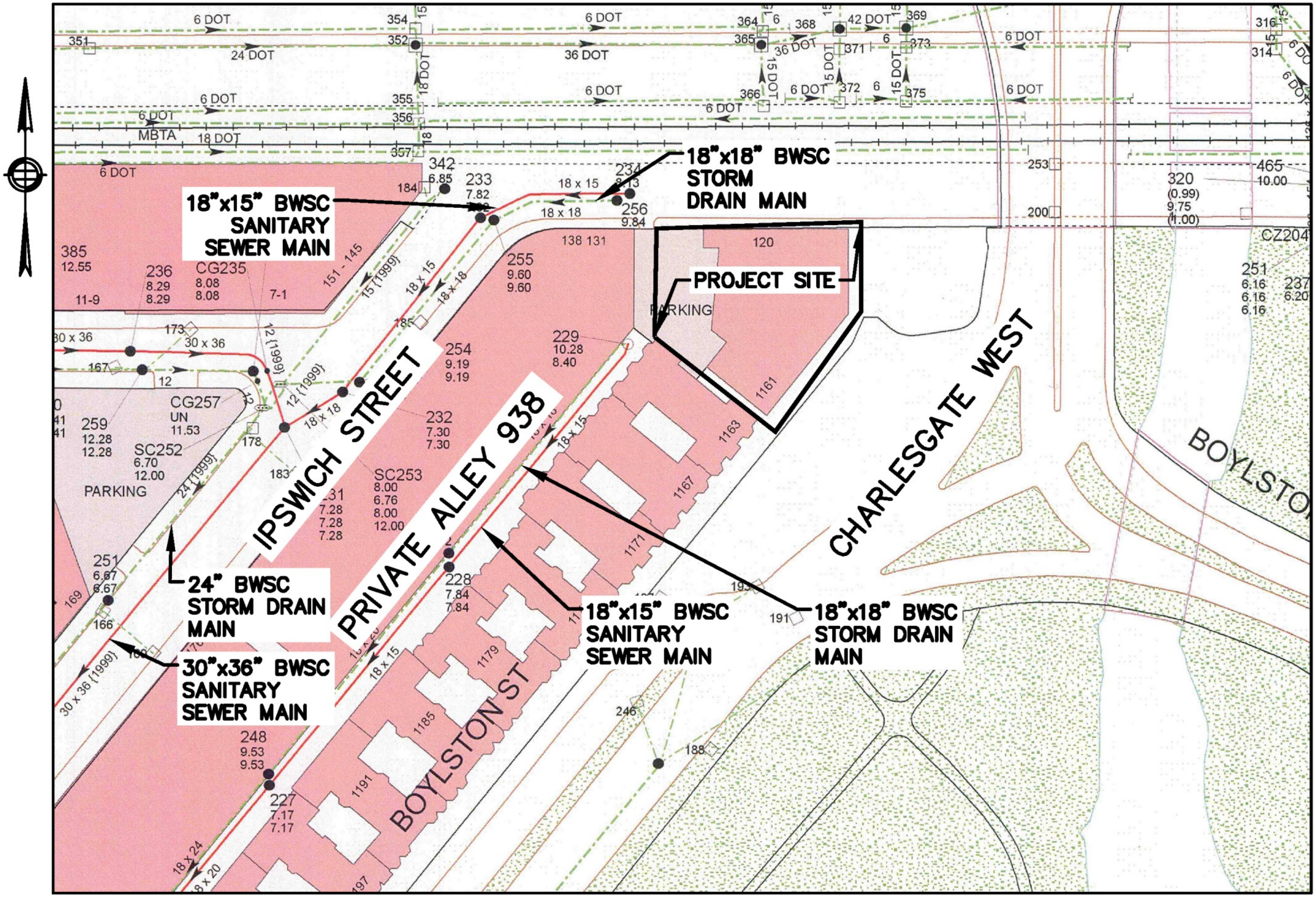
The Project's existing sanitary flows were estimated using 310 CMR 15.203 for office uses. 310 CMR 15.203 lists typical sewage generation values by the building use and are conservative values for estimating the sewage flows from buildings. The 310 CMR 15.203 values are used to evaluate new sewage flows or, to estimate existing sewer flows to determine the approximate increase in sewer flows due to the Project.

There are three existing office buildings on site with approximately 51,840 sf of office space. The existing average daily sewage generation is estimated to be approximately 3,888 gallons per day (gpd), as shown below in Table 8-1.

8.2.2 Wastewater Generation

The Project will consist of a new residential building with office space, and a restaurant. The development will include approximately 295 apartments (397 total bedrooms), office space, and a restaurant with approximately 190 seats.

Estimated Sewage flows calculated with 310 CMR 15.203 values and the proposed development program are summarized below in Table 8-1. The total estimated proposed sewage flow for the Project is approximately 50,883 gallons per day (gpd), or an increase of approximately 46,995 gpd compared to the existing condition.



SCALE:
1"=100'

2 Charlesgate West Boston, Massachusetts

Figure 8-1

Existing Sanitary Sewer and Drainage System

Nitsch Engineering

Table 8-1 Estimated Sewage Flows

Proposed Use	Units/Size	Design Flow Rate (GPD/unit)	Proposed Sanitary Flows (GPD)
Residential	397 bedrooms	110/bedroom	43,670
Office	7,500 sf	75/1,000 sf	563
Restaurant	190 seats	35/seat	6,650
TOTAL PROPOSED SANITARY FLOW			50,883
Existing Use	**Units/Size**	**Design Flow Rate (GPD/unit)**	**Existing Sanitary Flows (GPD)**
Office	51,840 sf	75/1000 sf	3,888
TOTAL EXISTING SANITARY FLOW			3,888
TOTAL INCREASE IN SEWER FLOWS			46,995

8.2.3 Sewage Capacity

The Project's impact on the existing BWSC systems in Ipswich Street and Private Alley 938 were analyzed. The existing sewer system capacity calculations are presented below in Table 8-2.

Table 8-2 Sewer Hydraulic Capacity Analysis

BWSC Sewer Manhole[2]	Slope (%)[1]	Dia. (inches)	Manning's Number	Flow Capacity (cfs)[3]	Flow Capacity (MGD)
Ipswich Street					
234 to 233	0.2%	18 x 15	0.013	4.00	2.59
			Minimum Flow Analyzed:	4.00	2.59
Private Alley 938					
229 to 228	0.2%	18 x 15	0.013	4.09	2.64
			Minimum Flow Analyzed:	4.09	2.64

1. Slope was calculated with inverts obtained from the BWSC Sewer Map received 07/12/2016.
2. BWSC sewer manhole numbers are from BWSC GIS Sewer Maps.
3. Flow calculations based on Manning's Equation.

Table 8-2 indicates the flow (hydraulic) capacity of the 18-inch by 15-inch sanitary sewer main in Ipswich Street, and the 18-inch by 15-inch sanitary sewer main in Private Alley 938. The minimum flow capacity is 2.59 million gallons per day (MGD) or 4.00 cubic feet per second (cfs) for the 18-inch by 15-inch main in Ipswich Street, 2.64 MGD or 4.09 cfs for the 18-inch by 15-inch system in Private Alley 938.

As previously stated, the approximate proposed increase in sewage flow is 46,995 gpd or 0.0469 MGD. Based on an increase in average daily flow of 0.0469 MGD; and with a factor of safety of 10 (total estimate = 0.0469 MGD x 10 = 0.469 MGD), the existing sewer mains in Ipswich Street and/or Private Alley 938 are not expected to have any capacity constraints.

8.2.4 Proposed Conditions

The proposed building will require new building sewer services. The new sewer services for the Project may connect to either the existing BWSC sanitary sewer mains in Ipswich Street or in Private Alley 938.

The Project will require new sanitary sewer connections to the BWSC sewer system. Improvements to and connections to BWSC infrastructure will be reviewed as part of the BWSC's Site Plan Review process for the Project. This process will include a comprehensive design review of the proposed service connections, an assessment of Project demands and system capacity, and the establishment of service accounts. Coordination with BWSC will include review and approval of the design, capacity, connections, and flow increase resulting from the proposed discharges to the sanitary sewer system. In total, the complete Project sewer generation is expected to increase wastewater flows by approximately 46,995 gpd for the Project. Approval for the increase in sanitary flow will come from BWSC.

8.3 Water System

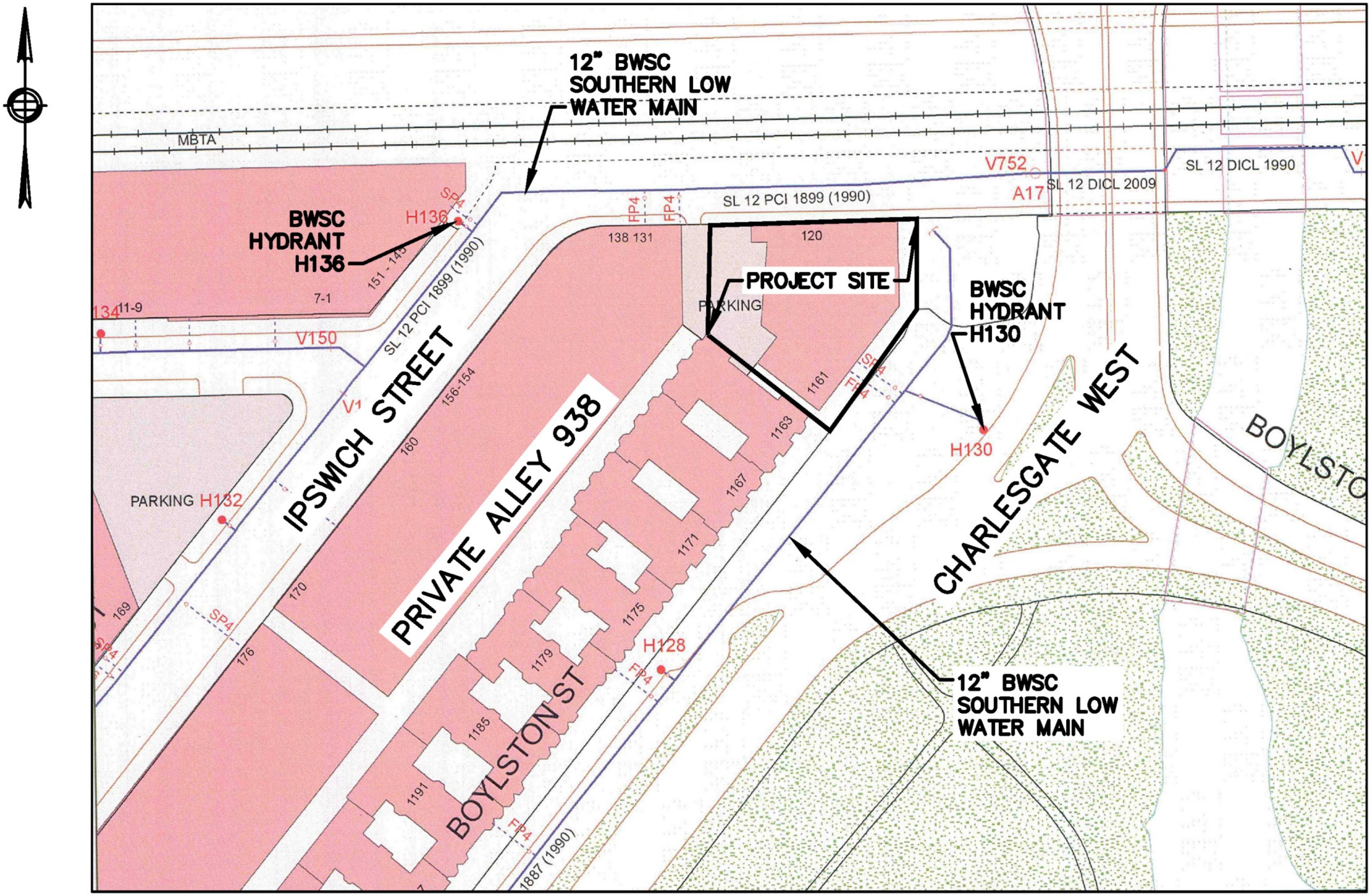
8.3.1 Existing Water System

Water for the Project will be provided by BWSC. BWSC is supplied water by the MWRA system.

There are five water systems within the City of Boston, and these provide service to portions of the City based on ground surface elevation. The five systems are the southern low (SL), southern high (SH), southern extra high (SEH), northern low (NL), and northern high (NH). Water mains are labeled by their system, pipe size, year installed, pipe material, and year cement lined (CL), if applicable.

There are existing BWSC water mains adjacent to the Project site. There is a 12-inch BWSC southern low main in Boylston Street/Charlesgate West (SL 12 PCL 1887 (1990)) and a 12-inch BWSC southern low water main in Ipswich Street (SL 12 PCL 1899(1990)).

Record Drawings indicate that the existing buildings share one water service and one fire protection service which connects to the 12-inch water main in Boylston Street/Charlesgate West. The existing BWSC water system is shown in Figure 8-2.



2 Charlesgate West **Boston, Massachusetts**

SCALE:
1"=100'

Nitsch Engineering

Figure 8-2

Existing Water System

The Project's approximate existing water usage for domestic water service is based on the Project's estimated existing sewage generation, described in the previous section. A conservative factor of 1.1 (10%) is applied to the estimated existing average daily sewage flows to account for consumption, system losses and other usages to estimate an average daily water demand. The estimate is used to compare the proposed average daily water demand to the existing conditions. The existing building's estimated water usage is estimated to be approximately 4,277 gallons per day (gpd). The existing BWSC water system is shown in Figure 8-2.

8.3.2 Anticipated Water Consumption

The Project's water demand estimate for the domestic services is based on the Project's estimated sewage generation, described in the previous section. A conservative factor of 1.1 (ten percent) is applied to the estimated daily sewage flows, calculated in Table 7-1 to account for consumption system losses, and other usages to estimate an average daily water demand. The estimated proposed domestic water demand is approximately 55,971 gallons per day, or an increase of approximately 51,694 gpd compared to the existing condition.

8.3.3 Existing Water Capacity

BWSC record flow test data containing actual flow and pressure for hydrants within the vicinity of the Project site was requested by the Proponent. Hydrant flow data was not available near the Project site. As the design progresses, the Proponent will request hydrant flows be conducted by BWSC adjacent to the Project, as hydrant flow test data must be less than one-year old when used for design.

8.3.4 Proposed Water Improvements

The proposed Project will require a new domestic water service and fire protection services. The domestic water and fire protection services for the Project will connect to the existing BWSC water mains in Ipswich Street and/or Private Alley 938.

The domestic water and fire protection service connections required for 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 will include 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.

8.3.5 Proposed Impacts

No water capacity constraints are anticipated within the BWSC water system as a result of the Project's construction.

Efforts to reduce water consumption will be made. Aeration fixtures and appliances will be chosen for water conservation qualities. In public areas, sensor operated faucets and toilets will be installed.

New water services will be installed in accordance with the latest local, state, and federal codes and standards. Backflow preventers will be installed at both domestic and fire protection service connections. New meters will be installed with Meter Transmitter Units(MTU's) as part of the BWSC's Automatic Meter Reading(AMR) system.

8.4 Stormwater System

8.4.1 Existing Storm Drainage System

The Project site consists of building roof, paved walkways, and landscaped areas. The existing site is approximately 94 percent impervious.

There are BWSC storm drain mains in Ipswich Street and Private Alley 938. There is an 18-inch by 18-inch BWSC storm drain main in Ipswich Street, and an 18-inch by 18-inch BWSC storm drain main in Private Alley 938. The 18-inch by 18-inch storm drain main in Ipswich Street, which begins just west of the west side property line in Ipswich Street and runs adjacent to the 132 Ipswich Street building, flows westerly and southerly to the 24-inch storm drain main in Ipswich Street. This main ultimately discharges to the Charles River via a storm drain outfall flowing north in Deerfield Street. The 18-inch by 18-inch storm drain main in Private Alley 938, which begins just south of Project site, flows southerly and westerly, increasing to an 18-inch by 24-inch storm drain main, and connects to a 15-inch storm drain main in Ipswich street which flows north. The main ultimately discharges to the Charles River via the same stormwater outfall flowing north in Deerfield Street.

Stormwater runoff from the paved areas on the western side of the site sheet flows and is collected by a catch basin north of the site on Ipswich Street. BWSC records do not indicate where this catch basin connects to, however it may connect to either the existing 18-inch storm drain main in Ipswich Street, or directly discharge to the Muddy River, which both ultimately discharge to the Charles River.

Stormwater runoff from the paved areas of the eastern side of the site is collected by either a leaching basin in the landscape area of the park in Charlesgate West, or by catch basins south of the site located on Boylston Street. BWSC records do not indicate where these catch basins connect to, however they may connect to the 10-inch storm drain main in

Boylston Street or directly discharge to the Muddy River. The 10-inch storm drain main in Boylston Street may ultimately discharge to the Charles River via the Muddy River or directly to the Charles River.

Record plans do not indicate existing building drain services, however, existing building services may connect to either existing 18-inch by 18-inch storm drain main in Ipswich Street or to the 18-inch x 18-inch storm drain main in Private Alley 938.

The existing BWSC Storm Drainage System is shown in Figure 8-1.

8.4.2 Proposed Drainage Improvements

The proposed design will be nearly 100 percent impervious, or an increase of approximately six percent compared to existing conditions. The proposed impervious area will consist mostly of building roof and paved pedestrian sidewalks. The Project will be designed to meet or reduce stormwater runoff peak rates and volumes, and to minimize the loss of annual stormwater recharge to groundwater through the use of on-site infiltration measures to the greatest extent practicable.

The Project is within the Groundwater Conservation Overlay District, and as a result, the Project will be designed to capture and recharge one-inch of stormwater from the impervious site areas. The Project's design will include a private closed drainage system that will be adequately sized for the site's expected stormwater flows, and will direct stormwater to the on-site infiltration system for groundwater recharge prior to overflow to the BWSC systems. Due to the limited site area, the Project will likely incorporate a combination of interior stormwater storage tanks and groundwater recharge wells, and underground recharge systems. Overflow connections to the BWSC storm drain mains will be provided for greater stormwater flows. The on-site infiltration systems will strive to infiltrate one-inch of stormwater runoff from impervious areas to the greatest extent practicable, in order to meet the BWSC stormwater quality and stormwater recharge requirements.

Improvements to the BWSC infrastructure and the existing private storm drain systems will be evaluated as part of the BWSC Site Plan Review Process.

8.4.3 Water Quality

The Project will not affect the water quality of nearby water bodies. Erosion and sediment control measures will be implemented during construction to minimize the transport of site soils to off-site areas and BWSC storm drain systems. During construction, existing catch basins will be protected with filter fabric, straw bales and/or crushed stone, to provide for sediment removal from runoff. These controls will be inspected and maintained throughout the construction phase until the areas of disturbance have been stabilized through the placement of pavement, structure, or vegetative cover.

All necessary dewatering will be conducted in accordance with applicable MWRA and BWSC discharge permits. Once construction is complete, the Project will be in compliance with local and state stormwater management policies, as described below

8.4.4 Compliance with DEP Stormwater Management Policy Standards

In 1996, the Massachusetts Department of Environmental Protection (MassDEP) issued the Stormwater Policy that established Stormwater Management Standards aimed at encouraging recharge and preventing stormwater discharges from causing or contributing to the pollution of the surface waters and groundwaters of the Commonwealth. MassDEP applies the Stormwater Management Standards pursuant to its authority under the Wetlands Protection Act, M.G.L. c. 131, § 40, and the Massachusetts Clean Waters Act, M.G.L .c. 21, §§ 26-53. The revised Stormwater Management Standards have been incorporated in the Wetlands Protection Act Regulations, 310 CMR 10.05(6)(k) and the Water Quality Certification Regulations, 314 CMR 9.06(6)(a).

A description of the Project's anticipated compliance with the Standards is outlined below:

Standard #1: No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

Compliance: The proposed design will comply with this standard. The design does not propose new stormwater conveyances and no new untreated stormwater will be directly discharged to, nor will erosion be caused to, wetlands or waters of the Commonwealth as a result of stormwater discharges related to the Project.

Standard #2: Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

Compliance: The proposed design will comply with this standard to the maximum extent practicable. The existing peak discharge rate will be met or will be decreased as a result of the improvements associated with the Project.

Standard #3: Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

Compliance: The Project will comply with this standard. The Project is located within Boston's Groundwater Conservation Overlay District, and the stormwater system will be designed to capture and infiltrate 1-inch of stormwater from the impervious site's areas.

Standard #4: Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:

a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;

b. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and

c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

Compliance: The proposed design will comply with this standard. Within the Project site, there will be mostly roof and paved sidewalks. Runoff from paved areas that would contribute unwanted sediments or pollutants to the existing storm drain system will be collected by deep sump, hooded catch basins and treated before discharging into the BWSC system.

Standard #5: For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

Compliance: The proposed design will comply with this standard. The proposed design will include source control, pollution prevention and pretreatment practices, as necessary.

Standard #6: Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a *significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.*

Compliance: Not Applicable. The proposed Project is not within an outstanding resource area.

Standard #7: A redevelopment Project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment Project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

Compliance: The Project will comply with this standard to the maximum extent practicable.

Standard #8: A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

Compliance: The proposed design will comply with this standard. A plan to control temporary construction-related impacts including erosion, sedimentation, and other pollutant sources during construction and land disturbing activities will be developed and implemented.

Standard #9: A long-term operation and maintenance (O&M) plan shall be developed and implemented to ensure that stormwater management systems function as designed.

Compliance: The Project will comply with this standard. An O&M Plan including long-term Best Management Practices (BMP) operation requirements will be prepared for the Project and will assure proper maintenance and functioning of the stormwater management system.

Standard #10: All illicit discharges to the stormwater management system are prohibited.

Compliance: The Project will comply with this standard. There will be no illicit connections associated with the Project. Temporary construction dewatering will be conducted in accordance with applicable BWSC and Massachusetts Water Resource Authority (MWRA) requirements, as necessary.

8.5 Electrical Service

Eversource Energy owns the electrical system in the vicinity of the Project site. It is expected that adequate service is available in the existing electrical systems in the surrounding streets to serve the Project. The Proponent will work with Eversource to confirm adequate system capacity as the design is finalized.

8.6 Natural Gas

National Grid has gas services in the vicinity of the Project site. The Proponent will work with National Grid to confirm adequate system capacity as design is finalized.

8.7 Telecommunications Systems

The Proponent will select private telecommunications companies to provide telephone, cable, and data services. There are several potential candidates with substantial Boston networks capable of providing service. Upon selection of a provider or providers, the Proponent will coordinate service connection locations and obtain appropriate approvals.

8.8 Utility Protection During Construction

Existing public and private infrastructure located within any public or private rights-of-way shall be protected during construction. The installation of proposed utilities within a public way will be in accordance with the BWSC, Boston Public Works Department, Dig-Safe Program, and applicable utility company requirements. Specific methods for construction of proposed utilities where they are near or within existing BWSC water, sewer, and drain facilities will be reviewed by the BWSC as part of the Site Plan Review Process. The necessary permits will be obtained before the commencement of work.

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. See Appendix G for the Accessibility Checklist.

9.2 Massachusetts Environmental Policy Act (MEPA)

The Proponent does not expect that the Project will require review by the Massachusetts Environmental Policy Act (MEPA) Office of the Massachusetts Executive Office of Energy and Environmental Affairs. The Project is not expected to exceed any of the review thresholds triggering the requirement to file an ENF of an EIR in connection with any state permits that might be required, and the Project will not seek state funding, or involve any state land transfers.

9.3 Massachusetts Historical Commission

The MHC has review authority over projects requiring state funding, licensing, permitting and/or approvals that may have direct or indirect impacts to properties listed in the State Register of Historic Places. If a state permit is required for the Project, the MHC review process will be initiated through the filing of an MHC Project Notification Form as prescribed in MHC's governing regulations.

9.4 Boston Landmarks Commission

The proposed demolition of the existing buildings on the Project site, including 2 Charlesgate West, 6 Charlesgate West, and 1161 Boylston Street will be subject to review by the Boston Landmarks Commission under Article 85 of the Boston Zoning Code. An Article 85 Application for each property will be submitted to the BLC.

9.5 Boston Civic Design Commission

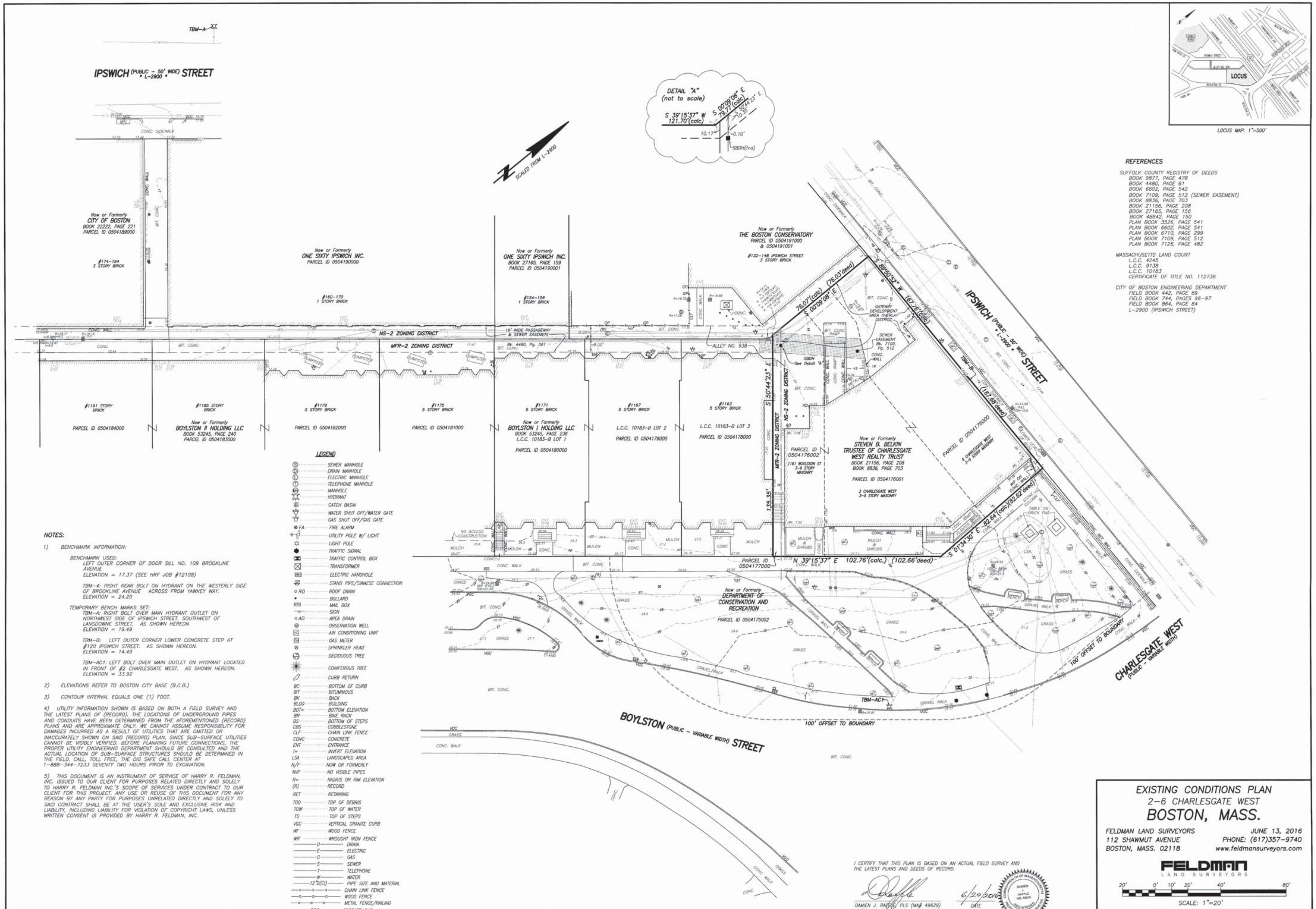
The Project will comply with the provisions of Article 28 of the Boston Zoning Code. This PNF will be submitted to the Boston Civic Design Commission by the BRA as part of the Article 80 process.

9.6 Division of Conservation and Recreation and Boston Parks and Recreation Department

Given the Project's proximity to the Fens park system, as well as the opportunity to provide better connections to the Fens through the DCR open space parcel adjacent to the Project site, the Proponent intends to work closely with both DCR and the Boston Parks and Recreation Department to improve the DCR parcel and to provide other improvements to the open space and park resources in the area.

Appendix A

Site Survey



NOTES:

1) BENCHMARK INFORMATION:

BENCHMARK USED:
LEFT OUTER CORNER OF DOOR SILL NO. 109 BROOKLINE AVENUE
ELEVATION = 17.37 (SEE HRF JOB #12108)

TBM-4: RIGHT REAR BOLT ON HYDRANT ON THE WESTERLY SIDE OF BROOKLINE AVENUE ACROSS FROM YAWKEY WAY.
ELEVATION = 24.20

TEMPORARY BENCH MARKS SET:
TBM-A: RIGHT BOLT OVER MAIN HYDRANT OUTLET ON NORTHWEST SIDE OF IPSWICH STREET. SOUTHWEST OF LANSDOWNE STREET. AS SHOWN HEREON
ELEVATION = 19.49

TBM-B: LEFT OUTER CORNER LOWER CONCRETE STEP AT #120 IPSWICH STREET. AS SHOWN HEREON.
ELEVATION = 14.49

TBM-AC1: LEFT BOLT OVER MAIN OUTLET ON HYDRANT LOCATED IN FRONT OF #2 CHARLESGATE WEST. AS SHOWN HEREON.
ELEVATION = 33.92

2) ELEVATIONS REFER TO BOSTON CITY BASE (B.C.B.)

3) CONTOUR INTERVAL EQUALS ONE (1) FOOT.

4) UTILITY INFORMATION SHOWN IS BASED ON BOTH A FIELD SURVEY AND THE LATEST PLANS OF (RECORD). THE LOCATIONS OF UNDERGROUND PIPES AND CONDUITS HAVE BEEN DETERMINED FROM THE AFOREMENTIONED (RECORD) PLANS AND ARE APPROXIMATE ONLY. WE CANNOT ASSUME RESPONSIBILITY FOR DAMAGES INCURRED AS A RESULT OF UTILITIES THAT ARE OMITTED OR INACCURATELY SHOWN ON SAID (RECORD) PLAN, SINCE SUB-SURFACE UTILITIES CANNOT BE VISIBLY VERIFIED. BEFORE PLANNING FUTURE CONNECTIONS, THE PROPER UTILITY ENGINEERING DEPARTMENT SHOULD BE CONSULTED AND THE ACTUAL LOCATION OF SUB-SURFACE STRUCTURES SHOULD BE DETERMINED IN THE FIELD. CALL, TOLL FREE, THE DIG SAFE CALL CENTER AT 1-888-344-7233 SEVENTY TWO HOURS PRIOR TO EXCAVATION.

5) THIS DOCUMENT IS AN INSTRUMENT OF SERVICE OF HARRY R. FELDMAN, INC. ISSUED TO OUR CLIENT FOR PURPOSES RELATED DIRECTLY AND SOLELY TO HARRY R. FELDMAN INC.'S SCOPE OF SERVICES UNDER CONTRACT TO OUR CLIENT FOR THIS PROJECT. ANY USE OR REUSE OF THIS DOCUMENT FOR ANY REASON BY ANY PARTY FOR PURPOSES UNRELATED DIRECTLY AND SOLELY TO SAID CONTRACT SHALL BE AT THE USER'S SOLE AND EXCLUSIVE RISK AND LIABILITY, INCLUDING LIABILITY FOR VIOLATION OF COPYRIGHT LAWS, UNLESS WRITTEN CONSENT IS PROVIDED BY HARRY R. FELDMAN, INC.

LEGEND

Ⓢ	SEWER MANHOLE
Ⓓ	DRAIN MANHOLE
Ⓔ	ELECTRIC MANHOLE
Ⓣ	TELEPHONE MANHOLE
⊜	MANHOLE
☼	HYDRANT
▦	CATCH BASIN
♁	WATER SHUT OFF/WATER GATE
♁	GAS SHUT OFF/GAS GATE
⊛ FA	FIRE ALARM
⊸	UTILITY POLE W/ LIGHT
☼	LIGHT POLE
●	TRAFFIC SIGNAL
⧓	TRAFFIC CONTROL BOX
⊠	TRANSFORMER
⊞	ELECTRIC HANDHOLE
SP	STAND PIPE/SIAMESE CONNECTION
○ RD	ROOF DRAIN
•	BOLLARD
▭	MAIL BOX
—o—	SIGN
○ AD	AREA DRAIN
◎	OBSERVATION WELL
AC	AIR CONDITIONING UNIT
GM	GAS METER
⊗	SPRINKLER HEAD
⊖	DECIDUOUS TREE
✳	CONIFEROUS TREE
⬯	CURB RETURN
BC	BOTTOM OF CURB
BIT	BITUMINOUS
BK	BACK
BLDG	BUILDING
BOT=	BOTTOM ELEVATION
BR	BIKE RACK
BS	BOTTOM OF STEPS
CBS	COBBLESTONE
CLF	CHAIN LINK FENCE
CONC	CONCRETE
ENT	ENTRANCE
I=	INVERT ELEVATION
LSA	LANDSCAPED AREA
N/F	NOW OR FORMERLY
NVP	NO VISIBLE PIPES
R=	RADIUS OR RIM ELEVATION
(R)	RECORD
RET	RETAINING
TOD	TOP OF DEBRIS
TOW	TOP OF WATER
TS	TOP OF STEPS
VGC	VERTICAL GRANITE CURB
WF	WOOD FENCE
WIF	WROUGHT IRON FENCE
——D——	DRAIN
——E——	ELECTRIC
——G——	GAS
——S——	SEWER
——T——	TELEPHONE
——W——	WATER
——12"D(CI)——	PIPE SIZE AND MATERIAL
—x—x—x—	CHAIN LINK FENCE
—▫—▫—▫—	WOOD FENCE
—o—o—o—	METAL FENCE/RAILING
——DSG——	DIGSAFE GAS

REFERENCES

SUFFOLK COUNTY REGISTRY OF DEEDS
- BOOK 9877, PAGE 478
- BOOK 4480, PAGE 61
- BOOK 6602, PAGE 542
- BOOK 7109, PAGE 512 (SEWER EASEMENT)
- BOOK 8836, PAGE 703
- BOOK 21156, PAGE 208
- BOOK 27165, PAGE 156
- BOOK 48842, PAGE 150
- PLAN BOOK 3526, PAGE 541
- PLAN BOOK 6602, PAGE 541
- PLAN BOOK 6710, PAGE 299
- PLAN BOOK 7109, PAGE 512
- PLAN BOOK 7126, PAGE 482

MASSACHUSETTS LAND COURT
- L.C.C. 4245
- L.C.C. 9138
- L.C.C. 10183
- CERTIFICATE OF TITLE NO. 112736

CITY OF BOSTON ENGINEERING DEPARTMENT
- FIELD BOOK 442, PAGE 89
- FIELD BOOK 744, PAGES 96-97
- FIELD BOOK 864, PAGE 84
- L-2900 (IPSWICH STREET)

I CERTIFY THAT THIS PLAN IS BASED ON AN ACTUAL FIELD SURVEY AND THE LATEST PLANS AND DEEDS OF RECORD.

DAMIEN J. RAFFLE, PLS (MA# 49629)
djr@feldmansurveyors.com

6/24/2016
DATE

DAMIEN J. RAFFLE NO. 49629

EXISTING CONDITIONS PLAN
2-6 CHARLESGATE WEST
BOSTON, MASS.

FELDMAN LAND SURVEYORS
112 SHAWMUT AVENUE
BOSTON, MASS. 02118

JUNE 13, 2016
PHONE: (617)357-9740
www.feldmansurveyors.com

FELDMAN
LAND SURVEYORS

20' 0' 10' 20' 40' 80'
SCALE: 1"=20'

RESEARCH: MGC	FIELD CHIEF: AC	PROJ MGR: DJR	APPROVED: DJR	SHEET NO. 1 OF 1
CALC: MGC	CADD: MGC	FIELD CHECKED	CRD FILE: 15161-EX	JOB NO. 15161

FILENAME: S:\PROJECTS\15100s\15161\DWG\15161-EX.dwg

Appendix B

Transportation Appendix

Available Upon Request

Appendix C

Wind Appendix

TABLE 1: MEAN SPEED AND EFFECTIVE GUST 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	13		Standing	21		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
	B	Spring	16	+23%	Walking	23		Acceptable
		Summer	13	+30%	Standing	18	+12%	Acceptable
		Fall	14	+17%	Standing	21	+11%	Acceptable
		Winter	16	+14%	Walking	24		Acceptable
		Annual	15	+15%	Standing	22		Acceptable
2	A	Spring	13		Standing	20		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	19		Acceptable
	B	Spring	16	+23%	Walking	24	+20%	Acceptable
		Summer	12	+20%	Sitting	18	+20%	Acceptable
		Fall	15	+25%	Standing	22	+22%	Acceptable
		Winter	16	+23%	Walking	24	+20%	Acceptable
		Annual	15	+25%	Standing	22	+16%	Acceptable
3	A	Spring	13		Standing	21		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
	B	Spring	21	+62%	Uncomfortable	29	+38%	Acceptable
		Summer	17	+70%	Walking	24	+50%	Acceptable
		Fall	20	+67%	Uncomfortable	28	+47%	Acceptable
		Winter	21	+50%	Uncomfortable	30	+36%	Acceptable
		Annual	20	+54%	Uncomfortable	28	+40%	Acceptable
4	A	Spring	11		Sitting	18		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	11		Sitting	18		Acceptable
	B	Spring	26	+136%	Uncomfortable	34	+89%	Unacceptable
		Summer	20	+122%	Uncomfortable	26	+86%	Acceptable
		Fall	24	+118%	Uncomfortable	32	+88%	Unacceptable
		Winter	25	+108%	Uncomfortable	33	+74%	Unacceptable
		Annual	24	+118%	Uncomfortable	32	+78%	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.

<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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
5	A	Spring	16		Walking	24		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	14		Standing	22		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	15		Standing	23		Acceptable
	B	Spring	27	+69%	Uncomfortable	37	+54%	Unacceptable
		Summer	19	+58%	Walking	27	+50%	Acceptable
		Fall	25	+79%	Uncomfortable	34	+55%	Unacceptable
		Winter	26	+53%	Uncomfortable	36	+44%	Unacceptable
		Annual	25	+67%	Uncomfortable	34	+48%	Unacceptable
6	A	Spring	16		Walking	23		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
	B	Spring	24	+50%	Uncomfortable	32	+39%	Unacceptable
		Summer	18	+50%	Walking	24	+33%	Acceptable
		Fall	22	+47%	Uncomfortable	30	+36%	Acceptable
		Winter	26	+53%	Uncomfortable	34	+36%	Unacceptable
		Annual	23	+44%	Uncomfortable	31	+35%	Acceptable
7	A	Spring	17		Walking	24		Acceptable
		Summer	14		Standing	19		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	18		Walking	26		Acceptable
		Annual	17		Walking	23		Acceptable
	B	Spring	26	+53%	Uncomfortable	34	+42%	Unacceptable
		Summer	21	+50%	Uncomfortable	27	+42%	Acceptable
		Fall	24	+50%	Uncomfortable	32	+39%	Unacceptable
		Winter	28	+56%	Dangerous	36	+38%	Unacceptable
		Annual	25	+47%	Uncomfortable	33	+43%	Unacceptable
8	A	Spring	14		Standing	21		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	19		Acceptable
	B	Spring	20	+43%	Uncomfortable	28	+33%	Acceptable
		Summer	17	+55%	Walking	24	+50%	Acceptable
		Fall	19	+46%	Walking	27	+42%	Acceptable
		Winter	21	+50%	Uncomfortable	29	+38%	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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Annual	19	+46%	Walking	27	+42%	Acceptable
9	A	Spring	15		Standing	21		Acceptable
		Summer	12		Sitting	16		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	14		Standing	20		Acceptable
	B	Spring	19	+27%	Walking	26	+24%	Acceptable
		Summer	15	+25%	Standing	20	+25%	Acceptable
		Fall	17	+21%	Walking	24	+20%	Acceptable
		Winter	18	+29%	Walking	26	+24%	Acceptable
		Annual	17	+21%	Walking	24	+20%	Acceptable
10	A	Spring	17		Walking	24		Acceptable
		Summer	14		Standing	19		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	17		Walking	24		Acceptable
		Annual	16		Walking	23		Acceptable
	B	Spring	24	+41%	Uncomfortable	32	+33%	Unacceptable
		Summer	19	+36%	Walking	25	+32%	Acceptable
		Fall	22	+38%	Uncomfortable	29	+26%	Acceptable
		Winter	22	+29%	Uncomfortable	30	+25%	Acceptable
		Annual	22	+38%	Uncomfortable	29	+26%	Acceptable
11	A	DATA NOT AVAILABLE						
	B	Spring	26		Uncomfortable	36		Unacceptable
		Summer	21		Uncomfortable	29		Acceptable
		Fall	24		Uncomfortable	34		Unacceptable
		Winter	28		Dangerous	39		Unacceptable
		Annual	25		Uncomfortable	35		Unacceptable
12	A	DATA NOT AVAILABLE						
	B	Spring	19		Walking	28		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	21		Uncomfortable	30		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.

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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
13	A	Spring	14		Standing	21		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	14		Standing	23		Acceptable
		Annual	13		Standing	21		Acceptable
	B	Spring	21	+50%	Uncomfortable	29	+38%	Acceptable
		Summer	17	+55%	Walking	23	+35%	Acceptable
		Fall	20	+67%	Uncomfortable	27	+42%	Acceptable
		Winter	23	+64%	Uncomfortable	31	+35%	Acceptable
		Annual	21	+62%	Uncomfortable	29	+38%	Acceptable
14	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	26	+62%	Uncomfortable	37	+61%	Unacceptable
		Summer	20	+54%	Uncomfortable	28	+56%	Acceptable
		Fall	24	+60%	Uncomfortable	34	+55%	Unacceptable
		Winter	28	+75%	Dangerous	40	+67%	Unacceptable
		Annual	26	+73%	Uncomfortable	36	+64%	Unacceptable
15	A	Spring	18		Walking	26		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	17		Walking	25		Acceptable
	B	Spring	26	+44%	Uncomfortable	36	+38%	Unacceptable
		Summer	20	+43%	Uncomfortable	28	+40%	Acceptable
		Fall	24	+50%	Uncomfortable	33	+38%	Unacceptable
		Winter	29	+53%	Dangerous	39	+44%	Unacceptable
		Annual	26	+53%	Uncomfortable	36	+44%	Unacceptable
16	A	Spring	18		Walking	25		Acceptable
		Summer	15		Standing	20		Acceptable
		Fall	17		Walking	23		Acceptable
		Winter	18		Walking	26		Acceptable
		Annual	17		Walking	24		Acceptable
	B	Spring	24	+33%	Uncomfortable	34	+36%	Unacceptable
		Summer	19	+27%	Walking	26	+30%	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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Fall	23	+35%	Uncomfortable	32	+39%	Unacceptable
		Winter	25	+39%	Uncomfortable	36	+38%	Unacceptable
		Annual	23	+35%	Uncomfortable	33	+38%	Unacceptable
17	A	Spring	18		Walking	24		Acceptable
		Summer	15		Standing	20		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	17		Walking	24		Acceptable
		Annual	17		Walking	23		Acceptable
	B	Spring	22	+22%	Uncomfortable	31	+29%	Acceptable
		Summer	18	+20%	Walking	25	+25%	Acceptable
		Fall	21	+31%	Uncomfortable	29	+26%	Acceptable
		Winter	23	+35%	Uncomfortable	32	+33%	Unacceptable
		Annual	21	+24%	Uncomfortable	30	+30%	Acceptable
18	A	Spring	16		Walking	23		Acceptable
		Summer	13		Standing	18		Acceptable
		Fall	15		Standing	21		Acceptable
		Winter	16		Walking	22		Acceptable
		Annual	15		Standing	21		Acceptable
	B	Spring	24	+50%	Uncomfortable	32	+39%	Unacceptable
		Summer	18	+38%	Walking	24	+33%	Acceptable
		Fall	22	+47%	Uncomfortable	29	+38%	Acceptable
		Winter	23	+44%	Uncomfortable	32	+45%	Unacceptable
		Annual	22	+47%	Uncomfortable	30	+43%	Acceptable
19	A	Spring	17		Walking	24		Acceptable
		Summer	15		Standing	20		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
	B	Spring	21	+24%	Uncomfortable	31	+29%	Acceptable
		Summer	17	+13%	Walking	24	+20%	Acceptable
		Fall	20	+25%	Uncomfortable	28	+22%	Acceptable
		Winter	22	+29%	Uncomfortable	32	+28%	Unacceptable
		Annual	20	+25%	Uncomfortable	30	+30%	Acceptable
20	A	Spring	17		Walking	24		Acceptable
		Summer	15		Standing	20		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	18		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
	B	Spring	20	+18%	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.

<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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Summer	17	+13%	Walking	23	+15%	Acceptable
		Fall	19	+19%	Walking	27	+17%	Acceptable
		Winter	21	+17%	Uncomfortable	31	+24%	Acceptable
		Annual	19	+19%	Walking	28	+22%	Acceptable
21	A	Spring	17		Walking	24		Acceptable
		Summer	15		Standing	20		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
	B	Spring	20	+18%	Uncomfortable	28	+17%	Acceptable
		Summer	16		Walking	22		Acceptable
		Fall	18	+12%	Walking	26	+13%	Acceptable
		Winter	20	+18%	Uncomfortable	29	+16%	Acceptable
		Annual	19	+19%	Walking	27	+17%	Acceptable
22	A	Spring	17		Walking	24		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	18		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
	B	Spring	20	+18%	Uncomfortable	29	+21%	Acceptable
		Summer	16	+14%	Walking	23	+15%	Acceptable
		Fall	19	+19%	Walking	27	+17%	Acceptable
		Winter	21	+17%	Uncomfortable	30	+20%	Acceptable
		Annual	19	+19%	Walking	28	+22%	Acceptable
23	A	Spring	17		Walking	24		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
	B	Spring	22	+29%	Uncomfortable	31	+29%	Acceptable
		Summer	17	+21%	Walking	24	+20%	Acceptable
		Fall	20	+25%	Uncomfortable	28	+22%	Acceptable
		Winter	23	+35%	Uncomfortable	33	+32%	Unacceptable
		Annual	21	+31%	Uncomfortable	30	+30%	Acceptable
24	A	Spring	16		Walking	23		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	15		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: MEAN SPEED AND EFFECTIVE GUST 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	+12%	Walking	26	+13%	Acceptable
		Summer	15	+15%	Standing	21	+11%	Acceptable
		Fall	17	+13%	Walking	24		Acceptable
		Winter	18	+12%	Walking	26		Acceptable
		Annual	17	+13%	Walking	25	+14%	Acceptable
25	A	Spring	16		Walking	23		Acceptable
		Summer	14		Standing	19		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	16		Walking	23		Acceptable
		Annual	15		Standing	22		Acceptable
	B	Spring	18	+12%	Walking	25		Acceptable
		Summer	14		Standing	19		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	17	+13%	Walking	24		Acceptable
26	A	Spring	16		Walking	22		Acceptable
		Summer	13		Standing	18		Acceptable
		Fall	15		Standing	21		Acceptable
		Winter	16		Walking	22		Acceptable
		Annual	15		Standing	21		Acceptable
	B	Spring	18	+12%	Walking	25	+14%	Acceptable
		Summer	14		Standing	19		Acceptable
		Fall	17	+13%	Walking	23		Acceptable
		Winter	18	+12%	Walking	25	+14%	Acceptable
		Annual	17	+13%	Walking	24	+14%	Acceptable
27	A	Spring	12		Sitting	18		Acceptable
		Summer	11		Sitting	15		Acceptable
		Fall	12		Sitting	17		Acceptable
		Winter	12		Sitting	18		Acceptable
		Annual	12		Sitting	17		Acceptable
	B	Spring	14	+17%	Standing	21	+17%	Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	14	+17%	Standing	21	+17%	Acceptable
		Annual	13		Standing	19	+12%	Acceptable
28	A	Spring	15		Standing	22		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	16		Walking	24		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: MEAN SPEED AND EFFECTIVE GUST 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	20	+33%	Uncomfortable	29	+32%	Acceptable
		Summer	17	+42%	Walking	24	+41%	Acceptable
		Fall	19	+36%	Walking	27	+35%	Acceptable
		Winter	22	+38%	Uncomfortable	31	+29%	Acceptable
		Annual	20	+33%	Uncomfortable	28	+33%	Acceptable
29	A	Spring	15		Standing	22		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	16		Walking	23		Acceptable
		Annual	14		Standing	21		Acceptable
	B	Spring	22	+47%	Uncomfortable	30	+36%	Acceptable
		Summer	15	+36%	Standing	22	+38%	Acceptable
		Fall	20	+43%	Uncomfortable	28	+40%	Acceptable
		Winter	21	+31%	Uncomfortable	30	+30%	Acceptable
		Annual	20	+43%	Uncomfortable	28	+33%	Acceptable
30	A	Spring	13		Standing	20		Acceptable
		Summer	9		Sitting	15		Acceptable
		Fall	11		Sitting	18		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	19		Acceptable
	B	Spring	18	+38%	Walking	25	+25%	Acceptable
		Summer	13	+44%	Standing	18	+20%	Acceptable
		Fall	16	+45%	Walking	23	+28%	Acceptable
		Winter	17	+31%	Walking	25	+25%	Acceptable
		Annual	16	+33%	Walking	24	+26%	Acceptable
31	A	Spring	16		Walking	24		Acceptable
		Summer	11		Sitting	18		Acceptable
		Fall	14		Standing	22		Acceptable
		Winter	15		Standing	24		Acceptable
		Annual	14		Standing	22		Acceptable
	B	Spring	27	+69%	Uncomfortable	36	+50%	Unacceptable
		Summer	18	+64%	Walking	25	+39%	Acceptable
		Fall	24	+71%	Uncomfortable	33	+50%	Unacceptable
		Winter	24	+60%	Uncomfortable	34	+42%	Unacceptable
		Annual	24	+71%	Uncomfortable	33	+50%	Unacceptable
32	A	Spring	11		Sitting	18		Acceptable
		Summer	8		Sitting	13		Acceptable
		Fall	10		Sitting	17		Acceptable
		Winter	11		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.

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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Annual	11		Sitting	17		Acceptable
	B	Spring	13	+18%	Standing	21	+17%	Acceptable
		Summer	9	+12%	Sitting	15	+15%	Acceptable
		Fall	12	+20%	Sitting	19	+12%	Acceptable
		Winter	13	+18%	Standing	20	+11%	Acceptable
		Annual	12		Sitting	19	+12%	Acceptable
33	A	Spring	13		Standing	20		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	13		Standing	19		Acceptable
		Annual	12		Sitting	18		Acceptable
	B	Spring	20	+54%	Uncomfortable	26	+30%	Acceptable
		Summer	14	+56%	Standing	18	+29%	Acceptable
		Fall	18	+50%	Walking	25	+39%	Acceptable
		Winter	19	+46%	Walking	26	+37%	Acceptable
		Annual	18	+50%	Walking	24	+33%	Acceptable
34	A	Spring	12		Sitting	18		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	13		Standing	19		Acceptable
		Annual	12		Sitting	18		Acceptable
	B	Spring	16	+33%	Walking	24	+33%	Acceptable
		Summer	12	+20%	Sitting	17	+13%	Acceptable
		Fall	15	+25%	Standing	22	+22%	Acceptable
		Winter	15	+15%	Standing	23	+21%	Acceptable
		Annual	15	+25%	Standing	22	+22%	Acceptable
35	A	Spring	17		Walking	25		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	24		Acceptable
	B	Spring	21	+24%	Uncomfortable	30	+20%	Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	19	+19%	Walking	28	+22%	Acceptable
		Winter	20	+18%	Uncomfortable	29	+16%	Acceptable
		Annual	19	+19%	Walking	27	+12%	Acceptable
36	A	Spring	12		Sitting	18		Acceptable
		Summer	9		Sitting	15		Acceptable
		Fall	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

TABLE 1: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	18		Acceptable
	B	Spring	14	+17%	Standing	22	+22%	Acceptable
		Summer	10	+11%	Sitting	16		Acceptable
		Fall	12		Sitting	20	+18%	Acceptable
		Winter	13		Standing	21		Acceptable
		Annual	12		Sitting	20	+11%	Acceptable
37	A	Spring	14		Standing	22		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	21		Acceptable
	B	Spring	14		Standing	22		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	13		Standing	21		Acceptable
		Winter	15		Standing	23		Acceptable
		Annual	14		Standing	21		Acceptable
38	A	Spring	14		Standing	21		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	14		Standing	20		Acceptable
	B	Spring	14		Standing	21		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	14		Standing	20		Acceptable
39	A	Spring	13		Standing	20		Acceptable
		Summer	11		Sitting	15		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	14		Standing	20		Acceptable
		Annual	13		Standing	19		Acceptable
	B	Spring	14		Standing	20		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	19		Acceptable
40	A	Spring	13		Standing	20		Acceptable
		Summer	10		Sitting	16		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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Fall	12		Sitting	19		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	19		Acceptable
	B	Spring	14		Standing	21		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	20		Acceptable
41	A	Spring	11		Sitting	18		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	10		Sitting	17		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	11		Sitting	17		Acceptable
	B	Spring	13	+18%	Standing	21	+17%	Acceptable
		Summer	10	+11%	Sitting	15		Acceptable
		Fall	12	+20%	Sitting	19	+12%	Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	19	+12%	Acceptable
42	A	Spring	9		Sitting	15		Acceptable
		Summer	7		Sitting	11		Acceptable
		Fall	8		Sitting	13		Acceptable
		Winter	10		Sitting	16		Acceptable
		Annual	9		Sitting	14		Acceptable
	B	Spring	10	+11%	Sitting	16		Acceptable
		Summer	7		Sitting	12		Acceptable
		Fall	9	+12%	Sitting	14		Acceptable
		Winter	11		Sitting	17		Acceptable
		Annual	10	+11%	Sitting	15		Acceptable
43	A	Spring	13		Standing	21		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	20		Acceptable
	B	Spring	15	+15%	Standing	24	+14%	Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	14	+17%	Standing	22	+16%	Acceptable
		Winter	14		Standing	23		Acceptable
		Annual	14		Standing	22		Acceptable
44	A	Spring	10		Sitting	16		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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Summer	8		Sitting	14		Acceptable
		Fall	9		Sitting	15		Acceptable
		Winter	10		Sitting	16		Acceptable
		Annual	9		Sitting	15		Acceptable
	B	Spring	9		Sitting	15		Acceptable
		Summer	8		Sitting	13		Acceptable
		Fall	9		Sitting	15		Acceptable
		Winter	9		Sitting	16		Acceptable
		Annual	9		Sitting	15		Acceptable
45	A	Spring	15		Standing	21		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	16		Walking	23		Acceptable
		Annual	14		Standing	21		Acceptable
	B	Spring	14		Standing	21		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	14		Standing	20		Acceptable
46	A	Spring	11		Sitting	18		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	11		Sitting	16		Acceptable
		Winter	12		Sitting	18		Acceptable
		Annual	11		Sitting	17		Acceptable
	B	Spring	12		Sitting	18		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	11		Sitting	17		Acceptable
47	A	Spring	13		Standing	19		Acceptable
		Summer	10		Sitting	14		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	12		Sitting	19		Acceptable
	B	Spring	11	-15%	Sitting	17	-11%	Acceptable
		Summer	8	-20%	Sitting	13		Acceptable
		Fall	10	-17%	Sitting	15	-17%	Acceptable
		Winter	11	-21%	Sitting	18	-14%	Acceptable
		Annual	10	-17%	Sitting	16	-16%	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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
48	A	Spring	12		Sitting	17		Acceptable
		Summer	9		Sitting	13		Acceptable
		Fall	11		Sitting	16		Acceptable
		Winter	13		Standing	18		Acceptable
		Annual	12		Sitting	17		Acceptable
	B	Spring	11		Sitting	16		Acceptable
		Summer	8	-11%	Sitting	12		Acceptable
		Fall	10		Sitting	15		Acceptable
		Winter	11	-15%	Sitting	17		Acceptable
		Annual	10	-17%	Sitting	16		Acceptable
49	A	Spring	15		Standing	21		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	16		Walking	22		Acceptable
		Annual	14		Standing	21		Acceptable
	B	Spring	15		Standing	21		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	16		Walking	22		Acceptable
		Annual	14		Standing	21		Acceptable
50	A	Spring	18		Walking	24		Acceptable
		Summer	15		Standing	20		Acceptable
		Fall	17		Walking	23		Acceptable
		Winter	19		Walking	26		Acceptable
		Annual	17		Walking	24		Acceptable
	B	Spring	18		Walking	25		Acceptable
		Summer	15		Standing	21		Acceptable
		Fall	17		Walking	24		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	18		Walking	25		Acceptable
51	A	Spring	14		Standing	21		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	14		Standing	21		Acceptable
	B	Spring	15		Standing	22		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	14		Standing	21		Acceptable
		Winter	17	+13%	Walking	24		Acceptable
		Annual	15		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.

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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
52	A	Spring	14		Standing	20		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	20		Acceptable
	B	Spring	14		Standing	20		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
53	A	Spring	14		Standing	21		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	14		Standing	21		Acceptable
	B	Spring	15		Standing	22		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	16		Walking	23		Acceptable
		Annual	14		Standing	21		Acceptable
54	A	Spring	10		Sitting	17		Acceptable
		Summer	8		Sitting	13		Acceptable
		Fall	10		Sitting	16		Acceptable
		Winter	11		Sitting	19		Acceptable
		Annual	10		Sitting	17		Acceptable
	B	Spring	11		Sitting	19	+12%	Acceptable
		Summer	9	+12%	Sitting	14		Acceptable
		Fall	10		Sitting	17		Acceptable
		Winter	12		Sitting	20		Acceptable
		Annual	11		Sitting	18		Acceptable
55	A	Spring	14		Standing	20		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	19		Acceptable
	B	Spring	14		Standing	21		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	14		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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Annual	13		Standing	20		Acceptable
56	A	Spring	14		Standing	20		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	14		Standing	19		Acceptable
	B	Spring	16	+14%	Walking	23	+15%	Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	14		Standing	21	+11%	Acceptable
		Winter	15		Standing	23		Acceptable
		Annual	14		Standing	21	+11%	Acceptable
57	A	Spring	16		Walking	23		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	16		Walking	22		Acceptable
	B	Spring	17		Walking	24		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
58	A	Spring	17		Walking	24		Acceptable
		Summer	14		Standing	19		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
	B	Spring	17		Walking	25		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	18		Walking	26		Acceptable
		Annual	17		Walking	24		Acceptable
59	A	Spring	17		Walking	24		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
	B	Spring	17		Walking	25		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	16		Walking	23		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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Winter	17		Walking	26		Acceptable
		Annual	16		Walking	24		Acceptable
60	A	Spring	18		Walking	25		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	18		Walking	25		Acceptable
		Annual	17		Walking	24		Acceptable
	B	Spring	18		Walking	25		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	17		Walking	23		Acceptable
		Winter	18		Walking	26		Acceptable
		Annual	17		Walking	24		Acceptable
61	A	Spring	17		Walking	24		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	16		Walking	22		Acceptable
		Winter	17		Walking	24		Acceptable
		Annual	16		Walking	23		Acceptable
	B	Spring	17		Walking	24		Acceptable
		Summer	14		Standing	19		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
62	A	Spring	17		Walking	24		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
	B	Spring	18		Walking	25		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	17		Walking	23		Acceptable
		Winter	18		Walking	26		Acceptable
		Annual	17		Walking	24		Acceptable
63	A	Spring	18		Walking	26		Acceptable
		Summer	15		Standing	20		Acceptable
		Fall	17		Walking	24		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	17		Walking	25		Acceptable
	B	Spring	19		Walking	26		Acceptable
		Summer	14		Standing	20		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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Fall	17		Walking	24		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	18		Walking	25		Acceptable
64	A	Spring	18		Walking	26		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	17		Walking	24		Acceptable
		Winter	19		Walking	26		Acceptable
		Annual	17		Walking	25		Acceptable
	B	Spring	18		Walking	26		Acceptable
		Summer	14		Standing	19		Acceptable
		Fall	17		Walking	24		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	17		Walking	25		Acceptable
65	A	Spring	18		Walking	25		Acceptable
		Summer	15		Standing	20		Acceptable
		Fall	17		Walking	24		Acceptable
		Winter	19		Walking	26		Acceptable
		Annual	17		Walking	25		Acceptable
	B	Spring	19		Walking	26		Acceptable
		Summer	15		Standing	20		Acceptable
		Fall	17		Walking	24		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	18		Walking	25		Acceptable
66	A	Spring	16		Walking	23		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	17		Walking	24		Acceptable
		Annual	16		Walking	22		Acceptable
	B	Spring	16		Walking	23		Acceptable
		Summer	14		Standing	19		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
67	A	Spring	16		Walking	23		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	16		Walking	22		Acceptable
		Winter	17		Walking	24		Acceptable
		Annual	16		Walking	22		Acceptable
	B	Spring	17		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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

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

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: MEAN SPEED AND EFFECTIVE GUST 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	19		Acceptable
		Fall	14		Standing	21		Acceptable
		Winter	16		Walking	25		Acceptable
		Annual	15		Standing	23		Acceptable
72	A	Spring	15		Standing	22		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	15		Standing	22		Acceptable
	B	Spring	16		Walking	24		Acceptable
		Summer	13		Standing	19	+12%	Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	17		Walking	26		Acceptable
		Annual	16		Walking	24		Acceptable
73	A	Spring	15		Standing	21		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	14		Standing	20		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	15		Standing	21		Acceptable
	B	Spring	17	+13%	Walking	25	+19%	Acceptable
		Summer	13	+18%	Standing	19	+19%	Acceptable
		Fall	15		Standing	23	+15%	Acceptable
		Winter	19	+19%	Walking	28	+17%	Acceptable
		Annual	17	+13%	Walking	24	+14%	Acceptable
74	A	Spring	16		Walking	23		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	15		Standing	21		Acceptable
		Winter	17		Walking	24		Acceptable
		Annual	15		Standing	22		Acceptable
	B	Spring	19	+19%	Walking	28	+22%	Acceptable
		Summer	15	+25%	Standing	22	+22%	Acceptable
		Fall	18	+20%	Walking	26	+24%	Acceptable
		Winter	21	+24%	Uncomfortable	30	+25%	Acceptable
		Annual	19	+27%	Walking	28	+27%	Acceptable
75	A	Spring	15		Standing	22		Acceptable
		Summer	13		Standing	18		Acceptable
		Fall	14		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.

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: MEAN SPEED AND EFFECTIVE GUST 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	+27%	Walking	27	+23%	Acceptable
		Summer	14		Standing	20	+11%	Acceptable
		Fall	17	+21%	Walking	24	+14%	Acceptable
		Winter	20	+25%	Uncomfortable	29	+26%	Acceptable
		Annual	18	+20%	Walking	26	+24%	Acceptable
76	A	Spring	20		Uncomfortable	29		Acceptable
		Summer	17		Walking	23		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	21		Uncomfortable	30		Acceptable
		Annual	19		Walking	28		Acceptable
	B	Spring	22		Uncomfortable	31		Acceptable
		Summer	18		Walking	25		Acceptable
		Fall	20	+11%	Uncomfortable	28		Acceptable
		Winter	24	+14%	Uncomfortable	33		Unacceptable
		Annual	22	+16%	Uncomfortable	30		Acceptable
77	A	Spring	20		Uncomfortable	28		Acceptable
		Summer	16		Walking	21		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	18		Walking	26		Acceptable
	B	Spring	21		Uncomfortable	30		Acceptable
		Summer	16		Walking	22		Acceptable
		Fall	19		Walking	27		Acceptable
		Winter	20		Uncomfortable	28		Acceptable
		Annual	19		Walking	27		Acceptable
78	A	Spring	19		Walking	28		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	17		Walking	25		Acceptable
		Winter	18		Walking	26		Acceptable
		Annual	17		Walking	25		Acceptable
	B	Spring	20		Uncomfortable	28		Acceptable
		Summer	15		Standing	21		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	18		Walking	27		Acceptable
		Annual	18		Walking	26		Acceptable
79	A	Spring	19		Walking	27		Acceptable
		Summer	17		Walking	23		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	20		Uncomfortable	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.

<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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Annual	19		Walking	26		Acceptable
	B	Spring	21	+11%	Uncomfortable	30	+11%	Acceptable
		Summer	17		Walking	24		Acceptable
		Fall	19		Walking	27		Acceptable
		Winter	21		Uncomfortable	31	+11%	Acceptable
		Annual	20		Uncomfortable	28		Acceptable
80	A	Spring	19		Walking	27		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	17		Walking	25		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	17		Walking	24		Acceptable
	B	Spring	20		Uncomfortable	29		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	18		Walking	26		Acceptable
		Annual	18		Walking	26		Acceptable
81	A	Spring	18		Walking	27		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	17		Walking	25		Acceptable
		Winter	19		Walking	28		Acceptable
		Annual	17		Walking	26		Acceptable
	B	Spring	20	+11%	Uncomfortable	29		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	18		Walking	26		Acceptable
		Winter	20		Uncomfortable	29		Acceptable
		Annual	19	+12%	Walking	27		Acceptable
82	A	Spring	13		Standing	21		Acceptable
		Summer	9		Sitting	15		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	19		Acceptable
	B	Spring	13		Standing	22		Acceptable
		Summer	9		Sitting	15		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	12		Sitting	20		Acceptable
		Annual	12		Sitting	19		Acceptable
83	A	Spring	11		Sitting	17		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	11		Sitting	16		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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Winter	11		Sitting	17		Acceptable
		Annual	11		Sitting	16		Acceptable
	B	Spring	11		Sitting	17		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	11		Sitting	16		Acceptable
		Winter	12		Sitting	18		Acceptable
		Annual	11		Sitting	17		Acceptable
84	A	Spring	14		Standing	20		Acceptable
		Summer	12		Sitting	16		Acceptable
		Fall	13		Standing	18		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	19		Acceptable
	B	Spring	14		Standing	20		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	15		Standing	21		Acceptable
		Annual	14		Standing	19		Acceptable
85	A	Spring	18		Walking	25		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	17		Walking	25		Acceptable
	B	Spring	18		Walking	25		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	17		Walking	23		Acceptable
		Winter	20		Uncomfortable	27		Acceptable
		Annual	18		Walking	25		Acceptable
86	A	Spring	14		Standing	20		Acceptable
		Summer	12		Sitting	16		Acceptable
		Fall	13		Standing	18		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	13		Standing	19		Acceptable
	B	Spring	14		Standing	20		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	13		Standing	19		Acceptable
87	A	Spring	14		Standing	21		Acceptable
		Summer	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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Fall	13		Standing	19		Acceptable
		Winter	13		Standing	21		Acceptable
		Annual	13		Standing	20		Acceptable
	B	Spring	14		Standing	21		Acceptable
		Summer	13		Standing	18		Acceptable
		Fall	13		Standing	20		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	20		Acceptable
88	A	Spring	13		Standing	21		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	20		Acceptable
	B	Spring	13		Standing	21		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
89	A	Spring	21		Uncomfortable	29		Acceptable
		Summer	18		Walking	24		Acceptable
		Fall	19		Walking	26		Acceptable
		Winter	20		Uncomfortable	29		Acceptable
		Annual	20		Uncomfortable	27		Acceptable
	B	Spring	21		Uncomfortable	29		Acceptable
		Summer	18		Walking	24		Acceptable
		Fall	20		Uncomfortable	27		Acceptable
		Winter	21		Uncomfortable	29		Acceptable
		Annual	20		Uncomfortable	28		Acceptable
90	A	Spring	17		Walking	25		Acceptable
		Summer	13		Standing	18		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	16		Walking	23		Acceptable
	B	Spring	17		Walking	25		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	16		Walking	23		Acceptable
91	A	Spring	16		Walking	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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Summer	12		Sitting	17		Acceptable
		Fall	15		Standing	21		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	22		Acceptable
	B	Spring	16		Walking	22		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	15		Standing	21		Acceptable
		Winter	18		Walking	24		Acceptable
		Annual	16		Walking	22		Acceptable
92	A	Spring	18		Walking	27		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	17		Walking	24		Acceptable
		Winter	20		Uncomfortable	29		Acceptable
		Annual	18		Walking	26		Acceptable
	B	Spring	18		Walking	26		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	20		Uncomfortable	28		Acceptable
		Annual	18		Walking	26		Acceptable
93	A	Spring	18		Walking	26		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	17		Walking	24		Acceptable
		Winter	20		Uncomfortable	29		Acceptable
		Annual	18		Walking	26		Acceptable
	B	Spring	17		Walking	25		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	19		Walking	27		Acceptable
		Annual	17		Walking	25		Acceptable
94	A	Spring	19		Walking	28		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	18		Walking	25		Acceptable
		Winter	21		Uncomfortable	30		Acceptable
		Annual	19		Walking	27		Acceptable
	B	Spring	18		Walking	27		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	17		Walking	24		Acceptable
		Winter	21		Uncomfortable	29		Acceptable
		Annual	18		Walking	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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
95	A	Spring	16		Walking	25		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	15		Standing	23		Acceptable
		Winter	17		Walking	26		Acceptable
		Annual	15		Standing	24		Acceptable
	B	Spring	16		Walking	24		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	17		Walking	26		Acceptable
		Annual	15		Standing	24		Acceptable
96	A	Spring	11		Sitting	18		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	11		Sitting	18		Acceptable
		Winter	12		Sitting	20		Acceptable
		Annual	11		Sitting	18		Acceptable
	B	Spring	11		Sitting	18		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	12		Sitting	20		Acceptable
		Annual	11		Sitting	18		Acceptable
97	A	Spring	11		Sitting	18		Acceptable
		Summer	8		Sitting	13		Acceptable
		Fall	10		Sitting	17		Acceptable
		Winter	11		Sitting	19		Acceptable
		Annual	10		Sitting	17		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
98	A	Spring	18		Walking	26		Acceptable
		Summer	15		Standing	21		Acceptable
		Fall	17		Walking	24		Acceptable
		Winter	18		Walking	26		Acceptable
		Annual	17		Walking	25		Acceptable
	B	Spring	18		Walking	27		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	17		Walking	25		Acceptable
		Winter	18		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: MEAN SPEED AND EFFECTIVE GUST 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	18		Walking	27		Acceptable
		Summer	13		Standing	21		Acceptable
		Fall	16		Walking	25		Acceptable
		Winter	19		Walking	30		Acceptable
		Annual	17		Walking	27		Acceptable
	B	Spring	17		Walking	26		Acceptable
		Summer	13		Standing	20		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	19		Walking	28		Acceptable
		Annual	17		Walking	26		Acceptable
100	A	Spring	18		Walking	27		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	17		Walking	25		Acceptable
		Winter	20		Uncomfortable	29		Acceptable
		Annual	18		Walking	27		Acceptable
	B	Spring	17		Walking	26		Acceptable
		Summer	13		Standing	20		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	19		Walking	28		Acceptable
		Annual	17		Walking	25		Acceptable
101	A	Spring	16		Walking	25		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	15		Standing	23		Acceptable
		Winter	17		Walking	26		Acceptable
		Annual	16		Walking	24		Acceptable
	B	Spring	16		Walking	25		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	15		Standing	23		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
102	A	Spring	16		Walking	25		Acceptable
		Summer	12		Sitting	19		Acceptable
		Fall	15		Standing	23		Acceptable
		Winter	17		Walking	26		Acceptable
		Annual	15		Standing	24		Acceptable
	B	Spring	15		Standing	25		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	14		Standing	23		Acceptable
		Winter	16		Walking	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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Annual	15		Standing	23		Acceptable
103	A	Spring	18		Walking	26		Acceptable
		Summer	13		Standing	20		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	18		Walking	26		Acceptable
		Annual	17		Walking	24		Acceptable
	B	Spring	18		Walking	26		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	24		Acceptable
104	A	Spring	21		Uncomfortable	30		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	19		Walking	27		Acceptable
		Winter	19		Walking	28		Acceptable
		Annual	19		Walking	27		Acceptable
	B	Spring	21		Uncomfortable	30		Acceptable
		Summer	15		Standing	21		Acceptable
		Fall	19		Walking	27		Acceptable
		Winter	20		Uncomfortable	28		Acceptable
		Annual	19		Walking	27		Acceptable
105	A	Spring	13		Standing	20		Acceptable
		Summer	9		Sitting	15		Acceptable
		Fall	11		Sitting	18		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	19		Acceptable
	B	Spring	13		Standing	20		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	11		Sitting	18		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	12		Sitting	18		Acceptable
106	A	Spring	16		Walking	24		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	15		Standing	23		Acceptable
	B	Spring	16		Walking	24		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	15		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.

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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Winter	16		Walking	24		Acceptable
		Annual	15		Standing	23		Acceptable
107	A	Spring	11		Sitting	18		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	11		Sitting	17		Acceptable
	B	Spring	10		Sitting	18		Acceptable
		Summer	9		Sitting	15		Acceptable
		Fall	10		Sitting	17		Acceptable
		Winter	11		Sitting	18		Acceptable
		Annual	10		Sitting	17		Acceptable
108	A	Spring	14		Standing	21		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	15		Standing	22		Acceptable
		Annual	14		Standing	20		Acceptable
	B	Spring	13		Standing	19		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	14		Standing	20		Acceptable
		Annual	13		Standing	19		Acceptable
109	A	Spring	15		Standing	23		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	15		Standing	23		Acceptable
	B	Spring	16		Walking	24		Acceptable
		Summer	14		Standing	21		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	23		Acceptable
110	A	Spring	12		Sitting	20		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	11		Sitting	19		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	11		Sitting	19		Acceptable
	B	Spring	13		Standing	21		Acceptable
		Summer	11		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.

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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			Mean Wind Speed			Effective Gust Wind Speed		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Fall	12		Sitting	20		Acceptable
		Winter	13		Standing	21	+11%	Acceptable
		Annual	12		Sitting	20		Acceptable
111	A	Spring	13		Standing	20		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	14		Standing	21		Acceptable
		Annual	13		Standing	19		Acceptable
	B	Spring	14		Standing	20		Acceptable
		Summer	11		Sitting	17		Acceptable
		Fall	13		Standing	19		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	20		Acceptable
112	A	Spring	11		Sitting	19		Acceptable
		Summer	10		Sitting	17		Acceptable
		Fall	11		Sitting	18		Acceptable
		Winter	12		Sitting	20		Acceptable
		Annual	11		Sitting	19		Acceptable
	B	Spring	11		Sitting	18		Acceptable
		Summer	9		Sitting	15	-12%	Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	11		Sitting	17	-11%	Acceptable
113	A	Spring	11		Sitting	18		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	12		Sitting	19		Acceptable
		Annual	11		Sitting	17		Acceptable
	B	Spring	11		Sitting	17		Acceptable
		Summer	9		Sitting	14		Acceptable
		Fall	10		Sitting	16		Acceptable
		Winter	12		Sitting	18		Acceptable
		Annual	11		Sitting	17		Acceptable
114	A	Spring	13		Standing	21		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	13		Standing	21		Acceptable
		Annual	12		Sitting	20		Acceptable
	B	Spring	13		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.

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: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
		Summer	10		Sitting	15		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	19		Acceptable
115	A	Spring	13		Standing	20		Acceptable
		Summer	11		Sitting	16		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	19		Acceptable
	B	Spring	12		Sitting	19		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	12		Sitting	18		Acceptable
		Winter	13		Standing	20		Acceptable
		Annual	12		Sitting	18		Acceptable
116	A	Spring	14		Standing	19		Acceptable
		Summer	11		Sitting	15		Acceptable
		Fall	12		Sitting	17		Acceptable
		Winter	15		Standing	20		Acceptable
		Annual	13		Standing	18		Acceptable
	B	Spring	14		Standing	19		Acceptable
		Summer	11		Sitting	15		Acceptable
		Fall	13		Standing	17		Acceptable
		Winter	15		Standing	20		Acceptable
		Annual	13		Standing	18		Acceptable
117	A	Spring	12		Sitting	19		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	11		Sitting	18		Acceptable
		Winter	13		Standing	19		Acceptable
		Annual	12		Sitting	18		Acceptable
	B	Spring	12		Sitting	19		Acceptable
		Summer	10		Sitting	15		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	13		Standing	19		Acceptable
		Annual	12		Sitting	18		Acceptable
118	A	Spring	13		Standing	20		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	14		Standing	22		Acceptable
		Annual	13		Standing	20		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
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Dangerous Conditions: > 27 mph

Effective Gust Criteria

Acceptable: ≤ 31 mph
Unacceptable: > 31 mph

TABLE 1: MEAN SPEED AND EFFECTIVE GUST 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	20		Acceptable
		Summer	10		Sitting	16		Acceptable
		Fall	12		Sitting	19		Acceptable
		Winter	14		Standing	23		Acceptable
		Annual	13		Standing	20		Acceptable
119	A	Spring	11		Sitting	19		Acceptable
		Summer	9		Sitting	15		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	12		Sitting	20		Acceptable
		Annual	11		Sitting	18		Acceptable
	B	Spring	11		Sitting	19		Acceptable
		Summer	9		Sitting	15		Acceptable
		Fall	11		Sitting	17		Acceptable
		Winter	12		Sitting	20		Acceptable
		Annual	11		Sitting	18		Acceptable
120	A	Spring	16		Walking	23		Acceptable
		Summer	12		Sitting	18		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	17		Walking	24		Acceptable
		Annual	15		Standing	22		Acceptable
	B	Spring	16		Walking	23		Acceptable
		Summer	12		Sitting	19		Acceptable
		Fall	15		Standing	22		Acceptable
		Winter	16		Walking	24		Acceptable
		Annual	15		Standing	22		Acceptable
121	A	Spring	15		Standing	24		Acceptable
		Summer	12		Sitting	19		Acceptable
		Fall	14		Standing	22		Acceptable
		Winter	16		Walking	25		Acceptable
		Annual	15		Standing	23		Acceptable
	B	Spring	15		Standing	24		Acceptable
		Summer	12		Sitting	19		Acceptable
		Fall	14		Standing	22		Acceptable
		Winter	16		Walking	26		Acceptable
		Annual	15		Standing	23		Acceptable
122	A	Spring	16		Walking	25		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	15		Standing	23		Acceptable
		Winter	18		Walking	27		Acceptable
		Annual	16		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
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Uncomfortable for Walking: > 19 and ≤ 27 mph
Dangerous Conditions: > 27 mph

Effective Gust Criteria

Acceptable: ≤ 31 mph
Unacceptable: > 31 mph

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BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
	B	Spring	16		Walking	25		Acceptable
		Summer	13		Standing	19		Acceptable
		Fall	15		Standing	23		Acceptable
		Winter	18		Walking	27		Acceptable
		Annual	16		Walking	25		Acceptable
123	A	Spring	17		Walking	25		Acceptable
		Summer	13		Standing	20		Acceptable
		Fall	15		Standing	23		Acceptable
		Winter	18		Walking	28		Acceptable
		Annual	17		Walking	25		Acceptable
	B	Spring	17		Walking	25		Acceptable
		Summer	14		Standing	20		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	19		Walking	28		Acceptable
		Annual	17		Walking	25		Acceptable
124	A	DATA NOT AVAILABLE						
	B	Spring	32		Dangerous	42		Unacceptable
		Summer	28		Dangerous	37		Unacceptable
		Fall	30		Dangerous	40		Unacceptable
		Winter	33		Dangerous	44		Unacceptable
		Annual	31		Dangerous	41		Unacceptable
125	A	DATA NOT AVAILABLE						
	B	Spring	37		Dangerous	49		Unacceptable
		Summer	28		Dangerous	38		Unacceptable
		Fall	34		Dangerous	45		Unacceptable
		Winter	37		Dangerous	50		Unacceptable
		Annual	35		Dangerous	46		Unacceptable
126	A	DATA NOT AVAILABLE						
	B	Spring	32		Dangerous	42		Unacceptable
		Summer	28		Dangerous	37		Unacceptable
		Fall	30		Dangerous	40		Unacceptable
		Winter	33		Dangerous	44		Unacceptable
		Annual	31		Dangerous	41		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.

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A – No Build
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Mean Wind Speed Criteria

Comfortable for Sitting:	≤ 12 mph
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Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
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TABLE 1: MEAN SPEED AND EFFECTIVE GUST CATEGORIES – MULTIPLE SEASONS

BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
127	A	DATA NOT AVAILABLE						
	B	Spring	34		Dangerous	45		Unacceptable
		Summer	27		Uncomfortable	36		Unacceptable
		Fall	32		Dangerous	42		Unacceptable
		Winter	37		Dangerous	49		Unacceptable
		Annual	33		Dangerous	44		Unacceptable
128	A	DATA NOT AVAILABLE						
	B	Spring	16		Walking	24		Acceptable
		Summer	14		Standing	22		Acceptable
		Fall	16		Walking	24		Acceptable
		Winter	17		Walking	25		Acceptable
		Annual	16		Walking	24		Acceptable
129	A	DATA NOT AVAILABLE						
	B	Spring	15		Standing	23		Acceptable
		Summer	12		Sitting	17		Acceptable
		Fall	14		Standing	21		Acceptable
		Winter	15		Standing	23		Acceptable
		Annual	14		Standing	21		Acceptable
130	A	DATA NOT AVAILABLE						
	B	Spring	18		Walking	25		Acceptable
		Summer	14		Standing	19		Acceptable
		Fall	16		Walking	23		Acceptable
		Winter	18		Walking	25		Acceptable
		Annual	17		Walking	24		Acceptable
131	A	DATA NOT AVAILABLE						
	B	Spring	18		Walking	27		Acceptable
		Summer	15		Standing	22		Acceptable
		Fall	17		Walking	25		Acceptable
		Winter	18		Walking	27		Acceptable
		Annual	17		Walking	26		Acceptable
132	A	DATA NOT AVAILABLE						
	B	Spring	20		Uncomfortable	29		Acceptable
		Summer	18		Walking	25		Acceptable
		Fall	19		Walking	28		Acceptable
		Winter	21		Uncomfortable	30		Acceptable
		Annual	20		Uncomfortable	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

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B – Build

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BRA Criteria			**Mean Wind Speed**			**Effective Gust Wind Speed**		
Loc.	Config.	Season	Speed(mph)	%Change	RATING	Speed(mph)	%Change	RATING
133	A	DATA NOT AVAILABLE						
	B	Spring	16		Walking	25		Acceptable
		Summer	13		Standing	20		Acceptable
		Fall	15		Standing	24		Acceptable
		Winter	18		Walking	28		Acceptable
		Annual	16		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.

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Dangerous Conditions:	> 27 mph

Effective Gust Criteria

Acceptable:	≤ 31 mph
Unacceptable:	> 31 mph

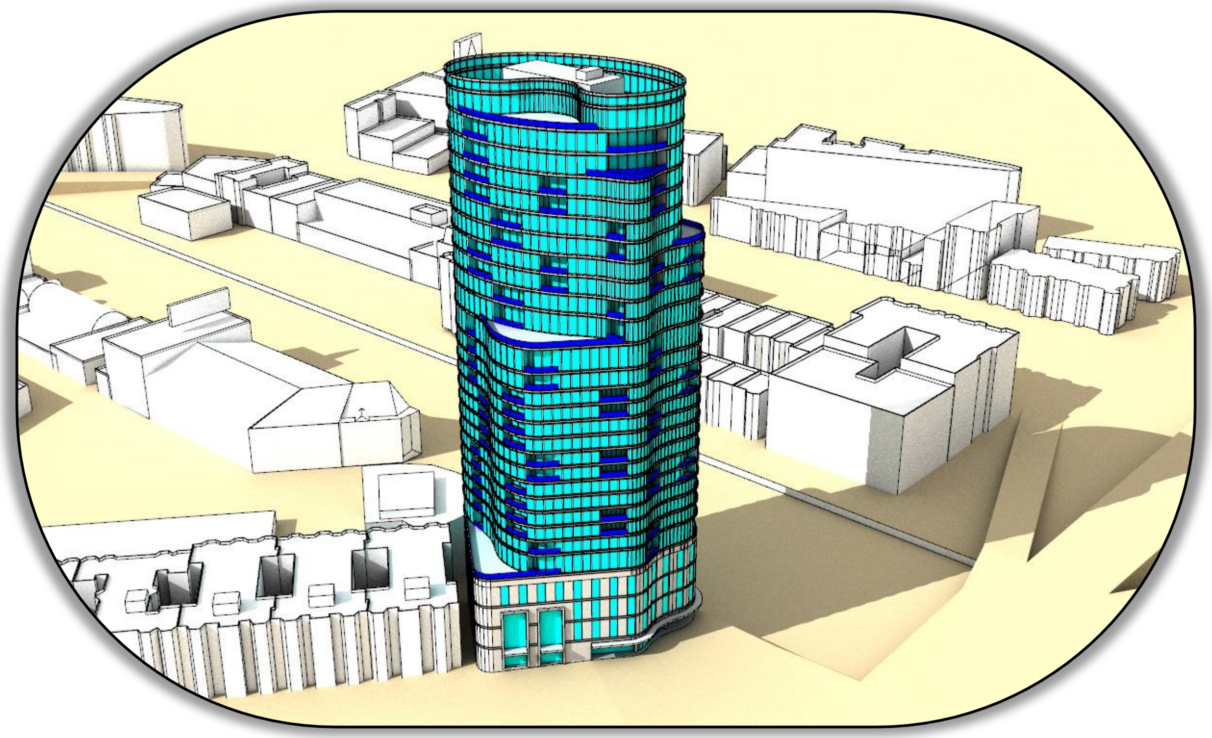
Appendix D

Solar Glare Study

Charlesgate
Boston, MA

Detailed Solar Reflection Analysis

RWDI #1600656
August 24, 2016



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EXECUTIVE SUMMARY

This report provides the computer modeling results of reflected sunlight from the proposed Charlesgate development. RWDI was retained to investigate the impact that solar reflections emanating from the development will have on the surrounding urban realm.

The faceted concave-shaped sections of the east, southeast, south, and southwest facades act to focus solar energy in the immediate vicinity of the facades. Significant increases in temperature may occur in these areas, and the thermal radiation at this location may be intense enough to potentially harm bare skin and cause thermal discomfort. However, these areas are between 50 and 300 feet above local grade, and therefore unlikely to pose a risk to people. The focal areas are also close enough to the Charlesgate building that future developments are unlikely to be impacted.

Focusing was also found to occur on the roof deck of the mechanical penthouse level (receptor P18). People that are standing there may experience high thermal impacts caused by the concave facade. The reflections are expected to exceed 2500 W/m² in intensity. This level of exposure to bare skin would lead to the onset of pain within 30 seconds. However, since access to this area is restricted, the risk to people can be reduced if operational mitigation is implemented at this location. For further details, refer to thermal impact plot for receptor P18 provided in Appendix A and the Recommendations section on page 23.

No other locations at pedestrian height are discovered to exceed RWDI's short-term thermal exposure criteria.

Moderate levels of visual impact fall on almost all of the pedestrian and facade receptors throughout the entire year, indicating a nuisance at worst.

No significant thermal impacts are expected to occur on the existing surrounding buildings (i.e. F11-F14) as the intensities of most of the incident reflections are predicted to be lower than 400 W/m^2.

Drivers travelling in some locations in the vicinity of the tower will experience an increased level of visual glare impact regardless of the glazing type. Many of these impacts are not expected to alter a driver's current experience as the sun will already be in the driver's line of sight. However, some reflections do occur when the sun would not already be in a driver's field of view, causing increased distraction. In particular a driver's experience could be affected when:

a) Travelling west on the train line (receptor D2) during some evenings in February, March, October, and November,

b) Travelling east along the Massachusetts Turnpike (receptor D5) in the mornings of January, February, May 10th – May 20th, July, October, and November,

c) Travelling east along Lansdowne St. (receptor D6) in some mornings of February, March 1st – March 15th, late March, May 17th – June 4th, July and September 26th – November 6th.

Although these reflections may cause distraction to the drivers, most of them are infrequent and short in duration, lasting from 2 to10 minutes.

The visual impacts are generally minor but if mitigation was desired it could be accomplished most easily through the addition of mullion fins or some other form of building mounted shading device. For further details, refer to the Recommendations section on page 23.

While the focusing occurring at the mechanical penthouse level exceeds our thermal criteria, it is our understanding that access to this area is controlled to maintenance staff only. Thus, an operationalized approach could be taken to mitigate the thermal impacts. For further details, refer to the Recommendations section on page 23.

TABLE OF CONTENTS

1. INTRODUCTION

This report provides the computer modelling results of reflected sunlight from the proposed Charlesgate development, which consists of a high-rise tower located at the Trans National Building site on Ipswich Street in Boston, MA. It is our understanding that the development will be surrounded by typical urban spaces such as busy roadways and other buildings.

RWDI has been retained to investigate the impact that solar reflections emanating from the proposed Charlesgate development will have on the surrounding urban realm.

A preliminary set of simulations was conducted to determine peak reflection intensities and the frequency of occurrence of reflections for a broad area around the development. This served to identify areas which may experience high intensity or very frequent reflections. This information, along with input from the design team, informed the selection of 21 points for a more detailed analysis.

These receptor points represent drivers, pedestrians, and building facades and the detailed results allow us to quantify the frequency, intensity and duration of glare events which occur at those locations.

The report also includes the criteria used by RWDI to judge when reflection is a risk. A copy of the preliminary report is included here as Appendix E for convenience.

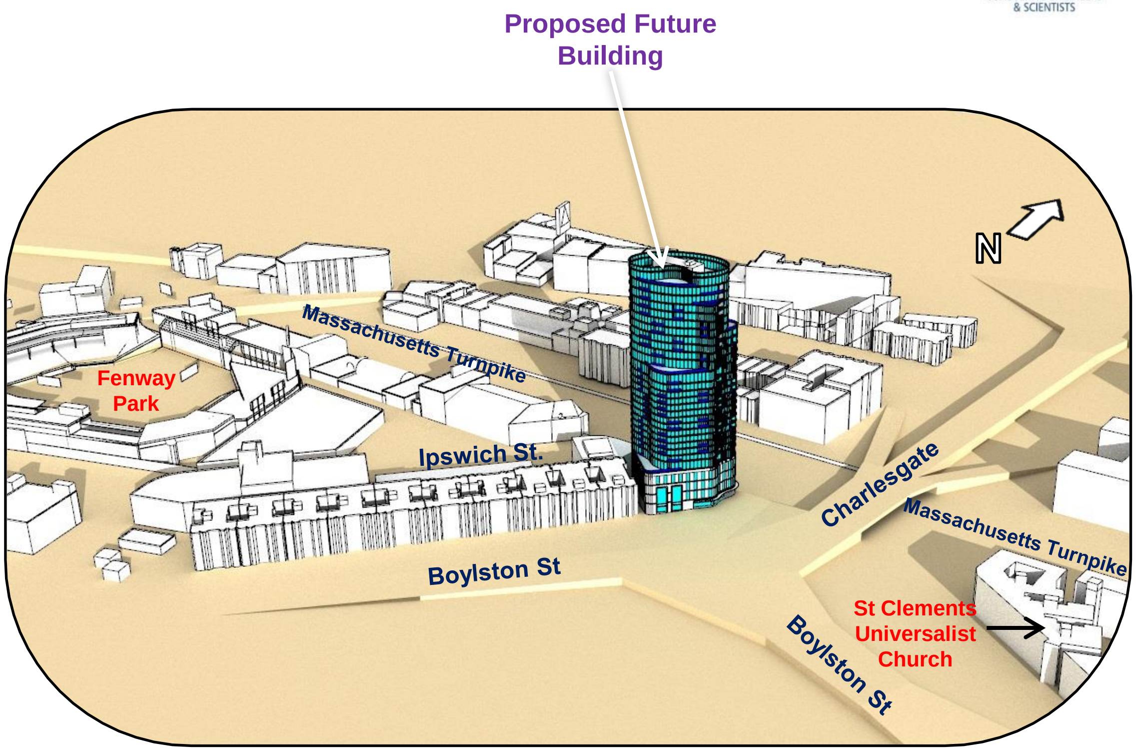


Figure 1: Proposed Charlesgate Development

2. BACKGROUND – URBAN REFLECTIONS

It is a common experience in urban areas to occasionally experience reflected light from glass and metallic surfaces. The interactions between a building and the sun can lead to numerous visual and thermal issues.

Visual glare can:

- impair the vision of motorists and others who cannot simply look away from the source because of an important activity;
- cause nuisance to pedestrians or occupants of nearby buildings; and,
- create undesirable patterns of light throughout the urban fabric.

Heat gain can***:***

- affect human thermal comfort;
- be a safety concern for people and materials, particularly if insolation levels are high as a result of focusing multiple reflections to a single point; and,
- alter heating and cooling loads of conditioned spaces affected by the reflections.

The most significant safety concerns with solar reflections occur with concave facades which act to focus the reflected light in a single area (Figure 2). In contrast, convex facades act to scatter reflections in a "pinwheel" pattern. As concave facades are present in the development, additional study was undertaken to ensure that the facade does not concentrate a significant amount of solar energy in sensitive areas.

To quantify the impact of solar reflections from the development, it is important to understand four critical characteristics:

1. ***Frequency*** (how often glare events occur);
2. ***Duration*** (how long each instance of glare lasts);
3. ***Intensity*** (how "bright"; the events are based on a combination of solar intensity, surface size and orientation, and the distance from the point of interest); and,
4. ***Location*** (does the reflection fall on a sensitive location).

RWDI's criteria for visual glare and heat gain is included in Appendix C.

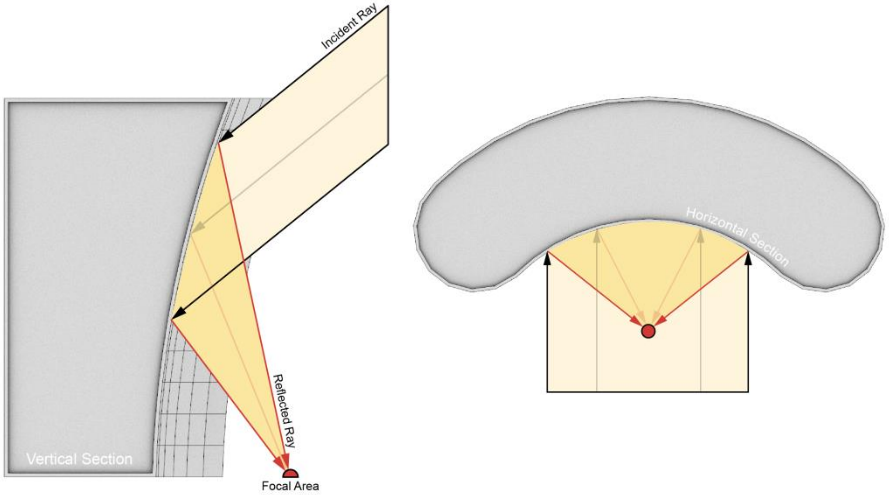


Figure 2: Illustration of an Example of Solar Focusing

Methodology

3. GENERAL METHODOLOGY

RWDI assessed the potential reflection issues using computer modelling based on RWDI's proprietary software called *Eclipse*, as per the steps outlined below:

- A 3D model of the area of interest (as shown in Figure 3) was developed and subdivided into many smaller triangular patches (see Figure 4). The reflective properties of the various surfaces were defined using the data presented in Appendix B.
- For each hour in a year, the expected solar position was determined, and "virtual rays" were drawn from the sun to each triangular patch of the 3D model. Each ray that was considered to be "unobstructed" was reflected from the building surface onto a horizontal plane called a 'Receiving Surface' placed at pedestrian height (1.5 m above local grade).
- This analysis used "clear sky" solar data from Boston Logan Airport. That is to say, a data set where it is assumed that no cloud cover ever occurs, which provides a "worst case" scenario showing the full extent of when and where glare could occur (refer to sun path diagram shown in Appendix D).
- Finally, a statistical analysis was performed to assess the frequency, and intensity of the glare events.

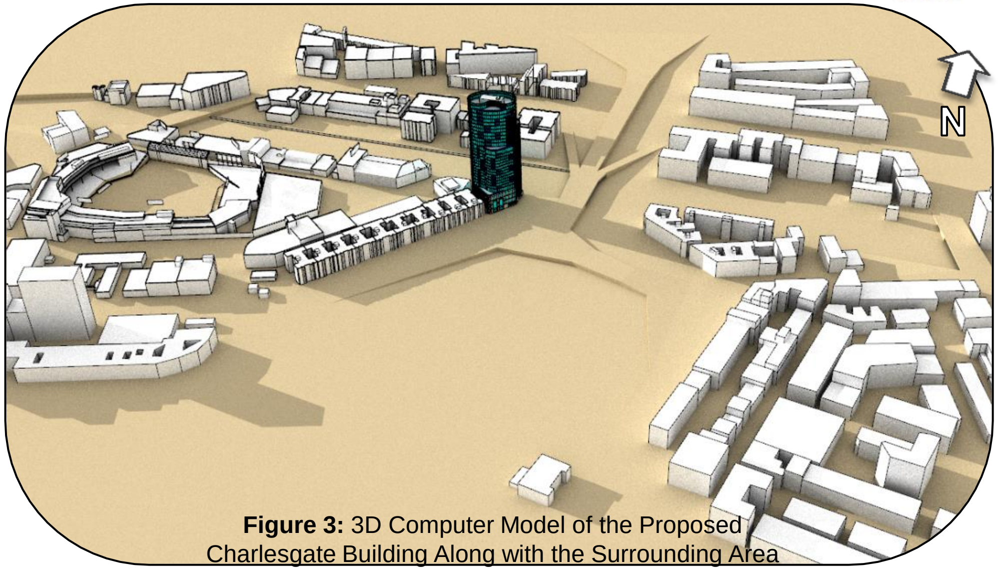


Figure 3: 3D Computer Model of the Proposed Charlesgate Building Along with the Surrounding Area

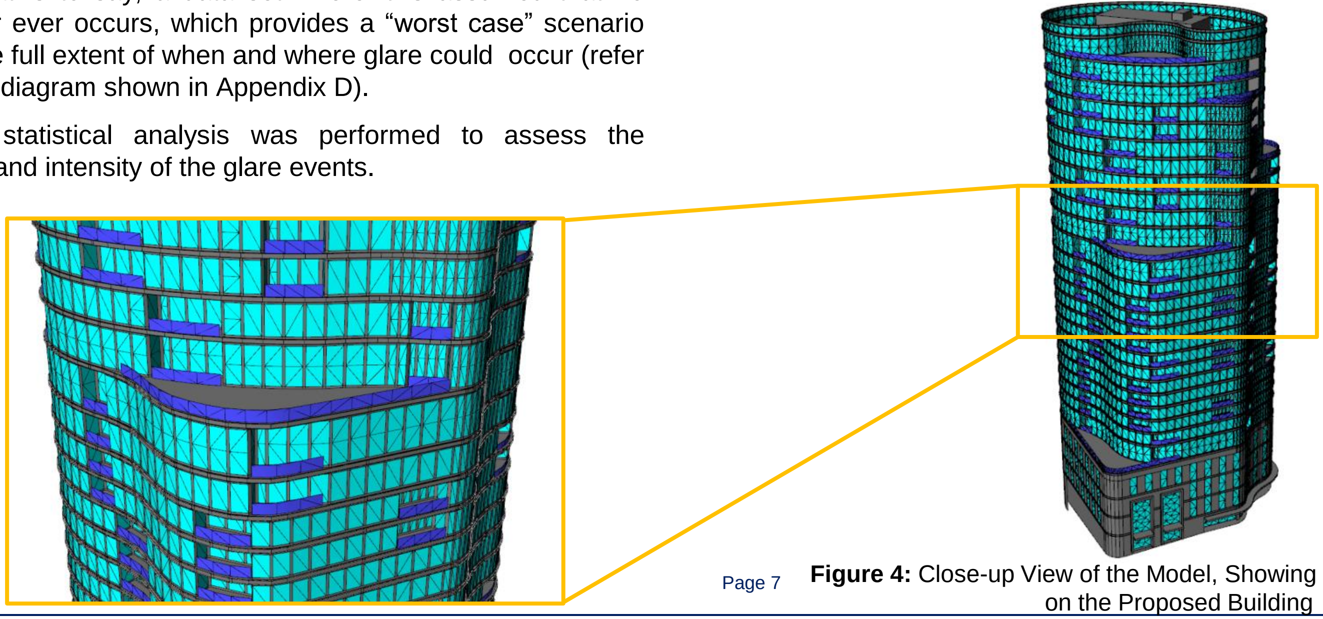


Figure 4: Close-up View of the Model, Showing Surface Subdivisions on the Proposed Building

4. ASSUMPTIONS AND LIMITATIONS

Key assumptions and simplifications of the modelling process included:

Model

- The analysis was conducted based on the geometry provided by Elkus Manfredi Architects to RWDI on July 21, 2016 (it should be noted that this study is highly dependent on building geometry, and any significant changes to the buildings' geometry are likely to require a new analysis).
- Potential reductions of solar reflections due to the presence of vegetation, or other non-architectural obstructions, were not included.
- Only a single reflection from the development is included in the analysis. That is to say, light that has reflected off several surfaces before reaching the 'Receiving Surface' is assumed to have a negligible impact.
- Only the proposed building was considered as potentially reflective in the current model. Existing structures were included for shading purposes but were not considered reflective.

Material Properties of Reflective Elements

- As of August 2016, the final glazing specification had not been made. Elkus Manfredi indicated to RWDI via email on July 19, 2016 that the glazing would be manufactured by PPG and employ their "Solarban 70XL" coating. However, the full spectrum reflectance of IGUs using Solarban 70XL can vary dramatically depending on the color of the glass. To simulate a worst-case condition, RWDI assumed clear glass, which yields the highest full spectrum reflectance (52%). Should the final glazing selection be considerably different from this, RWDI should review the choice to assess the impact on the results presented herein.
- Based on further email correspondence between RWDI and Elkus Manfredi (August 5, 2016), the guard rails on the upper floors were simulated as generic double-pane clear glazing units.
- The reflectance properties of the glazing units are summarized in Table 1. Figure 5 shows the location of the glazing on the facades. Further details are also available in Appendix B.
- Light reflections from other buildings and any other specular surfaces are not accounted for, nor is attenuation of light due to vegetation.

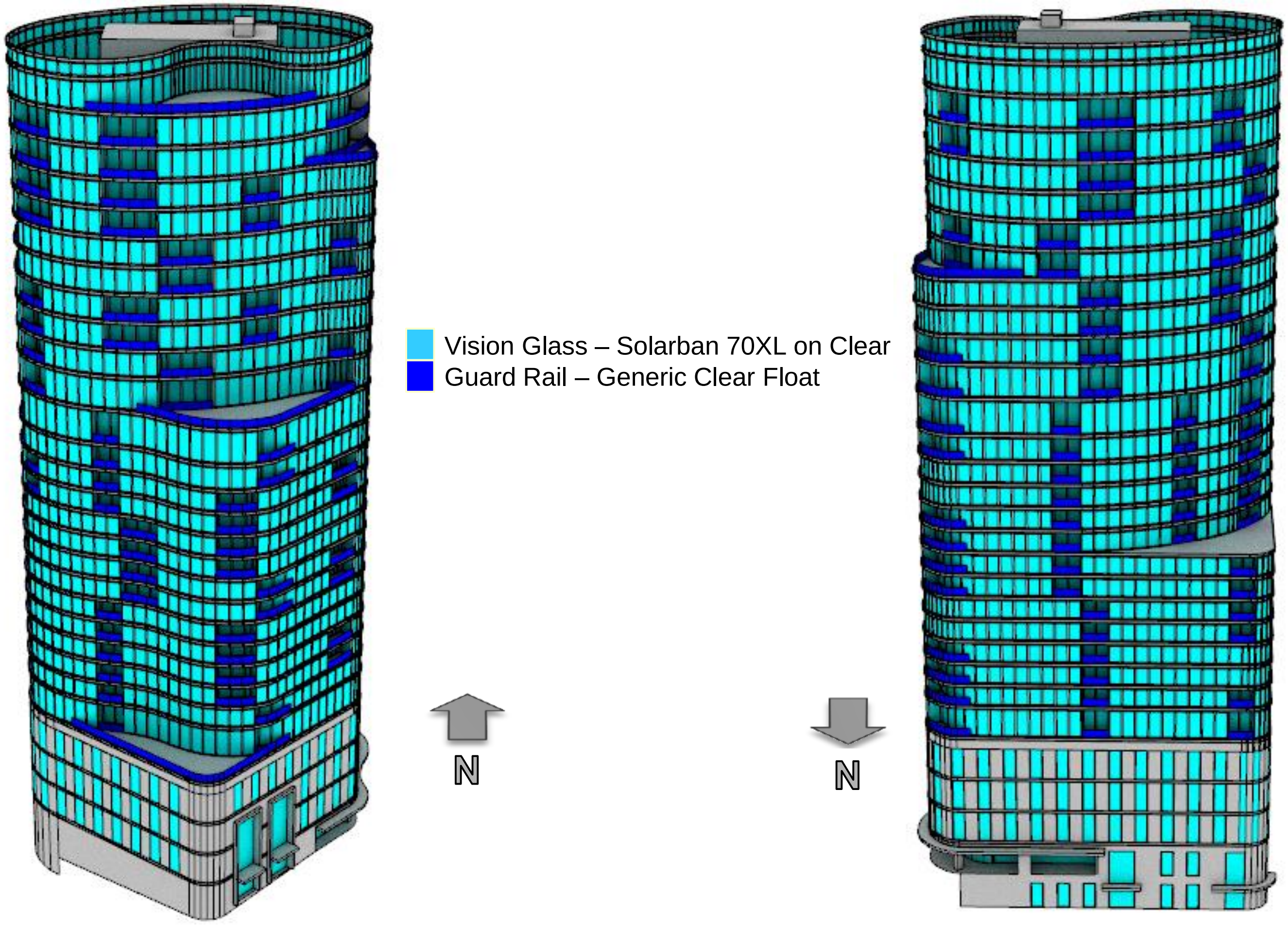
Meteorological Data

- Irradiance levels were computed using "clear sky" solar data at the location of Boston Logan International Airport. This data uses mathematical algorithms to artificially derive solar intensity values for a given latitude and altitude, ignoring local effects such as cloud cover.

Table 1: Visible and Full Spectrum Nominal Reflectance Values of Glazing

Glazing Location	Glazing Type	Visible Reflectance	Full Spectrum Reflectance
Screen Wall Glass	PPG Solarban 70 XL (on #2) + clear glass	12%	52%
Guard Rail Glass	Double-pane (1/4" or 1/2") low iron glass	15%	15%

4. ASSUMPTIONS AND LIMITATIONS (CONT'D)



View from South

View from North

Figure 5: Location of the Glazing on Charlesgate Tower Facades

5a. PRESENTATION OF RESULTS – VISUAL GLARE

Visual glare results are presented graphically using “annual glare impact diagrams” as shown in an example image below in Figure 6. The diagrams illustrate the frequency, duration and intensity of glare events. The horizontal axis of the diagram indicates the date, and the vertical axis indicates the hour of the day. We note that the referenced times are in local standard time, so in jurisdictions where Daylight Savings Time is used, the plot should be shifted by an hour when appropriate. The colour of the plot for a given combination of date and time indicates the relative impact of any glare sources found. Additional information on RWDI’s criteria for visual glare is included in Appendix C.

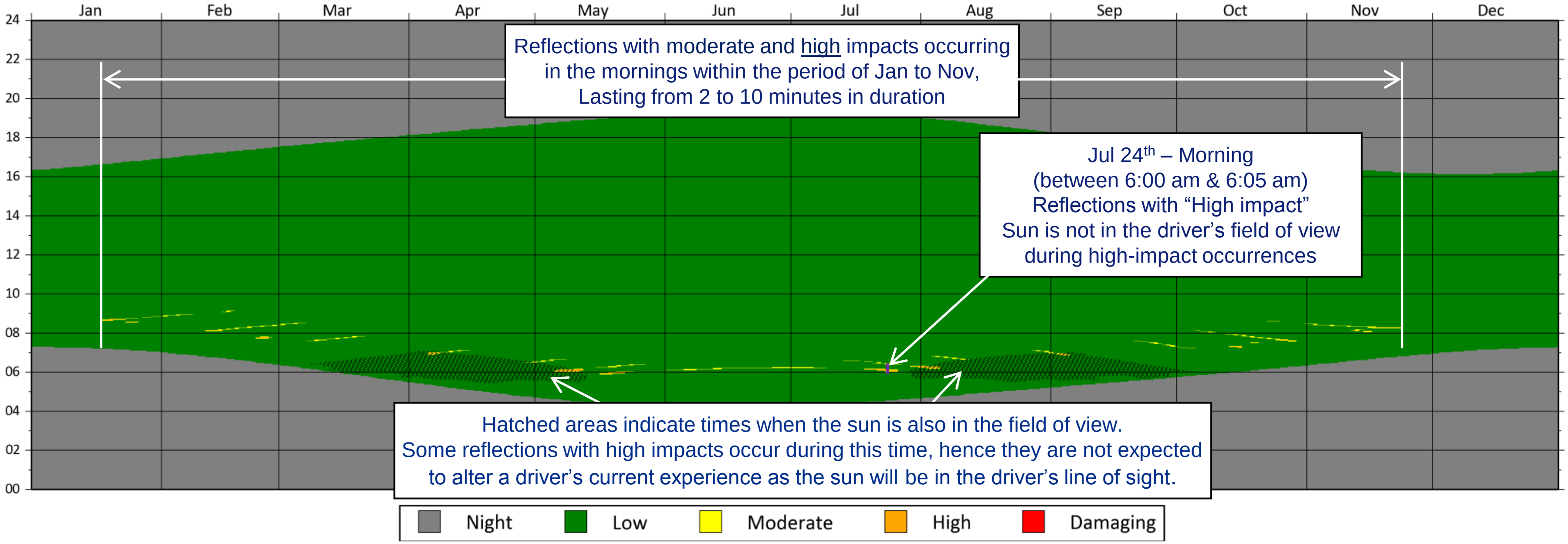
Low: Either no significant reflections occur or the reflections will have a minimal effect on a viewer, even when looking directly at the source.

Moderate: The reflections can cause some visual nuisance only to viewers looking directly at the source.

High: The reflections can cause safety issues to viewers who are unable to look away from the source (such as drivers).

Damaging: The brightest glare source is bright enough to permanently damage the eye for a viewer looking directly at the source.

The hatched areas represent times of the year when the observer would see the sun within their field of view. Hence, in these cases, the new impact imposed by the building will not add a new glare event.



Reflections with moderate and high impacts occurring in the mornings within the period of Jan to Nov, Lasting from 2 to 10 minutes in duration

Jul 24th – Morning
(between 6:00 am & 6:05 am)
Reflections with “High impact”
Sun is not in the driver’s field of view during high-impact occurrences

Hatched areas indicate times when the sun is also in the field of view.
Some reflections with high impacts occur during this time, hence they are not expected to alter a driver’s current experience as the sun will be in the driver’s line of sight.

Figure 6: Example of Annual Glare Impact Diagram – Receptor D5

5b. PRESENTATION OF RESULTS – THERMAL IMPACT ON DRIVERS AND PEDESTRIANS

The thermal impacts of the reflections from the building on the ***drivers***, and ***pedestrians*** receptors are presented using "annual heat impact diagrams" as shown in Figure 7. These diagrams illustrate the frequency, duration and intensity of reflection events categorized based on RWDI's short-term and ceiling exposure thresholds. The horizontal axis of the diagram indicates the date, and the vertical axis indicates the hour of the day. We note that the referenced times are in local standard time, so in jurisdictions where Daylight Savings Time is used, the plot should be shifted by an hour when appropriate.

The color of the plot for a given combination of date and time indicates the thermal impact of the reflected light at that point in time.

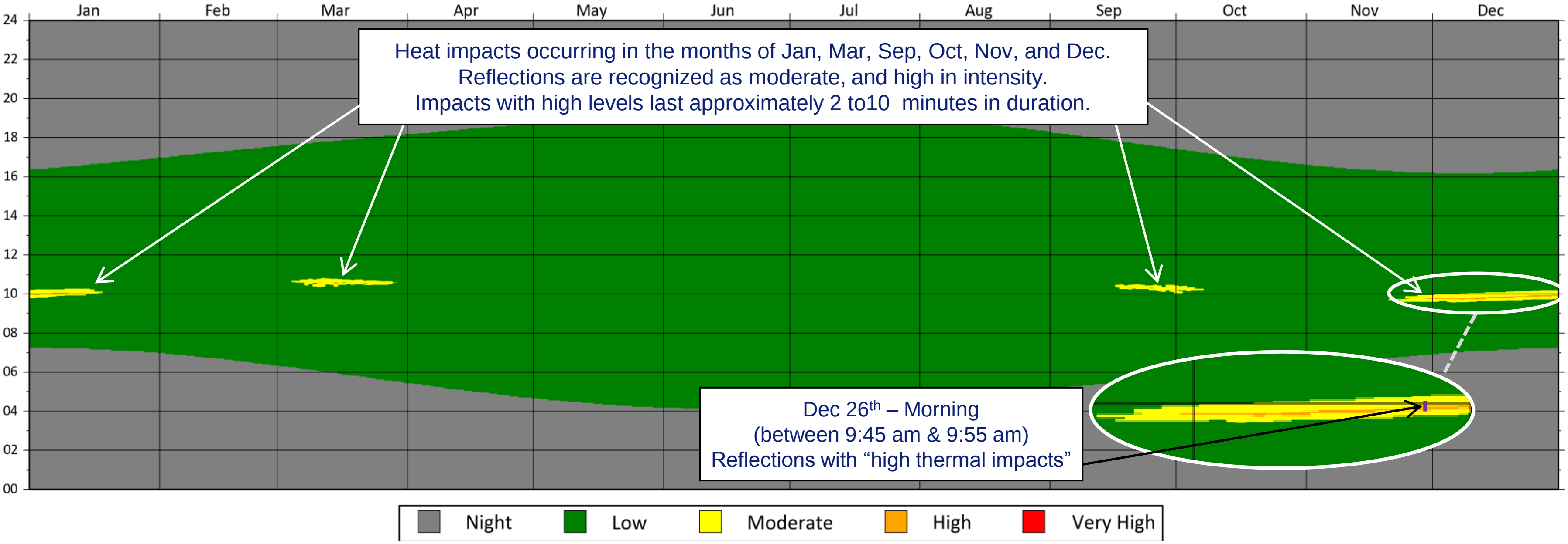
Low: Either no significant reflections occur or the reflection intensity is below the short-term exposure threshold of 1500 W/m^2.

Moderate: The reflection intensity is above the short-term exposure threshold of 1500 W/m^2 but below the safety threshold of 2500 W/m^2. Such reflections would quickly cause thermal discomfort in people.

High: The reflection intensity is above the safety threshold of 2500 W/m^2 but below 3500 W/m^2. This level of exposure to bare skin would lead to the onset of pain within 30 seconds.

Very High: The reflection intensity is above 3500 W/m^2. This level of exposure would lead to second degree burns on bare skin within 1 minute.

Additional information on RWDI's criteria for solar thermal is included in Appendix C.



Heat impacts occurring in the months of Jan, Mar, Sep, Oct, Nov, and Dec.
Reflections are recognized as moderate, and high in intensity.
Impacts with high levels last approximately 2 to10 minutes in duration.

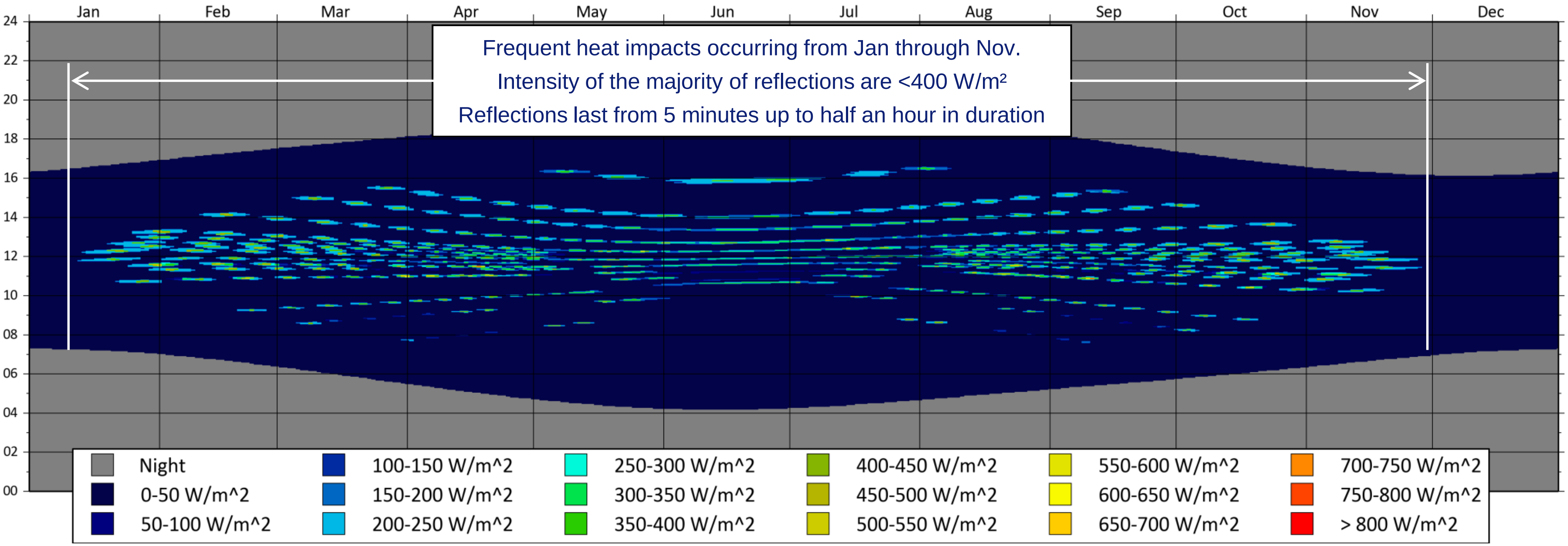
Dec 26th – Morning
(between 9:45 am & 9:55 am)
Reflections with "high thermal impacts"

Figure 7: Example of Thermal Impact Diagram – Receptor P18

5c. PRESENTATION OF RESULTS – THERMAL IMPACT ON FACADE

A different scale is used to illustrate the reflected thermal energy on ***facades*** in order to provide further clarity on the potential for heat gain issues. Figure 8 illustrates an example of the annual heat impact diagram on a facade receptor. The diagrams illustrate the irradiance levels of all predicted reflection events along with their frequency, and duration.

The format of the diagram is similar to the diagram described in the previous pages. The color of the plot for a given combination of date and time indicates the intensity of the reflected light at that point in time. Additional information on RWDI's criteria for solar thermal is included in Appendix C.



Frequent heat impacts occurring from Jan through Nov.
Intensity of the majority of reflections are <400 W/m²
Reflections last from 5 minutes up to half an hour in duration

Figure 8: Example of Annual Thermal Impact Diagram – Receptor F13

6. RECEPTOR LOCATIONS

The preliminary analysis (see Appendix E) informed the selection of specific receptor locations (shown on the following page) to be studied in the detailed analysis. These points were presented to the project team on August 12, 2016, and then revised and agreed upon on August 15, 2016.

The selected points were chosen to understand in more detail how reflections from the building will impact drivers, pedestrians and other buildings.

For points that represent people undertaking tasks with a defined direction of view (i.e. motorists and train drivers who must maintain forward visual contact) the assumed direction of view is indicated with an arrow.

Proposed Receptor Locations for Detailed Study

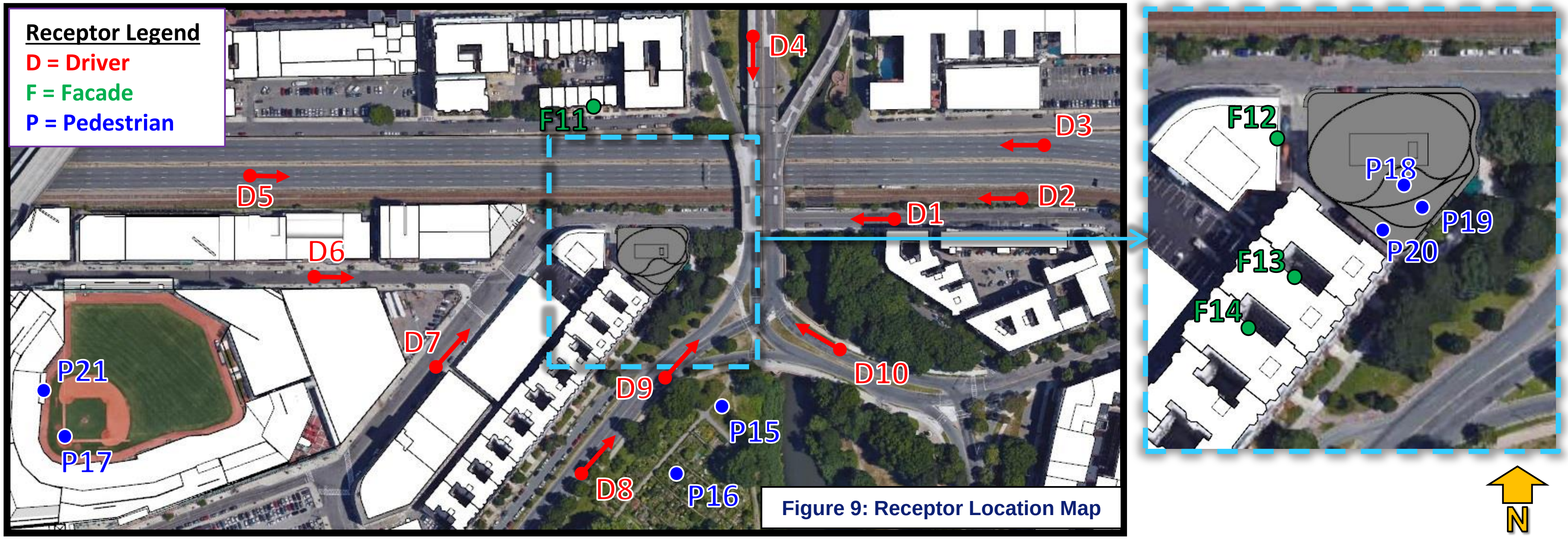


Figure 9: Receptor Location Map

Receptor Number	Receptor Description	Receptor Number	Receptor Description
D1	Drivers travelling west along Ipswich St.	**D10**	Drivers travelling northwest along Boylston St.
D2	Train drivers travelling west	**F11**	Facade of building to the north of development
D3	Drivers travelling west along Massachusetts Turnpike	**F12**	Facade of the Boston Conservatory building
D4	Drivers travelling south along Charlesgate St.	**F13-F14**	Facade of buildings to the southwest of development
D5	Drivers travelling east along Massachusetts Turnpike	**P15-P16**	Pedestrians in Fenway Victory Gardens
D6	Drivers travelling east along Lansdowne St.	**P17**	Baseball players standing at home plate in Fenway Park
D7	Drivers travelling northeast along Ipswich St.	**P18-P20**	Pedestrians standing on the exposed roof decks of the Charlesgate tower
D8-D9	Drivers travelling northeast along Boylston St.	**P21**	Baseball players standing in the third base dugout in Fenway Park

Summary of Results

7. RESULTS

Table 2 below summarizes the level of visual and thermal impacts around the Charlesgate building neighborhood at the receptors described earlier. Visual and thermal impact diagrams for each of the receptor points are provided in Appendix A.

Figures 10 and 11 illustrate the source of the glare from the Charlesgate tower on selected points at selected times. This is not an exhaustive list of all potential glare impacts, but rather serves to illustrate important results and observations.

7. RESULTS

Summary of Predicted Overall Level of Impact of Reflected Sunlight

Table 2: Summary of Overall Predicted Impacts on Receptors

Receptor Number	Receptor Type	Assumed Activity Risk Level	Assumed Ability to Self-Mitigate	Reflected Light Visual Impact	Direct Visual Impact of Sun at Time of High Impact Reflection event (Y/N)	Reflected Solar Thermal Impact on People	Reflected Solar Thermal Impact on Facade
D1	Driver	High	Low	High*	***Yes***	***Low***	–
D2	Driver	High	Low	High*	Evenings of Feb, Mar, Oct and Nov: ***No*** Evenings of Apr, May, and Aug: ***Yes***	***Low***	–
D3	Driver	High	Low	High*	***Yes***	***Low***	–
D4	Driver	High	Low	***Moderate***	–	***Low***	–
D5	Driver	High	Low	High*	Mornings of Jan, Feb, May 10th – May 20th, July, Oct, and Nov: ***No*** Mornings of Apr, May 4th – May 9th , Aug, and Sep: ***Yes***	***Low***	–
D6	Driver	High	Low	High*	Mornings of Feb, Mar 1st – Mar 15th, late Mar, May 17th – Jun 4th, Jul and Sep 26th – Nov 6th : ***No*** Mornings of Mar 16th – Apr 15th, May 2nd – May10th , Aug, and Sep 6th – Sep 25th :***Yes***	***Low***	–
D7	Driver	High	Low	***Moderate***	–	***Low***	–
D8	Driver	High	Low	***Moderate***	–	***Low***	–
D9	Driver	High	Low	***Moderate***	–	***Low***	–
D10	Driver	High	Low	***Moderate***	–	***Low***	–
F11-F14	Facade	Low	High	***Moderate***	–	–	***Low***
P15	Pedestrian	Low	High	***Moderate***	–	***Low***	–
P16-P17	Pedestrian	Low	High	***Low***	–	***Low***	–
P18	Pedestrian	Low	High	***Moderate***	–	High**	–
P19	Pedestrian	Low	High	***Moderate***	–	***Low***	–
P20	Pedestrian	Low	High	***Moderate***	–	***Low***	–
P21	Pedestrian	Low	High	***Low***	–	***Low***	–

*** The high impact reflections last from 2 to 10 minutes.**

**** The reflections with high thermal impact last from 2 to 10 minutes. This level of thermal exposure to bare skin would lead to the onset of pain within 30 seconds.**

Observations and Conclusions

8. OBSERVATIONS AND CONCLUSIONS

1. The faceted concave-shaped sections of the east, southeast, south, and southwest facades of the Charlesgate building act to focus solar energy. Although the location of the focal points are transient, they occur most frequently immediately in front of the concave facades. Increases in temperature may occur in these areas, and the thermal radiation at this location may be intense enough to cause thermal discomfort. However, given that the focal areas are between 50 and 300 feet above grade and close to the building, we do not consider this effect a safety risk to people or future developments.
2. People that are standing on the roof deck of the mechanical penthouse level (receptor P18) are predicted to experience high thermal impacts caused by the concave-shaped section of the top levels of the building's southern facade. The reflections are predicted to exceed both RWDI's short-term and ceiling exposure thresholds. This level of exposure to bare skin would lead to the onset of pain within 30 seconds. The reflections in question occur between 9:40 am and 10:40 am in the months of January, March, September, November, and December, lasting for approximately 2 to 10 minutes in duration. Figure 10 shows a sample set of reflections emanating from the concave shape facade that fall onto this receptor during the morning of January 6th. It is RWDI's understanding that this is a controlled access area, which is only accessible to maintenance staff, which reduces the potential risk. For further details, refer to thermal impact plot for receptor P18 provided in Appendix A and the recommendations section of this report.
3. No other points at a pedestrian height were found to exceed RWDI's thermal exposure criteria.
4. No significant thermal impacts are expected to occur on the facade receptors (i.e. F11-F14) as the intensities of most of the incident reflections are predicted to be lower than 400 W/m^2 and will occur when those facades are not exposed to direct sunlight.
5. Moderate levels of visual impact fall on most of the pedestrian and facade receptors for practically the entire year, indicating a nuisance at worst. However, some of the receptors representing spaces where people may linger, such as the Fenway Victory Gardens (P15), are predicted to be impacted by frequent, short duration reflections.
6. Drivers travelling in some locations in the vicinity of the tower are expected to experience an increased level of visual glare impact. Many of these impacts are not expected to alter a driver's current experience as the sun will already be in the driver's line of sight. These events occur to drivers when:
    a) Travelling west along Ipswich St. (receptor D1) in April, May, July, and August evenings,
    b) Travelling west on the train line (receptor D2) during some evenings in April, May, and August,
    c) Travelling west along Massachusetts Turnpike (receptor D3) in the evenings from March to May and July to September,
    d) Travelling east along Massachusetts Turnpike (receptor D5) during some mornings in April, May, August, and September,
    e) Travelling east along Lansdowne St. (receptor D6) in some mornings from mid-March to mid-April, early May to mid-May, as well as in August and September.

    The morning reflections occur between 5:45 am and 7:15 am, and the evening reflections take place between 4:30 pm and 6:00 pm. Most of the reflections in question are brief and last from 2 to10 minutes in duration. For further details refer to the visual impact diagram for receptors D1-D10 illustrated in Appendix A.

8. OBSERVATIONS AND CONCLUSIONS

7. On the other hand, some other high-impact reflections could cause distraction to the drivers as the sun will fall out of the driver's field of view. In particular, a driver's experience could be altered when:

   a) Travelling west on the train line (receptor D2) during some evenings in February, March, October, and November,

   b) Travelling east along Massachusetts Turnpike (receptor D5) in the mornings of January, February, May 10th – May 20th, July, October, and November,

   c) Travelling east along Lansdowne St. (receptor D6) in some mornings of February, March 1st – March 15th, late March, May 17th – June 4th, July and September 26th – November 6th.

   The morning reflections occur between 5:45 am and 9:00 am, and the evening reflections take place between 3:00 pm and 4:45 pm. Although the reflections in question may possibly alter the driver's experience, most of them are infrequent and short in duration, lasting from 2 to10 minutes.

   Figure 11 illustrates a sample set of high-impact reflections which emanate from middle one-third of the southern facade and fall onto the driver receptor point D6 on the morning of October 24th.

   For further details refer to the visual impact diagram for receptor drivers D1-D10 illustrated in Appendix A.

8. The simulations do not predict any thermal impact from the reflections within Fenway Park.

9. We do not anticipate any significant visual impacts to players in Fenway Park standing at home plate (receptor P17). However, some visual impacts were seen at the third base dugout (receptor P21) as well as elsewhere in the vicinity. These reflections are not expected to have an impact on play, as they are infrequent, dim and occur only in the early morning hours. Specifically, the impacts at the dugout occur for only a few days in May and August and do not occur after 6:30 am.

8. OBSERVATIONS AND CONCLUSIONS (CONT'D)

Glare Source Diagram for Selected Impacts on Pedestrian Receptor P18

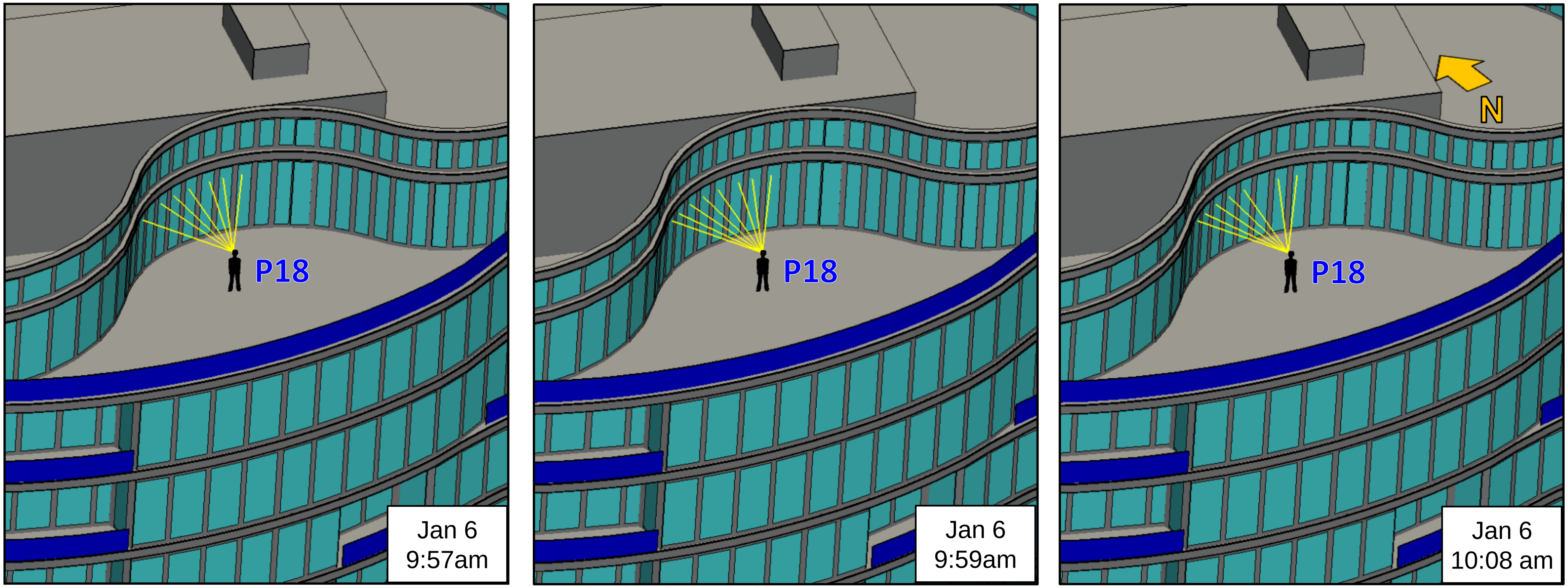


Figure 10: Illustration of Reflection Traces with High Thermal Impacts on Receptor P18 on January 6th Morning.

8. OBSERVATIONS AND CONCLUSIONS (CONT'D)

Glare Source Diagram for Selected Impacts on Driver Receptor D6

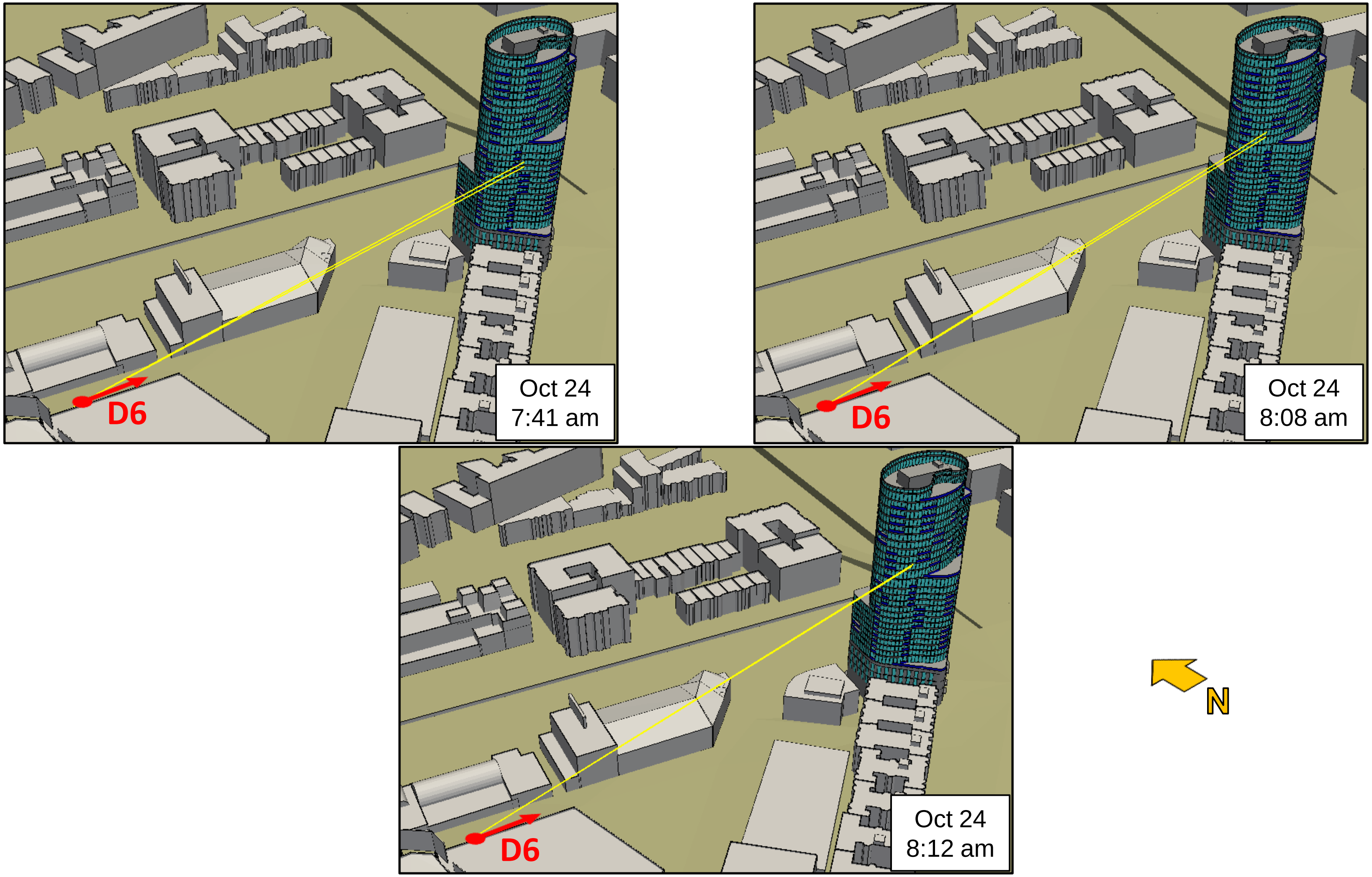


Figure 11: Illustration of Reflection Traces with High Impacts on Driver Receptor D6 on Oct 24th Morning. These impacts may alter a driver's experience as the sun would not already be in the driver's field of view.

Recommendations

9. RECOMMENDATIONS

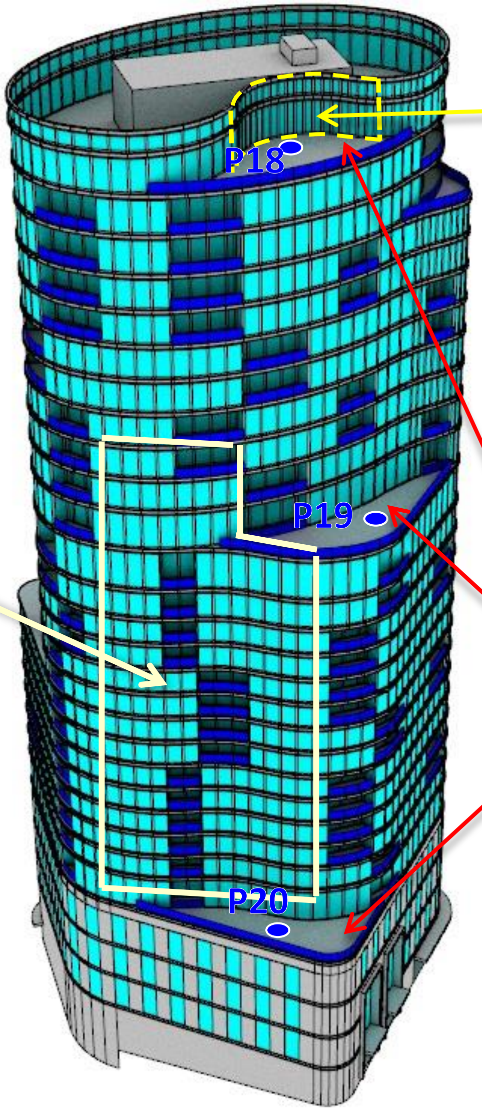
If mitigation is desired, RWDI recommends that the following mitigation options be considered (refer to Figures 12-13 in the following two pages for a mark-up of these recommendations):

1. *Operationalized Mitigation* – It is our understanding that the area where high thermal impacts have been predicted is restricted to maintenance staff only. Since access is well controlled, mitigation can be achieved through operational means. This would entail enacting the following measures:
    - Ensuring the only people who access these areas are maintenance staff who are informed that surfaces may be hotter than expected;
    - Scheduling any activities in the affected area in the afternoons (after 2:00pm EST), when the risk from focusing has passed and surfaces have had time to cool;
    - Selecting materials for this area which minimize radiative heat gains and the risk of heat related damage. (e.g. white crushed stone ballast or high-albedo pavers); and
    - Regularly inspecting this area for signs of accelerated material wearing or damage and repair as needed.
2. *Glazing Change-out* – If an operational solution was not desired then selecting glazing units with a lower **full spectrum** reflectance on the concave-shaped section of the top levels of the building's southern facade (area inside the dashed yellow lines in Figure 12) aids in reducing the intensity of high and moderate thermal impacts on the mechanical penthouse level roof deck (receptor P18).
3. *Building Mounted Shading Devices* – Breaking up the reflections emanating from the north facades of the development (areas in dashed orange in Figure 13) could be accomplished by constructing physical blockages. In particular, employing vertical fins approximately 6-8 inches deep would aid in intercepting high-impact glancing reflections falling onto driver receptors D1, D2, and D3 in the evening, and D5 and D6 in the morning.

    Applying similar adjustments with deeper fin size (8-10 inches deep) to the southwest facade of the development (areas inside the white lines in Figure 12) would aid in intercepting some of the morning reflections with high incidence angle falling onto receptors D5 and D6.

It should be noted that building mounted shading devices need careful design to ensure that they do not lead to potential problems with wind induced noise or vibration, snow and ice build up, etc. Thus, if mitigation via facade mounted shading structures is desired, RWDI would recommend re-running the simulations with the proposed shading devices included to predict their effectiveness.

9. RECOMMENDATIONS (CONT'D)



Because access to this area is controlled to maintenance staff only, an operationalized approach could be taken to mitigate the thermal impact.

- Access to this area must be restricted to only maintenance staff, and maintenance activities should be scheduled during the afternoon to avoid times when focusing can occur.
- Materials used in this area should be selected to minimize radiative heat gain and the risk of heat related damage.
- This area should be regularly inspected for accelerated material wearing or damage and repaired as needed.

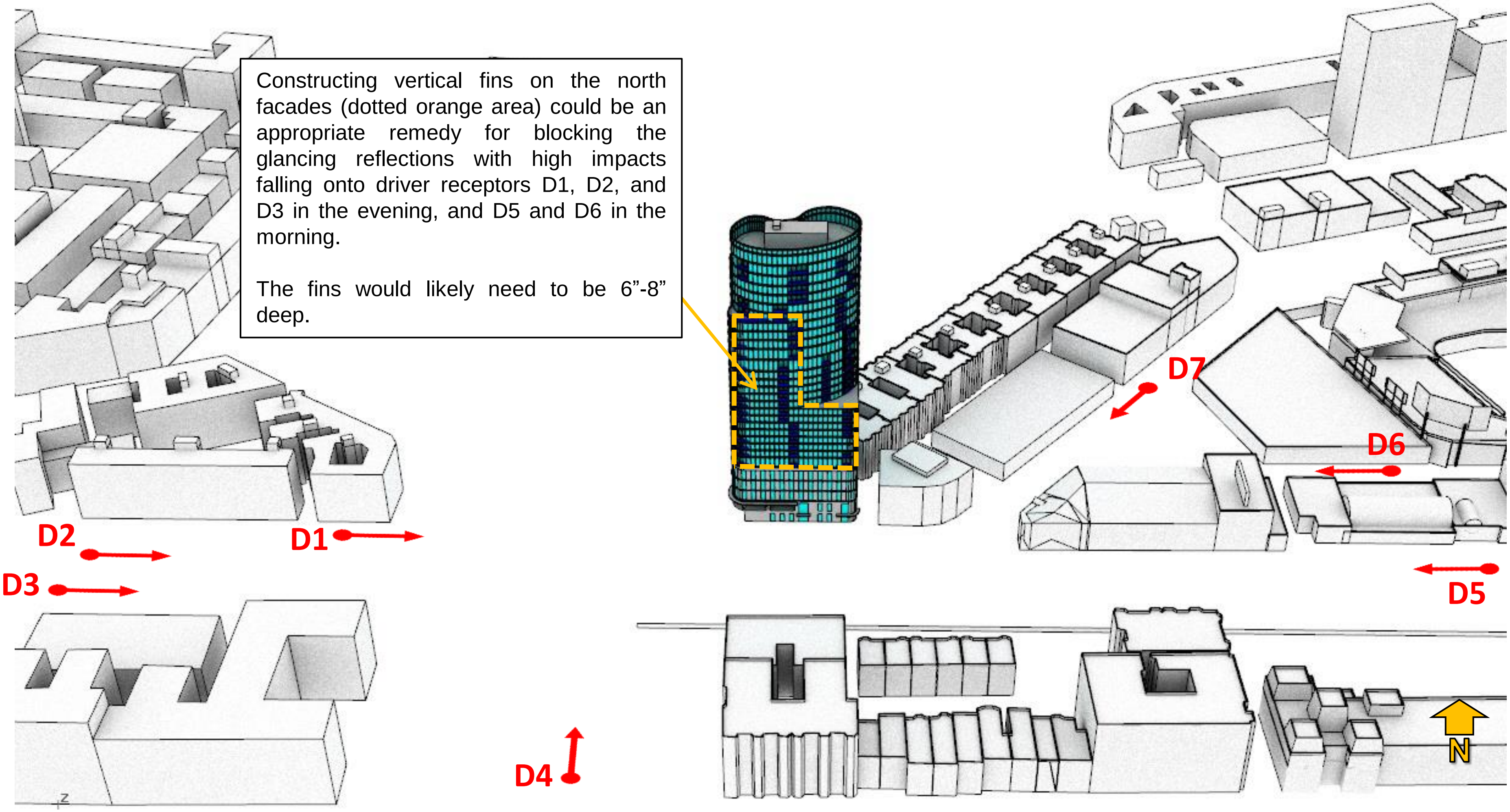
Mounting vertical fins on the southwest sections of the facade (area in white) would aid in intercepting high-impact morning reflections with high incidence angle falling onto receptors D5 and D6.

The fins would likely need to be 8"-10" deep.

Adding shading devices such as umbrellas, canopies, and vegetation in the terraces would also reduce the frequency and duration of thermal and visual impacts on receptors P18-P20.

Figure 12: Markup of the Recommendations for Glazing Change-out and Localized Shading Devices

9. RECOMMENDATIONS (CONT'D)



Constructing vertical fins on the north facades (dotted orange area) could be an appropriate remedy for blocking the glancing reflections with high impacts falling onto driver receptors D1, D2, and D3 in the evening, and D5 and D6 in the morning.

The fins would likely need to be 6”-8” deep.

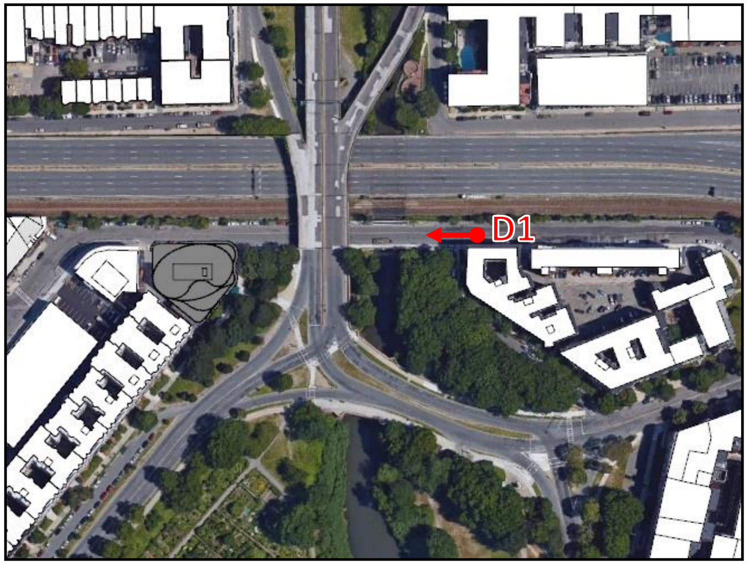
Figure 13: Markup of the Recommendations for Building-mounted Shading Devices

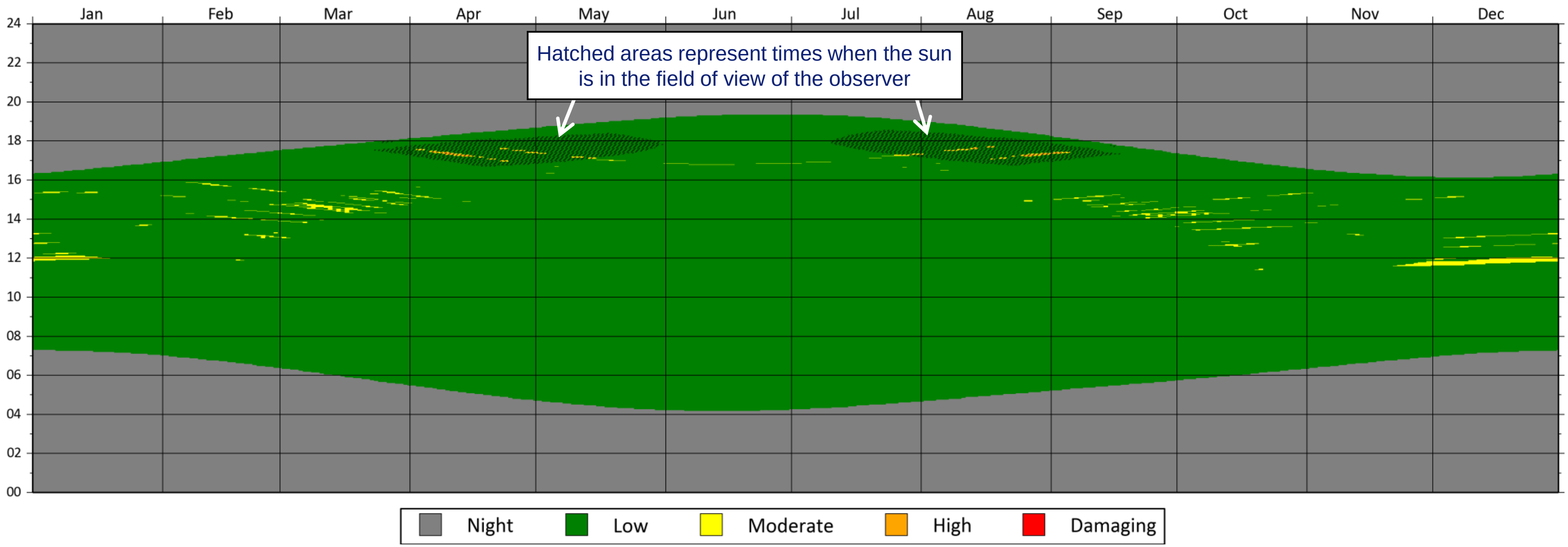
APPENDIX A – DETAILED REFLECTION RESULTS

Visual Reflection Impact Plots

Receptor D1 Annual Visual Impact

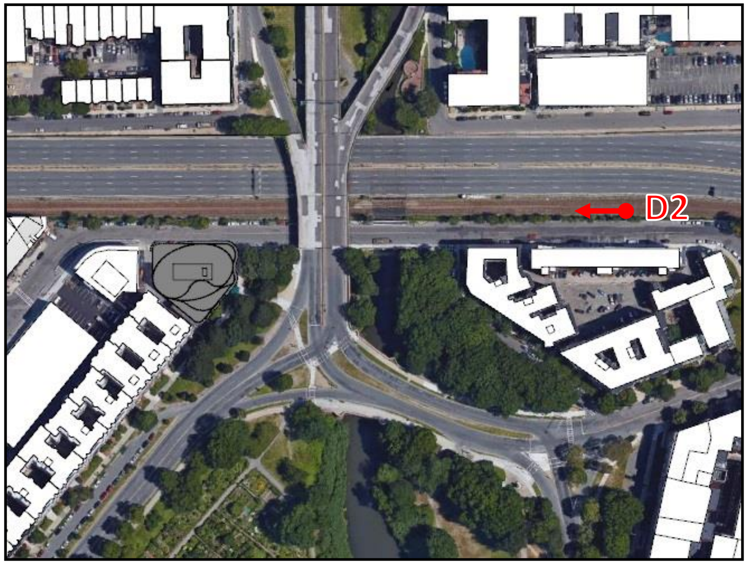
Receptor D1 was chosen to assess the visual risk associated with solar reflections affecting drivers travelling west along Ipswich St.

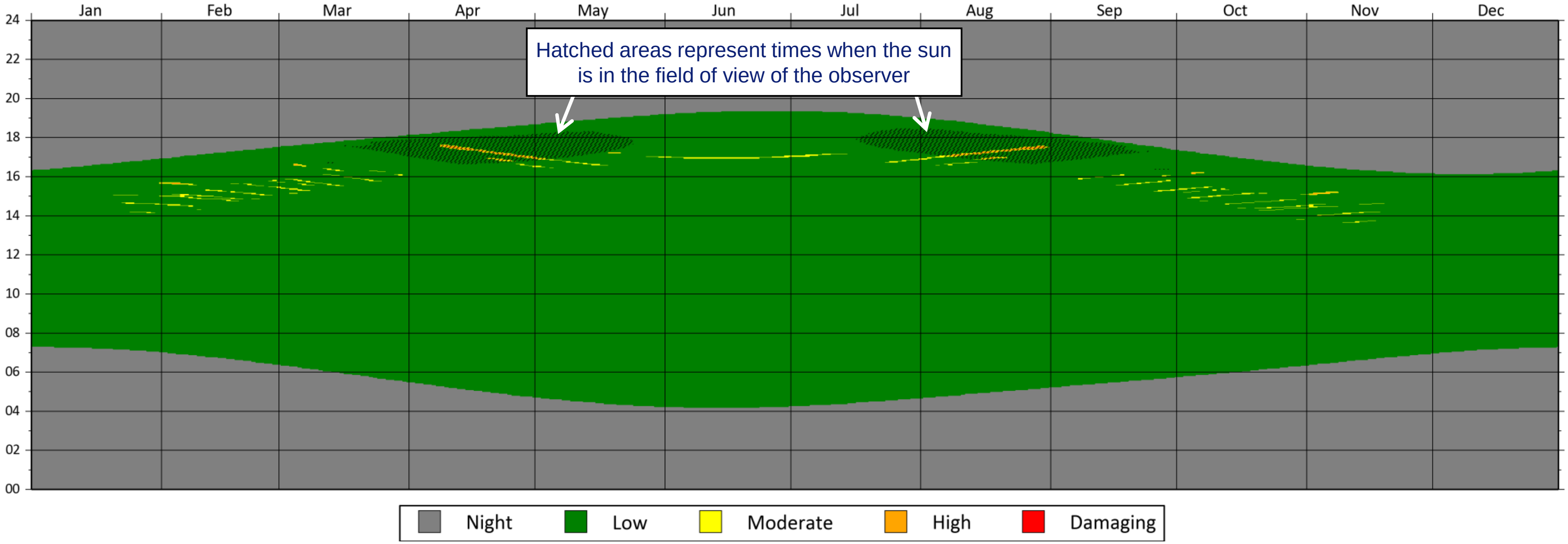



Hatched areas represent times when the sun is in the field of view of the observer

Receptor D2 Annual Visual Impact

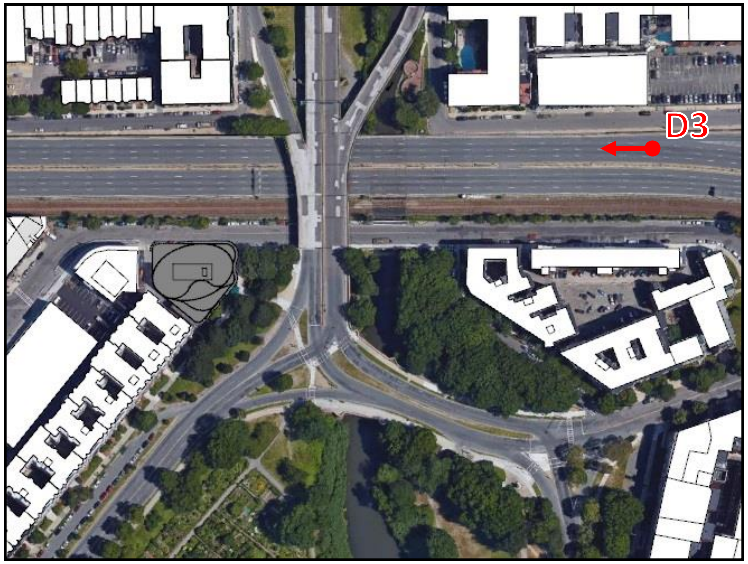
Receptor D2 was chosen to assess the visual risk associated with solar reflections affecting train drivers travelling west.

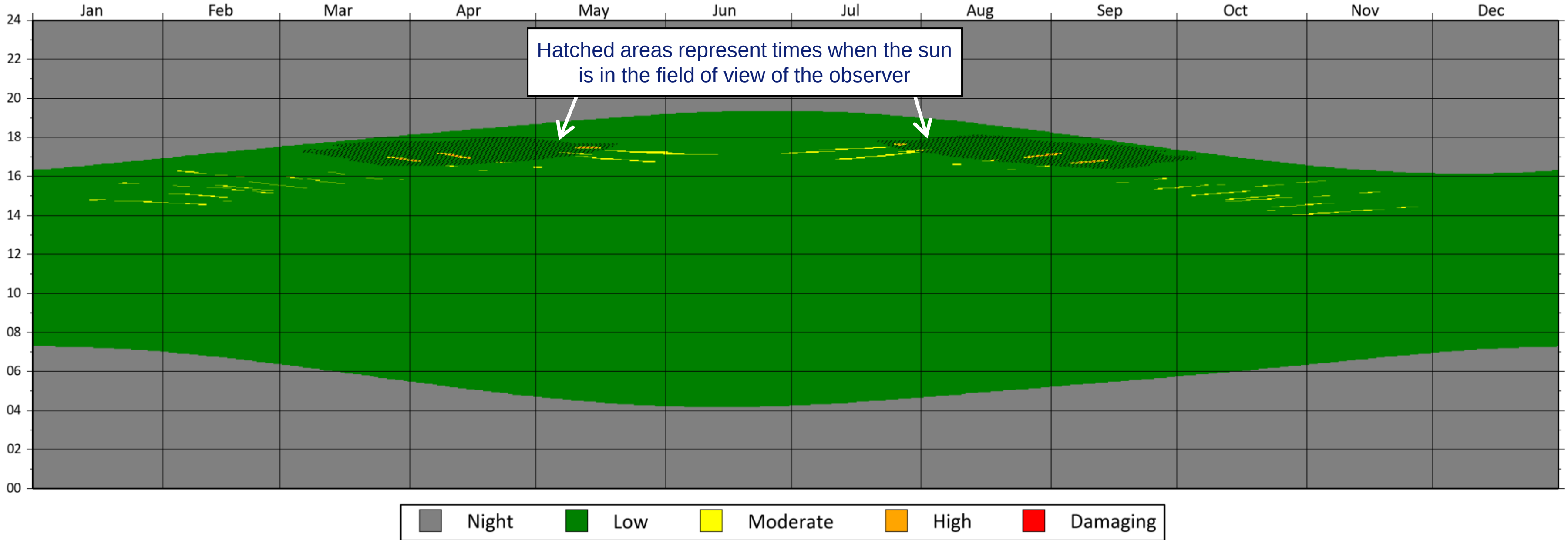




Receptor D3 Annual Visual Impact

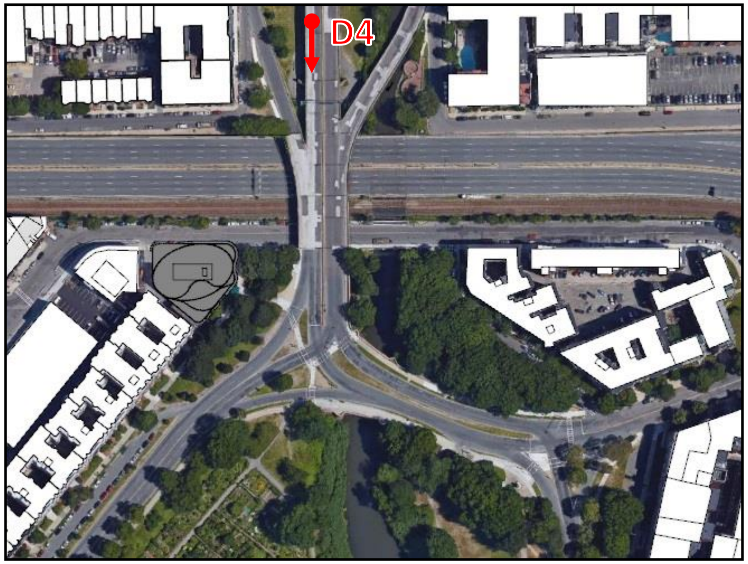
Receptor D3 was chosen to assess the visual risk associated with solar reflections affecting drivers travelling west along Massachusetts Turnpike.

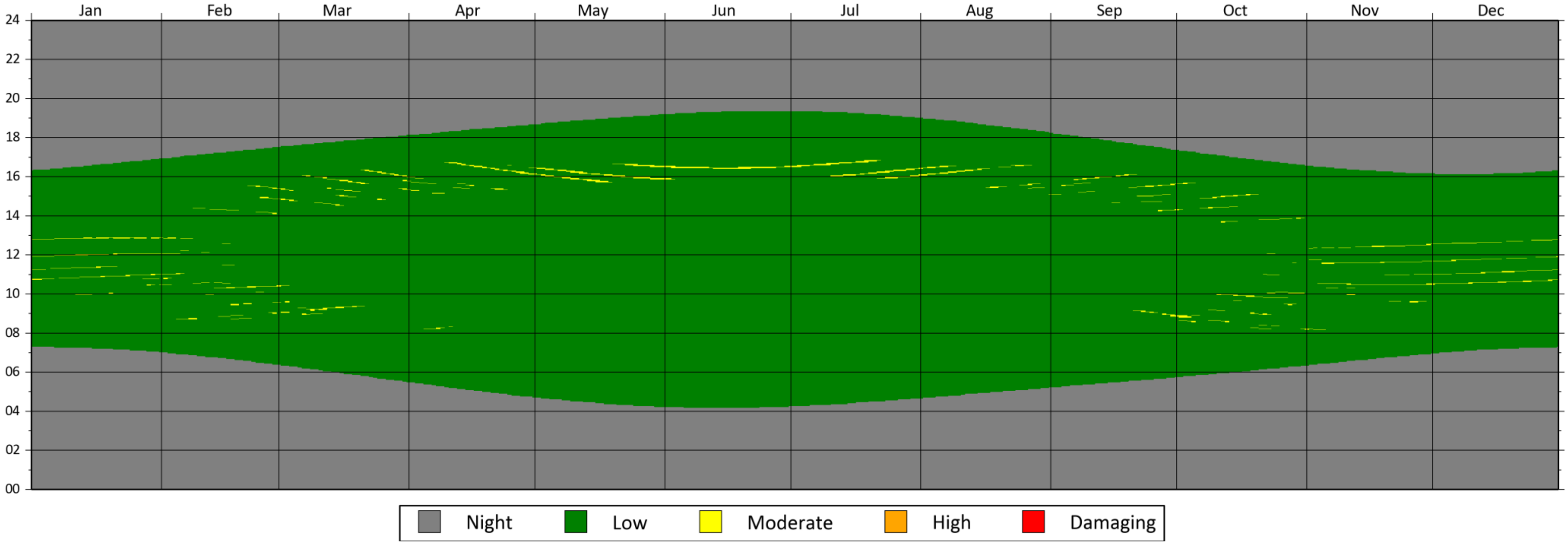



Hatched areas represent times when the sun is in the field of view of the observer

Receptor D4 Annual Visual Impact

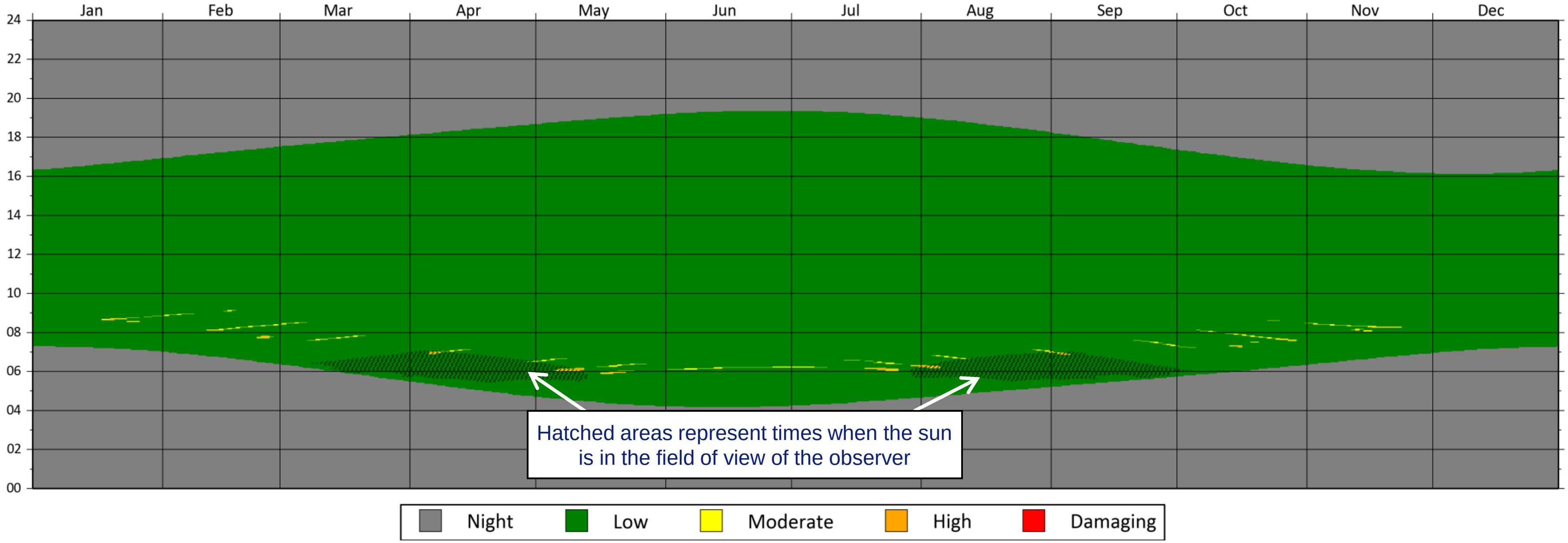
Receptor D4 was chosen to assess the visual risk associated with solar reflections affecting drivers travelling south along Charlesgate St.





Receptor D5 Annual Visual Impact

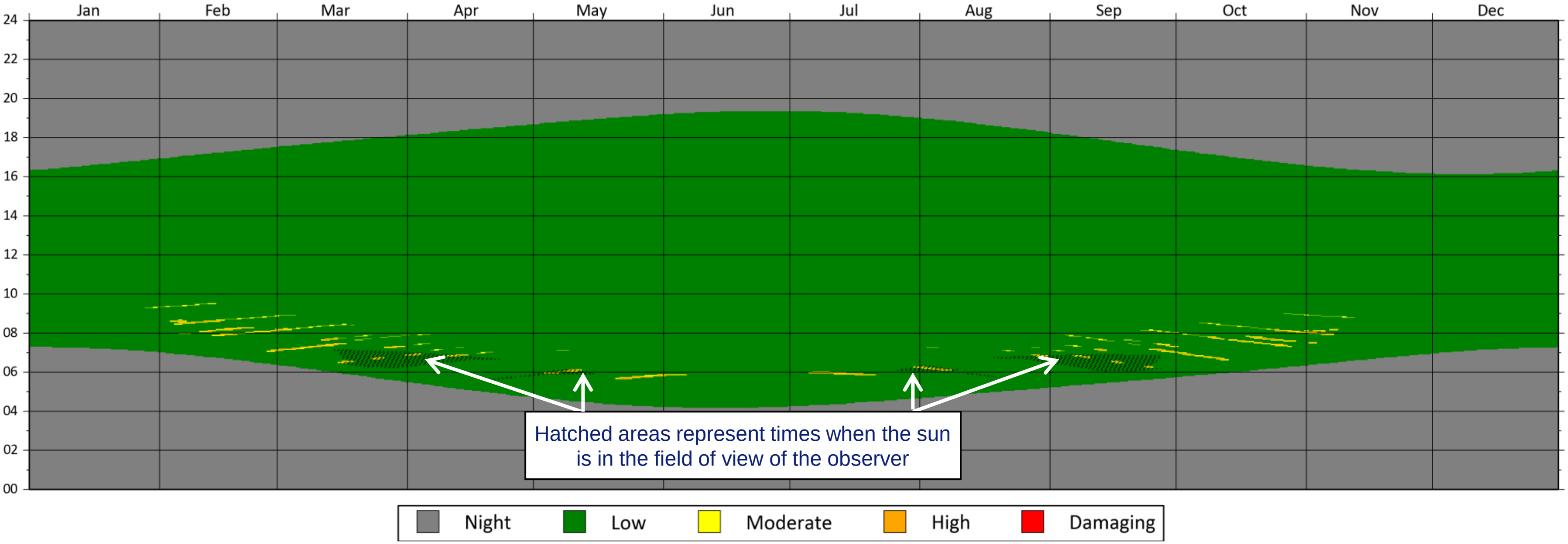
Receptor D5 was chosen to assess the visual risk associated with solar reflections affecting drivers travelling east along Massachusetts Turnpike.



Hatched areas represent times when the sun is in the field of view of the observer

Receptor D6 Annual Visual Impact

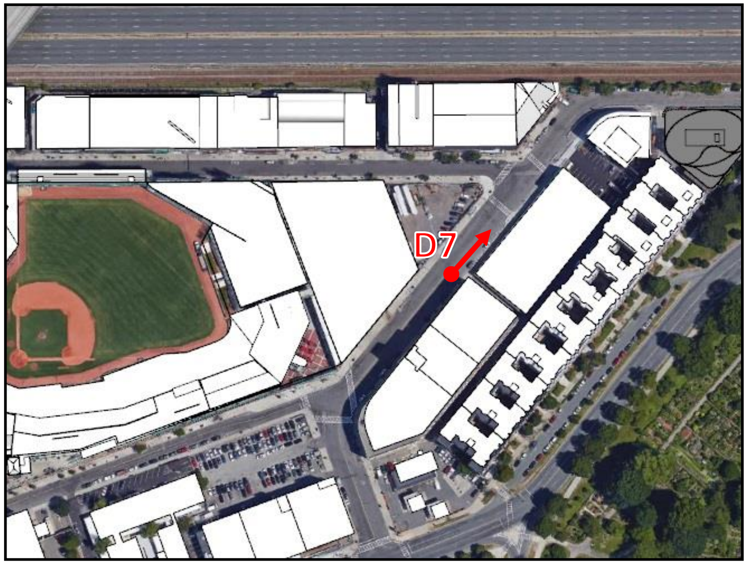
Receptor D6 was chosen to assess the visual risk associated with solar reflections affecting drivers travelling east along Lansdowne St.

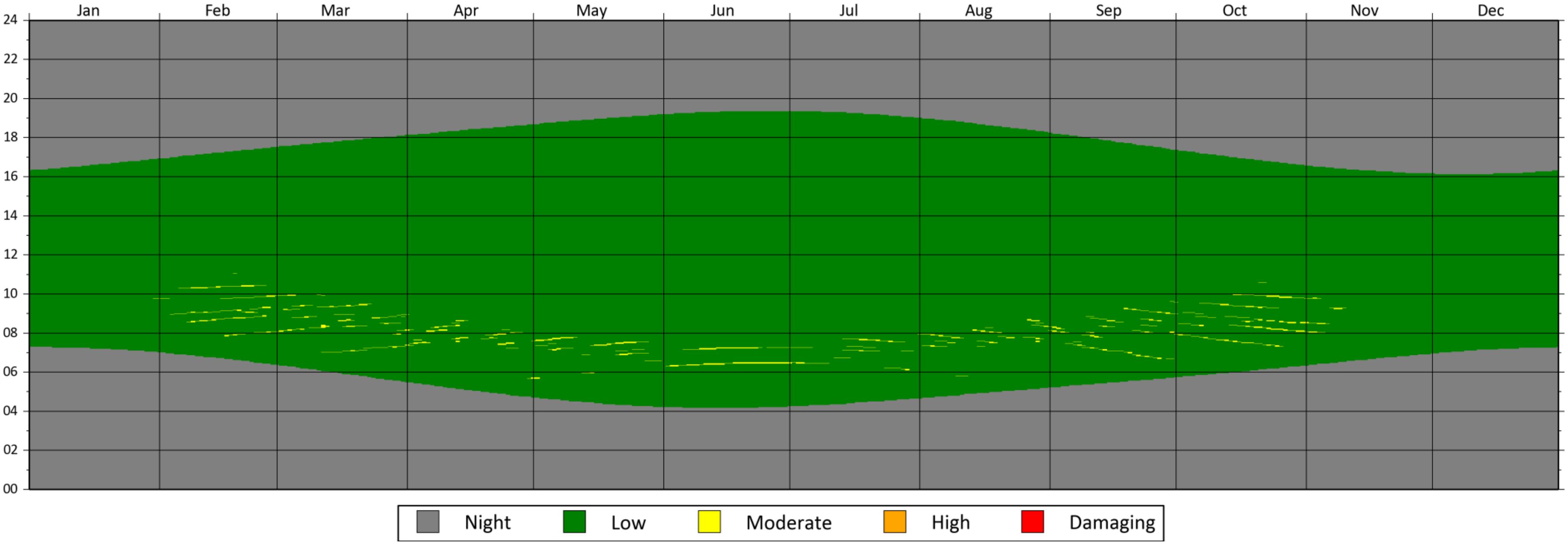


Hatched areas represent times when the sun is in the field of view of the observer

Receptor D7 Annual Visual Impact

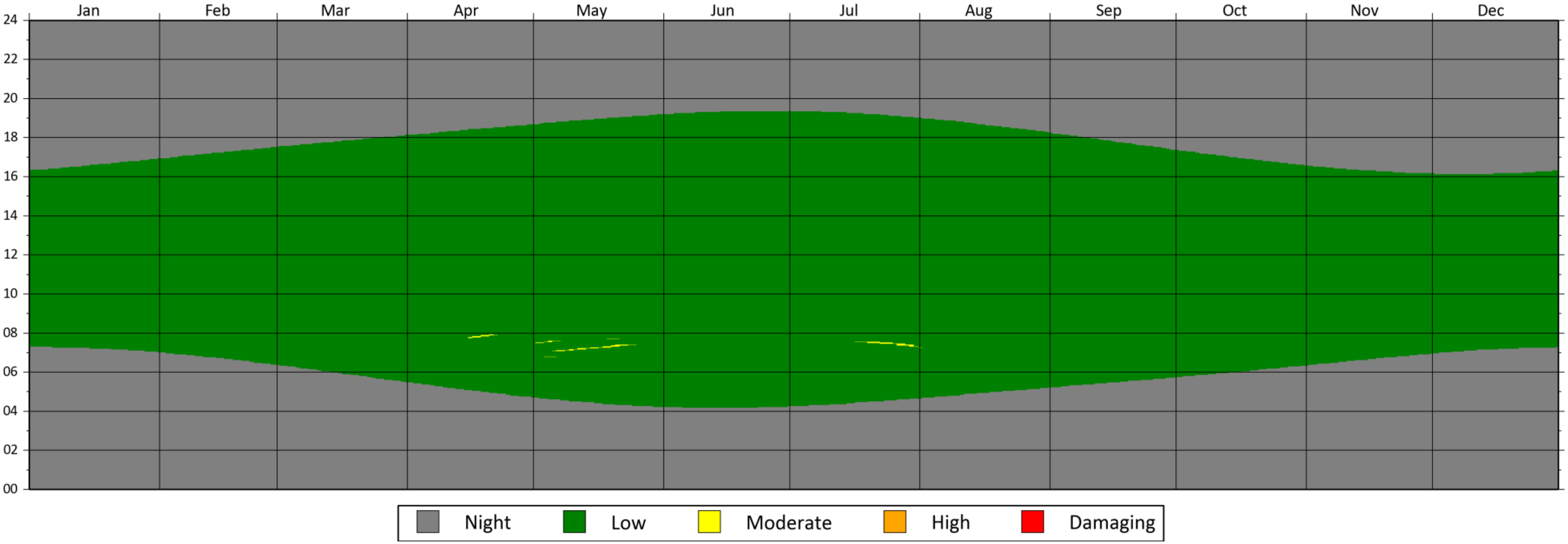
Receptor D7 was chosen to assess the visual risk associated with solar reflections affecting drivers travelling northeast along Ipswich St.





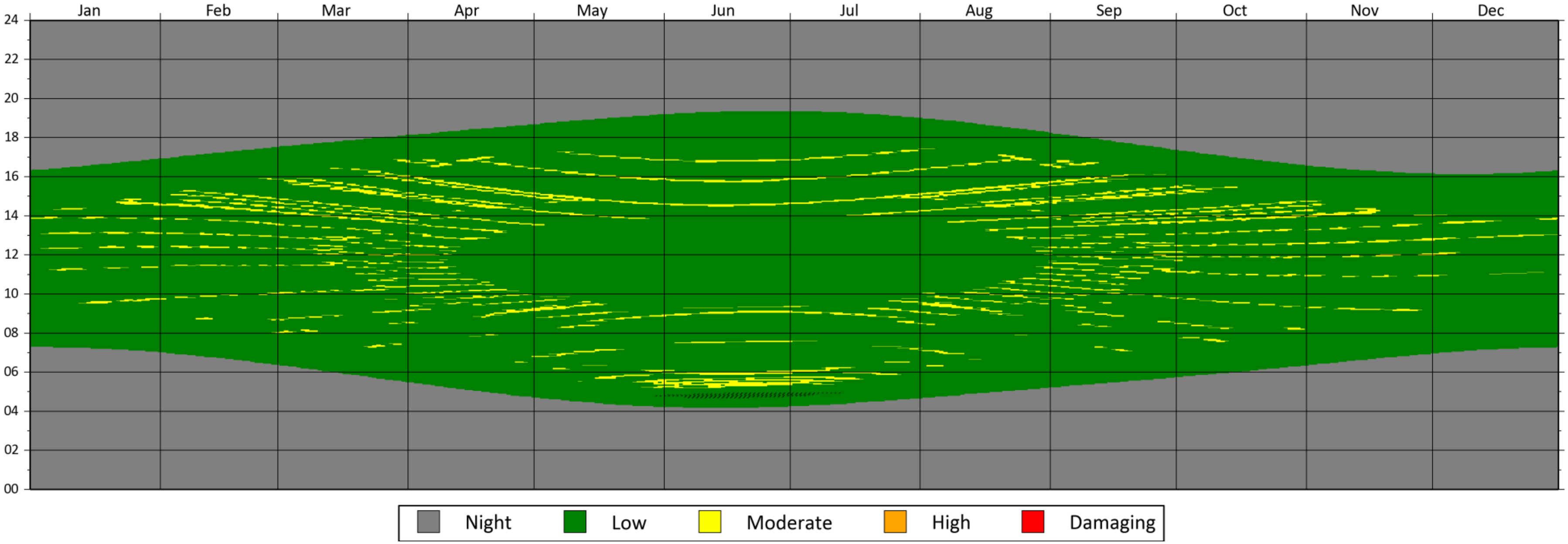
Receptor D8 Annual Visual Impact

Receptor D8 was chosen to assess the visual risk associated with solar reflections affecting drivers travelling northeast along Boylston St.



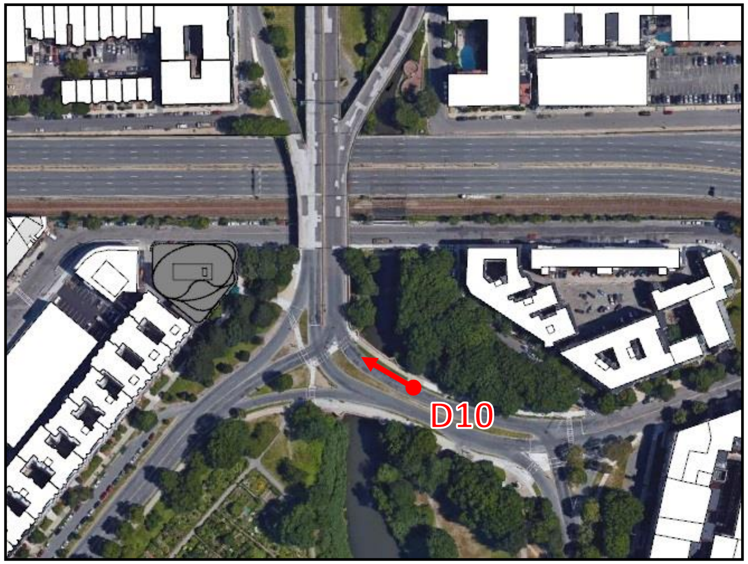
Receptor D9 Annual Visual Impact

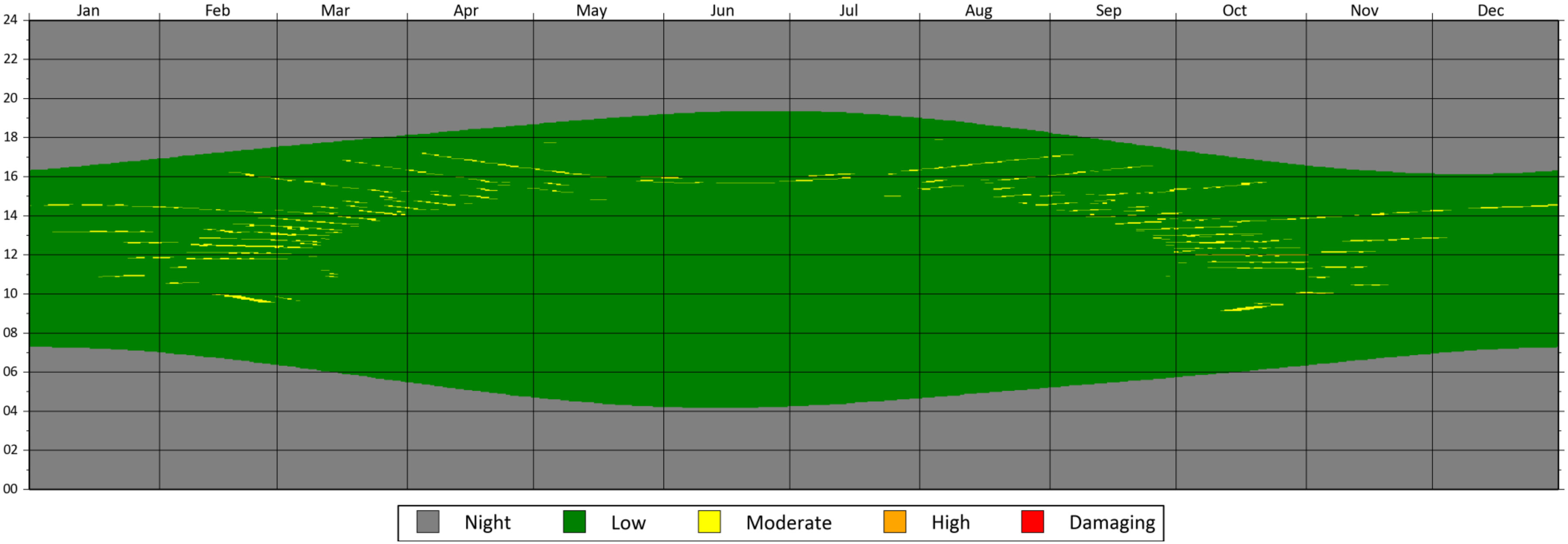
Receptor D9 was chosen to assess the visual risk associated with solar reflections affecting drivers travelling northeast along Boylston St.



Receptor D10 Annual Visual Impact

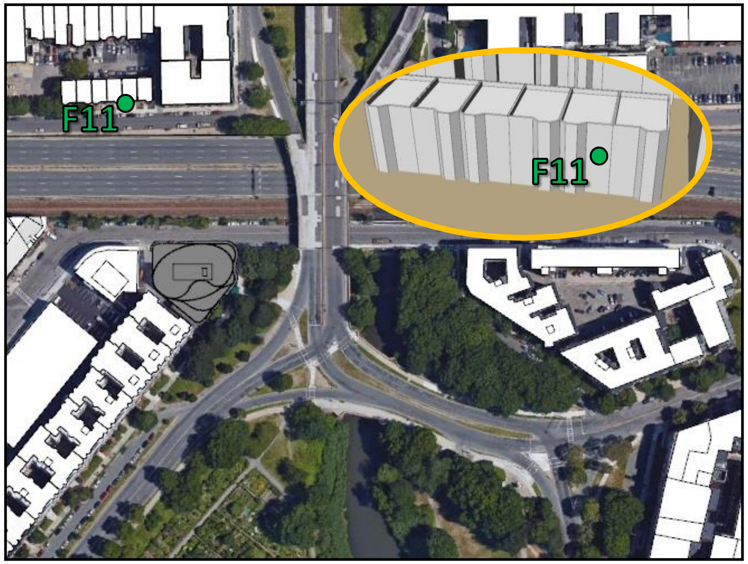
Receptor D10 was chosen to assess the visual risk associated with solar reflections affecting drivers travelling northwest along Boylston St.

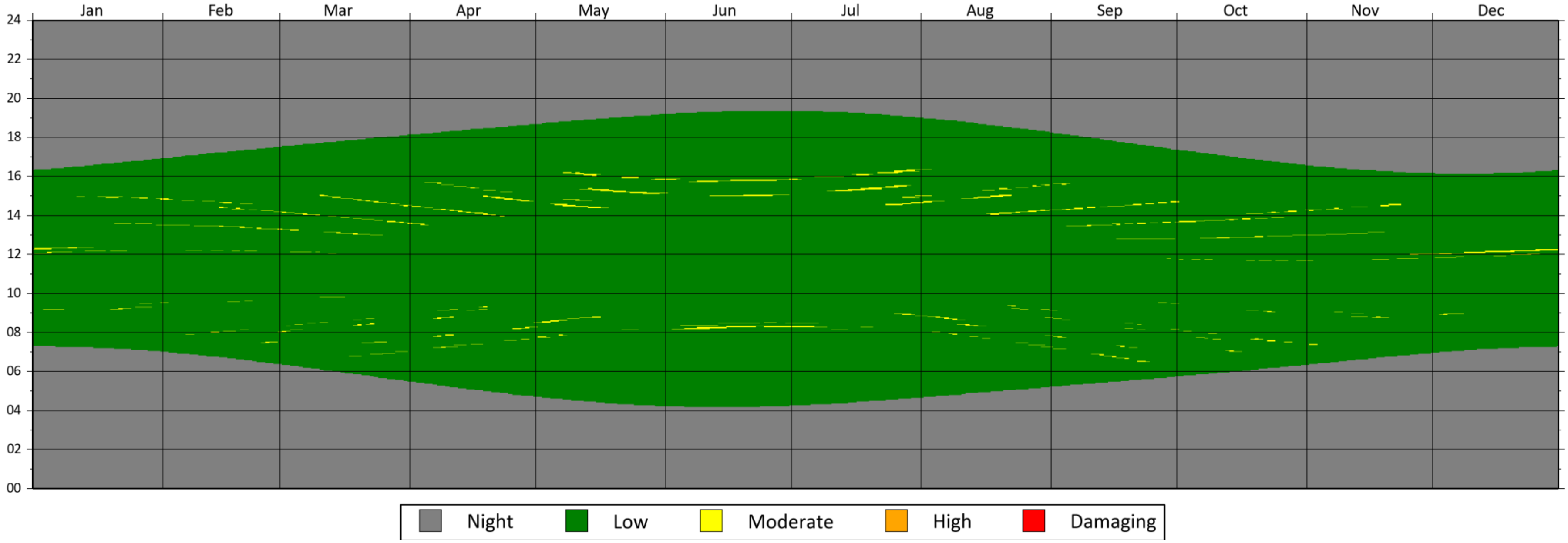




Receptor F11 Annual Visual Impact

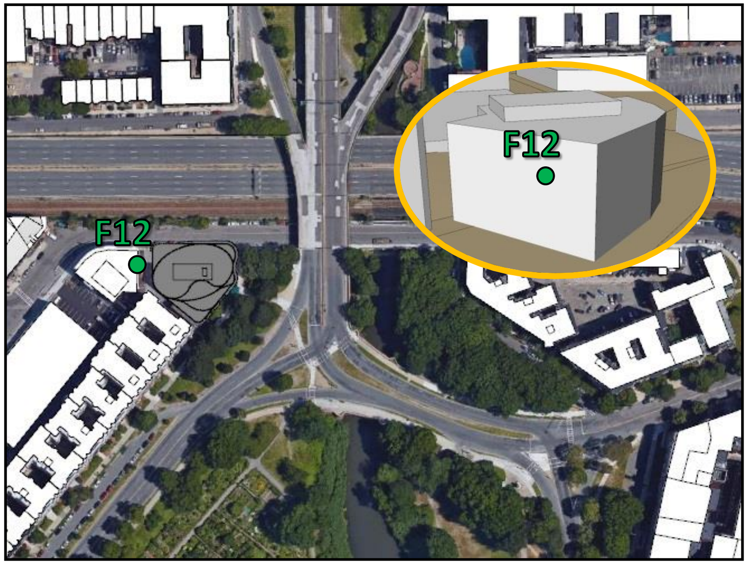
Receptor F11 is a receptor placed on the facade of building to the north of development.

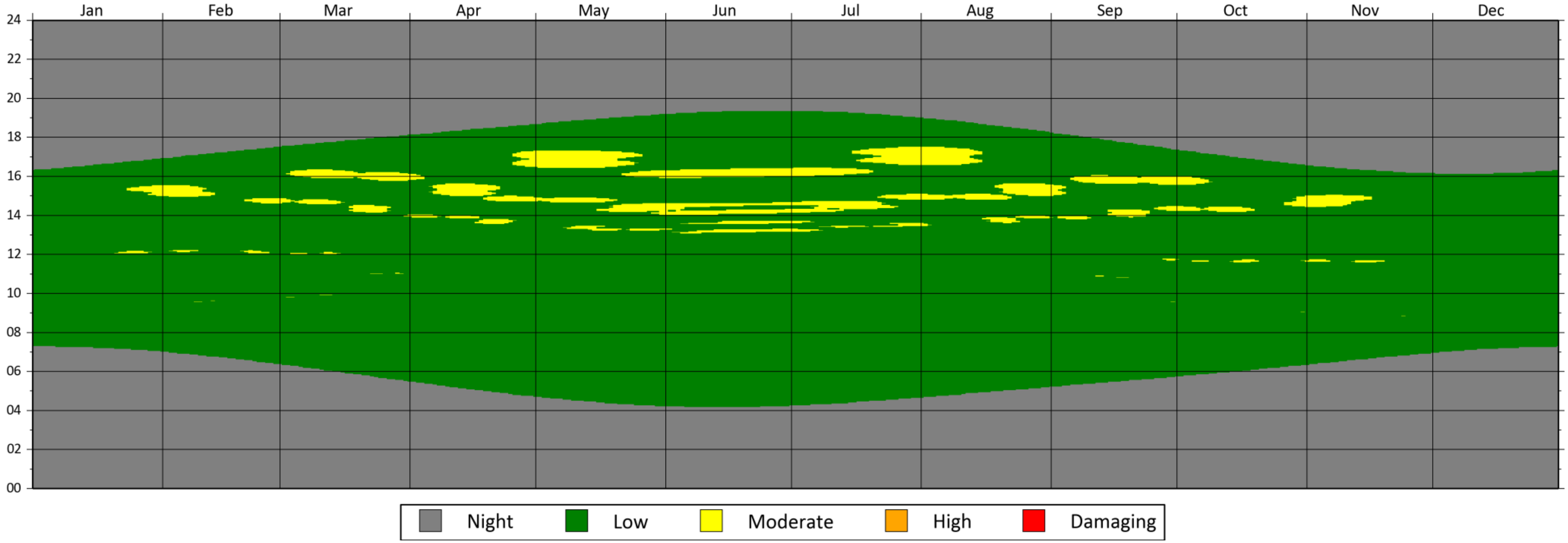




Receptor F12 Annual Visual Impact

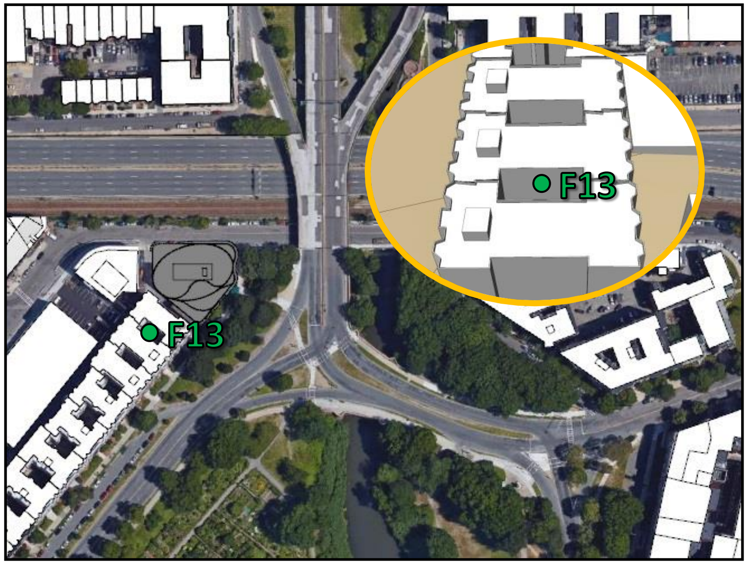
Receptor F12 is a receptor placed on the facade of the Boston Conservatory building.

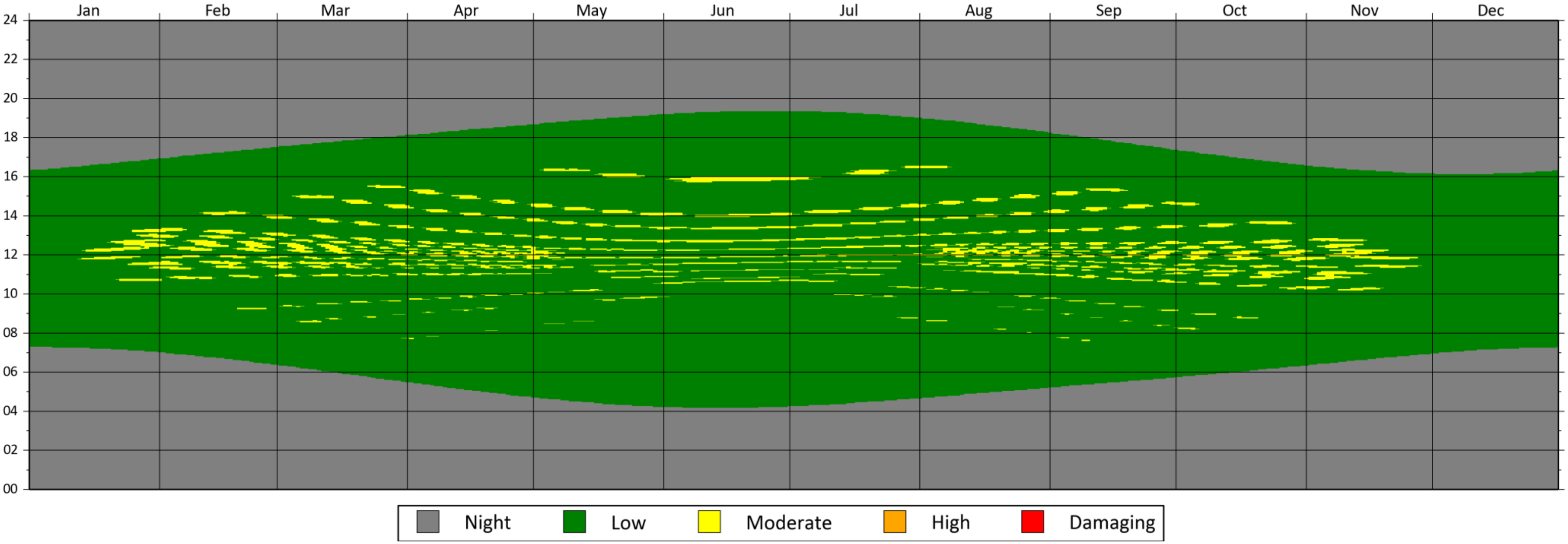




Receptor F13 Annual Visual Impact

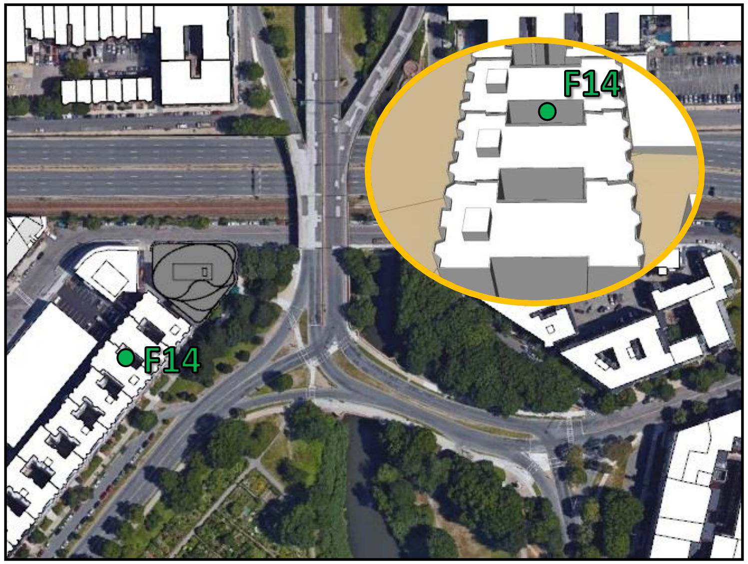
Receptor F13 is a receptor placed on the facade of a building to the southwest of the development.

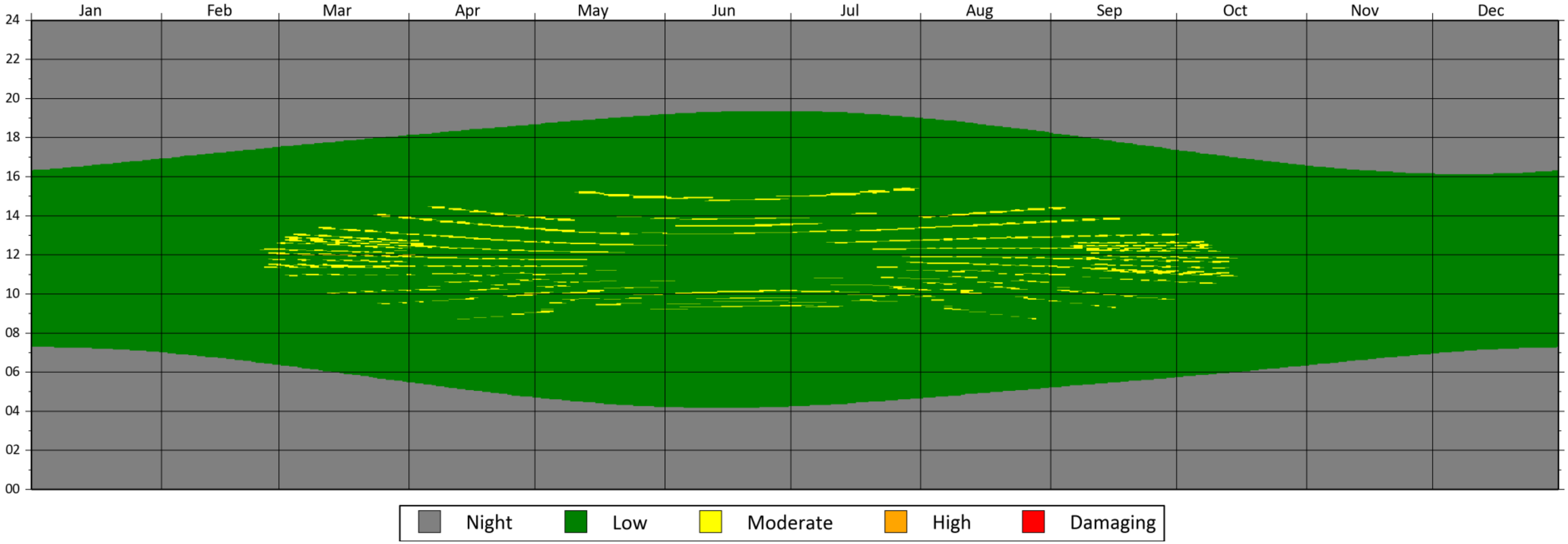




Receptor F14 Annual Visual Impact

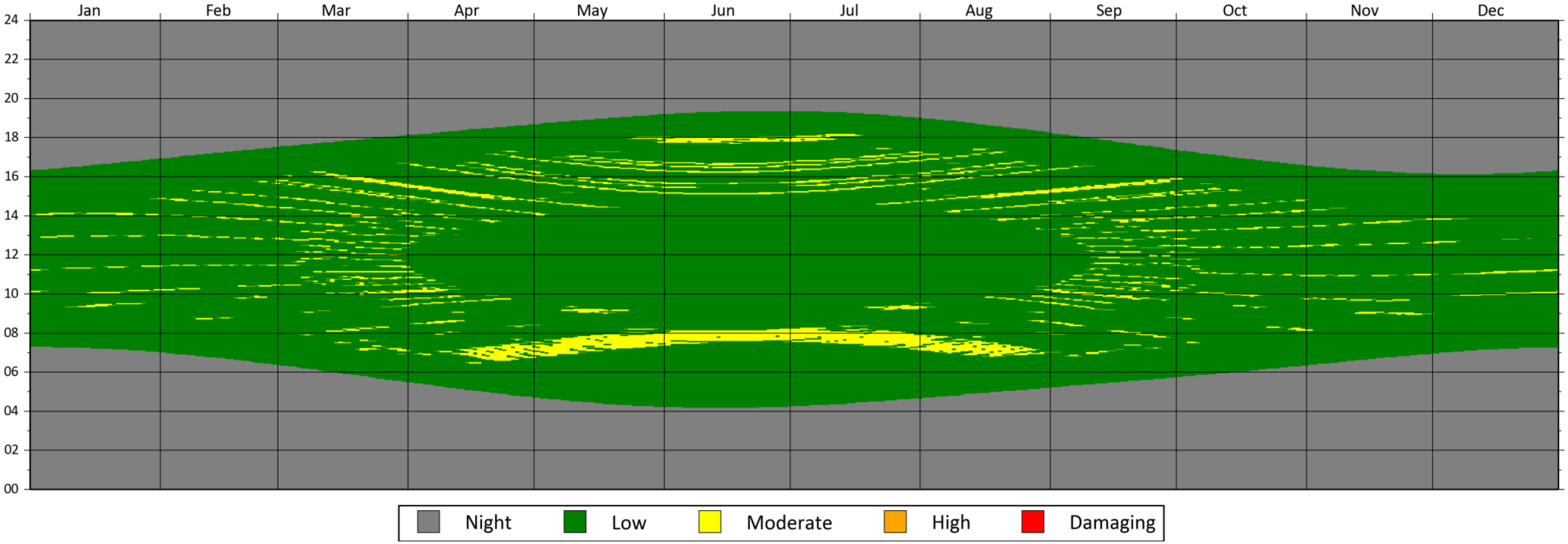
Receptor F14 is a receptor placed on the facade of a building to the southwest of the development.





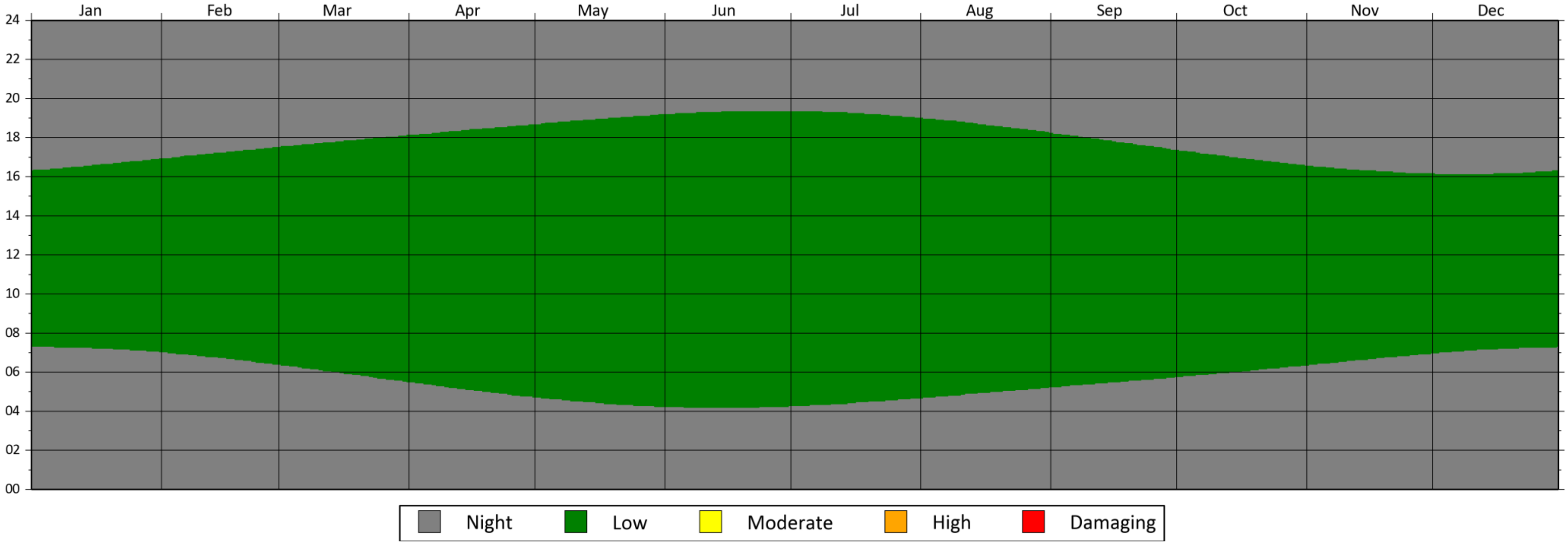
Receptor P15 Annual Visual Impact

Receptor P15 was chosen to assess the visual risk associated with solar reflections affecting pedestrians in Fenway Victory Gardens.



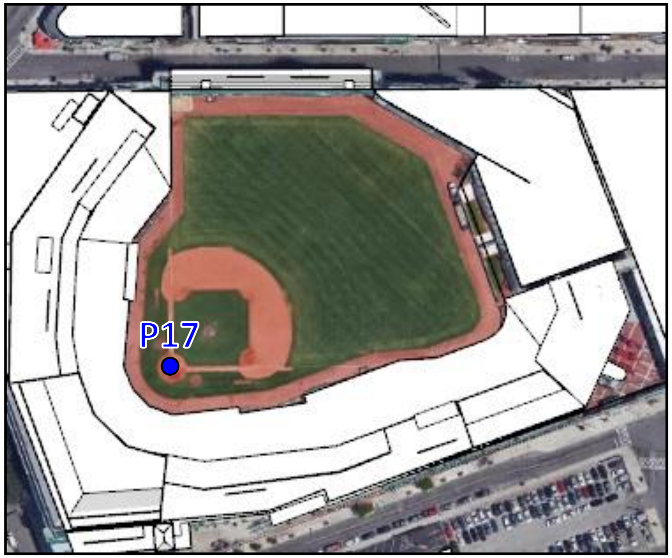
Receptor P16 Annual Visual Impact

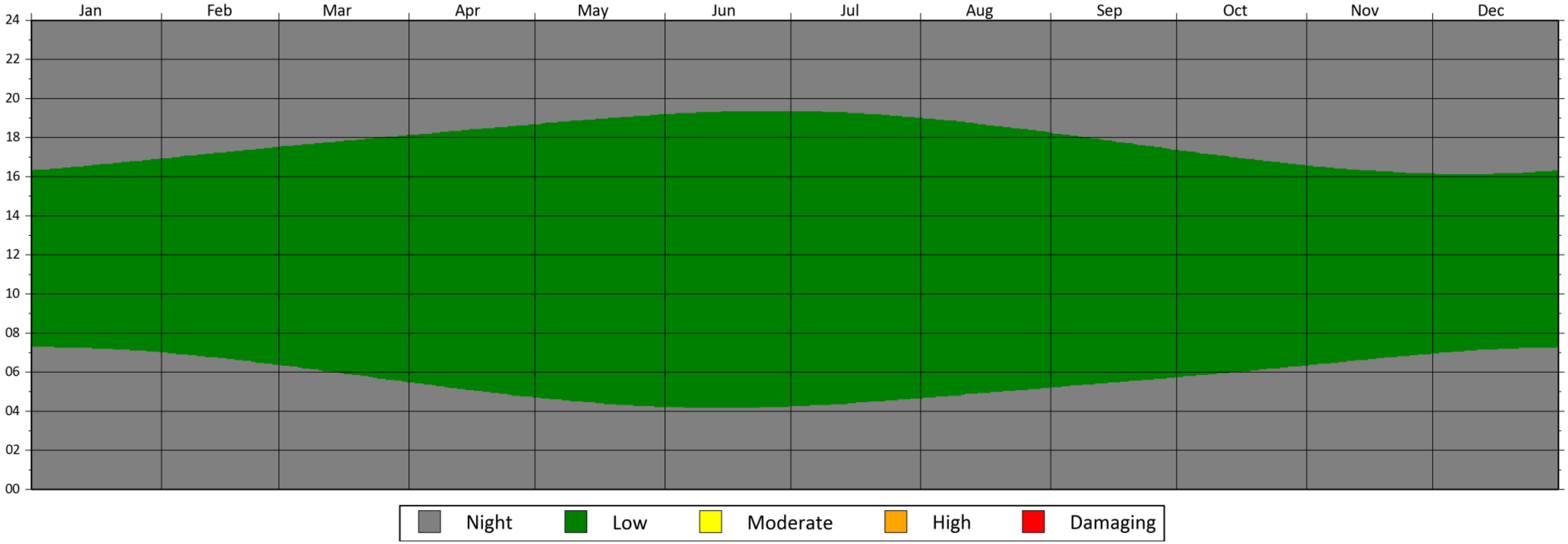
Receptor P16 was chosen to assess the visual risk associated with solar reflections affecting pedestrians in Fenway Victory Gardens.



Receptor P17 Annual Visual Impact

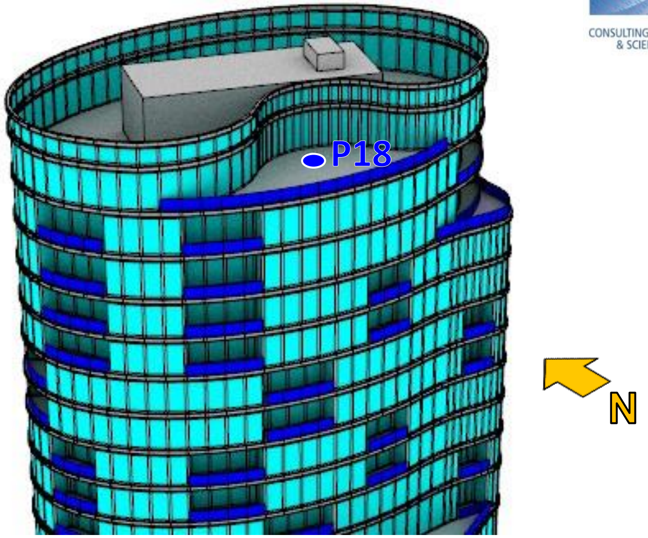
Receptor P17 was chosen to assess the visual risk associated with solar reflections affecting baseball players standing at home plate in Fenway Park.

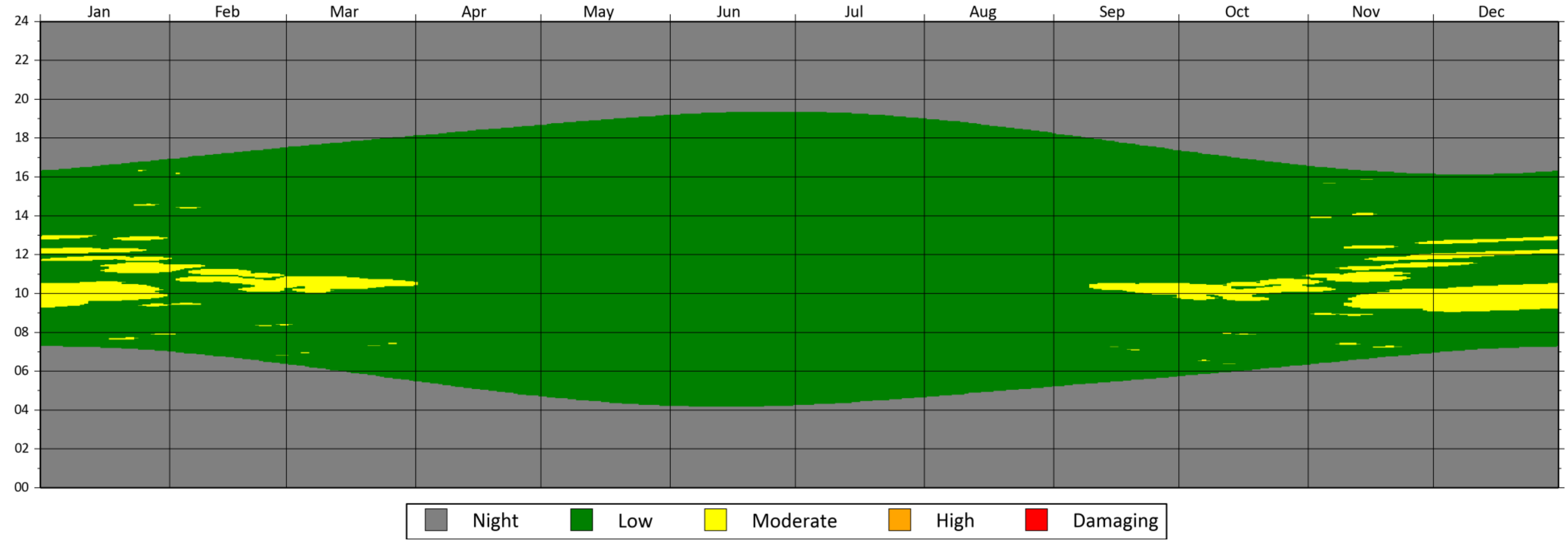




Receptor P18 Annual Visual Impact

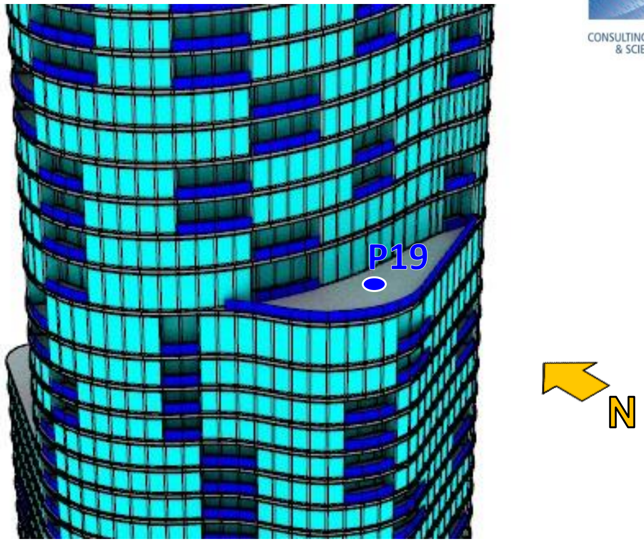
Receptor P18 was chosen to assess the visual risk associated with solar reflections affecting pedestrians standing on the roof deck of the mechanical penthouse level of Charlesgate tower.

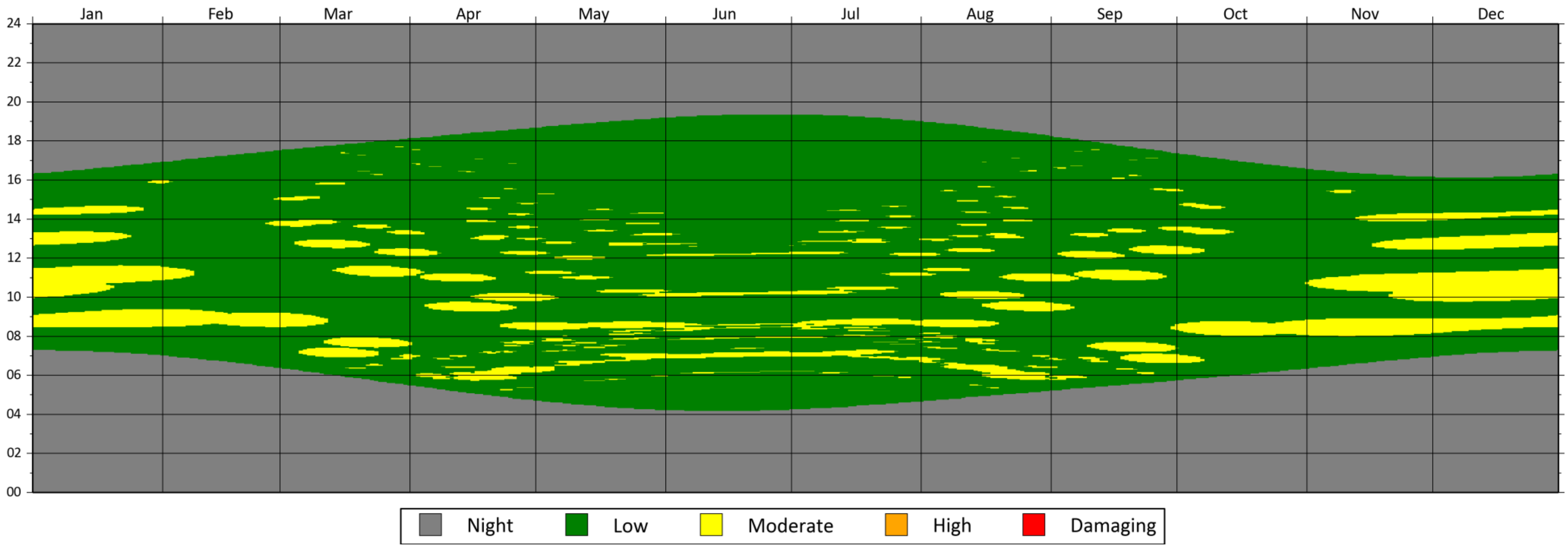




Receptor P19 Annual Visual Impact

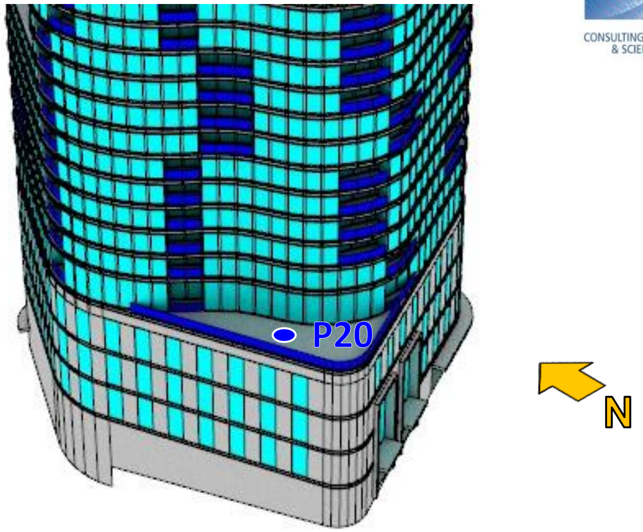
Receptor P19 was chosen to assess the visual risk associated with solar reflections affecting pedestrians standing on the 16th floor roof deck of Charlesgate tower.

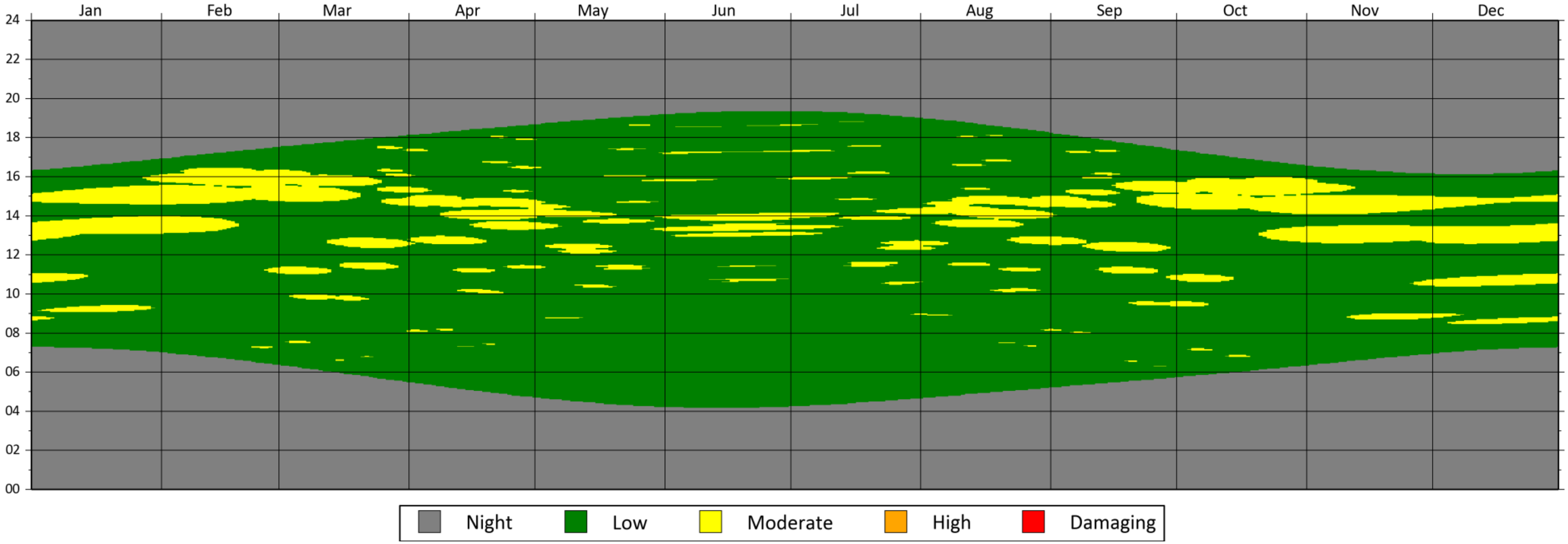




Receptor P20 Annual Visual Impact

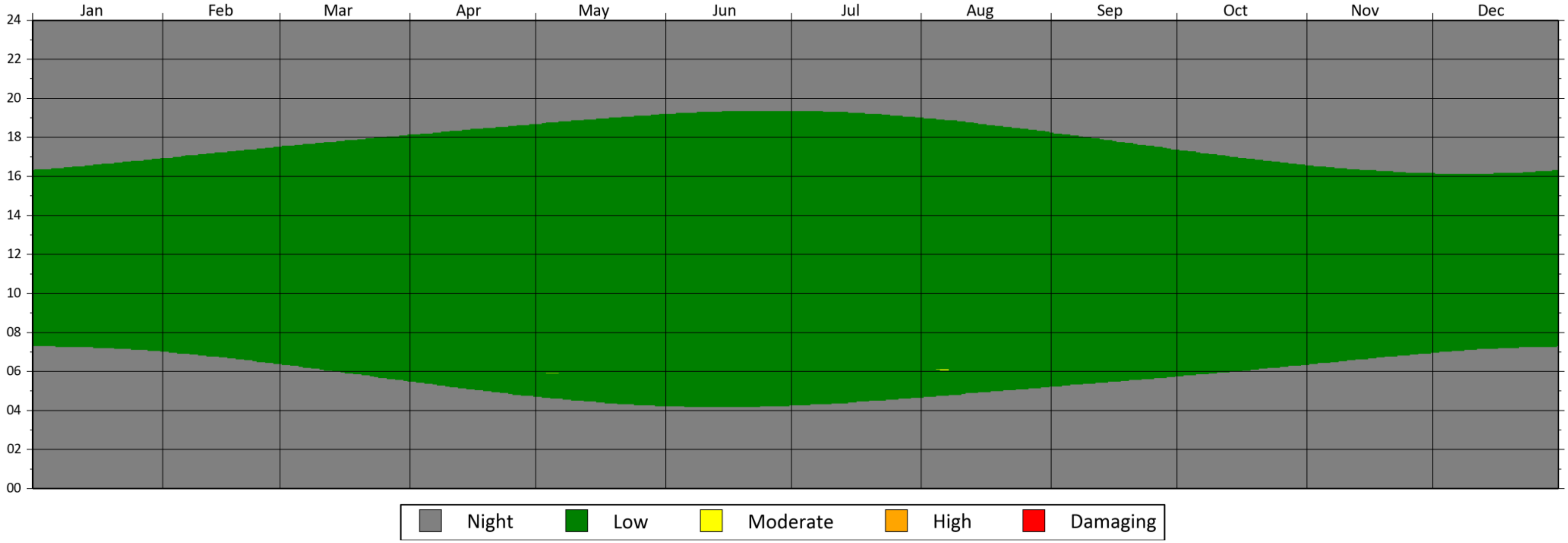
Receptor P20 was chosen to assess the visual risk associated with solar reflections affecting pedestrians standing on the podium roof of Charlesgate tower.





Receptor P21 Annual Visual Impact

Receptor P21 was chosen to assess the visual risk associated with solar reflections affecting baseball players at the third base dugout in Fenway Park.



Thermal Reflection Impact Plots

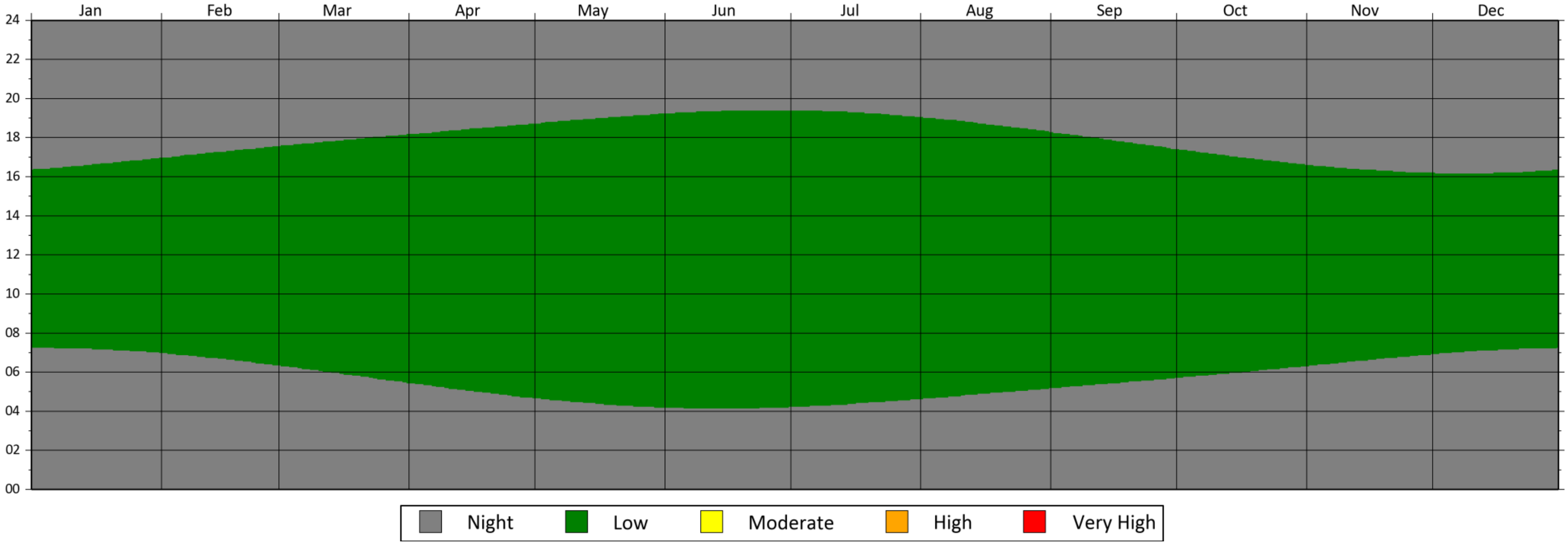
The following pages present the predicted thermal impacts on the drivers, pedestrians, and facade receptors. Since all reflections falling on ***driver*** receptors D1-D10, and ***pedestrian*** receptors P15-P17, P19, and P20 are predicted to be within RWDI's proposed short-term exposure thermal criteria (see Appendix C), they are all presented through only one representative diagram. However, the thermal impacts on pedestrian receptor P18 is illustrated in a separate diagram, as it experiences impacts that exceed the short-term and ceiling exposure thresholds.

A different scale is used to illustrate the reflected thermal energy on ***facades*** in order to provide further clarity on the potential for heat gain issues.

Thermal Impact on Drivers D1-D10, and Pedestrians P15-P17 and P19-P20

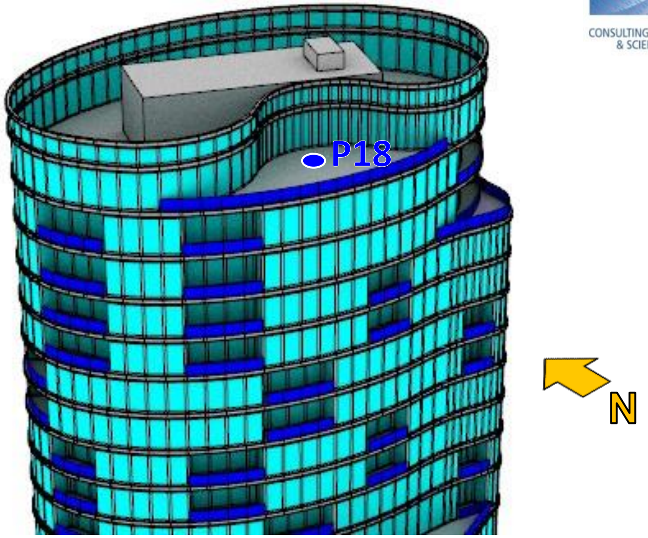
All reflections falling on driver receptors D1-D10, and pedestrian receptors P15-P17, P19, and P20 are predicted to be within RWDI's proposed exposure limits (see Appendix C).

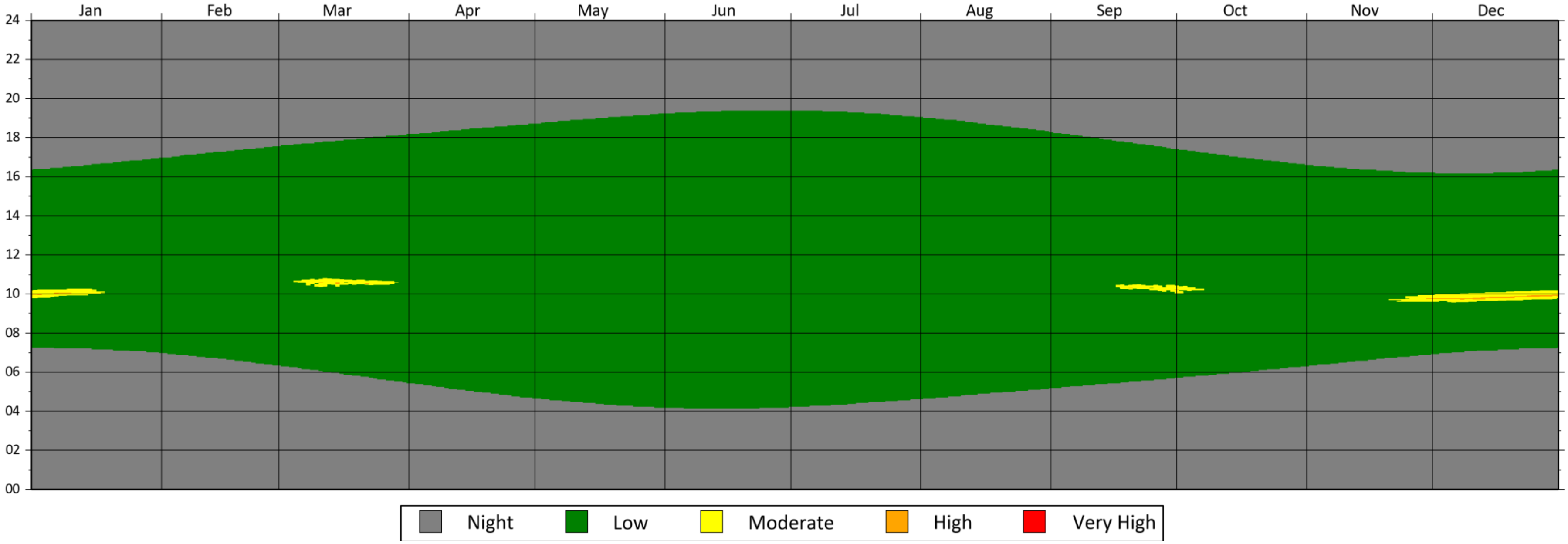
RWDI considers all the above-noted receptors in the neighborhood of Charlesgate development to have a **low** thermal impact since no significant reflections are predicted.



Receptor P18 Annual Thermal Impact

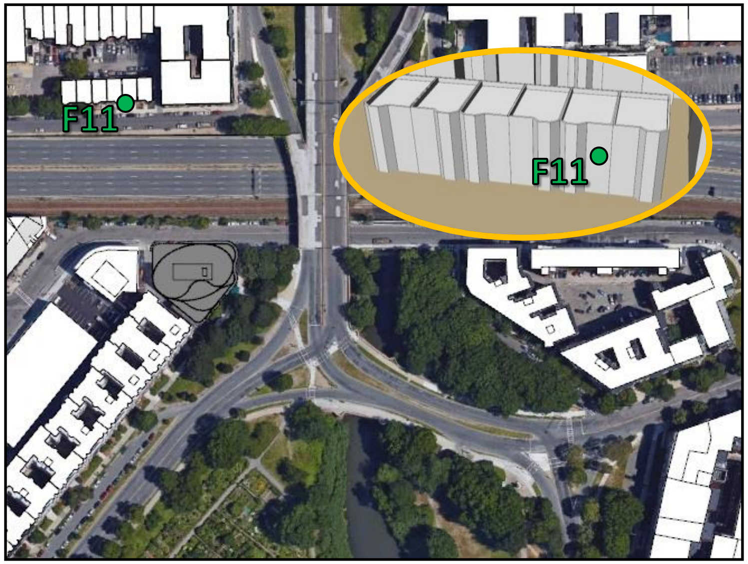
Receptor P18 was chosen to assess the heat gain associated with solar reflections affecting pedestrians standing on the roof deck of the mechanical penthouse level of Charlesgate tower.

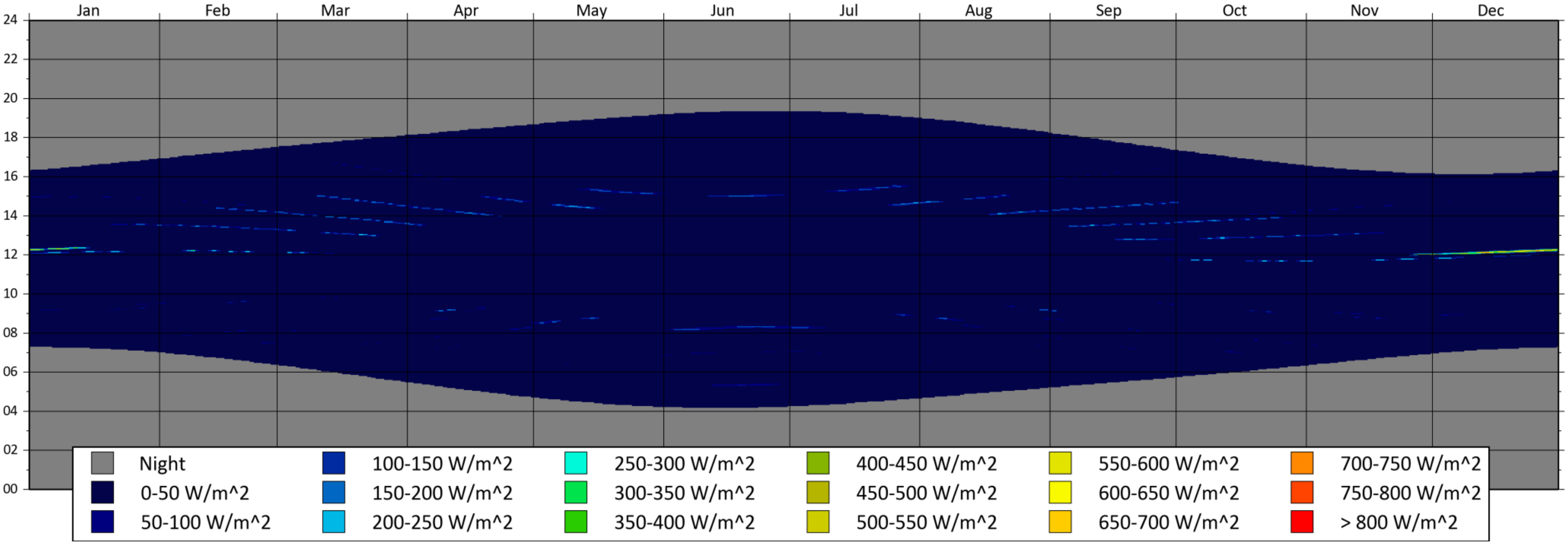




Receptor F11 Annual Thermal Impact

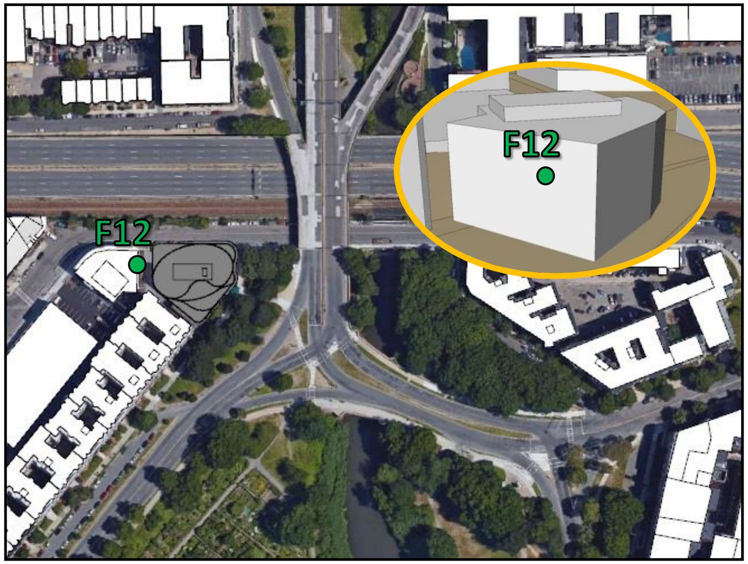
Receptor F11 is a receptor placed on the facade of building to the north of development.

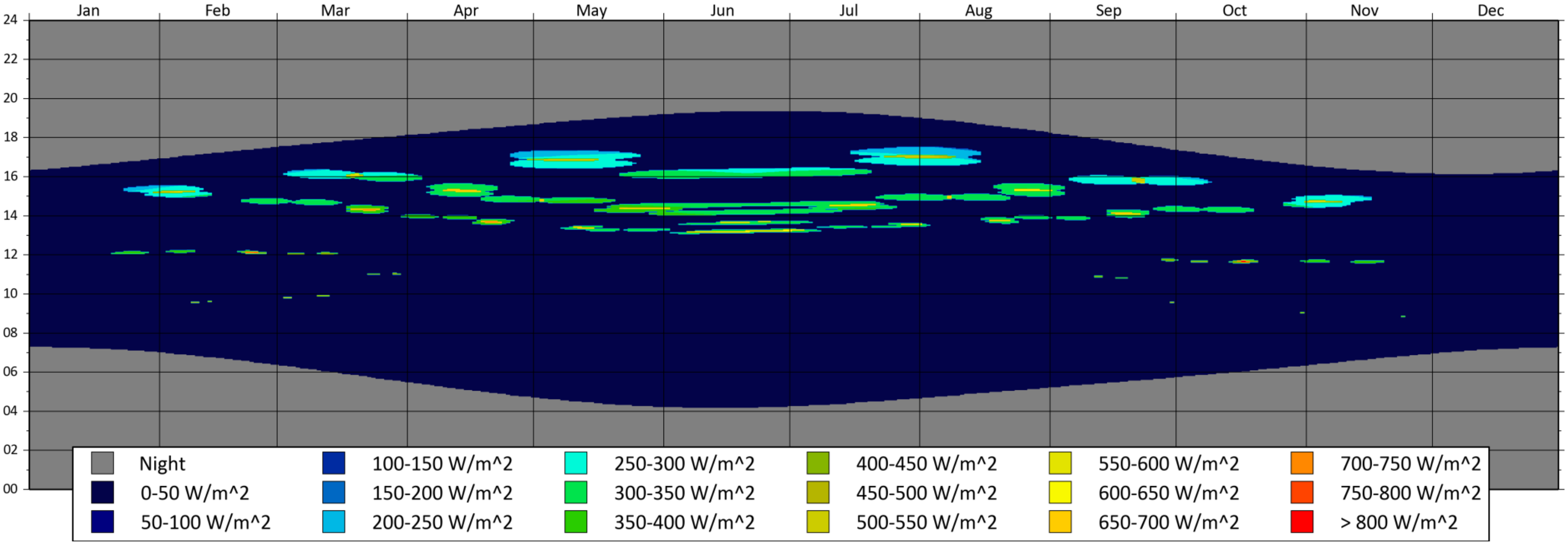




Receptor F12 Annual Thermal Impact

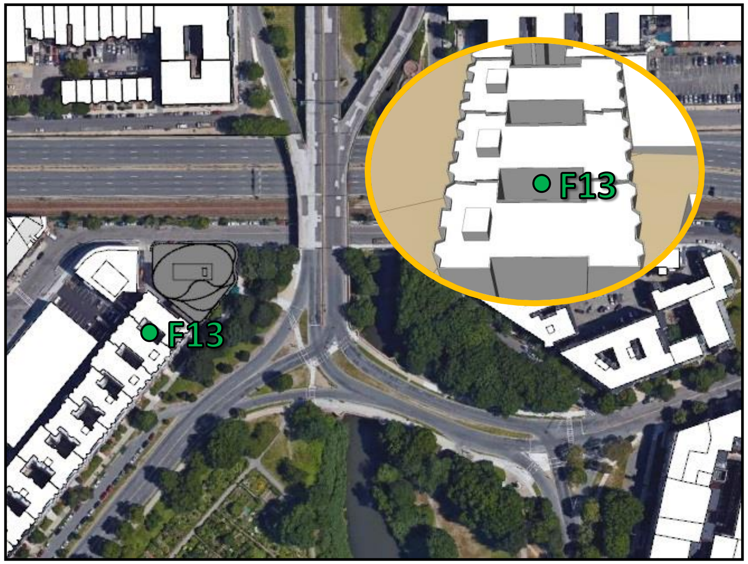
Receptor F12 is a receptor placed on the facade of the Boston Conservatory building.

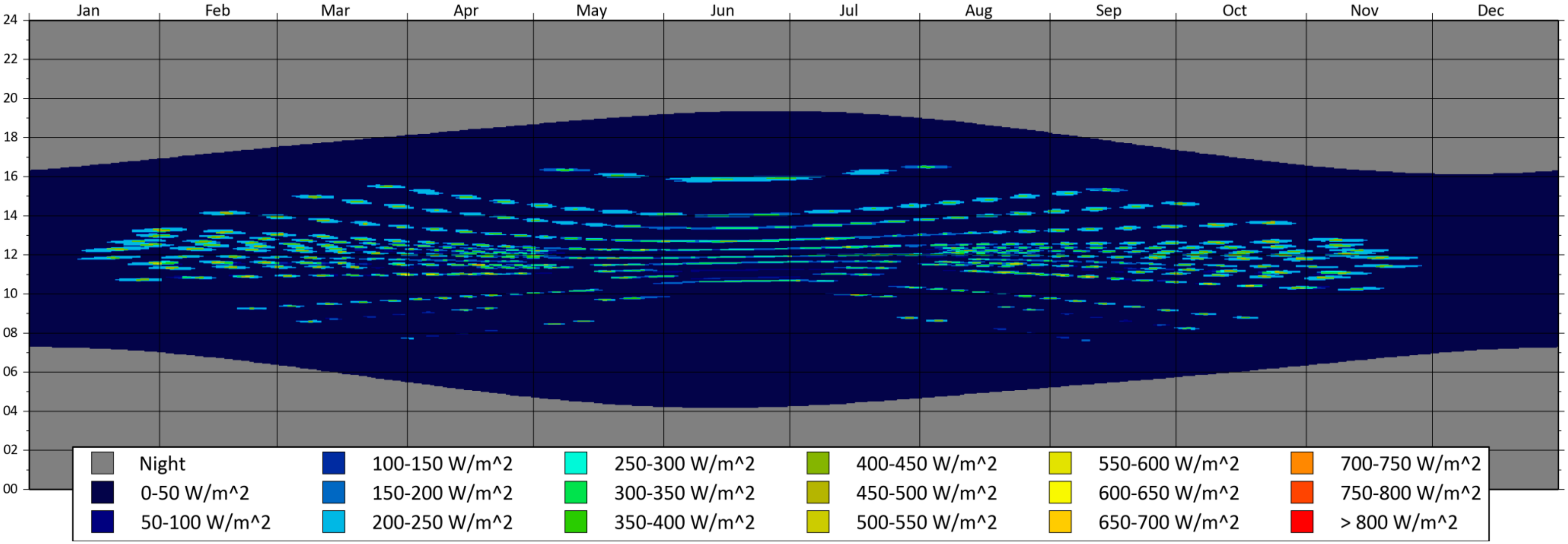




Receptor F13 Annual Thermal Impact

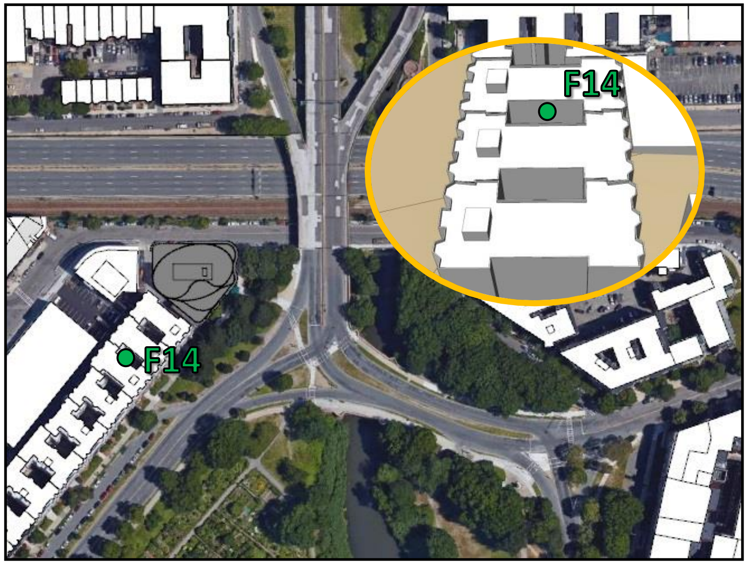
Receptor F13 is a receptor placed on the facade of a building to the southwest of the development.

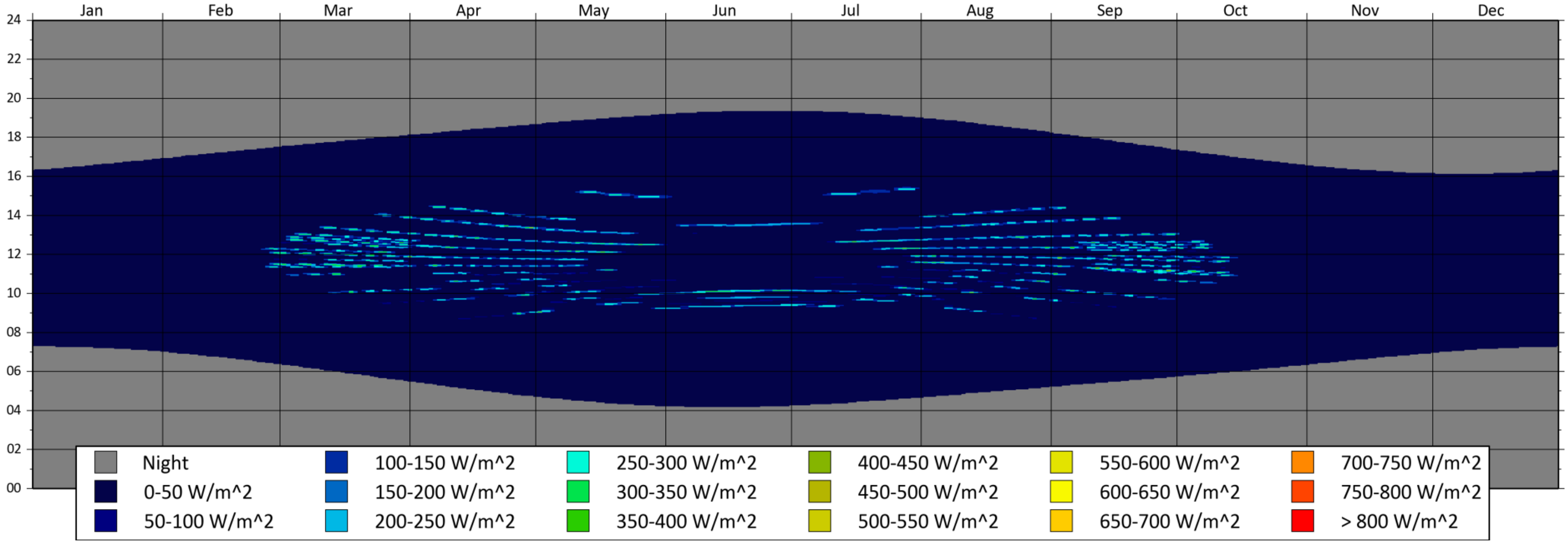




Receptor F14 Annual Thermal Impact

Receptor F14 is a receptor placed on the facade of a building to the southwest of the development.





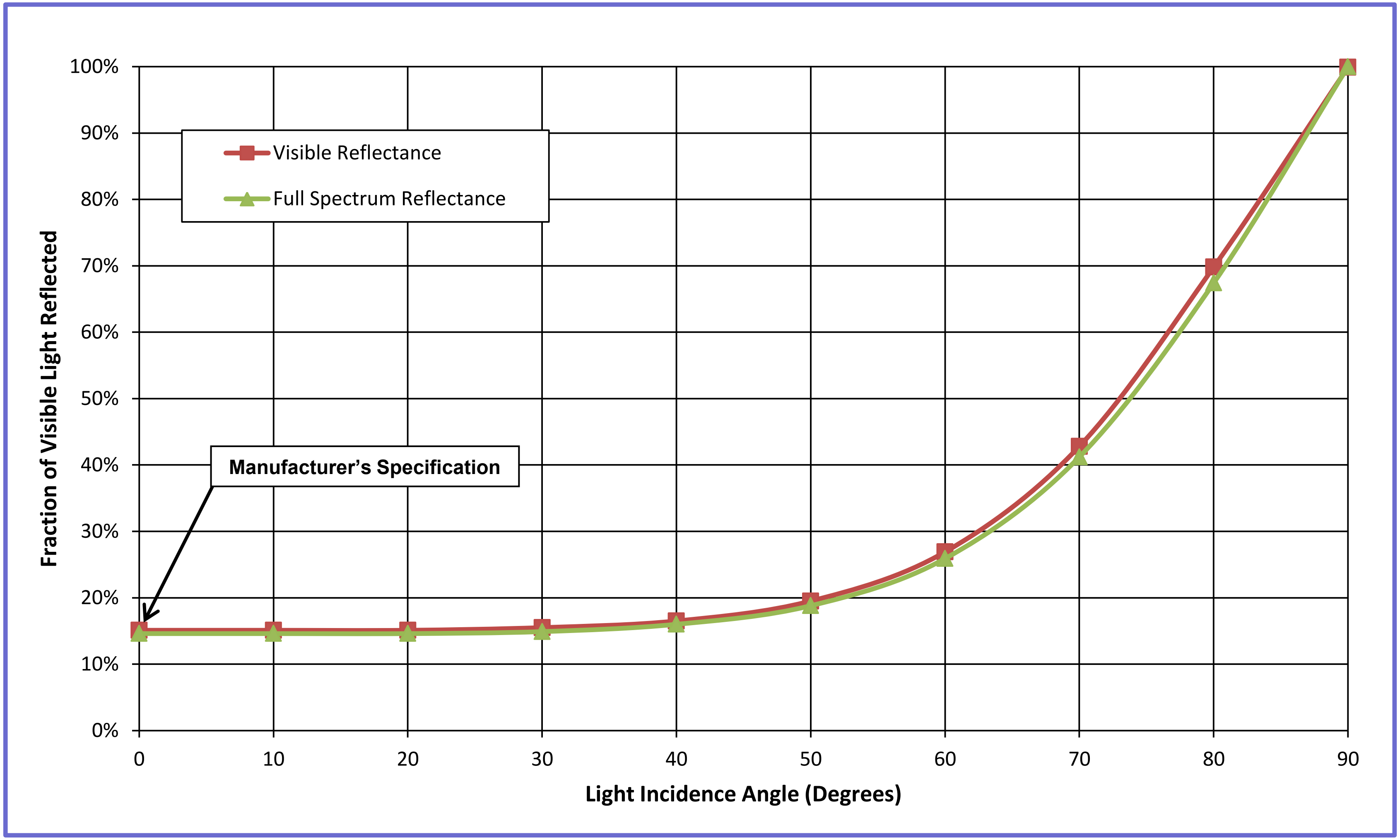
APPENDIX B –

MATERIAL PROPERTIES OF GLAZING FACADES

B1. FACADE GLASS PROPERTIES

Guard Rail

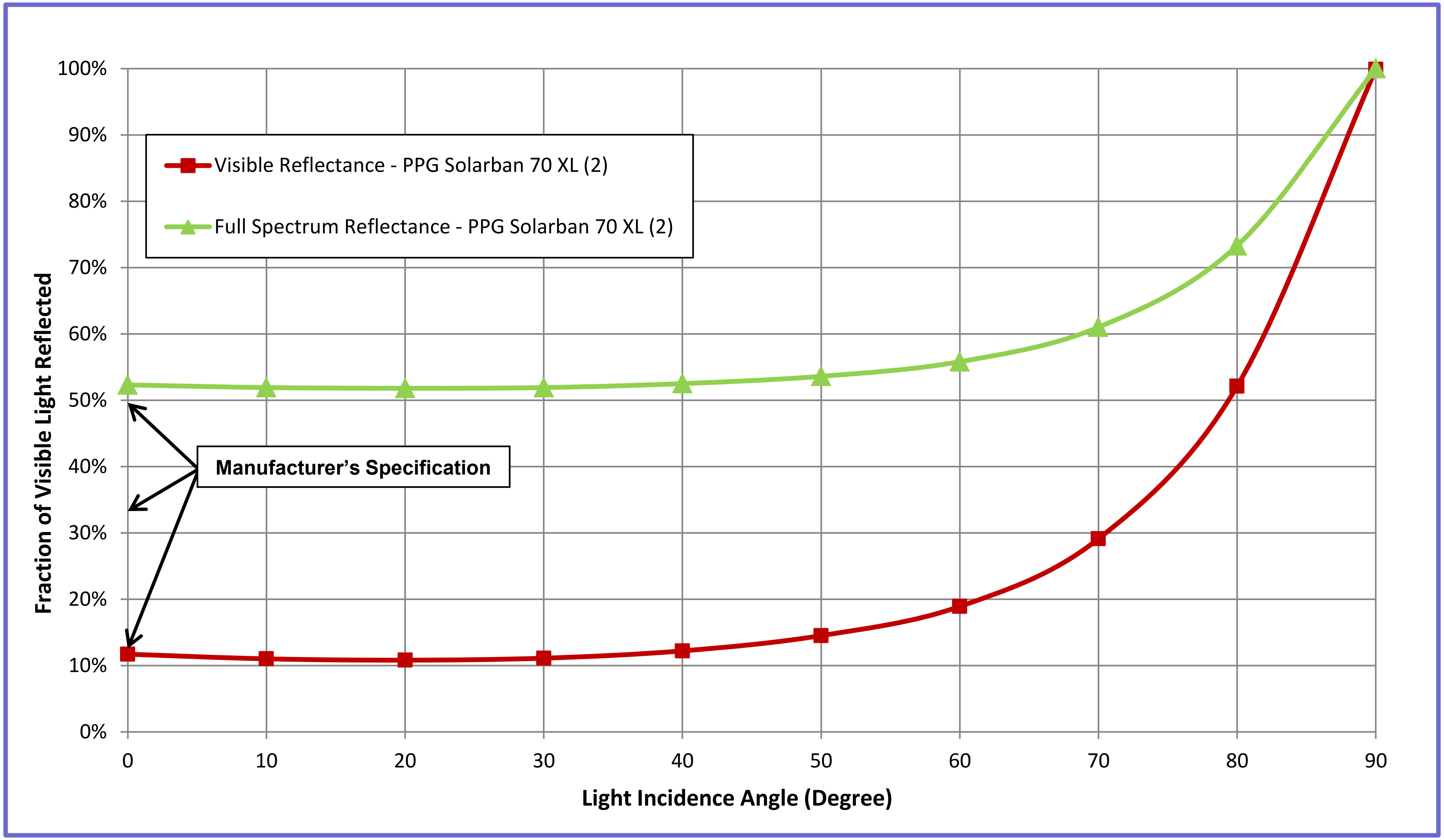
"Double-Pane Low Iron"



B2. FACADE GLASS PROPERTIES

Curtain Wall

"PPG Solarban 70 XL (2) + clear glass"



APPENDIX C –

THERMAL AND VISUAL GLARE CRITERIA

C1. CRITERIA – SOLAR THERMAL

Solar Focusing

Solar focusing is a phenomenon where more than one reflection falls on the same point. This can occur when reflection from multiple flat surfaces converge at a single point, but are more common on inward-curving (concave) facades. As concave facades are present in the development, additional study is recommended to ensure that the facade does not concentrate a significant amount of solar energy in sensitive areas.

There are currently no existing criteria or standards that define an “acceptable” level of reflected solar radiation from buildings. RWDI has conducted a literature review of available scientific sources to determine levels of solar radiation we would consider acceptable to an individual in the urban realm[1].

Irradiance Limits – People

The National Fire Protection Association (NFPA) sets thermal radiation criteria which define a tenable environment for people exiting a fire event in building or tunnel (NFPA 130). They set the upper limit for thermal radiation at 2,500 W/m². Irradiance levels at or below this value can be tolerated for at least several minutes without significantly affecting an individual’s ability to escape from a fire event. That being said, skin damage (sun burns) and pain can occur at this 2,500 W/m² threshold. According to British fire standards[2], the onset of pain for ***bare*** skin can occur within 30 seconds at an irradiance of 2,500 W/m². This threshold closely matches the irradiance exposure guidelines published by the U.S. Federal Emergency Management Agency (FEMA), summarized in the table to the right. This table also includes the length of time required before the onset of a second degree burn due to thermal radiation. It should be noted that these numbers are guideline values only, and that in reality many factors (skin colour, age, clothing choice, etc.) influence how a person reacts to thermal radiation. For our work RWDI have established **2,500 W/m² as a ceiling exposure limit**.

Due to the public nature of the building, the significant variability in both how individuals will respond to thermal irradiation exposure, and the fact that individuals may not fully appreciate the impact of the reflection until they are exposed, it is RWDI’s opinion that a lower threshold value may be more appropriate for human thermal comfort.

Thus, we suggest that for ground level areas where the public will be present, reflected irradiance levels should not exceed 1,500 W/m². This threshold value is a conservative one, which is based around the potential for damage to human skin, requiring several minutes of exposure before damage or discomfort potentially occurs.

For these reasons, we have applied a **short-term exposure limit of 1,500 W/m²** for our work.

Table C1: Time for Physiological Effects on Bare Skin at Specific Thermal Radiation Levels[3]

Thermal Irradiance [W/m²]	Time To Onset of Pain [sec]	Time To Onset of Second Degree Burn [sec]
1,000	115	663
2,000	45	187
3,000	27	92
4,000	18	57
5,000	13	40
6,000	11	30
8,000	7	20
10,000	5	14
12,000	4	11

[1] Danks, Ryan, Joel Good, and Ray Sinclair. "Assessing Reflected Sunlight from Building Facades: A Literature Review and Proposed Criteria." Building and Environment, July 2016: 193-202.

[2] The application of fire safety engineering principles to fire safety design of buildings – Part 6: Human Factors’ PD 7974-6:2004, British Standards Institution 2004.

[3] Federal Emergency Management Agency, U.S. Department of Transportation, and U.S. Environmental Protection Agency. 1988. Handbook of Chemical Hazard Analysis Procedures. Washington, D.C.: Federal Emergency Management Agency Publications Office.

C2. CRITERIA – VISUAL GLARE

To account for the high variability in how individuals experience bright light, RWDI would classify any reflection as "significant" if it is calculated to be least 50% as intense as one that would cause temporary flash blindness (i.e. the after images visible after one sees a camera flash in a dark room).

This is accomplished through the use of our computer model to determine the following information at each combination of location, date and time:

1. The maximum amount of radiation striking the back of the eye that a person would experience if looking directly at the source.
2. The size of the angle that the reflection subtends in the sky (i.e. how much of a viewer's field of vision that the glare takes up – Figure C1).

Using the above information, the maximum glare impact at a certain location can be identified using the methodology of Ho et al[1] (Figure C2) to determine the potential of the reflection to cause temporary flash-blindness.

As a reference, Figure C2 on the right illustrates where looking directly at the sun falls in terms of irradiance on the retina (on average about 8 W/cm²), and the size of the angle that the sun subtends in the sky (about 9.8 milliradians). This puts it just at the border of causing serious damage. This methodology assumes that the exposure time is equivalent to the length of an average person's blink response.

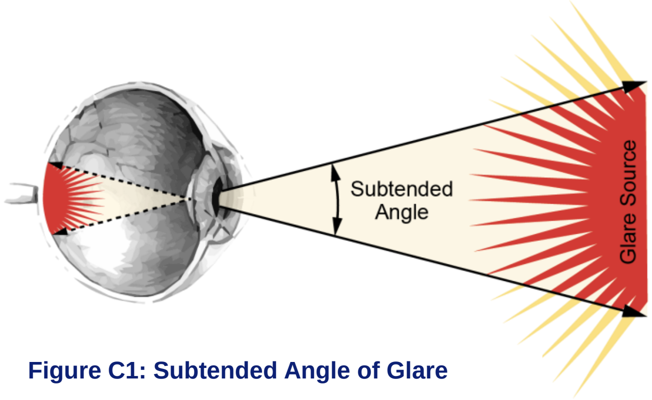
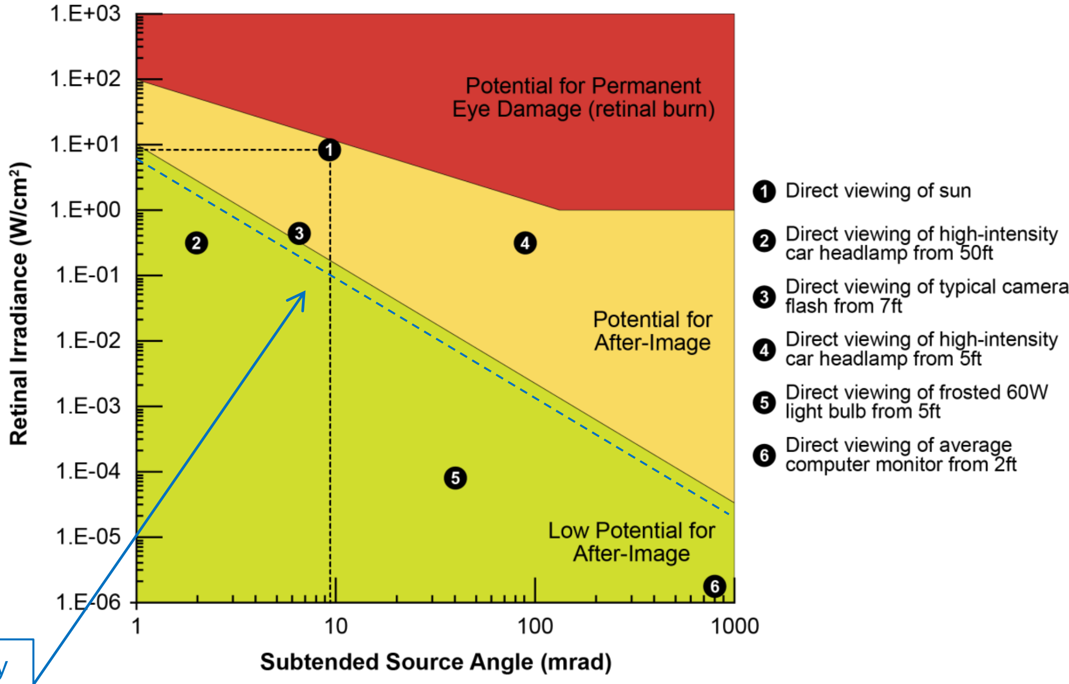


Figure C1: Subtended Angle of Glare



RWDI Criteria – 50% of the intensity of a reflection with the potential of causing after-imaging

Figure C2: After-image potential plot [1]

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[1] C. Ho, C. Ghanbari and R. Diver, "Methodology to Assess Potential Glint and Glare Hazards From Concentrating Solar Power Plants: Analytical Models and Experimental Validation," *J. Sol. Energy Eng.*, vol. 133, no. 3, pp. 031021-1 - 031022-9, 2011. http://dx.doi.org/10.1115/1.4004349.

C3. CRITERIA – VISUAL GLARE IMPACT CATEGORIES

In the detailed phase of the study, visual glare was assessed at 1 minute intervals, over the course of a year. At each combination of date and time, the maximum glare impact from all surfaces was determined. RWDI combined the maximum glare impact with the assumed task(s) occurring at the location in question to derive an overall impact category:

- **Low** – Either no significant glare sources are found or the intensity of the brightest source is less than what is required to cause flash blindness. There is little impact on viewers.
- **Moderate** – The brightest glare source is capable of causing flash blindness according to the RWDI criteria explained in section C2, but is either falling on a point representing a pedestrian (who can easily look away), or emanating from a location that falls outside of the line-of-sight of someone who has limited ability to look away from a given direction (i.e. a vehicle driver). These can be thought of as "nuisance" reflections.
- **High** – The brightest glare source is capable of causing flash blindness according to the RWDI criteria explained in section C2, and is emanating from a surface within the line-of-sight of a driver, pilot or someone else who has limited ability to look away and is performing a "high risk" activity (Figure C3). Such situations pose a significant risk of distraction and can reduce visual acuity for those operating vehicles or performing other high-risk tasks.
- **Damaging** – The brightest glare source is bright enough to permanently damage the eye. Reflections of this magnitude pose a significant threat to the safety of those nearby.

RWDI assumes that the "line-of-sight" for vehicle drivers included all surfaces within 20° of the direction of travel (Figure C3), and that no sunglasses or other eye protection equipment are worn. The 20° field of view was selected because, opaque elements of cars tend to limit a driver's vision beyond this angle [2].

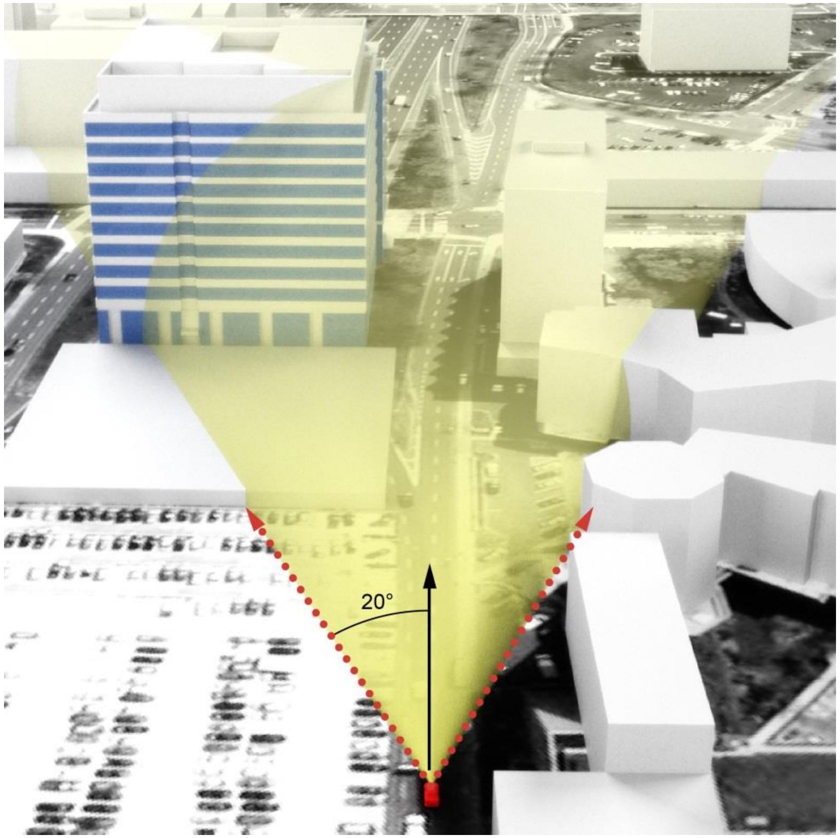

Figure C3: A driver's 20° cone of vision

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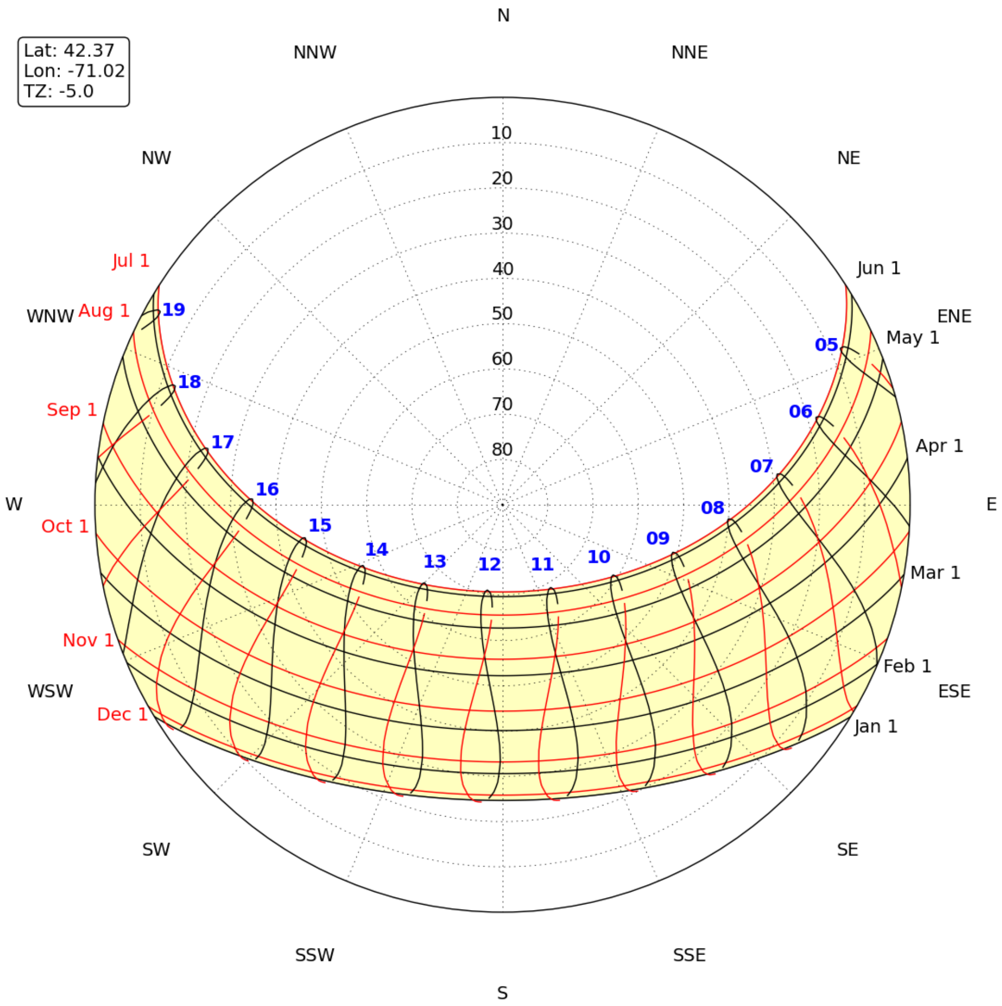
[2] F. Vargas-Martin and M. A. García-Pérez, "Visual fields at the wheel," *Optom. Vis. Sci.,* vol. 82, no. 8, pp. 675-681, 2005.

APPENDIX D – SUN PATH AT LOGAN AIRPORT

B. SUN PATH DIAGRAM FOR BOSTON, MA

The diagram presented here shows the projection of the sky illustrating the sun path over Boston for a complete year. The diagram is overlaid with red and black lines indicating the position of the sun at every time during the year.



APPENDIX E

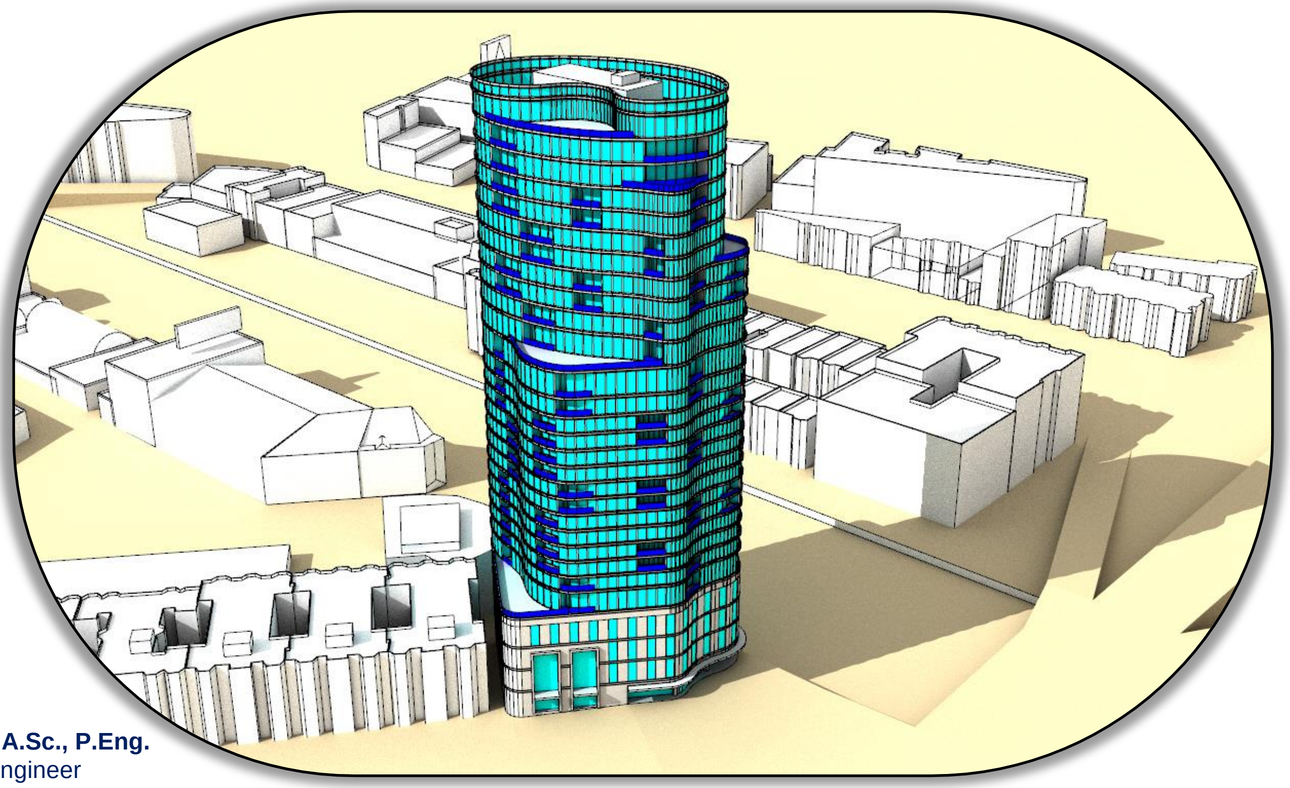
PRELIMINARY REPORT

Charlesgate

Boston, MA

Solar Reflection Analysis – Preliminary Results & Receptor Locations

RWDI #1600656
August 12, 2016



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1. INTRODUCTION

This report provides the computer modelling results of reflected sunlight from the proposed Charlesgate development, which consists of a high-rise tower located at the Trans National Building site on Ipswich Street in Boston, MA. It is our understanding that the development will be surrounded by typical urban spaces such as busy roadways, and other buildings.

RWDI has been retained to investigate the impact that solar reflections emanating from the proposed Charlesgate development will have on the surrounding urban realm.

This report outlines the preliminary reflection results for the proposed development, and also proposes a number of receptor locations (selected point locations) for the planned detailed phase of the study.

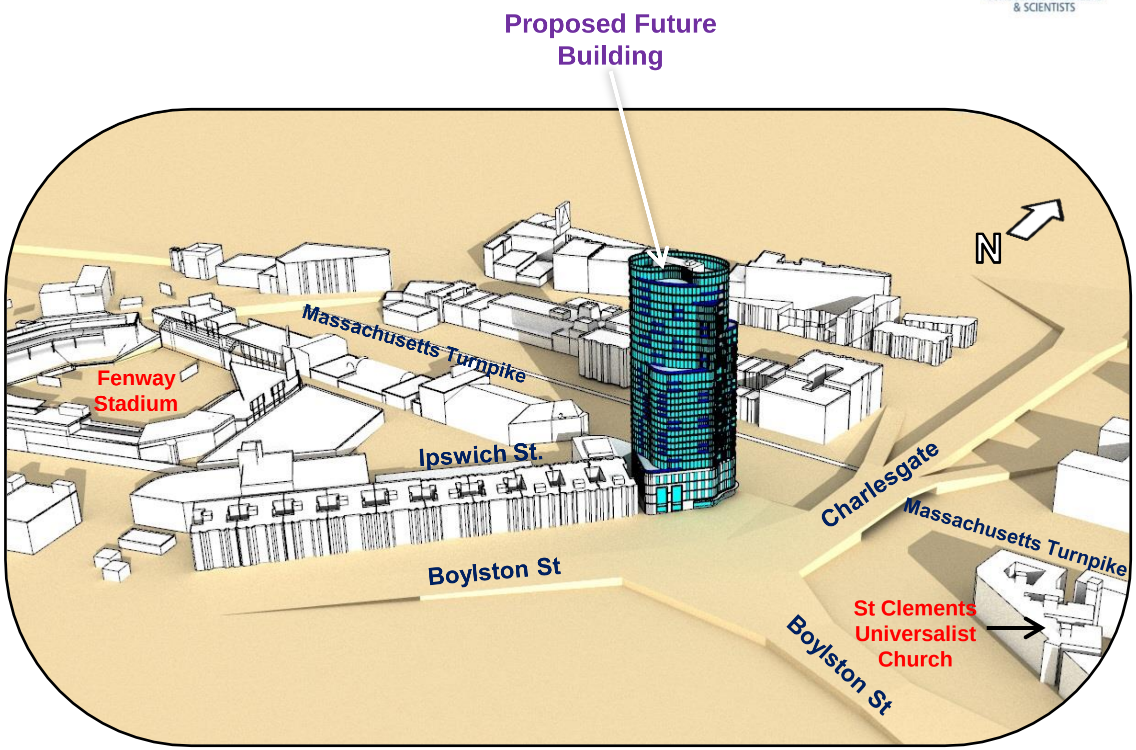


Figure 1: Proposed Charlesgate Development

2. BACKGROUND – URBAN REFLECTIONS

It is a common experience in urban areas to occasionally experience reflected light from glass and metallic surfaces. The interactions between a building and the sun can lead to numerous visual and thermal issues.

Visual glare can:

- impair the vision of motorists and others who cannot simply look away from the source because of an important activity;
- cause nuisance to pedestrians or occupants of nearby buildings; and,
- create undesirable patterns of light throughout the urban fabric.

Heat gain can***:***

- affect human thermal comfort;
- be a safety concern for people and materials, particularly if insolation levels are high as a result of focusing multiple reflections to a single point; and,
- alter heating and cooling loads of conditioned spaces affected by the reflections.

The most significant safety concerns with solar reflections occur with concave facades which act to focus the reflected light in a single area (Figure 2). In contrast, convex facades act to scatter reflections in a "pinwheel" pattern. As concave facades are present in the development, additional study was undertaken to ensure that the facade does not concentrate a significant amount of solar energy in sensitive areas.

To quantify the impact of solar reflections from the development, it is important to understand four critical characteristics:

1. ***Frequency*** (how often glare events occur);
2. ***Duration*** (how long each instance of glare lasts);
3. ***Intensity*** (how "bright"; the events are based on a combination of solar intensity, surface size and orientation, and the distance from the point of interest); and,
4. ***Location*** (does the reflection fall on a sensitive location).

RWDI's criteria for visual glare and heat gain is included in Appendix C.

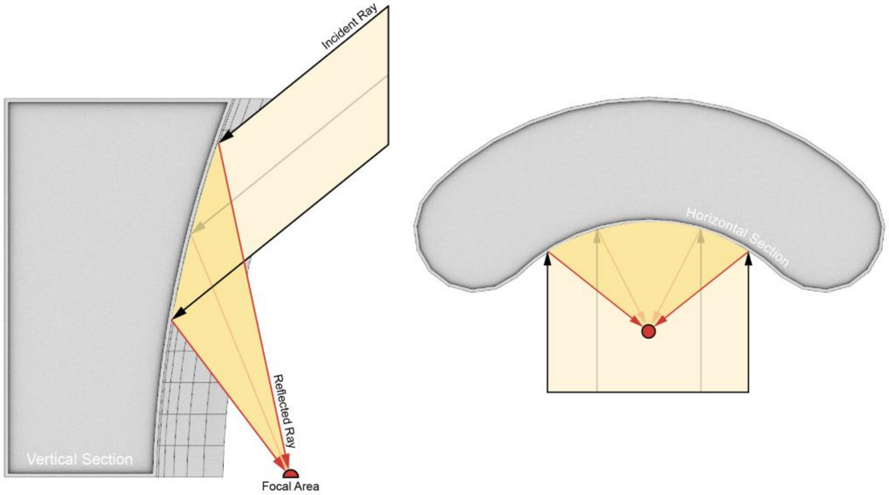


Figure 2: Illustration of an Example of Solar Focusing

3. GENERAL METHODOLOGY

RWDI assessed the potential reflection issues using computer modelling based on RWDI's proprietary software called *Eclipse*, as per the steps outlined below:

- A 3D model of the area of interest (as shown in Figure 3) was developed and subdivided into many smaller triangular patches (see Figure 4). The reflective properties of the various surfaces were defined using the data presented in Appendix A.
- For each hour in a year, the expected solar position was determined, and "virtual rays" were drawn from the sun to each triangular patch of the 3D model. Each ray that was considered to be "unobstructed" was reflected from the building surface onto a horizontal plane called a 'Receiving Surface' placed at pedestrian height (1.5m above local grade).
- This analysis used "clear sky" solar data at the location of Boston Logan Airport. That is to say, a data set where it is assumed that no cloud cover ever occurs, which provides a "worst case" scenario showing the full extent of when and where glare could occur (refer to sun path diagram shown in Appendix B).
- Finally, a statistical analysis was performed to assess the frequency, and intensity of the glare events.

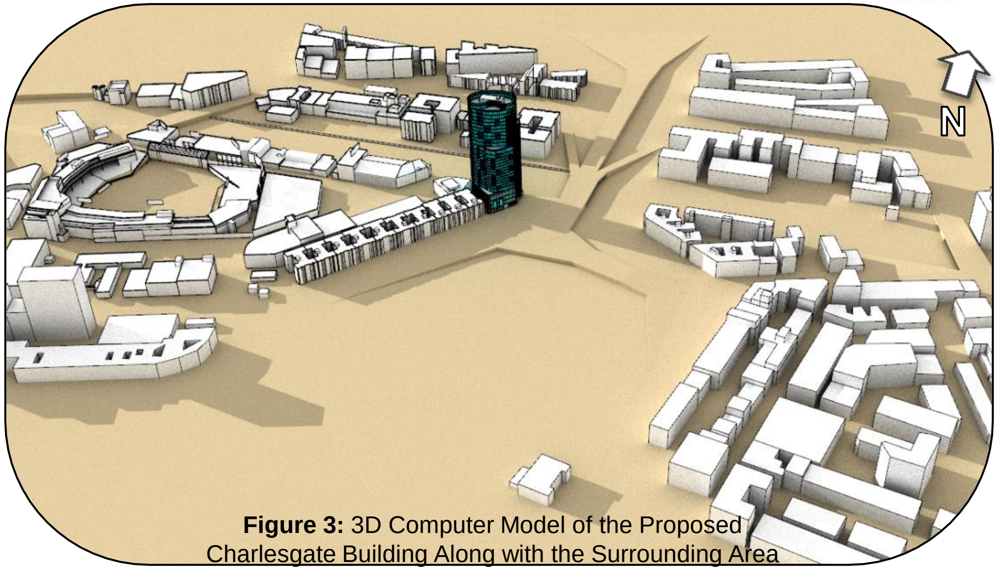


Figure 3: 3D Computer Model of the Proposed Charlesgate Building Along with the Surrounding Area

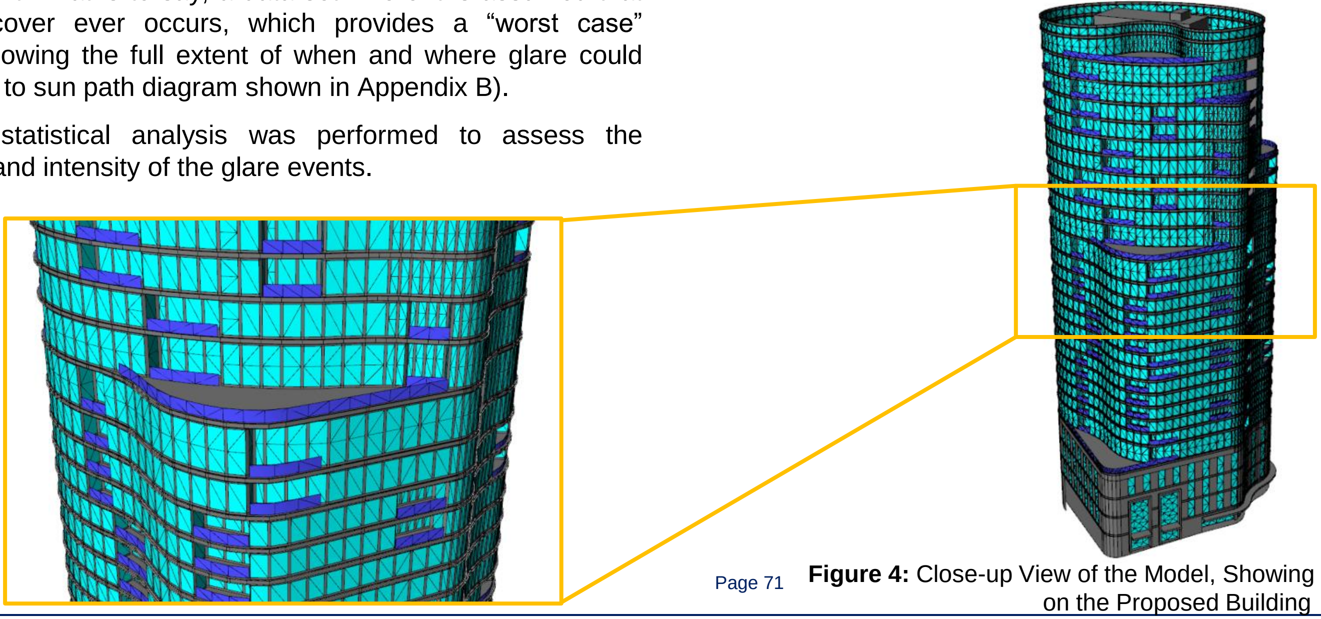


Figure 4: Close-up View of the Model, Showing Surface Subdivisions on the Proposed Building

4. ASSUMPTIONS AND LIMITATIONS

Key assumptions and simplifications of the modelling process included:

Model

- The analysis was conducted based on the geometry provided by Elkus Manfredi Architects to RWDI on July 21, 2016. It should be noted that this study is highly dependent on building geometry, and any significant changes to the buildings' geometry are likely to require a new analysis.
- Potential reductions of solar reflections due to the presence of vegetation, or other non-architectural obstructions, were not included.
- Only a single reflection from the development is included in the analysis. That is to say, light that has reflected off several surfaces before reaching the 'Receiving Surface' is assumed to have a negligible impact.
- Only the proposed building was considered as potentially reflective in the current model. Existing structures were included for shading purposes but were not considered reflective.

Material Properties of Reflective Elements

- At the time of this investigation the final glazing specification had not been made. Elkus Manfredi indicated to RWDI via email on July 19, 2016 that the glazing would be manufactured by PPG and employ their "Solarban 70XL" coating. However, the full spectrum reflectance of IGU's using Solarban 70XL can vary dramatically depending on the color of the glass. As a conservatism RWDI assumed clear glass, which yields the highest full spectrum reflectance (52%) to simulate a worst case condition. Should the final glazing selection be considerably different from this, RWDI should review to assess the impact on the results presented herein.
- Based on further email correspondence between RWDI and Elkus Manfredi (August 5, 2016) the guard rails on the upper floors were simulated as generic double-pane clear glazing units.
- The reflectance properties of the glazing are summarized in Table 1. Figure 5 shows the location of the glazing on the facades. Further details are also available in Appendix A.
- Light reflections from other buildings and any other specular surfaces are not accounted for, nor is attenuation of light due to vegetation.

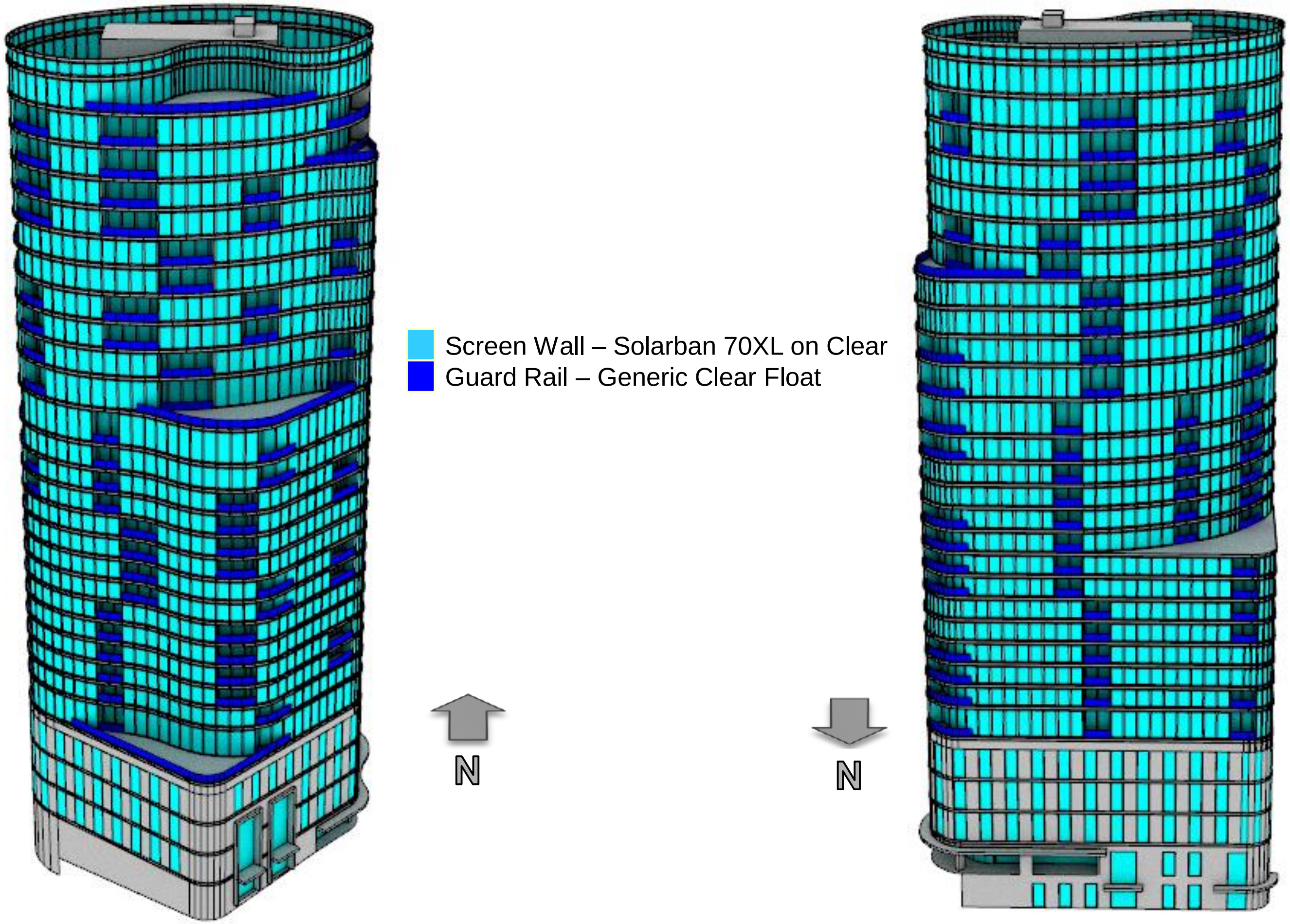
Meteorological Data

- Irradiance levels were computed using "clear sky" solar data at the location of Boston Logan Airport. This data uses mathematical algorithms to artificially derive solar intensity values for a given latitude and altitude, ignoring local effects such as cloud cover.

Table 1: Visible and Full Spectrum Nominal Reflectance Values of Glazing

Glazing Location	Glazing Type	Visible Reflectance	Full Spectrum Reflectance
Screen Wall Glass	PPG Solarban 70 XL (on #2) + clear glass	12%	52%
Guard Rail Glass	Double-pane (1/4" or 1/2") low iron glass	15%	15%

4. ASSUMPTIONS AND LIMITATIONS (CONT'D)



View from South

View from North

Figure 5: Location of the Glazing on Charlesgate Tower Facades

5. CRITERIA – VISUAL GLARE

To account for the high variability in how individuals experience bright light, RWDI would classify any reflection as “significant” if it is calculated to be least 50% as intense as one that would cause temporary flash blindness (i.e. the after images visible after one sees a camera flash in a dark room).

This is accomplished through the use of our computer model to determine the following information at each combination of location, date and time:

1. The maximum amount of radiation striking the ***back*** of the eye that a person would experience if looking directly at the source. (Note that this will be higher than the intensity of the radiation incident point due to the focusing effect of the human eye.)
2. The size of the angle that the reflection subtends in the field of view (i.e. how much of a viewer’s field of vision does the glare take up – Figure 6a).

Using the above information, the maximum glare impact at a certain location can be identified using the methodology of Ho et al[1] (Figure 6b) to determine the potential of the reflection to cause temporary flash-blindness.

As a reference, Figure 6b on the right illustrates where looking directly at the sun falls in terms of irradiance on the retina (on average about 8x10⁴ W/m²), and the size of the angle that the sun subtends in the sky (about 9.8 milliradians). This puts it just at the border of causing serious damage. This methodology assumes that the exposure time is equivalent to the length of an average person's blink response.

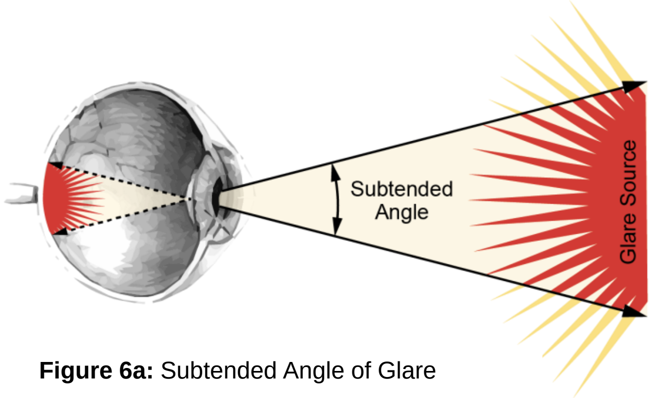
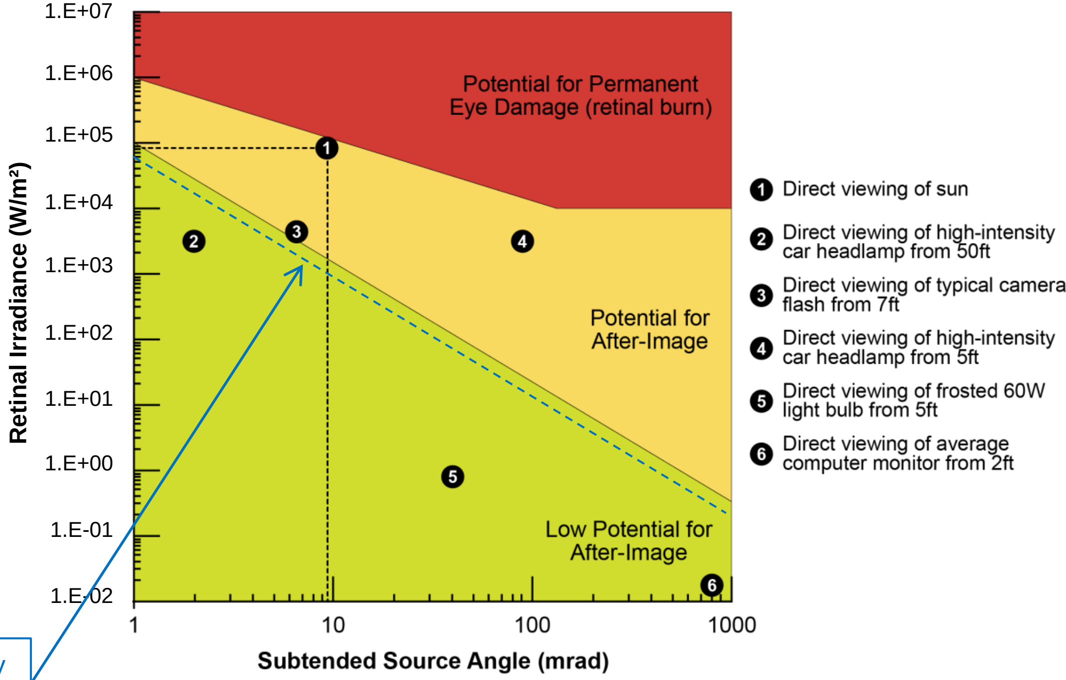


Figure 6a: Subtended Angle of Glare



RWDI Criteria – 50% of the intensity of a reflection with the potential of causing after-imaging

Figure 6b: After-image potential plot [1]

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[1] C. Ho, C. Ghanbari and R. Diver, "Methodology to Assess Potential Glint and Glare Hazards From Concentrating Solar Power Plants: Analytical Models and Experimental Validation," *J. Sol. Energy Eng.*, vol. 133, no. 3, pp. 031021-1 - 031022-9, 2011. http://dx.doi.org/10.1115/1.4004349.

5. CRITERIA – HEAT GAIN

Solar Focusing

Solar focusing is a phenomenon where more than one reflection falls on the same point. This can occur when reflections from multiple flat surfaces converge at a single point, but is more common on inward-curving (concave) facades. As this feature is present in this project, care must be taken to understand the potential solar insolation levels that reflections for the building may create.

There are currently no existing criteria or standards that define an "acceptable" level of reflected solar radiation from buildings. RWDI has conducted a literature review of available scientific sources to determine levels of solar radiation that could be considered acceptable to an individual in the urban realm[1].

Irradiance Limits – People

The U.S. National Fire Protection Association (NFPA) sets thermal radiation criteria which define a tenable environment for people exiting a fire event in a building or tunnel (NFPA 130). They set the upper limit for thermal radiation at 2,500 W/m². Irradiance levels at or below this value can be tolerated for at least several minutes without significantly affecting an individual's ability to escape from a fire event. That being said, skin damage (sun burns) and pain can occur at this 2,500 W/m² threshold. According to British fire standards[2], the onset of pain for ***bare*** skin can occur within 30 seconds at an irradiance of 2,500 W/m². This threshold closely matches the irradiance exposure guidelines published by the U.S. Federal Emergency Management Agency (FEMA), summarized in Table 2. This table also includes the length of time required before the onset of a second degree burn due to thermal radiation. It should be noted that these numbers are guideline values only, and that in reality many factors (skin color, age, clothing choice, etc.) influence how a person reacts to thermal radiation. For our work RWDI have established **2,500 W/m² as a ceiling exposure limit**.

Due to the public nature of the tower, the significant variability in both how individuals will respond to thermal irradiation exposure, and the fact that individuals may not fully appreciate the impact of the reflection until they are exposed, it is RWDI's opinion that a lower threshold value may be more appropriate for human thermal comfort.

Thus, we suggest that for ground level areas where the public will be present, reflected irradiance levels should not exceed 1,500 W/m². This threshold value is a conservative one, which is based around the potential for damage to human skin, requiring several minutes of exposure before damage or discomfort potentially occurs.

For these reasons, we have applied a **short-term exposure threshold of 1,500 W/m²** for our work.

Table 2: Time for Physiological Effects on Bare Skin at Specific Thermal Radiation Levels[3]

Thermal Irradiance [W/m²]	Time To Onset of Pain [s]	Time To Onset of Second Degree Burn [s]
1,000	115	663
2,000	45	187
3,000	27	92
4,000	18	57
5,000	13	40
6,000	11	30
8,000	7	20
10,000	5	14
12,000	4	11

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[1] Danks, R., Good, J., & Sinclair, R. (2016). Assessing reflected sunlight from building facades: A literature review and proposed criteria. Building and Environment, 103, 193-202.

[2] The application of fire safety engineering principles to fire safety design of buildings – Part 6: Human Factors' PD 7974-6:2004, British Standards Institution 2004.

[3] Federal Emergency Management Agency, U.S. Department of Transportation, and U.S. Environmental Protection Agency. 1988. Handbook of Chemical Hazard Analysis Procedures. Washington, D.C.: Federal Emergency Management Agency Publications Office.

6. PRELIMINARY RESULTS

The following plots are presented in this section:

1. ***Peak Annual Reflected Irradiance – Points:***

   This plot displays the annual peak values of the reflections for each grid cell emanating from the Charlesgate development at a typical pedestrian height (5 ft / 1.5 m) above grade.

   It is important to note that these plots show the *peak intensities* of all reflections from the facades that occur over the entire year. In order to attain a better understanding of the impact of the solar reflections on the development, other factors must be considered such as the frequency and duration of the reflections. These factors will be analyzed in detail in the next stage of the study.

   a) ***Visible Reflectance (Visual Glare):***

      These plots display the intensity of reflected visible light only.

      Depending on the ambient conditions, reflection intensities as low as 150 – 300 W/m² could be visible to people.

   b) ***Full Spectrum Reflectance (Heat Gain):***

      These plots present the total intensity of a reflection, including both visible light and thermal energy which relates to the overall heat gain.

      For full spectrum reflectance, RWDI considers 1500 W/m² as a short term exposure threshold and 2500 W/m² as a human safety threshold (as defined in Section 5 – Heat Gain Criteria).

2. ***Peak Annual Reflected Irradiance – Volumetric:***

   This plot displays the full spectrum annual peak values of the reflections emanating from the Charlesgate facades which exceed:

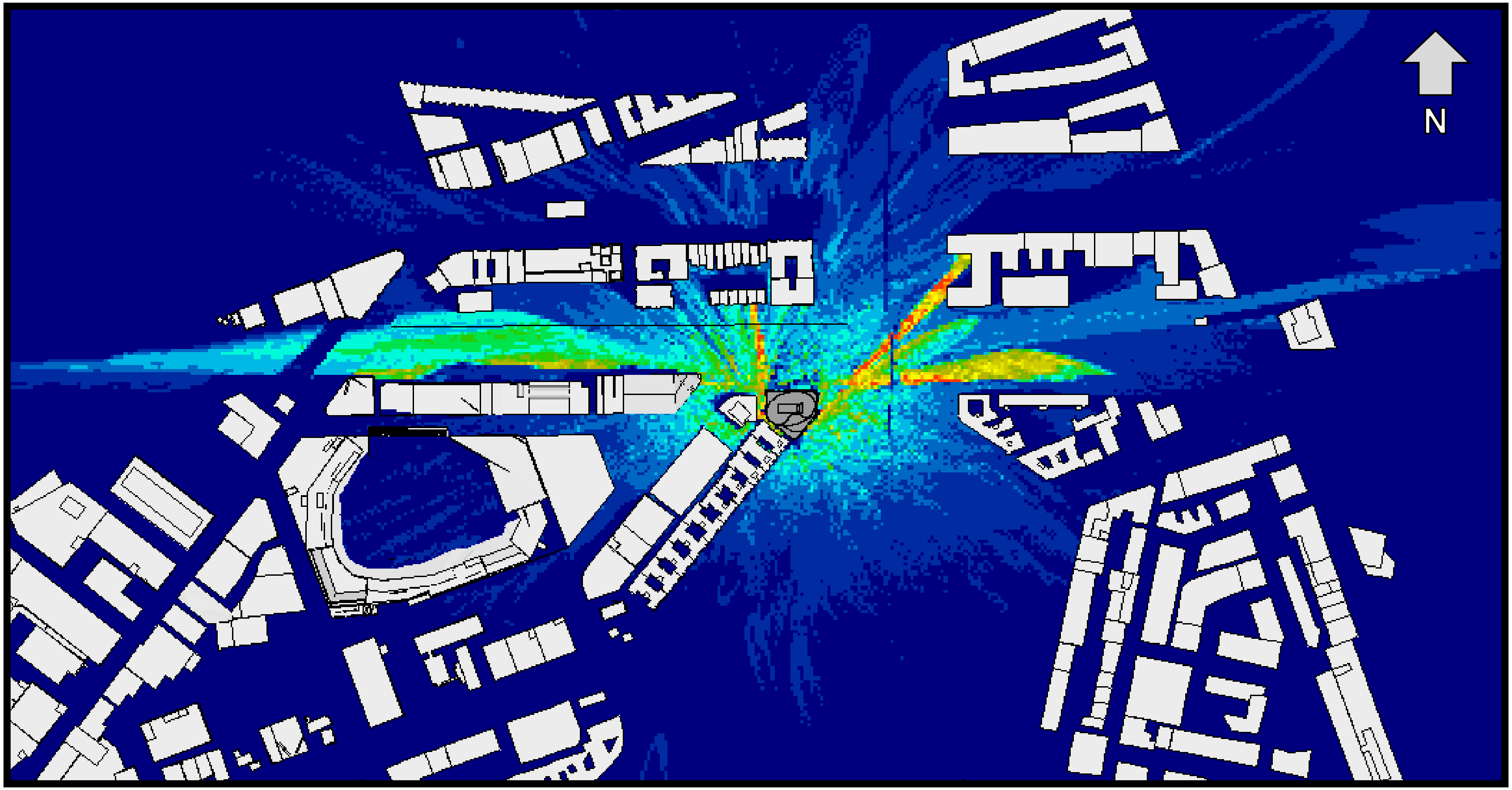
   a) 1500 W/m^2 (short-term exposure threshold)

   b) 2500 W/m^2 (ceiling exposure limit)

3. ***Percentage of Daylit Hours (or Frequency) of Reflected Light:***

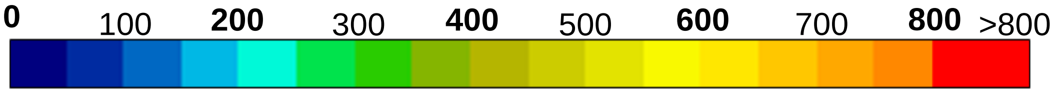
   This plot identifies the locations of the most frequent significant reflections emanating from the facades. In this context a ‘significant’ reflection is one that is at least 50% as intense as one that would cause after imaging on a viewer. (As defined in the Section 5 - Visual Glare Criteria).

1a) Peak Annual Reflected Irradiance: Visible Reflectance



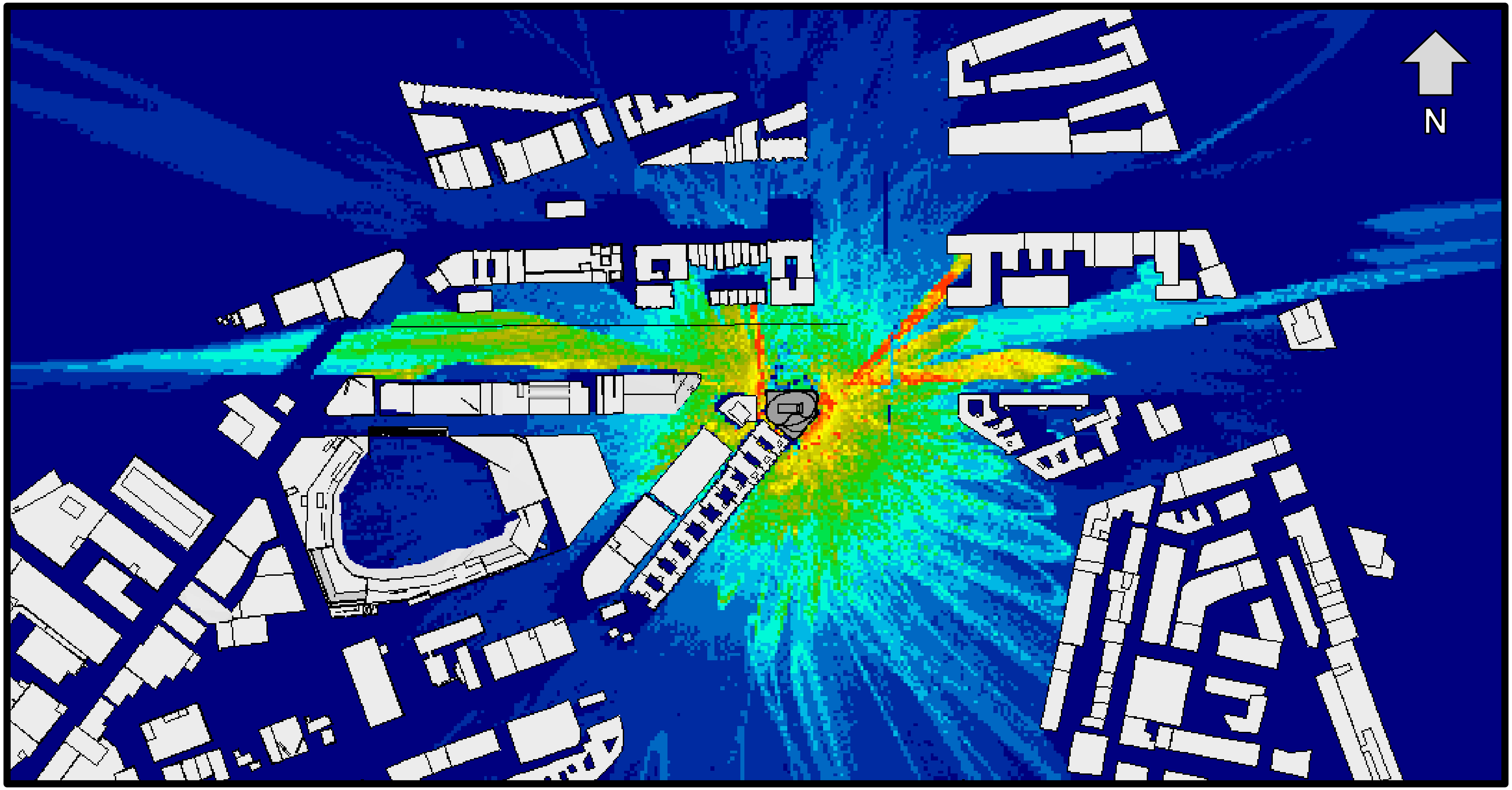
800 W/m² represents a typical intensity for direct sunlight.

Reflections as low as 150 W/m² may be visible to people, depending on ambient lighting levels.



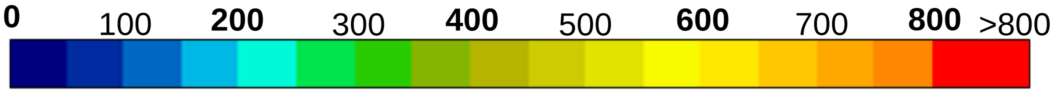
Peak Annual Reflected Irradiance [W/m²]

1b) Peak Annual Reflected Irradiance: Full Spectrum Reflectance



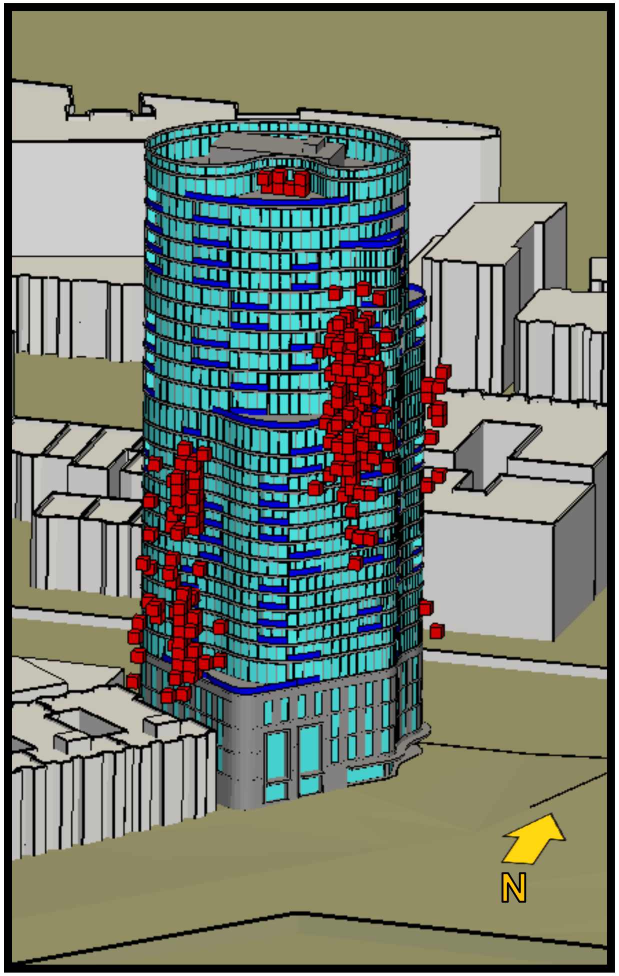
800 W/m² represents a typical intensity for direct sunlight.

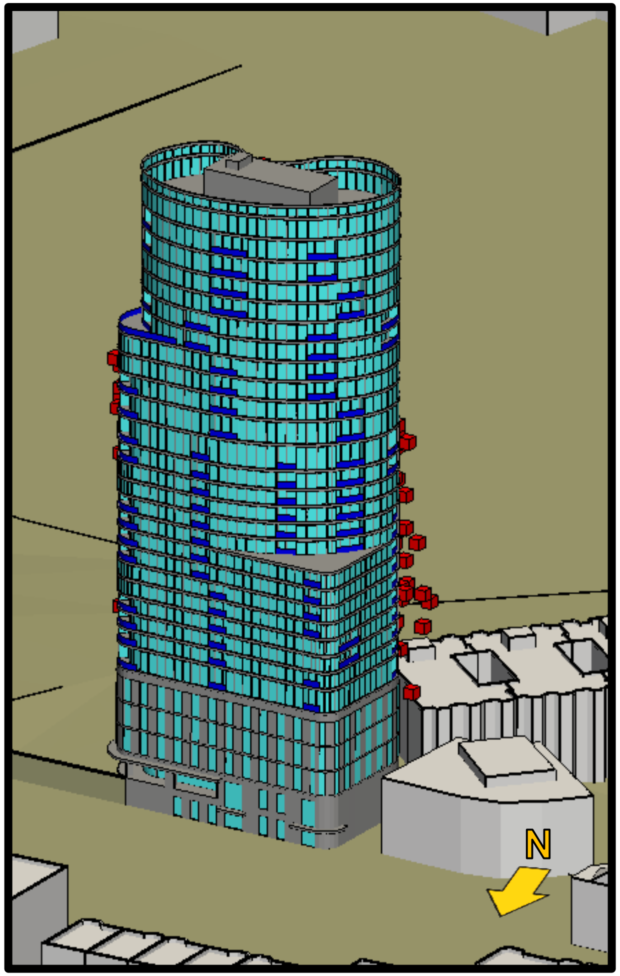
Reflections as low as 150 W/m² may be visible to people, depending on ambient lighting levels.



Peak Annual Reflected Irradiance [W/m²]

2a) Peak Annual Reflected Irradiance – Full Spectrum – Points Exceeding 1500 W/m²

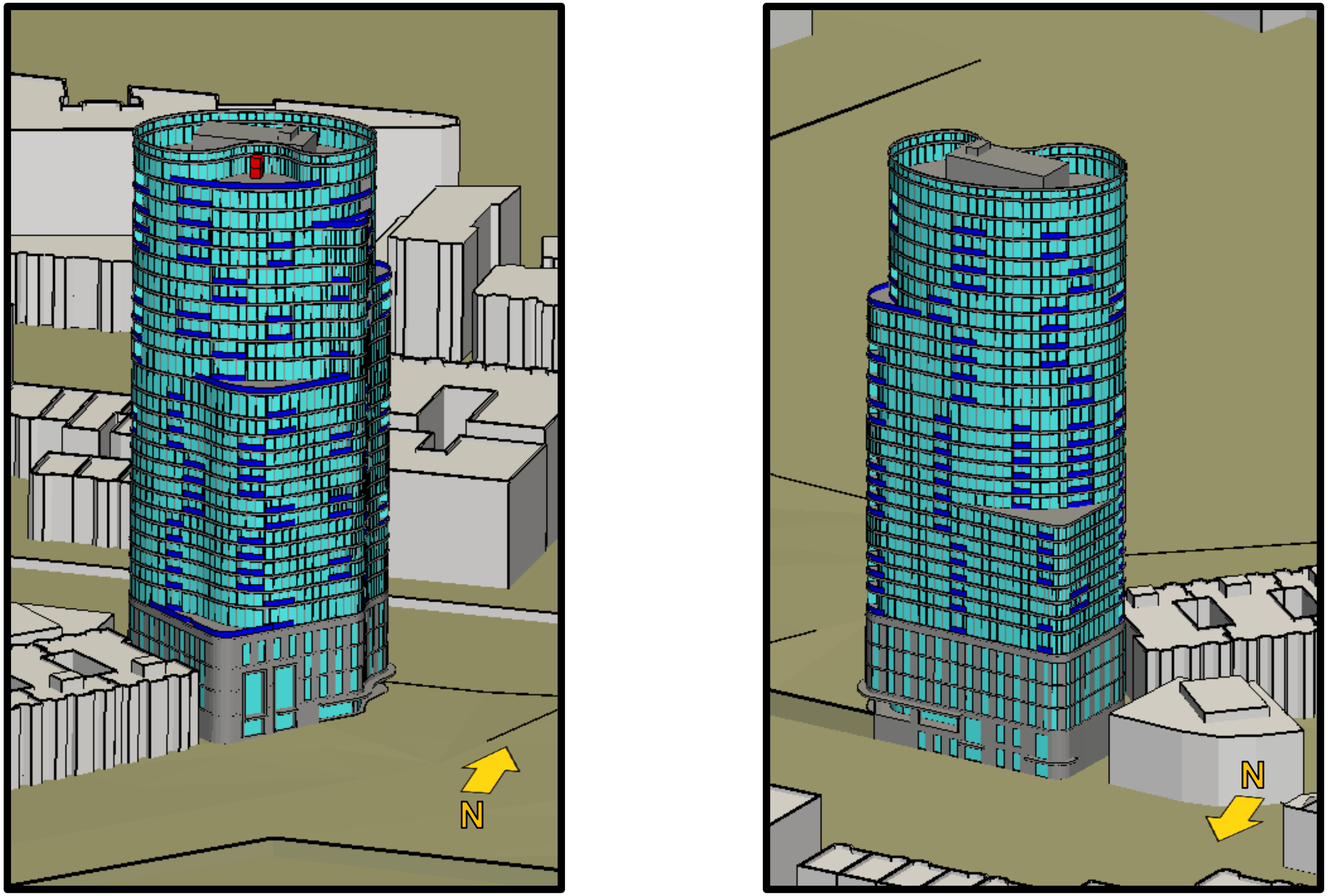




RWDI considers 1500 W/m² as a short term exposure threshold and reflections above 2500 W/m² as a human safety threshold.

A typical intensity for direct sunlight is 800 W/m².

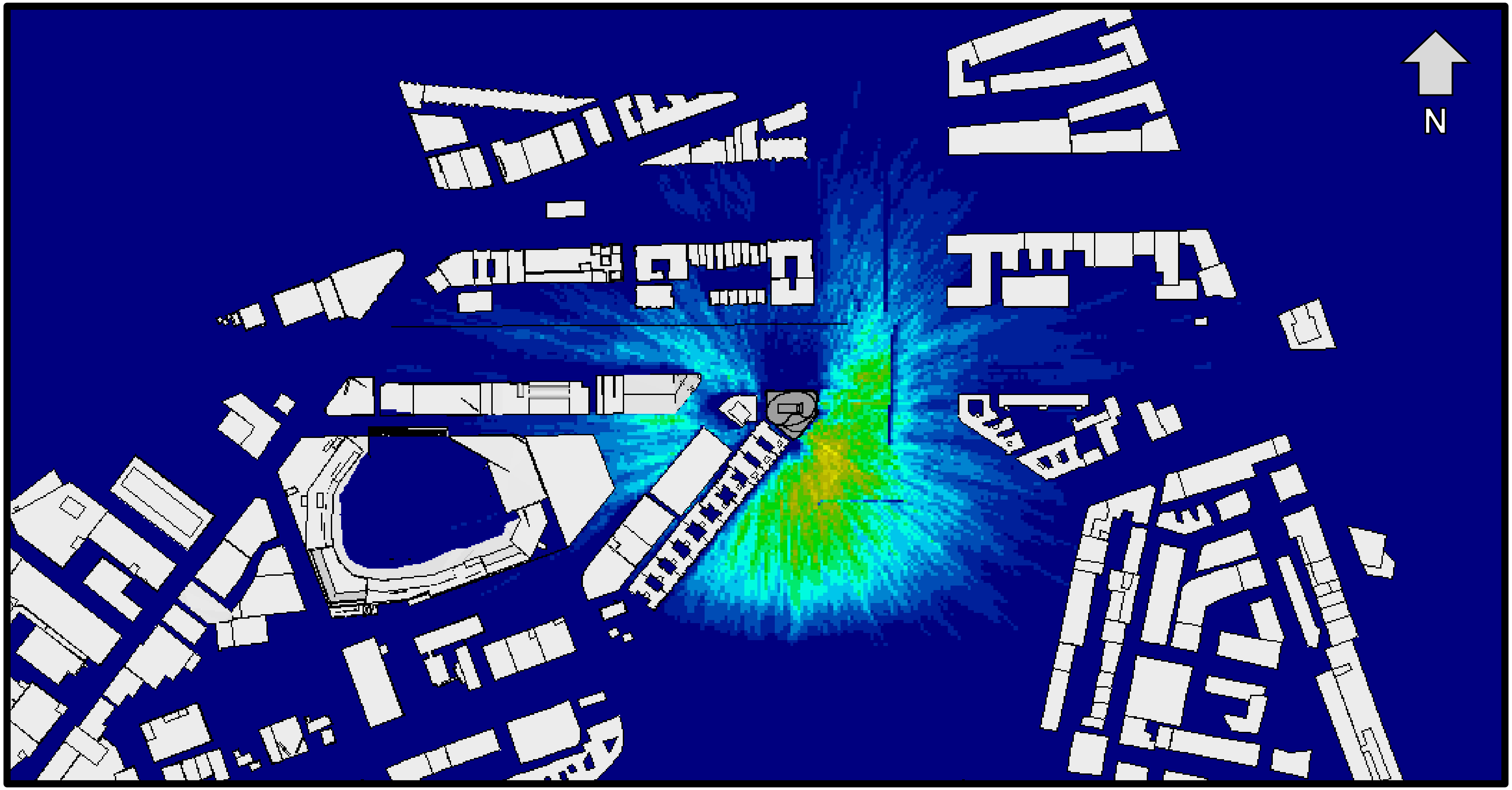
2b) Peak Annual Reflected Irradiance – Full Spectrum – Points Exceeding 2500 W/m^2

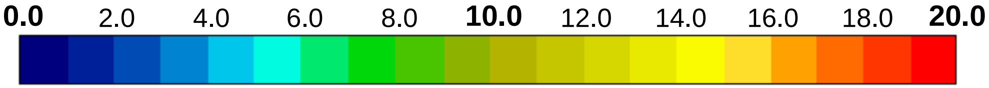


RWDI considers 1500 W/m² as a short term exposure threshold and reflections above 2500 W/m² as a human safety threshold.

A typical intensity for direct sunlight is 800 W/m².

3a) Percentage of Daylit Hours With Significant Reflection Impacts: Visible Reflectance





Percentage of Daytime Hours With Reflection

7. SUMMARY OF PRELIMINARY RESULTS

1. The faceted concave shaped sections of the east, southeast, south, and southwest facades of Charlesgate building act to focus solar energy. Although the location of the focal points are transient, they occur most frequently immediately in front of the concave facades, at heights ranging approximately from 50 feet to 300 feet above grade. Significant increases in temperature may occur in these areas, and the thermal radiation at this location may be intense enough to potentially harm bare skin and cause thermal discomfort.
2. More significantly, the simulations predict peak solar intensities above both RWDI's short-term and celling exposure thresholds in the terrace space located on the uppermost level of the building (area inside the red circle in Figure 7). This level of exposure to bare skin would lead to the onset of pain within 30 seconds. Hence, mitigation measures are strongly recommended, if the terrace is accessible to people. Strategic use of shading devices (umbrellas, canopies, vegetation, etc.) on the terrace could be a practical approach to limit the impact of reflections.
3. The lowermost terrace to the south (area inside the yellow circle in Figure 7) is subjected to impacts that exceed the short-term exposure but not the ceiling exposure limit. The primary source of the reflections are the concave shaped section of the south facade. Such reflections would quickly cause thermal discomfort in people standing on the terrace area. Similar use of shading devices would help in reducing the frequency and duration of impacts. Moreover, focused reflections with lesser intensities may impact the neighboring buildings to the southwest of the development.
4. Reflections at pedestrian level in the surrounding area of the building are scattered in a pinwheel pattern due to the faceted convex geometry of most of the screen walls, causing nuisance at worst. However, since some of the areas in question include spaces where people may linger, e.g. Fenway Victory Gardens, they could prove to be more of a nuisance and mitigation would be advisable.
5. Reflections are expected to occur most frequently at grade level to the east, south, and west of the development, while the areas to the north are impacted less often.
6. Reflections from the north and east facades of the development may affect motorists driving west along Massachusetts Turnpike, as well as train drivers travelling west via westbound trains. Additionally, drivers travelling east may be similarly impacted by the reflections from the north and west facades. Moreover, drivers on Boylston St. that are travelling northeast and northwest towards Charlesgate St. are expected to experience impacts from the south and southeast facades.
7. While some reflections may reach Fenway Park, they are expected to be very infrequent and dim.

The next step of the RWDI study includes a plan to explore the intensity, frequency and duration of these reflections with a detailed receptor analysis, where a number of points will be selected for a minute-by-minute analysis of the impacts of the reflected sunlight. This will allow a more detailed understanding of when and where the reflections come from which will better inform the design of potential mitigation measures.

Figure 8 illustrates RWDI's initial recommendations for the receptor locations. These points have been chosen based on where RWDI has predicted more intense and/or frequent reflections in the selected areas of study.

In closing, we propose to discuss the findings of this report and obtain the feedback and approval of the project team on the proposed receptor locations. This may include alternative locations that the project team can suggest based on issues of sensitivity inherent with the tasks or uses of the impacted locations.

7. SUMMARY OF RESULTS (CON'T)

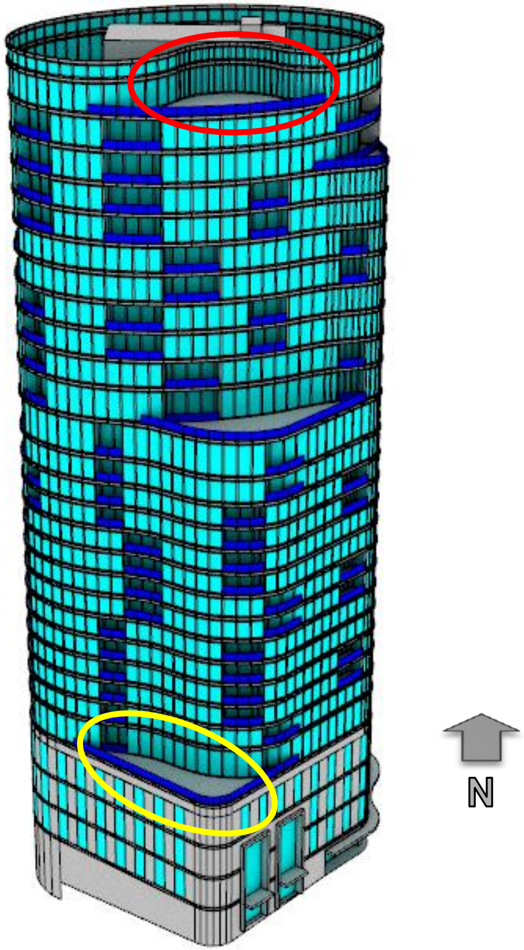


Figure 7: Mark-up of Locations subjected to focused reflected thermal energy

Proposed Receptor Locations for Detailed Study

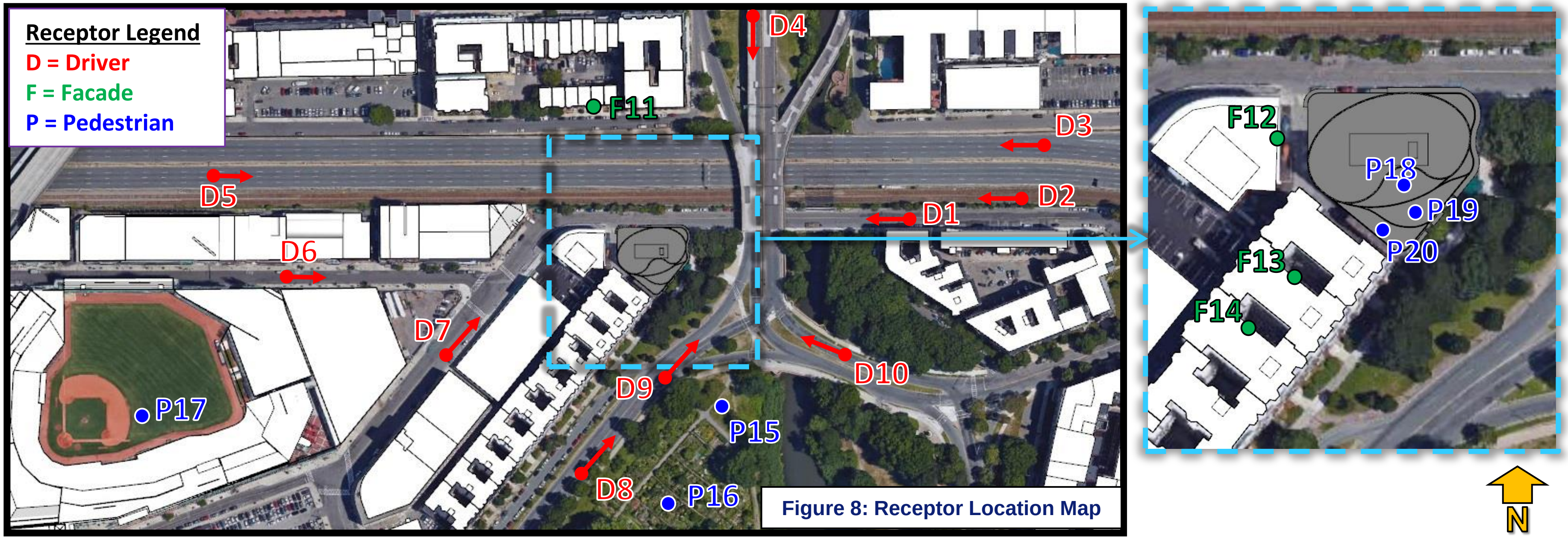


Figure 8: Receptor Location Map

Receptor Number	Receptor Description	Receptor Number	Receptor Description
D1	Drivers travelling west along Ipswich St.	**D10**	Drivers travelling northwest along Boylston St.
D2	Train drivers travelling west	**F11**	Facade of building to the north of development
D3	Drivers travelling west along Massachusetts Turnpike	**F12**	Facade of the Boston Conservatory building
D4	Drivers travelling south along Charlesgate St.	**F13-F14**	Facade of buildings to the southwest of development
D5	Drivers travelling east along Massachusetts Turnpike	**P15-P16**	Pedestrians in Fenway Victory Gardens
D6	Drivers travelling east along Lansdowne St.	**P17**	Pedestrian receptor on the field of Fenway Park
D7	Drivers travelling northeast along Ipswich St.	**P18-P20**	Pedestrians standing on the southern terraces of Charlesgate tower
D8-D9	Drivers travelling northeast along Boylston St.		

Appendix E

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 analysis.

Motor Vehicle Emissions

The EPA MOVES computer program generated motor vehicle emissions used in the garage stationary source analysis along with the mobile source CAL3QHC modeling and mesoscale analysis. The model input parameters were provided by MassDEP. Emission rates were derived for 2016 and 2021 for speed limits of idle, 10, 15, and 30 mph for use in the microscale analyses.

MOVES CO Emission Factor Summary

Carbon Monoxide Only

		2016	2021
Free Flow	30 mph	2.697	1.928
Right Turns	10 mph	4.447	3.116
Left Turns	15 mph	3.823	2.724
Queues	Idle	9.997	4.313

Notes: Winter CO emission factors are higher than Summer and are conservatively used
Urban Unrestricted Roadway type used

CAL3QHC

For the intersection studied, the CAL3QHC model was applied to calculate CO concentrations at sensitive receptor locations using emission rates derived in MOVES. 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 intersection. Idle emission rates for queue links were based on 0 mph emission rates derived in MOVES. Emission rates for speeds of 10, 15, and 30 mph were used for right turn, left turn, and free flow links, respectively.

2 Charlesgate West
Background Concentrations

POLLUTANT	AVERAGING TIME	Form	2012	2013	2014	Units	ppm/ppb to $\mu g/m^3$ Conversion Factor	2012-2014 Background Concentration ($\mu g/m^3$)	Location
SO_2 (1)(5)	1-Hour (4)	99th %	13.2	12.2	9.7	ppb	2.62	30.7	Kenmore Sq., Boston
	3-Hour (6)	H2H	10.6	13.9	9.4	ppb	2.62	36.4	Kenmore Sq., Boston
	24-Hour	H2H	5.4	6	5	ppb	2.62	15.7	Kenmore Sq., Boston
	Annual	H	1.9	1.0	0.9	ppb	2.62	4.9	Kenmore Sq., Boston
PM-10	24-Hour	H2H	28.0	50	53	$\mu g/m^3$	1	53	Kenmore Sq., Boston
	Annual	H	15.8	19.3	15.0	$\mu g/m^3$	1	19.3	Kenmore Sq., Boston
PM-2.5	24-Hour (4)	98th %	22.1	17.5	14.6	$\mu g/m^3$	1	18.1	Kenmore Sq., Boston
	Annual (4)	H	9.0	8.0	6.1	$\mu g/m^3$	1	7.7	Kenmore Sq., Boston
NO_2 (3)	1-Hour (4)	98th %	49	49	49	ppb	1.88	92.1	Kenmore Sq., Boston
	Annual	H	19.1	17.8	17.2	ppb	1.88	35.9	Kenmore Sq., Boston
CO (2)	1-Hour	H2H	1.3	1.3	1.3	ppm	1146	1489.8	Kenmore Sq., Boston
	8-Hour	H2H	1.1	1.0	1.1	ppm	1146	1260.6	Kenmore Sq., Boston
Ozone	8-Hour	H4H	0.062	0.059	0.054	ppm	1963	121.7	Harrison Ave., Boston
Lead	Rolling 3-Month	H	0.014	0.007	0.014	$\mu g/m^3$	1	0.014	Harrison Ave., Boston

Notes:
From 2012-2014 EPA's AirData Website

[1] SO_2 reported ppb. Converted to $\mu g/m^3$ using factor of 1 ppm = 2.62 $\mu g/m^3$.

[2] CO reported in ppm. Converted to $\mu g/m^3$ using factor of 1 ppm = 1146 $\mu g/m^3$.

[3] NO_2 reported in ppb. Converted to $\mu g/m^3$ using factor of 1 ppm = 1.88 $\mu g/m^3$.

[4] Background level is the average concentration of the three years.

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

Due to excessive size CAL3QHC, and MOVES input and output files are available on digital media upon request.

Appendix F

Climate Change Preparedness Checklist

Climate Change Preparedness and Resiliency Checklist for New Construction

In November 2013, in conformance with the Mayor's 2011 Climate Action Leadership Committee's recommendations, the Boston Redevelopment Authority adopted policy for all development projects subject to Boston Zoning Article 80 Small and Large Project Review, including all Institutional Master Plan modifications and updates, are to complete the following checklist and provide any necessary responses regarding project resiliency, preparedness, and to mitigate any identified adverse impacts that might arise under future climate conditions.

For more information about the City of Boston's climate policies and practices, and the 2011 update of the climate action plan, *A Climate of Progress*, please see the City's climate action web pages at http://www.cityofboston.gov/climate

In advance we thank you for your time and assistance in advancing best practices in Boston.

Climate Change Analysis and Information Sources:

1. Northeast Climate Impacts Assessment (www.climatechoices.org/ne/)
2. USGCRP 2009 (http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/)
3. Army Corps of Engineers guidance on sea level rise (http://planning.usace.army.mil/toolbox/library/ECs/EC11652212Nov2011.pdf)
4. Proceeding of the National Academy of Science, “Global sea level rise linked to global temperature”, Vermeer and Rahmstorf, 2009 (http://www.pnas.org/content/early/2009/12/04/0907765106.full.pdf)
5. “Hotspot of accelerated sea-level rise on the Atlantic coast of North America”, Asbury H. Sallenger Jr*, Kara S. Doran and Peter A. Howd, 2012 (http://www.bostonredevelopmentauthority.org/planning/Hotspot of Accelerated Sea-level Rise 2012.pdf)
6. “Building Resilience in Boston”: Best Practices for Climate Change Adaptation and Resilience for Existing Buildings, Linnean Solutions, The Built Environment Coalition, The Resilient Design Institute, 2103 (http://www.greenribboncommission.org/downloads/Building_Resilience_in_Boston_SML.pdf)

Checklist

Please respond to all of the checklist questions to the fullest extent possible. For projects that respond “Yes” to any of the D.1 – Sea-Level Rise and Storms, Location Description and Classification questions, please respond to all of the remaining Section D questions.

Checklist responses are due at the time of initial project filing or Notice of Project Change and final filings just prior seeking Final BRA Approval. A PDF of your response to the Checklist should be submitted to the Boston Redevelopment Authority via your project manager.

Please Note: When initiating a new project, please visit the BRA web site for the most current Climate Change Preparedness & Resiliency Checklist.

A.1 - Project Information

Project Name:	**2 Charlesgate West**
Project Address Primary:	**2 Charlesgate West**
Project Address Additional:	
Project Contact (name / Title / Company / email / phone):	**Justin Krebs/ President/ Trans National Properties/ jkrebs@transnationalgroup.com**

A.2 - Team Description

Owner / Developer:	**Trans National Properties**
Architect:	**Elkus Manfredit Architects**
Engineer (building systems):	**Consentini**
Sustainability / LEED:	**The Green Engineer**
Permitting:	**Epsilon Associates**
Construction Management:	
Climate Change Expert:	

A.3 - Project Permitting and Phase

At what phase is the project – most recent completed submission at the time of this response?

☑ PNF / Expanded PNF Submission	☐ Draft / Final Project Impact Report Submission	☐ BRA Board Approved	☐ Notice of Project Change
☐ Planned Development Area	☐ BRA Final Design Approved	☐ Under Construction	☐ Construction just completed:

A.4 - Building Classification and Description

List the principal Building Uses:	Residential, restaurant
List the First Floor Uses:	*Restaurant, Residential Lobby, Parking*

What is the principal Construction Type – select most appropriate type?

☐ Wood Frame	☐ Masonry	☐ Steel Frame	☑ Concrete

Describe the building?

Site Area:	*20,343 SF*	Building Area:	*344,000 SF*
Building Height:	*340 Ft.*	Number of Stories:	*29 Flrs.*
First Floor Elevation (reference Boston City Base):	*14 Elev.*	Are there below grade spaces/levels, if yes how many:	*1 level*

A.5 - Green Building

Which LEED Rating System(s) and version has or will your project use (by area for multiple rating systems)?

Select by Primary Use:	☑ New Construction	☐ Core & Shell	☐ Healthcare	☐ Schools
	☐ Retail	☐ Homes Midrise	☐ Homes	☐ Other
Select LEED Outcome:	☐ Certified	☑ Silver	☐ Gold	☐ Platinum

Will the project be USGBC Registered and / or USGBC Certified?

Registered:	*Yes / [✓ No]*	Certified:	*Yes / [✓ No]*

A.6 - Building Energy-

What are the base and peak operating energy loads for the building?

Electric:	*3,500 (kW)*	Heating:	*7,000 (MMBtu/hr)*
What is the planned building Energy Use Intensity:	*15 (kWh/SF)*	Cooling:	*780 (Tons/hr)*

What are the peak energy demands of your critical systems in the event of a service interruption?

Electric:	*750 (kW)*	Heating:	*7,000 (MMBtu/hr)*
		Cooling:	*0 (Tons/hr)*

What is nature and source of your back-up / emergency generators?

Electrical Generation:	*750 (kW)*		Fuel Source:	*Diesel*
System Type and Number of Units:	☑ Combustion Engine	☐ Gas Turbine	☐ Combine Heat and Power	*(Units)*

B - Extreme Weather and Heat Events

Climate change will result in more extreme weather events including higher year round average temperatures, higher peak temperatures, and more periods of extended peak temperatures. The section explores how a project responds to higher temperatures and heat waves.

B.1 - Analysis

What is the full expected life of the project?

Select most appropriate:	☐ 10 Years	☐ 25 Years	☑ 50 Years	☐ 75 Years

What is the full expected operational life of key building systems (e.g. heating, cooling, ventilation)?

Select most appropriate:	☐ 10 Years	☑ 25 Years	☐ 50 Years	☐ 75 Years

What time span of future Climate Conditions was considered?

Select most appropriate:	☐ 10 Years	☐ 25 Years	☑ 50 Years	☐ 75 Years

Analysis Conditions - What range of temperatures will be used for project planning – Low/High?

8/91 Deg.	Based on ASHRAE Fundamentals 2013 99.6% heating; 0.4% cooling

What Extreme Heat Event characteristics will be used for project planning – Peak High, Duration, and Frequency?

95 Deg.	*5 Days*	*6 Events / yr.*

What Drought characteristics will be used for project planning – Duration and Frequency?

30-90 Days	*0.2 Events / yr.*

What Extreme Rain Event characteristics will be used for project planning – Seasonal Rain Fall, Peak Rain Fall, and Frequency of Events per year?

45 Inches / yr.	*4 Inches*	*0.5 Events / yr.*

What Extreme Wind Storm Event characteristics will be used for project planning – Peak Wind Speed, Duration of Storm Event, and Frequency of Events per year?

130 Peak Wind	*10 Hours*	*0.25 Events / yr.*

B.2 - Mitigation Strategies

What will be the overall energy performance, based on use, of the project and how will performance be determined?

Building energy use below code:	***10%***	Per the 9th Edition MA Building Code Stretch Code Amendment 10% below ASHRAE 90.1 - 2013
How is performance determined:	DOE II based energy modeling	

What specific measures will the project employ to reduce building energy consumption?

Select all appropriate:	☑ High performance building envelop	☑ High performance lighting & controls	☐ Building day lighting	☑ EnergyStar equip. / appliances
	☐ High performance HVAC equipment	☑ Energy recovery ventilation	☐ No active cooling	☐ No active heating
Describe any added measures:				

What are the insulation (R) values for building envelop elements?

Roof:	*R = 25*	Walls / Curtain Wall Assembly:	*R = 13BATTS + R8 continuous insulation*
Foundation:	*R = 15*	Basement / Slab:	*R =10*
Windows:	*R = / U =0.4*	Doors:	*R = / U =0.7*

What specific measures will the project employ to reduce building energy demands on the utilities and infrastructure?

☐ On-site clean energy / CHP system(s)	☑ Building-wide power dimming	☑ Thermal energy storage systems	☑ Ground source heat pump

	☐ On-site Solar PV	☐ On-site Solar Thermal	☐ Wind power	☐ None
Describe any added measures:	The Project team is studying the feasibility of including a 75-100 Kw CHP			

Will the project employ Distributed Energy / Smart Grid Infrastructure and /or Systems?

Select all appropriate:	☐ Connected to local distributed electrical	☐ Building will be Smart Grid ready	☐ Connected to distributed steam, hot, chilled water	☐ Distributed thermal energy ready

Will the building remain operable without utility power for an extended period?

	Yes	If yes, for how long:	*Days*
If Yes, is building "Islandable?	Critical systems such as domestic water pump and ERUs and building heating are on generator, and can keep the building occupiable so long the generator can be refueled.		
If Yes, describe strategies:			

Describe any non-mechanical strategies that will support building functionality and use during an extended interruption(s) of utility services and infrastructure:

Select all appropriate:	☐ Solar oriented – longer south walls	☐ Prevailing winds oriented	☐ External shading devices	☐ Tuned glazing,
	☐ Building cool zones	☐ Operable windows	☐ Natural ventilation	☐ Building shading
	☐ Potable water for drinking / food preparation	☐ Potable water for sinks / sanitary systems	☐ Waste water storage capacity	☑ High Performance Building Envelop
Describe any added measures:				

What measures will the project employ to reduce urban heat-island effect?

Select all appropriate:	☐ High reflective paving materials	☐ Shade trees & shrubs	☐ High reflective roof materials	☐ Vegetated roofs
Describe other strategies:				

What measures will the project employ to accommodate rain events and more rain fall?

Select all appropriate:	☐ On-site retention systems & ponds	☑ Infiltration galleries & areas	☐ Vegetated water capture systems	☐ Vegetated roofs
Describe other strategies:				

What measures will the project employ to accommodate extreme storm events and high winds?

Select all appropriate:	☐ Hardened building structure & elements	☑ Buried utilities & hardened infrastructure	☐ Hazard removal & protective landscapes	☐ Soft & permeable surfaces (water infiltration)
Describe other strategies:				

C - Sea-Level Rise and Storms

Rising Sea-Levels and more frequent Extreme Storms increase the probability of coastal and river flooding and enlarging the extent of the 100 Year Flood Plain. This section explores if a project is or might be subject to Sea-Level Rise and Storm impacts.

C.1 - Location Description and Classification:

Do you believe the building to susceptible to flooding now or during the full expected life of the building?

No

Describe site conditions?

Site Elevation – Low/High Points: *14 Boston City Base Elev.(Ft.)*

Building Proximity to Water: *250 Ft.*

Is the site or building located in any of the following?

Coastal Zone: *No*

Velocity Zone: *No*

Flood Zone: *No*

Area Prone to Flooding: *No*

Will the 2013 Preliminary FEMA Flood Insurance Rate Maps or future floodplain delineation updates due to Climate Change result in a change of the classification of the site or building location?

2013 FEMA Prelim. FIRMs: *No*

Future floodplain delineation updates: *No*

What is the project or building proximity to nearest Coastal, Velocity or Flood Zone or Area Prone to Flooding?

220 Ft.

If you answered YES to any of the above Location Description and Classification questions, please complete the following questions. Otherwise you have completed the questionnaire; thank you!

C - Sea-Level Rise and Storms

This section explores how a project responds to Sea-Level Rise and / or increase in storm frequency or severity.

C.2 - Analysis

How were impacts from higher sea levels and more frequent and extreme storm events analyzed:

Sea Level Rise: *3 Ft.*

Frequency of storms: *0.25 per year*

C.3 - Building Flood Proofing

Describe any strategies to limit storm and flood damage and to maintain functionality during an extended periods of disruption.

What will be the Building Flood Proof Elevation and First Floor Elevation:

Flood Proof Elevation: *Boston City Base Elev.(Ft.)*

First Floor Elevation: *Boston City Base Elev. (Ft.)*

Will the project employ temporary measures to prevent building flooding (e.g. barricades, flood gates):

Yes / No

If Yes, to what elevation *Boston City Base Elev. (Ft.)*

If Yes, describe:

What measures will be taken to ensure the integrity of critical building systems during a flood or severe storm event:

☐ Systems located above 1st Floor.	☑ Water tight utility conduits	☐ Waste water back flow prevention	☐ Storm water back flow prevention

Were the differing effects of fresh water and salt water flooding considered:

Yes / No

Will the project site / building(s) be accessible during periods of inundation or limited access to transportation:

Yes / No	If yes, to what height above 100 Year Floodplain:	*Boston City Base Elev. (Ft.)*

Will the project employ hard and / or soft landscape elements as velocity barriers to reduce wind or wave impacts?

Yes / No

If Yes, describe:

Will the building remain occupiable without utility power during an extended period of inundation:

Yes / No	If Yes, for how long:	*days*

Describe any additional strategies to addressing sea level rise and or sever storm impacts:

C.4 - Building Resilience and Adaptability

Describe any strategies that would support rapid recovery after a weather event and accommodate future building changes that respond to climate change:

Will the building be able to withstand severe storm impacts and endure temporary inundation?

Select appropriate:	*Yes / No*	☐ Hardened / Resilient Ground Floor Construction	☐ Temporary shutters and or barricades	☐ Resilient site design, materials and construction

Can the site and building be reasonably modified to increase Building Flood Proof Elevation?

Select appropriate:	*Yes / No*	☐ Surrounding site elevation can be raised	☐ Building ground floor can be raised	☐ Construction been engineered
Describe additional strategies:				

Has the building been planned and designed to accommodate future resiliency enhancements?

Select appropriate:	*Yes / No*	☐ Solar PV	☐ Solar Thermal	☐ Clean Energy / CHP System(s)
		☐ Potable water storage	☐ Wastewater storage	☐ Back up energy systems & fuel

Describe any specific or additional strategies:	

Thank you for completing the Boston Climate Change Resilience and Preparedness Checklist!

For questions or comments about this checklist or Climate Change Resiliency and Preparedness best practices, please contact: John.Dalzell.BRA@cityofboston.gov

Appendix G

Accessibility Checklist

Accessibility Checklist

(to be added to the BRA Development Review Guidelines)

In 2009, a nine-member Advisory Board was appointed to the Commission for Persons with Disabilities in an effort to reduce architectural, procedural, attitudinal, and communication barriers affecting persons with disabilities in the City of Boston. These efforts were instituted to work toward creating universal access in the built environment.

In line with these priorities, the Accessibility Checklist aims to support the inclusion of people with disabilities. In order to complete the Checklist, you must provide specific detail, including descriptions, diagrams and data, of the universal access elements that will ensure all individuals have an equal experience that includes full participation in the built environment throughout the proposed buildings and open space.

In conformance with this directive, all development projects subject to Boston Zoning Article 80 Small and Large Project Review, including all Institutional Master Plan modifications and updates, are to complete the following checklist and provide any necessary responses regarding the following:

- improvements for pedestrian and vehicular circulation and access;
- encourage new buildings and public spaces to be designed to enhance and preserve Boston's system of parks, squares, walkways, and active shopping streets;
- ensure that persons with disabilities have full access to buildings open to the public;
- afford such persons the educational, employment, and recreational opportunities available to all citizens; and
- preserve and increase the supply of living space accessible to persons with disabilities.

We would like to thank you in advance for your time and effort in advancing best practices and progressive approaches to expand accessibility throughout Boston's built environment.

Accessibility Analysis Information Sources:

1. Americans with Disabilities Act – 2010 ADA Standards for Accessible Design
    a. http://www.ada.gov/2010ADAstandards_index.htm
2. Massachusetts Architectural Access Board 521 CMR
    a. http://www.mass.gov/eopss/consumer-prot-and-bus-lic/license-type/aab/aab-rules-and-regulations-pdf.html
3. Boston Complete Street Guidelines
    a. http://bostoncompletestreets.org/
4. City of Boston Mayors Commission for Persons with Disabilities Advisory Board
    a. http://www.cityofboston.gov/Disability
5. City of Boston – Public Works Sidewalk Reconstruction Policy
    a. http://www.cityofboston.gov/images_documents/sidewalk%20policy%200114_tcm3-41668.pdf
6. Massachusetts Office On Disability Accessible Parking Requirements
    a. www.mass.gov/anf/docs/mod/hp-parking-regulations-mod.doc
7. MBTA Fixed Route Accessible Transit Stations
    a. http://www.mbta.com/about_the_mbta/accessibility/

Article 80 | ACCESSIBILTY CHECKLIST

Project Information

Project Name:	2 Charlesgate West
Project Address Primary:	2 Charlesgate West
Project Address Additional:	
Project Contact (name / Title / Company / email / phone):	Justin Krebs/President/Trans National Properties/jkrebs@transnationalgroup.com

Team Description

Owner / Developer:	Trans National Properties
Architect:	Elkus Manfredi Architects
Engineer (building systems):	Cosentini
Sustainability / LEED:	The Green Engineer
Permitting:	Epsilon Associates
Construction Management:	

Project Permitting and Phase

At what phase is the project – at time of this questionnaire?

☑PNF / Expanded PNF Submitted	Draft / Final Project Impact Report Submitted	BRA Board Approved
BRA Design Approved	Under Construction	Construction just completed:

Article 80 | ACCESSIBILTY CHECKLIST

Building Classification and Description

What are the principal Building Uses - select all appropriate uses?

Residential – One to Three Unit	☑Residential - Multi-unit, Four +	Institutional	Education
Commercial	Office	Retail	Assembly
Laboratory / Medical	Manufacturing / Industrial	Mercantile	Storage, Utility and Other

First Floor Uses (List)	*Restaurant, office, residential lobby, parking*

What is the Construction Type – select most appropriate type?

Wood Frame	Masonry	Steel Frame	☑Concrete

Describe the building?

Site Area:	*20,343 SF*	Building Area:	*344,000 SF*
Building Height:	*340 Ft.*	Number of Stories:	*29 Flrs.*
First Floor Elevation:	*14 Elev.*	Are there below grade spaces:	*Ye*

Assessment of Existing Infrastructure for Accessibility:

This section explores the proximity to accessible transit lines and proximate institutions such as, but not limited to hospitals, elderly and disabled housing, and general neighborhood information. The proponent should identify how the area surrounding the development is accessible for people with mobility impairments and should analyze the existing condition of the accessible routes through sidewalk and pedestrian ramp reports.

Provide a description of the development neighborhood and identifying characteristics.	The Project site is located in the Fenway neighborhood with Fenway Park and the numerous restaurants along Lansdowne Street to the west, and the Emerald Necklace to the southeast. To the southwest of the site is the Boylston Street corridor, a rapidly growing area with multiple projects recently completed, under construction, or under review by the BRA.
List the surrounding ADA compliant MBTA transit lines and the proximity to the development site: Commuter rail, subway, bus, etc.	The site is located within a quarter mile of the Massachusetts Bay Transportation Authority (MBTA) Green line at Kenmore Station, and within one half mile of the commuter rail at Yawkey Station. The site is also in close proximity to several bus stations.

List the surrounding institutions: hospitals, public housing and elderly and disabled housing developments, educational facilities, etc.	The Boston Conservatory, Berklee College of Music, Boston University East Campus.
Is the proposed development on a priority accessible route to a key public use facility? List the surrounding: government buildings, libraries, community centers and recreational facilities and other related facilities.	The development is not on a priority accessible route. Within the vicinity of the Project site is the Emerald Necklace, Charlesgate Park, and Fenway Park.

Surrounding Site Conditions – Existing:

This section identifies the current condition of the sidewalks and pedestrian ramps around the development site.

Are there sidewalks and pedestrian ramps existing at the development site?	Yes
If yes above, list the existing sidewalk and pedestrian ramp materials and physical condition at the development site.	Concrete and in fair condition
Are the sidewalks and pedestrian ramps existing-to-remain? If yes, have the sidewalks and pedestrian ramps been verified as compliant? If yes, please provide surveyors report.	TBD
Is the development site within a historic district? If yes, please identify.	No

Surrounding Site Conditions – Proposed

This section identifies the proposed condition of the walkways and pedestrian ramps in and around the development site. The width of the sidewalk contributes to the degree of comfort and enjoyment of walking along a street. Narrow sidewalks do not support lively pedestrian activity, and may create dangerous conditions that force people to walk in the street. Typically, a five foot wide Pedestrian Zone supports two people walking side by side or two wheelchairs passing each other. An eight foot wide Pedestrian Zone allows two pairs of people to comfortable pass each other, and a ten foot or wider Pedestrian Zone can support high volumes of pedestrians.

Are the proposed sidewalks consistent with the Boston Complete Street Guidelines? See: www.bostoncompletestreets.org	The existing sidewalk conditions do not meet certain Complete Streets criteria. The Proponent will work with City agencies and the community to determine the most appropriate design for the proposed sidewalks.
If yes above, choose which Street Type was applied: Downtown Commercial, Downtown Mixed-use, Neighborhood Main, Connector, Residential, Industrial, Shared Street, Parkway, Boulevard.	
What is the total width of the proposed sidewalk? List the widths of the proposed zones: Frontage, Pedestrian and Furnishing Zone.	
List the proposed materials for each Zone. Will the proposed materials be on private property or will the proposed materials be on the City of Boston pedestrian right-of-way?	
If the pedestrian right-of-way is on private property, will the proponent seek a pedestrian easement with the City of Boston Public Improvement Commission?	
Will sidewalk cafes or other furnishings be programmed for the pedestrian right-of-way?	No
If yes above, what are the proposed dimensions of the sidewalk café or furnishings and what will the right-of-way clearance be?	

Proposed Accessible Parking:

See Massachusetts Architectural Access Board Rules and Regulations 521 CMR Section 23.00 regarding accessible parking requirement counts and the Massachusetts Office of Disability Handicap Parking

Regulations.

What is the total number of parking spaces provided at the development site parking lot or garage?	186 spaces
What is the total number of accessible spaces provided at the development site?	All of the parking will be attended parking
Will any on street accessible parking spaces be required? If yes, has the proponent contacted the Commission for Persons with Disabilities and City of Boston Transportation Department regarding this need?	No
Where is accessible visitor parking located?	All of the parking will be attended parking
Has a drop-off area been identified? If yes, will it be accessible?	Yes. It will be accessible.
Include a diagram of the accessible routes to and from the accessible parking lot/garage and drop-off areas to the development entry locations. Please include route distances.	Accessible drop-off for attended parking is located flush with grade and with building entry.

Circulation and Accessible Routes:

The primary objective in designing smooth and continuous paths of travel is to accommodate persons of all abilities that allow for universal access to entryways, common spaces and the visit-ability* of neighbors.

**Visit-ability – Neighbors ability to access and visit with neighbors without architectural barrier limitations*

Provide a diagram of the accessible route connections through the site.	
Describe accessibility at each entryway: Flush Condition, Stairs, Ramp Elevator.	Restaurant entry at Ipswich St. – Flush Condition Residential entry at Ipswich St. – Flush Condition

	Restaurant entry at Boylston St. level – Flush Condition Residential entries at Boylston St. level – Flush Condition
Are the accessible entrance and the standard entrance integrated?	Yes
If no above, what is the reason?	
Will there be a roof deck or outdoor courtyard space? If yes, include diagram of the accessible route.	Yes
Has an accessible routes way-finding and signage package been developed? If yes, please describe.	Not at this time.

Accessible Units: (If applicable)

In order to facilitate access to housing opportunities this section addresses the number of accessible units that are proposed for the development site that remove barriers to housing choice.

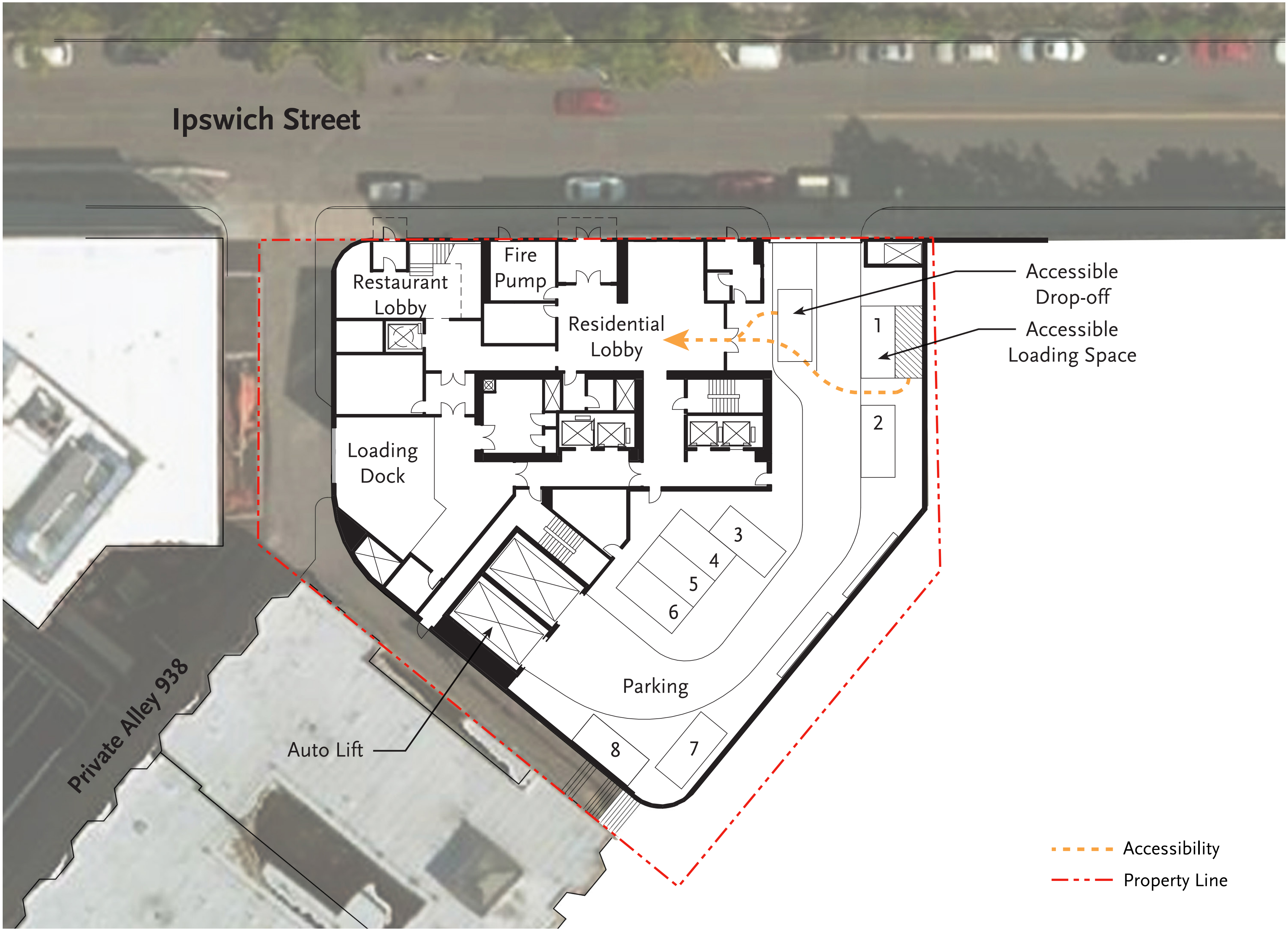
What is the total number of proposed units for the development?	295
How many units are for sale; how many are for rent? What is the market value vs. affordable breakdown?	Sale: 122 units Rental: 173 units The market value vs. affordable breakdown has not yet been determined.
How many accessible units are being proposed?	5% of rental units will be accessible as per 521 CMR
Please provide plan and diagram of the accessible units.	
How many accessible units will also be affordable? If none, please describe reason.	TBD
Do standard units have architectural barriers that would prevent entry or use of common space for persons with mobility	No

impairments? Example: stairs at entry or step to balcony. **If yes,** please provide reason.	
Has the proponent reviewed or presented the proposed plan to the City of Boston Mayor's Commission for Persons with Disabilities Advisory Board?	Not at this time
Did the Advisory Board vote to support this project? **If no,** what recommendations did the Advisory Board give to make this project more accessible?	

Thank you for completing the Accessibility Checklist!

For questions or comments about this checklist or accessibility practices, please contact:

kathryn.quigley@boston.gov | Mayors Commission for Persons with Disabilities

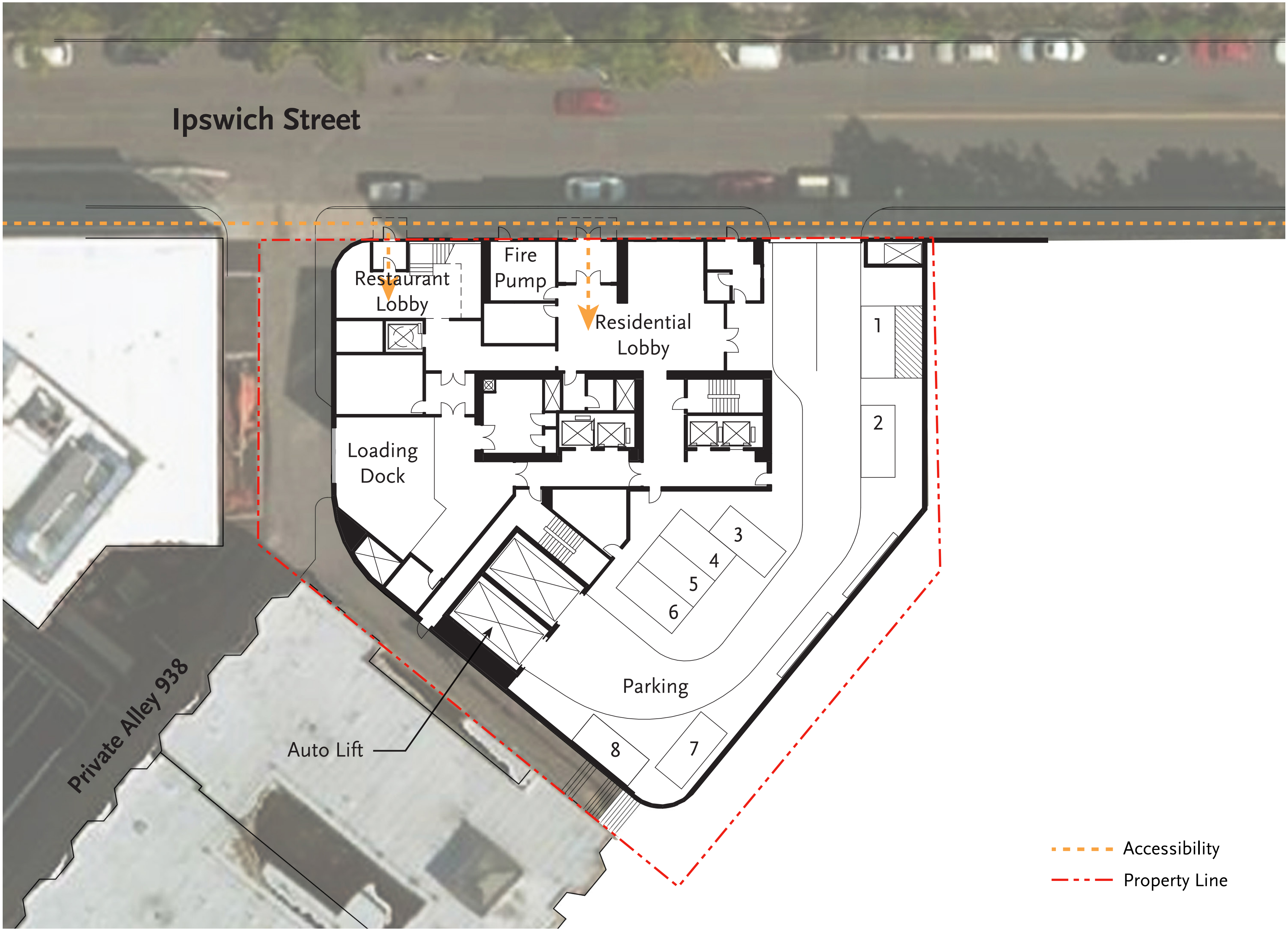


2 Charlesgate West Boston, Massachusetts

Figure x-x

Accessibility Diagram_Ipswich Lobby Level (EL 14' - 0")

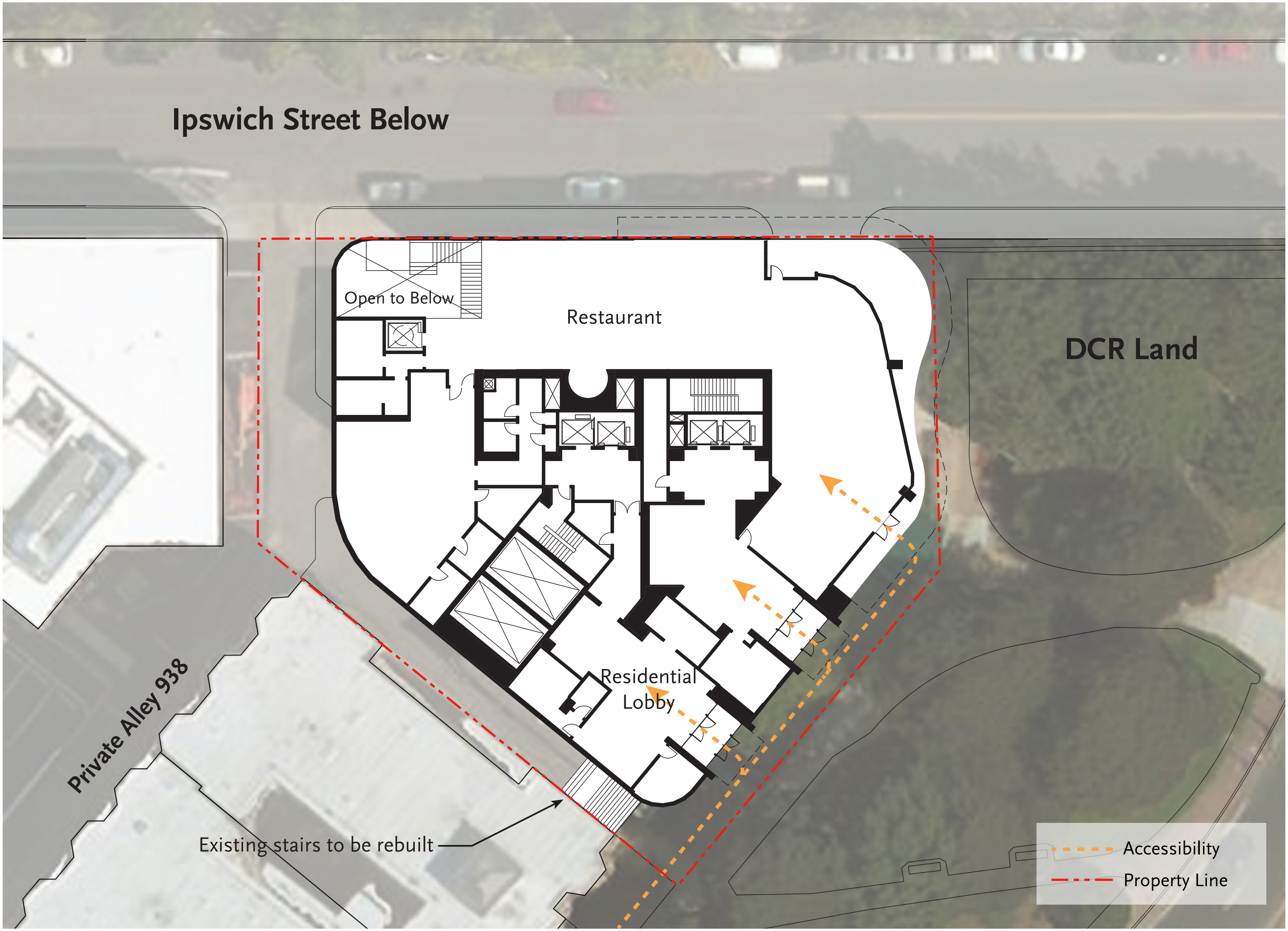
ELKUS MANFREDI ARCHITECTS



2 Charlesgate West Boston, Massachusetts

Figure x-x

Neighborhood Accessibility Diagram_Ipswich Lobby Level (EL 14' - 0")



2 Charlesgate West Boston, Massachusetts

Figure x-x
Neighborhood Accessibility Diagram_Boylston Lobby Level (EL 28' - 0")