JANUARY 31, 2017

The Back Bay/ South End Gateway Project

DRAFT ENVIRONMENTAL IMPACT REPORT/ DRAFT PROJECT IMPACT REPORT

VOLUME I



PREPARED BY

vhb

SUBMITTED TO
Executive Office of Energy and Environmental Affairs
Massachusetts Environmental Policy Act Office
Boston Planning & Development Agency

SUBMITTED BY
BP Hancock LLC

THROUGH ITS AFFILIATE
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Arup
Haley & Aldrich
Rowan William Davies and Irwin Inc.
Jensen Hughes
Nutter, McClennen, & Fish
Feldman Land Surveyors

The Back Bay/ South End Gateway Project

Boston, Massachusetts

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January 31, 2017

Table of Contents

DEIR/DPIR – Volume I

Chapter 1: Project Description

1.1 Project Overview 1-1
1.2 Site Context and Existing Conditions 1-3
1.3 Status of State and City Review 1-5
1.4 Project Description 1-6
1.5 Summary of Project Benefits 1-14
1.6 Regulatory Context 1-19
1.7 Agency Coordination/Community Outreach 1-23
1.8 Development Team 1-24
1.9 Legal Information 1-26

Chapter 2: Alternatives Analysis

2.1 Summary of Earlier Alternatives 2-1
2.2 DEIR/DPIR Alternatives 2-2
2.3 Qualitative and Quantitative Comparison of Alternatives 2-4

Chapter 3: Urban Design

3.1 Summary of Key Findings and Benefits 3-1
3.2 Neighborhood Context 3-3
3.3 Planning Principles and Design Goals 3-5
3.4 Air Rights Parcels Urban Design Summary 3-6
3.5 Site Design 3-15

Chapter 4: Transportation and Parking

4.1 Introduction 4-1
4.2 Summary of Key Findings and Benefits 4-3
4.3 Existing Conditions Assessment 4-4
4.4 2023 Future Conditions Assessment: No-Build Conditions 4-28
4.5 Project Traffic 4-38
4.6 Future Conditions Assessment: Build Condition 4-50

4.7 Future Conditions Assessment: Build with Mitigation Condition 4-70
4.8 Access and Circulation 4-84
4.9 Parking 4-89
4.10 Transit Analysis 4-100
4.11 Bicycle Analysis 4-122
4.12 Pedestrian Analysis 4-124
4.13 Mitigation Measures 4-130

Chapter 5: Sustainability and Greenhouse Gas Emissions Assessment

5.1 Summary of Key Findings and Benefits 5-1
5.2 Regulatory Context 5-2
5.3 Sustainability/Green Building Design Approach 5-4
5.4 Greenhouse Gas Emissions Assessment 5-9
5.5 Climate Change Preparedness and Resiliency 5-28

Chapter 6: Environmental Protection

6.1 Summary of Key Findings and Benefits 6-1
6.2 Wind 6-3
6.3 Shadow 6-9
6.4 Daylight 6-13
6.5 Solar Glare 6-15
6.6 Air Quality 6-17
6.7 Noise Analysis 6-29
6.8 Groundwater 6-39
6.9 Hazardous Materials 6-40
6.10 Geotechnical 6-41
6.11 Temporary Construction Impacts 6-43

Chapter 7: Infrastructure

7.1 Introduction 7-1
7.2 Summary of Key Findings and Benefits 7-2
7.3 Regulatory Context 7-3
7.4 Stormwater Management 7-3
7.5 Sanitary Sewage 7-11
7.6 Domestic Water and Fire Protection 7-15
7.7 Private Utilities 7-19

Chapter 8: Historic Resources

8.1 Summary of Key Findings and Benefits 8-1
8.2 Historic Resources 8-2
8.3 Potential Impacts to Historic Resources 8-7
8.4 Regulatory Context 8-11

List of Tables

Table No.	Table Title	Page Number
1-1	Proposed Development Program	1-8
1-2	List of Anticipated Permits and Approvals	1-21
1-3	Development Team Contact Information	1-24
2-1	Quantitative Comparison of Project Alternatives	2-6
3-1	Pedestrian Realm Improvements by Project	3-18
3-2	Complete Streets Guidelines Recommended Streetscape Dimensions (Downtown Commercial Zone)	3-20
4-1	Proposed Development Program	4-2
4-2	Daily Traffic Volumes: Dartmouth Street, South of Stuart Street	4-8
4-3	Daily Traffic Volumes: Stuart Street, East of Dartmouth Street	4-9
4-4	Daily Traffic Volumes: Clarendon Street, South of Stuart Street	4-10
4-5	Existing Weekday Garage Occupancy (June 2015)	4-11
4-6	Transit Service Summary	4-13
4-7	Crash Summary (2010-2014)	4-19
4-8	Level of Service Criteria	4-21
4-9	2016 Existing Conditions Signalized Intersection Vehicle LOS Morning Peak Hour	4-22
4-10	2016 Existing Conditions Signalized Intersection Vehicle LOS Evening Peak Hour	4-23
4-11	2016 Existing Conditions Unsignalized Intersection Vehicle LOS Morning Peak Hour	4-24
4-12	2016 Existing Conditions Unsignalized Intersection Vehicle LOS Evening Peak Hour	4-24
4-13	Level of Service Criteria	4-27
4-14	Mainline Capacity Analysis Merge Sections LOS – Existing Conditions Morning Peak Hour	4-27
4-15	Mainline Capacity Analysis Merge Sections LOS – Existing Conditions Evening Peak Hour	4-28
4-16	2023 No-Build Base and Alternate Condition Signalized Intersection Vehicle LOS Morning Peak Hour	4-32
4-17	2023 No-Build Base and Alternate Condition Signalized Intersection Vehicle LOS Evening Peak Hour	4-33

Table No.	Table Title	Page Number
4-18	2023 No-Build Base and Alternate Condition Unsignalized Intersection Vehicle LOS Morning Peak Hour	4-34
4-19	2023 No-Build Base and Alternate Condition Unsignalized Intersection Vehicle LOS Evening Peak Hour	4-35
4-20	Mainline Capacity Analysis Merge Sections LOS – No-Build Base Conditions Morning Peak Hour	4-37
4-21	Mainline Capacity Analysis Merge Sections LOS – No-Build Base Conditions Evening Peak Hour	4-37
4-22	Mainline Capacity Analysis Merge Sections LOS – No-Build Alternate Conditions Morning Peak Hour	4-38
4-23	Mainline Capacity Analysis Merge Sections LOS – No-Build Alternate Conditions Evening Peak Hour	4-38
4-24	ITE Land Use Code and Trip Rates	4-39
4-25	Unadjusted ITE Vehicle Trips (Base Condition)	4-40
4-26	Internal Person Trips – AM Peak Hour	4-41
4-27	Internal Person Trips – PM Peak Hour	4-41
4-28	Internal Person Trips – Daily	4-42
4-29	Mode Shares	4-43
4-30	Retail Pass-By Trips	4-43
4-31	Existing Garage West ITE Land Use Code and Trip Rates	4-44
4-32	Existing Land Uses Adjusted Trips (Garage West Parcel)	4-45
4-33a	Adjusted Project Trips (Base Scheme)	4-47
4-33b	Adjusted Project Trips (Alternate Scheme)	4-48
4-34	Regional Project Trip Distribution	4-50
4-35	2023 Build Base Condition (On-Ramp Open) Signalized Intersection Vehicle LOS Morning and Evening Peak Hour	4-52
4-36	2023 Build Alternate Condition (On-Ramp Closed) Signalized Intersection Vehicle LOS Morning and Evening Peak Hour	4-53
4-37	2023 Build Base Condition (On-Ramp Open) Unsignalized Intersection Vehicle LOS Morning and Evening Peak Hour	4-54
4-38	2023 Build Alternate Condition (On-Ramp Closed) Unsignalized Intersection Vehicle LOS Morning and Evening Peak Hour	4-55
4-39a	Signalized Intersection Level of Service – Morning Peak Hour	4-59
4-39b	Signalized Intersection Level of Service – Evening Peak Hour	4-63
4-39c	Unsignalized Intersection Level of Service – Morning Peak Hour	4-67

Table No.	Table Title	Page Number
4-39d	Unsignalized Intersection Level of Service – Evening Peak Hour	4-68
4-40	Mainline Capacity Analysis Merge Sections LOS – 2023 Build Base Conditions Morning Peak Hour (On-Ramp Open)	4-69
4-41	Mainline Capacity Analysis Merge Sections LOS – 2023 Build Base Conditions Evening Peak Hour (On-Ramp Closed)	4-69
4-42	Mainline Capacity Analysis Merge Sections LOS – 2023 Build Alternate Conditions Morning Peak Hour (On-Ramp Closed)	4-69
4-43	Mainline Capacity Analysis Merge Sections LOS – 2023 Build Alternate Conditions Evening Peak Hour (On-Ramp Closed)	4-70
4-44	Stuart Street/Clarendon Street Morning Peak Hour Mitigation	4-71
4-45	Stuart Street/Clarendon Street Morning Peak Hour Mitigation Signal Timing	4-72
4-46	Stuart Street/Arlington Street Morning Peak Hour Mitigation	4-73
4-47	Stuart Street/Arlington Street Evening Peak Hour Mitigation	4-74
4-48	Stuart Street/Arlington Street Evening Peak Hour Mitigation Signal Timing	4-74
4-49	Columbus Avenue/Dartmouth Street Morning Peak Hour Mitigation	4-75
4-50	Columbus Avenue/Dartmouth Street Evening Peak Hour Mitigation	4-76
4-51	Columbus Avenue/Clarendon Street Morning Peak Hour Mitigation	4-77
4-52	Columbus Avenue/Clarendon Street Evening Peak Hour Mitigation	4-78
4-53a	Stuart Street/Trinity Place Morning Peak Hour Mitigation	4-79
4-53b	Stuart Street/Trinity Place Evening Peak Hour Mitigation	4-79
4-54	Stuart Street/Trinity Place Morning and Evening Peak Hour Mitigation Signal Timing	4-80
4-55a	2023 Build Base Mitigated Condition Signalized Intersection Vehicle LOS and Delay Morning and Evening Peak Hour	4-83
4-55b	2023 Build Alternate Mitigated Condition Signalized Intersection Vehicle LOS and Delay Morning and Evening Peak Hour	4-83

Table No.	Table Title	Page Number
4-56	Daily Delivery/service vehicle Trip Generation Estimate	4-88
4-57	Boston Residential Parking Ratios	4-91
4-58	Proposed Parking Ratios	4-92
4-59a	Unadjusted ITE Parking Generation Estimate	4-94
4-59b	Adjusted ITE Parking Generation Estimate	4-95
4-60	ULI Shared Parking Ratios	4-95
4-61a	Weekday Parking Demand Inputs	4-97
4-61b	Weekday Parking Demand	4-97
4-62	Project Generated Transit Trips	4-101
4-63a	Transit Trip Distribution	4-101
4-63b	Number of Transit Trips by Mode	4-101
4-64	Transit Average Annual Growth Rates (2016-2023, CTPS)	4-102
4-65	2016 Existing Orange Line Utilization at Back Bay Station – OTP Policy Capacity	4-104
4-66	2023 No-Build Orange Line Utilization at Back Bay Station – OTP Policy Capacity	4-105
4-67	Orange Line Project Generated Transit Trips	4-105
4-68	2023 Build Orange Line Utilization at Back Bay Station – OTP Policy Capacity	4-106
4-69	V/C Summary at Back Bay Station – OTP Policy Capacity	4-106
4-70	2016 Existing Peak Hour MBTA Bus Frequency and Capacity around Back Bay Station	4-108
4-71	2016 Existing Peak Hour MBTA Bus Utilization around Back Bay Station	4-109
4-72	2023 No-Build Peak Hour MBTA Bus Utilization around Back Bay Station	4-111
4-73	Project-Generated Peak Hour Trips by MBTA Bus Route around Back Bay Station	4-112
4-74	2023 Build Peak Hour MBTA Bus Utilization around Back Bay Station	4-113
4-75	2016 Existing Estimated Peak Hour Commuter Rail Utilization at Back Bay Station	4-116
4-76	2023 No-Build Estimated Peak Hour Commuter Rail Utilization at Back Bay Station	4-118
4-77	Project-Generated Commuter Rail Trips at Back Bay Station	4-119
4-78	2023 Build Estimated Peak Hour Commuter Rail Utilization at Back Bay Station	4-120
4-79	Long-Term Bicycle Parking	4-123
4-80	Signalized Pedestrian Level of Service (PLOS)	4-126

Table No.	Table Title	Page Number
4-81a	Unsignalized Pedestrian Level of Service (PLOS) – AM Peak Hour	4-129
4-81b	Unsignalized Pedestrian Level of Service (PLOS) – PM Peak Hour	4-129
4-82	Phasing of Potential Transportation Mitigation	4-131
5-1	Garage West Office Key Model Assumptions	5-11
5-2	Garage West Office Stationary Source CO_2 Emissions (Base Scheme)	5-12
5-3	Garage East Residential Key Model Assumptions	5-13
5-4	Garage East Residential Stationary Source CO_2 Emissions	5-13
5-5	Station East Residential Key Model Assumptions	5-14
5-6	Station East Residential Stationary Source CO_2 Emissions	5-15
5-7	Station West Retail Key Model Assumptions	5-15
5-8	Station West Retail Stationary Source CO_2 Emissions	5-16
5-9	Stationary Source CO_2 Emissions for the Overall Project (Full Build)	5-17
5-10	Energy Use Intensity (kBtu/sf-yr)	5-17
5-11	Mobile Source CO_2 Emissions Analysis Results (tons per year)	5-26
5-12	Mobile Source CO_2 Emissions Mitigation Analysis Results (tons per year)	5-28
6-1	BPDA Mean Wind Criteria	6-6
6-2	Solar Azimuth and Altitude Data	6-10
6-3	National Ambient Air Quality Standards	6-18
6-4	Background Concentrations at Kenmore Square, Boston MA	6-19
6-5	Predicted Maximum 1-Hour CO Concentrations (Parts Per Million)	6-22
6-6	Predicted Maximum 8-Hour CO Concentrations (Parts Per Million)	6-23
6-7	Mesoscale Air Quality Analysis Results (kg/day)	6-27
6-8	Mitigation Analysis Results (kg/day)	6-28
6-9	Common Outdoor and Indoor Sound Levels	6-30
6-10	City of Boston Noise Standards by Zoning District	6-32
6-11	Existing Measured L90 Sound Levels, dB(A)	6-34
6-12	Future External Sound Levels, dB(A)	6-36
6-13	Traffic Data	6-37

Table No.	Table Title	Page Number
6-14	Train Information	6-38
6-15	Proposed Residential Unit Sound Levels, DNL	6-39
6-16	Subsurface Conditions	6-41
7-1	Project – Base Scheme: Net New Sewage Generation	7-13
7-2	Project – Alternate Scheme: Net New Sewage Generation	7-14
8-1	Historic Resources in the Vicinity of the Project Site	8-3
9-1	Phasing of potential Roadway Improvements	9-3
9-2	Pedestrian Realm Improvements by Project	9-5

List of Figures

Note: All report figures are provided at the end of each chapter/section.

Figure No.	Figure Title
1.1	Locus Map
1.2	Project Site Context
1.3a	Project Site Context – Aerial Photo Looking East
1.3b	Project Site Context – Aerial Photo Looking to the Northwest
1.4a	Existing Site Photographs – Garage West
1.4b	Existing Site Photographs – Garage East
1.4c	Existing Site Photographs – Station East
1.4d	Existing Site Photographs – Station West
1.5	Existing Conditions Survey
1.6a	Proposed Conditions Site Plan – Base Scheme
1.6b	Proposed Conditions Site Plan – Alternate Scheme
1.7a	PDA Boundary
1.7b	Parcel Ownership Diagram
1.7c	Parcel Ownership – Fee Ownership and Lease
1.7d	Development Parcel Diagram
2.1a	As-of-Right Zoning Alternative – Axon Looking Northeast
2.1b	As-of-Right Zoning Alternative – 20’ Parking Liner
2.2a	Third Residential Building Alternative – Axon Looking to the Southeast
2.2b	Third Residential Building Alternative – Floor Plans
2.3a	Daylight Analysis – As-of-Right Zoning Alternative – Center of Dartmouth Street
2.3b	Daylight Analysis – As-of-Right Zoning Alternative – Center of Stuart Street
2.3c	Daylight Analysis – As-of-Right Zoning Alternative – Center of Clarendon Street
2.4a	Daylight Analysis – Third Residential Building Alternative – Center of Dartmouth Street
2.4b	Daylight Analysis – Third Residential Building Alternative – Center of Stuart Street
2.4c	Daylight Analysis – Third Residential Building Alternative – Center of Clarendon Street
3.1	Neighborhood Context Plan
3.2a	View from Southwest Corridor Park - Existing Condition

3.2b	View from Southwest Corridor Park – Project Rendering Garage West Base Scheme
3.2c	View from Southwest Corridor Park – Project Rendering Garage West Alternate Scheme
3.2d	View from Dartmouth Street – Existing Condition
3.2e	View from Dartmouth Street – Project Rendering
3.2f	View from Stuart and Dartmouth Street - Existing Condition
3.2g	View from Stuart and Dartmouth Street - Project Rendering
3.2h	View from Stuart Street and Trinity Place – Existing Condition
3.2i	View from Stuart Street and Trinity Place – Project Rendering
3.2j	View from Columbus Avenue - Existing Condition
3.2k	View from Columbus Avenue - Project Rendering
3.2l	View from Clarendon Street - Existing Condition
3.2m	View from Clarendon Street - Project Rendering
3.3a	Overall Plan – Garage West Base Scheme – GW: Stuart Street Level / GE: Clarendon Street Level / SE: Platform Level / SW: Platform Level
3.3b	Overall Plan – Garage West Base Scheme – GW: Deck Level / GE: Level 2 / SE: Concourse Level / SW: Concourse Level
3.3c	Overall Plan – Garage West Base Scheme – GW: Levels 2-3 / GE: Levels 3-7 / SE: Level 2 / SW: Level 2
3.3d	Overall Plan – Garage West Base Scheme – GW: Levels 4-6 / GE: Levels 3-7 / SE: Level 3 / SW: Roof
3.3e	Overall Plan – Garage West Base Scheme – GW: Levels 8-11 / GE: Levels 10-27 / SE: Levels 4-34 / SW: Roof
3.3f	Overall Plan – Garage West Base Scheme – GW: Levels 18-21 / GE: Levels 10-27 / SE: Levels 4-34 / SW: Roof
3.3g	Overall Plan – Garage West Base Scheme – GW: 23-25 / GE: Levels 10-27 / SE: Levels 6-34 / SW: Roof
3.3h	Overall Plan – Garage West Base Scheme – GW: Level 26 / GE: Level 28 / SE: Level 35 / SW: Roof
3.3i	Overall Plan – Garage West Base Scheme – GW: Roof / GE: Roof / SE: Roof / SW: Roof
3.3j	Overall Plan – Garage West Alternate Scheme – GW: Stuart Street Level / GE: Clarendon Street Level / SE: Platform Level / SW: Platform Level
3.3k	Overall Plan – Garage West Alternate Scheme – GW: Deck Level / GE: Level 2 / SE: Concourse Level / SW: Concourse Level
3.3l	Overall Plan – Garage West Alternate Scheme – GW: Levels 2-3 / GE: Levels 3-7 / SE: Level 3 / SW: Level 2
3.3m	Overall Plan – Garage West Alternate Scheme – GW: Levels 4-6 / GE: Levels 3-7 / SE: Level 3 / SW: Roof
3.3n	Overall Plan – Garage West Alternate Scheme – GW: Levels 8-11 / GE: Levels 10-27 / SE: Levels 4-34 / SW: Roof

3.3o	Overall Plan – Garage West Alternate Scheme – GW: 18-21 / GE: Levels 10-27 / SE: Levels 4-34 / SW: Roof
3.3p	Overall Plan – Garage West Alternate Scheme – GW: Levels 23-25 / GE: Levels 10-27 / SE: Levels 4-34 / SW: Roof
3.3q	Overall Plan – Garage West Alternate Scheme – GW: Level 26 / GE: Level 28 / SE: Level 35 / SW: Roof
3.3r	Overall Plan – Garage West Alternate Scheme – GW: Roof / GE: Roof / SE: Roof / SW: Roof
3.3s	Overall Plan – Garage West Helix Alternate – GW: Stuart Street Level / GE: Clarendon Street Level / SE: Platform Level / SW: Platform Level
3.3t	Overall Plan – Garage West Helix Alternate – GW: Deck Level / GE: Level 2 / SE: Concourse Level / SW: Concourse Level
3.3u	Overall Plan – Garage West Helix Alternate – GW: Open to Below / Existing Garage: +45′ Level / GE: Levels 3-7 / SE: Open to Below / SW: Open to Below
3.4a	Garage West Base Scheme – Section A-A
3.4b	Garage West Base Scheme – Section B-B
3.4c	Garage West Base Scheme – Section C-C
3.4d	Garage West Base Scheme – Section D-D
3.4e	Garage West Alternate Scheme – Section A-A
3.4f	Garage West Alternate Scheme – Section D-D
3.5a	Elevation – Dartmouth Street
3.5b	Elevation – Stuart Street
3.5c	Elevation – Clarendon Street
3.6a	Project Massing – View 1 – View from Cambridge – Future Existing Condition
3.6b	Project Massing – View 1 – View from Cambridge – Future Proposed Condition
3.6c	Project Massing – View 2 – View from I-90 – Future Existing Condition
3.6d	Project Massing – View 2 – View from I-90 – Future Proposed Condition
3.6e	Project Massing – View 3 – View Clarendon and Tremont Streets – Future Existing Condition
3.6f	Project Massing – View 3 – View Clarendon and Tremont Streets – Future Proposed Condition
3.6g	Project Massing – View 4 – View from Dartmouth and Tremont Streets – Future Existing Condition
3.6h	Project Massing – View 4 – View from Dartmouth and Tremont Streets – Future Proposed Condition
3.6i	Project Massing – View 5 – View from Southwest Corridor – Future Existing Condition
3.6j	Project Massing – View 5 – View from Southwest Corridor – Future Proposed Condition
3.6k	Project Massing – Aerial looking to the Northeast – Future Existing Condition

3.6l	Project Massing – Aerial looking to the Northeast – Future Base Scheme
3.6m	Project Massing – Aerial looking to the Northeast – Future Alternate Scheme
3.6n	Project Massing – Aerial looking to the Southeast – Future Existing Condition
3.6o	Project Massing – Aerial looking to the Southeast – Future Base Scheme
3.6p	Project Massing – Aerial looking to the Southeast – Future Alternate Scheme
3.7a	Public Stuart Street Through-Block Connector – Existing Condition
3.7b	Public Stuart Street Through-Block Connector – Project Rendering
3.7c	Station West – View of Central Hall from Dartmouth Street Entry
3.7d	Station West – View of Potential Pedestrian Bridge
3.7e	Station West – View toward new Clarendon Street Entry at Station East
3.7f	Station West – View of Central Hall looking toward Dartmouth Street
3.8a	Overall Public Realm Improvements Plan
3.8b	Public Realm Improvements Plan – Station West
3.8c	Public Realm Improvements Plan – Garage West Base Scheme
3.8d	Public Realm Improvements Plan – Garage East
3.8e	Public Realm Improvements Plan – Station East
3.8f	Public Realm Improvements Plan – Garage West Alternate Scheme
3.9a	Circulation and Access Plan - Base Scheme
3.9b	Circulation and Access Plan - Alternate Scheme
4.1	Study Area Intersections
4.2a	2016 Existing Condition Vehicle Volumes - AM Peak Hour (8:00 AM – 9:00 AM)
4.2b	2016 Existing Condition Vehicle Volumes - PM Peak Hour (5:00 PM – 6:00 PM)
4.3a	Summary of Existing Off-Street Parking
4.3b	Existing On-Street Parking
4.3c	Existing Car-Share Locations
4.4a	Public Transportation
4.4b	Public Transportation Site Context - Rail
4.4c	Public Transportation Site Context - Bus
4.5a	Existing Bicycle Facilities Regional Context
4.5b	Existing Bicycle Parking Facilities
4.5c	2016 Existing Condition Bicycle Volumes - AM Peak Hour (8:00 AM – 9:00 AM)
4.5d	2016 Existing Condition Bicycle Volumes - PM Peak Hour (5:00 PM – 6:00 PM)
4.6a	2016 Existing Condition Pedestrian Volumes - AM Peak Hour (8:00 AM – 9:00 AM)

4.6b	2016 Existing Condition Pedestrian Volumes - PM Peak Hour (5:00 PM – 6:00 PM)
4.7a	2023 No-Build Base Condition Vehicle Volumes - AM Peak Hour (8:00 AM – 9:00 AM)
4.7b	2023 No-Build Base Condition Vehicle Volumes - PM Peak Hour (5:00 PM – 6:00 PM)
4.8a	2023 No-Build Alternate Condition (I-90 On-Ramp Closed) Trip Redistribution - AM (PM)
4.8b	2023 No-Build Alternate Condition (I-90 On-Ramp Closed) AM Peak Hour Trip Redistribution
4.8c	2023 No-Build Alternate Condition (I-90 On-Ramp Closed) PM Peak Hour Trip Redistribution
4.9a	2023 No-Build Alternate Condition Vehicle Volumes - AM Peak Hour (8:00 AM – 9:00 AM)
4.9b	2023 No-Build Alternate Condition Vehicle Volumes - PM Peak Hour (5:00 PM – 6:00 PM)
4.10	Regional Trip Distribution
4.11a	Project Generated Base Condition Vehicle Trips – AM Peak Hour (8:00 AM – 9:00 AM)
4.11b	Project Generated Base Condition Vehicle Trips – PM Peak Hour (5:00 PM – 6:00 PM)
4.12a	2023 Build Base Condition Vehicle Volumes - AM Peak Hour (8:00 AM – 9:00 AM)
4.12b	2023 Build Base Condition Vehicle Volumes - PM Peak Hour (5:00 PM – 6:00 PM)
4.13a	Project Generated Alternate Condition Vehicle Trips – AM Peak Hour (8:00 AM – 9:00 AM)
4.13b	Project Generated Alternate Condition Vehicle Trips – PM Peak Hour (5:00 PM – 6:00 PM)
4.14a	2023 Build Alternate Condition Vehicle Volumes - AM Peak Hour (8:00 AM – 9:00 AM)
4.14b	2023 Build Alternate Condition Vehicle Volumes - PM Peak Hour (5:00 PM – 6:00 PM)
4.15a	AM Peak Hour - Base Condition Intersection Level of Service
4.15b	PM Peak Hour - Base Condition Intersection Level of Service
4.15c	AM Peak Hour - Alternate Condition Intersection Level of Service
4.15d	PM Peak Hour - Alternate Condition Intersection Level of Service
4.16	Possible Transportation Mitigation
4.17a	AM Peak Hour – Base Condition Queues
4.17b	PM Peak Hour – Base Condition Queues
4.17c	AM Peak Hour – Alternate Condition Queues
4.17d	PM Peak Hour – Alternate Condition Queues

4.18a	Proposed Curbside Use – Base Scheme
4.18b	Proposed Curbside Use – Alternate Scheme
4.19	Proposed Typical Parking Plans
4.20a	Orange Line Outbound Load Profiles
4.20b	Orange Line Inbound Load Profiles
4.20c	Orange Line Platform Activity
4.21	MBTA Bus 39 Stop Relocation - Preferred Option
4.22	Proposed Bicycle Parking and Infrastructure Improvements
4.23	Transit Improvements
4.24	Plan of Trinity Place and St. James Avenue
5.1a	LEED Scorecard – Garage West
5.1b	LEED Scorecard – Garage East
5.1c	LEED Scorecard – Station East
5.1d	LEED Scorecard – Station West
6.1a	Pedestrian Wind Conditions – Mean Speed – No-Build
6.1b	Pedestrian Wind Conditions – Mean Speed – Base Scheme
6.1c	Pedestrian Wind Conditions – Mean Speed – Alternate Scheme
6.1d	Pedestrian Wind Conditions – Effective Gust – No-Build
6.1e	Pedestrian Wind Conditions – Effective Gust – Base Scheme
6.1f	Pedestrian Wind Conditions – Effective Gust – Alternate Scheme
6.1g	Pedestrian Wind Conditions – Category Change – No-Build to Base Scheme
6.1h	Pedestrian Wind Conditions – Category Change – No-Build to Alternative Scheme
6.2a	Shadow Studies – March 21st / September 21st (Equinoxes)
6.2b	Shadow Studies – June 21st (Solstice)
6.2c	Shadow Studies – December 21st (Solstice)
6.2e	Shadow Studies – Shading on Copley Square on October 21st
6.3a	Daylighting Analysis – Center of Dartmouth Street
6.3b	Daylighting Analysis – Center of Stuart Street
6.3c	Daylighting Analysis – Center of Clarendon Street
6.4a	Solar Glare Analysis: Pedestrian Locations
6.4b	Solar Glare Analysis: Driver Locations
6.4c	Solar Glare Analysis: Building Locations
6.5	Noise Receptor Locations
6.6	Air Quality Microscale Analysis Intersections
7.1a	Existing Storm Drainage Systems

7.1b Existing Storm Drainage Systems
7.2a Existing Sanitary Sewer Systems
7.2b Existing Sanitary Sewer Systems
7.3a Existing Water Supply Systems
7.3b Existing Water Supply Systems

8.1 Massachusetts Historical Commission Inventoried and Listed Properties (1/4 Mile Radius)
8.2a Pedestrian View #1 – View of the Project Site Looking West from Berkeley Street – Future Existing Condition
8.2b Pedestrian View #1 – View of the Project Site Looking West from Berkeley Street – Future Proposed Conditions
8.2c Pedestrian View #2 – View of the Project Site Looking North from Appleton Street – Future Existing Condition
8.2d Pedestrian View #2 – View of the Project Site Looking North from Appleton Street – Future Proposed Condition
8.2e Pedestrian View #3 – View of the Project Site Looking Northeast from Southwest Corridor Path – Future Existing Condition
8.2f Pedestrian View #3 – View of the Project Site Looking Northeast from Southwest Corridor Path – Future Proposed Condition
8.2g Pedestrian View #4 – View of the Project Site Looking East from Huntington Avenue – Future Existing Condition
8.2h Pedestrian View #4 – View of the Project Site Looking East from Huntington Avenue – Future Proposed Condition
8.2i Pedestrian View #5 – View of the Project Site Looking South from Copley Square – Future Existing Condition
8.2j Pedestrian View #5 – View of the Project Site Looking South from Copley Square – Future Proposed Condition
8.3a Historic Resource Shadow Study Key Plan
8.3b Historic Resource Shadow Study – Shading Impacts on Boston Public Library Central Library Exterior Façades
8.3c Historic Resource Shadow Study – Shading Impacts on New Old South Church Exterior Façades
8.3d Historic Resource Shadow Study – Shading Impacts on Trinity Church Exterior Façades
8.3e Historic Resource Shadow Study – Shading Impacts on the Youth's Companion Building Secondary Façade
8.3f Historic Resource Shadow Study – Shading Impacts on the YWCA Exterior Façades

1

Project Description

In accordance with the Massachusetts Environmental Policy Act ("MEPA") Massachusetts General Law ("MGL") Chapter 30, Section 61-62I and the regulations promulgated thereunder set forth in 301 CMR 11.00, and Article 80B of the City of Boston Zoning Code and Enabling Act (the "Code"), BP Hancock LLC, through its affiliate, Boston Properties Limited Partnership (the "Proponent"), respectfully submits this joint Draft Environmental Impact Report and Draft Project Impact Report ("DEIR/DPIR").

This chapter provides an overview of the Project history and existing site conditions, describes the Project and the Project Site, summarizes Project-related public benefits, and identifies the anticipated permits and approvals. This chapter also summarizes ongoing public agency and community outreach, identifies the development team and provides relevant legal information regarding the Proponent and the Project Site.

1.1 Project Overview

The Proponent is proposing a mixed-use redevelopment project encompassing four distinct sites and comprising up to approximately 1.26 million square feet, and consisting of a new office building with ground floor retail, two new residential buildings, and a one-story vertical retail expansion of the existing Massachusetts Bay Transportation Authority's ("MBTA") Back Bay/South End Station (the "Station"). The proposed Project will also result in the partial redevelopment of the existing 100 Clarendon Street Parking Garage (the "Garage"). This transformational development will deliver up to approximately 592,000 square feet of commercial office space, up to approximately 62,000 square feet of retail and restaurant space, and up to approximately 600 residential units in addition to project-related parking, loading and service uses (the "Project"). Notably, as certain components of the project are delivered, they will also create improved access to the existing Station.

Located primarily over active transportation infrastructure, including the I-90 Extension of the Massachusetts Turnpike (the "I-90") and the track and concourse levels of the Station, the Project is roughly bounded by Dartmouth Street to the west, Stuart Street and Trinity Place to the north, Trinity Place and Clarendon Street to the east, and the southern property line of the Station to the south (the "Project Site" or "Site"). The approximately 5.2-acre Project Site is shown in Figure 1.1, Figure 1.2a and Figures 1.3a-b.

The Proponent occupies and utilizes the majority of the Project Site pursuant to an existing Ground and Air Rights Lease with the Commonwealth of Massachusetts Department of Transportation ("MassDOT") (the "MassDOT Lease"). In addition, the

Proponent holds the fee interest in two terra-firma parcels which are also part of the Project Site and sit immediately adjacent to and partially under the northern façade of the Garage. See Figure 1.7c.The MassDOT lease authorizes four future ground and air rights development parcels as shown in Figure 1.7d in part over I-90 and the Station, and in part over a modest amount of terra firma (the "Air Rights Development Parcels"). The precise vertical and horizontal dimensions of the Air Rights Development Parcels will be finalized in consultation with MassDOT as the design of the Project is further advanced.

1.1.1 Project Vision

The Project is conceived as a holistic and transformative transit-oriented redevelopment centered around the Station. As shown on Figure 1.2, located a block from Copley Square and in proximity to some of Boston's most iconic architecture, including 200 Clarendon (formerly known as the John Hancock Tower), Trinity Church and the Boston Public Library, the Project offers a considerable opportunity to rejuvenate an underutilized urban site, transform the adjacent public realm, create an attractive and appealing place worthy of its prominent location and become an asset to the vibrant Back Bay and South End neighborhoods and the City as a whole. The Project will deliver world-class architecture, significant improvements to existing on-site transit infrastructure, first class office space, improved retail vitality and high quality residential space, contributing to the long term growth, and vitality of the City of Boston in an increasingly competitive national and international economic context.

By introducing a mix of uses in appropriate and carefully considered locations, the Project will reinforce the mixed-use character of the existing area, creating a sustainable development centered on an important transit node, and thereby encouraging the use of non-automotive means of transportation. Two of the proposed buildings flanking the Station are designed to interconnect with it and provide new public entrances to the Station and pedestrian-friendly accessible through-block connectors from both Clarendon and Stuart Streets, improving Station access, the transit customer experience, and permeability through the Project Site for the surrounding neighborhoods and businesses.

A critically important transit node in the City, the Station serves MBTA buses, Orange Line customers, regional commuters travelling on four different Commuter Rail lines, and longer range AMTRAK travelers from Washington, D.C., New York City and Chicago. As a result, the Station functions as a "front door" into Boston and the adjacent historic neighborhoods and, for many people, may be their first introduction to the City. Unfortunately, the Station has suffered from years of deferred maintenance, rendering it dirty, dim, and confusing to navigate. Its present condition creates an unwelcoming environment for commuters and visitors alike.

In response, and in parallel with the Proponent's efforts to develop the Air Rights Development Parcels, the Proponent agreed to pre-pay the rent on the existing 99-year MassDOT Lease in order to make funding available now to complete necessary Station repairs and upgrades in coordination with the MBTA. A portion of the rent

proceeds are to be used and were matched by the MBTA to complete a MBTA-led track-level ventilation system improvement project that will improve Station air quality and customer comfort. The remaining considerable funds are being used to complete a renovation of the Station Concourse, which is being managed and executed by the Proponent on behalf of the MBTA. In addition, as part of the MassDot Lease agreement, the Proponent agreed to assume property management responsibilities for the Station Concourse level for the duration of the lease term beginning in August 2015. These substantial and exceptional agreements are the product of a unique opportunity and represent a creative and successful strategy to form a public private partnership around an important civic and infrastructure asset. They demonstrate MassDOT's and the MBTA's strategic vision for maintaining and upgrading their assets and improving customer experience. They further demonstrate the Proponent's strong commitment to improving the neighborhoods and the Project Site, and continuing to be a strategic partner and advocate for Boston's transportation network.

Currently being designed by the Proponent and a consultant team in consultation with the MBTA and other rail services serving the Station, the Station Concourse renovation is anticipated to begin in 2018 in conjunction with the MBTA-led track-level ventilation project. Overall, the combined projects will dramatically improve the customer experience and improve Site operation and efficiency.

The Station Concourse project will achieve this by: restoring primary architectural elements to their original condition; improving access to and egress from the Station by doubling the number of entry doors; creating new and expanded waiting areas and substantially increased seating; introducing new lighting and improving passengers' thermal comfort; clarifying signage and wayfinding elements; completely renovating the public restrooms; and creating additional retail amenities for transit customers and the neighborhood, all the while preserving the Station's original architectural expression (the "Station Concourse Improvements"). Refer to Appendix E for a summary of this project's goals and a detailed description of the Station Concourse Improvements.

1.2 Site Context and Existing Conditions

1.2.1 Project Site and Existing Conditions

The Project Site is located between Boston's Back Bay and South End neighborhoods and in proximity to the Bay Village neighborhood. For over a century, it has been the site of significant transportation infrastructure, today principally consisting of a major Boston railroad station and a primary multi-lane interstate highway and associated on-ramp. The Station site, located on the southern side of the Project Site, originally housed a New York, New Haven and Hartford Railroad station which opened there in the 1880's. It was redeveloped several times until the current Station, designed by Kallmann, McKinnell and Wood, opened in 1987. The current Station structure occupies approximately half of the Station site between Dartmouth

and Clarendon Streets; the other portion of the Station site being occupied by a bus drop-off located on top of a concrete deck bridging the seven rail lines below.

The Project Site's significance as a transportation node was further reinforced with the construction of I-90 in the 1950's, which runs below the northern portion of the Site. The existing 8-story Garage, constructed primarily on air rights over I-90, was completed in 1970. Two concrete drums located on terra firma just to the north of I-90 serve as entry and exit points to the Garage. See Figures 1.4a-d for existing site photographs, Figure 1.5 for the Existing Conditions Plan, and Figures 1.6a-b for the Proposed Conditions Site Plans.

1.2.2 Project Site Context and Challenges to Redevelopment

The existing transportation uses, together with the Project Site's location on concrete decking above I-90 and the railroad tracks, create a form of physical isolation, separating the Site from the adjacent neighborhoods. Coupled with the limited on-site activity during non-rush hour periods, this isolated condition has the tendency to create a "blighted open area"[1] on the Project Site. The Project Site meets the criteria, of "blighted open area" and may appropriately be characterized as a "blighted open area", given: its location over both I-90 and active rail lines and transportation infrastructure which is isolated from the adjacent neighborhoods; its ownership, which is in both private and public ownership, again over and subject to intricate transportation infrastructure, the functionality of which will need to be maintained during construction; the lack of terra firma on the Site which makes construction highly costly and challenging and which, with the added burden of the active transportation system beneath, requires extensive and expensive foundation systems and complex and protracted construction management strategies.

Maintenance of infrastructure may also potentially be deferred due to the difficulty in accessing it. These factors and others support the use of the development tools of M.G.L. c. 121A and/or M.G.L. c. 121B to enable the Proponent to transform the Site into the Project, which unifies the urban fabric, is reflective of the City's urban design goals and beneficial to the adjacent abutters and neighborhoods.

Although redevelopment has occurred all around it, the majority of the Project Site has not been altered since its original development in the 1970's and 1980's. As described in further detail in Chapter 7, *Infrastructure*, the engineering challenges resulting from the impact of I-90, the Station, the Orange Line, and the commuter and passenger rail lines, all of which traverse the Project Site, limit its development potential and require extensive and expensive foundation systems and complex and

[1] According to relevant Massachusetts law and regulation, specifically including M.G.L c. 121A and M.G.L. c. 121B, a "blighted open area" is defined as " *a predominately open area which is detrimental to the safety, health, morals, welfare or sound growth of a community because it is unduly costly to develop it soundly through the ordinary operation of private enterprise by reason of the existence of ledge, rock, unsuitable soil, or other physical conditions, or by reason of the need for unduly expensive excavation, fill or grading, or by reason of the need for unduly expensive foundations ….or for unduly expensive measures incident to building around or over rights of way through the area, or for otherwise making the area appropriate for sound development, or by reason of obsolete, inappropriate or otherwise faulty platting or subdivision, deterioration of site improvements or facilities, division of the area by rights of way, diversity of ownership of plots, or inadequacy of transportation facilities or other utilities, ….*"

protracted construction management strategies. Accordingly, the Proponent may explore the possibility of utilizing urban redevelopment mechanisms, approvals or funding established pursuant to M.G.L. Chapter 121A and 121B for tax stabilization and title clearing purposes and/or I-Cubed funding for infrastructure updates.

Despite the major financial, engineering and logistical challenges, the Project Site is uniquely situated in the heart of one of Boston's most significant cultural and mixed-use downtown areas. The Project offers a unique opportunity to animate and dramatically improve an existing important city block and to help connect the Back Bay, South End and Bay Village neighborhoods, to both the Project Site and each other, creating an inviting and seamless urban fabric.

The Proponent is genuinely committed to creating intelligent transit-oriented development and has a record of successfully executing projects on or adjacent to significant urban public transit nodes including: The Prudential Center; The Hub on Causeway; Kendall Center in Kendall Square; Times Square Tower in New York City; and Salesforce Tower in San Francisco.

1.2.3 I-90 On-Ramp

Located beneath the Garage, the Project Site also contains a westbound on-ramp to I-90 (the "On-Ramp") which is accessed from Clarendon Street by way of a MassDOT-controlled service road. Independent of the Project proposed by the Proponent, MassDOT is studying the safety and utility of this On-Ramp and is considering its potential closure in close coordination with Federal Highway Authority ("FHWA") and the Boston Transportation Department ("BTD").

In response to the potential On-Ramp closure, the Proponent has prepared two development schemes for the affected portion of the Project. Both schemes have nearly identical development programs and, therefore, have functionally identical anticipated environmental impacts. The potential On-Ramp closure as well as the two alternate development schemes and their potential impacts and benefits are further described in Section 1.4, Chapter 3, *Urban Design,* and Chapter 4, *Transportation and Parking*. The Proponent is working with MassDOT, the City of Boston, and the community to fully consider the potential impacts and benefits of the On-Ramp closure on the Project.

1.3 Status of State and City Review

On March 29, 2016, the Proponent submitted a Project Notification Form ("PNF") to the Boston Redevelopment Authority now doing business as the Boston Planning and Development Agency ("BPDA"). This filing initiated a 30-day public comment period, which was extended with the Proponent's agreement, and ultimately closed on June 17, 2016. The BPDA reviewed the PNF pursuant to the Code and issued a Scoping Determination on the PNF that required the filing of a DPIR on August 30, 2016.

On April 15, 2016, in accordance with MEPA, the Proponent submitted an Environmental Notification Form ("ENF") that initiated a 20-day public comment period, which was also extended by the Proponent, to be coterminous with the PNF public comment period described above. On June 24, 2016, MEPA issued a Certificate on the ENF that required the filing of a DEIR.

This combined DEIR/DPIR addresses the scopes presented in the Secretary's Certificate (MEPA) and the BPDA Scoping Determination. In addition, it responds to the many public comments received on the ENF and PNF and included as part of the Secretary's Certificate and the BPDA Scoping Determination. A detailed response to all agency and public comments received can be found in Chapter 10, *ENF Response Response to Comments,* and Chapter 11, *PNF Response to Comments*. Copies of the Secretary's Certificate and the BPDA Scoping Determination can be found in Appendix B and Appendix C respectively.

1.4 Project Description

As described above and shown in Figure 1.7c, the Proponent occupies and utilizes a majority of the Project Site pursuant to the MassDOT Lease, which authorizes future air rights development and subdivides the Project Site into four Air Rights Development Parcels as illustrated in Figure 1.7d. These Air Rights Development Parcels include adjacent terra firma controlled by the Proponent, creating the following four parcels: Garage West, Garage East, Station East and Station West. Consistent with this parcelization, the Project has been planned and designed as four distinct and severable but interconnected components as shown in Figures 3.2a-m and described as follows and in Chapter 3, *Urban Design*:

› **Garage West Parcel**, located at the corner of Dartmouth and Stuart Streets, includes the demolition of the westernmost Garage entry drum and a portion of the existing Garage and the construction of a new 26-story building containing a new entrance and pedestrian connection to the Station from Stuart Street, up to approximately 592,000 square feet[2] of commercial office space, up to approximately 26,500 square feet of ground floor retail fronting on Dartmouth and Stuart Streets, and the reconstruction of approximately 200,000 gross square feet of the Garage. The reconfigured Garage will contain parking spaces to serve all uses in the Project as described further in Chapter 4, *Transportation and Parking*.

  The potential closure of the On-Ramp, as described above, primarily affects the Garage West Parcel and, therefore, two alternate development schemes have

[2] Unless labeled otherwise, all areas provided herein are described in gross floor area as such term is used in the definition of "Floor Area Ratio" in the Code; therefore, such areas specifically exclude floor area devoted to garage use, whether or not in the basement of a building or serving residential uses, mechanical equipment, storage, service and loading areas, and areas serving as access to, egress from or use by public transit services, including pedestrian bridge connections providing access to such public transit services, whether directly or indirectly as part of the overall Project. Please note that given the fact that the majority of the Project Site is on and over air rights, it is not possible to reconstruct parking spaces beneath one or more of the buildings, and thus this filing and PDA No.2 as amended will expressly exclude the square footage allocated to such parking for the purposes of calculating FAR.

been prepared by the Proponent. The first assumes the On-Ramp will remain open and functioning as it does today (the "Garage West Base Scheme") and the second assumes, as an outcome of the MassDOT study, the On-Ramp will be closed (the "Garage West Alternate Scheme"). These alternatives are reviewed in detail in Chapter 3, *Urban Design,* and Chapter 4, *Transportation and Parking*.

With the demolition of the existing Garage entry and exit drums (described above and below), a replacement Garage exit will be necessary to avoid negative traffic impacts to the surrounding neighborhoods as further described in Chapter 4, *Transportation and Parking*. The location of the new Garage exit is dependent on whether or not the On-Ramp remains open and the two possible alternative locations are described in detail in Chapter 3, *Urban Design*.

› **Garage East Parcel**, located on Clarendon Street, involves the demolition of the easternmost Garage exit drum and the construction of a new 28-story residential building containing up to approximately 240 units and up to approximately 222,000 square feet along the eastern end of the Garage, which will remain. Irrespective of the potential On-Ramp closure, it is anticipated that the existing vehicular access from Clarendon Street which passes under the Garage will remain, and therefore, only one scheme is presented for this parcel.

Station East Parcel, located on the existing bus drop-off along Clarendon Street, involves the relocation of the terminus of Bus 39 and the removal of the existing MBTA ventilation tower, subject to MBTA approval, in order to construct a new 35-story residential building containing a new entrance and pedestrian connection to the Station from Clarendon Street, up to approximately 360 units and up to approximately 382,000 square feet of residential space, and up to approximately 5,000 square feet of ground and second floor retail space. In addition, with the construction of the Station East Parcel, the Project includes the creation of a new approximately 11,000 square foot public plaza off Clarendon Street and the addition of a new redundant elevator to the Orange Line adjacent to the existing elevator within the Station. The possible reactivation of the Commuter Rail head house located on the south side of Columbus Avenue in order to provide redundant elevators to Tracks 1/3 and Track 2, if determined to be feasible, is also contemplated as part of the development of the Station East Parcel.

› **Station West Parcel**, located on Dartmouth Street above the existing Station Concourse, involves the vertical expansion of the Station, creating up to approximately 30,000 square feet of additional retail opportunities to serve both transit customers and the adjacent neighborhoods. In coordination with the separate Station Concourse Improvements project described above, the Project adds a single level of retail space on either side of the Station's central hall connected to the Station Concourse below (previously referred to in the ENF and PNF as the "Station West Base Scheme"). In addition, with the construction of the Station West Parcel, the Project includes the relocation and expansion of the existing pedestrian crosswalk and the upgrading of the open space in front of the Station to create a welcoming an inviting public plaza at the terminus of the Southwest Corridor Park.

1.4.1 Proposed Development Program

Development Program

The proposed development program is provided in Table 1-1 below:

Table 1-1 Proposed Development Program

	Garage West (base)	Garage West (alternate)	Garage East	Station East	Station West
Lot Area	68,846	68,846	52,966	38,413	64,676
Total (SF)[1]	606,400	618,400	222,100	387,000	30,000
Height (FT) [2]	365	365	305	400	42
# Stories	26	26	28	35	1
Office (SF)	582,600	591,900	-	-	-
Retail (SF)	23,800	26,500	-	5,100	30,000
Residential (SF)	-	-	222,100	381,900	-
Residential Units	-	-	240	360	-
Garage (SF)[3]	207,770	205,620	-	-	-
Parking (Spaces)	Up to 2,013 spaces to be provided Site-wide under all alternatives				
FAR[4]	8.81	8.98	4.19	10.07	0.46
FAR Total (across all sites): 5.53[5]					

1 Unless labeled otherwise, all areas provided herein are described in gross floor area as such term is used in the definition of "Floor Area Ratio" in the Code; therefore, such areas specifically exclude floor area devoted to garage use, whether or not in the basement of a building or serving residential uses, mechanical equipment, storage, service and loading areas, and areas serving as access to, egress from or use by public transit services, including pedestrian bridge connections providing access to such public transit services, whether directly or indirectly as part of the overall Project. Please note that given the fact that the majority of the Project Site is on and over air rights, it is not possible to reconstruct parking spaces beneath one or more of the buildings, and thus this filing and PDA No.2 as amended will expressly exclude the square footage allocated to such parking for the purposes of calculating FAR.

2 Notwithstanding the definition of "Building Height" set forth in the Code, with respect to each of the Air Rights Development Parcels, the following shall be the "grade" for each: (i) Garage West: 20'-6" BCB; (ii) Garage East: 19'-2" BCB; (iii) Station East: 31'-6" BCB; (iv) Station West: 29'-2" BCB; and the "Building Height" shall be the vertical distance from said "grade" to the top of the structure of the last occupied floor; Provided further that any elevator penthouse, stairway bulkhead or any other roof structure built for the purpose of accessing a roof deck or roof terrace as well as the said roof decks and roof terraces and other roof top amenities themselves, shall be excluded from the calculation of building height under the PDA.

3 Garage areas are provided in gross square feet, and represent only the areas of the reconstructed parking Garage.

4 Floor Area Ratio.

5 FAR Total provided is for Base Scheme only. FAR total for Alternate Schemes is 5.59.

1.4.2 Project Refinements since ENF and PNF Filings

Since the ENF and PNF filings, the Proponent has modified the Project in certain ways to incorporate feedback received from City and State Agencies as well as the community. In addition, dimensional refinements have been made as a result of ongoing and customary design evolution as summarized below.

› **Development Program and Building Dimensions:**

- **Garage East Parcel:** minor design evolutions have been made to conform the building's floorplate to typical residential unit dimensions, resulting in a modest overall increase of about 8,000 square feet, taking the total building size to approximately 222,000 square feet. In addition, amenity space has now been located on the building's top floor and is considered in establishing the building's maximum zoning height of 305 feet. The actual overall height of the building has not changed and there are no increased shadow impacts.
- **Station East Parcel:** in response to comments received regarding the desire for public open space, the Proponent and the development team have made concerted efforts to accommodate an approximately 11,000 square foot public plaza along Clarendon Street to be delivered with the Station East Parcel. Despite the significant challenges involved in landing foundations for air rights development and accommodating the multiple ground floor uses, the development team has maximized available space to create a dynamic and inviting public plaza that connects to the Frieda Garcia Park, the Station and the Southwest Corridor Park. In addition to providing an area of pause in the surrounding urban fabric and contributing to the City's network of open spaces, the plaza is designed to give priority to the pedestrian and movement along Clarendon Street, while still accommodating an indispensable protected vehicular drop-off and service access.

  To accommodate these plan enhancements, the Station East building has been shifted to the west, which required a minor reconfiguration of the proposed new Orange Line access. As shown in Figure 3.3b, a new stair to the Orange Line platform is proposed off the Clarendon Street plaza, and a redundant Orange Line elevator is proposed adjacent to the existing Orange Line elevator located in the Station Concourse, providing a reliable location for elevator access and doubling the level of elevator service. Both the stair and redundant elevator are anticipated to be delivered with the development of the Station East Parcel.

  As a result of shifting the Station East building to the west, the location and relationship of structural elements was modified to accommodate the existing foundations, resulting in a slightly larger floorplate for the residential building. This modification is reflected in a modest overall increase of approximately 10,000 square feet, taking the total building size to approximately 387,000 square feet. In addition, amenity space located on the building's top floor is now considered in establishing the building's maximum zoning height of 400 feet. The actual overall height of the building has not changed and there are no increased shadow impacts.

- **Station West Parcel** in response to agency and community feedback, the Proponent has elected to abandon the Station West Alternate Scheme presented in the ENF and PNF. This scheme contemplated the addition of two levels of retail above the existing Station Concourse, including one level that spanned over the central Station Hall. By reducing the retail expansion to a single story on either side of the central Station Hall and reducing the height of that one-story addition by four (4) feet, the Project addresses concerns raised on preserving the primary architectural intent of the original Kallmann, McKinnell and Wood structure. In addition, the footprint of the one-story addition has been reduced on the north side to produce a more marketable retail space. The design includes skylights in order to allow natural light to continue to enter the Station from the south and north.

1.4.3 Building Design Overview

The Project proposes a vibrant mixed-use development that combines high-quality sustainable architecture with a design that complements the urban fabric at multiple scales – city, district and street level. Given its location between Back Bay, South End and Bay Village, the Project will reinforce Boston's "high spine" planning strategy, which was developed to preserve the character of the City's historic neighborhoods by concentrating growth between them and using that new development to stitch those neighborhoods together into a continuous urban fabric. The Project is designed to address the city scale of the high spine with distinct structures, but also the district scale by being highly responsive to the vision and planning goals of the Stuart Street Planning Study and the recently-enacted Stuart Street District Zoning, particularly the height and density guidelines. At the pedestrian scale, the Project will produce a vibrant street-level experience and provide two new Station entances and through-block connections, simultaneously creating porosity through the Site while knitting together the Back Bay, South End and Bay Village neighborhoods. Furthermore, the Project incorporates specific design strategies to limit wind and shadow impacts on sidewalks and nearby public open spaces, such as Copley Square, the Southwest Corridor Park and Frieda Garcia Park, preserving and even improving the quality of the pedestrian experience. Refer to Chapter 3, *Urban Design,* for more details on the Project's design approach and supporting Project plans and renderings.

1.4.4 Public Realm Improvements

The design strategy for the Project Site focuses on creating pedestrian-oriented streets and sidewalks and reimagining the Site as a 21st century multi-modal transit hub, offering convenient rail and bus access, as well as direct connections to bicycle accommodations, ride share and taxis. The public realm around the Site will be significantly upgraded to provide a number of conveniences and amenities including new sidewalks, street lighting, street trees and landscaping, street furniture and other public amenities along Dartmouth, Stuart and Clarendon Streets, consistent with the BTD's Complete Streets Guidelines. In addition, inviting public plazas are

planned at the station entrances along Dartmouth and Clarendon Streets to accommodate not only pedestrian activity around the Station, but also to create connections to the Southwest Corridor Park to the west and the Frieda Garcia Park to the east. The effect is to strengthen the City's network of open spaces and provide additional amenities for the surrounding communities. Refer to Chapter 3, *Urban Design,* for additional detail.

1.4.5 Site Access and Loading

The Project Site benefits from strong connections with I-90 to and from the west and is significantly influenced by the overall prevailing one-way street circulation in this part of Back Bay and the South End. As described above, the entry and exit drums will be eliminated to allow for the development of the Garage West and Garage East Parcels, but the existing full service Garage driveway on Clarendon Street will remain, providing a right-in, right-out connection to Clarendon Street. This driveway presently functions as the main entry and, therefore, traffic patterns will not be substantially affected by the elimination of the entry drum. For those exiting to points south and east, this driveway will continue to offer the most convenient exit. In addition, for those exiting to points north and west, the Project will provide a new exit from the Garage in order to maintain convenient access to I-90 westbound and avoid adverse traffic impacts to the surrounding neighborhoods. The location of the new Garage exit is dependent upon the outcome of the potential On-Ramp closure, and will be either onto Dartmouth Street or onto Trinity Place. Either location will provide easy access to the Huntington Avenue and Arlington Street I-90 on-ramps for those travelling west and to Stuart Street for those bound for Storrow Drive and points north.

The Project Site also benefits from its adjacency to the Station and provides excellent connections to local and regional public transportation networks. The Station serves as a local Boston hub for regional AMTRAK service, providing connections to NYC, Washington D.C. and Chicago. Four Commuter Rail lines can be boarded at the Station making connections to South Station in downtown Boston to south and southwest regions of Massachusetts, extending to Rhode Island. The Orange Line runs through the Station, providing local rail service from Oak Grove in Malden to Forest Hills in Jamaica Plain with connections to the Green Line and northern Commuter Rail service at North Station, the Blue Line at State Street and the Red Line at Downtown Crossing. The Site also offers access to local and express MBTA bus routes with stops along Dartmouth, Clarendon and Stuart Streets. The Project Site is also within a quarter-mile of Copley Square station, providing transit access to the Green Line and additional local and express MBTA bus routes.

All Project loading and service functions will be located internal to the Site with access off Stuart or Clarendon Streets. The Garage West Parcel's loading dock is located on Trinity Place at the rear of the building and will be accessed from Stuart Street or Clarendon Street via the MassDOT-controlled service road. Service and loading for the Garage East Parcel will be located at the rear of the building accessed from Clarendon Street via the MassDOT-controlled service road. The

service and loading facility for the Station East and Station West Parcels is a combined facility located on the southern side of the Station East Parcel with access off of Clarendon Street via a new driveway loop. This facility will also serve the existing Station and the retailers in the Station Concourse. See Figures 3.9a-b.

1.4.6 Parking

Vehicle Parking

All vehicular parking for the Project will be accommodated on-site in the redeveloped Garage. The Project will require the partial demolition and reconstruction of the westernmost portion of the Garage in order to accommodate the development of the Garage West Parcel and minor modifications will be made to accommodate structural components of the Garage East Parcel. In its reconstructed state, there will be no net increase in the amount of parking provided, as the Project-related parking needs can be accommodated within the Garage's existing capacity. The Garage will provide up to the existing permitted capacity of 2,013 spaces, with up to 576 spaces permitted for public use. The Garage will continue to provide conveniently located spaces for car sharing services including Zipcar and Enterprise CarShare as well as Avis rental car services. Preferential parking locations will be reserved for Low Emission Fuel Efficient ("LEFE") vehicles and carpool/vanpool vehicles and electric car-charging stations will be provided.

The Project will leverage its strong transit-oriented location and will implement a comprehensive package of Transportation Demand Management ("TDM") strategies to reduce auto trips and parking demand. Refer to Chapter 4, *Transportation and Parking*, for further details on the Project's parking program and TDM plan.

Bicycle Parking

The Project will provide a variety of bicycle parking options for employees, residents and visitors of the Site. Short-term, outdoor bicycle parking will be provided throughout the Site, focused on locations near the Station and retail entrances. With the delivery of the Station East Parcel, a new Hubway station is proposed on the Clarendon Street plaza near the Station entrance. Long-term, covered and secure bicycle parking will be provided in four bike rooms located throughout the Site. The four secure rooms will provide up to approximately 484 spaces for employees and residents of the Project. Each parcel will have a designated and convenient bike room.

Refer to Chapter 4, *Transportation and Parking*, for further details of the Project's bicycle parking plan.

1.4.7 Route 39 Bus Terminus

The Proponent has been working with the MBTA on the relocation of the Route 39 bus terminus that will occur in conjunction with the development of the Station East Parcel. A preferred option was identified and evaluated by MBTA Service Planning

and deemed to be desirable because it does not significantly impact riders' experience and has the largest travel time savings, which is anticipated to improve headways and thereby increase customer satisfaction and ridership on Route 39. The preferred option reroutes Bus 39 around Copley Square and provides a bus stop at the existing St. James Street stop, easily accessible from the Station. The preferred option reduces overall route travel time and better aligns the route with the Green Line and other existing bus routes at the St. James Street stop. No relocation of the Route 39 terminus is anticipated until the Station East Parcel is actually developed. Refer to Chapter 4, *Transportation and Parking*, for further details.

1.4.8 Anticipated Project Schedule/Phasing

Four Parcel Approach to Severable Project Phases

The Proponent has undertaked a comprehensive review of the Project's impacts in accordance with MEPA and Article 80B of the Code, so that these impacts can best be evaluated and mitigated. As described in greater detail in Chapter 6, *Environmental Protection,* the impacts analysis has been completed and major discretionary permits for the Project will be obtained in one comprehensive review process on both the state and City level, so that the entirety of the Project at full build may be evaluated. As noted above in Section 1.4 the Proponent contemplates the development of the Project in as many as four (4) Air Rights Development Parcels, containing a mix of uses, each a "Project Component" for the purposes of this Project review. Each of these Air Rights Development Parcels may, in the future, be owned and developed by individual developers who will separately execute the required City agreements, abide by the relevant City and State approval and permit requirements, and obtain the requisite certifications of consistency and/or compliance as the case may be when subsequent developers will be deemed to be sucessors in interest to the Proponent for purposes of this DEIR/DPIR and abide by the obligations set forth herin. After the major discretionary permits for the Project have been obtained, the development of each of these Air Rights Development Parcels as a distinct Project Component may proceed as the Proponent (which term shall include each and every successor(s) in interest to the original Proponent) in its sole discretion determines is appropriate due to market conditions or other factors.

Summary and Evaluation of Phasing Scenarios

The Project is designed to accommodate a variety of phasing scenarios, while allowing the development to progress in a thoughtful and responsible manner. Essentially, each Project Component has the ability to be developed independently of the others and the mix of both commercial and residential uses allows the Project to remain responsive to evolving market conditions. The flexibility of sequencing is critical to the Project's economic viability and, therefore, success.

If demand for commercial office space allows the Garage West Parcel to be developed first, it will provide a new Garage exit in anticipation of the future demolition of the exit drum that will be removed to accommodate the Garage East

residential building. In addition, a new through block connection from Stuart Street to the Station will be provided to enhance the pedestrian connection from the Site to Copley Square in anticipation of the relocation of the Bus 39 terminus associated with the development of the Station East residential building. Either the Garage East or Station East Parcels could be developed subsequently.

If demand for residential space is stronger than that for commercial space, either the Station East or the Garage East Parcels could be developed first. If the Station East Parcel is developed first, it can occur without impacting the operation of the Garage today. It will provide a new public plaza, Station entrance and redundant Station elevators and will require the relocation of the Bus 39 terminus as described above. If the Garage East Parcel is developed first, the Proponent would reverse the direction of the entry drum located on the Garage West Parcel so that it becomes an exit drum with access to Trinity Place. This would allow the Garage East Parcel to be developed without substantial disruption to existing traffic patterns.

Due to its relatively small size, it is anticipated that the retail development on the Station West Parcel will be delivered coincident with either the Garage West or Station East Parcels.

1.5 Summary of Project Benefits

The Project will substantially revitalize the Project Site and serve to integrate and connect the surrounding Back Bay, South End, and Bay Village historic neighborhoods through the creation of a vibrant, sustainable, mixed-use and transit-oriented development. The Project will deliver numerous public benefits, including considerable urban design, accessibility and public realm improvements, a mix of new housing and job opportunities, and new tax revenues.

Additional public benefits for the surrounding neighborhoods and the City of Boston are summarized in the following subsections and described in detail in the chapters that follow.

Urban Design and Public Realm

Improved Street and Pedestrian Environment –

- The Project will create a high-quality continuous street frontage activated by vibrant and engaging ground floor uses, such as retail and restaurant spaces, and residential and commercial building lobbies. Through the use of glass facades wherever possible, the Project will provide transparency and create an inviting and safe ground-level experience for pedestrians.
- The Project will provide a greatly improved street-level experience with the removal of the two existing concrete parking drums on the Garage West and East Parcels, the removal of a section of deck along Stuart Street, and the rationalization of the existing service and parking area located under the Garage at the rear of abutting properties along Stuart Street.

- The Project will provide a significantly upgraded streetscape on all parcels, including new sidewalks, street lighting, landscaping and other public amenities along Dartmouth, Stuart and Clarendon Streets, consistent with the BTD's Complete Streets guidelines.
- With the development of the Garage West Parcel, the Project will create a new Station entrance on Stuart Street and a new indoor, weather-protected accessible through-block connection to the Station from Stuart Street, flanked by new retail improvements, thus increasing neighborhood connectivity and improving public safety within the district.
- With the development of the Station East Parcel, the Project will create a new Station entrance on Clarendon Street and a new indoor, weather-protected accessible through-block connection to the Station from Clarendon Street, flanked by new retail improvements, thus increasing neighborhood connectivity and improving public safety within the district.
- With the development of the Station East Parcel, a new 11,000 square foot public plaza will be delivered off Clarendon Street, adding to the neighborhood's inventory of open space and creating connections to other area parks, including the Southwest Corridor Park and Freida Garcia Park.
- With the development of the Station West Parcel, the existing open space on Dartmouth Street will be improved to offer an attractive public plaza connected to an expanded and relocated crosswalk, dramatically improving the connection with the Southwest Corridor Park and creating a welcoming civic entrance to the Station.

Improved Accessibility –

- The Project will enhance accessibility throughout the Site by regrading sidewalk slopes where possible, providing generous sidewalk widths that meet or exceed BTD's Complete Street Guidelines, and delivering the aforementioned fully enclosed, accessible connections from Stuart and Clarendon Streets to the Station with the development of the Garage West and Station East Parcels, respectively.
- With the development of the Garage West Parcel, the Project will create a new accessible drop-off lane along Stuart Street, in proximity to the future new Station entrance.
- With the development of the Station East Parcel, the Project will create a new accessible drop-off lane serving both the Project and the Station, in proximity to the future new Station entrance.
- With the development of the Station East Parcel, accessibility to the Station will be significantly improved through the addition of redundant elevators to the MBTA Orange Line and Commuter Rail tracks 1/3 and 2, where feasible.
- With the development of the Station West Parcel, the Project will enlarge the Dartmouth Street crosswalk, significantly improving pedestrian safety and enhancing the link between the Station and the Southwest Corridor Park.

Architecture –

The Project proposes high quality architecture that is responsive to the surrounding context, while creating signature buildings that add to Boston's collection of progressive architecture.

The Project reinforces the urban "high spine" planning strategy, while designing the buildings to minimize wind and shadow impacts on surrounding neighborhood public space resources such as Copley Square, the Southwest Corridor Park, and Frieda Garcia Park.

Social and Economic

Housing and Job Creation –

- Provide a variety of new high-quality housing opportunities, in compliance with the applicable Inclusionary Development Policy of the City of Boston.
- Create approximately 2,500 construction jobs and approximately 3,200[3] permanent jobs across all four Air Rights Development Parcels.
- Contribute approximately $5,500,000 in housing linkage and $1,100,000 in jobs linkage payments in accordance with the terms and provisions of Section 80B-7 of the Code.

Enhanced Tax Revenues – Generate approximately $15.3 million annually in new real estate tax revenues for the City of Boston across all four Air Rights Development Parcels upon stabilization.[4]

Innovative Office Space – Provide innovative new workplace opportunities for a variety of business types.

Enhanced Retail Opportunities – Provide new and diverse retail opportunities for neighborhood residents, transit customers and the public at large.

Transit and Transportation

Transit Oriented Development – The Project exemplifies transit-oriented development by developing high density housing, retail and office uses above and adjacent to a multi-modal transit hub served by multiple public transportation services, including MBTA Commuter Rail, Orange Line and local bus routes, and AMTRAK, resulting in a high proportion of transit trips rather than vehicle trips.

Station Upgrades –

- As described above, with the development of the Garage West Parcel, the Project will deliver a new Station Entrance from Stuart Street linked to the Station via a

[3] This estimate has been reduced slightly from the ENF/PNF filing due to the elimination of approximately 30,000 square feet of retail space in the Station West Alternate Scheme.

[4] This estimate assumes stabilization of all four Project Components in 2022

through-block connector, providing transit customers an accessible and weather-protected path.

- With the development of the Garage West Parcel, a dedicated bus pull-off area will be provided adjacent to the new Station entrance, making commuter connections safer and more convenient.
- With the development of the Station East Parcel, the Project will deliver a new Station Entrance from Clarendon Street linked to the Station via a through-block connector, providing transit customers an accessible and weather-protected path.
- With the development of the Station East Parcel, a new public plaza serving as a forecourt to the new Station entrance will be delivered, reinforcing the civic nature of the new Station entrance.
- With the development of the Station East Parcel, the Project will deliver a new redundant elevator to the Orange Line adjacent to the existing elevator, doubling the existing capacity and increasing reliability for transit customers. New redundant elevators will also be delivered to Tracks 1/3 and Track 2, if determined to be feasible.
- With the development of the Station West Parcel, the existing Dartmouth Street crosswalk will be relocated and expanded to align with the future Station entrance, improving commuter safety and access to the Station.
- With the development of the Station West Parcel, the existing open space on Dartmouth Street will be enhanced to create an inviting public plaza that welcomes transit customers and reinforces the civic nature of the existing Station entrance.

MBTA Revenue - The Project-generated transit trips are estimated to contribute an additional approximately $4.6 to 5.8 million in annual revenue for the MBTA based on current fare levels.

Station Concourse Improvements – Through a separate but related project, the Proponent has begun making significant functional and aesthetic improvements to, and has assumed property management responsibilities of, the Station Concourse in an effort to dramatically improve customer experience, comfort, and safety.

Pedestrians – The Project will improve the pedestrian environment significantly through the enhancement of sidewalks in the vicinity of the Project site, the creation of new open space, and the introduction of new pedestrian connections including the new station entrances on Stuart and Clarendon Streets.

Bicycle Accomodations and Parking –

- The Project will incorporate bicycle accommodations in compliance with BTD's guidelines to encourage cycling and walking, as strong transportation modes.
- With the development of the Station East Parcel, the Project will locate a new Hubway station on the Clarendon Street plaza near the new Station Entrance.

Transportation Demand Management Program – The Project will implement a robust program of TDM strategies to take full advantage of its multiple mobility options and its synergy with the surrounding vibrant mixed-use neighborhoods.

No Net New Parking –

- The capture of internal trips between different uses will result in the reduction of vehicle trips and opportunities to limit parking through sharing of parking spaces for different users by time of day.
- Due to the measures cited above as well as the capacity of the existing Garage and potential modifications to its operations resulting from the Project, no new net parking is proposed as part of the Project.

Sustainability/Environmental

Sustainable and high-performance building strategies are at the core of the design for the Project.

Area Revitalization – The Project revitalizes an underutilized urban site, uses land efficiently by increasing density in immediate proximity to public transportation, and encourages the use of non-automotive modes of transportation.

LEED Certification – In addition to compliance with Article 37, the Project will certify each building under the Leadership in Energy and Environmental Design® ("LEED") Version 3 rating system which provides verification of green building design.

Resource Conservation –

- By utilizing sustainable design strategies, the Project will exceed code requirements for reducing energy and water consumption as well as minimize impacts to regional infrastructure and water resources.
- Based on preliminary building energy models, the Project will achieve an estimated 15.4 percent reduction in stationary source CO_2 emissions by reducing overall energy consumption by approximately 19.7 percent through the implementation of energy optimizing building design and systems. (Note, the percentages of energy use are different than emission reductions due to emissions conversion factors.)

Verification and Benchmarking – Monitoring and verification of ongoing energy and water performance will also be possible through the enrollment of each building in ENERGY STAR Portfolio manager, EnerNOC's Energy Intelligence Software (EIS) platform and the Proponent's own internal sustainability data management system.

Renewable Energy – The Proponent has investigated the feasibility of clean and renewable energy sources, including photovoltaic (PV) panels, solar thermal, wind turbines, and cogeneration, and found that cogeneration and roof PV may be cost-effective potential strategies, Refer to Section 5.4.3 for full details. The viability of implementing these systems will continue to be evaluated as the Project design develops.

Improved Wellness – Through a variety of design strategies, the Project will promote health and wellness, assist in improving indoor air quality, and reduce the urban heat island effect. The Project will provide improved pedestrian facilities and bicycle accommodations to support heathy alternate modes of transport.

Climate Resilience – The Project will integrate strategies that reduce vulnerability to future climate change impacts related to flooding, severe precipitation and extreme heat. Refer to Section 5.5 for more information.

Stormwater Management –

- The Project will implement Best Management Practices ("BMPs") to improve water quality, reduce runoff volumes, and reduce peak discharge rates of runoff in comparison to pre-development conditions.
- The Project's BMPs will remove phosphorous from stormwater runoff from the Project Site, in accordance with Boston Water and Sewer Commission ("BWSC") design guidelines for projects that discharge to the Charles River Watershed.
- Green, or vegetated, roof areas will mitigate heat island effect, provide quality views for workers and residents, help manage stormwater runoff, and extend the life of the roof materials.
- A groundwater recharge system will infiltrate clean stormwater runoff in accordance with the standards articulated by the Groundwater Conservation Overlay District requirements.

1.6 Regulatory Context

This section lists the anticipated permits and approvals as well as the local planning and regulatory controls applicable to the Project.

1.6.1 City of Boston Zoning

Stuart Street District Zoning

The majority of the Project Site is located within the Stuart Street District established in accordance with Article 48 of the Code and as set forth on Zoning Map 1S. According to Zoning Map 1S, this portion of the Project Site is located in Area 4 of the Stuart Street District , and in part within an area designated as a Planned Development Area ("PDA"). Specifically, this portion of the Project Site, and the site of the adjacent office building owned by the Proponent and known as and numbered 200 Clarendon Street are located within PDA No. 2, which was first established in July, 1968 as later amended in August, 1982.

Given a number of factors, including the scale and complexity of the Project, mix of uses, possible multiple ownerships, number of parcels, and timeframe for completion of construction and development contemplated, amending and restating PDA No. 2 is the most appropriate method to obtain the required zoning approval for the Project in accordance with the Code. The Development Plan for PDA No. 2, as further amended and restated, will set forth the relevant use,

dimensional and other requirements applicable to the development of the Project in full compliance with the Code, including any relief which may be required from any of the Overlay Districts described below. The Project as described herein is generally consistent with the planning goals and requirements which would otherwise be applicable to development in the Stuart Street District without the benefit of the PDA No. 2 which is operative here. The BPDA has indicated that this approach to project permitting is appropriate. PDA Plan approval of the Project in accordance with Article 80C will be coordinated with Large Project Review in accordance with Article 80B of the Code. See Figure 1.7a, PDA Boundary.

Given the location of the Project Site within Downtown Boston, as that term is understood in accordance with the provisions of Section 85-2 of the Code, and the partial demolition of the existing Garage, review of such demolition in accordance with the provisions of Article 85 of the Code may be required. The need for Article 85 review will be determined through consultation with Boston Landmarks Commission staff in accordance with the provisions of Section 85-5 of the Code. If such review is required, it will be coordinated with the Article 80B and 80C approvals required for the Project.

Community Commercial Zoning Subdistrict Zoning

A small triangular shaped piece of the Project Site, located near the intersection of Clarendon Street and Columbus Avenue and currently vacant, is within the Community Commercial ("CC") Zoning Subdistrict of the South End Neighborhood Zoning District established in accordance with Article 64 of the Code as set forth on Zoning Map 1P. This area will be rezoned and included within the PDA No. 2 as part of the Project.

Other

The entire Project Site is within the Groundwater Conservation Overlay District ("GCOD") and the Restricted Parking Overlay District ("RPOD").

1.6.2 City of Boston Zoning Code Article 80B, Large Project Review

Because the Project exceeds 50,000 square feet of gross floor area and is located in a downtown zoning district, it is subject to Large Project Review by the BPDA pursuant to Article 80B of the Code. The Large Project Review process was commenced by the filing of a Letter of Intent with the BPDA on December 29, 2015, a copy of which is was included in Appendix A of the PNF filed on March 29, 2016. Refer to Section 1.3 for more information on the status of City review.

1.6.3 Massachusetts Environmental Policy Act (MEPA)

The Project is subject to review pursuant to MEPA because the proposed development involves a land transfer from the Commonwealth in the form of the future MassDOT Air Rights Leases, requires one or more state agency permits and

exceeds review thresholds established under the MEPA implementing regulations (301 CMR 11.03). These thresholds are:

- 11.03(1)(b)6: May require approval in accordance with M.G.L. c. 121A of a New urban redevelopment project consisting of 100 or more dwelling units or 50,000 or more sf of non-residential space.
- 11.03(4) a: New discharge or Expansion in discharge to a sewer system of 100,000 or more gpd of sewage.
- 11.03(6)(a)6: Generation of 3,000 or more New adt on roadways providing access to a single location.
- 11.03(10)(b)1: Demolition of an exterior part of a structure listed in the Inventory of Historic and Archaeological Assets of the Commonwealth;

A concurrent review process is being undertaken in accordance with the MEPA M.G.L. c. 30, Sections 61-62I and the regulations promulgated thereunder set forth at 301 CMR 11.00. Refer to Section 1.3 for more information on the status of State review.

Public Benefits Determination

The Project Site is located in landlocked tidelands. Accordingly, a Public Benefits Determination for the Project will be requested from MEPA under 301 CMR 13.02. Refer to section 9.8.3, Request for a Public Benefits Determination.

1.6.4 List of Anticipated Permits and Approval

Table 1-2 lists the permits and approvals from federal, state and local governmental agencies, which are anticipated to be required for the Project. It is possible that only some of the permits and approvals identified below will be required, and also that there are other permits and approvals which will be identified in the course of approval of the Project.

TABLE 1-2 - LIST OF ANTICIPATED PERMITS AND APPROVALS

Agency/Department	Permit/Approval/Action
Federal	
Federal Aviation Administration	▪ Determinations of No Air Hazard to Air Navigation
U.S. Environmental Protection Agency	▪ NPDES[1] General Permit
Housing and Urban Development	▪ Community Development Block Grant (if requested)
U.S. Department of Transportation	▪ Transportation Infrastructure Finance & Innovation Act (if requested) ▪ Railroad Rehabilitation & Improvement Financing (if requested)
Commonwealth of Massachusetts	
Department of Transportation ("MassDOT")	▪ Indirect/Direct Access Permit ▪ Permit for Construction in accordance with M.G.L. c. 40, Section 54A (if required) ▪ MBTA approvals and/or consent (if required) ▪ Finalization and execution of Air Rights Lease(s)

Agency/Department	Permit/Approval/Action
Executive Office of Administration and Finance	▪ Approval of Infrastructure Investment Incentive (I-Cued) Program funding (in coordination with Mass Development and the City of Boston, if requested) ▪ District Improvement Financing (in coordination with Mass Development and the City of Boston, if requested)
Executive Office of Housing and Economic Development	▪ MassWorks Infrastructure Program (if requested)
Department of Public Safety	▪ Building Permits or Approvals (as required)
Department of Environmental Protection	▪ Fossil Fuel Utilization Permit ▪ Pre-Construction Notice
Department of Housing and Community Development	▪ Urban Center Housing – Tax Increment Financing (if requested)
Executive Office of Energy and Environmental Affairs (MEPA Office)	▪ Review under the Massachusetts Environmental Policy Act and Public Benefits Determination.
Massachusetts Historical Commission	▪ State Register Review, including Determination of No Adverse Effect or Memorandum of Agreement
MassHousing	▪ Workforce Housing Program (if requested)
Massachusetts Office of Business Development	▪ Economic Development Incentive Program (if requested)
Massachusetts Water Resources Authority	▪ Construction Dewatering Permit (if required) ▪ Temporary Construction Dewatering Permit (if required) ▪ Sewer Use Discharge Permit (if required)
Architectural Access Board	▪ Variance for existing sidewalk grades (if required)
City of Boston	
Boston Air Pollution Control Commission	▪ Parking Freeze Permit Modification
Boston Assessing Department	▪ Negotiation of 6A Contract (if requested)
Boston Civic Design Commission	▪ Review and approval pursuant to Article 28 of the Code
Boston Public Safety Commission, Committee on Licenses	▪ Parking Garage Permit ▪ License for Storage of Inflammables
Boston Fire Department	▪ Fuel storage permit
Boston Inspectional Services Department	▪ Building Permit (Long Form) ▪ Demolition Permit ▪ Certificate of Occupancy
Boston Landmarks Commission	▪ Review pursuant to Article 85 of the Code for demolition of the Garage (if required)
Boston Parks and Recreation Commission	▪ Commission approval, in accordance with City Ordinance 7-4.112 (if required)
Boston Public Improvement Commission/ Department of Public Works	▪ License for installation of groundwater monitoring wells ▪ Specific Repair Approvals ▪ Discontinuances (if required) ▪ Permit for sign, awning, hood, canopy, or marquee, or other incursion over public right of way (as required) ▪ Street Layout (as required) ▪ Street and Sidewalk Occupation Permits ▪ Tieback/Earth Excavation Approvals (if required)

Agency/Department	Permit/Approval/Action
	▪ Air Rights Discontinuance (if required)
Boston Planning and Development Agency	▪ Review under Article 80, including Large Project Review, as required pursuant to Article 80B of the Code and PDA Review, as required pursuant to Article 80C of the Code ▪ Green Building Report(s) and Resiliency Checklist(s) as Part of Article 80 Review ▪ Development Impact Project Agreement(s) pursuant to Article 80B-7 of the Code ▪ Cooperation Agreement(s) ▪ Affordable Housing Agreement(s) ▪ Boston Residents Construction Employment Plan Agreement(s) ▪ Certification(s) of Consistency and Compliance ▪ M.G.L. c. 121A approval and attendant documentation and agreements (as required) ▪ M.G.L. c. 121B approval (as required)
Office of Jobs and Community Service	▪ Permanent Employment Agreement
Boston Employment Commission	▪ Boston Residents Construction Employment Plan Agreement(s)
Boston Public Works Department	▪ Curb Cut Permits ▪ Street Opening Permits ▪ Street/Sidewalk Occupancy Permits
Boston Transportation Department	▪ Transportation Access Plan Agreement ▪ Review and approval of a Construction Management Plan
Boston Water and Sewer Commission	▪ Sewer Extension/Connection Permit ▪ Sewer Use Discharge Permit ▪ Site Plan Approval ▪ Consent to construction or easement (if required) ▪ Temporary Construction Dewatering Permit ▪ Cross Connection/Backflow Prevention Approval
Boston Zoning Commission	▪ Zoning Approval subject to BPDA recommendation and approval under Article 80C of the Code, including PDA Modification Approval
Boston Zoning Board of Appeal	▪ Zoning and Building Code variance(s) (if required)
Boston Departments & Agencies	▪ Comments for Article 80B review ▪ General Operational Permits, Licenses (if required)

1. NPDES National Pollutant Discharge Elimination System
2. Because the Project Site is located within 100 feet of Frieda Garcia Park and the Southwest Corridor
3. PDA Planned Development Area

1.7 Agency Coordination/Community Outreach

Prior to and subsequent to filing the ENF and PNF, the Proponent has met with and received feedback from multiple State and City Agencies, elected officials, abutters and community stakeholders, including but not limited to MassDOT, the MBTA, MEPA, the Executive Office of Energy and Environmental Affairs, the BPDA, Boston

Civic Design Commission, BTD, Boston Water and Sewer Commission, the Groundwater Trust, the Disability Commission, the Public Improvements Commission, the Neighborhood Association of the Back Bay and the St. Botolph Neighborhood Association. During the public comment period, public meetings were held in both the Back Bay and South End neighborhoods on May 11 and 18, 2016, respectively. BPDA and MEPA scoping sessions, as well as a preliminary hearing to introduce the Project to the Boston Civic Design Commission were also held in May, all of which are open to the public.

A Citizens Advisory Committee ("CAC") comprised of 17 members representing a wide range of community groups was formed by the City of Boston in consultation with MassDOT, elected officials and community groups to review the Project's impacts and provide recommendations for mitigation. A total of 8 CAC meetings were held during the review of the PNF on a regular basis from April to October 2016, including 2 tours of the Project Site. These meetings covered a diverse range of topics including urban design and public realm, environmental impacts such as traffic, wind and shadow, sustainability, and the related Station Concourse Improvements and MBTA ventilation project.

The Proponent looks forward to continuing to receive feedback on the Project and continuing to coordinate with the relevant agencies, abutters and community representatives as the Project progresses.

1.8 Development Team

Table 1-3 identifies the members of the design and consulting team (the "Project Team") and provides their primary contact information.

Table 1-3 – Development Team Contact Information

DEVELOPMENT TEAM CONTACT INFORMATION	
Proponent	BP Hancock LLC c/o Boston Properties Limited Partnership 800 Boylston Street, Suite 1900 Boston, MA 02199 617.236.3300 *Contact: Michael Cantalupa, Melissa Schrock*
Legal Counsel	Nutter McClennen & Fish Seaport West 155 Seaport Boulevard Boston, MA 02210 617.439.2000 *Contact: Mary Marshall, James Ward*
Permitting & Transportation	VHB 99 High Street, 10th Floor Boston, MA 02110 617.728.7777 *Contact: Elizabeth Grob, Kyle Greaves*

Civil	WSP | Parsons Brinckerhoff 75 Arlington Street Boston, MA 02116 617.348.2950 *Contact: Andy Boyd*
Survey	Feldman Land Surveyors 112 Shawmut Avenue Boston, MA 02118 617.357.9740 *Contact: Paul Foley*
Sustainable Design	ARUP 955 Massachusetts Avenue Cambridge, MA 02139 617.864.2987 *Contact: Brian Swett*
Landscape Architecture	The Office of James Burnett 150 Staniford St #5, Boston, MA 02114 *Contact: Simon Beer*
Geotechnical Engineer & Environmental Engineer	Haley & Aldrich 465 Medford Street, Suite 2200 Boston, MA 02129 Tel: 617.886.7400 *Contact: Rebecca Higgins*
Residential Market Consultant	The Collaborative Companies 20 Park Plaza, Suite 833 Boston, MA 02116 617.236.0060 *Contact: Sue Hawkes*
Community Engagement	The Strategy Group 40 Court Street, 11th Floor Boston, MA 02108 617.263.3311 *Contact: Susan Tracy, David Newman*
Public Relations	Denterlein 3 Post Office Square, Suite 701 Boston, MA 02109 617.482.0042 *Contact: Geri Denterlein, Diana Pisciotta*
Code Compliance	JENSEN HUGHES 1661 Worcester Road, Suite 501 Framingham, MA 01701 508.620.8900 *Contact:* Eric H. Cote, PE
GARAGE WEST / GARAGE EAST / STATION EAST DEVELOPMENT TEAM	
Architect	Pelli Clarke Pelli Architects 322 8th Avenue 11th Floor New York, NY 10001 212.417.9496 *Contact: Rafael Pelli*

Structural Engineer	Magnusson Klemencic Associates 1301 Fifth Avenue, Suite 3200 Seattle, WA 98101 206.292.1200 *Contact: Ron Klemencic, Peter Somers* WSP | Parsons Brinckerhoff 75 Arlington Street Boston, MA 02116 617.348.2950 *Contact: Mohammad Haidar*
MEP Engineer	Bard, Rao + Athanas Consulting Engineers 10 Guest Street, 4th Floor Boston, MA 02135 617.254.0016 *Contact: Allan Ames, Kenneth Moore*
STATION WEST DEVELOPMENT TEAM	
Architect	Arrowstreet, Inc. 10 Post Office Square Boston, MA 02109 617.623.5555 *Contact: Jim Batchelor, Claes Andreasen*
Structural Engineer	McNamara Salvia 160 Federal Street, 5th Floor Boston, MA 02110 617.737.0040 *Contact: Adam McCarthy*
MEP Engineer	AHA Consulting Engineers, Inc. 700 Technology Square, Suite 402 Cambridge, MA 02139 781.372.3000 *Contact: Dan Campia*

1.9 Legal Information

1.9.1 Legal Judgments or Actions Pending Concerning the Proposed Project

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

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

The Proponent does not own any property which is in arrears on the payment of taxes due and owing to the City of Boston.

1.9.3 Site Control/Public Easements

The Project Site is owned in fee by each of the following: the Commonwealth of Massachusetts acting by and through MassDOT; the MBTA, and the Proponent. The conveyance by each of MassDOT's and the MBTA's interests in the Project Site to the Proponent to enable the development of each of the Air Rights Development Parcels is the subject of the MassDOT Lease, defined and described above. See Figure 1.7b, Parcel Ownership Diagram, Figure 1.7c, Fee Ownership and Lease and 1.7d, Development Parcel Diagram.

There are easements which provide for continued rail service and trackage rights within the Project Site. There is a water line easement from MassDOT to the City of Boston, acting by and through the BWSC, which affects a portion of the Project Site. These rights and easements to public or quasi-public parties will be observed and amended or modified as appropriate.

Others private parties have rights of passage, shared facilities and utilities, loading and parking on portions of the Project Site, which rights will be observed, amended or modified as appropriate to enable the Project to proceed.

1.9.4 Potential Public Funding Sources

As described above and in the chapters that follow, from an execution perspective, the air rights Project is both highly complex and costly due to the intrinsic engineering and logistical difficulties that accompany construction over existing and active transportation infrastructure and also highly ambitious in its goals to deliver myriad transit infrastructure, accessibility, and public realm improvements. The Proponent's focus on placemaking is evident in the Project's design, which is intended to create a seamless and integrated development by stitching three prominent and historic Boston neighborhoods together (Back Bay, South End and Bay Village), and delivering multiple public benefits to the existing Station, the surrounding neighborhoods, and the City of Boston. Due to the highly ambitious and complex nature of the Project in this regard, public financing may be required to defray certain engineering and infrastructure premiums and to enable the creation of all of the public benefits that are being proposed. At this time, no public funding has been sought, but as the Project develops, the Proponent may consider all appropriate forms of local, state and federal public financing to deliver the public goods associated with the Project. Possible sources are still being investigated by the Proponent for their potential applicability to the Project and if sought, would be the subject of appropriate public disclosures and/or processes at the time of application. These sources may include, but are not limited to the following:

› District Improvement Financing: This program is a form of tax increment financing commonly used at the City level to enable cities and towns to fund public works and infrastructure projects by allocating future real estate tax revenue generated from a proposed redevelopment or a defined district to paying down the subsidy. The district can consist of one or more parcels or lots of land, which need not be contiguous, or one or more buildings, which also

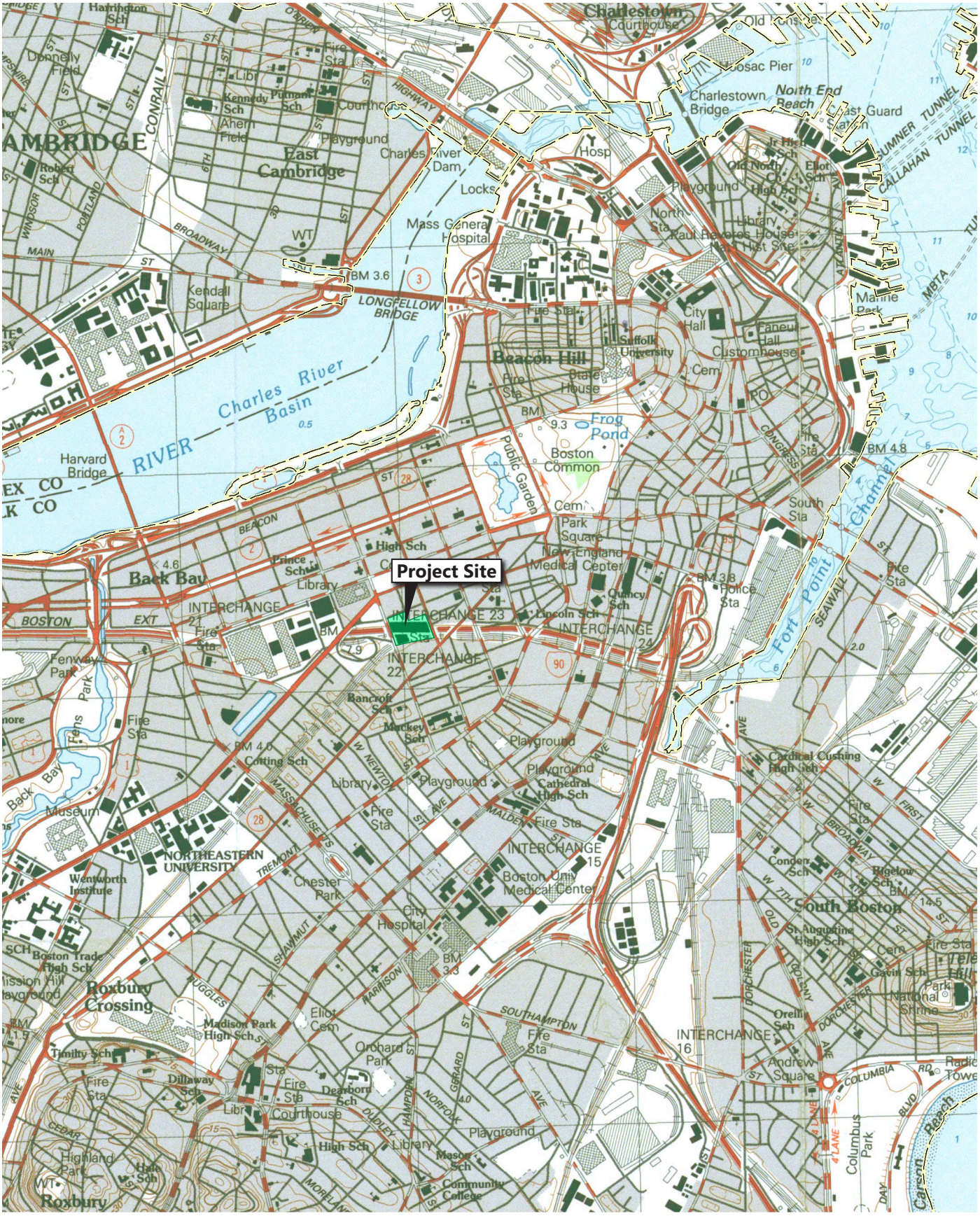
need not be contiguous. It is established through a public hearing process, and either a public or private entity can be designated to oversee the development plan and district. Various debt structures can be used depending on the specific needs of the project and time frames for debt service and project completion.

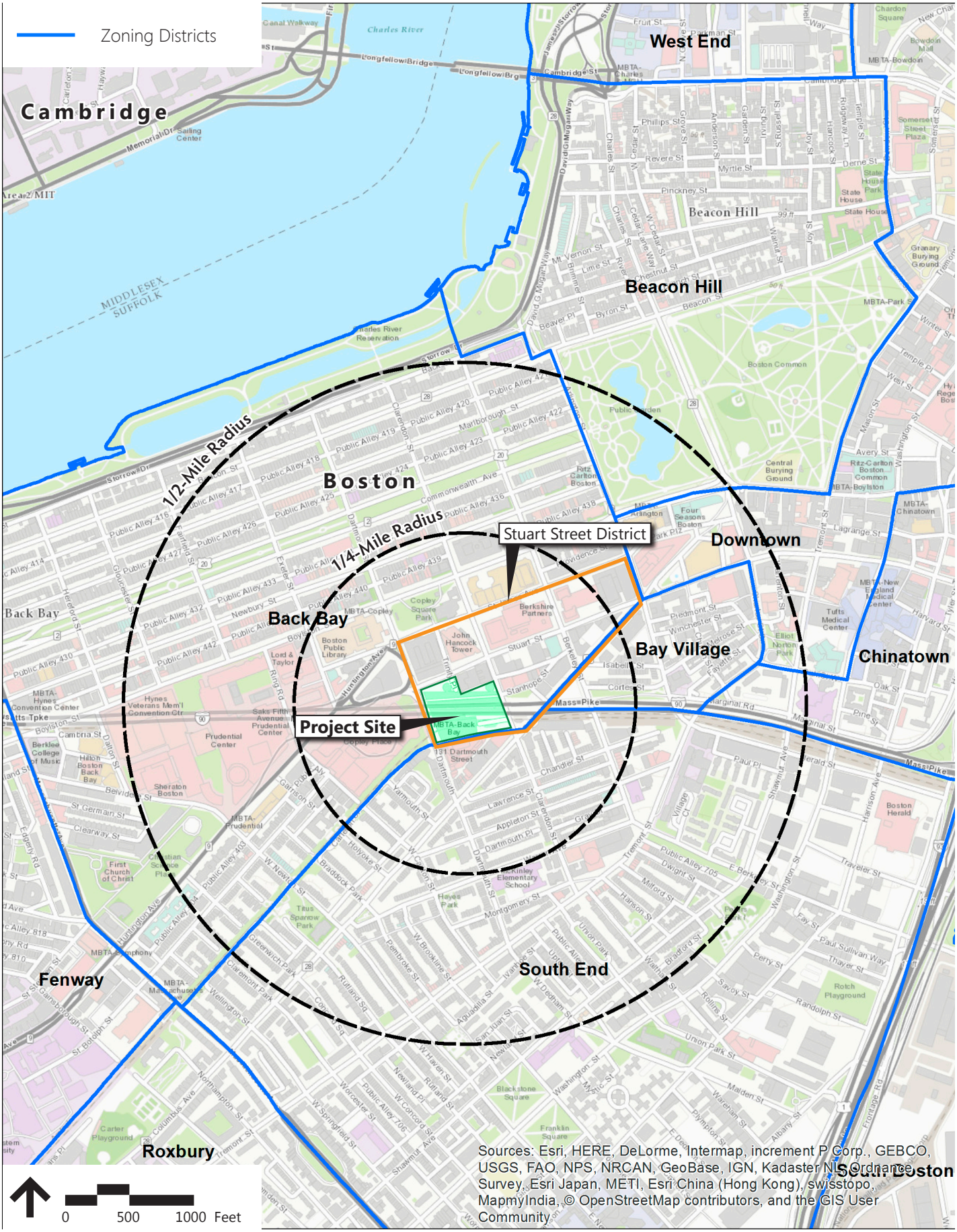
- I-Cubed (Infrastructure Investment Initiative): This program is a State-led initiative used to fund public infrastructure improvements through the generation of new State sales and income taxes that arise from private development, made possible only through significant investment in public infrastructure. Funding is generated via bonds that are issued by MassDevelopment following a stringent underwriting process. The debt service of the bonds is supported by future State income and sales tax generation resulting from new business and job creation. The public infrastructure improvements must fall between $10-50 million andthe project must be consistent with sustainable development principles and have projected annual state tax revenues that will be at least 1.5 times greater than the annual debt service. Several projects have utilized this program successfully to bring key transportation and infrastructure improvements to the City of Boston.
- MassWorks: The MassWorks Infrastructure Program is a grant, administered by the Executive Office of Housing and Economic Development and, awarded to cities and towns is used to help fund a range of infrastructure improvements designed to unlock local economic development priorities, job creation and public benefit that including transit oriented development (TOD) and the provision of affordable housing opportunities. Since 2011, the program has successfully invested more than $350 million in funding for over 180 projects.
- Economic Development Incentive Program (EDIP): This program is administered by the Massachusetts Office of Business Development and designed to stimulate business growth, foster job creation and attract and retain businesses by having companies enter agreements with the state and/or municipalities to hire workers in return for various types of tax relief. Most projects require the generation of significant out of state sales. For real estate, if a company makes a significant investment in a property that raises the assessed value, it can take advantage of Tax Increment Financing arrangements with municipalities to lower its annual property taxes.
- Transportation Infrastructure Finance & Innovation Act (TIFIA): This program is a Federal funding program that seeks to attract substantial private and other non-Federal co-investment in critical improvements to the nation's surface transportation system. Assistance comes in the form of low cost, flexible financing, loan guarantees and lines of credit. In order to qualify for TIFIA funding, the project must present transit-oriented improvements totaling $10M or more which seek to promote greater transit ridership, walkability and increased private investment.
- Railroad Rehabilitation & Improvement Financing (RRIF): This program is a Federal funding program that seeks to fund the improvement and development of railroad infrastructure through low-cost financing and Federal loan guarantees. An RRIF loan can be used to finance transit-oriented development that incorporates private investment, is located near (or functionally related) to a

passenger rail station and demonstrates new sources of revenue for the rail station through increased ridership, tenant lease payments or other revenue generation activities that support the cost.

- MassHousing – Workforce Housing Program: This program is a new, $100M fund set up to facilitate the creation of workforce housing, increasing rental housing opportunities for households earning 61%-120% of area median income (AMI) who may have incomes too high for subsidized housing but are priced out of affordable market rents as housing costs in Massachusetts continue to rise. The program provides up to $100,000 of subsidy per workforce housing unit in order to target the generation of 1,000 new units of workforce housing statewide and ensures workforce housing units will are deed restricted for an extended period of time, generally 30 years or longer.
- Urban Center Housing – Tax Increment Financing (UCH-TIF): This program, administered by DHCD authorizes cities and towns to promote housing and commercial development, including affordable housing, in commercial centers through tax increment financing. Eligible commercial centers are those areas used primarily for the sale of goods and services and with higher population density then the surrounding developed area. The tax financing allows a 20-year real estate tax exemption on the increased value of the property. The affordable housing component requires the developer to meet one of three thresholds: (i) 15% affordable units for families at or below 80% of AMI; (ii) 25% affordable for families at or below 110% of AMI; or (iii) in compliance with an existing inclusionary zoning ordinance or bylaw of city or town related to UCH-TIF agreements and affordable housing.
- Community Development Block Grant (CDBG): This program is administered through HUD to help cities and towns implement housing, community, and economic development projects that assist low and moderate-income residents, or that revitalize areas of slum or blight. Cities with over 50,000 residents receive funds directly from HUD to then give grants to eligible projects. Those projects may include housing rehabilitation or development, infrastructure, micro-enterprise and other business assistance, downtown or area revitalization, community/public facilities, and public social services. A private applicant can seek out CDBG funds in the City of Boston through the various agencies and departments that the City allocates its CDBG funds to for the purposes highlighted above.

As decribed above, given the Project's complexity and considerable proposed public goods to be delivered, the Proponent continues to explore the potential applicability of a variety of public funding sources which may include, but aren't limited to the list above. If public financing is sought, it would be the subject of appropriate public disclosures and/or processes at the time of application.


Project Site
Charlestown
Courthouse
Charlestown Bridge
North End Beach
East Cambridge
Charles River Dam
Mass General Hospital
Kendall Square
LONGFELLOW BRIDGE
Charles River Basin
RIVER
Harvard Bridge
Beacon Hill
Boston Common
Frog Pond
Public Garden
Back Bay
Fort Point Channel
SEAWALL
INTERCHANGE 21
INTERCHANGE 22
INTERCHANGE 23
INTERCHANGE 24
INTERCHANGE 15
INTERCHANGE 16
NORTHEASTERN UNIVERSITY
Roxbury Crossing
Roxbury
South Boston
Columbus Park
Carson Beach
Andrew Square
City Hall
South Sta
Boston Univ Medical Center
City Hospital
Chester Park
Orchard Park
Madison Park High Sch
Cardinal Cushing High Sch
Cathedral High Sch
Boston Common
Fenway Park
Back Bay Fens
Museum
Wentworth Institute
Boston Trade High Sch
Tobin Sch
Dillaway Sch
Dearborn Sch
Eliot Cem
Courthouse
Library
Fire Sta
High Sch
Community College
Mason Sch
Gavin Sch
Condon Sch
Bigelow Sch
Lincoln Sch
Quincy Sch
Prince Sch
Bancroft Sch
Mackey Sch
Cotting Sch
Kennedy Putnam Sch
Ahern Field
Donnelly Field
Robert Sch
Harrington Sch
Eliot Sch
Old North Church
Paul Revere House
Faneuil Hall
Customhouse
State House
Suffolk University
New England Medical Center
Police Sta
Marine Park
Playground
Cem
Park Square
Highland Park
Franklin Park
Orient Heights
Logan Airport
Revere Beach
Winthrop
Chelsea
Everett
Somerville
Cambridge
Boston
Brookline
Dorchester
Roxbury
Back Bay
Fenway
Kenmore
Allston
Brighton
Watertown
Newton
Medford
Malden
Revere



Source: ESRI World Topo Map



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Site Context
Aerial Photo Looking East

Figure 1.3a

Pelli Clarke Pelli Architects



Aerial Photo: Google Maps

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Site Context
Aerial Photo Looking To The Northwest

Figure 1.3b

Pelli Clarke Pelli Architects







Source (top photo): Bing Maps







Source (Top Photo): Bing Maps





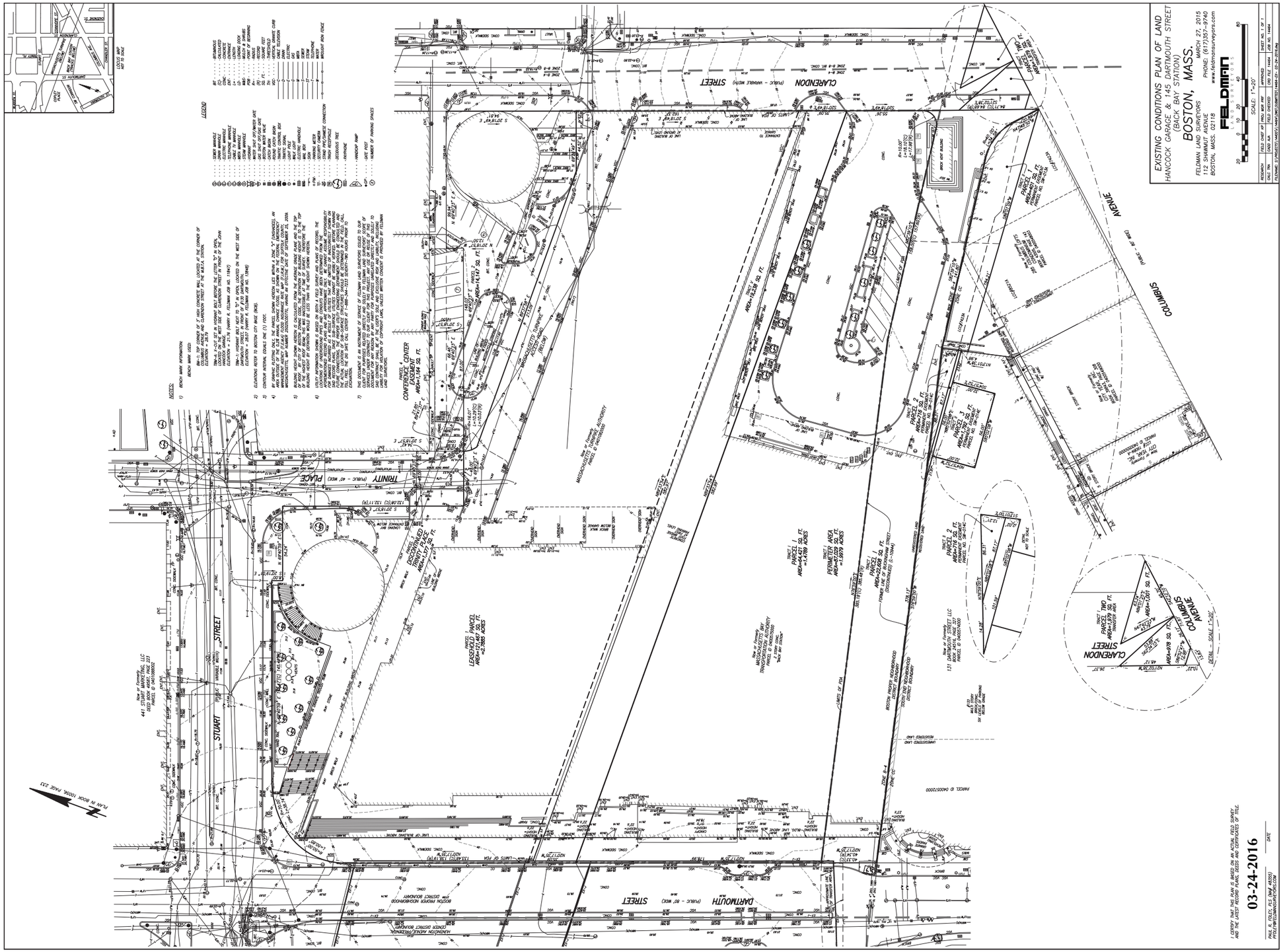


Source (Top Photo): Google Maps


SERVICE.
BACK BA
HAVE YOUR BACK.
SCHOOL BUS


Surprisingly
GOOD SERVICE.
ACK BAY, WE HAVE YOUR BACK.
TAXICAB 829-1222


WELCOME TO
BANKING REIMAGINED


EXISTING CONDITIONS PLAN OF LAND
HANCOCK GARAGE & 145 DARTMOUTH STREET
(BACK BAY STATION)
BOSTON, MASS.
MARCH 27, 2015
FELDMAN LAND SURVEYORS
112 SHAWMUT AVENUE
BOSTON, MASS. 02118
PHONE: (617)357-9740
www.feldmansurveyors.com
FELDMAN
LAND SURVEYORS
SCALE: 1"=20'
CLARENDON STREET (PUBLIC - VARIABLE WIDTH)
DARTMOUTH STREET (PUBLIC - 80' WIDE)
TRINITY PLACE (PUBLIC - 40' WIDE)
STUART STREET (PUBLIC - 80' WIDE)
COLUMBUS AVENUE (PUBLIC - 80' WIDE)
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PARCEL 1 AREA=42,521 SQ. FT. ±0.9761 ACRES
PARCEL 1 PERIMETER AREA=57,059 SQ. FT. ±1.3099 ACRES
PARCEL 1 AREA=2,688 SQ. FT.
PARCEL 2 AREA=718 SQ. FT.
PARCEL 1 AREA=1,001 SQ. FT.
PARCEL 2 AREA=478 SQ. FT.
PARCEL 1 AREA=10,228 SQ. FT.
PARCEL 2 AREA=718 SQ. FT.
PARCEL 3 AREA=728 SQ. FT.
PARCEL 4 AREA=1,001 SQ. FT.
PARCEL 5 AREA=478 SQ. FT.
PARCEL 6 AREA=1,001 SQ. FT.
PARCEL 7 AREA=478 SQ. FT.
PARCEL 8 AREA=1,001 SQ. FT.
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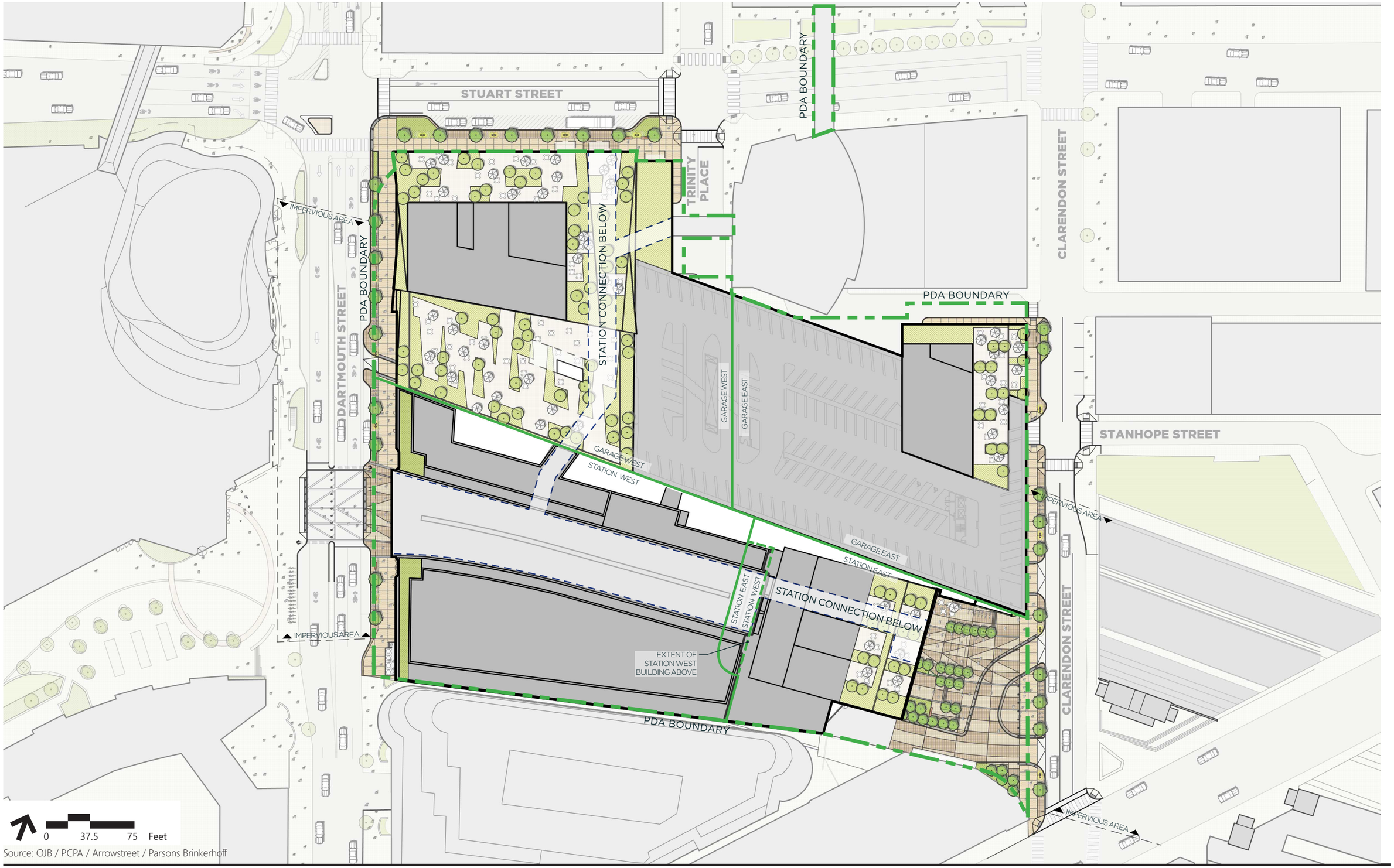
PARCEL 10 AREA=1,001 SQ. FT.
PARCEL 11 AREA=478 SQ. FT.
PARCEL



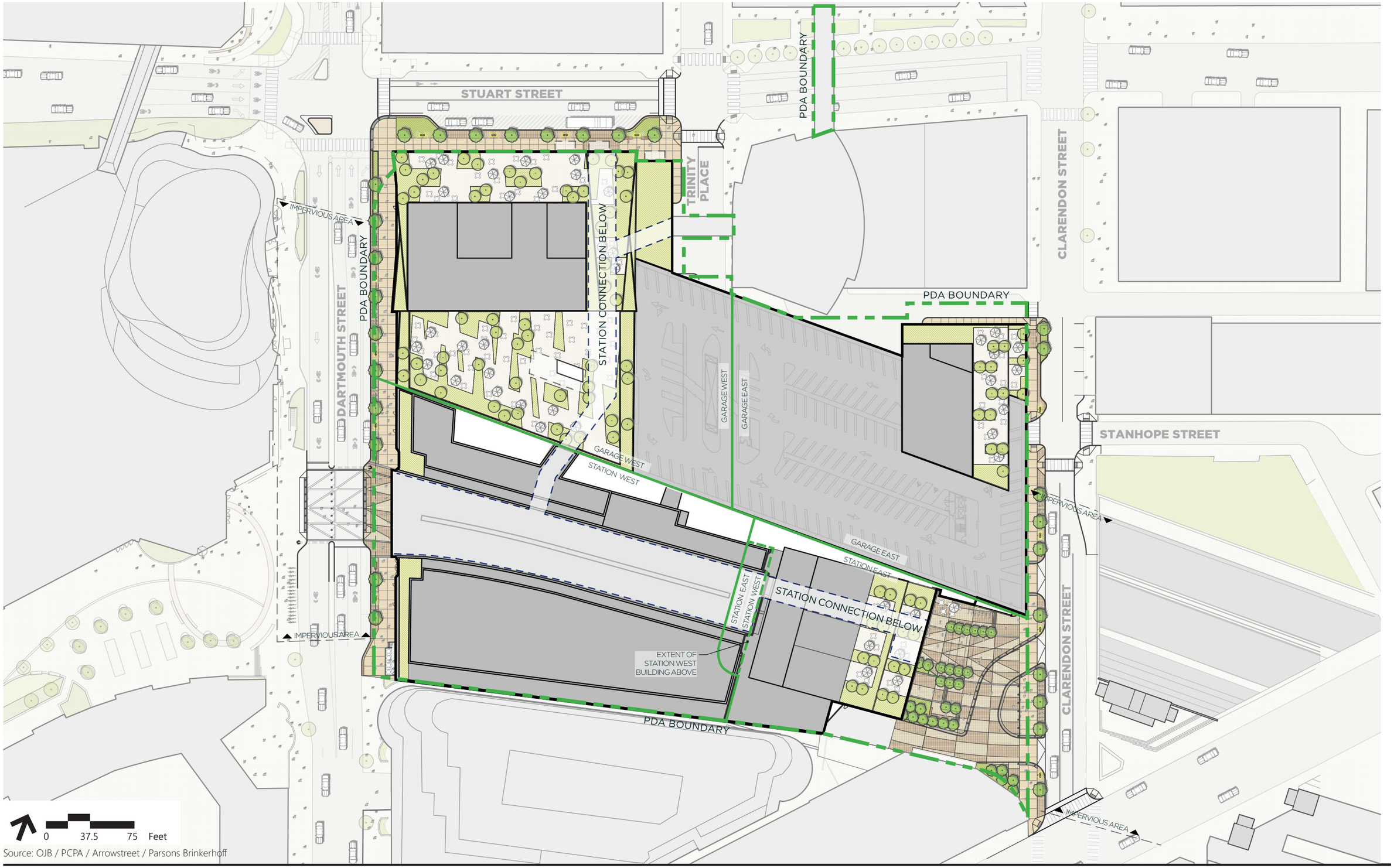
Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Proposed Conditions Site Plan - Base Scheme

Figure 1.6a

OJB



Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Proposed Conditions Site Plan - Alternate Scheme

Figure 1.6b
OJB

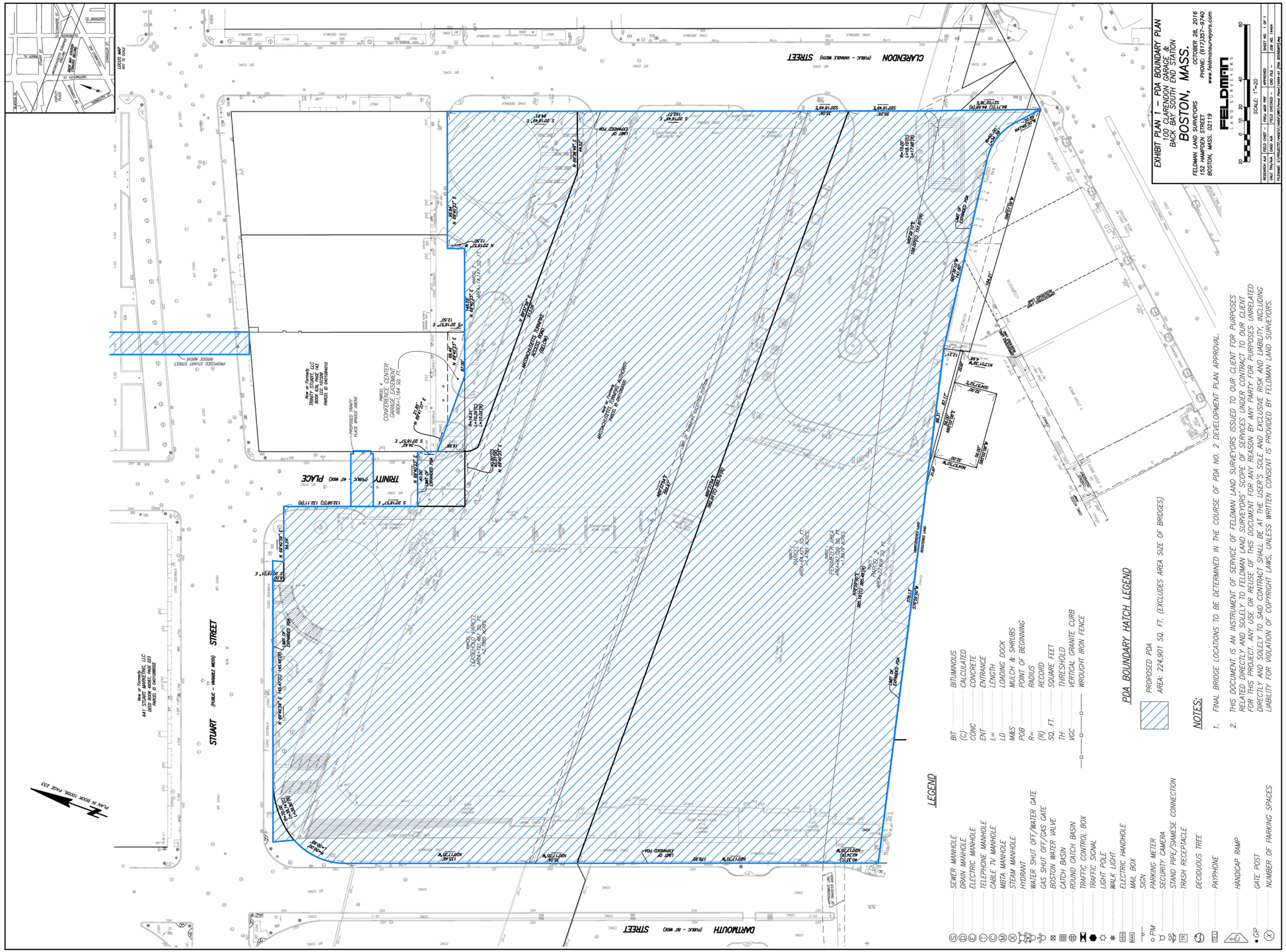


EXHIBIT PLAN 1 – PDA BOUNDARY PLAN
100 CLARENDON GARAGE, LLC
BACK BAY / SOUTH END
BOSTON, MASS.
OCTOBER 26, 2016
FELDMAN LAND SURVEYORS
1155 MASHPEE RIVER SKYWAY
BOSTON, MASS. 02119
PHONE: (617) 332-3366
www.feldmansurveyors.com
FELDMAN
LAND SURVEYORS
SCALE: 1"=20
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RESEARCH: AJK | FIELD CHIEF: - | PREV. MAP: PFM | APPROVED: | SHEET NO. 1 OF 1
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STUART STREET (PUBLIC - VARIABLE WIDTH)
DARTMOUTH STREET (PUBLIC - 80' WIDE)
TRINITY PLACE (PUBLIC - 40' WIDE)
PROPOSED STUART STREET (PUBLIC) ABOVE
PROPOSED TRINITY PLACE BRIDGE ABOVE
PARCEL 1 CONFERENCE CENTER GARAGE EASEMENT AREA=1,164 SQ. FT.
PARCEL 2 CONFERENCE CENTER GARAGE EASEMENT AREA=2,265 SQ. FT.
PARCEL 3 CONFERENCE CENTER GARAGE EASEMENT AREA=1,227 SQ. FT.
PARCEL 4 CONFERENCE CENTER GARAGE EASEMENT AREA=1,227 SQ. FT.
PARCEL 5 CONFERENCE CENTER GARAGE EASEMENT AREA=1,227 SQ. FT.
PARCEL 6 CONFERENCE CENTER GARAGE EASEMENT AREA=1,227 SQ. FT.
PARCEL


EXHIBIT PLAN 2 – OWNERSHIP/EASEMENT PLAN
100 CLARENDON GARAGE, 2E
BACK BAY / SOUTH END
BOSTON, MASS.
FELDMAN LAND SURVEYORS
1 LEE MILLS ROAD
BOSTON, MASS. 02119
OCTOBER 28, 2016
PHONE (617)305-8300
www.feldmansurveyors.com
FELDMAN
LAND SURVEYORS
SCALE: 1"=20
CLARENDON STREET (PUBLIC – VARIABLE WIDTH)
TRINITY PLACE (PUBLIC – 40' WIDE)
STUART STREET (PUBLIC – VARIABLE WIDTH)
DARTMOUTH STREET (PUBLIC – 80' WIDE)
PROPOSED TRINITY PLACE BRIDGE ABOVE
PROPOSED STUART STREET BRIDGE ABOVE
PROPOSED CONFERENCE CENTER GARAGE EASEMENT AREA=1,164 SQ. FT.
MASSACHUSETTS TURNPIKE AUTHORITY (MBTA)
CITY OF BOSTON (PROPOSED)
AREA = 715 SQ. FT.
CITY OF BOSTON (PROPOSED)
AREA = 291 SQ. FT.
LAND OF CLARENDON 100 LLC
LAND OF CLARENDON 100 LLC
LAND OF CLARENDON 100 LLC


EXHIBIT PLAN 3 – LEASE BOUNDARY PLAN
100 CLARENDON, 200 BERKELEY, 20 DARTMOUTH & BACK BAY GARAGE
BOSTON, MASS.
FELDMAN LAND SURVEYORS
125 HAMPDEN ST.
BOSTON, MASS. 02119
OCTOBER 28, 2016
PHONE: (617) 357-9740
www.feldmansurveyors.com
FELDMAN
LAND SURVEYORS
SCALE: 1"=20
RESEARCH: AJK | FIELD CHIEF: – | FIELD WORK PERF: –
DRAFTING: TR/AJK | FIELD CHECKED: – | CAD FILE: –
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LAND OF CITY OF BOSTON (PARKS DEPARTMENT)
LAND OF CITY OF BOSTON (PUBLIC WORKS DEPARTMENT)
LAND OF CITY OF BOSTON (PUBLIC IMPROVE


EXHIBIT PLAN 4 – DEVELOPMENT PARCEL PLAN
100 CLARENDON GARAGE, INC.
BACK BAY / SOUTH END
BOSTON, MASS.
OCTOBER 28, 2016
FELDMAN LAND SURVEYORS
1 LEE MANSION DRIVE
BOSTON, MASS. 02119
PHONE (617)328-2000
www.feldmansurveyors.com
FELDMAN
LAND SURVEYORS
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JOB NO. 14444
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TRINITY (PUBLIC – 40' WIDE) PLACE
STUART (PUBLIC – VARIABLE WIDTH) STREET
DARTMOUTH (PUBLIC – 80' WIDE) STREET
PROPOSED STUART STREET (NOT NEEDED IN DEDUCTION) BEFORE ABOVE PARCEL ID CALCULATIONS
PROPOSED TRINITY PLACE BRIDGE ABOVE (NOT NEEDED IN DEDUCTION) PARCEL IV TOTAL AREA CALCULATION
CONFERENCE CENTER GARAGE EASEMENT AREA=1,164 SQ. FT.
MASSACHUSETTS TURNPIKE AUTHORITY (MASS. TURNPIKE)
MASSACHUSETTS TURNPIKE AUTHORITY PARCEL 8 (MASS. TURNPIKE)
LAND OF CONNECTED PDA
PARCEL I LEASEHOLD AREA AREA=64,437 SQ. FT. =1.4789 ACRES
PARCEL I PERMANENT AREA AREA=97,029 SQ. FT. =1.9919 ACRES
PARCEL 2 AREA=22,868 SQ. FT. (CONVEYED TO CONNECTED PDA)
PARCEL 3 AREA=28,556 SQ. FT. (CONVEYED TO CONNECTED PDA)
PARCEL 4 AREA=5,000 SQ. FT. (CONVEYED TO CONNECTED PDA)
PARCEL 5 AREA=5,000 SQ. FT. (CONVEYED TO CONNECTED PDA)
PARCEL 6 AREA=5,000 SQ. FT. (CONVEYED TO CONNECTED PDA)
PARCEL 7 AREA=5,000 SQ. FT. (CONVEYED TO CONNECTED PDA)
PARCEL

2

Alternatives Analysis

In accordance with the Secretary's Certificate on the ENF and the BPDA's Scoping Determination on the PNF, this section provides a summary of Site development alternatives previously considered in the ENF and PNF, as well as an analysis of two new alternatives requested in the Secretary's Certificate, including an As-Of-Right Zoning Alternative, and an Alternative with a Third Residential Building in place of the office building proposed by the Proponent on the Garage West Parcel. The two new alternatives are presented alongside an analysis of their public benefits and environmental impacts compared to those of the Project. This section also includes a summary of the anticipated effect of each alternative on pedestrian level daylight obstruction as requested in the BPDA's Scoping Determination.

2.1 Summary of Earlier Alternatives

Prior to submitting the ENF and PNF, in the course of designing the Project, the Proponent considered numerous alternatives, including studying the potential impacts to the MassDOT and MBTA infrastructure located beneath the Project Site.

The ENF included a brief description of key alternatives considered, including:

1. **No-Build** - The No-Build Alternative would maintain the existing configuration of the Garage and the Station.
2. **Reduced Build** - The Reduced Build Alternative would involve the construction of a significantly smaller building on one or more of the parcels compared to the buildings proposed in the ENF and PNF Preferred Alternative. As described in the ENF, this alternative is not financially feasible due to the high costs involved with the foundation and structural systems and complex construction logistics procedures required to build over the active transportation infrastructure present at the Project Site. These factors render a smaller development infeasible based on cost.
3. **Increased Build** - The Increased Build Alternative would include a taller multi-story building on the Station West Parcel in place of the modest one-story vertical addition proposed in the Preferred Alternative. This alternative would require significant additional foundation, structural and vertical transportation systems, the construction of which would prove too disruptive to Station operations, impair public access to transit during construction and potentially significantly modify the Station's configuration. For these reasons, this Alternative is not being further pursued.
4. **Garage West Parcel "Bridge Alternative"** - The Garage West Parcel "Bridge Alternative" would involve the reorientation of the office building proposed for

this parcel from an east-west orientation to a north-south orientation. This orientation would require the significant elongation of the building along its longest dimension in order to span the mainline of I-90 and the northernmost track at the Station. Structural elements would be required to pass through both the Station Concourse and track level to the foundation below. The Proponent determined this alternative to be infeasible and cost-prohibitive due to the impacts to space and circulation within the Station associated with the necessary structural elements. In addition, the resulting building would be quite long and undesirable from an urban design and marketability perspective.

5. **ENF and PNF Preferred Alternative** - The Preferred Alternative described previously in the ENF and PNF includes the construction of two residential buildings, one 26-story office building with ground floor retail and a one to two-story vertical retail expansion of the existing Station. The Preferred Alternative also considers two different development plans for the Garage West Parcel in response to the potential closure of the I-90 On-Ramp. Since the overall program and associated impacts are nearly identical, the ENF considered both the Garage West Base Scheme and the Garage West Alternate Scheme as described in Section 3.4.1.

   Since the ENF and PNF filings, as further described in Section 1.4.2, the Proponent has modified the Preferred Alternative in certain ways to incorporate feedback received from City and State Agencies as well as the community. Most notably, the vertical retail expansion at the Station West Parcel has been reduced to a single story and a public plaza has been incorporated into the design of the Station East Parcel. In addition, minor dimensional refinements and clarifications have been made as detailed in Section 1.4.2.

2.2 DEIR/DPIR Alternatives

2.2.1 As-Of-Right Zoning Alternative

The As-Of-Right Alternative would involve a development that meets all the dimensional criteria of underlying zoning, in this case, the Stuart Street Zoning District (the "SSD"). As described in the BPDA Scoping Determination, the Preferred Alternative is "exemplary in its strong adherence to the Stuart Street Design Guidelines." Therefore, the As-Of-Right Alternative would be extremely similar to the Preferred Alternative. It would also include the construction of two residential buildings of 28 and 35 stories, one 26-story office building with ground floor retail and a one-story vertical retail expansion of the existing Station. The Garage East building, Station East building, and Garage West retail expansion detailed under the Preferred Alternative all currently comply with the SSD. See Figures 2.1a and 2.1b.

To meet all the dimensional criteria of the SSD, the Garage West building's commercial floorplates above 155 feet in height would be restricted to a maximum size of 30,000 square feet. This restriction would effectively reduce the net leasable area in the building by approximately 20,000 square feet and result in the loss of two

large office floor plates. Additionally, any portion of the Garage West building over 155 feet in height would need to be set back from the property line by a minimum of 25 feet, which would result in a uniform, rectilinear western facade for the commercial building. This would eliminate the building's potential to have outdoor terraces on this facade, and would provide less visual interest than the undulating façade design in the Preferred Alternative.

Additionally, under the SSD, service and parking areas must be set back a minimum of 20 feet from the building face, and should contain active building uses. This would directly impact the rebuilt portion of the Garage, and would result in a net loss of approximately 238 striped parking spaces. In addition, given the Garage levels are all above the ground floor, there is no viable active use for this residual building area, which could no longer be used for parking. See Figures 2.1a-b.

The Proponent has determined this alternative is not financeable because the high costs related to the foundation and structural systems, as well as the expensive and lengthy construction techniques required to construct over the active I-90 infrastructure, would render a smaller development financially infeasible and, therefore, unachievable. A reduction in leasable square footage as well as a loss in parking would result in a significant revenue loss and also prohibit the Project from being able to provide desirable proposed public benefits, such as the through-block connector from Stuart Street to the Station. In addition, other programmatic factors would bring the Project's execution into question. The loss of two large office floor plates would limit the building's appeal to particular tenant sectors and compromise its marketability. A decrease in the number of parking spaces would limit the Project's ability to provide Project-related parking on-site.

At the same time, the environmental impacts created by the Project would not be substantially diminished. As shown in Table 2-1, the water use, wastewater, daylight obstruction and trips generated by the Project would be substantially similar to the Preferred Alternative, as would the wind impacts which are detailed in the RWDI memorandum included in Appendix I. Therefore, the As-Of-Right Alternative would significantly reduce the public benefits of the Project, produce substantially similar environmental impacts and be financially infeasible.

2.2.2 Third Residential Building Alternative

The Third Residential Building Alternative would construct a 34-story, 296,448 square foot residential building in place of the 26-story, 618,400 square foot commercial building on the Garage West Parcel. The remainder of the Project would be unchanged. The Third Residential Building Alternative would still include two residential buildings of 28 and 35 stories on the Garage East and Station East Parcels, respectively, and the one-story vertical retail expansion of the existing Station on the Station West Parcel. See Figures 2.2a and 2.2b.

Due to its greatly reduced size and residential program, the Third Residential Building Alternative would generate significantly less revenue than the proposed commercial building, and therefore would not be able to support the partial

demolition and reconstruction of the Garage, leaving the existing Garage and entry drum in place along Dartmouth and Stuart Streets. In addition, this Alternative would not be able to provide the through-block connector and new Station entrance from Stuart Street, due to both economic and physical obstacles. This Alternative would result in fewer urban design and pedestrian realm improvements than are currently proposed under the Project as defined in Chapter 1, *Project Description*.

As shown in Table 2-1, the water use, wastewater and daylight obstruction would be substantially similar to the Preferred Alternative, as would the wind impacts which are detailed in the RWDI memorandum included in Appendix I. Due to the residential rather than commercial use, there would be a reduction in the number of Project-generated trips. However, this reduced impact is outweighed by the loss of the substantial transit-related and urban design benefits to be delivered with the Preferred Alternative.

Furthermore, the Third Residential Building Alternative would significantly reduce the public economic benefits associated with the Project. The number of construction jobs would be reduced by approximately 200 jobs, while the number of permanent jobs would be significantly reduced from 3,200 to only 75 across all four Project Components. The annual real estate taxes would be reduced an estimated $7.6 million from approximately $15.3 million with the Preferred Alternative to $7.7 million. Furthermore, the approximately $5,500,000 in housing linkage and $1,100,000 in jobs linkage payments would be eliminated entirely. For these reasons and those cited above, the Proponent has determined the Third Residential Building Alternative to be infeasible and would not be a project the Proponent would consider pursuing from an investment perspective.

2.2.3 Preferred Alternative

The Preferred Alternative (or the Project) as described in detail in Section 1.4 and shown on Figures 1.6a-b, Figures 3.2a-m and Figures 3.6a-p, proposes the construction of two residential buildings of 28 and 35 stories, one 26-story office building with ground floor retail and a one-story vertical retail expansion of the existing Station. The Preferred Alternative also considers two different development plans for the Garage West Parcel in response to the potential closure of the I-90 On-Ramp.

As indicated above, see Section 1.4.2 for a detailed summary of changes to the Project since the ENF and PNF filings.

2.3 Qualitative and Quantitative Comparison of Alternatives

The sections below compare potential environmental impacts of the Project alternatives. Table 2-1 below provides a quantitative impact analysis comparing the As-Of-Right Zoning Alternative, the Third Residential Building Alternative, and the

Preferred Alternative. The sections that follow qualitatively describe potential environmental impacts including wind, shadow and greenhouse gas emissions.

Table 2-1 Quantitative Comparison of Project Alternatives

Impact Category	As-Of-Right Zoning Alternative	Third Residential Building Alternative	Preferred Alternative (Base Scheme)
Land			
Size of Project Site	5.2 acres	5.2 acres	5.2 acres
Total Impervious Surface Area [2]	5.2 acres	5.2 acres	5.2 acres
Change from Existing	- 0 -	- 0 -	- 0 -
New Land Alteration	- 0 -	- 0 -	- 0 -
Water & Wastewater			
Water Use (GPD)	±174,515 GPD	±176,006 GPD	±176,123 GPD
Wastewater Generation (GPD)	±158,650 GPD	±160,005 GPD	±160,112 GPD
Daylight Obstruction			
Dartmouth Street	83.5%	78.8%	81.6%
Stuart Street	72.0%	70.1%	72.0%
Clarendon Street	79.1%	79.1%	79.1%
Traffic			
Total New Vehicle Trips per Day			
Unadjusted	11,862	6,830	12,932
Adjusted	3,547	1,449	3,627
Parking			
Total Garage Parking Spaces	1,775	2,013	2,013

GPD gallons per day

Land

Both build alternatives described above would result in no net change to impervious area from the Preferred Alternative, as the Project Site is currently fully paved and/or covered with buildings.

MBTA Station & Public Realm

The Preferred Alternative would provide the full scope of Station upgrades, pedestrian transit accessibility and public realm improvements described in Section 3.5. This includes the two new Station entrances and indoor, weather-protected accessible through-block connections to the Station from Stuart and Clarendon Streets, including escalators as well as an elevator, to connect the Stuart Street sidewalk to the Station Concourse level.

As described above, the As-Of-Right Alternative would result in the elimination of the new Station entrance and Stuart Street through-block connector due to economic constraints. The Third Residential Building Alternative would also not be able to support either the new Station entrance and through-block connector or the Garage reconstruction, leaving the existing Garage and entry drum in place along Dartmouth and Stuart Streets and preventing many of the streetscape improvements in this area from being accomplished.

Environmental Impacts

Water and Wastewater

Due to their modified development programs, the As-Of-Right Alternative and Third Residential Building Alternative are expected to require modestly less potable water and generate slightly less sanitary sewerage compared to the Preferred Alternative. However, these decreases are very small in magnitude and do not substantially reduce the Project's environmental impact. Please refer to Table 2-1 for a comparison against the Preferred Alternative.

Transportation

The As-Of-Right Alternative program has less office building square footage and would result in marginally fewer unadjusted and adjusted vehicle trips per day than the Preferred Alternative. The transportation impacts of this alternative would be very similar to the Preferred Alternative's impacts documented in Chapter 4, *Transportation and Parking*. Access to and from the building would be the same, as vehicles would still park in the Garage. As in the Preferred Alternative, service and loading would occur in the loading area off Trinity Place accessed from Stuart or Clarendon Street. Due to the buffer requirement, the As-Of-Right Alternative would only be able to provide 1,775 parking spaces as opposed to the 2,013 spaces

provided under the Preferred Alternative. Please refer to Table 2-1 for a comparison against the Preferred Alternative.

The Third Residential Building Alternative would also result in fewer unadjusted and adjusted vehicle trips than the Preferred Alternative due to the fact that residential uses typically generate fewer trips than commercial uses. As discussed in Section 2.2.2, the Third Residential Alternative would not be able to support the partial demolition and reconstruction of the Garage, leaving the existing Garage and entry drum in place along Dartmouth and Stuart Streets. Loading and service access under this Alternative would be consistent with existing conditions, which provides a small loading dock next to the Garage entry drum off Trinity Place. The Preferred Alternative and Third Residential Building Alternative would both provide up to 2,013 parking spaces. Refer to Table 2-1 for a comparison against the Preferred Alternative.

Wind

The Preferred Alternative incorporates undulating, cantilevered facades in the high-rise portion of the office building as well as podium features on the office and both residential buildings. These features help disseminate wind captured by the building façade and mitigate its impact at the street level. As described in detail in Chapter 6, *Environmental Protection*, under the Preferred Alternative, the pedestrian level wind comfort conditions are not expected to significantly change along Dartmouth Street, and will improve along Stuart Street when compared to the No-Build Alternative.

The As-Of-Right Zoning Alternative is very similar to the Preferred Alternative. The As-Of-Right Zoning Alternative includes an additional step at the south podium, and regular setbacks between the 14th floor and 22nd floor, similar to the undulating setbacks of the Preferred Alternative. These are minor design changes and the wind conditions at grade level are expected to be similar to the conditions predicted for the Preferred Alternative.

The overall massing and footprint of the Third Residential Building Alternative is substantially different from the Preferred Alternative, however, it is the same height and has approximately the same length of its northern façade facing the prevailing winds as the office building in the Preferred Alternative. Therefore, it is expected to capture approximately the same amount of wind as the Preferred Alternative. While it is a slenderer building with a smaller footprint, it has a much smoother façade than the irregular profile of the office building in the Preferred Alternative, which has multiple steps and a textured façade that is beneficial in reducing wind energy. The Third Residential Building Alternative does have a narrower façade facing the west and it incorporates small setbacks on the western and northern edges, creating a modest podium, which is a positive feature and would result in less downwashing flows at grade level than if there were no podium. Therefore, considering both positive and negative attributes, the Third Residential Building Alternative is anticipated to generate similar wind conditions as the Preferred Alternative. Refer to

Appendix I for a memo summarizing the results of the qualitative wind assessment of the two Site development alternatives.

Shadow

Under the Preferred Alternative, shadow impacts have already been minimized to the extent practicable to avoid pedestrian-level impacts, and are in full and complete compliance with the specific requirements of the SSD, including the two-hour shadow limitation on Copley Square. The slightly reduced floor plates under the As-Of-Right Alternative will not result in any appreciable reduction of pedestrian-level shadow impacts at any location around the Project Site. Under the Third Residential Building Alternative, the floor plates are smaller in size than the commercial building in the Preferred Alternative, but the overall height of the building is comparable. As a result, the pedestrian-level shadow impacts are expected to be substantially consistent with those of the Preferred Alternative.

Daylight

As would be expected when increasing the density of an urban site, the Preferred Alternative, as well as the As-Of-Right Zoning and Third Residential Building Alternatives result in an increase in daylight obstruction due to the increased height and massing of the new buildings. The anticipated obstruction of daylight at the ground level was prepared using the BPDA's Daylight Analysis Program ("BRADA") and was studied from viewpoints along Dartmouth Street, Stuart Street and Clarendon Street.

Under the No-Build Alternative, or existing condition, a large portion of the skydome is already obstructed due to the size of the existing and approved proposed structures and their proximity to the study points, including the substantial massing of the existing Garage and the approved 40 Trinity building.

As presented in figures 2.3a – 2.4c, the analysis of daylight obstruction indicates a modest increase over existing conditions in daylight obstruction for both the As-Of-Right Zoning and Third Residential Building Alternatives that is comparable to that observed with the Preferred Alternative. Please refer to Section 6.4 of Chapter 6, *Environmental Protection* and Figures 6.3a – 6.3c for the daylight analysis of the Preferred Alternative.

The anticipated impact for each viewpoint is as follows:

› **Dartmouth Street** – The skydome obstructed from Dartmouth Street will increase from 42.9 percent to 83.5 percent for the As-Of-Right Zoning Alternative (Figure 2.3a), 78.8 percent for the Third Residential Building Alternative (Figure 2.4a), and 81.6 percent for the Preferred Alternative Base Scheme (Figure 6.3a). This viewpoint exhibits the greatest variability (although still less than seven (7) percent) as a result of the changes in massing and height of the Garage West building. The rectilinear western façade of the As-Of-Right Zoning Alternative would result in a greater impact than the Preferred Alternative Base Scheme. The

Third Residential Building Alternative would result in the smallest obstruction of daylight due to the smaller floorplate of the upper floors.

While the approved 40 Trinity building is shown in the massing diagrams, the BRADA model predicts that it would not be visible from the study point due to the height and closer proximity of the garage.

- **Stuart Street** – The skydome obstructed from Stuart Street will increase from 66.4 percent to 72 percent for both the As-Of-Right Zoning Alternative (Figure 2.3b) and the Preferred Alternative (Figure 6.3b), and to 70.1 percent for the Third Residential Building Alternative (Figure 2.4b).
- **Clarendon Street** – The skydome obstructed from Clarendon Street will increase from 70.7 percent to 79.1 percent for the As-Of-Right Zoning Alternative (Figure 2.3c), the Third Residential Building Alternative (Figure 2.4c) and the Preferred Alternative (Figure 6.3c), as a result of the construction of the Garage East building. The Station East building is not visible due to the massing of the Garage.

In conclusion, the alternatives do not differ appreciably in their impact to the pedestrian daylight experience. The increase in skydome obstruction will be offset by substantial improvements to the public realm which are anticipated to improve the overall pedestrian experience as compared to the No-Build condition.

Sustainability and Greenhouse Gas Emissions

Under the As-Of-Right Alternative, the slightly smaller office building would result in slightly less energy usage resulting in marginally lower direct and indirect stationary source GHG emissions than the Preferred Alternative. Based on energy use intensity benchmarking[1], the Third Residential Building Alternative would be less energy intensive than the office use, resulting in lower direct and indirect stationary source GHG emissions than the Preferred Alternative.

For mobile sources, the As-Of-Right Alternative would result in two (2) percent fewer project generated trips than the Preferred Alternative, resulting in a negligible difference in mobile source GHG emissions. The Third Residential Building Alternative results in fewer project generated trips, which would result in lower GHG emissions than the Preferred Alternative. As discussed in Section 2.2.1 and 2.2.2, the minimal reduction in GHG emissions under the As-Of-Right or Third Residential Building Alternative does not outweigh the greatly reduced urban design, public realm, transit accommodations and economic public benefits that would be delivered with either of these when compared to the Preferred Alternative.

[1] "U.S. Energy Use Intensity by Property Type" Technical Reference. *Energy Star Portfolio Manager*. March 2016. Comparing the property types: 54.1 kBtu/sf-yr for high-rise apartment buildings, 75.2 kBtu/sf-yr for large office buildings.

Conclusion

Overall, the Preferred Alternative avoids or minimizes environmental impacts while providing maximum public benefit. It has been designed to comply to the greatest extent possible with the planning recommendations and community concerns established in the SSD to provide uses in appropriate and carefully considered locations that reinforce the mixed-use character of the existing area, create a sustainable development centered on an important transit node, and thereby encourage the use of non-automotive means of transportation. Further, the Preferred Alternative strongly supports the economic development and sustainable goals of the City of Boston and the Commonwealth. Analysis of the Preferred Alternative, including its existing Project Site characteristics, development costs, and mitigation requirements, did not identify a practical alternative that would significantly reduce the environmental impacts of the development while still meeting the Project goals. Neither the As-Of-Right Alternative nor the Third Residential Building Alternative are considered financially viable development opportunities and therefore, would not be financeable or achievable. Consequently, the Preferred Alternative is carried forward for further analysis in this document as the Project.

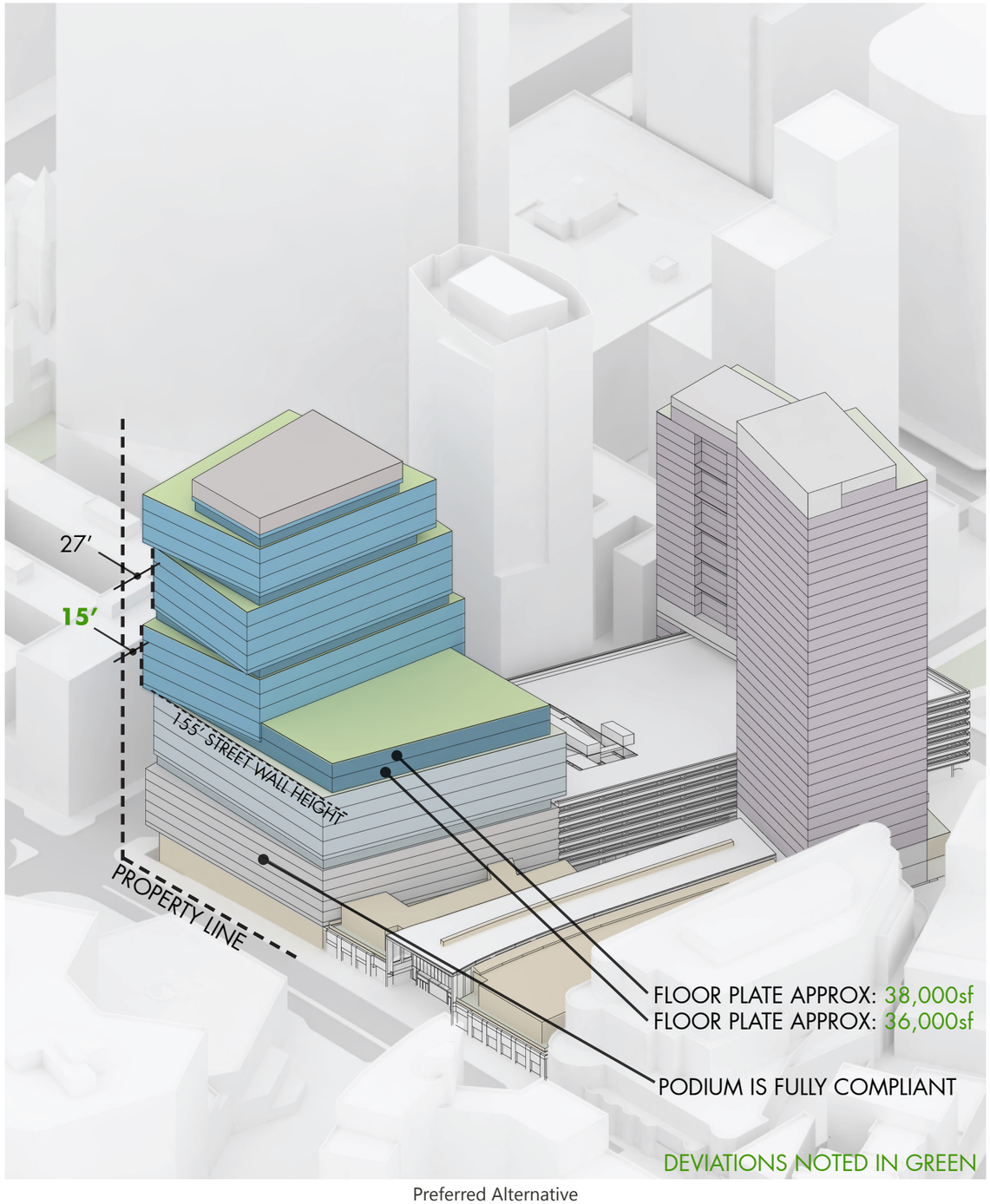
The Preferred Alternative offers greater public and environmental benefits that are expected to extend to the broader community, City, and region, providing new opportunities and serving as a catalyst for regional growth creating new jobs and tax revenues.

STUART STREET ZONING:

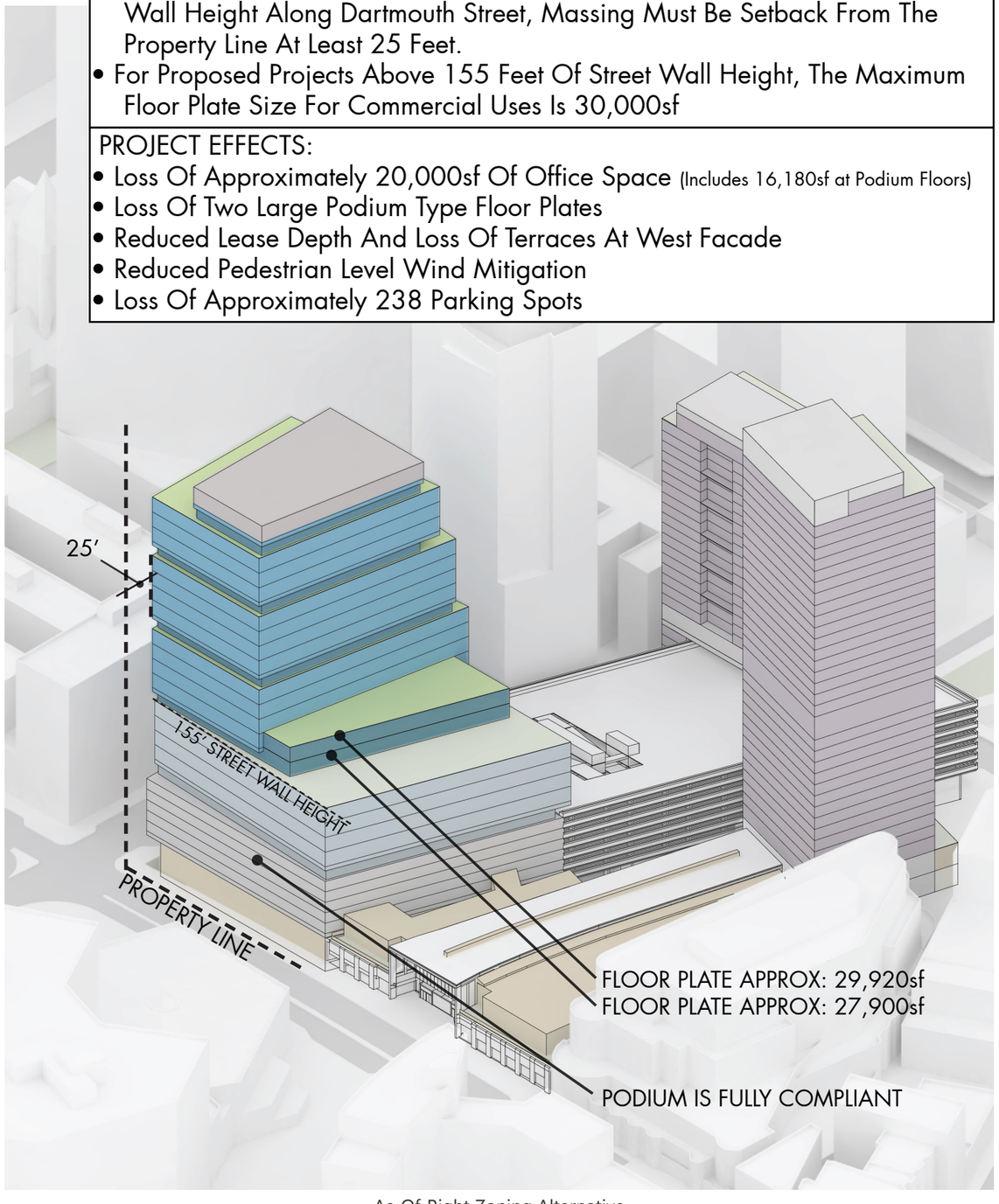
- For Portions Of A Proposed Project That Extend Above 155 Feet Of Street Wall Height Along Dartmouth Street, Massing Must Be Setback From The Property Line At Least 25 Feet.
- For Proposed Projects Above 155 Feet Of Street Wall Height, The Maximum Floor Plate Size For Commercial Uses Is 30,000sf

PROJECT EFFECTS:

- Loss Of Approximately 20,000sf Of Office Space (Includes 16,180sf at Podium Floors)
- Loss Of Two Large Podium Type Floor Plates
- Reduced Lease Depth And Loss Of Terraces At West Facade
- Reduced Pedestrian Level Wind Mitigation
- Loss Of Approximately 238 Parking Spots



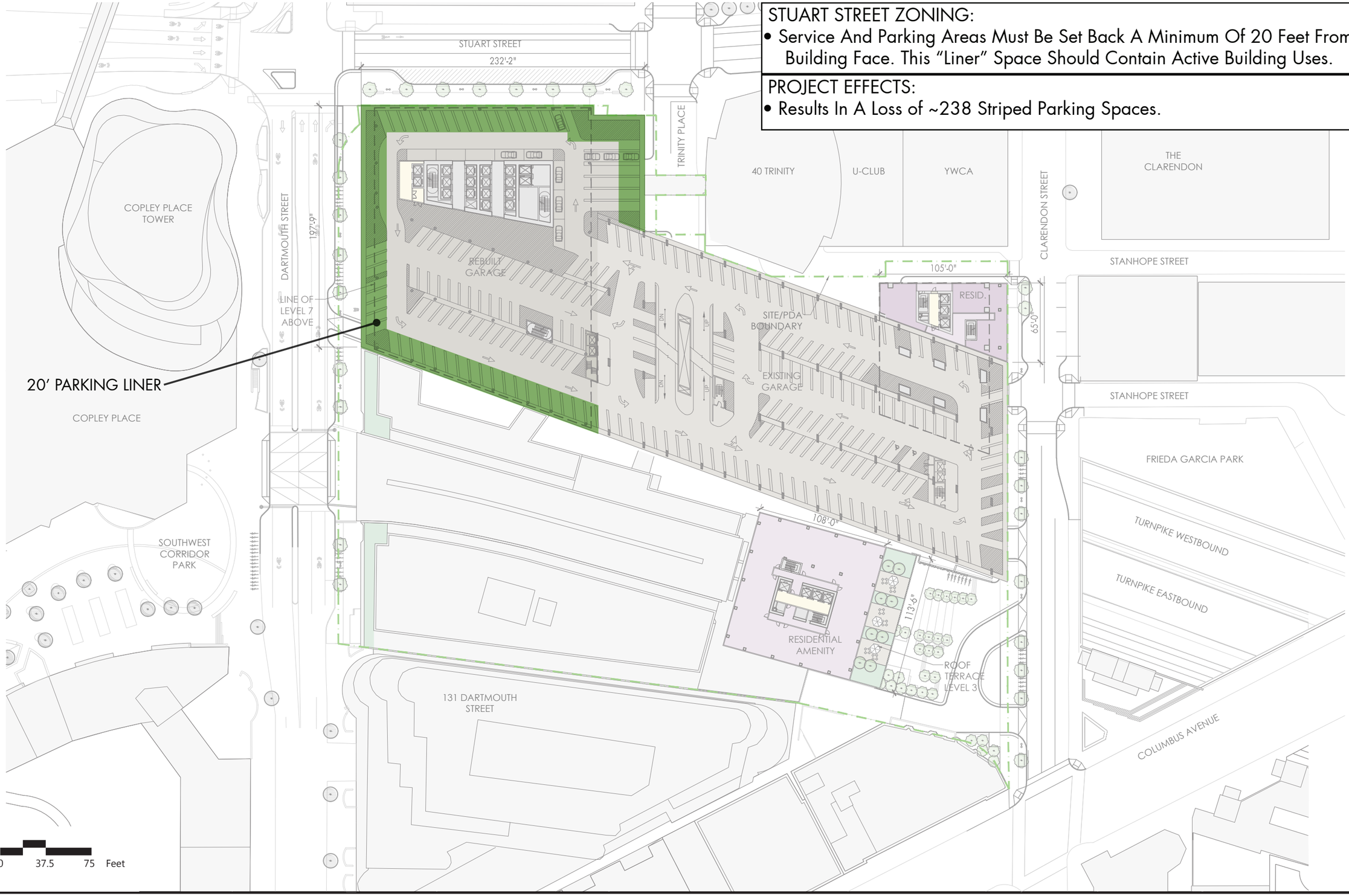
Preferred Alternative



As-Of-Right Zoning Alternative

STUART STREET ZONING:
- Service And Parking Areas Must Be Set Back A Minimum Of 20 Feet From The Building Face. This "Liner" Space Should Contain Active Building Uses.

PROJECT EFFECTS:
- Results In A Loss of ~238 Striped Parking Spaces.

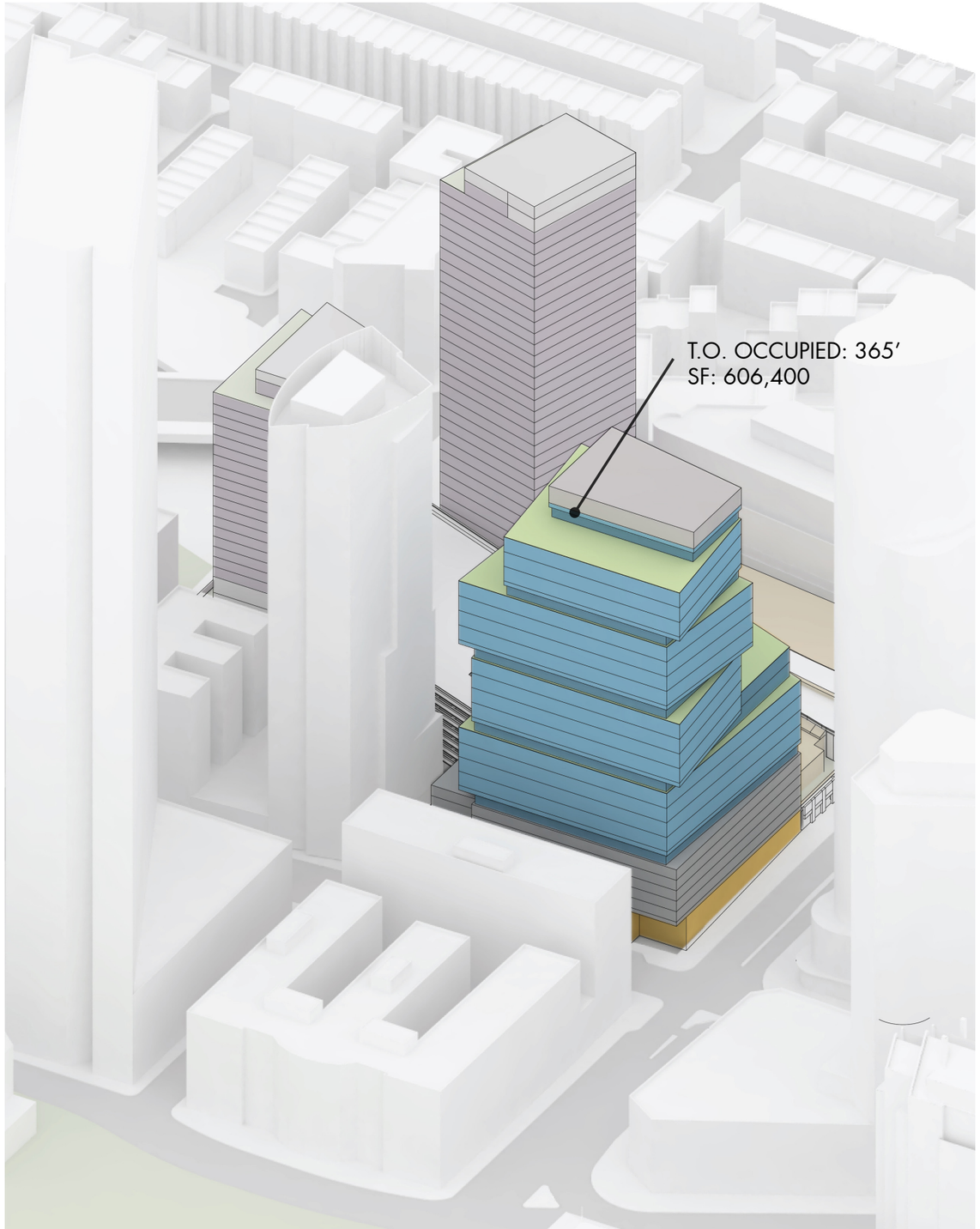


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

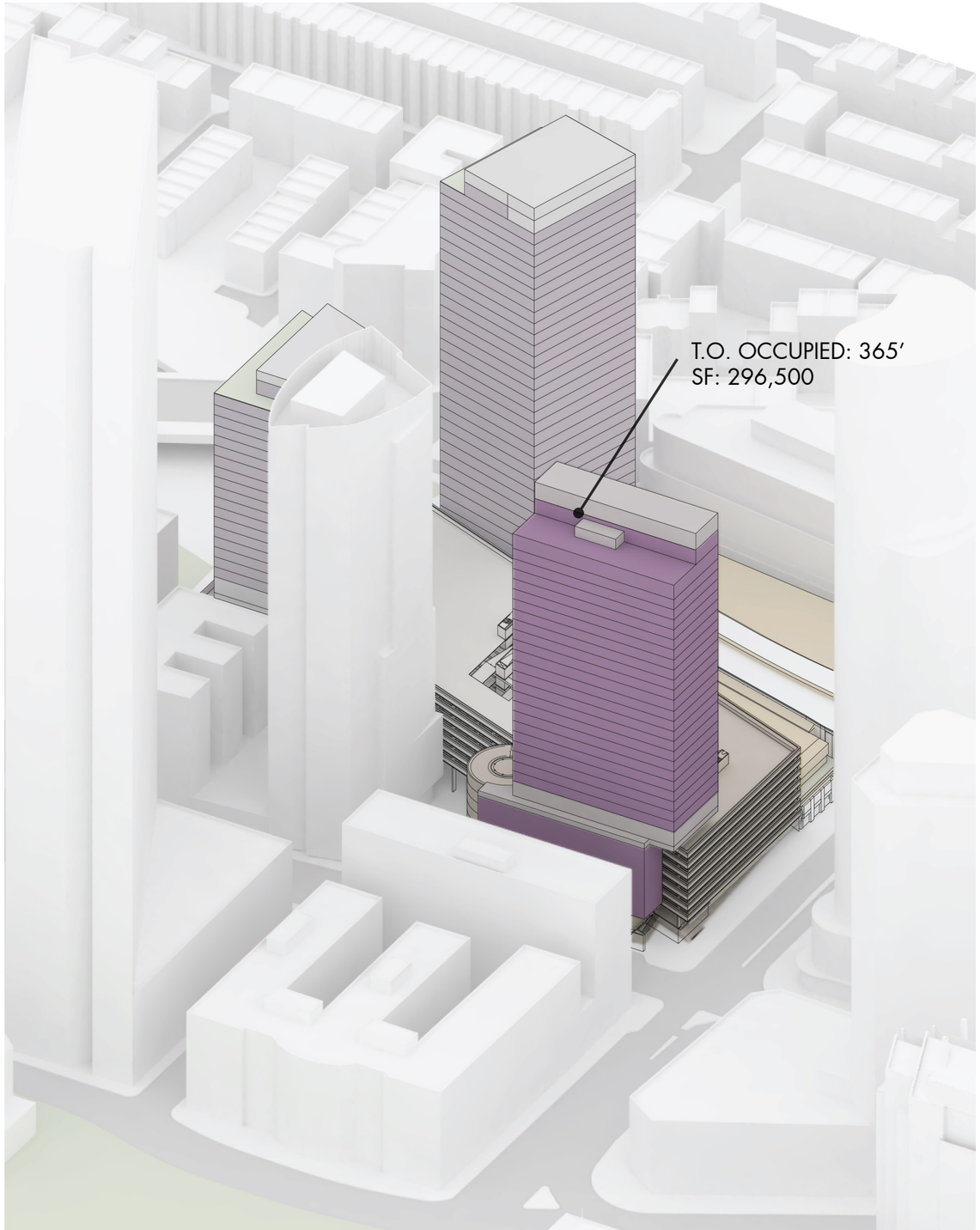
As-Of-Right Zoning Alternative
20' Parking Liner

Figure 2.1b

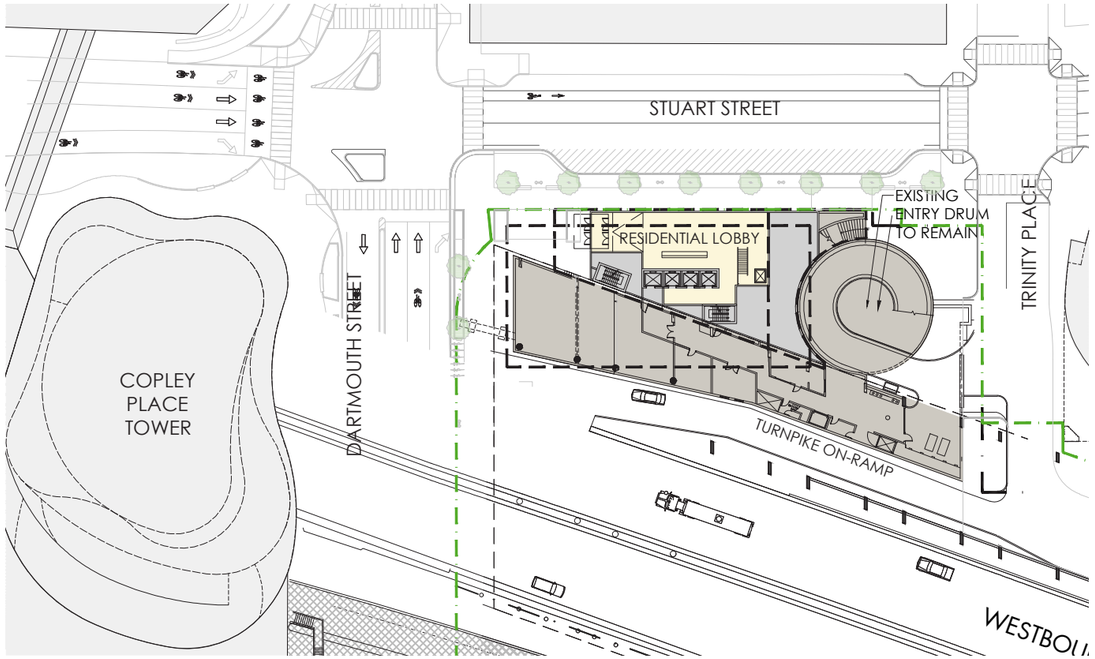
Pelli Clarke Pelli Architects



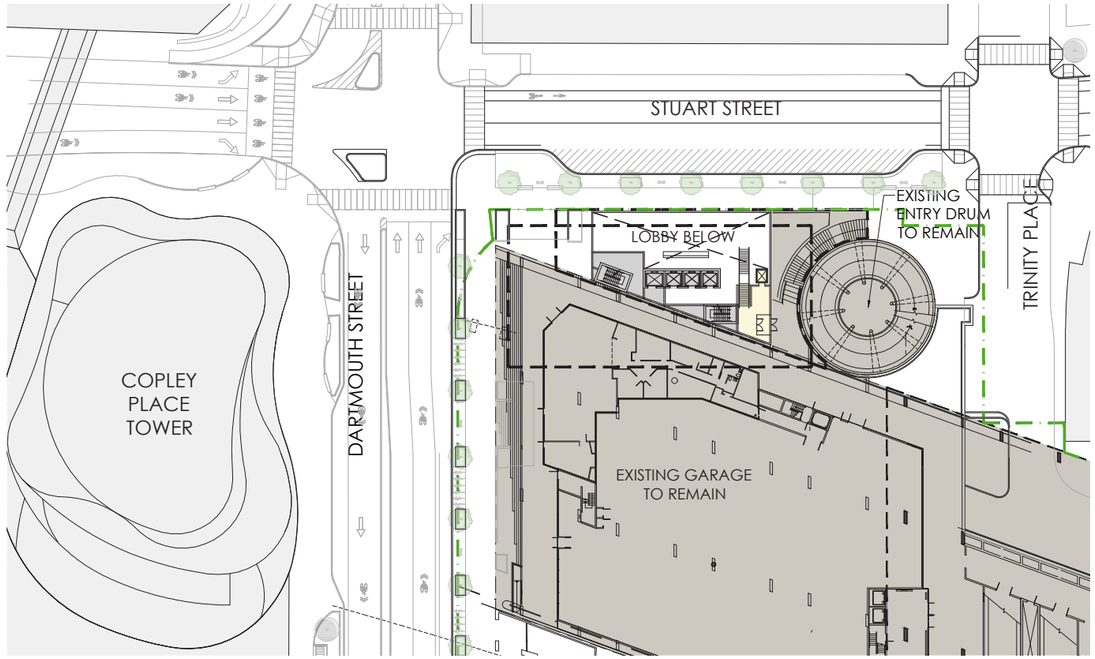
Preferred Alternative



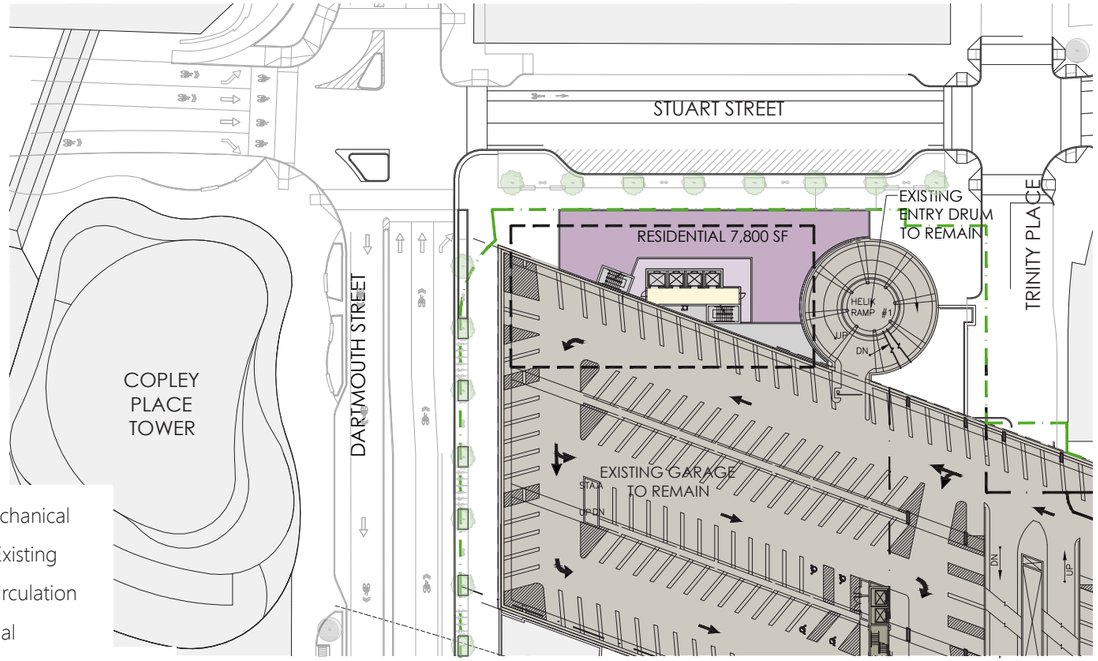
Third Residential Building Alternative



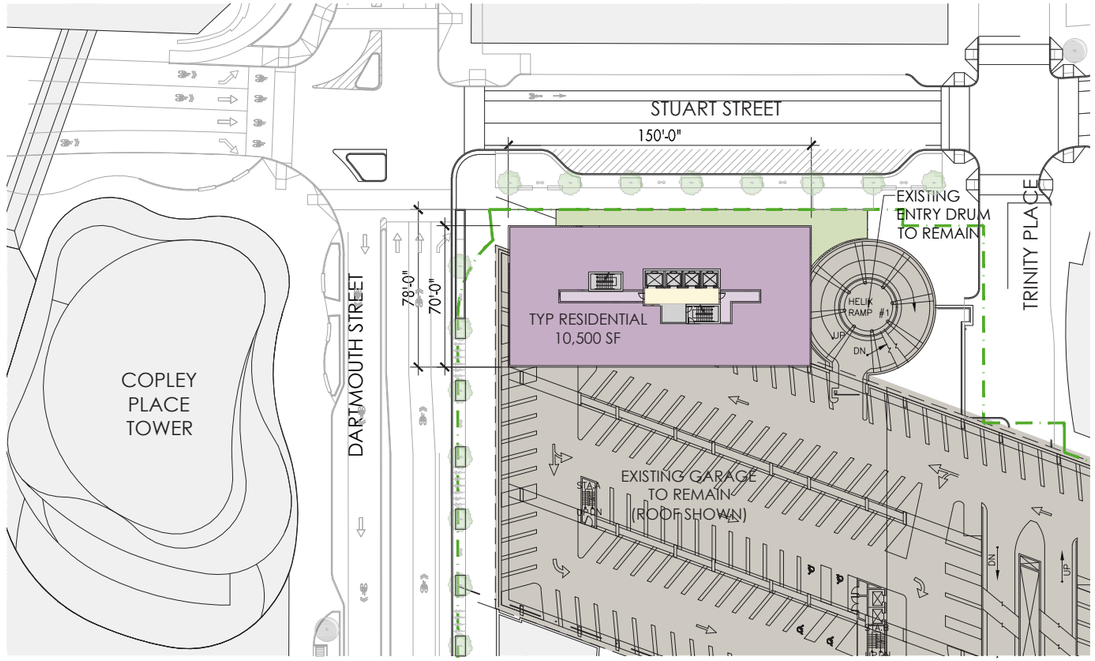
STUART STREET LEVEL



DECK LEVEL



TYPICAL LEVEL ADJACENT TO GARAGE



TYPICAL UPPER LEVEL

BOH/Mechanical
Garage Existing
Lobby/Circulation
Residential

0 37.5 75 Feet

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

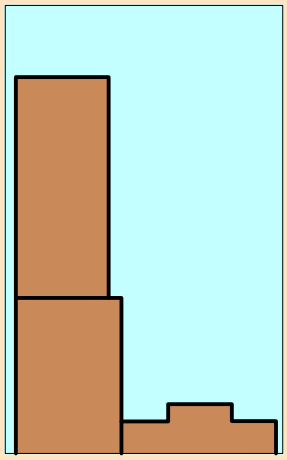
Third Residential Building Alternative
Floor Plans

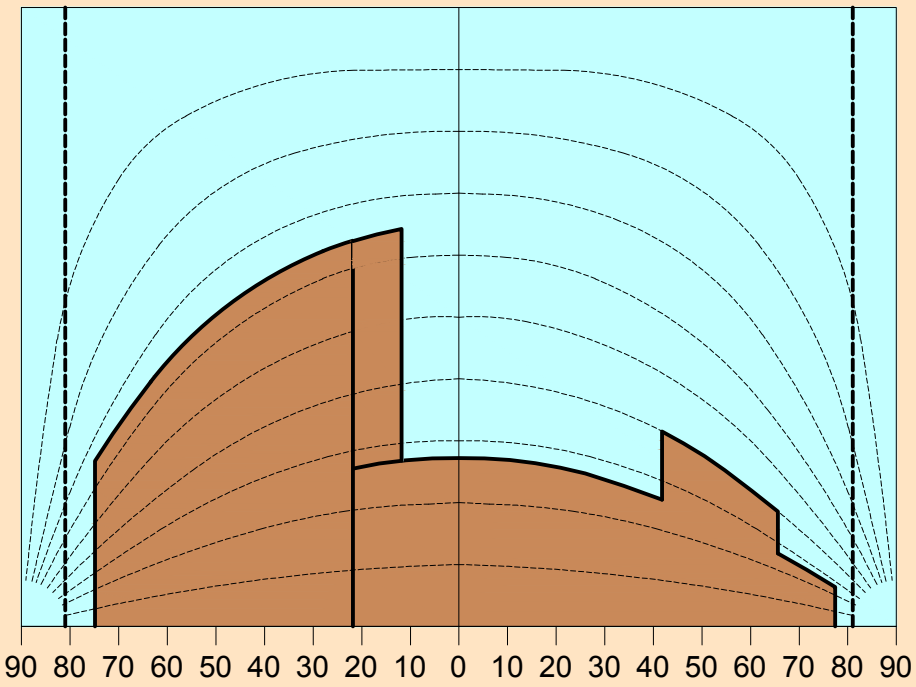
Figure 2.2b

Pelli Clarke Pelli Architects

Existing

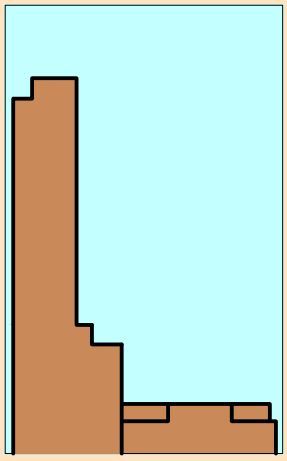
Obstruction of
Skyplane = 42.9%

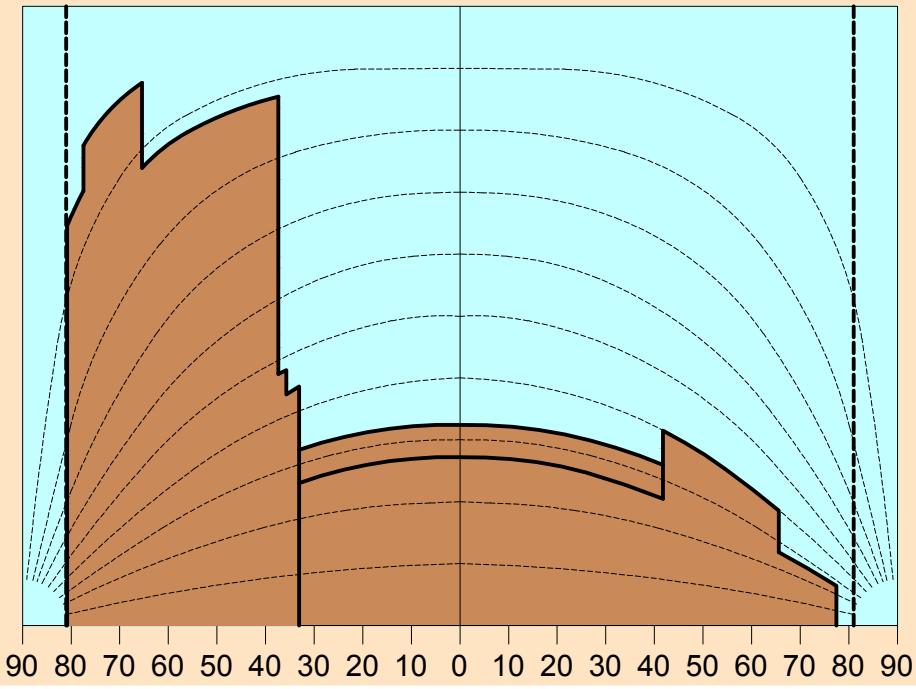




Proposed

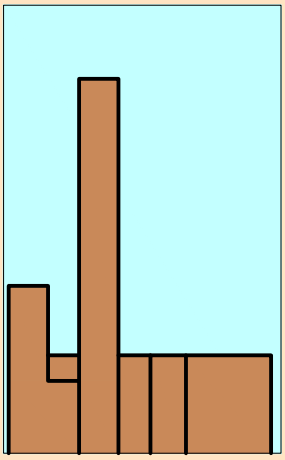
Obstruction of
Skyplane = 83.5%

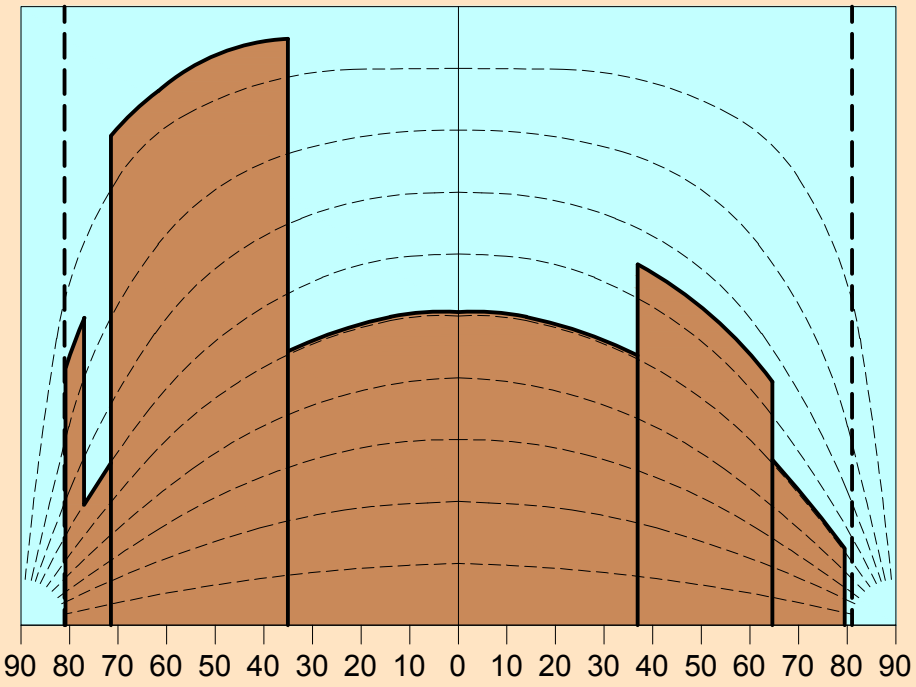




Existing

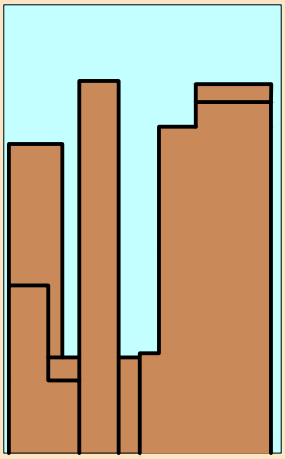
Obstruction of
Skyplane =66.4%

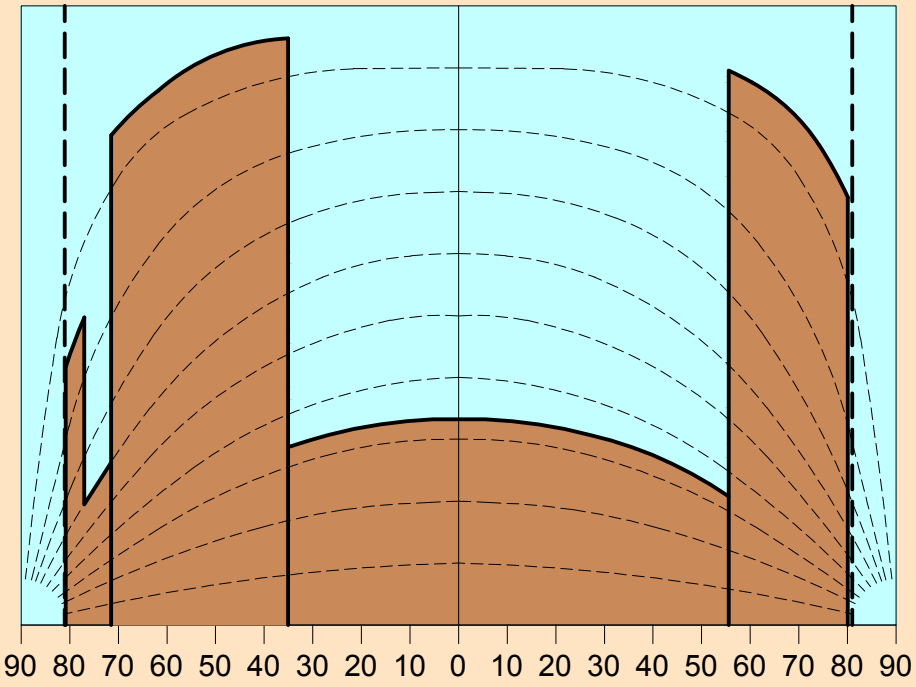




Proposed

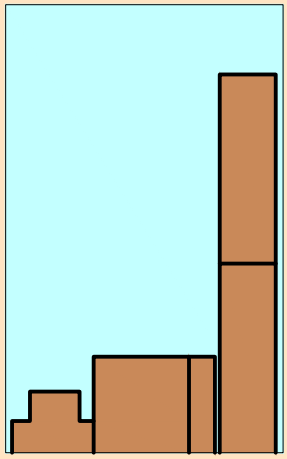
Obstruction of
Skyplane = 72.0%

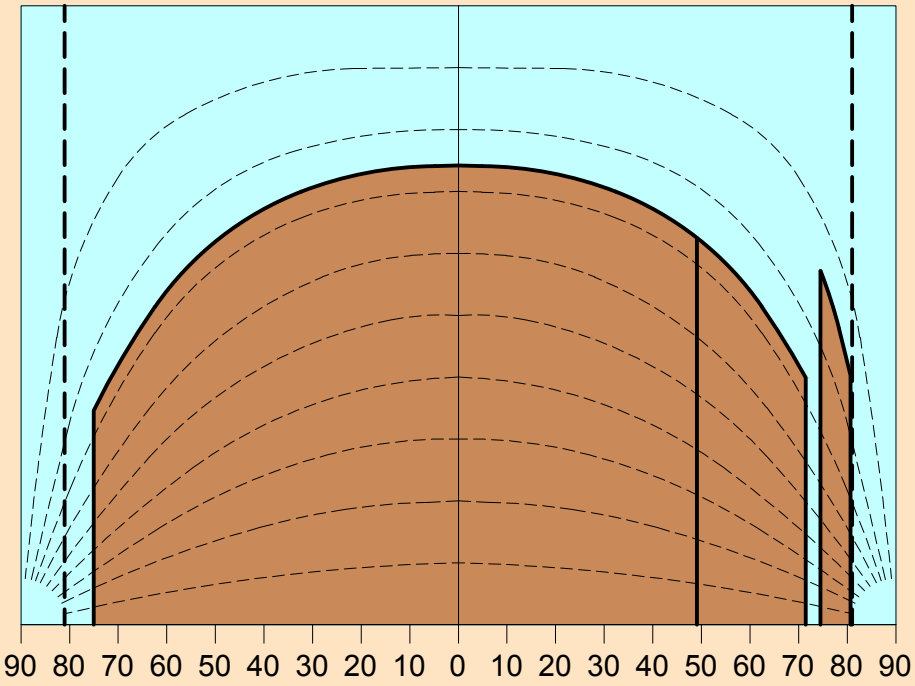




Existing

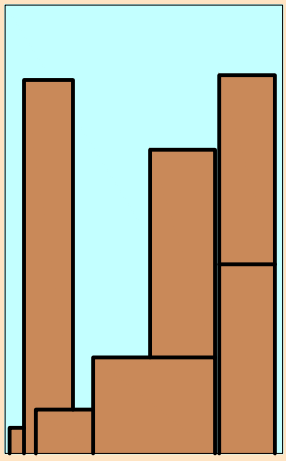
Obstruction of
Skyplane = 70.7%

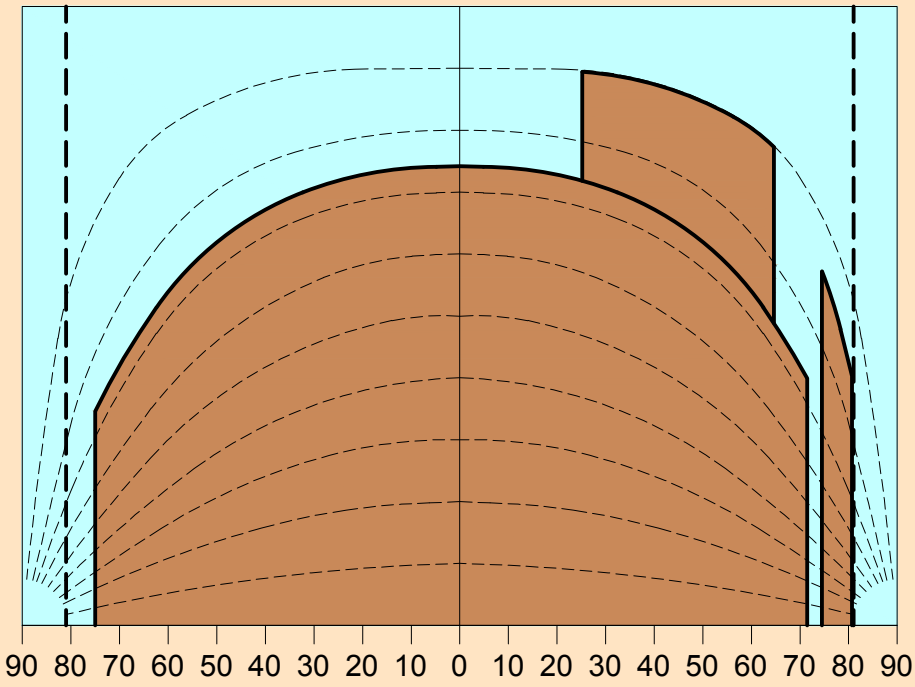


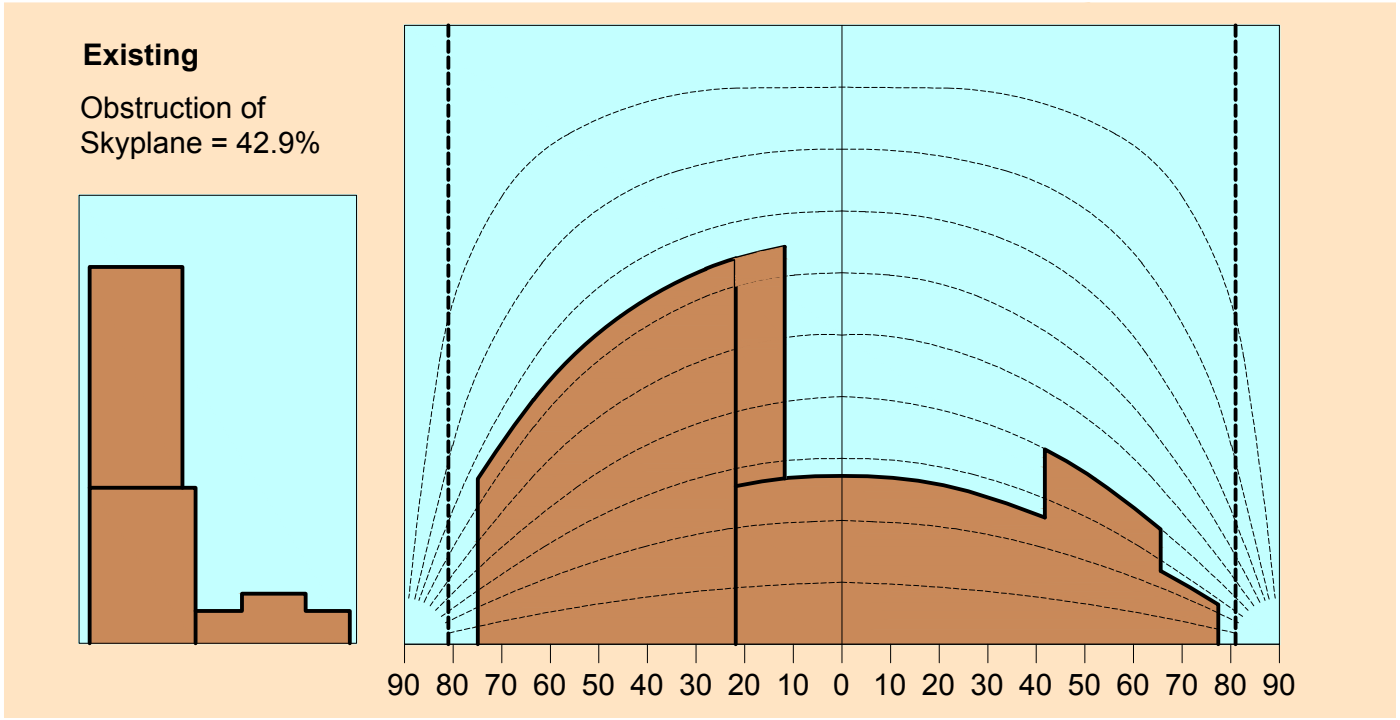


Proposed

Obstruction of
Skyplane = 79.1%






Existing
Obstruction of
Skyplane = 42.9%
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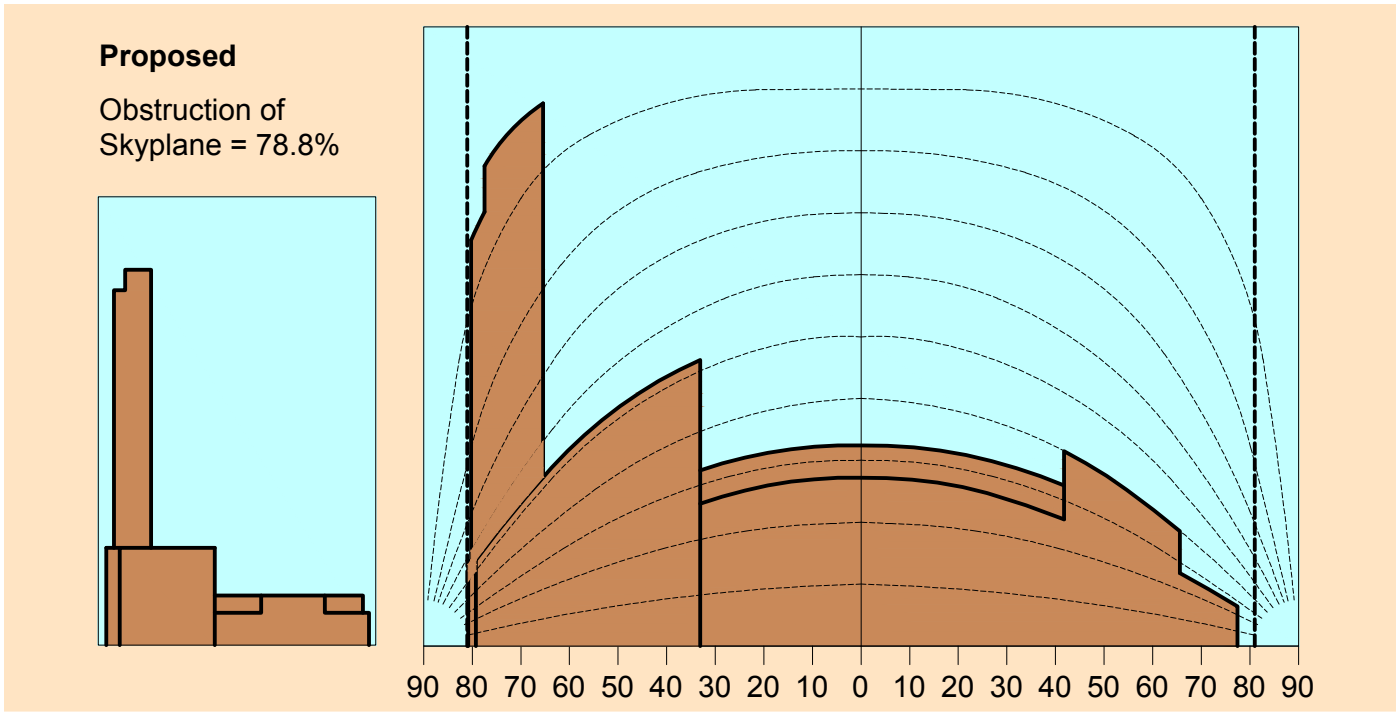
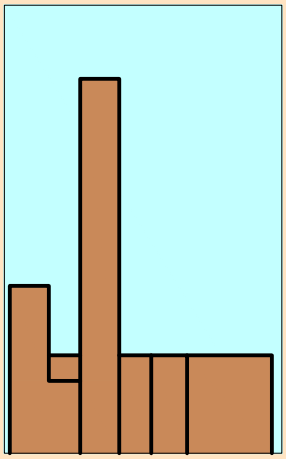
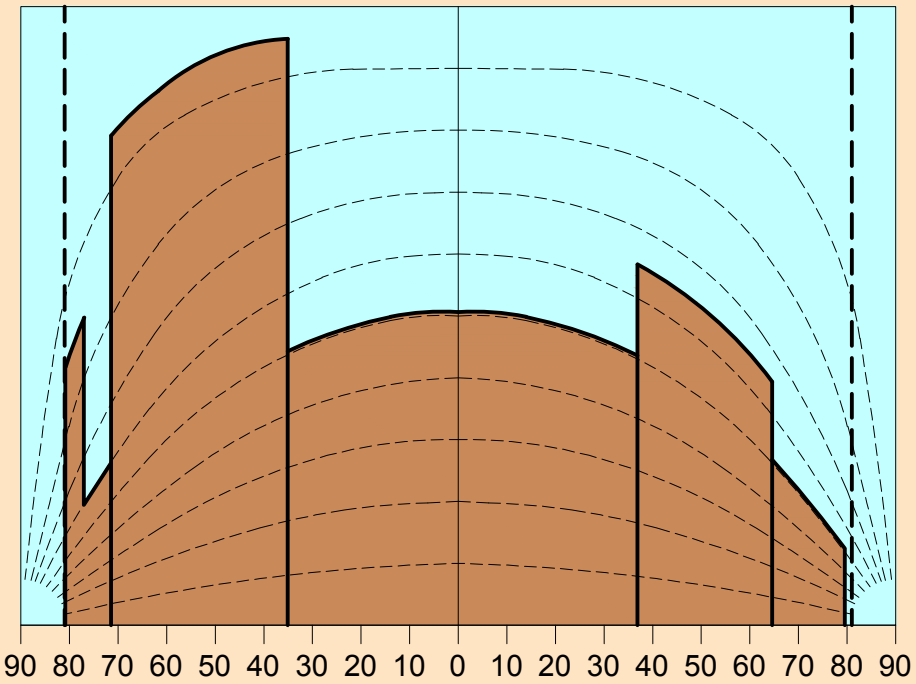

Proposed
Obstruction of
Skyplane = 78.8%
90 80 70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90

Existing

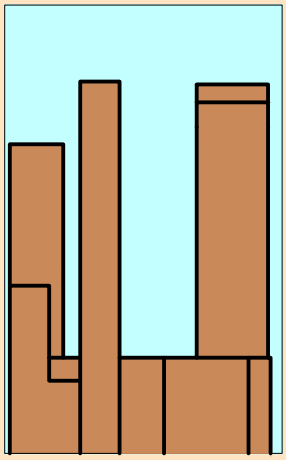
Obstruction of
Skyplane =66.4%

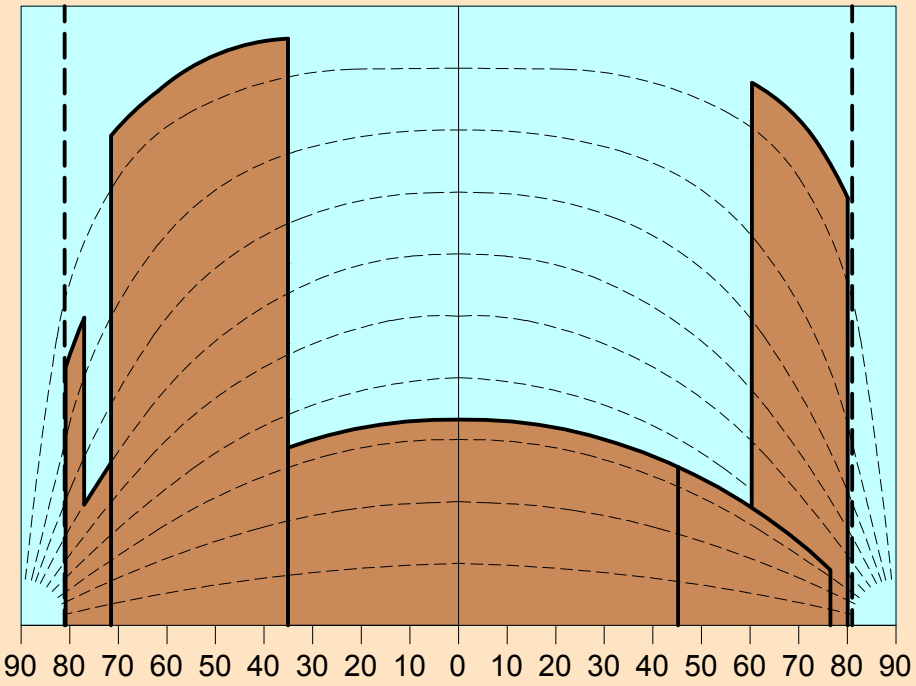




Proposed

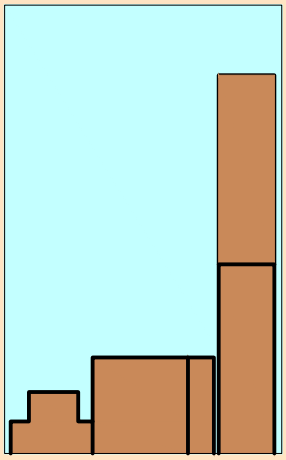
Obstruction of
Skyplane = 70.1%

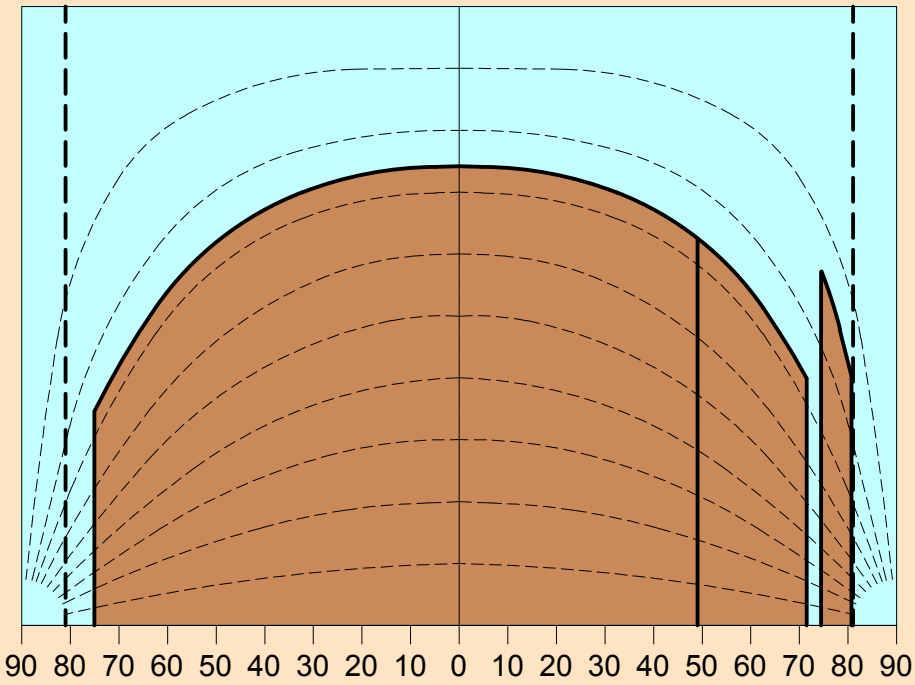




Existing

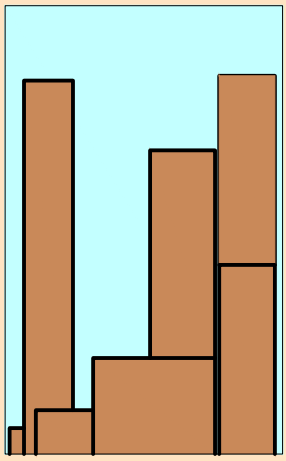
Obstruction of
Skyplane = 70.7%

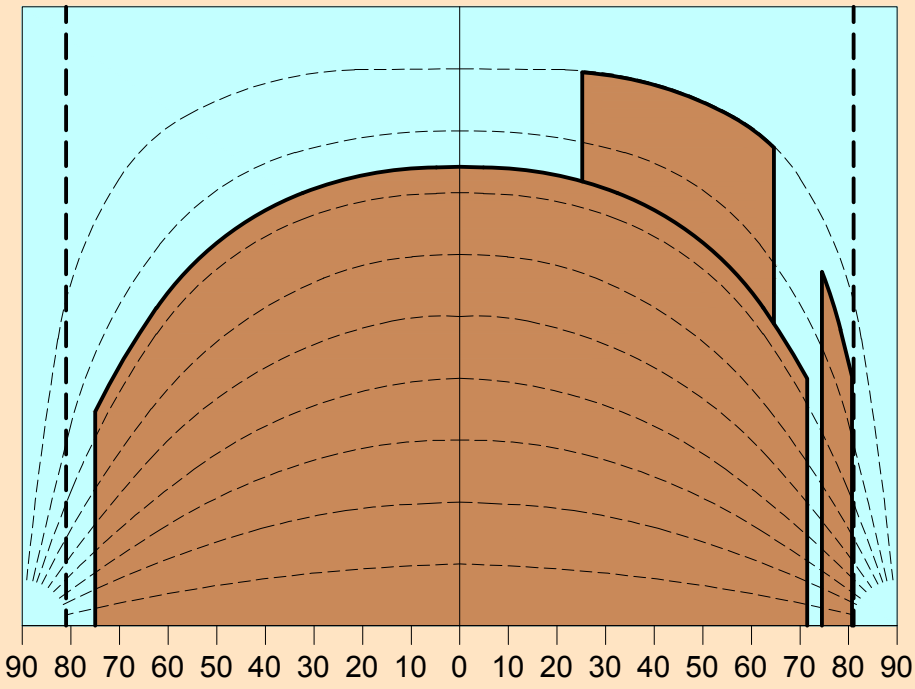




Proposed

Obstruction of
Skyplane = 79.1%





3

Urban Design

This chapter describes the existing urban context of the Project Site, and discusses the planning principles and design goals for the Project. It also describes the urban design characteristics (i.e., height and massing, character and exterior materials and signage) and public realm improvements, including landscaping, for the Project. Supporting graphics include view perspectives, building floorplans, building sections, building elevations, and massing diagrams.

3.1 Summary of Key Findings and Benefits

The Project represents a substantial design and functional upgrade to the Project Site and provides a number of benefits to both the immediate neighborhoods and the City of Boston. These benefits include providing public open space, improving retail vitality, providing first class office space and high quality residential space in this highly visible and accessible location. In addition, the Project offers substantial benefits to the existing on-site public transit infrastructure. The design for each of the Air Rights Development Parcels will dramatically improve the character of the public realm and neighborhood access at many levels, and the area will be significantly enhanced by the urban design and architectural character of the Project. Key urban design benefits include:

Improved Street and Pedestrian Environment –

- The Project will create a high-quality continuous street frontage activated by vibrant and engaging ground floor uses such as retail and restaurant spaces, and residential and commercial building lobbies. Through the use of glass facades wherever possible, the Project will provide transparency and create an inviting, safe and accessible ground-level experience for pedestrians.
- The Project will provide a greatly improved street-level experience with the removal of the two existing concrete parking drums on the Garage West and Garage East Parcels, the removal of a section of deck along Stuart Street, and the rationalization of the existing service and parking area located under the Garage at the rear of abutting properties along Stuart Street.
- The Project will provide a significantly upgraded streetscape, including new sidewalks, street lighting, landscaping and other public amenities along Dartmouth, Stuart and Clarendon Streets, consistent with the BTD Complete Streets guidelines.
- With the development of the Garage West Parcel, the Project will create a new Station entrance on Stuart Street and a new indoor, weather-protected accessible through-block connection to the Station from Stuart Street,

flanked by new retail improvements, thus increasing neighborhood connectivity and improving public safety within the district.

- With the development of the Station East Parcel, the Project will create a new Station entrance on Clarendon Street and a new indoor, weather-protected accessible through-block connection to the Station from Clarendon Street, flanked by new retail improvements, thus increasing neighborhood connectivity and improving public safety within the district.
- With the development of the Station East Parcel, a new 11,000 square foot public plaza will be delivered off Clarendon Street, adding to the neighborhood's inventory of open space and creating connections to other area parks, including the Southwest Corridor Park and Freida Garcia Park.
- With the development of the Station West Parcel, the existing open space on Dartmouth Street will be improved to offer an attractive public plaza connected to an expanded and relocated crosswalk, dramatically improving the connection with the Southwest Corridor Park and creating a welcoming civic entrance to the Station.

Improved Accessibility –

- The Project will enhance accessibility throughout the Site by regrading sidewalk slopes where possible, providing generous sidewalk widths that meet or exceed BTD's Complete Street Guidelines, and delivering the aforementioned fully enclosed, accessible connections from Stuart and Clarendon Streets to the Station with the development of the Garage West and Station East Parcels, respectively.
- With the development of the Garage West Parcel, the Project will create a new accessible drop-off lane along Stuart Street, in proximity to the future new Station entrance.
- With the development of the Station East Parcel, the Project will create a new accessible drop-off lane serving both the Project and the Station, in proximity to the future new Station entrance.
- With the development of the Station East Parcel, accessibility to the Station will be significantly improved through the addition of redundant elevators to the MBTA Orange Line and Commuter Rail tracks 1/3 and 2, where feasible.
- With the development of the Station West Parcel, the Project will enlarge the Dartmouth Street crosswalk, significantly improving pedestrian safety and enhancing the link between the Station and the Southwest Corridor Park.

Architecture –

- The Project proposes high quality architecture that is responsive to the surrounding context while creating signature buildings that contribute to the city's progressive architecture.

› The Project reinforces the urban "high spine" planning strategy, while designing the buildings to minimize wind and shadow impacts on surrounding neighborhood public space resources, such as Copley Square, the Southwest Corridor Park, and Frieda Garcia Park.

3.2 Neighborhood Context

As described in Chapter 1, *Project Description*, and illustrated in Figure 3.1, the Project Site is roughly bounded by Dartmouth Street to the west, Stuart Street and Trinity Place to the north, Trinity Place and Clarendon Street to the east, and the southern property line of the Station to the south. It is subdivided into four (4) Air Rights Development Parcels: Garage West Parcel and Garage East Parcel, which together encompass the current extent of the Garage plus a small amount of adjacent terra firma; Station East Parcel, over the existing bus drop-off; and Station West Parcel, over the existing Station building.

The Project Site is located primarily within the Stuart Street District (SSD or the "District"), at the intersection of three of Boston's historic neighborhoods – Back Bay, South End and Bay Village. The SSD is bounded by St. James Avenue to the north, Dartmouth Street to the west, Columbus Avenue to the south and Arlington Street to the east. As described in Section 3.3, the Project has been designed to be respectful of the character of the surrounding neighborhoods and the spirit of the SSD.

The architectural character of the Back Bay, South End and Bay Village neighborhoods is typified by three- to six-story brownstones flanking tree-lined streets. In addition to being home to some of Boston's most iconic structures, two linear green spaces give the Back Bay further distinction: the Commonwealth Avenue Mall links the Public Garden and the Fens as part of Boston's Emerald Necklace, and the Esplanade edges the Charles River. The South End is delimited along its northern border by the South West Corridor Park and defined by its characteristic brick bow-front townhouses built around a series of shared pocket parks, many with elegant fountains. In 1973, the South End was listed on the National Register of Historic Places as "the largest urban Victorian neighborhood in the country." To the east of the Project Site across I-90 lies the Bay Village Neighborhood, which is the smallest officially-recognized neighborhood in the City of Boston. It is characterized by a narrow, irregular street grid that encourages a quiet and pedestrian-friendly environment, and contains townhomes in a variety of architectural styles, including Federal, Greek Revival and Victorian. The Boston Public Garden and the Boston Common are located just two blocks away from the northern edge of Bay Village.

As further described in Chapter 8, *Historic Resources*, there are a number of historical architectural landmarks in the Project's vicinity, including Trinity Church, the Boston Public Library and the New Old South Church, as well as modern icons of the City such as the Prudential and 200 Clarendon Towers. Copley Square provides a proper civic foreground to these landmarks.

In proximity to the Project Site, the urban fabric of the Back Bay and South End neighborhoods is generally consistent in its respective massing and scale along Dartmouth and Clarendon Streets north of Boylston Street (Back Bay) and south of Columbus Avenue (South End). At the Project Site itself, however, this consistent fabric is interrupted as the Garage West and Garage East Parcels are dominated by the eight-story concrete Garage completed in 1970, and the Station West and Station East parcels contain the 1987 Kallman, McKinnell and Wood Station building and an under-used bus drop-off, respectively.

As described in greater detail in Section 1.2.2, although neighboring parcels have been recently redeveloped or are planned for redevelopment, the Project Site has remained relatively untouched since its initial construction in the 1970's and 1980's, largely due to the challenges imposed by the fact that the Project Site spans I-90 and seven rail lines serving the Station. The presencs of the bus drop-off and ventilation building on the Project Site are also impediments to development.

The Garage sits on top of a structural deck that spans both the eastbound and the westbound sections of I-90. Two full height concrete drums of approximately 70 feet in diameter, adjacent to Trinity Place and Clarendon Street, act as entry to and exit from the Garage, respectively. In addition, adjacent to the existing bus drop-off, a full service entry and exit point provides access to and from Clarendon Street.

The structural deck spanning I-90 has a significant impact on the existing pedestrian experience along Dartmouth, Stuart, and Clarendon Streets. Stairs, concrete planters, and concrete walls define the majority of the current street wall in this area. Retail storefronts facing Dartmouth Street are deeply recessed from the face of the Garage above, and appear dark and inactive, accessible by a stair and a ramp bridging the height difference from the sidewalk, which is up to six (6) feet. See Figure 1.4a.

Further south on Dartmouth Street the Station West Parcel is occupied by the Station building. The Station serves MBTA Orange Line customers, four (4) Commuter Rail lines (Franklin Line, Needham Line, Providence/Stoughton Line, Framingham/Worcester Line), as well as long-distance AMTRAK travelers. Conceived as a major transportation hub for the adjacent neighborhoods, the Station building is constructed of concrete, glass, and brick with signature glulam wood arches supporting the main Station Concourse. See Figure 1.4d.

The Stuart Street sidewalk is dominated by a concrete wall that is up to 13 feet tall, and the Garage entry drum at the intersection with Trinity Place. See Figure 1.4a. Access to the existing through-block connection from Stuart Street to the Station is limited and not designed to be accessible. The 13-foot height difference from the Stuart Street sidewalk to passageway level is only bridged by a stair at the corner of Dartmouth and Stuart Streets and another stair adjacent to the Garage entry drum. This passageway, which provides access to the Garage and Station, has a "back of house" character, with no retail storefronts or other active uses flanking it, and it partly overlooks the MassDOT service road and the Commuter Rail tracks below.

The existing pedestrian experience along Clarendon Street at the Garage East Parcel is characterized by the Garage exit drum located south of the YWCA building, the

MassDOT-controlled service road leading to the On-Ramp, a small retail storefront located above street level at deck level and the full service Garage entry and exit previously described. See Figure 1.4b.

Further south on Clarendon Street, the Station East Parcel is home to the existing MBTA bus drop-off, a large, concrete deck spanning the seven rail lines below. The Station East Parcel is surrounded by the concrete Garage façade to the north, the Station building to the west, 285 Columbus Avenue and 131 Dartmouth Street to the south. The sidewalk along Clarendon is broken up by the MBTA ventilation tower located in the southeast corner of the parcel. The ground floors of the abutting buildings to the South are designed as back of house / loading areas. See Figure 1.4c.

3.3 Planning Principles and Design Goals

The Project is planned to be a vibrant mixed-use development, combining high-quality sustainable architecture with a design that complements the urban fabric at multiple scales - city, district and pedestrian. See Figure 3.2a-p for renderings of the proposed Project.

The Project's addition of the commercial building at the intersection of Dartmouth and Stuart Streets, as well as the two residential buildings along Clarendon Street, will reinforce Boston's "high spine" planning strategy, which was developed to preserve the character of the City's historic neighborhoods by concentrating growth between them and using new development to stitch disconnected neighborhoods together into a continuous urban fabric. Although being planned and designed holistically, the buildings will be visually distinct and will contribute to the varied skyline of Boston. See Figures 3.6a-p. The Project will also reinforce the improvements of surrounding recently completed and planned developments, including projects approved at Copley Place, 40 Trinity and 380 Stuart Street.

At the same time, although the zoning mechanism for the Project is an amendment to the existing PDA No. 2 [1], at the district scale, the Project is highly responsive to the vision and planning goals established in the recently-enacted SSD, particularly the height and density guidelines, with which the Project wholly complies. As described in the BPDA Scoping Determination, the Preferred Alternative is "exemplary in its strong adherence to the Stuart Street Design Guidelines." The SSD was the result of a multi-year planning process involving numerous area stakeholders, organized to propose development guidelines and zoning recommendations for the Stuart Street corridor. The Project fills in existing urban voids with vibrant and active uses, defines street walls aligned with the surrounding context, improves transit access, creates public open space, and strongly improves the District's architectural quality and physical character. Urban vitality originating

[1] As set forth in greater detail in Section 1.6.1, zoning compliance for the Project as determined by PDA No.2 approval, is appropriate.

from this thriving and vibrant mixed-use Project will create an improved quality for living and working in the District.

At the pedestrian scale, in order to foster a positive street-level experience, neighborhood connectivity and convenience, and support public safety, the Project provides permeability throughout the Project Site wherever possible. New entrances and through-block connectors from Stuart and Clarendon Streets into the Station simultaneously improve Station identification and access, create porosity through the Project Site and help to knit together the adjacent neighborhoods. Furthermore, the Project incorporates specific design strategies to limit wind and shadow impacts on sidewalks and nearby public open spaces and it wholly conforms to the 2-hour shadow limitation on Copley Square, preserving, and even improving the quality of the pedestrian experience.

The podium of the commercial building at the Garage West Parcel as well as the low-rise portion of the residential building at the Garage East Parcel will define a pedestrian-friendly street wall and complement existing proportions and urban alignments of surrounding buildings. The existing formless corner at Dartmouth and Stuart Streets, as well as the space currently occupied by the Garage exit drum, will be infilled with thoughtfully scaled street frontage. On the Station East Parcel, the existing gap in the urban fabric created by the expansive and largely vacant bus drop-off will be transformed into an active public plaza along Clarendon Street, providing a vibrant and civic entrance into the Station. In addition, the one-story vertical expansion of the Station will give it a more appropriate scale in relationship to existing and proposed surrounding buildings, including 131 Dartmouth Street and Tent City.

3.4 Air Rights Parcels Urban Design Summary

The following section describes the Project's urban design goals and characteristics for each Air Rights Parcel. The descriptions include a summary of building design concept and development, height and massing, character and exterior materials and signage.

3.4.1 Garage West Parcel

Building Design Concept and Development

The proposed 26-story commercial building consists of a 13-story mixed-use podium, and a 13-story office high-rise constructed in place of the existing Garage at the corner of Dartmouth and Stuart Streets. Structurally, the existing Garage is divided into three (3) sections, separated by expansion joints running in the north-south direction. The proposed design assumes the demolition of the westernmost section, as well as the entry drum, in order to provide terra firma for the structural core of the Garage West building. Due to the very limited amount of terra firma and shallowness of the Project Site, the building's structural core is oriented in an east-west direction, which also allows for the maximization of active ground floor space

along Stuart Street. The building is designed not to place any additional load on the deck spanning I-90, by transferring building loads back to the core.

The podium contains ground floor retail at the Dartmouth Street level, five (5) levels of reconstructed and architecturally screened parking and seven (7) commercial office floors. At the Stuart Street level, two (2) office lobbies are provided, one at the corner of Dartmouth and Stuart Streets and the other further to the east along Stuart Street. The distinct lobbies allow building access to be separated into a high-rise lobby and a low-rise lobby, should the building be tenanted in that manner. Farther to the east and also accessed from Stuart Street is a new Station entrance via a public through-block connector (See Figure 3.7a-b and a retail/restaurant space at the corner of Stuart Street and Trinity Place).

Due to the change in grade around this Parcel, the second level above Stuart Street is directly accessible from Dartmouth Street. This level sits above the I-90 deck and houses approximately 22,000 square feet of new retail and restaurant space in addition to the through-block connector to the Station. New parking levels at the intermediate podium floors connect directly to the existing Garage levels, allowing the existing internal ramps to continue to be used for circulation. The last seven floors of the podium are designed for large floor-plate office use and the feasibility of an office roof deck on top of the podium is being explored by the Project Team.

The east-west oriented, 13-story high-rise portion of the building is centered on the structural core, ensuring workspaces will be optimized for daylight and views. The massing is broken down by inset floors located every fifth floor and the undulating, cantilevered facades create a dynamic architectural composition, while unifying the podium and the high-rise elements into a cohesive design. In addition, both of these façade design strategies, along with the podium itself, help disseminate wind captured by the building façade and mitigate its impact at the street level. At the top, the building is set back and stepped to respect the two (2)-hour shadow limitation on Copley Square (calculated collectively across all four parcels), allowing for potential office amenity decks on floors 22 and 26.

In addition, the Project Team is exploring the feasibility of a pedestrian bridge connection across Trinity Place between the through-block connector at the Garage West Parcel and the second floor of the proposed 40 Trinity building. The bridge would enhance public pedestrian circulation by providing a direct, accessible and weather-protected connection from the Station to the 40 Trinity building, which houses a hotel and restaurant space in addition to residential units. Architecturally, the bridge would help screen the service and loading areas of the Garage West and 40 Trinity buildings from the streetscape along Stuart Street.

The Proponent is also exploring the expansion of this bridge across Stuart Street in order to connect the Station to the 200 Clarendon building, further enhancing transit access, pedestrian safety, and neighborhood connectivity (See Figures 3.2h-i). Currently, along Stuart Street, there are three such bridges in the immediate vicinity of the Project, each providing an important weather-protected and accessible connection across the busy thoroughfare of Stuart Street. This new bridge would

provide a connection at a critical point along Stuart Street where the volume of pedestrians supports the need for alternative routes in addition to the sidewalks.

I-90 Ramp and Garage West Base and Alternate Schemes

As described in Chapter 1, *Project Description*, with the demolition of the existing Garage drums, a new replacement exit from the Garage is needed to minimize traffic impacts to the surrounding neighborhoods, as explained in detail in Chapter 4, *Transportation*. In order to address this issue, and due to the potential closure of the On-Ramp, two schemes are presented for the development of the Garage West Parcel.

In the Garage West Base Scheme, shown in plan-view in Figures 3.3a-i and section-view in Figures 3.4a and 3.4d, where the On-Ramp remains open, a new Garage exit opens on to Dartmouth Street just north of the Station. This exit effectively mirrors the condition at the existing full service entry/exit on Clarendon Street and would be managed by Garage personnel and/or a police detail to avoid pedestrian conflicts. In this scheme, due to the On-Ramp's location, the building's loading dock is located somewhat closer to Stuart Street, creating more of a visual presence for loading operations and resulting in a smaller retail space at the corner of Trinity Place and Stuart Street.

In the Garage West Alternate Scheme, where the On-Ramp is closed, it is possible to locate a new Garage exit within the space of the MassDOT-controlled service road, as shown in plan-view in Figure 3.3j-r and section-view in Figure 3.4e-f. Since the On-Ramp is closed, there will be no traffic conflicts with vehicles accessing the On-Ramp from Clarendon Street. This scheme offers less pedestrian conflict and allows the building's loading dock to be tucked further into the Project Site, limiting its visual presence from Stuart Street. The through-block pedestrian connection to the Station and the retail space at the corner of Trinity Place and Stuart Street also become more viable. In addition, with the On-Ramp closure, a number of additional safety-related improvements could be made to MassDOT infrastructure, including an emergency pull off in the I-90 tunnel, emergency pedestrian egress from the tunnel, and additional ventilation equipment within the tunnel.

Alternate Garage Exit Location

As requested by the Secretary of Energy and Environmental Affairs in the Certificate on the ENF, the Proponent has explored an alternative Garage exit location to the Dartmouth Street exit in the event the On-Ramp remains open. Upon exhaustive study, the only viable alternative is to provide a helix ramp at the corner of Stuart Street and Trinity Place, where there is enough terra firma to accommodate a ramp designed to bring vehicles down to street level from the level of the Garage. See Figure 3.3s-u. This ramp would exit onto Trinity Place, from which westbound vehicles could access the Huntington Avenue I-90 on-ramp, and north and eastbound vehicles could access Stuart Street.

Despite offering an adequate vehicular connection to the regional transportation infrastructure, placing the exit in this location would eliminate the possibility of the

new Station entrance and pedestrian through-block connector from Stuart Street to the Station and the retail space at the corner of Stuart Street and Trinity Place. In addition, the loading dock for the Garage West Parcel would be severely compromised for a commercial building of this size and the possibility of a pedestrian bridge connecting the Garage West Parcel to the 40 Trinity Building is also eliminated. For these reasons, this alternative exit location is judged inferior and is not being further pursued.

Height and Massing

As described above, the commercial building consists of a 13-story podium, and a 13-story high-rise. The podium is set back approximately 18 feet from the property line on Dartmouth Street to align with existing neighboring street wall conditions. No setbacks are required along Stuart Street and the podium street wall is consistent with that of neighboring buildings. The podium extends approximately 198 feet along Dartmouth Street, and approximately 230 feet along Stuart Street. The typical podium floor plate is approximately 40,500 square feet in both the Garage West Base and Alternate Schemes.

In the Garage West Base Scheme, the location of the On-Ramp translates to a slightly trapezoidal structural core and high-rise building floor plates. The typical high-rise floor plates range from approximately 19,000 to 23,000 square feet and the west façade is approximately 120 feet long and the north façade is approximately 193 feet in length. The total building area is approximately 606,400[2] square feet and the FAR is approximately 8.81.

In the Garage West Alternate Scheme, the structural core is regularized and the high-rise building floor plates are rectangular. The typical high-rise floor plates range from approximately 19,500 to 23,000 square feet, and the east and west façades are approximately 135 feet long, while the north and south façades are approximately 193 feet in length. The total building area is approximately 618,400 square feet and the FAR is approximately 8.98.

In both the Garage West Base and Alternate Schemes, the building height is approximately 365[3] feet. See Figures 3.6a-b and 3.6g-p for massing of the two schemes.

[2] Unless labeled otherwise, all areas provided herein are described in gross floor area as such term is used in the definition of "Floor Area Ratio" in the Code; therefore, such areas specifically exclude floor area devoted to garage use, whether or not in the basement of a building or serving residential uses, mechanical equipment, storage, service and loading areas, and areas serving as access to, egress from or use by public transit services, including pedestrian bridge connections providing access to such public transit services, whether directly or indirectly as part of the overall Project. Please note that given the fact that the majority of the Project Site is on and over air rights, it is not possible to reconstruct parking spaces beneath one or more of the buildings, and thus this filing and PDA No.2 as amended will expressly exclude the square footage allocated to such parking for the purposes of calculating FAR.

[3] Notwithstanding the definition of "Building Height" set forth in the Code, with respect to each of the Air Rights Development Parcels, the following shall be the "grade" for each: (i) Garage West: 20'-6" BCB; (ii) Garage East: 19'-2" BCB; (iii) Station East: 31'-6" BCB; (iv) Station West: 29'-2" BCB; and the "Building Height" shall be the vertical distance from said "grade" to the top of the structure of the last occupied floor; Provided further that any elevator penthouse, stairway bulkhead or any other roof structure

Character and Exterior Materials

The commercial office lobbies along Dartmouth and Stuart Streets will employ double-height transparent glass, blurring the boundary between indoor and outdoor and activating the streetscape.

Architecturally, both the podium and the high-rise portion of the building break down the massing by combining several floors into multi-story stacks, which creates unity but also allows the building to express the various uses through different façade characteristics. For example, podium-level parking floors, which are at minimum 26 feet above the sidewalk level, will be architecturally screened to mask the parking decks and integrate those levels into the overall building design. Screening materials could include folded and/or perforated metal panels that create a rich texture to balance and integrate with the glass storefronts below, and the office facades above.

At the high-rise portion of the building, the stacks shift in the east-west direction, some corners pushing in, some out, reinforcing the visual concept of stacked components. Apart from the visual effect, the shifting volumes allow the Project flexibility to provide outdoor terraces at setback floors, and to mitigate pedestrian level wind impacts. The exterior wall of the upper podium and high-rise portion of the building is anticipated to be a high-quality unitized, curtain wall system. The curtain wall will have vision glass with high-performance coatings and spandrel panels, where necessary, and will be high in light transmittance, while balancing reflectivity and energy performance requirements in order to minimize glare. See Figures 3.2a-c and 3.2f-g for renderings of Garage West and Figures 3.5a-b for Garage West elevations from Dartmouth and Stuart Streets.

Signage

Office lobby entrances will be thoughtfully designed with canopies and building identification signage appropriate for the building scale. Office tenant identification signage may also be provided on the building facades for low-rise and high-rise anchor tenants. Retail signage will be thoughtfully located and designed to generate an inviting streetscape. Appropriate and visible Station identification signage complying with MBTA standards will mark the new Station entrance on Stuart Street to the through-block connector.

3.4.2 Garage East Parcel

Building Design Concept and Development

The proposed 28-story residential building fronts Clarendon Street and is located just south of the existing YWCA building, at the intersection of Trinity Place. The building's façade along Clarendon Street aligns with the existing street wall of

built for the purpose of accessing a roof deck or roof terrace as well as the said roof decks and roof terraces and other roof top amenities themselves, shall be excluded from the calculation of building height under the PDA.

abutting properties and the building's structural core sits on a small amount of terra firma nestled between the YWCA and the Garage. As a result, the building has a side core and the first eight (8) levels have small floor plates.

The residential lobby at the ground floor faces Clarendon Street and creates an active street frontage, while the loading dock is tucked into the rear of the building, adjacent to the loading areas of the abutting properties and accessible from Trinity Place. Above the Garage, the building's footprint extends to the south and is supported by six (6) mega-columns threaded through the existing Garage. This requires a substantial structural transfer floor at level nine to support the residential levels above. At the top of the building, the floor plate is set back along the east and the north edges, allowing for a landscaped residential amenity deck with views toward the Charles River, Downtown Boston and Boston Harbor. The building has been designed to cast no shadow on Copley Square. See Figures 3.3a-i for plan-view and Figures 3.4c-d for section-view.

Height and Massing

The footprint of the building base is set on the property line, aligning with the Clarendon Street wall created by the existing adjacent properties. The east façade is approximately 65 feet in length along Clarendon Street and the north façade is approximately 105 feet and is set back 30 feet from the existing YWCA building (doubling the current distance of 15 feet to the face of existing Garage exit drum).

Above the existing garage, a 15-foot setback is provided from Clarendon Street for the high-rise portion of the building and the footprint expands toward the south to be approximately 140 feet along Clarendon Street, approximately 107 feet at the west façade, and approximately 90 feet at the north and south facades.

The floor plate is approximately 4,600 square feet at the base and approximately 10,100 square feet on a typical high-rise floor. The building rises 28 stories to a height of approximately 305 feet. The total building area is approximately 222,100 square feet, and the FAR is approximately 4.19. See Figures 3.6c-f and 3.6k-p for the Garage East massing.

Character and Exterior Materials

The residential lobby faces Clarendon Street and will use full height transparent glass to activate the façades and enliven the adjacent sidewalks. The patterned façade evokes vertical movement and is textured by the addition of balconies and multi-story cutouts. The location, shape, and size of these cutouts will be refined as the design advances to optimize sightlines and views. The exterior walls will consist of a high performance enclosure, which may include glass, masonry, and/or metal panels. Vision glass will have high-performance coatings and will be high in light transmittance, while balancing reflectivity and energy performance requirements in order to minimize glare. See Figures 3.2l-m for renderings of Garage East and Figure 3.5c for the elevation from Clarendon Street.

Signage

The residential lobby entrance will be scaled appropriately, and canopies and signage elements will be designed to complement the architectural identity and the residential nature of the building.

3.4.3 Station East Parcel

Building Design Concept and Development

The proposed 35-story residential building sits between the existing Station building and Clarendon Street. The building's form and location on the Project Site is primarily driven by the absence of terra firma on the Station East Parcel. The structure for the building will be threaded through the existing concrete deck, landing between the rail lines in the platforms below. The building is designed with a central core, allowing all elevations to have activated and transparent facades.

At the ground level, a new grand civic entrance to the Station and a direct stair connection to the Orange Line are provided off Clarendon Street. Inside, the pedestrian passageway to the Station is lined with retail and creates a cohesive connection to the existing Station. The residential building lobby is tucked into the southernmost portion of the building's footprint. All of these uses front onto a new landscaped pedestrian plaza that serves as a forecourt to the new Station entrance and creates an animated public space offering connectivity to other area open space resources, including the Southwest Corridor Park, Frieda Garcia Park and Copley Square. A new drop-off lane off Clarendon Street is also provided to allow for vehicular and service access to the building and the shared loading dock which serves both the Station and the Station East residential building. Located at the southwest corner of the Parcel, the loading facility faces the existing back of house and loading docks of 131 Dartmouth Street and 285 Columbus Avenue.

Due to the severe constraints of building over active rail lines, a significant structural transfer floor occupies the entire second level of the building. To create an inviting street presence, a second level of retail is proposed above the new Station entrance and residential lobby. The third floor of the high-rise contains residential amenity uses and is connected to an outdoor residential roof garden overlooking the public plaza and Clarendon Street. The floors above contain residential units. At the top, the building is set back along the east, allowing for the creation of a residential amenity deck with views toward Downtown Boston and the harbor. The building is designed to have no shadow impact on Copley Square. See Figures 3.3a-i for plan-view and Figures 3.4b-c for section view.

Height and Massing

The two-story podium is approximately 40 feet tall and is set back approximately 80 to 109 feet from the property line along Clarendon Street making the east façade at street level approximately 114 feet in length.

The high-rise portion of the building is set back approximately 99 to 129 feet from the property line along Clarendon Street, with east and west facades of approximately 114 feet and north and south facades of approximately 108 feet in length. The typical high-rise floor plate is approximately 11,700 square feet, the total building area is approximately 387,000 square feet, and the FAR is approximately 10.07. The building height is approximately 400 feet. See Figures 3.6c-p for Station East massing.

Character and Exterior Materials

The residential lobby faces the proposed public plaza along Clarendon Street and will use full height transparent glass to activate the façades and enliven the adjacent public realm. The patterned façade evokes vertical movement and is textured by the addition of balconies and multi-story cutouts. The location, shape, and size of these cutouts will be refined as the design advances to optimize sightlines and views. The exterior walls will consist of a high-performance enclosure, which may include glass, masonry, and/or metal panels. Vision glass will have high-performance coatings and will be high in light transmittance, while balancing reflectivity and energy performance requirements in order to minimize glare. See Figures 3.2j-m for renderings of Station East and Figure 3.5c for the elevation from Clarendon Street.

Signage

Appropriate and visible Station identification signage complying with MBTA standards will mark the new Station entrance to the through-block connection at the Station East Parcel. The residential lobby entrance will be scaled appropriately, and canopies and signage elements will be designed to complement the architectural identity and the residential nature of the building. Retail signage will be thoughtfully located and designed to generate an inviting streetscape.

3.4.4 Station West Parcel

Building Design Concept and Development

The Project proposes a vertical expansion of the Station, adding a single level of retail to either side of the Station Central Hall, previously referred to in the ENF and PNF as the "Station West Base Scheme". In response to agency and community feedback received to date, the Proponent decided to abandon the "Station West Alternate Scheme" presented in the ENF and PNF. The Alternate scheme contemplated the addition of two levels of retail above the existing Station Concourse, including one level that spanned over the Station Central Hall. By limiting the retail expansion to a single story and further reducing the height of that story by four (4) feet, the Project addresses concerns raised about preserving the architectural intent of the original structure, while still augmenting the Station's scale to respond to area development and expanding the available amenities for Station patrons.

The signature arched façade of the Station will be retained as an important civic gesture and its prominence reinforced through its framing by adjacent transparent elements. In addition, the footprint of the one-story addition on the north side has been substantially reduced to produce a more marketable retail space. The design on both sides includes skylights in order to allow natural light into the Station from the south and north. The expansion will be accessed directly from the existing Station Concourse by a combination of new elevators, stairs, and/or escalators and the two sides may be linked by a pedestrian bridge spanning the Station Central Hall.

Along Dartmouth Street, the new retail level is designed to step back from the floor below it, allowing the original façade to remain dominant while also creating an outdoor space that further activates the Station and the streetscape with new seating and landscaping overlooking Dartmouth Street. See Figures 3.3a-d for plan-view and Figures 3.4a-b for section-view.

Height and Massing

The height and massing of the retail expansion is designed to contribute to activation of the Dartmouth streetscape. The single-story addition totals approximately 30,000 square feet across both sides and is 42 feet above Dartmouth Street with an FAR of approximately 0.46. See Figures 3.6k-m for the massing of Station West.

Character and Exterior Materials

The retail expansion is designed to be minimal and light, integrating with the surrounding existing and future structures, and allowing the original Station building to maintain its architectural identity. The materials for the addition will be primarily glass and metal panel, detailed to respect the rhythm of the existing building, but also to read as a sensitive yet modern intervention. See Figures 3.2a-e for renderings of Station West and Figure 3.5a for the elevation from Dartmouth Street.

Signage

At the ground level, existing Station identification and retail tenant signage will remain or be modified, as necessary, to comply with MBTA wayfinding requirements. New retail signage at the vertical expansion will be thoughtfully located and designed to generate an inviting streetscape.

Integration with Station Concourse Improvements Project

As discussed in Section 1.1.1, in anticipation of developing the four (4) future Air Rights Development Parcels, the Proponent agreed to pre-pay the rent on the existing 99-year MassDOT lease so that these substantial funds could be used to make necessary Station upgrades. A portion of the rent proceeds are being used by the MBTA for a track-level ventilation improvement project. In addition, the Proponent agreed to manage and execute the upgrades at the Station Concourse

level and to assume property management responsibilities of the Station Concourse level for the duration of the MassDOT lease. Please refer to Appendix E for a detailed description, plans and renderings of this renovation project.

The Station West retail expansion has been designed to integrate with and complement the Station Concourse Improvements project. The vertical transportation that will be required to reach the second level is tucked into the retail space that will be developed as part of the Station Concourse Renovation, thus preserving circulation and waiting area at the Station Concourse level. The second level addition will include skylights along the north and south sides of the Station's Central Hall, thus allowing natural light to continue to enter through the existing clerestory windows. Furthermore, the second level retail space will be fully heated and cooled, which will create a thermal buffer between the Station Concourse and the outside, further improving the thermal comfort within the Station Concourse. See Figures 3.7c-f.

3.5 Site Design

The Project Site design strategy for the Project is focused on creating pedestrian-friendly and adequately sized sidewalks and streets through the use of clean, modern lines forming a series of clearly defined pedestrian corridors and spaces. The design employs orderly lines and materials to organize pedestrian and vehicular circulation, create a safe environment and acknowledge the inherent multi-modal nature of the Project Site. See Figures 3.8a-f and Figures 3.9a-b for Pedestrian Realm Improvements plans and Circulation and Access plans respectively.

To reinforce the connection between the new buildings and the public way, the Project will rehabilitate the perimeter sidewalks and enhance the public realm to incorporate the BTD Complete Streets design principles. These principles include clearly defined pedestrian routes, bicycle facilities, landscaping and permeable edges, where possible. These strategies will improve public accessibility and better support stormwater management.

3.5.1 Pedestrian Realm Improvements

As illustrated in Figures 3.8a-f and Table 3-1 at the end of this section, the Project includes significant improvements to the streetscape on the Project Site. Specific improvements proposed for each Air Rights Development Parcel are summarized below.

Station West

The Station West pedestrian realm improvements along Dartmouth Street will create a new 6.5-foot furnishing zone that will include unit pavers, street trees, bike racks, trash receptacles, benches and street lighting. A generous 15-foot wide pedestrian zone will be provided, exceeding even the maximum dimension recommended by BTD's Complete Street Guidelines by three (3) feet (See Table 3-2 below), to

accommodate pedestrian circulation to and from the Station. South of the Station entrance along Dartmouth Street, the furnishing zone will transition to a 1.5-foot dimension that meets the minimum recommendation. This allows for the pedestrian zone to transition to accommodate an existing raised outdoor restaurant patio. Within this area the pedestrian zone ranges from17.75 feet to 13 feet, which still exceeds the minimum recommendation.

The paving at the entrance to the Station will be upgraded to create a Station entry plaza and will mimic the interior flooring of the Station, creating a visually cohesive experience for pedestrians traveling through the Station from Dartmouth to Clarendon Streets. The Dartmouth Street crosswalk will be relocated to be centered on the Station's Central Hall and the new entrances to be provided as part of the Station Concourse Improvements project (See Appendix E). The crosswalk will also be enlarged to 60 feet wide in order to better serve pedestrian traffic to and from the Station. This crosswalk will also mimic the interior flooring of the Station. Architectural bollards will protect pedestrians on the curb and will prevent vehicular U-turns between the north-bound and south-bound lanes. South of the pedestrian crossing an accessible vehicular drop-off and bus stop area will remain and north of the crosswalk area, a taxi zone will remain, providing access to the Station and reinforcing the multi-modal nature of the Project Site. Public art opportunities may also be considered in this area. See Figure 3.8b.

Garage West

The Garage West Parcel public realm improvements along Dartmouth Street will include creating a 6.5-foot furnishing zone with new unit pavers, street trees, bike racks, trash receptacles, benches and street lighting. A generous 15-foot wide pedestrian zone will be provided, exceeding even the maximum dimension recommended by BTD's Complete Street Guidelines. A flush pedestrian condition with tactile paving to provide warning to pedestrians will be used at the potential vehicular crossing in the Base Scheme along with visual and audible warning devices. To further emphasize pedestrian priority, the material and patterning of the sidewalk will continue across the new Garage exit. At the intersection of Dartmouth and Stuart Street, the crosswalks at the southeast corner will converge to a continuous flush curb with tactile paving and bollards, separating pedestrian and vehicular zones.

Along Stuart Street, the entrance to the office building lobbies and new Station entrance will be highlighted with special paving that will be cohesive with other materials used across the Project Site. A 6.5-foot furnishing with street trees and other street furnishings will be created, dramatically improving the pedestrian experience. At this location, where foot traffic is less than along Dartmouth Street, an ample 11-foot pedestrian zone will be provided. A new accessible vehicular drop-off and bus stop area will provide access to the new Station entrance and through-block connector, as well as to the office lobbies and retail space. New landscape zones at either end of the block will buffer the pedestrian zone from the intersections and drop off areas. Enhanced paving may continue across Trinity Place, creating a

pedestrian-friendly crossing and further buffering the loading and service areas from Stuart Street. See Figure 3.8c for the Base Scheme and 3.8f for the Alternate Scheme.

Garage East

Along Clarendon Street, the Garage East Parcel pedestrian realm improvements in front of the residential tower will include a three-foot furnishing zone with new unit paving. A 9-foot pedestrian zone will be provided with a planting area at the lobby entry flanking the drop-off zone. The dimensions of the furnishing and pedestrian zone exceed the minimum of BTD's Complete Streets Guidelines.

The MassDOT service road leading to the On-Ramp has been modified to better align with the intersection of Stanhope and Clarendon Streets. An enhanced crosswalk with tactile paving and curb bump outs will create a shorter, safer crossing for pedestrians and control traffic speed. South of the access road along Clarendon Street, closer to the Station, the pedestrian zone will be expanded to a generous 15 feet, exceeding even the maximum dimension recommended by BTD's Complete Streets Guidelines, a portion of which will remain covered by the second-floor of the Garage overhang. A 6.5-foot furnishing zone with street trees and other furnishings will also be provided to soften this edge and incorporate it with the streetscape at the Garage East and Station East Parcels. The width of the Garage driveway curb cut will be reduced and realigned, visual and audible warning devices will be incorporated and a flush pedestrian condition with tactile paving to warn pedestrians of the crossing will be utilized, ensuring that pedestrians have the priority at the crossing. To further emphasize pedestrian priority the material and patterning of the sidewalk will continue across the Garage driveway. See Figure 3.8d.

Station East

Further south on Clarendon Street, the Station East Parcel pedestrian realm improvements will include a 6.5-foot furnishing zone with new unit pavers, street trees, bike racks, trash receptacles, benches and street lighting. Here, close to the new Station entrance, the generous 15-foot pedestrian zone will continue until the intersection of Clarendon Street and Columbus Avenue. A new, approximately 11,000 square foot public plaza will enhance the new Station entrance. The plaza will feature paving that mimics the interior flooring of the Station through block connector, creating a visually cohesive experience for pedestrians traveling through the Station from Dartmouth to Clarendon Streets.

The plaza will offer generous landscape treatments in raised planters and will utilize architectural bollards to protect pedestrians from vehicular traffic using the drop-off/service lane. Pedestrian circulation will be prioritized through the use of flush curbs and tactile paving along the edge of the public plaza and where the sidewalk crosses the drop-off lane. To further emphasize pedestrian priority, the material and patterning of the sidewalk will continue across the drop-off lane. Vehicles will enter the drop-off lane through sloped drive aprons outside of the pedestrian path of travel. A new Hubway station is proposed on the north side of the plaza, near the

new Station entrance, reinforcing the multi-modal nature of the Project Site. Opportunities for public art may also be considered within this area. See Figure 3.8e.

Table 3-1 Pedestrian Realm Improvements by Project

Project Parcel	Improvement
Station West	› Relocated and enlarged Dartmouth Street crosswalk with tactile paving at curb ramps and bollards for pedestrian protection › Improved Station entry plaza › New concrete paving within pedestrian zone › New unit paving within furnishing zone that includes new street trees in raised planters, benches, street lights, and bicycle racks
Garage West	› New accessible Station entrance and through block connection from Stuart Street › Widened pedestrian zone with new concrete paving along Stuart Street › New unit paving within furnishing zone that includes new street trees (some in raised planters), benches, street lights and bicycle racks › Improved and reconfigured accessible ramp and stairs at retail entrance on Dartmouth Street › Continuous pedestrian walkway at vehicular crossing › Improved grade slope within pedestrian zone at corner of Dartmouth Street and Stuart Street › Reconfigured crosswalks at Stuart Street that improve accessibility › New accessible drop-off area and bus stop along Stuart Street
Garage East	› New concrete paving within pedestrian zone › New unit paving within furnishing zone that includes new street trees (some in raised planters), benches, street lights and bicycle racks. › Reconfigured crosswalk at Clarendon and Stanhope Streets that increase pedestrian safety and accessibility › The Garage drive width and has been reduced and realigned to Clarendon Street › Improved grade slope within pedestrian zone along Garage façade adjacent to Clarendon Street

Station East	› New accessible Station entrance and through block connection from Clarendon Street › New landscaped public plaza with trees in raised planters › New concrete paving within pedestrian zone › New proposed Hubway station › New unit paving within furnishing zone that includes new street trees in raised planters, benches, street lights, and bicycle racks › Reconfigured crosswalks that increase pedestrian safety and accessibility › New redundant elevator to Orange Line › Potential new redundant elevator to tracks 1/3 and 2 › New vehicular drop-off lane

3.5.2 Incorporation of BTD's Complete Streets Dimensional Guidelines

It is the intent of the Proponent to incorporate the goals of BTD's Complete Street Guidelines, wherever possible. As described in Section 3.5.1 and in Table 3-2 below, the proposed pedestrian realm improvements exceed the minimum recommended dimensions for the Pedestrian Zone in Downtown Commercials Zones, in fact, in most areas, particularly along Dartmouth and Clarendon Streets, the Project exceeds the *maximum* dimension recommended for the Pedestrian Zone to account for the pedestrian volumes in and around the Station. In addition, the Project meets the minimum and preferred dimensions for the furnishing and frontage zones throughout the Project Site.

As described in Section 7.3.2, the Project is also evaluating green initiatives to manage stormwater run-off and smart technologies to improve the everyday user's experience and convenience.

Table 3-2 Complete Streets Guidelines Recommended Streetscape Dimensions (Downtown Commercial Zone)

	Frontage Zone		**Pedestrian Zone**		**Furnishing Zone**	
	Preferred	*Minimum*	*Preferred*	*Minimum*	*Preferred*	*Minimum*
Downtown Commercial District	2′	0′	12′	8′	6′	1.5′
Proposed Conditions						
	Maximum	*Minimum*	*Maximum*	*Minimum*	*Maximum*	*Minimum*
Dartmouth Street	2′	0′	17.75′ (15′ typical)	13′	6..5′	1.5′
Stuart Street	2′	0′	11′	11′	18.5′	6.5′
Clarendon Street	6′ (along Garage)	0′	15′	9′	6.5′	3′

3.5.3 On-Street Parking / Curb Side Uses

Although no new on-street parking is anticipated as part of the Project, four separate and distinct drop-off zones are anticipated to be provided around the Project Site, accommodating public transit stops, taxis stands, and vehicular drop-off uses and further encouraging the multi-modal nature of the Project Site. These locations are intended to provide convenience and safety for public transit users, office tenants, residents and visitors, while also maintaining the traffic flow on the adjacent City streets. See Figures 4.18a-b for Curbside Use plans.

A dedicated handicap passenger drop-off area and MBTA Route 10 bus stop will remain south of the new enlarged Station crosswalk on Dartmouth Street. The drop-off areas to the north of the Station entrance will remain designated for taxis and off-peak commercial deliveries between the hours of 10:00 a.m. and 3:00 p.m.

Along Stuart Street, the existing MBTA Route 502, 503, 504, and 553 bus stop will be greatly improved by dedicating a 100-foot wide pull off area in front of the new Station entrance and through-block connector. The widened sidewalk and clear separation from travel lanes will augment pedestrian safety and improve bus maneuvering and traffic flow. The remaining portion of this area will be dedicated to vehicular drop-off serving the Station entrance, office lobbies and retail space. As

described above, this whole area will be lined with street trees and landscape buffering to further enhance pedestrian comfort and safety.

Along Clarendon Street, the Garage East Parcel will accommodate a modest drop-off area at the residential lobby entry. As previously described, the proposed plaza at the Station East Parcel will accommodate a separated drop-off lane to allow off-street access to the new Station entrance and through-block connector, the residential lobby and the joint service and loading area.

3.5.4 Landscaping and Lighting

Proposed landscaping will incorporate trees and plants species that provide interest year-round, and are well suited for urban conditions and the New England climate. Stuart Street and the northern portion of Clarendon and Dartmouth Streets will allow for plantings within existing terra firma, however, where necessary, raised planters will be utilized to accommodate appropriate soil volumes and drainage for the proposed plantings.

Lighting is integral to pedestrian safety, and for an active and vibrant evening and night streetscape. A variety of different light sources, including vehicular light poles, pedestrian light poles, illuminated bollards and accent lighting will be provided throughout the streetscape furnishings zone and within the plaza areas.

3.5.5 Pedestrian Accessibility

The Project will significantly improve accessibility around the Project Site, and address the goals outlined in the Accessibility Checklist provided in Appendix J at various levels:

<u>In connection with the development of the Garage West Parcel:</u>

- A new drop-off area will be provided along Stuart Street.
- A new accessible through-block connection between Stuart Street and the Station will be provided, including escalators as well as an elevator, to connect the Stuart Street sidewalk to the Station Concourse. Currently only two stairs, one at the corner of Dartmouth Street and the other hugging the existing Garage drum, bridge the up to 13-foot grade difference in this area.
- The existing concrete wall along Stuart Street (up to 13 feet tall) will be replaced by the commercial building lobby, a public entrance to the Station, and a retail/restaurant space at the corner of Stuart Street and Trinity Place.
- The pedestrian realm along Stuart Street will be significantly increased, and include an 11-foot wide pedestrian zone and a 6.5-foot wide furnishing zone that incudes street trees, lighting, benches, and planting.
- The transition between the sidewalk and the retail level above the I-90 deck along Dartmouth Street (up to a six-foot height difference) will be reconfigured to include an improved accessible ramp, planters, seating, and modified stairs.

- Through the proposed improvements, the grading and sidewalk slopes will be improved to increase accessibility at the corner of Dartmouth and Stuart Street.

In connection with the development of the Garage East Parcel:

- A new drop-off area will be provided along Clarendon Street.
- Reconfigured crosswalks will be provided at Clarendon and Stanhope Streets to improve pedestrian safety.
- The vehicular entry to I-90 from Clarendon Street will be narrowed and realigned to meet the Stanhope and Clarendon Street intersection and to reduce the crossing length in order to improve pedestrian safety. Through the proposed improvements, the grading and sidewalk slopes will be improved to increase accessibility.
- The width of the Garage curb cut will be reduced to prioritize pedestrians.
- A 15-foot wide pedestrian zone will be provided adjacent to the Garage.

In connection with the development of the Station East Parcel:

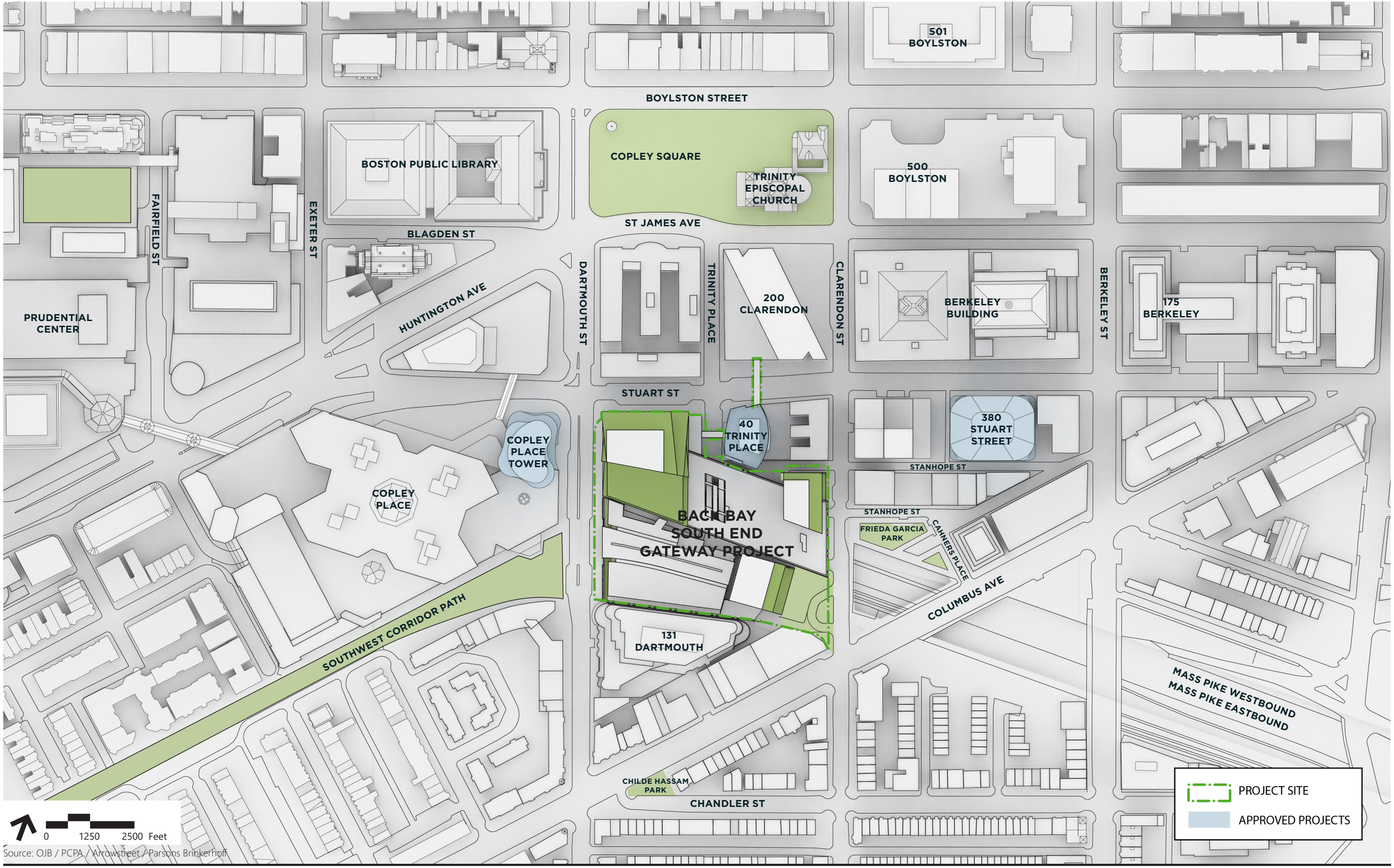
- A new drop-off lane, separated from the landscaped plaza, will serve the new Station and residential entrances.
- A new public landscaped plaza will be provided with accessible ramps to bridge the elevation difference between Clarendon Street and the new Station and residential entrances.
- A 15-foot wide pedestrian zone will be provided along Clarendon Street to the intersection with Columbus Avenue.
- A new redundant elevator for the Orange Line will be provided adjacent to the existing elevator inside the Station building.
- Where feasible, new redundant elevators to Tracks 1/3 and 2 at the existing head house on the south side of Columbus Avenue may be provided.

In connection with the development of the Station West Parcel:

- The existing crosswalk will be relocated and significantly enlarged to better serve pedestrian traffic to and from the Station.
- A dedicated handicap drop-off zone, bus stop and taxi stand will remain.

Accessible Housing Units

- It is anticipated that five (5) percent of the units in the Garage East Parcel and Station East Parcel residential buildings will be designed to be accessible, in compliance with 521 CMR.



Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

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Neighborhood Context Plan

Figure 3.1
OJB



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View From Southwest Corridor Park - Existing Conditions

Figure 3.2a

ARROWSTREET
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View From Southwest Corridor Park - Project Rendering
Garage West Base Scheme

Figure 3.2b

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View From Southwest Corridor Park - Project Rendering
Garage West Alternate Scheme

Figure 3.2c

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View From Dartmouth Street - Existing Condition

Figure 3.2d

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View From Dartmouth Street - Project Rendering

Figure 3.2e

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View From Stuart and Dartmouth Street - Existing Condition

Figure 3.2f

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View From Stuart and Dartmouth Street - Project Rendering

Figure 3.2g

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View From Stuart Street and Trinity Place - Existing Condition

Figure 3.2h

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View From Stuart and Trinity Place - Project Rendering

Figure 3.2i

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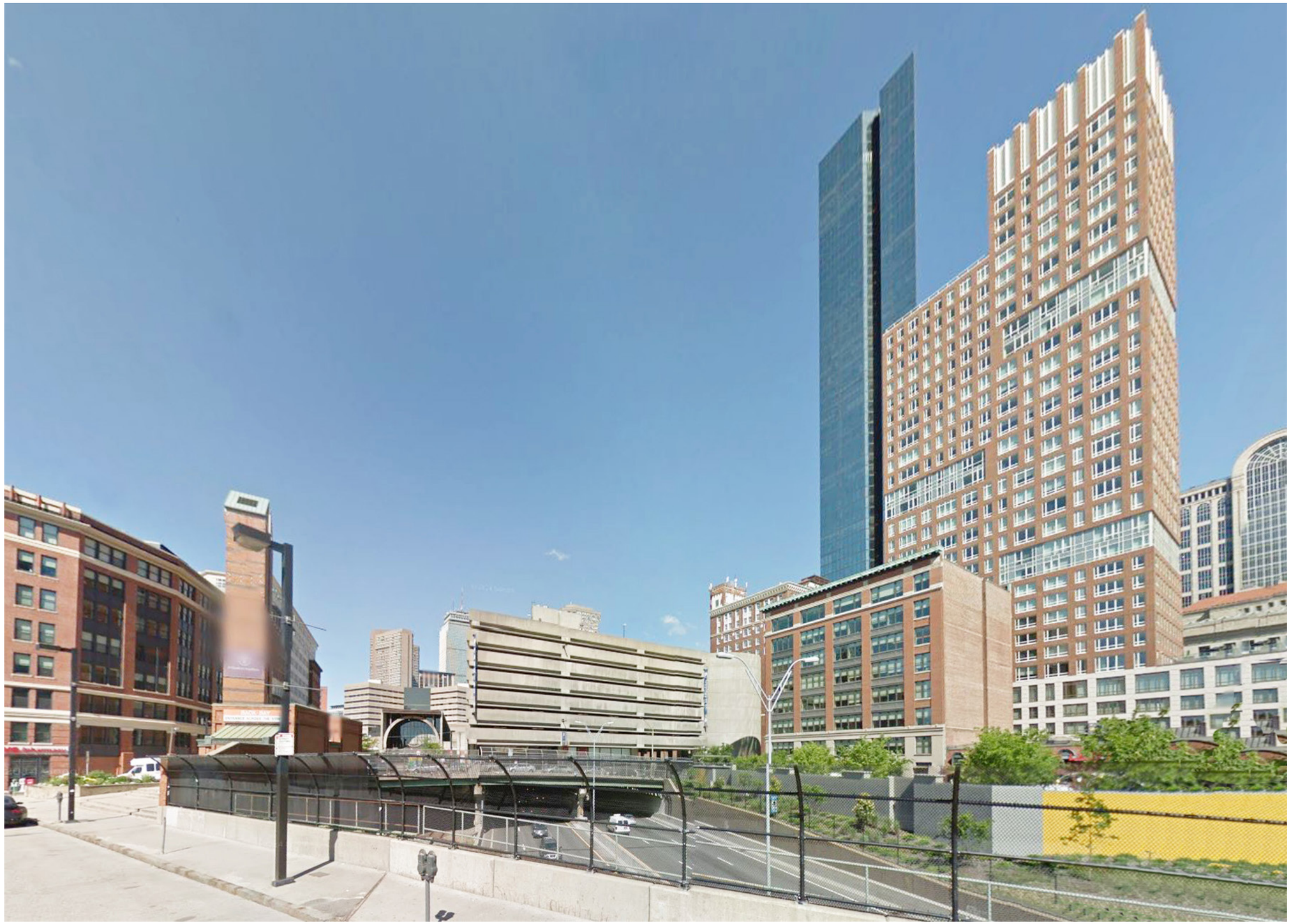

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View From Columbus Avenue - Existing Condition

Figure 3.2j

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View From Columbus Avenue - Project Rendering

Figure 3.2k

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View From Clarendon Street - Existing Condition

Figure 3.2I

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View From Clarendon Street - Project Rendering

Figure 3.2m

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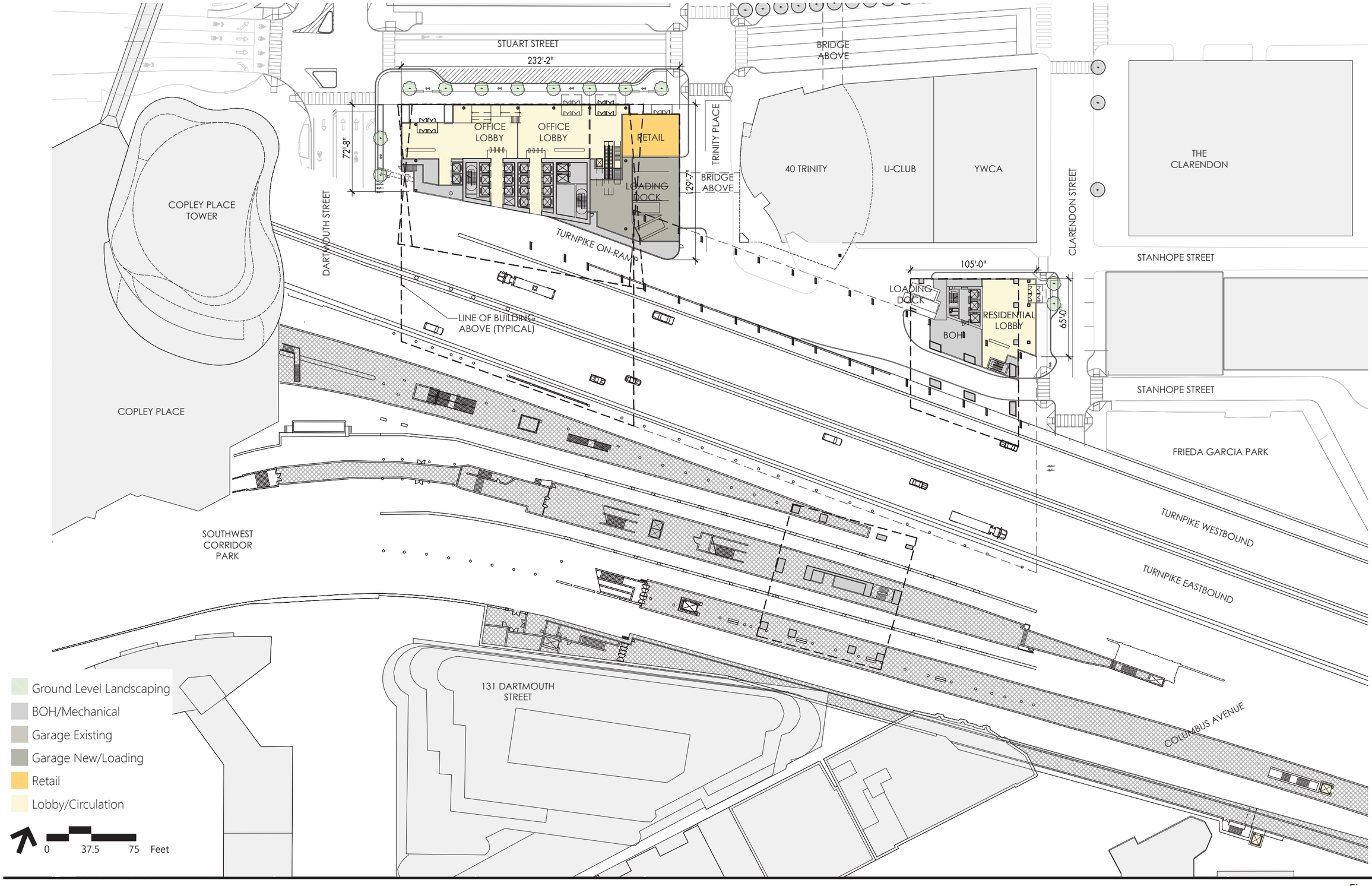

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Figure 3.3a

Overall Plan - Garage West Base Scheme
GW: Stuart Street Level • GE: Clarendon Street Level • SE: Platform Level • SW: Platform Level

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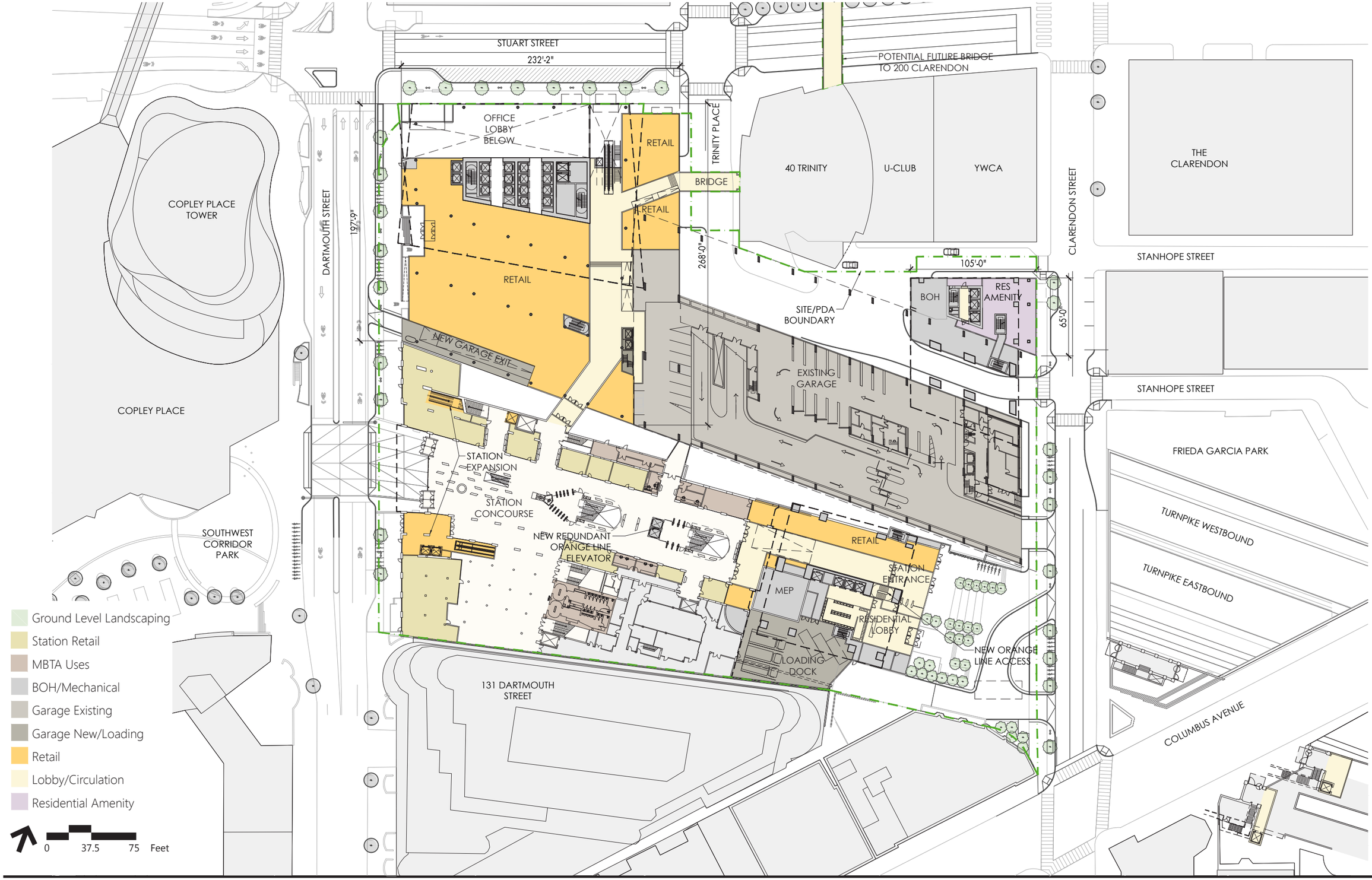

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Overall Plan - Garage West Base Scheme
GW: Deck Level • GE: Level 2 • SE: Concourse Level • SW: Concourse Level

Figure 3.3b

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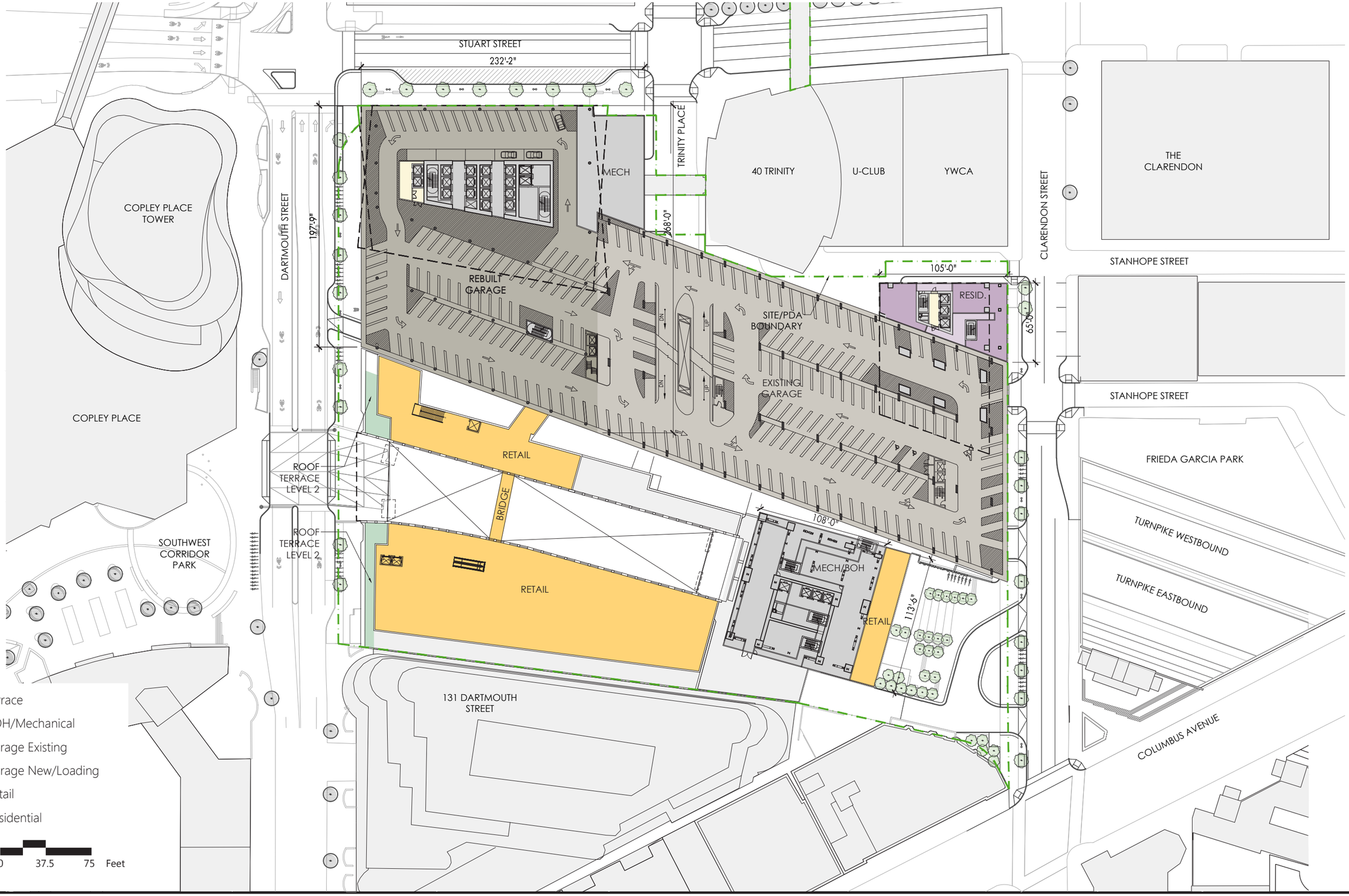

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Figure 3.3c

Overall Plan - Garage West Base Scheme
GW: Levels 2-3 • GE: Levels 3-7 • SE: Level 2 • SW: Level 2

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Figure 3.3d

Overall Plan - Garage West Base Scheme
GW: Levels 4-6 • GE: Levels 3-7 • SE: Level 3 • SW: Roof

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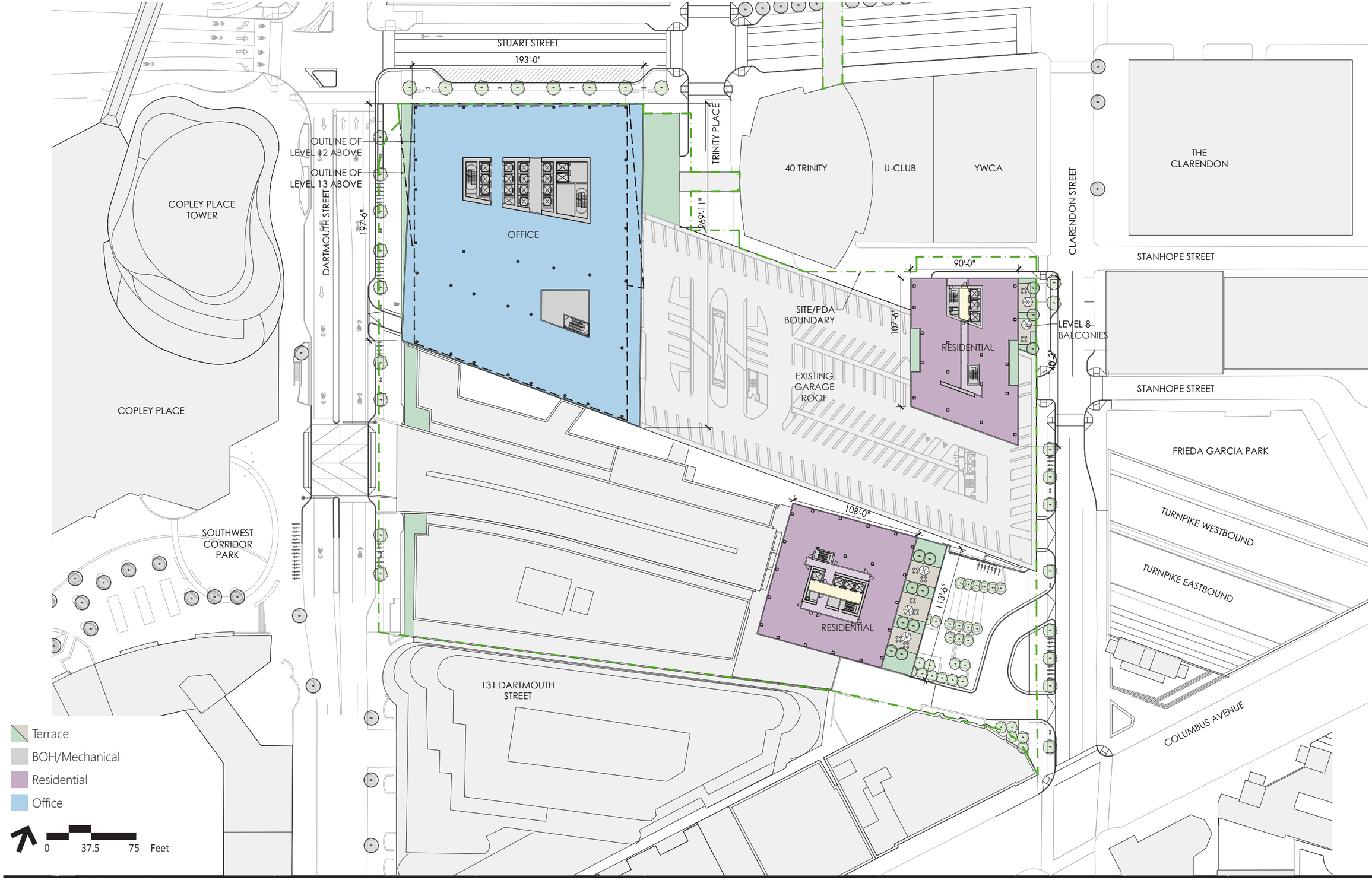

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Overall Plan - Garage West Base Scheme
GW: Levels 8-11 • GE: Levels 10-27 • SE: Levels 4-34 • SW: Roof

Figure 3.3e

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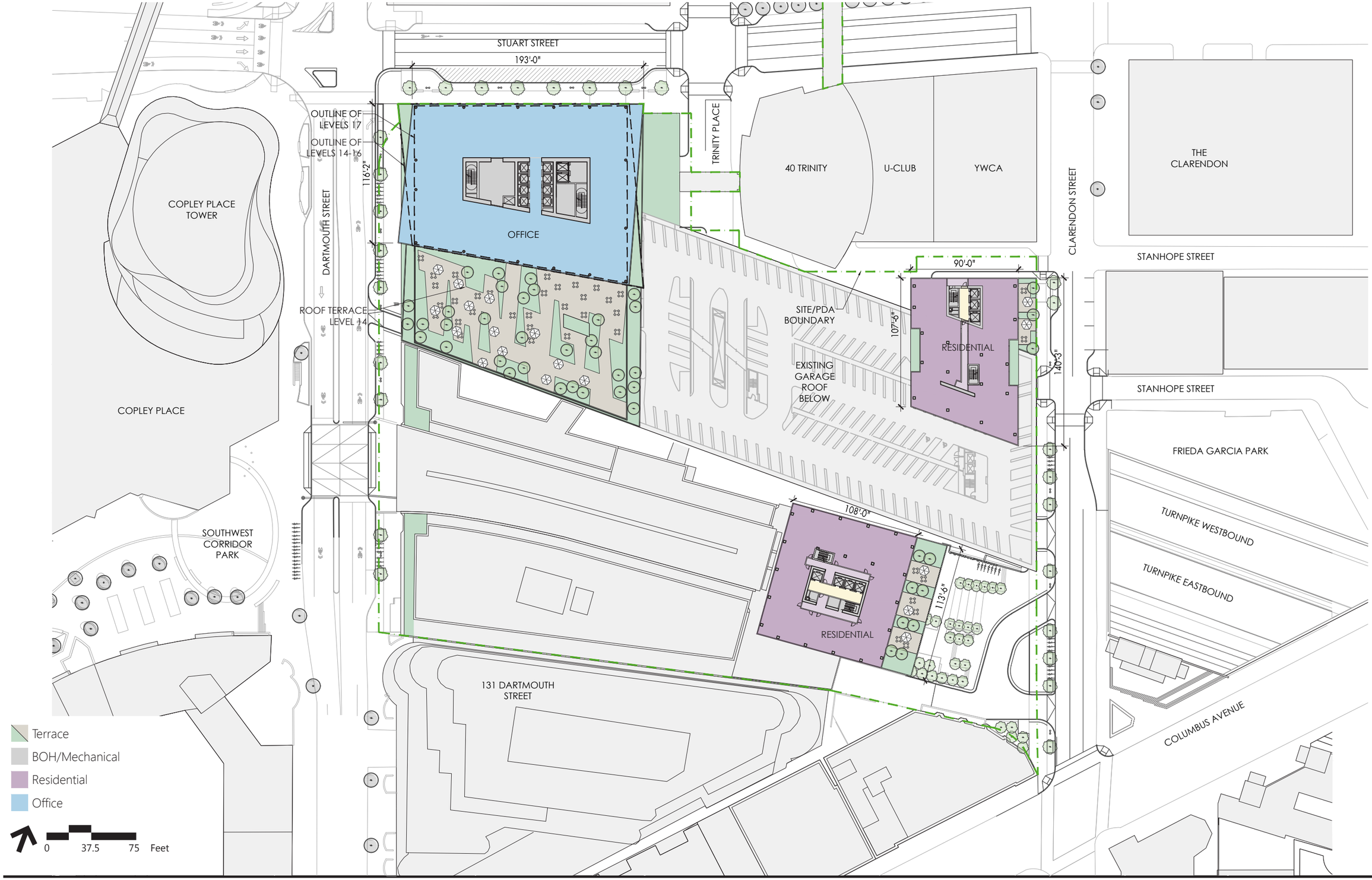

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Figure 3.3f

Overall Plan - Garage West Base Scheme
GW: Levels 18-21 • GE: Levels 10-27 • SE: Levels 4-34 • SW: Roof

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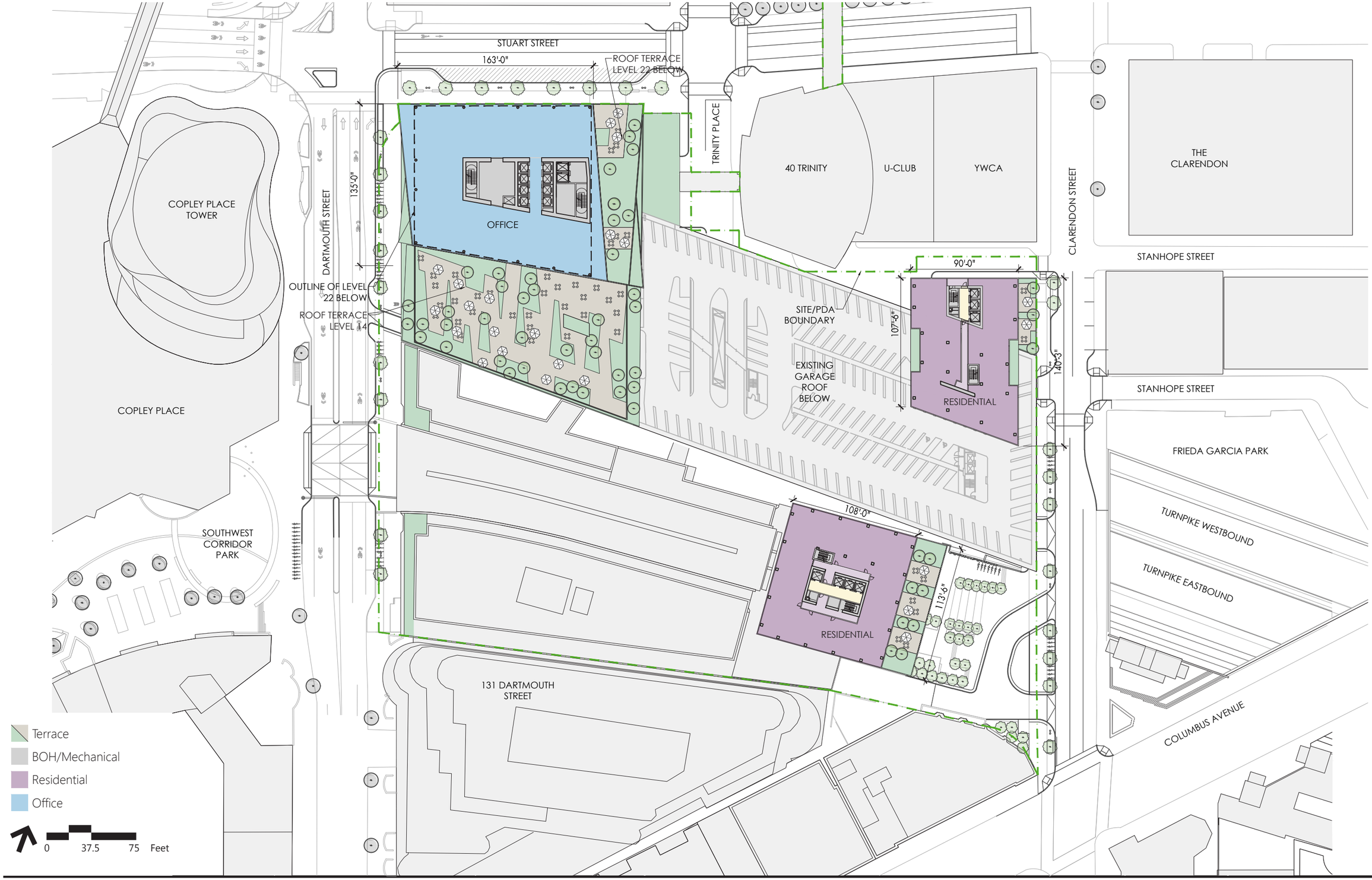

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Figure 3.3g

Overall Plan - Garage West Base Scheme
GW: Levels 23-25 • GE: Levels 10-27 • SE: Levels 4-34 • SW: Roof

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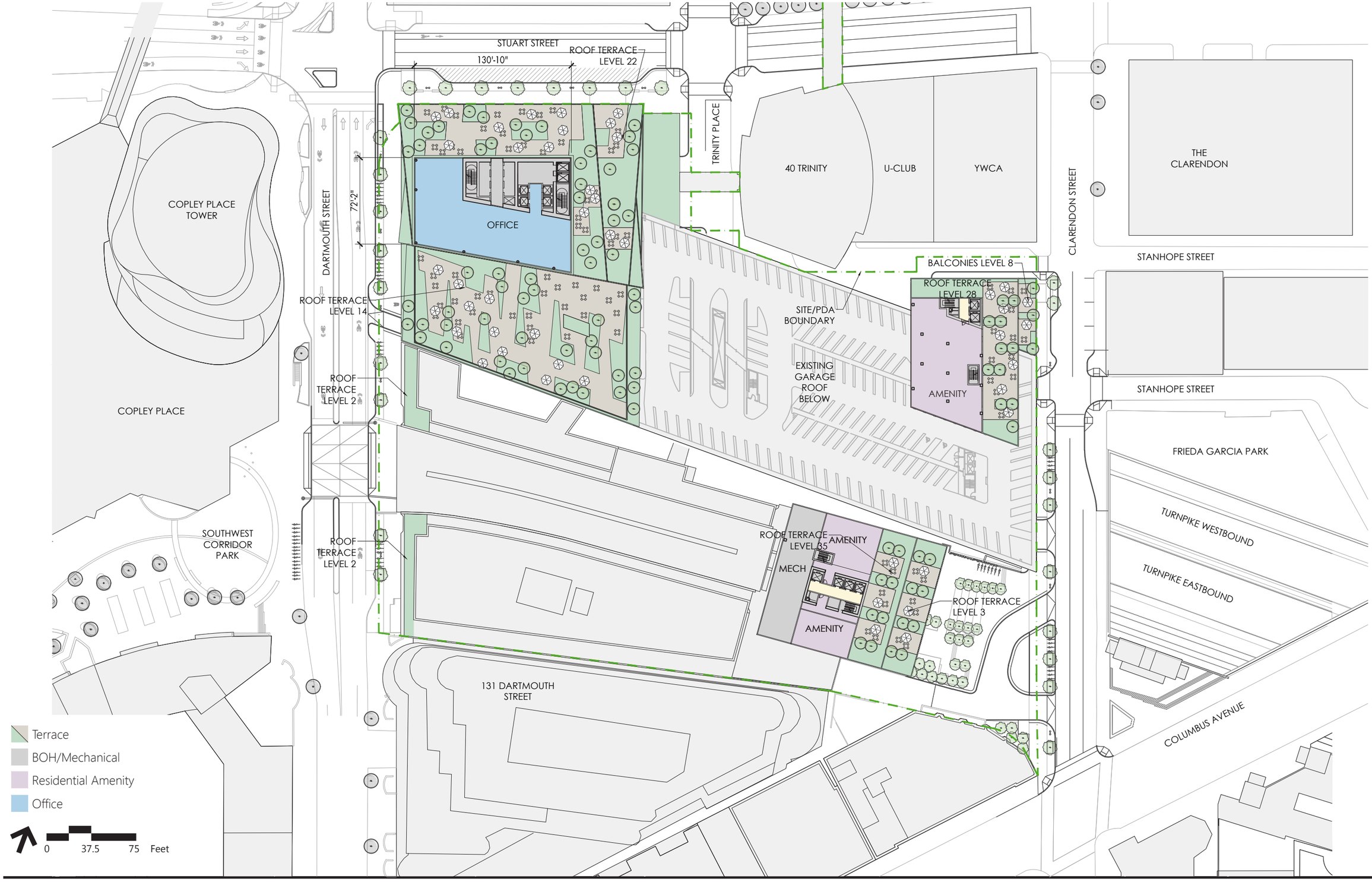

The Back Bay / South End Gateway Project
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Figure 3.3h

Overall Plan - Garage West Base Scheme
GW: Level 26 • GE: Level 28 • SE: Level 35 • SW: Roof

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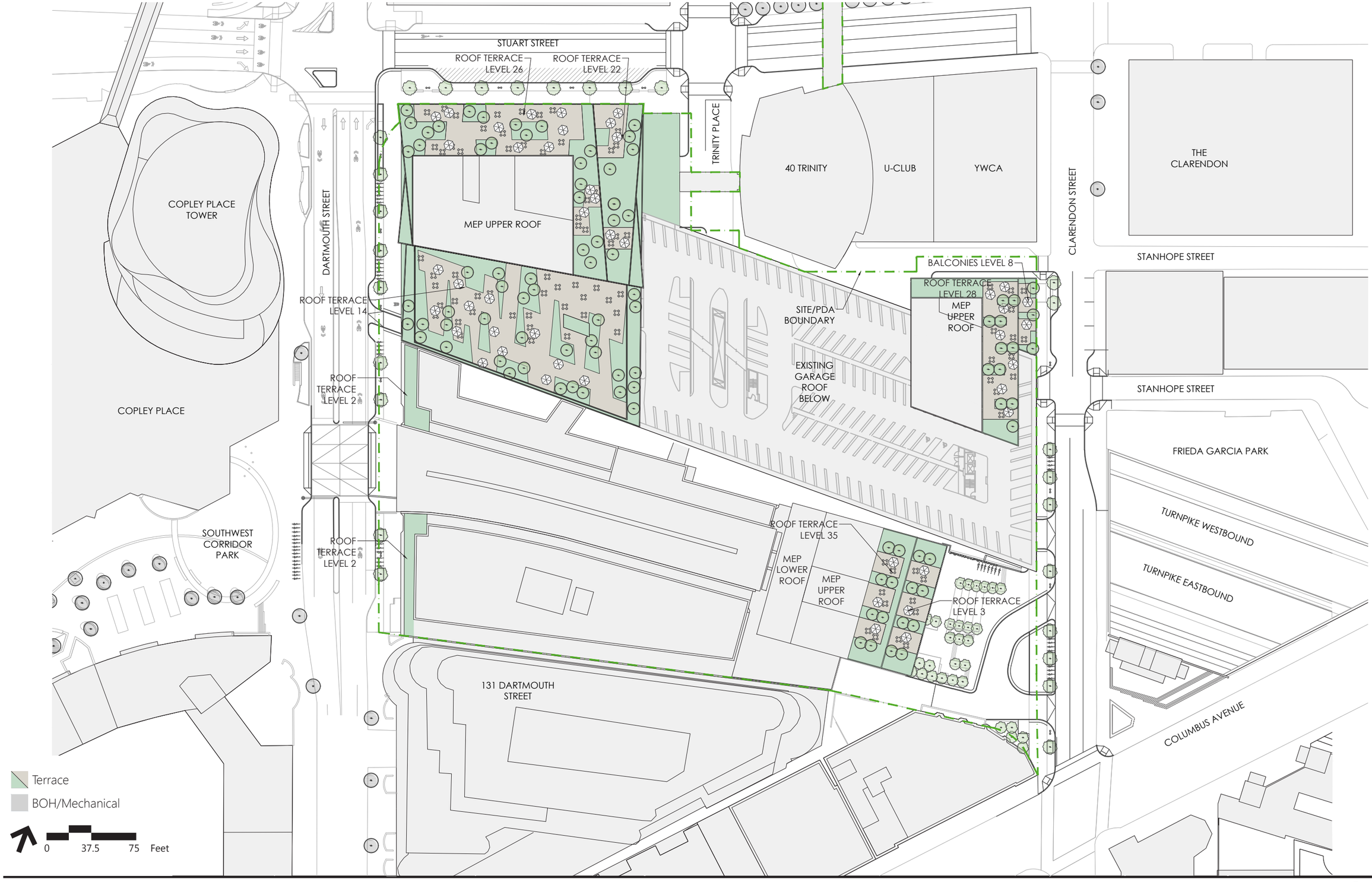

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Figure 3.3i

Overall Plan - Garage West Base Scheme
GW: Roof • GE: Roof • SE: Roof • SW: Roof

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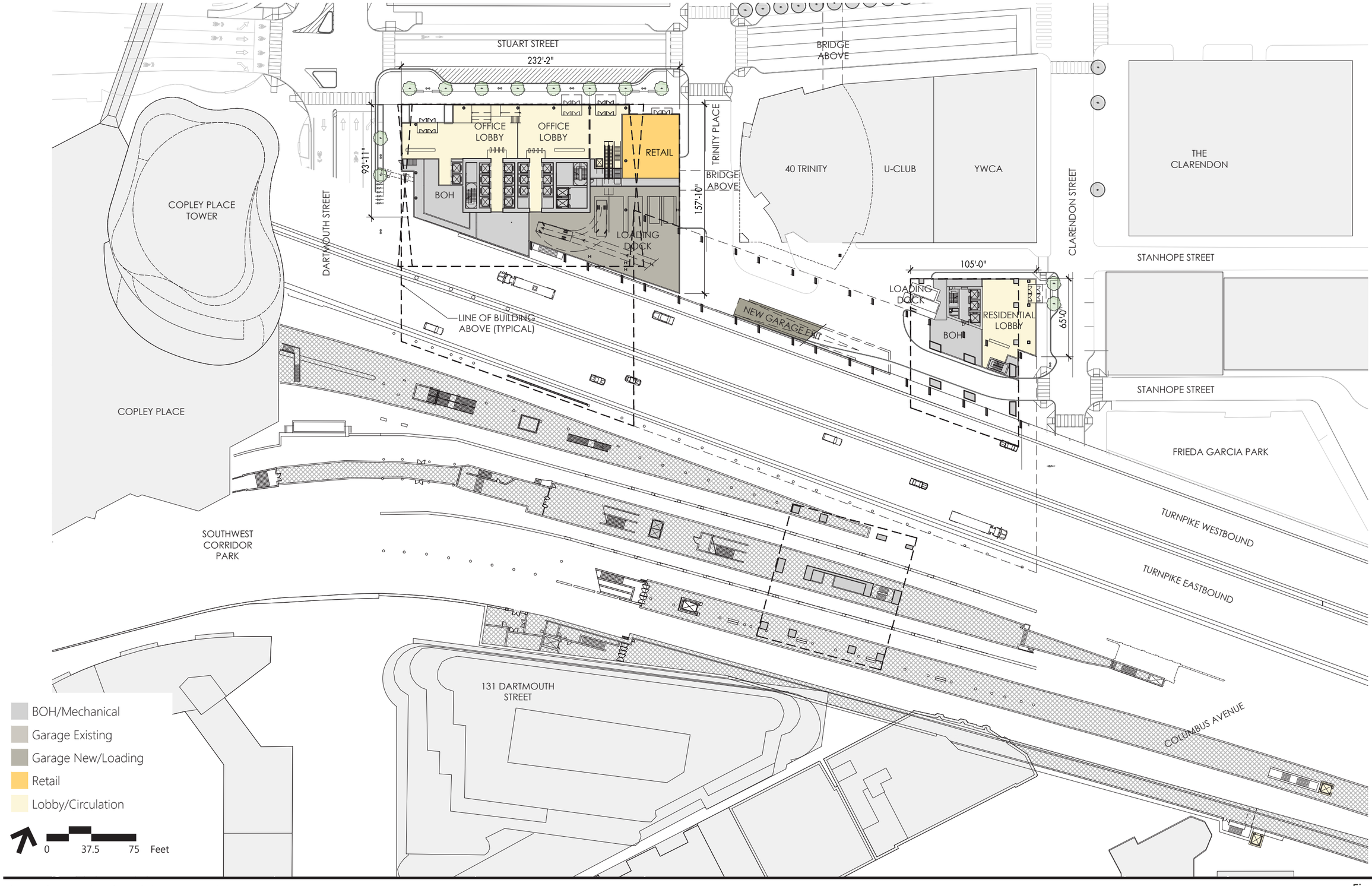

The Back Bay / South End Gateway Project
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Figure 3.3j

Overall Plan - Garage West Alternate Scheme
GW: Stuart Street Level • GE: Clarendon Street Level • SE: Platform Level • SW: Platform Level

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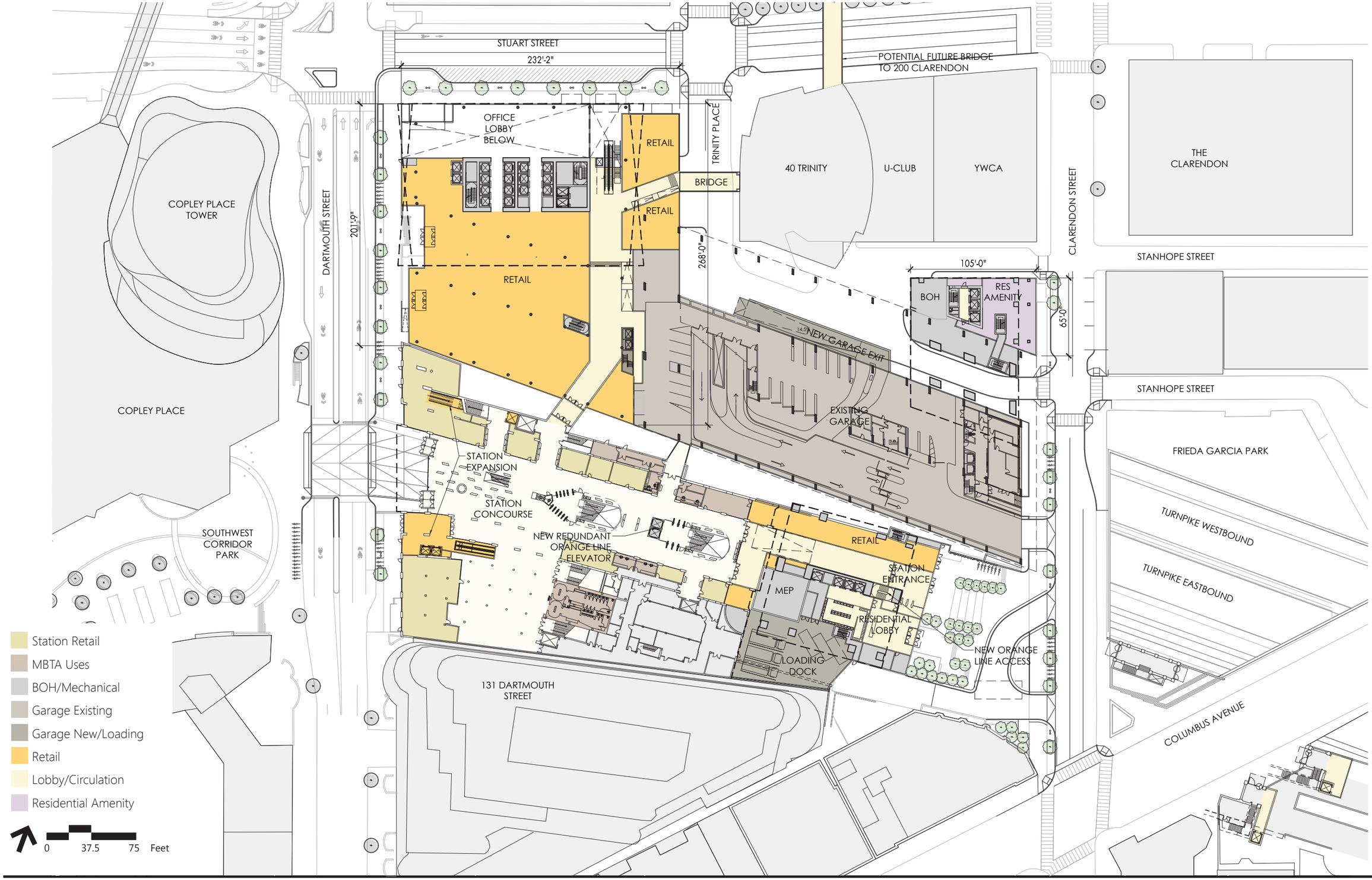

The Back Bay / South End Gateway Project
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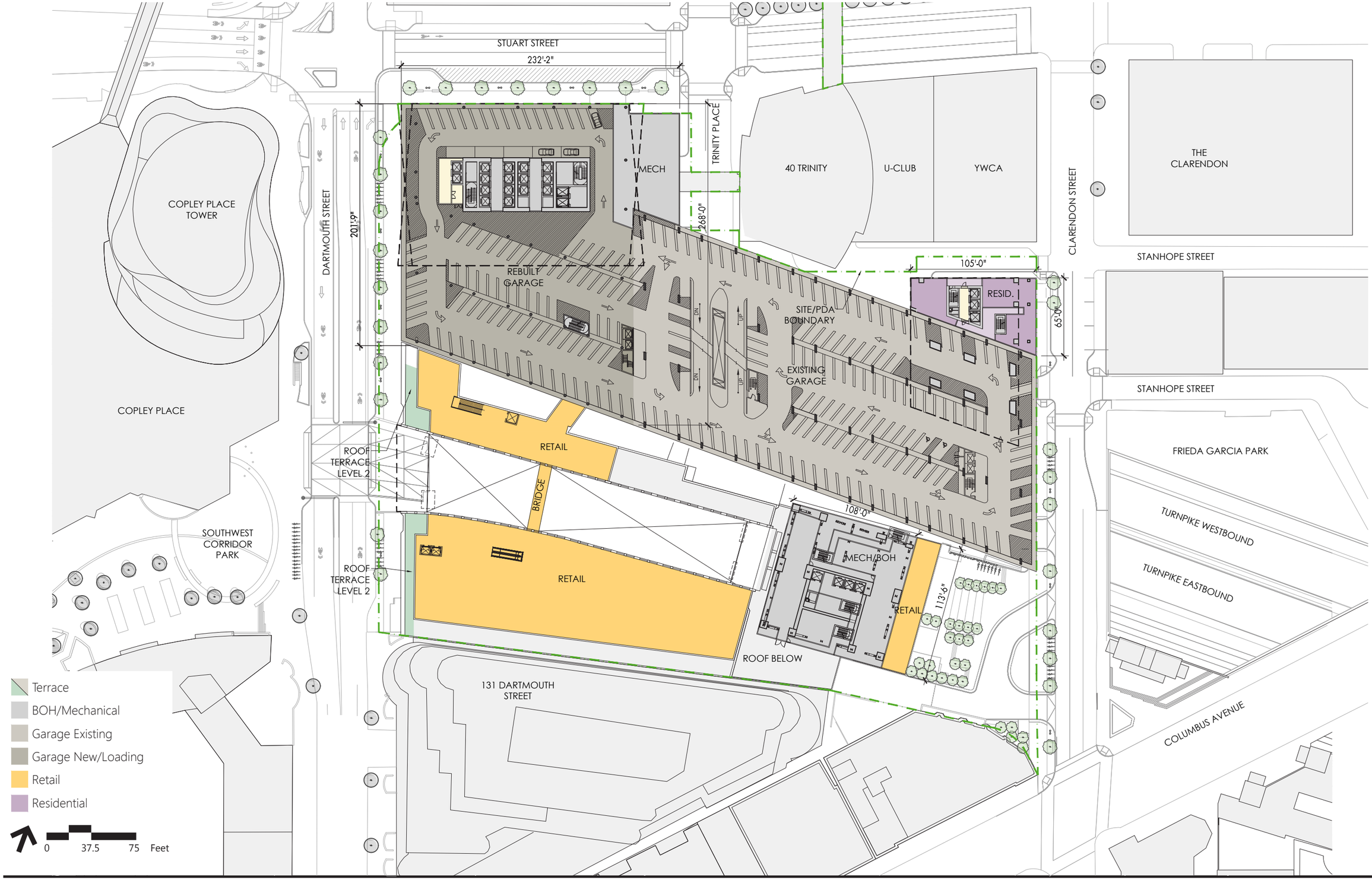
BOSTON PROPERTIES

Overall Plan - Garage West Alternate Scheme
GW: Deck Level • GE: Level 2 • SE: Concourse Level • SW: Concourse Level

Figure 3.3k

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Overall Plan - Garage West Alternate Scheme
GW: Levels 2-3 • GE: Levels 3-7 • SE: Level 2 • SW: Level 2

Figure 3.3l

Pelli Clarke Pelli Architects

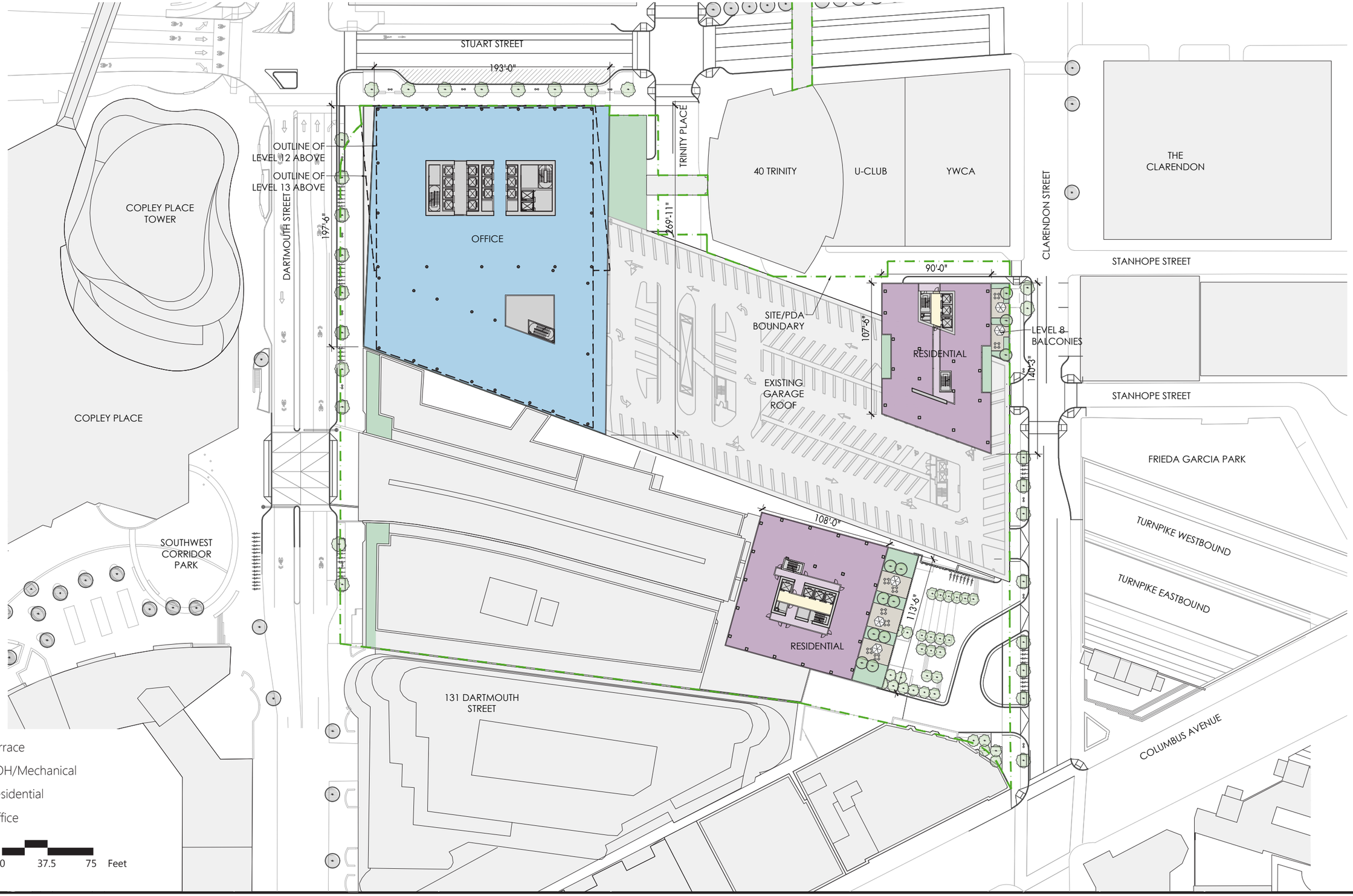


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Figure 3.3m

Overall Plan - Garage West Alternate Scheme
GW: Levels 4-6 • GE: Levels 3-7 • SE: Level 3 • SW: Roof

Pelli Clarke Pelli Architects

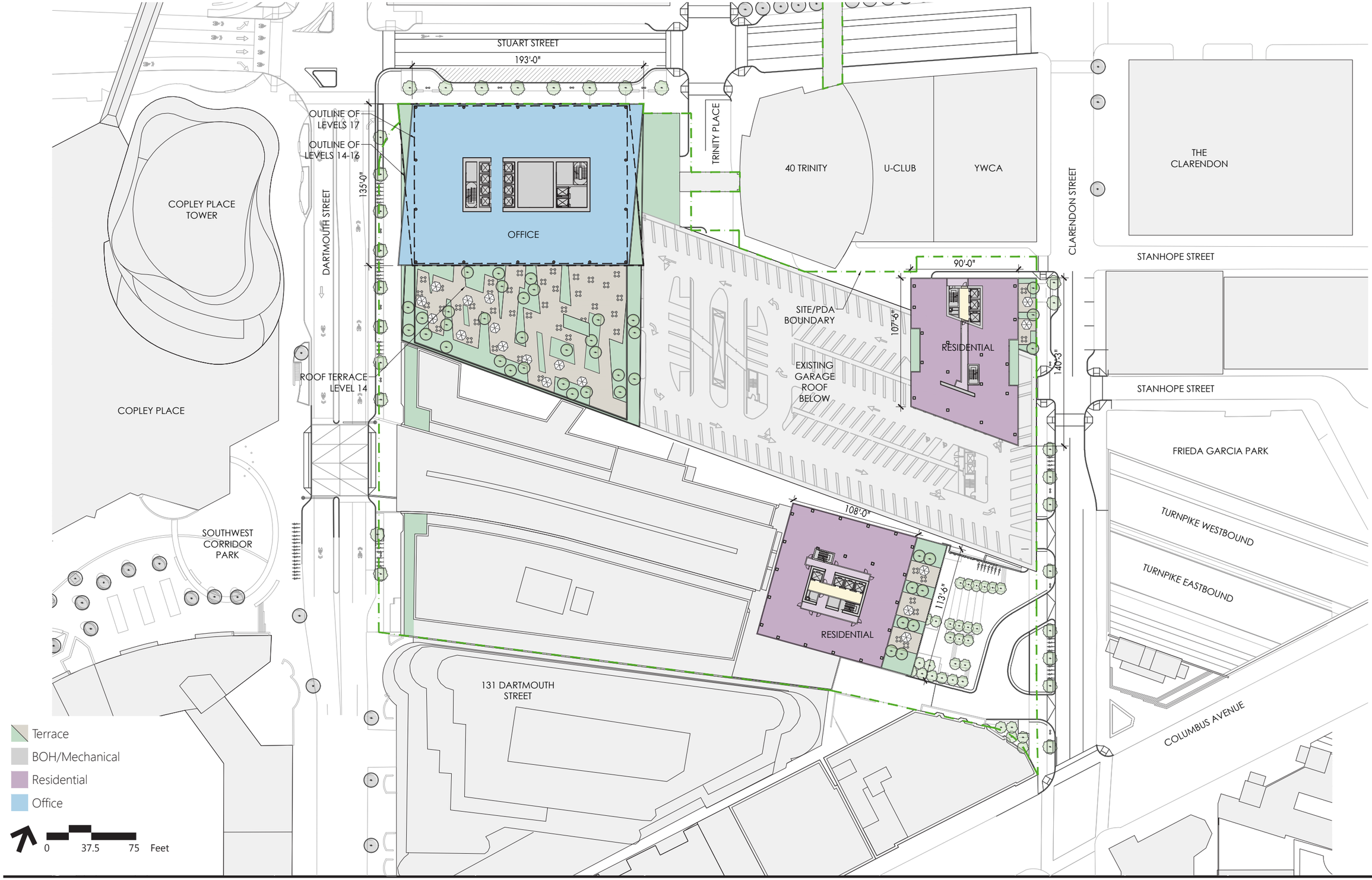


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Overall Plan - Garage West Alternate Scheme
GW: Levels 8-11 • GE: Levels 10-27 • SE: Levels 4-34 • SW: Roof

Figure 3.3n

Pelli Clarke Pelli Architects

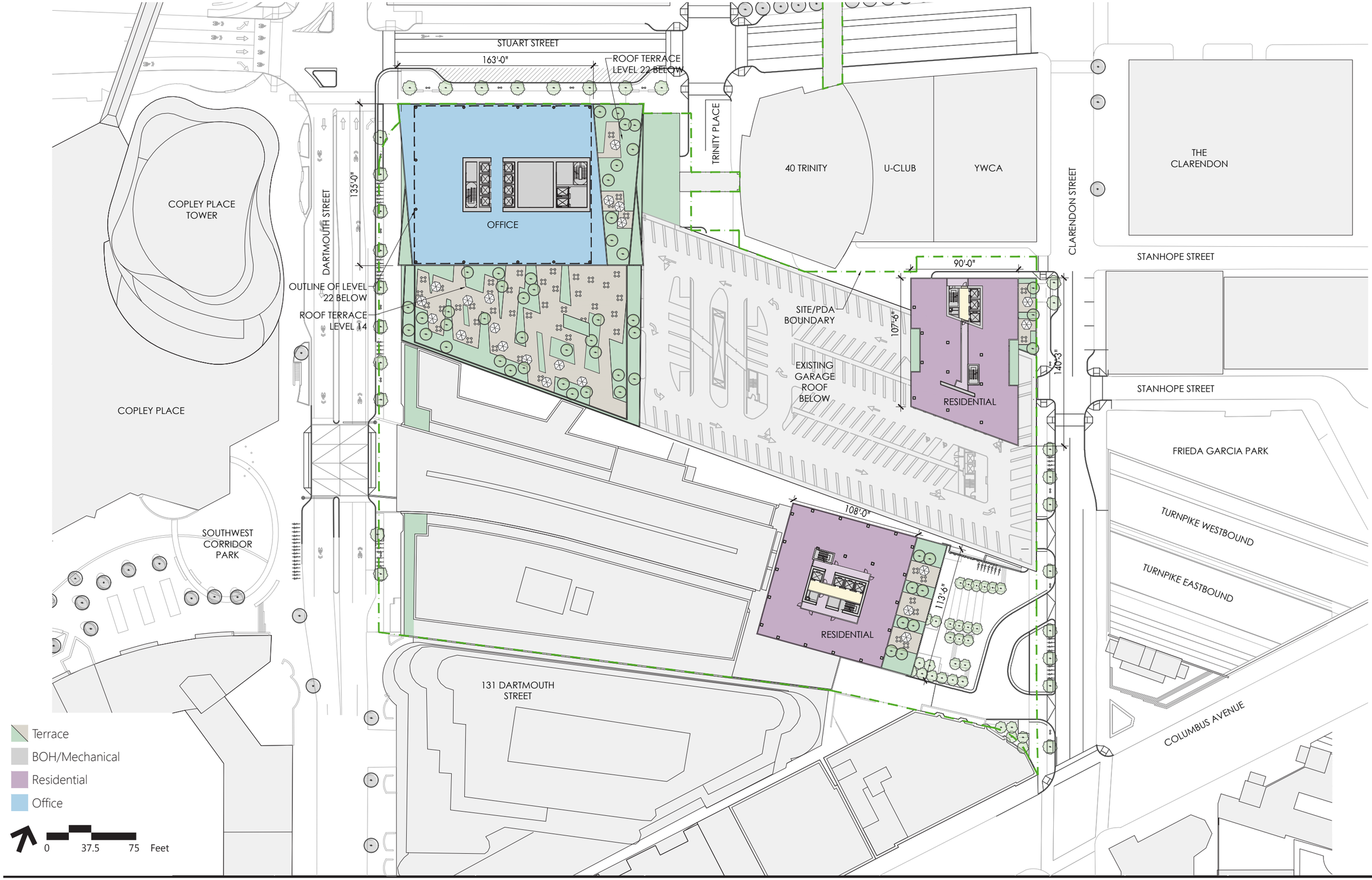


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Overall Plan - Garage West Alternate Scheme
GW: Levels 18-21 • GE: Levels 10-27 • SE: Levels 4-34 • SW: Roof

Figure 3.3o

Pelli Clarke Pelli Architects

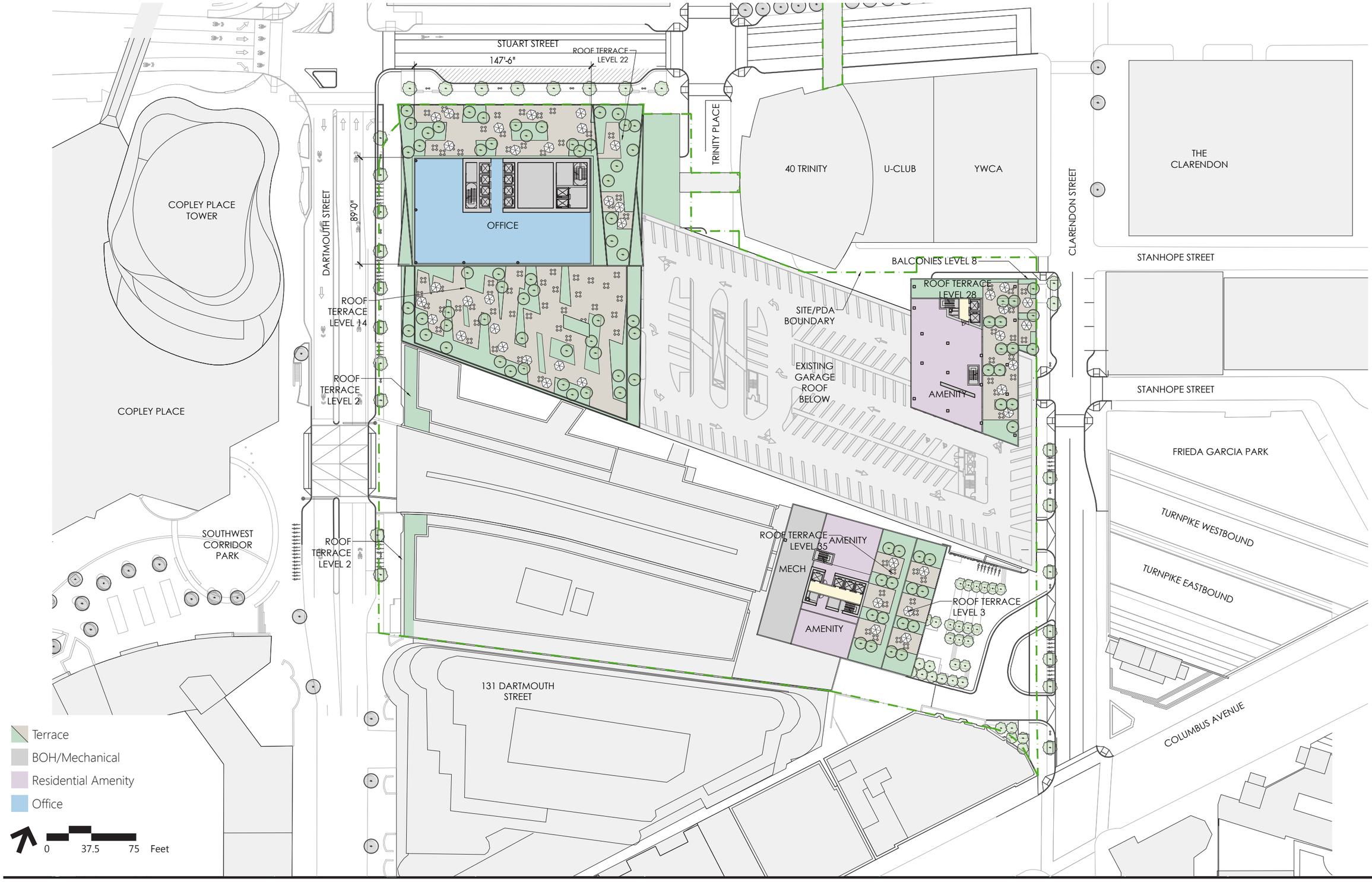


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Overall Plan - Garage West Alternate Scheme
GW: Levels 23-25 • GE: Levels 10-27 • SE: Levels 4-34 • SW: Roof

Figure 3.3p

Pelli Clarke Pelli Architects

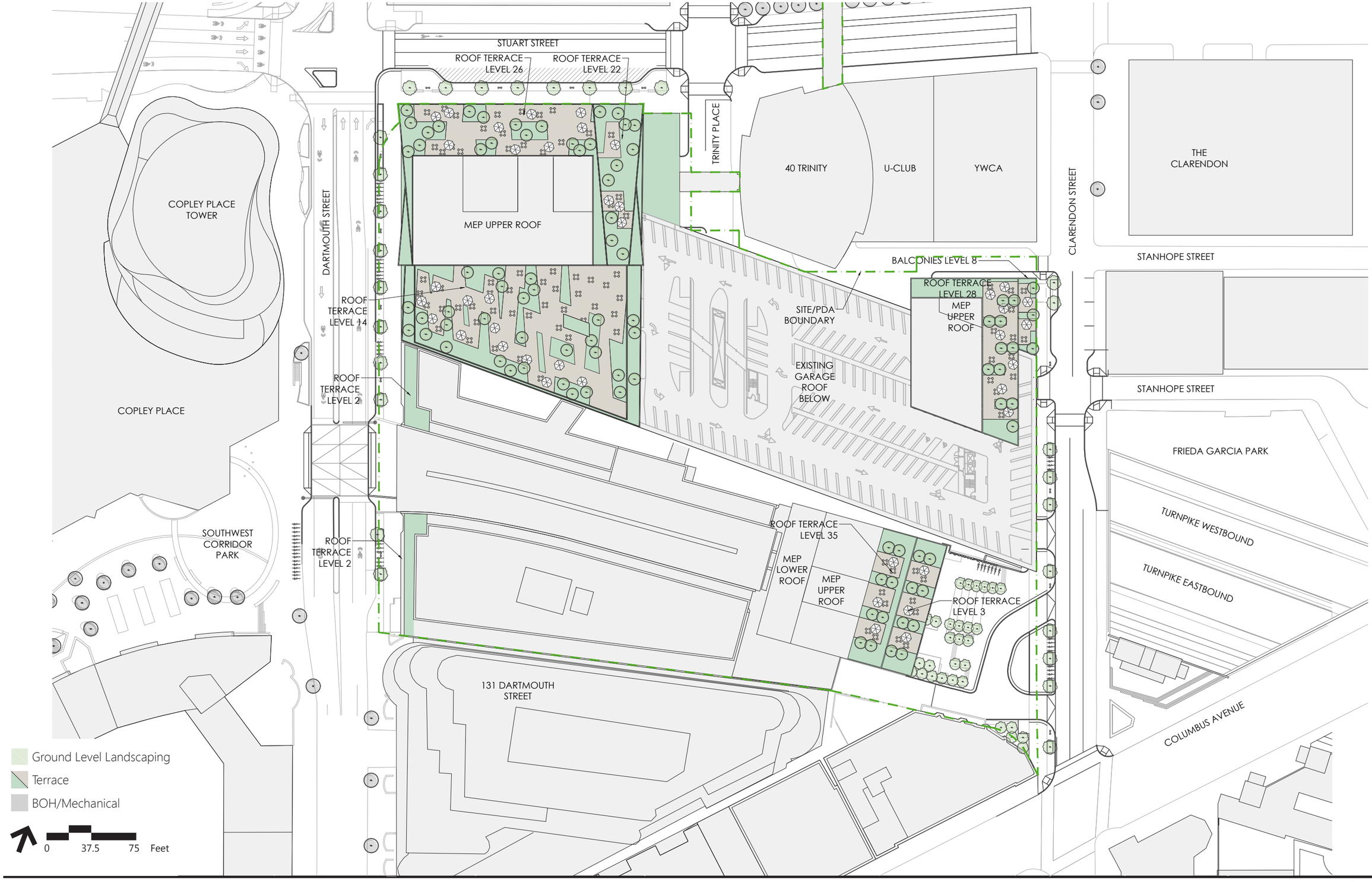


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Overall Plan - Garage West Alternate Scheme
GW: Level 26 • GE: Level 28 • SE: Level 35 • SW: Roof

Figure 3.3q

Pelli Clarke Pelli Architects

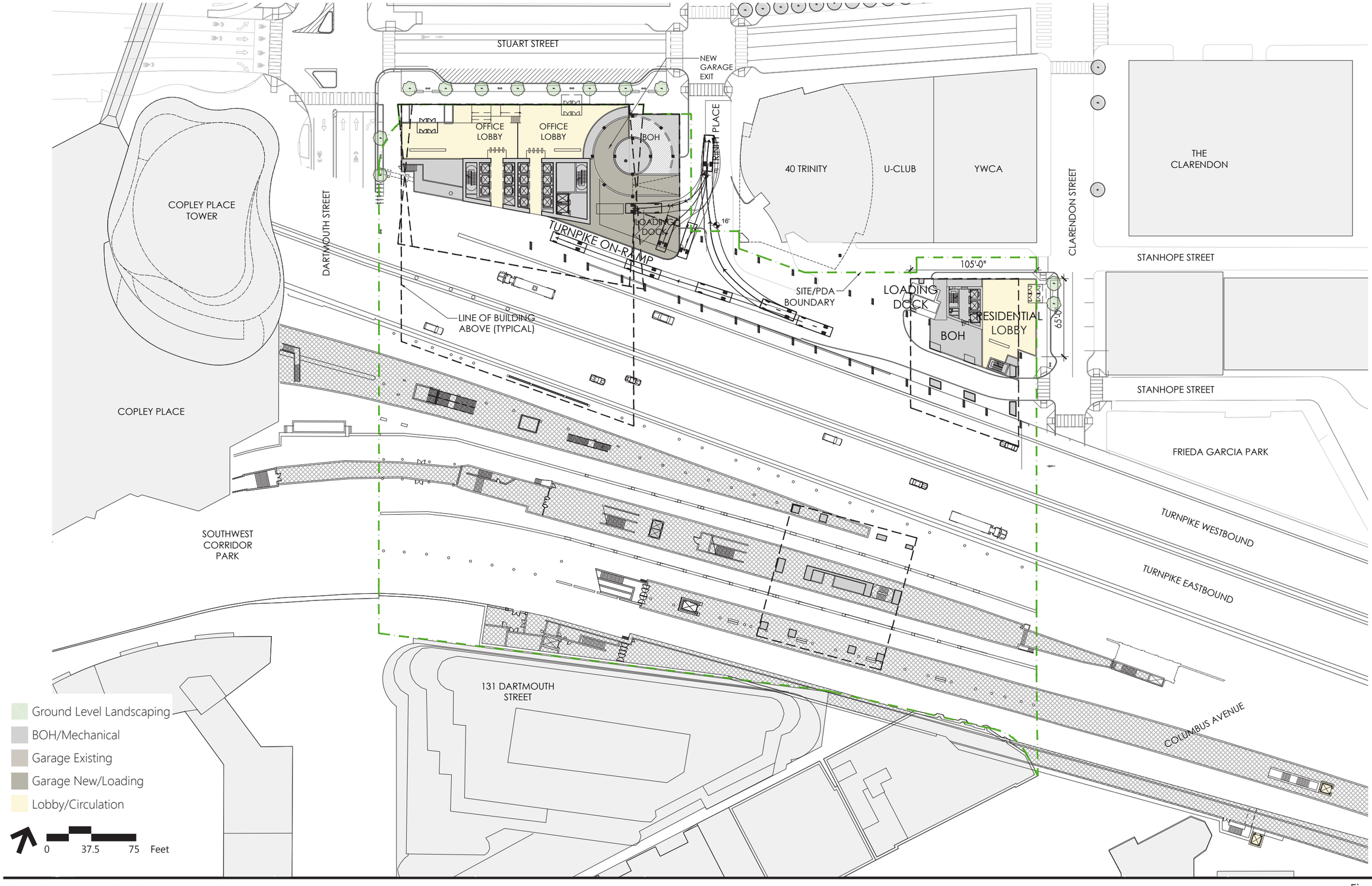


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Overall Plan - Garage West Alternate Scheme
GW: Roof • GE: Roof • SE: Roof • SW: Roof

Figure 3.3r

Pelli Clarke Pelli Architects

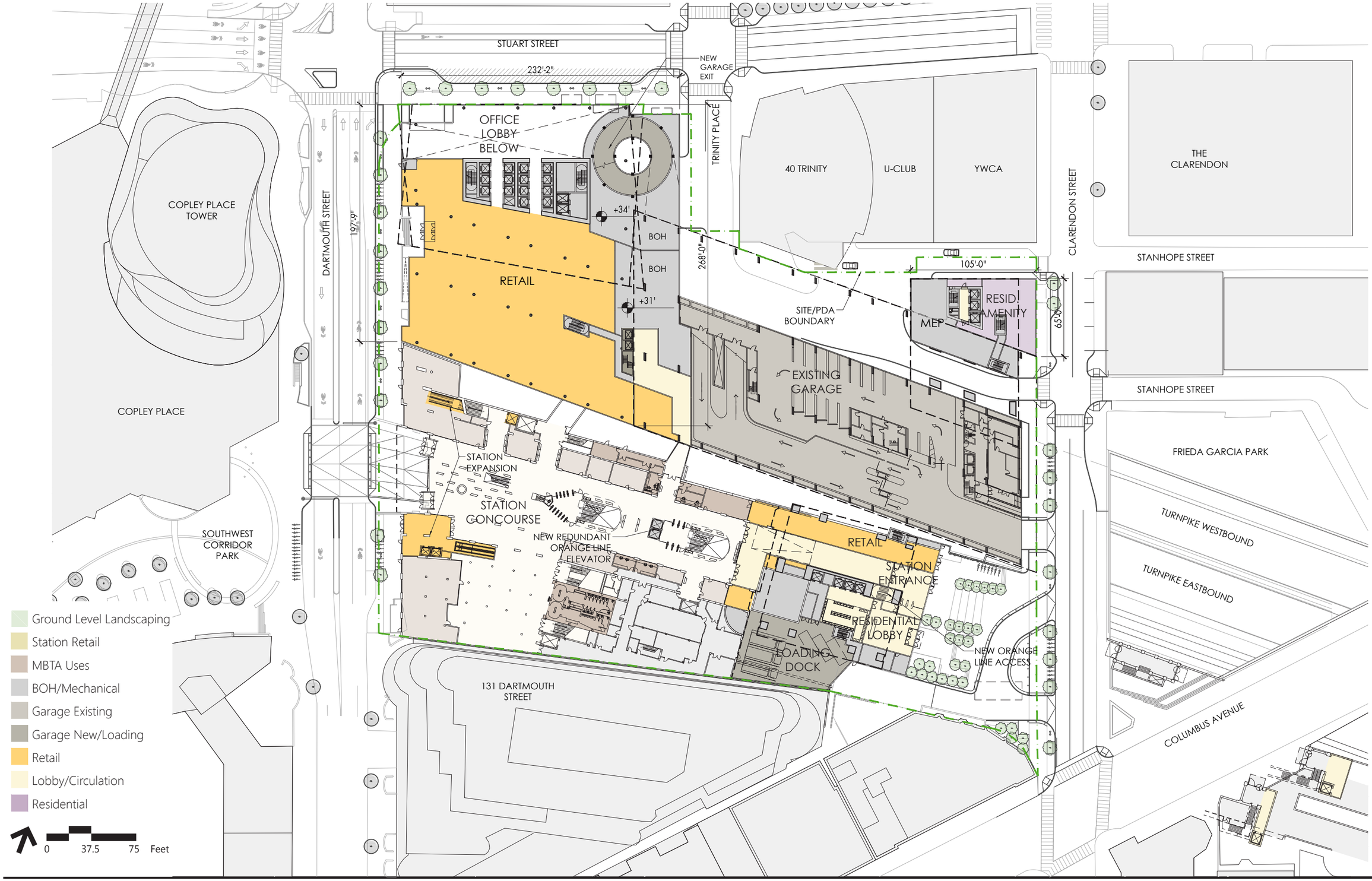


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Overall Plan - Garage West Helix Alternate
GW: Stuart Street Level • GE: Clarendon Street Level • SE: Platform Level • SW: Platform Level

Figure 3.3s

Pelli Clarke Pelli Architects

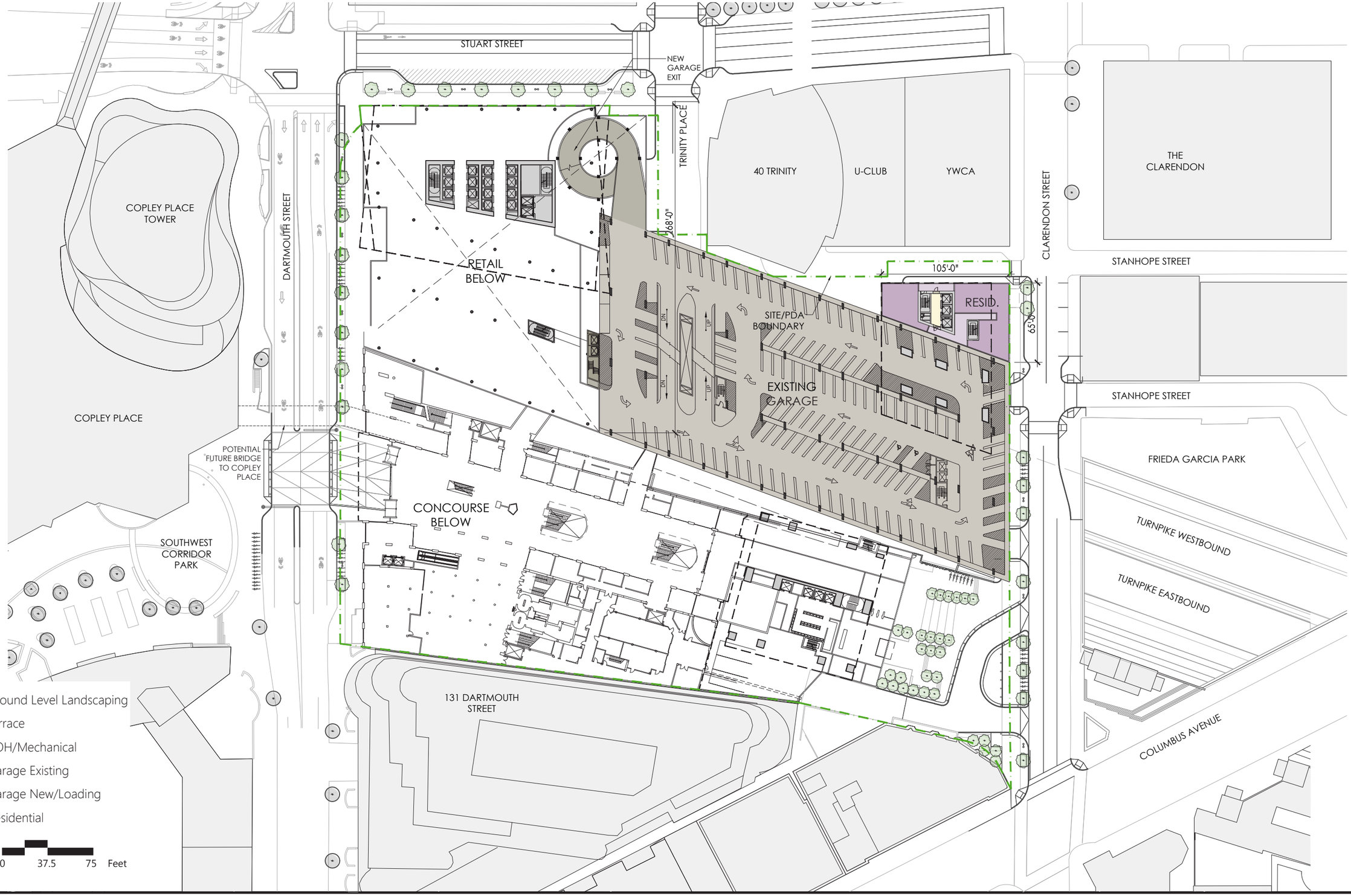


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Overall Plan - Garage West Helix Alternate
GW: Deck Level • GE: Level 2 • SE: Concourse Level • SW: Concourse Level

Figure 3.3t

Pelli Clarke Pelli Architects

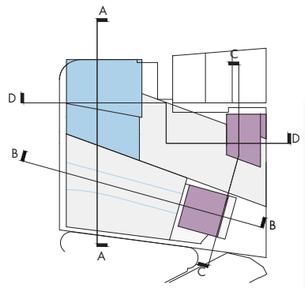


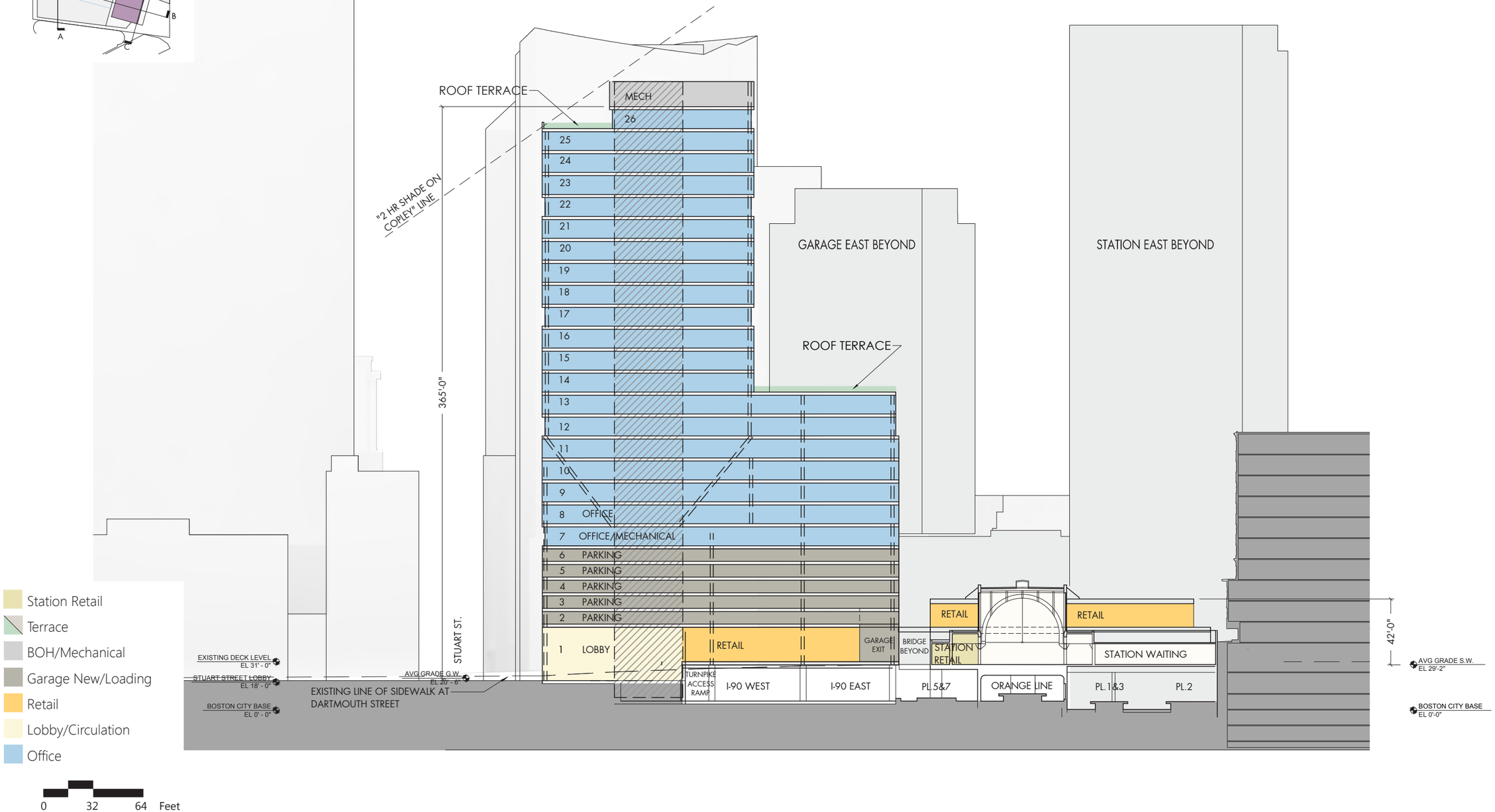
The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Figure 3.3u

Overall Plan - Garage West Helix Alternate
GW: Open To Below • Existing Garage: +45' Level • GE: Levels 3-7 • SE: Open To Below • SW: Open To Below

Pelli Clarke Pelli Architects



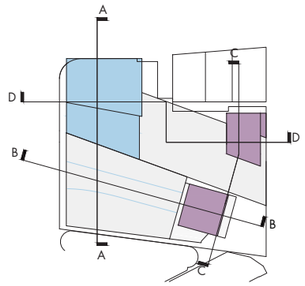


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Garage West Base Scheme
Section A-A

Figure 3.4a

Pelli Clarke Pelli Architects

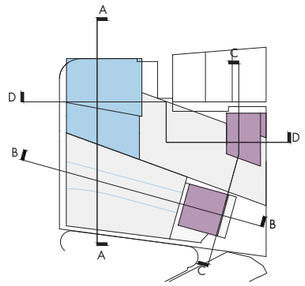


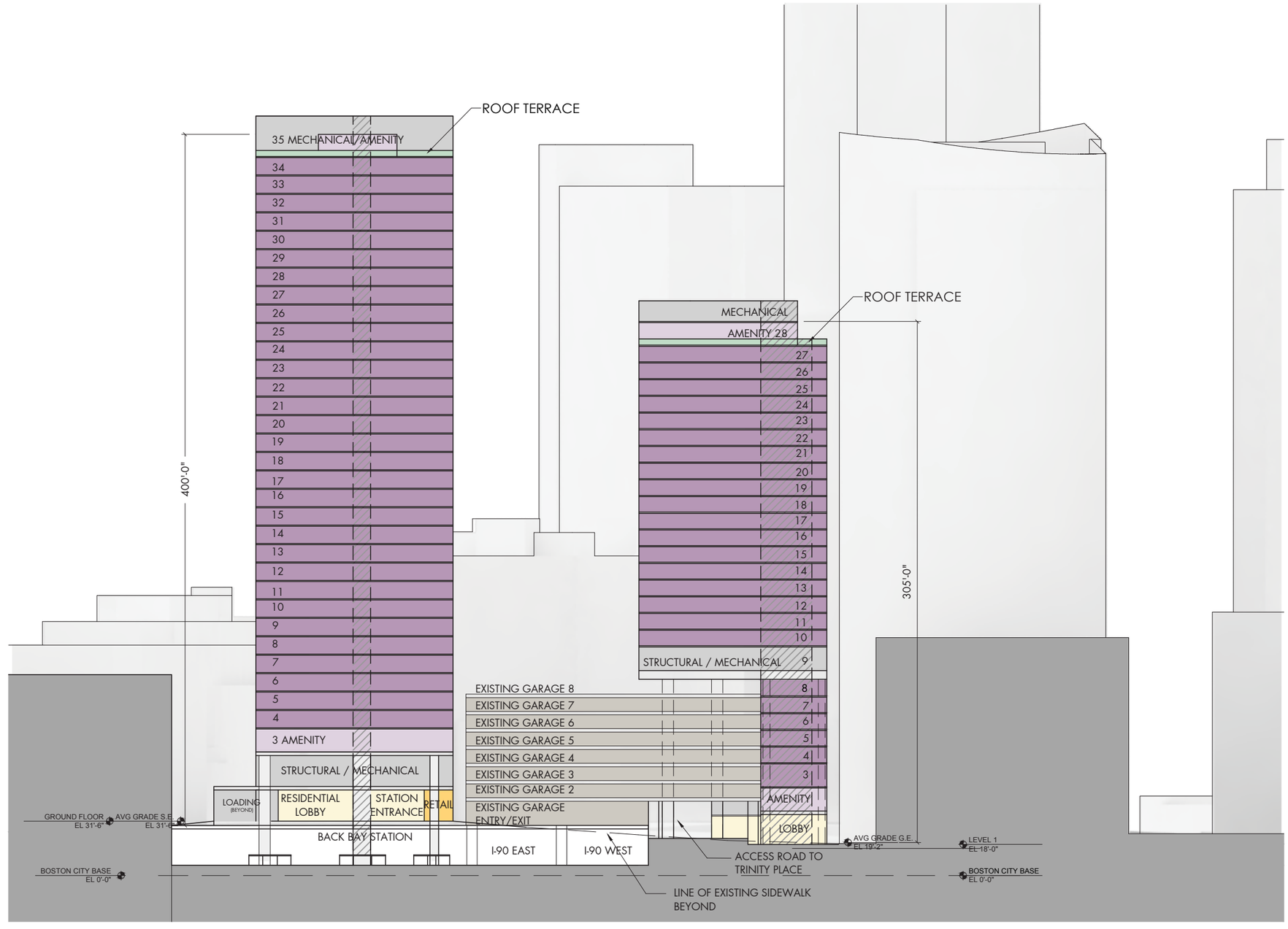
The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Garage West Base Scheme
Section B-B

Figure 3.4b

Pelli Clarke Pelli Architects





Terrace
BOH/Mechanical
Existing Garage
Retail
Lobby/Circulation
Residential Amenity
Residential

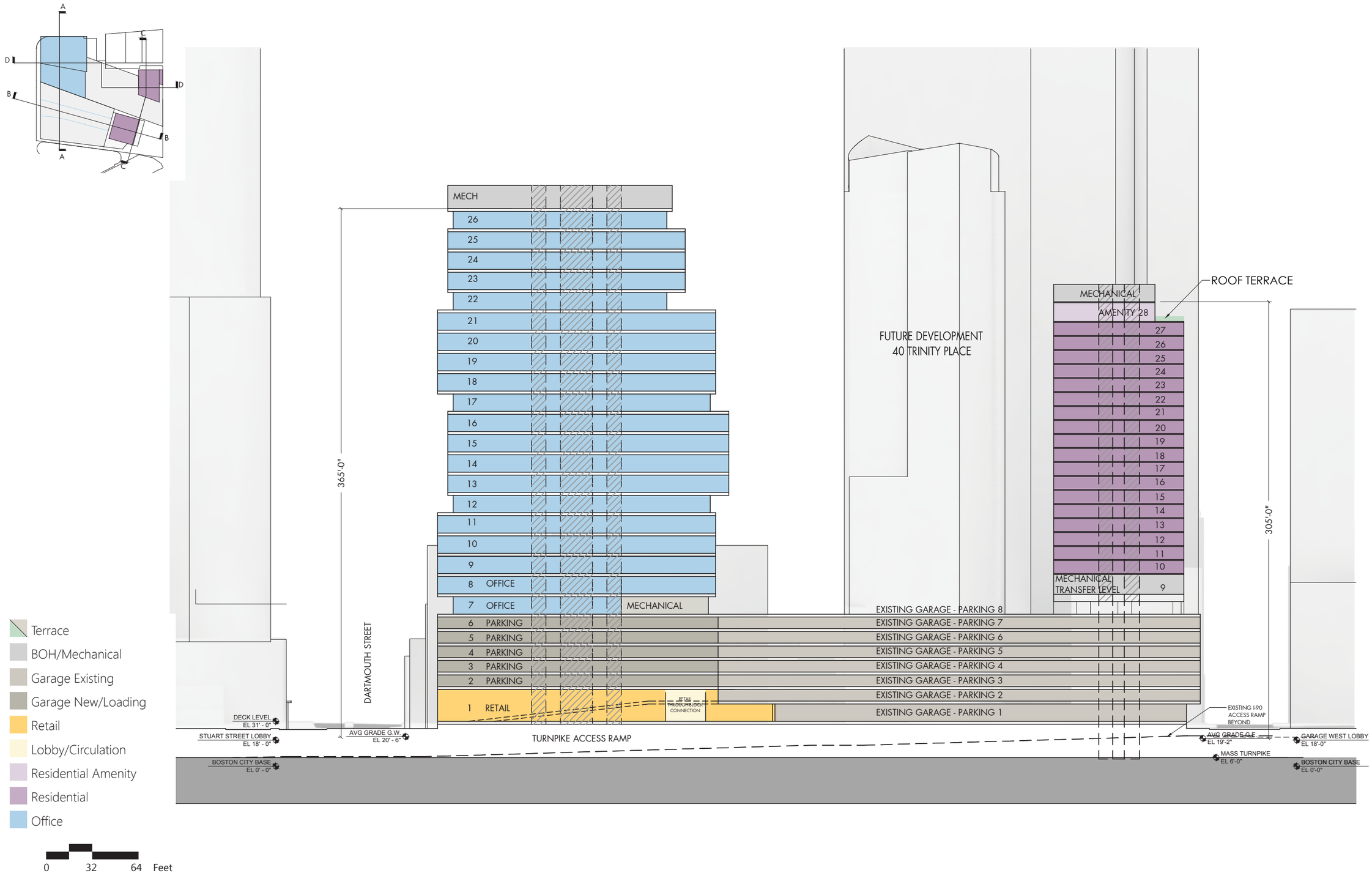
0 32 64 Feet

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Garage West Base Scheme
Section C-C

Figure 3.4c

Pelli Clarke Pelli Architects

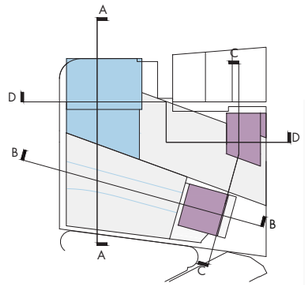


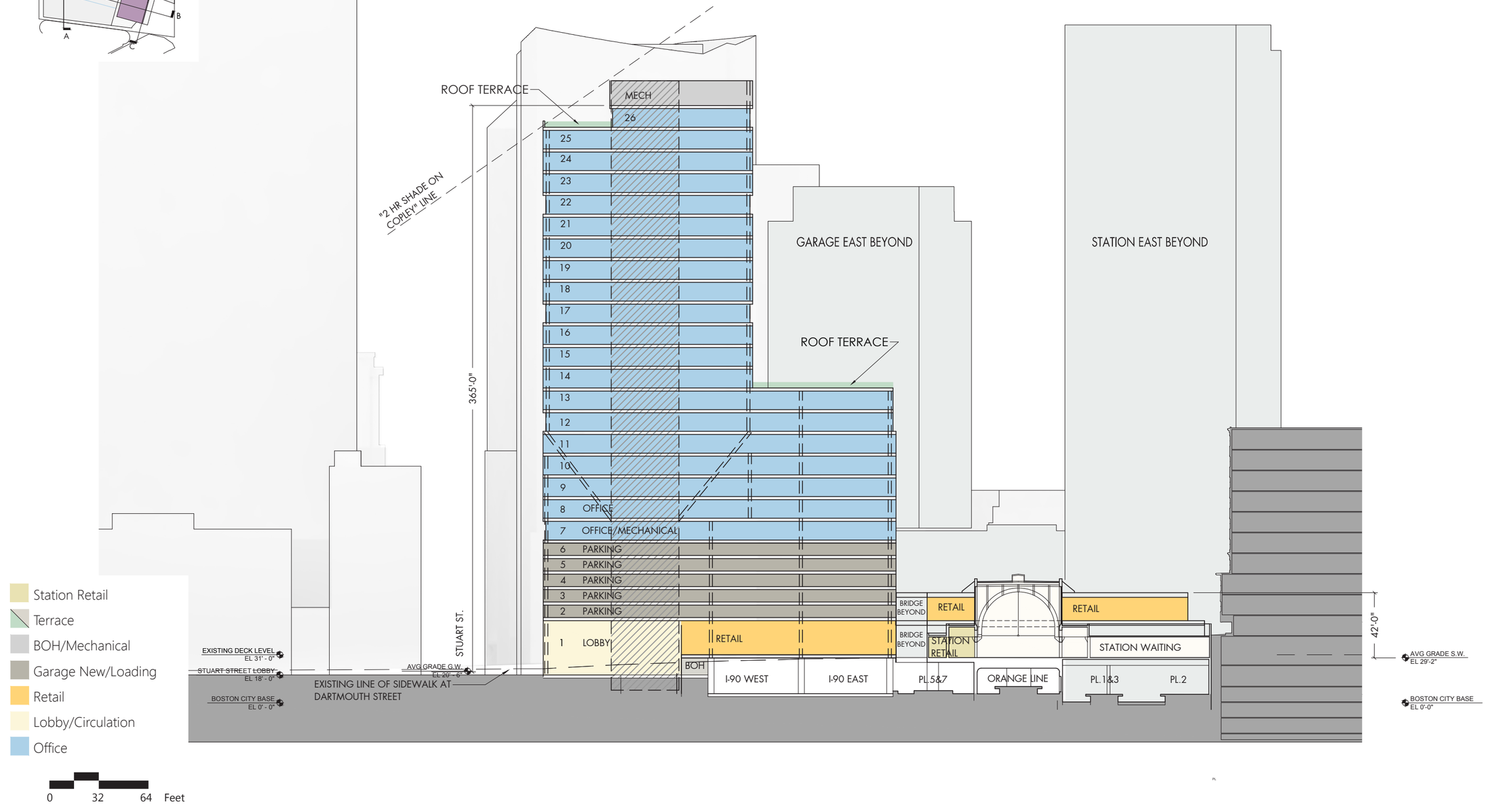
The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Garage West Base Scheme
Section D-D

Figure 3.4d

Pelli Clarke Pelli Architects



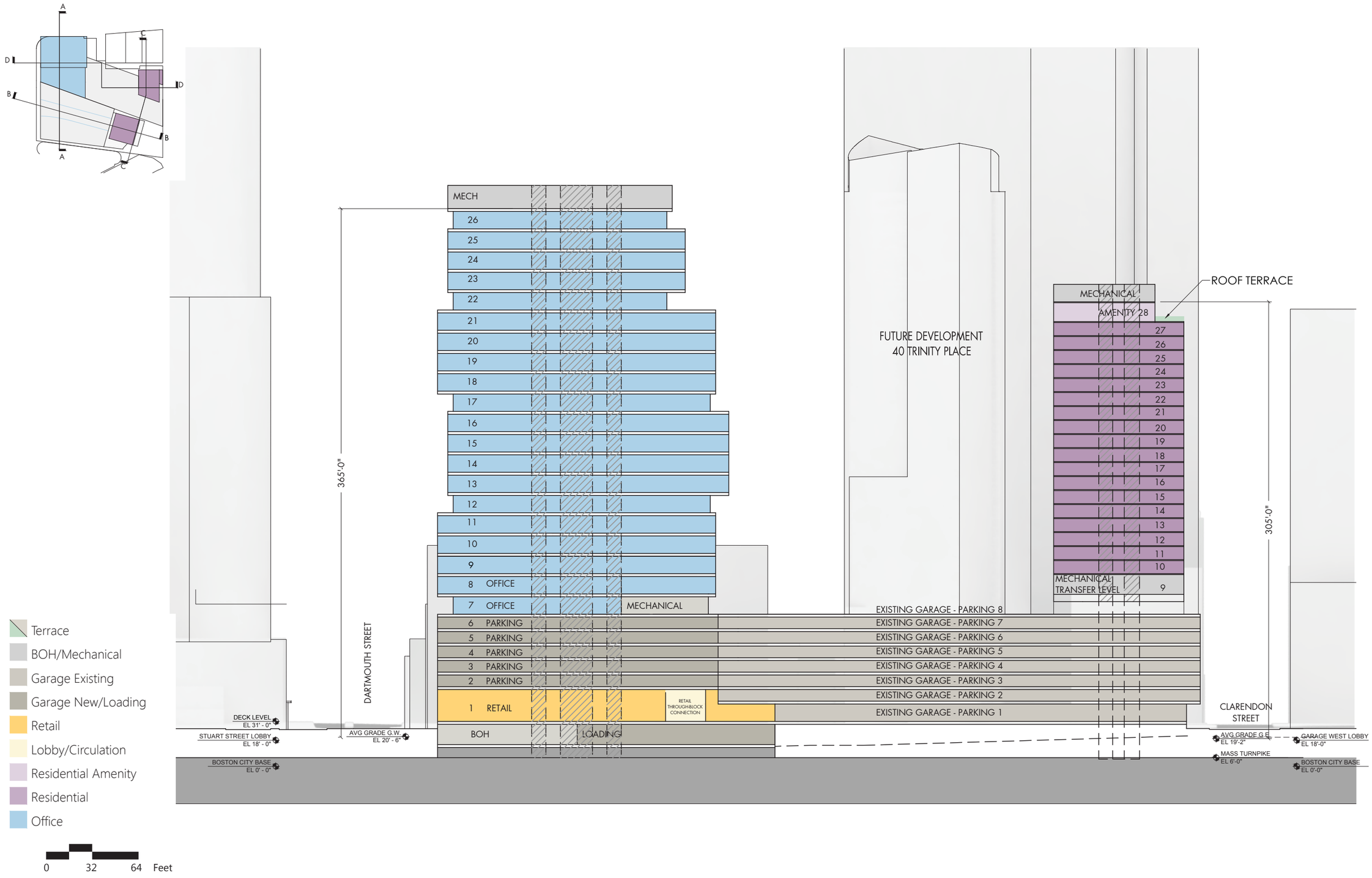


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Garage West Alternate Scheme
Section A-A

Figure 3.4e

Pelli Clarke Pelli Architects

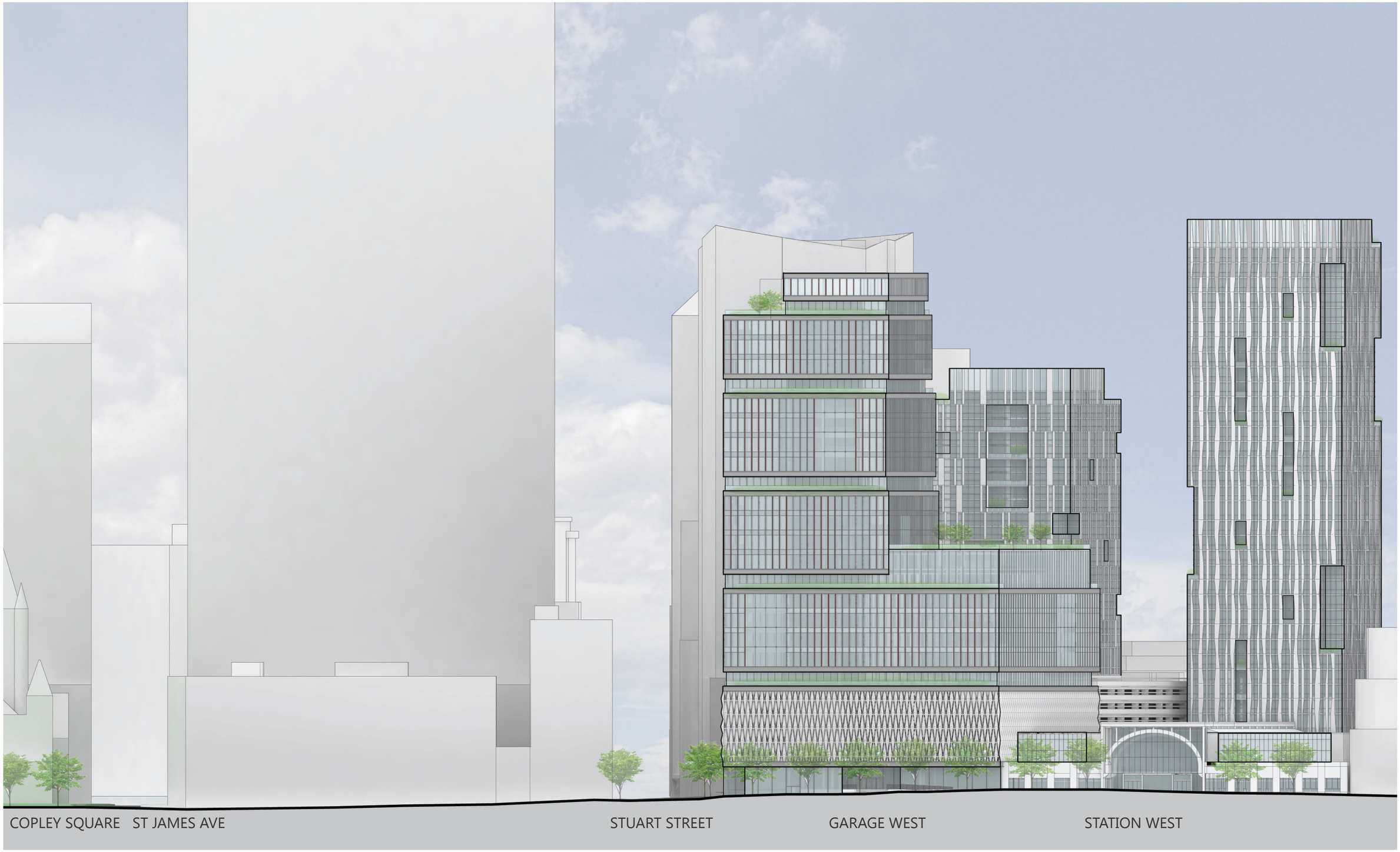


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Garage West Alternate Scheme
Section D-D

Figure 3.4f

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Elevation - Dartmouth Street

Figure 3.5a

Pelli Clarke Pelli Architects

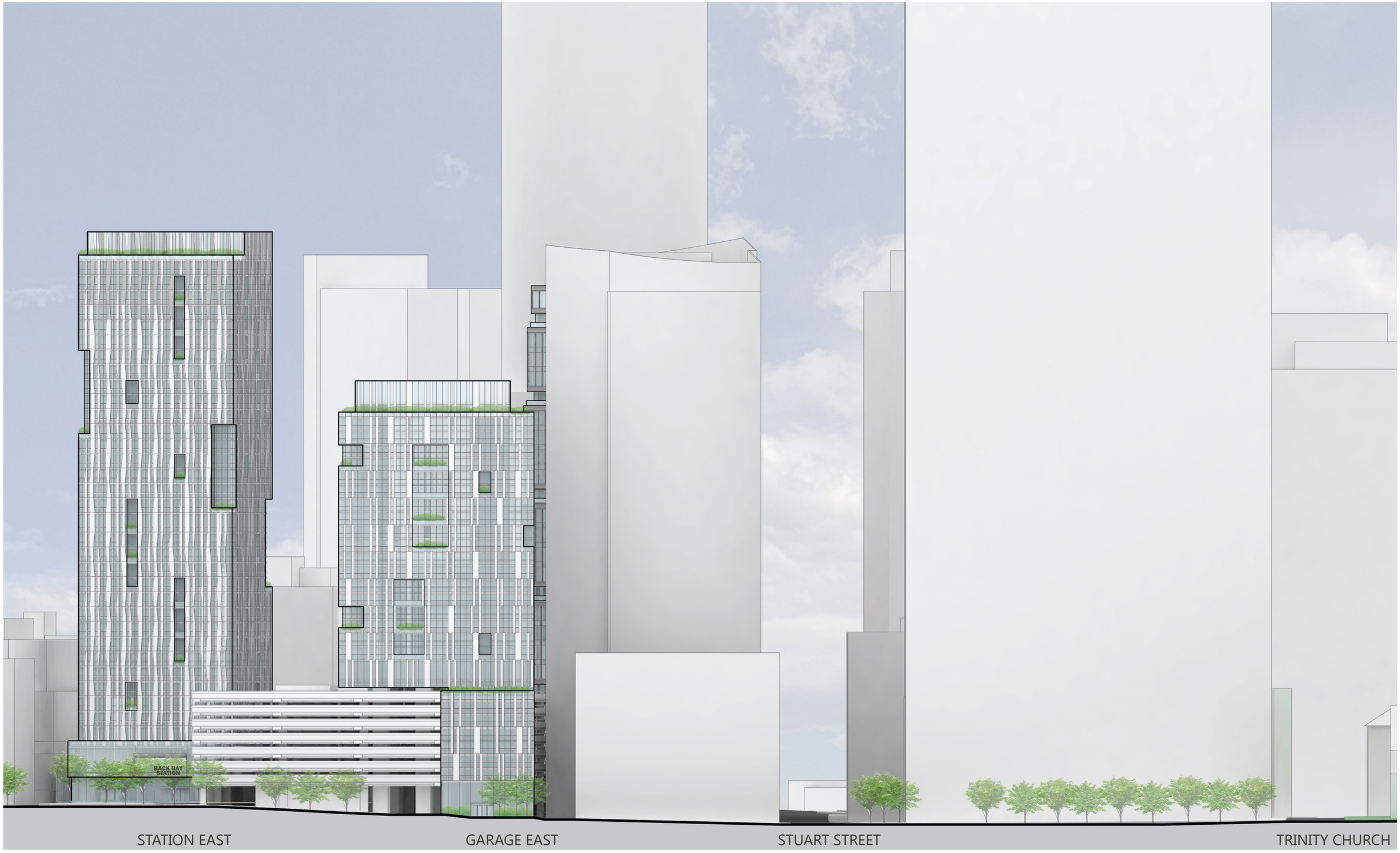


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Elevation - Stuart Street

Figure 3.5b

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Elevation - Clarendon Street

Figure 3.5c

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - View 1 - View from Cambridge
Future Existing Condition

Figure 3.6a

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - View 1 - View from Cambridge
Future Proposed Condition

Figure 3.6b

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - View 2 - View from I-90
Future Existing Condition

Figure 3.6c

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - View 2 - View from I-90
Future Proposed Condition

Figure 3.6d

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - View 3 - View Clarendon and Tremont Streets
Future Existing Condition

Figure 3.6e

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - View 3 - View Clarendon and Tremont Streets
Future Proposed Condition

Figure 3.6f

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - View 4 - View From Dartmouth and Tremont Streets
Future Existing Condition

Figure 3.6g

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - View 4 - View From Dartmouth and Tremont Streets
Future Proposed Condition

Figure 3.6h

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - View 5 - View from Southwest Corridor
Future Existing Condition

Figure 3.6i

Pelli Clarke Pelli Architects

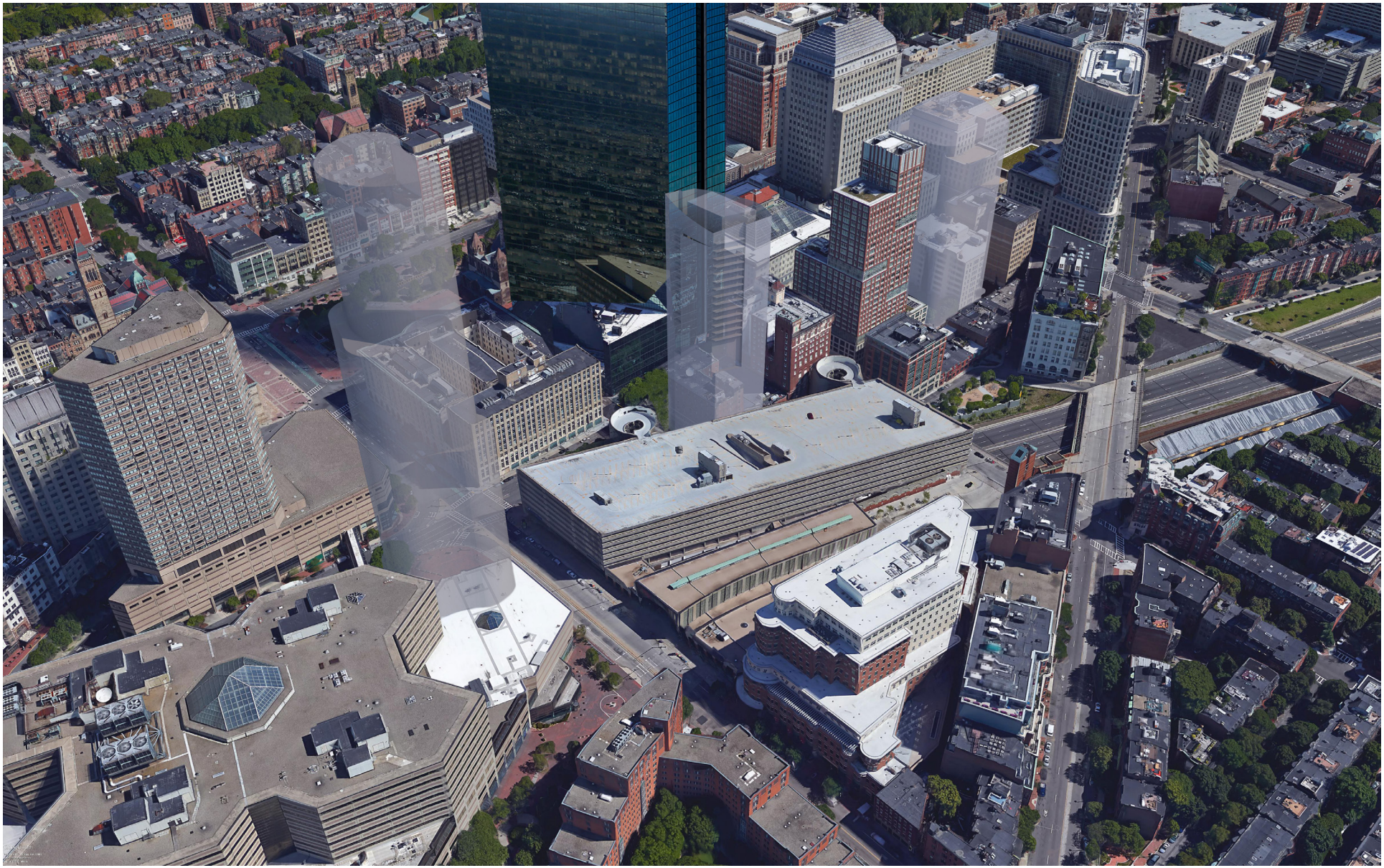


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - View 5 - View from Southwest Corridor
Future Proposed Condition

Figure 3.6j

Pelli Clarke Pelli Architects

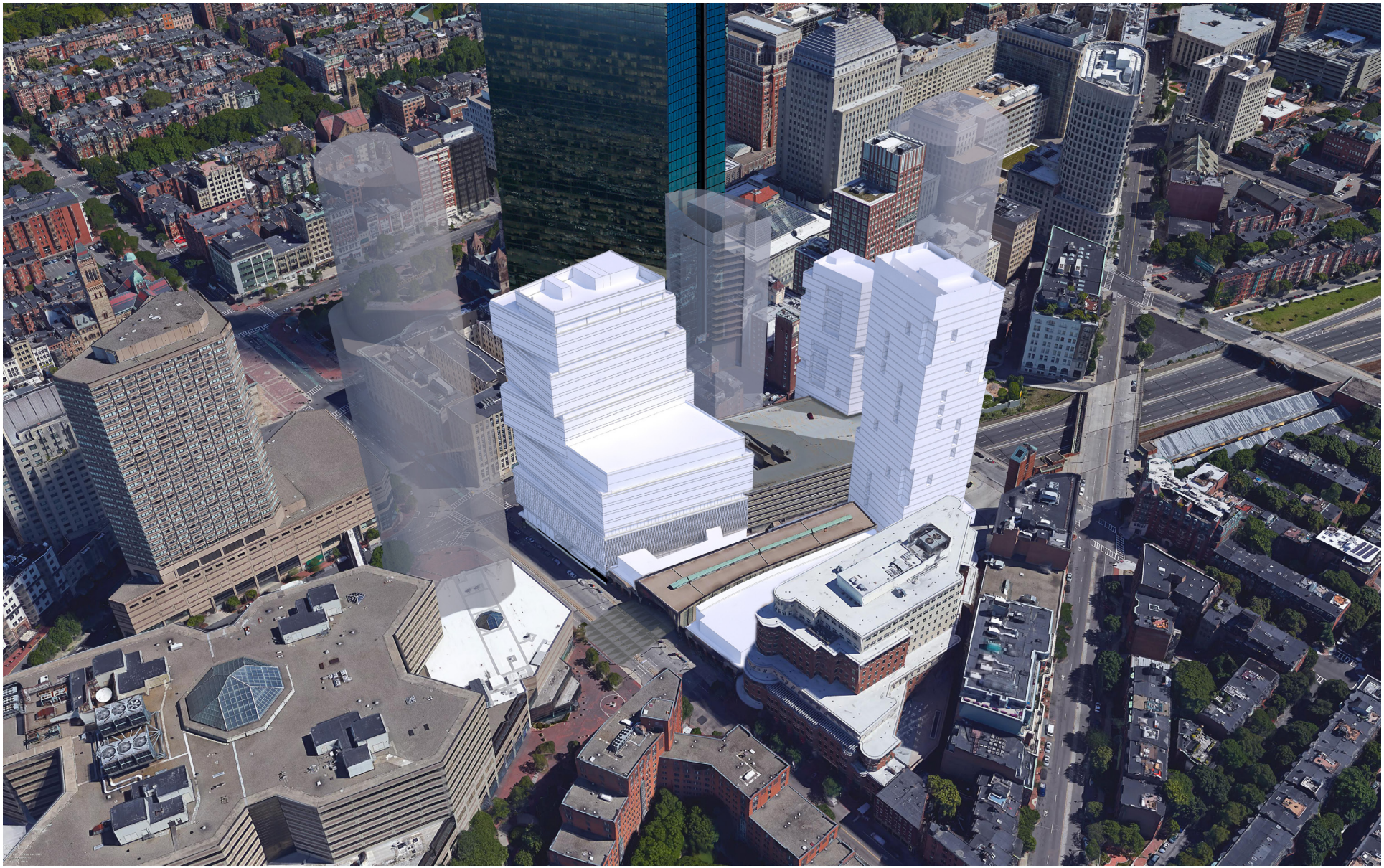


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - Aerial looking to the Northeast
Future Existing Condition

Figure 3.6k

Pelli Clarke Pelli Architects

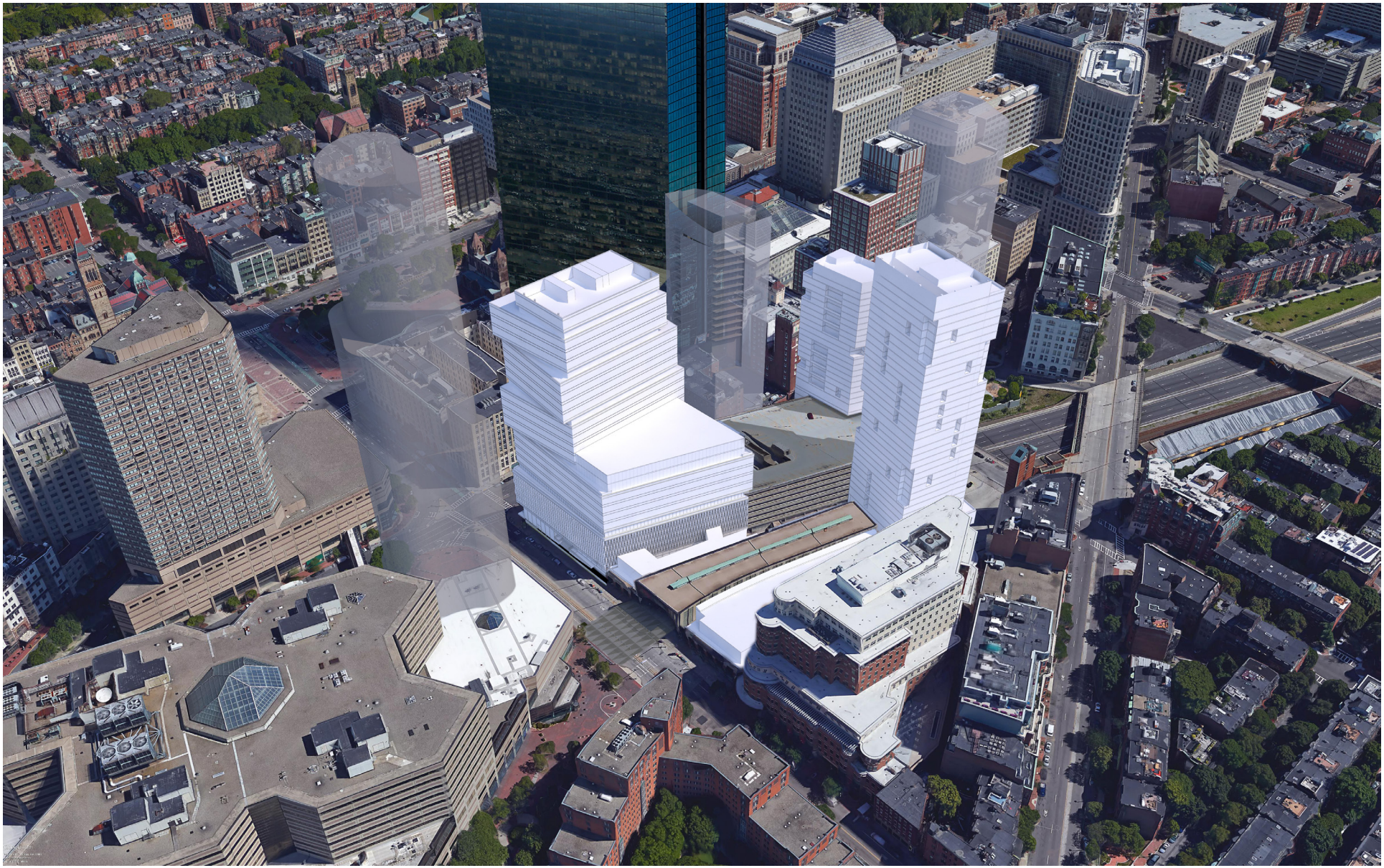


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - Aerial looking to the Northeast
Future Base Scheme

Figure 3.6l

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - Aerial looking to the Northeast
Future Alternate Scheme

Figure 3.6m

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - Aerial looking to the Southeast
Future Existing Condition

Figure 3.6n

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - Aerial looking to the Southeast
Future Base Scheme

Figure 3.6o

Pelli Clarke Pelli Architects



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Project Massing - Aerial looking to the Southeast
Future Alternate Scheme

Figure 3.6p

Pelli Clarke Pelli Architects


Back Bay Station
Garage @ 100 Clarendon
Dartmouth Street Elevator




PUBLIC PARKING
GARAGE AT 100 CLARENDON
NEXT RIGHT


PUBLIC PARKING
GARAGE AT 100 CLARENDON
Eastern Bank
← Entrance
← ATM
REDBONES
P27-689


SWISS MADE
BACK BAY SOUTH
ORANGE LINE
COMMUTER RAIL
AMTRAK
CRUMBLE
HOTEL
ORANGE LINE
COMMUTER RAIL
AMTRAK



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Station West - View of Central Hall from Dartmouth Street Entry

Figure 3.7c

ARROWSTREET



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Station West - View of Potential Pedestrian Bridge

Figure 3.7d

ARROWSTREET



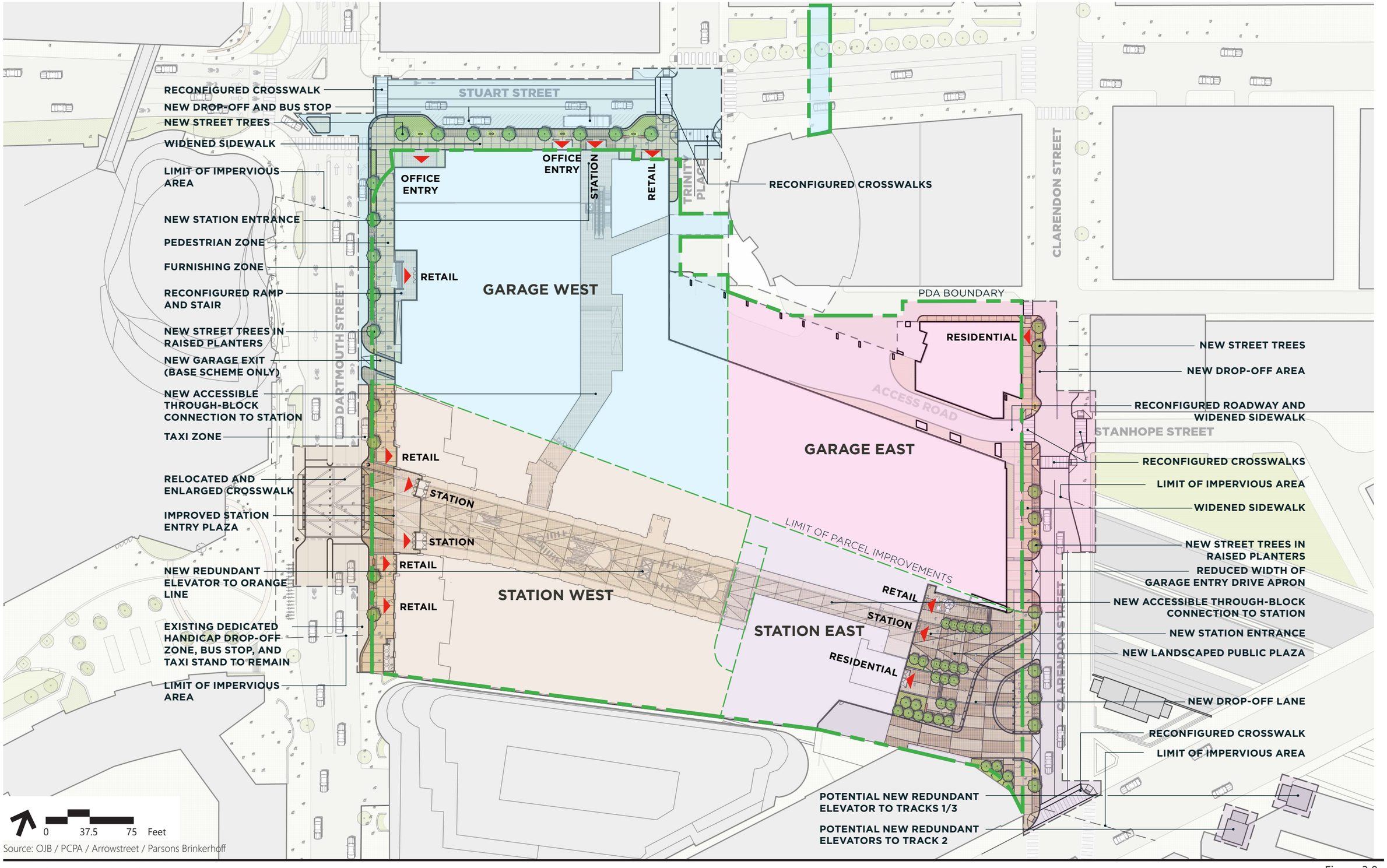
The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Station West - View toward new Clarendon Street Entry at Station East

Figure 3.7e

ARROWSTREET


BACK BAY NEWS
BACK BAY NEWS
TRACKS 1 & 3
TRACKS 1 & 3
OAK GROVE 4 MINUTES 10:49
OAK GROVE 7 MINUTES 10:52
FOREST HILLS 3 MINUTES 10:48
FOREST HILLS 6 MINUTES 10:51
ORANGE LINE
ALL TRAINS
ORANGE LINE
ALL TRAINS



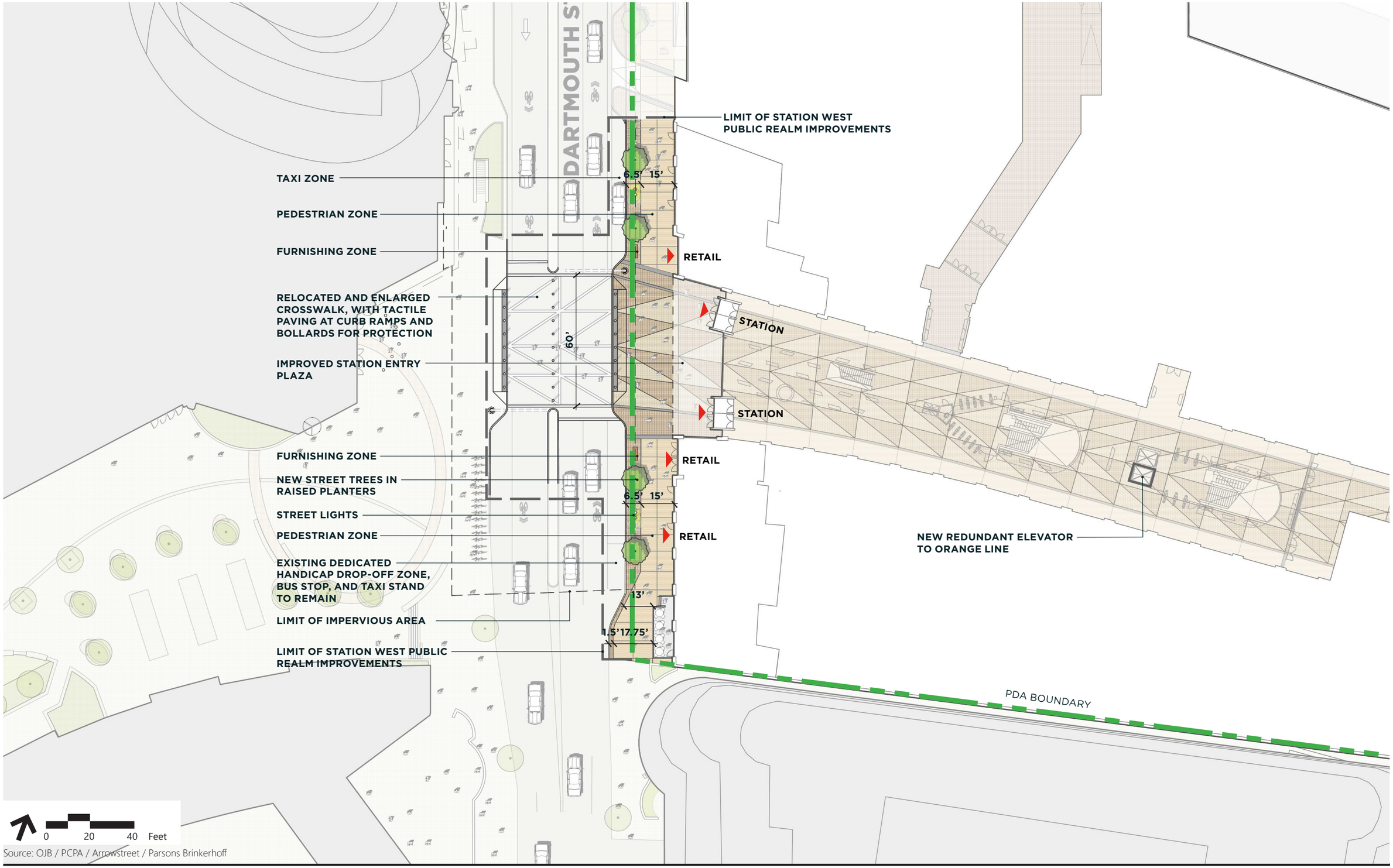
Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Overall Public Realm Improvements Plan

Figure 3.8a

OJB



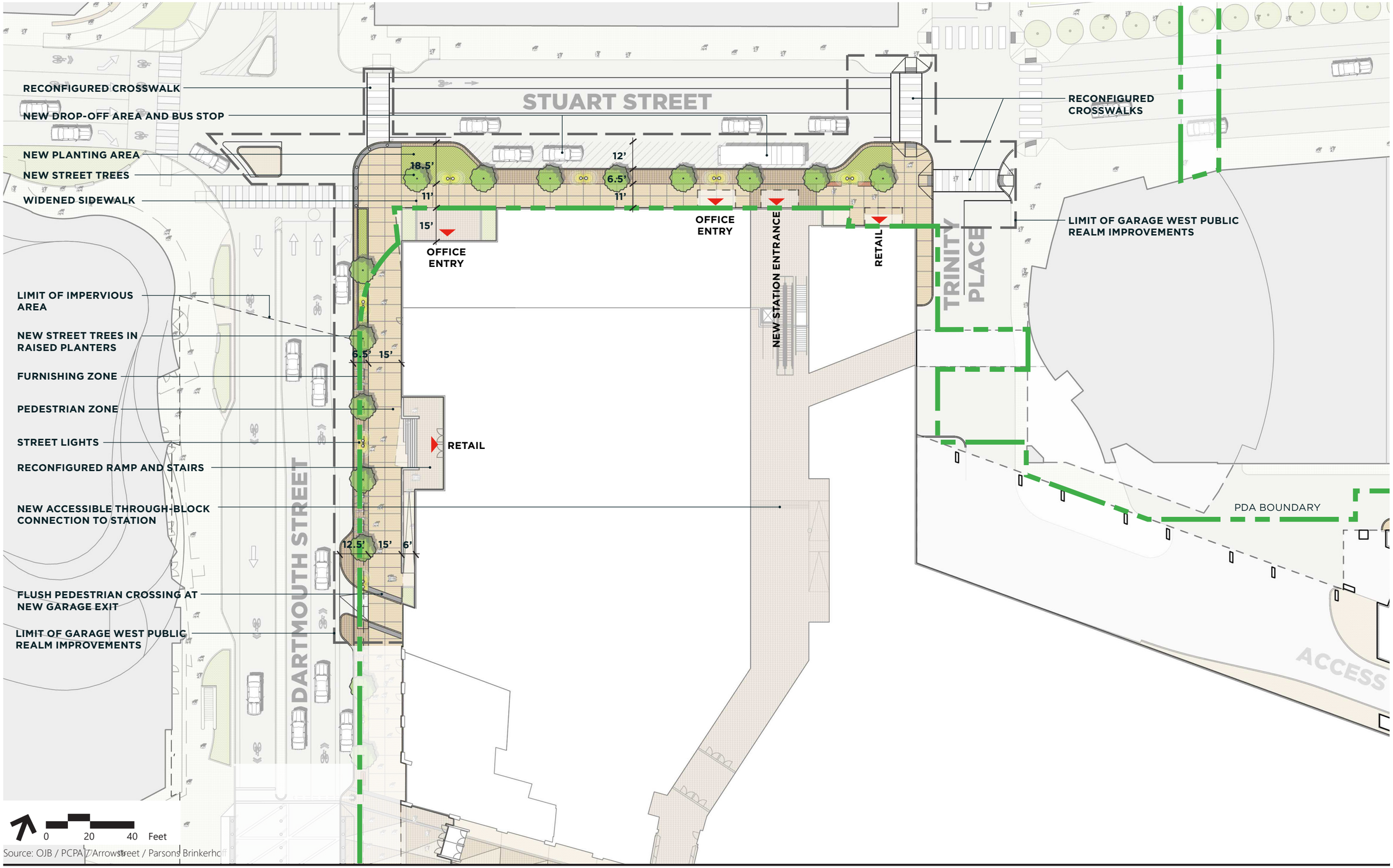
Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Public Realm Improvements Plan – Station West

Figure 3.8b

OJB



Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Public Realm Improvements Plan – Garage West Base Scheme

Figure 3.8c

OJB



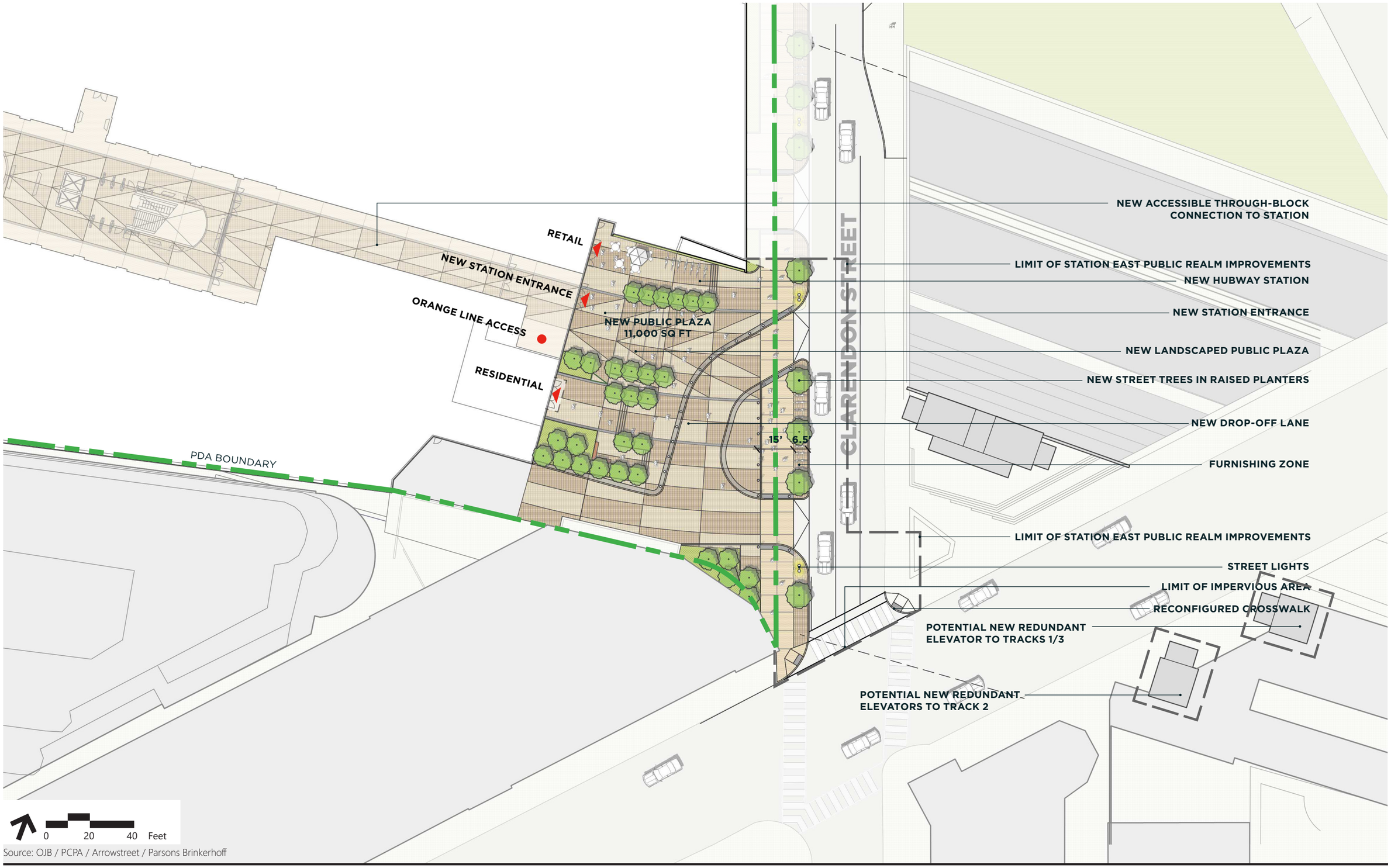
Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

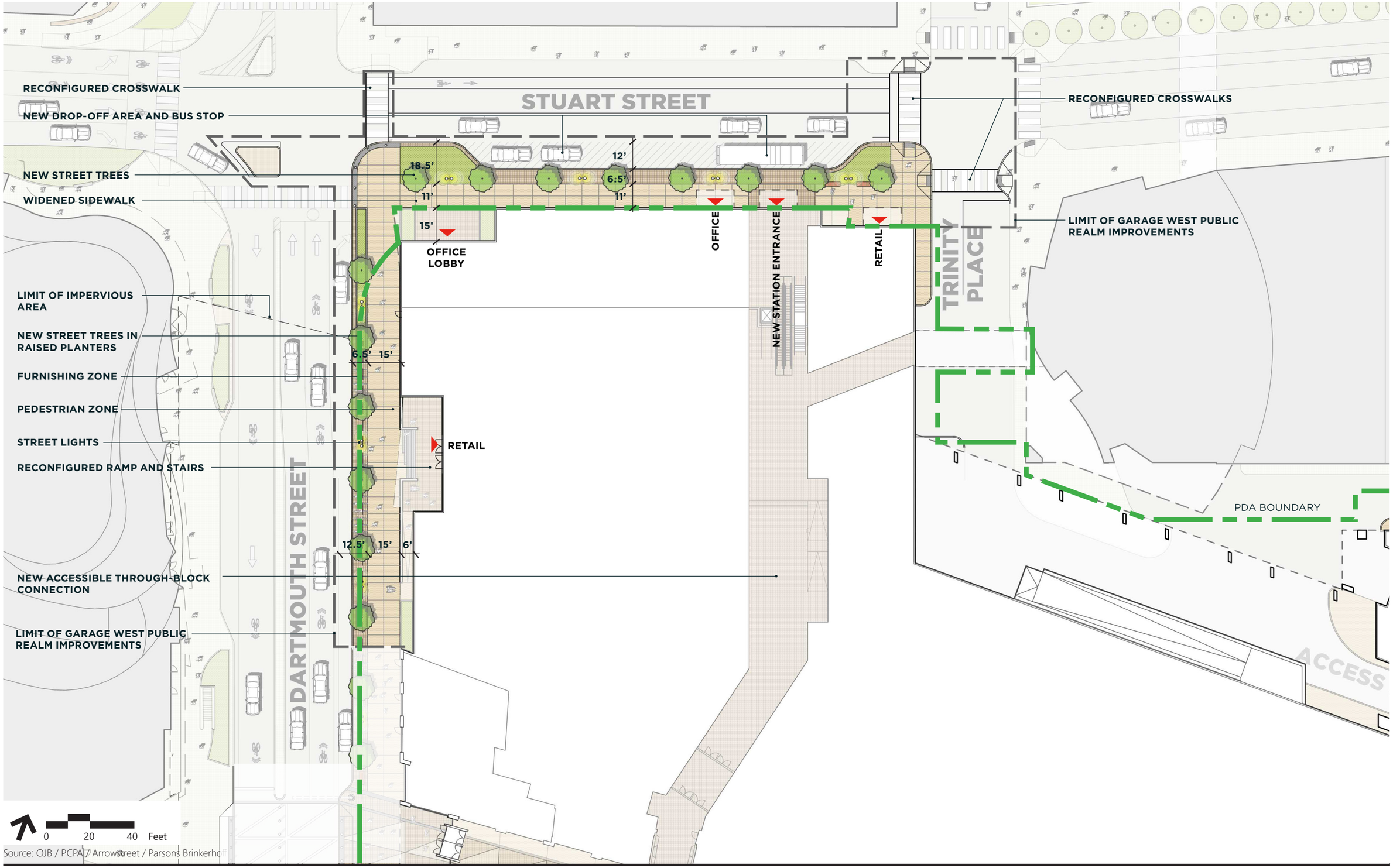
Public Realm Improvements Plan – Garage East

Figure 3.8d

OJB



Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff



Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Public Realm Improvements Plan – Garage West Alternate Scheme

Figure 3.8f
OJB

Building Entry
Pedestrian Access
Internal Access
Future Potential Bridge Connection
Vehicular Access
Loading Access
Loading, Service, and Delivery Locations
Bike Lane (by Others)
Sharrow (by Others)

STUART STREET
OFFICE LOBBY
OFFICE
STATION
RETAIL
TRINITY PLACE
CLARENDON STREET
RETAIL
DARTMOUTH STREET
GARAGE EXIT
RESIDENTIAL
STANHOPE STREET
RETAIL
STATION
STATION
RETAIL
RETAIL
GARAGE ACCESS
RETAIL
STATION
RESIDENTIAL
CLARENDON STREET

0 37.5 75 Feet

Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Circulation and Access Plan - Base Scheme

Figure 3.9a

OJB

STUART STREET

OFFICE LOBBY

OFFICE

STATION

RETAIL

TRINITY PLACE

CLARENDON STREET

RETAIL

DARTMOUTH STREET

RESIDENTIAL

GARAGE EXIT

ACCESS ROAD

STANHOPE STREET

RETAIL

STATION

STATION

RETAIL

RETAIL

GARAGE ACCESS

RETAIL

STATION

RESIDENTIAL

CLARENDON STREET

0 37.5 75 Feet

Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Circulation and Access Plan - Alternate Scheme

Figure 3.9b

OJB

4

Transportation and Parking

This chapter presents the analysis of the transportation and parking aspects of the Project, as described in detail in Chapter 1, *Project Description*. Specifically, this evaluation includes the following elements:

- Definition and presentation of existing traffic, including roadway capacities, parking, transit, pedestrian and bicycle circulation, loading and overall Project Site conditions.
- An evaluation of the Project's long-term transportation impacts, including roadway capacities, parking, transit, pedestrian and bicycle circulation, loading and overall Project conditions.
- A detailed summary of the proposed transportation mitigation and improvements the Project will contribute to the Back Bay and South End neighborhoods to help reduce the transportation impacts and improve overall accessibility to and from the area.

Additional detail and supporting information is provided in Appendix F of this DEIR/DPIR, which is provided electronically on the enclosed CD-ROM. Hardcopies of any or all of these supporting materials are available upon request.

4.1 Introduction

The Project Site is truly transit-oriented, being located directly adjacent to and over the Back Bay/South End Station with immediate access to multiple public transportation services, including MBTA Commuter Rail, Orange Line, local bus routes, and AMTRAK (see Section 4.3.2 for details of services). In addition, it enjoys excellent local and regional roadway access due to its central location in Back Bay and the proximity of one ramp from I-90 eastbound and several ramps to I-90 westbound.

The mix of residential, commercial and retail uses in the Project will benefit from excellent transit accessibility, resulting in a high proportion of transit-trips rather than vehicle-trips. Further, the capture of internal trips between different Project uses will result in a reduction of vehicle trips and create opportunities to control parking demand through the sharing of parking spaces by different types of users according to the time of day. Accordingly, no new parking is proposed as part of the Project, and the Garage will maintain the ability to provide up to the existing permitted capacity of 2,013 spaces should it be warranted to meet demand.

Additionally, the Project will implement a robust program of TDM strategies to take full advantage of the multiple adjacent mobility options and its synergy with the surrounding vibrant mixed-use neighborhoods. To encourage bicycling, the TDM

plan will incorporate long and short-term bicycle accommodations within the Garage and elsewhere within the Project Site.

4.1.1 Project Description

As described previously in Section 1.4, the Project is composed of four parcels: Garage West Parcel, Garage East Parcel, Station East Parcel and Station West Parcel, and has been planned and designed as four distinct and several but interconnected Project Components which may proceed independently. The proposed development program is presented in Table 4-1:

Table 4-1 Proposed Development Program

	Garage West (base)	Garage West (alternate)	Garage East	Station East	Station West
Lot Area	68,846	68,846	52,966	38,413	64,676
Total (SF)[1]	606,400	618,400	222,100	387,000	30,000
Height (FT) [2]	365	365	305	400	42
# Stories	26	26	28	35	1
Office (SF)	582,600	591,900	-	-	-
Retail (SF)	23,800	26,500	-	5,100	30,000
Residential (SF)	-	-	222,100	381,900	-
Residential Units	-	-	240	360	-
Garage (SF)[3]	207,770	205,620	-	-	-
Parking (Spaces)	Up to 2,013 spaces to be provided Site-wide under all alternatives				
FAR[4]	8.81	8.98	4.19	10.07	0.46

FAR Total (across all sites): 5.53[5]

1 Unless labeled otherwise, all areas provided herein are described in gross floor area as such term is used in the definition of "Floor Area Ratio" in the Code; therefore, such areas specifically exclude floor area devoted to garage use, whether or not in the basement of a building or serving residential uses, mechanical equipment, storage, service and loading areas, and areas serving as access to, egress from or use by public transit services, including pedestrian bridge connections providing access to such public transit services, whether directly or indirectly as part of the overall Project. Please note that given the fact that the majority of the Project Site is on and over air rights, it is not possible to reconstruct parking spaces beneath one or more of the buildings, and thus this filing and PDA No.2 as amended will expressly exclude the square footage allocated to such parking for the purposes of calculating FAR.

2 Notwithstanding the definition of "Building Height" set forth in the Code, with respect to each of the Air Rights Development Parcels, the following shall be the "grade" for each: (i) Garage West: 20'-6" BCB; (ii) Garage East: 19'-2" BCB; (iii) Station East: 31'-6" BCB; (iv) Station West: 29'-2" BCB; and the "Building Height" shall be the vertical distance from said "grade" to the top of the structure of the last occupied floor; Provided further that any elevator penthouse, stairway bulkhead or any other roof structure built for the purpose of accessing a roof deck or roof terrace as well as the said roof decks and roof terraces and other roof top amenities themselves, shall be excluded from the calculation of building height under the PDA.

3 Garage areas are provided in gross square feet, and represent only the areas of the reconstructed parking Garage.
4 Floor Area Ratio.
5 FAR Total provided is for Base Scheme only. FAR total for Alternate Schemes is 5.59.

4.1.2 I-90 On-Ramp

As described in Section 1.2.3, independent of the Project proposed by the Proponent, MassDOT is studying the safety and utility of the On-Ramp at Clarendon Street and is considering its potential closure. MassDOT is preparing an Interchange Modification Report (IMR) for submittal to the Federal Highway Administration (FHWA) for review.

As discussed in Section 1.4 and Chapter 3, *Urban Design*, the Proponent has prepared two development schemes for the portion of the Project affected by the potential I-90 On-Ramp closure. Both schemes have nearly identical development programs and are, therefore, effectively the same in terms of Project trip generation. The Proponent has worked with MassDOT and the City of Boston to identify the effects of the On-Ramp closure to traffic circulation in the area. The DEIR/DPIR analysis of the Project evaluates its potential impacts, positive and negative, under both scenarios with and without the On-Ramp closure.

4.2 Summary of Key Findings and Benefits

Transit Oriented Development – The Project exemplifies transit-oriented development by developing high density housing, retail and office uses above and adjacent to a multi-modal transit hub served by multiple public transportation services, including MBTA Commuter Rail, Orange Line and local bus routes, and AMTRAK, resulting in a high proportion of transit trips rather than vehicle trips.

Station Upgrades –

- As described above, with the development of the Garage West Parcel, the Project will deliver a new Station Entrance from Stuart Street linked to the Station via a through-block connector, providing transit customers an accessible and weather-protected path.
- With the development of the Garage West Parcel, a dedicated bus pull-off area will be provided adjacent to the new Station entrance, making commuter connections safer and more convenient.
- With the development of the Station East Parcel, the Project will deliver a new Station Entrance from Clarendon Street linked to the Station via a through-block connector, providing transit customers an accessible and weather-protected path.
- With the development of the Station East Parcel, a new public plaza serving as a forecourt to the new Station entrance will be delivered, reinforcing the civic nature of the new Station entrance.
- With the development of the Station East Parcel, the Project will deliver a new redundant elevator to the Orange Line adjacent to the existing elevator, doubling

the existing capacity and increasing reliability for transit customers. New redundant elevators will also be delivered to Tracks 1/3 and Track 2, if determined to be feasible.

- With the development of the Station West Parcel, the existing Dartmouth Street crosswalk will be relocated and expanded to align with the future Station entrance, improving commuter safety and access to the Station.
- With the development of the Station West Parcel, the existing open space on Dartmouth Street will be enhanced to create an inviting public plaza that welcomes transit customers and reinforces the civic nature of the existing Station entrance.

MBTA Revenue - The Project-generated transit trips are estimated to contribute approximately an additional $4.6 to 5.8 million in annual revenue for the MBTA based on current fare levels.

Station Concourse Improvements – Through a separate but related project, the Proponent has begun making significant functional and aesthetic improvements to, and has assumed property management responsibilities of, the Station Concourse in an effort to dramatically improve customer experience, comfort, and safety.

Pedestrians – The Project will improve the pedestrian environment significantly through the enhancement of sidewalks in the vicinity of the Project site, the creation of new open space, and the introduction of new pedestrian connections including the new station entrances on Stuart and Clarendon Streets.

Bicycle Accommodations and Parking –

- The Project will incorporate bicycle accommodations to encourage cycling and walking, as strong transportation modes.
- With the development of the Station East Parcel, the Project will locate a new Hubway station on the Clarendon Street plaza near the new Station Entrance.

Transportation Demand Management Program – The Project will implement a robust program of TDM strategies to take full advantage of its multiple mobility options and its synergy with the surrounding vibrant mixed-use neighborhoods.

No Net New Parking –

- The capture of internal trips between different uses will result in the reduction of vehicle trips and opportunities to limit parking through sharing of parking spaces for different users by time of day.
- Due to the measures cited above as well as the capacity of the existing Garage and potential modifications to its operations resulting from the Project, no new net parking is proposed as part of the Project.

4.3 Existing Conditions Assessment

The Project Site is located at the nexus of the Back Bay and South End neighborhoods of Boston with direct access to the major roadway arterials, public

transit alternatives and a vast system of sidewalks and bike lanes to connect the Site with the surrounding community and adjacent neighborhoods. The Site adjoins the bustling Back Bay/South End transportation hub, which includes AMTRAK, four Commuter Rail lines, the MBTA Orange Line, nine MBTA Bus routes and the MBTA Green Line located within minutes of the Site, making this Project an ideal Transit Oriented Development (TOD). The following sections provide details on the excellent existing transportation infrastructure supporting the Project Site.

4.3.1 Vehicle Facilities

Roadways

The Project is bounded by Dartmouth Street to the west, Stuart Street to the north, Clarendon Street to the east, and the southern property line of the Station to the south. The site also accommodates direct access from Clarendon Street, under the existing Garage, onto I-90 Westbound. Figure 1.2 – Project Site Context, previously presented shows the existing roadway infrastructure surrounding the Project.

Dartmouth Street runs north/south and is bounded by Back Street to the north and Tremont Street to the south. Dartmouth Street is one-way southbound for one block between Back Street and Beacon Street and one-way northbound from Stuart Street to Beacon Street. Dartmouth Street is two-way from Stuart Street to Tremont Street where it continues southeast as West Dedham Street. At the Project Site, Dartmouth Street provides one southbound lane and two northbound lanes with parking on both sides.

Stuart Street is one-way running west to east from Huntington Avenue to Charles Street and two-way from Charles Street to Washington Street. It continues east of Washington Street as Kneeland Street. At the Project Site, Stuart Street is three travel lanes with parking on both sides.

Clarendon Street borders the east end of the Site, running one-way southbound from Back Street to Tremont Street. At the Project Site, Clarendon Street is a two lane roadway with parking on the east side.

Study Intersections

The Project study area has been expanded from the 20 intersection study area proposed in the ENF and PNF to include intersections identified in the MassDOT Scope of Work submitted on the ENF and PNF, dated June 17, 2016 and the Secretary's Certificate on the ENF, dated June 24, 2014. The study area includes the following 28[1] intersections, as shown in Figure 4.1.

[1] It should be noted that the Secretary's Certificate on the ENF identified 32 study intersections. However, due to different intersection nomenclature, 4 of the locations are duplicates and the combined list includes a total of 28 study intersections.

1. Boylston Street / Clarendon Street
2. Boylston Street / Berkeley Street
3. St. James Avenue / Dartmouth Street
4. St. James Avenue / Trinity Place (unsignalized)
5. St. James Avenue / Clarendon Street
6. St. James Avenue / Berkeley Street
7. St. James Avenue / Arlington Street
8. Huntington Avenue / Exeter Street / Stuart Street
9. Stuart Street / Dartmouth Street
10. Stuart Street / Trinity Place
11. Stuart Street / Clarendon Street
12. Stuart Street / Berkeley Street
13. Stuart Street / Arlington Street
14. Stuart Street / I-90 Westbound Off-Ramp (unsignalized)
15. Clarendon Street / Stanhope Street (unsignalized)
16. Clarendon Street / Garage Driveway (unsignalized)
17. Columbus Avenue / Dartmouth Street
18. Columbus Avenue / Clarendon Street
19. Columbus Avenue / Cahners Place (unsignalized)
20. Columbus Avenue / Berkley Street
21. Arlington Street / Marginal Road / I-90 On-Ramp
22. Arlington Street / Herald Street / Tremont Street
23. Albany Street / Herald Street
24. Albany Street / I-93 Southbound On-Ramp (unsignalized)
25. Albany Street / Travelers Street
26. Traveler Street / Frontage Road / W Broadway / I-93 Northbound On-Ramp / I-90 Westbound On-Ramp
27. Berkeley Street / Storrow Drive On-Ramp (unsignalized)
28. Clarendon Street / Storrow Drive Off-Ramp (unsignalized)

Existing vehicular traffic data was collected for all of the study area intersections for the morning and evening weekday peak hours. Traffic counts for a number of locations were available from studies of recently approved projects, including 40 Trinity Place, 380 Stuart Street and 370-380 Harrison Avenue. These counts were grown to 2016 volumes using a growth rate of 0.25 percent per year, as confirmed by BTD. The majority of intersections directly surrounding the Project Site were counted in August 2016; these intersections were adjusted according to the MassDOT Seasonal Adjustment Factors. Based on the compiled vehicular traffic data, the existing weekday morning peak hour occurs between 8:00 AM and 9:00 AM, while the existing weekday evening peak hour occurs between 5:00 PM and 6:00 PM.

Figures 4.2a and 4.2b present the 2016 Existing Conditions weekday peak hour traffic volumes.

The MassDOT and MEPA DEIR Scopes both requested a Saturday peak hour analysis for the Project. Based on subsequent communications with MassDOT and MEPA, this analysis was determined unnecessary due to the reduced number of Project-generated Saturday trips and the reduced number of existing and background Saturday traffic in the area when compared to the weekday peak hour volumes. To confirm this assumption and satisfy this requirement, the Proponent conducted Weekday and Saturday ATRs at three locations adjacent to the Project Site over four days from Wednesday, September 28, 2016 through Saturday, October 1, 2016. Tables 4-2 through 4-4 show a comparison of weekday traffic to Saturday traffic, detailed count data is provided in Appendix F. The volumes show lower Saturday volumes throughout the day compared to the weekday peak hour counts.

In addition, a Saturday peak hour trip generation calculation is presented in Appendix F to show the reduced number of trips the Project will generate during the weekend when compared to the weekday peak hours.

TABLE 4-2 DAILY TRAFFIC VOLUMES: DARTMOUTH STREET, SOUTH OF STUART STREET

Time of Day	Wednesday 9/28/2016	Thursday 9/29/2016	Friday 9/30/2016	Saturday 10/1/2016
12:00 AM	144	211	203	437
01:00 AM	88	129	164	316
02:00 AM	60	94	152	184
03:00 AM	44	68	66	73
04:00 AM	76	68	83	47
05:00 AM	289	287	286	92
06:00 AM	532	482	527	180
07:00 AM	838	846	809	351
08:00 AM	1,023	992	986	443
09:00 AM	877	825	860	601
10:00 AM	763	821	846	678
11:00 AM	750	749	751	739
12:00 PM	737	771	888	825
01:00 PM	726	813	870	763
02:00 PM	843	751	885	814
03:00 PM	828	860	966	911
04:00 PM	975	944	1,061	912
05:00 PM	1,106	1,153	1,122	896
06:00 PM	1,045	1,093	1,047	908
07:00 PM	810	828	926	803
08:00 PM	739	719	710	707
09:00 PM	595	558	624	613
10:00 PM	522	507	676	689
11:00 PM	310	311	581	675
Daily Total	**14,720**	**14,880**	**16,089**	**13,657**

Note: Volumes are a sum of northbound and southbound volumes

TABLE 4-3 DAILY TRAFFIC VOLUMES: STUART STREET, EAST OF DARTMOUTH STREET

Time of Day	Wednesday 9/28/2016	Thursday 9/29/2016	Friday 9/30/2016	Saturday 10/1/2016
12:00 AM	131	408	201	367
01:00 AM	84	237	136	319
02:00 AM	69	188	81	239
03:00 AM	37	206	68	89
04:00 AM	75	91	93	57
05:00 AM	262	268	241	94
06:00 AM	587	592	613	176
07:00 AM	1,015	1,048	910	320
08:00 AM	1,138	953	1,111	421
09:00 AM	961	961	954	646
10:00 AM	784	805	798	781
11:00 AM	731	718	803	828
12:00 PM	710	768	854	923
01:00 PM	686	725	736	941
02:00 PM	781	734	873	1,004
03:00 PM	840	818	986	1,045
04:00 PM	906	977	1,022	1,062
05:00 PM	1,025	1,026	1,011	1,029
06:00 PM	965	1,046	1,017	928
07:00 PM	679	758	828	864
08:00 PM	522	529	618	585
09:00 PM	490	483	556	555
10:00 PM	438	413	573	597
11:00 PM	428	307	564	640
Daily Total	**14,344**	**15,059**	**15,647**	**14,510**

TABLE 4-4 DAILY TRAFFIC VOLUMES: CLARENDON STREET, SOUTH OF STUART STREET

Time of Day	Wednesday 9/28/2016	Thursday 9/29/2016	Friday 9/30/2016	Saturday 10/1/2016
12:00 AM	63	78	113	238
01:00 AM	39	66	88	189
02:00 AM	41	37	56	113
03:00 AM	24	27	27	31
04:00 AM	37	47	55	28
05:00 AM	168	207	189	72
06:00 AM	298	300	280	125
07:00 AM	541	510	508	225
08:00 AM	727	693	685	277
09:00 AM	646	619	600	360
10:00 AM	473	505	504	461
11:00 AM	415	527	535	454
12:00 PM	537	516	575	493
01:00 PM	468	499	531	481
02:00 PM	602	541	629	605
03:00 PM	628	604	664	611
04:00 PM	635	658	705	588
05:00 PM	706	758	657	651
06:00 PM	771	758	710	644
07:00 PM	587	594	656	527
08:00 PM	400	403	485	414
09:00 PM	345	380	370	378
10:00 PM	244	269	385	348
11:00 PM	151	205	340	330
Daily Total	**9,546**	**9,801**	**10,347**	**8,643**

Parking

The existing parking Garage on the Project Site is served by an entry/exit driveway located on Clarendon Street accessible by all Garage users, and a pair of drum speed-ramps accessible to parking pass holders only. The entry drum (located on the Garage West Parcel) is accessed from Stuart Street via Trinity Place, and the exit drum (located on the Garage East Parcel) connects to the MassDOT service road from Clarendon Street (under the Garage), which in turn leads to the I-90 On-Ramp and also connects to Stuart Street via Trinity Place.

As allowed under the Downtown Parking Freeze Permit and Private Parking Space Exemption issued by the Boston Air Pollution Control Commission (APPC), the existing Garage can accommodate up to 2,013 parking spaces. As permitted, the Garage is currently subject to certain parking lease commitments, and provides limited parking to the general public.

Garage occupancy counts were obtained for the month of October 2016. Table 4-5 provides an average hourly weekday (Tuesday, Wednesday, Thursday) summary of the existing garage occupancy.

TABLE 4-5 EXISTING WEEKDAY GARAGE OCCUPANCY (OCTOBER 2016)

Time of Day	Average Entries	Average Exits	Average Occupancy	Percent Occupied[1]
1:00 AM	1	21	417	23%
2:00 AM	2	10	382	19%
3:00 AM	1	10	373	19%
4:00 AM	3	2	374	19%
5:00 AM	6	2	378	19%
6:00 AM	102	4	475	24%
7:00 AM	162	21	616	31%
8:00 AM	278	49	845	42%
9:00 AM	411	57	1,199	60%
10:00 AM	285	40	1,443	72%
11:00 AM	125	41	1,527	76%
12:00 PM	81	45	1,563	78%
1:00 PM	**64**	**57**	**1,570**	**78%**
2:00 PM	51	103	1,518	75%
3:00 PM	70	139	1,448	72%
4:00 PM	76	145	1,379	69%
5:00 PM	56	238	1,198	60%
6:00 PM	95	312	981	49%
7:00 PM	89	239	831	41%
8:00 PM	55	151	735	37%
9:00 PM	21	112	645	32%
10:00 PM	13	80	577	29%
11:00 PM	9	69	517	26%
12:00 AM	5	62	460	23%
Total	2,060	2,009	-	-

1 Expressed as a percentage of the 2,013 permitted spaces

As shown in Table 4.5, the average garage peak occupancy occurs at 1:00 PM, with a 78 percent average occupancy. Based on the average entry and exit volumes of 2,035 2-way trips (2,060 enter, 2,009 exit), each of the 2,013 parking spaces has an average turnover rate of 1.01 times per day.

Figure 4.3a identifies other off-street parking facilities in the area. In total, in addition to the Garage spaces, there are approximately 6,083 off-street parking spaces available to employees, tenants, and visitors within an approximately five-minute walking distance of the Project Site.

Figure 4.3b presents existing on-street parking regulations within a quarter-mile (approximately five-minute walk) radius of the Project Site. The majority of on-street curbside uses adjacent to and north of the Site are either metered parking, or are signed no parking. South of the Site is mostly resident parking.

In addition to the various public and private parking facilities in the area, the Project Site is well serviced by car-sharing services including ZipCar and Enterprise CarShare. Figure 4.3c identifies car-share locations within a quarter-mile (approximately five-minute walk) radius of the Project Site.

4.3.2 Transit Facilities and Service

The Project Site is extremely well served by public transportation, including the following:

- Back Bay Station:
  - MBTA Orange Line
  - Four (4) MBTA Commuter Rail Lines
    - Franklin Line
    - Needham Line
    - Providence/Stoughton Line
    - Framingham/Worcester Line
  - AMTRAK, serving NYC, Washington, D.C., and Chicago
- Copley Square Station:
  - MBTA Green Line
- MBTA Bus Routes:
  - 9, 10, 39, 55, 170, 502 Express, 503 Express, 504 Express, 553 Express

The transit services are summarized in Table 4-6. Figure 4.4a shows the Project Site in the context of the wider MBTA system, while Figures 4.4b and 4.4c show the MBTA services, including bus stop locations, in the immediate vicinity of the Project Site.

TABLE 4-6 TRANSIT SERVICE SUMMARY

Transit Service	Origin – Destination	Major Stops	Nearest Stop to Project Site	Peak Hour Headway (minutes)[1]	Weekday Daily Ridership[2]	Hours of Service[1]
Commuter Rail Services						
Franklin Line	Forge Park/I-495 – South Station	Back Bay Station Ruggles Station	Back Bay Station	20 – 40	12,480	Weekdays: 4:00 AM – 12:50 AM Saturday: 6:30 AM – 12:30 AM Sunday: 10:40 AM – 12:20 AM
Needham Line	Needham Heights – South Station	Back Bay Station Ruggles Station Forest Hills Station	Back Bay Station	30 – 40	6,972	Weekday: 6:05 AM – 11: 10 AM Saturday: 7:10 AM – 12:00 AM Sunday: No Service
Providence/Stoughton Line	Wickford Junction – South Station	Route 128 Station Ruggles Station Back Bay Station	Back Bay Station	10-30	26,465	Weekday: 4:50 AM – 1: 10 AM Saturday: 6:35 AM – 12:15 AM Sunday: 11:05 AM – 12:15 AM
Framingham/Worcester Line	Worchester/Union Station – South Station	Yawkey Station Back Bay Station	Back Bay Station	5-35	16,293	Weekday: 4:20 AM – 1:30 AM Weekend: 6:40 AM – 12:30 AM
MBTA Subway Services						
Orange Line	Oak Grove Station – Forest Hills Station	North Station Downtown Crossing Station Back Bay Station Ruggles Station	Back Bay Station	6	203,406	Weekday: 5:16 AM – 12:35 AM Saturday: 5:16 AM – 1:50 AM Sunday: 6:00 AM – 12:35 AM
Green Line B Branch	Boston College – Park Street	Park Street Station Copley Kenmore	Copley Square Station	6	227,645[3]	Weekday: 5:01 AM – 12:52 AM Saturday: 4:45 AM – 2:10 AM Sunday: 5:20 AM – 12:48 AM
Green Line C Branch	Cleveland Circle – North Station	Park Street Station Copley Kenmore	Copley Square Station	6	227,645[3]	Weekday: 5:01 AM – 12:46 AM Saturday: 4:50 AM – 1:46 AM Sunday: 5:30 AM – 12:48 AM
Green Line D Branch	Riverside – Park Street	Park Street Station Copley Fenway	Copley Square Station	6	227,645[3]	Weekday: 4:56 AM – 12:49 AM Saturday: 4:55 AM – 1:49 AM Sunday: 5:25 AM – 12:45 AM
Green Line E Branch	Lechmere – Heath Street	Park Street Station Copley Kenmore	Copley Square Station	6	227,645[3]	Weekday: 5:01 AM – 12:53 AM Saturday: 5:01 AM – 2:04 AM Sunday: 5:35 AM – 12:47 AM

MBTA Bus Services

Route 9	City Point – Copley Square	Brookline Ave Huntington Ave E Berkeley Street	Saint James Ave @ Dartmouth Street	5 – 10	6,604	Weekday: 5:13 AM – 1:14 AM Saturday: 5:10 AM – 1:14 AM Sunday: 6:00 AM – 1:12 AM
Route 10	City Point – Copley Square	Back Bay Station Andrew Station JFK/UMass Station	Back Bay Station	20 – 25	3,387	Weekday: 4:55 AM – 1:31 AM Saturday: 6:15 AM – 1:14 AM Sunday: 6:00 AM – 1:11 AM
Route 39	Forest Hills Station – Back Bay Station	Copley Symphony Station Longwood Ave	Back Bay Station	6 – 10	14,877	Weekday 4:42 AM – 2:44 AM Saturday: 4:37 AM – 2:47 AM Sunday: 5:45 AM – 1:17 AM
Route 55	Jersey & Queensberry Streets – Copley Square or Park & Tremont Streets	Arlington Station Prudential Station Fenway Park	Saint James Ave @ Dartmouth Street	15 – 30	917	Weekday 4:56 AM – 11:10 PM Saturday: 6:00 AM – 11:11 PM Sunday: 8:15 AM – 11:09 PM
Route 170	Central Square, Waltham – Dudley Square	Central Square, Waltham Back Bay Station Dudley Station	Back Bay Station	25 – 60	92	Weekday: 6:15 AM – 7:48 AM & 3:55 PM – 6:11 PM Weekend: No Service
Route 502 Express	Watertown – Copley Square	Watertown Yard Washington St @ Bacon St Saint James Ave @ Dartmouth Street	Saint James Ave @ Dartmouth Street	6 – 12	1,206	Weekday: 6:45 AM – 7:22 PM Weekend: No Service
Route 503 Express	Brighton Center – Copley Square via Oak Square & Mass Turnpike	Winship St @ Union St Park St @ Elmwood St Saint James Ave @ Dartmouth Street	Saint James Ave @ Dartmouth Street	15 – 35	564	Weekday: 6:40 AM – 7:29 PM Weekend: No Service
Route 504 Express	Watertown/Newton Corner – Downtown via Mass Turnpike	Washington St @ Bacon St Stuart St @ Dartmouth Street Federal St @ Franklin St	Stuart Street @ Dartmouth Street	10 – 15	1,548	Weekday: 6:20 AM – 8:09 PM Saturday: 7:30 AM – 8:04 PM Sunday: No Service
Route 553 Express	Roberts – Downtown via Newton Corner, Central Squ., Waltham & Mass Turnpike	Central Square, Waltham Newton Corner Copley Square	Stuart Street @ Dartmouth Street (Inbound) Saint James Ave @ Dartmouth Street (Outbound)	20 – 30	978	Weekday Copley Square Service Inbound: 8:17 PM – 9:31 PM Outbound: 7:11 PM – 9:54 PM Weekend: No Copley Square Service

1 Based on the most recent schedule provided on the MBTA website as of March 2016
2 Ridership data from MBTA Blue Book 2014
3 Green Line Daily Ridership expressed in Total Green Line riders for all Branches

4.3.3 Bicycle Facilities

The Project Site is served by bicycle lanes and shared lane pavement markings on the surrounding roadways. Shared lanes, indicated by sharrows, are provided on St. James Avenue, Columbus Avenue, Dartmouth Street, and Huntington Avenue. The shared lane on Columbus Avenue westbound changes to a marked bicycle lane at the approach to Dartmouth Street. The shared lane on Dartmouth Street northbound also changes to a marked bicycle lane at the approach to St. James Avenue. Huntington Avenue westbound provides a shared bicycle lane that changes to a marked bicycle lane at the approach to Dartmouth Street. In addition, the Southwest Corridor Park provides a connection with bicycle or shared paths between Back Bay Station and Forest Hills Station.

Four existing Hubway stations are located within a quarter-mile of the Site. The closest existing Hubway station provides 19 bicycle docks and is normally located on the Copley Place Plaza across from the Station entrance on Dartmouth Street. It has been temporarily relocated to the southwest corner of Dartmouth and Stuart Streets during construction at Copley Place. To the north of the Project Site, the Hubway station at the Boston Public Library (700 Boylston Street) has 25 bicycle docks, and the station at the New Balance Store (Boylston at Dartmouth) has 15 bicycle docks. Northeast of the Site, the station at the corner of Boylston Street and Berkeley Street has 15 bicycle docks. Figure 4.5a identifies the existing bicycle facilities including bike lanes, shared lanes, and multi-use paths surrounding the Project Site.

Short-term Bicycle Parking

The Site currently provides limited short-term, outdoor bicycle parking. Approximately 20 bicycle racks (~40 spaces) are provided on the Site. Approximately 32 of the spaces are located within the bus drop-off area near the Clarendon Street Station entrance. Field observations indicate that these racks were used sparingly while it was noticed that parking meters and sign posts around the Site are heavily utilized to secure bicycles. The remaining racks are located on sidewalks around the site as single racks (8 spaces).

Long-term Bicycle Parking

Currently the Site provides three long-term bicycle parking locations. Approximately 70 outdoor bicycle parking spaces are provided adjacent to Trinity Place, under the Garage. These spaces were observed to be used mostly by motorcycle or scooter parking spaces rather than cyclists. Approximately 22 spaces are provided on the ground floor level of the Garage. Additionally, the MBTA provides 40 secure spaces in a bicycle cage located the MBTA station close to the Clarendon Street entrance. During Site observations the bicycle cage was full, and bicycles were observed tied to the exterior fence of the cage. Figure 4.5b shows the existing bicycle parking facilities including short- and long-term bicycle parking areas as well as Hubway stations within the Project Site and immediate area.

Bicycle volumes were collected in coordination with the vehicle turning movement volumes and are shown in Figures 4.5c and 4.5d for the morning and evening peak hours, respectively.

4.3.4 Pedestrian Facilities

The Project Site is well served by pedestrian facilities including sidewalks along all local roadways, crosswalks at all study area intersections and activated streetscapes and building fronts. Sidewalks are provided on all the Project Site frontages, although as described in Chapter 3, *Urban Design,* some locations are in poor repair and have significant gradients as a result of the vertical profiles along Dartmouth Street and Clarendon Street. Crosswalks and pedestrian signals are provided at all study area signalized intersections.

High levels of pedestrians were observed going to and from the existing Project Site, particularly around the Station. The signalized crosswalk on Dartmouth Street provides a heavily used connection between the Station and the Southwest Corridor Park, as well as the entrance to Copley Place Mall. During the morning peak hour, approximately 2,253 pedestrians cross Dartmouth Street at the Station entrance, and approximately 2,347 pedestrians cross during the evening peak hour. The pedestrians leaving the Station often appear at Dartmouth Street in clusters due to the arrival times of trains at Back Bay Station. The existing crosswalk is only 15-feet wide with a median break that is only 9-feet wide. It was observed that pedestrians cross at all locations along Dartmouth Street, when it is convenient for them to cross and when sufficient gaps in vehicular traffic present themselves. The pedestrians often cross one lane of traffic and use the concrete median as a refuge until there is a sufficient gap in oncoming traffic to continue crossing. A strong desire line was observed from the Station entrance to Copley Place toward the northwest during the morning peak hour, and the desire line reversed during the evening peak as pedestrians traveled to the Station entrance from Copley Place. It was also observed that some of the pedestrians crossing at the signalized crosswalk walk outside the crosswalk markings due to the number of pedestrians crossing during the pedestrian phase.

Pedestrian and vehicle conflicts were observed at the unsignalized intersections of Clarendon Street/Stanhope Street and Clarendon Street/Garage Driveway. Pedestrian and vehicle conflicts cause uncertainty for vehicles and pedestrians, as neither mode is able to establish an effective and cohesive traffic pattern. A strong pedestrian desire line was observed crossing from the Station side of Clarendon Street walking northeast toward the intersection of Clarendon and Stanhope Streets, where no crosswalk is currently provided.

During peak times, high volumes of pedestrians were also observed crossing in front of the Clarendon Street Garage driveway, which provides very few gaps for vehicles to enter and exit the Garage. During the morning peak period, a Garage employee is present to periodically stop pedestrians to allow vehicles to enter and exit the Garage. During the evening peak period, there is typically a police officer directing vehicular and pedestrian

traffic at the intersection to reduce the vehicle and pedestrian conflicts within this area and create a balanced flow of traffic by both modes.

Pedestrian volumes were collected in coordination with the vehicle turning movement volumes and are shown in Figures 4.6a and 4.6b for the morning and evening peak hours, respectively.

4.3.5 Truck Network

According to an interactive map of the trucking network within Massachusetts on the MassDOT website, there are no specified restrictions for freight at the study area intersections. The nearest roadway segments with restrictions are W. Newton Street to the south of the Site (from Columbus Avenue to Tremont Street) and Isabella Street east of the Site (Berkeley Street to Arlington Street). On these two segments, vehicles 2.5 tons and over are restricted at all times.

4.3.6 Multimodal Connectivity

By virtue of its transit oriented location, the Project Site is positioned at a major hub of multimodal connectivity, where pedestrians and cyclists connect with users of autos, bus, subway, Commuter Rail and Amtrak.

4.3.7 Crash Analysis

A detailed crash analysis was conducted to identify potential vehicle accident trends and/or roadway deficiencies in the traffic study area. The most current vehicle accident data for the traffic study area intersections for the latest five years were obtained from MassDOT for the years 2009 to 2014. A summary of the study area intersections vehicle accident history is presented in Table 4-7.

MassDOT has six districts within Massachusetts, and the study area falls under District 6[2]. The District 6 average crash rate, per million entering vehicles, for signalized intersections is 0.70, and the average crash rate for unsignalized intersections is 0.53. The only study area intersection with a calculated crash rate higher than the District 6 average value is the unsignalized intersection of Berkeley Street at the Storrow Drive Ramps. From 2010-2014, this intersection had 36 reported crashes, and 23 of the 36 crashes were angle collisions. Nearly all of the crashes occurred with dry pavement conditions during off peak weekday and weekend hours. None of the crashes involved non-motorized (bike or pedestrian) modes and none resulted in a fatality.

The statewide crash rates for signalized and unsignalized intersections are higher than the District 6 rates, 0.77 for signalized and 0.58 for unsignalized. None of the study area

[2] MassDOT District 6 includes the following cities and towns as defined on the MassDOT website: Boston, Braintree, Brookline, Cambridge, Canton, Chelsea, Dedham, Dover, Milton, Needham, Newton, Quincy, Randolph, Watertown, Wellesley, Weston, Westwood, Weymouth, Winthrop.

intersections, except for the intersection of Berkeley Street at the Storrow Drive Ramps, exceed the statewide crash rates.

Additionally, the study area intersections were compared to the MassDOT Highway Safety Improvement Plan (HSIP) map of the top crash locations. The intersections of Clarendon Street at Storrow Drive Off-Ramp, Berkeley Street at Storrow Drive on-ramp, and Traveler Street at West Broadway and I-93/I-90 on-ramps are classified as HSIP clusters from 2012-2014.

There are two intersections within the Project study area that have had a fatal crash within the studied time period. A fatality occurred in March 2010 at the intersection of Albany Street and Travelers Street in which a vehicle traveling southbound struck a pedestrian. The incident occurred late at night, when the roadway was wet, and the intersection at the time was not lit. Since the 2010 incident, no other pedestrian crashes have been reported. The intersection has been improved through the development of the parcels to the west of the intersection which has increased lighting and visibility around the intersection. Another fatal crash occurred at the intersection of Arlington, Tremont, and Herald Streets in January 2011. There is very little information reported about this incident other than it involved a passenger car during the morning peak hour. Other than this tragic fatal crash, this intersection only had reports of six crashes in the last five years of available data and no crashes involving a bicycle or pedestrian.

TABLE 4-7 CRASH SUMMARY (2010-2014)

	Albany St at Herald St	Albany St at Traveler St	Arlington St at Marginal Rd and I-90 Ramp	Arlington St at Tremont St/Herald St	Berkeley St at Storrow On Ramp	Boylston St at Berkeley St	Boylston St at Clarendon St	Clarendon St at Stanhope St & I-90 Ramp	Columbus Ave at Berkeley St	Columbus Ave at Clarendon St	Columbus Ave at Dartmouth St	St. James at Arlington St	St. James Ave at Berkeley St	St. James Ave at Clarendon St	St. James Ave at Dartmouth St	Storrow Off Ramp at Clarendon St	Stuart St at Arlington St	Stuart St at Berkeley St	Stuart St at Clarendon St	Stuart St at Dartmouth St	Stuart St at Trinity Place	Traveler St at I-93 and I-90 Ramps
Currently Signalized?	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
MassHighway ACR	0.70	0.70	0.70	0.70	0.53	0.70	0.70	0.53	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.53	0.70	0.70	0.70	0.70	0.70	0.70
MassHighway CCR	0.25	0.68	0.06	0.15	0.88	0.05	0.18	0.06	0.28	0.03	0.03	0.03	0.15	0.03	0.04	0.28	0.20	0.12	0.06	0.06	0.00	0.40
Exceeds?	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Year																						
2010	5	9	0	1	6	1	3	0	2	0	0	0	1	1	2	0	6	3	0	1	0	3
2011	4	6	1	2	6	0	0	1	2	0	0	0	2	0	0	1	3	1	1	0	0	6
2012	1	6	0	1	10	1	1	0	2	0	0	1	1	0	0	0	0	0	0	0	0	2
2013	5	5	1	1	7	0	1	0	2	1	0	0	1	0	0	1	0	0	0	2	0	12
2014	0	4	0	1	7	0	1	0	1	0	1	0	0	0	0	1	1	0	1	0	0	10
Total	15	30	2	6	36	1	6	1	9	1	1	1	5	1	2	3	10	4	2	3	0	23
Average	3.00	6.00	0.40	1.20	7.20	0.20	1.20	0.20	1.80	0.20	0.20	0.20	1.00	0.20	0.40	0.60	2.00	0.80	0.40	0.60	0.00	4.60
Collision Type																						
Angle	2	10	0	5	23	0	0	0	3	0	0	0	1	0	0	1	3	2	1	0	0	15
Head-on	1	1	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rear-end	7	0	0	0	4	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
Rear-to-Rear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sideswipe, opposite direction	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sideswipe, same direction	1	8	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	1	2	0	2
Single vehicle crash	1	4	0	0	1	1	0	0	1	0	0	0	0	0	1	2	2	0	0	0	0	3
Unknown	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Not reported	3	7	1	1	0	0	2	1	5	0	1	1	3	0	1	0	4	2	0	1	0	1
Total	15	30	2	6	36	1	6	1	9	1	1	1	5	1	2	3	10	4	2	3	0	23
Crash Severity																						
Fatal injury	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-fatal injury	3	7	0	3	14	1	3	0	5	0	0	0	3	0	0	1	3	0	0	1	0	7
Property damage only	11	17	0	2	16	0	1	1	2	1	0	0	0	0	2	2	2	1	2	2	0	16
Not Reported	1	5	2	0	6	0	1	0	2	0	1	1	2	1	0	0	5	3	0	0	0	0
Unknown	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	15	30	2	6	36	1	6	1	9	1	1	1	5	1	2	3	10	4	2	3	0	23

	Albany St at Herald St	Albany St at Traveler St	Arlington St at Marginal Rd and I-90 Ramp	Arlington St at Tremont St/Herald St	Berkeley St at Storrow On Ramp	Boylston St at Berkeley St	Boylston St at Clarendon St	Clarendon St at Stanhope St & I-90 Ramp	Columbus Ave at Berkeley St	Columbus Ave at Clarendon St	Columbus Ave at Dartmouth St	St. James at Arlington St	St. James Ave at Berkeley St	St. James Ave at Clarendon St	St. James Ave at Dartmouth St	Storrow Off Ramp at Clarendon St	Stuart St at Arlington St	Stuart St at Berkeley St	Stuart St at Clarendon St	Stuart St at Dartmouth St	Stuart St at Trinity Place	Traveler St at I-93 and I-90 Ramps
Time of Day																						
Weekday, 7:00 AM - 9:00 AM	0	3	0	1	2	0	0	0	1	0	1	0	1	0	0	0	2	1	0	0	0	2
Weekday, 4:00 PM - 6:00 PM	0	10	0	0	2	0	0	0	1	0	0	0	1	1	1	0	2	0	1	0	0	5
Saturday, 11:00 AM - 2:00 PM	0	0	1	0	2	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	2
Weekday, other time	10	10	1	3	16	1	5	1	4	1	0	0	1	0	1	2	3	2	1	2	0	8
Weekend, other time	5	7	0	2	14	0	1	0	2	0	0	1	2	0	0	0	2	1	0	1	0	6
Total	15	30	2	6	36	1	6	1	9	1	1	1	5	1	2	3	10	4	2	3	0	23
Pavement Conditions																						
Dry	9	20	0	3	29	1	3	0	4	1	0	0	1	1	1	3	6	3	1	2	0	21
Wet	2	5	1	2	7	0	1	0	2	0	0	0	1	0	0	0	2	0	1	0	0	2
Snow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Ice	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sand, mud, dirt, oil, gravel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water (standing, moving)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slush	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Not reported	4	5	1	1	0	0	2	1	3	0	1	1	3	0	0	0	2	1	0	1	0	0
Total	15	30	2	6	36	1	6	1	9	1	1	1	5	1	2	3	10	4	2	3	0	23
Non Motorist (Bike, Pedestrian)																						
Total	0	2	0	0	0	1	1	0	1	0	1	0	0	0	0	0	2	0	0	1	0	1

4.3.8 Intersection Operation

An intersection capacity analysis was conducted for the 2016 Existing Conditions morning and evening peak hours to determine how well the roadway facilities serve the existing traffic demand. Intersection operating conditions are classified by a quantified level-of-service (LOS).

LOS is a qualitative measure of control delay at an intersection providing an index to the operational qualities of a roadway or intersection. LOS designations range from A to F, with LOS A representing the best operating conditions and LOS F representing the worst operating conditions. LOS D is typically considered acceptable in a downtown, urban environment, while LOS E indicates that vehicles experience significant delay and queuing, while LOS F suggests unacceptable delays for the average vehicle. LOS designation is reported differently for signalized and unsignalized intersections. Longer delays at signalized intersections than at unsignalized intersections are perceived as acceptable.

For signalized intersections, the analysis considers the operations of each lane or lane group entering the intersection and the LOS designation is for the overall conditions at the intersection. For unsignalized intersections, however, this analysis assumes the traffic on the mainline is not affected by traffic on the side streets. The LOS is only determined for left turns from the main street and all movements from the minor street. The LOS designation is for the most critical movement, which is most often the left turn out of the side street.

Synchro 8.0 software was used to evaluate the LOS operations at the study area intersection. This analysis is based on the 2000 Highway Capacity Manual (HCM). Table 4-8 below presents the LOS delay threshold criteria as defined in the HCM.

TABLE 4-8 LEVEL OF SERVICE CRITERIA

Level of Service	Unsignalized Intersection Control Delay (sec/veh)	Signalized Intersection Control Delay (sec/veh)
LOS A	0 – 10	0 – 10
LOS B	> 10 – 15	> 10 – 20
LOS C	> 15 – 25	> 20 – 35
LOS D	> 25 – 35	> 35 – 55
LOS E	> 35 – 50	> 55 – 80
LOS F	> 50	> 80

Adjustments were made to the Synchro model to include the characteristics of each intersection, such as geometry, signal timings, heavy vehicles, bus operations, parking activity, bicycle conflicts, and pedestrian crossings. The overall intersection LOS results of the 2016 Existing Conditions analysis for the morning and evening peak hours are summarized in Tables 4-9 through 4-12 for signalized and unsignalized intersections, respectively. Detailed LOS results including delay by

movement, queuing, and volume-to-capacity ratio are presented in Tables 4-39a through 4-39d at the end of Section 4.6.

The 2016 Existing Conditions analysis for morning and evening peak hours at unsignalized intersections were calibrated based on observed field conditions and modifications, such as acceptable vehicle gap (in seconds), so that they would more accurately replicate the existing network.

Table 4-9 2016 Existing Conditions Signalized Intersection Vehicle LOS Morning Peak Hour

Intersection	2016 Existing Condition VLOS
1. Boylston Street/Clarendon Street	C
2. Boylston Street/Berkeley Street	B
3. St. James Avenue /Dartmouth Street	C
5. St. James Avenue/ Clarendon Street	B
6. St. James Avenue/Berkeley Street	C
7. St. James Avenue/ Arlington Street	C
8. Huntington Avenue/Exeter Street/ Stuart Street	C
9. Stuart Street/ Dartmouth Street	B
10. Stuart Street/Trinity Place	A
11. Stuart Street/Clarendon Street	B
12. Stuart Street/Berkeley Street	D
13. Stuart Street/Arlington Street	D
17. Columbus Avenue/ Dartmouth Street	E
18. Columbus Avenue/ Clarendon Street	D
20. Columbus Avenue/Berkeley Street	C
21. Arlington Street/Marginal Road/I-90 On-Ramp	B
22. Arlington Street/Herald Street/Tremont Street	D
23. Albany Street/Herald Street	C
25. Albany Street/Traveler Street	C
26. Traveler Street/ Frontage Road/ W Broadway/ I-93 Northbound On-Ramp/ I-90 Westbound On-Ramp	E

Note:

Intersection numbers correspond to numbering found on Figure 4.1.

Table 4-10 2016 Existing Conditions Signalized Intersection Vehicle LOS Evening Peak Hour

Intersection	2016 Existing Condition VLOS
1. Boylston Street/Clarendon Street	B
2. Boylston Street/Berkeley Street	C
3. St. James Avenue/Dartmouth Street	C
5. St. James Avenue/Clarendon Street	C
6. St. James Avenue/Berkeley Street	C
7. St. James Avenue/Arlington Street	C
8. Huntington Avenue/Exeter Street/Stuart Street	C
9. Stuart Street/Dartmouth Street	B
10. Stuart Street/Trinity Place	A
11. Stuart Street/Clarendon Street	B
12. Stuart Street/Berkeley Street	B
13. Stuart Street/Arlington Street	F
17. Columbus Avenue/Dartmouth Street	E
18. Columbus Avenue/Clarendon Street	C
20. Columbus Avenue/Berkeley Street	C
21. Arlington Street/Marginal Road/I-90 On-Ramp	C
22. Arlington Street/Herald Street/Tremont Street	C
23. Albany Street/Herald Street	D
25. Albany Street/Traveler Street	D
26. Traveler Street/Frontage Road/ W Broadway/ I-93 Northbound On-Ramp/I-90 Westbound On-Ramp	D

Note: Intersection numbers correspond to numbering found on Figure 4.1.

Table 4-11 2016 Existing Conditions Unsignalized Intersection Vehicle LOS Morning Peak Hour

Intersection	Approach	2016 Existing Conditions VLOS
4. St. James Avenue/Trinity Place	Trinity Place NB Left	C
14. Stuart Street/I-90 Westbound Off-Ramp	I-90 Westbound Off-Ramp NEB Right	F
15. Clarendon Street/Stanhope Street	Stanhope Street WB Left/Thru	F
16. Clarendon Street/Garage Driveway	Garage Driveway EB Right	F
19. Columbus Avenue/Cahners Place	No conflicts at this location	A
24. Albany Street/I-93 Southbound On-Ramp	No conflicts at this location	A
27. Berkeley Street/Storrow Drive On-Ramp	Back Street EB Left/Hard Left	C
28. Clarendon Street/Storrow Drive Off-Ramp	Back Street EB Thru/Right	B

Note: Intersection numbers correspond to numbering found on Figure 4.1.

Table 4-12 2016 Existing Conditions Unsignalized Intersection Vehicle LOS Evening Peak Hour

Intersection	Approach	2016 Existing Conditions VLOS
4. St. James Avenue/Trinity Place	Trinity Place NB Left	C
14. Stuart Street/I-90 Westbound Off-Ramp	I-90 Westbound Off-Ramp NEB Right	D
15. Clarendon Street/Stanhope Street	Stanhope Street WB Left/Thru	F
16. Clarendon Street/Garage Driveway	Garage Driveway EB Right	F
19. Columbus Avenue/Cahners Place	No conflicts at this location	A
24. Albany Street/I-93 Southbound On-Ramp	No conflicts at this location	A
27. Berkeley Street/ Storrow Drive On-Ramp	Back Street EB Left/Hard Left	C
28. Clarendon Street/Storrow Drive Off-Ramp	Back Street EB Thru/Right	B

Note: Intersection numbers correspond to numbering found on Figure 4.1.

As indicated in the above tables, most of the study area intersections operate at an acceptable LOS D or better during the morning and evening peak hours. Of the 28 intersections, the following intersections had existing overall intersection LOS worse than LOS D.

#13 Stuart Street/Arlington Street – During the morning peak hour, the intersection operates at an acceptable overall LOS D, while the evening peak hour operates at an overall LOS F. The Columbus Street northeast bound approach experiences significant delays due to limited allocated green time for the amount of traffic entering the intersection from this approach. The approach operates at an LOS F, with a very high delay. The Stuart Street approach also operates at a LOS F. Although all other approaches operate at an acceptable LOS D or better, the Columbus Street approach significantly impacts the overall intersection LOS.

#15 Stanhope Street/Clarendon Street – During both the morning and evening peak hours, the unsignalized intersection operates at an overall LOS F due to the high delays experienced on the minor street, Stanhope Street. Vehicles entering the intersection from Stanhope Street have to stop and wait for gaps in the free-flow traffic of Clarendon Street as well as yield to the pedestrian traffic crossing Clarendon and Trinity Place. While not evident in the Synchro analysis due to limitations, the Clarendon Street free-flow approach also experiences delays and considerable conflicts with pedestrians. There is a considerable amount of pedestrian traffic crossing Clarendon during the peak hours, causing delays for the southbound approach. This intersection has significant vehicle to vehicle and vehicle to pedestrian conflicts that are observed to be narrowly controlled by the unsignalized configuration of the intersection. As discussed below, the operations of this intersection are impacted by the downstream intersection, Clarendon Street at the Garage Driveway.

#16 Clarendon Street/Garage Driveway – During the morning and evening peak hours, the intersection operates at an overall LOS F due to the minor street, the Garage Driveway, experiencing significant delays. These delays are caused by limited gaps in the Clarendon Street free-flow traffic heading southbound and the pedestrian traffic crossing the Driveway approach. The existing operations, as Synchro has modeled, were identified and have been corrected using human controlled metering of the vehicle and pedestrian traffic. During the morning peak hour, when Clarendon Street traffic is lower, a garage attendant is present to control pedestrians crossing in front of the bridge. This limits the queues on Clarendon Street trying to enter the garage and the queues within the garage trying to exit. During the evening peak hour, a police officer is used to control the Clarendon Street vehicular traffic as well as pedestrian traffic. While this is important for limiting the backups within the Garage, there is an upstream impact on the rest of the Clarendon Street corridor back to the intersection with Stuart Street.

#17 Columbus Avenue/Dartmouth Street – During the morning and evening peak hours, the intersection operates at an overall LOS E. This is due to the Columbus Avenue northeastbound approach operating at a LOS F. There are many conflicts limiting the gaps available to vehicle turning left onto Dartmouth Street. A high volume of Columbus Avenue southwestbound through vehicles limits the available gaps for left turns in addition to having to yield to pedestrians who are crossing Dartmouth Street during the concurrent pedestrian phase. Conflicts increase on this movement and thus the analyzed lane group of the Columbus Avenue northeastbound approach operates at LOS F. The other movements and approaches operate at acceptable LOS D or better for both morning and evening peak periods.

#26 Traveler Street/ Frontage Road/ W Broadway/ I-93 Northbound On-Ramp/ I-90 Westbound On-Ramp – The morning peak hour operates at an overall LOS E, while the evening peak hour operates at an acceptable LOS D. During the morning peak hour, a high volume of vehicles are using Travelers Street westbound to turn onto Frontage Road or the on-ramps. The demand at this approach is greater than the allotted green time can supply in capacity and therefore high delays occur.

While the intersection of Clarendon Street and Stuart Street shows a favorable LOS during both the morning and evening peak hours, this intersection is affected by the operations of Clarendon Street downstream and pedestrian traffic. Intersection observations indicate that the right turn from Stuart Street onto Clarendon Street experiences some delays and queue formation. The high volume of pedestrians crossing the Clarendon Street southern approach concurrently with Stuart Street vehicle traffic turning right onto Clarendon Street reduces the volume of vehicles turning right. Also affecting the right turns are the downstream operations at Clarendon and Stanhope and Clarendon at the Garage Driveway intersections. The effects of these intersection operations have been discussed above and do have impacts on the Clarendon at Stuart Street intersection. These effects cannot be analyzed within the Synchro software and HCM analysis.

4.3.9 Queue Analysis

The 2016 Existing Conditions queue length analysis was conducted in conjunction with the LOS analysis using Synchro software. The queue analysis is consistent with the LOS analysis shown and discussed above as well as observed conditions in the field. Queue lengths for the 50th percentile and 95th percentile are provided in Tables 4-39a through 4-39d for all analysis conditions.

4.3.10 I-90 Mainline Analysis

As requested in the MEPA Certificate, operational analysis for the I-90 mainline, including the merge sections for the Arlington Street, Clarendon Street, and

Huntington Avenue on-ramps were conducted for the existing, no-build, and build conditions. The analysis is based on the procedures presented in the Highway Capacity Manual (HCM) Chapter 13, *Freeway Merge and Diverge Segments*. Merging maneuvers create turbulence as a result of high-lane changing rate which can affect operations along the freeway. The methodology presented in the HCM predicts the operating characteristics within a ramp influence area, which includes the two rightmost lanes of the freeway for a distance of 1,500 feet downstream from the merge point. Table 4-13 summarizes the LOS criteria for freeway merge segments as defined by HCM.

TABLE 4-13 LEVEL OF SERVICE CRITERIA

Level of Service	Density (pc/mi/ln)
LOS A	0 – 10
LOS B	>10 – 20
LOS C	>20 – 28
LOS D	>28 – 35
LOS E	>35
LOS F	Demand exceeds capacity

Mainline capacity analysis for the three merging sections within the study area was conducted using Highway Capacity Software (HCS) Version 6.8. The software is based on the methodology defined by HCM. The Existing Condition merge analysis HCS output is provided in Appendix F.

Weekday morning and evening peak hour merge capacity analyzes are presented in Tables 4-14 and 4-15 respectively.

TABLE 4-14 MAINLINE CAPACITY ANALYSIS MERGE SECTIONS LOS – EXISTING CONDITIONS MORNING PEAK HOUR

Location	Volume (veh/hr)	Density (pc/mi/ln)	Speed	LOS
Arlington On-Ramp	310	21.3	51	C
Clarendon On-Ramp	50	21.2	51	C
Huntington On-Ramp	290	23.6	50	C

TABLE 4-15 MAINLINE CAPACITY ANALYSIS MERGE SECTIONS LOS – EXISTING CONDITIONS EVENING PEAK HOUR

Location	Volume (veh/hr)	Density (pc/mi/ln)	Speed	LOS
Arlington On-Ramp	550	30.7	49	D
Clarendon On-Ramp	150	30.7	49	D
Huntington On-Ramp	460	34.3	49	D

Under existing conditions, all merge segments during the morning peak hour operated at LOS C. As described by HCM, at LOS C, operation "influence area speeds begin to decline". During the evening peak hour, all merging segments experienced a LOS D, which is described as "influence area turbulence becomes intrusive."

The limitation with the merge HCS analysis is the inability to incorporate issues, including delays and impacted speeds, due to congestions downstream from the ramps. The I-90 mainline is known to be congested particularly during the evening peak period, when many vehicles are exiting the downtown Boston area. The cause of this backup is due to upstream bottlenecks and trickles down to the merge sections analyzed in this analysis. While the evening peak hour analysis does indicate a LOS D operation at all merge segments, the vehicles using these on-ramps and already within the I-90 mainline may experience densities, speeds, and LOS conditions that are not as favorable.

4.4 2023 Future Conditions Assessment: No-Build Conditions

The No-Build Future Condition analyzes the future transportation conditions within the Project study area absent of the proposed Project. The future condition projects seven years into the future and adjusts the traffic conditions to estimate the vehicle volumes and infrastructure improvements within the area.

The No-Build Future Condition, as identified in the MassDOT DEIR Scope of Work, evaluates the Base Condition which maintains the I-90 On-Ramp and the Alternate Condition which assumes the closure of the I-90 On-Ramp. As described above, an IMR, conducted by MassDOT as a separate study from this Project, is being prepared to identify whether this closure is feasible or not. The report will be presented to FHWA for review and approval. Since the IMR is being conducted in parallel to the Project transportation study, the LOS analysis has been conducted both with and without the I-90 On-Ramp. These conditions are described further below.

4.4.1 Background Growth

A general area-wide traffic growth rate was applied to the existing conditions peak hour traffic volumes to reasonably account for general future traffic growth in the

Project study area. As confirmed by BTD, an annual growth rate of 0.25 percent per year for seven years was applied to the 2016 Existing Conditions vehicle volumes.

In addition, vehicular traffic and infrastructure improvements associated with specific planned projects in the area of the Project Site have been incorporated into the No-Build Condition vehicle volumes. These projects include:

- **Copley Place Residential Addition and Retail Expansion Project** – This project has been approved by the BPDA for approximately 774,000 square feet of new development. The project consists of approximately 542 new residential units with approximately 114,000 sf of new retail/restaurant space. The project proposes to make pedestrian improvements to the Huntington Avenue/Stuart Street/Exeter Street intersection and geometric and lane configuration improvements at the Dartmouth St/Stuart St intersections. These infrastructure changes are detailed in Appendix F.
- **40 Trinity Place Project** – This project has been approved by the BPDA for a 31-story mixed-use building including approximately 146 residential units, an approximately 154-room hotel and approximately 20,000 square feet of retail/restaurant space.
- **380 Stuart Street Project** – This project has been approved by the BPDA for a new building of approximately 615,000 square feet of office and 10,000 square feet of ground floor retail/café space. The existing building, of approximately 140,000 square feet will be demolished. The project will also provide 175 parking spaces in a below-grade garage.

4.4.2 2023 No-Build Base Condition

The 2023 No-Build Base Condition includes the seven-year general area-wide background growth and the traffic associated with specific trips as well as infrastructure changes within the study area. The I-90 On-Ramp remains open for use and traffic patterns around the study area are consistent with the 2016 Existing Conditions. Figures 4.7a and 4.7b present the 2023 No-Build Base Condition traffic volumes for the morning and evening peak hours, respectively.

The Copley Place Expansion Project, as approved by the BPDA, plans to modify the intersections of Huntington Avenue/Stuart Street and Dartmouth Street/Stuart Street. These changes have been incorporated into the 2023 No-Build Conditions. At Huntington Avenue, the northeastbound lanes are reduced to one bear right and one bear right/right-turn lane. The southwestbound lanes are reduced in width to 11 feet for the through lanes and 10 feet for the left turn lane. At Dartmouth Street/Stuart Street, the Stuart Street eastbound channelized right-turn lane is removed and the channelized left-turn median shrinks in size. The lane configuration will consist of one left-turn lane, two thru lanes, and one thru/right-turn lane. Both Copley Place Expansion Project intersection modifications improve the pedestrian crossings by reducing the crossing length and crosswalk angles. Improved bicycle infrastructure is also provided with sharrows along Stuart Street to the Dartmouth

Street intersection where a bike lane will begin on the north side of Stuart Street. Sharrows are also provided on both sides on Dartmouth Street between the signalized mid-block crossing to Stuart Street. A bike lane is provided on Dartmouth Street north of the Stuart Street intersection.

The 40 Trinity Place Project, as approved by the BPDA, plans to modify the cross-section of Stuart Street and lane configurations at the intersections of Stuart Street/Trinity Place and Stuart Street/Clarendon. These changes have been incorporated into the 2023 No Build Conditions. 40 Trinity will maintain the three-lane cross-section from Dartmouth Street to Trinity Place and provide a bicycle lane on the north side of Stuart Street. At Trinity Place, the southernmost travel lane is modified to become a right-turn only lane, also provided is a thru lane and a thru/left-turn lane. Stuart Street provides two receiving lanes at Trinity Place and gradually flares to a three lane cross-section at the approach to Clarendon Street. The bike lane on the northern side of Stuart Street is maintained between Trinity Place and Clarendon Street and a bike box is provided at the approach with Clarendon Street. The approach to Clarendon Street is modified to provide a right-turn only lane.

No roadway modifications are being implemented by the 380 Stuart Street Project.

4.4.3 2023 No-Build Alternate Condition

The 2023 No-Build Alternate Condition includes the background growth and infrastructure changes as described above as well as the closure of the On-Ramp. The MassDOT scope acknowledges the Proponent's request to use the existing Charles River Basin (CRB) model to evaluate the effect of the ramp closure on traffic conditions in the Project study area, and requests additional information on the calibration of the model and its compatibility with the Central Transportation Planning Staff (CTPS) model to be used by MassDOT for the preparation of the On-Ramp closure IMR. VHB will use the CRB model to develop peak hour traffic diversions associated with the proposed On-Ramp closure under existing conditions, and will project these diversions over a 7-year time horizon as a basis for the No-Build condition with the On-Ramp closure (the future No-Build condition without the On-Ramp closure will also be modeled). The Project Build conditions will also include scenarios both with and without the On-Ramp closure.

The following narrative summarizes the CRB model and VHB's calibration of the model to best represent the effects of the On-Ramp closure.

VHB had previously developed a Charles River Basin sub-area existing conditions travel demand model for MassDOT as a tool in the gathering and evaluation of transportation information related to the Accelerated Bridge Program. The model is a weekday morning and evening peak hour travel demand model and was based on and compatible with the larger CTPS regional model. The sub-area model includes all of the City of Cambridge (except North Cambridge), the City of Boston from Charlestown to Allston, the northern portion of the Town of Brookline, the eastern

portion of the Town of Watertown and the southeastern portion of the City of Somerville. The sub-area model is a useful tool for establishing traffic volume shifts associated with the potential closure of the On-Ramp.

Two assignment scenarios were conducted for the morning and evening peak hours:

- Existing Roadway Network Conditions which included the On-Ramp;
- Modified Roadway Network Conditions which assumed the On-Ramp was closed.

Once both assignments were completed, difference plots and select link plots were created to identify the likely shifts in travel patterns. Based on these data, the Traffic Analysis Zones (TAZs) in the sub-area model that were most impacted by the On-Ramp closure were identified. VHB relied upon knowledge of the study area, including locations of parking, local roadway features, I-90 mainline and on-ramp characteristics, and existing traffic circulation patterns, in analysis of the model results.

Based on this information, it is predicted that under Existing conditions, approximately 40 of the 50 existing morning peak hour vehicles utilizing the On-Ramp would divert to the Huntington Avenue on-ramp, while the remaining 10 trips would divert to the Arlington Street on-ramp. During the evening peak hour, 120 of the 150 existing vehicles using the On-Ramp are estimated to use the Huntington Avenue on-ramp while 30 vehicles would divert to the Arlington Street on-ramp. The trip redistribution pattern for the Alternate Scheme is shown in Figure 4.8a. Figures 4.8b and 4.8c show the diverted trips from the On-Ramp to the two other I-90 on-ramps in the area under 2023 No-Build Alternate Condition, if the ramp were closed. This distribution pattern (approximately 80 percent of the trips to the Huntington Avenue on-ramp and 20 percent to the Arlington Street on-ramp) has been used to re-assign the on-ramp trips under the No-Build and Build Conditions with the On-Ramp closed.

These trip diversions were applied to the No-Build Alternate Condition traffic volumes to produce the 2023 No-Build Alternate Condition traffic volumes for the morning and evening peak hours. These volumes are presented in Figures 4.9a and 4.9b, respectively.

4.4.4 2023 No-Build Intersection Operation

An intersection capacity analysis was conducted for the 2023 No-Build Base and Alternate Condition morning and evening peak hours. The results have been compared to the 2016 Existing Condition LOS and are presented in Tables 4-16 through 4-19. Detailed LOS results including volume to capacity (V/C) ratio and delay for lane groups and approaches are provided in Tables 4-39a through 4-39d at the end of Section 4.6 and the Synchro printouts are presented in Appendix F. Figures 4.15a through 4.15d, provided at the end of Section 4.6, show the overall intersection LOS composition for each analyzed condition.

TABLE 4-16 2023 NO-BUILD BASE AND ALTERNATE CONDITION SIGNALIZED INTERSECTION VEHICLE LOS MORNING PEAK HOUR

	VLOS		
Intersection	**2016 Existing Condition**	**2023 No-Build On-Ramp Open Condition**	**2023 No-Build On-Ramp Closed Condition**
1. Boylston Street/Clarendon Street	C	C	C
2. Boylston Street/Berkeley Street	B	B	B
3. St. James Avenue /Dartmouth Street	C	C	C
5. St. James Avenue/Clarendon Street	B	B	B
6. St. James Avenue/Berkeley Street	C	C	C
7. St. James Avenue/Arlington Street	C	C	C
8. Huntington Avenue/Exeter Street/ Stuart Street	C	C	C
9. Stuart Street/Dartmouth Street	B	B	B
10. Stuart Street/Trinity Place	A	B	B
11. Stuart Street/Clarendon Street	B	B	B
12. Stuart Street/Berkeley Street	D	D	D
13. Stuart Street/Arlington Street	D	E	E
17. Columbus Avenue/Dartmouth Street	E	F	F
18. Columbus Avenue/Clarendon Street	D	D	D
20. Columbus Avenue/Berkeley Street	C	C	C
21. Arlington Street/Marginal Road/I-90 On-Ramp	B	B	B
22. Arlington Street/Herald Street/Tremont Street	D	D	D
23. Albany Street/Herald Street	C	C	C
25. Albany Street/Traveler Street	C	C	C
26. Traveler Street/Frontage Road/ W Broadway/ I-93 Northbound On-Ramp/ I-90 Westbound On-Ramp	E	E	E

TABLE 4-17 2023 NO-BUILD BASE AND ALTERNATE CONDITION SIGNALIZED INTERSECTION VEHICLE LOS EVENING PEAK HOUR

	VLOS		
Intersection	**2016 Existing Condition**	**2023 No-Build On-Ramp Open Condition**	**2023 No-Build On-Ramp Closed Condition**
1. Boylston Street/Clarendon Street	B	C	C
2. Boylston Street/Berkeley Street	C	C	C
3. St. James Avenue /Dartmouth Street	C	C	C
5. St. James Avenue/Clarendon Street	C	C	C
6. St. James Avenue/Berkeley Street	C	C	C
7. St. James Avenue/Arlington Street	C	C	C
8. Huntington Avenue/Exeter Street/ Stuart Street	C	C	C
9. Stuart Street/Dartmouth Street	B	B	B
10. Stuart Street/Trinity Place	B	B	B
11. Stuart Street/Clarendon Street	B	B	A
12. Stuart Street/Berkeley Street	B	B	B
13. Stuart Street/Arlington Street	F	F	F
17. Columbus Avenue/Dartmouth Street	E	E	E
18. Columbus Avenue/Clarendon Street	C	C	C
20. Columbus Avenue/Berkeley Street	C	C	C
21. Arlington Street/Marginal Road/I-90 On-Ramp	C	C	C
22. Arlington Street/Herald Street/Tremont Street	C	C	C
23. Albany Street/Herald Street	D	E	E
25. Albany Street/Traveler Street	D	D	D
26. Traveler Street/Frontage Road/ W Broadway/ I-93 Northbound On-Ramp/ I-90 Westbound On-Ramp	D	D	D

TABLE 4-18 2023 NO-BUILD BASE AND ALTERNATE CONDITION UNSIGNALIZED INTERSECTION VEHICLE LOS MORNING PEAK HOUR

		VLOS		
Intersection	**Approach**	**2016 Existing Conditions**	**2023 No-Build On-Ramp Open Condition**	**2023 No-Build On-Ramp Closed Condition**
4. St. James Avenue/Trinity Place	Trinity Place NB Left	C	C	C
14. Stuart Street/I-90 Westbound Off-Ramp	I-90 Westbound Off-Ramp NEB Right	F	F	F
15. Clarendon Street/Stanhope Street	Stanhope Street WB Left/Thru	F	F	E
16. Clarendon Street/Garage Driveway	Garage Driveway EB Right	F	F	F
19. Columbus Avenue/Cahners Place	No conflicts at this location	A	A	A
24. Albany Street/I-93 Southbound On-Ramp	No conflicts at this location	A	A	A
27. Berkeley Street/Storrow Drive On-Ramp	Back Street EB Left/Hard Left	C	C	C
28. Clarendon Street/Storrow Drive Off-Ramp	Back Street EB Thru/Right	B	B	B

TABLE 4-19 2023 NO-BUILD BASE AND ALTERNATE CONDITION UNSIGNALIZED INTERSECTION VEHICLE LOS EVENING PEAK HOUR

Intersection	Approach	VLOS		
		2016 Existing Conditions	2023 No-Build Ramp Open Condition	2023 No-Build Ramp Closed Condition
4. St. James Avenue/ Trinity Place	Trinity Place NB Left	B	B	B
14. Stuart Street/I-90 Westbound Off-Ramp	I-90 Westbound Off-Ramp NEB Right	D	F	F
15. Clarendon Street/Stanhope Street	Stanhope Street WB Left/Thru	F	F	F
16. Clarendon Street/Garage Driveway	Garage Driveway EB Right	F	F	F
19. Columbus Avenue/Cahners Place	No conflicts at this location	A	A	A
24. Albany Street/I-93 Southbound On-Ramp	No conflicts at this location	A	A	A
27. Berkeley Street/Storrow Drive On-Ramp	Back Street EB Left/Hard Left	D	D	D
28. Clarendon Street/Storrow Drive Off-Ramp	Back Street EB Thru/Right	C	C	C

The future background growth in vehicle traffic in the study area will have an impact on the study area intersections under 2023 No-Build Conditions. As indicated above, a majority of the study area intersections will operate at the same LOS under Existing and 2023 No-Build Base and Alternate Conditions, with the exception of the following intersections.

#1 **Boylston Street/Clarendon Street –** The intersection of Boylston Street/Clarendon Street experiences a decrease in LOS during the evening peak hour. Boylston Street/Clarendon Street changes from LOS B to LOS C with a slight increase in overall intersection delay from 19.7 seconds in the Existing Condition to 20.3 seconds in both the 2023 No-Build Base and Alternate Conditions during the evening peak hour.

#10 **Stuart Street/Trinity Place** – The intersection performance decreases slightly from LOS A to LOS B in the No-Build Base and Alternate Conditions during the morning peak hour. This is due to increased vehicle volume at the intersection along with intersection modifications. As proposed by the 40 Trinity Place project, lane configuration changes will be made along Stuart Street. These changes include reducing the Stuart Street eastbound approach to two thru lanes and one right turn

only lane (currently three thru lanes and one right turn only lane) and creating a parking lane along Stuart Street to the east of the intersection. These changes along with additional vehicle volume growth slightly increases delay, tripping the LOS B threshold. The overall intersection delay increases from 7.4 seconds in the Existing Condition to 10.1 seconds and 11.2 seconds in the 2023 No-Build Base and Alternate Conditions, respectively.

#13 **Stuart Street/Arlington Street** – The intersection of Stuart Street/Arlington Street is affected in the morning peak hour by the no-build volumes. Stuart Street/Arlington Street decreases from LOS D to LOS E due to the addition of vehicles in the network from area projects and general regional growth. The addition of vehicles causes an overall intersection delay increase from 54.9 seconds in the Existing Condition to 57.9 seconds and 59.2 seconds in the 2023 No-Build Base and Alternate conditions, respectively.

#14 **Stuart Street/I-90 Westbound Off-Ramp** – The unsignalized intersection of Stuart Street/I-90 Westbound Off-Ramp shows a decrease in LOS from LOS D to LOS F from Existing Condition to 2023 No-Build Base and Alternate Conditions. However, it should be noted that the I-90 off-ramp does not operate as a conventional un-signalized intersection, and in practice there is weaving of traffic movements. Therefore, the Synchro analysis does not fully reflect the actual operations in practice.

#17 **Columbus Avenue/Dartmouth Street** – The intersection of Columbus Avenue/Dartmouth Street is affected by the increase in background vehicles from the Existing to No-Build Conditions. The intersection decreases from LOS E to LOS F during the morning peak hour. This decrease is caused by additional vehicles turning left from Columbus Avenue to Dartmouth Street in both the northeastbound and southwestbound directions and increased volume on Dartmouth Street southbound. The overall intersection delay increases from 76.7 seconds in the Existing Condition to 85.0 seconds in both the 2023 No-Build Base and Alternate Conditions.

#23 **Albany Street/Herald Street** – During the evening peak hour, the intersection decreases from LOS D to LOS E due to the addition of background project trips traveling eastbound on Herald Street and the regional growth of all movements at this intersection. The overall intersection delay increases from 45.3 seconds in the Existing Condition to 56.3 in both the 2023 No-Build Base and Alternate Conditions during the evening peak hour.

4.4.5 2023 No-Build Queue Analysis

The 2023 No-Build Condition queue length analysis was conducted in conjunction with the LOS analysis using Synchro software. The queue analysis is consistent with

the LOS analysis shown and discussed above as well as observed conditions in the field. Queue lengths for the 50th percentile and 95th percentile are provided in Tables 4-39a through 4-39d, at the end of Section 4.6, while Figures 4.17a through 4.17d provide a graphical representation of the modeled queue lengths for all analyzed conditions.

4.4.6 2023 No-Build I-90 Mainline Analysis

The 2023 No-Build mainline analysis for the three merge sections were conducted using the same inputs as the Existing Conditions analysis with the exception of vehicle volume changes. The 2023 No-Build Base Condition analyzes the I-90 mainline with the Clarendon Street I-90 ramp open under 2023 No-Build Base Condition volumes presented in Figures 4.7a and 4.7b. The results are presented in Tables 4-20 and 4-21.

TABLE 4-20 MAINLINE CAPACITY ANALYSIS MERGE SECTIONS LOS – NO-BUILD BASE CONDITIONS MORNING PEAK HOUR

Location	Volume (veh/hr)	Density (pc/mi/ln)	Speed	LOS
Arlington On-Ramp	315	21.7	51	C
Clarendon On-Ramp	60	21.7	51	C
Huntington On-Ramp	310	24.2	50	C

TABLE 4-21 MAINLINE CAPACITY ANALYSIS MERGE SECTIONS LOS – NO-BUILD BASE CONDITIONS EVENING PEAK HOUR

Location	Volume (veh/hr)	Density (pc/mi/ln)	Speed	LOS
Arlington On-Ramp	560	31.3	49	D
Clarendon On-Ramp	164	31.5	49	D
Huntington On-Ramp	504	35.4	48	E

The 2023 No-Build Alternate Condition I-90 mainline analysis analyzes only two merge segments, as the On-Ramp is assumed closed. The trips using the On-Ramp are diverted to the other two area ramps based on the CRB model redistribution, presented in Section 4.4.3. The redistributed No-Build ramp trips were presented previously in Figures 4.8b and 4.8c and the cumulative 2023 No-Build Alternate Condition volumes were presented in Figures 4.9a and 4.9b. The mainline analysis results for the 2023 No-Build Alternate Condition are presented in Tables 4-22 and 4-23.

TABLE 4-22 MAINLINE CAPACITY ANALYSIS MERGE SECTIONS LOS – NO-BUILD ALTERNATE CONDITIONS MORNING PEAK HOUR

Location	Volume (veh/hr)	Density (pc/mi/ln)	Speed	LOS
Arlington On-Ramp	325	21.8	51	C
Clarendon On-Ramp	-	-	-	-
Huntington On-Ramp	350	24.3	50	C

TABLE 4-23 MAINLINE CAPACITY ANALYSIS MERGE SECTIONS LOS – NO-BUILD ALTERNATE CONDITIONS EVENING PEAK HOUR

Location	Volume (veh/hr)	Density (pc/mi/ln)	Speed	LOS
Arlington On-Ramp	590	31.6	49	D
Clarendon On-Ramp	-	-	-	-
Huntington On-Ramp	624	35.7	48	E

Based on this analysis, the On-Ramp closure does not appear to impact the LOS of the other area on-ramps. Under both the Base and Alternate Conditions during the evening peak hour, the Huntington Avenue on-ramp decreased from an LOS D during Existing Conditions to an LOS E under No-Build Conditions. Although the LOS grade decreased, the density increases by less than 1.5 pc/mi/ln and just tips the threshold from LOS D to LOS E. As this decrease appears in both the Base and Alternate Conditions, it can be concluded that it is due to general background growth.

There are negligible differences when comparing the Base and Alternate Conditions. The increase in ramp volumes at the Arlington Street and Huntington Street Ramps due to the closure of the Clarendon Street On-Ramp increases ramp densities by less than 0.5 pc/mi/ln in both peak hours. The LOS is not affected due to the Clarendon Street On-Ramp closure.

4.5 Project Traffic

The Project generated trips were calculated using the methodologies outlined in the ITE Trip Generation Handbook, 9th Edition (August 2014). The steps taken to most accurately estimate the number of Project-generated trips is as follows:

Step 1 – Identify Project Land Use Codes and estimate ITE Unadjusted Vehicle Trips

Step 2 – Convert ITE Unadjusted Vehicle Trips into Person Trips

Step 3 – Estimate Internal Capture Trips

Step 4 – Calculate Net-New Person Trips

Step 5 – Calculate Trips by Mode using Mode Shares

Step 6 – Convert Person-Vehicle Trips to Adjusted Vehicle Trips

Step 7 – Estimate Pass-by Vehicle Trips

Step 8 – Estimate Existing land use trip generation and Calculate Net-New Trips

The following details the inputs and calculations used to determine the Project generated trips. Base Scheme trip generation has been presented in detail below; the Alternate Scheme trip generation was also conducted using the following methodology with the final adjusted trip generation provided at the end of this section.

4.5.1 Unadjusted ITE Vehicle Trips

The Project is comprised of office, residential and retail land uses. The ITE Trip Generation Manual categorizes these land uses and provides daily, morning, and evening peak hour unadjusted vehicle trip generation rates. The average rates for each land use code were used in estimating the unadjusted ITE vehicle trips. The land use codes and respective trip generation rates are shown in Table 4-24.

TABLE 4-24 ITE LAND USE CODE AND TRIP RATES

Land Use	ITE LUC	Average Trip Rate Daily	Average Trip Rate AM Peak Hour	Average Trip Rate PM Peak Hour
Office	LUC 710 General Office	11.03	1.56	1.49
Residential	LUC 220 Apartment	6.65	0.51	0.62
Retail	LUC 820 Shopping Center	42.70	0.96	3.71

These rates were used to calculate the unadjusted vehicle trips for the Project and are presented in Table 4-25.

TABLE 4-25 UNADJUSTED ITE VEHICLE TRIPS (BASE SCHEME)

	Daily	AM Peak Hour	PM Peak Hour
Garage West Office			
In	3,213	800	148
Out	3,213	109	721
Total	6,426	909	868
Garage West Retail			
In	508	14	42
Out	508	9	46
Total	1,016	23	90
Garage East Residential			
In	798	24	97
Out	798	98	52
Total	1,596	122	149
Station West Retail			
In	641	18	53
Out	641	11	58
Total	1,282	28	111
Station East Residential			
In	1,197	37	145
Out	1,197	147	78
Total	2,394	184	223
Station East Retail			
In	109	3	9
Out	109	2	10
Total	218	5	19
Total Office Trips			
In	3,213	800	148
Out	3,213	109	721
Total	6,426	909	868
Total Residential Trips			
In	1,995	61	242
Out	1,995	245	130
Total	3,990	306	372
Total Retail Trips			
In	1,258	35	105
Out	1,258	21	114
Total	2,516	57	219
Total Trips Base Scheme			
In	**6,466**	**896**	**494**
Out	**6,466**	**375**	**964**
Total	**12,932**	**1,271**	**1,458**
Total Trips Alternate Scheme	**13,149**	**1,289**	**1,482**

Source: ITE Trip Generation Handbook 9th Edition; LUC 710 – Office (average rate); LUC 220 - Apartment (average rate), LUC 820 – Shopping Center (average rate)

4.5.2 Person Trips

The unadjusted vehicle trips are converted into person trips by applying the national average vehicle occupancy (AVO) of 1.13 for office/residential and 1.67 for retail as presented in the 2009 National Household Travel Survey.

4.5.3 Internal Capture Trips

As described in the ITE Trip Generation Handbook "[b]ecause of the complimentary nature of these land uses, some trips are made among the on-site uses. This capture of trips internal to the site has the net effect of reducing vehicle trip generation between the overall development site and the external street system (compared to the total number of trips generated by comparable land uses developed individually on stand-alone sites) …an internal capture rate can generally be defined as the percentage of total person trips generated by a site that are made entirely within the site. The trip origin, destination, and travel path are all within the site."

Based on the methodology outlined in the ITE Trip Generation Handbook and the respective *Spreadsheet Tool for Estimation of Trip Generation and Internal Trip Capture at a Mixed-Use Development,* the internal capture rates and subsequent person trips were estimated. Table 4-26 and 4-27 provide a summary of the internal person trips between each land use. The worksheets used to estimate the internal person trips are provided in Appendix F.

TABLE 4-26 INTERNAL PERSON TRIPS – AM PEAK HOUR

	Destination (To)		
Origin (From)	Office	Residential	Retail
Office	-	0	19
Residential	6	-	3
Retail	10	1	-

Source: ITE Trip Generation Handbook 3rd Edition Spreadsheet

TABLE 4-27 INTERNAL PERSON TRIPS – PM PEAK HOUR

	Destination (To)		
Origin (From)	Office	Residential	Retail
Office	-	11	14
Residential	6	-	18
Retail	4	52	-

Source: ITE Trip Generation Handbook 3rd Edition Spreadsheet

The 3rd Edition ITE Trip Generation Handbook provides guidance on the morning and evening peak hour internal capture methodology, but does not define internal

capture rates for daily trips. The ITE Trip Generation Handbook 2nd edition provides daily internal capture rates that can be used to adjust the Project generated person trips. This methodology was used to estimate the daily internal capture trips of the Project and are presented in Table 4-28. The worksheet used to estimate these trips is presented in Appendix F.

TABLE 4-28 INTERNAL PERSON TRIPS – DAILY

	Destination (To)		
Origin (From)	Office	Residential	Retail
Office	-	68	84
Residential	>12[1]	-	189
Retail	63	231	-

Source: ITE Trip Generation Handbook 2rd Edition Worksheet

[1] ITE Trip Generation Handbook 2nd edition methodology does not provide estimates of internal residential to office person trips outside of peak hours.

The internal capture trips were proportioned for each individual component for each land use to generate the net-new person trips generated by the Project.

4.5.4 Mode Share

The mode shares used are consistent with the PNF, filed on March 29, 2016, and are based on Census Transportation Planning Products (CTPP). The CTPP is based on the 2006-2010 5-year American Community Survey Data. The information provided by this planning tool provides mode-specific origin (work/home)-destination (home/work) information which provides mode share data for the area as well as trip distribution information. The information collected and analyzed is for Census Tracts 106, 703, and 707 of Suffolk County, Massachusetts. The Project is located in Census Tract 707 specifically, while the information gathered and analyzed encompassed a larger and more diverse sample size (to include more residential) extending to adjacent census tracts, 106 to the northwest and 703 to the northeast.

The mode shares, by use, for the Project are presented in Table 4-29.

TABLE 4-29 MODE SHARES

Mode	Office	Residential	Retail
Drive Alone	30%	19%	30%
Rideshare	7%	4%	7%
Transit	51%	31%	51%
Walk	9%	37%	9%
Bike	1%	3%	1%
Other	2%	6%	2%

4.5.5 Adjusted Project Trips

The mode shares discussed above were applied to the net-new person trips to generate the adjusted Project trips by mode.

A local AVO was applied to the rideshare mode to more accurately reflect the number of vehicles generated by the Site. The local AVO for office was calculated to be 2.45 and 2.84 for residential.

A local retail AVO is difficult to identify and therefore the national AVO of 1.67 was applied to the whole vehicle mode share. This approach was used due to the limited data and research available for local retail mode share and AVO characteristics.

The vehicle mode share Project-generated trips are a total of the drive alone and rideshare trips. Detailed trip generation worksheets are provided in Appendix F.

4.5.6 Pass-By Trips

Pass-by vehicle trips were estimated using the guidance in the ITE Trip Generation Handbook, 3rd Edition, which provides data on pass-by trips for various size developments for LUC 820, Shopping Center. Based on the data available, a modest estimate for the pass-by trip percentage for this size retail component is 30 percent for the PM peak period. Data for the AM peak and the daily pass-by trip percentage is not provided. Table 4-30 shows the estimated PM peak pass-by trips associated with this Project.

TABLE 4-30 RETAIL PASS-BY TRIPS

	PM Peak
In	10
Out	10
Total	20

The pass-by vehicle trips are trips already in the network and will stop into the retail component of the Project en-route to another destination. These trips are not additional trips added to the network, but rather existing trips which are represented in the Project driveway counts.

4.5.7 Existing Land Use Trip Generation

The Garage West Parcel contains existing land uses that will be relocated with the redevelopment of the parcel. These land uses include a Harvard Vanguard medical office and an Eastern Bank Branch. Using the same methodology described above, exclusive of internal capture and pass-by trips, an estimated trip generation was calculated. Table 4-31 presents the ITE land use codes and rates as well as the VOR used for the analysis. The retail mode share presented in Table 4-29 was used to estimate the number of trips by mode. Table 4-32 presents the estimated existing trips to be removed with the development of the Garage West Parcel.

TABLE 4-31 EXISTING GARAGE WEST ITE LAND USE CODE AND TRIP RATES

Land Use	ITE LUC	Average Trip Rate Daily	Average Trip Rate AM Peak Hour	Average Trip Rate PM Peak Hour	VOR
Harvard Vanguard Medical Office	LUC 720 Medical Office Building	36.13	2.39	3.57	1.37
Eastern Bank Branch	LUC 911 Walk-in Bank	N/A	N/A	12.13	1.67

Note: LUC 911 Walk-in Bank does not have data for Daily and AM Peak Hour trip rates and provides its own VOR.

TABLE 4-32 EXISTING LAND USES ADJUSTED TRIPS (GARAGE WEST PARCEL)

	Vehicle[1]	Transit	Walk	Bike	Other
Daily (24-hour)					
Harvard Vanguard Medical Office					
In	158	298	53	6	12
Out	158	298	53	6	12
Total	316	596	106	12	24
Eastern Bank Branch					
In	-	-	-	-	-
Out	-	-	-	-	-
Total	-	-	-	-	-
Total IN	158	298	53	6	12
Total OUT	158	298	53	6	12
TOTAL (In+Out)	316	596	106	12	24
AM Peak Hour					
Harvard Vanguard Medical Office					
In	16	31	6	1	1
Out	5	8	1	0	0
Total	21	39	7	1	1
Eastern Bank Branch					
In	-	-	-	-	-
Out	-	-	-	-	-
Total	-	-	-	-	-
Total IN	16	31	6	1	1
Total OUT	5	8	1	0	0
TOTAL (In+Out)	21	39	7	1	1
PM Peak Hour					
Harvard Vanguard Medical Office					
In	9	17	3	0	1
Out	22	42	7	1	2
Total	31	59	10	1	3
Eastern Bank Branch					
In	6	15	3	0	1
Out	9	19	3	0	1
Total	15	34	6	0	2
Total IN	15	32	6	0	2
Total OUT	31	61	10	1	3
TOTAL (In+Out)	**46**	**93**	**16**	**1**	**5**

1. Adjusted Vehicle trips include drive alone and carpool/vanpool (HOV)

4.5.8 Project-Generated Trips

Existing trips generated by Harvard Vanguard Medical Offices and Eastern Bank are removed from the estimated adjusted Project trips for each mode. The net-new Project-generated trips for the Base Scheme are shown in Table 4-33a and the trips for the Alternate Scheme are shown in Table 4-33b.

The Project is expected to generate just over 3,600 daily (24-hour) vehicle trips, with just over 380 and 370 vehicle trips being made in the Base Scheme during the morning and evening peak hours, respectively. This level of actual vehicle trip

generation reflects the Project's location in an existing urban environment. As shown in Table 4-33b, there are insignificant differences from the Base Scheme to the Alternate Scheme trip generation with approximately one additional vehicle trip every ten minutes during the morning and evening peak hours. The nominally higher trip generation for the Alternate Scheme was used as a basis for both analyses.

It is worth noting that the current trip generation associated with the existing Garage is largely associated with adjacent off-site land uses and is not generated by the actual existing on-site uses (primarily parking); whereas the projected future vehicle trips shown here, which will use the Garage, will be generated by the Project itself located on the Site.

TABLE 4-33A ADJUSTED PROJECT TRIPS (BASE SCHEME)

	Vehicle[1]	Transit	Walk	Bike	Other
Daily (24-hour)					
Office					
In	1,014	1,522	268	30	59
Out	985	1,476	260	29	58
Total	1,999	2,998	528	59	117
Residential					
In	400	606	723	58	117
Out	422	640	765	62	124
Total	822	1,246	1,488	120	241
Retail					
In	405	932	164	18	37
Out	401	921	163	18	36
Total	806	1,853	327	36	73
Total IN	1,819	3,060	1,155	106	213
Total OUT	1,808	3,037	1,188	109	218
TOTAL (In+Out)	**3,627**	**6,097**	**2,343**	**215**	**431**
AM Peak Hour					
Office					
In	275	422	74	8	17
Out	29	45	8	1	2
Total	304	467	82	9	19
Residential					
In	14	22	25	2	4
Out	55	83	99	8	16
Total	69	105	124	10	20
Retail					
In	9	19	3	0	0
Out	5	12	2	0	0
Total	14	31	5	0	0
Total IN	298	463	102	10	21
Total OUT	89	140	109	9	18
TOTAL (In+Out)	**387**	**603**	**211**	**19**	**39**
PM Peak Hour					
Office					
In	36	48	8	2	1
Out	229	341	61	7	13
Total	265	389	69	9	14
Residential					
In	43	65	78	7	13
Out	25	38	45	3	7
Total	68	103	123	10	20
Retail					
In	31	72	13	2	2
Out	29	68	12	2	2
Total	60	140	25	4	4
Total IN	100	185	99	11	16
Total OUT	273	447	118	12	22
TOTAL (In+Out)	**373**	**632**	**217**	**23**	**38**

TABLE 4-33B ADJUSTED PROJECT TRIPS (ALTERNATE SCHEME)

	Vehicle[1]	Transit	Walk	Bike	Other
Daily (24-hour)					
Office					
In	1,033	1,550	273	30	60
Out	1,003	1,504	265	29	59
Total	2,036	3,054	538	59	119
Residential					
In	397	603	720	58	117
Out	420	638	761	62	123
Total	817	1,241	1,481	120	240
Retail					
In	423	974	172	19	38
Out	419	963	170	19	37
Total	842	1,937	342	38	75
Total IN	1,853	3,127	1,165	107	215
Total OUT	1,842	3,105	1,196	110	219
TOTAL (In+Out)	**3,695**	**6,232**	**2,361**	**217**	**434**
AM Peak Hour					
Office					
In	280	429	75	8	17
Out	30	46	8	1	2
Total	310	475	83	9	19
Residential					
In	14	22	25	2	4
Out	55	83	99	8	16
Total	69	105	124	10	20
Retail					
In	9	20	3	0	0
Out	5	13	2	0	0
Total	14	33	5	0	0
Total IN	303	471	103	10	21
Total OUT	90	142	109	9	18
TOTAL (In+Out)	**393**	**613**	**212**	**19**	**39**
PM Peak Hour					
Office					
In	38	49	8	2	1
Out	232	348	62	7	13
Total	270	397	70	9	14
Residential					
In	43	65	78	7	13
Out	25	38	45	3	7
Total	68	103	123	10	20
Retail					
In	23	76	14	2	2
Out	21	73	13	2	2
Total	44	149	27	4	4
Total IN	104	190	100	11	16
Total OUT	278	459	120	12	22
TOTAL (In+Out)	**382**	**649**	**220**	**23**	**38**

4.5.9 Trip Distribution and Assignment

The adjusted Project trips are assigned to the study area roadway network based on the Project trip distribution. As discussed previously, the Project is analyzed for a Base Condition and an Alternate condition. The Base Condition maintains the On-Ramp. The Alternate Condition analyzes the Project assuming the On-Ramp is closed.

Site egress is slightly different under the Alternate Condition. The Base Condition maintains the existing Clarendon Street entrance/exit driveway and provides a new Garage exit driveway onto Dartmouth Street. The Alternate Condition also maintains the existing Clarendon Street entrance/exit driveway, while providing a second Garage exit driveway onto Trinity Place. This different egress slightly alters exiting vehicles within the direct vicinity of the Project Site and is reflected in the Project trip distribution and assignment, discussed below.

The Regional Project trip distribution is generated based on the origin-destination US Census Bureau American Community Survey 2006-2010 Five-year Estimates for the area which include Census Tracts 106, 703, and 707 of Suffolk County, Massachusetts. Slight modifications were made based on the BTD zone rates and the trip distribution used by surrounding area projects. Office and retail follow the same trip distribution pattern, and residential follows a slightly different pattern based on the census data.

Table 4-34 and Figure 4.10 present the Regional Project trip distribution for both the Base and Alternate Conditions.

TABLE 4-34 REGIONAL PROJECT TRIP DISTRIBUTION

Trip Assignment	Office	Residential	Retail
Storrow Drive Eastbound	11%	9%	11%
Storrow Drive Westbound	15%	10%	15%
Boylston Street	3%	3%	3%
I-90	34%	26%	34%
E Berkeley Street	15%	14%	15%
Dartmouth Street	3%	5%	3%
Columbus Avenue to/from West	8%	5%	8%
Columbus Ave to/from East	6%	15%	6%
Huntington Avenue	5%	13%	5%
Total	100%	100%	100%

Base Condition Trip Assignment

As discussed previously, the Project will eliminate the existing Garage entrance and exit drums while maintaining the existing Clarendon Street entrance/exit driveway. With the I-90 On-Ramp maintained, the Base Condition will provide a new Garage exit driveway onto Dartmouth Street. The Base Condition trips are assigned to the roadway network based on this change in Garage access using the Regional Project trip distribution described above. Approximately half of the Garage exits would be diverted to the new Dartmouth Street Garage exit, passing through the Dartmouth/Stuart Street intersection.

Alternate Condition Trip Assignment

The Alternate Condition Project trips are assigned to the roadway network using the same Regional and Base Project trip distribution, but adjusted for the closure of the On-Ramp using the CRB Model redistribution presented in Section 4.3.3.

4.6 Future Conditions Assessment: Build Condition

The future 2023 Build Condition assessment builds upon the No-Build conditions with the addition of the fully occupied, proposed Project. The Project-generated Base Condition vehicle trips were assigned to the Project study area based on the distribution summarized above in Table 4-34 and shown in Figures 4.11a and 4.11b. The cumulative 2023 Build Base Condition vehicle volumes are presented in Figure 4.12a and 4.12b for the morning and evening peak hours, respectively.

The Project-generated Alternate Condition vehicle trips are summarized in Figures 4.13a and 4.13b. The cumulative 2023 Build Alternate Condition vehicle volumes, with the On-Ramp closed, are presented in Figures 4.14a and 4.14b. The redistribution of vehicle trips using the On-Ramp are based on the CRB Model trip distribution results previously shown in Figure 4.8a.

4.6.1 2023 Build Intersection Operational Analysis

Intersection capacity analysis was conducted for the 2023 Build Base and Alternate Condition morning and evening peak hours. The results have been compared to the 2016 Existing Condition and 2023 No-Build Base and Alternate Condition LOS and are presented in Tables 4-35 through 4-38. Detailed LOS results including V/C ratio and delay for lane groups and approaches are provided in Tables 4-39a through 4-39d at the end of this Section. Figures 4.15a through 4.15d show the LOS results for all analysis conditions during the morning and evening peak hour. Synchro printouts are presented in Appendix F.

TABLE 4-35 2023 BUILD BASE CONDITION (ON-RAMP OPEN) SIGNALIZED INTERSECTION VEHICLE LOS MORNING AND EVENING PEAK HOUR

	AM			PM		
Intersection	**2016 Existing Condition**	**2023 No-Build Base Condition**	**2023 Build Base Condition**	**2016 Existing Condition**	**2023 No-Build Base Condition**	**2023 Build Base Condition**
1. Boylston Street/Clarendon Street	C	C	C	B	C	C
2. Boylston Street/Berkeley Street	B	B	B	C	C	C
3. St. James Avenue /Dartmouth Street	C	C	C	C	C	C
5. St. James Avenue/ Clarendon Street	B	B	B	C	C	C
6. St. James Avenue/Berkeley Street	C	C	C	C	C	D
7. St. James Avenue/ Arlington Street	C	C	C	C	C	C
8. Huntington Avenue/Exeter Street/ Stuart Street	C	C	C	C	C	C
9. Stuart Street/ Dartmouth Street	B	B	B	B	B	C
10. Stuart Street/Trinity Place	A	B	B	B	B	B
11. Stuart Street/Clarendon Street	B	B	D	B	B	B
12. Stuart Street/Berkeley Street	D	D	D	B	B	B
13. Stuart Street/Arlington Street	D	E	E	F	F	F
17. Columbus Avenue/ Dartmouth Street	E	F	F	E	E	F
18. Columbus Avenue/ Clarendon Street	D	D	D	C	C	D
20. Columbus Avenue/Berkeley Street	C	C	C	C	C	C
21. Arlington Street/Marginal Road/I-90 On-Ramp	B	B	B	C	C	C
22. Arlington Street/Herald Street/Tremont Street	D	D	D	C	C	C
23. Albany Street/Herald Street	C	C	C	D	E	E
25. Albany Street/Traveler Street	C	C	C	D	D	D
26. Traveler Street/ Frontage Road/ W Broadway/ I-93 Northbound On-Ramp/ I-90 Westbound On-Ramp	E	E	E	D	D	D

TABLE 4-36 2023 BUILD ALTERNATE CONDITION (ON-RAMP CLOSED) SIGNALIZED INTERSECTION VEHICLE LOS MORNING AND EVENING PEAK HOUR

	AM			PM		
Intersection	**2016 Existing Condition**	**2023 No-Build Alternate Condition**	**2023 Build Alternate Condition**	**2016 Existing Condition**	**2023 No-Build Alternate Condition**	**2023 Build Alternate Condition**
1. Boylston Street/Clarendon Street	C	C	C	B	C	C
2. Boylston Street/Berkeley Street	B	B	B	C	C	C
3. St. James Avenue/ Dartmouth Street	C	C	C	C	C	C
5. St. James Avenue/Clarendon Street	B	B	B	C	C	C
6. St. James Avenue/Berkeley Street	C	C	C	C	C	D
7. St. James Avenue/Arlington Street	C	C	C	C	C	C
8. Huntington Avenue/Exeter Street/Stuart Street	C	C	C	C	C	C
9. Stuart Street/Dartmouth Street	B	B	B	B	B	B
10. Stuart Street/Trinity Place	A	B	C	B	B	D
11. Stuart Street/Clarendon Street	B	B	D	B	A	B
12. Stuart Street/Berkeley Street	D	D	D	B	B	B
13. Stuart Street/Arlington Street	D	E	E	F	F	F
17. Columbus Avenue/ Dartmouth Street	E	F	F	E	E	F
18. Columbus Avenue/ Clarendon Street	D	D	D	C	C	D
20. Columbus Avenue/Berkeley Street	C	C	C	C	C	C
21. Arlington Street/Marginal Road/I-90 On-Ramp	B	B	B	C	C	C
22. Arlington Street/Herald Street/Tremont Street	D	D	D	C	C	C
23. Albany Street/Herald Street	C	C	C	D	E	E
25. Albany Street/Traveler Street	C	C	C	D	D	D
26. Traveler Street/Frontage Road/ W Broadway/ I-93 Northbound On-Ramp/ I-90 Westbound On-Ramp	E	E	E	D	D	D

TABLE 4-37 2023 BUILD BASE CONDITION (ON-RAMP OPEN) UNSIGNALIZED INTERSECTION VEHICLE LOS MORNING AND EVENING PEAK HOUR

	AM			PM		
Intersection/Approach	**2016 Existing Conditions**	**2023 No-Build Base Condition**	**2023 Build Base Condition**	**2016 Existing Conditions**	**2023 No-Build Base Condition**	**2023 Build Base Condition**
4. St. James Avenue/ Trinity Place						
Trinity Place NB Left	C	C	C	B	B	C
14. Stuart Street/I-90 Westbound Off-Ramp						
I-90 Westbound Off-Ramp NEB Right	F	F	F	D	F	F
15. Clarendon Street/ Stanhope Street						
Stanhope Street WB Left/Thru	F	F	F	F	F	F
16. Clarendon Street/ Garage Driveway						
Garage Driveway EB Right	F	F	F	F	F	F
19. Columbus Avenue/Cahners Place	A	A	A	A	A	A
24. Albany Street/I-93 Southbound On-Ramp	A	A	A	A	A	A
27. Berkeley Street/ Storrow Drive On-Ramp						
Back Street EB Left/Hard Left	C	C	C	D	D	D
28. Clarendon Street/Storrow Drive Off-Ramp						
Back Street EB Thru/Right	B	B	B	C	C	C

TABLE 4-38 2023 BUILD ALTERNATE CONDITION (ON-RAMP CLOSED) UNSIGNALIZED INTERSECTION VEHICLE LOS MORNING AND EVENING PEAK HOUR

	AM			PM		
Intersection/Approach	**2016 Existing Conditions**	**2023 No-Build Alternate Condition**	**2023 Build Alternate Condition**	**2016 Existing Conditions**	**2023 No-Build Alternate Condition**	**2023 Build Alternate Condition**
4. St. James Avenue/ Trinity Place						
Trinity Place NB Left	C	C	C	B	B	C
14. Stuart Street/I-90 Westbound Off-Ramp						
I-90 Westbound Off-Ramp NEB Right	F	F	F	D	F	F
15. Clarendon Street/ Stanhope Street						
Stanhope Street WB Left/Thru	F	E	F	F	F	F
16. Clarendon Street/ Garage Driveway						
Garage Driveway EB Right	F	F	F	F	F	F
19. Columbus Avenue/ Cahners Place	A	A	A	A	A	A
24. Albany Street/I-93 Southbound On-Ramp	A	A	A	A	A	A
27. Berkeley Street/ Storrow Drive On-Ramp						
Back Street EB Left/Hard Left	C	C	C	D	D	D
28. Clarendon Street/ Storrow Drive Off-Ramp						
Back Street EB Thru/Right	B	B	B	C	C	C

In the 2023 Build Base and Alternate Conditions eight intersections experience a change in LOS. The intersection of Stuart Street/Clarendon Street changes in the Base Scheme in the morning peak hour, and the intersections of St. James Avenue/Berkeley Street, Stuart Street/Dartmouth Street, Columbus Avenue/Dartmouth Street, Columbus Avenue/Clarendon Street, and St. James Avenue/Trinity Place change LOS in the Base Scheme in the evening peak hour.

In the Alternate Scheme, Stuart Street/Clarendon Street, Stuart Street/Trinity Place, and Clarendon Street/Stanhope Street change LOS during the morning peak hour. During the evening peak hour in the Alternate Scheme, Stuart Street/Clarendon Street, Columbus Avenue/Dartmouth Street, Columbus Avenue/Clarendon Street, Stuart Street/Trinity Place, St. James Avenue/Berkeley Street, and St. James Avenue/Trinity Place change LOS. The intersections that experience a change in LOS are discussed in more detail below.

#4 **St. James Avenue/Trinity Place** – The unsignalized intersection of St. James Avenue/Trinity Place decreases from LOS B to LOS C from both the 2023 No-Build Base Condition to 2023 Build Base Condition and from the 2023 No-Build Alternate Condition to 2023 Build Alternate Condition during the evening peak hour. The delay at the St. James Avenue approach only increases by 1.1 seconds in 2023 Build Base Condition and 5.2 seconds, but this trips the categorization for LOS C with 15.6 seconds and 19.8 seconds of delay at this approach for the 2023 Build Base Condition and 2023 Build Alternate Condition, respectively.

#6 **St. James Avenue/Berkeley Street** – This intersection decreases from LOS C to LOS D from the 2023 No-Build Base Condition to 2023 Build Base Condition in the evening peak hour. This decrease in intersection operations is due to the Project-generated trips traveling northbound on Berkeley Street towards Storrow Drive and trips traveling westbound on St. James Avenue towards the Site. The overall intersection delay increases by 7.8 seconds from 31.4 seconds in the 2023 No-Build Base Condition to 39.2 seconds in the 2023 Build Base Condition.

In the 2023 Build Alternate Condition, St. James Avenue/Berkeley Street decreases from LOS C to LOS D during the evening peak hour due to the Project generated trips traveling northbound on Berkeley Street towards Storrow Drive and trips traveling westbound on St. James Avenue towards the site. The overall intersection delay increases by 8.1 seconds from 31.5 seconds in the 2023 No-Build Alternate Condition to 39.6 seconds in the 2023 Build Alternate Condition.

While decreasing in LOS, the intersection still operates at an acceptable LOS D under Future 2023 Build Base and Alternate Conditions.

#3 **Stuart Street/Dartmouth Street** – This intersection decreases from LOS B to LOS C from 2023 No-Build Base Condition to 2023 Build Base Condition during the evening peak hour. This intersection's decreased operation is due to the Project-generated trips traveling eastbound on Stuart Street and northbound on Dartmouth Street. In the 2023 Build Base Condition, the Project exit is located on Dartmouth Street resulting in a higher volume of vehicles at the Dartmouth Street northbound approach. The overall intersection delay increases by only 1.1 seconds from 19.0 seconds in the 2023 No-Build Base Condition to 20.1 seconds in the 2023 Build Base Condition. The slight delay increase causes the overall operations to decrease to LOS C by only two-tenths of a second.

The intersection will continue to operate at an acceptable LOS C, while only increasing overall intersection delay by 1.1 seconds under Base Conditions.

The intersection does not experience this slight LOS increase under the Build Alternate Condition as the Garage exit is onto Trinity Place instead of Dartmouth Street.

#10 **Stuart Street/Trinity Place** – During the morning and evening peak hour, intersection operations decrease under the 2023 Build Alternate Condition. The morning peak hour decreases from LOS B to LOS C and the evening peak hour decreases from LOS B to LOS D. Under the 2023 Build Alternate Condition, the On-Ramp is closed and a new Garage exit is created exiting onto Trinity Place. Exiting trips now on Trinity Place create higher volumes at this approach, and the existing signal timing cannot process the vehicles efficiently. The overall intersection delay increases in the morning peak hour from 11.2 seconds in the 2023 No-Build Alternate Condition to 21.2 seconds in the 2023 Build Alternate Condition. In the evening peak hour, the overall intersection delay increases from 15.0 seconds in the 2023 No-Build Alternate Condition to 42.8 seconds in the 2023 Build Alternate Condition. In the event that the Alternate Condition is pursued, mitigation could be done at this intersection to improve the signal timing. This may allow additional green time for the Project-generated vehicles exiting Trinity Place without heavily disrupting the Stuart Street eastbound approach.

#11 **Stuart Street/Clarendon Street** – The intersection performance decreases during the morning peak hour under the 2023 Build Base Condition and during both the morning and evening peak hour under the 2023 Build Alternate Condition. The morning peak hour LOS decreases from LOS B to LOS D under both the Base and Alternate Conditions. The Project will remove the existing Garage drum entrance on Trinity Place, diverting all entering Garage traffic to the Clarendon Street driveway, through the Stuart Street/Clarendon Street intersection. The increase in vehicles taking right turns onto Clarendon Street from Stuart Street to access the Garage increase the Stuart Street eastbound delay. The overall intersection delay increases from 16.8 seconds in the 2023 No-Build Base Condition to 41.6 seconds in the 2023 Build Base Condition during the morning peak hour. Similarly, the delay increases from 16.5 seconds in the 2023 No-Build Alternate Condition to 38.4 seconds in the 2023 Build Alternate Condition during the morning peak hour. The evening peak hour LOS decreases from LOS A to LOS B for the same reason mentioned above. The overall intersection delay increases from 9.8 seconds in the 2023 No-Build Alternate Condition to 14.0 seconds in the 2023 Build Alternate Condition.

#15 **Clarendon Street/Stanhope Street** – The intersection LOS decreases during the morning peak hour from LOS E to LOS F from the 2023 No-Build Alternate Condition to the 2023 Build Alternate Condition. The LOS improves slightly from 2016 Existing Condition (LOS F) to 2023 No-Build Alternate Condition (LOS E) due to the movement of vehicles accessing the I-90 ramp, but the LOS decreases in the 2023 Build Alternate Condition due to the introduction of project-generated trips.

#17 **Columbus Avenue/Dartmouth Street** – The intersection decreases from LOS E to LOS F from 2023 No-Build Condition to 2023 Build Condition for the both the Base and Alternate Conditions during the evening peak hour. The decrease in LOS at this intersection is due to inbound Project trips turning left from the Columbus Avenue northeastbound onto Dartmouth Street and trips leaving the Site traveling southwestbound on Columbus Avenue. The increased thru volume reduces gaps needed for left-turning vehicles to pass through the intersection. The overall intersection delay increases from 79.3 seconds in the 2023 No-Build Base and Alternate Conditions to 108.2 seconds in the 2023 Build Base and Alternate Conditions.

#18 **Columbus Avenue/Clarendon Street** – This intersection decreases from LOS C to LOS D from 2023 No-Build Base Condition to 2023 Build Base Condition and from the 2023 No-Build Alternate Condition to the 2023 Build Alternate Condition during the evening peak hour. The decrease in LOS at this intersection is due to the exiting project trips at the Clarendon Street southbound approach. The overall intersection delay increases from 30.0 seconds in the 2023 No-Build Base Condition to 36.3 seconds in the 2023 Build Base Condition.

The intersection also decreases during the evening peak hour from LOS C to LOS D from 2023 No-Build Alternate Condition to 2023 Build Alternate Condition due to the addition of project trips at this intersection. The overall intersection delay increases from 30.6 seconds in the 2023 No-Build Alternate Condition to 36.6 seconds in the 2023 Build Alternate Condition.

All other study area intersections function under the 2023 Build Base and Alternate Conditions at the same LOS as the 2023 No-Build Base and Alternate Conditions during the morning and evening peak hours.

Tables 4-39a through 4-39d present detailed LOS results of all analyzed conditions.

4.6.2 2023 Build Queue Analysis

The 2023 Build Condition queue length analysis was conducted in conjunction with the LOS analysis using Synchro software. The queue analysis is consistent with the LOS analysis shown and discussed above. Queue lengths for the 50th percentile and 95th percentile are provided in Tables 4-39a through 4-39d while Figures 4.17a through 4.17d provide a graphical representation of the modeled queue lengths. Synchro printouts are presented in Appendix F.

TABLE 4-39A SIGNALIZED INTERSECTION LEVEL OF SERVICE – MORNING PEAK HOUR

		2016 Existing Condition					2023 No-Build Base Condition					2023 No-Build Alternate Condition					2023 Build Base Condition					2023 Build Alternate Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
1. Boylston Street/Clarendon Street	Boylston Street EB Thru/Right	0.40	13.6	B	78	107	0.41	13.8	B	81	111	0.41	13.8	B	81	111	0.42	13.9	B	84	115	0.42	13.9	B	84	115
	Clarendon Street SB Left/Thru	0.77	29.6	C	207	284	0.81	31.3	C	222	304	0.32	31.3	C	222	304	0.84	33.1	C	235	#333	0.33	33.1	C	235	#333
	OVERALL	**0.56**	**22.0**	**C**	**-**	**-**	**0.58**	**23.1**	**C**	**-**	**-**	**0.58**	**23.1**	**C**	**-**	**-**	**0.60**	**24.2**	**C**	**-**	**-**	**0.60**	**24.2**	**C**	**-**	**-**
2. Boylston Street/Berkeley Street	Boylston Street EB Left/Thru	0.52	14.5	B	50	64	0.53	14.4	B	50	65	0.54	14.4	B	51	m65	0.54	14.1	B	50	m64	0.54	14.1	B	50	m64
	Berkeley Street NB Thru/Right	0.49	18.7	B	192	m221	0.51	19.0	B	m65	m219	0.51	19.0	B	200	m219	0.52	19.2	B	67	m220	0.52	19.2	B	67	m220
	OVERALL	**0.51**	**16.9**	**B**	**-**	**-**	**0.52**	**17.0**	**B**	**-**	**-**	**0.52**	**17.0**	**B**	**-**	**-**	**0.53**	**17.1**	**B**	**-**	**-**	**0.53**	**17.1**	**B**	**-**	**-**
3. St James Avenue /Dartmouth Street	St James Avenue WB Thru	0.44	16.7	B	93	135	0.46	18.2	B	99	145	0.50	18.4	B	112	160	0.46	17.9	B	96	138	0.53	18.9	B	120	168
	St James Avenue WB Right	0.11	10.2	B	1	m10	0.11	9.4	A	0	m9	0.11	8.7	A	0	m9	0.11	8.8	A	0	m9	0.11	8.6	A	0	m9
	Dartmouth Street NB Left	0.18	13.2	B	10	33	0.22	13.5	B	19	44	0.23	13.6	B	27	53	0.23	13.6	B	23	48	0.25	13.8	B	32	59
	Dartmouth Street NB Thru	0.73	27.5	C	131	174	0.76	38.4	D	137	180	0.76	38.4	D	137	180	0.76	38.5	D	137	182	0.76	38.4	C	137	180
	OVERALL	**0.44**	**23.8**	**C**	**-**	**-**	**0.46**	**24.2**	**C**	**-**	**-**	**0.49**	**24.1**	**C**	**-**	**-**	**0.47**	**24.0**	**C**	**-**	**-**	**0.51**	**24.1**	**C**	**-**	**-**
5. St James Avenue/ Clarendon Street	St James Avenue WB Left/Thru	0.36	5.3	A	27	m42	0.38	5.6	A	32	m47	0.39	5.6	A	34	m49	0.40	5.3	A	30	m44	0.41	5.3	A	32	m46
	Clarendon Street SB Thru/Right	0.53	25.8	C	221	284	0.56	26.1	C	237	300	0.56	26.1	C	237	300	0.59	26.4	C	252	m307	0.59	26.4	C	252	m307
	OVERALL	**0.46**	**16.8**	**B**	**-**	**-**	**0.48**	**17.0**	**B**	**-**	**-**	**0.49**	**17.0**	**B**	**-**	**-**	**0.51**	**16.9**	**B**	**-**	**-**	**0.51**	**16.9**	**B**	**-**	**-**
6. St James Avenue/Berkeley Street	St James Avenue WB Thru/Right	0.64	31.1	C	134	183	0.66	31.6	C	140	189	0.66	31.6	C	140	189	0.72	33.6	C	157	211	0.72	33.6	C	157	211
	Berkeley Street NB Left/Thru/Right	0.88	23.2	C	78	#145	0.93	27.2	C	90	#168	0.93	27.2	C	90	#168	0.94	29.1	C	94	#176	0.94	29.1	C	94	#175
	OVERALL	**0.56**	**25.7**	**C**	**-**	**-**	**0.58**	**28.6**	**C**	**-**	**-**	**0.58**	**28.6**	**C**	**-**	**-**	**0.61**	**30.6**	**C**	**-**	**-**	**0.61**	**30.6**	**C**	**-**	**-**
7. St James Avenue/ Arlington Street	St James Avenue EB Right	0.17	30.2	C	31	49	0.18	30.3	C	31	49	0.18	30.3	C	31	49	0.18	30.3	C	31	49	0.18	30.3	C	31	49
	Park Plaza WB Left	0.26	31.6	C	53	99	0.27	31.7	C	54	101	0.27	31.7	C	54	101	0.27	31.7	C	54	101	0.27	31.7	C	54	101
	Park Plaza WB Thru	0.47	33.5	C	111	157	0.48	34.2	C	113	160	0.48	34.2	C	113	160	0.48	34.2	C	113	160	0.48	34.2	C	113	160
	Arlington Street SB Thru/Right	0.70	29.9	C	257	312	0.72	30.4	C	265	320	0.72	30.4	C	265	320	0.75	31.2	C	279	337	0.75	31.2	C	279	337
	OVERALL	**0.47**	**30.9**	**C**	**-**	**-**	**0.48**	**31.2**	**C**	**-**	**-**	**0.48**	**31.2**	**C**	**-**	**-**	**0.50**	**31.8**	**C**	**-**	**-**	**0.50**	**31.8**	**C**	**-**	**-**
8. Huntington Avenue/Exeter Street/ Stuart Street	Huntington Avenue NEB Right	0.42	28.2	C	92	132	0.55	30.9	C	137	199	0.55	30.9	C	137	199	0.57	31.4	C	144	208	0.57	31.4	C	144	208
	Huntington Avenue SWB Left	0.30	40.0	D	37	100	0.47	44.1	D	75	147	0.47	44.1	D	75	147	0.47	44.1	D	75	147	0.47	44.1	D	75	147
	Huntington Ave SWB Thru	0.15	8.9	A	37	47	0.16	9.0	A	38	49	0.16	9.0	A	38	49	0.16	9.0	A	39	50	0.16	9.0	A	39	50
	Exeter Street SB Left	0.59	42.1	D	144	215	0.64	43.7	D	159	232	0.64	43.7	D	159	232	0.64	43.7	D	159	232	0.64	43.7	D	159	232
	Exeter Street SB Thru/Right	0.48	38.2	D	110	185	0.37	35.4	D	70	134	0.37	35.4	D	70	134	0.37	35.4	D	70	134	0.37	35.4	D	70	134
	Garage Driveway NB Left	0.15	33.2	C	12	35	0.22	34.7	C	21	50	0.22	34.7	C	21	50	0.22	34.7	C	21	50	0.22	34.7	C	21	50
	Garage Driveway NB Right	0.04	30.4	C	0	2	0.10	31.2	C	5	48	0.10	31.2	C	5	48	0.10	31.2	C	5	48	0.10	31.2	C	5	48
	OVERALL	**0.45**	**27.9**	**C**	**-**	**-**	**0.56**	**29.3**	**C**	**-**	**-**	**0.56**	**29.3**	**C**	**-**	**-**	**0.57**	**29.4**	**C**	**-**	**-**	**0.57**	**29.4**	**C**	**-**	**-**

TABLE 4-39A SIGNALIZED INTERSECTION LEVEL OF SERVICE – MORNING PEAK HOUR

		2016 Existing Condition					2023 No-Build Base Condition					2023 No-Build Alternate Condition					2023 Build Base Condition					2023 Build Alternate Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
9. Stuart Street/ Dartmouth Street	Stuart Street EB Left	0.58	6.9	A	177	259	0.72	10.3	B	235	378	0.72	10.3	B	235	378	0.72	10.3	B	235	378	0.72	10.3	B	235	378
	Stuart Street EB Thru	0.42	12.1	B	130	161	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Stuart Street EB Right	0.61	18.4	B	191	291	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Stuart Street EB Thru/Right	-	-	-	-	-	0.68	17.3	B	249	302	0.68	17.3	B	249	302	0.73	18.5	B	281	340	0.73	18.5	B	281	340
	Dartmouth Street NB Thru	0.42	25.3	C	107	122	0.42	25.4	C	110	124	0.42	25.4	C	110	124	0.46	25.9	C	120	134	0.42	25.4	C	110	124
	Dartmouth Street NB Right	0.24	25.2	C	10	35	0.27	26.1	C	11	38	0.27	26.1	C	11	38	0.72	48.5	D	66	118	0.54	35.7	D	41	81
	OVERALL	**0.58**	**14.6**	**B**	**-**	**-**	**0.69**	**16.8**	**B**	**-**	**-**	**0.69**	**16.8**	**B**	**-**	**-**	**0.76**	**19.1**	**B**	**-**	**-**	**0.72**	**18.1**	**B**	**-**	**-**
10. Stuart Street/Trinity Place	Stuart Street EB Left/Thru	0.34	4.0	A	78	99	0.53	5.8	A	150	197	0.54	6.8	A	113	197	-	-	-	-	-	-	-	-	-	-
	Stuart Street EB Right	0.42	7.9	A	0	28	0.46	9.1	A	0	31	0.46	9.4	A	0	31	-	-	-	-	-	-	-	-	-	-
	Stuart Street EB Left/Thru/Right	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.73	8.7	A	271	365	0.78	12.9	B	260	348
	Trinity Place NB Thru	0.35	35.1	D	27	33	0.59	40.3	D	49	52	0.66	42.4	D	69	63	0.59	40.3	D	49	52	0.91	68.0	E	130	110
	Trinity Place SB Left/Thru	0.05	44.7	D	26	43	0.33	44.2	D	30	46	0.31	42.7	D	31	47	0.45	45.3	D	30	47	0.34	39.7	D	30	47
	OVERALL	**0.41**	**7.4**	**A**	**-**	**-**	**0.54**	**10.1**	**B**	-	-	**0.56**	**11.2**	**B**	**-**	**-**	**0.70**	**11.8**	**B**	**-**	**-**	**0.81**	**21.2**	**C**	**-**	**-**
11. Stuart Street/Clarendon Street	Stuart Street EB Thru	0.57	18.2	B	190	245	0.61	17.7	B	138	175	0.61	17.8	B	211	175	0.63	18.3	B	116	205	0.63	16.5	C	125	m206
	Stuart Street EB Right	0.32	15.4	B	27	67	0.37	15.3	B	32	68	0.37	15.4	B	56	68	1.19	120.6	F	~378	#559	1.17	110.6	F	~370	m#541
	Clarendon Street SB Left/Thru	0.23	15.5	B	203	249	0.52	16.1	B	217	269	0.51	15.3	B	211	253	0.58	17.4	B	245	313	0.57	16.8	B	240	299
	OVERALL	**0.52**	**16.8**	**B**	**-**	**-**	**0.56**	**16.8**	**B**	**-**	**-**	**0.55**	**16.5**	**B**	**-**	**-**	**0.85**	**41.6**	**D**	**-**	**-**	**0.84**	**38.4**	**D**	**-**	**-**
12. Stuart Street/Berkeley Street	Stuart Street EB Left/Thru	0.62	42.0	D	277	340	0.65	41.2	D	288	353	0.65	41.3	D	290	353	0.67	41.1	D	296	360	0.67	40.9	D	296	361
	Berkeley Street NB Thru/Right	0.81	41.3	D	220	267	0.84	42.3	D	228	277	0.84	42.1	D	228	277	0.84	41.6	D	231	#280	0.84	41.5	D	231	#281
	OVERALL	**0.60**	**41.6**	**D**	**-**	**-**	**0.63**	**41.7**	**D**	**-**	**-**	**0.63**	**41.7**	**D**	**-**	**-**	**0.64**	**41.4**	**D**	**-**	**-**	**0.64**	**41.2**	**D**	**-**	**-**
13. Stuart Street/Arlington Street	Stuart Street EB Thru/Right	1.05	91.8	F	~286	#406	1.08	99.6	F	~299	#420	1.08	99.6	F	~299	#420	1.09	104.7	F	~306	#427	1.09	104.7	F	~306	#427
	Columbus Avenue NEB Right	0.94	82.9	F	118	#212	0.96	86.6	F	121	#217	0.99	95.5	F	126	#227	0.98	92.8	F	124	#224	1.02	103.4	F	~132	#235
	Columbus Avenue SWB Left/Thru	0.50	45.0	D	66	80	0.51	45.3	D	68	82	0.51	45.3	D	68	82	0.58	46.8	D	77	91	0.58	46.8	D	77	91
	Arlington Street SB Left	0.72	28.2	C	209	304	0.74	28.8	C	214	#320	0.74	28.8	C	214	#320	0.74	28.1	C	214	m302	0.74	28.1	C	214	m302
	Arlington Street SB Thru	0.81	28.2	C	246	313	0.83	28.7	C	250	#323	0.83	28.7	C	250	#323	0.83	28.0	C	250	#323	0.83	28.0	C	250	#323
	Arlington Street SB Right	0.42	19.2	B	98	m150	0.43	19.2	B	101	m151	0.43	19.2	B	101	m151	0.43	18.7	B	101	m145	0.43	18.7	B	101	m145
	OVERALL	**0.74**	**54.9**	**D**	**-**	**-**	**0.75**	**57.9**	**E**	**-**	**-**	**0.76**	**59.2**	**E**	**-**	**-**	**0.76**	**60.2**	**E**	**-**	**-**	**0.77**	**61.7**	**E**	**-**	**-**

TABLE 4-39A SIGNALIZED INTERSECTION LEVEL OF SERVICE – MORNING PEAK HOUR

		2016 Existing Condition					2023 No-Build Base Condition					2023 No-Build Alternate Condition					2023 Build Base Condition					2023 Build Alternate Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
17. Columbus Avenue/ Dartmouth Street	Columbus Avenue NEB Left/Thru	1.30	188.9	F	~303	#444	1.36	210.7	F	~319	#460	1.36	210.7	F	~319	#460	1.53	285.5	F	~362	#506	1.53	285.5	F	~362	#506
	Columbus Avenue NEB Right	0.15	24.0	C	12	32	0.15	24.0	C	12	32	0.15	24.0	C	12	32	0.15	24.0	C	12	32	0.15	24.0	C	12	32
	Columbus Avenue SWB Left/Thru	0.84	34.1	C	143	m#208	0.89	40.8	D	147	m#216	0.89	40.8	D	147	m#216	1.06	82.6	F	~167	m#240	1.06	82.7	F	~167	m#240
	Columbus Avenue SWB Right	0.53	14.1	B	47	m72	0.54	14.3	B	48	m75	0.54	14.3	B	48	m75	0.54	14.2	B	49	m75	0.54	14.2	B	49	m76
	Dartmouth Street NB Left/Thru/Right	0.83	44.1	D	195	#352	0.85	46.2	D	202	#364	0.85	46.2	D	202	#364	0.87	48.3	D	208	#377	0.87	48.3	D	208	#377
	Dartmouth Street SB Left	0.30	27.2	C	19	49	0.31	27.6	C	20	50	0.31	27.6	C	20	50	0.32	27.8	C	20	50	0.32	27.8	C	20	50
	Dartmouth Street SB Thru/Right	0.87	50.7	D	182	#323	0.91	56.4	E	193	#343	0.91	56.4	E	193	#343	0.91	56.4	E	193	#343	0.91	56.4	E	193	#343
	OVERALL	**0.84**	**76.7**	**E**	**-**	**-**	**0.87**	**85.0**	**F**	**-**	**-**	**0.87**	**85.0**	**F**	**-**	**-**	**0.93**	**113.0**	**F**	**-**	**-**	**0.93**	**113.0**	**F**	**-**	**-**
18. Columbus Avenue/ Clarendon Street	Columbus Avenue NEB Thru/Right	0.41	23.2	C	115	m93	0.42	23.3	C	118	m92	0.42	23.3	C	118	m92	0.42	23.4	C	117	m84	0.42	23.4	C	117	m84
	Columbus Avenue SWB Left/Thru	0.27	18.3	B	62	84	0.28	18.4	B	62	85	0.28	18.4	B	62	85	0.28	17.8	B	60	m81	0.28	17.9	B	60	m81
	Clarendon Street SB Left/Thru/Right	0.98	55.7	E	183	#283	1.02	64.5	E	~196	#287	1.02	66.9	E	~198	#291	1.08	88.4	F	~222	#315	1.08	87.6	F	~223	m#258
	OVERALL	**0.42**	**37.7**	**D**	**-**	**-**	**0.43**	**42.2**	**D**	**-**	**-**	**0.43**	**43.4**	**D**	**-**	**-**	**0.44**	**54.8**	**D**	**-**	**-**	**0.44**	**54.4**	**D**	**-**	**-**
20. Columbus Avenue/Berkeley Street	Columbus Avenue NEB Left/Thru	0.45	13.7	B	77	m96	0.46	13.8	B	80	m97	0.46	13.8	B	80	m97	0.48	14.9	B	91	m104	0.48	14.9	B	91	m104
	Columbus Avenue SWB Thru/Right	0.27	21.4	C	44	69	0.28	21.5	C	45	71	0.28	21.5	C	45	71	0.31	21.9	C	54	81	0.31	21.9	C	54	81
	Berkeley Street NB Left/Thru/Right	0.72	27.8	C	182	233	0.75	28.5	C	191	244	0.75	28.6	C	244	579	0.79	29.9	C	204	261	0.79	30.0	C	204	261
	OVERALL	**0.57**	**23.1**	**C**	**-**	**-**	**0.59**	**23.7**	**C**	**-**	**-**	**0.59**	**23.7**	**C**	**-**	**-**	**0.62**	**24.8**	**C**	**-**	**-**	**0.62**	**24.9**	**C**	**-**	**-**
21. Arlington Street/Marginal Road/I-90 On-Ramp	Marginal Road WB Left	0.02	11.2	B	5	14	0.02	11.2	B	5	14	0.02	11.2	B	5	14	0.02	11.2	B	5	14	0.02	11.2	B	5	14
	Marginal Road WB Thru	0.17	12.2	B	37	56	0.17	12.3	B	38	56	0.17	12.3	B	38	56	0.17	12.3	B	38	56	0.17	12.3	B	38	56
	Arlington Street SB Bear Left/Right	0.60	19.3	B	133	174	0.61	19.5	B	137	178	0.61	19.6	B	139	181	0.61	19.5	B	138	180	0.62	19.7	B	140	183
	OVERALL	**0.37**	**17.7**	**B**	**-**	**-**	**0.38**	**17.9**	**B**	**-**	**-**	**0.38**	**18.0**	**B**	**-**	**-**	**0.38**	**18.0**	**B**	**-**	**-**	**0.38**	**18.1**	**B**	**-**	**-**
22. Arlington Street/Herald Street/Tremont Street	Arlington Street EB Left/Thru	0.49	26.0	C	140	179	0.50	25.8	C	144	183	0.50	26.1	C	144	183	0.51	26.2	C	145	185	0.51	26.2	C	145	185
	Arlington Street EB Right	0.26	23.8	C	57	104	0.26	23.8	C	58	105	0.26	23.8	C	58	105	0.26	23.8	C	58	105	0.26	23.8	C	58	105
	Tremont Street NB Thru	0.57	31.5	C	158	235	0.58	31.8	C	161	240	0.58	31.8	C	161	240	0.58	31.8	C	161	240	0.58	31.8	C	161	240
	Tremont Street NB Right	1.04	81.2	F	~393	#566	1.05	86.6	F	~406	#581	1.05	86.6	F	~406	#581	1.05	86.6	F	~406	#581	1.05	86.6	F	~406	#581
	Tremont Street SB Left/Thru	0.23	24.2	C	51	74	0.24	24.3	C	52	75	0.24	24.3	C	52	75	0.24	24.3	C	52	75	0.24	24.3	C	52	75
	OVERALL	**0.61**	**42.2**	**D**	**-**	**-**	**0.62**	**43.8**	**D**	**-**	**-**	**0.62**	**43.8**	**D**	**-**	**-**	**0.62**	**43.8**	**D**	**-**	**-**	**0.62**	**43.8**	**D**	**-**	**-**
23. Albany Street/Herald Street	Herald Street EB Right	0.81	30.0	C	284	396	0.83	31.1	C	294	#413	0.83	31.1	C	294	#413	0.83	31.0	C	294	#411	0.83	31.0	C	294	#411
	Herald Street EB Hard Right	0.63	24.6	C	189	295	0.64	25.1	C	194	304	0.64	25.1	C	194	304	0.66	25.4	C	199	312	0.66	25.4	C	199	312
	Albany Street SB Thru/Bear Right	0.70	30.2	C	225	354	0.71	30.8	C	230	363	0.71	30.8	C	230	363	0.71	30.8	C	230	363	0.71	30.8	C	230	363
	Albany Street SB Bear Right	0.68	26.4	C	209	282	0.69	26.7	C	214	289	0.69	26.7	C	214	289	0.69	26.7	C	214	289	0.69	26.7	C	214	289
	OVERALL	**0.76**	**28.0**	**C**	**-**	**-**	**0.78**	**28.6**	**C**	**-**	**-**	**0.78**	**28.6**	**C**	**-**	**-**	**0.77**	**28.7**	**C**	**-**	**-**	**0.77**	**28.7**	**C**	**-**	**-**

TABLE 4-39A SIGNALIZED INTERSECTION LEVEL OF SERVICE – MORNING PEAK HOUR

Intersection	Approach	2016 Existing Condition					2023 No-Build Base Condition					2023 No-Build Alternate Condition					2023 Build Base Condition					2023 Build Alternate Condition				
		V/C Ratio	Delay	VLOS	50th % Queue (feet)	95th % Queue (feet)	V/C Ratio	Delay	VLOS	50th % Queue (feet)	95th % Queue (feet)	V/C Ratio	Delay	VLOS	50th % Queue (feet)	95th % Queue (feet)	V/C Ratio	Delay	VLOS	50th % Queue (feet)	95th % Queue (feet)	V/C Ratio	Delay	VLOS	50th % Queue (feet)	95th % Queue (feet)
25. Albany Street/Traveler Street	Traveler Street EB Thru	0.76	61.0	E	172	175	0.78	62.4	E	176	179	0.78	62.4	E	176	179	0.78	62.4	E	176	179	0.78	62.4	E	176	179
	Traveler Street EB Right	0.07	38.6	D	6	21	0.08	38.7	D	8	22	0.08	38.7	D	8	22	0.08	38.7	D	8	22	0.08	38.7	D	8	22
	Albany Street SB Left	0.70	21.2	C	376	561	0.71	21.6	C	389	579	0.71	21.6	C	389	579	0.71	21.6	C	389	579	0.71	21.6	C	389	579
	Albany Street SB Left/Thru/Right	0.69	18.6	B	378	476	0.70	18.9	B	390	491	0.70	18.9	B	390	491	0.70	18.9	B	390	491	0.70	18.9	B	390	491
	OVERALL	**0.64**	**24.7**	**C**	-	-	**0.65**	**25.2**	**C**	-	-	**0.65**	**25.2**	**C**	-	-	**0.65**	**25.2**	**C**	-	-	**0.65**	**25.2**	**C**	-	-
26. Traveler Street/ Frontage Road/ W Broadway/ I-93 Northbound On-Ramp/ I-90 Westbound On-Ramp	Traveler Street EB Left/Bear Left	0.86	54.2	D	208	m#339	0.88	55.4	E	214	m#347	0.88	55.4	E	214	m#347	0.88	55.4	E	214	m#347	0.88	55.4	E	214	m#347
	Traveler Street EB Thru	0.43	20.4	C	233	308	0.43	20.6	C	241	316	0.43	20.6	C	241	316	0.43	20.6	C	241	316	0.43	20.6	C	241	316
	W Broadway WB Right/Bear Right	1.23	160.9	F	~576	#821	1.25	170.6	F	~592	#839	1.25	170.6	F	~592	#839	1.25	170.6	F	~592	#839	1.25	170.6	F	~592	#839
	W Broadway WB Right	1.08	105.5	F	~465	#679	1.11	113.4	F	~481	#697	1.11	113.4	F	~481	#697	1.11	113.4	F	~481	#697	1.11	113.4	F	~481	#697
	Frontage Road NB Thru	0.26	31.2	C	80	116	0.27	31.3	C	82	118	0.27	31.3	C	82	118	0.27	31.3	C	82	118	0.27	31.3	C	82	118
	Frontage Road NB Right	0.56	36.4	D	152	201	0.57	36.6	D	156	205	0.57	36.6	D	156	205	0.57	36.6	D	156	205	0.57	36.6	D	156	205
	OVERALL	**0.89**	**69.3**	**E**	-	-	**0.91**	**72.7**	**E**	-	-	**0.91**	**72.7**	**E**	-	-	**0.91**	**72.7**	**E**	-	-	**0.91**	**72.7**	**E**	-	-

Notes:
95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite

TABLE 4-39B SIGNALIZED INTERSECTION LEVEL OF SERVICE – EVENING PEAK HOUR

		2016 Existing Condition					2023 No-Build Base Condition					2023 No-Build Alternate Condition					2023 Build Base Condition					2023 Build Alternate Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
1. Boylston Street/Clarendon Street	Boylston Street EB Thru/Right	0.55	15.0	B	134	174	0.56	15.1	B	137	178	0.56	15.1	B	137	178	0.56	15.1	B	138	178	0.56	15.1	B	138	178
	Clarendon Street SB Left/Thru	0.67	27.1	C	158	223	0.71	28.3	C	172	241	0.71	28.3	C	172	241	0.72	28.6	C	176	246	0.72	28.6	C	176	246
	OVERALL	**0.60**	**19.7**	**B**	**-**	**-**	**0.62**	**20.3**	**C**	**-**	**-**	**0.62**	**20.3**	**C**	**-**	**-**	**0.63**	**20.5**	**C**	**-**	**-**	**0.63**	**20.5**	**C**	**-**	**-**
2. Boylston Street/Berkeley Street	Boylston Street EB Left/Thru	0.69	32.7	C	201	253	0.71	33.1	C	205	258	0.71	33.1	C	205	258	0.71	33.1	C	205	258	0.71	33.1	C	205	258
	Berkeley Street NB Thru/Right	0.58	32.2	C	170	m207	0.61	32.9	C	184	m205	0.61	32.9	C	184	m205	0.65	33.7	C	200	m206	0.65	33.7	C	200	m206
	OVERALL	**0.63**	**32.4**	**C**	**-**	**-**	**0.66**	**33.0**	**C**	**-**	**-**	**0.66**	**33.0**	**C**	**-**	**-**	**0.67**	**33.4**	**C**	**-**	**-**	**0.67**	**33.4**	**C**	**-**	**-**
3. St James Avenue/ Dartmouth Street	St James Avenue WB Thru	0.56	17.6	B	196	256	0.62	18	B	217	280	0.73	20.7	B	258	326	0.62	18.1	B	218	281	0.81	24.9	C	290	363
	St James Avenue WB Right	0.31	18.9	B	20	46	0.32	17.4	B	0	41	0.32	16.0	B	0	35	0.32	16.8	B	0	39	0.33	13.9	B	0	29
	Dartmouth Street NB Left	0.32	7.1	A	18	35	0.41	10.6	B	35	m111	0.42	11.2	B	72	m78	0.46	10.5	B	38	m76	0.43	11.5	B	80	m82
	Dartmouth Street NB Thru	0.82	22.1	C	160	#210	0.84	35.1	D	157	#230	0.84	35.1	D	157	#230	0.85	35.1	D	161	#236	0.84	35.1	C	157	#230
	OVERALL	**0.56**	**20.4**	**C**	**-**	**-**	**0.62**	**21.5**	**C**	**-**	**-**	**0.67**	**22.3**	**C**	**-**	**-**	**0.63**	**21.2**	**C**	**-**	**-**	**0.71**	**23.5**	**C**	**-**	**-**
5. St James Avenue/ Clarendon Street	St James Avenue WB Left/Thru	0.54	31.9	C	163	m202	0.58	33.0	C	179	m215	0.60	33.0	C	185	m221	0.59	32.9	C	182	m214	0.61	32.9	C	187	m220
	Clarendon Street SB Thru/Right	0.45	6.2	A	41	54	0.49	6.1	A	43	57	0.49	6.3	A	45	59	0.50	6.1	A	44	57	0.50	6.2	A	46	60
	OVERALL	**0.49**	**20.2**	**C**	**-**	**-**	**0.53**	**20.9**	**C**	**-**	**-**	**0.54**	**21.0**	**C**	**-**	**-**	**0.53**	**20.8**	**C**	**-**	**-**	**0.54**	**20.9**	**C**	**-**	**-**
6. St James Avenue/Berkeley Street	St James Avenue WB Thru/Right	0.67	30.4	C	151	213	0.70	31.3	C	161	226	0.70	31.3	C	161	226	0.72	31.9	C	166	233	0.72	31.9	C	166	233
	Berkeley Street NB Left/Thru/Right	0.87	25.0	C	228	#291	0.94	31.4	C	249	#330	0.94	31.6	C	249	#329	1.01	43.2	D	~272	#367	1.01	43.9	D	~272	#367
	OVERALL	**0.56**	**27.0**	**C**	**-**	**-**	**0.60**	**31.4**	**C**	**-**	**-**	**0.60**	**31.5**	**C**	**-**	**-**	**0.63**	**39.2**	**D**	**-**	**-**	**0.63**	**39.6**	**D**	**-**	**-**
7. St James Avenue/ Arlington Street	St James Avenue EB Right	0.33	35.2	D	64	83	0.33	35.2	D	64	84	0.33	35.2	D	64	84	0.33	35.2	D	64	84	0.33	35.2	D	64	84
	Park Plaza WB Left	0.55	41.1	D	113	178	0.56	41.5	D	116	182	0.56	41.5	D	116	182	0.56	41.5	D	116	182	0.56	41.5	D	116	182
	Park Plaza WB Thru	0.63	39.6	D	156	202	0.64	39.9	D	160	205	0.64	39.9	D	160	205	0.64	39.9	D	160	205	0.64	39.9	D	160	205
	Arlington Street SB Thru/Right	0.63	26.4	C	234	284	0.65	26.8	C	243	295	0.65	26.8	C	243	295	0.66	27.0	C	248	300	0.66	27.0	C	248	300
	OVERALL	**0.49**	**31.5**	**C**	**-**	**-**	**0.51**	**31.9**	**C**	**-**	**-**	**0.51**	**31.9**	**C**	**-**	**-**	**0.51**	**31.9**	**C**	**-**	**-**	**0.51**	**31.9**	**C**	**-**	**-**
8. Huntington Avenue/Exeter Street/ Stuart Street	Huntington Avenue NEB Right	0.61	30.6	C	171	224	0.73	34.6	C	220	302	0.73	34.6	C	220	302	0.74	35.0	D	225	308	0.74	35.0	D	225	308
	Huntington Avenue SWB Left	0.34	42.4	D	49	119	0.55	48.8	D	85	173	0.55	48.8	D	85	173	0.55	48.8	D	85	173	0.55	48.8	D	85	173
	Huntington Ave SWB Thru	0.18	9.1	A	49	63	0.19	9.2	A	51	66	0.19	9.2	A	51	66	0.20	9.3	A	53	68	0.20	9.3	A	53	68
	Exeter Street SB Left	0.56	40.8	D	140	196	0.61	42.3	D	155	212	0.61	42.3	D	155	212	0.61	42.3	D	155	212	0.61	43.2	D	155	212
	Exeter Street SB Thru/Right	0.38	37.5	D	24	81	0.32	35.9	D	15	63	0.32	35.9	D	15	63	0.32	35.9	D	15	63	0.32	35.9	D	15	63
	Garage Driveway NB Left	0.12	42.6	D	39	69	0.47	43.2	D	46	77	0.47	43.2	D	46	77	0.47	43.2	D	46	77	0.47	43.2	D	46	77
	Garage Driveway NB Right	0.45	37.7	D	78	114	0.56	41.2	D	111	148	0.56	41.2	D	111	148	0.56	41.2	D	111	148	0.56	41.2	D	111	148
	OVERALL	**0.54**	**28.6**	**C**	**-**	**-**	**0.65**	**31.4**	**C**	**-**	**-**	**0.62**	**31.4**	**C**	**-**	**-**	**0.65**	**31.4**	**C**	**-**	**-**	**0.65**	**31.4**	**C**	**-**	**-**

TABLE 4-39B SIGNALIZED INTERSECTION LEVEL OF SERVICE – EVENING PEAK HOUR

		2016 Existing Condition					2023 No-Build Base Condition					2023 No-Build Alternate Condition					2023 Build Base Condition					2023 Build Alternate Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
9. Stuart Street/ Dartmouth Street	Stuart Street EB Left	0.65	8.6	A	206	314	0.81	14.4	B	285	498	0.81	14.4	B	285	498	0.81	14.4	B	285	498	0.81	14.4	B	285	498
	Stuart Street EB Thru	0.69	17.0	C	202	254	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Stuart Street EB Right	0.15	18.7	B	0	56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Stuart Street EB Thru/Right	-	-	-	-	-	0.73	23.9	C	221	276	0.73	23.9	C	221	276	0.75	24.5	C	230	288	0.75	24.5	C	230	288
	Dartmouth Street NB Thru	0.35	15.4	B	89	124	0.36	15.5	B	91	127	0.36	15.5	B	91	127	0.41	16.1	B	108	149	0.36	15.5	B	91	127
	Dartmouth Street NB Right	0.21	15.4	B	4	34	0.24	16.1	B	7	40	0.24	16.1	B	7	40	0.63	28.4	C	50	#154	0.31	17.5	B	13	55
	OVERALL	**0.61**	**16.7**	**B**	**-**	**-**	**0.75**	**19.0**	**B**	**-**	**-**	**0.75**	**19.0**	**B**	**-**	**-**	**0.81**	**20.1**	**C**	**-**	**-**	**0.75**	**19.4**	**B**	**-**	**-**
10. Stuart Street/Trinity Place	Stuart Street EB Left/Thru	0.31	3.8	A	8	178	0.49	4.7	A	13	320	0.35	3.1	A	31	72	-	-	-	-	-	-	-	-	-	-
	Stuart Street EB Right	0.09	2.0	A	0	27	0.17	4.0	A	0	m5	0.17	5.0	A	0	m5	-	-	-	-	-	-	-	-	-	-
	Stuart Street EB Left/Thru/Right	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.41	7.0	A	23	403	0.38	4.3	A	35	48
	Trinity Place NB Thru	0.67	39.9	D	75	124	0.76	45.3	D	92	152	0.85	50.6	D	133	#242	0.76	45.3	D	92	152	1.18	135.5	F	~297	#477
	Trinity Place SB Left/Thru	0.55	41.8	D	47	m87	0.56	42.3	D	54	m96	0.56	41.1	D	53	m98	0.60	44.3	D	54	m98	0.71	44.6	D	54	m#128
	OVERALL	**0.40**	**11.1**	**B**	**-**	**-**	**0.55**	**13.3**	**B**	**-**	**-**	**0.49**	**15.0**	**B**	**-**	**-**	**0.64**	**14.4**	**B**	**-**	**-**	**0.82**	**42.8**	**D**	**-**	**-**
11. Stuart Street/ Clarendon Street	Stuart Street EB Thru	0.47	5.9	A	57	71	0.49	6.8	A	61	105	0.49	5.4	A	59	66	0.52	10.7	B	74	153	0.52	18.1	B	93	m113
	Stuart Street EB Right	0.41	6.8	A	32	49	0.45	8.2	A	35	74	0.45	6.7	A	34	m47	0.67	15.9	B	60	146	0.63	23.5	C	70	m139
	Clarendon Street SB Left/Thru	0.50	19.1	B	118	164	0.52	18.9	B	121	167	0.48	16.2	B	83	108	0.54	19.5	B	133	181	0.50	16.9	B	89	115
	OVERALL	**0.47**	**11.5**	**B**	**-**	**-**	**0.50**	**12.0**	**B**	**-**	**-**	**0.48**	**9.8**	**A**	**-**	**-**	**0.60**	**15.0**	**B**	**-**	**-**	**0.56**	**14.0**	**B**	**-**	**-**
12. Stuart Street/ Berkeley Street	Stuart Street EB Left/Thru	0.66	15.5	B	267	349	0.74	17.0	B	304	388	0.74	17.2	B	302	388	0.77	18.6	B	328	410	0.77	16.8	B	263	408
	Berkeley Street NB Thru/Right	0.64	19.0	B	130	163	0.66	19.0	B	132	167	0.66	20.0	B	137	171	0.69	20.5	C	150	185	0.69	21.5	C	155	190
	OVERALL	**0.56**	**17.1**	**B**	**-**	**-**	**0.61**	**17.9**	**B**	**-**	**-**	**0.61**	**18.5**	**B**	**-**	**-**	**0.64**	**19.5**	**B**	**-**	**-**	**0.64**	**18.9**	**B**	**-**	**-**
13. Stuart Street/ Arlington Street	Stuart Street EB Thru/Right	1.10	104.8	F	~332	#455	1.16	127.1	F	~364	#489	1.16	127.1	F	~364	#489	1.18	138.1	F	~380	#506	1.18	138.1	F	~380	#506
	Columbus Avenue NEB Right	1.84	447.7	F	~238	#345	1.88	462.2	F	~244	#352	2.03	528.9	F	~271	#381	2.03	528.9	F	~271	#381	2.17	593.4	F	~298	#411
	Columbus Avenue SWB Left/Thru	0.58	51.3	D	56	92	0.60	51.6	D	57	93	0.60	51.6	D	57	93	0.63	53.1	D	61	98	0.63	53.1	D	61	98
	Arlington Street SB Left	0.57	25.3	C	165	260	0.58	25.2	C	163	263	0.58	25.2	C	163	263	0.58	25.1	C	160	255	0.58	25.1	C	160	255
	Arlington Street SB Thru	0.92	39.0	D	321	#437	0.93	40.5	D	327	#449	0.93	40.5	D	327	#449	0.93	40.3	D	327	#449	0.93	40.3	D	327	#449
	Arlington Street SB Right	0.44	22.1	C	90	154	0.45	22.0	C	89	151	0.45	22.0	C	89	151	0.45	21.8	C	88	m149	0.45	21.8	C	88	m149
	OVERALL	**0.89**	**116.8**	**F**	**-**	**-**	**0.92**	**126.0**	**F**	**-**	**-**	**0.93**	**140.3**	**F**	**-**	**-**	**0.94**	**143.2**	**F**	**-**	**-**	**0.96**	**158.3**	**F**	**-**	**-**

TABLE 4-39B SIGNALIZED INTERSECTION LEVEL OF SERVICE – EVENING PEAK HOUR

		2016 Existing Condition					2023 No-Build Base Condition					2023 No-Build Alternate Condition					2023 Build Base Condition					2023 Build Alternate Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
17. Columbus Avenue/ Dartmouth Street	Columbus Avenue NEB Left/Thru	1.33	212.9	F	~291	#466	1.41	244.8	F	~308	#484	1.41	244.8	F	~308	#484	1.68	364.2	F	~342	#520	1.68	364.2	F	~342	#520
	Columbus Avenue NEB Right	0.08	25.9	C	17	42	0.08	25.9	C	18	43	0.08	25.9	C	18	43	0.08	25.9	C	18	43	0.08	25.9	C	18	43
	Columbus Avenue SWB Left/Thru	0.83	43.3	D	255	#376	0.86	52.8	D	264	#394	0.86	52.8	D	264	#394	1.02	84.6	F	~316	#476	1.02	84.6	F	~316	#476
	Columbus Avenue SWB Right	0.51	33.6	C	136	201	0.52	33.9	C	140	205	0.52	33.9	C	140	205	0.52	33.9	C	140	205	0.52	33.9	C	140	205
	Dartmouth Street NB Left/Thru/Right	0.70	39.3	D	209	320	0.72	39.9	D	214	327	0.72	39.9	D	214	327	0.72	40.4	D	217	333	0.72	40.4	D	217	333
	Dartmouth Street SB Left	0.28	29.0	C	33	72	0.29	29.3	C	34	74	0.29	29.3	C	34	74	0.29	29.3	C	34	74	0.29	29.3	C	34	74
	Dartmouth Street SB Thru/Right	0.78	42.0	D	231	#380	0.80	45.8	D	240	#396	0.80	45.8	D	240	#396	0.80	45.8	D	240	#396	0.80	45.8	D	240	#396
	OVERALL	**0.82**	**72.1**	**E**	**-**	**-**	**0.86**	**79.3**	**E**	**-**	**-**	**0.86**	**79.3**	**E**	**-**	**-**	**0.97**	**108.2**	**F**	**-**	**-**	**0.97**	**108.2**	**F**	**-**	**-**
18. Columbus Avenue/ Clarendon Street	Columbus Avenue NEB Thru/Right	0.81	43.7	D	206	#344	0.83	45.5	D	210	#352	0.83	45.5	D	210	#352	0.87	51.7	D	210	#352	0.87	51.7	D	210	#352
	Columbus Avenue SWB Left/Thru	0.66	26.6	C	100	125	0.68	27.5	C	102	128	0.68	27.7	C	103	128	0.74	30.9	C	103	129	0.74	31.1	C	104	129
	Clarendon Street SB Left/Thru/Right	0.84	23.9	C	138	224	0.85	24.8	C	145	244	0.85	25.7	C	168	288	0.92	32.9	C	265	#422	0.92	33.3	C	290	#422
	OVERALL	**0.59**	**29.0**	**C**	**-**	**-**	**0.60**	**30.0**	**C**	**-**	**-**	**0.60**	**30.6**	**C**	**-**	**-**	**0.64**	**36.3**	**D**	**-**	**-**	**0.64**	**36.6**	**D**	**-**	**-**
20. Columbus Avenue/Berkeley Street	Columbus Avenue NEB Left/Thru	0.47	23.0	C	136	m231	0.48	23.3	C	140	m228	0.48	23.2	C	140	m228	0.55	25.8	C	182	m241	0.55	25.8	C	182	m241
	Columbus Avenue SWB Thru/Right	0.19	18.6	B	33	64	0.20	18.8	B	33	65	0.20	18.8	B	33	65	0.21	19.1	B	36	70	0.21	19.1	B	36	70
	Berkeley Street NB Left/Thru/Right	0.68	27.2	C	158	190	0.69	27.4	C	165	197	0.69	27.5	C	162	194	0.70	27.5	C	169	201	0.70	27.4	C	165	198
	OVERALL	**0.55**	**24.7**	**C**	**-**	**-**	**0.57**	**24.9**	**C**	**-**	**-**	**0.57**	**24.9**	**C**	**-**	**-**	**0.61**	**25.8**	**C**	**-**	**-**	**0.61**	**25.8**	**C**	**-**	**-**
21. Arlington Street/ Marginal Road/I-90 On-Ramp	Marginal Road WB Left	0.02	11.1	B	3	11	0.02	11.1	B	3	11	0.02	11.1	B	3	11	0.02	11.1	B	3	11	0.02	11.1	B	3	11
	Marginal Road WB Thru	0.28	13.2	B	67	92	0.29	13.2	B	69	93	0.29	13.2	B	69	93	0.29	13.2	B	69	93	0.29	13.2	B	69	93
	Arlington Street SB Bear Left/Right	0.83	25.2	C	219	279	0.86	26.5	C	230	293	0.88	27.9	C	239	#313	0.88	27.7	C	239	#312	0.90	29.3	C	248	#347
	OVERALL	**0.54**	**22.3**	**C**	**-**	**-**	**0.56**	**23.4**	**C**	**-**	**-**	**0.57**	**24.4**	**C**	**-**	**-**	**0.57**	**24.3**	**C**	**-**	**-**	**0.58**	**25.6**	**C**	**-**	**-**
22. Arlington Street/Herald Street/Tremont Street	Arlington Street EB Left/Thru	0.64	27.3	C	208	253	0.67	27.8	C	218	264	0.67	27.8	C	218	264	0.68	28.1	C	224	271	0.68	28.1	C	224	271
	Arlington Street EB Right	0.32	23.4	C	75	127	0.34	23.7	C	79	134	0.34	23.7	C	79	134	0.34	23.7	C	79	134	0.34	23.7	C	79	134
	Tremont Street NB Thru	0.89	45.3	D	278	#464	0.91	54.8	D	285	#476	0.91	54.8	D	285	#476	0.91	54.8	D	285	#476	0.91	54.8	D	285	#476
	Tremont Street NB Right	0.42	29.3	C	105	173	0.43	29.4	C	107	176	0.43	29.4	C	107	176	0.43	29.4	C	107	176	0.43	29.4	C	107	176
	Tremont Street SB Left/Thru	0.27	26.1	C	64	93	0.28	26.2	C	65	95	0.28	26.2	C	65	95	0.28	26.2	C	65	95	0.28	26.2	C	65	95
	OVERALL	**0.61**	**32.3**	**C**	**-**	**-**	**0.62**	**33.0**	**C**	**-**	**-**	**0.62**	**33.0**	**C**	**-**	**-**	**0.63**	**33.1**	**C**	**-**	**-**	**0.63**	**33.1**	**C**	**-**	**-**
23. Albany Street/ Herald Street	Herald Street EB Right	1.04	65.3	E	~498	#659	1.07	75.4	E	~526	#688	1.07	75.4	E	~526	#688	1.09	80.4	F	~540	#703	1.09	80.4	F	~540	#703
	Herald Street EB Hard Right	0.79	30.6	C	280	#440	0.81	32.0	C	291	#489	0.81	32.0	C	291	#489	0.82	32.7	C	297	#500	0.82	32.7	C	297	#500
	Albany Street SB Thru/Bear Right	0.82	38.6	D	282	#480	0.96	57.0	E	384	#636	0.96	57.0	E	384	#636	0.96	57.0	E	384	#636	0.96	57.0	E	384	#636
	Albany Street SB Bear Right	0.83	33.3	C	273	365	0.96	48.2	D	346	#499	0.96	48.2	D	346	#499	0.96	48.2	D	346	#499	0.96	48.2	D	346	#499
	OVERALL	**0.94**	**45.3**	**D**	**-**	**-**	**1.02**	**56.3**	**E**	**-**	**-**	**1.02**	**56.3**	**E**	**-**	**-**	**1.03**	**58.2**	**E**	**-**	**-**	**1.03**	**58.2**	**E**	**-**	**-**

TABLE 4-39B SIGNALIZED INTERSECTION LEVEL OF SERVICE – EVENING PEAK HOUR

		2016 Existing Condition					2023 No-Build Base Condition					2023 No-Build Alternate Condition					2023 Build Base Condition					2023 Build Alternate Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
25. Albany Street/ Traveler Street	Traveler Street EB Thru	1.27	171.8	F	~314	#497	1.29	198.4	F	~323	#506	1.29	198.4	F	~323	#506	1.29	198.4	F	~323	#506	1.29	198.4	F	~323	#506
	Traveler Street EB Right	0.04	37.2	D	0	31	0.04	37.2	D	0	32	0.04	37.2	D	0	32	0.04	37.2	D	0	32	0.04	37.2	D	0	32
	Albany Street SB Left	0.47	14.2	B	27	114	0.49	14.5	B	34	129	0.49	14.5	B	34	129	0.49	14.5	B	34	129	0.49	14.5	B	34	129
	Albany Street SB Left/Thru/Right	0.71	16.6	B	363	464	0.72	18.3	B	376	481	0.72	18.3	B	376	481	0.72	18.3	B	376	481	0.72	18.3	B	376	481
	OVERALL	**0.75**	**43.6**	**D**	**-**	**-**	**0.76**	**45.1**	**D**	**-**	**-**	**0.76**	**45.1**	**D**	**-**	**-**	**0.76**	**45.1**	**D**	**-**	**-**	**0.76**	**45.1**	**D**	**-**	**-**
26. Traveler Street/ Frontage Road/ W Broadway/ I-93 Northbound On-Ramp/ I-90 Westbound On-Ramp	Traveler Street EB Left/Bear Left	0.99	91.9	F	245	#432	1.01	98.0	F	~257	#445	1.01	98.0	F	~257	#445	1.01	98.0	F	~257	#445	1.01	98.0	F	~257	#445
	Traveler Street EB Thru	0.53	12.6	B	208	261	0.54	12.8	B	213	268	0.54	12.8	B	213	268	0.54	12.8	B	213	268	0.54	12.8	B	213	268
	W Broadway WB Right/Bear Right	0.78	43.7	D	275	390	0.80	45.7	D	287	#418	0.80	45.7	D	287	#418	0.80	45.7	D	287	#418	0.80	45.7	D	287	#418
	W Broadway WB Right	0.68	37.2	D	229	321	0.71	38.2	D	239	333	0.71	38.2	D	239	333	0.71	38.2	D	239	333	0.71	38.2	D	239	333
	Frontage Road NB Thru	0.39	35.8	D	111	141	0.40	35.9	D	113	143	0.40	35.9	D	113	143	0.40	35.9	D	113	143	0.40	35.9	D	113	143
	Frontage Road NB Right	0.88	53.1	D	231	265	0.90	54.7	D	236	271	0.90	54.7	D	236	271	0.90	54.7	D	236	271	0.90	54.7	D	236	271
	OVERALL	**0.86**	**39.1**	**D**	**-**	**-**	**0.89**	**40.5**	**D**	**-**	**-**	**0.89**	**40.5**	**D**	**-**	**-**	**0.89**	**40.5**	**D**	**-**	**-**	**0.89**	**40.5**	**D**	**-**	**-**

Notes:
95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite

TABLE 4-39C UNSIGNALIZED INTERSECTION LEVEL OF SERVICE – MORNING PEAK HOUR

		2016 Existing Condition					2023 No-Build Base Condition					2023 No-Build Alternate Condition					2023 Build Base Condition					2023 Build Alternate Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
4. St James Avenue/ Trinity Place	Trinity Place NB Left	0.15	15.1	C	-	13	0.19	16.0	C	-	18	0.25	17.1	C	-	25	0.2	16.1	C	-	18	0.37	19.4	C	-	43
	OVERALL	**-**	**2.5**	**A**	**-**	**-**	**-**	**2.9**	**A**	**-**	**-**	**-**	**3.3**	**A**	**-**	**-**	**-**	**2.9**	**A**	**-**	**-**	**-**	**4.5**	**A**	**-**	**-**
14. Stuart Street/I-90 Westbound Off-Ramp	I-90 Westbound Off-Ramp NEB Right	1.09	84.9	F	-	530	1.52	264.6	F	-	1020	1.52	264.8	F	-	1021	1.65	321.1	F	-	1201	1.65	321.1	F	-	1201
	OVERALL	**-**	**53.2**	**F**	**-**	**-**	**-**	**162.3**	**F**	**-**	**-**	**-**	**162.4**	**F**	**-**	**-**	**-**	**201.0**	**F**	**-**	**-**	**-**	**201.0**	**F**	**-**	**-**
15. Clarendon Street/Stanhope Street	Stanhope Street WB Left/Thru	0.67	57.8	F	-	98	0.70	63.7	F	-	106	0.57	45.0	E	-	76	1.58	359.1	F	-	349	1.19	190.0	F	-	255
	OVERALL	**-**	**8.1**	**A**	**-**	**-**	**-**	**8.8**	**A**	**-**	**-**	**-**	**5.9**	**A**	**-**	**-**	**-**	**49.1**	**E**	**-**	**-**	**-**	**25.3**	**D**	**-**	**-**
16. Clarendon Street/Garage Driveway	Garage Driveway EB Right	1.28	467.2	F	-	106	1.32	491.2	F	-	108	1.32	491.4	F	-	108	4.46	Err	F	-	Err	4.42	Err	F	-	Err
	OVERALL	**-**	**22.8**	**C**	**-**	**-**	**-**	**23.2**	**C**	**-**	**-**	**-**	**23.4**	**C**	**-**	**-**	**-**	**653.6**	**F**	**-**	**-**	**-**	**773.9**	**F**	**-**	**-**
19. Columbus Avenue/Cahners Place	**-**																									
	OVERALL																									
24. Albany Street/I-93 Southbound On-Ramp	**-**																									
	OVERALL																									
27. Berkeley Street/ Storrow Drive On-Ramp	Back Street EB Left/Hard Left	0.20	17.9	C	-	18	0.21	18.5	C	-	20	0.21	18.5	C	-	20	0.21	18.8	C	-	20	0.21	18.8	C	-	20
	OVERALL	**-**	**0.9**	**A**	**-**	**-**	**-**	**0.9**	**A**	**-**	**-**	**-**	**0.9**	**A**	**-**	**-**	**-**	**0.9**	**A**	**-**	**-**	**-**	**0.9**	**A**	**-**	**-**
28. Clarendon Street/Storrow Drive Off-Ramp	Back Street EB Thru/Right	0.13	12.2	B	-	12	0.14	12.6	B	-	12	0.14	12.6	B	-	12	0.15	13.0	B	-	13	0.15	13.0	B	-	13
	OVERALL	**-**	**2.2**	**A**	**-**	**-**	**-**	**2.2**	**A**	**-**	**-**	**-**	**2.2**	**A**	**-**	**-**	**-**	**2.1**	**A**	**-**	**-**	**-**	**2.1**	**A**	**-**	**-**
Project Exit/Dartmouth Street	Project Exit WB Right	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.09	11.2	B	-	8	-	-	-	-	-
	OVERALL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.9	A	-	-	-	-	-	-	-

Notes:
95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite

TABLE 4-39D UNSIGNALIZED INTERSECTION LEVEL OF SERVICE – EVENING PEAK HOUR

		2016 Existing Condition					2023 No-Build Base Condition					2023 No-Build Alternate Condition					2023 Build Base Condition					2023 Build Alternate Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
4. St James Avenue/ Trinity Place	Trinity Place NB Left	0.28	14.6	B	-	29	0.30	14.5	B	-	32	0.41	14.6	B	-	51	0.33	15.6	C	-	36	0.63	19.8	C	-	110
	OVERALL	**-**	**2.4**	**A**	**-**	**-**	**-**	**2.6**	**A**	**-**	**-**	**-**	**3.4**	**A**	**-**	**-**	**-**	**2.7**	**A**	**-**	**-**	**-**	**6.0**	**A**	**-**	**-**
14. Stuart Street/I-90 Westbound Off-Ramp	I-90 Westbound Off-Ramp NEB Right	0.81	31.7	D	-	202	1.24	154.0	F	-	533	1.24	153.8	F	-	532	1.28	173.3	F	-	581	1.28	173.3	F	-	581
	OVERALL	**-**	**14.0**	**B**	**-**	**-**	**-**	**68.4**	**F**	**-**	**-**	**-**	**68.3**	**F**	**-**	**-**	**-**	**78**	**F**	**-**	**-**	**-**	**78.0**	**F**	**-**	**-**
15. Clarendon Street/Stanhope Street	Stanhope Street WB Left/Thru	1.66	485.7	F	-	216	1.79	542.7	F	-	227	0.71	113.5	F	-	88	2.32	774.6	F	-	306	0.90	143.4	F	-	130
	OVERALL	**-**	**51.3**	**F**	**-**	**-**	**-**	**56.5**	**F**	**-**	**-**	**-**	**8.5**	**A**	**-**	**-**	**-**	**85.6**	**F**	**-**	**-**	**-**	**12.9**	**B**	**-**	**-**
16. Clarendon Street/Garage Driveway	Garage Driveway EB Right	88.8	Err	F	-	-	95.5	Err	F	-	Err	91.23	Err	F	-	Err	167.64	Err	F	-	Err	153.65	Err	F	-	Err
	OVERALL	**-**	**2383**	**F**	**-**	**-**	**-**	**2406**	**F**	**-**	**-**	**-**	**2366.4**	**F**	**-**	**-**	**-**	**2937.8**	**F**	**-**	**-**	**-**	**3150.8**	**F**	**-**	**-**
19. Columbus Avenue/Cahners Place	**-**																									
	OVERALL																									
24. Albany Street/I-93 Southbound On-Ramp	**-**																									
	OVERALL																									
27. Berkeley Street/ Storrow Drive On-Ramp	Back Street EB Left/Hard Left	0.58	28.3	D	-	89	0.62	30.8	D	-	98	0.62	30.8	D	-	98	0.64	33.4	D	-	105	0.64	33.4	D	-	105
	OVERALL	**-**	**2.9**	**A**	**-**	**-**	**-**	**3.1**	**A**	**-**	**-**	**-**	**3.1**	**A**	**-**	**-**	**-**	**77.4**	**F**	**-**	**-**	**-**	**3.2**	**A**	**-**	**-**
28. Clarendon Street/Storrow Drive Off-Ramp	Back Street EB Thru/Right	0.27	17.7	C	-	28	0.29	18.7	C	-	30	0.29	18.7	C	-	30	0.30	18.9	C	-	30	0.30	18.9	C	-	30
	OVERALL	**-**	**5.1**	**A**	**-**	**-**	**-**	**5.1**	**A**	**-**	**-**	**-**	**5.1**	**A**	**-**	**-**	**-**	**5.1**	**A**	**-**	**-**	**-**	**5.1**	**A**	**-**	**-**
Project Exit/Dartmouth Street	Project Exit WB Right	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.26	12.3	B	-	26	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**	**2.5**	**A**	**-**	**-**	-	-	-	-	-

Notes:
95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite

4.6.3 2023 Build Mainline Analysis

The 2023 Build mainline analysis was conducted using the same inputs as the previous Existing and No-Build Conditions analysis with the exception of vehicle volume changes. Project-generated vehicle trips were added to the No-Build ramp volumes. The 2023 Build Base Condition mainline merge analyzes are presented in Tables 4-40 and 4-41 for the morning and evening peak hours, respectively. The 2023 Build Alternate Condition mainline merge analyzes are presented in Tables 4-42 and 4-43 for the morning and evening peak hours, respectively.

TABLE 4-40 MAINLINE CAPACITY ANALYSIS MERGE SECTIONS LOS – 2023 BUILD BASE CONDITIONS MORNING PEAK HOUR (ON-RAMP OPEN)

Location	Volume (veh/hr)	Density (pc/mi/ln)	Speed	LOS
Arlington On-Ramp	317	21.7	51	C
Clarendon On-Ramp	67	21.8	51	C
Huntington On-Ramp	326	24.4	50	C

TABLE 4-41 MAINLINE CAPACITY ANALYSIS MERGE SECTIONS LOS – 2023 BUILD BASE CONDITIONS EVENING PEAK HOUR (ON-RAMP OPEN)

Location	Volume (veh/hr)	Density (pc/mi/ln)	Speed	LOS
Arlington On-Ramp	599	31.4	49	D
Clarendon On-Ramp	191	31.7	49	D
Huntington On-Ramp	692	36.1	48	E

The mainline analysis results for the 2023 Build Alternate Condition are presented in Tables 4-42 and 4-43

TABLE 4-42 MAINLINE CAPACITY ANALYSIS MERGE SECTIONS LOS – 2023 BUILD ALTERNATE CONDITIONS MORNING PEAK HOUR (ON-RAMP CLOSED)

Location	Volume (veh/hr)	Density (pc/mi/ln)	Speed	LOS
Arlington On-Ramp	327	21.9	51	C
Clarendon On-Ramp	-	-	-	-
Huntington On-Ramp	373	24.5	50	C

TABLE 4-43 MAINLINE CAPACITY ANALYSIS MERGE SECTIONS LOS – 2023 BUILD ALTERNATE CONDITIONS EVENING PEAK HOUR (ON-RAMP CLOSED)

Location	Volume (veh/hr)	Density (pc/mi/ln)	Speed	LOS
Arlington On-Ramp	599	31.6	49	D
Clarendon On-Ramp	-	-	-	-
Huntington On-Ramp	692	36.4	48	E

No LOS changes occur between 2023 No-Build and Build Conditions under the Base and Alternate Conditions. Density at all on-ramps increase by less than 1 pc/mi/la. The differences between the Base and Alternate Conditions when Project trips are added are minimal and have a negligible effect on the mainline merge segments.

4.7 Future Conditions Assessment: Build with Mitigation Condition

Based on the VLOS analysis previously discussed, there are a few intersections that decline in operations as a result of the Project. To address these impacts, this analysis has considered possible traffic mitigation improvements as potential options for further evaluation in coordination with BTD at the following intersections:

Signal Timing

- #11 Stuart Street/Clarendon Street
- #13 Stuart Street/Arlington Street
- #17 Columbus Avenue/Dartmouth Street
- #18 Columbus Avenue/Clarendon Street
- #10 Stuart Street/Trinity Place – Alternate Scheme only

Possible Signalization of Intersection

- #4 St. James Avenue/Trinity Place
- #15 Clarendon Street/Stanhope Street

Roadway Modifications

- Stuart Street from Dartmouth Street to Trinity Place
- Clarendon Street from Stanhope Street to Columbus Avenue

Possible Roadway Modification

- Trinity Place One-way between St. James Avenue and Stuart Street

Figure 4.16 identifies the locations of the possible traffic mitigation improvements described below. Figures 4.17a through 4.17d show the queue lengths under all analysis conditions for the intersections with discussed mitigation measures.

4.7.1 Proposed Mitigation—Signal Timing

#11 Stuart Street/Clarendon Street

This signalized intersection experiences a decrease in performance from LOS B to LOS D in the 2023 Build Base and Build Alternate Conditions during the morning peak hour. This is due to the movement of vehicles currently entering Trinity Place to access the 100 Clarendon Street garage. Under both build conditions, the vehicles will travel to Stuart Street/Clarendon Street and take a right turn onto Clarendon Street to access the garage. To accommodate the detoured vehicles at this intersection and reduce the delay under build conditions, the signal timing was optimized. The results from the mitigation analysis during the morning peak hour are shown in Table 4-44.

TABLE 4-44 STUART STREET/CLARENDON STREET MORNING PEAK HOUR MITIGATION

		2023 Build Base Condition					2023 Build Base Mitigated Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
11. Stuart Street/Clarendon Street	Stuart Street EB Thru	0.63	18.3	B	116	205	0.52	11.3	B	72	125
	Stuart Street EB Right	1.19	120.6	F	~378	#559	0.97	42.2	D	280	#497
	Clarendon Street SB Left/Thru	0.58	17.4	B	245	313	0.73	26.5	C	252	321
	OVERALL	**0.85**	**41.6**	**D**	**-**	**-**	**0.86**	**24.3**	**C**	**-**	**-**

Notes:
95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite

Signal timing was adjusted in the morning peak hour in an attempt to reduce overall intersection delay. As shown in Table 4-44, the overall intersection delay was reduced by 17.3 seconds due to mitigation through slight signal timing adjustments. Table 4-45 presents the signal timing changes at Stuart Street/Clarendon Street.

TABLE 4-45 STUART STREET/CLARENDON STREET MORNING PEAK HOUR MITIGATION SIGNAL TIMING

		2023 Build Base Condition	2023 Build Base Mitigated Condition
11. Stuart Street/ Clarendon Street	Stuart Street EB Thru/Right	41 sec	49 sec
	Clarendon Street SB Thru/Left	46 sec	38 sec
	Leading Pedestrian Interval	3 sec	3 sec
	TOTAL	**90 sec**	**90 sec**

As Table 4-45 shows, the total cycle length and pedestrian phase were not modified from 2023 Build Base Condition to the 2023 Build Base Mitigated Condition. The Stuart Street eastbound phase increased by eight (8) seconds of green time while the Clarendon Street southbound phase was reduced by eight (8) seconds of green time. The addition of green time to the Stuart Street phase reduces the eastbound right turn delay by 78.4 seconds and the thru movement by 7.0 seconds while only adding 9.1 seconds of delay to the Clarendon Street southbound movement.

#13 Stuart Street/Arlington Street

The morning peak hour operations decline from LOS D under 2016 Existing Condition to LOS E in the 2023 No-Build Base and 2023 Build Base Condition. In the evening peak hour, intersection performance is LOS F in the 2016 Existing Conditions and remains LOS F for the future conditions. While the Project does not have a substantial impact on this intersection, the Proponent is prepared to provide mitigation at this intersection in an effort to reduce delay and improve intersection functionality within the area. Signal timings for the phases could be optimized for increased overall performance. Tables 4-46 and 4-47 display the comparison between the 2023 Build Base Condition and the 2023 Build Mitigated Base Condition for the morning and evening peak hour, respectively.

TABLE 4-46 STUART STREET/ARLINGTON STREET MORNING PEAK HOUR MITIGATION

		2023 Build Base Condition					2023 Build Mitigated Base Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
13. Stuart Street/ Arlington Street	Stuart Street EB Thru/Right	1.09	104.7	F	~306	#427	0.97	67.1	E	270	#396
	Columbus Avenue NEB Right	0.98	92.8	F	124	#224	0.98	92.8	F	124	#224
	Columbus Avenue SWB Left/Thru	0.58	46.8	D	77	91	0.58	46.8	D	77	91
	Arlington Street SB Left	0.74	28.1	C	214	m302	0.81	33.5	C	215	m#343
	Arlington Street SB Thru	0.83	28.0	C	250	#323	0.91	35.1	D	251	#364
	Arlington Street SB Right	0.43	18.7	B	101	m145	0.47	20.3	C	102	m149
	OVERALL	**0.76**	**60.2**	**E**	**-**	**-**	**0.76**	**51.8**	**D**	**-**	**-**

Notes:
95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite

Signal timing was adjusted in the morning peak hour to allow for three (3) more seconds of green time at the Stuart Street eastbound approach. This was made possible by reducing the Arlington Street southbound green time by three (3) seconds. Although this green time reduction at Arlington Street southbound decreased the approach performance slightly, the intersection benefits by an overall delay reduction of 8.4 seconds and an improvement of LOS E to LOS D. All other movement timing and the cycle length remained the same.

TABLE 4-47 STUART STREET/ARLINGTON STREET EVENING PEAK HOUR MITIGATION

		2023 Build Base Condition					2023 Build Base Mitigated Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
13. Stuart Street/ Arlington Street	Stuart Street EB Thru/Right	1.18	138.1	F	~380	#506	1.23	158.0	F	~390	#516
	Columbus Avenue NEB Right	2.03	528.9	F	~271	#381	1.44	265.4	F	~235	#346
	Columbus Avenue SWB Left/Thru	0.63	53.1	D	61	98	0.45	45.3	D	58	94
	Arlington Street SB Left	0.58	25.1	C	160	255	0.60	25.7	C	147	240
	Arlington Street SB Thru	0.93	40.3	D	327	#449	0.96	44.8	D	331	#460
	Arlington Street SB Right	0.45	21.8	C	88	m149	0.46	22.3	C	81	m140
	OVERALL	**0.94**	**143.2**	**F**	**-**	**-**	**0.94**	**109.8**	**F**	**-**	**-**

Notes:
95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite

Signal timing was adjusted in the evening peak hour in an attempt to reduce overall intersection delay. As shown in Table 4-47, the overall intersection delay was reduced by 33.4 seconds due to mitigation through slight signal timing adjustments. Table 4-48 presents the signal timing changes at Stuart Street/Arlington Street.

TABLE 4-48 STUART STREET/ARLINGTON STREET EVENING PEAK HOUR MITIGATION SIGNAL TIMING

		2023 Build Base Condition	2023 Build Base Mitigated Condition
13. Stuart Street/ Arlington Street	Stuart Street EB Thru/Right	33 sec	32 sec
	Columbus Avenue NEB Right	16 sec	20 sec
	Columbus Avenue SWB Left/Thru		
	Arlington Street SB Left	40 sec	37 sec
	Arlington Street SB Thru		
	Arlington Street SB Right		
	Pedestrian	21 sec	21 sec
	TOTAL	**110 sec**	**110 sec**

As Table 4-48 shows, the total cycle length and pedestrian phase were not modified from 2023 Build Base Condition to the 2023 Build Base Mitigated Condition. The Columbus Avenue northeastbound/southwestbound phase increased by four (4) seconds of green time while the Arlington Street southbound phase and the Stuart Street eastbound phase reduce by three (3) seconds of green time and

one (1) second of green time, respectively. The addition of green time to the Columbus Avenue phase reduces the northeastbound right turn delay by 263.5 seconds.

#17 Columbus Avenue/Dartmouth Street

As discussed in the VLOS analysis, this intersection has an increased number of left turns at the Columbus Avenue northeastbound and southwestbound approaches. In an effort to accommodate the additional vehicle trips, the signal timing was adjusted to create an optimized signal condition. The overall intersection level of service and delay can be greatly improved through mitigation. Tables 4-49 and 4-50 display the comparison between the 2023 Build Base Condition and the 2023 Build Mitigated Condition for the morning and evening peak hour, respectively.

TABLE 4-49 COLUMBUS AVENUE/DARTMOUTH STREET MORNING PEAK HOUR MITIGATION

		2023 Build Base Condition					2023 Build Base Mitigated Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
17. Columbus Avenue/Dartmouth Street	Columbus Avenue NEB Left/Thru	1.53	285.5	F	~362	#506	1.39	222.4	F	~345	#488
	Columbus Avenue NEB Right	0.15	24.0	C	12	32	0.13	22.2	C	11	30
	Columbus Avenue SWB Left/Thru	1.06	82.6	F	~167	m#240	0.89	61.8	E	97	#276
	Columbus Avenue SWB Right	0.54	14.2	B	49	m75	0.50	33.8	C	67	109
	Dartmouth Street NB Left/Thru/Right	0.87	48.3	D	208	#377	0.94	62.4	E	217	#397
	Dartmouth Street SB Left	0.32	27.8	C	20	50	0.35	31.2	C	21	53
	Dartmouth Street SB Thru/Right	0.91	56.4	E	193	#343	1.00	78.5	E	203	#364
	OVERALL	**0.93**	**113.0**	**F**	**-**	**-**	**0.93**	**103.3**	**F**	**-**	**-**

Notes:
95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite

Signal timing in the morning peak hour at Columbus Avenue/Dartmouth Street was modified to accommodate the northeastbound and southwestbound volumes and improve overall intersection delay. The adjustment only incorporated moving two (2) seconds of green time from the Dartmouth Street north/south phase to the Columbus Avenue northeast/southeast phase. The pedestrian phase timing and cycle length were not changed. The overall intersection delay decreased by 9.7 seconds. To reduce the number of left turn conflicts with pedestrians, the

concurrent pedestrian time during the northeast/southwest phase was eliminated in the Mitigated Condition.

TABLE 4-50 COLUMBUS AVENUE/DARTMOUTH STREET EVENING PEAK HOUR MITIGATION

		2023 Build Base Condition					2023 Build Base Mitigated Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
17. Columbus Avenue/Dartmouth Street	Columbus Avenue NEB Left/Thru	1.68	364.2	F	~342	#520	1.24	168.2	F	~290	#468
	Columbus Avenue NEB Right	0.08	25.9	C	18	43	0.07	22.5	C	17	40
	Columbus Avenue SWB Left/Thru	1.02	84.6	F	~316	#476	0.81	43.6	D	274	#376
	Columbus Avenue SWB Right	0.52	33.9	C	140	205	0.45	28.6	C	129	190
	Dartmouth Street NB Left/Thru/Right	0.72	40.4	D	217	333	0.76	44.5	D	224	#365
	Dartmouth Street SB Left	0.29	29.3	C	34	74	0.32	31.7	C	35	77
	Dartmouth Street SB Thru/Right	0.80	45.8	D	240	#396	0.84	51.8	D	247	#414
	OVERALL	**0.97**	**108.2**	**F**	**-**	**-**	**0.88**	**64.9**	**E**	**-**	**-**

Notes:
95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite

Signal timing was adjusted in the evening peak hour to allow for five (5) more seconds of green time during the Columbus Avenue northeast/southwest phase. These five (5) seconds of green were taken from the Dartmouth Street north/south phase. The delay at the Columbus Avenue northeast and southwest approaches was reduced significantly. The overall intersection delay was reduced by 43.3 seconds and the LOS was improved from LOS F to LOS E.

#18 Columbus Avenue/Clarendon Street

The Project creates additional vehicle trips at the Clarendon Street southbound approach to this intersection. To account for the additional trips at this approach, the signal timing was optimized to increase intersection performance and allow more time for vehicles to be processed efficiently through the intersection. Additionally, the existing parking lane at the Clarendon Street southbound approach was removed to allow for the creation of a left turn only lane. The existing two lanes were assigned as thru only and thru/right turn lanes in an effort to avoid unnecessary measures to keep the thru alignment to the southern portion of Clarendon Street beyond the intersection. Tables 4-51 and 4-52 display the comparison between the 2023 Build Base Condition and

the 2023 Build Mitigated Condition for the morning and evening peak hour, respectively.

TABLE 4-51 COLUMBUS AVENUE/CLARENDON STREET MORNING PEAK HOUR MITIGATION

		2023 Build Base Condition					2023 Build Base Mitigated Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
18. Columbus Avenue/Clarendon Street	Columbus Avenue NEB Thru/Right	0.42	23.4	C	117	m84	0.46	8.8	A	60	m61
	Columbus Avenue SWB Left/Thru	0.28	17.8	B	60	m81	0.31	16.6	B	56	m83
	Clarendon Street SB Left	-	-	-	-	-	0.53	35.9	D	66	m99
	Clarendon Street SB Thru/Right	-	-	-	-	-	0.73	38.6	D	97	m140
	Clarendon Street SB Left/Thru/Right	1.08	88.4	F	~222	#315	-	-	-	-	-
	OVERALL	**0.44**	**54.8**	**D**	**-**	**-**	**0.40**	**25.5**	**C**	**-**	**-**

Notes:
95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite

The signal timing was adjusted in the morning peak hour to allow for the Columbus Avenue northeast/southwest movement to have seven (7) more seconds of green time, and the Clarendon Street phase was reduced by seven (7) seconds. The addition of the left turn only lane provided Clarendon Street with congestion relief as shown in the LOS D in the 2023 Build Mitigated Condition in comparison to the 2023 Build Base Condition LOS F. The overall intersection delay was reduced by 29.3 seconds and the LOS was improved from LOS D to LOS C. The cycle length and pedestrian phase timing were not modified during the mitigation analysis.

TABLE 4-52 COLUMBUS AVENUE/CLARENDON STREET EVENING PEAK HOUR MITIGATION

Intersection	Approach	2023 Build Base Condition					2023 Build Base Mitigated Condition				
		V/C Ratio	Delay	VLOS	50th % Queue (feet)	95th % Queue (feet)	V/C Ratio	Delay	VLOS	50th % Queue (feet)	95th % Queue (feet)
18. Columbus Avenue/Clarendon Street	Columbus Avenue NEB Thru/Right	0.87	51.7	D	210	#352	0.70	33.4	C	192	#363
	Columbus Avenue SWB Left/Thru	0.74	30.9	C	103	129	0.54	21.2	C	79	121
	Clarendon Street SB Left	-	-	-	-	-	0.73	32.9	C	205	233
	Clarendon Street SB Thru/Right	-	-	-	-	-	0.69	29.4	C	207	209
	Clarendon Street SB Left/Thru/Right	0.92	32.9	C	265	#422	-	-	-	-	-
	OVERALL	**0.64**	**36.3**	**D**	**-**	**-**	**0.57**	**29.0**	**C**	**-**	**-**

Notes:
95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite

Signal timing was adjusted in the evening peak hour to allow for six (6) more seconds of green time in the Clarendon Street southbound approach, and six (6) seconds of green time is taken from the Columbus Avenue northeast/southwest phase. The vehicle volumes are heaviest at the Clarendon Street southbound approach in the evening with exiting Project trips dispersing into the network at this location. The additional green time and proposed left turn only lane allow vehicles to pass through the intersection with less delay. The overall intersection delay is reduced by 6.7 seconds and the LOS is improved from LOS D in the 2023 Build Base Condition to LOS C in the 2023 Build Mitigated Condition.

#10 Stuart Street/Trinity Place – Alternate Scheme Only

Under the Alternate Scheme the second Garage exit is located on Trinity Place, adding volume onto the northbound approach. The analysis indicates that the intersection will decrease from a LOS B to LOS C in the morning peak hour and LOS B to LOS D in the evening peak hour. This is due to insufficient green time provided to the Trinity Place approach. The results due to signal timing optimization are reflected in Table 4-53a and 4-53b for morning and evening peak hour, respectively. Minor signal timing adjustments to increase the green time for Trinity Place will reduce the LOS changes under the Alternate Scheme.

TABLE 4-53A STUART STREET/TRINITY PLACE MORNING PEAK HOUR MITIGATION

		2023 Build Alt Condition					2023 Build Alt Mitigated Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
10. Stuart Street/Trinity Place	Stuart Street EB Left/Thru/Right	0.78	12.9	B	260	348	0.80	14.6	B	297	410
	Trinity Place NB Thru/Right	0.91	68.0	E	130	110	0.85	52.7	D	123	103
	Trinity Place SB Left/Thru	0.34	39.7	D	30	47	0.29	37.4	D	29	45
	OVERALL	**0.81**	**21.2**	**C**	**-**	**-**	**0.81**	**20.5**	**C**	**-**	**-**

Notes:
95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite

TABLE 4-53B STUART STREET/TRINITY PLACE EVENING PEAK HOUR MITIGATION

		2023 Build Alt Condition					2023 Build Alt Mitigated Condition				
Intersection	**Approach**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**	**V/C Ratio**	**Delay**	**VLOS**	**50th % Queue (feet)**	**95th % Queue (feet)**
10. Stuart Street/Trinity Place	Stuart Street EB Left/Thru/Right	0.38	4.3	A	35	48	0.72	9.5	A	62	107
	Trinity Place NB Thru/Right	1.18	135.5	F	~297	#477	0.96	59.9	E	232	#423
	Trinity Place SB Left/Thru	0.71	44.6	D	54	m#128	0.44	24.3	C	47	m95
	OVERALL	**0.82**	**42.8**	**D**	**-**	**-**	**0.82**	**24.3**	**C**	**-**	**-**

Notes:
95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal
~ Volume exceeds capacity, queue is theoretically infinite

As shown in Table 4-53a, the addition of green time to the Trinity Place phase during the morning peak hour reduces the northbound thru/right delay by 15.3 seconds and the southbound left/thru delay by 2.3 seconds while only adding 1.7 seconds of delay to the Stuart Street eastbound movement. The overall intersection delay for the evening peak hour reduces by 0.7 seconds and the intersection remains LOS C. In Table 4.53b, during the evening peak hour, the Trinity Place northbound approach delay was reduced by 75.6 seconds and the southbound left/thru delay by 20.3 seconds while only adding 5.3 seconds of delay to the Stuart Street eastbound movement. The overall intersection delay for the evening peak hour reduces by 18.5 seconds, and the intersection performance increases from LOS D to LOS C. The reductions in delay were a result of the signal timing modification for morning and evening peak hours as shown in Table 4-54.

TABLE 4-54 STUART STREET/TRINITY PLACE MORNING AND EVENING PEAK HOUR MITIGATION SIGNAL TIMING

		Morning Peak Hour		Evening Peak Hour	
		2023 Build Alt Condition	**2023 Build Alt Mitigated Condition**	**2023 Build Alt Condition**	**2023 Build Alt Mitigated Condition**
10. Stuart Street/ Trinity Place	Stuart Street EB Left/Thru/Right	65 sec	61 sec	58 sec	51 sec
	Trinity Place NB Thru/Right	25 sec	29 sec	32 sec	39 sec
	Trinity Place SB Left/Thru				
	TOTAL	**90 sec**	**90 sec**	**90 sec**	**90 sec**

As Table 4-54 shows, the total cycle length was not modified from 2023 Build Alternate Condition to the 2023 Build Alternate Mitigated Condition. In the morning peak hour, the Stuart Street eastbound phase decreased by four (4) seconds of green time while the Trinity Place northbound/southbound phase was increased by four (4) seconds of green time. In the evening peak hour, the Stuart Street eastbound phase decreased by seven (7) seconds of green time while the Trinity Place northbound/southbound phase was increased by seven (7) seconds of green time. The slight modifications to the allocated green time allows for better functionality of the Trinity Place northbound/southbound approaches.

4.7.2 Proposed Mitigation—Possible Signalization of Intersection

#4 St. James Avenue/Trinity Place

This unsignalized intersection experiences heavy pedestrian volumes at the existing crosswalks due to its proximity to Copley Square. There are crosswalks along all three legs of this intersection—two on St. James Avenue and one at the Trinity Place approach. It may be beneficial to signalize this intersection for the purpose of metering the frequency of pedestrian crossings. This would both allow a safe passage time for pedestrians to cross the street and minimize the disruption of vehicles traveling along St. James Avenue from Clarendon Street to Dartmouth Street. The intersection has the potential to function at LOS A/B with the implementation of a traffic signal in comparison to the LOS C shown in the unsignalized analysis conditions. However, it should be noted that the intersection may not satisfy traffic warrants for signalization, and further discussion with BTD is necessary to determine if the improvement should be considered desirable for pedestrian operations.

#15 Clarendon Street/Stanhope Street

This unsignalized intersection is another location where signal implementation may be justified. The vehicles at the Stanhope Street approach experience queuing and delay caused by the insufficient gaps in the free flow volumes traveling southbound on Clarendon Street. Additionally, this would offer a signalized crossing for pedestrians crossing Clarendon Street to and from the Project. The intersection has the potential to function at LOS C during the morning and evening peak hour in comparison to the LOS F (Stanhope Street approach) under all of the unsignalized analysis conditions. Of perhaps greater importance, although not reflected in a Synchro analysis, the signalization would be expected to benefit the operations further downstream on Clarendon Street at the Garage driveway by regulating traffic flow and pedestrian activity and creating improved gaps in traffic. Again, it should be noted that the intersection may not satisfy traffic warrants for signalization, and further discussion with BTD is necessary to determine if the improvement should be considered.

4.7.3 Proposed Mitigation—Roadway Modifications

Stuart Street between Dartmouth Street and Trinity Street

The Proponent has been working with other approved projects in the area to coordinate a consistent Stuart Street plan from Dartmouth Street to Clarendon Street. The Copley Place Residential/Retail project will provide improvements at the Stuart Street/Dartmouth Street intersection which include modifications to traffic islands, and lane configurations and alignment. The 40 Trinity Place project has proposed a two through-lane cross-section from Dartmouth Street to Clarendon Street with a third lane dedicated to a right-turn only lane at Trinity Place and a Valet/Drop-off transitioning to a right-turn only lane at Clarendon Street. With the elimination of the Garage entrance drum on Trinity Place the need for a right-turn only lane is eliminated, thus minimizing the need for a three-lane cross-section on Stuart Street from Dartmouth to Trinity Place. The Proponent proposes to convert the segment of roadway to provide two travel lanes (a shared left/thru and a shared thru/right). A third lane would maintain the MBTA bus stop and provide a drop-off area in front of the Garage West Building.

Impacts to traffic operations would be negligible as the right-turn only lane at Trinity Place is no longer needed for the Garage entrance drum. The two through lanes incorporated into the No-Build analysis will be maintained.

Clarendon Street from Stanhope Street to Columbus Avenue

Currently Clarendon Street from Stanhope Street to Columbus Avenue provides metered parking along the east side of the street. In coordination with the Project,

the Proponent proposes to convert the parking lane into a left turn only lane to help serve the vehicles approaching the Clarendon Street/Columbus Avenue intersection from the north. This roadway improvement has been analyzed and is discussed previously in Section 4.7.1 – Proposed Mitigation Signal Timings.

Trinity Place and St. James Avenue between Clarendon and Dartmouth Streets

BTD has requested that a public realm plan for these streets showing pedestrian flow and accommodation of curbside assignments for various users. The proposed plan is presented in Figure 4.24. The Proponent looks forward to developing this plan in coordination with BTD.

4.7.4 Proposed Mitigation—Possible Roadway Modifications

Trinity Place between St. James Avenue and Stuart Street

This roadway segment currently accommodates two-way traffic, and provides access to abutting loading and parking garages. It may be beneficial to convert the circulation to northbound only between Stuart Street and St. James Avenue, thereby allowing conversion of approximately 6 – 8 ft of roadway width to pedestrian or streetscape improvements. This would result in the diversion of existing southbound trips to other roadways, but would have the benefit of allowing the existing taxi queuing for the Fairmont Copley Hotel to occur on the "correct" side of the street.

4.7.5 Summary of Proposed Mitigation

With the mitigation in place as described in the previous sections, the results have been compared to the 2016 Existing Condition, the 2023 No-Build Base Condition, and the 2023 Build Base Condition LOS and are presented in Table 4-55a. Table 4-55b provides the proposed mitigation for Stuart Street/Trinity Place for the 2023 Build Alternate Condition. Detailed LOS results including V/C ratio and delay for lane groups and approaches and the Synchro printouts are presented in Appendix F.

TABLE 4-55A 2023 BUILD BASE MITIGATED CONDITION SIGNALIZED INTERSECTION VEHICLE LOS AND DELAY MORNING AND EVENING PEAK HOUR

	AM				PM			
Intersection	**2016 Existing Condition**	**2023 No-Build Base Condition**	**2023 Build Base Condition**	**2023 Build Base Mitigated Condition**	**2016 Existing Condition**	**2023 No-Build Base Condition**	**2023 Build Base Condition**	**2023 Build Base Mitigated Condition**
11. Stuart Street/Clarendon Street	B (16.8 sec)	B (16.8 sec)	D (41.6 sec)	C (24.3 sec)	B (11.5 sec)	B (12.0 sec)	B (15.0 sec)	N/A
13. Stuart Street/ Arlington Street	D (54.9 sec)	E (57.9 sec)	E (60.2 sec)	D (51.8**)**	F (116.8 sec)	F (126.0 sec)	F (143.2 sec)	F (109.8 sec)
17. Columbus Avenue/ Dartmouth Street	E (76.7 sec)	F (85.0 sec)	F (113.0 sec)	F (103.3 sec)	E (72.1 sec)	E (79.3 sec)	F (108.2 sec)	E (64.9 sec)
18. Columbus Avenue/ Clarendon Street	D (37.7 sec)	D (42.2 sec)	D (54.8 sec)	C (25.5 sec)	C (29.0 sec)	C (30.0 sec)	D (36.3 sec)	C (29.6 sec)

TABLE 4-55B 2023 BUILD ALTERNATE MITIGATED CONDITION SIGNALIZED INTERSECTION VEHICLE LOS AND DELAY MORNING AND EVENING PEAK HOUR

	AM				PM			
Intersection	**2016 Existing Condition**	**2023 No-Build Alternate Condition**	**2023 Build Alternate Condition**	**2023 Build Alternate Mitigated Condition**	**2016 Existing Condition**	**2023 No-Build Alternate Condition**	**2023 Build Alternate Condition**	**2023 Build Base Alternate Condition**
10. Stuart Street/Trinity Place	A (7.4 sec)	B (11.2 sec)	C (21.2 sec)	C (20.5 sec)	B (11.1 sec)	B (15.0 sec)	D (42.8 sec)	C (24.3 sec)

For the mitigated intersections, signal timing for various phases was changed in an effort to optimize the signal and increase intersection performance without proposing major intersection geometry modifications or cycle length changes. The overarching goal of the mitigation effort was to bring the intersection LOS to the 2016 Existing Condition performance level, wherever possible, while creating the least disruptive means to accomplish this task. Although, the intersection of Stuart Street/Arlington Street in the evening peak hour remains LOS F for all conditions, and Columbus Avenue/Dartmouth Street remains LOS F during the morning peak hour, the overall delay at these to intersections was reduced. Stuart Street/Arlington Street experienced a delay reduction of 33.4 seconds in the evening peak hour with mitigation, bringing it below the 2016 Existing Condition. The Columbus Avenue/Dartmouth Street delay was reduced by 9.7 seconds during the morning peak hour.

In addition to the proposed signal timing improvements the Proponent proposes the following roadway modifications:

1. Provide a consistent Stuart Street cross-section between Dartmouth Street and Clarendon Street, consistent with the improvements to be implemented by the Copley Square Residential/Retail Project, by maintaining two travel lanes and converting the right-turn only lane at Trinity Place, proposed by the 40 Trinity Place project, into a drop-off area for the Garage West Building and maintaining the MBTA bus stop.
2. Converting the parking lane on the east side of Clarendon Street from Stanhope Street to Columbus Avenue to a left-turn only lane. Providing a clear, three lane cross-section at the Clarendon Street approach to Columbus Avenue.

In addition to the above mitigation, the following *possible* improvements have been identified for consideration in consultation with BTD:

1. Signalization of Trinity Place at St. James Avenue.
2. Signalization of Stanhope Street at Clarendon Street.
3. Conversion of Trinity Place between Stuart Street and St. James Avenue to one-way north traffic flow with pedestrian/streetscape improvements.
4. BTD requested the Proponent investigate operations and curbside activities along St. James Street between Dartmouth Street and Clarendon Street. Potential improvements are currently being evaluated by the design team and are shown in Figure 3.24.

4.8 Access and Circulation

As discussed in Chapter 3, *Urban Design,* Site access will be greatly enhanced by the urban design and architectural character of the Project. Figures 3.9a and 3.9b, previously presented, show vehicular, bicycle, and pedestrian access to and through the Project.

4.8.1 Vehicle Site Access

The existing parking Garage on the Project Site is served by an entry/exit driveway located on Clarendon Street accessible by all users, and a pair of drum speed-ramps limited to parking pass holders only. The entry drum (located on the Garage West Parcel) is accessed from Stuart Street via Trinity Place, and the exit drum (located on the Garage East Parcel) connects to the MassDOT service road from Clarendon Street (under the Garage), which in turn leads to the On-Ramp and also connects to Stuart Street via Trinity Place.

The Project Site benefits from strong connections with I-90 to and from the west. In addition to the locations of its access points, the distribution of Garage trips is

significantly influenced by the overall prevailing one-way street circulation in this part of Back Bay and South End.

It is worth noting that the Garage driveway on Clarendon Street, while limited to right-turns because of the one-way direction of Clarendon Street, is normally controlled by a police detail during the weekday evening peak period when most Garage trips are exiting. During the morning peak period, when most Garage trips are entering, a Garage staff member normally controls the driveway. Although there is a need to manage traffic movements at times, the primary reason for manual control is because of the high level of pedestrian activity at the driveway as a result of the Projects proximity to the Station.

As described in Chapter 3, *Urban Design,* the entry and exit speed-ramp drums will be eliminated to allow for the development of the Garage West and Garage East Parcels. With the removal of the exit drum when the Garage East Parcel is developed, the direct connection from the Garage to the On-Ramp is severed, although the I-90 On-Ramp may remain open for traffic accessing it from Clarendon Street, pending potential MassDOT actions regarding the On-Ramp through the IMR process.

With the future Project, trips currently using the entry drum may continue on Stuart Street and simply turn right on Clarendon Street to access the existing Garage driveway. However, once the Garage East Parcel is developed, vehicles currently using the exit drum will no longer have a direct connection to I-90 and will need to find another route to access I-90 westbound or Trinity Place/Stuart Street. Directing those trips to the existing exit on Clarendon Street would result in a more circuitous routing to reach both I-90 westbound and Trinity Place/Stuart Street, and may result in additional traffic passing through the South End neighborhood. To address this potential negative impact, the Base Scheme includes a new exit ramp connection to Dartmouth Street where trips can reach both I-90, via the Huntington Avenue on-ramp, and Trinity Place/Stuart Street directly.

In the Alternate Scheme, described in detail in Chapter 3, *Urban Design,* the On-Ramp would be closed. Under this scenario, it would be feasible to introduce a new exit ramp from the Garage connecting to Trinity Place. Vehicles currently using the entry drum may continue on Stuart Street and simply turn right on Clarendon Street to access the existing Garage driveway, similar to the Base Scheme. Vehicles currently using the exit drum will be able to use the new Garage exit ramp to reach Trinity Place from where they can easily access Stuart Street or the Huntington Avenue on-ramp. Here too, the new Garage exit ramp in the Alternate Scheme will also avoid diverting all exit-ramp users to Clarendon Street and the potential negative traffic impacts to the South End neighborhood, described above. In addition, it is thought that this alternate location for a new Garage exit ramp offers less pedestrian conflicts than the exit onto Dartmouth Street in the Base Scheme.

As requested by BTD, the Proponent has investigated the connection from the Station to Logan Airport. The Logan Airport Shuttle stops at Copley Square on Boylston Street at Dartmouth Street, which is less than a quarter-mile (less than 5-

minute walk) from the Project Site. Assess to the shuttle from the Station will be improved by the Stuart Street through-block connector to be delivered with the Garage West parcel and other public realm improvements proposed in Chapter 3, *Urban Design*. Another option, to be discussed with MassPort and BTD would be to add an additional stop at the existing St. James bus stop on the south side of Copley Square. This would provide an even shorter route to and from the Project Site.

4.8.2 Loading, Service and Deliveries

Curbside Loading

Curbside regulations adjacent to the Site have been modified, where appropriate, to maximize the available space in front of each Project Component and regulate these spaces to accommodate short-term loading areas and high turnover drop-off/pick-up zones. Figure 4.18a and 4.18b identify the proposed curbside regulations surrounding the Project for the Base and Alternate Schemes, respectively.

- **Dartmouth Street** – Regulations along the east side of the roadway, adjacent to the Site, are fairly consistent with existing curbside uses. The existing MBTA parking zone and handicapped accessible parking area will be maintained south of the mid-block crossing at the Station entrance. To the north a taxi stand will be maintained between the crosswalk and the new Base Scheme Garage exit. A time restricted commercial loading zone is provided to the north of the Garage exit. Restrictions will limit vehicles from using this zone during peak commuter times when increased capacity for the right-turn lane on Dartmouth Street is needed.
- **Stuart Street** – The curbside area in front of Garage West will retain the existing MBTA bus stop and provide a drop-off/pick-up loading area in front of the proposed office building lobby. The Proponent will consider maintaining time-restricted food truck parking within this area, consistent will current regulation, if other more appropriate areas are not identified and if demand for this service is high.
- **Clarendon Street** – The proposed curbside areas along Clarendon Street from Stanhope service street to Dartmouth Street have been enhanced to focus on pedestrian circulation and visibility. A small, time-restricted, drop-off zone is proposed in front of the Garage East residential entrance. The Garage driveway curb cut will be reduced to provide more sidewalk and waiting area for pedestrians. The two curb cuts for the existing busway will remain, but will turn into a significant drop-off for the Station and Station East residential building. Parking on the east side of Clarendon Street will be removed to provide a longer left-turn pocket lane.

Truck Access and Egress

There are three designated loading areas supporting the Project shown previously in Figures 3.9a and 3.9b.

Garage West will provide three loading docks plus two trash/recycling compactor bays, under the Base Condition, accessed off of Stuart Street via Trinity Place. Under the Alternate Condition, the Garage West loading area will provide the same number of docks.

Garage East provides one loading dock and one trash/recycling compactor bay at the rear of the building. Trucks will enter the site off of Clarendon Street via the access road/Trinity Place and leave through Trinity Place exiting the site at the intersection of Stuart Street and Trinity Place.

Station East and Station West parcels will be served by a joint loading dock accessible off of Clarendon Street via a service drive connected to the new Station drop-off area. The loading area will provide approximately three loading bays with three additional bays for trash and recycling compactors.

Truck Routes

Service and delivery trucks will access the site using only designated truck routes, as outlined by the City of Boston. Regionally, trucks will use the Massachusetts Turnpike (I-90), I-93, Massachusetts Avenue and Commonwealth Avenue, while larger trucks will avoid Storrow Drive due to height restrictions. Local trucks will use Stuart Street and Clarendon Street to access the Project's loading docks with connections from Huntington Avenue, Dartmouth Street and Boylston Street.

Daily Deliveries

Daily truck trips were estimated based on the National Cooperative Highway Research Program (NCHRP) Synthesis 298 Report: Truck Trip Generation Data. The report is published by the Transportation Research Board (TRB) and provides daily truck trip rates by land use for specific cities. The rates presented in the report are estimated for individual buildings and do not account for larger mixed-use developments, such as the Project, in which service and delivery trucks will serve multiple buildings, and land uses, with one trip to the Site. A 25 percent reduction in individual building truck trip generation was applied, although a greater percentage of sharing may happen in practice, and the estimates are therefore conservative (high). Table 4-56 shows the estimated daily number of truck trips each building and subsequent land use will generate. Detailed worksheets for each building and trip rates used are included in Appendix F.

TABLE 4-56 DAILY DELIVERY/SERVICE VEHICLE TRIP GENERATION ESTIMATE

Project Component	Loading Dock Deliveries (SU-30 or larger)	Short-Term Deliveries (Small trucks, vans and cars)	Total # of Daily Deliveries
Garage West			
Office	16	10	26
Retail	6	9	15
Subtotal	22	19	41
Garage East			
Residential	2	37	39
Subtotal	2	37	39
Station East			
Residential	3	64	67
Retail	1	3	4
Subtotal	4	67	71
Station West			
Retail	7	11	18
Subtotal	7	11	18
Grand Total	**35**	**134**	**169**

Based on the NCHRP Report, the Project is estimated to generate 169 daily truck trips, 35 of which will be larger delivery vehicles using the seven proposed loading docks. The remaining 134 estimated truck trips will include smaller van and pickup truck deliveries such as food and flower deliveries, USPS, UPS, and FedEx, etc. The daily package delivery and catering services will be encouraged to use the loading docks when making longer, multi-building stops within the Project, to eliminate congestion at curbside.

As discussed above, the curbside regulations adjacent to the Project Site have been modified, where appropriate, to provide short-term drop-off/pick-up areas for passenger cars and are also intended for use by rideshare and taxi services. A semi-circular drop-off zone within the new Clarendon Street plaza will serve as a Station and residential drop-off area. These spaces can also be utilized by short service vehicles such as food delivery or courier. Property management will monitor these highly active curbside areas to minimize disruptions to adjacent travel lanes and make sure there is consistent vehicle turnover.

Individual Project components will be encouraged to schedule larger deliveries during off-hours to limit the impacts of truck traffic on local streets. Trash and recycling pick-up will be scheduled for off-hour servicing. In addition, move-in/move-out activities will be managed and scheduled to decrease the impacts to daily traffic and loading operations around the site.

4.9 Parking

4.9.1 Existing Supply and Demand

As allowed under the Downtown Parking Freeze Permit and Private Parking Space Exemption issued by the Boston APPC, the existing Garage can accommodate up to 2,013 parking spaces. Based on the existing parking occupancy presented previously, the Garage has an average daily occupancy of 78 percent at 1:00 PM, with an average turn-over rate of 1.01 times per day per space. As permitted, the Garage is currently subject to certain parking lease commitments and additionally provides a limited amount of parking to the general public.

Current Trends in Parking Demand

Current trends indicate that parking demand in downtown Boston is decreasing across all land uses. This is due to a variety of reasons including shifting demographics, cost of parking and auto ownership, improved transit service, and social and environmental concerns. Each of the following factors will continue to influence how Boston commuters and residents make travel decisions in the future.

- *Improved and expanded transit service* – Metropolitan residents commuting into downtown have more transit options than when the Garage was first built. In the 1970's and 1980's, the MBTA extended the subway lines on both the Red Line (to Alewife and Quincy Center) and Orange Line (to Oak Grove). In the past 15 years, ridership on all transit lines has increased. Commuter Rail service has been extended south into Providence and west to Worcester, along with restored service on the Old Colony and Greenbush lines. System wide, Commuter Rail ridership has increased by almost 50 percent since 1997.
- *Urban population rates* – The population of the City of Boston reached its peak in 1950, but like many other cities, declined thereafter. In recent decades, Boston's population has been increasing and is now over 650,000 people, the highest number since 1970. The central downtown district experienced a 23 percent population growth (over 5,000 residents) between 2000 and 2010. The increased supply of downtown housing units is attracting "empty nesters" and young professionals who do not want to commute to work by automobile.
- *Auto-ownership* – Based on 2010 census data, about 55 percent of households in the central district of Boston do not own a vehicle. The residential parking demand is trending at about 0.50 spaces per unit in downtown neighborhoods.
- *Car sharing services* – An alternative to car ownership, auto share services provide access to vehicles for short-term use. Zipcar, the most popular auto sharing service in Boston, estimates each of its Zipcars replaces 20 privately owned vehicles. There are many Zipcar locations in downtown Boston,

including six vehicles at the Garage. Additionally, Enterprise has two car-share vehicles at the Garage.

- *Parking supply and cost* – The parking "freeze", established in 1976 by the Massachusetts Department of Environmental Protection and the U.S. Environmental Protection Agency, was put in place to improve and maintain air quality in the region by limiting the number of new public parking spaces and thereby reducing auto travel into the City. The policy, while capping the public supply (at 35,556 spaces), allows the economics of supply and demand to influence parking fees, which are some of the highest in the nation.
- *Increased bicycle use* – Bicycle use and awareness is rising in the City. About 2.1 percent of Boston commuters biked to work in 2009, up over 120 percent from 2007. Between 2007 and 2010, the City created over 52 miles of new bicycle lanes. Hubway, launched in July 2011, is a bicycle sharing system with more than 180 stations and 1,600 bicycles available throughout Boston, Brookline, Cambridge, and Somerville.
- *Social and environmental concerns* – Increased awareness of sustainability and the desire to reduce dependence on oil, motivate many people to reduce or avoid auto travel.

These factors have contributed to declining parking ratios for both residential projects and office buildings within downtown Boston. Table 4-57 provides the parking ratios of various residential and office projects within Boston. All projects have been approved by BTD.

TABLE 4-57 BOSTON RESIDENTIAL PARKING RATIOS

Project Name	Project Type	Location	Parking Ratio
Archstone – Boston Common	Apartment	Chinatown/Theater	0.38 spaces/unit
120 Kingston Street (Radian)	Apartment	Chinatown	0.35 spaces/unit
Archstone – Avenir	Apartment	West End	0.47 spaces/unit
The Boston Garden	Apartment	West End	0.40 spaces/unit
Avalon Bay – North Station	Apartment	West End	0.44 spaces/unit
One Back Bay	Apartment	Back Bay	0.46 spaces/unit
Exeter Residences	Apartment	Back Bay	0.70 spaces/unit
Kensington Place – Hinge Block	Apartment	Downtown	0.40 spaces/unit
45 Stuart Street (Ava)	Apartment	Downtown	0.49 spaces/unit
Lovejoy Wharf – 131 Beverly Street	Condo	Downtown	0 spaces/unit
The Victor	Apartment	Downtown	0.50 spaces/unit
One Canal	Apartment	Downtown	0.50 spaces/unit
319 A Street	Apartment	South Boston	0 spaces/unit
Ink Block	Apartment	South End	0.44 spaces/unit
275 Albany Street (The Troy)	Apartment	South End	0.5 spaces/unit
380 Stuart Street	Office/Retail	Back Bay	0.28 spaces/ksf
80 East Berkeley Street	Office/Retail	South End	0.65 spaces/ksf
321 Harrison Avenue	Office	South End	0.51 spaces/ksf
125 Nashua Street	Office	North Station	0.49 spaces/ksf
Two Brookline Place	Office	Brookline	0.43 spaces/ksf
500 Boylston Street	Retail/Office Addition	Back Bay	0
157 Berkeley Street	Office	Back Bay/South End	0.82 spaces/ksf
Vertex, Fan Pier	Office	South Boston	0.30 spaces/ksf
Atlantic Wharf	Office	Downtown	
North Station	Office	North Station	0.50 spaces/ksf

The presented ratios show that a majority of the residential projects provide less than 0.5 spaces per unit, less than the required residential parking ratio within the Back Bay/Stuart Street District. A wider range of office parking ratios are presented, with a few projects in the Back Bay having less than a 0.3 space/ksf parking ratio. The Project fits within the current trends of providing low parking ratios within the downtown Boston neighborhood of Back Bay.

4.9.2 Project Parking Supply

As described in Section 3.4, the Project will require the partial demolition and reconstruction of the existing Garage in order to accommodate the future proposed uses on the Garage West and Garage East Parcels. In its reconstructed state, under a managed parking scenario, the Garage will have the ability to provide up to the existing permitted capacity of 2,013 spaces, maintaining the existing allowed, with up to 576 spaces which have been permitted for use by the general public.

However, building upon the strongly transit-oriented nature of the Project's location, the current trends in declining parking needs in Boston and in response to local transportation goals, the Project will seek to minimize dependence on auto travel, and will implement a comprehensive package of Transportation Demand Management (TDM) strategies to reduce auto trips and parking demand. This is reflected in the estimated trip generation for the Project, previously presented, which will generate approximately 3,627 daily vehicle trips (1819 in, 1808 out) with only 387 vehicle trips (298 in, 89 out) estimated during the morning peak hour and 373 vehicle trips (100 in, 273 out) estimated during the evening peak hour. As part of TDM, and management of the Garage in general, the proposed parking supply will reflect the limited parking ratios and incorporation of shared parking between residential and commercial uses that is currently being employed at similar urban, mixed-use, transit-oriented developments throughout the City of Boston.

The projected parking supply for the Project is based on the following preliminary ratios:

Office:	0.4 spaces per KSF
Retail:	0.4 spaces per KSF
Residential:	0.4 spaces per unit

The resulting parking program for the Project is summarized in Table 4-58 below.

TABLE 4-58 PROPOSED PARKING RATIOS

Land Use	Size[1]	Parking Ratio	Parking Spaces
Office	582,600 SF[2]	0.4 spaces per KSF	233
Residential	600 units	0.4 spaces per unit	180[3]
Retail	58,900 SF[2]	0.4 spaces per KSF	24
Project Sub-total			**437***
Existing commitments			992
Permitted public parking[4]			Up to 576
Total			**Up to 2,013**

1 Garage West Base Scheme

2 Unless labeled otherwise, all areas provided herein are described in gross floor area as such term is used in the definition of "Floor Area Ratio" in Article 2 of the Code; therefore, such areas specifically exclude floor area devoted to garage use, whether or not in the basement of a building or serving residential uses, mechanical equipment, storage, service and loading areas, and areas serving as access to, egress from or use by public transit services. Please note that given the fact that the majority of the Project Site is on and over air rights, it is not possible to reconstruct parking spaces beneath one or more of the buildings, and thus this filing and PDA No.2 as amended will expressly exclude the square footage allocated to such parking for the purposes of calculating FAR.

3 Assumes 25% shared residential spaces

4 As allowed under the APPC

* Under the. the Garage West Alternate Scheme, office parking would be 237 spaces, and retail parking would be 25 spaces, bringing the Project sub-total to 442 spaces.

Based on the above analysis and the planned layout for the future parking structure, the reconstructed Garage will be able to accommodate a sufficient number of striped parking spaces to support the proposed Project uses as well as providing flexibility under a managed parking scenario to continue to offer a limited number of public parking spaces up to the permitted maximum of 2,013. Figure 4.19 shows a typical garage floor layout under a managed and non-managed scenario.

As indicated above, the Project will provide 0.4 spaces per residential unit, or up to 240 residential parking spaces (based on up to 600 units). In addition, the Project will provide 233 spaces for office use and 24 spaces for retail use in the Base Scheme. This would bring the total parking supply for the Project to up to 497 spaces. However, in keeping with existing downtown trends, 25 percent of the residential spaces are assumed to be shared with other uses, reducing the total Project-related parking supply by 60 spaces to 437 spaces under the Base Scheme (the Alternate Scheme would have 5 additional spaces).

4.9.3 Garage Parking Allocation

The Garage will provide preferential parking for handicap accessible users, carpools/vanpools, car-share, electric vehicles and LEFE vehicles (low emission, fuel efficient).

Handicap Accessible – the Garage will provide the required amount of handicap accessible spaces in compliance with ADA guidelines. These spaces will be given the highest priority in preferential locations and be located near elevators and doorways.

Car-Sharing – Currently the Garage reserves fourteen (14) parking spaces for car-share vehicles, six (6) for ZipCar, six (6) for Maven, and two (2) for Enterprise CarShare. The Project will maintain the existing fourteen car-sharing spaces and work with each provider to provide more if demand warrants. These spaces will be located in the Garage for convenient access to users.

Electric Vehicles (EV) – Currently the Garage provides six (6) EV stations. BTD has requested that 5% of the total number of parking spaces be fitted for EV stations, approximately 100 spaces. The Proponent will maintain the existing six EV stations and outfit additional spaces for future stations if and when demand warrants. An assessment of EV demand will be conducted and the appropriate amount of stations will be installed when demand exceeds current supply.

Carpool/Vanpool – Initially 50 parking spaces will be designated for carpool/vanpool preferential parking, located within close proximity of elevators and doorways.

There are many parking space allocations competing for preferential parking locations. Handicap accessible spaces will be given highest priority when allocating parking spaces. Car-sharing, EV stations, and carpool/vanpool spaces will be located throughout the Garage with convenient locations to elevators and doorways. In addition, the Garage will continue to lease space to Avis for their car-rental service.

4.9.4 Project Parking Demand

The dynamic of parking supply to meet demand in an urban, transit-oriented location presents certain challenges because available methodologies are generally based on data from situations where there is low transit and limited alternative mode choice. Further, they do not reflect the goals of minimizing auto use by not providing unlimited supply to satisfy demand, as reflected in the restrictive zoning requirements or the goals of the City of Boston and the Back Bay/Stuart Street District to reduce the number of parking spaces required for development.

This disparity is recognized in the MEPA ENF Certificate, which states that "ITE's Parking Generation document should be consulted, but it may not effectively predict parking rates for this mixed-use project." Therefore, analysis has been performed for the Project parking demand based on both ITE and ULI methodologies to establish benchmarks for "un-constrained" parking supply, as described in the following sections.

ITE Parking Generation Analysis

ITE has published a Parking Generation Handbook to guide developments on the amount of parking that should be provided. This handbook is similar to the ITE Trip Generation Handbook used for estimating the number of unadjusted vehicle trips a development will generate. Like the Trip Generation Handbook, the ITE Parking Generation Handbook has a primary use for estimating parking generation in suburban areas rather than urban areas with extensive alternative modes of transportation available. As shown below in Table 4-59a the ITE Parking Generation Handbook estimates the unadjusted parking demand of the Project is 2,397 parking spaces.

TABLE 4-59A UNADJUSTED ITE PARKING GENERATION ESTIMATE

Land Use	Size	Unadjusted Parking Spaces
Office	582,600 SF	1,411
Residential	600 units	754
Retail	58,900 SF	232
Total ITE Estimate		**2,397**

The estimate, like the ITE Trip Generation estimate, does not account for the urban environment of the Project Site. As demonstrated by the mode shares associated with this area and used for the Project, there is only a 19 and 30 percent SOV rate for residents and employees, respectively. Therefore, the unadjusted ITE Parking Generation estimate dramatically *overstates* the demand for this Project. The ITE Parking Generation estimate also does not take into consideration a shared parking strategy which the Proponent will be implementing under this Project.

Similar to the ITE Trip Generation, the unadjusted parking demand estimate was adjusted for AVO, mode share HOV, and residential shared parking. Table 4-59b provides the adjusted ITE parking demand of the Project.

TABLE 4-59B ADJUSTED ITE PARKING GENERATION ESTIMATE

Land Use	Unadjusted Parking Spaces	Adjusted SOV Parking Demand	Adjusted HOV Parking Demand	Shared Parking	Total Parking Demand
Office	1,411	478	46		524
Residential	754	84	18	25%	76
Retail	232	47	11		58
Total ITE Estimate	**2,397**	610	74		658

Based on the adjusted ITE Parking Generation estimates the Project will have a peak parking demand of 658 spaces. As noted previously, the estimated ITE parking generation does not take into account the restrictive zoning requirements or the goals of the City of Boston and the Stuart Street District to reduce the number of parking spaces required for development, and is representative of an "un-constrained" demand.

ULI Shared Parking Analysis

As discussed above, the Project proposes to implement a shared parking strategy between the office, residential, and retail components of the new Project. Implementing a shared parking philosophy within the Garage allows the Project to eliminate the need to build new parking as well as reduce the number of designated spaces for the new Project.

A shared parking analysis was conducted following the standard practices suggested in the Urban Land Institute's (ULI) Shared Parking report, second edition (2015, latest available report). The current standard practices suggested in the ULI Shared Parking report use specific parking demand rates (a ratio of the number of parking spaces needed over a standard measure, e.g. per unit, per 1,000 square feet, etc.) needed to support a similar stand-along use. Table 4-60 shows the base parking rates documented in the Shared Parking report by land use for employees, residents, and visitors. These rates are associated with weekday peak period conditions, as parking demand in the area will be highest during the weekday due to the high amount of office uses at the Project Site and within the surrounding area.

TABLE 4-60 ULI SHARED PARKING RATIOS

Land Use	Employees	Residents	Units
Office (>500,000 sf)	2.6	-	Per 1,000 GFA
Retail	0.7	-	Per 1,000 GFA
Residential	-	0.5	Per unit

Based on the standard ULI methodology these base factors are adjusted using three factors: 1) mode split (percent drive), 2) non-captive parking demand reductions, and 3) temporal variations (hourly and seasonal).

Mode Split (Percent Drive) represents the percentage for users that drive to the Site. For residences, this is the percentage that leave their car at home during the day (if 40 percent drive to work, then 60 percent, leave their car at home). The mode splits used for this analysis are based off of the mode shares previously presented (See Section 4.5.4 – Mode Share and AVO).

Non-Captive Factors represent the decrease in parking demand due to users visiting multiple uses on-site during a single visit and therefore only one parking space is needed for multiple trips to various land uses. These factors are based on percentages provided in the ULI Shared Parking report and are provided in Appendix F.

Temporal Variations are parking demand variations that happen throughout the day and the year. The ULI Shared Parking report provides hourly and seasonal adjustments used for this analysis and are provided in Appendix F.

An analysis addresses multiple times of the day during the month of October, a typical time of the year. Tables 4-61a and 4-61b provide the adjustment factors used for each land use and the calculated shared parking demand for the Project based on the standard ULI Shared Parking methodology.

TABLE 4-61A WEEKDAY PARKING DEMAND INPUTS

Land Use – User Group	Size (KSF or Units)	ULI Parking Ratio	Unadjusted Demand	Mode Split	Unshared Demand	Non-Captive Factor	Monthly Adjustment (Oct)
Office SOV	582.6 KSF	2.6	1,515	30%	455	98%	100%
Office HOV	582.6 KSF	2.6	1,515	7%	43	98%	100%
Retail SOV	58.9 KSF	0.7	41	30%	7	100%	80%
Retail HOV	58.9 KSF	0.7	41	7%	2	100%	80%
Residential SOV	600 units	0.5	300	81%	243	100%	100%
Residential HOV	600 units	0.5	300	96%	101	100%	100%
Total Parking Space Demand			**3,712**		**852**		

TABLE 4-61B WEEKDAY PARKING DEMAND

Land Use – User Group	Peak Hour Adjustment (8 AM)	Shared Parking Demand	Peak Hour Adjustment (2 PM)	Shared Parking Demand	Peak Hour Adjustment (5 PM)	Shared Parking Demand	Peak Hour Adjustment (10 PM)	Shared Parking Demand
Office SOV	75%	334	100%	446	50%	223	1%	3
Office HOV	75%	32	100%	42	50%	21	1%	0
Retail SOV	40%	2	95%	5	95%	5	40%	0
Retail HOV	40%	1	95%	1	95%	1	40%	0
Residential SOV	60%	146	70%	170	85%	207	100%	88
Residential HOV	60%	61	70%	71	85%	86	100%	37
Total Parking Space Demand		**576**		**735**		**543**		**128**

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The ULI Shared Parking analysis estimates the peak parking demand to be 735 at 2:00 PM on a weekday. During the beginning and end of a traditional work day, the analysis estimates that the parking demand would be 576 at 8:00 AM and 543 at 5:00 PM. Overnight the parking demand would be residential parking and a few office employees for a demand of approximately 128.

The ULI Shared Parking analysis estimates a peak parking demand higher than the adjusted ITE Parking Generation estimate of 658. Again as noted previously, the estimated ULI analysis does not take into account the restrictive zoning requirements or the goals of the City of Boston and the Stuart Street District to reduce the number of parking spaces required for development, and is more representative of an "un-constrained" demand.

In conclusion, while the analysis identifies benchmark parking demand estimates based on ITE and ULI methodologies, the Project as proposed seeks to capitalize on the TOD aspect of the Site as well as implement TDM measures to reduce the Project's demand for parking. Therefore, the Project has established the 437 provided parking spaces as a goal consistent with current local City of Boston trends and policy objectives. It is also important to note that while only 437 spaces will be dedicated to the Project, there is additional capacity in the Garage for public parking which can be utilized by patrons of the Project.

As presented in Section 4.3.1, the average turnover rate of parking spaces in the garage is 1.01 times per day, which is expected to increase as a result of the additional Project parking demand. The trip generation analysis presented in Section 4.5.8 projects an average of 1,848 2-way daily Project vehicle trips (total 3,696 enter + exit), although not all of these trips will use the Garage. Assuming that 20 percent of trips comprise taxi, Uber and other drop-off or pick-up trips, 1,478 2-way Project trips are expected to use the garage, which would increase the average parking space turnover rate to 1.44 times per day compared to the existing average turnover rate of 1.01 times per day.

4.9.5 Off-Site Parking Opportunities

As identified in Section 4.2 – Existing Conditions, there are multiple off-site parking options for visitors to the Site. In total there are approximately 6,083 parking spaces within a quarter-mile with a majority of the spaces located in underground garages. These spaces offer a variety of options including daily early-bird specials and incremental, hourly rates to monthly parking and overnight rates.

The parking analysis demonstrates that under a managed scenario, the Garage can support the parking demand of the Project, but if visitors to the Site choose to park elsewhere, there are options within close proximity.

4.9.6 Parking Management Strategy

The Garage is currently monitored daily to ensure monthly cardholders are able to park in the Garage and transient parkers are limited up to the allowable number. Tenants of the area are provided a limited number of parking permits, as outlined in each individual lease, and are charged the full market-rate monthly cardholder price. Other employees or visitors without monthly permits are subject to the market-rate daily rates, currently up to $40.00 per day.

New tenants of the Project will negotiate the number of parking permits and the specified amount will be within the individual leases. All new monthly parking permits will be charged the full market-rate monthly rate. This will encourage more employees to take alternative modes of transportation and reduce the number of monthly parkers parking in the area on a regular basis.

Residents will be provided the opportunity to buy a monthly parking permit at full market-rate or an overnight parking pass at a reduced market rate. This will encourage a low auto-ownership rate and could further reduce the demand for parking in the area, as well as encourage the shared parking strategy.

A portion of the existing parking demand is from transient users. These users comprise employees who do not buy a monthly pass, visitors to area businesses and area retail customers, and are therefore infrequent users of the Garage. Under future conditions there may be a slight increase in such users, but there are many other commuting and parking options within the area, including the (up to) 576 permitted spaces in the Garage for public parking. As previously stated, an objective of the Project's parking plan as a TDM strategy is not to encourage single-occupancy vehicle (SOV) trips by providing unlimited parking.

4.10 Transit Analysis

As discussed in Section 4.2.2 – Transit Facilities and Service, the Project is well served by public transportation and has the added benefit of its adjacency to the Station. As a result, the surrounding transit system will move many people to and from the Site. The Project trip generation analysis estimates that the Project will generate a total of 6,097 daily transit trips (3,060 in, 3,037 out), 603 (463 in, 140 out) of which will occur in the morning peak hour and 632 (185 in, 447 out) in the evening peak hour. The Project-generated transit trips are estimated to contribute an additional approximately $4.6 to 5.8 million in annual revenue for the MBTA based on current fare levels. Table 4-62 provides a summary of the estimated transit trips generated by the site.

TABLE 4-62 PROJECT GENERATED TRANSIT TRIPS

	Employees	Residents	Retail	Total
AM Peak Hour				
In	422	22	19	463
Out	45	83	12	140
Total	467	105	31	603
PM Peak Hour				
In	48	65	72	185
Out	341	38	68	447
Total	389	103	140	632

These trips were assigned to a specific transit mode based on the 2006-2010 5-year American Community Survey CTPP Data, the same data used to develop the Project mode split discussed in Section 4.5.4. Table 4.63a shows the transit mode distribution and Table 4.63b shows the subsequent transit trips assigned to each mode.

TABLE 4-63A TRANSIT TRIP DISTRIBUTION

Transit Mode	Employees	Residents	Retail
Commuter Rail	23.5%	5.1%	23.5%
Orange Line	50.7%	73.5%	50.7%
Green Line	5.7%	8.2%	5.7%
Bus	20.1%	13.2%	20.1%
Total	100.0%	100.0%	100.0%

TABLE 4-63B NUMBER OF TRANSIT TRIPS BY MODE

	Commuter Rail	Orange Line	Green Line	Bus
AM Peak Hour				
In	108	235	27	93
Out	34	69	9	28
Total	142	304	36	121
PM Peak Hour				
In	43	94	11	37
Out	105	226	25	91
Total	148	320	36	128

In order to understand the Project trip impacts on the existing and future transit system an in-depth transit analysis was conducted. The analysis involved a four step approach described below.

1. **Existing Conditions** – For each transit line/route the existing capacity and ridership was quantified using existing data provided by the MBTA and CTPS. A volume to capacity (V/C) ratio was calculated to determine the existing utilization of the line/route.

2. **2023 No-Build Conditions** – CTPS provided future growth estimates for the analyzed lines/routes presented in Table 4-64. These rates were applied to the existing condition ridership numbers to estimate the future 2023 ridership, without the Project. In addition, capacity adjustments were made to lines/routes where future improvements are expected. A V/C ratio was calculated to determine the estimated 2023 future utilization of each line/route without the Project, the 2023 No-Build ridership. The 2023 No-Build V/C ratios provide a baseline to which the Project impacts can be compared.

TABLE 4-64 TRANSIT AVERAGE ANNUAL GROWTH RATES (2016-2023, CTPS)

Transit Mode	AM Peak Hour	PM Peak Hour
Commuter Rail	1.4%	1.2%
Orange Line	1.3%	1.2%
Bus Route #9	4.0%	3.0%
Bus Route #10	0.2%	2.0%
Bus Route #39	0.8%	1.3%
Bus Route #55	0.1%	3.0%
Bus Route #170	1.0%	2.0%
Bus Route #502	2.0%	3.0%
Bus Route #503	4.0%	4.0%

3. **2023 Build Future Conditions –** The estimated Project transit trips were assigned to a transit mode based on local mode split data presented above in Table 4-63a. These trips were further assigned to Inbound and Outbound transit directions based on existing transit volumes and were added to the 2023 No-Build ridership numbers to generate the 2023 Build ridership estimates. The capacity of each line/route was consistent with the capacity projected under the 2023 No-Build Conditions. The V/C ratio and utilization of each line/route with the Project was calculated.

4. **Project Impact –** The 2023 Build V/C ratio was compared to the 2023 No-Build baseline V/C ratio to understand the Project's impact on each line/route.

The Orange Line, MBTA bus routes and Commuter Rail lines were evaluated using the method described above for the morning and evening peak hours.

4.10.1 MBTA Orange Line Analysis

Existing ridership was determined from load profiles provided by the MBTA for April 2016, the most recent data available. Existing Orange Line capacity is based on vehicle load standards from MBTA's Service Delivery Policy and Crush Capacity and MBTA Blue Book 14th edition data, definitions provided below.

- Policy Capacity – refers to the load standards or passengers per car volume defined by the MBTA's Service Delivery Policy which states the standards "establish the average maximum number of passengers allowed per vehicle to provide a safe and comfortable ride." Each vehicle type in the MBTA fleet has a defined "policy capacity" and is published in the MBTA Blue Book.
- Crush Capacity – refers to a higher load capacity of a vehicle and is calculated by adding the number of seated passengers plus 1.5 square feet per standing passenger (2 square feet on buses). The MBTA Blue Book publishes the "crush capacity" for each vehicle type in the MBTA fleet.
- Scheduled Capacity – refers to the capacity of a particular MBTA fleet based on the published schedule and policy/crush capacity of the vehicle type. The scheduled capacity assumes there are no delays that interfere with the number of vehicles scheduled to arrive or service a location within a certain time period, typically the peak period or hour.

On-Time Performance (OTP)

Line capacity also depends on the reliability or On-Time Performance (OTP) of the trains within a specific period of time. Scheduled Orange Line capacity is based on six-minute peak hour headways, trains of six cars each, and a car capacity range between MBTA Policy and Crush capacities, 131 passengers and 224 passengers per car, respectively. The resulting scheduled peak hour capacity ranges from 7,860 and 13,440 passengers. This capacity assumes no delays or reductions in the number of trains servicing Back Bay Station during the peak hour. While this is an idealized assumption, the Orange Line does consistently operate above the MBTA's reliability target. The MBTA publishes OTP measures related to the reliability of their services. MassDOT's Annual Performance Report for fiscal year 2016 defines MBTA Subway reliability as "the percent of customers who wait no longer than the scheduled time between trains. The calculations for this measure do not yet account for the effects of overcrowding or bus shuttles…" As reported for fiscal year 2016, the Orange Line's reliability was 91 percent and during recent months (November 2016) it operated at an average reliability of 93 percent during the peak hour (www.mbtabackontrack.com).

The MBTA's target Subway reliability is 90 percent. This target OTP factor was incorporated into the following Orange Line capacity calculations. The scheduled

capacity was reduced to account for the MBTA's target subway reliability of 90 percent, in order to incorporate the various delays that may sometimes occur on the Orange Line.

Table 4-65 summarizes the existing peak hour Orange Line conditions at the Station under 90 percent of policy capacity. A similar peak hour analysis was conducted using 90 percent of crush capacity and is provided in Appendix F along with detailed calculation sheets.

TABLE 4-65 2016 EXISTING ORANGE LINE UTILIZATION AT BACK BAY STATION – OTP POLICY CAPACITY

	Load Entering	Boarding / Alighting	Load Exiting	OTP Policy Capacity[1]	Entering V/C Ratio	Exiting V/C Ratio
AM Peak Hour						
Outbound (South to Forest Hills)	3,919	221 / 2,260	1,880	7,074	0.55	0.27
Inbound (North to Oak Grove)	5,232	1,109 / 758	5,583	7,074	0.74	0.79
PM Peak Hour						
Outbound (South to Forest Hills)	5,823	745 / 1,092	5,476	7,074	0.82	0.77
Inbound (North to Oak Grove)	2,665	2,365 / 306	4,724	7,074	0.38	0.67

[1] A 90% OTP capacity is reflected in the OPT Policy Capacity calculation

As presented, the existing Orange Line trains are operating within MBTA policy capacity with V/C ratios below 1.0. However, it is important to note that this analysis is conducted for the whole peak hour, and does not recognize the "peak of the peak" conditions which occur within the peak hours. In practice, the Orange Line operates at a V/C ratio of over capacity during the ten to twenty minutes of "peak of the peak" conditions. There are also occurrences where trains are bunched together and do not operate on evenly spaced headways, again increasing V/C at certain times and affecting rider experience. As a result, although the Orange Line operates at or above MBTA target reliability of 90 percent on average, in practice, some overcrowding and delay are experienced by riders.

Future improvements to the Orange Line will address these overcrowding and bunching issues with new Orange Line cars. The new rolling stock, expected to be in service in 2019, will decrease headways from 6 to 4.5 minutes and are expected to make it easier to maintain the scheduled headways. With shortened headways, transit capacity will increase and transit users' wait time will be reduced. The MBTA target reliability OTP factor of 90 percent is reflected in the future policy capacity calculations that follow.

Future ridership projections for the Orange Line, provided by CTPS and shown in Table 4-64, project the morning peak ridership to increase by 1.3 percent annually and the evening peak by 1.2 percent annually. Existing ridership was increased by the average annual growth rate for 7 years to estimate the 2023 No-Build ridership. Table 4-66 summarizes the 2023 No-Build conditions at Back Bay Station.

TABLE 4-66 2023 NO-BUILD ORANGE LINE UTILIZATION AT BACK BAY STATION – OTP POLICY CAPACITY

	Load Entering	Boarding / Alighting	Load Exiting	OTP Policy Capacity[1]	Entering V/C Ratio	Exiting V/C Ratio
AM Peak Hour						
Outbound (South to Forest Hills)	4,290	242 / 2,474	2,058	9,432	0.45	0.22
Inbound (North to Oak Grove)	5,727	1,214 / 830	6,111	9,432	0.61	0.65
PM Peak Hour						
Outbound (South to Forest Hills)	6,330	810 / 1,187	5,953	9,432	0.67	0.63
Inbound (North to Oak Grove)	2,897	2,571 / 333	5,135	9,432	0.31	0.54

[1] A 90% OTP capacity is reflected in the OPT Policy Capacity calculation

The estimated future 2023 No-Build demand is expected to be accommodated by the estimated future capacity. Future ridership, as estimated by CTPS provided growth rates, is expected to increase by approximately 10% over the next 7 years. The capacity increase related to the new Orange Line train cars coming online in 2019 will increase capacity by approximately 30%. The V/C ratios calculated for the 2023 No-Build Condition indicate that the Orange Line will be able to support the estimated future growth.

Project trips assigned to the Orange Line were added to the estimated future 2023 No-Build ridership to produce the Build ridership demand estimates, with the Project fully occupied. The Project trips were assigned to inbound and outbound trains based on the existing ridership load data and shown in Table 4-67. Future Orange Line capacity remains the same for No-Build and Build analyses. Table 4-68 shows the estimated Build load and ridership data. Table 4-69 provides a summary of the V/C ratios for all analyzed conditions.

TABLE 4-67 ORANGE LINE PROJECT GENERATED TRANSIT TRIPS

	Out (Boarding)	In (Alighting)	Total
AM Peak Hour			
Outbound (South to Forest Hills)	11	176	187
Inbound (North to Oak Grove)	58	59	117
Total	69	235	304
PM Peak Hour			
Outbound (South to Forest Hills)	54	73	127
Inbound (North to Oak Grove)	172	21	193
Total	226	94	320

TABLE 4-68 2023 BUILD ORANGE LINE UTILIZATION AT BACK BAY STATION – OTP POLICY CAPACITY

	Load Entering	Boarding / Alighting	Load Exiting	OTP Policy Capacity[1]	Entering V/C Ratio	Exiting V/C Ratio
AM Peak Hour						
Outbound (South to Forest Hills)	4,466	253 / 2,650	2,069	9,432	0.47	0.22
Inbound (North to Oak Grove)	5,786	1,271 / 889	6,169	9,432	0.61	0.65
PM Peak Hour						
Outbound (South to Forest Hills)	6,404	864 / 1,261	6,007	9,432	0.68	0.64
Inbound (North to Oak Grove)	2,918	2,743 / 353	5,307	9,432	0.31	0.56

[1] A 90% OTP capacity is reflected in the OPT Policy Capacity calculation

TABLE 4-69 V/C SUMMARY AT BACK BAY STATION – OTP POLICY CAPACITY

	2016 Existing Conditions		2023 No-Build Conditions		2023 Build Conditions	
	Entering V/C Ratio	Exiting V/C Ratio	Entering V/C Ratio	Exiting V/C Ratio	Entering V/C Ratio	Exiting V/C Ratio
AM Peak Hour						
Outbound (South to Forest Hills)	0.55	0.27	0.45	0.22	0.47	0.22
Inbound (North to Oak Grove)	0.74	0.79	0.61	0.65	0.61	0.65
PM Peak Hour						
Outbound (South to Forest Hills)	0.82	0.77	0.67	0.63	0.68	0.64
Inbound (North to Oak Grove)	0.38	0.67	0.31	0.54	0.31	0.56

With the addition of the Project-generated Orange Line trips, the analysis shows there is negligible impact on all Orange Line loads entering and exiting the Station during the peak hours, although slight increases in the V/C ratio for many of the analyzed periods is shown. Under policy capacities, V/C ratios increase by one or two one-hundredth, which is not expected to have a noticeable effect on existing riders passing through the Station or future riders using the Station.

The need for increased capacity on the Orange Line in the future will be met with the implementation of the new rolling stock in 2019. As demonstrated, the Project's future transit trips are expected to have a negligible impact on the Orange Line under future conditions. Figures 4.20a through 4.20c graphically show the incremental ridership and platform activity impacts on the Orange Line throughout the day.

4.10.2 MBTA Bus Analysis

The MBTA bus analysis focuses on the routes prescribed within the MassDOT DEIR Scope, routes #10, #39, and #170 as well as the commuter express buses #502 and #503 and the local buses #9 and #55. Express bus #504 provides service to the Back Bay/South End area outside of peak commuting hours, stopping in the area between 9:05 AM through 4:00 PM, therefore the #504 is not included in the peak hour V/C analysis. Express bus #553 provides limited service to Back Bay/South End area, only stopping during weekday evening inbound and outbound service after the peak hour. Service is scheduled between 7:10 and 9:55 PM, therefore the #553 was not included in the peak hour V/C analysis.

Existing MBTA bus capacity is based on vehicle load standards from MBTA's Service Delivery Policy and Crush Capacity and MBTA Blue Book 14th edition data, definitions provided previously for policy, crush and scheduled capacity.

Each bus route operates under different frequencies during the peak hours. The number of buses servicing the Back Bay/South End area was determined by the time stamp information provided with the load profile data. Table 4-70 summarizes the existing frequency and capacity of each bus during the morning and evening Project peak hours.

TABLE 4-70 2016 EXISTING PEAK HOUR MBTA BUS FREQUENCY AND CAPACITY AROUND BACK BAY STATION

	Frequency	Policy Capacity per Bus	Peak Hour Policy Capacity	Crush Capacity per Bus	Peak Hour Crush Capacity
AM Peak Hour					
Bus 9 Inbound	11	54	594	74	814
Bus 9 Outbound	8	54	432	74	592
Bus 10 Inbound	3	54	162	74	222
Bus 10 Outbound	4	54	216	74	296
Bus 39 Inbound	8	79	632	104	832
Bus 39 Outbound	10	79	790	104	1,040
Bus 55 Inbound	0	54	0	0	0
Bus 55 Outbound	2	54	108	74	148
Express Bus 170 Inbound	0	54	0	74	0
Express Bus 170 Outbound	2	54	108	74	148
Express Bus 502 Inbound	11	54	594	74	814
Express Bus 502 Outbound	6	54	324	74	444
Express Bus 503 Inbound	4	54	216	74	296
Express Bus 503 Outbound	3	54	162	74	222
PM Peak Hour					
Bus 9 Inbound	7	54	378	74	518
Bus 9 Outbound	9	54	486	74	666
Bus 10 Inbound	3	54	162	74	222
Bus 10 Outbound	3	54	162	74	222
Bus 39 Inbound	8	79	632	104	832
Bus 39 Outbound	9	79	711	104	936
Bus 55 Inbound	0	54	0	0	0
Bus 55 Outbound	2	54	108	74	148
Express Bus 170 Inbound	2	54	108	74	148
Express Bus 170 Outbound	0	54	0	74	0
Express Bus 502 Inbound	5	54	270	74	370
Express Bus 502 Outbound	5	54	270	74	370
Express Bus 503 Inbound	2	54	108	74	148
Express Bus 503 Outbound	2	54	108	74	148

Existing ridership was determined from load profiles provided by the MBTA for Fall 2015, the most recent data available, and are provided in Appendix F. This data was used to calculate an existing V/C ratio. Table 4-71 summarizes the existing MBTA

bus conditions around the Station under policy and crush capacity. Detailed calculation sheets are provided in Appendix F.

TABLE 4-71 2016 EXISTING PEAK HOUR MBTA BUS UTILIZATION AROUND BACK BAY STATION

	Policy Capacity		Crush Capacity	
	Entering V/C Ratio	**Exiting V/C Ratio**	**Entering V/C Ratio**	**Exiting V/C Ratio**
AM Peak Hour				
Bus 9 Inbound	0.51	0.35	0.37	0.25
Bus 9 Outbound	0.25	0.30	0.18	0.22
Bus 10 Inbound	0.33	0.20	0.24	0.14
Bus 10 Outbound	0.25	0.50	0.19	0.36
Bus 39 Inbound	0.06	-	0.05	-
Bus 39 Outbound	-	0.16	-	0.12
Bus 55 Inbound	-	-	-	-
Bus 55 Outbound	0.29	0.31	0.21	0.23
Express Bus 170 Inbound	-	-	-	-
Express Bus 170 Outbound	0.11	0.20	0.08	0.15
Express Bus 502 Inbound	0.38	0.02	0.28	0.01
Express Bus 502 Outbound	0.19	0.16	0.14	0.11
Express Bus 503 Inbound	0.56	0.13	0.41	0.10
Express Bus 503 Outbound	0.06	0.13	0.04	0.09
PM Peak Hour				
Bus 9 Inbound	0.15	0.08	0.11	0.06
Bus 9 Outbound	0.18	0.54	0.13	0.39
Bus 10 Inbound	0.46	0.24	0.34	0.18
Bus 10 Outbound	0.29	0.40	0.21	0.29
Bus 39 Inbound	0.07	-	0.05	-
Bus 39 Outbound	-	0.05	-	0.04
Bus 55 Inbound	-	-	-	-
Bus 55 Outbound	0.31	0.42	0.23	0.30
Express Bus 170 Inbound	0.23	0.05	0.17	0.03
Express Bus 170 Outbound	-	-	-	-
Express Bus 502 Inbound	0.21	0.04	0.15	0.03
Express Bus 502 Outbound	0.04	0.59	0.03	0.43
Express Bus 503 Inbound	0.04	-	0.03	-
Express Bus 503 Outbound	0.07	0.70	0.05	0.51

The existing peak hour ridership within the Back Bay/South End area is accommodated by the existing capacity of the buses under scheduled conditions. The only bus that may experience slight crowding is the #503 outbound express bus leaving the Back Bay/South End area during the evening peak hour.

CTPS provided future ridership projections for bus route as shown previously in Table 4-64. Existing ridership was grown by the average annual growth rate for 7 years to estimate the 2023 No-Build ridership. There is no information on schedule updates to the bus routes and frequencies at this time and therefore no future capacity changes were incorporated into the No-Build analysis. Table 4-72 summarizes the 2023 No-Build conditions surrounding the Station.

TABLE 4-72 2023 NO-BUILD PEAK HOUR MBTA BUS UTILIZATION AROUND BACK BAY STATION

	Policy Capacity		Crush Capacity	
	Entering V/C Ratio	Exiting V/C Ratio	Entering V/C Ratio	Exiting V/C Ratio
AM Peak Hour				
Bus 9 Inbound	0.67	0.46	0.49	0.33
Bus 9 Outbound	0.32	0.40	0.23	0.29
Bus 10 Inbound	0.33	0.20	0.24	0.15
Bus 10 Outbound	0.26	0.51	0.19	0.37
Bus 39 Inbound	0.07	-	0.05	-
Bus 39 Outbound	-	0.17	-	0.13
Bus 55 Inbound	-	-	-	-
Bus 55 Outbound	0.29	0.31	0.21	0.23
Express Bus 170 Inbound	-	-	-	-
Express Bus 170 Outbound	0.12	0.22	0.09	0.16
Express Bus 502 Inbound	0.43	0.02	0.32	0.01
Express Bus 502 Outbound	0.22	0.18	0.16	0.13
Express Bus 503 Inbound	0.74	0.18	0.54	0.13
Express Bus 503 Outbound	0.07	0.17	0.05	0.13
PM Peak Hour				
Bus 9 Inbound	0.18	0.10	0.13	0.07
Bus 9 Outbound	0.22	0.66	0.16	0.48
Bus 10 Inbound	0.53	0.27	0.39	0.20
Bus 10 Outbound	0.33	0.46	0.24	0.34
Bus 39 Inbound	0.08	-	0.06	-
Bus 39 Outbound	-	0.06	-	0.04
Bus 55 Inbound	-	-	-	-
Bus 55 Outbound	0.39	0.52	0.28	0.38
Express Bus 170 Inbound	0.27	0.06	0.20	0.04
Express Bus 170 Outbound	-	-	-	-
Express Bus 502 Inbound	0.26	0.05	0.19	0.04
Express Bus 502 Outbound	0.05	0.73	0.04	0.53
Express Bus 503 Inbound	0.05	-	0.03	-
Express Bus 503 Outbound	0.10	0.93	0.07	0.68

The estimated future 2023 No-Build demand is shown to be accommodated by the existing scheduled capacity. The #503 outbound express bus is close to policy capacity during the evening peak hour, but is still well below the crush capacity.

Bus Project trips were assigned to each route based on the projected future growth provided by CTPS and added to the estimated future No-Build ridership to produce the Build ridership demand estimates, with the Project fully occupied. Table 4-73 shows the number of Project trips assigned to analyze each bus route.

TABLE 4-73 PROJECT-GENERATED PEAK HOUR TRIPS BY MBTA BUS ROUTE AROUND BACK BAY STATION

	Out (Boarding)	In (Alighting)	Total
AM Peak Hour			
Bus 9 Inbound	-	31	31
Bus 9 Outbound	9	-	9
Bus 10 Inbound	-	2	2
Bus 10 Outbound	1	-	1
Bus 39 Inbound	-	6	6
Bus 39 Outbound	2	-	2
Bus 55 Inbound	-	-	-
Bus 55 Outbound	0	1	1
Express Bus 170 Inbound	-	-	-
Express Bus 170 Outbound	2	8	10
Express Bus 502 Inbound	-	15	15
Express Bus 502 Outbound	5	-	5
Express Bus 503 Inbound	-	31	31
Express Bus 503 Outbound	9	-	9
PM Peak Hour			
Bus 9 Inbound	-	6	6
Bus 9 Outbound	15	-	15
Bus 10 Inbound	-	4	4
Bus 10 Outbound	10	-	10
Bus 39 Inbound	-	3	3
Bus 39 Outbound	6	-	6
Bus 55 Inbound	-	-	-
Bus 55 Outbound	15	6	21
Express Bus 170 Inbound	10	4	14
Express Bus 170 Outbound	-	-	-
Express Bus 502 Inbound	-	6	6
Express Bus 502 Outbound	15	-	15
Express Bus 503 Inbound	-	8	8
Express Bus 503 Outbound	20	-	20

Table 4-74 provides a summary of the policy and crush V/C ratios for the Build Condition.

TABLE 4-74 2023 BUILD PEAK HOUR MBTA BUS UTILIZATION AROUND BACK BAY STATION

	Policy Capacity		Crush Capacity	
	Entering V/C Ratio	Exiting V/C Ratio	Entering V/C Ratio	Exiting V/C Ratio
AM Peak Hour				
Bus 9 Inbound	0.72	0.46	0.52	0.33
Bus 9 Outbound	0.32	0.42	0.23	0.31
Bus 10 Inbound	0.35	0.20	0.25	0.15
Bus 10 Outbound	0.26	0.51	0.19	0.38
Bus 39 Inbound	0.08	-	0.06	-
Bus 39 Outbound	-	0.17	-	0.13
Bus 55 Inbound	-	-	-	-
Bus 55 Outbound	0.30	0.31	0.22	0.23
Express Bus 170 Inbound	-	-	-	-
Express Bus 170 Outbound	0.19	0.24	0.14	0.18
Express Bus 502 Inbound	0.46	0.02	0.33	0.01
Express Bus 502 Outbound	0.22	0.19	0.16	0.14
Express Bus 503 Inbound	0.88	0.18	0.64	0.13
Express Bus 503 Outbound	0.07	0.23	0.05	0.17
PM Peak Hour				
Bus 9 Inbound	0.20	0.10	0.14	0.07
Bus 9 Outbound	0.22	0.69	0.16	0.51
Bus 10 Inbound	0.56	0.27	0.41	0.20
Bus 10 Outbound	0.33	0.52	0.24	0.38
Bus 39 Inbound	0.08	-	0.06	-
Bus 39 Outbound	-	0.07	-	0.05
Bus 55 Inbound	-	-	-	-
Bus 55 Outbound	0.44	0.66	0.32	0.48
Express Bus 170 Inbound	0.31	0.15	0.22	0.11
Express Bus 170 Outbound	-	-	-	-
Express Bus 502 Inbound	0.28	0.05	0.20	0.04
Express Bus 502 Outbound	0.05	0.78	0.04	0.57
Express Bus 503 Inbound	0.12	-	0.09	-
Express Bus 503 Outbound	0.10	1.11	0.07	0.81

The Project-generated trips have a slight impact on the bus capacity, with all Bus routes expected to continue to operate well within MBTA policy capacity (with V/C ratios below 1.0) except for the #503 express outbound bus during the evening peak

hour. While policy capacity is over 1.0, the bus still continues to operate well below crush capacity.

Route 39 Bus Terminus Relocation

As the development of the Station East Parcel will require the terminus of the Route 39 Bus to be relocated, the Proponent has been working with the MBTA to identify an acceptable alternative. MBTA Service Planning performed an analysis of the various alternative routings for the Bus Route 39. The preferred option reroutes Bus 39 around Copley Square and provides a bus stop at the existing St. James Street stop, easily accessible from the Station. The preferred option reduces overall route travel time and better aligns the route with the Green Line and other existing bus routes at the St. James Street stop. MBTA Service planning analyzed the service impacts of the proposal and deemed it to be preferable to all other options because it had the largest travel time savings and did not have a significant impact on riders' experience. The travel time savings under this option is expected to improve headways and thereby increase customer satisfaction and ridership on Route 39. Figure 4.21 presents the MBTA preferred re-routing for the 39 Bus.

MBTA Service Planning also determined that an "equity analysis" (statistical comparison on adverse impact results from a proposed change to service) was not required for the proposed rerouting of Route 39, as the scope of this change does not constitute a "major service change."

No relocation of Bus 39 is anticipated until the Station East Parcel is actually developed.

4.10.3 Commuter Rail Analysis

The Station is serviced by four Commuter Rail lines with a terminus at each of South Station, Franklin, Needham, Providence/Stoughton, and Framingham/Worcester. Existing load volumes for Back Bay Station were provided by CTPS, from passenger counts conducted in 2012. The counts provided ons, offs, and loads exiting the station for three hours of the morning peak period, 6:00 AM-9:00 AM, and three hours of the evening peak period, 3:00 PM-6:00 PM. The provided passenger load data was grown by CTPS provided average annual growth factors for four (4) years to estimate the 2016 ridership information at the Station. A peak hour factor was used to adjust the three hour volumes to one-hour morning and evening peaks. It was assumed that 60 percent of the three-hour volume was serviced at the Station during the peak, one-hour, analysis period.

Additionally, passenger boarding and alighting data was checked with more recent pedestrian counts conducted at the Station. As part of the Back Bay Station Concourse Improvements Project, pedestrian volume counts were conducted on the concourse level on Thursday, September 10, 2015. Peak period counts collected, among others, entry and exit data for the five Commuter Rail tracks at the Station during the morning peak period, 7:00 to 9:00 AM and evening peak period 4:00 to

6:00 PM. Information on train arrivals and estimated passenger boarding's and alighting's from each Commuter Rail train were estimated. This information was used to verify the 2012 ridership volumes grown to estimate 2016 existing volumes, discussed above. Based on the peak hours, the 2015 station pedestrian counts are similar to the 2016 estimated volumes.

Assumptions were also made to estimate the peak hour capacity of the Commuter Rail lines. Current train schedules were used to determine the number of trains servicing each line during the peak hours and the MBTA 2014 provided commuter car seat information. Each fleet of commuter cars provides a different number of seats and the number of cars in each train can vary depending on the historic passenger demand volumes. An average number of seats per car was determined to be 143 passengers/car and the average number of cars per train was assumed as six. Based on these assumptions and the estimated passenger volumes, existing morning and evening peak hour V/C ratios were calculated. Table 4-75 summarizes the volume, capacity, and V/C ratio of the four Commuter Rail lines.

TABLE 4-75 2016 EXISTING ESTIMATED PEAK HOUR COMMUTER RAIL UTILIZATION AT BACK BAY STATION

	Load Entering	Boarding / Alighting	Load Exiting	Estimated Capacity	Entering V/C Ratio	Exiting V/C Ratio
Franklin Line						
AM Peak Hour						
Inbound (to South Station)	1,856	14 / 728	1,142	2,574	0.72	0.44
Outbound (to Franklin)	9	15 / 1	23	858	0.01	0.03
PM Peak Hour						
Inbound (to South Station)	72	13 / 33	52	1,716	0.04	0.03
Outbound (to Franklin)				2,574	0.40	0.62
Needham Line						
AM Peak Hour						
Inbound (to South Station)	953	12 / 297	668	1,716	0.56	0.39
Outbound (to Needham)	78	13 / 59	32	858	0.09	0.04
PM Peak Hour						
Inbound (to South Station)	31	19 / 16	34	858	0.04	0.04
Outbound (to Needham)	659	328 / 5	982	858	0.77	1.14
Providence/Stoughton Line						
AM Peak Hour						
Inbound (to South Station)	4,038	27 / 1,848	2,217	4,290	0.94	0.52
Outbound (to Providence/Stoughton)	147	51 / 61	137	858	0.17	0.16
PM Peak Hour						
Inbound (to South Station)	152	40 / 94	98	2,574	0.06	0.04
Outbound (to Providence/Stoughton)	1,988	1,157 / 20	3,125	3,432	0.58	0.91
Framingham/Worcester Line						
AM Peak Hour						
Inbound (to South Station)	2,325	28 / 974	1,379	3,432	0.68	0.40
Outbound (to Framingham/Worcester)	86	80 / 9	157	858	0.10	0.18
PM Peak Hour						
Inbound (to South Station)	129	2 / 35	96	858	0.15	0.11
Outbound (to Framingham/Worcester)	1,122	591 / 12	1,701	3,432	0.33	0.50

The peak commuter directions are heavily utilized as show by the calculated V/C ratios. The evening peak hour trains headed outbound on the Needham line are estimated to be over capacity. It should be noted that the peak hour ridership has

been estimated from three hour counts and the capacity of each train has been approximated, but individual train capacities can vary, which could change V/C ratios slightly.

The estimated existing ridership volumes were grown by the average annual growth rates for the Commuter Rail provided by CTPS, 1.4 percent for the morning peak and 1.2 percent for the evening peak, for seven years to estimate the 2023 No-Build Condition passenger volumes. No changes to the line capacities were made. The resulting V/C ratios are presented in Table 4-76.

TABLE 4-76 2023 NO-BUILD ESTIMATED PEAK HOUR COMMUTER RAIL UTILIZATION AT BACK BAY STATION

	Load Entering	Boarding / Alighting	Load Exiting	Estimated Capacity	Entering V/C Ratio	Exiting V/C Ratio
Franklin Line						
AM Peak Hour						
Inbound (to South Station)	2,046	15 / 802	1,259	2,574	0.79	0.49
Outbound (to Franklin)	9	17 / 1	25	858	0.01	0.03
PM Peak Hour						
Inbound (to South Station)	79	14 / 36	57	1,716	0.05	0.03
Outbound (to Franklin)	1,133	600 / 10	1,723	2,574	0.44	0.67
Needham Line						
AM Peak Hour						
Inbound (to South Station)	1,050	13 / 327	736	1,716	0.61	0.43
Outbound (to Needham)	86	14 / 65	35	858	0.10	0.04
PM Peak Hour						
Inbound (to South Station)	33	21 / 17	37	858	0.04	0.04
Outbound (to Needham)	716	357 / 5	1,068	858	0.83	1.24
Providence/Stoughton Line						
AM Peak Hour						
Inbound (to South Station)	4,451	30 / 2,037	2,444	4,290	1.04	0.57
Outbound (to Providence/Stoughton)	162	56 / 67	151	858	0.19	0.18
PM Peak Hour						
Inbound (to South Station)	166	43 / 102	107	2,574	0.06	0.04
Outbound (to Providence/Stoughton)	2,161	1,258 / 22	3,397	3,432	0.63	0.99
Framingham/Worcester Line						
AM Peak Hour						
Inbound (to South Station)	2,563	31 / 1,074	1,520	3,432	0.75	0.44
Outbound (to Framingham/Worcester)	95	88 / 10	173	858	0.11	0.20
PM Peak Hour						
Inbound (to South Station)	140	2 / 38	104	858	0.16	0.12
Outbound (to Framingham/Worcester)	1,220	642 / 13	1,849	3,432	0.36	0.54

The estimated increase in ridership will have some effects of the Commuter Rail lines, particularly the morning inbound Providence/Stoughton line which estimates future ridership demands higher than the estimated capacities. The reverse commuter, the evening outbound Providence/Stoughton line is estimated to operate at a V/C ratio of 0.99, just under the estimated capacity.

Commuter Rail Project trips were added to the 2023 No-Build estimated ridership to understand the impacts the Project will have on the capacity of each line. Trips were assigned to the lines servicing Back Bay Station based on existing ridership volumes and are presented in Table 4-77. Commuter Rail Build utilization is summarized in Table 4-78.

TABLE 4-77 PROJECT-GENERATED COMMUTER RAIL TRIPS AT BACK BAY STATION

	Franklin Line		**Needham Line**		**Providence/ Stoughton Line**		**Framingham/ Worcester Line**	
AM Peak Hour	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound
In	20	0	8	2	50	2	26	0
Out	2	2	2	2	4	7	4	11
Total	22	2	10	4	54	9	30	11
PM Peak Hour								
In	6	2	3	1	18	4	7	2
Out	0	21	1	13	2	45	0	23
Total	6	23	4	14	20	49	7	25

TABLE 4-78 2023 BUILD ESTIMATED PEAK HOUR COMMUTER RAIL UTILIZATION AT BACK BAY STATION

	Load Entering	Boarding / Alighting	Load Exiting	Estimated Capacity	Entering V/C Ratio	Exiting V/C Ratio
Franklin Line						
AM Peak Hour						
Inbound (to South Station)	2,066	17 / 822	1,261	2,574	0.80	0.49
Outbound (to Franklin)	9	19 / 1	27	858	0.01	0.03
PM Peak Hour						
Inbound (to South Station)	85	14 / 42	57	1,716	0.05	0.03
Outbound (to Franklin)	1,135	621 / 12	1,744	2,574	0.44	0.68
Needham Line						
AM Peak Hour						
Inbound (to South Station)	1,058	15 / 335	738	1,716	0.62	0.43
Outbound (to Needham)	88	16 / 67	37	858	0.10	0.04
PM Peak Hour						
Inbound (to South Station)	36	22 / 20	38	858	0.04	0.04
Outbound (to Needham)	717	370 / 6	1,081	858	0.84	1.24
Providence/Stoughton Line						
AM Peak Hour						
Inbound (to South Station)	4,501	34 / 2,087	2,448	4,290	1.05	0.57
Outbound (to Providence/Stoughton)	164	63 / 69	158	858	0.19	0.18
PM Peak Hour						
Inbound (to South Station)	184	45 / 120	109	2,574	0.07	0.04
Outbound (to Providence/Stoughton)	2,165	1,303 / 26	3,442	3,432	0.63	1.00
Framingham/Worcester Line						
AM Peak Hour						
Inbound (to South Station)	2,589	35 / 1,100	1,524	3,432	0.75	0.44
Outbound (to Framingham/Worcester)	95	99 / 10	184	858	0.11	0.21
PM Peak Hour						
Inbound (to South Station)	147	2 / 45	104	858	0.17	0.12
Outbound (to Framingham/Worcester)	1,222	665 / 15	1,872	3,432	0.36	0.55

The Project trips have negligible impacts to the estimated future ridership and V/C operations. The small number of trips added to the evening peak hour outbound

Providence/Stoughton line causes the V/C ratio to increase by 0.01 to show a V/C of 1.0.

4.10.4 Station Platform Analysis

The development of the Station East Parcel will result in small reductions to existing track-level platform areas as a result of the new structural columns necessary to support the residential building above. Currently, the Orange Line center platform, which serves both Inbound and Outbound Orange Line trains, has an approximate total area of 10,600 square feet, and the heaviest platform loadings occur when both an Inbound and Outbound train are present simultaneously. Based on existing peak hour ridership, the maximum number of passengers on the platform as a result of an Inbound and Outbound train arriving simultaneously is approximately 450 passengers (average boardings and alightings for both trains), yielding a platform density of approximately 23.5 square feet per passenger.

As a result of the changes to accommodate the Station East building, the platform area will be reduced to approximately 9,400 square feet, a reduction of approximately 11 percent. However, under 2023 conditions, the Orange Line headways are projected to be reduced from 6 minutes to 4.5 minutes. This improvement in headways will have the effect of reducing the number of passengers per train by approximately 30 percent. Therefore, under 2023 No Build Conditions, when the maximum platform loading is projected to be approximately 375 passengers, the platform density will be reduced to 25 square feet per passenger, a slight improvement over Existing Conditions.

Under 2023 Build Conditions, assuming the additional ridership from all Project-generated trips, the maximum platform loading is projected to increase by approximately 25 passengers to 400 passengers per train (inbound and outbound train arriving simultaneously). This is expected to result in a platform density of 23.5 square feet per passenger, which is the same density experienced under Existing Conditions today.

In addition, Commuter Rail platforms 1/3 and 5/7 will also experience small reductions due to columns from the Station East building. Four columns will land on platform 1/3, occupying a total of 144 square feet. Existing egress widths will be maintained, and no measurable impact is expected. Two columns will land at the easternmost portion of platform 5/7 at a location that is not used for train boarding or alighting. This impact will not be noticeable to users of this platform.

4.10.5 Station Concourse Improvements Project

In parallel with the Project and in coordination with the MBTA, through a separate but related project, the Proponent has begun making significant functional and aesthetic improvements to, and has assumed property management responsibilities of, the Station Concourse in an effort to dramatically improve customer experience and comfort. In addition, the MBTA is currently undertaking a parallel project to

improve ventilation at the track level and provide an environmental separation between the platform and concourse levels.

The Station Concourse renovation is anticipated to begin in 2018 in conjunction with the MBTA track-level ventilation project, although a renovation of the public restrooms already began in January 2017 and is expected to be complete in mid-2017. The Station renovations are important not only for transit customers, but also to the adjacent Back Bay, South End and Bay Village neighborhoods and for the City of Boston. Despite its iconic and thoughtful design, the Station has suffered from years of deferred maintenance and is in need of renovation.

There are four major goals guiding the Station Concourse Improvements:

1. Create a first-class "Airport Quality" Transit Hub.
2. Improve customer experience and access.
3. Generate revenue to support Station operations.
4. Allow the MBTA to focus on Transit operations and the Proponent to focus on property management.

A more detailed discussion of the Station Concourse Improvements project can be found in Section 3.4.4 and Appendix E.

4.11 Bicycle Analysis

4.11.1 Summary of Existing Conditions

As identified in Section 4.3.3 and illustrated in Figure 4.5a and 4.5b the Project is in close proximity to a well-connected bicycle network and within a quarter-mile of four existing Hubway stations. The existing Project Site provides approximately 20 bicycle racks (~40 spaces) around the Project Site, with an observed demand for additional spaces. A variety of long-term spaces are provided within the Project Site, from covered outdoor spaces to spaces located within the Garage and additional spaces within the Station. A total of approximately 132 spaces are distributed between those three long-term parking locations. It was observed that the covered, outdoor spaces and spaces within the Garage had limited use, while the spaces within the Station at the Pedal and Park facility were highly utilized with a demand for more.

4.11.2 Project Bicycle Parking

The Project will provide a variety of bicycle parking options for employees, residents and visitors of the Project Site. Short-term, outdoor bicycle parking will be provided throughout the Project Site with a focus on locations near the Station and retail entrances. A total of 70 spaces (35 racks) are proposed for the entire Project, and, if demand warrants, additional racks will be installed. Garage West will provide 30

spaces (15 racks) and Station West will provide 20 spaces (10 racks). Station East and Garage East will provide 10 spaces (5 racks) each. The spaces will be conveniently located near retail spaces and building entrances. In addition, a number of spaces will be located in close proximity to the Station entrances. The Project is also proposing to provide a new Hubway Station on the Clarendon Street Plaza near the Station entrance.

Long-term, covered and secure bicycle parking will be provided in four bike rooms located throughout the Project Site, one for each parcel. For the residential Project Components, a ratio of 0.5 spaces per unit will be employed to determine the long-term bike parking to be provided. The four secure rooms will provide up to approximately 480 total spaces for employees and residents of the Project. Table 4-79 shows the number of spaces provided for each Parcel.

TABLE 4-79 LONG-TERM BICYCLE PARKING

Land Use	Garage West[1]	Garage East[2]	Station East[2]	Station West	Total
Office	150	-	-	-	150
Retail	12	-	3[3]	15	30
Residential	-	120	180	-	300
Total	162	120	180[3]	18[3]	480

1 Under the Garage West Alternate Scheme, the same amount of bicycle parking will be provided for each Project Component.

2 Based on a ratio of 0.5 spaces per unit.

3 Station East long-term retail bike spaces will be combined with Station West long-term spaces to provide 18 spaces within the Station East Parcel as shown in Figure 4.22.

Figure 4.22 shows the proposed bicycle parking locations and new Hubway location.

4.11.3 Future Bicycle Facilities/Infrastructure

In addition to the Project bicycle parking spaces (70 short-term outdoor spaces and 480 long-term covered and secure spaces), the Station Concourse Improvements project, discussed previously, will provide additional commuter bicycle parking within the Station. The existing Pedal and Park facility within the Station provides 40 bicycle spaces, the new space will double the amount of parking, with up to 80 bicycle spaces. See Figure 4.22.

Bicycle infrastructure improvements are planned to be implemented along Stuart and Dartmouth Streets by other approved projects. As documented in the Copley Place Project TAPA, the redesigned intersection of Dartmouth Street at Stuart Street, shows sharrows on Dartmouth Street south of the intersection and on Stuart Street to the west of the intersection. That project will redesign the section of Stuart Street from Dartmouth Street to Trinity Place to accommodate a five-foot bike lane on the north side of the street. It is anticipated that this bike lane will be continued from Trinity Place to Clarendon Street with the 40 Trinity project. With the development of

the Garage West Parcel, the Project will coordinate its street frontage, adjacent drop-off/bus stop lane and adjacent traffic lanes with the future bike lane to be created.

In conjunction with the development of the Station East Parcel, the Proponent will discuss with BTD the provision of sharrows along Clarendon Street from the Stanhope/Trinity Place alleyways to Columbus Avenue and the provision of a bike box on the approach to Columbus Avenue.

4.12 Pedestrian Analysis

4.12.1 Summary of Existing Conditions

As identified in Section 4.2.4, the Project Site is well served by pedestrian facilities including sidewalks along all local roadways, crosswalks at all study area intersections and activated streetscapes and building fronts. Sidewalks near the Project Site are in good condition and striped crosswalks and pedestrian signals are available at all study area signalized intersections.

4.12.2 Future Pedestrian Facilities/Infrastructure

The Project represents a substantial design and functional upgrade to the Project Site and provides a number of benefits to both the immediate neighborhoods and the City of Boston. The design for each of the Air Rights Development Parcels will dramatically improve the character of the public realm and neighborhood access at many levels, and the area will be significantly enhanced by the urban design and architectural character of the Project. Key urban design benefits include:

Improved Street and Pedestrian Environment –

- The Project will create a high-quality continuous street frontage activated by vibrant and engaging ground floor uses, such as retail and restaurant spaces, and residential and commercial building lobbies. Through the use of glass facades wherever possible, the Project will provide transparency and create an inviting and safe ground-level experience for pedestrians.
- A greatly improved street-level experience with the removal of the two existing concrete parking drums on the Garage West and East Parcels, the removal of a section of deck along Stuart Street, and the rationalization of the existing service and parking area located under the Garage at the rear of abutting properties along Stuart Street.
- The Project will provide a significantly upgraded streetscape on all parcels, including new sidewalks, street lighting, landscaping and other public amenities along Dartmouth, Stuart and Clarendon Streets, consistent with the BTD's Complete Streets guidelines.

- With the development of the Garage West Parcel, the Project will create a new Station entrance on Stuart Street and a new indoor, weather-protected accessible through-block connection to the Station from Stuart Street, flanked by new retail improvements, thus increasing neighborhood connectivity and improving public safety within the district.
- With the development of the Station East Parcel, the Project will create a new Station entrance on Clarendon Street and a new indoor, weather-protected accessible through-block connection to the Station from Clarendon Street, flanked by new retail improvements, thus increasing neighborhood connectivity and improving public safety within the district.
- With the development of the Station East Parcel, a new 11,000 square foot public plaza will be delivered off Clarendon Street, adding to the neighborhood's inventory of open space and creating connections to other area parks, including the Southwest Corridor Park and Frieda Garcia Park.
- With the development of the Station West Parcel, the existing open space on Dartmouth Street will be improved to offer an attractive public plaza connected to an expanded and relocated crosswalk, dramatically improving the connection with the Southwest Corridor Park and creating a welcoming civic entrance to the Station.

Improved Accessibility –

- The Project will enhance accessibility throughout the Site by regrading sidewalk slopes where possible, providing generous sidewalk widths that meet or exceed BTD's Complete Street Guidelines, and delivering the aforementioned fully enclosed, accessible connections from Stuart and Clarendon Streets to the Station with the development of the Garage West and Station East Parcels, respectively.
- With the development of the Garage West Parcel, the Project will create a new accessible drop-off lane along Stuart Street, in proximity to the future new Station entrance.
- With the development of the Station East Parcel, the Project will create a new accessible drop-off lane serving both the Project and the Station, in proximity to the future new Station entrance.
- With the development of the Station East Parcel, accessibility to the Station will be significantly improved through the addition of redundant elevators to the MBTA Orange Line and Commuter Rail tracks 1/3 and 2, where feasible.
- With the development of the Station West Parcel, the Project will enlarge the Dartmouth Street crosswalk, significantly improving pedestrian safety and enhancing the link between the Station and the Southwest Corridor Park.

The improvements and benefits summarized above are described in detail previously in Chapter 3, *Urban Design*.

4.12.3 Pedestrian LOS

Pedestrian level-of-service (PLOS) was analyzed using the methodology outlined in the latest HCM. PLOS at signalized intersections is dictated by the portion of the signal cycle dedicated to the pedestrian crossing. Accordingly, increasing pedestrian volumes does not alter PLOS at signalized intersections. As walk times and cycle lengths will not change between Existing, No-Build, and Build Conditions, PLOS will remain the same under all conditions. Table 4-80 provides the PLOS at each signalized intersection crosswalks for morning and evening peak hours.

For signalized intersections, the PLOS is calculated using the crosswalk length and the conflicting vehicular flow rates for the morning and evening peak hours. Table 4-81a and 4-81b provide the PLOS for each unsignalized intersection crosswalks for morning and evening peak hours, respectively.

TABLE 4-80 SIGNALIZED PEDESTRIAN LEVEL OF SERVICE (PLOS)

Intersection	Crosswalk	AM PLOS	PM PLOS
1. Boylston Street/ Clarendon Street	East	C	C
	West	C	C
	North	B	B
	South	B	B
2. Boylston Street/ Berkeley Street	East	D	D
	West	D	D
	North	C	C
	South	C	C
3. St. James Avenue/ Dartmouth Street	East	C	C
	West	C	C
	North	B	B
	Southwest	B	B
	South	B	B
5. St. James Avenue/ Clarendon Street	East	B	B
	West	B	B
	North	B	C
	South	B	C
6. St. James Avenue/ Berkeley Street	East	D	D
	West	D	D
	North	B	B
	South	B	B
7. St. James Avenue/ Arlington Street	East	E	E
	West	E	E
	North	B	C
	South	B	C

Intersection	Crosswalk	AM PLOS	PM PLOS
8. Huntington Avenue/ Exeter Street/Stuart Street	East	E	E
	West	E	E
	North	C	C
	Northeast	E	E
	South	C	C
9. Stuart Street/Dartmouth Street	East	C	C
	West	C	C
	North	B	B
	South	B	B
10. Stuart Street/Trinity Place	East	D	C
	West	D	C
	North	A	A
	South	A	A
11. Stuart Street/ Clarendon Street	East	B	B
	West	B	B
	North	B	B
	South	B	B
12. Stuart Street/Berkeley Street	East	D	D
	West	C	C
	North	D	D
	South	A	A
13. Stuart Street/Arlington Street	East	E	E
	West	D	D
	North	D	D
	Northeast	D	D
	South	E	E
	Southwest	D	D
17. Columbus Avenue/ Dartmouth Street	East	D	E
	West	D	E
	North	B	B
	South	B	B
18. Columbus Avenue/ Clarendon Street	East	D	D
	West	D	D
	North	D	D
	South	D	D

Intersection	Crosswalk	AM PLOS	PM PLOS
20. Columbus Avenue/ Berkeley Street	East	D	D
	West	D	D
	North	C	C
	South	C	C
21. Arlington Street/ Marginal Road/I-90 On-Ramp	East	B	B
	West	B	B
	North	C	C
22. Arlington Street/ Herald Street/Tremont Street	East	D	D
	West	D	D
	North	D	D
	South	D	D
23. Albany Street/Herald Street	West	C	B
	North	E	D
25. Albany Street/Traveler Street	West	D	B
	South	E	E
26. Traveler Street/Frontage Road/W Broadway/I-93 Northbound On-Ramp/I-90 Westbound On-Ramp	East	E	E
	South	D	C

TABLE 4-81A UNSIGNALIZED PEDESTRIAN LEVEL OF SERVICE (PLOS) – AM PEAK HOUR

Intersection	Crosswalk	Existing	No-Build Base	No-Build Alternate	Build Base	Build Alternate
4. St. James Avenue/ Trinity Place	East	E	E	E	E	E
	West	A	A	A	A	A
	South	F	F	F	F	F
15. Clarendon Street/ Stanhope Street	East	F	F	F	F	F
	West	A	A	A	A	A
	North	A	A	A	A	B
16. Clarendon Street/ Garage Driveway	West	B	B	B	D	D

Note: Base assumes On-Ramp is open, Alternate assumes On-Ramp is closed.

TABLE 4-81B UNSIGNALIZED PEDESTRIAN LEVEL OF SERVICE (PLOS) – PM PEAK HOUR

Intersection	Crosswalk	Existing	No-Build Base	No-Build Alternate	Build Base	Build Alternate
4. St. James Avenue/ Trinity Place	East	F	F	F	F	F
	West	A	A	B	A	B
	South	F	F	F	F	F
15. Clarendon Street/ Stanhope Street	East	F	F	F	F	F
	West	A	A	A	A	A
	North	A	A	A	A	A
16. Clarendon Street/Garage Driveway	West	B	B	B	D	D

Note: Base assumes On-Ramp is open, Alternate assumes On-Ramp is closed.

The unsignalized intersections experience a slight change in PLOS in the Build and Build Alt condition in the morning and the No-Build Alt, Build, and Build Alt conditions in the evening. The crosswalk at Clarendon Street/Garage Driveway experiences a decrease from PLOS B to PLOS D in the Build condition for both morning and evening peak due to the addition of project trips entering and exiting the garage at Clarendon Street. The west crosswalk at St. James Avenue/Trinity Place decreases form PLOS A to PLOS B in the No-Build Alt and Build Alt in the evening peak hour. This is due to the reassignment of exiting trips onto Trinity Place that turn left onto St. James Avenue to access Huntington Avenue and I-90.

While the Project is expected to increase overall pedestrian activity in the area, the public realm improvements summarized above and described in detail in Chapter 3, *Urban Design*, are designed to accommodate and benefit both existing and new pedestrians. In addition, the proposed bridges across Trinity Place and Stuart Street will provide alternative routes for street crossings and contribute to overall pedestrian safety.

4.13 Mitigation Measures

4.13.1 Phasing of Proposed Physical and Operational Transportation Improvements

As previously discussed in Section 4.7 and shown on Figure 4.16, the Project proposes certain physical and operational transportation improvements in order to mitigate Project impacts. These mitigation measures include the following:

Signal Timing

- Stuart Street/Arlington Street (#13)
- Columbus Avenue/Dartmouth Street (#17)
- Columbus Avenue/Clarendon Street (#18)
- Stuart Street/Clarendon Street (#11)
- Stuart Street/Trinity Place (#10) – Alternate Scheme only

Possible Signalization of Intersection

- St. James Avenue/Trinity Place (#4)
- Clarendon Street/Stanhope Street (#15)

Roadway Modifications

- Stuart Street from Dartmouth Street to Trinity Place
- Clarendon Street from Stanhope Street to Columbus Avenue

Possible Roadway Modification

- Trinity Place One-way between St. James Avenue and Stuart Street

Phasing of Transportation Mitigation Measures

As the Project has been designed to be phasable, the implementation of the mitigation measures described above will also be appropriately phased. The transportation improvements to be implemented in association with each parcel are summarized in Table 4-82 below. Please note related public realm improvements and their phasing are described in Section 3.5.1 and shown on Figures 3.8a–f.

TABLE 4-82 PHASING OF POTENTIAL TRANSPORTATION MITIGATION

Possible Mitigation	Project Parcel
Stuart Street/Arlington Street (#13)	Garage West
Columbus Avenue/Dartmouth Street (#17)	Garage West or Station East
Columbus Avenue/Clarendon Street (#18)	Garage East or Station East
St. James Avenue/Trinity Place (#4)	Garage West
Clarendon Street/Stanhope Street (#15)	Garage East or Station East
Stuart Street/Clarendon Street (#11)	Garage West or Garage East
Stuart Street/Trinity Place (#10) – Alternate Scheme only	Garage West or Garage East
Stuart Street from Dartmouth Street to Trinity Place	Garage West
Clarendon Street from Stanhope Street to Columbus Avenue	Station East
Trinity Place One-way between St. James Avenue and Stuart Street	Garage West

4.13.2 Transportation Demand Management (TDM)

General TDM Measures

The proposed TDM measures aim to reduce drive-alone trips, or single occupancy vehicles (SOVs), by encouraging employees, residents and visitors to use alternative modes of transportation. The following general TDM measures apply to all Project Components:

- Designate a Transportation Coordinator to oversee all transportation-related operational matters at each Project Component site, including vehicular operations, servicing and loading, parking and implementation of the TDM Plan. The Transportation Coordinator will act as the contact and liaison for the City, local Transportation Management Association (TMA) and tenants/residents of the Project.
- Post and make available transit maps, schedules and other information relevant to commuting options in the office and residential building lobbies.
- Provide real-time transportation information in all new lobbies within each Project Component using Transit Screen or other similar products including online platforms.
- Provide preferential parking to carpool and vanpool participants.

- Join A Better City TMA which provides a variety of commuter benefits including, but not limited to:
  - Guaranteed Ride Home, Workout to Work, Ride Matching, Express Yourself cash incentives to try out particular MBTA services, Carpool and Vanpool Subsidies
- Participation in transportation awareness events including: Car-Free Week, MassCommunte Bicycle Challenge, and Lunchtime Walking Series.
- On-site transportation fairs and commuter related events.

Residential TDM Measures

The proposed residential TDM measures outlined below will be available to all residents of the Project:

- With the delivery of the Station East Parcel, provide one new Hubway station located on the public plaza.
- Residents of Garage East will have access to up to 120 long-term covered and secure bicycle parking spaces located on the first floor of the Garage accessible from Clarendon Street.
- Residents of Station East will have access to up to 180 long-term covered and secure bicycle parking spaces located on the building's second floor, accessible through the lobby.

Office TDM Measures

The proposed office tenant TDM measures outlined below will be available to all Project office tenants:

- With the delivery of the Garage West Parcel, tenant employees will have access to 150 long-term covered and secure bicycle parking spaces located on the second floor of the Garage, accessible from Stuart Street.

4.13.3 Monitoring Program

The Proponent is committed to conducting a Transportation Monitoring Program. The intent of the monitoring program is to confirm that the post-development impacts of the Project are consistent with the forecast estimates and to ensure that the mitigation measures are completed and/or maintained. The monitoring program will include the following elements:

- **Employee and Resident Survey** – A survey will be distributed to determine commuting modes to/from the Project Site, transit ridership, bicycle parking utilization, occupancy of car-sharing parking spaces, occupancy of alternative fueled vehicle parking spaces, electric vehicle charging station demand and usage, and overall parking demands.

- **Garage Volume Data** – Collection of traffic volume information will be collected over a continuous seven-day period at each Garage entrance/exit.
- **Verification of Mitigation Measures** - The implementation of the proposed mitigation measures, TDM measures, parking accommodations, and on-site amenities will be verified.
- **Traffic Data Collection** – Traffic data (i.e. TMCs for vehicles, pedestrians, bicycles) will be collected during the weekday morning peak period (7:00 – 9:00 AM) and evening peak period (4:00 – 6:00 PM) and operations analysis performed at "mitigated" intersections, including those involving Garage entrances.
- **Monitoring Program Schedule and Reporting** – This monitoring will be performed annually commencing six (6) months after full completion and occupancy of the first building and will continue for a period of five (5) years after occupancy of the full build-out of the Project. Should subsequent phases extend beyond five years, the traffic monitoring program will cease until the next phase of the Project is completed. Results of the monitoring program will be summarized in a technical memorandum, including an update on TDM effectiveness and transit ridership, and will be provided to the MassDOT and BTD.

4.13.4 Construction Management Plan (CMP)

The Proponent will develop a detailed evaluation of potential short-term construction-related transportation impacts including construction vehicle traffic, parking supply and demand, and pedestrian access. Detailed Construction Management Plans (CMP) will be developed at the appropriate time for each phase of the Project once the phasing plan is finalized. Further clarity is needed on key elements such as start date, construction duration, and other active construction sites in the area at the time of each Project component's commencement. These plans will detail construction vehicle routing and staging.

Construction Vehicle Traffic

Construction vehicles will be necessary to move construction materials to and from the Project Site. Every effort will be made to reduce noise, control fugitive dust, and minimize other disturbances associated with construction traffic. Truck staging and laydown areas for the Project will be carefully planned. The need for Project Site occupancy (lane closures) along roadways adjacent to the Project Site is not known at this time.

Construction Parking Issues

Contractors will be encouraged to devise access plans for their personnel that de-emphasize auto use (such as seeking off-site parking, provide transit subsidies, on-site lockers, etc.) Construction workers will also be encouraged to use public

transportation to access the Project Site because no new parking will be provided for them. Because of the construction workers' early arrival/departure (typically 7:00AM-3:00PM) schedule, a conflict for on-street parking is not anticipated.

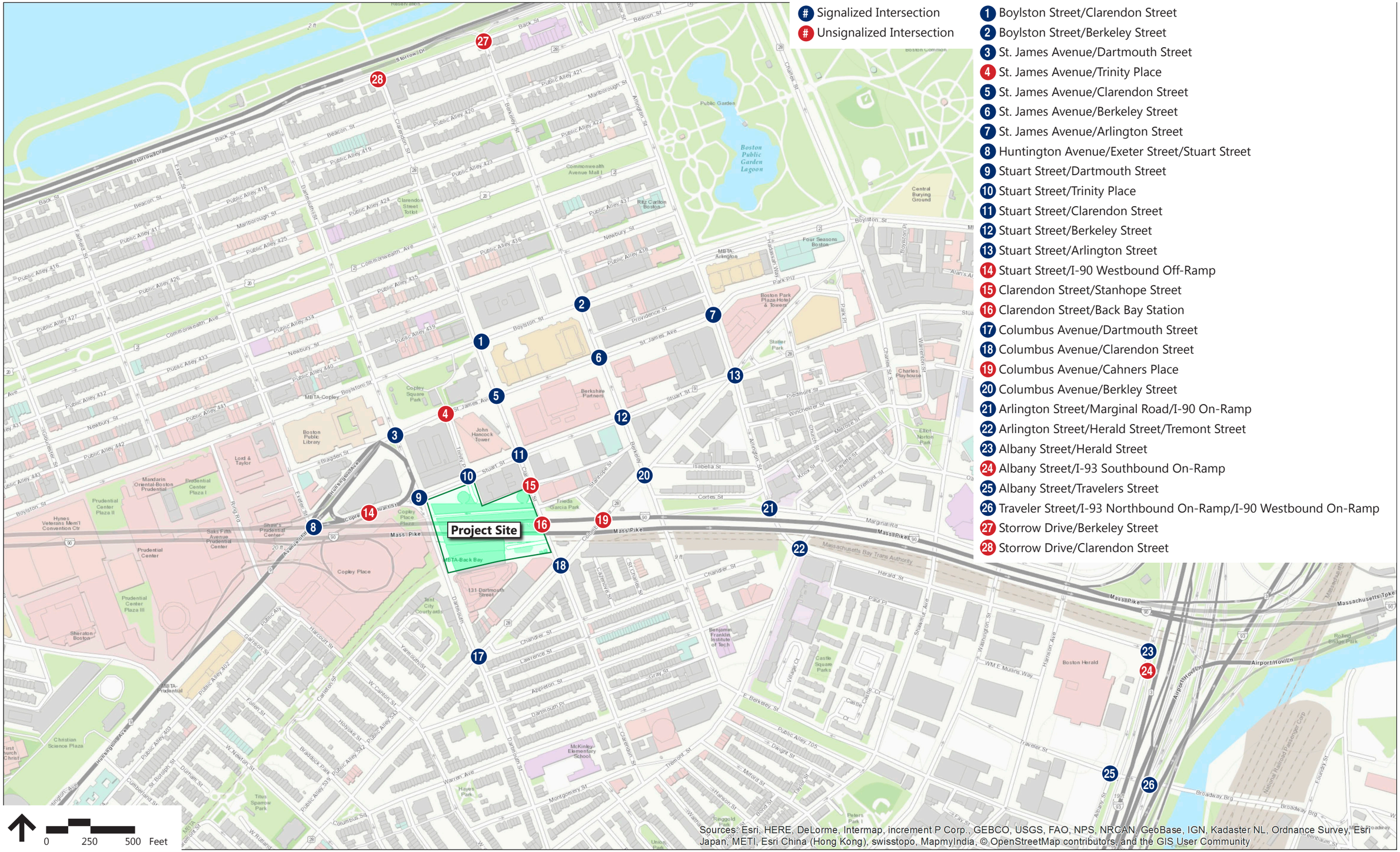
Pedestrian Access during Construction

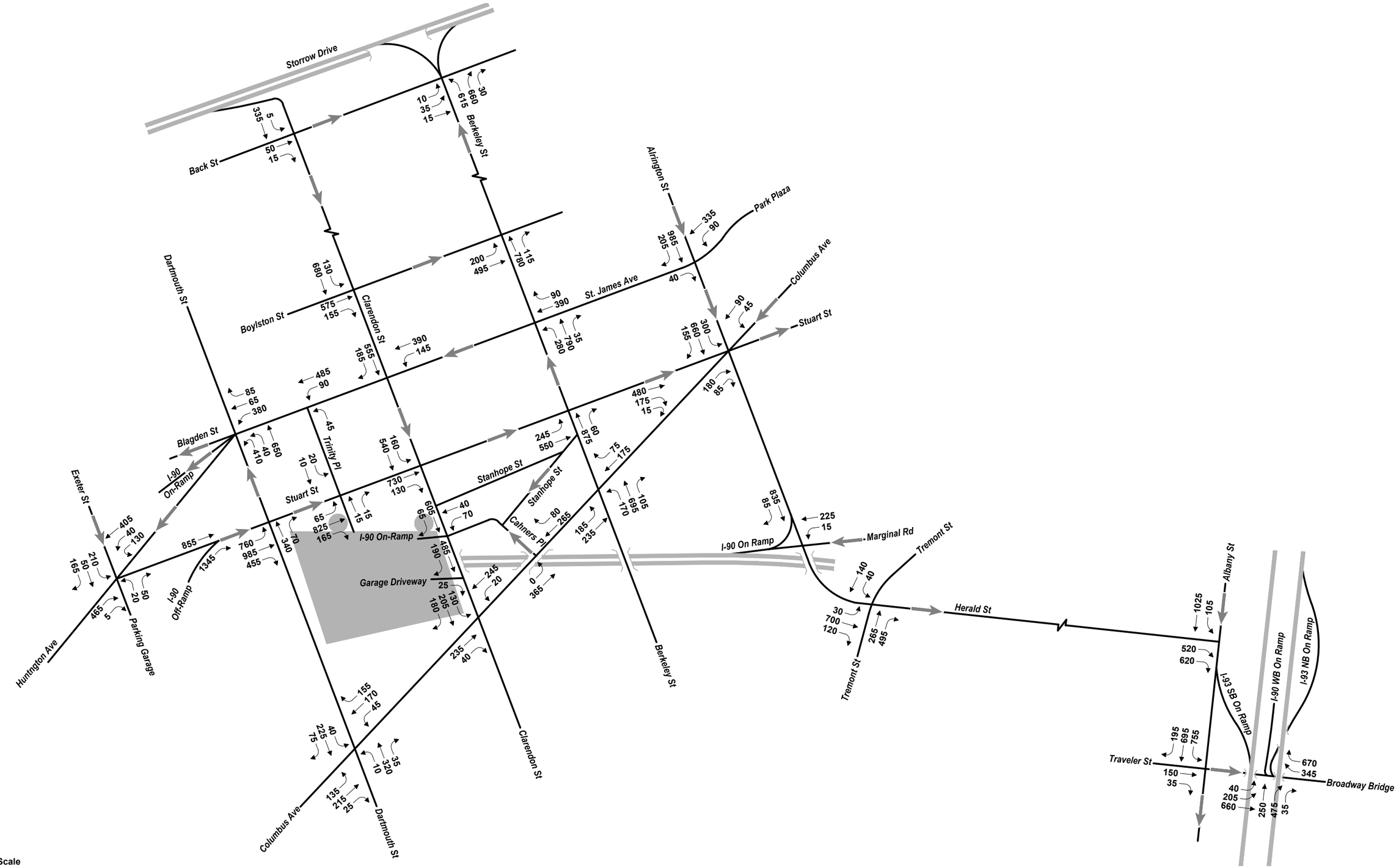
During the construction period, pedestrian activity adjacent to the Project Site may be impacted by sidewalk closures. A variety of measures will be considered and implemented to protect the safety of pedestrians. Temporary walkways, appropriate lighting, and new directional and informational signage to direct pedestrians around the construction sites will be provided. After construction is complete, finished pedestrian sidewalks will be permanently reconstructed around the new facilities. Any damage as a result of construction vehicles or otherwise will be repaired per City standards.

4.13.5 Transportation Access Plan Agreement (TAPA)

The Proponent will enter into one or more Transportation Access Plan Agreement (TAPAs) with the BTD for each Project Component which will formalize and document all transportation mitigation and TDM commitments. The TAPAs will assign TDM implementation to the appropriate responsible entity within each of the four Project Components be that the building owner, an employer, or tenant.

Mitigation commitments are the result of the detailed transportation analyses and identification of Project impacts, as documented in the above chapter, and specific agreements made between the Proponent and the City of Boston. Specific mitigation measures have not been discussed with the City at this time. Upon the City's review of this transportation analysis and assessment of Project impacts, TDM commitments will be discussed and agreed upon for each phase of the Project. A TAPA will be executed for each Project Component in advance of its building permit issuance.


Project Site
Storrow Dr
Back St
Beacon St
Boylston St
Commonwealth Ave
Newbury St
Marlborough St
Public Garden
Boston Public Garden Lagoon
Boston Common
Central Burying Ground
Copley Square Park
Boston Public Library
John Hancock Tower
Berkshire Partners
Four Seasons Boston
Ritz Carlton Boston
Boston Park Plaza Hotel & Towers
Statler Park
Charles Playhouse
Prudential Center
Copley Place
Hynes Veterans Mem'l Convention Ctr
Saks Fifth Avenue Prudential Center
Shaw's Prudential Center
Prudential Center Plaza I
Prudential Center Plaza II
Prudential Center Plaza III
Sheraton Boston
Lord & Taylor
Mandarin Oriental-Boston
Residence Inn Boston Prudential
Mass Pike
Massachusetts Bay Trans Authority
MBTA-Back Bay
MBTA-Copley
MBTA-Prudential
MBTA-Arlington
131 Dartmouth Street
Joint City County ads
Frieda Garcia Park
McKinley Elementary School
Hayes Park
Titus Sparrow Park
Peters Park I
Ringgold Park
Braddock Park
Union Park
Christian Science Plaza
Benjamin Franklin Institute of Tech
Castle Square Parks
Boston Herald
Elliot Norton Park
Rolling Bridge Park
National Railroad Passenger Corp
Massachusetts Tpke
Airport/Hovil Ln
WM.E. Mullins Way
Herald St
Chandler St
Cortes St
Isabella St
Tremont St
Dwight St
Traveler St
E. Berkeley St
Broadway Brg
Marginal Rd



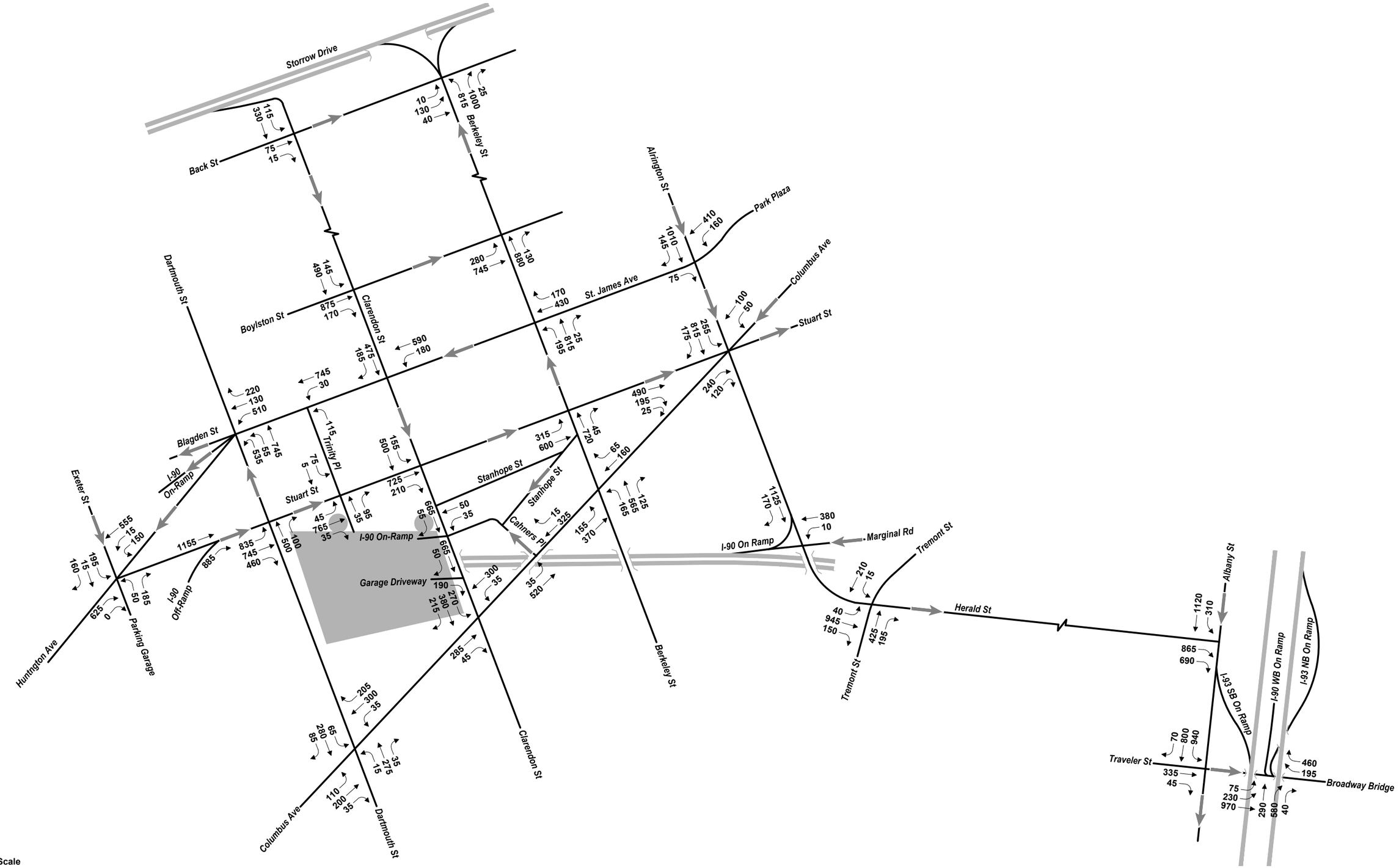
The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2016 Existing Condition Vehicle Volumes
AM Peak Hour (8:00 AM - 9:00 AM)

Figure 4.2a

vhb



The Back Bay / South End Gateway Project

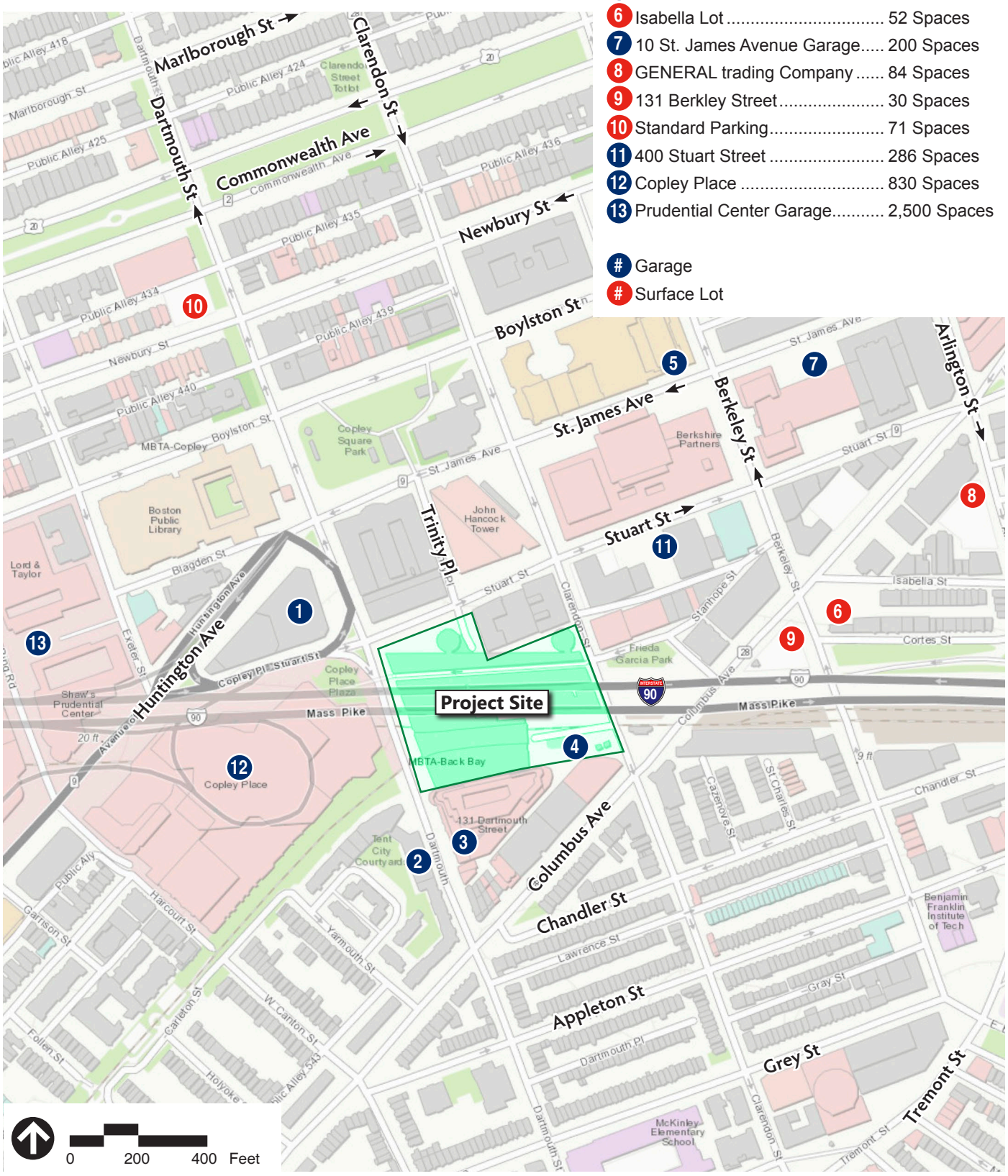
BOSTON PROPERTIES

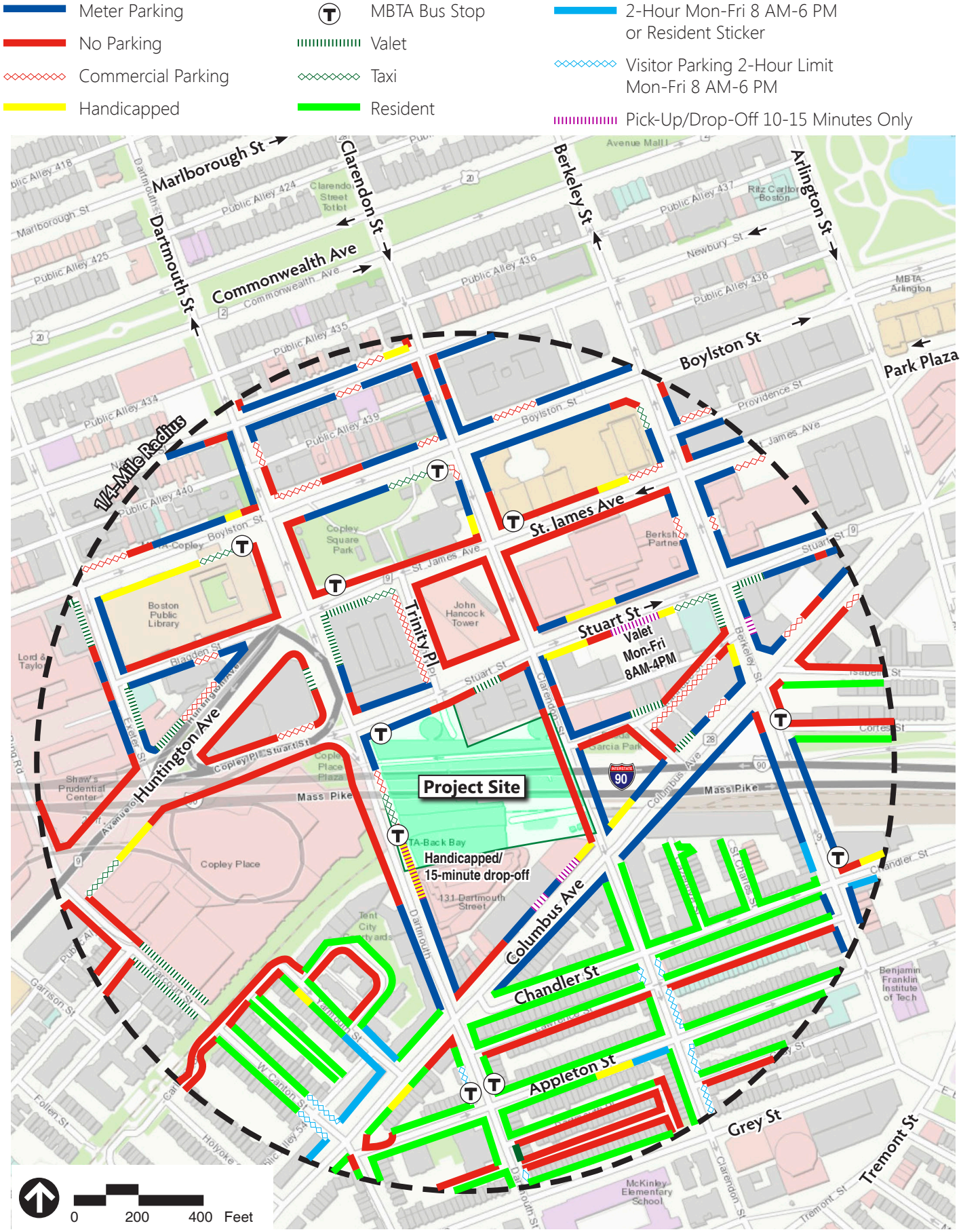
2016 Existing Condition Vehicle Volumes
PM Peak Hour (5:00 PM - 6:00 PM)

Figure 4.2b

	Location	Spaces
1	The Westin-Copley Place	250 Spaces
2	Dartmouth Street Garage	697 Spaces
3	IMPARK Parking	70 Spaces
4	100 Clarendon Street Garage	2,013 Spaces
5	Back Bay Garage	1,000 Spaces
6	Isabella Lot	52 Spaces
7	10 St. James Avenue Garage	200 Spaces
8	GENERAL trading Company	84 Spaces
9	131 Berkley Street	30 Spaces
10	Standard Parking	71 Spaces
11	400 Stuart Street	286 Spaces
12	Copley Place	830 Spaces
13	Prudential Center Garage	2,500 Spaces

Garage
Surface Lot





The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

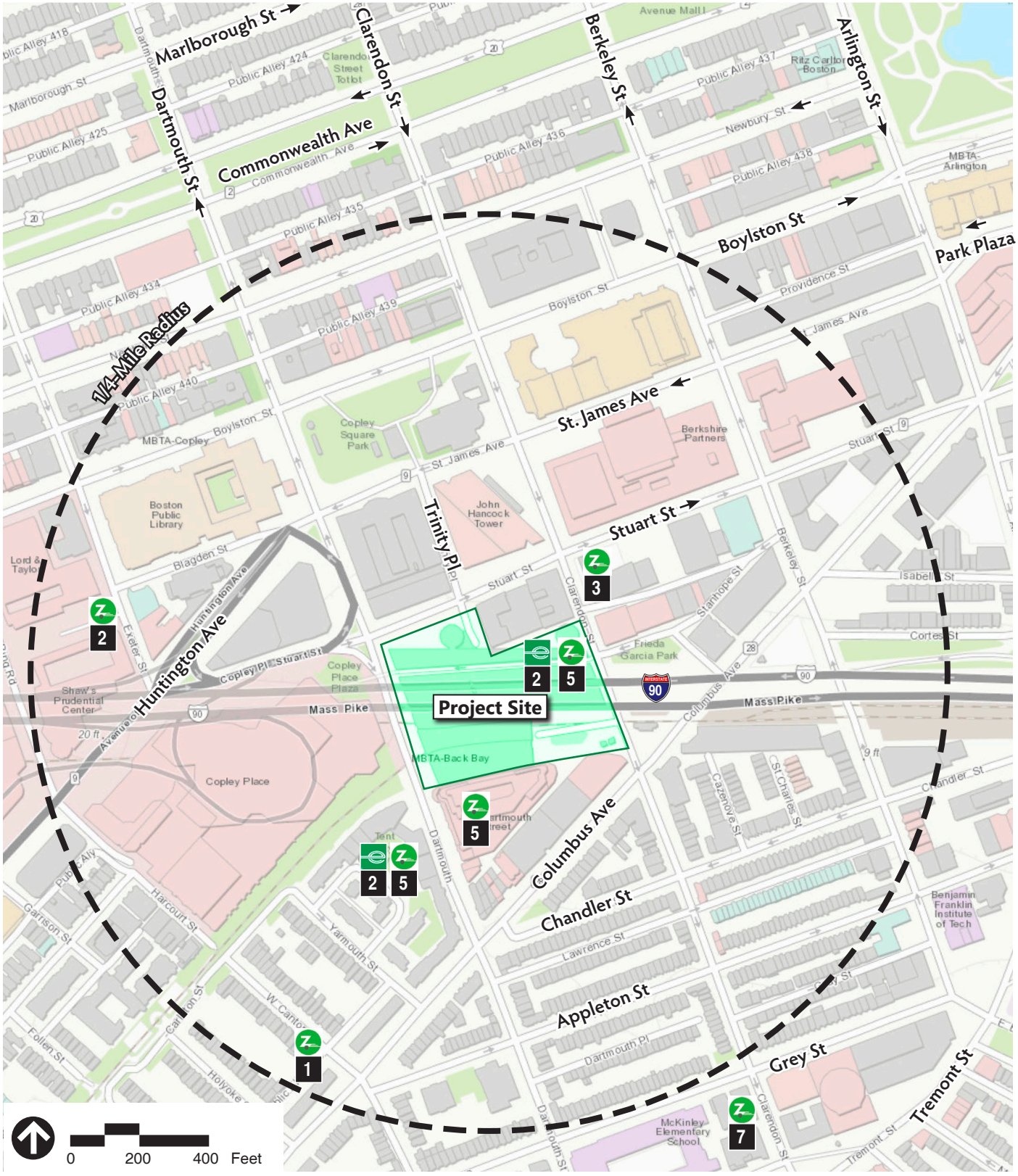
Existing On-Street Parking

Figure 4.3b

ZipCar

Enterprise

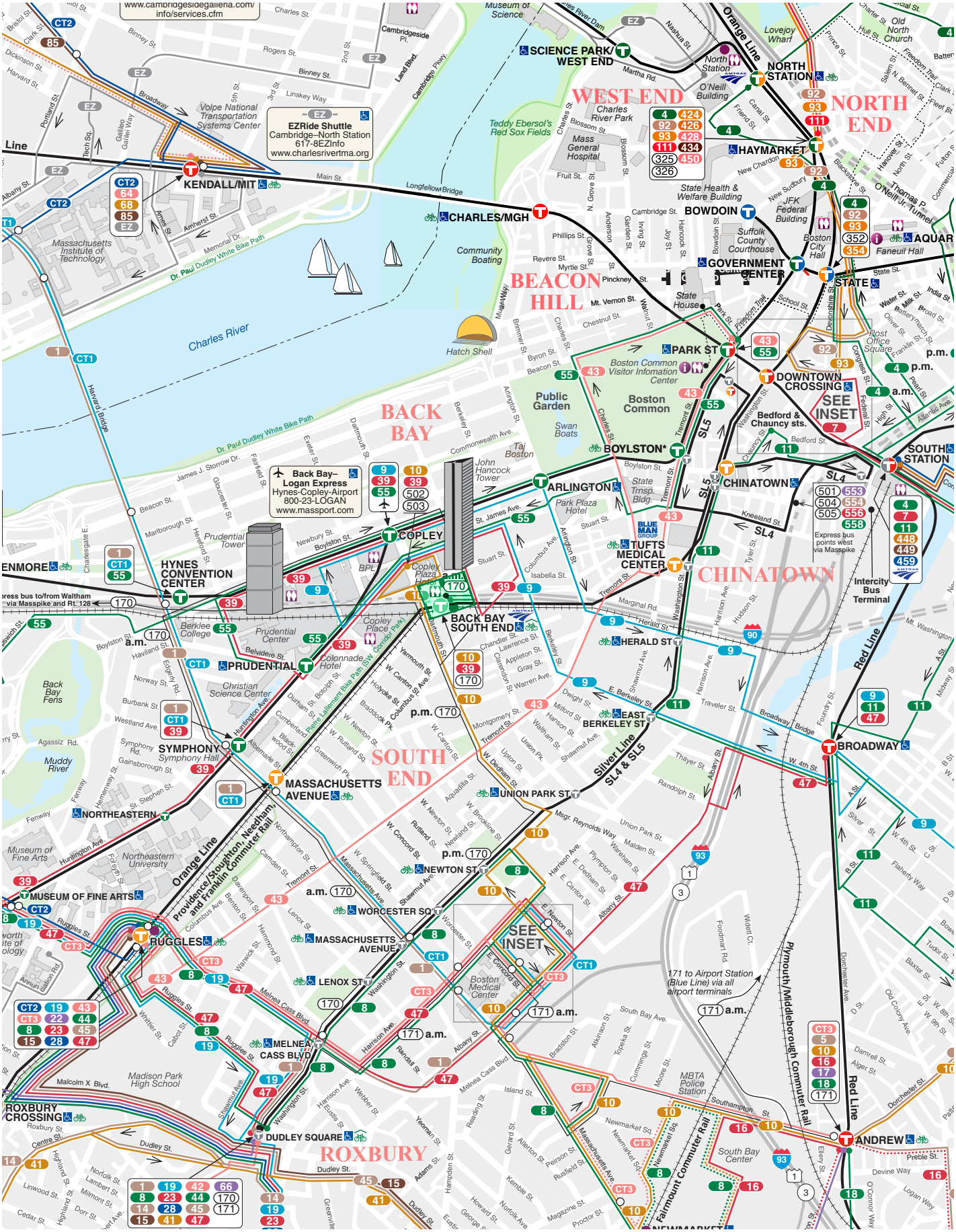
Number of Provided Vehicles



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Existing Car-Share Locations

Figure 4.3c



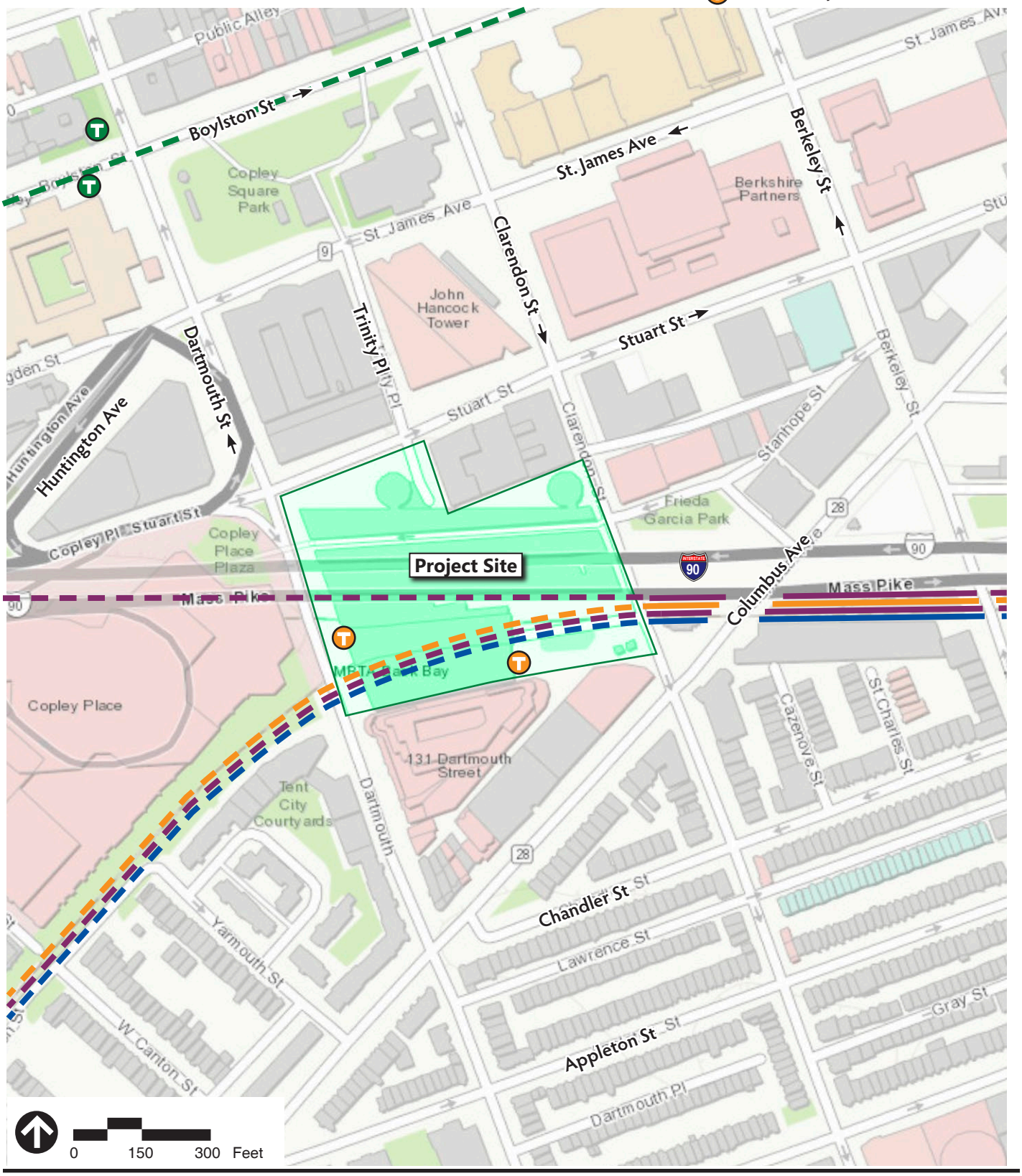
Source: MBTA.com

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Public Transportation

Figure 4.4a

vhb

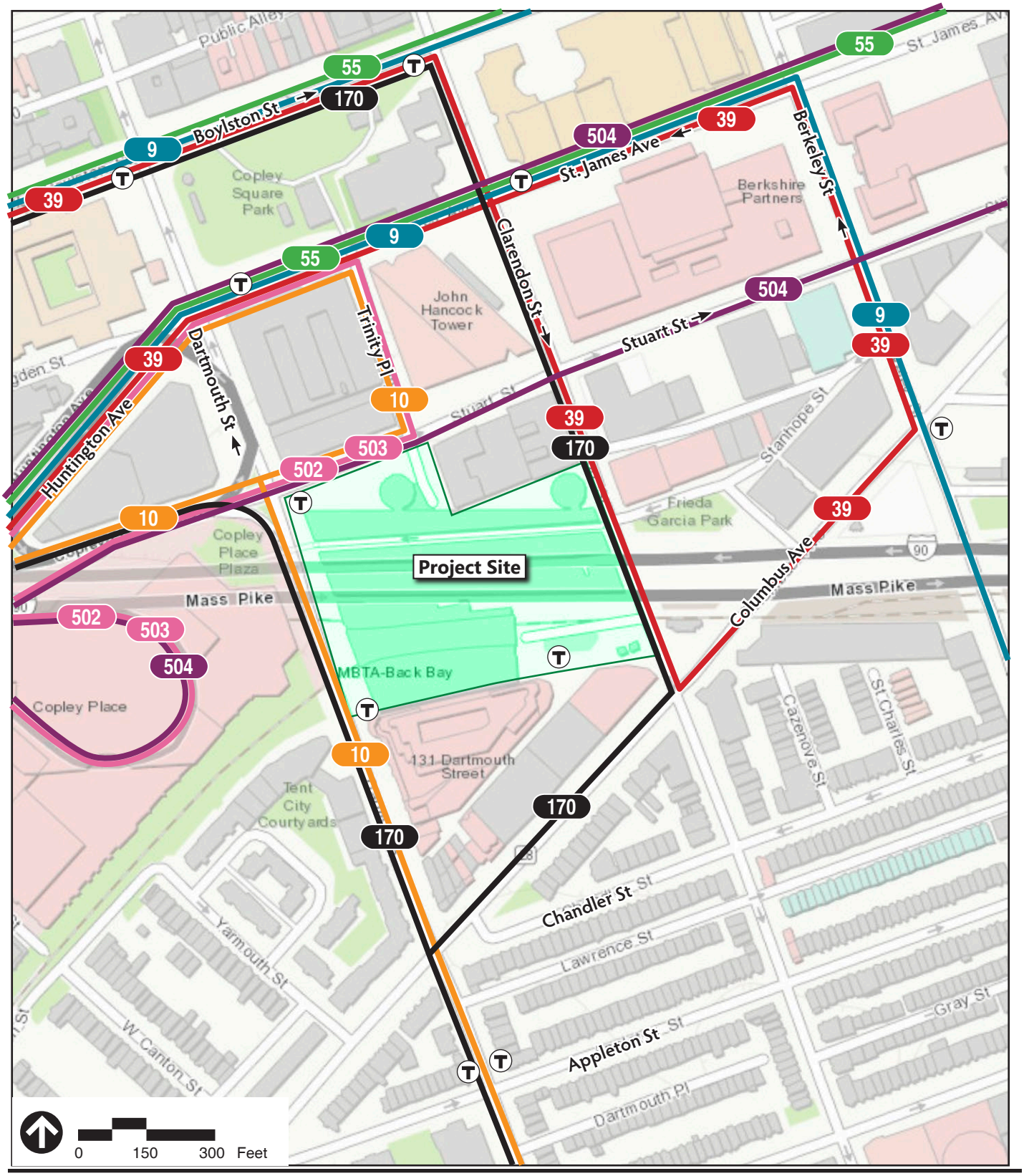


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Public Transportation Site Context

Figure 4.4b

Ⓣ MBTA Bus Stop

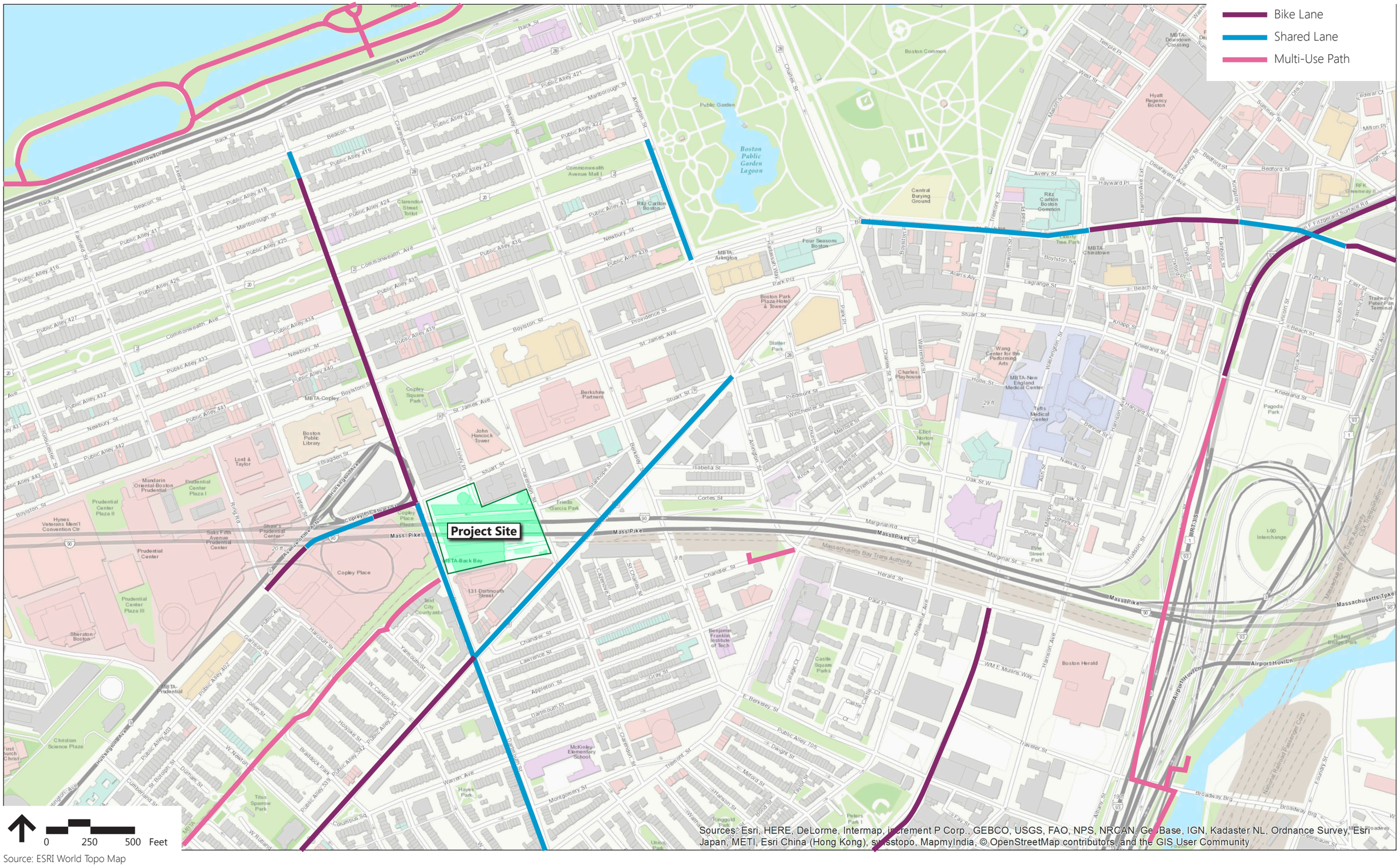


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

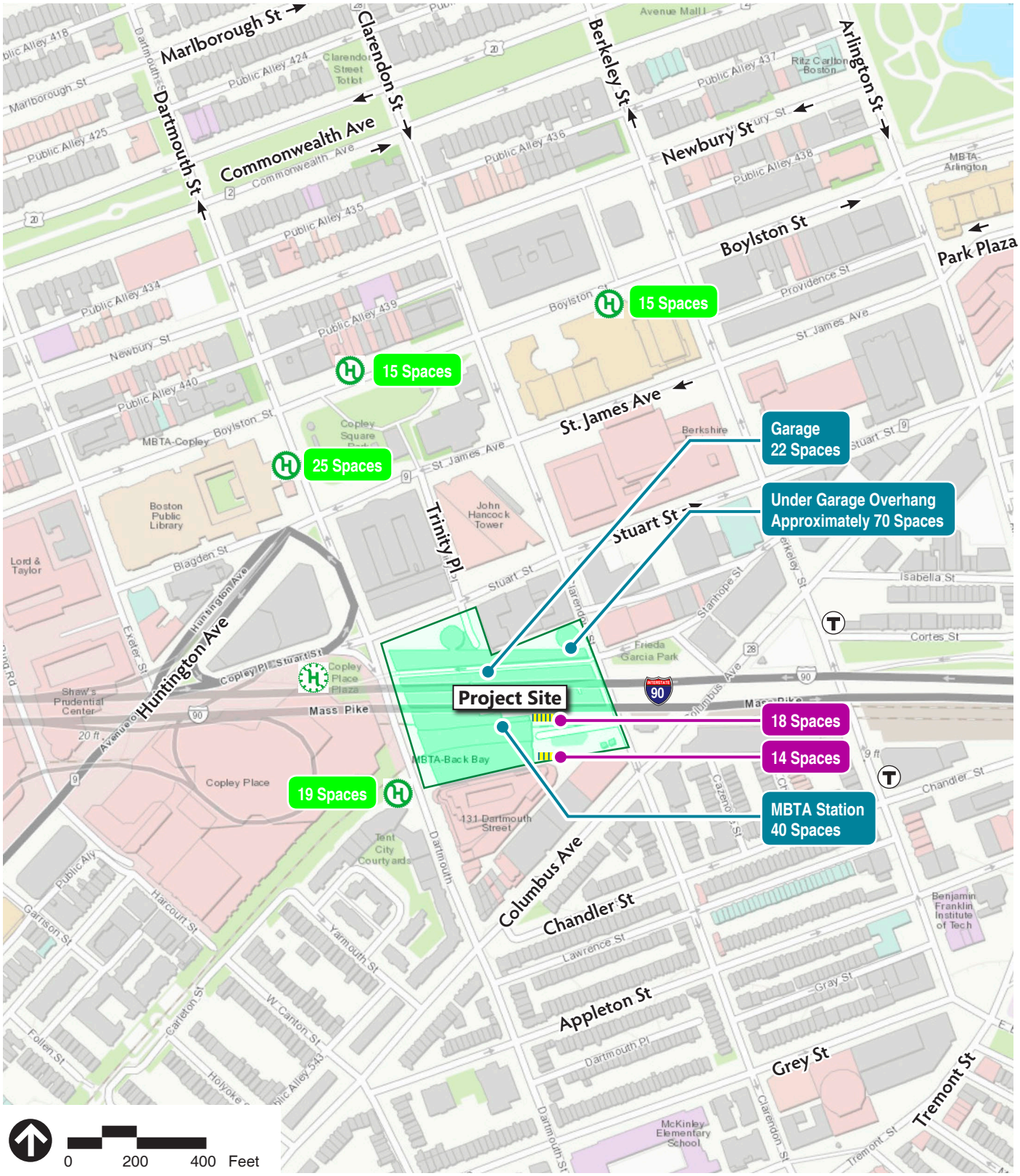
Public Transportation Site Context

Figure 4.4c

vhb



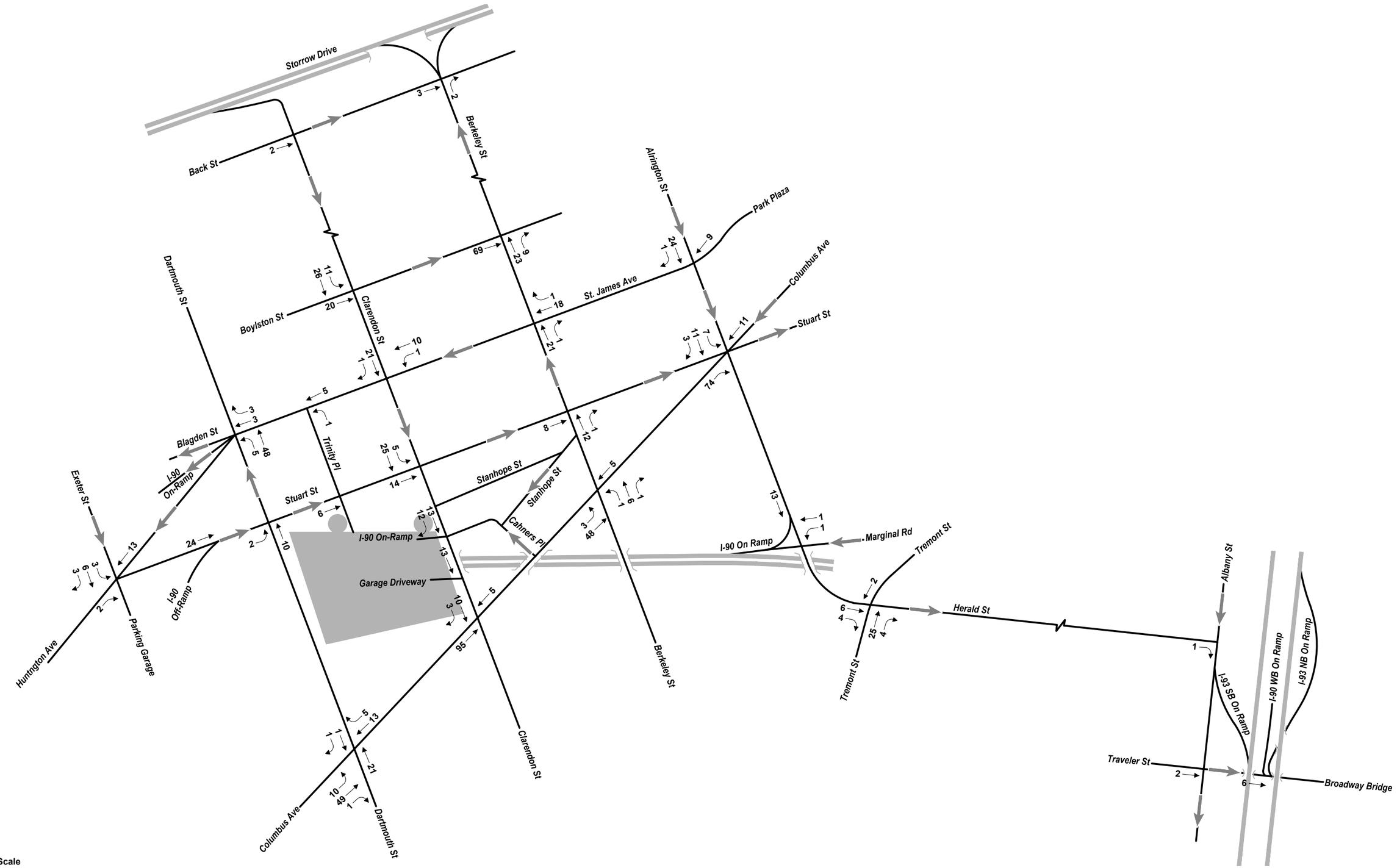
Source: ESRI World Topo Map



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Existing Bicycle Parking Facilities

Figure 4.5b

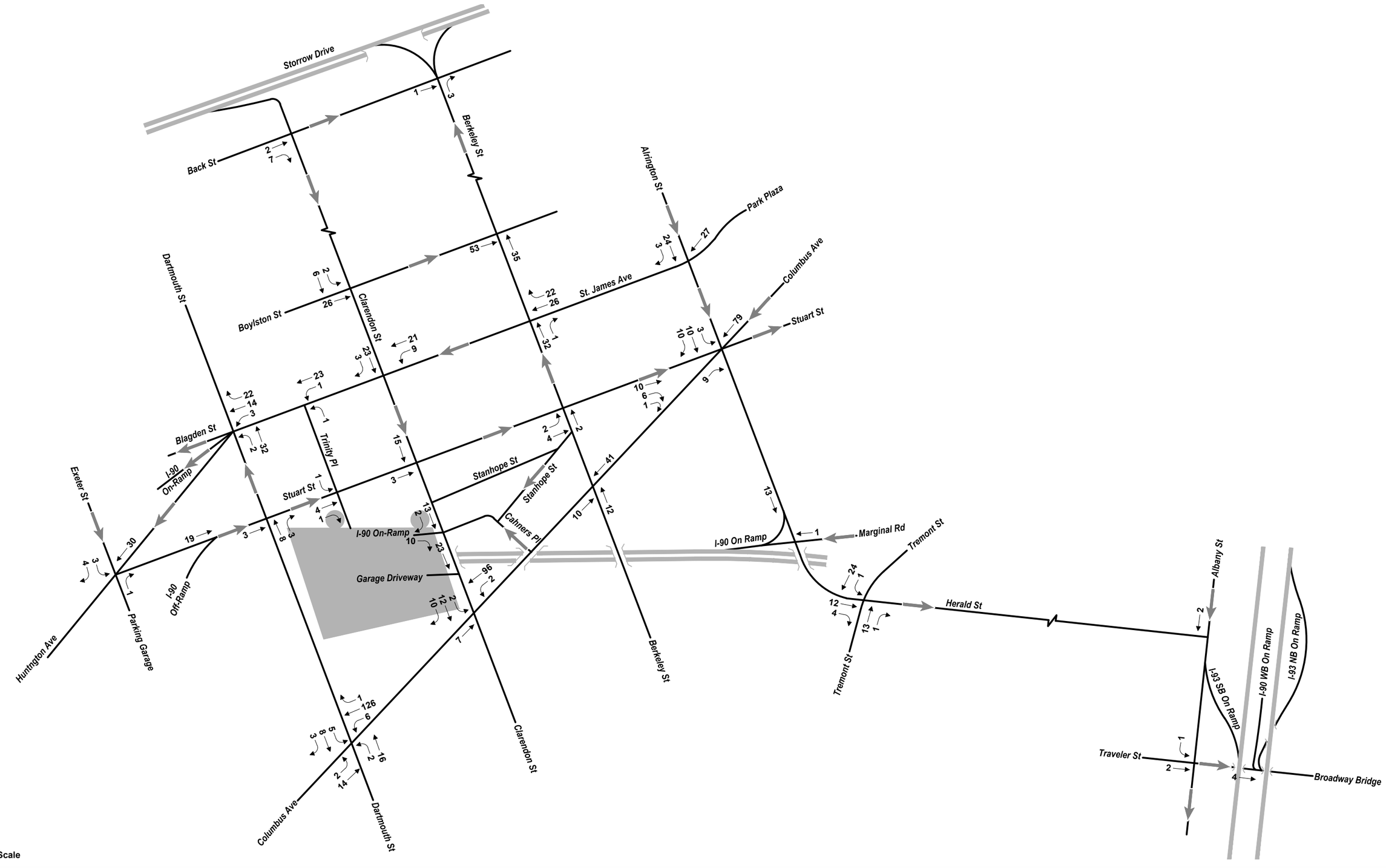


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2016 Existing Condition Bicycle Volumes
AM Peak Hour (8:00 AM - 9:00 AM)

Figure 4.5c

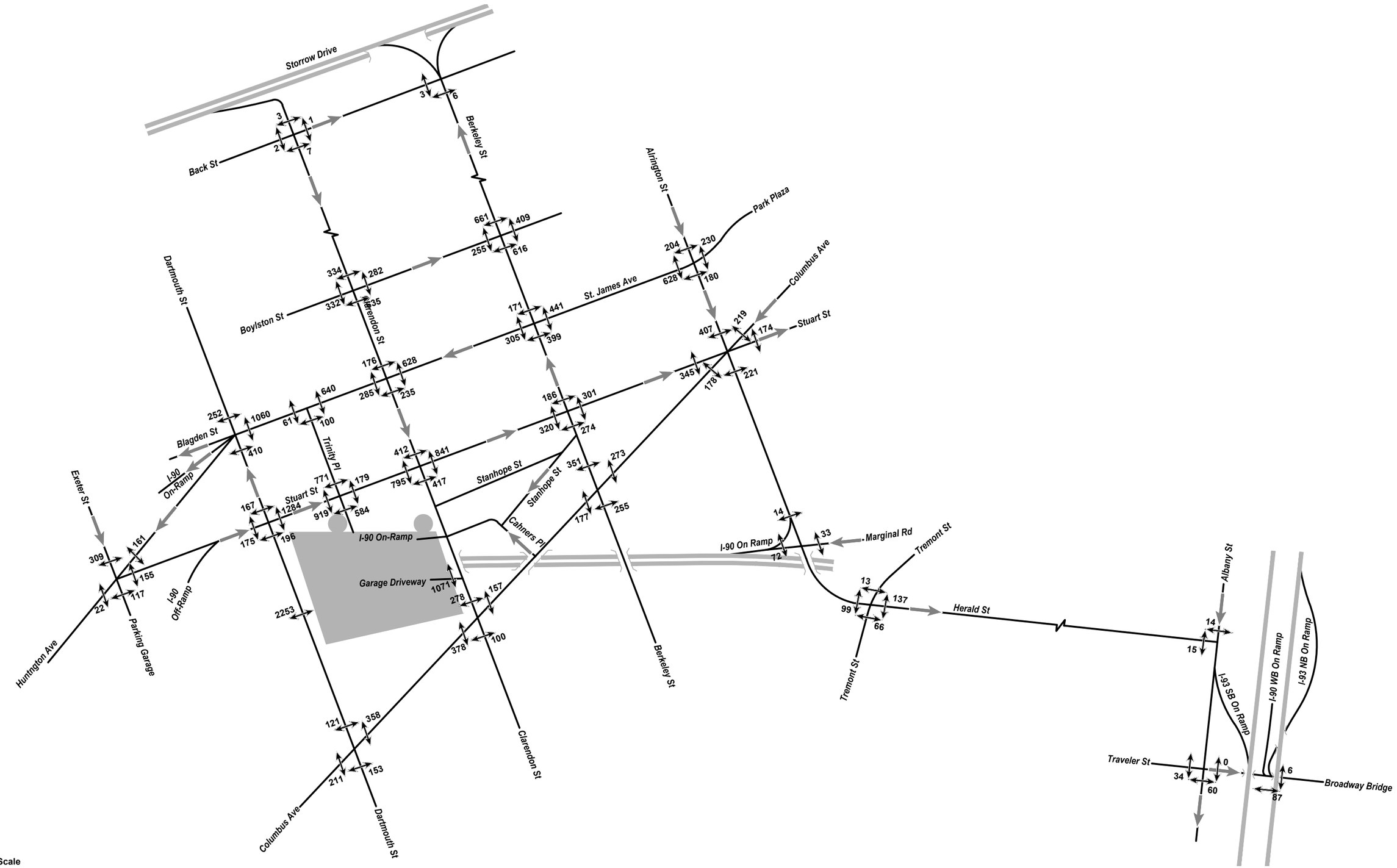


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2016 Existing Condition Bicycle Volumes
PM Peak Hour (5:00 PM - 6:00 PM)

Figure 4.5d

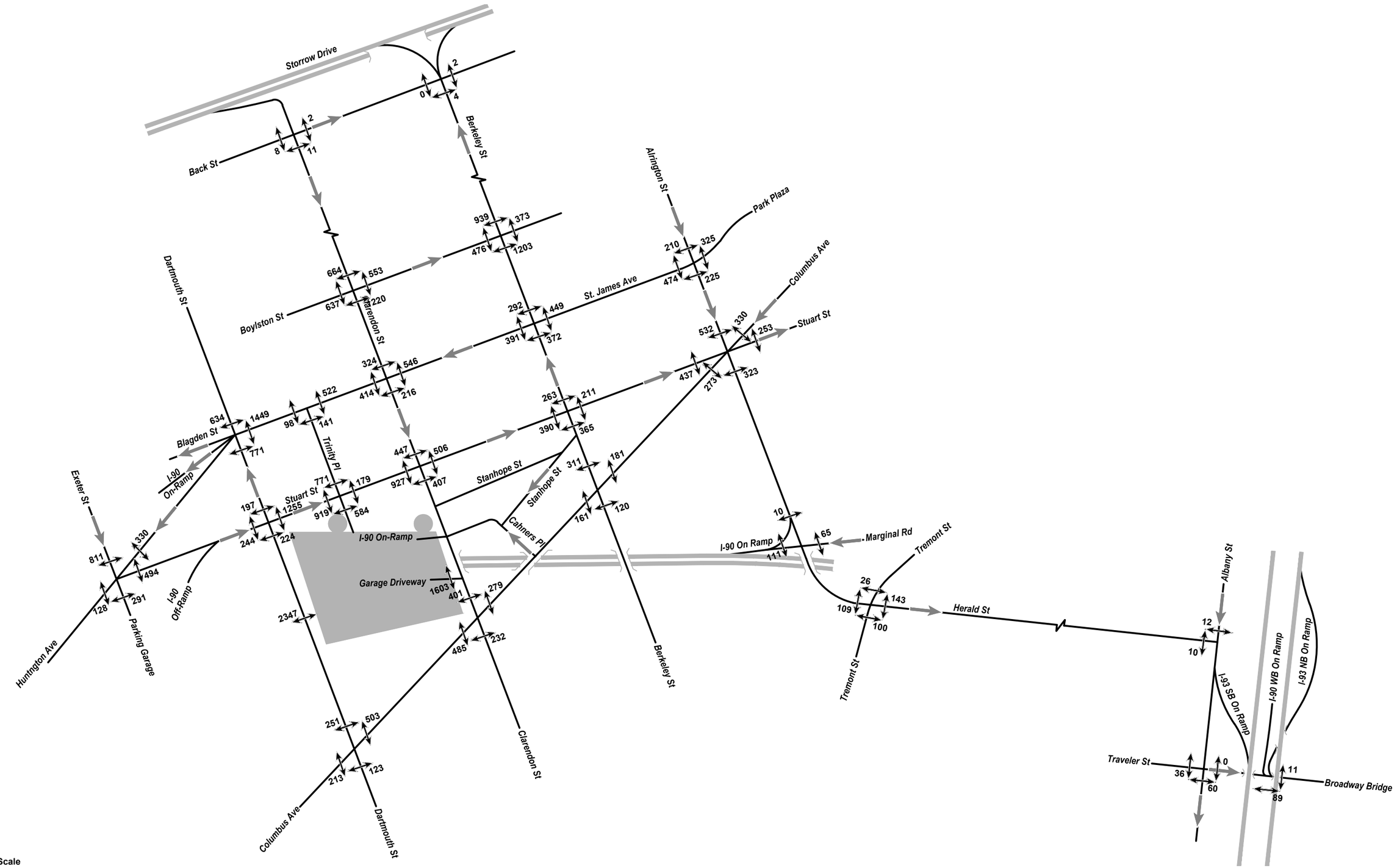


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2016 Existing Condition Pedestrian Volumes
AM Peak Hour (8:00 AM - 9:00 AM)

Figure 4.6a

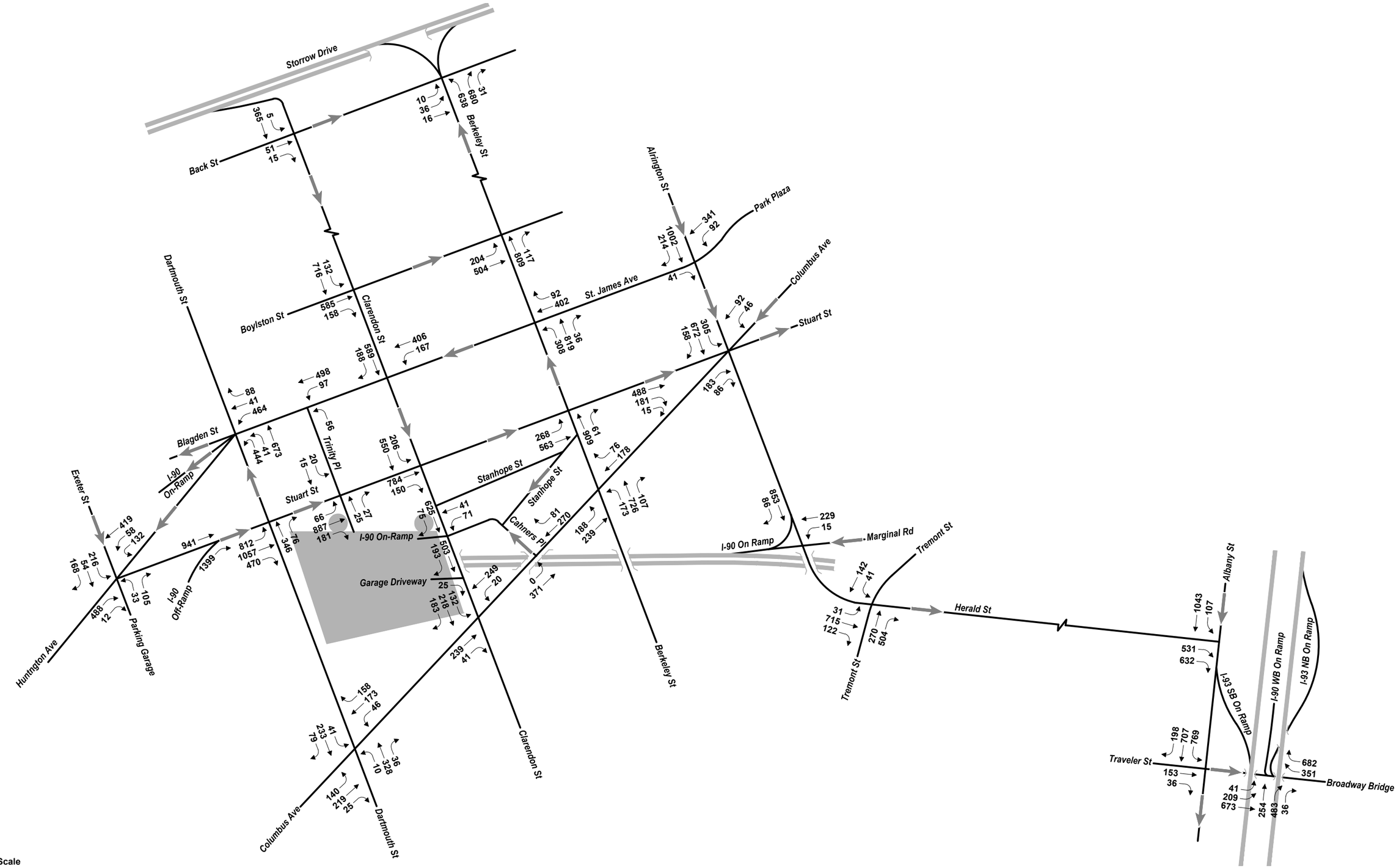


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2016 Existing Condition Pedestrian Volumes
PM Peak Hour (5:00 PM - 6:00 PM)

Figure 4.6b



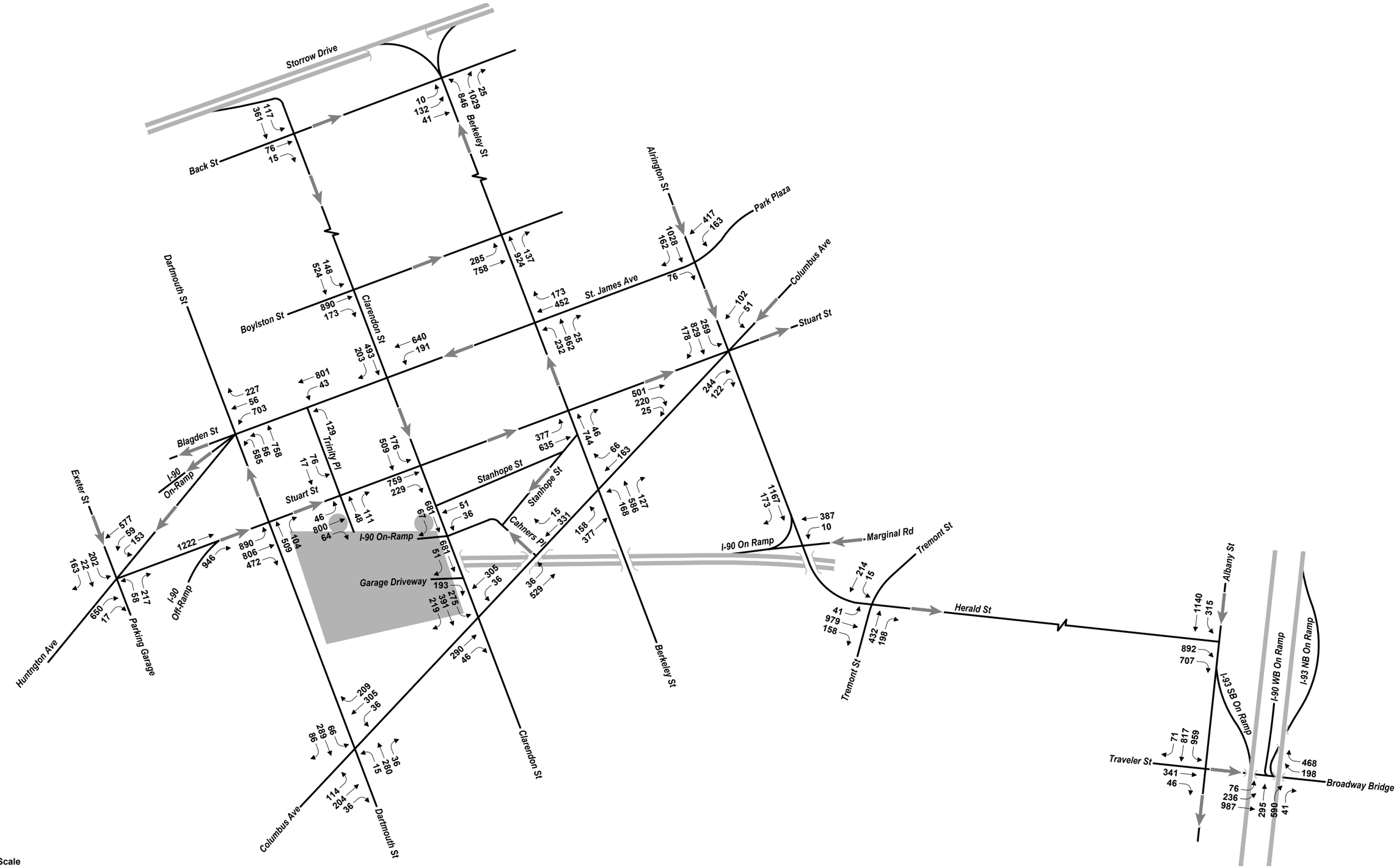
The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2023 No-Build Base Condition Vehicle Volumes
AM Peak Hour (8:00 AM - 9:00 AM)

Figure 4.7a

vhb

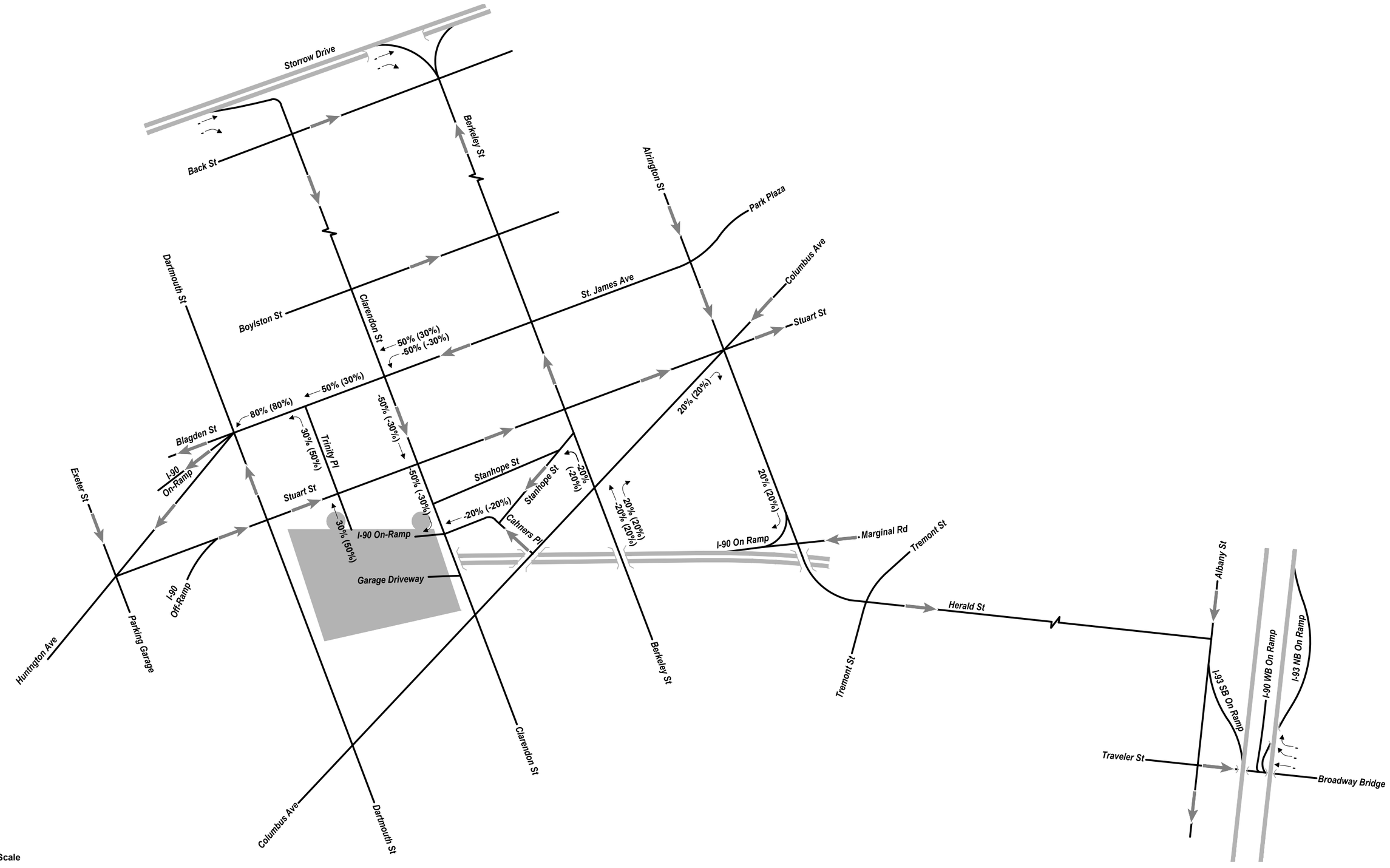


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2023 No-Build Base Condition Vehicle Volumes
PM Peak Hour (5:00 PM - 6:00 PM)

Figure 4.7b



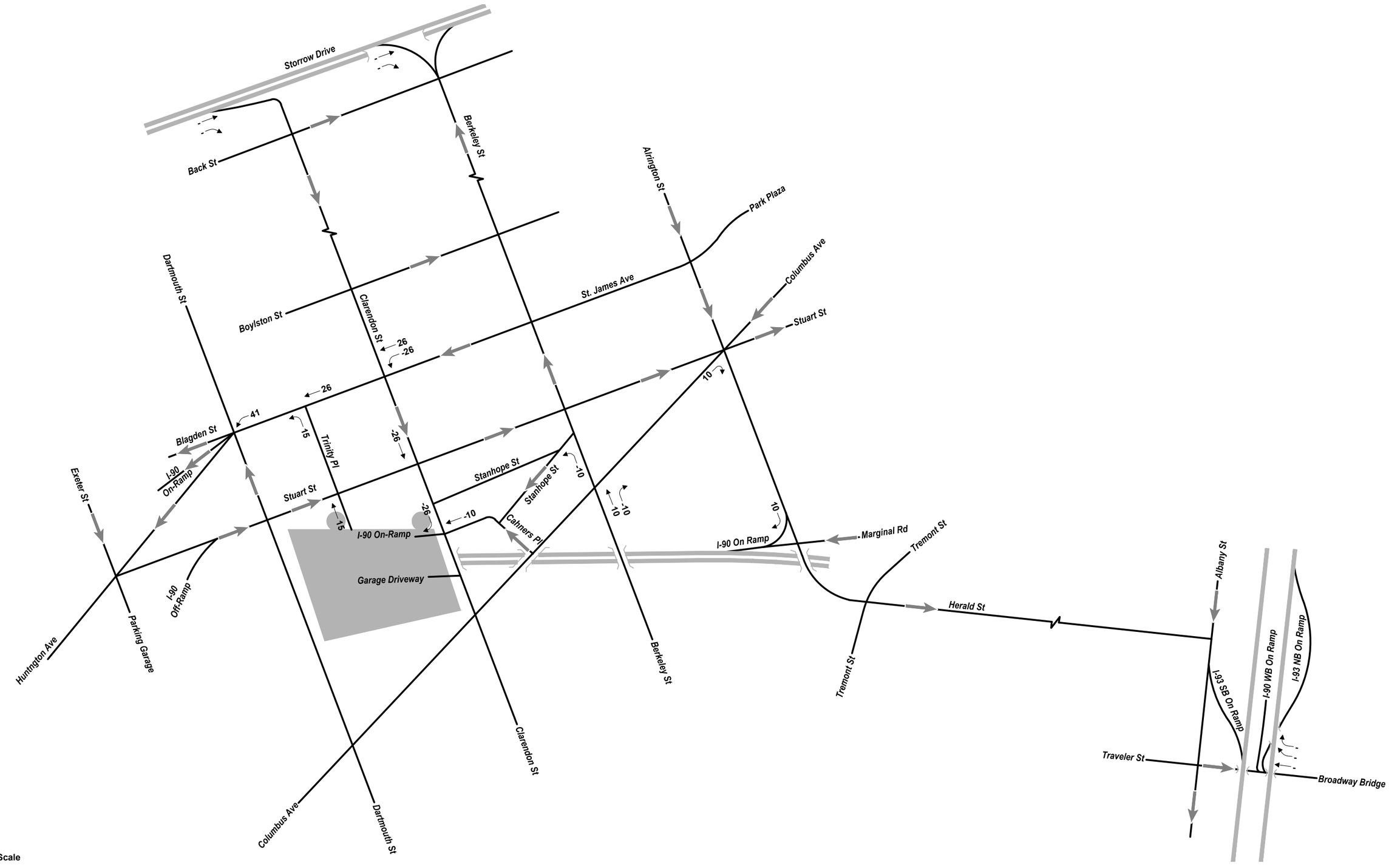
The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2023 No-Build Alternate Condition (I-90 On-Ramp Closed)
Percent Trip Redistribution - AM (PM)

Figure 4.8a

vhb

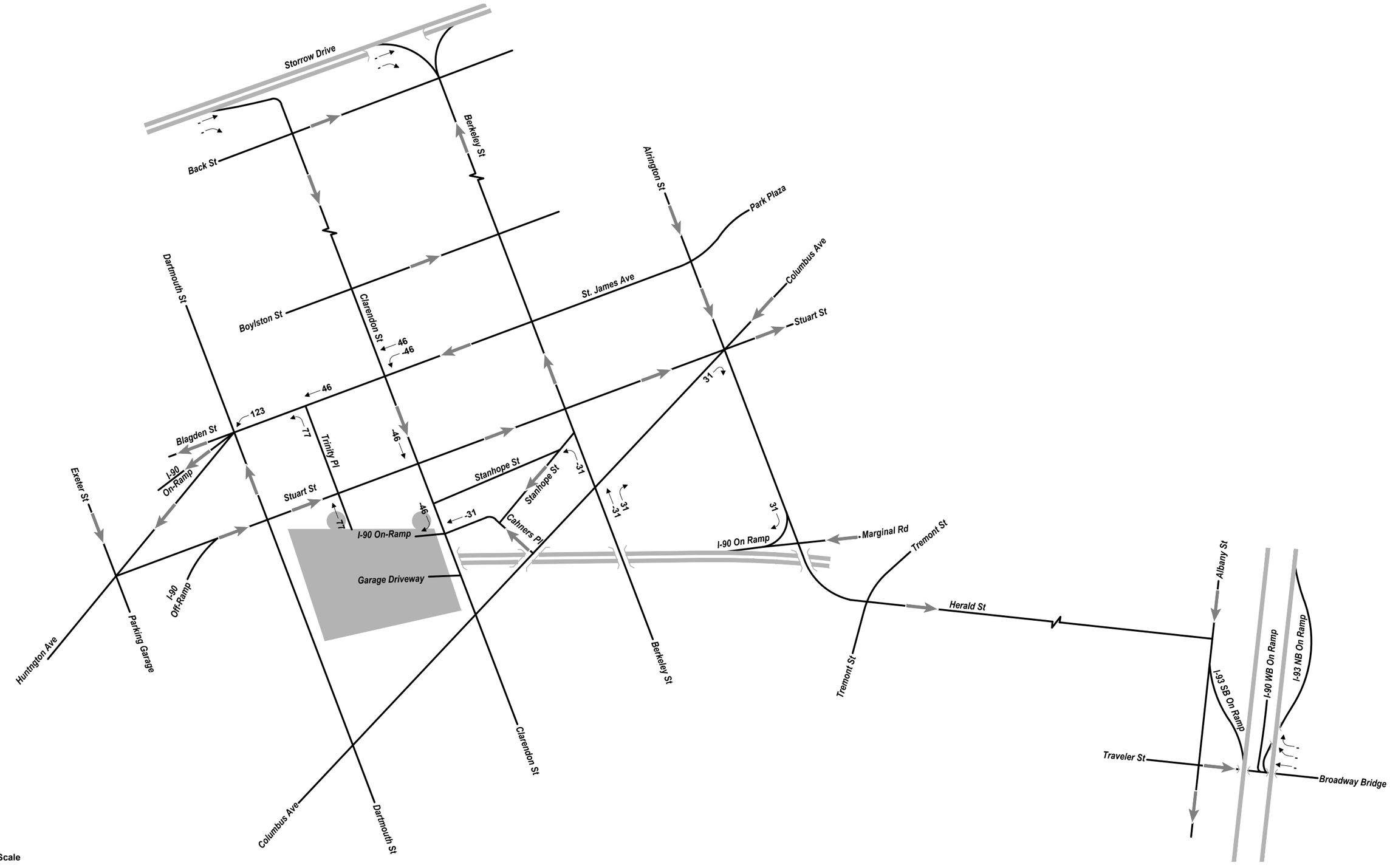


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2023 No-Build Alternate Condition (I-90 On-Ramp Closed) AM Peak Hour Trip Redistribution

Figure 4.8b



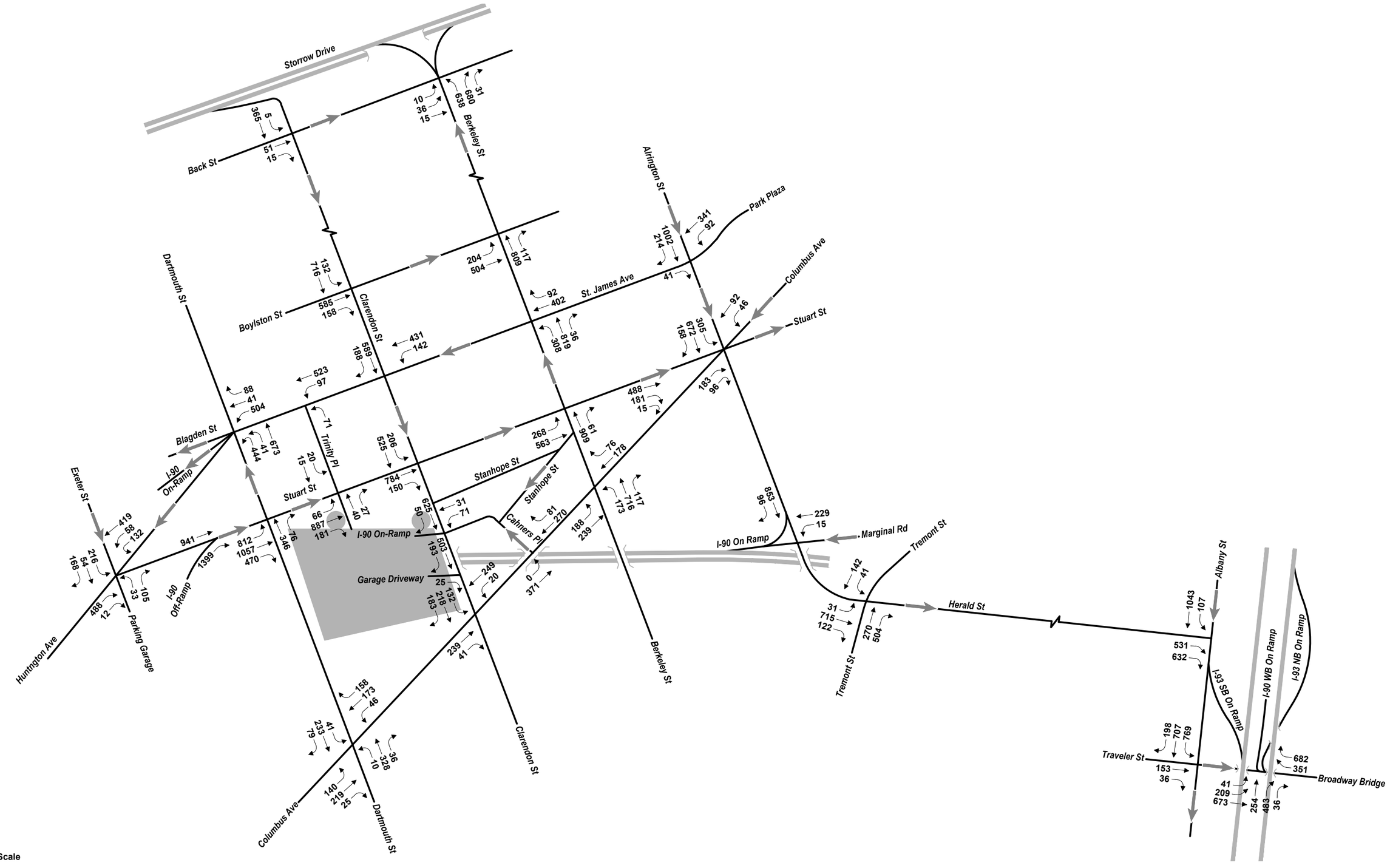
The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2023 No-Build Alternate Condition (I-90 On-Ramp Closed)
PM Peak Hour Trip Redistribution

Figure 4.8c

vhb

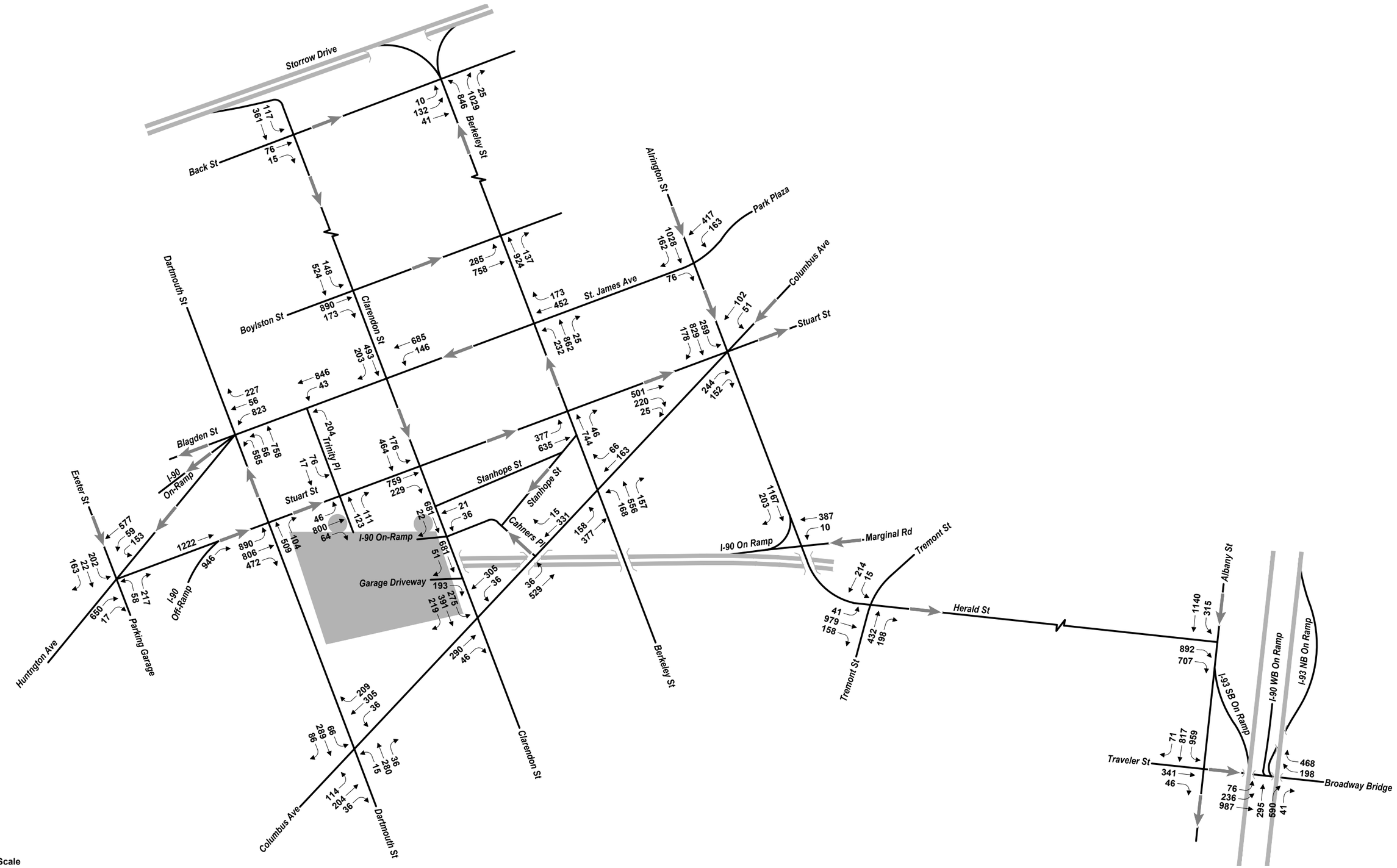


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2023 No-Build Alternate Condition Vehicle Volumes
AM Peak Hour (8:00 AM - 9:00 AM)

Figure 4.9a

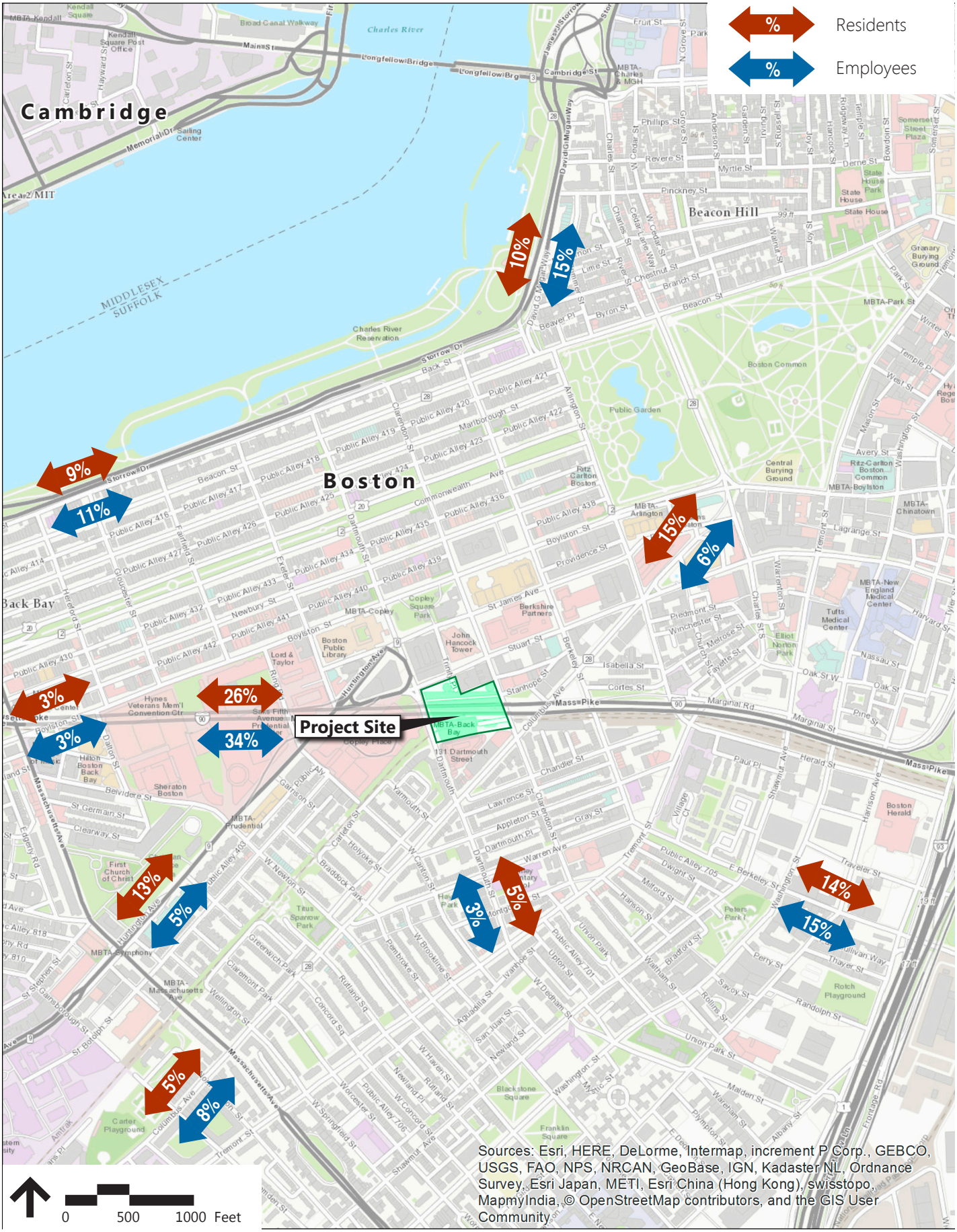


The Back Bay / South End Gateway Project

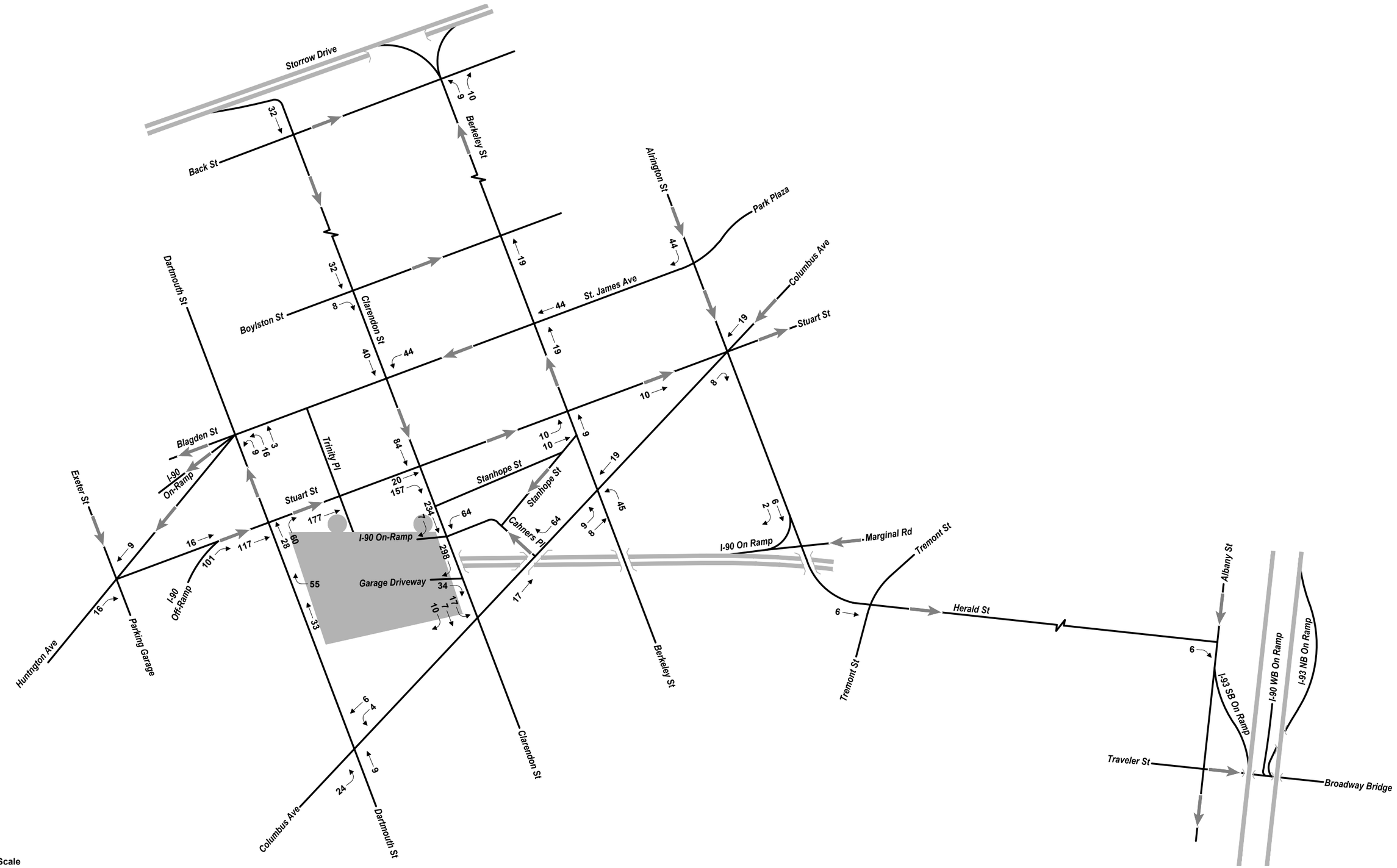
BOSTON PROPERTIES

2023 No-Build Alternate Condition Vehicle Volumes
PM Peak Hour (5:00 PM - 6:00 PM)

Figure 4.9b



Source: ESRI World Topo Map

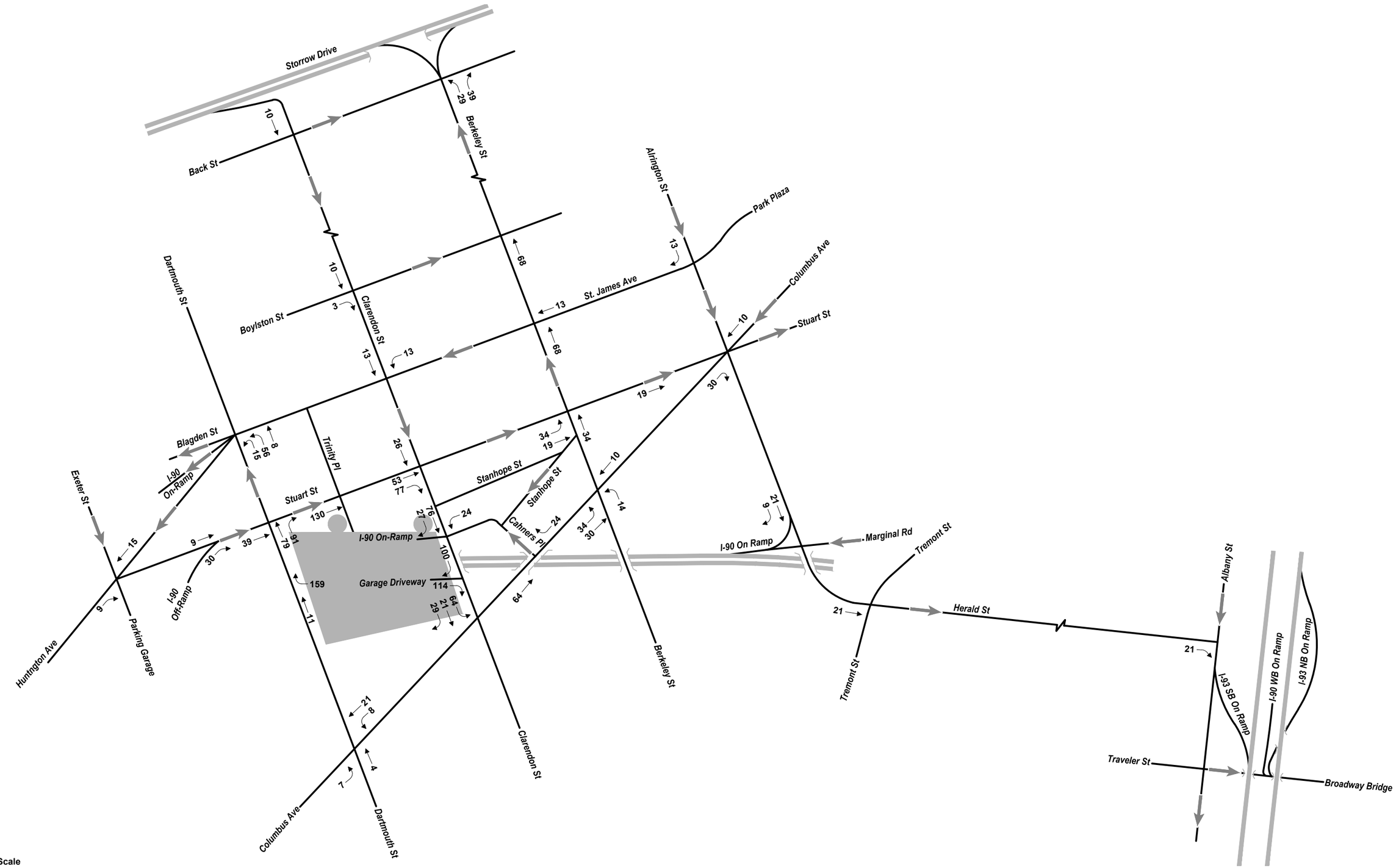


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

Project Generated Base Condition Vehicle Trips
AM Peak Hour (8:00 AM - 9:00 AM)

Figure 4.11a

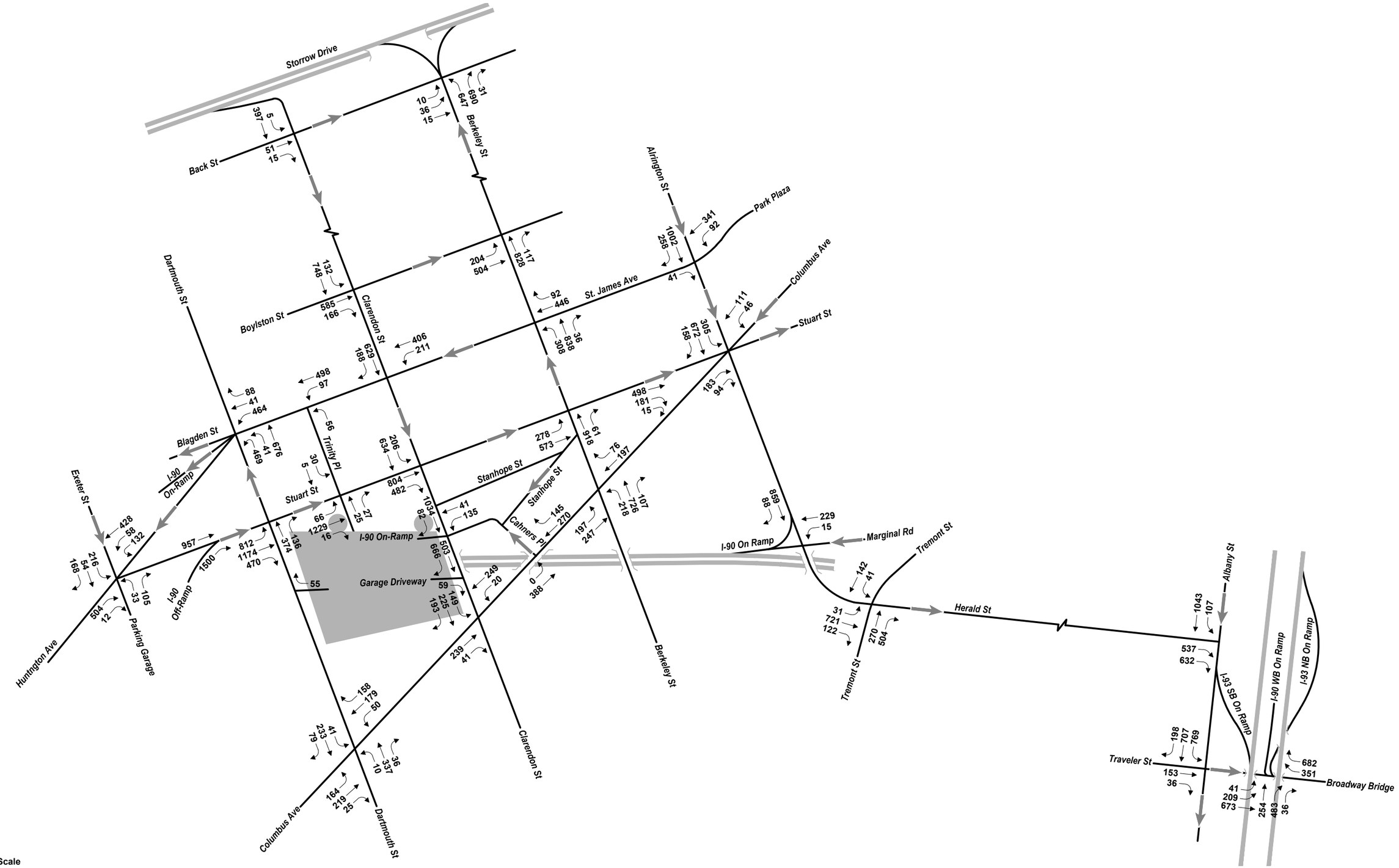


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

Project Generated Base Condition Vehicle Trips
PM Peak Hour (5:00 PM - 6:00 PM)

Figure 4.11b



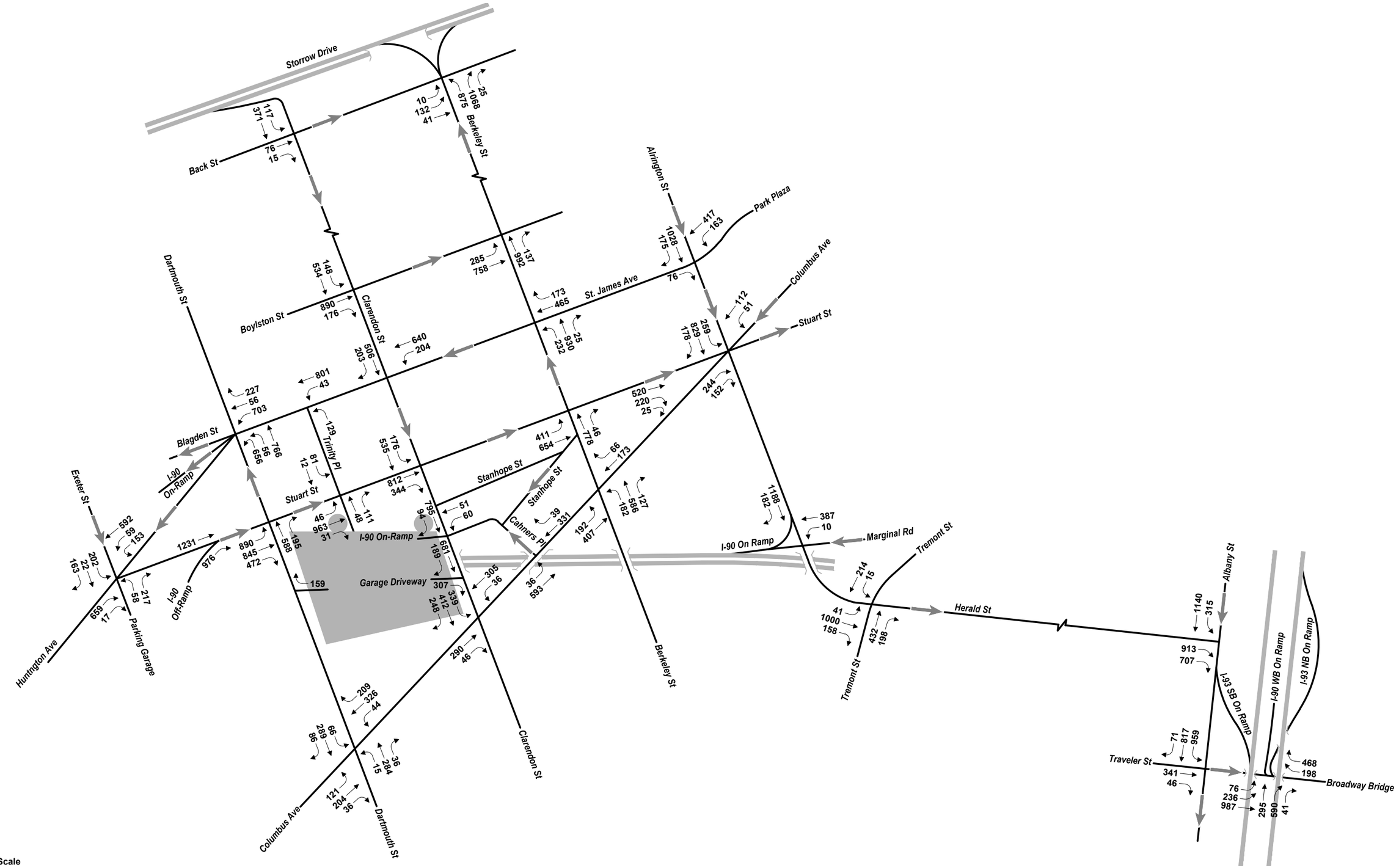
The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2023 Build Base Condition Vehicle Volumes
AM Peak Hour (8:00 AM - 9:00 AM)

Figure 4.12a

vhb

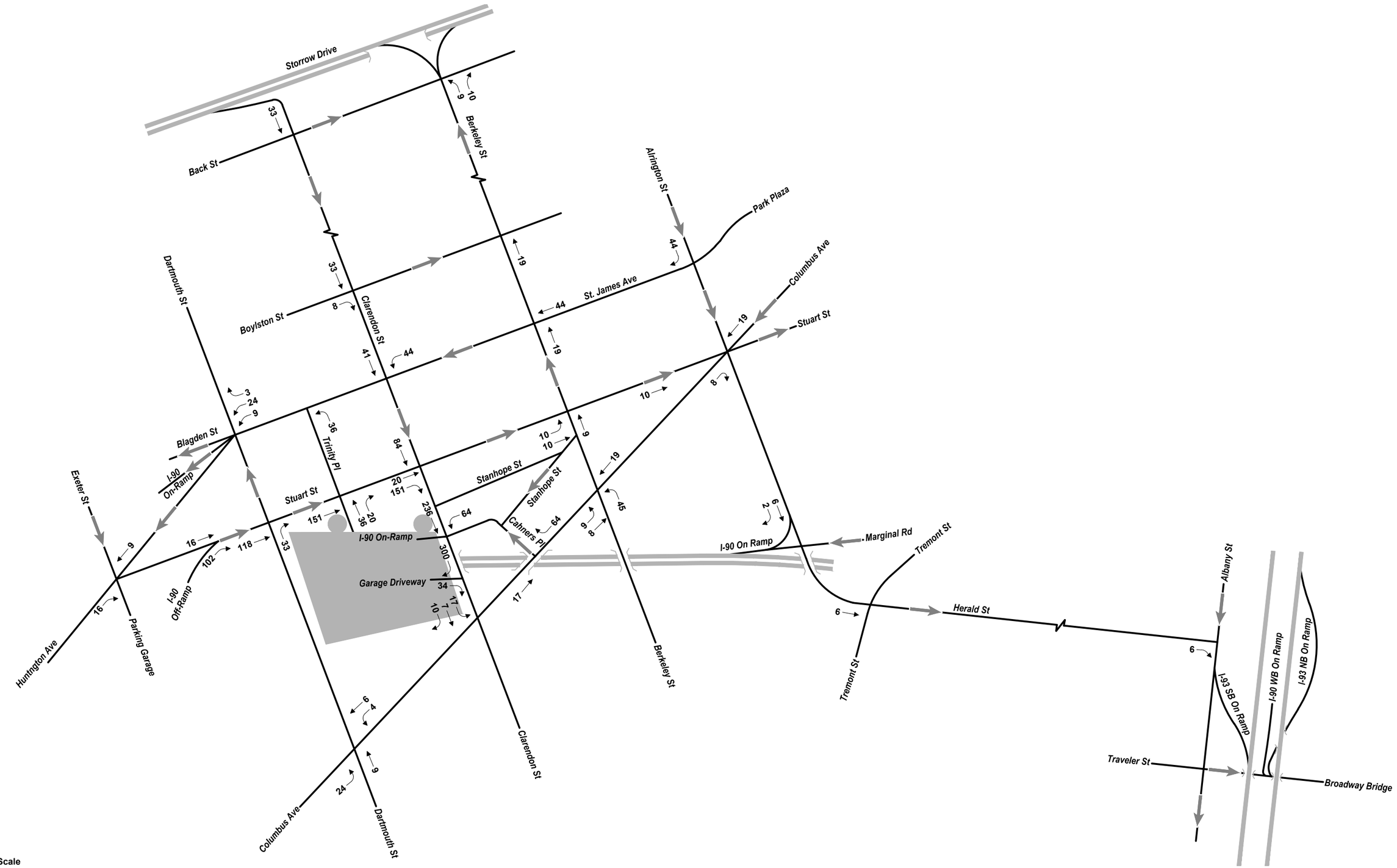


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2023 Build Base Condition Vehicle Volumes
PM Peak Hour (5:00 PM - 6:00 PM)

Figure 4.12b

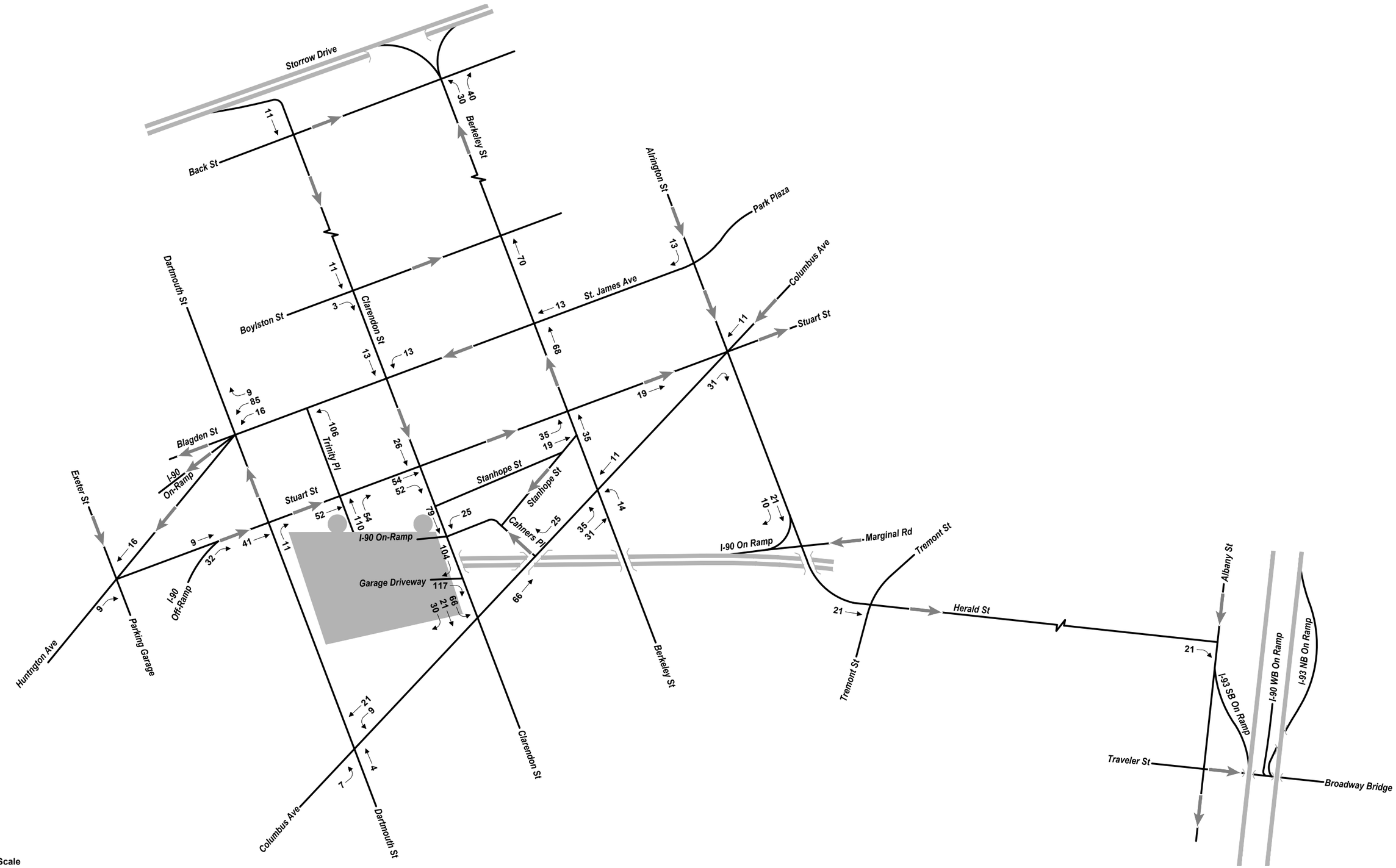


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

Project Generated Alternate Condition Vehicle Trips
AM Peak Hour (8:00 AM - 9:00 AM)

Figure 4.13a

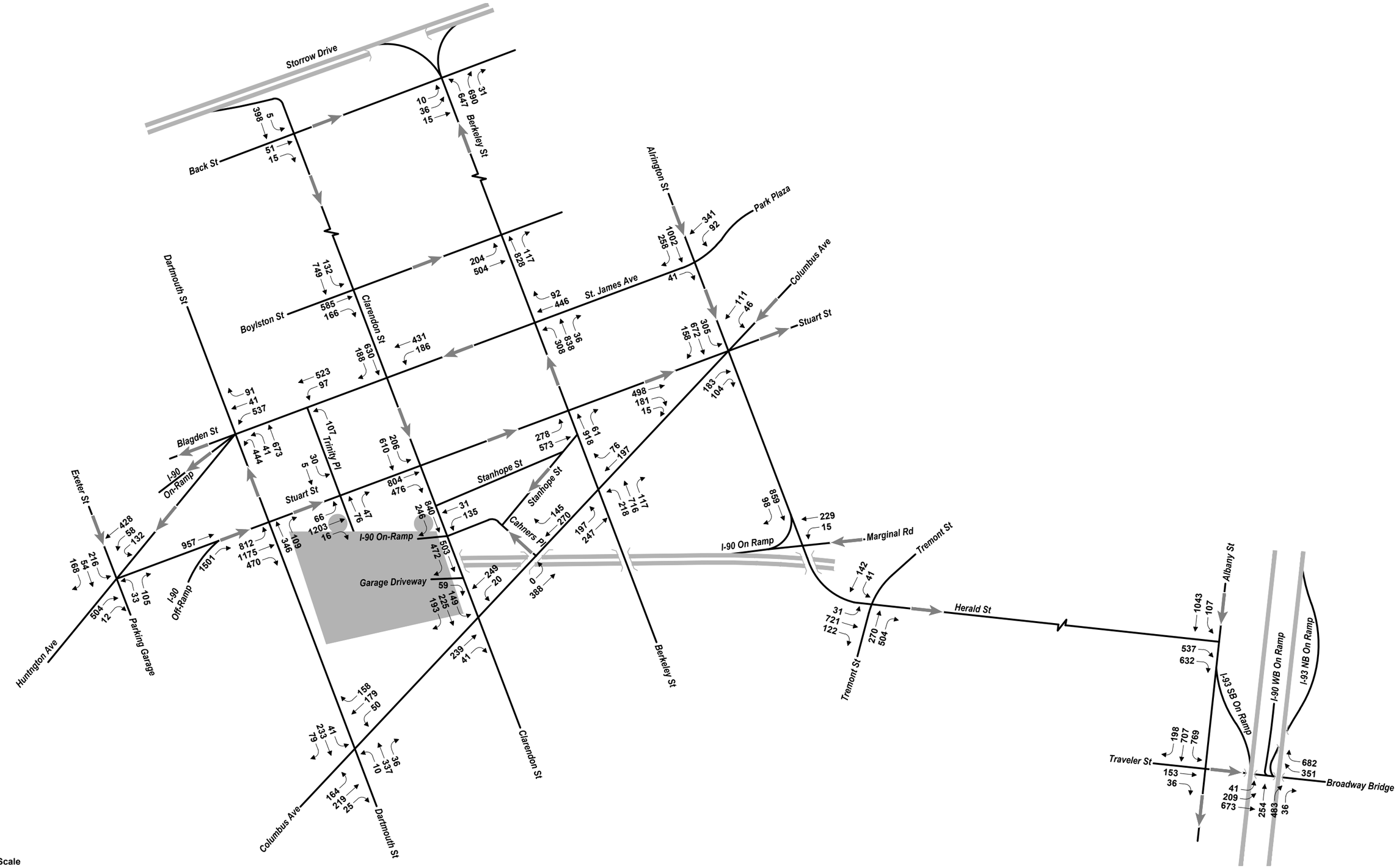


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

Project Generated Alternate Condition Vehicle Trips
PM Peak Hour (5:00 PM - 6:00 PM)

Figure 4.13b

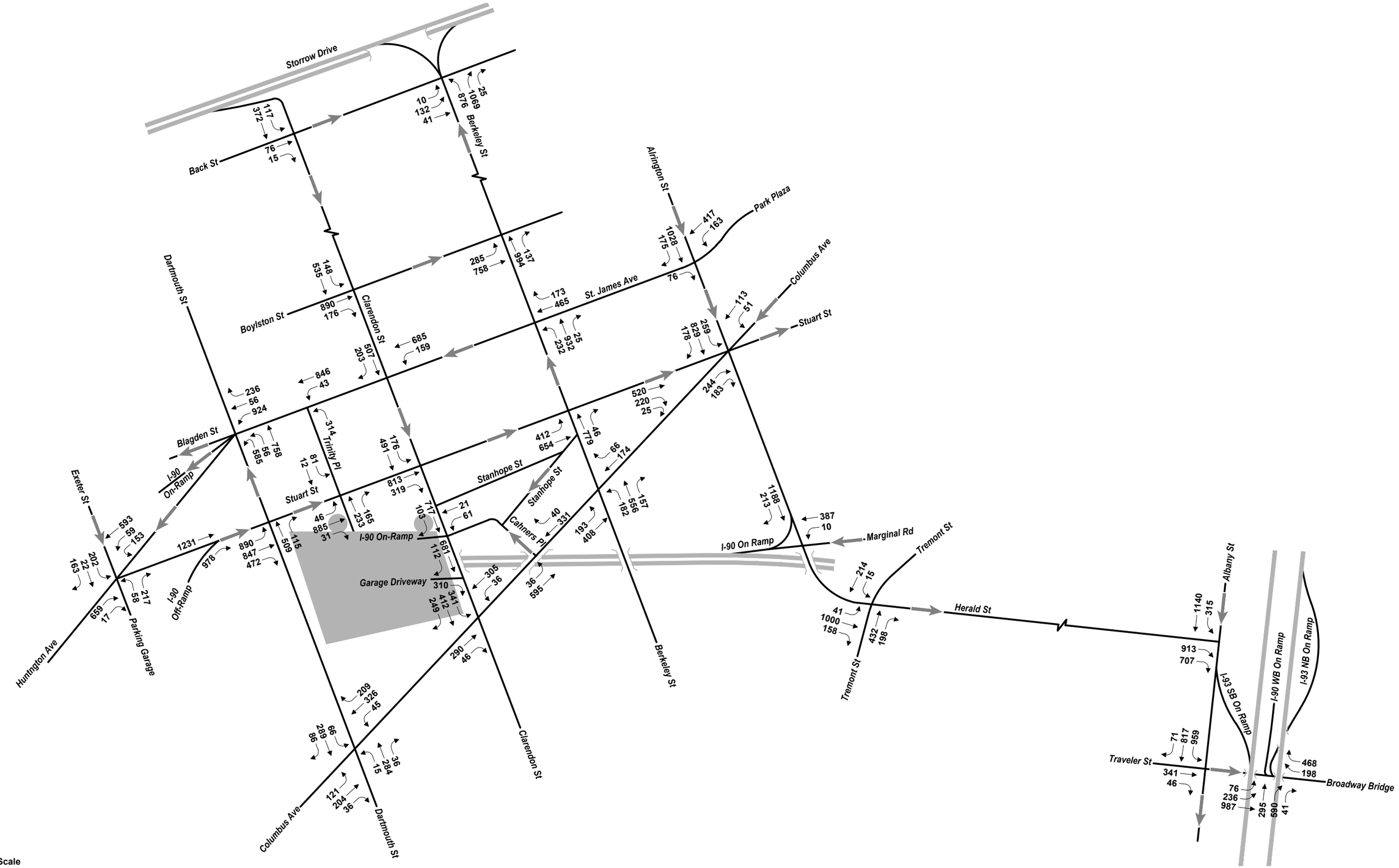


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2023 Build Alternate Condition Vehicle Volumes
AM Peak Hour (8:00 AM - 9:00 AM)

Figure 4.14a

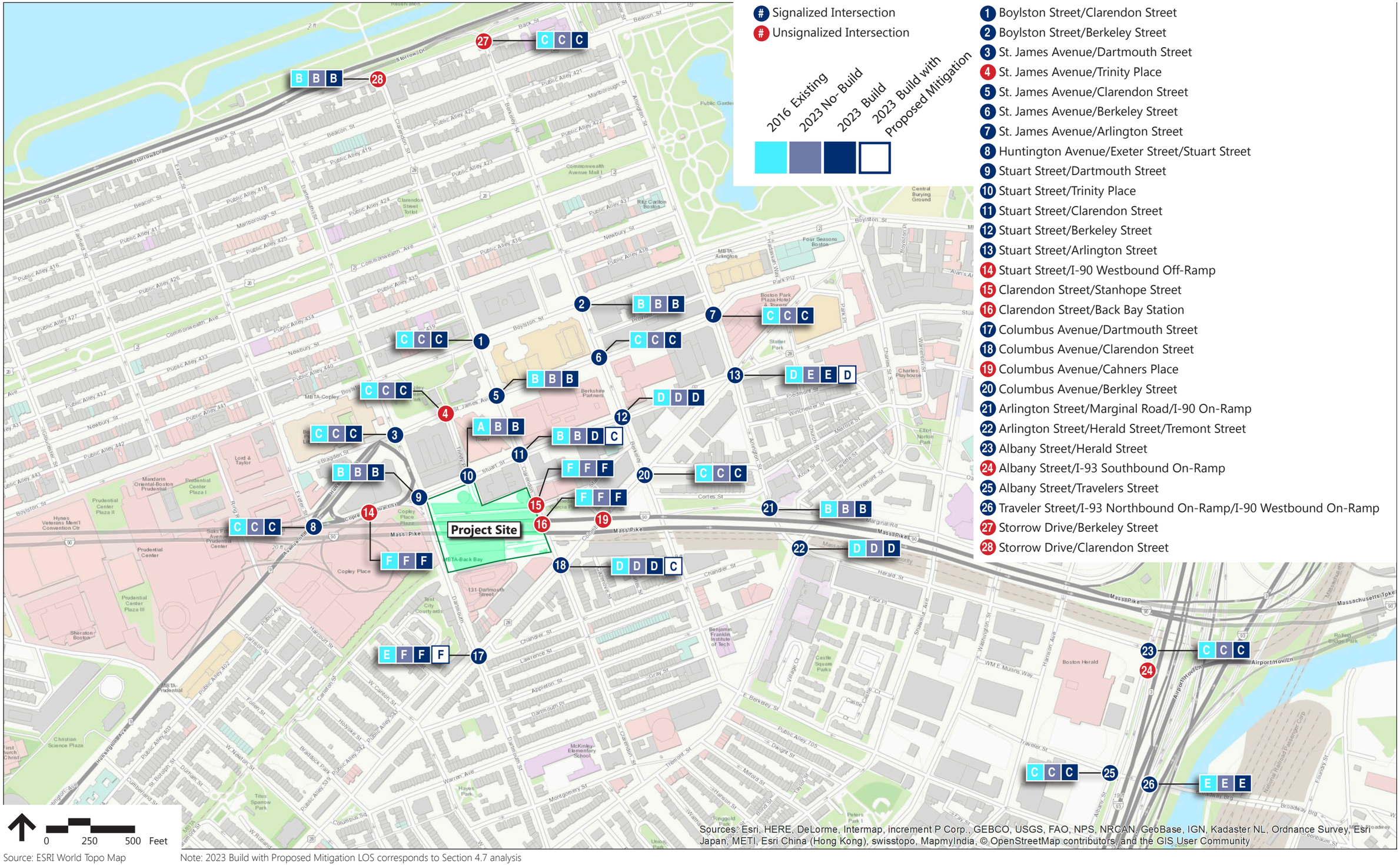


The Back Bay / South End Gateway Project

BOSTON PROPERTIES

2023 Build Alternate Condition Vehicle Volumes
PM Peak Hour (5:00 PM - 6:00 PM)

Figure 4.14b



Signalized Intersection
Unsignalized Intersection

2016 Existing
2023 No-Build
2023 Build
2023 Build with Proposed Mitigation

1. Boylston Street/Clarendon Street
2. Boylston Street/Berkeley Street
3. St. James Avenue/Dartmouth Street
4. St. James Avenue/Trinity Place
5. St. James Avenue/Clarendon Street
6. St. James Avenue/Berkeley Street
7. St. James Avenue/Arlington Street
8. Huntington Avenue/Exeter Street/Stuart Street
9. Stuart Street/Dartmouth Street
10. Stuart Street/Trinity Place
11. Stuart Street/Clarendon Street
12. Stuart Street/Berkeley Street
13. Stuart Street/Arlington Street
14. Stuart Street/I-90 Westbound Off-Ramp
15. Clarendon Street/Stanhope Street
16. Clarendon Street/Back Bay Station
17. Columbus Avenue/Dartmouth Street
18. Columbus Avenue/Clarendon Street
19. Columbus Avenue/Cahners Place
20. Columbus Avenue/Berkley Street
21. Arlington Street/Marginal Road/I-90 On-Ramp
22. Arlington Street/Herald Street/Tremont Street
23. Albany Street/Herald Street
24. Albany Street/I-93 Southbound On-Ramp
25. Albany Street/Travelers Street
26. Traveler Street/I-93 Northbound On-Ramp/I-90 Westbound On-Ramp
27. Storrow Drive/Berkeley Street
28. Storrow Drive/Clarendon Street

0 250 500 Feet

Source: ESRI World Topo Map

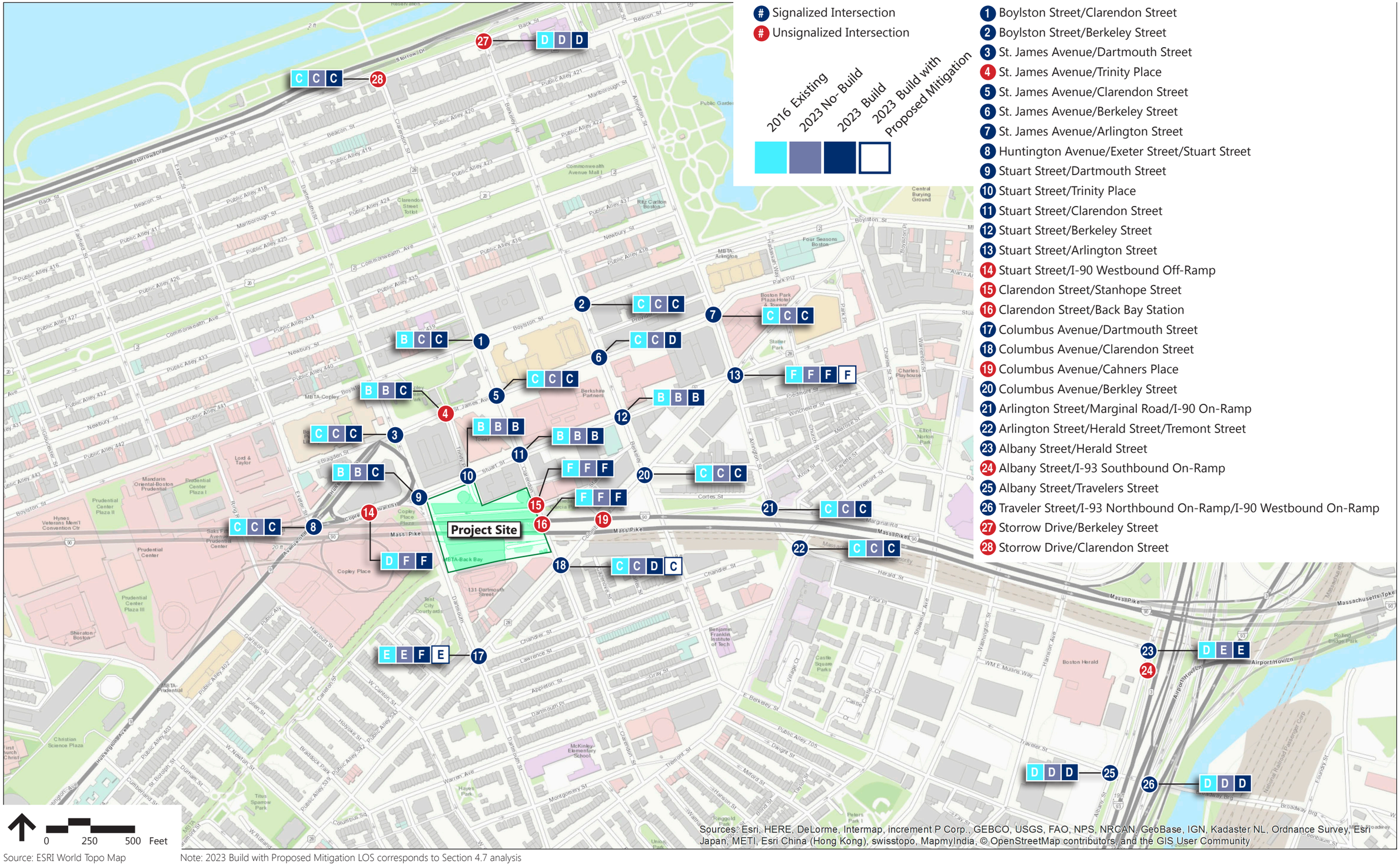
Note: 2023 Build with Proposed Mitigation LOS corresponds to Section 4.7 analysis

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

AM Peak Hour - Base Condition Intersection Level of Service

Figure 4.15.a

vhb



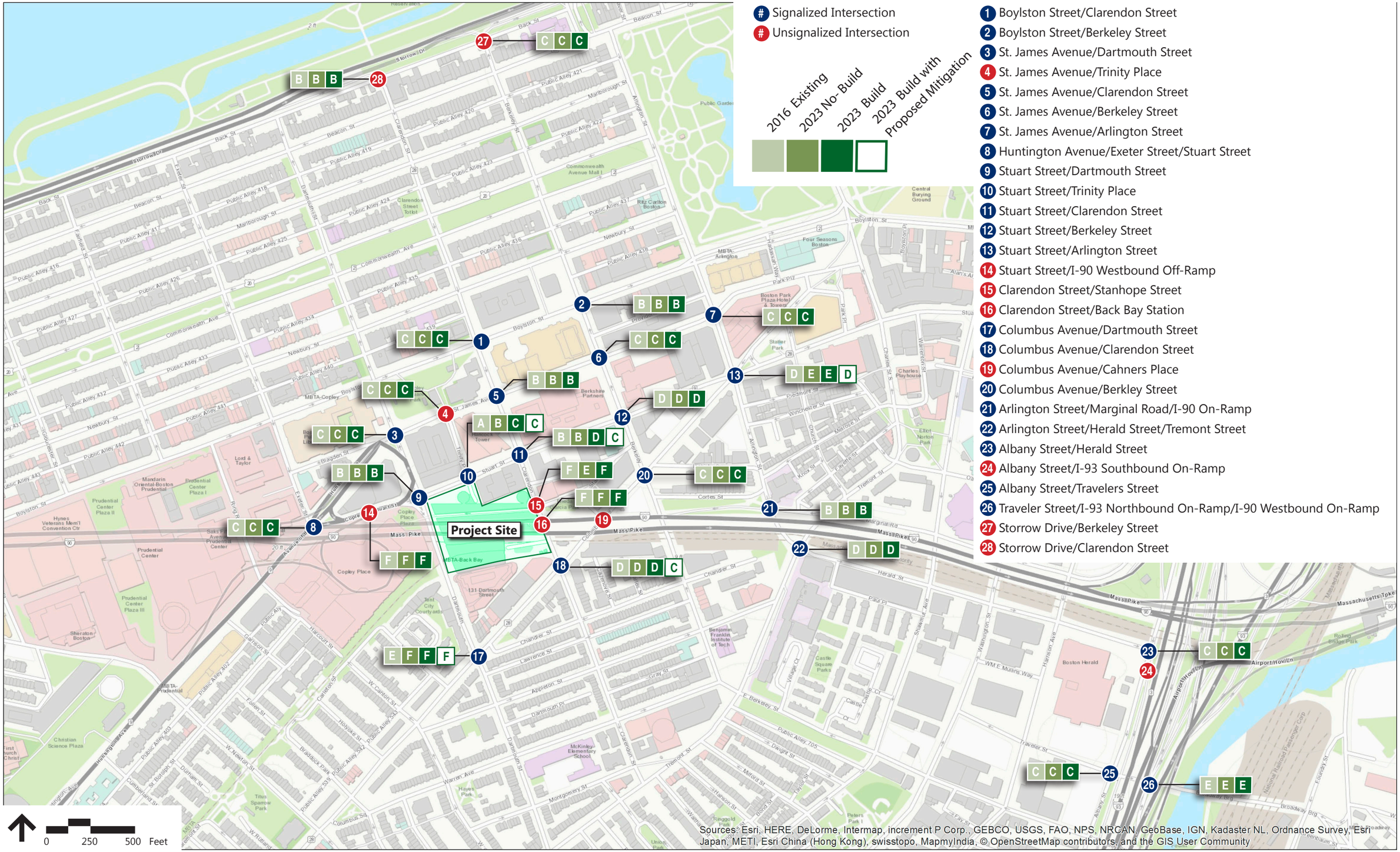
Source: ESRI World Topo Map

Note: 2023 Build with Proposed Mitigation LOS corresponds to Section 4.7 analysis

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

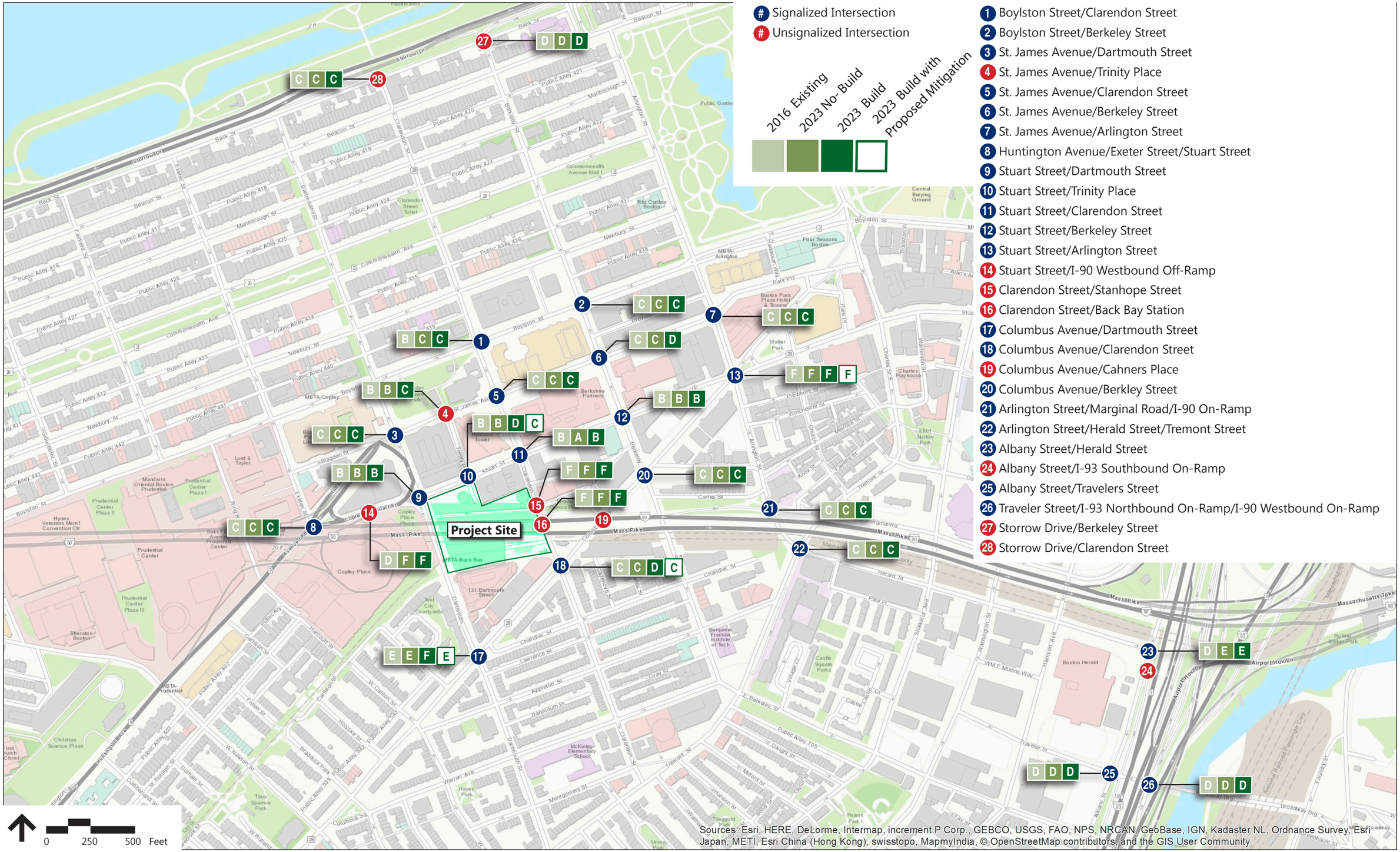
PM Peak Hour - Base Condition Intersection Level of Service

Figure 4.15.b



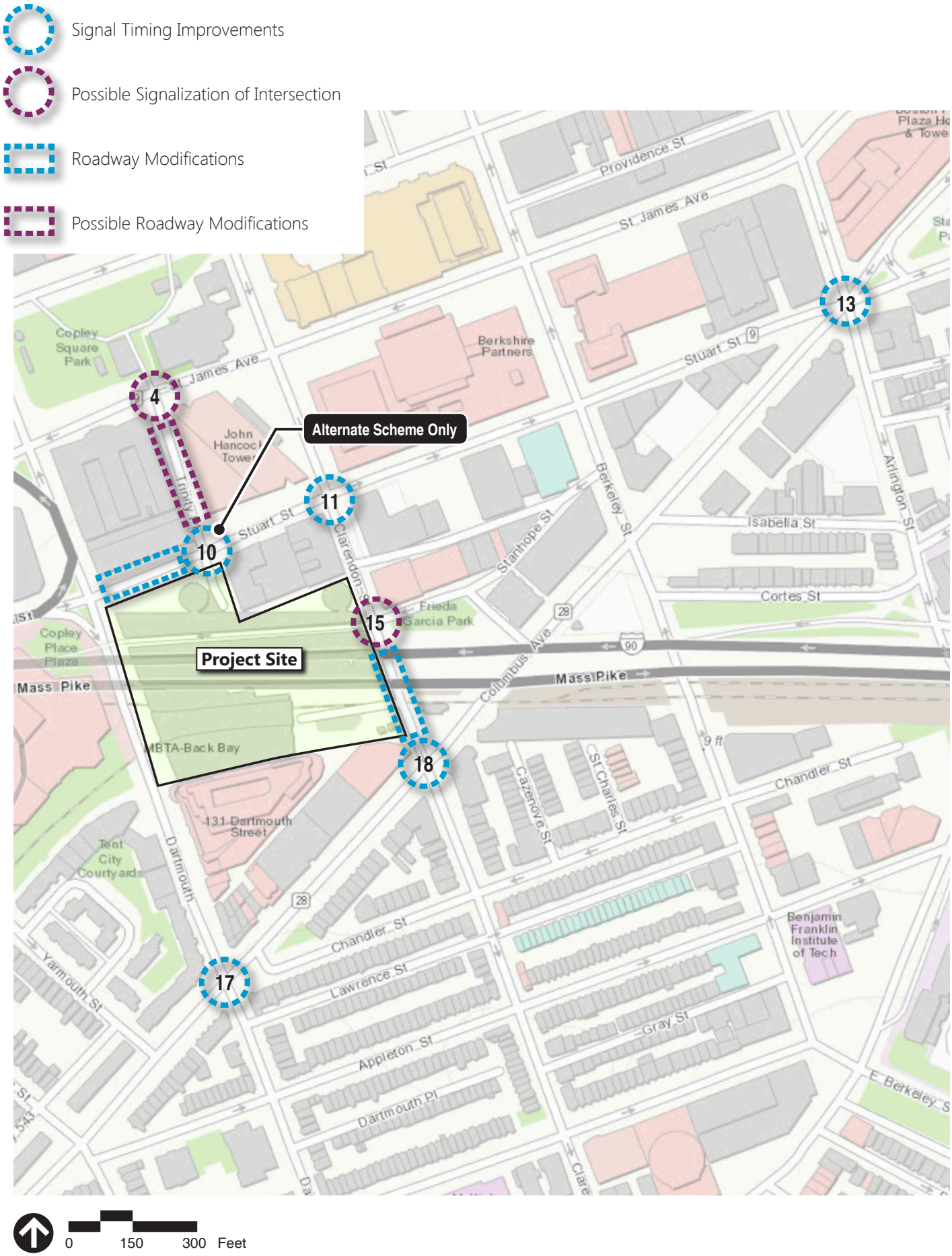
Source: ESRI World Topo Map

Note: 2023 Build with Proposed Mitigation LOS corresponds to Section 4.7 analysis



Source: ESRI World Topo Map

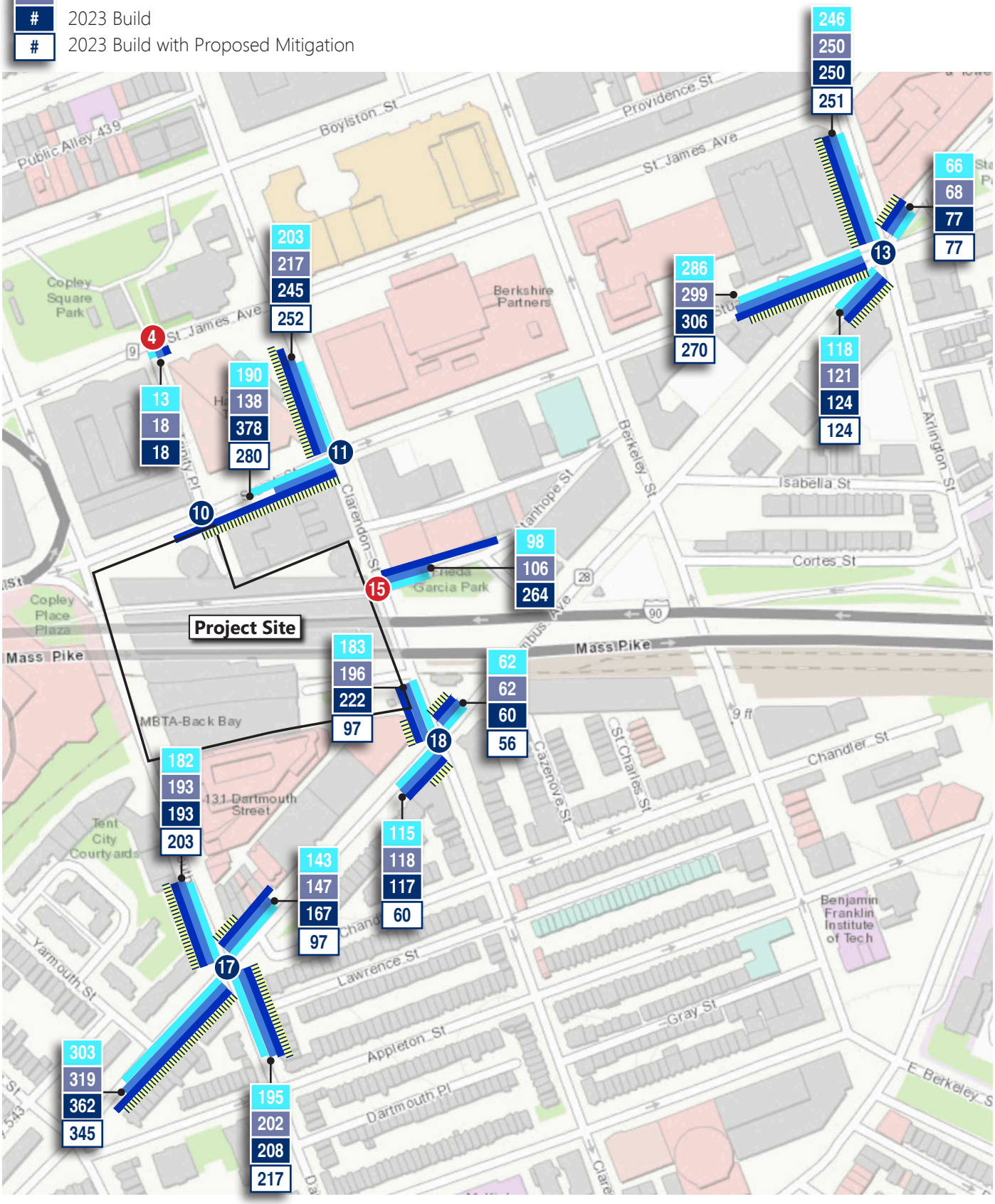
Note: 2023 Build with Proposed Mitigation LOS corresponds to Section 4.7 analysis



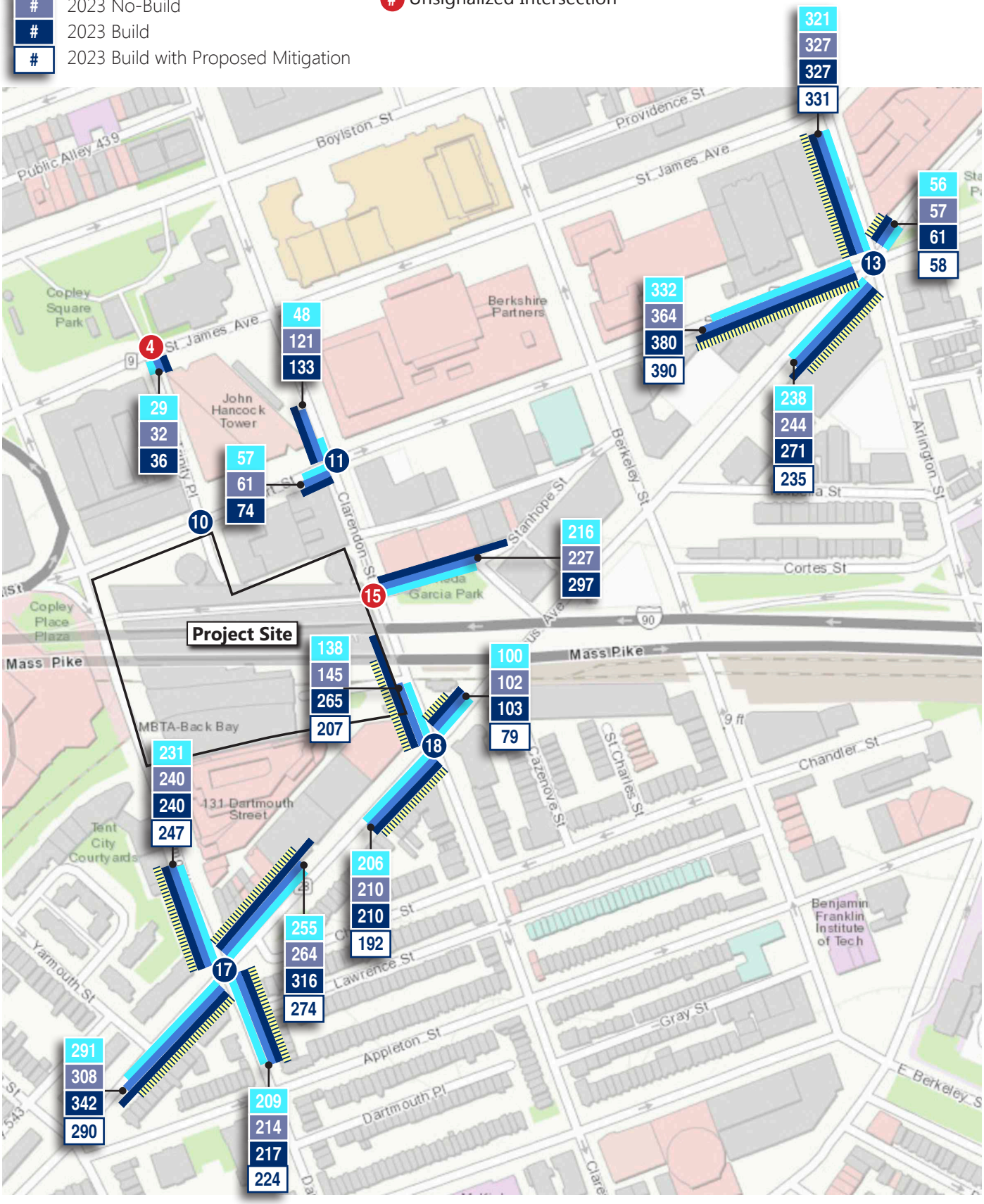
The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Possible Transportation Mitigation

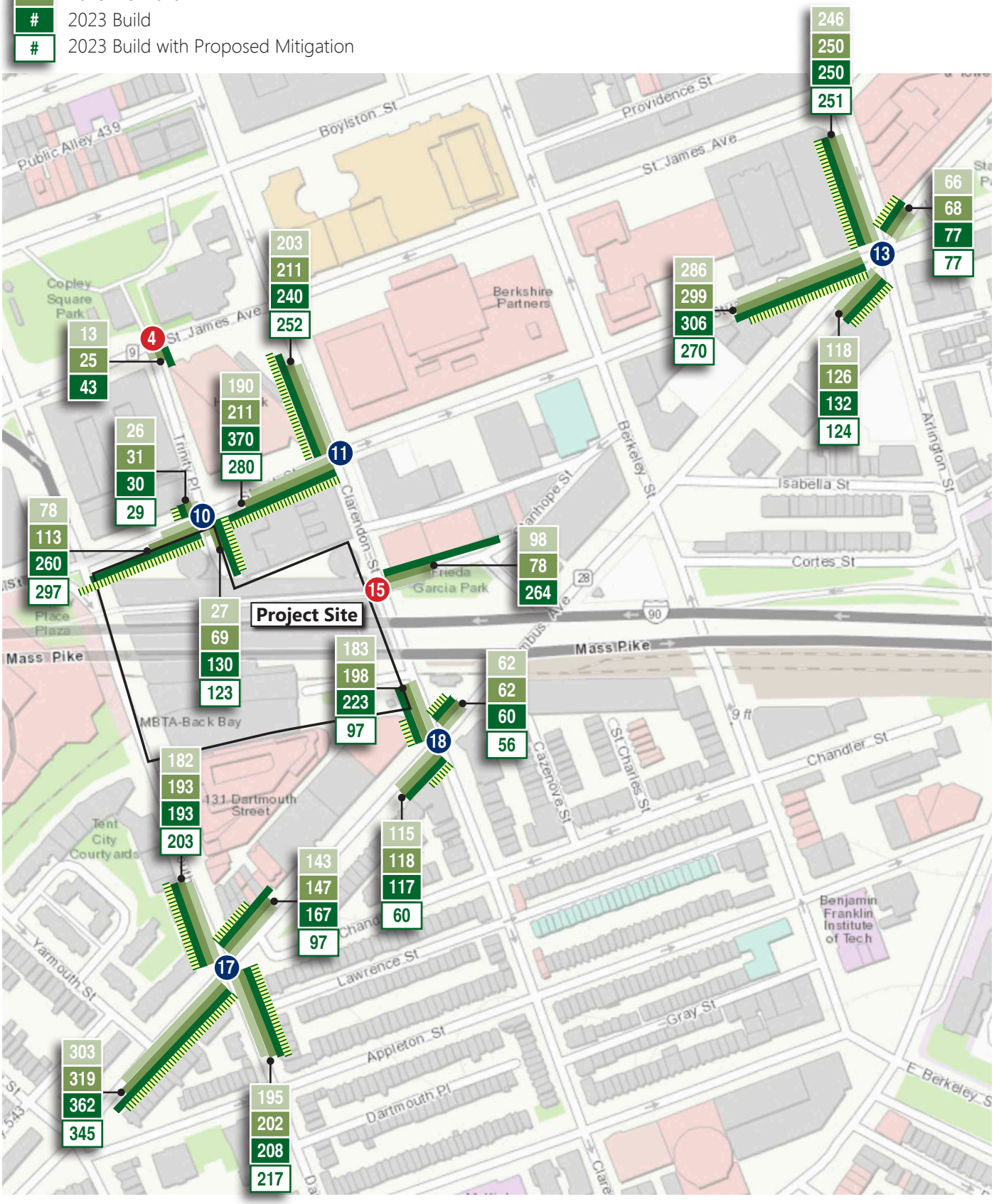
Figure 4.16



Note: 2023 Build with Proposed Mitigation Queue corresponds to Section 4.7 analysis



Note: 2023 Build with Proposed Mitigation Queue corresponds to Section 4.7 analysis

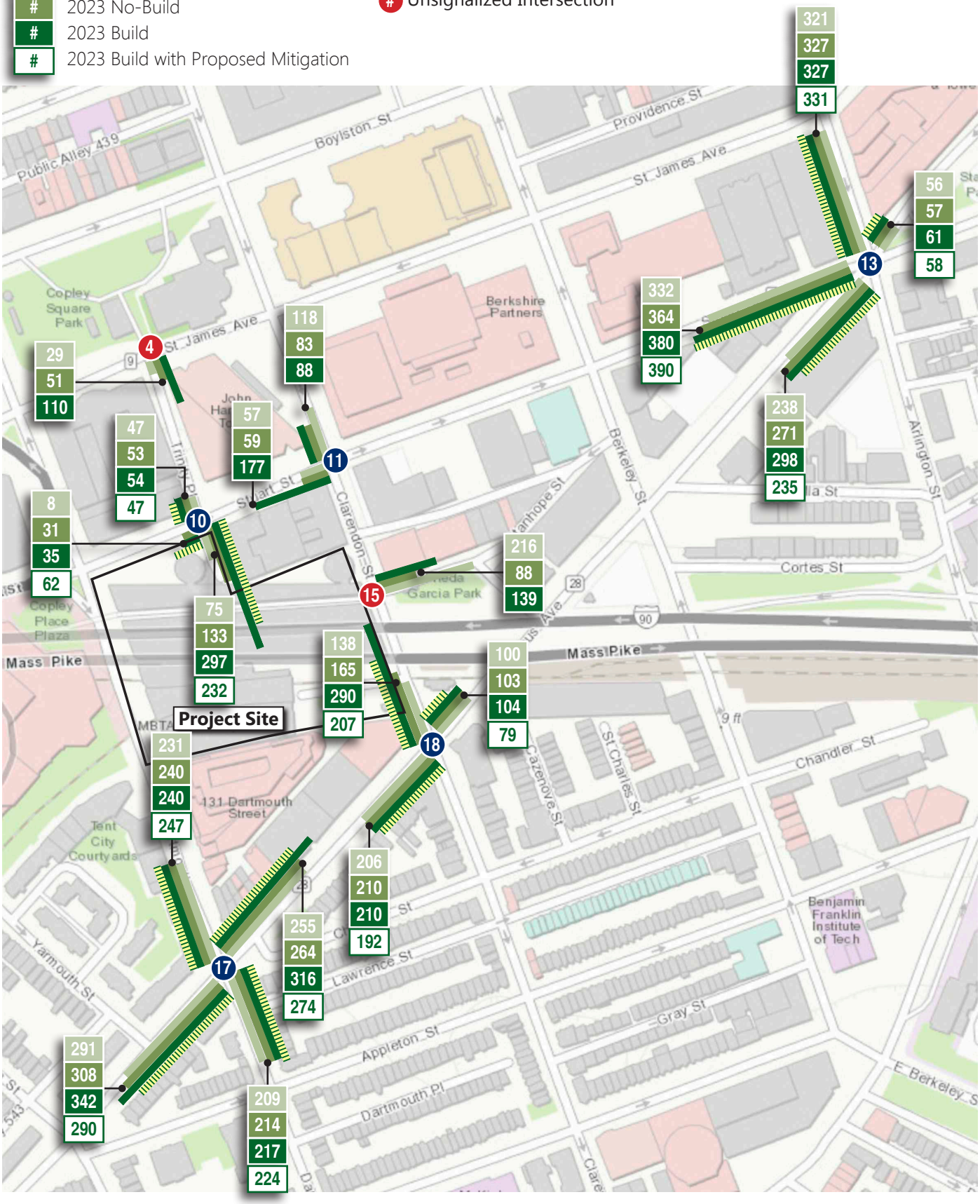


Note: 2023 Build with Proposed Mitigation Queue corresponds to Section 4.7 analysis

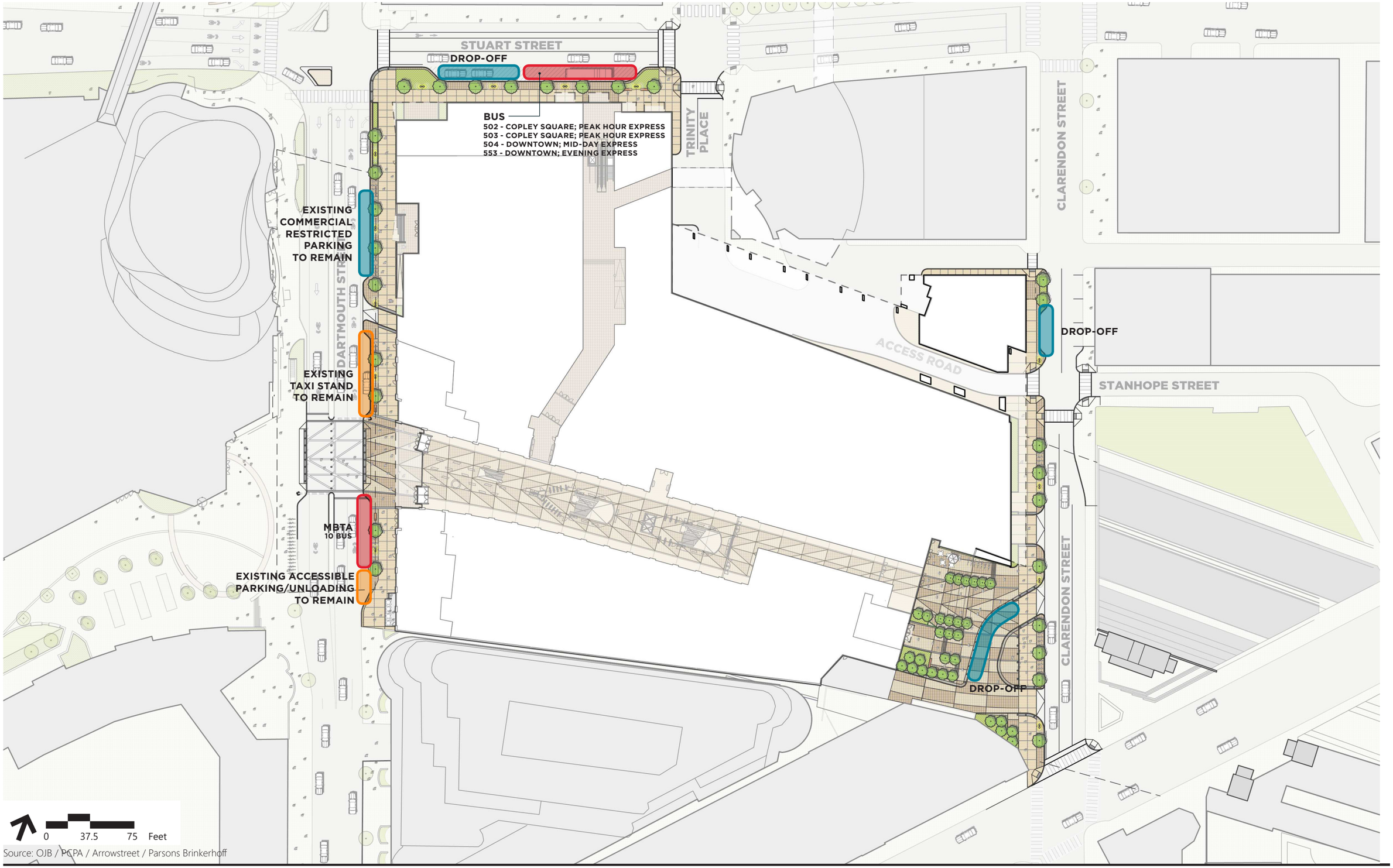
The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

AM Peak Hour - Alternate Condition Queues

Figure 4.17c



Note: 2023 Build with Proposed Mitigation Queue corresponds to Section 4.7 analysis



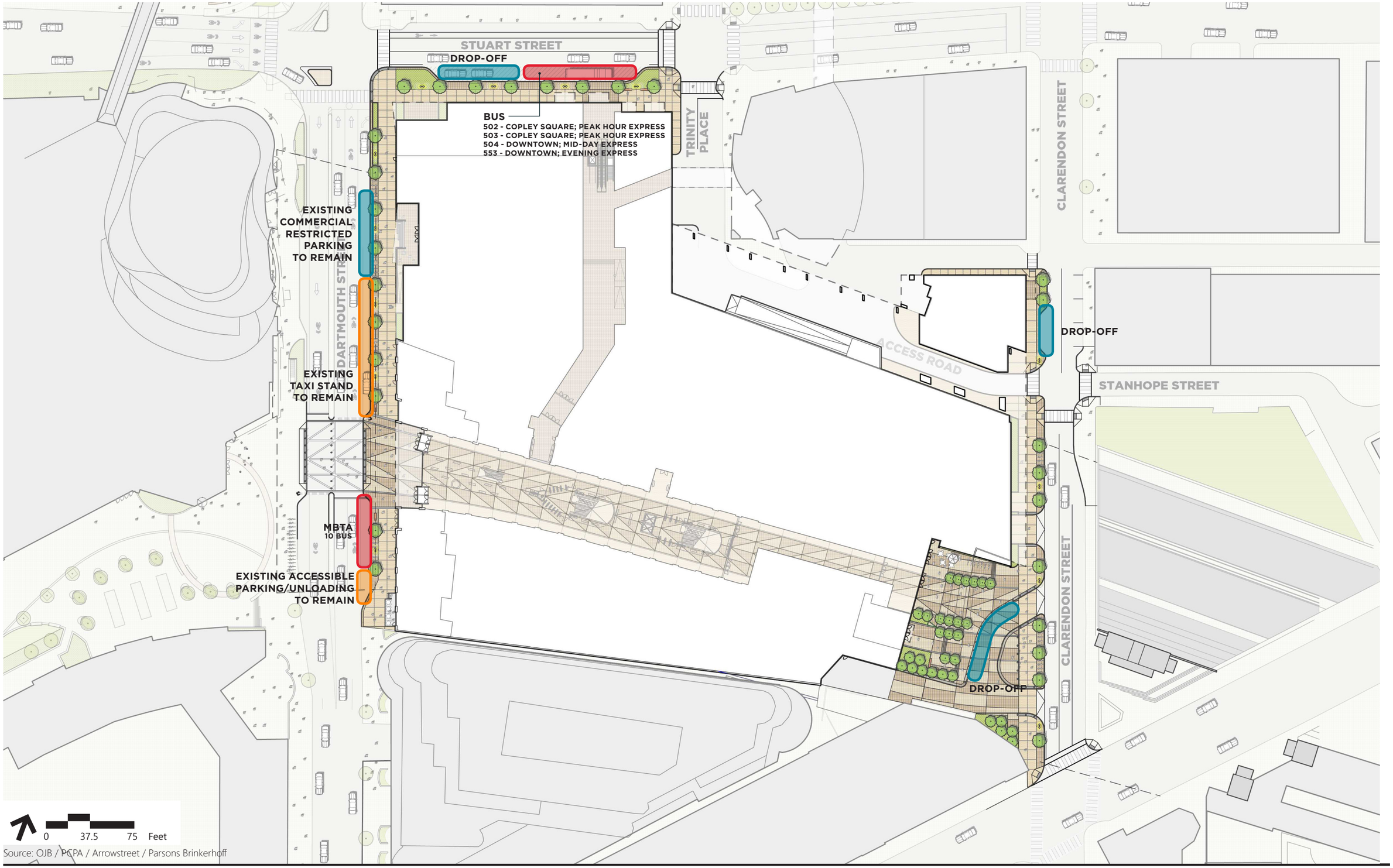
Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Proposed Curbside Use - Base Scheme

Figure 4.18a

OJB



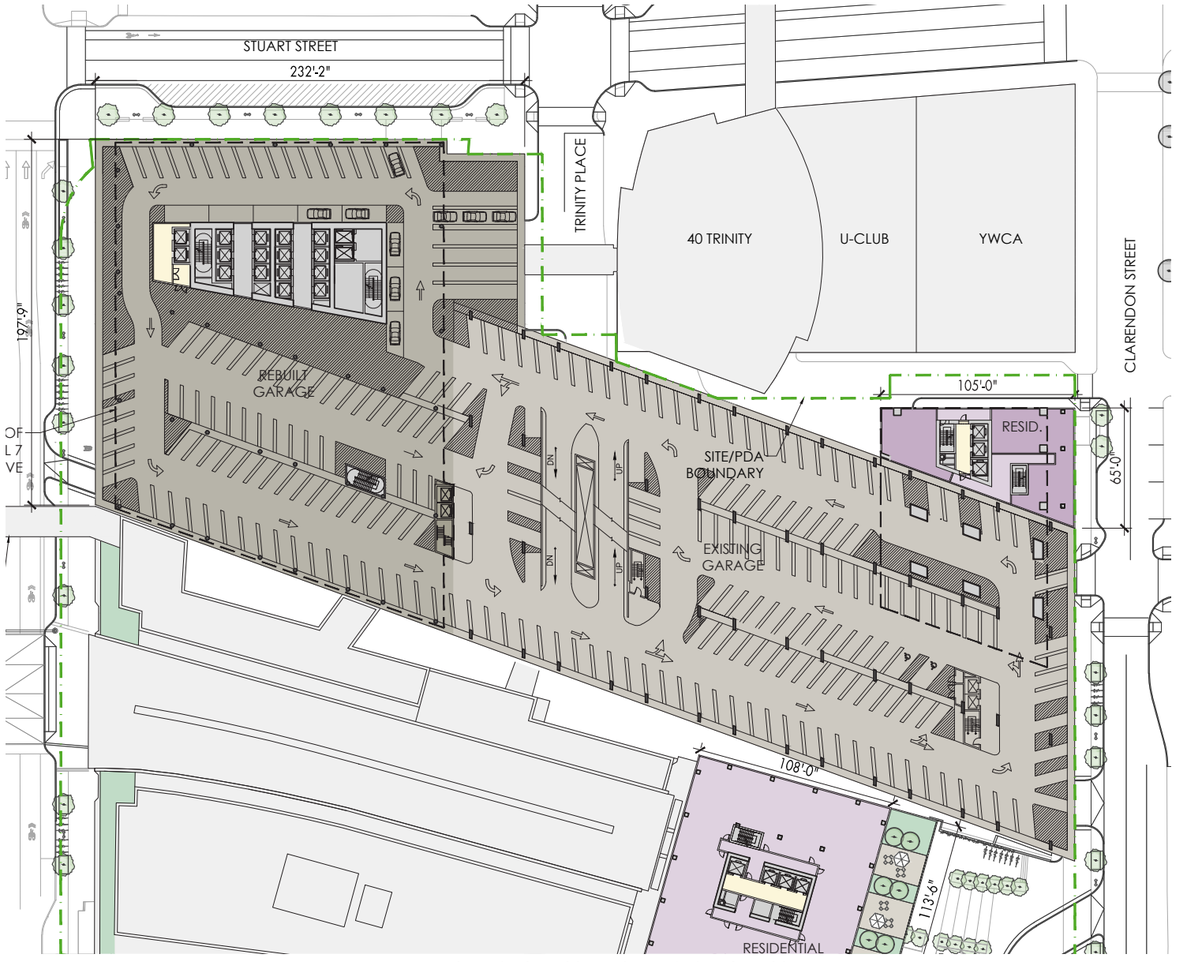
Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

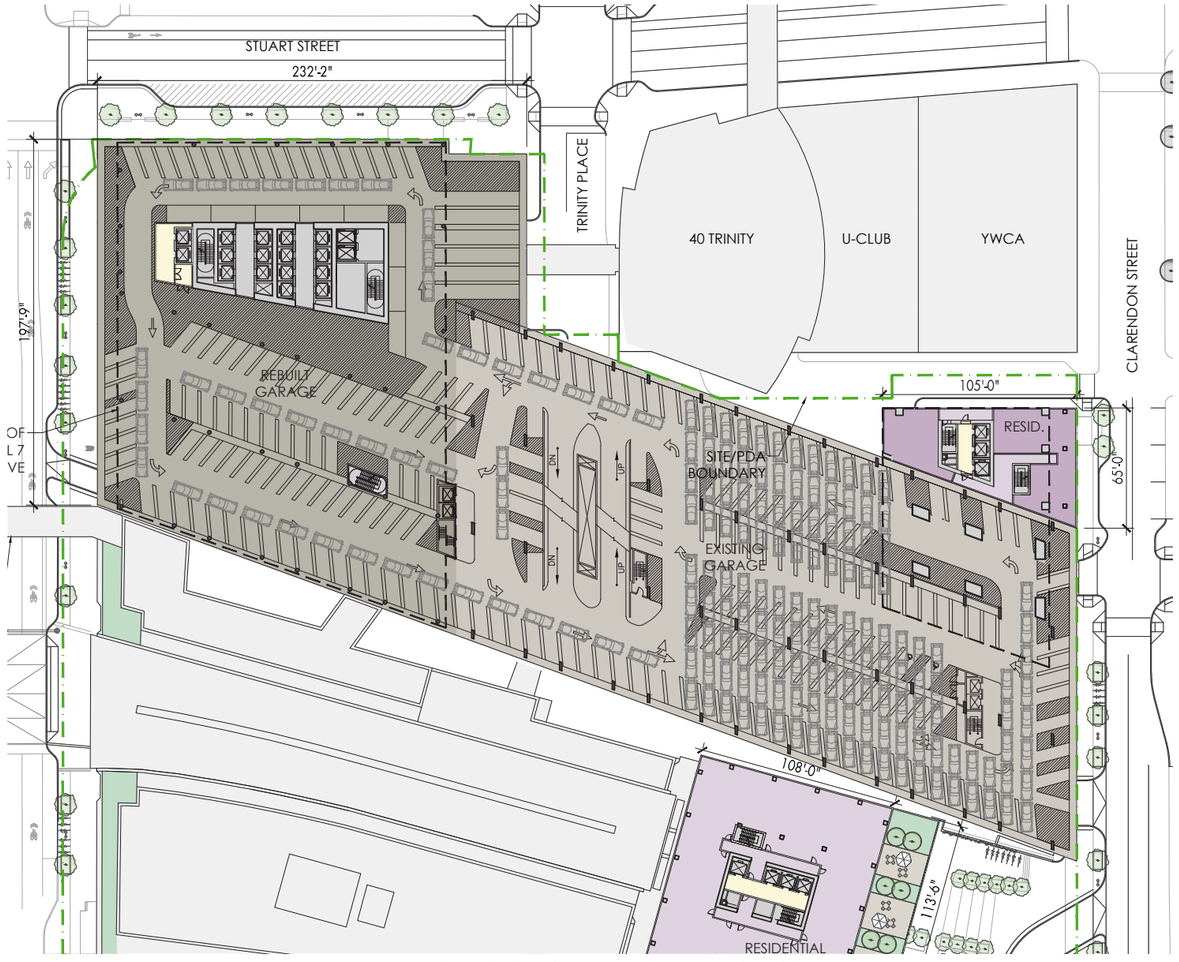
Proposed Curbside Use - Alternate Scheme

Figure 4.18b

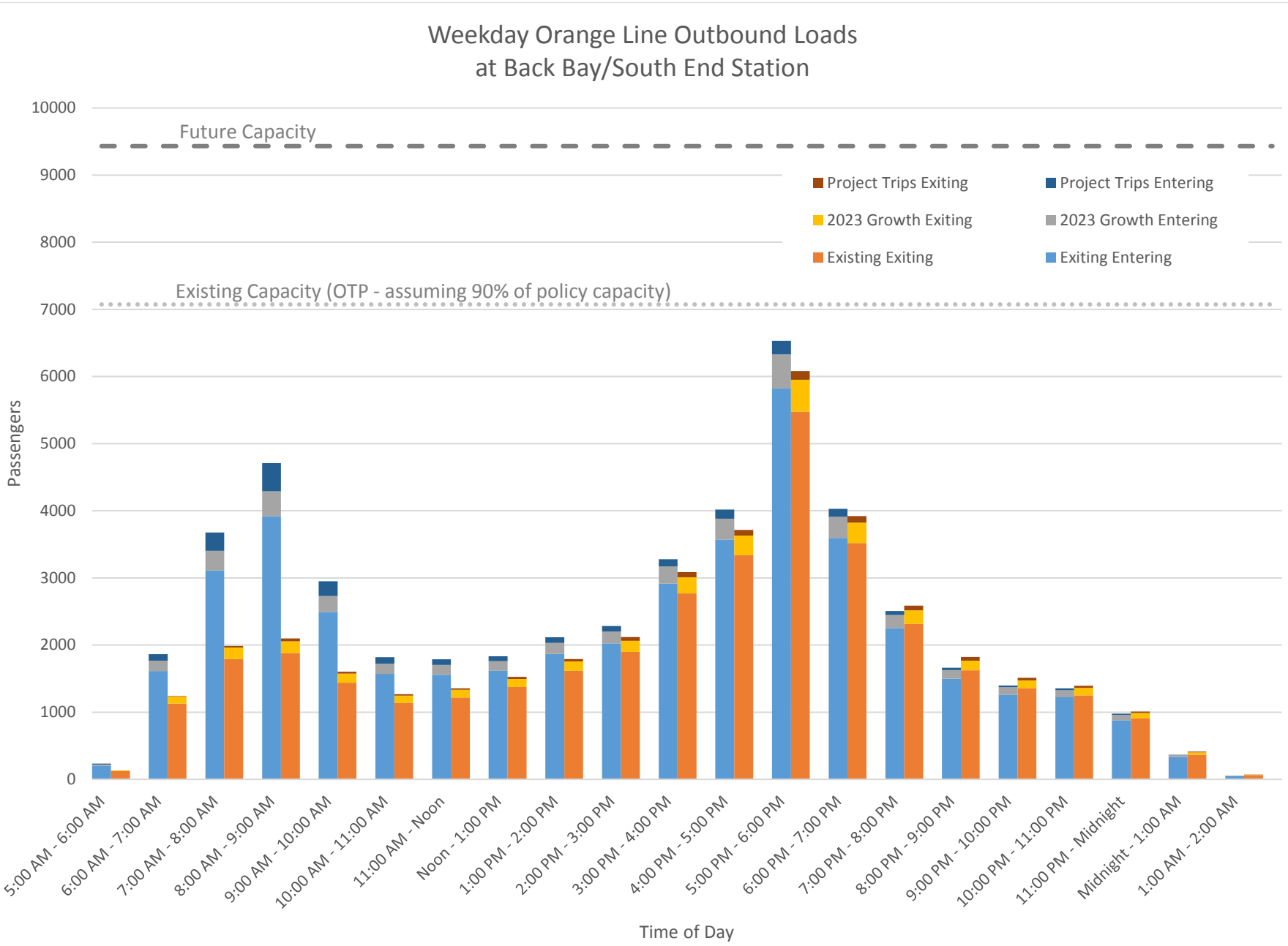
OJB

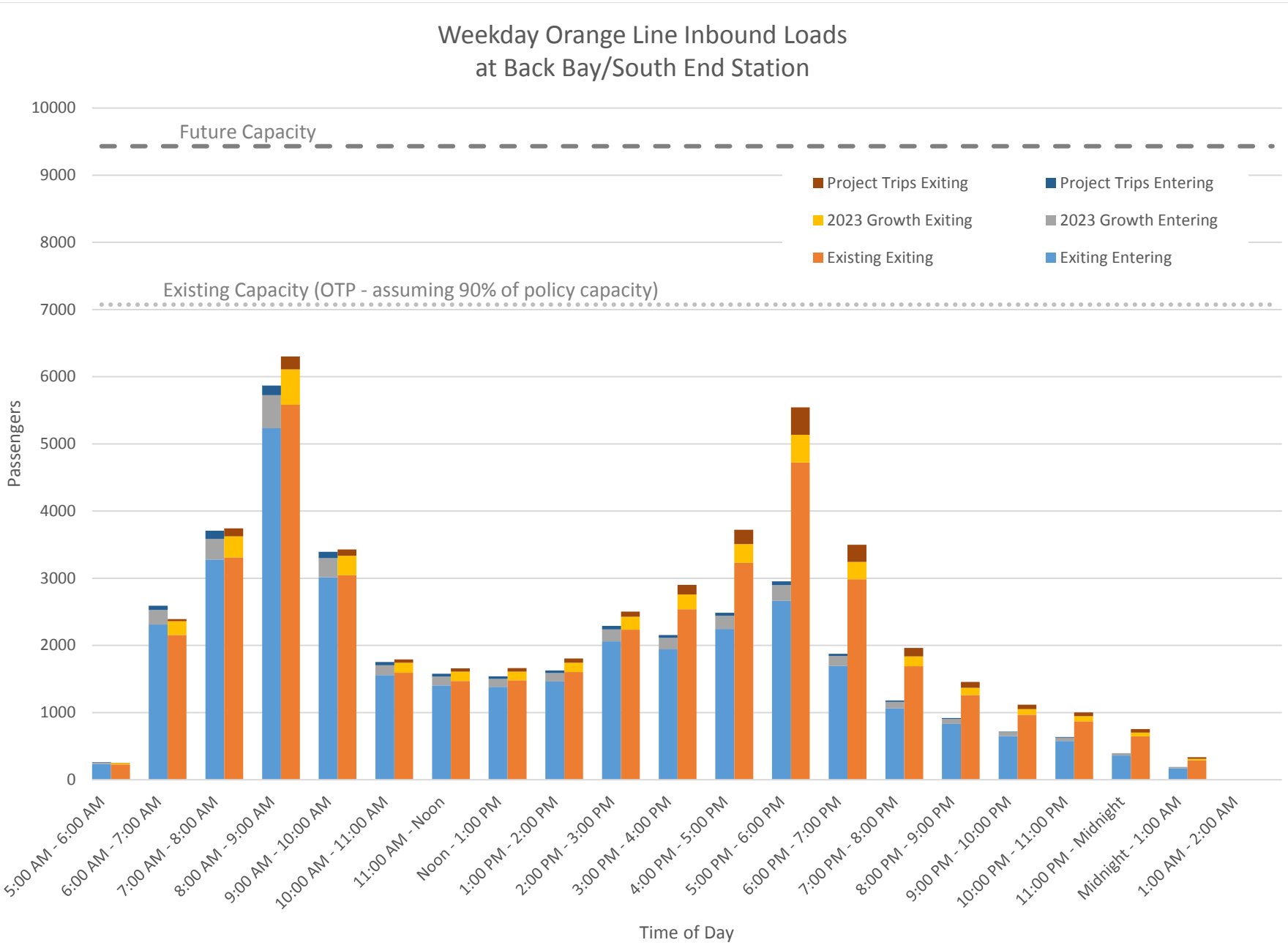


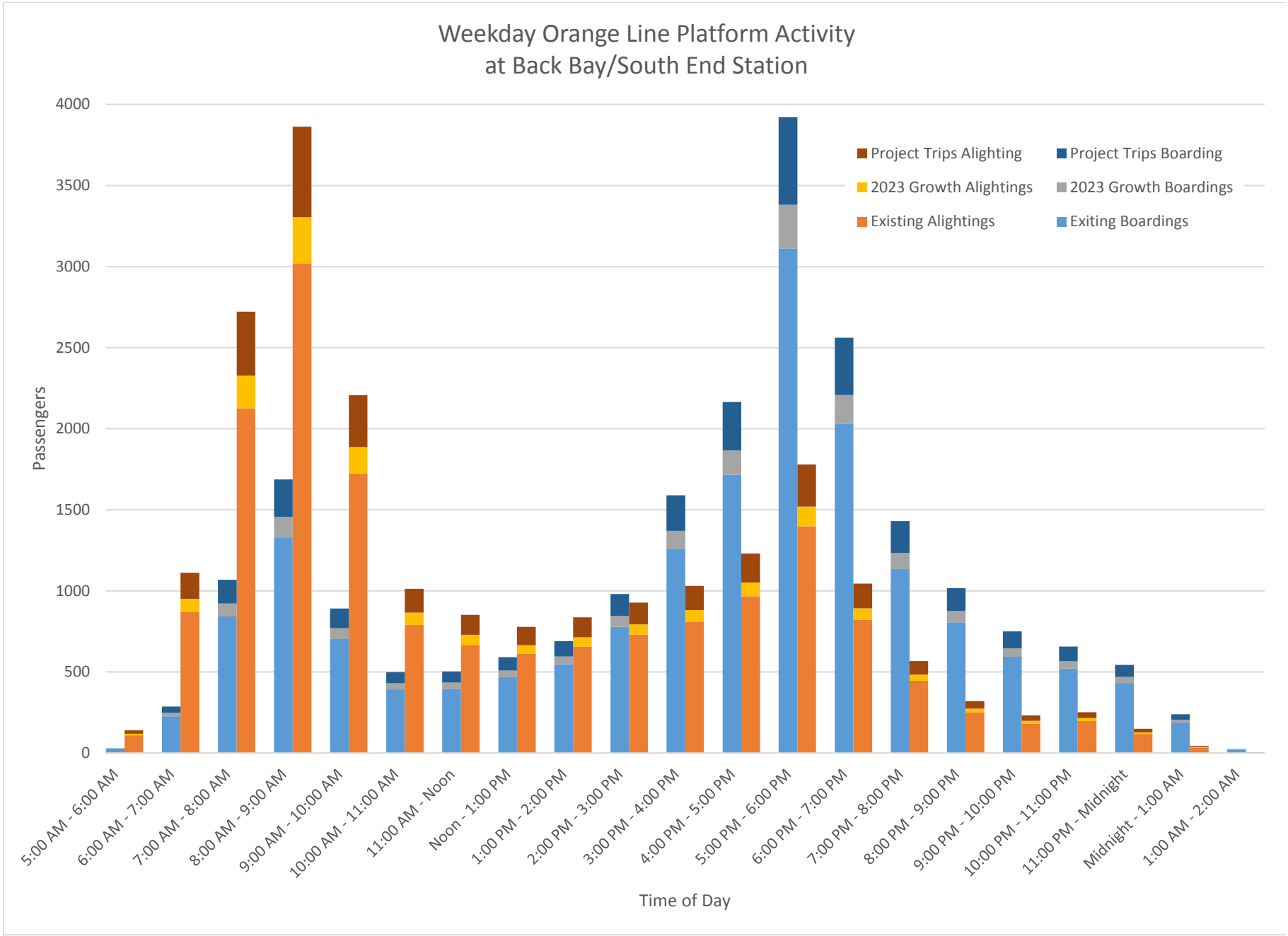
Proposed Typical Parking Plan - Striped Parking

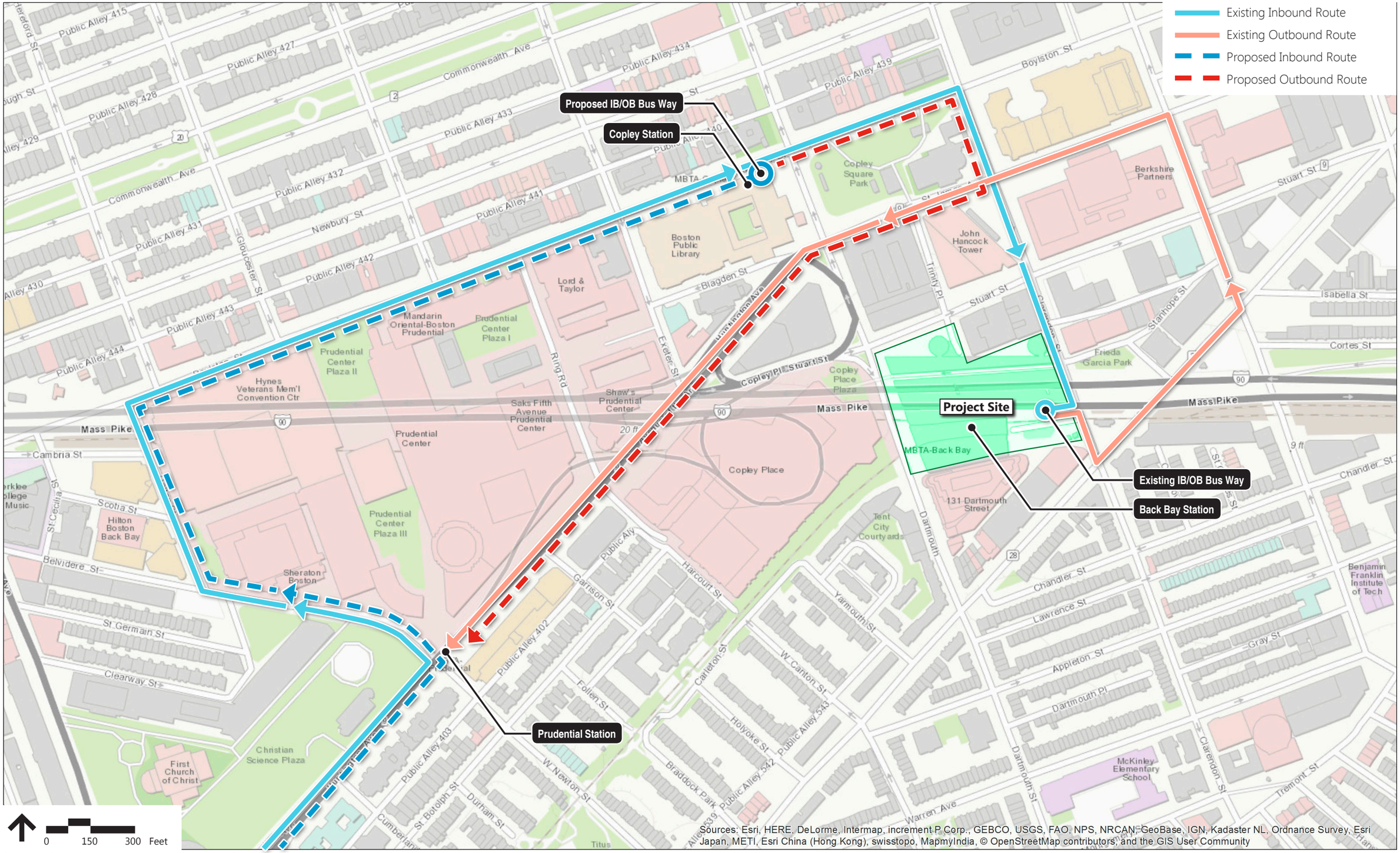


Proposed Typical Parking Plan - Managed Parking


Weekday Orange Line Outbound Loads
at Back Bay/South End Station
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Passengers
Future Capacity
Existing Capacity (OTP - assuming 90% of policy capacity)
Project Trips Exiting
Project Trips Entering
2023 Growth Exiting
2023 Growth Entering
Existing Exiting
Exiting Entering
5:00 AM - 6:00 AM
6:00 AM - 7:00 AM
7:00 AM - 8:00 AM
8:00 AM - 9:00 AM
9:00 AM - 10:00 AM
10:00 AM - 11:00 AM
11:00 AM - Noon
Noon - 1:00 PM
1:00 PM - 2:00 PM
2:00 PM - 3:00 PM
3:00 PM - 4:00 PM
4:00 PM - 5:00 PM
5:00 PM - 6:00 PM
6:00 PM - 7:00 PM
7:00 PM - 8:00 PM
8:00 PM - 9:00 PM
9:00 PM - 10:00 PM
10:00 PM - 11:00 PM
11:00 PM - Midnight
Midnight - 1:00 AM
1:00 AM - 2:00 AM
Time of Day


Weekday Orange Line Inbound Loads
at Back Bay/South End Station
Future Capacity
Existing Capacity (OTP - assuming 90% of policy capacity)
Project Trips Exiting
Project Trips Entering
2023 Growth Exiting
2023 Growth Entering
Existing Exiting
Exiting Entering
Passengers
Time of Day
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
5:00 AM - 6:00 AM
6:00 AM - 7:00 AM
7:00 AM - 8:00 AM
8:00 AM - 9:00 AM
9:00 AM - 10:00 AM
10:00 AM - 11:00 AM
11:00 AM - Noon
Noon - 1:00 PM
1:00 PM - 2:00 PM
2:00 PM - 3:00 PM
3:00 PM - 4:00 PM
4:00 PM - 5:00 PM
5:00 PM - 6:00 PM
6:00 PM - 7:00 PM
7:00 PM - 8:00 PM
8:00 PM - 9:00 PM
9:00 PM - 10:00 PM
10:00 PM - 11:00 PM
11:00 PM - Midnight
Midnight - 1:00 AM
1:00 AM - 2:00 AM


Weekday Orange Line Platform Activity
at Back Bay/South End Station
Passengers
4000
3500
3000
2500
2000
1500
1000
500
0
Project Trips Alighting
Project Trips Boarding
2023 Growth Alightings
2023 Growth Boardings
Existing Alightings
Exiting Boardings
5:00 AM - 6:00 AM
6:00 AM - 7:00 AM
7:00 AM - 8:00 AM
8:00 AM - 9:00 AM
9:00 AM - 10:00 AM
10:00 AM - 11:00 AM
11:00 AM - Noon
Noon - 1:00 PM
1:00 PM - 2:00 PM
2:00 PM - 3:00 PM
3:00 PM - 4:00 PM
4:00 PM - 5:00 PM
5:00 PM - 6:00 PM
6:00 PM - 7:00 PM
7:00 PM - 8:00 PM
8:00 PM - 9:00 PM
9:00 PM - 10:00 PM
10:00 PM - 11:00 PM
11:00 PM - Midnight
Midnight - 1:00 AM
1:00 AM - 2:00 AM
Time of Day



Source: Preferred Option provided by Peter Paravalos of the MBTA via email to Melissa Schrock on September 30, 2016

Short Term Bike Racks (Includes Parking Qty)
Hubway
Long Term Bike Storage
Pedal & Park Facility

STUART STREET
TRINITY PLACE
CLARENDON STREET
DARTMOUTH STREET
ACCESS ROAD
STANHOPE STREET

+10
+10
+10
+10
+10
+10
+10

GARAGE WEST
162 LONG TERM BICYCLE PARKING (CONCOURSE LEVEL)

GARAGE EAST
UP TO 120* LONG TERM BICYCLE PARKING (GARAGE LEVEL 1)

STATION CONCOURSE
PEDAL & PARK FACILITY
80 LONG TERM BICYCLE PARKING (CONCOURSE LEVEL)

STATION EAST & WEST RETAIL
18 LONG TERM BICYCLE PARKING (CONCOURSE LEVEL)

STATION EAST
UP TO 180* LONG TERM BICYCLE PARKING (SECOND LEVEL)

EXISTING HUBWAY

PROPOSED HUBWAY

0 37.5 75 Feet

Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

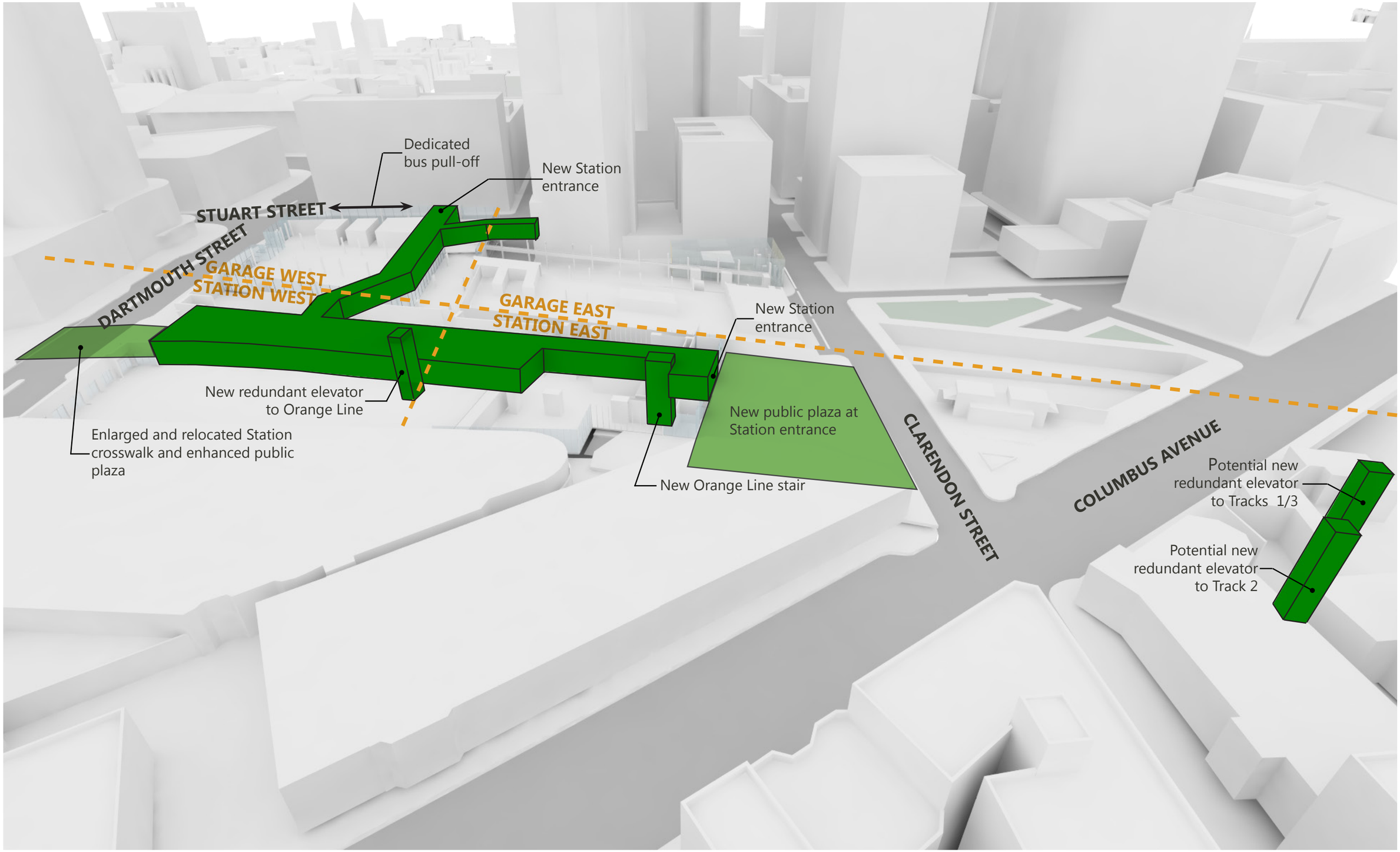
***0.5 BICYCLES/UNIT**

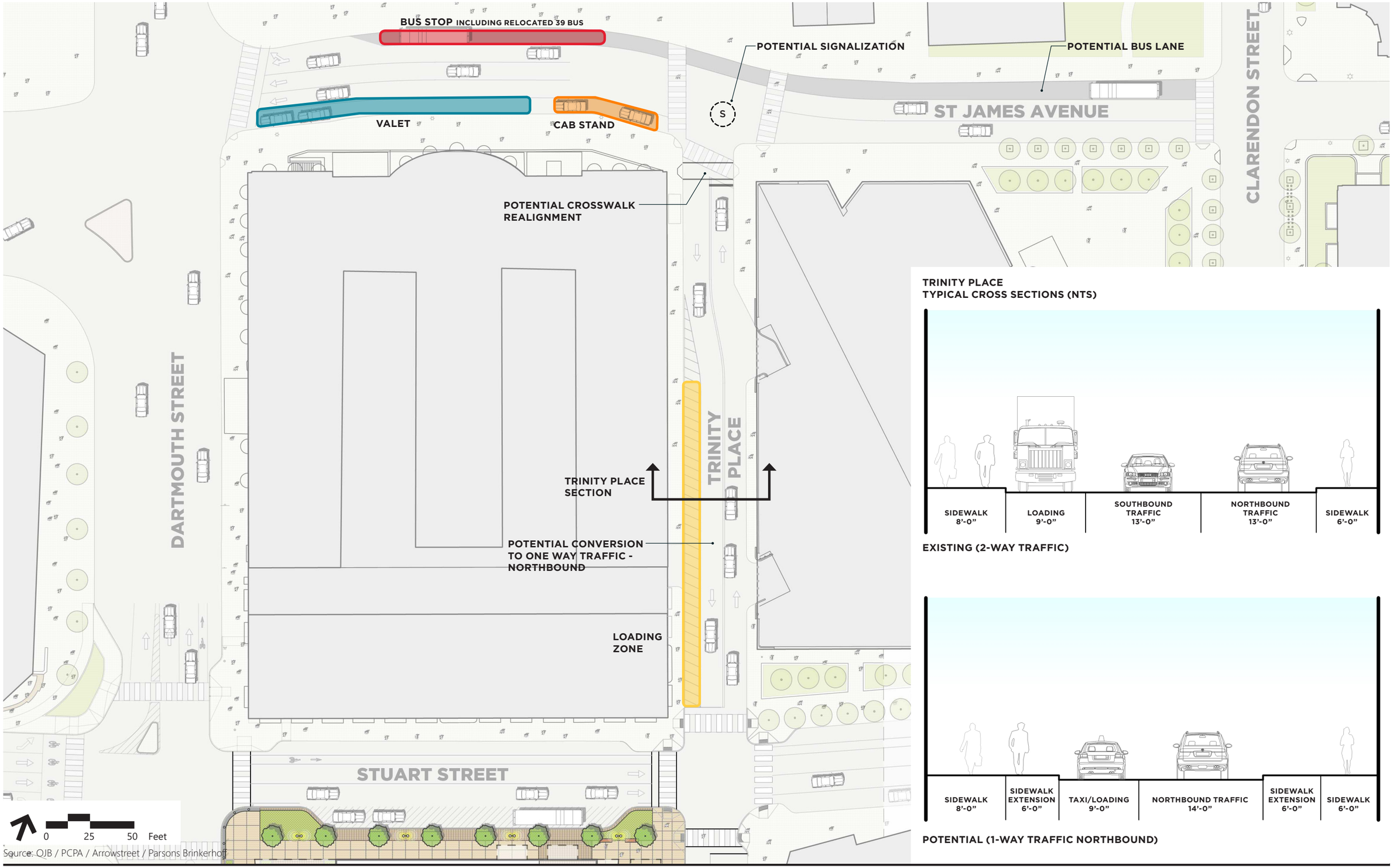
The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Proposed Bicycle Parking and Infrastructure Improvements

Figure 4.22

OJB


Dedicated
bus pull-off
New Station
entrance
STUART STREET
DARTMOUTH STREET
GARAGE WEST
STATION WEST
GARAGE EAST
STATION EAST
New Station
entrance
New redundant elevator
to Orange Line
Enlarged and relocated Station
crosswalk and enhanced public
plaza
New public plaza at
Station entrance
New Orange Line stair
CLARENDON STREET
COLUMBUS AVENUE
Potential new
redundant elevator
to Tracks 1/3
Potential new
redundant elevator
to Track 2



Source: OJB / PCPA / Arrowstreet / Parsons Brinkerhoff

TRINITY PLACE
TYPICAL CROSS SECTIONS (NTS)

EXISTING (2-WAY TRAFFIC)

POTENTIAL (1-WAY TRAFFIC NORTHBOUND)

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Plan of Trinity Place and St. James Avenue

Figure 4.24
OJB

5

Sustainability and Greenhouse Gas Emissions Assessment

This chapter provides an overview of the local and state regulatory context related to sustainable design and presents the results of the Greenhouse Gas (GHG) emissions assessment, in accordance with the MEPA Greenhouse Gas Emissions Policy and Protocol (the "MEPA GHG Policy").[1] The Proponent is committed to incorporating many key aspects of sustainability and high performance building design as well as addressing climate change impacts and planning for resilience, where applicable and feasible, as it is their intent to operate the proposed buildings in a sustainable manner. As described in Section 1.4.8, these measures will be implemented for each Project Component on a component by component basis by the Proponent, including each and every successor(s) in interest.

5.1 Summary of Key Findings and Benefits

Area Revitalization – The Project revitalizes an underutilized urban site, uses land efficiently by increasing density in immediate proximity to public transportation, and encourages the use of non-automotive modes of transportation.

LEED Certification – In addition to compliance with Article 37, the Project will certify each building under the LEED-NC v3 rating system which provides third-party verification of green building design and construction.

Resource Conservation –

- By utilizing sustainable design strategies, the Project will exceed code requirements for reducing energy and water consumption as well as minimize impacts to regional infrastructure and water resources.
- Based on preliminary building energy models, the Project will achieve an estimated 15.4 percent reduction in stationary source CO_2 emissions by reducing overall energy consumption by approximately 19.7 percent through the implementation of energy optimizing building design and systems.

Verification and Benchmarking – Monitoring and verification of ongoing energy and water performance will also be possible through the enrollment of each building in EPA's ENERGY STAR Portfolio manager, EnerNOC's Energy Intelligence Software (EIS) platform and the Proponent's own internal sustainability data management system.

[1] MEPA Greenhouse Gas Policy and Protocol, Executive Office of Energy and Environmental Affairs, effective November 1, 2007 (revised version effective May 5, 2010).

Renewable Energy – The Project has investigated the feasibility of clean and renewable energy sources, including solar photovoltaic (PV) panels, solar thermal, wind turbines, and cogeneration. Based on the energy and payback analysis, cogeneration and roof PV are shown to be cost-effective potential strategies, refer to Section 5.4.3 for full details. While not included in the base design assumptions of the preliminary energy models, these systems will continue to be evaluated as the Project design develops. Further discussions with the utilities are required to understand their limitations and capacity to accept surplus energy from potential on-site renewable energy sources, and evaluate the impact this will have on the feasibility of on-site renewable energy systems as the Project's design progresses.

Improved Wellness – Through a variety of design strategies, the Project will promote health and wellness, assist in improving indoor air quality, and reduce the urban heat island effect. The Project will provide improved pedestrian facilities and bicycle accommodations to support heathy modes of transport.

Climate Resilience – The Project will integrate strategies to help reduce vulnerability to future climate change impacts related to flooding, severe precipitation and extreme heat.

Stormwater Management –

- The Project will implement Best Management Practices ("BMPs") to improve water quality, reduce runoff volumes, and reduce peak discharge rates of runoff in comparison to pre-development conditions.
- The Project's BMPs will remove phosphorous from stormwater runoff from the Project Site, in accordance with BWSC design guidelines for projects that discharge to the Charles River Watershed.
- Green or vegetated roof areas will contribute to mitigating heat island effects, providing quality views for building occupants and residents, managing stormwater runoff, and extending the life of roof materials.
- Groundwater recharge system(s) will infiltrate clean stormwater runoff in accordance with the standards articulated by the GCOD requirements to the extent practicable.

5.2 Regulatory Context

5.2.1 MEPA Greenhouse Gas Policy and Protocol

The Executive Office of Energy and Environmental Affairs (EEA) has developed the "MEPA GHG Policy, which requires project proponents to identify and describe feasible measures to minimize both mobile and stationary source GHG emissions generated by their proposed project(s). Mobile sources include vehicles traveling to and from a project while stationary sources include on-site boilers, heaters, and/or internal combustion engines (direct sources) as well as the consumption of energy in the form of fossil fuels (indirect sources). Greenhouse gases include several air pollutants, such as carbon dioxide (CO_2), methane, hydrofluorocarbons, and

perfluorocarbons. The MEPA GHG Policy calls for the evaluation of CO_2 emissions for a land development project because CO_2 is the predominant man-made contributor to global warming. This evaluation makes use of the terms CO_2 and GHG interchangeably.

The MEPA GHG Policy states that all projects undergoing MEPA review requiring the submission of an Environmental Impact Report (EIR) must quantify the project's GHG emissions and identify measures to avoid, minimize, or mitigate such emissions. In addition to quantifying project-related GHG emissions, the MEPA GHG Policy requires proponents to quantify the effectiveness of proposed improvements in terms of energy savings, and therefore, potential emissions reductions. The goal of the MEPA GHG Policy is to identify and implement measures to minimize or reduce the total GHG emissions anticipated to be generated by that respective project.

5.2.2 Draft MEPA Climate Change Adaptation and Resiliency Policy

In September 2014, the MEPA Office issued a draft policy for addressing potential impacts associated with climate change. The policy's intent is to facilitate the consideration and assessment of risk and vulnerabilities of a project or action under foreseeable scenarios or conditions associated with climate change in order to identify potential mitigation measures.

5.2.3 Massachusetts Stretch Energy Code

As part of the Green Communities Act of 2008, Massachusetts developed an optional building code, known as the "Stretch Energy Code," that gives cities and towns the ability to choose stronger energy performance in buildings than otherwise required under the state building code. Codified by the Board of Building Regulations and Standards as 780 CMR Appendix 115.AA of the 9th edition Massachusetts Building Code, the Stretch Energy Code is an appendix to the Massachusetts Building Code, based on further amendments to the International Energy Conservation Code (IECC). The Stretch Energy Code increases the energy efficiency code requirements for new construction and major residential renovations or additions in municipalities that adopt it. The Stretch Energy Code applies to new commercial buildings over 5,000 square feet and multi-family residential buildings over three (3) stories. The City of Boston adopted the Stretch Energy Code, which became mandatory on July 1, 2011.

On July 1, 2014, the IECC 2009 and ASHRAE 90.1-2007 ceased to be a code option for non-Stretch Energy Code communities, and the IECC 2012 and ASHRAE standard 90.1-2010 became the new/updated state-wide energy code.

Effective January 1, 2017, the IECC 2015/ASHRAE 90.1-2013 standard became the new/updated state-wide energy code as an amendment to the 9th edition of the State Building Code, and the Stretch Energy Code was amended to require 10 percent greater energy efficiency compared to ASHRAE 90.1-2013. Given the adoption of the most-recently revised Stretch Energy Code, the Project has incorporated these new requirements into its basis of design.

5.2.4 City of Boston Article 37 – Green Buildings

Through Article 37 – Green Buildings, the City of Boston encourages major building projects to be "planned, designed, constructed, and managed to minimize adverse environmental impacts; to conserve natural resources; to promote sustainable development; and to enhance the quality of life in Boston." Any project that is subject to Article 80, Large Project Review is also subject to the requirements of Article 37.

An interdisciplinary committee, the Boston Interagency Green Building Committee (IGBC), consisting of at least one representative from certain city agencies, including the BPDA, Boston Environment Department (BED), BTD, the Inspectional Services Department, and the Mayor's Office advises the BPDA on a proposed project's compliance with Article 37.

Boston Green Building Credits

Appendix A of Article 37 lists "Boston Green Building Credits," which are credits that may be included in the calculation toward achieving a LEED certifiable project. These credits were developed by the City and are intended to address local issues unique to development in Boston. The credits include the following categories: Modern Grid; Historic Preservation; Groundwater Recharge; and Modern Mobility.

5.3 Sustainability/Green Building Design Approach

The Project incorporates a holistic approach to sustainability that promotes livability and economic development, while also mitigating the external impacts related to energy, emissions, water consumption, and waste production, which will be implemented on a component by component basis. The developer of each Project Component will track and verify sustainable design strategies and measures to demonstrate compliance with Article 37 through the LEED-NC v3 rating system and was registered with the USGBC/GBCI on April 6, 2016.

5.3.1 Sustainability Charrette

As a further step to enhance sustainability on the project, the Proponent participated in a Sustainability Charrette on April 13, 2016 with the Regen Network. Facilitated by David Gottfried of Regen, the Charrette was attended by over 40 sustainability professionals, industry experts and manufacturers and was intended to generate additional ideas for consideration on the Project.

The Project was presented across five (5) subject areas: energy, water, building materials, health & wellness, and community. Each subject area was presented, followed by a question and answer period and finally, idea statements were generated by each participant for the given subject area and aggregated on the wall for display and discussion. Over the course of the three-hour charrette, in excess of 200 ideas were generated.

A sample of the ideas that are currently incorporated in the Project include, engaging Utilities for incentives related to lighting and controls, energy and water sub-metering, limiting VOC content for interior materials, providing a dedicated outdoor air system (DOAS), water source heat pumps and operable windows in the residential buildings. In addition, ideas that the Project team is exploring further include on-site energy storage, mixed-mode ventilation, orientation specific building envelope performance, no permanent irrigation, and requirements for interior finish materials including EPDs (environmental product declarations), HPDs (health product declarations) and formaldehyde and PVC reduction or elimination.

5.3.2 Sustainability Strategies

As illustrated in Figures 5.1a-d, sustainable, high-performance building strategies are central to the design of the Project. Consideration has been and will continue to be given to the sustainability strategies summarized below, grouped into the categories of site location and design, energy conservation, water conservation, resiliency, building materials and waste reduction, and occupant wellness.

Site Location and Design

- The Project is an inherently sustainable transit-oriented site that locates density in the urban core while encouraging mobility and the utilization of public transportation systems. Transit-oriented development reduces single-occupancy vehicle trips, vehicle miles travelled (VMT) to/from the Project, and transportation-related carbon emissions.
- The Project Site is proximate to numerous cultural and institutional amenities such as libraries, churches, and higher education and health care facilities in addition to shops, services and healthy dining options.
- The Project will incentivize the use of low-emitting and fuel efficient vehicles (LEV) by providing prioritized parking locations.
- The Project will encourage cycling by providing convenient short-term and safe and secure long-term bicycle storage.
- Public open space provides outdoor recreational spaces and amenities for residents, employees and the public.

Energy Conservation

- Reduce energy consumption by 19.7 percent (beyond ASHRAE 90.1-2013 as the baseline) resulting in a 15.4 percent reduction in associated GHG emissions through the use of energy-efficient building systems and design.[2]
- Minimize impact on the grid by exceeding minimum energy use performance requirements, designing highly efficient HVAC systems, and

[2] The baseline energy model in this chapter estimates the buildings' electricity and gas usage based using Appendix G of ASHRAE 90.1-2013 for comparison with the Stretch Energy Code. A baseline model using ASHRAE 90.1-2007 is used in the Energy Modeling Report of Appendix H for determination of LEED Credits in accordance with LEED 2009.

exploring the use of a demand response capable system to minimize electricity use during peak periods. and/or incorporate on-site energy storage.

- Continuous measurement and management of electricity and gas using real time energy consumption metering, EnerNOC's Energy Intelligence Software, EPA's ENERGY STAR Portfolio Manager® and periodic energy audits. The Proponent has established company-wide energy and emissions goals and continue their efforts to maintain a building ENERGY STAR score of 75 or better.
- Incorporate energy-efficient building systems and other Energy Conservation Measures ("ECMs"), including:
  - High performance mechanical systems including active chilled beams in office uses, water source heat pumps in residential uses, and dedicated outside air system with energy recovery to reduce heating, cooling, and fan energy.
  - High efficiency condensing boilers and premium efficiency chillers with variable frequency drives and water-side economizer to minimize energy required to generate heating hot water and chilled water.
  - Condensing boilers for domestic hot water production. Low flow fixtures to reduce domestic hot water usage.
  - High-efficiency lighting predominantly incorporating light emitting diode (LED) fixtures and lighting controls to reduce energy consumption and demand. Garage West Parcel has targeted a 0.6 W/SF lighting power density, representing an all-LED lighting design.
  - Aggressive plug load reduction by utilizing Energy-Star rated appliances and equipment and specifying regenerative elevators.
  - High-performance building envelope where the thermal barrier acts as the interface between the interior of the building and the outdoor environment (including the walls, roof, and foundation) is optimized to balance energy use, acoustics, daylight, glare, views and thermal comfort. The building envelope plays an important role in determining the amount of energy necessary to maintain a comfortable indoor environment relative to the outside environment.
  - Additional strategies for a high performance envelope include self-shading of buildings, orientation specific envelope design, energy-efficient glazing, increased insulation in wall and roof areas, and partially vegetated roofs.
  - A natural gas emergency power generator to provide multiple environmental and resiliency benefits over a diesel emergency generator including: less odor; opportunity for waste heat recovery, elimination of on-site fuel storage and lower GHG emissions.

Water Conservation

- Minimize impact on municipal water supply by reducing potable water consumption through ultra-low, and low-flow fixtures.
- Minimize impact on stormwater systems and regional water resources through treatment and groundwater recharge, as described in Chapter 7, *Infrastructure*.
- Incorporation of green roofs, where feasible, to help enhance biodiversity, minimize stormwater run-off, and mitigate the heat island effect.
- A preliminary study has shown rainwater harvesting is unlikely to be feasible on the Project Site due to the primacy of the Groundwater Conservation Overlay District requirements.

Resiliency

The Project has studied and intends to implement the following non-mechanical resilience strategies to support building functionality:

- Mitigate heat island effects through use of hardscape and roof materials with a high solar reflectance.
- Provide operable windows for natural ventilation in residential buildings.
- Provide a high performance building envelope as described above.

In addition to the passive design strategies identified above, the Project has begun and will continue to study implementation of the following active system strategies:

- Locate critical equipment above the ground floor elevation such that it is not vulnerable to flooding.
- Standby on-site power generation for systems in the residential buildings to enable shelter-in-place.
- The HVAC system has been evaluated for performance during extreme weather events and anthropogenic future climate change.
- Redundant connections for domestic water and fire protection systems ensure functionality in case of damage or other problems caused by extreme weather events.
- Sewage backflow valves prevent backflow into the buildings during rainstorms and floods to avoid building damage and maintain occupant safety and comfort.
- The Project has also considered how cogeneration could be implemented as an efficient energy source to improve overall operating efficiency by recovering waste heat and producing electricity. Where feasible, cogeneration will continue to be investigated for each parcel as the design advances.
- The Project is exploring the use of a demand response capable system in order to minimize electricity use during peak periods and also considering the incorporation of on-site energy storage.

› To protect against high winds, the Project has a hardened building structure and infrastructure, buried utilities, and protective landscapes.

Building Materials and Waste Reduction

› Adaptive reuse of the existing Garage and structural decks will result in significant savings in embodied energy and materials through reduction in the need for raw materials, associated energy in the transportation of new materials and reduction in the amount of demolition waste generated by the Project.

› A Construction Waste Management Plan (CWMP) will be developed and implemented by the construction manager with the goal to divert as much demolition debris and construction waste from area landfills as possible, with a targeted minimum diversion rate of 75 percent.

› Recyclables including paper, glass, plastics, metals and cardboard will be collected throughout the new buildings and designated storage for these recyclables will be provided in the Project. The recyclables will be collected by a contracted waste management company on a regular basis.

Occupant Wellness

› Excellent indoor air quality through demand controlled ventilation, green cleaning practices, and use of interior finish materials that are low-emitting and/or do not off-gas VOCs. The Proponent also conducts operational indoor air quality testing to ensure air quality on an annual basis.

› Consideration of user thermal and visual comfort by designing facades based on their solar orientation.

› Maximized exterior views and daylighting through the use of approximately 65 percent vision glass in commercial areas and 55 percent vision glass in residential areas.

5.3.3 Compliance with Article 37

Consistent with the sustainability goals for the Project and requirements of Article 37, the Proponent and Project Team are incorporating sustainable design and construction strategies, principles and practices into the Project. Each component of the Project will be LEED certified with the USGBC under LEED-NC v3. The Project is targeting a LEED Gold rating for the Garage West commercial building, and a Silver rating for the Garage East and Station East residential buildings and the Station West retail expansion. The preliminary LEED-NC Scorecards are presented in Figures 5.1a-d.

The Proponent and Project Team will continue to evaluate and incorporate sustainable design and energy conservation strategies as the design process continues with the hope of increasing LEED points. Refer to Appendix G for a complete summary of LEED compliance by credit category.

5.4 Greenhouse Gas Emissions Assessment

5.4.1 Stationary Source Emissions Assessment

The following presents the results of the stationary GHG emissions assessment, in accordance with the MEPA GHG Policy.[3] The stationary source analysis reflects the most recent design plans for all Project components as of this filing.

The Project has been designed to meet the requirements of the MEPA GHG Policy in that it is committed to incorporating reasonable and feasible energy conservation measures to reduce energy consumption. The Project will also meet the requirements of the Stretch Energy Code and incorporate sustainable and high-performance building design, including energy conservation measures.

5.4.1.1 Methodology

To provide for energy efficiency and reduced stationary source GHG emissions, the Proponent has evaluated the following key planning and design criteria:

1. Methods to reduce overall energy demand through appropriate design and sizing of systems;
2. Methods to incorporate cost-effective energy-optimizing systems.

Each Project component was modeled with the proposed building geometry, HVAC system type, occupancy schedule, and ventilation rates as the baseline buildings.

Direct stationary source CO_2 emissions include those emissions from the facility itself, such as boilers, heaters, and internal combustion engines. Indirect stationary source CO_2 emissions are derived from the consumption of electricity, heat, or cooling from off-site sources, such as electrical utility or district heating and cooling systems. The direct and indirect stationary source CO_2 emissions from the proposed building sources are calculated through an energy analysis procedure that combines multiple eQuest[4] models with Excel spreadsheets for pre and post-processing based on assumptions for the Project's building elements, such as (but not limited to) the specific type of use(s) and users of the buildings, building configuration and architecture type, building envelope (walls/windows), interior fit-out (where known), and HVAC equipment efficiency ratings.

The GHG mitigation measures can be divided into the buildings' construction materials, architecture, and the heating and cooling processes. The following presents the specific proposed building improvements (and their correlating energy modeling parameters for reference, where applicable) that are assumed to be included as part of the Project for the purpose of this analysis. The specific proposed

[3] *MEPA Greenhouse Gas Emissions Policy and Protocol*, Executive Office of Energy and Environmental Affairs, effective November 1, 2007 (revised version effective May 5, 2010).

improvements may be subject to design modifications as necessary to achieve the GHG emissions reduction based on the final building program and design.

Energy Model and Analysis Conditions

The energy analysis is used to estimate the amount of annual energy consumption by simulating a year of building operations based on typical yearly weather and user inputs. The model estimates each buildings' electricity and gas usage based on building design and system assumptions using Appendix G of ASHRAE 90.1-2013[5]. The amount of consumed energy is then converted into the amount of CO_2 emitted using the standardized conversion factors. CO_2 emissions were quantified for (1) the Base Case corresponding to the minimum requirements of ASHRAE 90.1-2013 and (2) the Design Case, which includes all energy saving measures that were deemed to be reasonable and feasible. The stationary source assessment calculated CO_2 emissions for the following build conditions:

- **Build Condition with MA Building Code (the "Base Case"):** The Project assuming typical construction materials and building equipment/systems that meet the minimum requirements of the base code. This baseline is established by the energy code as being defined by ASHRAE 90.1–2013.
- **Build Condition with Energy Conservation Measures (the "Design Case"):** The Project assuming building design and system improvements that meet the MEPA GHG Policy. Based on the current design and preliminary building modeling results, the Project will meet the MEPA GHG Policy requirement for energy reduction savings and the Stretch Energy Code.

5.4.1.2 Energy Consumption and GHG Emissions Assessment

Future Stationary Source CO_2 Emissions

The Project will develop an office building, two new residential buildings, and a one-story retail expansion of the Station. The approach to and results of the building energy model for each of the Project Components are presented below.

The noteworthy improvements for the base building (or core and shell) are presented in the sections below. While specific improvements may be subject to modification as the design progresses, the Proponent is committed to achieving the stationary source GHG emissions reductions estimated herein for the final building program and design.

Following the *Building Energy Efficiency Measures* section, a fenestration alternatives assessment is presented. These various fenestration alternatives for the proposed residential and office buildings were assessed in response to the MEPA Certificate and DOER comment letter on the ENF.

[5] American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., *ASHRAE 90.1-2013-Energy Standard for Buildings Except Low-Rise Residential Buildings*, Appendix G, 2013.

A full report on the energy modeling conducted for the Project can be found in Appendix H.

Garage West Office Building

Table 5-1 below provides a summary of the proposed building improvements assumed for the new Garage West office building. Key energy savings features include improved glazing properties, active chilled beams, condensing boilers, an energy recovery wheel, an on-site chiller plant, and lighting power density improvements.

Table 5-1 Garage West Office Key Model Assumptions

	Base Case	Design Case
Building Envelope (Construction Assemblies)		
Wall Opaque- U-Factor	0.055	0.055
Wall Spandrel/Shadow Box- U-Factor	0.055	0.200
Roof U-Factor	0.032	0.032
Fenestration and Shading		
Fenestration Area	40%	65%
Vertical Glazing U-Factor	0.42	0.39 (0.29 COG)
Vertical Glazing SHGC[1]	0.40	0.29
HVAC (Air-side)		
Primary System	Type 7- VAV with Reheat.	Dedicated Outside Air Unit with Energy Recovery Serving Active Chilled Beams
Design Air Flow Rates (cfm)	Self-Sized by Simulation	Approx. 850,000
Exhaust Air Energy Recovery	Total Energy Recovery Wheel	Total Energy Recovery Wheel
Primary Cooling Source	On-site Chiller Plant	On-site Chiller Plant
CHW Loop Supply Temp/Delta-T	44 ˚F / 12 ˚F	42 ˚F / 16 ˚F
Primary Heating Source	On-site Boiler Plant	On-site Condensing Boiler Plant
HW Loop Supply Temp/Delta-T	180 ˚F / 50 ˚F	140 ˚F / 50 ˚F
Domestic Water Heating		
Equipment Type	Electric Resistance Storage Water Heater	Condensing Hot Water Heater
Lights		
Interior Lighting	0.82 W/sf	0.6 W/sf
Dimming Controls	As Required by Ashrae 90.1-2013 Section 9.4.1.1	All Perimeter Spaces

1 SHGC = Solar Heat Gain Coefficient

The total estimated annual electricity and natural gas consumption, and associated emissions for the Garage West office building are presented in Table 5-2. Under the Base Case, the CO_2 emissions are estimated to be 4,728.4 tons per year. With the currently proposed building design and system improvements, the estimated energy

use reduction for the building is 21.2 percent, which equates to a 17.6 percent reduction in stationary source CO_2 emissions when compared to the Base Case. The stationary source CO_2 emissions percent reduction for the building under the Design condition was quantified as follows: 834.1/ 4,728.4 = 0.176 x 100 = 17.6 percent.

$$\textit{Reduction \%} = \frac{\textit{Emissions Reductions Due to Project Improvements (End Use Savings)}}{\textit{Project-Generated Emissions (Base Case Emissions)}}$$

This methodology is applied consistently to the remaining buildings to determine the percent reduction of stationary source emissions.

Table 5-2 Garage West Office Stationary Source CO_2 Emissions (Base Scheme)

	Energy Consumption			CO_2 Emissions		
	Electricity (MWh/yr)	**Natural Gas (MMBtu/yr)**	**Total (MMBtu/yr)**	**Electricity (tons/ yr)**	**Natural Gas (tons/ yr)**	**Total (tons/ yr)**
Base Case	9,328	22,928	54,763	3,385.9	1,342.4	4,728.4
Design Case	8,389	14,499	43,132	3,045.4	848.9	3,894.3
End-Use Savings	939	8,429	11,631	340.5	493.5	834.1
Percent Savings			**21.2%**			**17.6%**

tons/yr = short tons per year

Note: Under the Design Case for the Garage West Alternate Scheme, the building is expected to consume 43,964 MMBtu per year of energy and produce 3,969.4 tons per year of CO_2.

Garage East Residential Building

Table 5-3 below presents a summary of the improvements that were included in the energy model for the new Garage East residential building. Key energy savings features include improved glazing properties, better HVAC equipment, inclusion of an energy recovery wheel, and a more efficient water heater.

Table 5-3 Garage East Residential Key Model Assumptions

	Base Case	Design Case
Building Envelope (Construction Assemblies)		
Wall Opaque- U-Factor	0.055	0.055
Wall Spandrel/Shadow Box- U-Factor	0.055	0.200
Roof U-Factor	0.032	0.032
Fenestration and Shading		
Fenestration Area	40%	55%
Vertical Glazing U-Factor	0.42	0.39 (0.29 COG)
Vertical Glazing SHGC[1]	0.40	0.29
HVAC (Air-side)		
Primary System	Type 1- PTAC	Dedicated Outside Air Unit with Energy Recovery Serving Heat Pumps
Exhaust Air Energy Recovery	Not Required	Total Energy Recovery Wheel
Primary Cooling Source	Direct Expansion	Water Source Heat Pumps
Primary Heating Source	Gas-Fired Hot Water Boilers	Water Source Heat Pumps Connected to Condensing Boilers
Domestic Water Heating		
Equipment Type	Gas Storage Water Heater	Condensing Hot Water Heater
Lights		
Interior Lighting	0.51 W/sf	0.51 W/sf

1 SHGC = Solar Heat Gain Coefficient

The total estimated annual electricity use and natural gas consumption, and associated emissions for Garage East residential building are presented in Table 5-4 below. Under the Base Case, the CO_2 emissions are estimated to be 1,625.8 tons per year. With the currently proposed building design and system improvements, the estimated energy use reduction for the building is approximately 19.8 percent, which equates to a 14.0 percent reduction (227.5 tons per year) in stationary source CO_2 emissions when compared to the Base Case.

Table 5-4 Garage East Residential Stationary Source CO2 Emissions

	Energy Consumption			CO_2 Emissions		
	Electricity (MWh/yr)	Natural Gas (MMBtu/yr)	Total (MMBtu/yr)	Electricity (tons/ yr)[1]	Natural Gas (tons/ yr)	Total (tons/ yr)
Base Case	2,625	11,493	20,452	952.9	672.9	1,625.8
Design Case	2,683	7,250	16,406	973.8	424.5	1,398.3
End-Use Savings	-58	4,243	4,046	-20.9	248.4	227.5
Percent Savings			**19.8%**			**14.0%**

tons/yr = short tons per year

Station East Residential Building

Table 5-5 below provides a summary of the proposed building improvements assumed for the new Station East residential building. Key energy savings features include improved glazing properties, better HVAC equipment, inclusion of an energy recovery wheel, and a more efficient water heater.

Table 5-5 Station East Residential Key Model Assumptions

	Base Case	Design Case
Building Envelope (Construction Assemblies)		
Wall Opaque- U-Factor	0.055	0.055
Wall Spandrel/Shadow Box- U-Factor	0.055	0.200
Roof U-Factor	0.032	0.032
Fenestration and Shading		
Fenestration Area	40%	55%
Vertical Glazing U-Factor	0.42	0.39 (0.29 COG)
Vertical Glazing SHGC[1]	0.40	0.29
HVAC (Air-side)		
Primary System	Type 1- PTAC	Dedicated Outside Air Unit with Energy Recovery Serving Heat Pumps
Exhaust Air Energy Recovery	Not Required	Total Energy Recovery Wheel
Primary Cooling Source	Direct Expansion	Water Source Heat Pumps
Primary Heating Source	Gas-Fired Hot Water Boilers	Water Source Heat Pumps Connected to Condensing Boilers
Domestic Water Heating		
Equipment Type	Gas Storage Water Heater	Condensing Hot Water Heater
Lights		
Interior Lighting	0.51 W/sf	0.51 W/sf

1 SHGC = Solar Heat Gain Coefficient

The total estimated annual electricity and natural gas consumption, and associated emissions for the Station East residential building are presented in Table 5-6. Under the Base Case, the CO_2 emissions are estimated to be 2,737.6 tons per year. With the currently proposed building design and system improvements, the estimated energy use reduction for the building is 19.8 percent, which equates to a 14.0 percent reduction in stationary source CO_2 emissions when compared to the Base Case.

Table 5-6 Station East Residential Stationary Source CO_2 Emissions

	Energy Consumption			CO_2 Emissions		
	Electricity (MWh/yr)	**Natural Gas (MMBtu/yr)**	**Total (MMBtu/yr)**	**Electricity (tons/ yr)[1]**	**Natural Gas (tons/ yr)**	**Total (tons/ yr)**
Base Case	4,420	19,353	34,439	1,604.5	1,133.1	2,737.6
Design Case	4,518	12,208	27,627	1,639.9	714.8	2,354.7
End-Use Savings	-98	7,145	6,812	-35.4	418.3	382.9
Percent Savings			**19.8%**			**14.0%**

tons/yr = short tons per year

Station West Retail

Table 5-7 below provides a summary of the proposed building improvements assumed for the Station West retail expansion. Key energy savings features include improved glazing properties, improved condensing boilers, and premium efficiency cooling towers.

Table 5-7 Station West Retail Key Model Assumptions

	Base Case	**Design Case**
Building Envelope (Construction Assemblies)		
Wall Opaque- U-Factor	0.055	0.055
Wall Spandrel/Shadow Box- U-Factor	0.055	0.200
Roof U-Factor	0.032	0.032
Fenestration and Shading		
Vertical Fenestration Area	Maximum 40%	Approx. 40%
Vertical Glazing U-Factor	0.42	0.39 (0.29 COG)
Vertical Glazing SHGC	0.40	0.40
Horizontal Fenestration Area	Maximum 3%	Approx. 20%
Horizontal Glazing U-Factor	0.50	0.39 (0.29 COG)
Horizontal Glazing SHGC[1]	0.40	0.40
HVAC (Air-side)		
Primary System	Type 6- Water Source Heat Pump	Dedicated Outside Air Unit with Energy Recovery Serving Heat Pumps
Exhaust Air Energy Recovery	Not Required	Total Energy Recovery Wheel
Primary Cooling Source	Direct Expansion	Water Source Heat Pumps
Primary Heating Source	Electric Heat Pump and Gas-Fired Hot Water Boilers	Water Source Heat Pumps Connected to Condensing Boilers
Domestic Water Heating		
Equipment Type	Condensing Hot Water Heater	Condensing Hot Water Heater
Lights		
Interior Lighting	Retail: 1.26 W/sf Restaurant: 1.01 W/sf	Retail: 1.26 W/sf Restaurant: 1.01 W/sf

1 SHGC = Solar Heat Gain Coefficient

The total estimated annual electricity and natural gas consumption, and associated emissions for Station West retail expansion are presented in Table 5-8. Under the Base Case, the CO_2 emissions are estimated to be 535.0 tons per year. With the currently proposed building design and system improvements, the estimated energy use reduction for the building is 7.9 percent, which equates to a 7.3 percent reduction in stationary source CO_2 emissions when compared to the Base Case. Since the Retail expansion is less than 100,000 sf, it is not required to comply with the Stretch Energy Code. However, since the skylight glazing percentage exceeds the ASHRAE 90.1-2013 prescriptive requirement of three (3) percent, the building will need to follow the Energy Cost Budget (ECB) performance path outlined in ASHRAE 90.1-2013 Chapter 11 to meet the energy code.

Table 5-8 Station West Retail Stationary Source CO_2 Emissions[1]

	Energy Consumption			CO_2 Emissions		
	Electricity (MWh/yr)	**Natural Gas (MMBtu/yr)**	**Total (MMBtu/yr)**	**Electricity (tons/ yr)[1]**	**Natural Gas (tons/ yr)**	**Total (tons/ yr)**
Base Case	627	5,250	7,390	227.6	307.4	535.0
Design Case	597	4,766	6,805	216.9	279.0	495.9
End-Use Savings	30	484	585	10.7	28.4	39.1
Percent Savings			**7.9%**			**7.3%**

tons/yr = short tons per year

1 Station West is less than 100,000 sf and is not required to meet the Stretch Code. It complies with the Energy Cost Budget performance path outlined in ASHRAE 90.1-2013 for code compliance.

Overall Project Emissions (Full Build)

The total estimated annual electricity use and natural gas consumption, and associated emissions for the Project (all buildings combined, or full build out) are presented in Table 5-9. Under the Base Case, the CO_2 emissions for the Project are estimated to be 9,626.8 tons per year. With the currently proposed building design and system improvements, the estimated CO_2 emissions are 8,143.2 tons per year which is a savings of 1,483.6 tons per year. The equivalent estimated energy use reduction for the Project is approximately 19.7 percent, which equates to an approximately 15.4 percent overall reduction in stationary source CO_2 emissions when compared to the Base Case. The reduction in stationary source energy is consistent with the Massachusetts Stretch Energy Code.

Table 5-9 Stationary Source CO_2 Emissions for the Overall Project (Full Build)

	Energy Consumption (MMBtu/yr)			CO_2 Emissions (tons/yr)		
Project Component	Base Case	Design Case	Percent Savings	Base Case	Design Case	Percent Reduction
Garage West Office (Base Scheme)[2]	54,763	43,132	21.2%	4,728.4	3,894.3	17.6%
Garage East Residential	20,452	16,406	19.8%	1,625.8	1,398.3	14.0%
Station East Residential	34,439	27,627	19.8%	2,737.6	2,354.7	14.0%
Station West Retail[1]	7,390	6,805	7.9%	535.0	495.9	7.3%
Total	**117,044**	**93,970**	**19.7%**	**9,626.8**	**8,143.2**	**15.4%**

tons/yr = short tons per year

1 Station West is less than 100,000 sf and is not required to meet the Stretch Code. It complies with the Energy Cost Budget performance path outlined in ASHRAE 90.1-2013 for code compliance.

2 Under the Design Case for the Garage West Alternate Scheme, the Overall Project is expected to consume 94,802 MMBtu per year of energy and produce 8,218.3 tons per year of CO_2.

5.4.1.3 Energy Use Index

Energy Use Intensity, or (EUI), is a tool used to provide a common basis of comparison for energy use for various building uses. It is the total amount of energy used at a project over a one-year period, divided by the square footage of that building and represents the energy consumed by a building relative to its size. Based on a recent US Department of Energy (DOE) research report, the median EUIs for prototype buildings in Climate Zone 5A are 54.1 kBtu/sf-yr for high-rise apartment buildings, 75.2 kBtu/sf-yr for large office buildings, 64.7 kBtu/sf-yr for retail, and 418.8 kBtu/sf-yr for restaurant, under ASHRAE 90.1-2013.[6] Table 5-10 below provides the as-modeled EUI for each component of the Project under the Base and Design Cases.

Table 5-10 Energy Use Intensity (kBtu/sf-yr)

		Energy Use Index (kBtu/sf-yr)			
Project Component	Conditioned Area (sf)[1]	Base Case[2]	Design Case	Percent Improvement	Prototype Benchmark EUIs
Garage West Office	712,040	77	61	21.2%	75.2
Garage East Residential	259,296	79	63	19.8%	54.1
Station East Residential	436,625	79	63	19.8%	54.1
Station West Retail	30,900	239	220	7.9%[3]	241[4]

3 Areas here are representative of Gross Square Footage (GSF) including mechanical and public transit access space.

4 The Base Case represents current Base Energy Code ASHRAE 90.1-2013 standards.

5 Station West is less than 100,000 sf and is not required to meet the Stretch Code. It complies with the Energy Cost Budget performance path outlined in ASHRAE 90.1-2013 for code compliance.

6 The Prototype EUI for Station West was calculated by proportioning the benchmark EUI for retail (64.7 kBtu/sf-yr) and for restaurant (418.8 kBtu/sf-yr) by 50% retail and 50% restaurant. This proportion was derived from the assumed retail and restaurant area split for Station West

6 "Cost-Effectiveness of the ASHRAE Standard 90.1-2013 for the State of Massachusetts". *US Department of Energy*. December 2015.

The Design Case EUIs of the Project components generally fall around the median values provided by the prototype buildings in the DOE study. Both the Garage West and Station West show improvements over the Prototype Benchmarks in the design case. The residential buildings of Garage East and Station East result in slightly higher EUIs than the prototype. The Prototype Benchmark EUIs are for theoretical buildings with designs that do not exactly reflect the Project they are being compared against. As such, differences between the modeled EUIs and the Benchmarks are expected. In all components, the Design Case EUIs represent significant improvement over the Base Case EUIs, which is required by the Stretch Energy Code and demonstrates the Proponent's commitment to constructing a green Project.

5.4.2 Fenestration Alternatives Assessment

In response to the MEPA Certificate and DOER comment letter, three fenestration alternatives optimizing the spandrel and glazing thermal performance were assessed for the proposed residential and office buildings. The results of this alternatives assessment are presented in Appendix H, at the end of the BR+A Concept Design Phase Energy Analysis Report. The fenestration alternatives assessed include U-values based on the following:

- Typical Curtainwall Design
- Current Design
- ASHRAE 90.1-2013 Prescriptive

Compared to a typical curtainwall design, the current design achieves a two (2) percent to three (3) percent reduction for the residential buildings and a one (1) percent to two (2) percent reduction for the office building in terms of energy use, energy cost, and carbon footprint. An envelope assembly meeting the ASHRAE 90.1-2013 prescriptive U-values would result in an additional two (2) percent to three (3) percent reduction for the residential buildings and one (1) to two (2) percent reduction for the office building in terms of energy use, energy cost, and carbon footprint. Although the spandrel areas of the current envelope design are below the prescriptive U-values of ASHRAE 90.1-2013, a whole building approach to the energy requirements is being utilized. This whole building approach allows the efficiency of some building systems to compensate for others to achieve the overall project energy goals in a manner that is cost-effective and considers user comfort and well-being. The Project team will continue to investigate cost effective opportunities to meet or exceed the ASHRAE 90.1-2013 Prescriptive envelope criteria as the design progresses.

5.4.3 On-Site Clean and Renewable Energy Analysis

A variety of clean and renewable energy sources were or are currently being evaluated for the Project, including solar, solar thermal, wind, and cogeneration in the form of combined heat and power (CHP). Based on the energy and payback analysis, cogeneration and roof PV are cost-effective potential strategies. While not

included in the base design assumptions of the preliminary energy models, these systems will continue to be evaluated as the Project design develops.

As the Project moves forward in evaluating and implementing any of the renewable energy sources discussed below, the limitations of Eversource will need to be considered. The cost-effectiveness of some of the renewable energy sources is dependent on the ability to route surplus energy generated on-site into the local grid system and receive compensation from the utility. The Proponent will further discuss Eversource's capacity to accept surplus energy from potential on-site renewable energy sources, and evaluate the impact this will have on the feasibility of on-site renewable energy systems as the Project's design progresses.

Solar Photovoltaic (PV) Panels

The Project has conducted an analysis for both rooftop solar PV and facade-mounted or Building-Integrated (BIPV) panels for the residential and office buildings. The roof of the retail at the Station West building will be shadowed for the majority of the year and hence is not recommended for roof PV. Assuming a net usable roof area of 25 percent (1,300 sf for Garage East, 2,200 sf for Station East, 2,900 sf for Garage West), the rooftop PV array could produce approximately 0.6 percent of the total building energy consumption and offset approximately 58 tons of CO_2 per year for all buildings combined (a 0.8 percent reduction). A simple payback analysis indicates a payback of approximately 6 to 7 years for each Project Component. Please refer to Appendix H for details on cost assumptions.

For the BIPV array, spandrel is replaced with PV panels for the upper half of each building's south facade (13 floors at 6,000 sf total for Garage East, 17 floors at 8,800 sf total for Station East, 12 floors at 9,200 sf total for Garage West). The building mounted PV array could produce approximately 1.7 percent of the total building energy consumption and offset approximately 157 tons of CO_2 per year for all buildings combined (a 2.1 percent reduction). A simple payback analysis indicates a payback of approximately 14 to 16 years for each Project Component, which is not currently cost-effective. Please refer to Appendix H for details on cost assumptions.

Rooftop PV will continue to be investigated for the residential and office buildings in subsequent phases and interconnection feasibility discussed with Eversource. If, in the future, it is determined that PV integration with the façade can be achieved more cost effectively resulting in a lower investment cost, façade PV may also be studied further at a later date.

Solar Thermal

The feasibility of generating thermal energy from solar thermal was assessed for the Garage East and Station East residential buildings. Assuming that 25 percent of the residential roof area is available for a solar thermal system, 17 percent of the annual residential domestic hot water heating consumption can be offset. This translates to approximately 1.4 percent in energy savings, 0.5 percent in cost savings, and a 0.9 percent carbon footprint reduction. A simple payback analysis indicates a payback

of approximately 14 years for each Project Component. Please refer to Appendix H for details on cost assumptions.

Ultimately, solar thermal was rejected because it competes with solar PV roof area, and solar PV is a more cost-effective approach to producing renewable energy on-site.

Wind

Vertical axis wind turbines on the roof of each of the residential and office buildings were evaluated. The results below are based on an installation of five 1-kW turbines for Garage East, ten 1-kW turbines for Station East, and ten 1-kW turbines for Garage West. Based on information provided by a typical wind turbine manufacturer, each turbine is estimated to have an annual electric production of 770 kWh at an average wind speed of 5.5 m/s. With this design, the residential and office buildings can achieve approximately 0.1 percent in energy, energy cost, and carbon footprint savings. A simple payback analysis indicates a payback that far exceeds the life span of the system. Please refer to Appendix H for details on cost assumptions.

The feasibility of generating electricity from wind sources was rejected for the following reasons:

- Energy savings compared to the investment cost are not cost-effective compared to other renewable strategies.
- Average wind speed in Boston is not high enough for cost-effective electricity generation; and
- Small, vertical wind turbines provide insignificant electricity generation relative to total building demand.

Combined Heat and Power (Co-Generation)

Small CHP reciprocating engines were evaluated for the roof of each of the residential and office buildings. The CHP utilizes natural gas fuel input to produce electricity and recoverable heat. For the residential buildings, the recovered heat is used for domestic hot water heating; for the office building, it would be used for building reheat. Based on typical residential domestic hot water demand, it is estimated that approximately 30 percent of the annual heat produced will be wasted for the residential building. For the office building, it is estimated that 50 percent of the annual heat produced will go to waste due to variable demand.

The results are summarized below and indicate that a cogeneration system may yield source energy and energy cost savings for both building types. Based on a 60 kW reciprocating engine for Station East, a 35 kW reciprocating engine for Garage East, and a 60 kW reciprocating engine for Garage West, multiple CHP systems could offset 2.1 percent of source energy and would result in a net increase of 18 tons of CO_2 per year for all buildings combined (0.3 percent increase).

A simple payback analysis indicates a payback of approximately 3 to 4 years for each Project Component. Please refer to Appendix H for details on cost assumptions.

CHP will continue to be investigated for the Station East and Garage East residential buildings in subsequent phases.

Conclusion: Based on the energy and payback analysis, cogeneration in the form of combined heat and power and roof PV are considered cost-effective potential strategies. While not included in the base design assumptions of the preliminary energy models, these systems will continue to be evaluated as the Project design develops. If PV integration with the façade can be achieved more cost effectively resulting in a lower investment cost, façade PV may also be studied further. As discussed above, the Proponent will further discuss with Eversource the limitations in accepting surplus energy generated by an on-site renewable energy system, and will evaluate the corresponding impact on the cost-effectiveness of that system.

Solar thermal is not being pursued further since the roof area competes with solar PV roof area, and solar PV is a more cost-effective approach to producing renewable energy on-site. Generating electricity from wind turbines is not cost-effective compared to other renewable strategies, and this strategy is also not being pursued further.

5.4.4 Summary of Building Energy Efficiency Measures

The energy savings calculated in the energy modeling were based on several key energy conservation measures for the Project.

For the office building at Garage West Parcel, modeled ECMs include:

- High efficiency condensing boilers to meet space heating demands
- Dedicated outside air system with energy recovery
- Floor-by-floor VAV reheat units serving chilled beams
- Premium efficiency water-cooled chiller plant with variable frequency drives
- Low lighting power densities to be achieved from efficient LED lighting

For the residential buildings at Garage East and Station East Parcels, modeled ECMs include:

- High efficiency vertical stacked water source heat pumps connected to condensing boilers and cooling towers
- High efficiency condensing boilers to meet space heating and domestic hot water demands
- Dedicated outside air system with energy recovery serving heat pumps

For the retail building at the Station West Parcel, modeled ECMs include:

- Water source heat pumps connected to high efficiency condensing boilers for meeting space heating demands
- Water source heat pumps connected to premium efficiency cooling towers with variable frequency drives

- Approximately 40 percent window to wall ratio with insulated shadow box or spandrel
- Approximately 20 percent skylight to roof ratio

As the Project's design develops, the Project Team will consider further load reduction where possible through additional strategies such as mixed-mode ventilation and enhanced envelope, lighting, mechanical, and renewable energy systems.

Other Beneficial Measures

Other beneficial measures are intended to be incorporated into the Project's design which cannot be incorporated into the energy modeling due to modeling limitations. These measures are described below.

Building Commissioning

Building commissioning will be conducted prior to and during occupancy to ensure the building systems are operating efficiently and as designed. This quality control process optimizes the energy performance of the building, reduces maintenance cost, and extends the lifespan of the building systems. Facilities staff will be trained on how to properly operate building systems, with special consideration to new high performance technologies such as chilled beams. The period between audits depends on energy performance. The Proponent will conduct an enhanced commissioning process during the construction process, including functional testing of all major lighting and HVAC systems. The Proponent will benchmark the performance of the building against the performance of other buildings in their portfolio and national/local averages at least twice a year after the buildings are placed in service and stabilized. If underperformance is identified, the Proponent will audit major lighting and HVAC systems and address deficiencies.

Energy Tracking and Monitoring

The Proponent has a robust internal program for tracking building energy use over time, using Energy Star Portfolio Manager and Energy Intelligence Software.

The Proponent will implement a Measurement and Verification (M&V) plan that will utilize the base building energy management system to monitor operation of equipment or systems. As a core and shell project, the office building at Garage West will include a centrally monitored electronic metering network in the base building design that is capable of being expanded to accommodate and document future tenant sub-metering. Additionally, retail tenants in Garage West, Station East and Station West shall be metered either via check meters or utility meters, depending on the utility.

The Proponent has been a very strong supporter of the City's Climate Action Plan, currently complies with the Building Energy Use Disclosure Ordinance, and will report whole building energy use for each component of the Project.

Green Tenant Guidelines

The Proponent will provide Tenant Design and Construction Guidelines to potential office and retail tenants during the leasing process. The intent of these guidelines is to educate future tenants about implementing sustainable design and construction features in their tenant improvement build-outs as well as adopting green building practices that support the overall sustainability goals of the Project. The guidelines will also communicate the sustainable and resource-efficient features incorporated into the Project and provide suggested sustainable strategies enabling tenants to coordinate their leased space design and construction with the rest of the Project systems.

These office and retail lease guidelines may include the following information:

- Descriptions of sustainable design, construction, and operational features of the Project, including resource conservation goals and features (i.e., low-flow plumbing fixtures, sub-metered systems, lighting controls) as well as building certifications, such as LEED.
- Descriptions of current regulatory requirements that pertain to leasable spaces (i.e., Stretch Energy Code, City of Boston energy reporting requirements).
- A list of approved categories of fit-out materials with performance standards, such as recycled content, regional availability, VOC content limits for adhesives, sealants, paints and coatings, NAUF composite wood materials, and CRI and/or FloorScore compliant flooring materials.
- Waste reduction goals and recycling facilities/programs.
- Information on Green Cleaning guidelines/policies.
- Information regarding Project-wide features that aim to encourage alternative transportation and TDM measures.
- Information on how to train/inform maintenance staff and employees on sustainable design/operation features.

In addition, the Proponent is exploring the creation of Green Tenant Guidelines for residential tenants which would provide information on utilizing the sustainable design features of the building and the individual unit to their fullest potential. These could include information on how to use the heating and cooling systems, ways to conserve energy and water, plug load controls, waste reduction and recycling, green cleaning guidelines and products, non-automotive transportation and cycling options and identification of amenities within walking distance.

Energy Efficiency Assistance

The Proponent is aware that the Project's electricity and natural gas service providers may potentially offer technical assistance and incentives for implementing energy efficiency measures. The Proponent has begun initial conversations with the utility companies to introduce the service providers to the Project and plan for future involvement. The first step in the technical assistance program is an energy systems design charrette to be held with service provider personnel in the forthcoming schematic design stage. By working with these utilities throughout the design

process, the Proponent will evaluate additional energy conservation strategies. During this process additional energy savings and associated GHG emissions reductions may be achieved.

As discussed throughout this chapter, the design team has already proposed an energy usage target for the Project that will yield significant energy and water performance improvements over a code-compliant building. The Proponent has engaged energy modeling services and the services of multiple environmental and sustainability consultants to drive the Project to be as energy and resource efficient as possible.

Solid/C&D Waste Reduction and potential GHG reductions

Recycling and reuse programs will be developed and implemented by all construction contractors to reduce the amount of waste that is sent to landfill throughout construction. Prior to the start of construction, the construction management team will prepare and submit a Construction Waste Management Plan (CWMP) which will be implemented on Site. By keeping a large portion of the existing 8-story garage, a significant amount of construction waste associated with demolition and new construction is avoided by the Project. The Project will target a minimum diversion rate of 75 percent of C&D waste.

Storage of collected recyclables will be accommodated in designated recycling areas of the new buildings. A contracted waste management company will collect the recyclables on a regular basis. The Project is targeting 100 percent of paper, corrugated cardboard, glass, plastic and metal to be recycled during operations. Information on recyclable materials and the recycling program will be distributed to residential tenants and the office and retail Tenant Design and Construction Guidelines will include strategies to reduce waste through recycling and reuse programs.

5.4.5 Mobile Source Emissions Assessment

Mobile source GHG emissions are based upon traffic volumes, the distance vehicles travel, and GHG emission rates. The mobile source emissions are calculated by performing a mesoscale analysis to evaluate the changes in CO_2 emissions for the existing and future conditions within the traffic study area. The GHG mobile source analysis estimates the area-wide CO_2 emissions from vehicle traffic for a period of one year.

Analysis Conditions

Consistent with the traffic analysis, the following conditions were analyzed: the 2016 Existing Condition; and 2023 future No-Build and Build Conditions. The analysis compares the future No-Build and Build Conditions in order to identify the anticipated changes in traffic conditions and mobile source GHG emissions as a result of the Project. Where applicable, the Existing Condition is considered for comparison purposes only.

Mobile Source Emission Rates and Inventories

EPA's Office of Transportation and Air Quality (OTAQ) has developed the Motor Vehicle Emission Simulator (MOVES)[7]. MOVES2014a is EPA's latest motor vehicle emissions model for state and local agencies to estimate GHG and other emissions from cars, trucks, buses, and motorcycles.

All the vehicle emissions used in the mobile source GHG mesoscale analysis model were obtained using EPA's MOVES2014a emissions model. MOVES2014a calculates emission factors from motor vehicles in a mass per distance format (often grams per mile) for existing and future conditions and applies these factors to Vehicle Miles Travelled (VMT) data to obtain emissions inventories. The emissions calculated for this air quality assessment include Tier 3 emission standards, which is an EPA program that sets new vehicle emissions standards, including lowering the sulfur content of gasoline, heavy-duty engine and vehicle greenhouse gas regulations (2014-2018), and the second phase of light-duty vehicle GHG regulations (2017-2025). It also includes Massachusetts-specific conditions, such as the state vehicle registration age distribution and the statewide Inspection and Maintenance (I/M) Program.[8] These stringent emissions regulation programs often result in smaller emissions inventories with the passage of time when comparing similar scenarios. Input data for the MOVES2014a model was obtained from DEP and used Project-specific developed inputs where appropriate.

The MOVES2014a model was run at a project-level to obtain emission factors for each link of the mesoscale analysis. The model was set to calculate the emissions burden by choosing to model emissions processes that are specifically related to vehicles in the study area. Links were created that used the appropriate speeds and grades for each roadway segment.

Traffic Data

The air quality study used traffic data (volumes, delays, and speeds) developed for each analysis condition. The mesoscale analysis for CO_2 emissions considered a yearly traffic volume developed from weekday and weekend periods. The vehicle miles traveled data used in the air quality analysis were developed based on the traffic data analyzed in this report (Chapter 4*, Transportation and Parking)*. The analysis presents two overarching scenarios that are reflective of the transportation study – one in which the I-90 Westbound On-Ramp at Clarendon Street remains open in the future condition (Base Scenario-On-Ramp Open) and the other in which the On-Ramp is closed (Alternate Scenario-On-Ramp Closed).

Existing Mobile Source CO_2 Emissions

Table 5-11 presents CO_2 emissions from mobile sources under all conditions. The calculation of Existing Conditions mobile source emissions provides a base for which future years are evaluated. The mobile source analysis calculated the existing CO_2

7 MOVES2014a (Motor Vehicles Emission Simulator), December 2015, US EPA, Office of Mobile Sources, Ann Arbor, MI.

8 The Stage II Vapor Recovery System is the process of collecting gasoline vapors form vehicles as they are refueled. This requires the use of a special gasoline nozzle at the fuel pump.

emissions from the major roadways in the study area. These CO_2 emissions, estimated to be 30,016 tons per year, establish a baseline to which future emissions can be compared. Results are presented in short tons (2,000 lbs.) per year.

Future Mobile Source CO_2 Emissions

Future Project-related mobile source CO_2 emissions calculations are based upon changes in traffic and emission's factor data. The traffic data includes traffic volumes, vehicle miles traveled, roadway operations, and physical roadway improvements. The emission factor data includes emission reduction programs and the years of analysis.

The mobile source analysis estimated the future study area CO_2 emissions due to the changes in traffic and emission data. Under the Base Scenario No-Build Condition, CO_2 emissions were estimated to be 27,576 tons per year. Under the Alternate Scenario No-Build Condition, CO_2 emissions were estimated to be 27,607 tons per year. Under the Base Scenario Build Condition, the CO_2 emissions were estimated to be 29,397 tons per year. Under the Alternate Scenario Build Condition, the CO_2 emissions were estimated to be 29,309 tons per year.

The total Project-related mobile source GHG emissions are 1,821 tons per year in the Base Ramp Scenario and 1,702 tons per year in the Alternate Ramp Scenario, as presented in Table 5-11. These increases represent an approximately 6 percent increase in CO_2 emissions for the mesoscale study area for future 2023 conditions under both the Base and Alternate Ramp Scenarios.

Table 5-11 Mobile Source CO_2 Emissions Analysis Results (tons per year)

Pollutant	Scenario	2016 Existing Conditions	2023 No-Build Conditions[1]	2023 Build Conditions	Project-related CO_2 Emissions[2]
Greenhouse Gas (CO_2)	Base (On-Ramp Open)	30,016	27,576	29,397	1,821
	Alternate (On-Ramp Closed)	30,016	27,607	29,309	1,702

1 The future No-Build condition emissions are lower than the existing conditions emissions due to the implementation of state and federal emission control programs, such as the Federal Motor Vehicle Emission Control Program (Tier 3) and the Stage II Vapor Recovery System, and the Massachusetts Inspection and Maintenance program.

2 Represents the difference in CO_2 emissions between the Build and No-Build Conditions.

Proposed Mitigation Measures

The mobile source GHG assessment calculated the GHG emissions for Project-related mobile sources. A comprehensive transportation mitigation program has been developed to mitigate impacts of project-related traffic. Specifically, the traffic mitigation measures proposed by the Proponent to minimize the traffic impacts of

the full build-out of the Project include travel demand management (TDM) measures and roadway improvements to the surrounding traffic network.

The Proponent is committed to implementing a comprehensive TDM program. A full description of the TDM program is detailed in Chapter 4*, Transportation and Parking*. Implementation of the TDM program is expected to improve air quality in the study area by promoting the use of alternative forms of transportation over the use of single-occupant motor vehicle trips to the Project Site. Although not easily modeled, previous estimates of similar TDM programs in an urban area have ranged on the order of two (2) percent reduction in Vehicle Miles Travelled from the Project generated trips. Assuming a similar relationship to GHG emissions, this would correlate to an approximate 36 tons of CO_2 per year reduction in mobile source GHG based on estimated Project emissions in the Base Ramp scenario and 34 tons per year in the Alternate Ramp Scenarios.

Additionally, the Proponent has assessed potential roadway improvements to reduce delay and improve operations at the study area intersections. These improvements include:

- Optimize signal timings at the intersections of Columbus Avenue/Dartmouth Street, Columbus Avenue/Clarendon Street, Arlington Street/Stuart Street, Clarendon Street/Stuart Street, and Stuart Street/Trinity Place (the last one under the Alternate Scenario Only);
- Further study the feasibility of signalizing the intersections of Clarendon Street/Stanhope Street and St James Avenue/Trinity Place;
- Convert the existing Clarendon Street southbound parking lane to a left-turn only travel lane at the intersection of Clarendon Street and Columbus Avenue; and
- Further study of the feasibility of converting circulation on Trinity Place to northbound only between Stuart Street and St. James Avenue

Assessing the reduction in vehicle delay due to these roadway improvements results in a 1,150 tons per year reduction in CO_2 emissions in the Base Ramp Scenario and a 995 tons per year reduction in the Alternate Ramp Scenario. Coupled with the estimated reductions due to the TDM Program, this results in final Project-related CO_2 emissions of 635 tons per year in the Base Ramp Scenario and 673 tons per year in the Alternate Ramp Scenario. A summary of the mitigation emissions reduction is seen in Table 5-12.

Table 5-12 Mobile Source CO_2 Emissions Mitigation Analysis Results (tons per year)

Pollutant	Scenario	Project-Related CO_2 Emissions[1]	Estimated Reductions Due to TDM Measures[2]	Estimated Reductions Due to Roadway Improvements[3]	Resulting Project-Related CO_2 Emissions
Greenhouse Gas (CO_2)	Base (Ramp Open)	1,821	-36	-1,150	635
	Alternate (Ramp Closed)	1,702	-34	-995	673

1 Represents the difference in CO_2 emissions between the Build and No-Build Conditions
2 Mitigation from TDM Measures estimated as two (2) percent of unmitigated Project-related emissions.
3 Mitigation from Roadway improvements or signal timing optimization improving delays at intersections.

5.5 Climate Change Preparedness and Resiliency

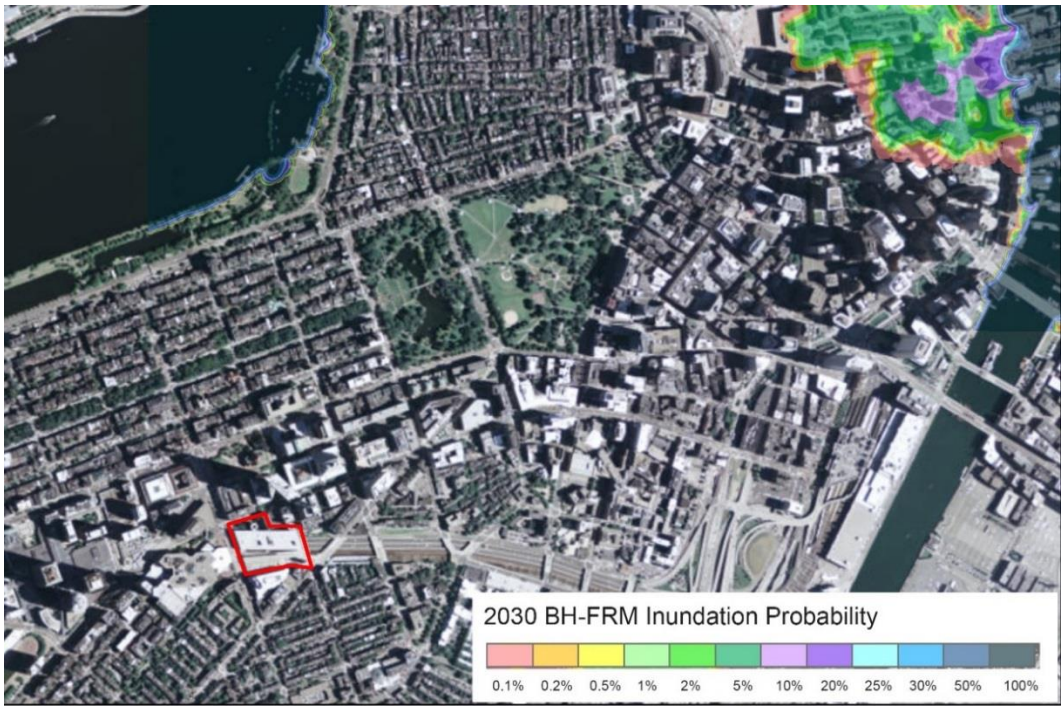
As required by the BPDA for all Large Project Review projects, the Proponent has considered anticipated changes in climate, which is reflected in the Resiliency Checklist provided in Appendix J. The Checklist reflects the commitment of the Proponent to mitigate the impacts of climate change by considering a variety of strategies as outlined in Section 5.3.2.

The following sections further describe how climate change has been considered in the early stages of the Project's design.

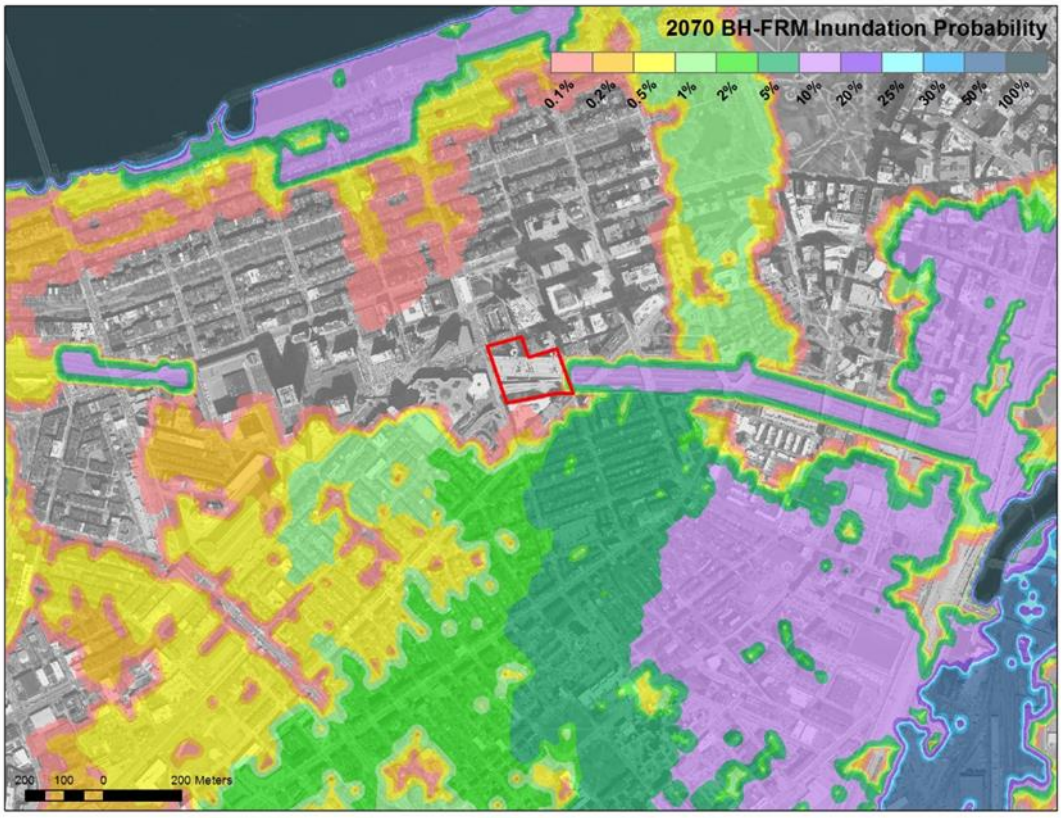
5.5.1 Potential Sea Level Rise

The potential effects of climate change, including rising sea levels and more frequent extreme storms increase the probability of coastal and riverine flooding and enlarge the 100-year floodplain. Utilizing the Coastal Flood Exceedance maps published in the MassDOT-FHWA Pilot Project Report: Climate Change and Extreme Weather, Vulnerability Assessments and Adaptation Options for the Central Artery/Tunnel (June 2015), the Project Site is not at high risk of inundation from sea level rise during its design life.

The following two maps show the 2030 (top) and 2070 (bottom) inundation probabilities from the high emissions scenario of the same flood risk model, developed by the Woods Hole Group. These maps show that there will be no flooding due to sea level rise in 2030 at or near the Project Site. In 2070, the projections also show minimal risk to the immediate Project Site despite the potential flooding of I-90 which could result in substantial flooding of regional transportation systems and the surrounding area. The Climate Ready Boston report, released in December 2016, indicated no change in sea level rise projections.



2030 Inundation Probability



2070 Inundation Probability

5.5.2 Extreme Weather Conditions

This section examines how the Project may be affected by and will prepare for climate change-induced extreme weather events.

The 2011 *Massachusetts Climate Change Adaptation Report* projects an increase in extreme weather events which could consist of drought, tropical rainfall patterns (i.e., increased precipitation), extreme heat and cold stretches, an increase in the number of days with extreme heat (i.e., temperatures greater than 90°F and 100°F) and increased winter precipitation, yet fewer days of snow.

The latest Climate Ready Boston report, released in December 2016, predicts an increase in the days of extreme heat from previous research; an additional 10 days above 90 degrees by 2030 to 20-40 in total, and an additional 22 days above 90 degrees by 2070 to 25-90 in total. Projections for increased precipitation and sea level rise from previous reports have remained consistent, as do implications to the Project Site.

Please refer to the Preparedness and Resiliency Checklist in Appendix J for additional details on how the Project will respond to extreme weather conditions.

5.5.3 Potential Resiliency Measures

The Proponent and Project Team continue to evaluate potential design elements to mitigate the effects of climate change as the design of each Project Component progresses.

Site & Building Resiliency Measures

The Project has studied and intends to implement the following non-mechanical strategies to support building functionality and use during an extended interruption of utility services and infrastructure:

- Mitigate heat island effects through use of hardscape and roof materials with a high solar Operable windows for natural ventilation in residential areas.
- High performance building envelopes.
- Design of intakes and other building penetrations to mitigate water infiltration in flood events.

In addition to the passive design strategies identified above, the Project has begun and will continue to study implementation of the following active strategies:

- The HVAC system has been evaluated for performance during extreme weather events and anthropogenic future climate change.
- Redundant connections for domestic water and fire protection systems ensure functionality in case of damage or other problems caused by extreme weather events.

- Sewage backflow valves prevent backflow into the buildings during rainstorms and floods to avoid building damage and maintain occupant safety and comfort.
- Elevated equipment ensures continued functionality in case of flooding.
- Considering standby power for systems in the residential towers to enable shelter-in-place.
- Based on the energy and payback analysis, cogeneration and roof PV are cost-effective strategies. While not included in the base design proposal, these systems will continue to be evaluated as the Project design advances. Any renewable systems implemented will enhance resiliency.
- The Project is exploring the use of a demand response capable system in order to minimize electricity use during peak periods and also considering the incorporation of on-site energy storage.

The Project has taken specific measures to manage stormwater and protect against extreme weather conditions. To protect against high winds, the Project has a hardened building structure and infrastructure, buried utilities, and protective landscapes. Additionally, the Project will meet the requirements of the Groundwater Conservation Overlay District.

Back Bay Station

The Project is located adjacent to and above the Station. As a result, the Proponent has discussed resiliency efforts with the MBTA as it relates to the Station. The MBTA's Climate Change Resiliency Specialist in the Department of Environmental Affairs described the following efforts currently being undertaken by the MBTA:

- The MBTA has identified climate change resiliency as a key objective for its 2040 strategy and will further incorporate resiliency into other MBTA activities.
- The MBTA is planning to conduct a system-wide climate change vulnerability assessment and, subsequently, pursue resiliency measures.
- The MBTA recently modified its Architecture and Engineering services RFP template, such that new projects must now evaluate climate-and weather-related vulnerabilities (both historical and projected) and identify potential adaptation options. The intent is for this evaluation to occur by the 30 percent design stage for each project.
- A climate change vulnerability assessment for the Blue Line is being finalized. The Blue Line was selected for the pilot study as it is the shortest of the rapid transit lines, currently experiences flooding at Aquarium Station during very high tides and coastal storm events, and is likely to be heavily-exposed to storm surge events at multiple additional locations within 20-30 years.
- There are several FTA-funded climate change resiliency projects in-progress; (1) flood protection at the Fenway Portal on the "E" Green Line which has

previously experienced freshwater flooding and (2) the reconstruction and expansion of the seawall at the Charlestown bus garage.

- In addition to the MBTA's efforts, the Proponent is implementing a renovation of the concourse level of the Station, as described in detail in Appendix E. A primary objective for concourse improvements is to enhance thermal and visual comfort within the Station through passive design measures. Strategies include reducing heat gains and solar exposure in the summer and maximizing them in the winter, and inducing air flow through the Station. These measures will make the Station more resilient to future temperature changes, particularly extreme heat.

LEED 2009 for Core and Shell Development

Project Checklist

Back Back / South End Gateway Project: Garage West

Y	?	N			
24	2	2	**Sustainable Sites**	Possible Points:	28
Y			Prereq 1	Construction Activity Pollution Prevention	
1			Credit 1	Site Selection	1
5			Credit 2	Development Density and Community Connectivity	5
		1	Credit 3	Brownfield Redevelopment	1
6			Credit 4.1	Alternative Transportation—Public Transportation Access	6
2			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	2
3			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
2			Credit 4.4	Alternative Transportation—Parking Capacity	2
	1		Credit 5.1	Site Development—Protect or Restore Habitat	1
	1		Credit 5.2	Site Development—Maximize Open Space	1
1			Credit 6.1	Stormwater Design—Quantity Control	1
1			Credit 6.2	Stormwater Design—Quality Control	1
1			Credit 7.1	Heat Island Effect—Non-roof	1
1			Credit 7.2	Heat Island Effect—Roof	1
		1	Credit 8	Light Pollution Reduction	1
1			Credit 9	Tenant Design and Construction Guidelines	1
4	3	3	**Water Efficiency**	Possible Points:	10
Y			Prereq 1	Water Use Reduction—20% Reduction	
2	2		Credit 1	Water Efficient Landscaping	2 to 4
		2	Credit 2	Innovative Wastewater Technologies	2
2	1	1	Credit 3	Water Use Reduction	2 to 4
18	7	11	**Energy and Atmosphere**	Possible Points:	37
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
9	4	8	Credit 1	Optimize Energy Performance	3 to 21
	1	3	Credit 2	On-Site Renewable Energy	4
2			Credit 3	Enhanced Commissioning	2
2			Credit 4	Enhanced Refrigerant Management	2
3			Credit 5.1	Measurement and Verification—Base Building	3
2			Credit 5.2	Measurement and Verification—Tenant Submetering	3
	2		Credit 6	Green Power	2

Y	?	N			
4	3	6	**Materials and Resources**	Possible Points:	13
Y			Prereq 1	Storage and Collection of Recyclables	
		5	Credit 1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 5
2			Credit 2	Construction Waste Management	1 to 2
		1	Credit 3	Materials Reuse	1
1	1		Credit 4	Recycled Content	1 to 2
1	1		Credit 5	Regional Materials	1 to 2
	1		Credit 6	Certified Wood	1
5	5	2	**Indoor Environmental Quality**	Possible Points:	12
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
	1		Credit 1	Outdoor Air Delivery Monitoring	1
		1	Credit 2	Increased Ventilation	1
1			Credit 3	Construction IAQ Management Plan—During Construction	1
1			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
1			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
	1		Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
	1		Credit 5	Indoor Chemical and Pollutant Source Control	1
		1	Credit 6	Controllability of Systems—Thermal Comfort	1
1			Credit 7	Thermal Comfort—Design	1
	1		Credit 8.1	Daylight and Views—Daylight	1
	1		Credit 8.2	Daylight and Views—Views	1
4	2		**Innovation and Design Process**	Possible Points:	6
1			Credit 1.1	Exemplary Performance SSc2 Development Density	1
1			Credit 1.2	Exemplary Performance SSc4.1 Public Transportation	1
	1		Credit 1.3	Exemplary Performance MRc2 Construction Waste Management	1
	1		Credit 1.4	Innovation in Design: Green Building Education	1
1			Credit 1.5	Innovation in Design: Green Cleaning Policy/Program	1
1			Credit 2	LEED Accredited Professional	1
3		1	**Regional Priority Credits**	Possible Points:	4
		1	Credit 1.1	On-site renewable energy	1
1			Credit 1.2	Stormwater design - quantity control	1
1			Credit 1.3	Heat island effect - nonroof	1
1			Credit 1.4	Heat island effect - roof	1

Y	?	N			
62	22	25	**Total**	Possible Points:	110

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

LEED 2009 for New Construction and Major Renovations

Project Checklist

Back Back / South End Gateway Project: Garage East

Y	?	N			
21	3	2	**Sustainable Sites**	Possible Points:	26
Y			Prereq 1	Construction Activity Pollution Prevention	
1			Credit 1	Site Selection	1
5			Credit 2	Development Density and Community Connectivity	5
		1	Credit 3	Brownfield Redevelopment	1
6			Credit 4.1	Alternative Transportation—Public Transportation Access	6
	1		Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
3			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
2			Credit 4.4	Alternative Transportation—Parking Capacity	2
	1		Credit 5.1	Site Development—Protect or Restore Habitat	1
	1		Credit 5.2	Site Development—Maximize Open Space	1
1			Credit 6.1	Stormwater Design—Quantity Control	1
1			Credit 6.2	Stormwater Design—Quality Control	1
1			Credit 7.1	Heat Island Effect—Non-roof	1
1			Credit 7.2	Heat Island Effect—Roof	1
		1	Credit 8	Light Pollution Reduction	1
4	4	2	**Water Efficiency**	Possible Points:	10
Y			Prereq 1	Water Use Reduction—20% Reduction	
2	2		Credit 1	Water Efficient Landscaping	2 to 4
		2	Credit 2	Innovative Wastewater Technologies	2
2	2		Credit 3	Water Use Reduction	2 to 4
11	5	19	**Energy and Atmosphere**	Possible Points:	35
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
4	3	12	Credit 1	Optimize Energy Performance	1 to 19
		7	Credit 2	On-Site Renewable Energy	1 to 7
2			Credit 3	Enhanced Commissioning	2
2			Credit 4	Enhanced Refrigerant Management	2
3			Credit 5	Measurement and Verification	3
	2		Credit 6	Green Power	2
4	4	6	**Materials and Resources**	Possible Points:	14
Y			Prereq 1	Storage and Collection of Recyclables	
		3	Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
		1	Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
2			Credit 2	Construction Waste Management	1 to 2
		2	Credit 3	Materials Reuse	1 to 2

Y	?	N			
			Materials and Resources, Continued		
1	1		Credit 4	Recycled Content	1 to 2
1	1		Credit 5	Regional Materials	1 to 2
	1		Credit 6	Rapidly Renewable Materials	1
	1		Credit 7	Certified Wood	1
8	5	2	**Indoor Environmental Quality**	Possible Points:	15
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
1			Credit 1	Outdoor Air Delivery Monitoring	1
		1	Credit 2	Increased Ventilation	1
1			Credit 3.1	Construction IAQ Management Plan—During Construction	1
1			Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
1			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
1			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
	1		Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
	1		Credit 5	Indoor Chemical and Pollutant Source Control	1
1			Credit 6.1	Controllability of Systems—Lighting	1
		1	Credit 6.2	Controllability of Systems—Thermal Comfort	1
1			Credit 7.1	Thermal Comfort—Design	1
	1		Credit 7.2	Thermal Comfort—Verification	1
	1		Credit 8.1	Daylight and Views—Daylight	1
	1		Credit 8.2	Daylight and Views—Views	1
4	2		**Innovation and Design Process**	Possible Points:	6
1			Credit 1.1	Exemplary Performance SSc2 Development Density	1
1			Credit 1.2	Exemplary Performance SSc4.1 Public Transportation	1
	1		Credit 1.3	Exemplary Performance MRc2 Construction Waste Management	1
	1		Credit 1.4	Innovation in Design: Green Building Education	1
1			Credit 1.5	Innovation in Design: Green Cleaning Policy/Program	1
1			Credit 2	LEED Accredited Professional	1
3		1	**Regional Priority Credits**	Possible Points:	4
		1	Credit 1.1	On-site renewable energy	1
1			Credit 1.2	Stormwater design - quantity control	1
1			Credit 1.3	Heat island effect - nonroof	1
1			Credit 1.4	Heat island effect - roof	1

Y	?	N			
55	23	32	**Total**	Possible Points:	110

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

LEED 2009 for New Construction and Major Renovations

Project Checklist

Back Back / South End Gateway Project: Station East

Y	?	N			
21	3	2	**Sustainable Sites**	Possible Points:	26
Y			Prereq 1	Construction Activity Pollution Prevention	
1			Credit 1	Site Selection	1
5			Credit 2	Development Density and Community Connectivity	5
		1	Credit 3	Brownfield Redevelopment	1
6			Credit 4.1	Alternative Transportation—Public Transportation Access	6
	1		Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
3			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
2			Credit 4.4	Alternative Transportation—Parking Capacity	2
	1		Credit 5.1	Site Development—Protect or Restore Habitat	1
	1		Credit 5.2	Site Development—Maximize Open Space	1
1			Credit 6.1	Stormwater Design—Quantity Control	1
1			Credit 6.2	Stormwater Design—Quality Control	1
1			Credit 7.1	Heat Island Effect—Non-roof	1
1			Credit 7.2	Heat Island Effect—Roof	1
		1	Credit 8	Light Pollution Reduction	1
4	4	2	**Water Efficiency**	Possible Points:	10
Y			Prereq 1	Water Use Reduction—20% Reduction	
2	2		Credit 1	Water Efficient Landscaping	2 to 4
		2	Credit 2	Innovative Wastewater Technologies	2
2	2		Credit 3	Water Use Reduction	2 to 4
11	5	19	**Energy and Atmosphere**	Possible Points:	35
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
4	3	12	Credit 1	Optimize Energy Performance	1 to 19
		7	Credit 2	On-Site Renewable Energy	1 to 7
2			Credit 3	Enhanced Commissioning	2
2			Credit 4	Enhanced Refrigerant Management	2
3			Credit 5	Measurement and Verification	3
	2		Credit 6	Green Power	2
4	4	6	**Materials and Resources**	Possible Points:	14
Y			Prereq 1	Storage and Collection of Recyclables	
		3	Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
		1	Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
2			Credit 2	Construction Waste Management	1 to 2
		2	Credit 3	Materials Reuse	1 to 2

Y	?	N			
			Materials and Resources, Continued		
1	1		Credit 4	Recycled Content	1 to 2
1	1		Credit 5	Regional Materials	1 to 2
	1		Credit 6	Rapidly Renewable Materials	1
	1		Credit 7	Certified Wood	1
8	5	2	**Indoor Environmental Quality**	Possible Points:	15
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
1			Credit 1	Outdoor Air Delivery Monitoring	1
		1	Credit 2	Increased Ventilation	1
1			Credit 3.1	Construction IAQ Management Plan—During Construction	1
1			Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
1			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
1			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
	1		Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
	1		Credit 5	Indoor Chemical and Pollutant Source Control	1
1			Credit 6.1	Controllability of Systems—Lighting	1
		1	Credit 6.2	Controllability of Systems—Thermal Comfort	1
1			Credit 7.1	Thermal Comfort—Design	1
	1		Credit 7.2	Thermal Comfort—Verification	1
	1		Credit 8.1	Daylight and Views—Daylight	1
	1		Credit 8.2	Daylight and Views—Views	1
4	2		**Innovation and Design Process**	Possible Points:	6
1			Credit 1.1	Exemplary Performance SSc2 Development Density	1
1			Credit 1.2	Exemplary Performance SSc4.1 Public Transportation	1
	1		Credit 1.3	Exemplary Performance MRc2 Construction Waste Management	1
	1		Credit 1.4	Innovation in Design: Green Building Education	1
1			Credit 1.5	Innovation in Design: Green Cleaning Policy/Program	1
1			Credit 2	LEED Accredited Professional	1
3		1	**Regional Priority Credits**	Possible Points:	4
		1	Credit 1.1	On-site renewable energy	1
1			Credit 1.2	Stormwater design - quantity control	1
1			Credit 1.3	Heat island effect - nonroof	1
1			Credit 1.4	Heat island effect - roof	1

Y	?	N			
55	23	32	**Total**	Possible Points:	110

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

LEED 2009 for Core and Shell Development

Project Checklist

Back Back / South End Gateway Project: Station West

Y	?	N			
22	4	2	**Sustainable Sites**	Possible Points:	28
Y			Prereq 1	Construction Activity Pollution Prevention	
1			Credit 1	Site Selection	1
5			Credit 2	Development Density and Community Connectivity	5
		1	Credit 3	Brownfield Redevelopment	1
6			Credit 4.1	Alternative Transportation—Public Transportation Access	6
	2		Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	2
3			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
2			Credit 4.4	Alternative Transportation—Parking Capacity	2
	1		Credit 5.1	Site Development—Protect or Restore Habitat	1
	1		Credit 5.2	Site Development—Maximize Open Space	1
1			Credit 6.1	Stormwater Design—Quantity Control	1
1			Credit 6.2	Stormwater Design—Quality Control	1
1			Credit 7.1	Heat Island Effect—Non-roof	1
1			Credit 7.2	Heat Island Effect—Roof	1
		1	Credit 8	Light Pollution Reduction	1
1			Credit 9	Tenant Design and Construction Guidelines	1
4	3	3	**Water Efficiency**	Possible Points:	10
Y			Prereq 1	Water Use Reduction—20% Reduction	
2	2		Credit 1	Water Efficient Landscaping	2 to 4
		2	Credit 2	Innovative Wastewater Technologies	2
2	1	1	Credit 3	Water Use Reduction	2 to 4
11	9	17	**Energy and Atmosphere**	Possible Points:	37
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
4	4	13	Credit 1	Optimize Energy Performance	3 to 21
		4	Credit 2	On-Site Renewable Energy	4
2			Credit 3	Enhanced Commissioning	2
2			Credit 4	Enhanced Refrigerant Management	2
3			Credit 5.1	Measurement and Verification—Base Building	3
	3		Credit 5.2	Measurement and Verification—Tenant Submetering	3
	2		Credit 6	Green Power	2

Y	?	N			
3	4	6	**Materials and Resources**	Possible Points:	13
Y			Prereq 1	Storage and Collection of Recyclables	
		5	Credit 1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 5
2			Credit 2	Construction Waste Management	1 to 2
		1	Credit 3	Materials Reuse	1
1	1		Credit 4	Recycled Content	1 to 2
	2		Credit 5	Regional Materials	1 to 2
	1		Credit 6	Certified Wood	1
4	6	2	**Indoor Environmental Quality**	Possible Points:	12
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
1			Credit 1	Outdoor Air Delivery Monitoring	1
		1	Credit 2	Increased Ventilation	1
1			Credit 3	Construction IAQ Management Plan—During Construction	1
1			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
	1		Credit 4.3	Low-Emitting Materials—Flooring Systems	1
	1		Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
	1		Credit 5	Indoor Chemical and Pollutant Source Control	1
		1	Credit 6	Controllability of Systems—Thermal Comfort	1
	1		Credit 7	Thermal Comfort—Design	1
	1		Credit 8.1	Daylight and Views—Daylight	1
	1		Credit 8.2	Daylight and Views—Views	1
4	2		**Innovation and Design Process**	Possible Points:	6
1			Credit 1.1	Exemplary Performance SSc2 Development Density	1
1			Credit 1.2	Exemplary Performance SSc4.1 Public Transportation	1
	1		Credit 1.3	Exemplary Performance MRc2 Construction Waste Management	1
	1		Credit 1.4	Innovation in Design: Green Building Education	1
1			Credit 1.5	Innovation in Design: Green Cleaning Policy/Program	1
1			Credit 2	LEED Accredited Professional	1
3		1	**Regional Priority Credits**	Possible Points:	4
		1	Credit 1.1	On-site renewable energy	1
1			Credit 1.2	Stormwater design - quantity control	1
1			Credit 1.3	Heat island effect - nonroof	1
1			Credit 1.4	Heat island effect - roof	1

Y	?	N			
51	28	31	**Total**	Possible Points:	110

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

6

Environmental Protection

This chapter presents information on the environmental conditions in the vicinity of the Project Site and the potential changes that may occur as a result of the Project. A key goal of the Project is to redevelop the Project Site for more efficient and improved uses, while avoiding or minimizing potential adverse environmental impacts.

As discussed in more detail below, the Project-related impacts, which are to be expected in urban development of this scale, are counterbalanced by the significant benefits for the adjacent neighborhoods and the City, including the realization of many of the City's planning goals expressed in the recently enacted SSD. The following sections identify Project impacts and discuss steps that have been or will be taken through design and management to avoid, minimize, and/or mitigate adverse effects. Temporary construction-period impacts will be managed to minimize disruption to the surrounding neighborhoods.

In compliance with the Article 80 Large Project Review guidelines of the Code, this Project will address potential environmental impacts in the following categories:

- Pedestrian Wind
- Shadow
- Daylight
- Solar Glare
- Air Quality
- Water Quality
- Noise
- Solid and Hazardous Waste
- Groundwater
- Geotechnical
- Construction

Where the current state of the design allows, this DEIR/DPIR provides a full assessment of Project impacts. The Proponent looks forward to working through the Article 80 and MEPA processes with city and state agencies and the community to further refine the Project and its associated benefits.

6.1 Summary of Key Findings and Benefits

The analysis of potential environmental impacts resulting from the Project include the following conclusions:

- Wind - The Project will not result in any new unacceptable or unsafe wind conditions in or around the Project Site. Preliminary wind analysis results indicate that the majority of the surrounding area will remain comfortable at the pedestrian level, with some areas experiencing improved wind conditions due to the Project. The Project will continue to explore additional wind mitigation options, including landscape treatments and building elements to ensure

pedestrian comfort at the Project Site and surrounding area by reducing wind speed and gusts.

- Shadow – Shadow impacts have been minimized to the extent practicable to avoid noticeable pedestrian impacts, and are in compliance with the specific requirements of the SSD, including the two-hour shadow limitation on Copley Square.
- Daylight – The Project will result in a modest reduction in the visible skydome when viewed from adjacent sidewalks compared to existing conditions. Such changes are consistent with the Project's urban context.
- Solar Glare – A conservative analysis of the anticipated solar glare impacts indicates that the Project will have only minor and infrequent impacts which will be minimized through building design.
- Air Quality – The air quality analysis demonstrates that the Project will conform to the National Ambient Air Quality Standards and will not have an adverse impact on local air quality.
- Noise – The sound levels associated with the Project's mechanical equipment will be attenuated with mechanical enclosures and screening located on the roof, and therefore will have no adverse noise impacts at nearby sensitive receptor locations. Potential noise impacts associated with deliveries are expected to be negligible as the majority of loading will primarily be enclosed and will be managed.
- Water Quality – The Project will meet all applicable stormwater management standards to the extent practicable by implementing a treatment train of Best Management Practices to improve water quality.
- Hazardous Materials – The Project Site does not contain any known reported releases of oil and hazardous materials and no related impacts are anticipated.
- Groundwater – The potential for groundwater impacts at the Project Site is limited by the small amount of terra firma affected and no impacts are anticipated due to the lack of substantive excavation in the Project.
- Geotechnical – The geotechnical engineer and contractor will work closely together throughout the excavation and foundation construction to avoid adverse impacts on adjacent structures and infrastructure during the installation of the foundation elements. Soil disturbance and vibration will be limited by low displacement foundation elements.
- Construction – The Project has been designed to avoid, minimize and mitigate potential construction-related impacts. The Project Team will work with the City to reduce potential construction period impacts.

6.2 Wind

Pursuant to Section B.1 of the BPDA Development Review Guidelines, a pedestrian wind tunnel study was conducted to assess the potential effect of the Project on pedestrian-level wind conditions around the Project Site and to provide recommendations for minimizing any potential adverse effects. The following conditions were simulated:

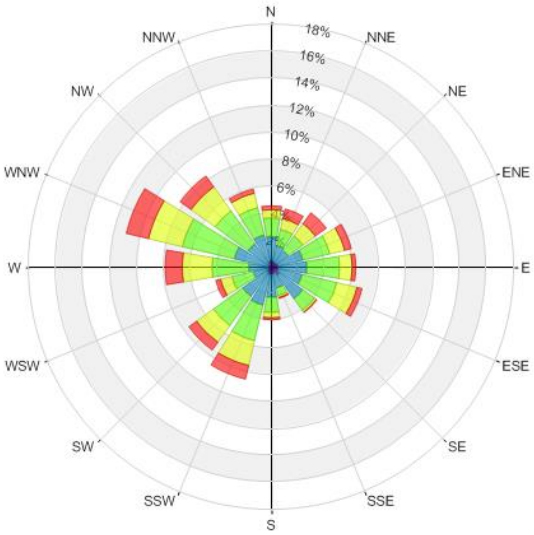
- **No-Build Condition**: includes all existing buildings and BPDA-approved buildings within a 1,600-foot radius of the Project area;
- **Base Scheme**: includes the proposed Base Scheme of the Project and all existing and BPDA approved buildings within a 1,600-foot radius of the Project area; and
- **Alternate Scheme**: includes the proposed Alternate Scheme of the Project and all existing and BPDA approved buildings within a 1,600-foot radius of the Project area.

6.2.1 Methodology

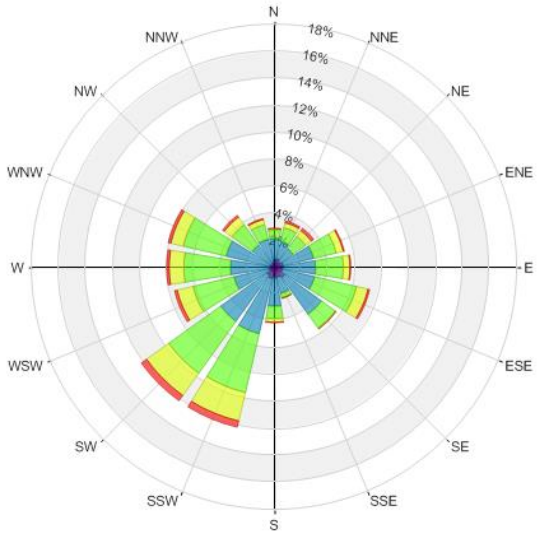
A scale model was equipped with specially designed wind speed sensors at 135 grade level locations, chosen in consultation with the BPDA, which estimated the mean and fluctuating components of wind speed at a full-scale height of five feet above grade in pedestrian areas throughout the Project Site. Wind speeds were measured for 36 wind directions, in 10 degree increments, starting from true north. The results were then combined with long-term meteorological data, recorded during the years 1991 to 2015 at Boston's Logan International Airport, in order to estimate full scale wind conditions. Meteorological data summarizing the annual and seasonal wind climates in the Boston area based on the data from Logan Airport is provided in Appendix I.

The “wind roses” presented below summarize the annual and seasonal wind climates in the Boston area, based on the data from Boston Logan International Airport. The wind rose for spring, for example, summarizes the wind data from March, April, and May. In general, as indicated by the red and yellow color bands on the wind rose, the prevailing winds at this time of year are from the west-northwest, northwest, west, south-southwest and southwest. In addition to these directions, winds are also prevalent from the east-southeast and east-northeast direction.

Wind Roses



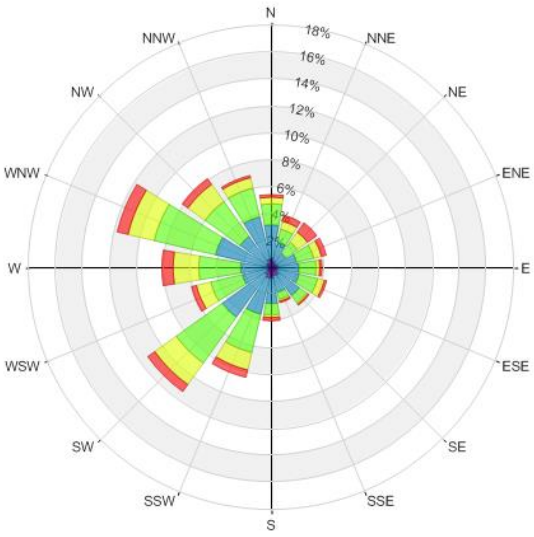
Spring
(March-May)



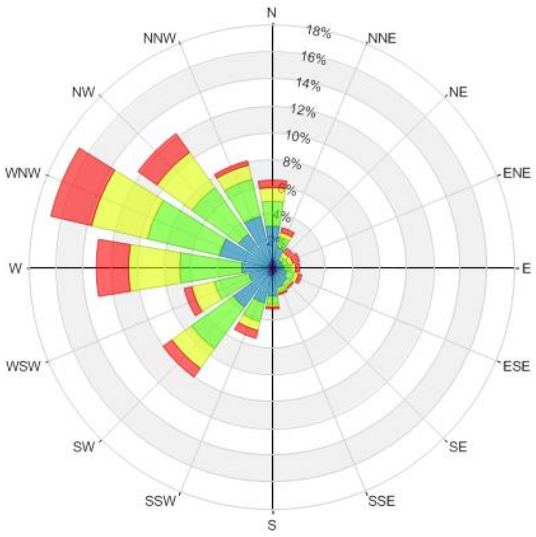
Summer
(June-August)



Wind Speed (mph)
Calm
1-5
6-10
11-15
16-20
>20

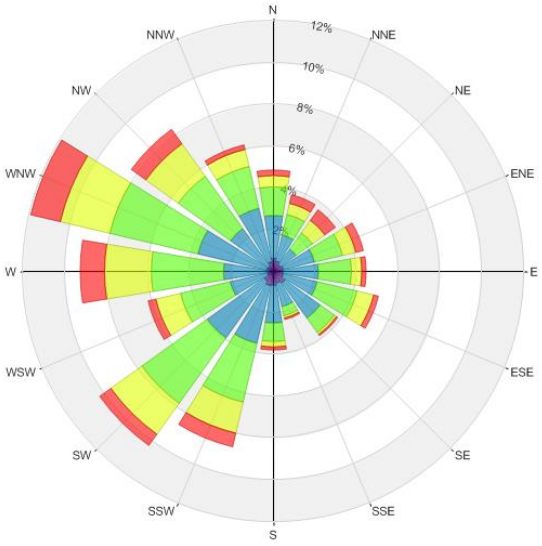


Fall
(September-November)



Winter
(December-February)

Wind Speed (mph)
Calm
1-5
6-10
11-15
16-20
>20



Annual Winds

Wind Speed (mph)
Calm
1-5
6-10
11-15
16-20
>20

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

This study involves state of the art measurement and analysis techniques to predict wind speed conditions at the Project Site. Nevertheless, some subjectivity 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 study represent an average for the total population. Also, unforeseen future changes in the Project area, such as the construction or removal of buildings, can affect the conditions experienced at the Project 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 may occur but on a less frequent basis.

Pedestrian Wind Criteria

The BPDA has adopted two standards for assessing the relative wind comfort of pedestrians. First, the BPDA wind design guidance criterion indicates that an effective gust velocity (hourly mean wind speed plus 1.5 times the root mean square wind speed) of 31 miles per hour should not be exceeded more than one percent of the time. The second set of criteria used by the BPDA 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, as listed in Table 6-1 below, 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).

Table 6-1 BPDA Mean Wind Criteria*

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 in a typical downtown location in Boston is generally comfortable for the pedestrian use of sidewalks and thoroughfares and meets the BPDA effective gust velocity criterion. However, without any mitigation measures, this typical

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

downtown wind climate is likely to be frequently uncomfortable for more passive activities such as sitting.

6.2.2 Pedestrian Wind Findings

Figures 6.1a-c graphically depict the predicted mean speed and estimated wind comfort conditions at each wind measurement location based on the modeled annual winds for the No-Build, Base Scheme, and Alternate Scheme Conditions. Figures 6.1d-f depict annual wind safety conditions for the No-Build, Base Scheme, and Alternate Scheme Conditions, and Figures 6.1g-h depict the comfort category change between the No-Build to Base Scheme, and the No-Build to Alternate Scheme. Typically, summer and fall winds tend to be somewhat more comfortable than annual winds while winter and spring winds are somewhat less comfortable than annual winds. The following summary of pedestrian wind comfort is based on annual winds for each simulated condition.

No-Build Condition

Under the No-Build Condition, annual mean wind speeds at most of the on-site locations are generally comfortable for walking or better, with calmer wind speeds, comfortable for sitting or standing found primarily along the eastern and western edges of the Project Site. A few on-site locations along Stuart Street (Locations 1-5 and 66) and Clarendon Street (Location 9) are rated as uncomfortable, but not dangerous.

At off-site locations surrounding the Project Site, mean wind speeds are generally comfortable for walking, standing, or sitting with the exception of a few locations along Stuart Street (Locations 67, 76, 83 and 126), one location along Stanhope Street to the east of the Project Site (Location 62), a few locations further to the north of the Project Site along St. James Avenue and Boylston Street (Locations 79, 81, 92, 93, 99 and 131), two (2) locations along Exeter Street and Huntington Avenue to the northwest of the Project Site (Locations 113 and 117, respectively), and one (1) location along Trinity Place to the north of the Project Site (Location 101). Generally, the off-site locations to the south of the Project Site are comfortable for standing, or sitting.

Higher mean wind speeds categorized as dangerous were detected at one (1) off-site location at the southeast corner of intersection of Trinity Place and St. James Avenue (Location 90) on an annual basis.

The annual effective gust speeds are found to be acceptable at all locations monitored in and around the Project Site with the exception of one isolated location along Stuart Street (Location 4), and five off-site locations north of the Site on Trinity Place (Locations 90 and 101), St. James Avenue (Location 93), and west of the Project Site along Huntington and Exeter Street (Locations 113 and 117 respectively).

Base Scheme Condition

Under the Base Scheme Condition, the modeled pedestrian wind comfort conditions are expected to be similar or better than the No-Build Condition at most on-site locations around the Project on an annual basis. The Project will improve Pedestrian wind comfort conditions at ten (10) locations on the Project Site, including the Garage West office lobby entrances on Stuart Street (Locations 2-5), the Garage East residential lobby entrance on Clarendon Street (Locations 8-10), and the new public plaza and Station East retail, residential and Station entrances on Clarendon Street (Locations 12, 13 and 50).

Wind conditions comfortable for sitting or standing are predicted at entrances to the Station, Garage West and Station West buildings on Dartmouth Street (Locations 15-20), at entrances to the Garage East and Station East buildings on Clarendon Street (Locations 8 – 13), and at most locations around the perimeter of the proposed development. Wind conditions comfortable for sitting and walking are predicted at the Garage West entrances on Stuart Street (Locations 2 - 5).

The existing on-site uncomfortable conditions predicted for under the No-Build condition, generally improve, under the Build condition, especially along Stuart and Clarendon Streets, with the exception of two (2) locations, where uncomfortable conditions are predicted at the corner of Dartmouth Street and Stuart Street (Location 1), and just to the south of the proposed Station East building (Location 14), which is in a service area. Uncomfortable conditions at both locations can be mitigated through building elements such as canopies.

The addition of the Project is anticipated to result in slightly lower wind speeds and improved pedestrian wind comfort conditions at off-site locations to the north along Dartmouth Street, Trinity Place and Clarendon Street and to the southeast on Stanhope Street and along Columbus Avenue over I-90. Slightly higher wind speeds are predicted at a few off-site locations to the south along Columbus Avenue and Clarendon Street, and to the east on Stanhope and Stuart Streets. Wind conditions will remain essentially unchanged to the west and north along Dartmouth Street and within the Southwest Corridor Park. Overall, no new uncomfortable or dangerous off-site wind conditions are anticipated as a result of the Project.

There are no new dangerous mean conditions predicted either on-site or off-site on an annual basis for the Base Scheme.

Under the Base Scheme Condition, the annual effective gust speeds modeled are expected to remain unchanged from the No-Build Condition at most locations on and around the Project Site on an annual basis. The Project actually improves one (1) location along Stuart Street where an exceedance of the effective gust criterion under the No-Build Condition is eliminated under the Base Scheme Condition, thus improving the pedestrian experience.

Alternate Scheme Condition

Under the Alternate Scheme Condition, wind conditions are expected to be extremely similar to the Base Scheme Condition. The Alternate Scheme Condition provides the same improvements as the Base Scheme Condition to the annual mean and effective gust speeds and results in the same overall improvement of the pedestrian-level wind environment.

6.3 Shadow

6.3.1 Regulatory Context

An analysis of the shading impact under the No-Build and Build Conditions is a requirement of the Article 80, Large Project Review (Section 80B-2(c) of the Code). The shading analysis was prepared in accordance with the requirements of Section B.2. of the BPDA Development Review Guidelines, with the additional requirements established by the recently enacted Stuart Street Zoning District. For a conservative projection of shadow impacts, the analysis utilizes the worst case scenario, which is the Garage West Base Scheme. This scheme results in the largest shadow impact to adjacent public spaces.

6.3.2 Methodology

A shadow impact analysis was conducted at regular time intervals to investigate the effect that the Project will have throughout the year. In order to represent a variety of shadow conditions at various times of the day, and times of the year, 3 time intervals (9:00 AM, 12:00 PM, 3:00 PM) are represented for the Vernal and Autumnal Equinoxes (March 21st and September 21st, see Figure 6.2a), Summer Solstice (June 21st, see Figure 6.2b), and Winter Solstice (December 21st, see Figure 6.2c). 6:00

PM has been added to the June 21st shadow study. This study takes into consideration Daylight Savings Time ("DST"), and therefore times are presented in Eastern Standard Time ("EST") and Eastern Daylight Time ("EDT"). The study shows both existing shadows in and around the Project Site, and the limited shadow impact of the Project. The analysis focuses on the shadow cast onto existing pedestrian areas, open spaces, and sidewalks adjacent to and in the vicinity of the Project Site.

Special consideration and analysis has been given to Copley Square, with an additional section illustrating that the Project casts no more than two (2) hours of shadow on the Square between the hours of 8:00 am to 2:30 pm on any given day from March 21st to October 21st in accordance with the Stuart Street Zoning District (see Figure 6.2d).

Table 6-2 shows the solar azimuth and altitude data. Times are listed as EST and EDT, as appropriate. The data reflects a latitude of 42.358° and a longitude of -71.06°

Table 6-2 Solar Azimuth and Altitude Data

Date	Time	Azimuth *	Altitude **
March 21 EDT	9:00 AM	112.59	23.61
March 21 EDT	12:00 PM	161.17	46.69
March 21 EDT	3:00 PM	223.5	39.26
June 21 EDT	9:00 AM	93.51	39.95
June 21 EDT	12:00 PM	149.52	68.8
June 21 EDT	3:00 PM	246.32	56.48
June 21 EDT	6:00 PM	280.71	23.83
September 21 EDT	9:00 AM	115.54	25.89
September 21 EDT	12:00 PM	166.28	47.2
September 21 EDT	3:00 PM	227.1	37.14
October 21 EDT	10:09 AM	140.54	27.83
October 21 EDT	11:19 AM	159.15	34.33
October 21 EDT	11:53 AM	169.14	36.04
October 21 EDT	12:37 PM	182.53	36.62
December 21 EST	9:00 AM	141.93	14.34
December 21 EST	12:00 PM	184.36	24.12
December 21 EST	3:00 PM	224.96	10.1

*Azimuth is measured in degrees clockwise from North
**Altitude is measured in degrees up from the horizon

6.3.3 Results

The incremental shadows produced are consistent with the existing urban shadow pattern, are moderate in relation to shadows cast by the taller structures surrounding the Project Site, and are not expected to have any noticeable effect on pedestrian use patterns.

March 21st and September 21st

The future No-Build and net new shadows associated with the Project for March 21st and September 21st are illustrated in Figure 6.2a. March 21st is the Vernal Equinox, when the length of daytime and nighttime are equal. The sun rises on March 21 at 6:45 AM EDT in the southeastern sky and sets at 6:57 PM EDT. September 21st is the autumnal equinox and the daytime and nighttime hours are equal. The sun rises at 6:31 AM EDT in the southeastern sky and sets at 6:42 PM EDT. The shadows cast on this date are almost identical to those on March 21, the vernal equinox.

At 9:00 AM EDT, the Garage West building casts net new shadows towards the McKim Building of the Boston Public Library and shades portions of Dartmouth, Stuart, and Blagden Streets. The Station West building casts incremental net new shadows onto Dartmouth Street, without casting any new shadows onto the

sidewalks. The Station East building shadows and the Garage East building shadows remain largely within the Project Site.

At 12:00 noon EDT, the sun is in the south-southeasterly sky and shadows are cast nearly in line with the street grid. The Garage West building shades adjacent portions of Stuart Street. The Garage East building shadows, the Station East building shadows, and the Garage West building shadows remain largely within the Project Site.

At 3:00 PM EDT, the sun is in the southwestern sky and shadows are cast to the northeast. The net new shadows cast by the Garage West building shade a portion of Stuart Street towards the 200 Clarendon building. The Garage East building casts a small incremental new shadow on Stanhope Street. The Station East building casts an incremental new shadow onto Stanhope Street, Frieda Garcia Park, Cahners Place, as well as small areas of I-90. The Station West shadow remains entirely within the Project Site.

On both March 21st and September 21st, no net new shadows are cast by the Project on Copley Square.

June 21st

The future No-Build and net new shadows associated with the Project for June 21st are illustrated in Figure 6.2b. June 21st is the Summer Solstice and the longest day of the year. The sun rises at 5:08 AM EDT in the southeastern sky and sets at 8:25 PM EDT.

At 9:00 AM EDT, the Garage West building casts shadows to the west-northwest, shading the southern portion of the Stuart Street/Dartmouth Street intersection, including some adjacent sidewalks. The shadows cast by the Garage East building reach a small portion of Trinity Place, south of Stuart Street. Both the Station East building and the Station West building cast some new shadows onto Dartmouth Street, including sidewalks.

At 12:00 noon EDT, the sun is in the southern sky and casts the shortest shadows of the day. The Garage West building's shadows extend to the northern side of Stuart Street and a portion of the Dartmouth Street sidewalk at this intersection. The Garage East building casts limited shadow onto Trinity Place. The shadows cast by the Station East building and the Station West building remain within the Project Site.

At 3:00 PM EDT, the sun is in the western sky and shadows are cast east-northeast. The Garage West building casts a new shadow on portions of the southern sidewalk along Stuart Street, as well as a small portion on Trinity Place south of Stuart Street. The Garage East building casts shadows onto Stanhope Street and a portion of Frieda Garcia Park. The Station East building adds shadow to a portion of Clarendon Street north of the Columbus Avenue intersection, including the adjacent sidewalks, as well as areas of I-90. Shadows cast by the Station West building remain within the Project Site.

At 6:00 PM EDT, the sun is in the west-northwestern sky and shadows are cast toward the east-southeast. Much of the shadow cast by the Project is absorbed by the existing No-Build condition shadows. The Garage West building casts new shadow on Columbus Avenue, as well as a portion of I-90 and the rail lines. The Garage East building shades a small portion of Columbus Avenue, as well as I-90 and the rail lines. The Station East building casts incremental net new shadow on rooftops in the South End. The Station West building shadows remain largely within the Project Site.

On June 21st, no net new shadows are cast by the Project on Copley Square or the Southwest Corridor Park.

December 21st

The future No-Build and net new shadows associated with the Project on December 21st are depicted on Figure 6.2c. December 21st is the Winter Solstice and the shortest day of the year. The sun is at its lowest inclination above the horizon at each hour of the day. Even low buildings cast long shadows in northerly latitudes such as Boston's. The sun rises at 7:10 AM EST and sets at 4:15 PM EST.

At 9:00 AM EST, the Garage West building casts a shadow in a northwestern direction extending toward Newbury Street filling in gaps in the heavily shaded urban landscape. The net new shadows cast by this building will cover a small portion of the western sidewalk along Dartmouth Street, as well as the intersection with Blagden Street and Huntington Avenue. Small sidewalk portions of Boylston Street will also be shaded, but the majority of new net shadows will land on existing buildings, creating minimal adverse effects on the pedestrian environment. The new incremental net shadow cast by the Garage East building will reach a small portion of Boylston Street and Copley Square. The Station East building shadow will shade a portion of the Dartmouth / Boylston Street intersection as well as a small portion of sidewalk of Newbury Street and Dartmouth Street, but will not add any new shadows to Copley Square. The Station West building shadows remain entirely within the Project Site.

At 12:00 noon EST, the sun is in the southern sky and shadows are cast nearly due north. The incremental shadows cast by the Garage West building include a small portion of the northern Stuart Street sidewalk, and a small portion of the northeastern corner of Copley Square, which is already largely in shadow under the No-Build Condition. Net new shadows cast by the Garage East building, Station West building and the Station East building will land on existing buildings.

By 3:00 PM EST, the shadows cast by the No-Build Condition and the Project are long and extend in the northeast direction. The net new shadows cast by the Garage West and Garage East buildings will fall on existing building rooftops. The net new shadows cast by the Station East building will include a narrow band along Stanhope Street near its intersection with Berkeley Street. Other additional shadows will cover portions of existing buildings, and are not expected to alter pedestrian activity in the area. The Station West building shadows remain within the Project Site.

October 21st

The future No-Build and net new shadows associated with the Project on October 21st are depicted on Figure 6.2d. On October 21st the sun rises at 7:05 AM EDT and sets at 5:52 PM EDT. Expected shadows cast on this date were examined to identify the duration of Project-generated net new shadows cast on Copley Square. It is important to note that the Project has been designed to account for the 2-hour limitation collectively across all Project components. As such, only the Garage West building has any shadow impact on Copley Square. This detailed analysis identified two intervals during the morning hours where new shadows were cast on Copley Square – between 10:09 AM and 11:19 AM EDT and between 11:53 AM and 12:37 PM EDT.

At 10:09 AM EDT, the net new shadows cast by the Garage West building will enter Copley Square adjacent to Dartmouth Street approximately mid-block between Boylston Street and St. James Avenue. By 11:19 AM EDT the new shadows will be entirely behind those cast by the Fairmont Copley Plaza Hotel. The duration of new shadow cast on Copley Square at this time is limited to one hour and ten minutes.

At 11:53 AM EDT, the shadow from the Garage West building will emerge from behind the Fairmont Copley Plaza on the north side of St. James Avenue opposite Trinity Place and will last approximately 44 minutes, until 12:37 PM EDT.

The total duration of the net new shadows cast on Copley Square by the Project are expected to last approximately one hour and 54 minutes total, in compliance with the requirements specified in the Stuart Street Zoning District regulations. No net new shadows are cast on the Southwest Corridor Park.

6.4 Daylight

The following section describes the anticipated effect on daylight coverage at the Project Site as a result of the Project. An analysis of the percentage of skydome obstructed under the No-Build and Build Conditions is a requirement of Article 80 (Section 80B-2(c)). The daylight analysis was prepared using the BPDA's Daylight Analysis Program ("BRADA") and has been completed in accordance with the requirements of Article 80. The results of the analysis are presented in Figures 6.3a-c.

6.4.1 BRADA Software

The BRADA program was developed in 1985 by the Massachusetts Institute of Technology to estimate the pedestrian's view of the skydome taking into account the massing and building materials used. The software approximates a pedestrian's view of a site based on input parameters such as: location of viewpoint, length and height of buildings, and the relative reflectivity of the building facades. The model typically uses the midpoint of an adjacent right-of-way or sidewalk as the analysis viewpoint. Based on these data, the model calculates the perceived skydome obstruction and provides a graphic depicting the analysis conditions.

The model inputs were taken from a combination of the BPDA City model, an existing conditions survey, and schematic design plans prepared by the Project's architects. As described above, the BRADA software considers the relative reflectivity of building facades when calculating perceived daylight obstruction. Highly reflective materials are thought to reduce the perceived skydome obstruction when compared to non-reflective materials. For the purposes of this daylight analysis, the building facades are considered non-reflective, resulting in a conservative estimate of daylight obstruction.

6.4.2 Viewpoints

The following viewpoints were used for this daylight analysis:

- **Dartmouth Street** – This viewpoint is located on the centerline of Dartmouth Street, centered on the western side of the Project Site adjacent to the Station West Parcel.
- **Stuart Street** – This viewpoint is located on the centerline of Stuart Street between Trinity Place and Dartmouth Street along the northern side of the Project.
- **Clarendon Street** – This viewpoint is located on the centerline of Clarendon Street, centered on the eastern side of the Project adjacent to the Garage East Parcel.

These points represent existing and proposed building façades when viewed from the adjacent public way.

6.4.3 Results

Daylight Existing/No-Build Conditions

Under the Existing/No-Build Condition, a large portion of the skydome is already obstructed due to the existing structures in close proximity to the study point. The existing skydome visible based on the viewpoint, ranging from approximately 43 percent at the Dartmouth Street study point, 66 percent on the Stuart Street study point, and 71 percent at the Clarendon Street study point. As depicted in the figures, the substantial massing of the Garage and 40 Trinity building are strong contributions to the existing skydome obstructions.

Daylight Build Conditions

The Project-related daylight impacts for the viewpoints are presented in Figure 6.3a-c. Under the Proposed Conditions, the viewpoints along the three roadways are expected to experience an increase in skydome obstruction, as would be expected when increasing the height and massing on an urban site. The modest increase in skydome obstruction will be offset by substantial improvements to the public realm which are anticipated to improve the overall pedestrian experience as compared to existing conditions.

Skydome obstruction impacts are as follows:

- **Dartmouth Street** – The skydome obstructed from the Dartmouth Street study point will increase from 42.9 percent to 81.6 percent under the Garage West Base Scheme, and 85.1 percent under the Garage West Alternate Scheme, resulting from the proposed buildings on the Garage West and Station West Parcels. While the 40 Trinity building is shown in the massing diagram, the BRADA model predicts that it would not be visible from the study point due to the height and closer proximity of the Garage West building. The increased skydome obstruction resulting from Garage West building is clearly shown in Figure 6.3a.
- **Stuart Street** – The skydome obstructed at the Stuart Street study point will increase modestly from 66.4 percent to 72.0 percent resulting from the new building on the Garage West Parcel (Figure 6.3b). Neither the Station East, nor Station West buildings are visible from the study point.
- **Clarendon Street** – The skydome obstructed from the Clarendon Street study point will increase modestly from 70.7 percent to 79.1 percent at the study point resulting from the construction of the Garage East building (Figure 6.3c). The Station East building is not visible due to the massing of the Garage.

6.5 Solar Glare

The City of Boston BPDA Development Guidelines require projects undergoing Large Project Review to analyze the potential impacts from solar glare on the following areas to identify the potential for visual impairment or discomfort due to reflective spot glare:

- Potentially affected streets
- Public open spaces
- Pedestrian areas

Furthermore, projects must consider the potential for solar heat buildup in any nearby buildings receiving reflective sunlight from the Project, if applicable. Refer to Appendix K for the full Solar Glare report.

6.5.1 Analysis Software

The analysis was conducted using DIVA version 4 in the Grasshopper Parametric Modeling Platform. DIVA uses RADIANCE and DAYSIM as its daylight simulation engines. A ray tracing approach was used for the simulations.

All simulations were carried out under CIE Clear Sky which assumes no cloud cover for the simulated period. This helped identify a worst case scenario for the analysis results. The Boston Logan International Airport TMY3 weather file was used for the analysis.

6.5.2 Solar Glare Definitions

The thresholds established to determine acceptable levels of glare are as follows;

- Imperceptible glare: No glare can be perceived.
- Perceptible glare: Glare can be perceived in the scene from the specific location but does not contribute to high reflectance values and has little effect on the observer.
- Disturbing glare: Potential for after image may occur if viewer is directly in line of sight of glare source for elongated periods of time (e.g. hours).
- Intolerable glare: Potential for eye damage if viewer is directly in line of sight at the source.

6.5.3 Solar Glare Analysis Locations

Solar glare impacts were analyzed for thirteen (13) locations around the Project Site and include five (5) pedestrian, four (4) driver and four (4) adjacent building locations. See Figures 6.4a-c.

6.5.4 Solar Glare Analysis Results

Analysis results are provided in Figures 6.4a-c. Solar glare impacts are as follows;

- Of the thirteen (13) locations included in the analysis, there were no instances of intolerable glare at any of the locations.
- There were no glare issues indicated at five (5) locations and only modest glare instances at the remaining locations.

Pedestrian locations: Two of the five pedestrian locations (Locations 3 and 5) experienced no glare issues whatsoever. Of the three locations that did experience some glare (Locations 1, 2 and 4), there were only five annual instances of disturbing glare, each lasting only between one and two hours, for a total of approximately 20 hours annually. The glare experienced at these instances can easily be remedied by looking away from the point source. See figure 6.4a.

Driver locations: Three of the four driver locations (Locations 6, 8, and 9) experienced no glare issues whatsoever. Only location 7 experienced two (2) annual instances of disturbing glare, each lasting only between one and two hours, for a total of approximately 15 hours annually. The glare experienced at these instances can easily be remedied simply by looking away from the point source or turning down the internal visor in the vehicle. Additionally, any impacts will be momentary given the high speed of vehicle travel. See figure 6.4b.

Adjacent building locations: Each of the building locations (location 10, 11, 12 and 13) experienced minimal instances of disturbing glare each lasting no longer than one hour. The glare experienced at these instances can easily be remedied by utilizing internal blinds. See figure 6.4c.

6.5.5 Heat Buildup

The Project is not anticipated to cause heat buildup from solar exposure as a result of the following:

- None of the proposed buildings have curvilinear geometries.
  - According to Yang et al[2], curved envelopes could magnify sunlight in the same way as solar concentrators and cause higher thermal intensities in surrounding neighborhoods. In extreme scenarios longer exposure has melted urban elements.
- Project glazing has been established at approximately 20 percent reflectivity to minimize hazardous thermal irradiance.
- Solar glare analysis results presented in this report did not indicate any instances of intolerable glare. Drawing on the proportionate relationship between solar reflectance and thermal energy, high thermal irradiance values are therefore not anticipated.
- The location with the highest solar glare experienced was location 7 on I-90 westbound. Cars on highway are not stationary and therefore there is no anticipated heat buildup risk at this location.

6.6 Air Quality

This section presents an overview of the air quality assessment for the Project. The purpose of the air quality assessment is to demonstrate that the Project will not result in a violation of applicable local, state, and federal air quality standards. A microscale analysis was conducted to show that carbon monoxide ("CO") concentrations at study area intersections will not violate National Ambient Air Quality Standards (NAAQS). Additionally, a mesoscale analysis was performed for oxides of nitrogen ("NOx") and volatile organic compounds ("VOCs") to determine the potential impact on the regional Ozone inventory. The Project will incorporate reasonable and feasible mitigation measures to reduce VOCs and NOx emissions for the build condition, including a robust TDM program.

6.6.1 Microscale Analysis

This section presents an overview of and the results for the microscale ("hot spot") assessment conducted for the Project. The purpose of the air quality assessment is to demonstrate that the Project satisfies applicable local, state and federal requirements, and to determine whether it complies with the 1990 Clean Air Act Amendments ("CAAA") following the local and the U.S. Environmental Protection Agency ("EPA") policies and procedures.

The air quality assessment conducted for this Project includes a localized analysis of CO concentrations. The microscale analysis evaluated CO concentrations from

[2] X Yang, L Grobe1 "Simulation of Reflected Daylight From Building Envelopes", Proceedings of BS2013

vehicles traveling through congested intersections in the area around the Project Site under the existing conditions, as well as concentrations from Project-specific impacts under the future conditions. The results from this evaluation were compared to the NAAQS.

Background

The CAAA resulted in states being divided into attainment and non-attainment areas, with classifications based upon the severity of their air quality problems. Air quality control regions are classified and divided into one of three categories: attainment, non-attainment and maintenance areas depending upon air quality data and ambient concentrations of pollutants. Attainment areas are regions where ambient concentrations of a pollutant are below the respective NAAQS; non-attainment areas are those where concentrations exceed the NAAQS. A maintenance area is an area that used to be non-attainment, but has demonstrated that the air quality has improved to attainment. After 20 years of clean air quality, maintenance areas can be re-designated as attainment areas. Projects located in maintenance areas are required to evaluate their CO concentrations on the NAAQS.

The Project is located in the City of Boston, which under the EPA designation, is a CO maintenance area. As such, CO concentrations need to be evaluated for this Project.

Air Quality Standards

The EPA has established the NAAQS to protect the public health. Massachusetts has adopted similar standards as those set by the EPA. Table 6-3 presents the NAAQS for carbon monoxide.

Table 6-3 National Ambient Air Quality Standards

	Primary Standards		
Pollutant	**Averaging Time**	**Level**	**Form**
Carbon Monoxide	1-hour	35 ppm (40 mg/m^3)	Not to be exceeded more than once per year
	8-hour	9 ppm (10 mg/m^3)	

Carbon monoxide is directly emitted by motor vehicles, and the predominant source of air pollution anticipated from typical developments is emissions from project-related motor vehicle traffic. A product of incomplete combustion, CO is a colorless and odorless gas that prevents the lungs from passing oxygen to the blood stream. According to the EPA, 60 percent of CO emissions result from motor vehicle exhaust, while other sources of CO emissions include industrial processes, non-transportation fuel combustion and natural sources (i.e., wildfires). In cities, as much as 95 percent of CO emissions may come from automobile exhaust.[3]

[3] U.S. EPA. 2003. National air quality and emissions trends report – 2003 special studies edition. EPA/454/R-03/005. Research Triangle Park, NC.

The CO concentrations from motor vehicle traffic related to the Project have been calculated and reveal that the Project will comply with the NAAQS Standards.

Background Concentrations

The total CO concentrations that receptor locations will experience include background concentrations from other existing surrounding emission sources. Background concentrations are ambient pollution levels from other stationary, mobile, and area sources. The EPA and DEP maintain an air quality monitoring network and produce annual air quality reports that include monitoring data for CO. Ambient background air quality concentrations were obtained from the closest monitoring site with three years of data available, located in Kenmore Square in Boston. For CO background concentrations, DEP recommends using the largest value for the most recent three years of the second highest concentration recorded for each year.

The design background concentration values of CO using the three most recent years of data are shown in Table 6-4.

Table 6-4 Background Concentrations at Kenmore Square, Boston MA

Pollutant	Averaging Time	Background Concentration
Carbon Monoxide (CO)	1-Hour[1]	1.3 ppm
	8-Hour[1]	0.9 ppm

1 Using the highest second-high value recorded in the three most recent years (2013-2015).

BPDA Development Review Guidelines

The BPDA Development Review Guidelines require that "a microscale analysis predicting localized carbon monoxide concentrations should be performed, including identification of any locations projected to exceed the National or Massachusetts Ambient Air Quality Standards, for projects in which:

- Project traffic would impact intersections or roadway links currently operating at Level of Service D, E, or F or would cause LOS to decline to D, E, or F; or
- 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
- The Project will generate 3,000 or more new average daily trips on roadways providing access to a single location.

As presented in Chapter 4, *Transportation and Parking*, the traffic analysis indicates that the LOS at several of the study intersections will remain at or decline to D, E, or F under the build condition. As such, a microscale analysis was conducted pursuant to the BPDA Development Review Guidelines.

Microscale ("Hot Spot") Analysis Methodology

The modeling for the microscale analysis followed the EPA's guidelines. The traffic data was evaluated and locations were selected based on the requirements of the BPDA Development Review Guidelines and the EPA modeling guidance. Figure 6.6 shows the locations of the air quality study area intersections and receptors.

EPA's Office of Transportation and Air Quality ("OTAQ") has developed the Motor Vehicle Emission Simulator ("MOVES2014a"). MOVES2014a is EPA's latest motor vehicle emissions model for state and local agencies to estimate pollutants from cars, trucks, buses, and motorcycles. Emission factors were developed using the MOVES2014a program, and were combined with the traffic data in EPA's Cal3QHC model to calculate the CO worst-case concentrations. EPA's Cal3QHC is an air quality dispersion model that applies emission factors obtained from MOVES2014a to projected traffic conditions in order to obtain localized pollutant concentrations at real-world locations.

The microscale analysis utilized the traffic (volumes and speeds) and emission factor data for the 2016 Existing, 2023 No Build, and 2023 Build Conditions. These data were incorporated into air quality models and demonstrate that the Project will meet the CAAA criteria. The microscale analysis calculated CO concentrations at congested intersections near the Project Site under Existing, No Build, and Build conditions. The worst-case CO concentrations were added to the background levels to determine if the Project's concentrations complied with the NAAQS.

The microscale analysis calculates maximum 1-hour and 8-hour CO concentrations in the Project area during the peak CO season (winter). EPA's computer model CAL3QHC Version 2.0[4] was used to predict CO concentrations for each intersection. Receptor locations were selected near the congested intersections based upon areas where the public may have access. The intersection receptors were placed at the edge of the roadway, but not closer than 10 feet (3 meters) from the nearest travel lane; as required by EPA. The results calculated at these receptor locations represent the highest concentrations at each intersection (Figure 6.6). Receptor locations farther away from the intersections will have lower concentrations because of the dispersion characteristics. The receptor locations that are along other roadways in the study area are also expected to have lower concentrations than the receptor locations at the intersection. The emission rates for vehicles traveling along these roadways are much lower than the emission rates for vehicles queuing at intersections.

The air quality study evaluates the air quality impacts of the vehicular traffic associated with the Project on the environment. The vehicle traffic represents the worst-case conditions, which includes the increase in traffic volumes due to specific developments proposed for the study area, projected traffic growth over time, and future traffic associated with the Project. The air quality study utilizes traffic and

[4] User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections, US Environmental Protection Agency, Office of Air Quality Planning and Standards, Technical Support Division; Research Triangle Park, NC; EPA-454/R-92-005; November 1992

emissions data for the existing, future No-Build and future Build Conditions. These data are incorporated into the EPA air quality models to generate air pollutant concentrations that demonstrate whether or not the Project would have air quality impacts. The scenarios modeled include:

- **Existing Conditions (2016):** reflects existing traffic volumes in the traffic study area.
- **No-Build Condition (2023):** reflects background growth associated with other planned projects and general background regional growth.
- **Build Condition (2023):** assuming the 2023 No Build Condition background growth with the Project fully constructed and in operation.

Emission Rates

All the vehicle emission factors used in the microscale analysis were obtained using the EPA's MOVES2014a emissions model. MOVES2014a calculates CO emission factors from motor vehicles for free-flow conditions in grams per vehicle mile and for idling conditions in grams per vehicle hour. The emission rates used in this study were developed with the assistance of DEP. The emission factors for the microscale analysis were based upon a peak hour on a typical weekday in the winter for Suffolk County. The CO emission factors were calculated for idle and free-flow conditions based upon roadway travel speeds.

The emissions calculated for this air quality assessment include Tier 3 emission standards, which is an EPA program that sets new vehicle emissions standards, including lowering the sulfur content of gasoline, heavy-duty engine, and vehicle GHG regulations (2014-2018), and the second phase of light-duty vehicle GHG regulations (2017-2025). It also includes Massachusetts specific conditions, such as the state vehicle registration age distribution and the statewide Inspection and Maintenance ("I/M") Program. These stringent emissions regulation programs often result in smaller emissions inventories with the passage of time when comparing similar scenarios.

Traffic Data

The air quality study uses traffic data (volumes, delays, and speeds) developed for each analysis condition based upon the traffic analysis for the Project. The traffic volumes and level of-service for the study area were evaluated, and based on the BPDA Development Review Guidelines, four intersections (Figure 6.6) were selected for analysis:

- Stuart Street at Dartmouth Street
- Columbus Avenue at Arlington Street & Stuart Street
- Columbus Avenue at Dartmouth Street
- Albany Street at Herald Street

The analysis considered the evening peak hour traffic conditions as intersection volumes are generally larger and LOS is generally lower.

6.6.2 Microscale Air Quality Study Results

The microscale analysis determined that the 1-hour CO concentrations for the 2016 Existing Condition ranged from a minimum of 1.5 parts per million ("ppm") to a maximum of 1.8 ppm. The corresponding maximum 8-hour CO concentrations ranged from a minimum of 1.0 ppm to a maximum of 1.3 ppm. The microscale CO results are presented in Table 6-5 and Table 6-6. All the 1-hour and 8-hour concentrations are below the CO NAAQS of 35 and 9 ppm, respectively. These values are consistent with the area's designation as a CO Maintenance area.

The CO concentrations for each intersection under the No-Build and Build Conditions are also presented in Table 6-5 and Table 6-6. The results show that there are minimal to no increases for 1-hour and 8-hour CO concentrations between the 2023 No Build and Build conditions due to the minor traffic volume increase and minimal intersection delays experienced at the study intersections. The 1-hour CO concentrations ranged between 1.4 and 1.7 ppm, and the 8-hour CO concentrations ranged between 1.0 and 1.2 ppm for the 2023 No-Build and Build conditions. Some of the CO concentrations show a decrease from Existing to No-Build because emission rates decrease from 2016 to 2023 due to Massachusetts and Federal programs as discussed earlier in the Emission Rates section. The results of the microscale analysis demonstrate that the 2023 No Build and Build CO concentrations (both 1-hour and 8-hour values) for the Project are well below the NAAQS.

Table 6-5 Predicted Maximum 1-Hour CO Concentrations (Parts Per Million)[1, 2]

			1-Hour CO Concentrations (ppm)		
No.	**Intersection**	**Receptor[3]**	**2016 Existing**	**2023 No-Build[4]**	**2023 Build**
1	Stuart Street at Dartmouth Street	Northeast	1.5	1.5	1.5
		Southeast	1.5	1.4	1.4
		Southwest	1.5	1.4	1.4
		Northwest	1.5	1.5	1.5
2	Columbus Avenue at Arlington Street & Stuart Street	North	1.7	1.7	1.7
		Northeast	1.8	1.6	1.6
		East	1.8	1.6	1.6
		South	1.7	1.6	1.6
		Southwest	1.7	1.5	1.5
		Northwest	1.5	1.4	1.4
3	Columbus Avenue at Dartmouth Street	North	1.7	1.5	1.6
		East	1.6	1.5	1.5
		South	1.6	1.5	1.5
		West	1.8	1.6	1.6
4	Albany Street at Herald Street	East	1.8	1.7	1.7
		Southwest	1.8	1.7	1.7
		Northwest	1.5	1.5	1.5

Source: VHB, Inc.

1 See Figure 6.6 for intersection and receptor locations.
2 The concentrations are expressed in parts per million (ppm) and include a 1-hour background concentration of 1.3 ppm. The background concentration is based on the past 3 years of monitoring data collected at DEP's Kenmore Square monitoring site. The 1-hour NAAQS for CO is 35 ppm. The emissions presented represent the highest emissions experienced at each intersection.
3 Concentrations represent maximum concentrations within the grouping of receptors placed in the respective directions of each intersection.
4 The No-Build/Build Conditions represents the Garage West Base Scheme where the I-90 On-Ramp remains open (see Chapter 4, *Transportation and Parking* for additional details).

Table 6-6 Predicted Maximum 8-Hour CO Concentrations (Parts Per Million)[1, 2]

			8-Hour CO Concentrations (ppm)		
No.	Intersection	Receptor[3]	2016 Existing	2023 No-Build	2023 Build
1	Stuart Street at Dartmouth Street	Northeast	1.0	1.0	1.0
		Southeast	1.0	1.0	1.0
		Southwest	1.0	1.0	1.0
		Northwest	1.0	1.0	1.0
2	Columbus Avenue at Arlington Street & Stuart Street	North	1.2	1.2	1.2
		Northeast	1.3	1.1	1.1
		East	1.3	1.1	1.1
		South	1.2	1.1	1.1
		Southwest	1.2	1.0	1.0
		Northwest	1.0	1.0	1.0
3	Columbus Avenue at Dartmouth Street	North	1.2	1.0	1.1
		East	1.1	1.0	1.0
		South	1.1	1.0	1.0
		West	1.3	1.1	1.1
4	Albany Street at Herald Street	East	1.3	1.2	1.2
		Southwest	1.3	1.2	1.2
		Northeast	1.0	1.0	1.0

Source: VHB, Inc.
1 See Figure 6.6 for intersection and receptor locations.
2 The concentrations are expressed in parts per million (ppm) and include an 8-hour background concentration of 0.9 ppm and a persistence factor of 0.7. The background concentration is based on the past 3 years of monitoring data collected at DEP's Kenmore Square monitoring site. The 8-hour NAAQS for CO is 9 ppm. The emissions presented represent the highest emissions experienced at each intersection.
3 Concentrations represent maximum concentrations within the grouping of receptors placed in the respective directions of each intersection
4 The No-Build/Build Conditions represents the Garage West Base Scheme where the I-90 On-Ramp remains open (see Chapter, 4 *Transportation and Parking* for additional details).

Conclusion of Microscale Analysis

The air quality evaluation demonstrated that the development of the Project would not result in adverse localized air quality impacts. The microscale analysis evaluated Project-related vehicles traveling through congested intersections in the study area. This analysis demonstrates that all existing and future carbon monoxide concentrations are below the NAAQS. Specifically:

- All the one-hour CO concentrations ranged from 1.4 to 1.7 ppm and are well below the CO NAAQS of 35 ppm.
- All the eight-hour CO concentrations ranged from 1.0 to 1.2 ppm and are below the CO NAAQS of 9 ppm.

The microscale study demonstrates that the Project conforms to the CAAA and the SIP because:

- No violation of the NAAQS is expected to be created.
- No increase in the frequency or severity of any existing violations (none of which are related to this development) is anticipated to occur.
- No delay in attainment of any NAAQS is expected to result due to the implementation of the proposed action.

Based upon the analysis presented herein and the conclusions summarized above, no significant adverse air quality impacts from the Project are anticipated on the microscale level.

6.6.3 Mesoscale Air Quality Analysis

The purpose of the mesoscale analysis is to estimate the area-wide emissions of VOC and NOx during a typical day in the peak ozone season (summer) consistent with the requirements of the State Implementation Plan ("SIP"). The mesoscale analysis evaluates the change in VOC and NOx emissions from average daily traffic volumes and vehicle emission rates. To demonstrate compliance with the SIP criteria, the air quality study must show the Project's change in daily (24-hour period) VOC and NOx emissions.

DEP has established guidelines that define the modeling and review criteria for air quality studies prepared pursuant to review under the MEPA. These guidelines require that mesoscale analyses be prepared for proposed development projects to determine the change in Project-related ozone precursor emissions. The predominant source of ozone precursor emissions anticipated from the Project is emissions from Project-related traffic. Ozone is not directly emitted by motor vehicles, but is generated when VOC and NOx emissions from motor vehicles, stationary sources, and area sources react in the atmosphere with sunlight and heat. Project-related ozone impacts are determined by assessing the changes in VOC and NOx emissions of motor vehicles. DEP criteria require that proposed development projects include all reasonable and feasible emission reduction mitigation measures if the ozone emissions from the Build Condition are greater than the No Build Condition. Massachusetts has incorporated this criterion into the SIP.

Suffolk County is in attainment for all NAAQS criteria pollutants with the exception of the revoked 1997 8-hour ozone standard and the revoked 1979 1-hour ozone standard, and is a maintenance area for carbon monoxide. As such, the air quality analysis calculated emission inventories of the two pollutants that contribute to the violation of the revoked ozone NAAQS from mobile sources-VOC and NOx.

The mesoscale analysis evaluated the change in emissions from Project-related traffic for the Existing, No Build, and Build Conditions. The air quality analysis demonstrates that the Project will meet DEP air quality criteria through reasonable and feasible emission reduction mitigation measures. While the Build Condition VOC and NOx emissions are estimated to increase as compared to the No Build Condition, the Project will be implementing such mitigation measures (including a TDM program and roadway improvements) that will reduce VOC emissions and NOx emissions resulting in less Project-related emissions than under the Build Condition without mitigation.

Mesoscale Analysis Methodology

The ozone mesoscale air quality analysis was conducted following procedures similar to the GHG mobile source analysis, presented in Chapter 5, *Sustainability and Greenhouse Gas Emissions Assessment*.

The mesoscale analysis evaluated the change in emissions with and without the Project, specifically, daily (24-hour period) VOC and NOx emissions from the average daily traffic volumes and vehicle emission rates. DEP guidelines require that the air quality study utilize traffic and emissions data for existing and future (No Build and Build) conditions. The traffic and emissions data are incorporated into the EPA and DEP air quality models to generate emission's estimates that demonstrate whether the Project will have air quality impacts.

The mesoscale air quality analysis utilized developed traffic data (volumes, speeds, and roadway geometry) and emission factor data for Existing, No-Build, and Build Conditions. The mesoscale study area is similar to the study area used in the transportation analysis. Some of the major roadways that were included in the mesoscale analysis include Dartmouth Street, Clarendon Street, Arlington Street, Columbus Avenue, St. James Avenue, Boylston Street, and Herald Street.

The mesoscale analysis calculated the changes in VOC and NOx emissions for the existing and future conditions within the study area. The mesoscale analysis traffic and emission factor data were developed for the three aforementioned conditions. These data were incorporated into air quality models to evaluate the changes in VOC and NOx emissions.

Modeling Methodology & Emission Rates

All the vehicle emissions used in the mesoscale analysis model were obtained using EPA's MOVES2014a emissions model. MOVES2014a calculates emission factors from motor vehicles in mass per distance format (often grams per mile) for the analysis year and applies these factors to Vehicle Miles Travelled ("VMT") data to obtain emissions inventories. The emissions calculated for this air quality assessment include Tier 3 emission standards and vehicle GHG regulations (2014-2018), and the second phase of light-duty vehicle GHG regulations (2017-2025) as well as Massachusetts specific conditions. These stringent emissions regulation programs

often result in smaller emissions inventories with the passage of time when comparing similar scenarios.

The MOVES2014a model was run at a project-level to obtain emission factors for each link of the mesoscale analysis. The model was set to calculate the emissions burden by choosing to model emissions processes that are specifically related to vehicles in the study area. Links were created that used the appropriate speeds and grades for each roadway segment.

Traffic Data

The air quality study used traffic data (volumes) developed for each analysis condition. The mesoscale analysis uses typical daily peak and off-peak traffic volumes for the ozone summer season. The VMT data used in the air quality analysis were developed based on the traffic data analyzed in this report, see *Chapter 4, Transportation and Parking*. The analysis presents two overarching scenarios that are reflective of the transportation study – one in which the I-90 Westbound On-Ramp at Clarendon Street remains open in the future condition (Base Scenario-On-Ramp Open) and the other in which the On-Ramp is closed (Alternate Scenario-On-Ramp Closed).

6.6.4 Mesoscale Air Quality Study Findings

Existing Mesoscale Emissions

The mesoscale analysis calculated the existing VOC and NOx emissions for the study area inventory. These emissions, estimated to be 80.5 kilograms per day (kg/day) of VOCs and 52.1 kg/day of NOx establish an Existing Condition to which future emissions can be compared. The Existing Condition is the same for both the Base and Alternate Ramp Scenarios.

Future Mesoscale Emissions

Future Project-related emission calculations are based upon changes in traffic, delay, and emission factor data. The traffic data includes traffic volumes that were used to calculate VMT on the study network and delays. The emission factor data included emission reduction programs, shifts in vehicle type populations, and other factors. Under the Base Scenario No-Build Condition, VOC emissions were estimated to be 68.1 kg/day and NOx emissions were estimated to be 24.6 kg/day. Under the Alternate Scenario No-Build Condition, VOC emissions were estimated to be 68.3 kg/day and NOx emissions were estimated to be 24.6 kg/day. The 2023 VOC and NOx emissions are lower than the 2016 emissions due to the implementation of emission control programs, such as the Federal Motor Vehicle Emission Control Program (Tier 3), the Stage II Vapor Recovery System, and the Massachusetts Vehicle Inspection and Maintenance program.

Under the Base Scenario Build Condition, as presented in Table 6-7, the VOC emissions are estimated to be 71.1 kg/day and the NOx emissions are estimated to

be 26.0 kg/day. Under the Alternate Scenario Build Condition, the VOC emissions are estimated to be 71.1 kg/day and the NOx emissions are estimated to be 26.0 kg/day. The SIP requires that Projects with VOC and NOx emissions under the Build Condition that are greater than the No-Build Condition include all reasonable and feasible emission reduction measures. The mitigation measures include a TDM Program, roadway improvements, and signal timing optimization presented in Chapter 4, *Transportation and Parking* and summarized in the Proposed Mitigation Measures section below.

Table 6-7 Mesoscale Air Quality Analysis Results (kg/day)

Pollutant	Scenario	2016 Existing Conditions	2023 No-Build Conditions[1]	2023 Build Conditions	Project-related Emissions[2]
Volatile Organic Compounds (VOCs)	Base (Ramp Open)	80.5	68.1	71.1	3.0
	Alternate (Ramp Closed)	80.5	68.3	71.1	2.8
Oxides of Nitrogen (NOx)	Base (Ramp Open)	52.1	24.6	26.0	1.4
	Alternate (Ramp Closed)	52.1	24.6	26.0	1.4

1 The future no build condition emissions are lower than the existing conditions emissions due to the implementation of state and federal emission control programs, such as the Federal Motor Vehicle Emission Control Program (Tier 3) and the Stage II Vapor Recovery System, and the Massachusetts Inspection and Maintenance program.

2 Represents the difference in emissions between the Build and No-Build Conditions.

Proposed Mitigation Measures

The mobile source mesoscale assessment calculated the emissions for Project-related mobile sources. A comprehensive TDM program and roadway improvements to the surrounding traffic network have been developed to mitigate impacts of Project-related traffic.

The Proponent is committed to a comprehensive TDM program that will shift single occupancy vehicle trips to alternate modes of transportation. Details of this program are provided in Chapter 4*, Transportation and Parking*. Implementation of the TDM program is expected to improve air quality in the study area by promoting the use of alternate forms of transportation over the use of single-occupant motor vehicle trips to the Project Site. Although not easily modeled, previous estimates of similar TDM programs in an urban area have ranged on the order of two (2) percent reduction in Vehicle Miles Travelled from the Project generated trips. Assuming a similar relationship to VOCs and NOx emissions, this would correlate to an approximate reduction of 0.06 kg/day of VOCs and 0.03 kg/day of NOx under both the Base and Alternate Ramp Scenarios.

Additionally, the Proponent is proposing to make multiple roadway improvements throughout the network. These improvements include:

- Optimize signal timings at the intersections of Columbus Avenue/Dartmouth Street, Columbus Avenue/Clarendon Street, Arlington Street/Stuart Street, Clarendon Street/Stuart Street, and Stuart Street/Trinity Place (Alternate Scenario Only);
- Further study the feasibility of signalizing the intersections at Clarendon Street/Stanhope Street and St James Avenue/Trinity Place;
- Convert the existing Clarendon Street southbound parking lane to a left-turn only travel lane at the intersection of Clarendon Street and Columbus Avenue; and
- Further study of the feasibility of converting circulation on Trinity Place to northbound only between Stuart Street and St. James Avenue.

A full description of these improvements is provided in Chapter 4*, Transportation and Parking*. These roadway improvements result in delay savings and consequentially a 0.8 kg/day reduction of VOCs and a 0.8 kg/day reduction of NOx in the Base Ramp Scenario. A 0.6 kg/day reduction of VOCs and a 0.7 kg/day reduction of NOx is mitigated in the Alternate Ramp Scenario. This results in a final Project-related emissions of 2.2 kg/day of VOCs and 0.6 kg/day of NOx for the Base Ramp Scenario and 2.1 kg/day of VOCs and 0.6 kg/day of NOx for the Alternate Ramp Scenarios. A summary of the mitigation emissions reduction is seen in Table 6-8.

Table 6-8 Mitigation Analysis Results (kg/day)

Pollutant	Scenario	Project-related Emissions[1]	Estimated Reductions Due to TDM Measures[2]	Estimated Reductions Due to Roadway Improvements[3]	Resulting Project-related Emissions
Volatile Organic Compounds (VOCs)	Base (Ramp Open)	3.0	-0.06	-0.8	2.2
	Alternate (Ramp Closed)	2.8	-0.06	-0.6	2.1
Oxides of Nitrogen (NO_x)	Base (Ramp Open)	1.4	-0.03	-0.8	0.6
	Alternate (Ramp Closed)	1.4	-0.03	-0.7	0.6

1 Represents the difference in CO_2 emissions between the Build and No-Build Conditions.
2 Mitigation from TDM Measures estimated as 2 percent of unmitigated Project-related emissions.
3 Mitigation from roadway improvement measures, such as signal optimization and physical roadway changes.

Conclusion of Mesoscale Analysis

The air quality assessment demonstrates that the Project complies with local, state, and federal air quality requirements on a mesoscale level. The air quality assessment demonstrates that the Project complies with CAAA and is consistent with the guidelines of DEP, and the Project will incorporate reasonable and feasible measures to reduce VOC and NOx emissions in the ozone mesoscale analysis. The implementation of these mitigation measures will reduce the Build Condition VOC and NOx emissions associated with the Project.

6.7 Noise Analysis

The noise assessment evaluated existing ambient sound levels and the potential noise impacts associated with the Project's activities, including mechanical equipment and loading activities. This section discusses the fundamentals of noise, noise impact criteria, noise analysis methodology, and potential noise impacts. A noise monitoring program was developed for determining existing ambient conditions in the vicinity of the Project Site. The analysis demonstrates that the Project will comply with City of Boston noise regulations and the U.S. Department of Housing and Urban Development's (HUD's) noise goals.

6.7.1 Noise Fundamentals

Noise is defined as unwanted or excessive sound. Sound becomes unwanted when it interferes with normal activities such as sleep, communication, work or recreation. How people perceive sound depends on several measurable physical characteristics, which include the following:

- Intensity - Sound intensity is often equated to loudness.
- Frequency - Sounds are comprised of acoustic energy distributed over a variety of frequencies. Acoustic frequencies, commonly referred to as tone or pitch, are typically measured in Hertz. Pure tones have all their energy concentrated in a narrow frequency range.

Sound levels are most often measured on a logarithmic scale of decibels (dB). The decibel scale compresses the audible acoustic pressure levels, which can vary from the threshold of hearing (zero dB) to the threshold of pain (120 dB). Because sound levels are measured in dB, the addition of two sound levels is not linear. Adding two equal sound levels creates a 3 dB increase in the overall level. Research into the general relationships between sound level and human perception indicates that a 3 dB increase is a doubling of acoustic energy and is the threshold of perceptibility to the average person, and that a 10 dB increase is a tenfold increase in acoustic energy, but is perceived as a doubling in loudness to the average person.

The human ear does not perceive sound levels from each frequency as equally loud. To compensate for this phenomenon in perception, a frequency filter known as A-weighted [dB(A)] is used to evaluate environmental noise levels. Table 6-9 presents a list of common outdoor and indoor sound levels.

Table 6-9 Common Outdoor and Indoor Sound Levels

Outdoor Sound Levels	Sound Pressure (μPa)[1]		Sound Level dB(A)[2]	Indoor Sound Levels
	6,324,555	-	110	Rock Band at 5 m
Jet Over Flight at 300 m		-	105	
	2,000,000	-	100	Inside New York Subway Train
Gas Lawn Mower at 1 m		-	95	
	632,456	-	90	Food Blender at 1 m
Diesel Truck at 15 m		-	85	
Noisy Urban Area—Daytime	200,000	-	80	Garbage Disposal at 1 m
		-	75	Shouting at 1 m
Gas Lawn Mower at 30 m	63,246	-	70	Vacuum Cleaner at 3 m
Suburban Commercial Area		-	65	Normal Speech at 1 m
	20,000	-	60	
Quiet Urban Area—Daytime		-	55	Quiet Conversation at 1 m
	6,325	-	50	Dishwasher Next Room
Quiet Urban Area—Nighttime		-	45	
	2,000	-	40	Empty Theater or Library
Quiet Suburb—Nighttime		-	35	
	632	-	30	Quiet Bedroom at Night
Quiet Rural Area—Nighttime		-	25	Empty Concert Hall
Rustling Leaves	200	-	20	
		-	15	Broadcast and Recording Studios
	63	-	10	
		-	5	
Reference Pressure Level	20	-	0	Threshold of Hearing

Source: *Highway Noise Fundamentals*. Federal Highway Administration, September 1980.

1 μPA – MicroPascals, which describe pressure. The pressure level is what sound level monitors measure.

2 dB(A) – A-weighted decibels, which describe pressure logarithmically with respect to 20 μPa (the reference pressure level).

A variety of sound level indicators can be used for environmental noise analysis. These indicators describe the variations in intensity and temporal pattern of the sound levels. The following is a list of the most common sound level descriptors:

- L90 is the sound level which is exceeded for 90 percent of the time during the time period. The L90 is generally considered to be the ambient or background sound level.
- Leq is the A-weighted sound level, which averages the background sound levels with short-term transient sound levels and provides a uniform method for comparing sound levels that vary over time.

› Ldn or DNL is the day-night average sound level representative of a 24-hour period with a penalty adjustment for sound levels occurring between 10:00 PM and 7:00 AM.

6.7.2 Methodology

The noise analysis evaluated the potential noise impacts associated with the Project's operations, which include mechanical equipment and loading/service activities. The noise analysis included measurements of existing ambient background sound levels and an evaluation of potential noise impacts associated with the proposed mechanical equipment (e.g., HVAC units, cooling tower, etc.) and loading activities. The study area was evaluated and sensitive receptor locations in the vicinity of the Project were identified and examined. The Project Site layout and building design, as it relates to the loading areas and management of deliveries at the Project Site were also considered. The analysis considered sound level reductions due to distance, proposed building design, and obstructions from surrounding structures. The majority of the equipment associated with the proposed buildings on the Garage West, Garage East, and Station East parcels are located within fully enclosed mechanical penthouses at the roof level of each building. Additionally, there will also be some equipment, such as transformers and electrical switch gears, located within mechanical rooms at lower levels which will have louvers where ventilation is necessary. As such, the sound level impacts associated with these three buildings are considered negligible as the mechanical room and penthouse structures will attenuate the noise associated with the equipment. The quantitative noise analysis, therefore, focused on equipment that is associated with the Station West parcel, which consists of equipment not located within a fully enclosed mechanical penthouse.

In addition, the noise study includes an assessment of potential impacts on the proposed residential use. The assessment followed HUD guidelines and procedures outlined in The Noise Guidebook (Guidebook)[5]. The noise study utilized HUD's Day-Night Noise Level (DNL) Calculator, which is a model used to calculate the DNL associated with roadway traffic and rail sources. The DNL Calculator takes into consideration traffic volume, travel speed, and the distance between the receptor and noise source.

6.7.3 Noise Impact Criteria

The City of Boston and the United States Department of Housing and Urban Development (HUD) have developed noise impact criteria that establish noise thresholds deemed to result in adverse impacts. The noise analysis for the Project compared existing and future sound levels to these criteria and determined whether or not the Project will generate noise impacts at sensitive receptor locations in the

[5] Section 51.103, The N*oise Guidebook,* U.S. Department of Housing and Urban Development, Office of Environment and Energy.

vicinity of the Project or will be impacted by the nearby transportation facilities (I-90 and MBTA commuter rail).

6.7.3.1 City of Boston Noise Impact Criteria

The City of Boston has developed noise standards that establish noise thresholds deemed to result in adverse impacts. Under Chapter 40, Section 21 of the General Laws of the Commonwealth of Massachusetts and Title 7, Section 50 of the City of Boston Code, the Air Pollution Control Commission of the City of Boston has adopted Regulations for the Control of Noise in the City of Boston. These regulations establish allowable sound levels based upon the land use affected by a proposed development. Table 6-10 summarizes the allowable sound levels that should not be exceeded.

Table 6-10 City of Boston Noise Standards by Zoning District

Land Use Zone District	Daytime (7:00 AM – 6:00 PM)	All Other Times (6:00 PM – 7:00 AM)
Residential	60 dB(A)	50 dB(A)
Residential/Industrial	65 dB(A)	55 dB(A)
Business	65 dB(A)	65 dB(A)
Industrial	70 dB(A)	70 dB(A)

Source: Regulations for the Control of Noise in the City of Boston, Air Pollution Control Commission.

With a mix of residential and commercial uses in the vicinity of the Project Site, the assessment focused on the noise standards for a residential zoning district as it is the more stringent criteria. As shown in Figure 6.5, the existing more sensitive receptors in proximity to the Project Site include the Tent City Apartments (130 Dartmouth Street), the residences at One Back Bay Apartments (135 Clarendon Street), the YWCA/Hotel 140 (140 Clarendon Street), 285 Columbus Avenue, and the planned residences at 40 Trinity. Residential receptor locations would be considered impacted if experiencing sound levels exceeding 60 dB(A) during the daytime periods (7:00 AM to 6:00 PM) and 50 dB(A) during the nighttime conditions (6:00 PM to 7:00 AM). The noise analysis for the Project used these standards to evaluate existing conditions. These standards were also used to evaluate if the Project will generate sound levels that result in adverse impacts.

6.7.3.2 HUD Noise Impact Criteria

The HUD standard is intended to protect residential receptor locations from noise sources, such as highways, rail lines, and airports that may cause interference with normal activities, such as sleep and conversation. The HUD Guidebook states that a noise assessment is required if a proposed residential development is located within 15 miles of an airport, within 3,000 feet of a railway, or within 1,000 feet of a major roadway. The Project Site is located within all of these threshold distances.

HUD uses a day-night average sound level (DNL or Ldn) as the value for establishing goals for determining acceptable sound levels. The DNL levels are based on a

multitude of factors and provide a noise indicator of a 24-hour weighted average sound level. The DNL is derived from hourly sound level values and includes a nighttime penalty that accounts for increased annoyance during these hours. Studies have shown that additional annoyance occurs during the nighttime since background sound levels are typically at their minimum and many people are noise sensitive while trying to sleep.

HUD considers a DNL of 65 db or lower as an acceptable exterior sound level and 45 db as an acceptable interior goal. Exterior sound levels above 65 db but not exceeding 75 db is normally unacceptable. However, a waiver may be granted if noise attenuation measures (such as noise barriers and/or special building construction material) are provided. HUD considers exterior sound levels above 75 db to be unacceptable. Residential buildings are constructed such that the walls are expected to reduce the outdoor sound levels by a minimum of 20 db. Therefore, indoor sound levels for residential buildings of 45 db or less are considered acceptable.

6.7.3.3 Receptor Locations

The noise analysis included an evaluation of the study area to identify nearby sensitive receptor locations, which typically include areas of sleep and areas of outdoor activities. The noise analysis identified five nearby off-site sensitive receptor locations in the vicinity of the Project (R1, R2, R3, R4, and R5). In addition, the analysis also considered the proposed office building at the Garage West Parcel and residential buildings at the Garage East and Station East Parcels (R6, R7, and R8). As shown in Figure 6.5 the receptor locations include the following:

- R1 – Tent City Apartments (130 Dartmouth Street);
- R2 – One Back Bay Apartments (135 Clarendon Street);
- R3 – YWCA/Hotel 140 (140 Clarendon Street);
- R4 – 285 Columbus Avenue;
- R5 – Planned residences at 40 Trinity and Copley Place;
- R6 – Proposed Garage West Building;
- R7 – Proposed Garage East Building; and
- R8 – Proposed Station East Building.

6.7.4 Existing Noise Conditions

A noise monitoring program was conducted to establish existing ambient conditions. The existing sound levels were measured using a Type 1 sound analyzer (Larson Davis 831). Measurements were conducted at two locations on January 14, 2015; Dartmouth Street south of Stuart Street and Clarendon Street south of Stuart Street, as shown in Figure 6.5. Measurements were conducted between 10:00 AM and 11:00 AM to represent a typical weekday daytime period and between 4:00 AM and 5:00 AM to represent the nighttime period. The existing measured sound level data are summarized in Table 6-11.

Table 6-11 Existing Measured L90 Sound Levels, dB(A)

	City of Boston Residential District Noise Criteria		Measured Leq. Sound Levels	
Monitoring Locations	**Daytime**	**Nighttime**	**Daytime**	**Nighttime**
M1 – Dartmouth Street	60	50	61	52
M2 – Clarendon Street	60	50	70	54

Source: VHB, Inc.

The measured L90 sound levels range from approximately 61 dB(A) to approximately 70 dB(A) during the daytime period and from approximately 52 dB(A) to approximately 54 dB(A) during the nighttime period. These sound levels are representative of a typical active urban area. The results of the noise monitoring program indicate that the existing sound levels within the study area are currently slightly above the City of Boston's daytime standard of 60 dB(A) and nighttime standard of 50 dB(A). Based on field observations, the dominant noise sources included vehicular traffic traveling along the local roadways and I-90. In addition, noise from mechanical equipment operating at nearby buildings was also audible even though masked by the traffic noise.

6.7.5 Project Noise Analysis

The noise analysis evaluated the potential noise impacts associated with the Project's proposed mechanical equipment and loading activities. The analysis determined the potential sound level impacts at the nearby sensitive receptor locations and the proposed residential uses.

6.7.5.1 Mechanical Equipment

Since the Project is in the early stages of the design process, the specific details of the final selection of mechanical equipment are not known at the time of this noise assessment. However, based on preliminary design plans, the anticipated mechanical equipment associated with the Project may include the following:

- Cooling tower,
- Energy recovery units,
- Exhaust fans,
- Make up air handling units,
- Boilers,
- Pumps,
- Air cooled condensers; and
- Emergency generator.

The majority of the mechanical equipment associated with the proposed buildings on the Garage West, Garage East, and Station West Parcels will be located on the rooftops of the proposed building, utilizing the heights of the buildings in providing

noise attenuation. Additionally, equipment will be located either within fully enclosed mechanical penthouses on the roof or within mechanical rooms at lower levels. As such, the sound levels associated with the Project's mechanical equipment on these three buildings would be attenuated by the structure and are expected to be negligible. The sound levels associated with these three proposed buildings' rooftop mechanical equipment would not contribute to the overall existing sound levels at the surrounding sensitive receptor locations.

The mechanical equipment associated with the building on the Station West Parcel consists of boilers and pumps that will be located within a fully enclosed mechanical penthouse on the low roof of the Station. However, there will also be energy recovery units and a cooling tower that located on the roof top, external to the mechanical penthouse but behind a screen wall. The mechanical penthouse structure will attenuate sound levels associated with the equipment housed in the mechanical room. The attenuated sound levels are considered negligible and would not contribute to the overall existing sound levels at the surrounding sensitive receptor locations. As for the equipment located externally behind the screen wall, there are some minor potential noise impacts associated with this equipment.

A quantitative analysis was conducted for this external equipment using the manufacturer's specifications provided by the mechanical engineer. The reference sound level data for the rooftop mechanical equipment were analyzed using the industry accepted noise modeling program CadnaA. The sound levels associated with the equipment were projected to the receptor locations using the properties of sound propagation following the ISO 9613 methodology[6]. These sound levels were adjusted to reflect the distances to the sensitive receptor locations, propagation path, and applicable blockages (such as building structures). The calculated sound levels, presented in Table 6-12, represent the exterior sound levels at the nearby sensitive receptor locations.

[6] ISO 9613-2:1996 "Acoustics-Attenuation of sound during propagation outdoors-Part: 2" *International Organization for Standardization*. Reviewed 2012.

Table 6-12 Future External Sound Levels, dB(A)

	Existing Sound Levels		Project Generated Sound Levels	Future Sound Levels		Change in Sound Levels	
Receptor Location	**Daytime**	**Nighttime**	**Day/Night**	**Daytime**	**Nighttime**	**Daytime**	**Nighttime**
R1 – Tent City Apartments	61	52	37	61	52	+0	+0
R2 – One Back Bay Apartments	70	54	26	70	54	+0	+0
R3 – YWCA/Hotel 140	70	54	28	70	54	+0	+0
R4 – 285 Columbus Avenue	70	54	35	70	54	+0	+0
R5 – 40 Trinity/Copley Place	70	54	34	70	54	+0	+0
R6 – Garage West	70	54	45	70	55	+0	+1
R7 – Garage East	70	54	46	70	55	+0	+1
R8 – Station East	70	54	44	70	55	+0	+1

Source: VHB, Inc.

The Project-generated sound levels are expected to be the same during both daytime and nighttime periods, as the equipment are assumed to be operating at full load during both daytime and nighttime periods. As shown in Table 6-12, the overall project-generated sound levels due to rooftop equipment ranged from approximately 21 dB(A) to 46 dB(A) at the nearby receptor locations. The cumulative sound levels, with existing ambient sound levels and the operation of the rooftop equipment, are expected to range from 61 dB(A) to 70 dB(A) during the daytime and 52 dB(A) to 55 dB(A) during the nighttime.

The operation of the anticipated rooftop equipment will not increase existing daytime sound levels. The nighttime sound levels will increase by a maximum of approximately 1 dB(A) over the existing nighttime sound levels. This increase is considered negligible and will not result in a perceptible difference to the average human ear as this increase is less than 3 dB(A). In addition, this minor increase only occurs within the Project Site. Existing off-site sensitive receptor locations experience no change in daytime sound levels as a result of the Project.

6.7.5.2 Service and Loading Activities

Daily loading and service activities associated with the proposed residential buildings are expected to consist of small delivery/service vehicles (such as FedEx/UPS vans). Loading activities are expected to occur in designated loading areas at each proposed building. Loading for the residential units, which will predominantly be moving-related activities, will be accommodated at covered loading areas at each building. Deliveries associated with proposed retail uses may consist of single unit trucks. Retail and office space uses will be served by covered loading areas within each building. Loading activities will be managed so that service and loading operations do not impact traffic on the adjacent roadways. Since loading activities will primarily be enclosed and will be managed, potential noise

impacts to nearby sensitive receptor locations are expected to be negligible and to comply with the City's noise standards.

6.7.5.3 Impacts on Proposed Residential Use

HUD requires a noise assessment of noise sources that are located within certain distances of major transportation facilities, such as major roadways, rail lines, and airports. The Project is located approximately:

- 2.5 miles from Logan International Airport,
- 135 feet to 235 feet from I-90,
- 185 feet to 245 feet from MBTA Orange Line and commuter rail service.

Based on HUD procedures and guidelines, the Project is located nearby major transportation facilities, therefore, the noise analysis evaluated noise associated with these facilities.

The noise evaluation gathered noise contour information associated with Logan Airport from Massport, traffic data from MassDOT's Transportation Data Management System, and train data from the MBTA schedules. The analysis was conducted using HUD's DNL Calculator for determining the sound levels at the Project Site. The Project is a mixed-use development consisting of four parcels (Garage West, Garage East, Station East, and Station West). The noise assessment focused on the two residential buildings located closest to the noise sources (Garage East and Station East).

The noise assessment reviewed the noise contours developed for Logan Airport. In addition, traffic traveling on I-90 was considered as it is located in the vicinity of the Project Site. The Garage East building is located approximately 135 feet from I-90, and the Station East building is located approximately 235 feet from I-90. The assessment also considered rail activities associated with the MBTA rapid transit Orange Line and commuter rail, which is located approximately 185 feet from the Garage East building and 245 feet from the Station East building. Table 6-13 summarizes the traffic data assumed for the analysis. Table 6-14 summarizes the train information assumed for the analysis.

Table 6-13 Traffic data on I-90

	Interstate 90 (MassPike)		
Vehicle Type	Cars	Medium Trucks	Heavy Trucks
Effective Distance to Garage East	135 ft.	135 ft.	135 ft.
Effective Distance to Station East	235 ft	235 ft	235 ft
Average Speed	55 mph	55 mph	55 mph
Average Daily Trips (ADT)	139,710	7,358	2,996
Night Fraction of ADT	16%	16%	16%
Road Gradient	1%	1%	1%

Table 6-14 Train Information

Orange Line	
Train Type	Electric
Effective Distance to Garage East	185 ft
Effective Distance to Station East	245 ft
Average Train Speed	30 mph
Engines Per Train	1
Railway Cars Per Train	8
Average Train Operations (ATO)	285 trains per day
Night Fraction of ATO	20%
Commuter Rail	
Train Type	Diesel
Effective Distance to Garage East	185 ft
Effective Distance to Station East	245 ft
Average Train Speed	30 mph
Engines Per Train	1
Railway Cars Per Train	8
Average Train Operations (ATO)	196 trains per day
Night Fraction of ATO	20%

Based on the noise contours developed for Logan Airport, the Project Site is located beyond the 60 dB DNL contour, and therefore not considered to be impacted by aircraft activities associated with Logan Airport. The results from the DNL Calculator indicate that the Garage East residential building will experience an overall exterior DNL of approximately 79 db associated with nearby major roadways and rail activities. The Station East building will experience an overall DNL of approximately 76 db associated with the nearby transportation facilities. These levels are greater than HUD's exterior goal of 65 db. With levels greater than HUD's threshold, the Project will require noise attenuation measures to minimize the impacts. The facades of the proposed buildings abutting the I-90 and the rail lines will be designed to incorporate noise attenuating building material that will reduce interior sound levels below HUD's interior goal of 45 dB(A). The interior goal of 45 dB(A) is achievable by using building materials that provide a minimum of approximately 34 dB(A) of noise attenuation for the Garage East residential units, and approximately 31 dB(A) for the Station East residential units. These levels of reduction are considered achievable since general construction materials typically provide approximately 20 dB(A) of reduction. The additional reduction could be achieved with different building techniques and/or material with greater acoustical properties. The exterior sound levels and the necessary attenuation level for the two residential buildings are shown in Table 6-15.

Table 6-15 Proposed residential unit sound levels, DNL

Building	Overall Exterior Sound Level (dB)[1]	Minimum Required Attenuation Level (dB(A)[2]
Garage East	79	34
Station East	76	31

1 Calculation conducted with online HUD DNL Calculator available at https://www.hudexchange.info
2 Sound level reduction necessary to meet HUD's interior goal of 45 dB(A).

6.7.6 Conclusion of Noise Assessment

The noise assessment determined that the sensitive receptor locations in the vicinity of the Project Site currently experience sound levels exceeding the City of Boston's nighttime noise criteria. With much of the proposed equipment located within mechanical penthouses on the rooftop of each Project Component, the sound levels associated with the Project's mechanical equipment are expected to have no adverse noise impacts at nearby sensitive receptor locations. While potential noise impacts associated with the emergency generators are also expected to be negligible, a separate MassDEP permitting process will allow for further review of this equipment at a later date. The Project will be designed such that the loading areas will be enclosed within the proposed building structures, therefore containing noise associated with loading activities. As a result of the preliminary design, the Project's operations will have no adverse noise impacts at nearby sensitive receptor locations, and will adhere to the City of Boston's Noise Standards as the project-generated sound levels are below the City's standards.

The noise assessment also demonstrates that the proposed residential buildings abutting major roadways and rail lines will experience exterior sound levels above HUD's noise goals. However, with the appropriate building material, the Project would meet the HUD indoor noise goals. During the design process, the residential buildings will incorporate sufficient acoustical material with the appropriate sound transmission class rating to achieve HUD's indoor noise goal of 45 dB(A).

6.8 Groundwater

Groundwater levels in the vicinity of the Site are monitored by the Boston Groundwater Trust ("BGwT") in observation wells typically located in the public sidewalks. Groundwater levels reported by the BGwT in wells near the Site between 1999 and 2015 have ranged from Elevation two (2) to Elevation Seven (7) above the Boston City Base ("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. The potential for groundwater impacts at the Project Site is limited by the small amount of terra firma affected and no impacts are anticipated due to the lack of substantive excavation proposed. As discussed further in Chapter 7, *Infrastructure*, the Project Site is located

within the GCOD, and will therefore provide a recharge system designed to infiltrate clean runoff and replenish the groundwater table to the extent feasible.

6.9 Hazardous Materials

The Proponent conducted an ASTM Phase I Preliminary Site Assessment for the Project area in January 2015, specifically at the existing Garage and Station. No chemical testing of soil or groundwater was conducted as part of this assessment, as is typical for Phase I assessments. No previous data on soil and groundwater quality was discovered during the assessment. Prior to construction of the Garage, historic uses of the property included a print shop, bowling alley, railroad right-of-way, railroad station, and auto repair garages. The Station site has been occupied by various railroad stations since the 1800's.

No reported releases of oil or hazardous materials have occurred within the limits of the Project Site. Portions of the Project Site are underlain by urban fill, which is ubiquitous throughout Boston. As is typical of this material, it is anticipated that the urban fill will be impacted by metals, PAHs, petroleum hydrocarbons, and other compounds at concentrations above Massachusetts Contingency Policy ("MCP") Reportable Concentrations. Elevated concentrations of petroleum hydrocarbons, volatile organic compounds ("VOCs"), polycyclic aromatic hydrocarbons ("PAHs"), and metals have been detected in soil at parcels adjacent to the Project Site. The constituents are associated with historic use from the area's former and current railway activities and historic site filling.

The Garage is listed as a Resource Conservation and Recovery Act Conditionally Exempt Small Quantity Generator ("RCRA-CESQG") of ignitable hazardous wastes. According to previous reports this hazardous waste generation was in connection with John Hancock's reproduction/graphics department formerly located at the Garage. Violations were not identified in connection with hazardous waste generation at the Project Site. The hazardous waste generator designation is not anticipated to adversely affect the Project Site based on the current RCRA-CESQG status and the lack of RCRA generator violations and releases associated with this status.

Back Bay Dry Cleaners, a tenant located along Dartmouth Street on the ground floor of the Station, is listed on the US Historic Cleaner database (2002-2012) and Drycleaner databases (present day). The listing on the Drycleaner database indicated the following about the dry cleaning facility: "Classification Type: Non-applicability classification – still in business but not using perc [tetrachloroethylene]." On December 5, 2014, Haley & Aldrich interviewed Back Bay Dry Cleaner personnel about their on-site operations. Personnel stated that no dry cleaning was conducted on-site and that the facility operated solely as a drop-off/pick-up location. Based on current operations, and the lack of reported releases associated with the dry cleaning business, Back Bay Dry Cleaners is not anticipated to adversely affect the Project Site.

In accordance with normal practices, the Proponent will be conducting testing to characterize and classify the soil to be generated from foundation spoils, for off-site removal to appropriate facilities. Materials excavated during construction of the Project will be managed in accordance with applicable regulatory requirements including, if necessary, a Release Abatement Measure ("RAM") Plan under the MCP.

6.10 Geotechnical

6.10.1 Site Conditions

The Project Site is abutted by 40 Trinity, University Club, the YWCA Building and Stuart Street to the north; 131 Dartmouth Street and 285-287 Columbus Avenue to the south; Copley Place Mall and Dartmouth Street to the west; and 33-35 Stanhope Street, 131 Clarendon Street and Clarendon Street to the east. Below-grade structures that are located adjacent to and below the Project Site include: I-90, MBTA Orange Line and Commuter Rail lines, and Amtrak rail lines.

Buildings in the vicinity of the Project Site are supported on a variety of foundation systems, including deep end-bearing concrete drilled shafts and H-piles bearing in glacial deposits or bedrock, and wood piles and belled concrete caissons founded in the upper marine clay. Municipal utilities are present beneath surrounding streets and sidewalks.

6.10.2 Subsurface Soil and Bedrock Conditions

Based on available subsurface data, subsurface soil strata present at the Project Site are listed below in Table 6-13, in order of increasing depth below ground surface:

Table 6-16 Subsurface Conditions

Generalized Strata	Approx. Range in Thickness (ft)
Miscellaneous Fill	7 to 37
Organic Deposits	5 to 46
Marine Clay	29 to 92
Glacial Till	1 to 19
Bedrock (Depth)	92 to 145 ft
Bedrock (Top Elev, BCB)	El. -80 to -120

6.10.3 Proposed Construction

The foundation support requirements for the three new high-rise buildings are still under design; however, based on available information and the currently planned heights of the proposed structures, we anticipate the following foundation types:

› Garage West Parcel (26-story office) – planned to be supported on reinforced concrete Drilled Shaft foundations, and Drilled-in Micropiles extending into

bedrock. The podium structure replacing the existing Garage will be supported on the existing Garage foundations, consisting of a combination of drilled concrete shafts and driven precast concrete piles.

- Garage East Parcel (28-story residential) - planned to be supported on a combination of Drilled Shaft foundations, and Drilled-in Micropiles extending into bedrock.
- Station East Parcel (34-story residential) - planned to be supported on a combination of Drilled Shaft foundations and Drilled-In Micropiles extending into bedrock.
- Station West Parcel (additional retail level(s) over the Station) – planned to be supported by existing foundations. No new foundations are anticipated to be needed.

The above-noted foundation types are low displacement elements which reduce the potential for soil disturbance and vibrations during installation.

Excavation will be performed locally for foundation elements and cap beams or grade beams to a depth of approximately eight (8) feet below street grades (about Elevation 8 BCB). Additionally, a temporary lateral earth support system may be required to complete construction for the below grade structures.

Temporary dewatering may be required during construction to remove groundwater or stormwater. A temporary construction dewatering permit will be obtained from governing agencies prior to discharge of temporary 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.

6.10.4 Mitigation Measures

Mitigation measures will be incorporated into the design and construction of the Project to limit potential adverse impacts, including the following:

- The Project Team will conduct studies, prepare designs and specifications, and monitor the contractor's performance for conformance to the Project's contract documents with specific attention to protecting nearby structures and facilities, and reducing impacts to groundwater levels.
- The proposed foundation system will consist of LBEs which are installed within slurry-filled trenches; as well as drilled foundations consisting of drilled shafts and micropiles. Each of these foundation types will minimize vibrations, noise, and soil disturbances (compared to driven foundations).
- Performance criteria will be established in the Project specifications for the system with respect to movements, and the construction sequence of the foundations. The contractor will be required to plan, employ, and modify as necessary, construction methods and take all necessary steps during the work to protect nearby buildings and other facilities.
- Performance criteria will be established for maintenance of groundwater levels during construction in the vicinity of the Project. The contractor will be required

to implement necessary steps during the work to not lower groundwater levels outside the limits of the Project Site. The feasibility of recharging temporary dewatering effluent into the ground will be investigated during the design of the Project.

› Geotechnical instrumentation will be installed and monitored before and during the foundation installation portion of the work to observe the performance of the adjacent buildings and structures.

6.11 Temporary Construction Impacts

The following section generally describes the potential temporary impacts resulting from construction activities and proposed mitigation measures anticipated to reduce these impacts. As design progresses an in advance of construction commencement on any of the Project Components, construction mitigation techniques will be reviewed by appropriate regulatory agencies through the development and submission of a component-specific Construction Management Plan ("CMP"). The overall duration of construction for the Project will be dependent on the sequencing of the various phases.

6.11.1 Site Preparation and Water Quality

During construction, measures will be implemented avoid impacts to adjacent properties. These may include pre-construction surveys and vibration monitoring. The Geotechnical Engineer and contractor will work closely together throughout the excavation and foundation construction to avoid adverse impacts on adjacent structures and infrastructure.

A plan to minimize construction-related impacts including erosion, sedimentation, and other water quality pollutant sources during construction, and any land disturbance activities will be developed and implemented in accordance with the National Pollutant Discharge Elimination System ("NPDES") General Permit requirements. Additionally, construction dewatering discharges will be controlled and discharged in accordance with the state and local dewatering standards.

6.11.2 Groundwater

Construction dewatering will be required to remove groundwater during the pile cap, grade beam and elevator pit excavation and construction. A NPDES Construction General Permit ("CGP") will be obtained from the EPA to facilitate discharge of groundwater generated during Project dewatering operations into the storm drain system in the vicinity of the Project Site. Likewise, a Dewatering Permit will also be obtained from the City of BWSC. These permits will determine the level of treatment required prior to discharge.

6.11.3 Soil Management

The Project will retain a Licensed Site Professional ("LSP") to manage the environmental aspects of the Project, including proper management and/or disposal of contaminated soil and groundwater encountered during construction of each Project Component. Prior to general excavation, the soils anticipated to be excavated will be evaluated for environmental contaminants and characterized in accordance with current DEP policies and procedures.

6.11.4 Traffic Management and Logistics

Construction traffic will be properly managed to minimize impacts on traffic conditions, pedestrians and area businesses and residents during construction. In advance of any activity taking place on the Project Site, a component-specific CMP will be developed for each parcel to address construction activities and site management to the satisfaction of the BTD. The following elements will be addressed in any such CMP:

- Designation of truck routes for deliveries
- Pedestrian walkways indicating any temporary crosswalks, delineated walkways around the Project Site, and areas of overhead protection where deemed necessary
- Existing Station public access points
- Existing Garage access points
- Temporary way-finding signage to guide the public
- Project Site enclosure fencing and gates
  - Gates for construction traffic to facilitate vehicles entering and exiting the Project Site with the flow of traffic on the adjacent streets
  - Project Site enclosure fencing on top of concrete barriers to provide a solid barrier for public protection
- Location and sizing of staging areas for on-site storage of construction materials
  - Concrete pump and truck staging locations for concrete placement
  - Construction hoist locations with loading and truck placement
  - Tower crane placement with designated offloading zones
  - Construction waste and debris management dumpster locations
- Police detail officer traffic and Project Site access gate management
- Locations of Boston Fire Department access and temporary construction standpipe fire department connections
- Definition of work hours
  - Standard project hours for the majority of the work

- Select activities requiring deviation from the City of Boston allowable construction hours will be minimized and identified, following city off hour permit criteria, where required
- Due to the work being located over and around active rail and highway infrastructure, off hour work is anticipated and will be coordinated for these areas with MassDOT and the MBTA

6.11.5 Construction Trip Generation and Worker Parking

The number of workers required during construction will vary based on Project phasing and possible overlap of the multiple parcels, with a minimum peak project workforce of up to 350 workers on a daily basis. Because the workforce will arrive and depart prior to peak commuter traffic periods, the workforce trips are not expected to have a large impact on the area's transportation system. Construction workers will be strongly encouraged to arrive at the Site via public transportation.

6.11.6 Truck Routes and Volumes

The vehicular access to the Project Site during the construction period will vary during different periods of the construction schedule. The peak phase of the deliveries will be during the erection of the structure and placement of the floor slabs, where a maximum of up to 50 delivery trucks per building per day may be anticipated. Less than half of that amount would be expected per building during the remaining portions of the schedule. Police details will be assigned to all active gate locations on days with active deliveries to ensure that vehicles are not impacting traffic operations.

6.11.7 Construction Air Quality/Dust Control

Construction activities may result in a slight, short-term increase in air pollution emissions. The primary source of potential construction emissions is from dust resulting from construction operations, and emissions from the construction machinery.

To minimize dust emissions from construction activities, water will be sprayed on any active demolition activities and on the Project Site itself when atmospheric conditions cause drying of the Project Site. Any material spoils generated from excavation on-site will be covered while stored on-site, and material management will dictate generated spoils be removed from the Project Site on a regular basis. All demolition will be performed in a manner where elements are removed intact through "deconstruction" methodology, whenever possible. The construction-related air quality impact from dust would be of relatively short duration, as the scheduled time for demolition would be short in comparison to the overall construction schedule. During the building construction, debris netting will be installed around the building's perimeter until the façade construction encloses each floor, keeping any dust and debris contained to the building itself. Other specific activities such as spray on fireproofing where structural steel is used for the primary

structure will be contained within debris tarps moved up through the building as the work progresses.

In addition to the above preventative measures, all vehicular egress locations around the Project Site will be equipped with vehicle wash stations and stone tracking mats. The tracking mats will be monitored and maintained to control buildup of particles to ascertain their effectiveness. Street and sidewalk sweeping procedures will also be deployed on a regular basis when vehicular traffic is exiting the Project Site.

Emission controls from construction vehicles and machinery would include proper maintenance and reduced idling on-site. Through the enforcement of the State's anti-idling laws, including the installation of anti-idling signage, the vehicle emissions are not anticipated to have any substantive impact on ambient air quality. In addition, the Proponent is committed to meeting the requirements of the DEP State Revolving Fund for diesel construction equipment. These require that all non-road diesel equipment rated 50 horsepower or greater that will be used on a construction site meet EPA's Tier 4 emission limits or be retrofitted with appropriate emission reduction equipment. Emission reduction equipment includes EPA-verified, CARB-verified or DEP-approved diesel oxidation catalysts or diesel particulate filters.

6.11.8 Construction Noise

The construction activity associated with the Project may temporarily increase nearby sound levels due to the use of construction equipment. Construction machinery will be used intermittently throughout the Project's construction phases, primarily during daytime periods. Efforts to use the least intrusive equipment will be implemented, where practical. The Project will maintain compliance with the City of Boston noise control regulations for construction throughout its construction period.

6.11.9 Odor Control During Construction

Odor issues are not anticipated due to the lack of organic soils on the Project Site; however, if such soils are encountered with the development of any Project Component, the Proponent will undertake appropriate mitigation measures to control the odor associated with their removal, such as:

- Cut and cover utility trenches whenever possible
- Protection of excavated materials with plastic sheathing to encapsulate odors
- Removal of excavated materials from the Project Site in a covered vehicle on a frequent basis

6.11.10 Rodent Control During Construction

The City of Boston has declared that the infestation of rodents in the city as a serious problem. In order to control this infestation, the City enforces the requirements established under the Massachusetts State Sanitary Code, Chapter 211, 105 CMR 410.550 and the State Building Code, Section 108.6. Policy Number 87-4

(City of Boston) established that preparation of a program for the extermination of rodents shall be required for issuance of permits for demolition, excavation, foundation, and basement rehabilitation. The Proponent will employ the services of a rodent control firm to develop and implement a rodent control program prior to demolition and on a regular basis throughout the duration of construction of any Project Component.

Control measures will include trap placement throughout the construction site of each Project Component as well as in immediately adjacent areas to control both rodents on-site as well as fleeing rodents. The traps will be checked and disposed of frequently replacing them with fresh traps as necessary. As the construction of a Project Component progresses, traps will also be installed throughout the building to control any migration within the new construction. Food will be limited to a designated area on-site for the workforce to eat, and the food waste will be removed from the Project Site on a daily basis. This process and policy will be strictly enforced with the development of each Project Component.

6.11.11 Public Safety During Construction

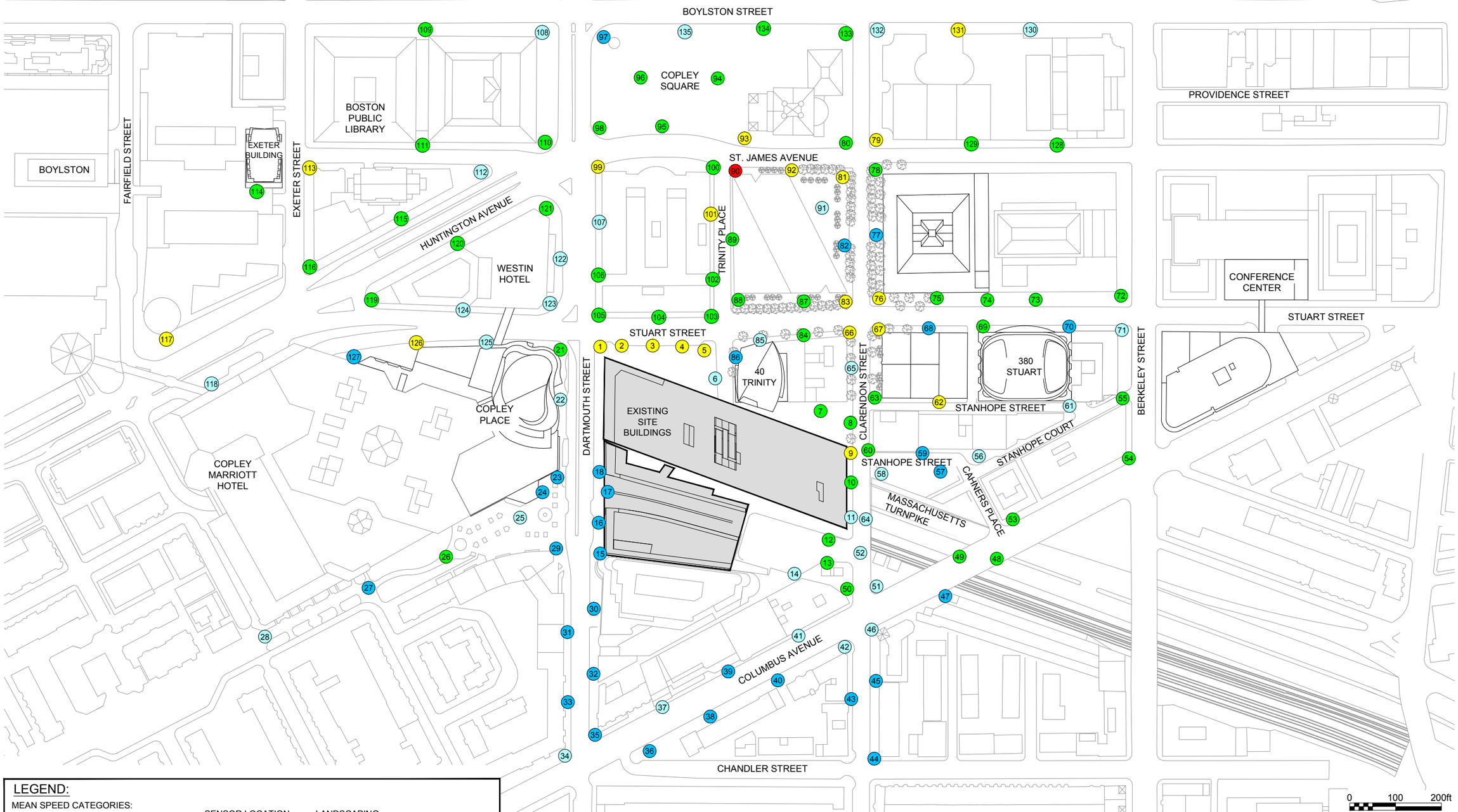
Prior to the beginning of each phase of construction, the construction manager of each Project Component will produce a Site Specific Safety Plan to be reviewed and approved by the City as well as all other agencies impacted in conjunction with the CMP.

The entire perimeter of each building's construction site will be protected with a construction fence with debris net on top of concrete barriers to separate the construction activities and general public. Vehicular gates will be provided for construction traffic in alignment with the flow of traffic on perimeter roads to allow safe entrance and exiting for construction vehicles. Police details will be employed at the construction gates to assist in managing vehicular and pedestrian traffic. Coordination with the Boston Police Department will be essential in providing safe travel routes for pedestrians during peak construction periods.

Sidewalks around the perimeter of each construction phase will be maintained during construction, and overhead protection will be utilized in areas where the new construction is in close proximity to the general public. Netting at the building perimeter will be installed at all sides of the building as the structure progresses, and the netting will be jumped up to maintain a close proximity to the work above as the structure rises. Debris netting will be installed vertically at the perimeter of all floors until the building envelope is installed to contain any material during windy conditions.

As some Project Components will be constructed around and within an existing transportation station, designated access points to the Station will be installed and managed throughout the duration of those Project Components. These will include primary as well as emergency access and egress routes. All work within and adjacent to the existing Station and I-90 facilities will be coordinated with all permit requirements and work procedures inclusive of any and all monitoring and safety

procedures dictated by the MBTA, MassDOT, AMTRAK and other governing authorities.

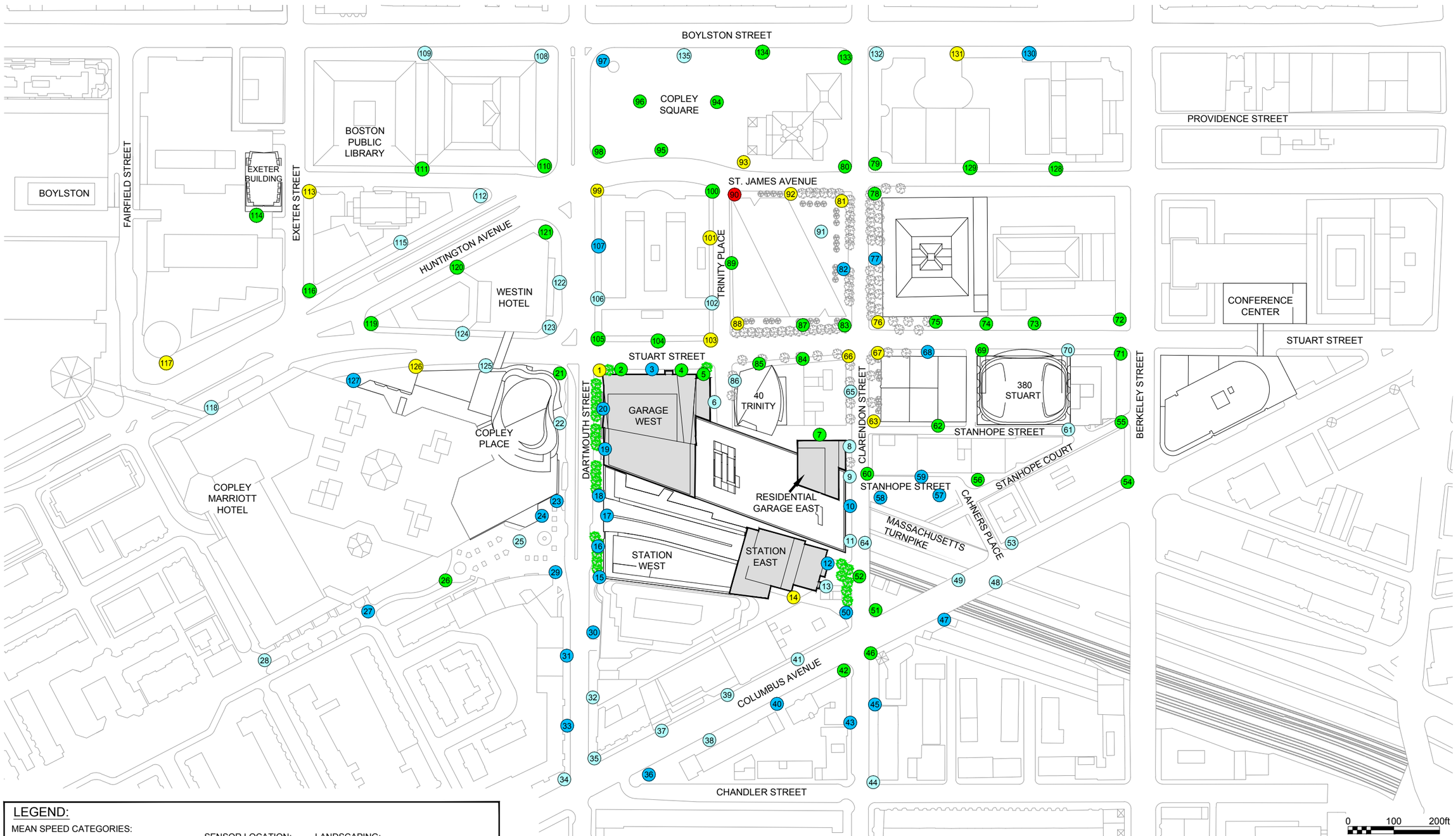


LEGEND:

MEAN SPEED CATEGORIES:
- Sitting
- Standing
- Walking
- Uncomfortable
- Dangerous

SENSOR LOCATION:
- Grade Level

LANDSCAPING:
- Existing Marcescent Shrubs - 8' Tall
- Existing Marcescent Trees - 20' Tall



LEGEND:

MEAN SPEED CATEGORIES:
- Sitting
- Standing
- Walking
- Uncomfortable
- Dangerous

SENSOR LOCATION:
- Grade Level

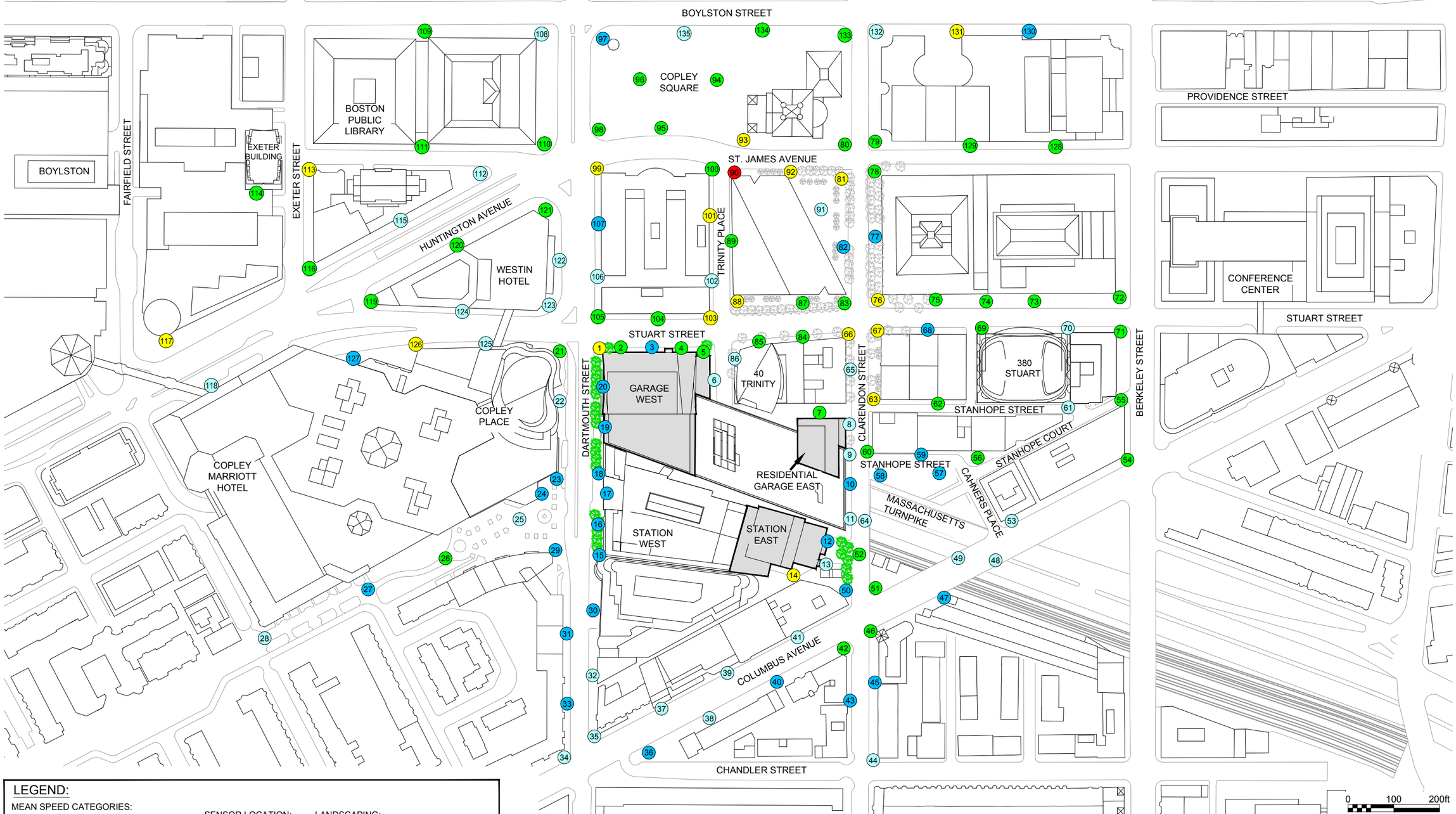
LANDSCAPING:
- Existing Marcescent Shrubs - 8' Tall
- Existing Marcescent Trees - 20' Tall
- Proposed Marcescent Trees - 20' Tall

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Pedestrian Wind Conditions - Mean Speed - Base Scheme

RWDI CONSULTING ENGINEERS & SCIENTISTS

Figure 6.1b



LEGEND:

MEAN SPEED CATEGORIES:
- Sitting
- Standing
- Walking
- Uncomfortable
- Dangerous

SENSOR LOCATION:
- Grade Level

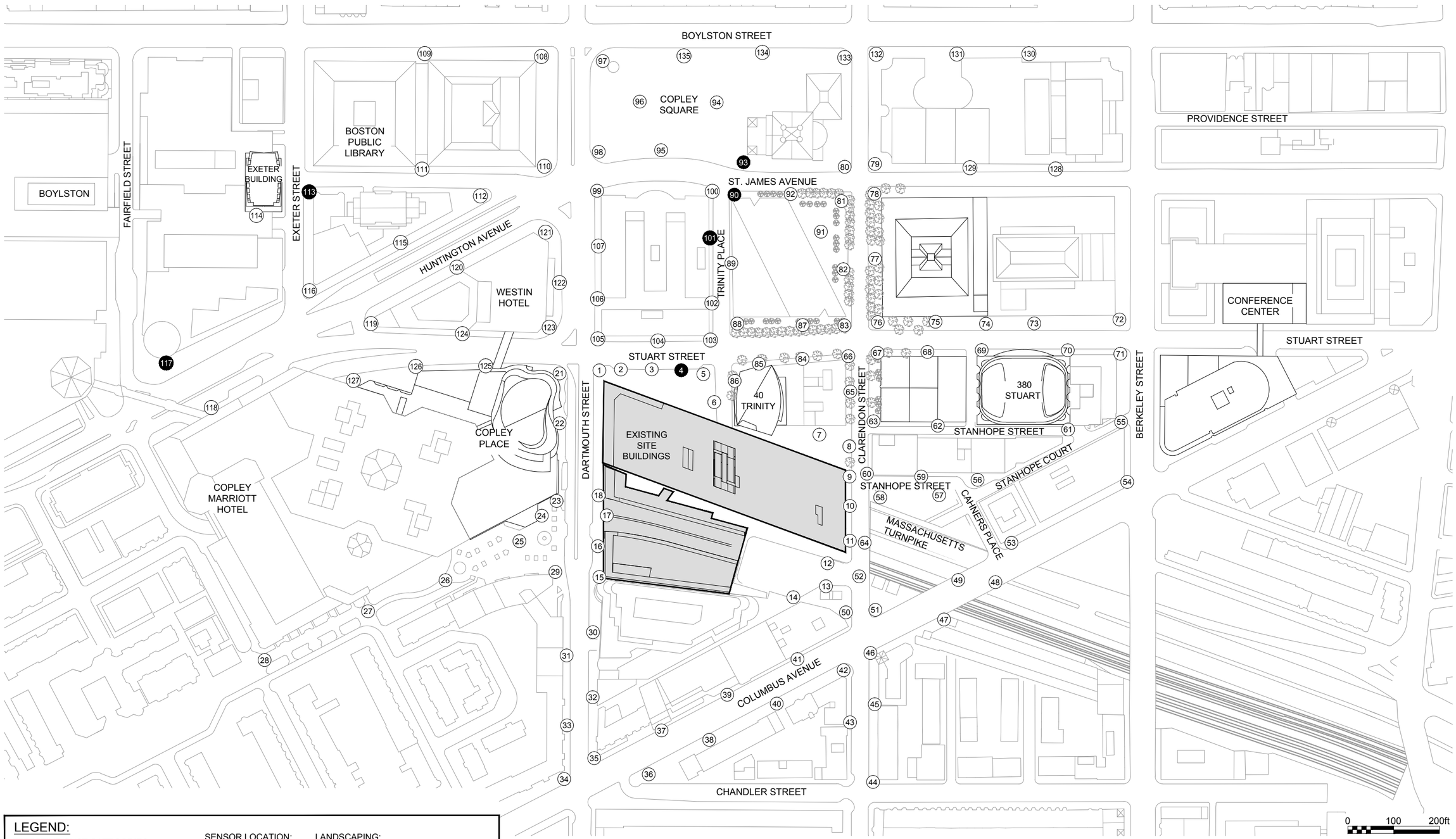
LANDSCAPING:
- Existing Marcescent Shrubs - 8' Tall
- Existing Marcescent Trees - 20' Tall
- Proposed Marcescent Trees - 20' Tall

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Pedestrian Wind Conditions - Mean Speed - Alternate Scheme

RWDI CONSULTING ENGINEERS & SCIENTISTS

Figure 6.1c



LEGEND:

EFFECTIVE GUST CATEGORIES:
- Acceptable
- Unacceptable

SENSOR LOCATION:
- Grade Level

LANDSCAPING:
- Existing Marcescent Shrubs - 8' Tall
- Existing Marcescent Trees - 20' Tall

BOYLSTON STREET

BOSTON PUBLIC LIBRARY

COPLEY SQUARE

PROVIDENCE STREET

BOYLSTON

FAIRFIELD STREET

EXETER BUILDING

EXETER STREET

ST. JAMES AVENUE

HUNTINGTON AVENUE

WESTIN HOTEL

TRINITY PLACE

CONFERENCE CENTER

STUART STREET

STUART STREET

DARTMOUTH STREET

GARAGE WEST

40 TRINITY

CLARENDON STREET

380 STUART

BERKELEY STREET

STANHOPE STREET

STANHOPE COURT

COPLEY PLACE

COPLEY MARRIOTT HOTEL

RESIDENTIAL GARAGE EAST

CAHNERS PLACE

MASSACHUSETTS TURNPIKE

STATION WEST

STATION EAST

COLUMBUS AVENUE

CHANDLER STREET

0 100 200ft

LEGEND:

EFFECTIVE GUST CATEGORIES:

Acceptable

Unacceptable

SENSOR LOCATION:

Grade Level

LANDSCAPING:

Existing Marcescent Shrubs - 8' Tall

Existing Marcescent Trees - 20' Tall

Proposed Marcescent Trees - 20' Tall

BOYLSTON STREET

BOSTON PUBLIC LIBRARY

COPLEY SQUARE

PROVIDENCE STREET

BOYLSTON

FAIRFIELD STREET

EXETER BUILDING

EXETER STREET

HUNTINGTON AVENUE

WESTIN HOTEL

ST. JAMES AVENUE

TRINITY PLACE

CONFERENCE CENTER

STUART STREET

COPLEY PLACE

COPLEY MARRIOTT HOTEL

DARTMOUTH STREET

GARAGE WEST

40 TRINITY

RESIDENTIAL GARAGE EAST

CLARENDON STREET

380 STUART

BERKELEY STREET

STANHOPE STREET

STANHOPE COURT

CAHNERS PLACE

MASSACHUSETTS TURNPIKE

STATION WEST

STATION EAST

COLUMBUS AVENUE

CHANDLER STREET

0 100 200ft

LEGEND:

EFFECTIVE GUST CATEGORIES:
- Acceptable
- Unacceptable

SENSOR LOCATION:
- Grade Level

LANDSCAPING:
- Existing Marcescent Shrubs - 8' Tall
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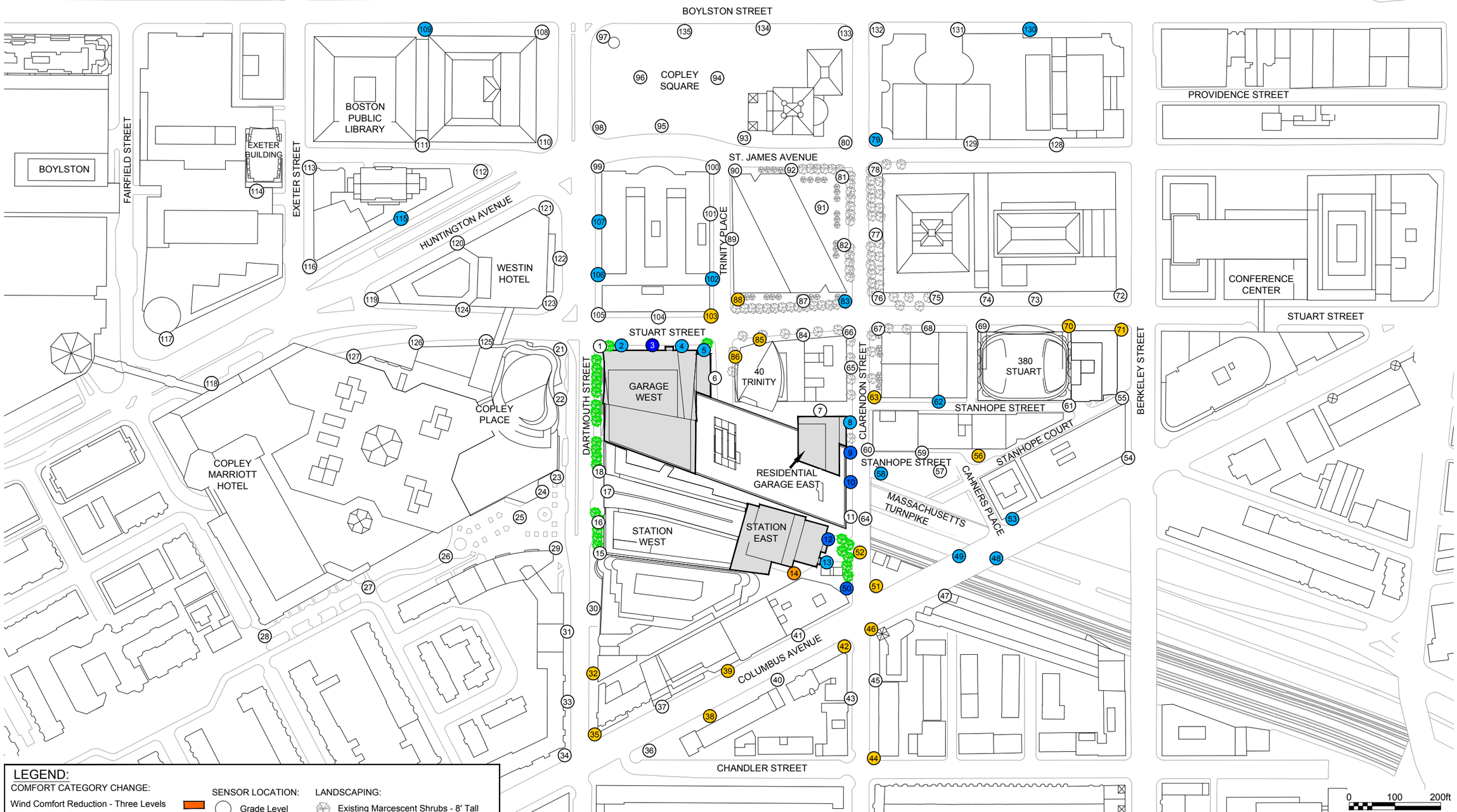
BOYLSTON STREET
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COPLEY SQUARE
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BOYLSTON
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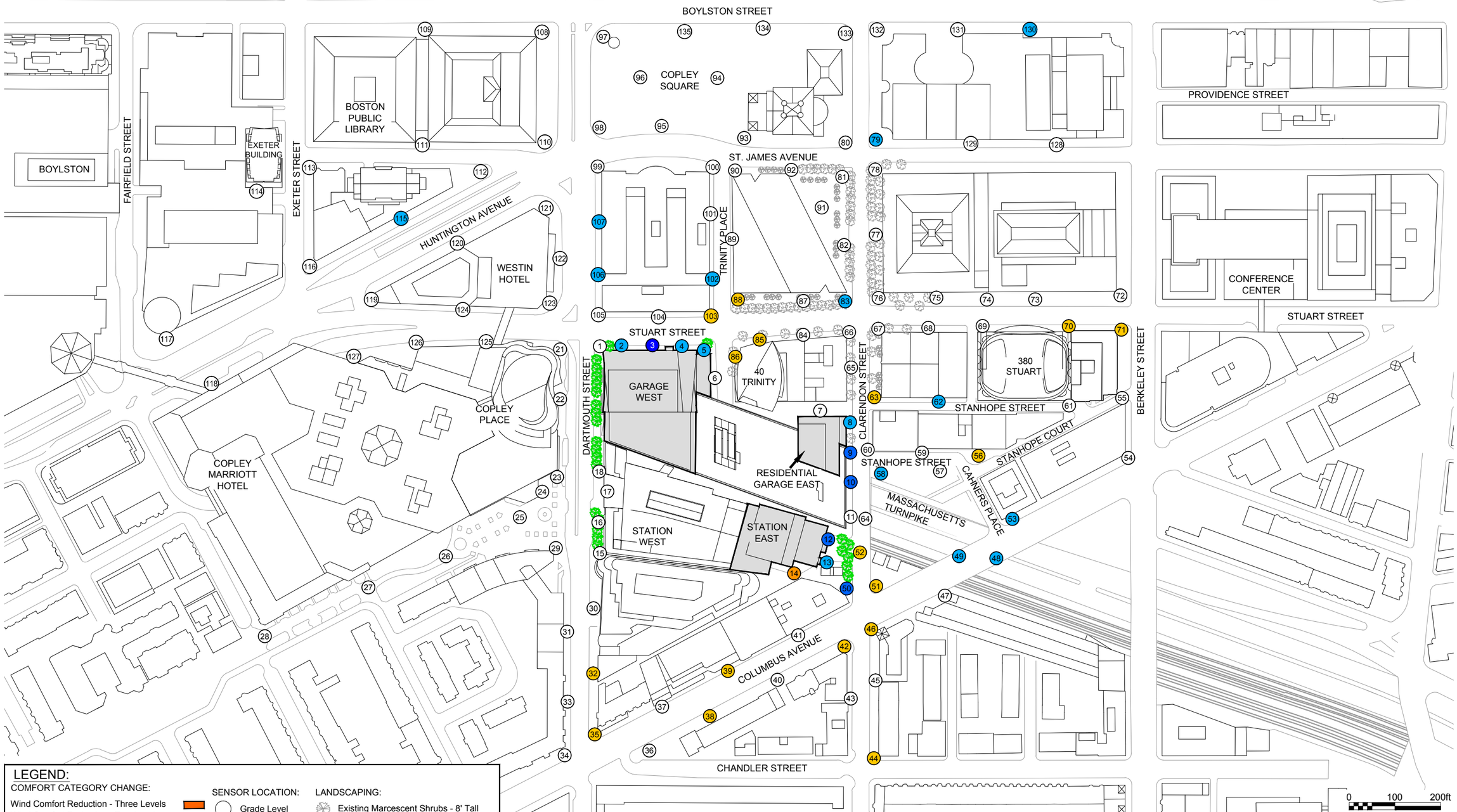
BERKELEY STREET
STANHOPE STREET
STANHOPE COURT
RESIDENTIAL GARAGE EAST
CAHNERS PLACE
MASSACHUSETTS TURNPIKE
STATION WEST
STATION EAST
COLUMBUS AVENUE
CHANDLER STREET
0
100
200ft
LEGEND:
COMFORT CATEGORY CHANGE:
Wind Comfort Reduction - Three Levels
Wind Comfort Reduction - Two Levels
Wind Comfort Reduction - One Level
No Comfort Category Change
Wind Comfort Improvement - One Level
Wind Comfort Improvement - Two Levels
Wind Comfort Improvement - Three Levels
SENSOR LOCATION:
Grade Level
LANDSCAPING:
Existing Marcescent Shrubs - 8' Tall
Existing Marcescent Trees - 20' Tall
Proposed Marcescent Trees - 20' Tall


BOYLSTON STREET
BOSTON PUBLIC LIBRARY
COPLEY SQUARE
PROVIDENCE STREET
BOYLSTON
FAIRFIELD STREET
EXETER BUILDING
EXETER STREET
HUNTINGTON AVENUE
WESTIN HOTEL
ST. JAMES AVENUE
TRINITY PLACE
CONFERENCE CENTER
STUART STREET
COPLEY PLACE
COPLEY MARRIOTT HOTEL
GARAGE WEST
40 TRINITY
380 STUART
DARTMOUTH STREET
CLARENDON STREET
BERKELEY STREET
STANHOPE STREET
STANHOPE COURT
CAHNERS PLACE
RESIDENTIAL GARAGE EAST
STATION WEST
STATION EAST
MASSACHUSETTS TURNPIKE
COLUMBUS AVENUE
CHANDLER STREET
0
100
200ft
LEGEND:
COMFORT CATEGORY CHANGE:
Wind Comfort Reduction - Three Levels
Wind Comfort Reduction - Two Levels
Wind Comfort Reduction - One Level
No Comfort Category Change
Wind Comfort Improvement - One Level
Wind Comfort Improvement - Two Levels
Wind Comfort Improvement - Three Levels
SENSOR LOCATION:
Grade Level
LANDSCAPING:
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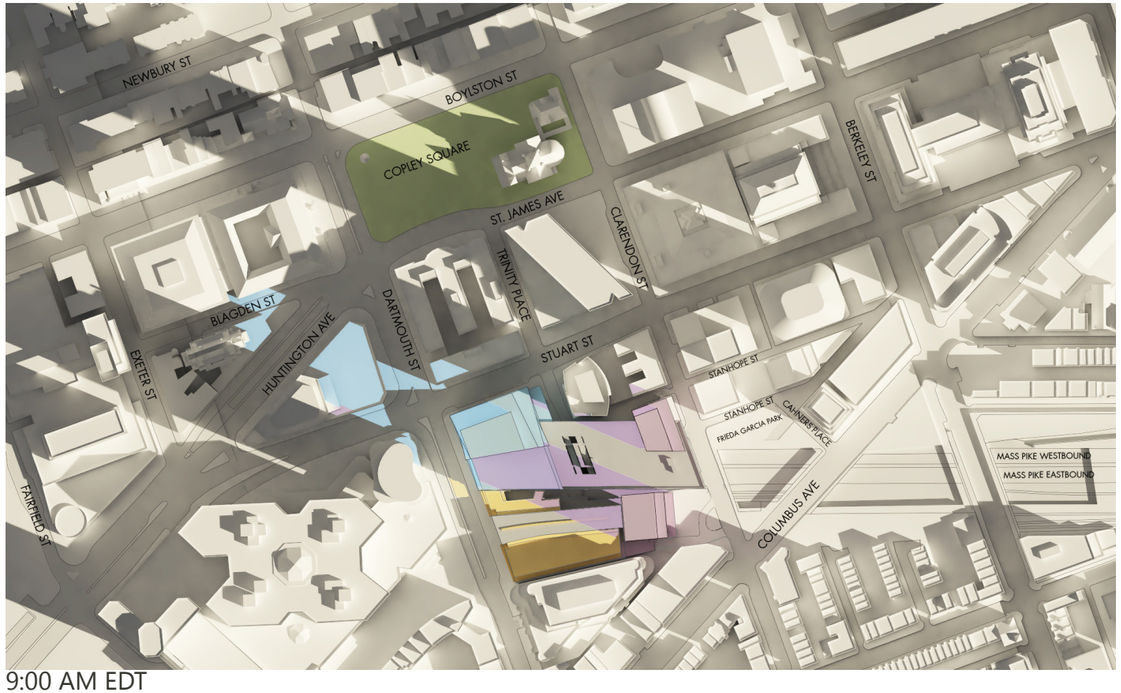
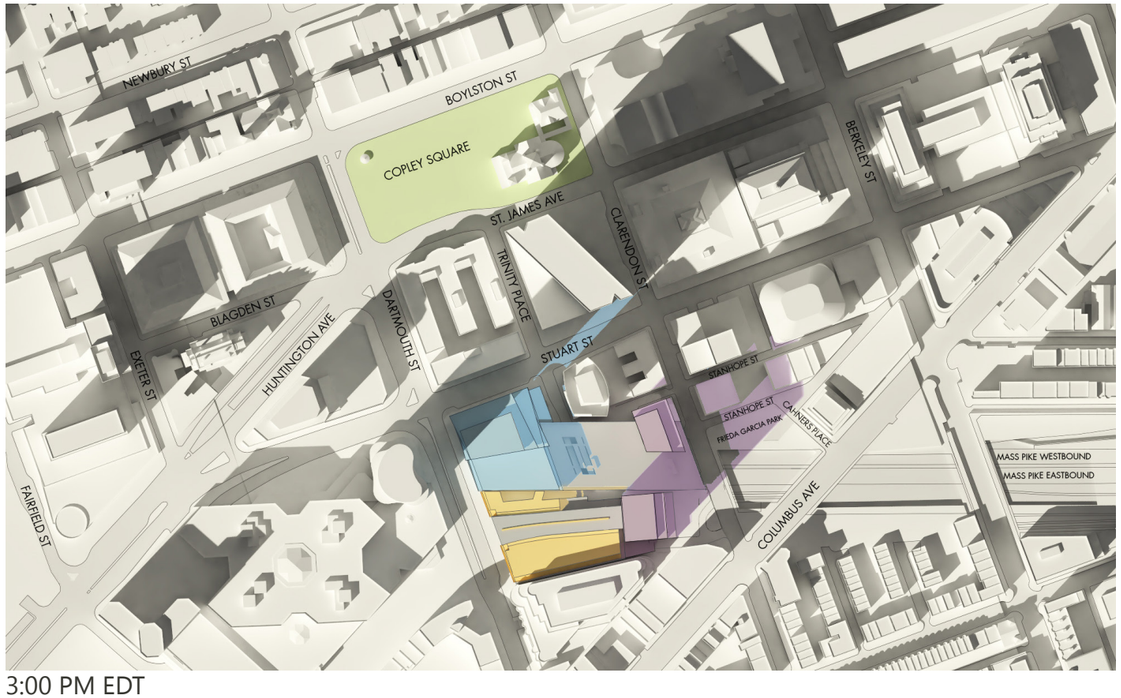
Existing Marcescent Trees - 20' Tall
Proposed Marcescent Trees - 20' Tall



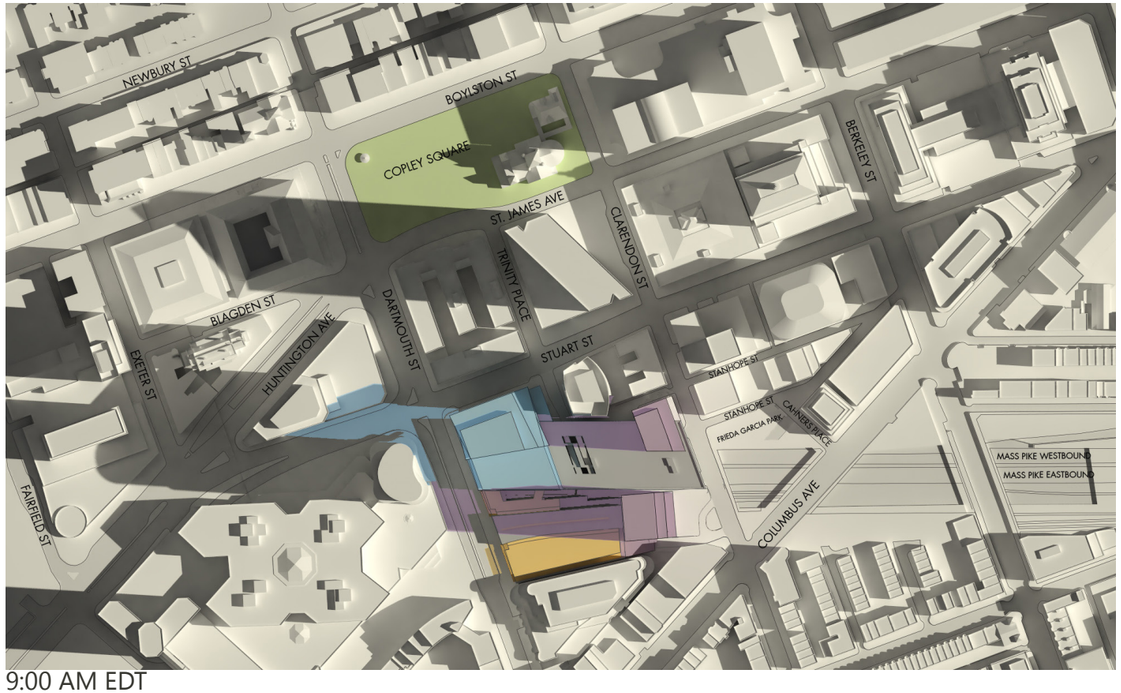
9:00 AM EDT



3:00 PM EDT



12:00 PM EDT



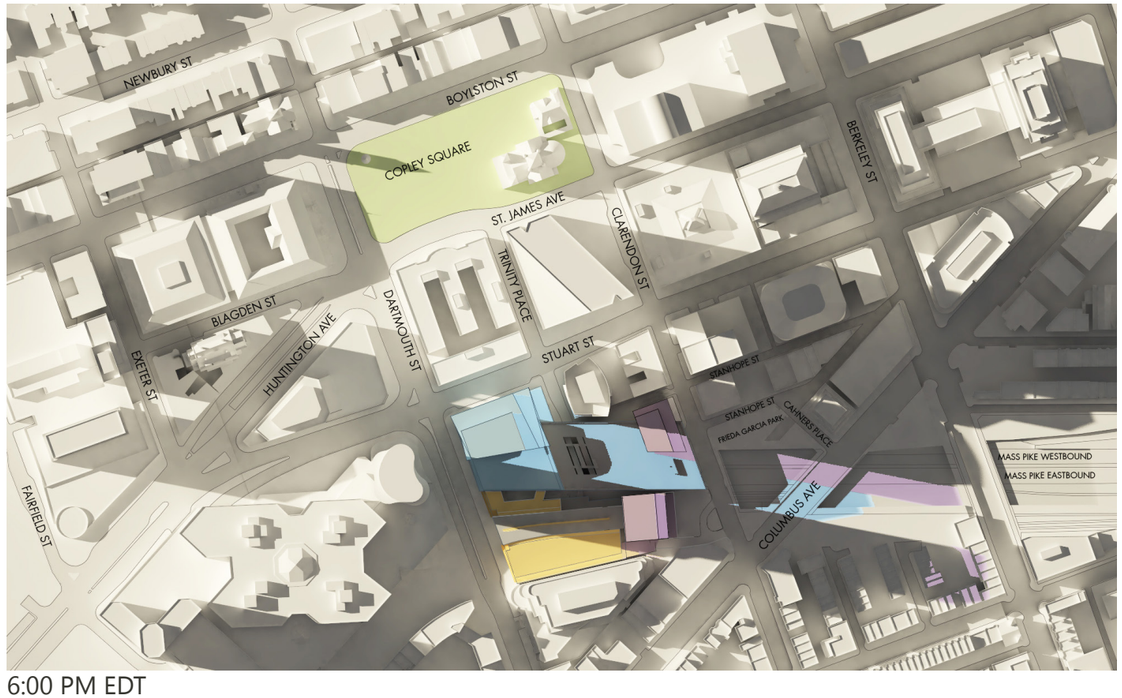
9:00 AM EDT



12:00 PM EDT



3:00 PM EDT



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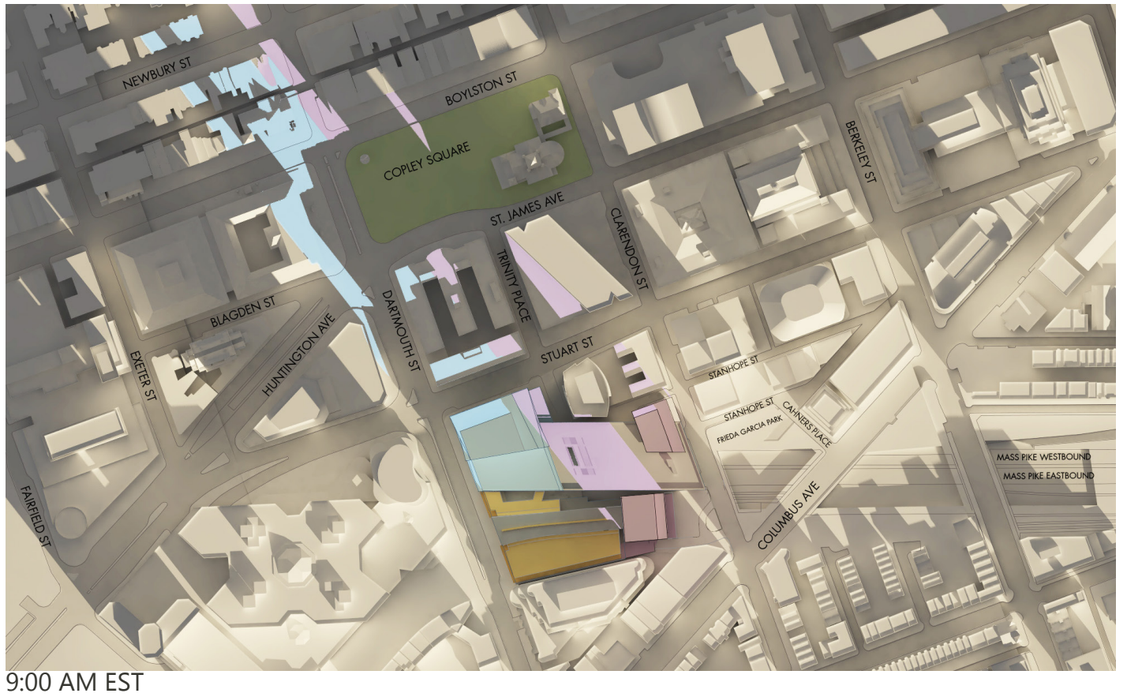
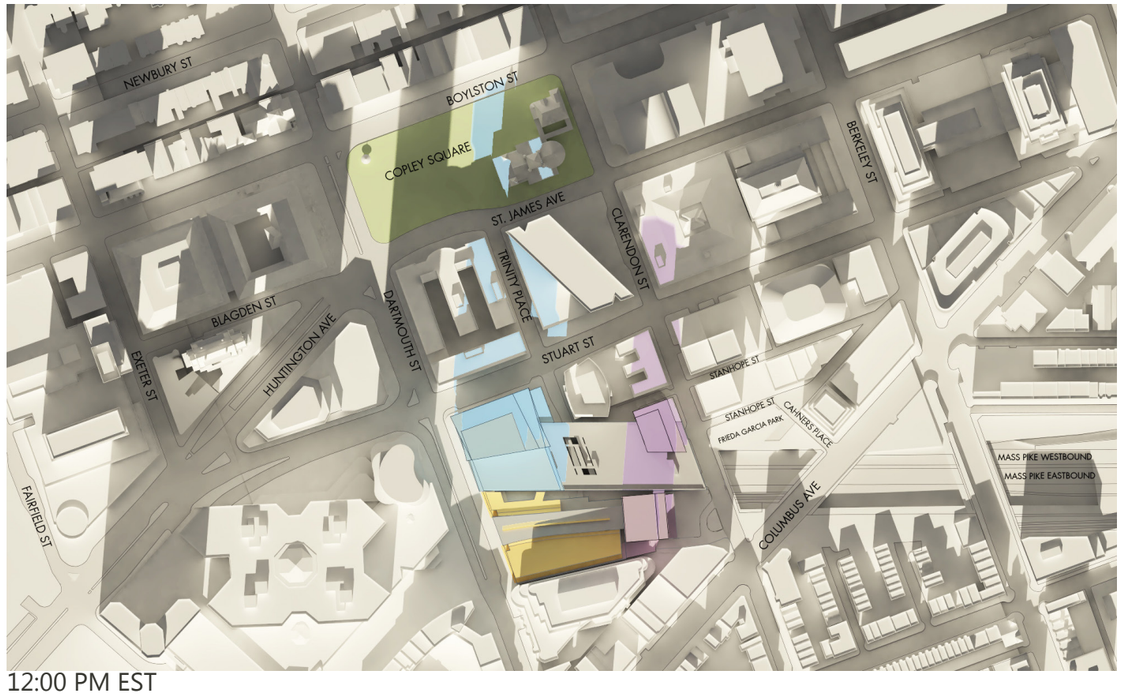


9:00 AM EST



12:00 PM EST



3:00 PM EST



10:09 AM EDT - SHADOW BEGINS



11:19 AM EDT - SHADOW GOES BEHIND FAIRMONT COPLEY PLAZA

START:
10:09AM
END:
11:19AM
1:10 HR

START:
11:53AM
END:
12:37PM
44 MIN

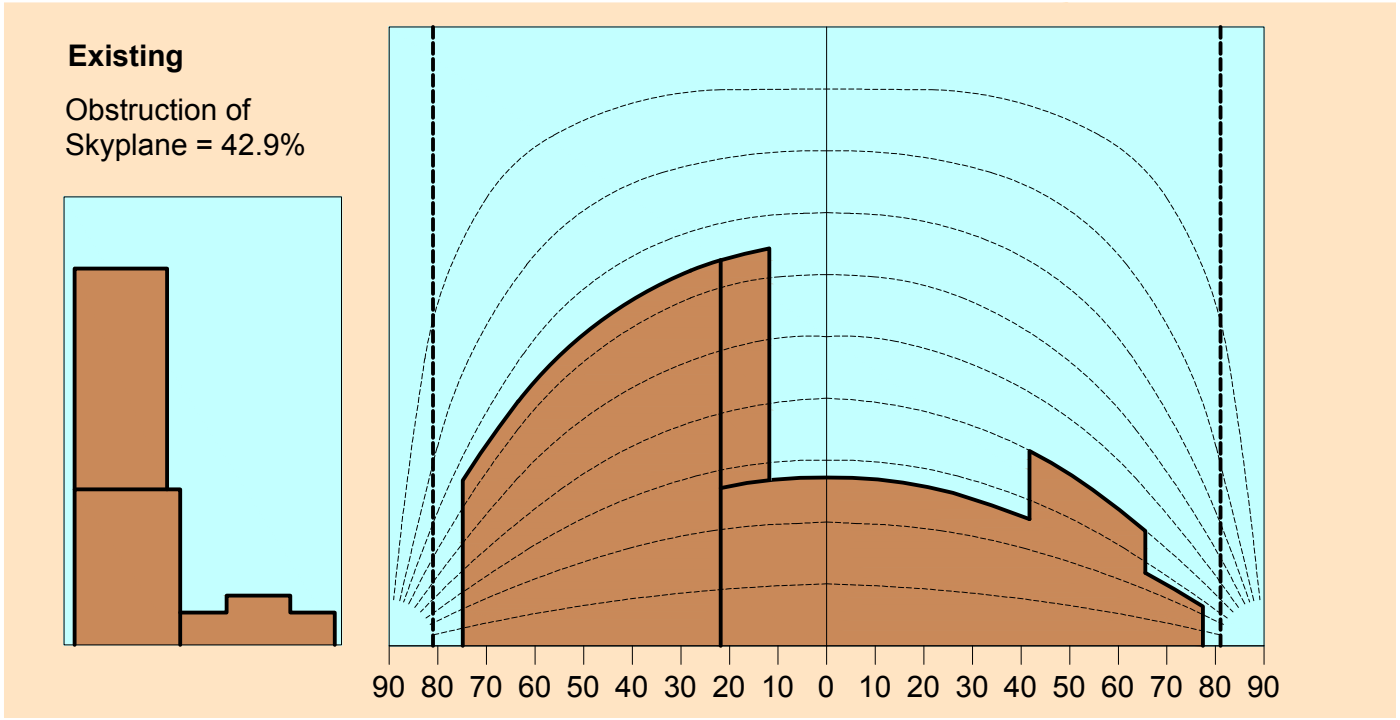
TOTAL
1:54 HR

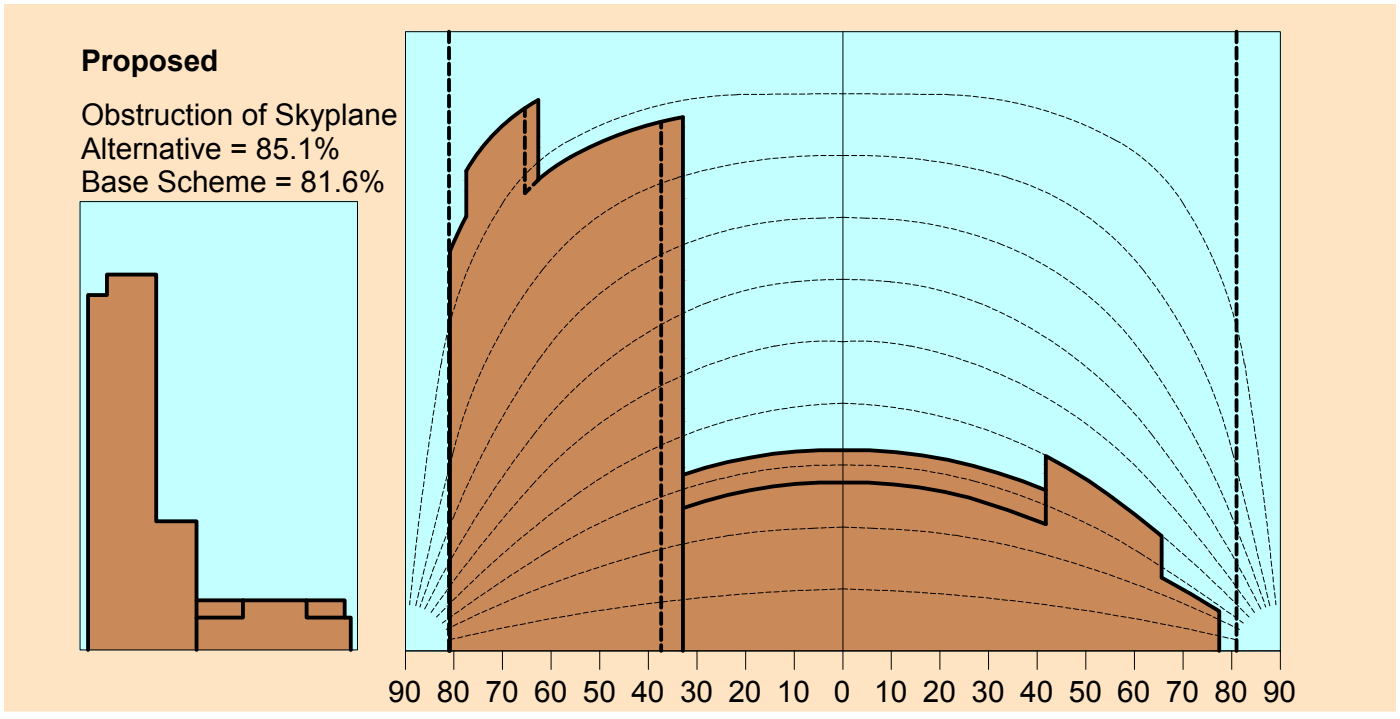


11:53 AM EDT - SHADOW EMERGES FROM BEHIND FAIRMONT COPLEY PLAZA



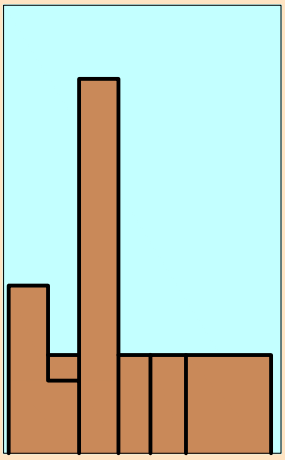
12:37 PM EDT - SHADOW LEAVES COPLEY SQUARE

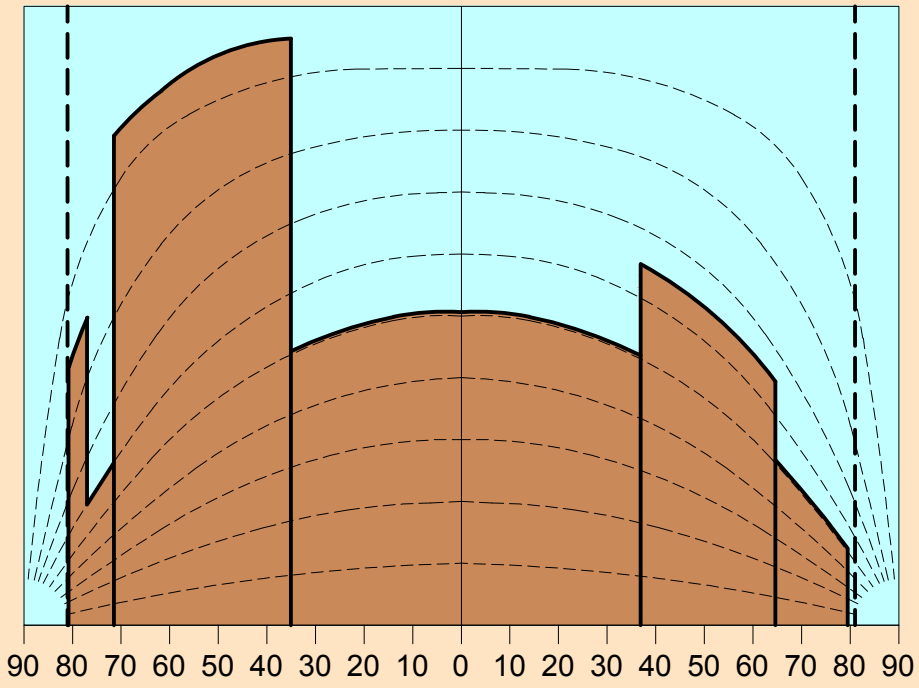

Existing
Obstruction of
Skyplane = 42.9%
90 80 70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90


Proposed
Obstruction of Skyplane
Alternative = 85.1%
Base Scheme = 81.6%
90 80 70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90

Existing

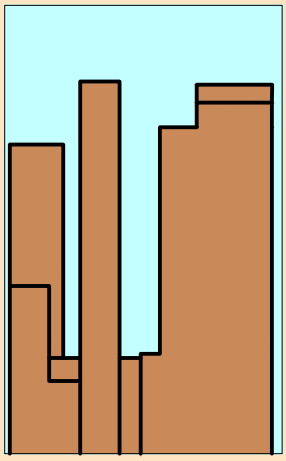
Obstruction of
Skyplane =66.4%

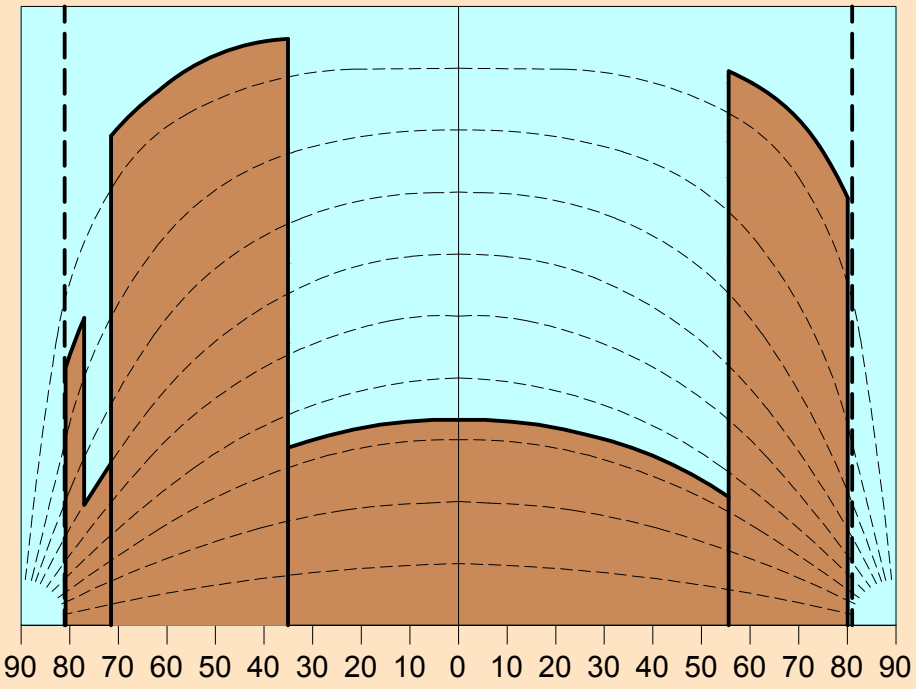




Proposed

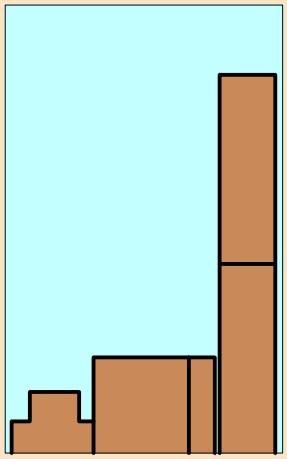
Obstruction of
Skyplane = 72.0%

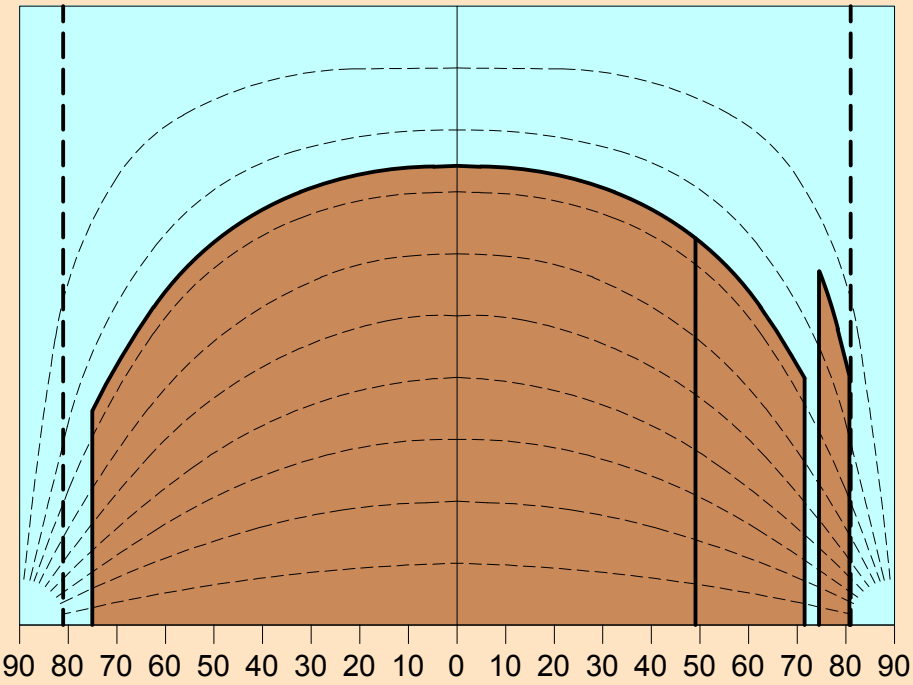




Existing

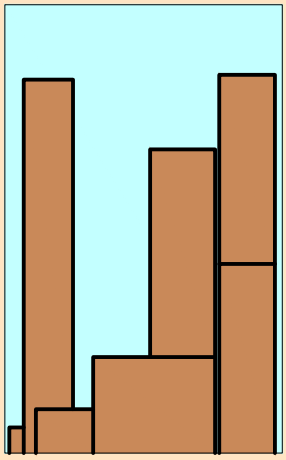
Obstruction of
Skyplane = 70.7%

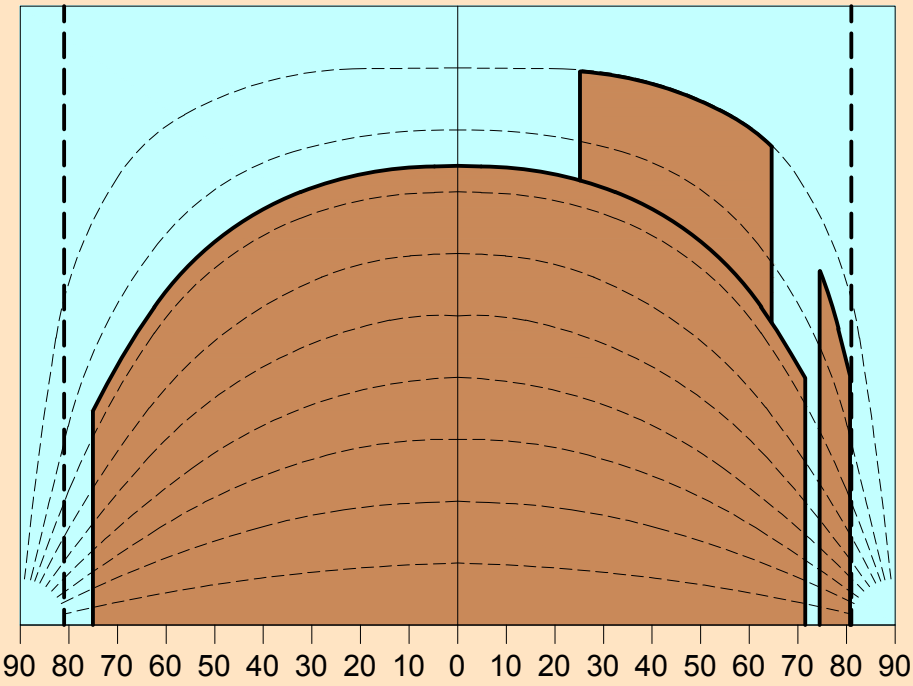




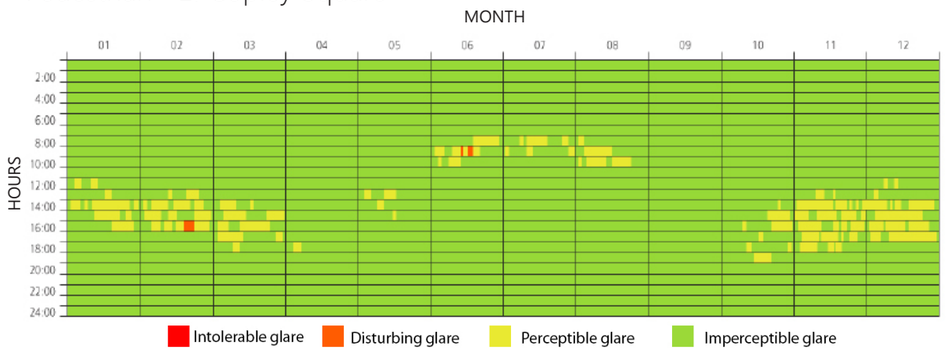
Proposed

Obstruction of
Skyplane = 79.1%





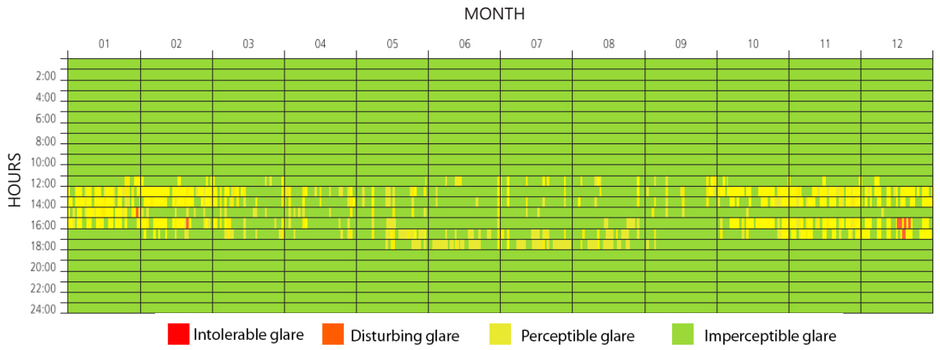
Pedestrian #1: Copley Square



Two instances of disturbing glare are experienced and indicated to be no longer than one to two hours. They can be remedied by looking away from the point source.

6 of 8,760 hours annually (0.07%) show disturbing glare

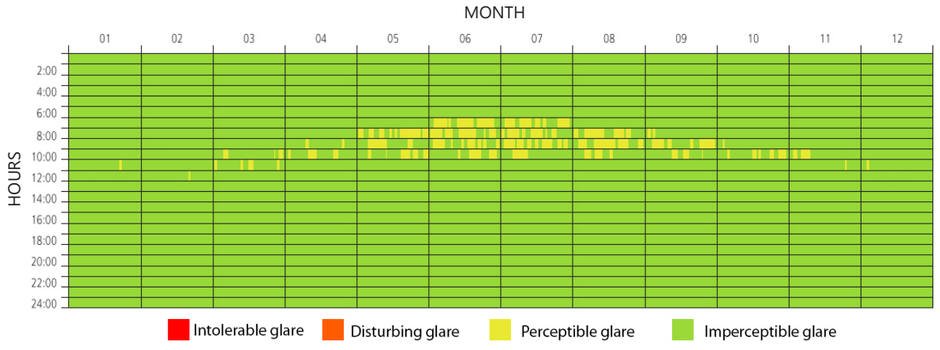
Pedestrian #2: Dartmouth & Stuart Streets



One instance of disturbing glare is experienced and indicated to be no longer than one to two hours. It can be remedied by looking away from the point source.

5 of 8,760 hours annually (0.06%) show disturbing glare

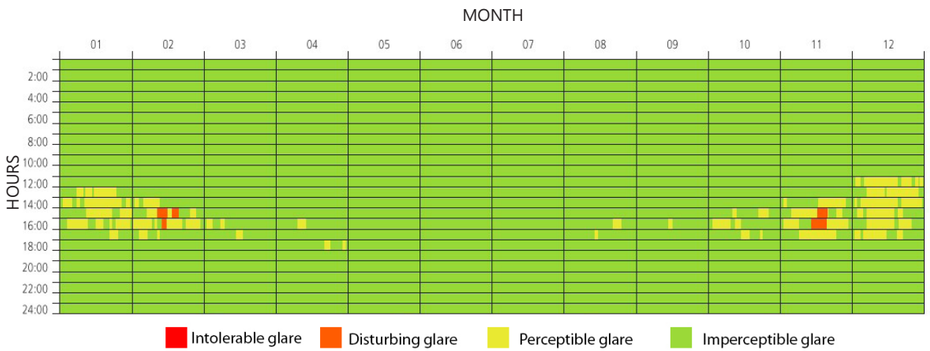
Pedestrian #3: Clarendon & Stuart Streets



No glare issues to be addressed.

0 of 8,760 hours annually (0.0%) show disturbing glare

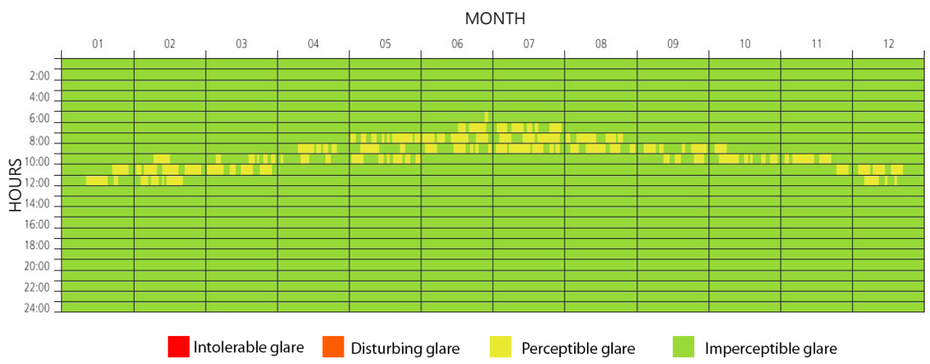
Pedestrian #4: Southwest Corridor Park



Two instances of disturbing glare are experienced and indicated to be no longer than one to two hours. They can be remedied by looking away from the point source.

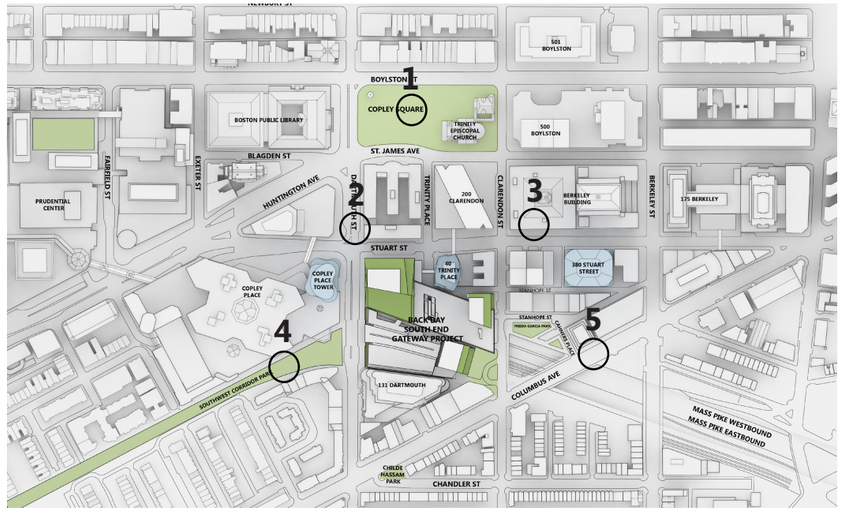
9 of 8,760 hours annually (0.10%) show disturbing glare

Pedestrian #5: Columbus Ave & Cahners Place



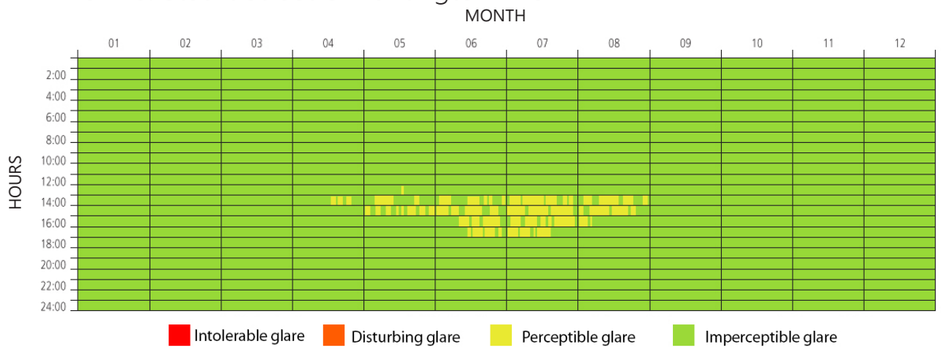
No glare issues to be addressed.

0 of 8,760 hours annually (0.0%) show disturbing glare



Location Key Plan

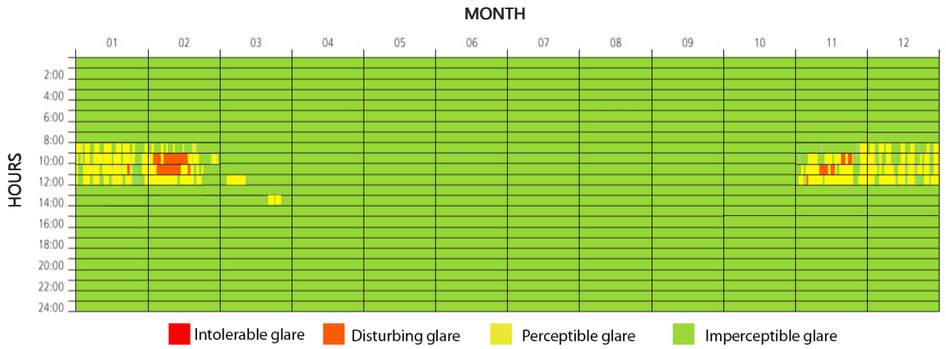
Driver #6: Stuart Street & Huntington Ave



No glare issues to be addressed.

0 of 8,760 hours annually (0.0%) show disturbing glare

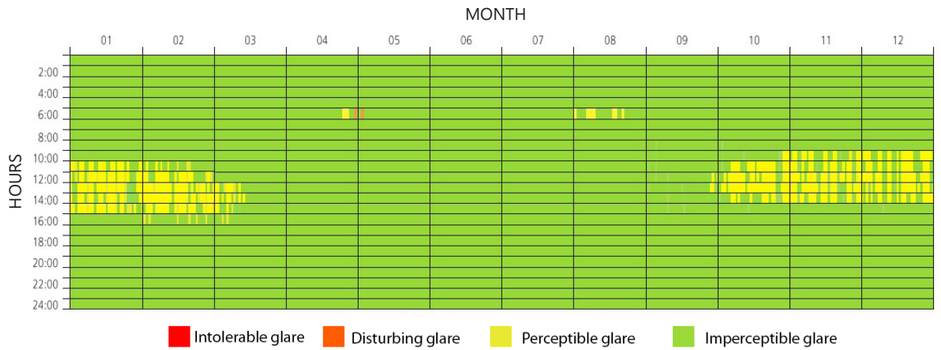
Driver #7: Mass Pike Westbound



Two (2) instances of disturbing glare are experienced and indicated to be no longer than one to two hours. They can be remedied easily by looking away from the point source or turning down the internal visor in the vehicle. Additionally, given cars are moving at high speeds any glare experienced will be momentary.

15 of 8,760 hours annually (0.17%) show disturbing glare

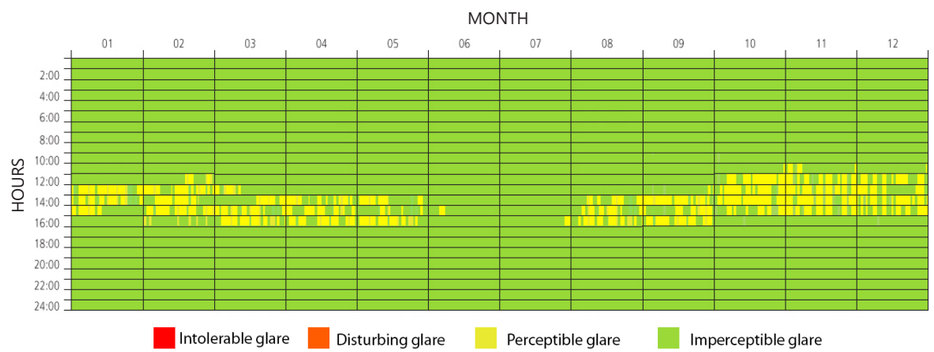
Driver #8: Columbus Ave



No glare issues to be addressed.

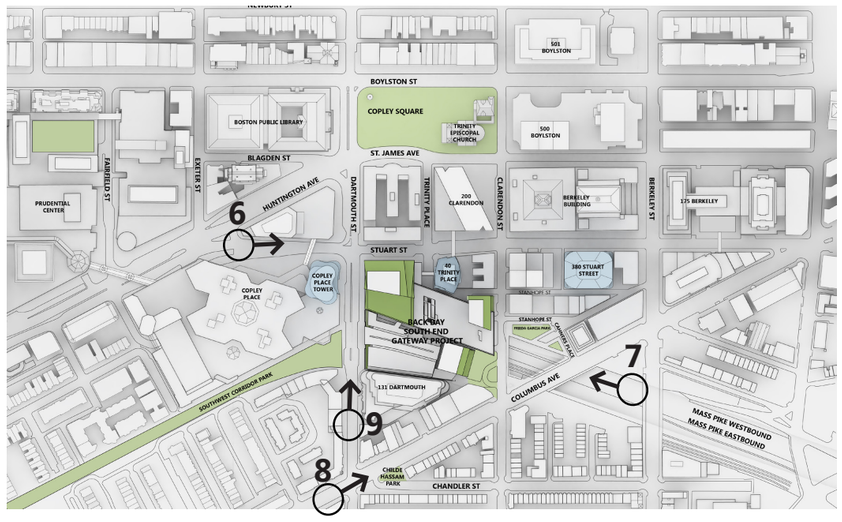
1 of 8,760 hours annually (0.0%) show disturbing glare

Driver #9: Dartmouth Street Northbound



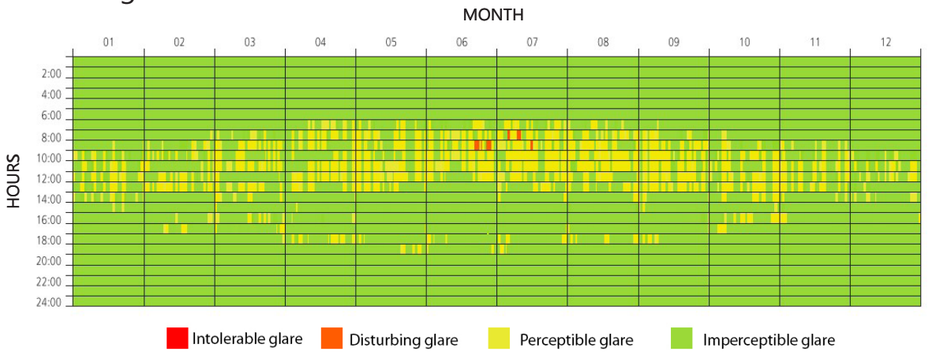
No glare issues to be addressed.

0 of 8,760 hours annually (0.0%) show disturbing glare



Location Key Plan

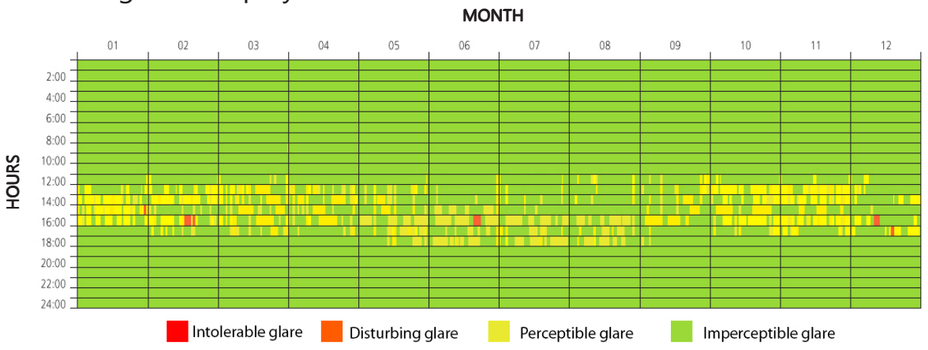
Building #10: 100 Clarendon Street



Minimal instances of disturbing glare are experienced and indicated to be no longer than one hour. They can be remedied easily by utilizing internal blinds.

8 of 8,760 hours annually (0.09%) show disturbing glare

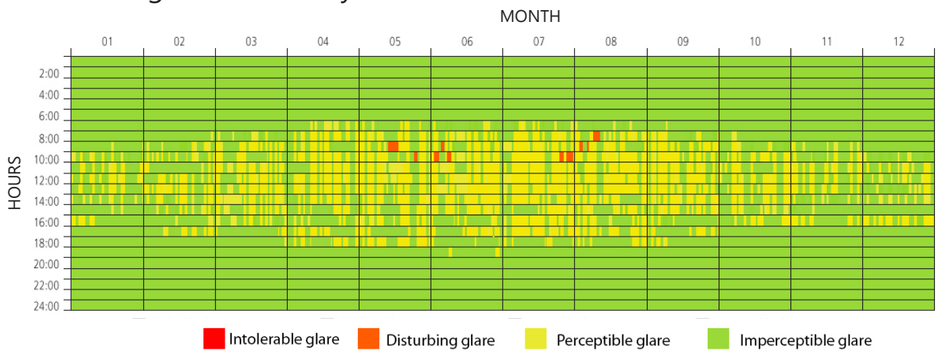
Building #11: Copley Place Tower



Minimal instances of disturbing glare are experienced and indicated to be no longer than one hour. They can be remedied easily by utilizing internal blinds.

11 of 8,760 hours annually (0.13%) show disturbing glare

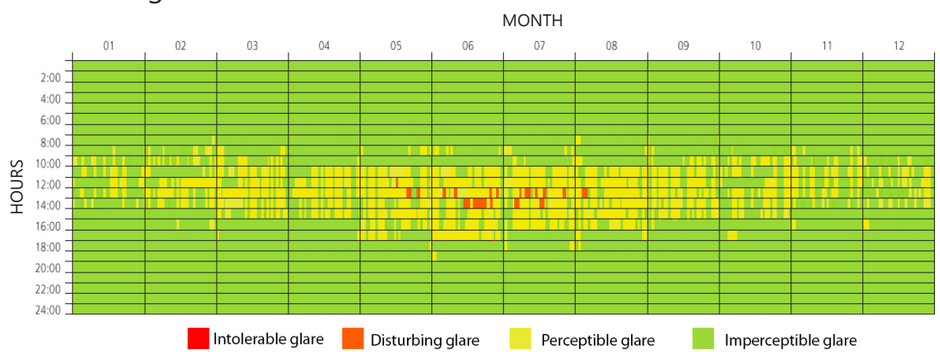
Building #12: 40 Trinity Place



Minimal instances of disturbing glare are experienced and indicated to be no longer than one hour. They can be remedied easily by utilizing internal blinds.

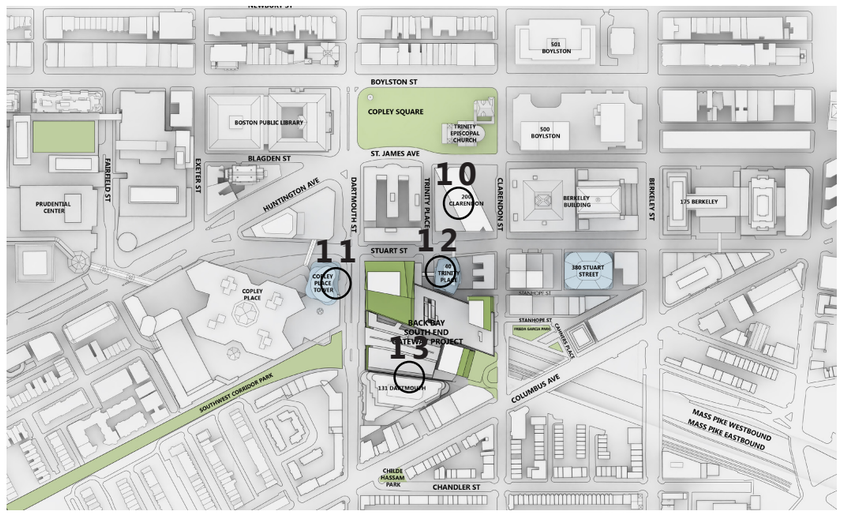
14 of 8,760 hours annually (0.16%) show disturbing glare

Building #13: 131 Dartmouth

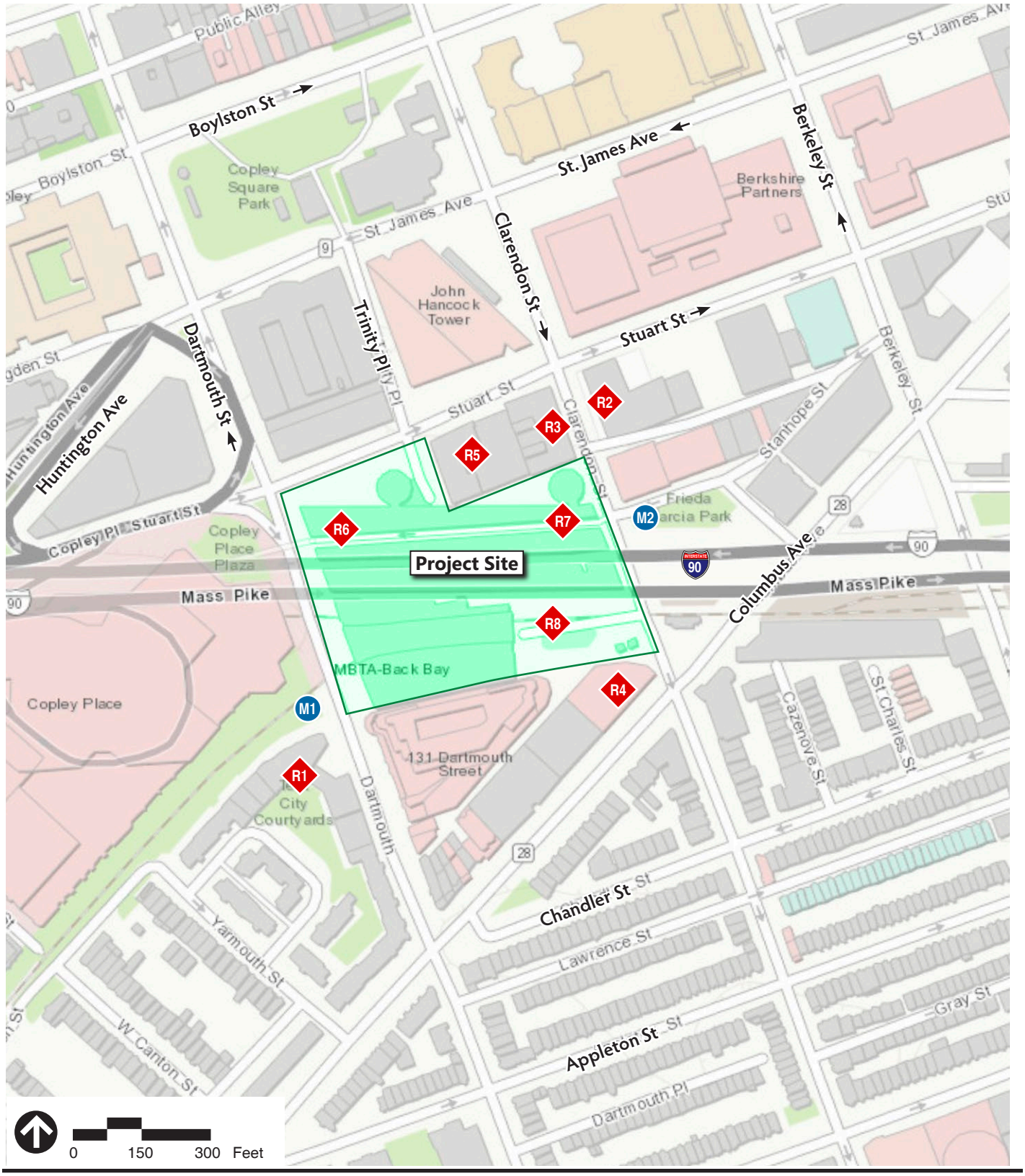


Minimal instances of disturbing glare are experienced and indicated to be no longer than one hour. They can be remedied easily by utilizing internal blinds.

15 of 8,760 hours annually (0.017%) show disturbing glare



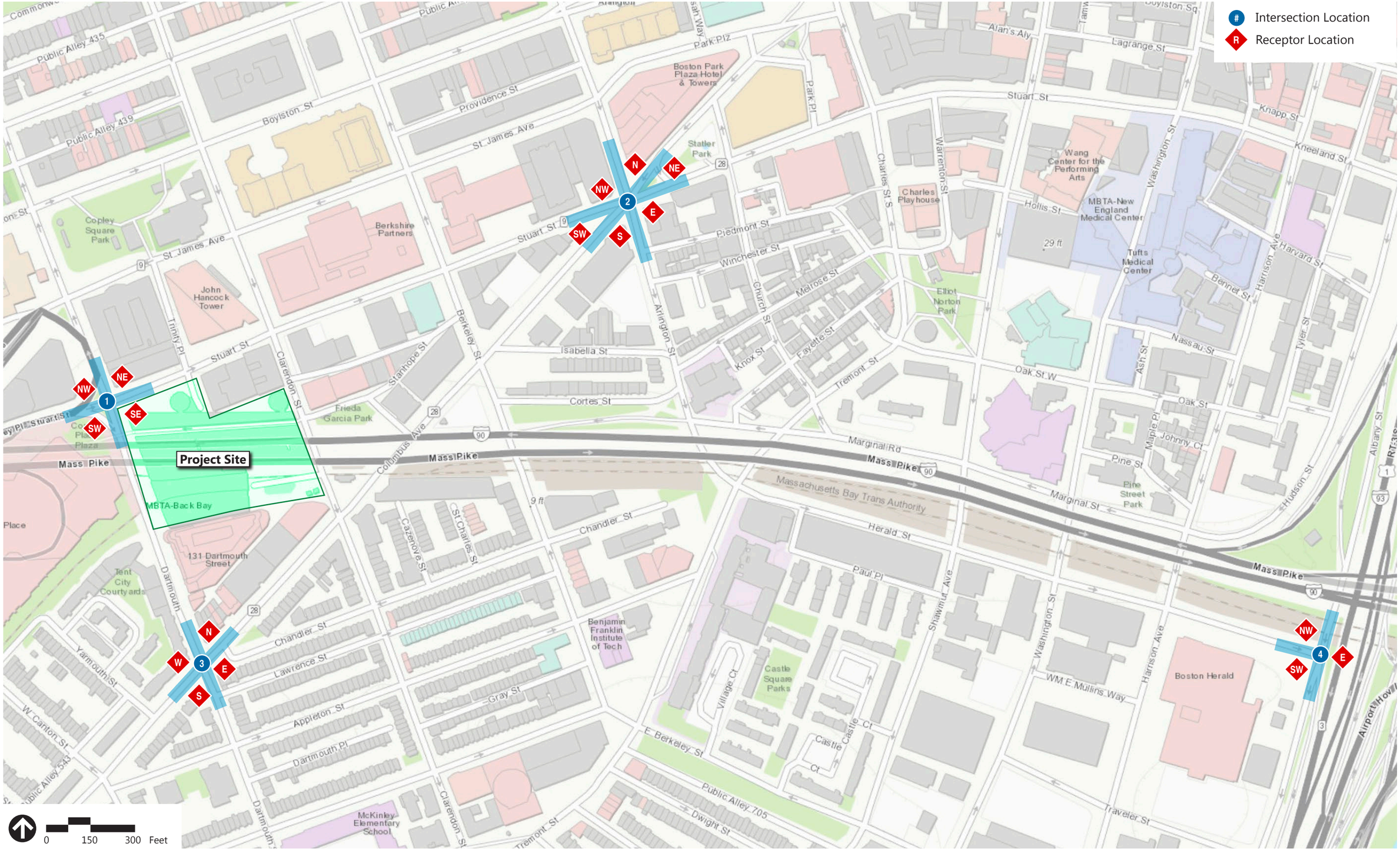
Location Key Plan



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Noise Receptor Locations

Figure 6.5



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Air Quality Microscale Analysis Intersections

Figure 6.6

7

Infrastructure

This chapter describes the infrastructure systems that will support the Project. The following utility systems are evaluated: stormwater management, sanitary sewage, domestic water and fire protection, natural gas, electric, and telecommunications.

7.1 Introduction

The Project will connect to existing utility systems available in public streets adjacent to the Project Site. These utility systems include those owned or managed by BWSC, MassDOT, MBTA, private utility companies, and on-site infrastructure systems. As design of the Project progresses, the availability and capacity of the existing utility systems will be assessed and coordinated with the applicable utility authorities and providers.

The Proponent will coordinate the design of the proposed utility connections with BWSC, MassDOT, MBTA and applicable private utility providers. All utility connections will be designed to minimize adverse effects to the existing systems and surrounding areas. The Proponent will acquire the appropriate utility permits and approvals prior to construction of each Project Component on a component by component basis.

Based on initial discussions with BWSC, the following items will be coordinated during the Site Plan Approval process for each Project Component in accordance with BWSC requirements:

- Prior to demolition of any buildings, all water, sewer, and storm drain connections to the buildings will be cut and capped at the main pipe.
- The Proponent will submit a Site Plan and a General Service Application for each Project Component to the BWSC Engineering Customer Service Department for review and approval when the design of the new water and wastewater systems and the proposed service connections to those systems are 50 percent complete.
- The Proponent will comply with the MassDEP infiltration/inflow (I/I) removal policy and develop an I/I mitigation plan through coordination with BWSC.
- The Proponent will evaluate the capacity of the water, sewer, and storm drain systems serving the Project Site to determine if the systems are adequate to meet the Project demands.
- The Proponent will explore opportunities for implementing water conservation measures in addition to those required by the State Plumbing Code. In particular, the Proponent will consider outdoor landscaping which requires minimal use of water to maintain.

- The Proponent will obtain a Hydrant Permit for use of any hydrant during the construction of each Project Component .
- The Proponent will submit with the Site Plan a phosphorus reduction plan for the proposed development. The Site Plan will indicate how storm drainage from roof drains will be handled and the feasibility of retaining stormwater discharge on-site. No stormwater will be discharged to a sanitary sewer system.
- The Proponent will obtain a NPDES General Permit for Construction from the EPA and MassDEP for each Project Component .
- The Proponent will submit a Stormwater Pollution Prevention Plan that includes a stormwater management plan in compliance with MassDEP Stormwater Management Standards for each Project Component .
- The Proponent will comply with BWSC's requirement that existing stormwater and sanitary sewer service connections, which are to be re-used by the Project, be dye tested to confirm they are connected to the appropriate system.

7.1.1 Complexities Associated with Air-Rights Construction

Approximately three quarters of the Project Site is located on concrete decking above major transportation facilities, including I-90, the Station, MBTA Commuter Rail and passenger rail lines, and the MBTA Orange Line. In addition, the Project Site contains the Garage and an off-street bus turnaround loop for the MBTA Bus Route 39 with a ventilation building.

The existing transportation infrastructure elements listed above bring about intricate design, engineering, and construction challenges for the Project. The key challenges include:

- Maintaining the functionality and operations of, and minimizing disturbances to, the existing transportation infrastructure during construction of the Project.
- Establishing the interface between existing infrastructure that will remain and the proposed building elements for the Project.
- Air rights construction and severe lack of terra firma requiring extensive and expensive foundation systems.
- Complexity for establishing utility corridors, loading facilities, and vehicular and pedestrian access points for the Project.
- Extensive construction period monitoring.

As noted in Sections 1.2.2 and 3.2, these are all factors which present significant challenges, unique to the Project Site, to developing the Project.

7.2 Summary of Key Findings and Benefits

The key findings and benefits relative to the utility systems include:

- Compliance with the MassDEP Stormwater Management Standards, in accordance with the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00) and Water Quality Certification Regulations (314 CMR 9.00);
- Implementation of a treatment train of BMPs to improve water quality, reduce runoff volumes, and reduce peak discharge rates of runoff in comparison to pre-development conditions;
- Provision for groundwater recharge by installing a recharge system designed to infiltrate clean stormwater runoff, in accordance with the standards articulated in the GCOD requirements;
- Provision of phosphorous removal for stormwater runoff from the Project Site, in accordance with BWSC design guidelines for projects that discharge to the Charles River Watershed; and
- Compliance with the requirements of the BWSC's 4:1 I/I mitigation program.

7.3 Regulatory Context

The following section outlines the regulatory framework required for utility connection reviews and standards. A complete list of the anticipated state and local permits associated with the Project is included in Chapter 1, *Project Description*. Relative to infrastructure, each Project Component will require:

- Site Plan Approval from BWSC for all storm drainage, sanitary sewer, and water service connections to BWSC infrastructure.
- MassDOT approval for all storm drainage connections to the MassDOT system (where applicable).
- MBTA approval for all storm drainage connections to the MBTA system (where applicable).
- Boston Fire Department review and approval regarding the fire protection measures, including Siamese connections, hydrants, and standpipes.
- Design and coordination of proposed energy systems (natural gas and electric) with the respective system owners.
- Authorization for excavation from the Boston Public Works Department ("BPWD"), through the street opening permit process, for any new utility connections or existing connections to be capped or removed.

7.4 Stormwater Management

This section outlines the existing and proposed stormwater management infrastructure systems for the Project.

7.4.1 Existing Drainage Conditions

BWSC, MassDOT, and the MBTA own and maintain the storm drainage lines in the vicinity of the Project Site. BWSC infrastructure is separated into two systems, north

and south, that discharge to two distinct outfalls: the Charles River and the Fort Point Channel. The MassDOT system discharges to the Fort Point Channel. The MBTA infrastructure is separated into two systems, east and west, that discharge to two distinct outfalls: the Fort Point Channel and the Deer Island Waste Water Treatment Plant. Service is provided via the following systems. See Figures 7.1a-b.

Garage West Parcel

- A 12-inch BWSC storm drain line exists within Dartmouth Street along the Garage West Parcel frontage. This storm drain line directs flows northward towards Stuart Street where it combines with an 18-inch storm drain line located in Stuart Street west of Dartmouth Street. The storm drain flows continue northward towards Copley Square and ultimately discharge to the Charles River.
- A 15-inch BWSC storm drain line exists within Stuart Street along the Garage West Parcel frontage. This storm drain line directs flows eastward towards Trinity Place where it combines with an 18-inch storm drain line located in Stuart Street, east of Trinity Place, and an 18-inch x 18-inch storm drain line located in Trinity Place, south of Stuart Street. The storm drain flows continue northward towards Copley Square and ultimately discharge to the Charles River.
- An 18-inch x 18-inch BWSC storm drain line exists within Trinity Place along the Garage West Parcel frontage. This storm drain line directs flows northward towards Stuart Street where it combines with the 15-inch and 18-inch storm drain lines located in Stuart Street. The storm drain flows continue northward towards Copley Square and ultimately discharge to the Charles River.
- Stormwater runoff from the western portion of the Garage is collected in a series of downspouts that discharge to two header pipe systems, located at the northern and southern limits of the Garage, that range in size from 6-inches to 10-inches. The header pipe systems convey flows to an existing 48-inch MassDOT storm drain line within the I-90 westbound mainline. The storm drain flows continue eastward and ultimately discharge to the Fort Point Channel.

Garage East Parcel

- A 15-inch BWSC storm drain line exists within Clarendon Street along the Garage East Parcel frontage. This storm drain line directs flows northward towards Stuart Street where it combines with an 18-inch storm drain line located in Stuart Street, east of Clarendon Street. The storm drain flows continue eastward along Stuart Street and ultimately discharge to the Charles River.
- Stormwater runoff from the eastern portion of the Garage is collected in a series of downspouts that discharge to two header pipe systems, located at the northern and southern limits of the Garage, that range in size from 6-inches to 10-inches. The header pipe systems convey flows to an existing 48-inch MassDOT storm drain line within the I-90 westbound mainline. The storm drain flows continue eastward and ultimately discharge to the Fort Point Channel.
- Stormwater runoff from the I-90 access road is collected in a series of catch basins within the access road that discharge to the existing 18-inch x 18-inch

BWSC drain line within Trinity Place. This storm drain line is described in the subsection above.

Station East Parcel

- No storm drain lines exist along the frontage for the Station East Parcel. The Station East Parcel fronts on the bridge section of Clarendon Street.
- A 15-inch BWSC storm drain line exists within Clarendon Street, north of the Station East Parcel. This storm drain line is described in the subsection above.
- An 18-inch BWSC storm drain line exists within Columbus Avenue, west of Clarendon Street and south of the Station East Parcel. This storm drain line directs flows eastward towards Clarendon Street and then southward along Clarendon Street through the Back Bay and ultimately discharges to the Fort Point Channel.
- Stormwater runoff from the existing bus loop for the Station is collected in a series of catch basins that discharge directly to a 12-inch MBTA storm drain line below the bus loop. This storm drain line directs flows eastward within the MBTA Tunnel and ultimately discharges to the Fort Point Channel.

Station West Parcel

- A 15-inch BWSC storm drain line exists within Dartmouth Street, south of the Station West Parcel. This storm drain line directs flows southward towards Columbus Avenue and then eastward along Columbus Avenue through the Back Bay and ultimately discharges to the Fort Point Channel.
- Stormwater runoff from the existing roof of the Station is collected internally in a series of downspouts that discharge to an 8-inch MBTA storm drain line below the Station. This storm drain line directs flows westward to the 30-inch to 36-inch MBTA storm drain lines within the MBTA Tunnel and ultimately discharges to the Deer Island Waste Water Treatment Plant.

7.4.2 Proposed Drainage Approach

The Project will require Site Plan Review and approvals from BWSC and approvals from MassDOT and the MBTA for each Project Component, where applicable. The Proponent will continue to coordinate with BWSC, MassDOT, and the MBTA on the design of and capacity for proposed connections to their storm drain systems. A thorough capacity analysis of the existing public infrastructure will be conducted as part of the BWSC Site Plan Review. Mitigation measures to be provided by the Proponent will also be decided at that time once the proposed design for each Project Component reaches an appropriate level of detail.

Proposed storm drain connections are anticipated to be provided as follows:

Garage West Parcel

- Stormwater runoff from the majority of the Garage West Parcel, which will be comprised of new roof areas for the Garage West building, will be directed to the

MassDOT system located within I-90 that ultimately discharges to the Fort Point Channel. Prior to discharging to the MassDOT system:

- Stormwater runoff from the new roof areas of the Garage West building will first be directed to structural BMPs designed to improve water quality through trapping oil, floatables, and Total Suspended Solids ("TSS"), then
- Clean runoff will be directed to a recharge system designed to infiltrate stormwater runoff in order to replenish groundwater and provide phosphorous removal.
- Overflow from the recharge system will discharge to the existing MassDOT system.

› Surface runoff from the public way (sidewalks, driveway aprons, and street surfaces) along the Garage West Parcel frontages will discharge to existing BWSC storm drain systems within Dartmouth Street, Stuart Street, and Trinity Place. There will be no increase in surface runoff to the BWSC storm drain systems.

Garage East Parcel

› Stormwater runoff from the majority of the Garage East Parcel, which will be comprised of new roof areas for the Garage East building and existing garage area to remain, will be directed to the MassDOT system located within I-90 that ultimately discharges to the Fort Point Channel. Prior to discharging to the MassDOT system:

- Stormwater runoff from the new roof areas of the Garage East building will first be directed to structural BMPs designed to improve water quality through trapping oil, floatables, and TSS;
- Clean runoff will be directed to a recharge system designed to infiltrate stormwater runoff in order to replenish groundwater and provide phosphorous removal.
- Overflow from the proposed recharge system will discharge to the existing MassDOT system.

› Surface runoff from the public way (sidewalks, driveway aprons, and street surfaces) along the Garage East Parcel frontages will discharge to existing BWSC storm drain systems within Clarendon Street and the I-90 access road. There will be no increase in surface runoff to the BWSC storm drain systems.

Station East Parcel

› The Station East Parcel is entirely located on the Air Rights Development Parcel over the Station track level. Stormwater runoff from the majority of the Station East Parcel, which will be comprised of new roof areas for the Station East building, will be directed to the existing MBTA system below the concrete deck that ultimately discharges to the Fort Point Channel. Prior to discharging to the existing MBTA system:

- Stormwater runoff from the new roof areas of the Station East building will first be directed to structural BMPs designed to improve water quality through trapping oil, floatables, and TSS, then
- Clean runoff will be directed to a recharge system, located to the south of the Station East Parcel, designed to infiltrate stormwater runoff in order to replenish groundwater and provide phosphorous removal.
- Overflow from the recharge system will discharge to the existing MBTA system.

› Surface runoff from the proposed pick-up/drop-off area and entrance plaza for the Station East building will first be directed to structural BMPs designed to improve water quality through oil, floatables, and TSS removal. Then, clean runoff will likely be directed to the existing MBTA storm drain system below that ultimately discharges to the Fort Point Channel. There will be no increase in surface runoff to the MBTA storm drain systems.

› Surface runoff from the public way (sidewalks, driveway aprons, and street surfaces) along the Station East Parcel frontage will discharge to existing BWSC storm drain systems within Clarendon Street and Columbus Avenue. There will be no increase in surface runoff to the BWSC storm drain systems.

Station West Parcel

› Existing storm drain connections for the existing Station roof will remain.

› Stormwater runoff from the new roof area for the Station West Air Rights Development Parcel, which is entirely located over the Station track and concourse levels, will first be directed to structural BMPs designed to improve water quality through oil, floatables, and TSS removal. Then, clean runoff will likely be directed to the existing MBTA storm drain system below the existing Station that ultimately discharges to the Deer Island Waste Water Treatment Plant.

› Surface runoff from the entrance plaza for the Station and the public way (sidewalks and street surfaces) along the Station West Parcel frontage will discharge to existing BWSC storm drain systems within Dartmouth Street. There will be no increase in surface runoff to the BWSC storm drain systems.

7.4.3 Compliance with Boston Zoning Code Article 32: Groundwater Conservation Overlay District

The Project Site is located within the GCOD, as established by Article 32 of the Code described in Section1.6.1. The Project will include facilities to capture stormwater runoff and direct it to infiltration systems consistent with the requirements of Article 32, with the goal of replenishing the groundwater table.

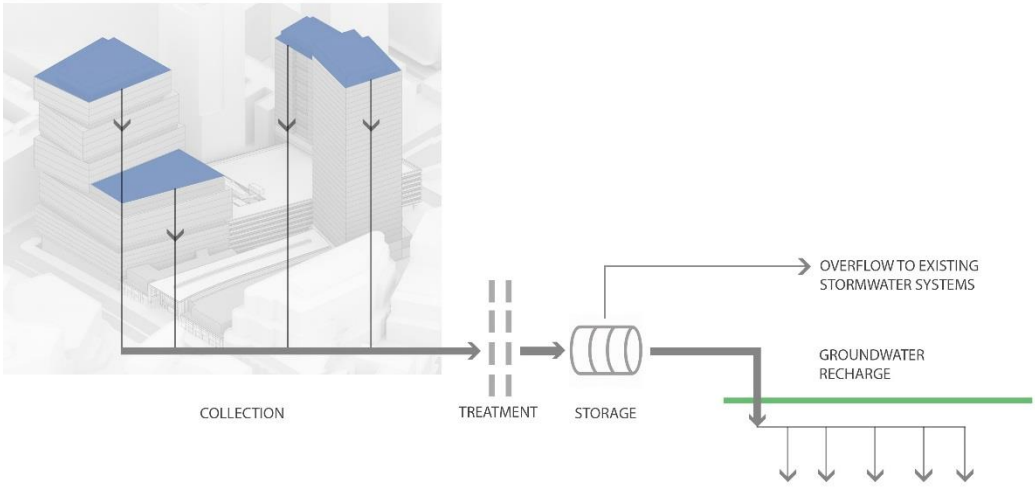
However, approximately three quarters of the Project Site is located on the Air Rights Development Parcel located over transportation facilities and infrastructure that are at an elevation below the desired groundwater recharge elevation. Therefore, it may not be possible to infiltrate the first inch of runoff over the entire

post-development impervious area. To provide groundwater recharge, to the maximum extent practicable, the proposed stormwater management system will include recharge chambers or wells designed to infiltrate runoff over a 72-hour period.

In addition, the proposed recharge system will provide stormwater treatment in the form of phosphorous removal, in accordance with BWSC design guidelines for projects that discharge stormwater runoff via a BWSC outfall.

The Proponent will provide the BPDA, BWSC and Boston Groundwater Trust a letter stamped by a professional engineer registered in Massachusetts that details how the GCODcriteria will be achieved for each individual Project Component prior to the issuance of a building permit in compliance with the requirements of PDA No. 2.

Groundwater Recharge Diagram



7.4.4 Compliance with MassDEP Stormwater Standards

The Project will comply with the Stormwater Management Standards as established in the Massachusetts Stormwater Handbook issued by MassDEP in 1997 and revised in 2008. A brief explanation of each standard and the compliance of each Project Component is provided 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.

› The proposed design will fully comply with Standard 1. All proposed stormwater conveyances for the Project will not discharge untreated stormwater directly to or cause erosion or scour to wetlands or receiving waters.

Standard 2: Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.

› The proposed design will fully comply with Standard 2. As a result of the improvements associated with the Project, the post-development peak discharges rates will not exceed the pre-development peak discharge rates.

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.

› The proposed design will fully comply with Standard 3. Stormwater recharge will be provided through a subsurface infiltration system.

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.

› The proposed design will fully comply with Standard 4. Stormwater runoff will be captured in a series of deep-sump hooded catch basins and/or directed to proprietary particle separators to provide 80% TSS removal prior to discharging to the existing BWSC, MassDOT, and MBTA drainage systems.

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.

› The proposed design will comply with Standard 5 to the maximum extent practicable. The Project is considered a land use with higher potential pollutant loads ("LUHPPL"), generating more than 1,000 vehicle trips per day, and therefore will be designed with BMPs sized to treat the one-inch Water Quality Volume. However, due to the site constraints – including urban conditions, congestion of existing underground utilities and infrastructure, air rights development, and the severe lack of terra firma – the use of proprietary particle separators as primary treatment for runoff from the Project Site will be necessary. Therefore, the

Project will be seeking relief from the pre-treatment and structural BMP requirements of this Standard under the provisions of Standard 7.

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.

› The proposed design will fully comply with Standard 6. The Project is not located within, and will not discharge untreated stormwater to, a critical area, as defined by Standard 6.

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.

› The Project is a redevelopment and therefore will be designed to comply only to the maximum extent practicable for the pretreatment and structural BMP requirements of Standard 5. The Project will be designed to fully comply with all other Standards.

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.

› The proposed design will fully comply with Standard 8. The Project will disturb more than one (1) acre of land and is therefore required to obtain coverage under the EPA NPDES Construction General Permit. As required under the permit, a Stormwater Pollution Prevention Plan ("SWPPP") will be developed and submitted before any land disturbances occur and will be monitored and complied with during the construction of each Project Component.

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

› The proposed design will fully comply with Standard 9. An Operations and Maintenance Plan (O&M Plan), including long-term BMP operation requirements, will be prepared for the Project to ensure proper maintenance and functioning of the proposed stormwater management system.

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

› The proposed design will fully comply with Standard 10. There will be no illicit connections associated with the proposed Project.

7.5 Sanitary Sewage

The following section outlines the existing and proposed sanitary sewage infrastructure systems for the Project.

7.5.1 Existing Sewage System

An initial meeting was held with BWSC on March 7, 2016 and no issues relative to existing sewer capacity are anticipated for the Project. BWSC owns and maintains the sanitary sewer lines in the vicinity of the Project Site and service is provided via the following systems. See Figures 7.2a-b.

Garage West Parcel

› A 12-inch sanitary sewer line exists within Dartmouth Street along the Garage West Parcel frontage. This sanitary sewer line flows northward towards Stuart Street where it combines with an 18-inch x 66-inch sanitary sewer line located in Stuart Street west of Dartmouth Street. The sanitary sewer flows continue northward towards Copley Square and ultimately to the Deer Island Waste Water Treatment Plant.

› A 10-inch sanitary sewer line exists within Stuart Street along the Garage West Parcel frontage. This sanitary sewer line flows eastward towards Trinity Place where it combines with an 18-inch x 36-inch sanitary sewer line located in Stuart Street, east of Trinity Place, and an 18-inch x 33-inch sanitary sewer line located in Trinity Place, south of Stuart Street. The sanitary sewer flows continue northward towards Copley Square and ultimately to the Deer Island Waste Water Treatment Plant.

› An 18-inch x 33-inch sanitary sewer line exists within Trinity Place along the Garage West Parcel frontage. This sanitary sewer line flows northward towards Stuart Street where it combines with the 10-inch and 18-inch x 36-inch sanitary sewer lines located in Stuart Street. The sanitary sewer flows continue northward towards Copley Square and ultimately to the Deer Island Waste Water Treatment Plant.

› A 6-inch sanitary sewer connection exists between the Garage and the 10-inch sanitary sewer line within Stuart Street.

Garage East Parcel

- An 18-inch x 18-inch sanitary sewer line exists within Clarendon Street along the Garage East Parcel frontage. This sanitary sewer line flows northward towards Stuart Street where it combines with a 12-inch sanitary sewer line located in Stuart Street, east of Clarendon Street. The sanitary sewer flows continue eastward along Stuart Street and ultimately to the Deer Island Waste Water Treatment Plant.

Station East Parcel

- No sanitary sewer lines exist along the frontage for the Station East Parcel. The Station East Parcel fronts on the bridge section of Clarendon Street.
- An 18-inch x 18-inch sanitary sewer line exists within Clarendon Street, north of the Station East Parcel. This sanitary sewer line is described in the subsection above.
- A 10-inch sanitary sewer line exists within Columbus Avenue, west of Clarendon Street and south of the Station East Parcel. This sanitary sewer line flows eastward towards Clarendon Street and then southward along Clarendon Street through the Back Bay and ultimately to the Deer Island Waste Water Treatment Plant.

Station West Parcel

- A 10-inch sanitary sewer line exists within Dartmouth Street along the Station West Parcel frontage. This sanitary sewer line flows southward towards Columbus Avenue and then westward along Columbus Avenue through the Back Bay and ultimately to the Deer Island Waste Water Treatment Plant.
- A 6-inch sanitary sewer connection exists between the Station and the 10-inch sanitary sewer line within Dartmouth Street.

7.5.2 Proposed Sewage Generation

Based on the current building program, the Project is expected to increase the sanitary sewer discharge from the Project Site by between 158,008 to 159,547 gallons per day (gpd). It is anticipated that BWSC will require Inflow and Infiltration ("I/I") removal and/or mitigation since the proposed discharge rate exceeds 15,000 gpd.

Existing and proposed sewer generation rates are provided in Tables 7-1 and 7-2 below for the Project.

Table 7-1 Project – Base Scheme: Net New Sewage Generation

Project Parcel	Program Type	Units	Generation Rate (gpd)	Generation (gpd)
New Project-Related Sewage Generation				
Garage West	Office	582,600 sf	75/1,000 sf	43,695
Garage West	Retail[1]	17,850 sf	50/1,000 sf	893
Garage West	Restaurant[1]	109 seats	35/seat	3,815
Garage West	Fast Food[1]	139 seats	20/seat	2,780
Garage East	Residential[2]	324 bedrooms	110/bedroom	35,640
Station East	Retail[1]	3,825 sf	50/1,000 sf	191
Station East	Restaurant[1]	23 seats	35/seat	805
Station East	Fast Food[1]	30 seats	20/seat	600
Station East	Residential[3]	565 bedrooms	110/bedroom	62,150
Station West	Retail[1]	22,500 sf	50/1,000 sf	1,125
Station West	Restaurant[1]	138 seats	35/seat	4,830
Station West	Fast Food[1]	175 seats	20/seat	3,500
TOTAL				160,024
Existing Sewage Generation to be Removed				
Garage West	Medical Office	23,633 sf	75/1,000 sf	1,773
Garage West	Bank	3,233 sf	75/1,000 sf	243
TOTAL				2,016
NET NEW				**158,008**

[1] Sewage generation calculations assume 25% of the proposed retail space will be dedicated to restaurants. Half of that space may serve sit-down restaurants and half may serve quick, casual dining.

[2] Assumes an approximate mix of 70% studios and one bedroom units, and 30% two-bedroom and three bedroom units.

[3] Assumes an approximate mix of 50% studios and one bedroom units, and 50% two-bedroom and three bedroom units.

Notes:

- Based on Massachusetts State Environmental Code (Title 5) 310 CMR 15.203.
- gpd = gallons per day; sf = square feet

Table 7-2 Project – Alternate Scheme: Net New Sewage Generation

Project Parcel	Program Type	Units	Generation Rate (gpd)	Generation (gpd)
New Project-Related Sewage Generation				
Garage West	Office	591,900 sf	75/1,000 sf	44,393
Garage West	Retail[1]	19,875 sf	50/1,000 sf	994
Garage West	Restaurant[1]	121 seats	35/seat	4,235
Garage West	Fast Food[1]	155 seats	20/seat	3,100
Garage East	Residential[2]	324 bedrooms	110/bedroom	35,640
Station East	Retail[1]	3,825 sf	50/1,000 sf	191
Station East	Restaurant[1]	23 seats	35/seat	805
Station East	Fast Food[1]	30 seats	20/seat	600
Station East	Residential[3]	565 bedrooms	110/bedroom	62,150
Station West	Retail[1]	22,500 sf	50/1,000 sf	1,125
Station West	Restaurant[1]	138 seats	35/seat	4,830
Station West	Fast Food[1]	175 seats	20/seat	3,500
TOTAL	Office			161,563
Existing Sewage Generation to be Removed				
Garage West	Medical Office	23,633 sf	75/1,000 sf	1,773
Garage West	Bank	3,233 sf	75/1,000 sf	243
TOTAL				2,016
NET NEW				**159,547**

[1] Sewage generation calculations assume 25% of the proposed retail space will be dedicated to restaurants. Half of that space may serve sit-down restaurants and half may serve quick, casual dining.

[2] Assumes an approximate mix of 70% studios and one bedroom units, and 30% two-bedroom and three bedroom units.

[3] Assumes an approximate mix of 50% studios and one bedroom units, and 50% two-bedroom and three bedroom units.

Notes:

- Based on Massachusetts State Environmental Code (Title 5) 310 CMR 15.203.
- gpd = gallons per day; sf = square feet

7.5.3 Proposed Sewage Connections

The Project will require Site Plan Review and approval from BWSC prior to the issuance of a building permit for each Project Component. The Proponent will continue to coordinate with BWSC on the design of and capacity for proposed connections to their sanitary sewer systems.

Proposed sanitary sewage connections will likely be provided as follows:

Garage West Parcel

› During the initial meeting with BWSC on March 7, 2016, BWSC stated that the existing 18-inch x 33-inch sanitary sewer line located in Trinity Place is oversized and outdated. BWSC recommended the construction of a new sanitary sewer line within Trinity Place and abandoning the existing 18-inch by 33-inch sanitary sewer line. Therefore, sanitary sewer service for the Garage West Parcel will likely connect to the newly constructed sanitary sewer line within Trinity Place.

› The 6-inch sanitary sewer connection between the existing 100 Clarendon Street Garage and the 10-inch sanitary sewer line within Stuart Street will be cut and capped at the main.

Garage East Parcel

› Sanitary sewer service for the Garage East Parcel will likely connect to the 18-inch x 18-inch sanitary sewer line that exists within Clarendon Street.

Station East Parcel

› Sanitary sewer service for the Station East Parcel will likely connect to either the 18-inch x 18-inch sanitary sewer line that exists within Clarendon Street or the 10-inch sanitary sewer line that exists within Columbus Avenue.

› Proposed sanitary sewer service connections will require coordination with the MBTA deck structure and the MassDOT bridge structure on Clarendon Street.

Station West Parcel

› Existing sanitary sewer service connections for the track and concourse levels of the Station will remain.

› Additional new sanitary sewer service connections for the Station West Air Rights Development Parcel will connect to one of the following:

- Existing 10-inch sanitary sewer line within Dartmouth Street,
- Existing 10-inch sanitary sewer line within Stuart Street through the Garage West development, or
- Existing 18-inch x 18-inch sanitary sewer line within Clarendon Street through the Station East development.

7.5.4 Sewer System Mitigation

BWSC requires all new sewer connections or expansions of existing connections that exceed 15,000 gallons per day of wastewater to mitigate the impacts of the development by removing four (4) gallons of infiltration and inflow (I/I) for each new gallon of wastewater flow. The Proponent will comply with this requirement and develop an I/I mitigation plan for each Project Component through coordination with BWSC.

7.6 Domestic Water and Fire Protection

The following section outlines the existing and proposed water infrastructure systems for the Project.

7.6.1 Existing Water Service

Based on the initial meeting with BWSC on March 7, 2016, no issues relative to existing water system capacity are anticipated for the Project. BWSC owns and maintains the water supply mains in the vicinity of the Project Site. Service is provided through two distribution systems designated as Southern High Service ("SH") and Southern Low Service ("SL"). The SH service is intended to supply water for building fire protection systems. SL service is intended to supply water for domestic use and fire hydrant demand.

Water service is provided via the following systems. See Figures 7.3a-b.

Garage West Parcel

- A 10-inch SH water main exists within Stuart Street along the Garage West Parcel frontage. The pipe material is pit-cast iron ("PCI") installed in 1912 and relined in 2010.
- A 12-inch SH water main exists within Trinity Place along the Garage West Parcel frontage. From Stuart Street, this water main continues southward towards the I-90 access road then eastward along the access road to Clarendon Street, thus creating a loop between Stuart Street and Clarendon Street. The pipe material is PCI installed in 1921; no relining date is listed.
- A 6-inch water service connection exists between the Garage and the 10-inch SH water main within Stuart Street. This 6-inch connection splits to provide both 6-inch fire protection and 6-inch sprinkler service to the Garage.
- A 4-inch domestic water service connection exists between the Garage and the 10-inch SH water main within Stuart Street.
- An existing hydrant (H92) is located on the north side of Stuart Street across the street from the Garage West Parcel frontage.
- An existing hydrant (H90) is located on the east side of Trinity Place across the street from the Garage West Parcel frontage.

Garage East Parcel

- A 12-inch SH water main exists within Clarendon Street along the Garage East Parcel frontage. The pipe material is PCI installed in 1921; no relining date is listed.
- A 12-inch SH water main exists within the I-90 access road adjacent to the Garage East Parcel. This water main loop is described in the subsection above.
- An existing hydrant (H120) is located on the west side of Clarendon Street along the Garage East Parcel frontage.

Station East Parcel

- No water service lines exist along the frontage for the Station East Parcel. The Station East parcel fronts on the bridge section of Clarendon Street.

- A 12-inch SH water main exists within Clarendon Street, north of the Station East Parcel. This water main is described in the subsection above.
- A 20-inch SH water main exists within Columbus Avenue, south of the Station East Parcel. The pipe material is PCI installed in 1874 and relined in 1972.
- A 12-inch SL water main exists within Columbus Avenue, south of the Station East Parcel. The pipe material is ductile iron cement lined ("DICL") installed in 1992.
- An existing hydrant (H86) is located on the west side of Clarendon Street at the Columbus Avenue intersection near the Garage East Parcel frontage.

Station West Parcel

- A 12-inch SL water main exists within Dartmouth Street along the Station West Parcel frontage. This main connects to a 12-inch SL water main in Columbus Avenue. The pipe material is PCI installed in 1901 and relined in 1972.
- A 6-inch fire protection service connection exists between the Station and the 12-inch SL water main within Dartmouth Street. The pipe material is DICL installed in 1981.
- A 4-inch domestic water service connection exists between the Station and the 12-inch SL water main within Dartmouth Street. The pipe material is DICL installed in 1980.
- An existing hydrant (H68) is located on the west side of Dartmouth Street across the street from the Station West Parcel frontage.

7.6.2 Proposed Water Usage

Title 5 Generation

- Based on the current building program and the Title 5 sewer generation rates, the Project is expected to discharge approximately an average of 161,500 gpd of sanitary sewage from the Project Site. Therefore, the expected water usage is 177,650 gpd, subject to future reduction through water conservation measures that each Project Component may implement.

Landscape Water Requirement

- Based on the current building program, the Project is expected to require the following peak month water usage for landscaping:
    - Garage West: 25,600 gallons
    - Garage East: 4,500 gallons
    - Station East: 7,600 gallons
    - Station West: 2,300 gallons
    - **Total Project: 40,000 gallons**

Fire Flow Requirements

- Based on the current building program, the Project is expected to require the following fire flows:
  - Garage West: 2,750 gallons per minute (gpm)
  - Garage East: 2,750 gpm
  - Station East: 2,750 gpm
  - Station West: 660 gpm

Air-conditioning Make-up Water

- Based on the current building program, the Project is expected to require the following peak flow of air-conditioning make-up water:
  - Garage West: 80 gpm
  - Garage East: 30 gpm
  - Station East: 46 gpm
  - Station West: 15 gpm
  - **Total Project: 171 gpm**

7.6.3 Proposed Water Service Connections

The Project will require Site Plan Review and approval from BWSC prior to the issuance of a building permit for each Project Component. The Proponent will continue to coordinate with BWSC on the locations, design of, and capacity for proposed connections to their water systems.

Proposed water service connections will likely be provided as follows:

Garage West Parcel

- During the initial meeting with BWSC on March 7, 2016, BWSC stated that the existing 12-inch SH water main that exists within Trinity Place is old (1921) and that they do not want to own pipes within the development area. BWSC recommended constructing a new water service connection within Trinity Place and abandoning the 12-inch SH water main loop within Trinity Place and the I-90 access road. Therefore, water service for the Garage West Parcel will likely connect to either the 10-inch SH water main that exists within Stuart Street or the newly constructed 12-inch SH water main within Trinity Place.
- Redundant fire protection connections will be required for the proposed high-rise commercial building.
- The existing 6-inch fire protection and 4-inch domestic water service connections between the existing Garage and the 12-inch SH water main within Stuart Street will be cut and capped at the main.

› Water service for the portion of the Garage to remain will likely connect to the 12-inch SH water main that exists within Clarendon Street.

Garage East Parcel

› Water service for the Garage East Parcel will likely connect to the 12-inch SH water main that exists within Clarendon Street.

› Redundant fire protection connects will be required for the proposed high-rise residential building.

Station East Parcel

› Water service for the Station East Parcel will likely connect to one of the following:

- Existing 12-inch SH water main within Clarendon Street,
- Existing 12-inch SL water main within Columbus Avenue.

› Proposed water service connections will require coordination with the MBTA deck structure and the MassDOT bridge structure on Clarendon Street.

› Redundant fire protection connects will be required for the proposed high-rise residential building.

Station West Parcel

› Existing water service connections for the track and concourse levels of the Station will remain.

› Additional new water service connections for the Station West Air Rights Development Parcel will likely be provided from the Garage West or Station East buildings or from Dartmouth Street.

7.6.4 Water Supply Conservation and Mitigation Measures

The Project will implement the following measures to address water supply conservation:

› Low flow water fixtures will be installed to meet, at a minimum, a 30% reduction in potable water use compared to baseline.

› Energy Star appliances will be installed for the residential buildings at Garage East and Station East Parcels.

› Water-efficient landscaping will be implemented through appropriate plant selection.

7.7 Private Utilities

The following section outlines the existing private utility systems for the Project.

7.7.1 Natural Gas Service

Natural gas is provided by National Grid in the vicinity of the Project Site. Natural gas is provided via the following systems:

Garage West Parcel

- A 12-inch gas main exists within Stuart Street along the Garage West Parcel frontage.
- A gas main, size unknown, exists within Trinity Place along the Garage West Parcel frontage, but will be confirmed as design develops.
- Natural gas service for the Garage West Parcel will likely connect to the gas main that exists within Trinity Place.
- Natural gas service for the portion of the Garage to remain will likely connect to the 8-inch gas main that exists within Clarendon Street.

Garage East Parcel

- An 8-inch gas main exists within Clarendon Street along the Garage East Parcel frontage.
- Natural gas service for the Garage East Parcel will likely connect to the gas main that exists within Clarendon Street.

Station East Parcel

- No natural gas service lines exist along the frontage for the Station East Parcel. The Station East Parcel fronts on the bridge section of Clarendon Street.
- An 8-inch gas main is known to exist within Clarendon Street, north of the Station East Parcel, and natural gas service is anticipated to exist within Columbus Avenue, south of the Station East Parcel, but will be confirmed as design develops.
- Natural gas service for the Station East Parcel will likely connect to either the 8-inch gas main that exists within Clarendon Street or to the gas main that is anticipated to exist within Columbus Avenue.
- Proposed natural gas service connections will require coordination with the MBTA deck structure and the MassDOT bridge structure on Clarendon Street.

Station West Parcel

- Natural gas service is anticipated to exist within Dartmouth Street along the Station West Parcel frontage, and will be confirmed as design develops.
- A 3-inch natural gas service connection and meter assembly exist at the southwest corner of the Station
- Existing natural gas service connections for the track and concourse levels of the Station will remain.

Additional new natural gas service connections for the Station West Air Rights

Development Parcel will likely be provided from the Garage West or Station East buildings. As the energy system designs for the proposed buildings are further developed, the Proponent will coordinate service connection locations and system requirements with National Grid to ensure adequate capacity for natural gas service is available to serve the Project. Final design and installation of natural gas services will similarly be coordinated with National Grid.

7.7.2 Electrical Service

Electric service is provided by Eversource Energy in the vicinity of the Project Site. Electric service is provided via the following systems:

Garage West Parcel

- Electric service exists within Dartmouth Street, Stuart Street, and Trinity Place along the Garage West Parcel frontage.
- Electric service for the Garage West Parcel will likely connect to the electric system that exists within Stuart Street and reinforce the system within Trinity Place.
- Electric service for the portion of the Garage to remain will likely connect to the electric system that exists within Clarendon Street.

Garage East Parcel

- Electric service exists within Clarendon Street and the I-90 access road along the Garage East Parcel frontage.
- Electric service for the Garage East Parcel will likely connect to the electric system that exists within Clarendon Street.

Station East Parcel

- Electric service exists within the sidewalk on the east side of Clarendon Street along the Station East Parcel frontage. However, it is anticipated that this electric service is only intended for street lighting.
- Electric service is known to exist within Clarendon Street, north of the Station East Parcel, and electric service is anticipated to exist within Columbus Avenue, south of the Station East Parcel, but will be confirmed as design develops.
- Electric service for the Station East Parcel will likely connect to either the electric system that exists within Clarendon Street or to the electric system that is anticipated to exist within Columbus Avenue.
- Proposed electric service connections will require coordination with the MBTA deck structure and the MassDOT bridge structure on Clarendon Street.

Station West Parcel

- Electric service exists within Dartmouth Street along the Station West Parcel frontage.

- Existing electric service connections for the track and concourse levels of Back Bay Station will remain.
- Additional new electric service connections for the Station West Air Rights Development Parcel will likely be provided from the Garage West or Station East buildings.

As the electric system designs for the proposed buildings are further developed, the Proponent will coordinate service connection locations and system requirements with Eversource Energy. On-site transformer facilities are required and will be subject to design and construction approval from Eversource Energy. Final design and installation of electric services and components will similarly be coordinated with Eversource Energy.

7.7.3 Telecommunication Service

Telecommunication service is provided via the following systems:

Garage West Parcel

- Telecommunication services exist within Stuart Street and Trinity Place along the Garage West Parcel frontage.
- Telecommunication services for the Garage West Parcel will likely connect to the telecommunication systems that exist within Stuart Street.

Garage East Parcel

- Telecommunication services exist within Clarendon Street along the Garage East Parcel frontage.
- Telecommunication services for the Garage East Parcel will likely connect to the telecommunication systems that exist within Clarendon Street.

Station East Parcel

- No telecommunication services exist along the frontage for the Station East Parcel. The Station East Parcel fronts on the bridge section of Clarendon Street.
- Telecommunication services are known to exist within Clarendon Street, north of the Station East Parcel, and are anticipated to exist in Columbus Avenue, south of the Station East Parcel, but will be confirmed as design develops.
- Telecommunication service for the Station East Parcel will likely connect to either the telecommunication system that exists within Clarendon Street or to the telecommunication system that is anticipated to exist within Columbus Avenue.
- Proposed telecommunication service connections will require coordination with the MBTA deck structure and the MassDOT bridge structure on Clarendon Street.

Station West Parcel

- Telecommunication services exist within Dartmouth Street along the Station West Parcel frontage.

- Existing telecommunication connections for the track and concourse levels of Back Bay Station will remain.
- Additional new telecommunication service connections for the Station West Air Rights Development Parcel will likely be provided from the Garage West or Station East buildings.

The Proponent will select private telecommunications companies to provide telephone, cable TV and data services. Upon selection of a provider or providers, the Proponent will coordinate service connection locations and system requirements and obtain appropriate approvals.

7.7.4 Protection of Utilities During Construction

Existing public and private utility infrastructure within the public ways in the vicinity of the Project Site will be protected during construction of the Project.

The installation of proposed utility service lines and connections within public ways will be in accordance with BWSC, MassDOT, the MBTA, Boston Public Works Department, the Dig-Safe Program, and applicable private utility company requirements. Specific methods for constructing proposed utilities where they are near to, or connect with, existing storm drain, sanitary sewer, or water facilities will be reviewed by BWSC as part of their Site Plan Review process.

The Proponent will continue to coordinate with BWSC, MassDOT, the MBTA, and applicable private utility companies to ensure safe and coordinated utility operations in connection with the Project. All necessary permits for each Project Component will be obtained before the commencement of any work.

Project Boundary

Project Phase Boundary

TRINITY CHURCH

JOHN HANCOCK TOWER

WESTIN HOTEL

PARKING GARAGE

Garage West

Garage East

DARTMOUTH ST

TRINITY PL

STUART ST

CLARENDON ST

PRIVATE RD

PUBLIC ALLEY NO. 559

STANHOPE ST

COLUMBUS AV

CAHNERS PL

15" storm drain

18"x18" storm drain

15" storm drain

12" storm drain

48" storm drain

0 50 100 Feet

Source: Boston Water and Sewer Commission

Continued on Sheet 2 of 2

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Existing Storm Drainage Systems
Sheet 1 of 2

Figure 7.1a

vhb

Continued from Sheet 1 of 2

Project Boundary

Project Phase Boundary

48" storm drain

12" storm drain

Station East

Station West

BACK BAY TRAIN STATION

PARKING GARAGE

Groundwater Tank

DARTMOUTH ST

COLUMBUS AV

YARMOUTH PL

CHANDLER ST

LAWRENCE ST

APPLETON ST

CLARENDON ST

CAZENOVE ST

SAINT CHARLES ST

GRAY ST

0 50 100 Feet

Source: Boston Water and Sewer Commission

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Existing Storm Drainage Systems
Sheet 2 of 2

Figure 7.1b

Project Boundary

Project Phase Boundary

18"x18" sanitary sewer

18"x33" sanitary sewer

10" sanitary sewer

12" sanitary sewer

TRINITY CHURCH

JOHN HANCOCK TOWER

WESTIN HOTEL

PARKING GARAGE

Garage West

Garage East

DARTMOUTH ST

TRINITY PL

STUART ST

CLARENDON ST

PRIVATE RD

PUBLIC ALLEY NO. 559

STANHOPE ST

CAHNERS PL

COLUMBUS AV

US POST OFFICE

Continued on Sheet 2 of 2

0 50 100 Feet

Source: Boston Water and Sewer Commission

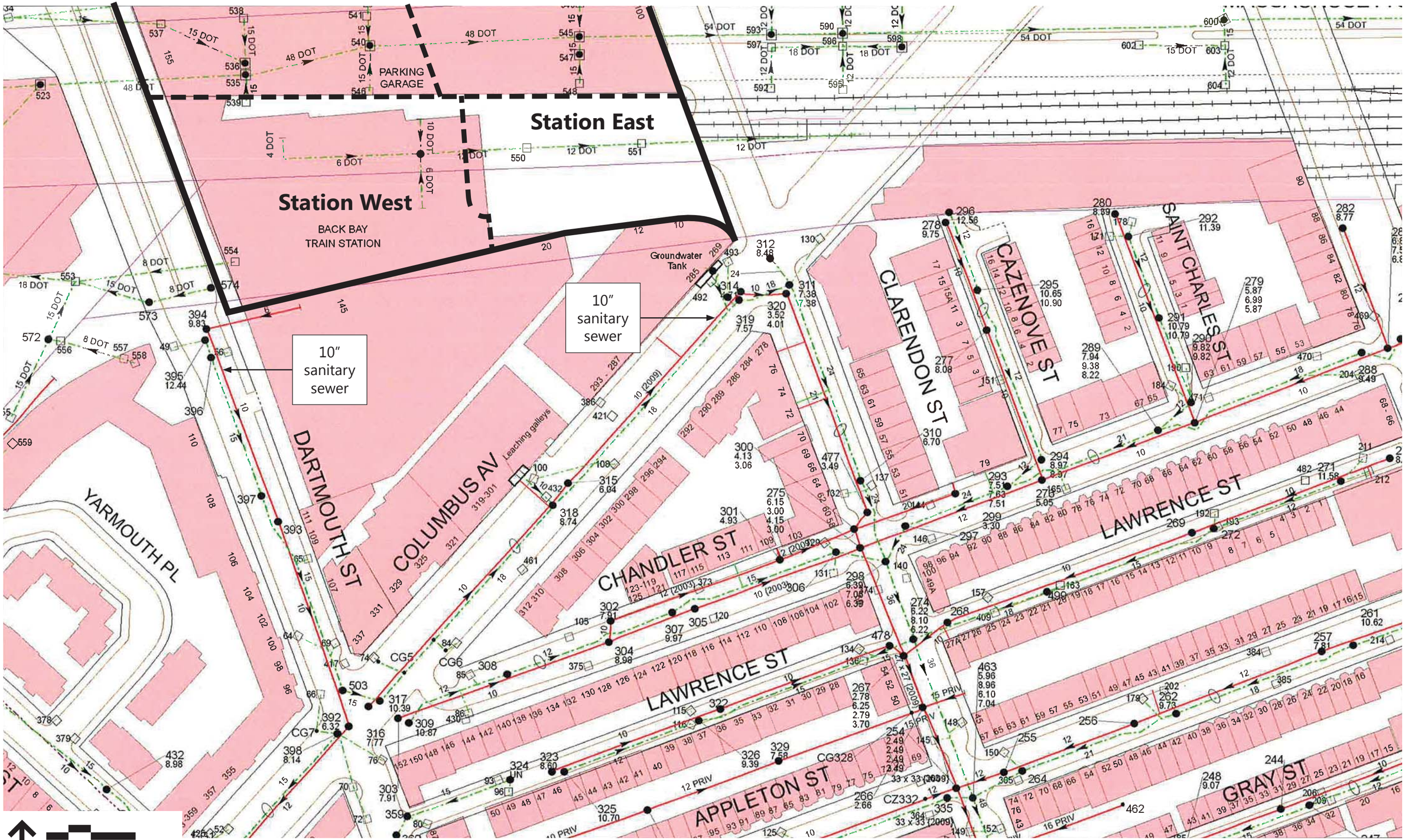
The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Existing Sanitary Sewer Systems
Sheet 1 of 2

Figure 7.2a

vhb

Continued from Sheet 1 of 2

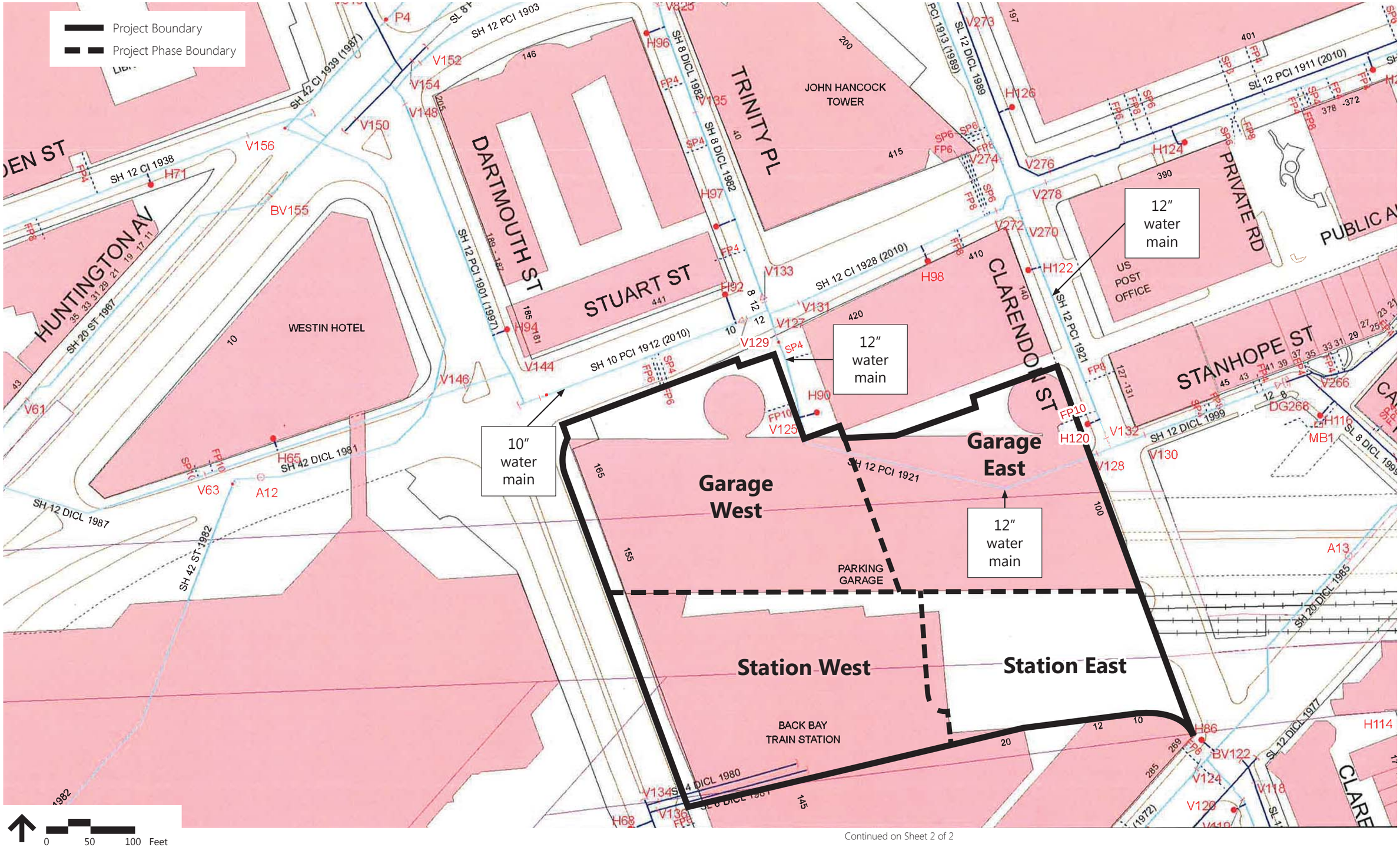


Source: Boston Water and Sewer Commission

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Existing Sanitary Sewer Systems
Sheet 2 of 2

Figure 7.2b



Continued on Sheet 2 of 2

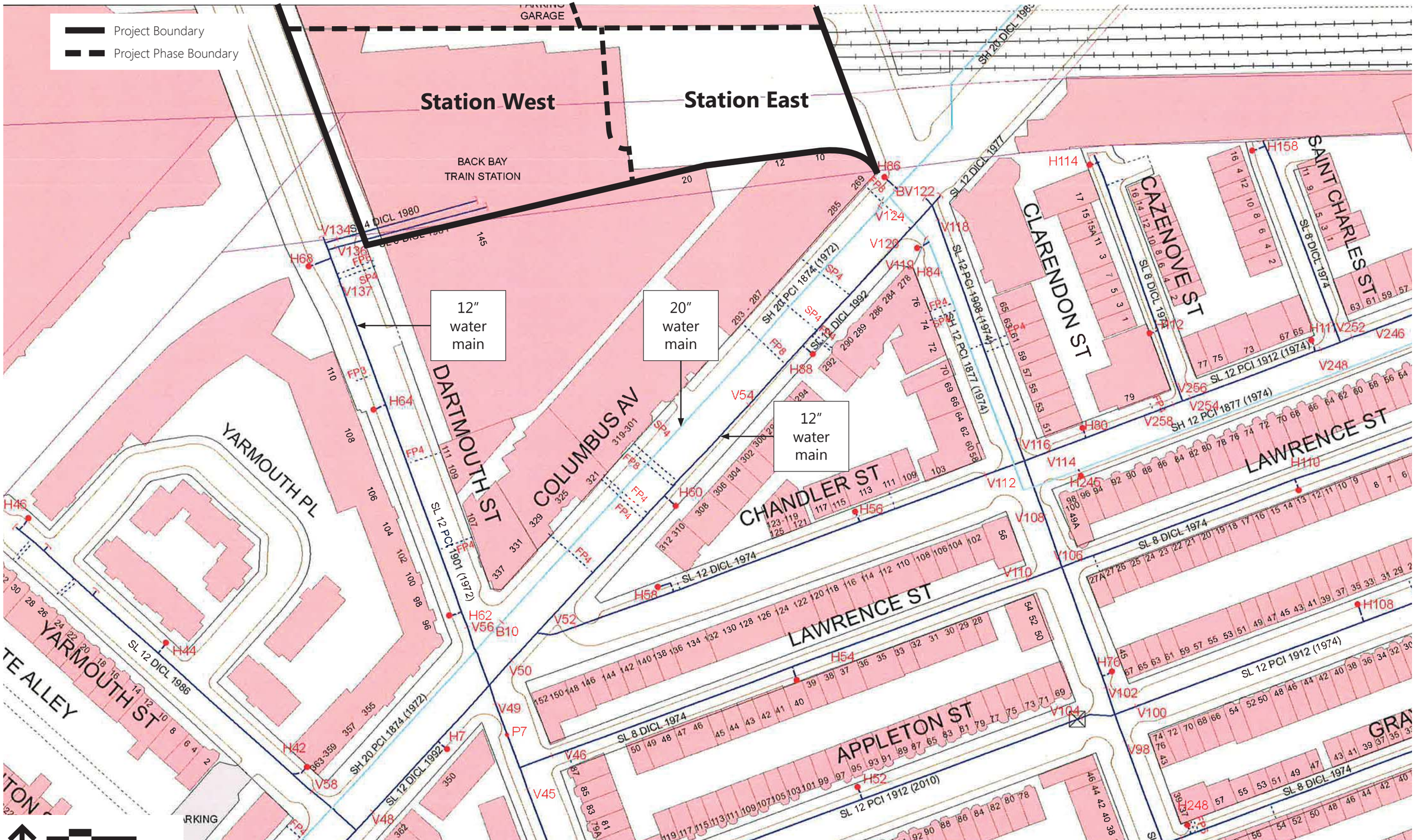
Source: Boston Water and Sewer Commission

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Existing Water Supply Systems
Sheet 1 of 2

Figure 7.3a

Continued from Sheet 1 of 2



Source: Boston Water and Sewer Commission

The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Existing Water Supply Systems
Sheet 2 of 2

Figure 7.3b

8

Historic Resources

This chapter identifies properties located within and in close proximity to the Project Site that are listed in the National and State Registers of Historic Places and/or included in the Inventory of Historic and Archaeological Assets of the Commonwealth. The chapter also describes potential Project effects to these properties, as well as Project-related benefits.

8.1 Summary of Key Findings and Benefits

- The Project Site contains one building, the 100 Clarendon Street Garage, (formerly known as the Hancock Garage, built in 1970), which is included in the Massachusetts Historical Commission (MHC) Inventory of Historic and Archaeological Assets of the Commonwealth (the "Inventory"). Despite this inclusion, the Garage does not meet the 50-year age threshold commonly used in the evaluation of historic significance and has not been recommended as eligible for inclusion in the National Register by the MHC.
- There are 21 historic resources located within a ¼-mile radius of the Project Site. This includes five State and National Register-listed and eligible districts, 11 individually designated properties, and five inventoried properties.
- Urban Design Effects – The Project is not expected to introduce materials that are incompatible with the current streetscape and skyline, as visible from historic properties.
- Shadow Effects – The results of the shadow analysis indicate that net new shadow on historic resources resulting from the Project will generally be limited to short periods of time during the day, and/or on secondary sides and rear façades of the affected buildings.
- Wind Effects – The results of a wind tunnel analysis indicate that wind impacts to historic properties as a result of the Project are anticipated to be minimal, and conditions are expected to improve in several locations proximate to historic properties.
- Geotechnical Effects – No impacts to abutting historic resources are anticipated, due to the use of low displacement foundation types, and the monitoring of soil movement and groundwater during construction, which will assist in identifying whether modifications to construction methods will be necessary to protect nearby buildings.
- Historic Context – The Project Site is located in an area that combines some of Boston's most well-known historic landmarks with some of its tallest examples of 20th-century architecture. The site is part of the "High Spine," a 1960s planning concept proposed by the Boston Society of Architects' Committee on Civic

Design, which envisioned a corridor of tall skyscrapers linking Back Bay to Boston Harbor. Today, peaks of the proposed spine are evident at the Prudential Center complex, 200 Clarendon (formerly known as the John Hancock Tower, constructed in 1976), and the Financial District. In the vicinity of the Project Site, the spine traverses a corridor between the historic neighborhoods of the Back Bay and South End, and in proximity to the Bay Village Historic District, concentrating two centuries of architecture in an active, varied environment.

8.2 Historic Resources

8.2.1 Historic Resources within the Project Site

Hancock Garage, 100 Clarendon Street (BOS.2366)

Completed in 1970, the Garage is an eight-story concrete parking garage with storefronts along the west side and commercial activities along the eastern side. It occupies the air rights directly above I-90, running the full length of the block on the south side of Stuart Street between Clarendon and Dartmouth Streets, adjacent to the Station. The building is included in the Inventory (BOS.2366), and was recorded as part of a 1990 comprehensive survey of commercial buildings along Stuart Street.

The Garage was constructed for the John Hancock Life Insurance Company, which, at the time of the Garage's construction, occupied its second tower, located to the northeast of the Project Site on the east side of Clarendon Street. In 1976, the company completed its hallmark 60-story skyscraper located opposite the Garage on the north side of Stuart Street. The Garage was designed by the Boston engineering firm of Nichols, Norton & Zaldastani, established by John Nichols and Paul Norton in 1940, who were joined by Dr. Othar Zaldastani in 1952.

The Garage building has a parallelogram footprint, with two cylindrical speed ramp towers on the north side. It is strictly utilitarian in appearance and construction, with long, uninterrupted bands of concrete marking each story. Concrete piers support the ground level. On Clarendon Street, driveways mark each corner of the façade, providing access to the Garage and the I-90 On-Ramp, while on Dartmouth Street, the upper stories overhang a pedestrian arcade with deeply recessed glazed storefronts. The storefronts are raised above street level and accessed by concrete steps. Due to the slope of the Site, the number of steps varies from over a dozen at the north end of the Dartmouth Street façade to only three at the south end. On the south side of the Garage, the building abuts the Station (see Figure 1.4a-c for existing site photographs).

8.2.2 Resources in the Vicinity of Project Site

The area surrounding the Project Site has been thoroughly documented by historic resource surveys, resulting in several listed and inventoried historic resources (Table 8-1; Figure 8-1. Nearly all of the historic resources located within a ¼-mile radius of the Project Site contribute to a National Register-listed historic district, a National

Register-eligible historic district, and/or a local historic district. Some of the resources within these districts also have an individual designation, as a National Historic Landmark, a National Register individually-listed property, and/or a Boston Landmark.

Table 8-1 Historic Resources in the Vicinity of the Project Site

No.	Resource Name	Location	MHC Inventory No.	Designation
A	Back Bay Architectural District	N/A	BOS.BW	LHD
B	Back Bay Historic District	N/A	BOS.BT/ NR #73001948	NRDIS
C	Park Square-Stuart Street Historic District	N/A	BOS.ZF	INV
D	South End District/South End Landmark District	N/A	BOS.AB/BOS.AC / NR #73000324	NRDIS, LHD
E	St. Botolph Street Area/ Architectural Conservation District	N/A	BOS.BV	NRDOE, LHD
F	Bay Village Historic District	N/A	BOS.BQ	LHD
1	New Old South Church	645 Boylston Street	BOS.2953/NR # 70000690	NRIND, NRDIS, NHL, LHD
2	Boston Public Library (McKim Building)	700 Boylston Street	BOS.2624/NR #73001948	NRIND, NRDIS, NHL, LL
3	Boston Public Library (Johnson Building)	700 Boylston Street	BOS.2625	NRDIS, LL
4	Trinity Church	206 Clarendon Street	BOS.2623/NR #70000733	NRIND, NRDIS, NHL
5	Trinity Rectory	Clarendon Street/Newbury Street	BOS.2694/NR # 72000150	NRIND, NRDIS, LHD
6	Berkeley Building	414-426 Boylston Street	BOS.2615	NRDIS, LL
7	YWCA Boston	140 Clarendon Street	BOS.2368/NR # 04000119	NRIND
8	Youth's Companion Building	140-144 Berkeley Street/195-215 Columbus Avenue	BOS.2377/NR #74000393	NRIND
9	Armory of the First Corps of Cadets	97-105 Arlington Street/130 Columbus Avenue	BOS.2371	NRIND, LL
10	Cyclorama Building (Boston Center for the Arts)	543-547 Tremont Street	BOS.1446/NR # 73000318	NRIND, NRDIS, LHD

No.	Resource Name	Location	MHC Inventory No.	Designation
11	First Baptist Church	110 Commonwealth Avenue	BOS.3472/NR # 72000146	NRIND, NRDIS, LHD
12	Boylston Apartments	780 Boylston Street	BOS.2628	INV
13	N/A	760 Boylston Street	BOS.2627	INV
14	Hotel Lenox	Boylston Street/61 Exeter Street	BOS.2626	INV
15	District 4 Fire House	200 Columbus Avenue	BOS.2378	INV

NRIND National Register of Historic Places, Individual Listing
NRDIS National Register of Historic Places, District
NHL National Historic Landmark
NRDOE Determined eligible for listing in the National Register by the Keeper of the Register (State Register of Historic Places)
LHD Local Historic District (State Register of Historic Places)
LL Boston Local Landmark (State Register of Historic Places)
INV Listed in the Inventory of Historic and Archaeological Assets of the Commonwealth, no current designation

Back Bay Historic District (BOS.BT/ NR #73001948)/Back Bay Architectural District (BOS.BW)

North of the Project Site is the nationally-registered **Back Bay Historic District**, a largely residential area constructed during the late 19th century on newly-filled tidal flats on the south bank of the Charles River. While recognized for its dense concentration of complementary high-style brownstones arranged in a strict grid pattern, the district also boasts a number of institutional buildings, hotels, apartment buildings, and commercial buildings, as well as public spaces such as the Commonwealth Avenue Mall and Copley Square. The predominantly residential portion of the district, located north of Copley Square, has also been designated as a local historic district, the **Back Bay Architectural District**.

The historic districts (both National Register and local) have a number of buildings that are individually listed in the National Register. Several are also National Historic Landmarks and/or Boston Landmarks. Many of these individually designated buildings are situated around Copley Square, which is one block north of the Project Site. **Trinity Church (BOS.2623/NR #70000733)**, H.H. Richardson's most famous work, was constructed 1872-1877, with the porches completed by Richardson's successor in the 1890s. The Greek cross plan church has a massive central tower and features the rusticated polychrome stone, heavy arches, bands of windows, and decorative flashing that would come to define the Romanesque Revival, or "Richardsonian Romanesque," style. Artistic highlights also include stained glass windows by John La Farge and William Morris Studios, and sculpture by Daniel Chester French and Augustus Saint-Gaudens. It is a National Historic Landmark and a Boston Landmark. Located on the west side of Copley Square, the Boston Public Library is composed of two quite different but complementary sections, the 1895 **McKim Building (BOS.2624/NR #73001948**), which is a National Historic

Landmark and a Boston Landmark, and the 1971 **Johnson Building (BOS.2625)**, a Boston Landmark. The original building is one of the earliest executions of the Renaissance Revival style by the nationally recognized firm of McKim, Mead and White, with elaborate decoration on the exterior and interior. Similarly, Philip Johnson is one of the 20th century's best-known architects, and his addition created a contemporary response to the 19th century design. The 1874 **New Old South Church (BOS.2953/NR #70000690)**, a Gothic Revival style church executed in Roxbury puddingstone, was designed by Cummings and Sears. It features a soaring campanile on the front façade and is decorated with sandstone bands and tracery, wrought iron screens, and has an ornamental slate tile roof. The church is a National Historic Landmark.

North of Copley Square, the historic district contains two more individually-listed H.H. Richardson designs. The **Trinity Rectory (BOS.2694/NR # 72000150)**, located one block north of Copley Square, was built in 1880 and includes carved reliefs and a Syrian arch over a deeply recessed main entrance. The **First Baptist Church (BOS.3472/NR # 72000146)**, located at the north edge of the ¼-mile radius, was completed in 1871. It features several of Richardson's Romanesque design elements, and a tall tower with a carved frieze by Frederic Auguste Bartholdi. One block east of Copley Square is the **Berkeley Building (BOS.2615)**, a Boston Landmark. This 1905 Beaux Arts building designed by Codman and Despradelle features five-story arched bays across the façade executed in architectural terra cotta.

South End District (BOS.AB/NR #73000324)/South End Landmark District (BOS.AC)

Another 19th century residential historic district is located just south of the Project Site, the nationally-registered **South End District**. The district was similarly developed on filled land, surrounding Washington Street, the original route along the Boston Neck. It is characterized by streetscapes of relatively uniform bow-front row houses, several of which are along tree-lined streets surrounding open parks. The district is also home to a number of churches, which served the population as it evolved from an exclusive, high-income neighborhood to a more diverse community of multi-family homes during the late 19th and early 20th centuries. The boundaries of the National Register district largely coincide with those of the **South End Landmark District**, a local historic district, with variations mostly occurring on the southeast side where the local historic district encompasses a larger area.

Both the National Register historic district and the local historic district include the **Cyclorama (BOS.1446/NR #73000318),** which is also individually listed in the National Register. Designed by the well-known firm Cummings and Stearns, it was constructed in 1884 to house the monumental painting, "The Battle of Gettysburg," in the round. The current façade was added in the early 20th century, when the building served as the Boston Flower Exchange.

Saint Botolph Architectural Conservation District (BOS.BV)

The **Saint Botolph Architectural Conservation District**, another residential neighborhood constructed on filled land, was developed nearly entirely during the last two decades of the 19th century. It became associated with a population of artists, writers, and craftspeople who taught, worked, and lived in the area. The district is a designated local historic district, is listed in the State Register, and has been determined National Register-eligible by the Keeper of the Register.

Bay Village Historic District (BOS.BQ)

The **Bay Village Historic District** is a predominantly intact early 19th-century residential district comprised of two- to three-story red brick row houses set on raised granite basements. Developed largely between 1825-1840, the area was constructed on former mudflats. The district is a designated local historic district and is listed in the State Register.

Inventoried Properties

The ¼-mile radius also includes five properties included in the Inventory. Directly north and east of the Project Site is the **Park Square – Stuart Street Historic District**. The commercial district comprises dozens of buildings that illustrate the area's growth as a business and institutional hub during the years following the American Civil War, into the mid- and late-20th century. The district is notable for its concentration of buildings designed by some of Boston, New York, and Chicago's most prominent firms. The area includes three buildings individually listed in the National Register. The **YWCA Boston building (BOS.2368/NR #04000119)** was constructed in 1924 for this rapidly growing organization. The 13-story brick and limestone building contained residential units, classrooms, recreational facilities, an auditorium, offices, and dining facilities. The **Youth's Companion Building (BOS.2377/NR #74000393)** is a five-story Romanesque Revival style building completed in 1892 for the popular literary magazine's publisher. The **Armory of the First Corps of Cadets (BOS.2371**), another Romanesque Revival style building, was completed in 1897. The building is also a Boston Landmark.

At the west end of the radius are the 1964 **Boylston Apartments (BOS.2628)**, the 1965 department store building at **760 Boylston Street (BOS.2627)**, and the 1901 Hotel Lenox (BOS.2626). At the east end of the radius is the 1970 **District 4 Fire House (BOS.2378)**.

8.2.3 Archaeological Resources

There are no known archaeological resources within the Project Site that are listed in the State and National Registers or included in the Inventory. Prior to the construction of the original buildings on the site during the 19th century, the Project Site was filled land with a depth of 20-25 feet. In addition, the majority of the Site is air rights and infrastructure over I-90 or rail lines; therefore, it is unlikely that the Project will affect previously unidentified archaeological resources.

8.3 Potential Impacts to Historic Resources

8.3.1 Urban Design

As described in Chapter 3, *Urban Design*, the Project has been designed to reinforce the planning and design strategies developed as part of the Stuart Street Zoning District. The Stuart Street Zoning District resulted from the multi-year Stuart Street Planning Study, the goal of which was to support the design of high-quality, continuous street frontage and the creation of new workplace and residential spaces in this central urban area that respect the neighborhood context. While the Project will be authorized as an amendment to PDA No. 2, consistent with the intent of the Stuart Street Zoning District, it will considerably enhance the architectural character of this area, which is highly trafficked by local residents and visitors alike. The Project includes improved civic access to the Station, which is an important city gateway to rail, subway, and bus lines.

The Project responds to the urban-scale design goals of the "High Spine" corridor with the introduction of a commercial high-rise building on Dartmouth Street and two residential high-rises near Clarendon Street, complementing existing High Spine proportions and reinforcing existing urban alignments. At the street level, the Project includes significant, appropriately scaled streetscape improvements, including bringing the street wall closer to Clarendon Street, and creating a dynamic public plaza that serves as a forecourt to a new Station entrance. The streetscape will be activated along Dartmouth, Stuart, and Clarendon Streets with new street-level retail and lobby spaces. This highly-visible pedestrian environment is currently characterized by dark, deeply-recessed retail storefronts, Garage speed ramps and driveways, and a mostly vacant bus turn around. The demolition of the large, imposing concrete speed ramp along Clarendon Street in favor of a residential lobby will create greater distance between the building on the Garage East Parcel and the adjacent YWCA Boston building, affording the latter building greater street presence.

The design of the Project utilizes modern glass storefront systems in the commercial and residential building lobbies in order to create and reinforce connections between the exterior and interior environments. The full-height glass walls will be low in reflectivity while maintaining high visibility. Exterior wall materials, which may include glass, masonry, and/or metal panel will be modern and sustainable without competing with the existing urban fabric. Along Dartmouth and Stuart Streets, façade areas on reconstructed parking levels will be architecturally screened and designed to be harmonious with the commercial podium. The Project is expected to use contextually appropriate materials that are compatible with the current streetscape and skyline, as visible from these properties. Renderings of pedestrian-level perspectives of the Project from locations proximate to historic resources are presented in Figures 8.1 and 8.2a-j.

8.3.2 Shadow

A shadow analysis was conducted for the Project, consistent with both Section 80B-2(c) of the Code and the guidance provided by the recently enacted Stuart Street Zoning District. The results of the shadow analysis are provided in Chapter 6, *Environmental Protection*. All new shadow has been minimized to the maximum extent practicable, and is limited to less than two hours of shadow on Copley Square between 8:00 am to 2:30 pm on any given day from March 21 to October 21, as specified in the Stuart Street Zoning District regulations.

Targeted net new shadow analyses specific to the façades of the Boston Public Library, Trinity Church, New Old South Church, the YWCA Boston building, and the Youth's Companion Building were completed in order to understand potential net new shadows on the facades of these historic resources (Figures 8.3a-f). The analysis studied anticipated net new shadows on the dates of March 21, June 21, September 21, and December 21, representing the days in the year when the midday sun is at its highest (June 21) and lowest point (December 21), and the dates when shadows are midway through a period of lengthening (March 21 and September 21). The results reveal that net new shadows on these resources as a result of the Project are very limited, and occur primarily during the winter period.

Boston Public Library

The southeast corner of the library, consisting of the front (east) and side (south) façades of the McKim Building, faces the Project. The shadow analysis reveals that the Project will result in a modest amount of net new shadow during the morning hours on March 21, September 21, and December 21 (Figure 8.3b). There would be no net new shadow on June 21, and no net new shadow would be cast on the library's interior courtyard on any of the study dates

On March 21 and September 21, the Project is anticipated to result in 87 minutes of net new shadow on the side (south) façade of the building along Blagden Street, ending by 9:32 am. On December 21, the Project would result in 120 minutes of net new shadow, which moves across the south and east façades and ends entirely by 9:30 am. While not strictly governed by the Stuart Street Zoning District guidelines for shadow on Copley Square Park, this net new shadow is compliant with the intent of the guidelines, as it falls outside the seasonal restriction and meets the hourly limitations.

New Old South Church

A shadow analysis of the east and south facades of New Old South Church facing the Project was undertaken. The analysis indicates that new shadow is anticipated only on the December 21, proceeding north across the façades for a total of 130 minutes during the morning hours, ending by 9:55 am (Figure 8.3c). While not strictly governed by the Stuart Street Zoning District guidelines for shadow on Copley Square Park, this net new shadow is compliant with the intent of the guidelines, as it falls outside the seasonal restriction and meets the hourly

limitations. No net new shadow is anticipated for March 21, June 21, or September 21.

Trinity Church

The analysis indicates that net new shadow on Trinity Church is restricted to only the December 21 study date, when a total of 90 minutes of net new shadow is anticipated to occur on the west façade (Figure 8.3d). New shadow would enter the façade at 11:15 am, and exit entirely by 12:45 pm. While not strictly governed by the Stuart Street Zoning District guidelines for shadow on Copley Square Park, this net new shadow is compliant with the intent of the guidelines, as it falls outside the seasonal restriction and meets the hourly limitations. No net new shadow is anticipated on March 21, June 21, or September 21.

Youth's Companion Building

The primary façade of this building faces south onto Columbus Avenue, away from the Project. A narrow portion of the rear (north) façade of the building faces the Project along Stanhope Street. The analysis indicates the Project will result in some net new shadow on this secondary façade on March 21, September 21, and December 21 (Figure 8.3e). No net new shadow is anticipated on June 21.

On March 21 and September 21 study dates, the Project will result in 109 minutes of net new shadow in the late afternoon, on the small portion of the rear façade visible along Stanhope Street, ending by 5:15 pm. On December 21, net new shadow is limited to 3:00-3:45 pm.

YWCA Boston

The YWCA Boston building is located to the north of and adjacent to the Project, across a service alley. The primary façades of the building face away from the Project - north onto Stuart Street and east onto Clarendon Street, and will experience no new shadow from the Project.

The shadow analysis indicates that net new shadow will be created by the Garage East residential building and will cross the secondary south (side) and west (rear) façades along the service alley, on March 21, June 21, September 21, and December 21 (Figure 8.3f). On March 21 and September 21, some net new shadow is anticipated on limited portions of the south façade of the building and the upper portion of the interior court facades. The shadow is anticipated to last seven (7) hours and 31 minutes on those dates, ending at 3:41 pm. The analysis indicates five (5) hours and 30 minutes of net new shadow on limited areas of the south and rear elevations of the building on June 21, ending at 2:20 pm. The Project is expected to create net new shadow on the south and west façades of the building for eight (8) hours and 39 minutes on December 21, beginning at sunrise and lasting until 3:50 pm.

8.3.3 Wind

A wind tunnel analysis was conducted which compared existing and proposed conditions, pursuant to the Section B.1 of the BPDA Development Review guidelines (See Section 6.2, *Wind,* and Appendix I for complete details). Overall, the results of the wind tunnel analysis indicate minimal change in wind conditions on an annual basis, at 135 test sites, resulting from the Project. Wind conditions at test locations north of the Project Site, within and proximate to the Back Bay Historic District, the Boston Public Library, New Old South Church, Trinity Church, and the Berkeley Building, indicate no change from existing (No-Build) conditions, and at several locations the Project will actually improve wind comfort conditions (Locations 79, 109 and 130 in Figure 6.1g).

East of the Project Site, most test sites near the YWCA Boston building, the Bay Village Historic District, the Park Square-Stuart Street Historic District, the Youth's Companion Building, and the Armory of the First Corps of Cadets indicated either no change or a modest reduction in wind comfort conditions. The predicted wind speeds remain in the acceptable ranges for sitting and standing at nearly all the test site locations that are anticipated to be subject to a reduction in wind comfort, except at the corner Stanhope Street and Clarendon Street. One location along Stanhope Street will experience an increase in pedestrian wind comfort conditions as a result of the Project (Location 62 in Figure 6.1g and 6.1h). There is no predicted change in wind conditions to the west of the Project Site, near the St. Botolph Historic District.

Along Columbus Avenue, Dartmouth Street and Clarendon Street, just south of the Project in the South End District, test sites indicate either no change from existing conditions or a modest reduction in wind comfort conditions. The predicted wind speeds remain in the acceptable ranges for sitting and standing at all of the test site locations. Wind impacts to historic properties as a result of the Project are anticipated to be very minimal, and conditions are expected to improve in several locations proximate to historic properties.

8.3.4 Geotechnical

The immediate Project Site is abutted by the South End District, which is listed in the National Register and is a local historic district, and the YWCA Boston building, which is individually listed in the National Register. As described in Section 6.10, *Geotechnical*, the anticipated foundation types for the new structures are low displacement, which will minimize potential for soil disturbance, noise, and vibration, and protect abutting structures during construction. Geotechnical considerations will be very thoroughly evaluated by the Project Team in coordination with MassDOT and the MBTA due to the below-grade work and the necessary interface with transportation infrastructure below the Air Rights Development Parcels (I-90, MBTA Orange and Commuter Rail lines, AMTRAK).

As described in Section 6.11, *Temporary Construction Impacts*, the Project Team will monitor the contractor's conformance to protect nearby structures and minimize

groundwater level impacts outside the Project Site. Performance criteria will be established to monitor soil movement and groundwater during construction, and the contractor will be required to modify construction methods to protect nearby buildings, if necessary. These best management practices will be implemented to avoid impacts to abutting and nearby historic resources.

8.4 Regulatory Context

Boston Landmarks Commission (BLC) Article 80

Submission of the PNF to the BPDA initiated review of the Project by the BLC under the Article 80 review process.

Boston Landmarks Commission Article 85

As discussed in Chapter 1, *Project Description*, review of the partial demolition of the Garage in accordance with the provisions of Article 85 of the Code may be required. The need for Article 85 review will be determined through consultation with Boston Landmarks Commission staff in accordance with the provisions of Section 85-5 of the Code. If such review is required, it will be coordinated with the Article 80B and 80C approvals required for the Project.

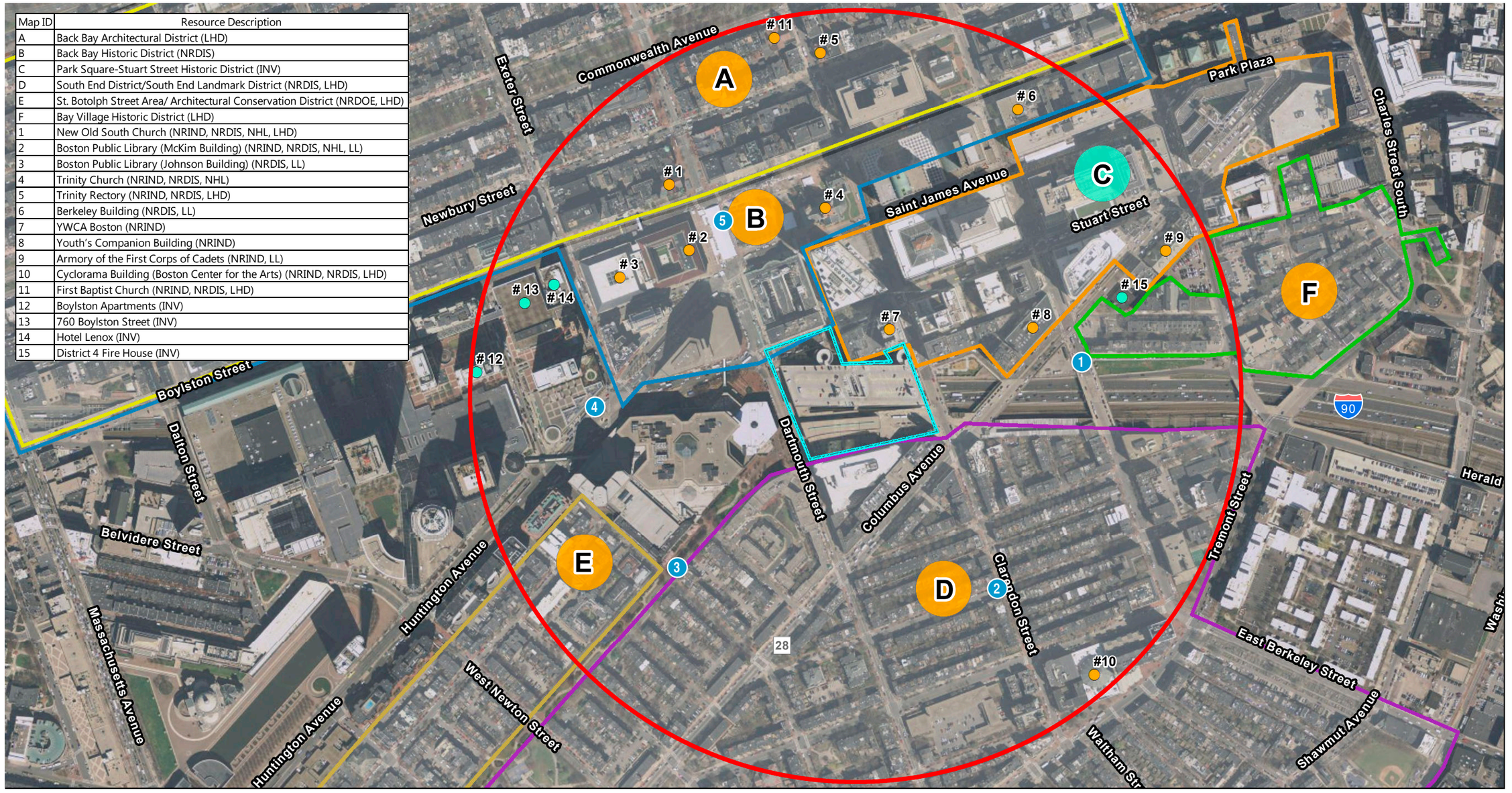
Massachusetts Historical Commission

The MHC has review authority over projects requiring state or federal funding, licensing, permitting, and/or approvals, in order to evaluate potential direct or indirect impacts to properties listed in, or eligible for listing in, the National and State Registers of Historic Places, in compliance with State Register Review requirements (M.G. L. Chapter 9, Sections 27-27c, as amended by Chapter 254 of the Acts of 1988) and Section 106 of the National Historic Preservation Act of 1966 (Section 106), if necessary.

The MHC provided comments on the ENF for the proposed Project to the Executive Office of Energy and Environmental Affairs (EEA) in a letter dated June 15, 2016. On behalf of the Proponent, VHB submitted a letter to MHC, dated October 12, 2016, providing clarification on two issues raised in MHC's comment letter. In response to a concern that the closure of the I-90 westbound On-Ramp was not being reviewed under Section 106, VHB clarified that the proposed closure of the I-90 On-Ramp is a separate project being proposed and studied by MassDOT, and not the Proponent. It will be subject to National Environmental Policy (NEPA) review with the Federal Highway Administration (FHWA) as the lead federal agency. MHC also commented that any proposed air rights development agreements with MassDOT involving development over I-90 would necessitate approval by the FHWA. In the response letter to MHC, VHB noted that the Proponent has an existing Ground and Air Rights Lease with MassDOT authorizing the future Air Rights Development Parcels. MassDOT confirmed that as no federal funding applies to this section of I-90, FHWA

approval of the Air Rights Development Parcels is not necessary, and therefore does not trigger review of the Project under NEPA or Section 106.

Map ID	Resource Description
A	Back Bay Architectural District (LHD)
B	Back Bay Historic District (NRDIS)
C	Park Square-Stuart Street Historic District (INV)
D	South End District/South End Landmark District (NRDIS, LHD)
E	St. Botolph Street Area/ Architectural Conservation District (NRDOE, LHD)
F	Bay Village Historic District (LHD)
1	New Old South Church (NRIND, NRDIS, NHL, LHD)
2	Boston Public Library (McKim Building) (NRIND, NRDIS, NHL, LL)
3	Boston Public Library (Johnson Building) (NRDIS, LL)
4	Trinity Church (NRIND, NRDIS, NHL)
5	Trinity Rectory (NRIND, NRDIS, LHD)
6	Berkeley Building (NRDIS, LL)
7	YWCA Boston (NRIND)
8	Youth's Companion Building (NRIND)
9	Armory of the First Corps of Cadets (NRIND, LL)
10	Cyclorama Building (Boston Center for the Arts) (NRIND, NRDIS, LHD)
11	First Baptist Church (NRIND, NRDIS, LHD)
12	Boylston Apartments (INV)
13	760 Boylston Street (INV)
14	Hotel Lenox (INV)
15	District 4 Fire House (INV)



0 200 400 800 Feet

Legend

- 1/4 Mile Radius
- Site Location
- Historic Resources
- Inventoried Resources

MHC Designation Codes

NRIND	National Register of Historic Places, Individual Listing
NRDIS	National Register of Historic Places, District
NRDOE	Determined eligible for listing in the National Register by the Keeper of the Register (State Register of Historic Places)
NHL	National Historic Landmark
LHD	Local Historic District (State Register of Historic Places)
LL	Boston Local Landmark (State Register of Historic Places)
INV	Listed in the Inventory of Historic and Archaeological Assets of the Commonwealth, no current designation

Perspective Locations

X X Historic District Designation



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Pedestrian View #1: View of the Project Site Looking West from Berkeley Street - Future Existing Condition

Figure 8.2a

vhb



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Pedestrian View #1: View of the Project Site Looking West from Berkeley Street - Future Proposed Condition

Figure 8.2b

vhb



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Pedestrian View #2: View of the Project Site Looking North from Appleton Street - Future Existing Condition

Figure 8.2c

vhb



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Pedestrian View #2: View of the Project Site Looking North from Appleton Street - Future Proposed Condition

Figure 8.2d

vhb



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Pedestrian View #3: View of the Project Site Looking Northeast
from Southwest Corridor Path - Future Existing Condition

Figure 8.2e



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Pedestrian View #3: View of the Project Site Looking Northeast
from Southwest Corridor Path - Future Proposed Condition

Figure 8.2f



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Pedestrian View #4: View of the Project Site Looking East from Huntington Avenue - Future Existing Condition

Figure 8.2g

vhb



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Pedestrian View #4: View of the Project Site Looking East from Huntington Avenue - Future Proposed Condition

Figure 8.2h

vhb



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Pedestrian View #5: View of the Project Site Looking South from Copley Square - Future Existing Condition

Figure 8.2i

vhb

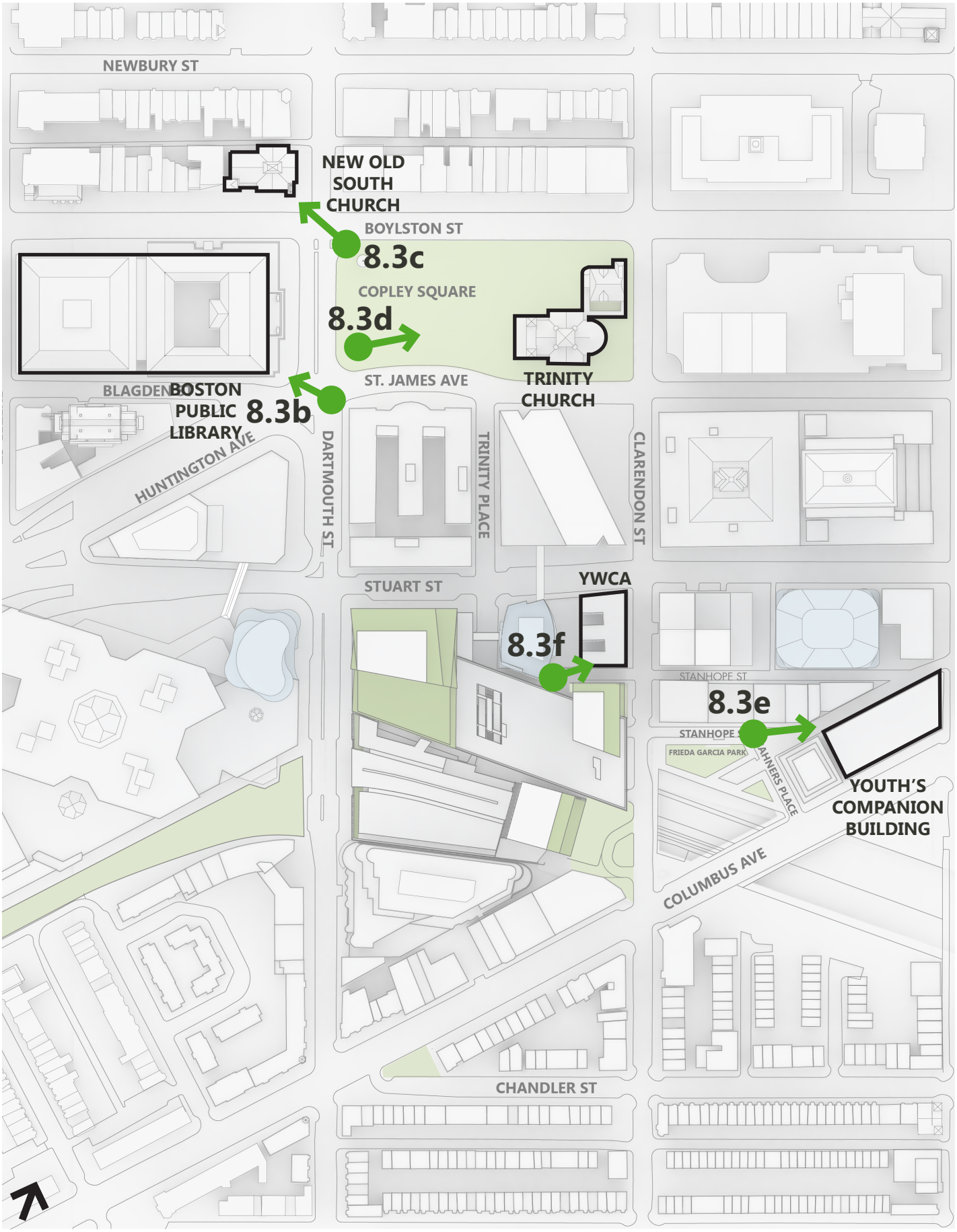


The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Pedestrian View #5: View of the Project Site Looking South from Copley Square - Future Proposed Condition

Figure 8.2j

vhb



The Back Bay / South End Gateway Project
DEIR/DPIR
BOSTON PROPERTIES

Historic Resource Shadow Study Key Plan

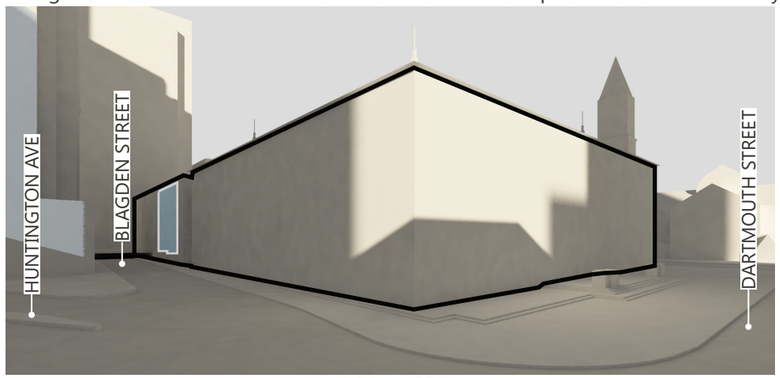
Figure 8.3a

Pelli Clarke Pelli Architects

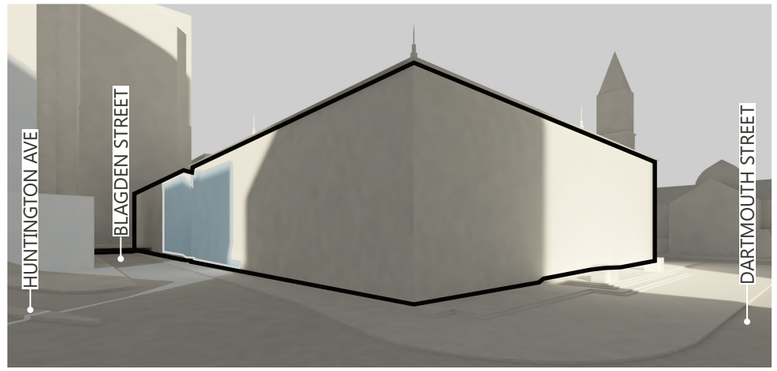
BOSTON PUBLIC LIBRARY

MARCH 21 AND SEPTEMBER 21 (Equinox)

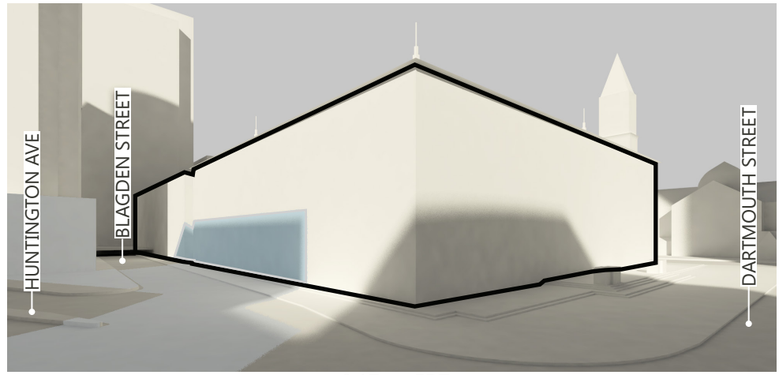
Garage West casts a small amount of net new shadow on portions of the Secondary Facade of the Boston Public Library in the morning from **8:05am to 9:32am for a total of 87 Minutes.**



8:20am EDT



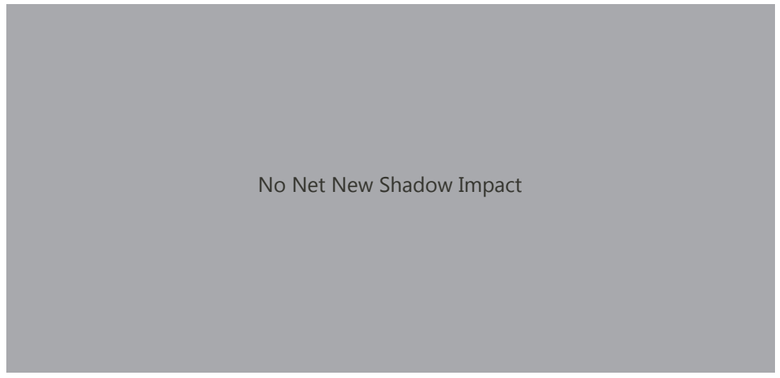
8:51am EDT



9:17am EDT

JUNE 21 (Solstice)

No net new shadow impact.



9:00am EDT



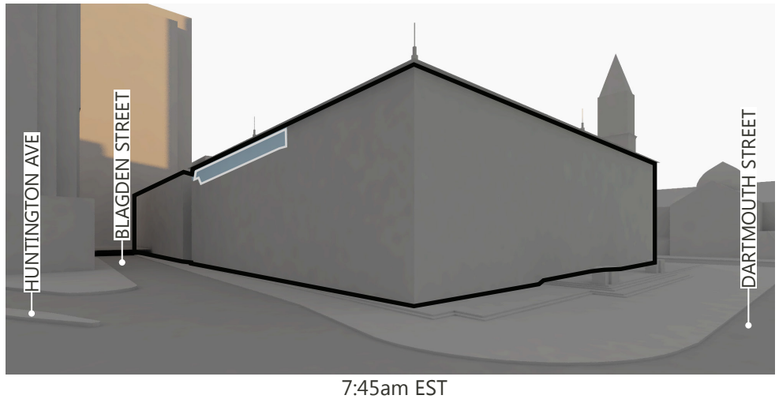
12:00pm EDT



3:00pm EDT

DECEMBER 21 (Solstice)

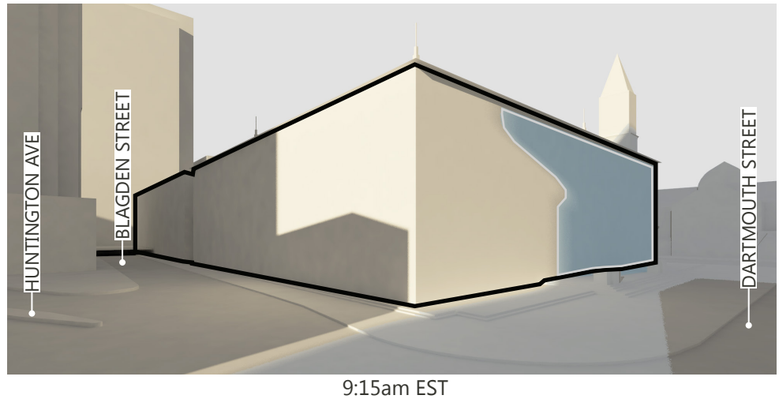
Garage West casts net new shadow on portions of the South and East Facades of the Boston Public Library in the early morning from **7:30am to 9:30am for a total of 120 Minutes.**



7:45am EST



8:30am EST



9:15am EST

Legend | Area Of Existing Shadow | Area Of Net New Shadow From Proposed Office Building | Area Of Net New Shadow From Proposed Residential Buildings

NEW OLD SOUTH CHURCH

MARCH 21 AND SEPTEMBER 21 (Equinox)
No net new shadow impact



9:00am EDT



12:00pm EDT



3:00pm EDT

JUNE 21 (Solstice)
No net new shadow impact.



9:00am EDT



12:00pm EDT

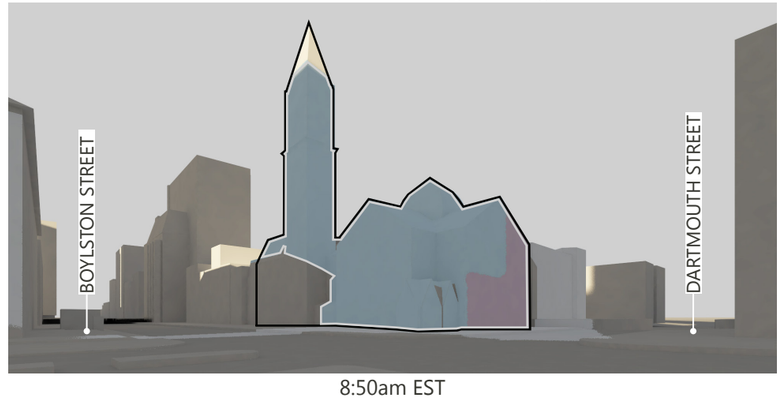


3:00pm EDT

DECEMBER 21 (Solstice)
Garage West and Station East cast net new shadow on portions of the South and East Facades of the New Old South Church in the early morning from **7:45am to 9:55am for a total of 130 Minutes.**



8:00am EST



8:50am EST

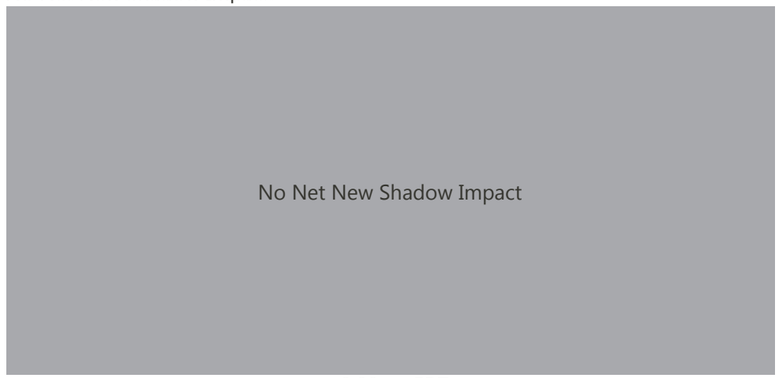


9:40am EST

Legend | Area Of Existing Shadow | Area Of Net New Shadow From Proposed Office Building | Area Of Net New Shadow From Proposed Residential Buildings

TRINITY CHURCH

MARCH 21 AND SEPTEMBER 21 (Equinox)
No Net New Shadow Impact.



9:00am EDT



12:00pm EDT

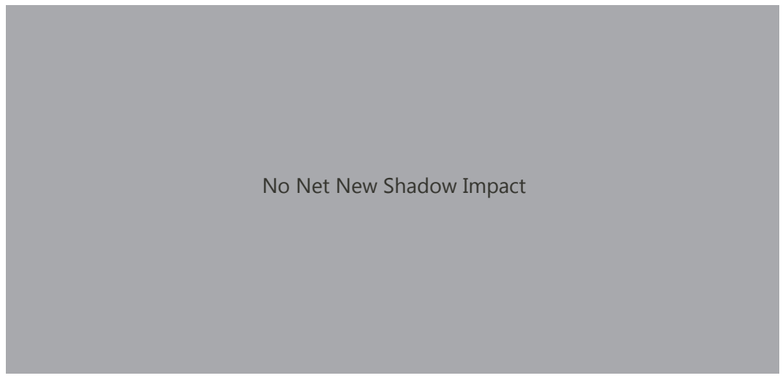


3:00pm EDT

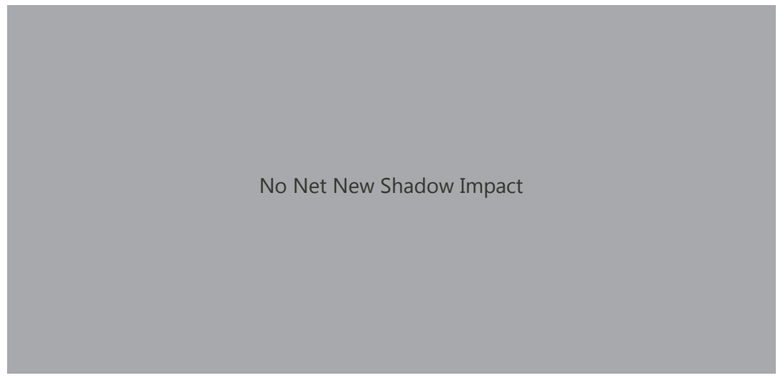
JUNE 21 (Solstice)
No Net New Shadow Impact.



9:00am EDT



12:00pm EDT



3:00pm EDT

DECEMBER 21 (Solstice)
Garage West casts net new shadow on portions of the West Facade of Trinty Curch from **11:15am to 12:45pm for a total of 90 Minutes.**



11:30am EST



12:00pm EST



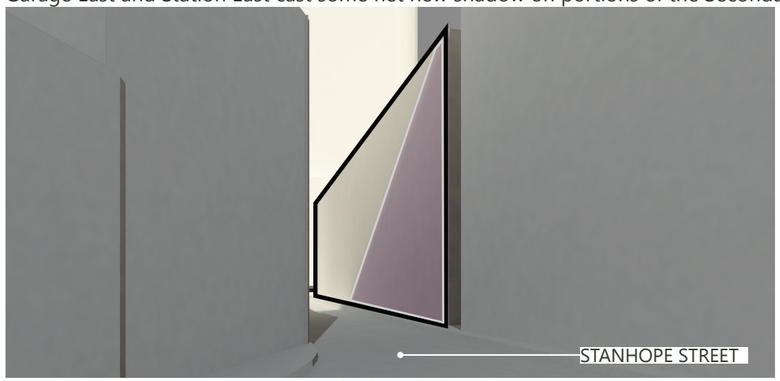
12:30am EST

Legend | Area Of Existing Shadow | Area Of Net New Shadow From Proposed Office Building | Area Of Net New Shadow From Proposed Residential Buildings

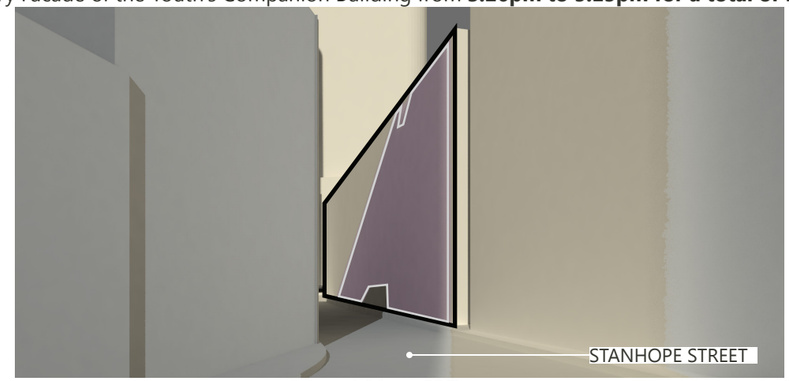
YOUTH'S COMPANION BUILDING (SECONDARY FACADE)

MARCH 21 AND SEPTEMBER 21 (Equinox)

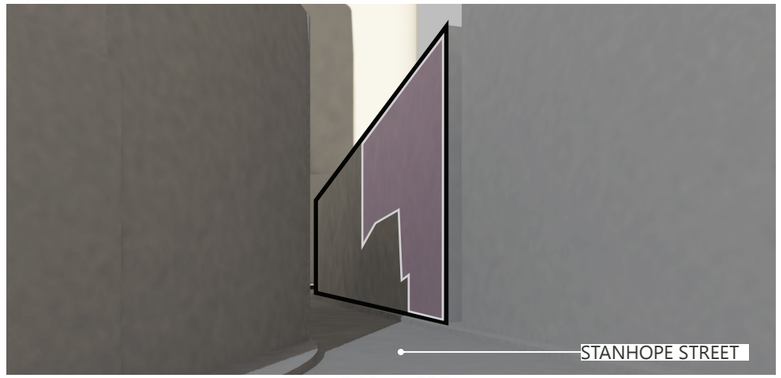
Garage East and Station East cast some net new shadow on portions of the Secondary Facade of the Youth's Companion Building from **3:26pm to 5:15pm for a total of 109 Minutes.**



3:41pm EDT



4:20pm EDT



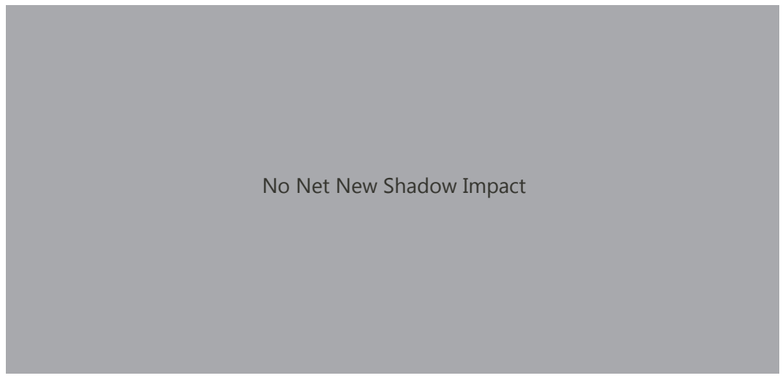
5:00pm EDT

JUNE 21 (Solstice)

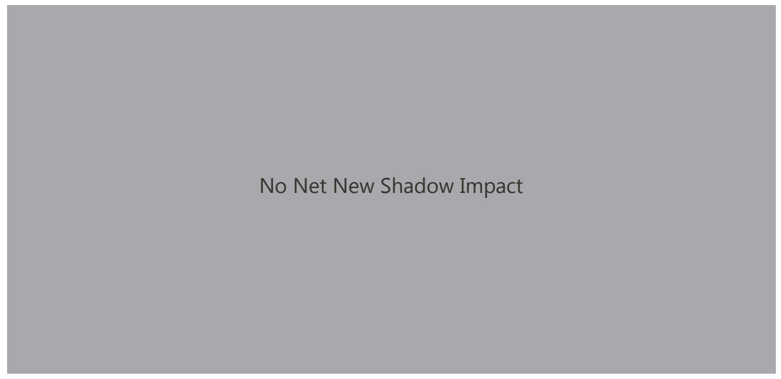
No net new shadow impact.



9:00am EDT



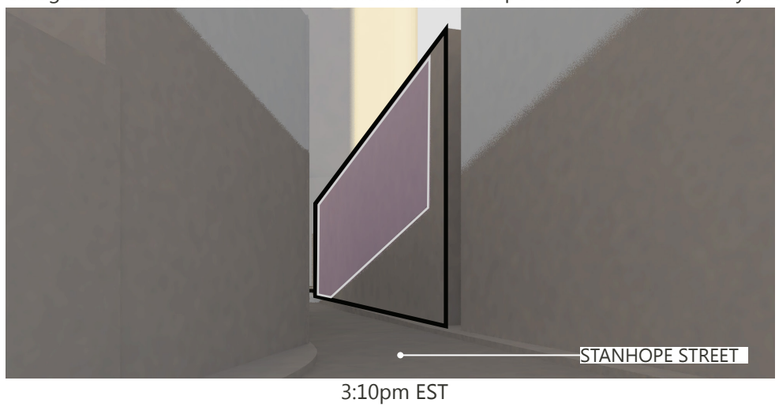
12:00pm EDT



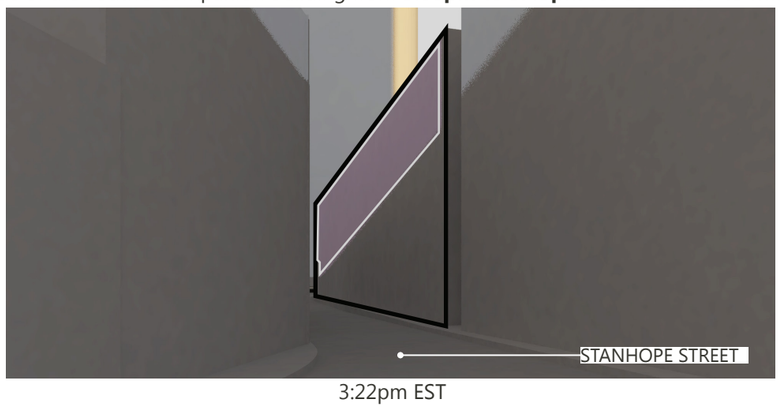
3:00pm EDT

DECEMBER 21 (Solstice)

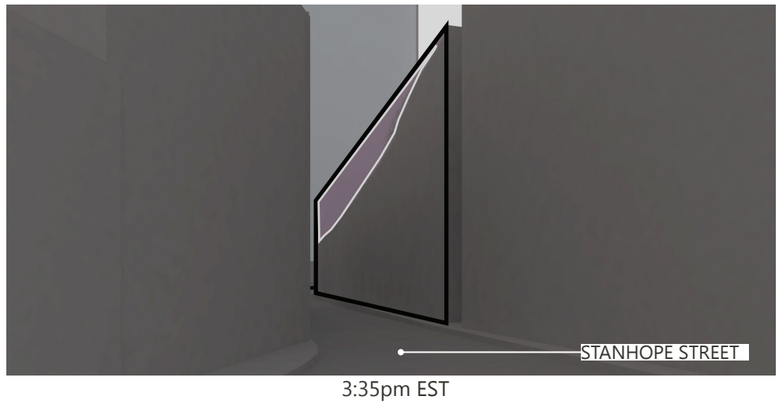
Garage East and Station East cast net new shadow on portions of the Secondary Facade of the Youth's Companion Building from **3:00pm to 3:45pm for a total of 45 Minutes.**



3:10pm EST



3:22pm EST



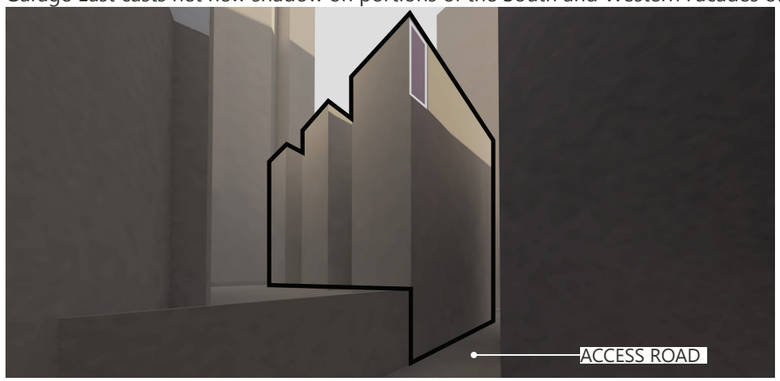
3:35pm EST

Legend | Area Of Existing Shadow | Area Of Net New Shadow From Proposed Office Building | Area Of Net New Shadow From Proposed Residential Buildings

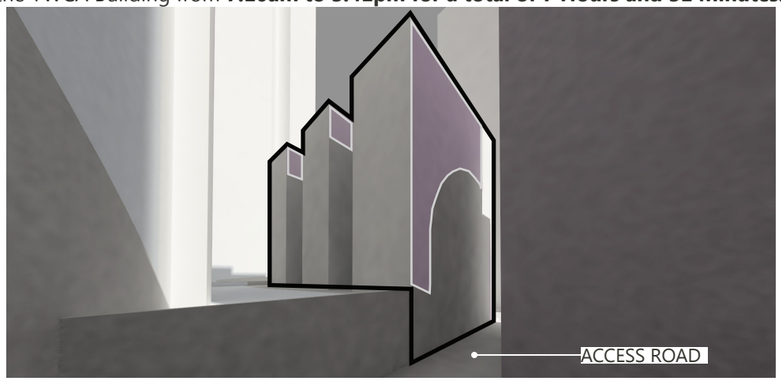
YWCA

MARCH 21 AND SEPTEMBER 21 (Equinox)

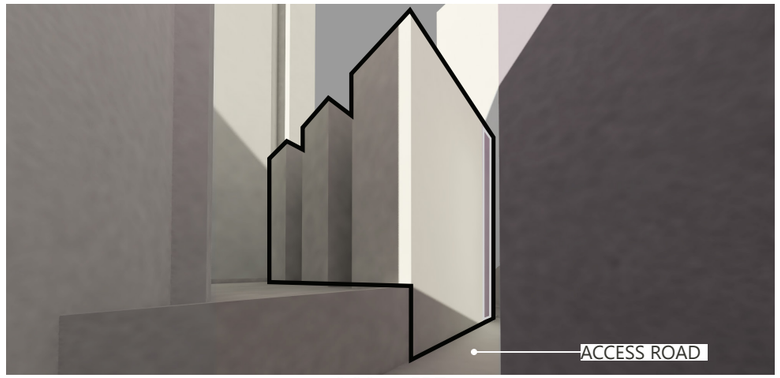
Garage East casts net new shadow on portions of the South and Western Facades of the YWCA Building from **7:10am to 3:41pm for a total of 7 Hours and 31 Minutes.**



7:25am EDT



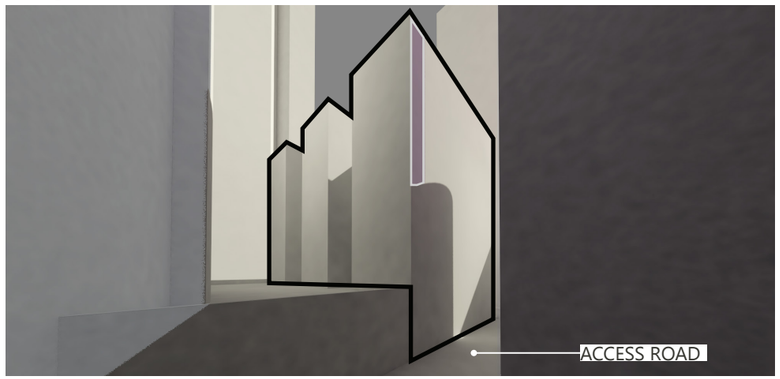
11:25am EDT



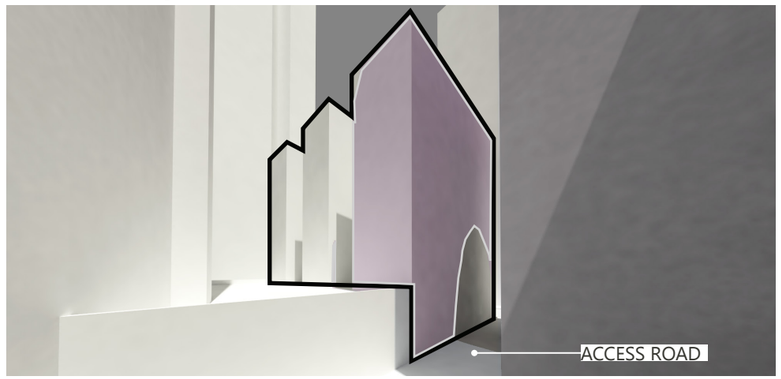
3:26pm EDT

JUNE 21 (Solstice)

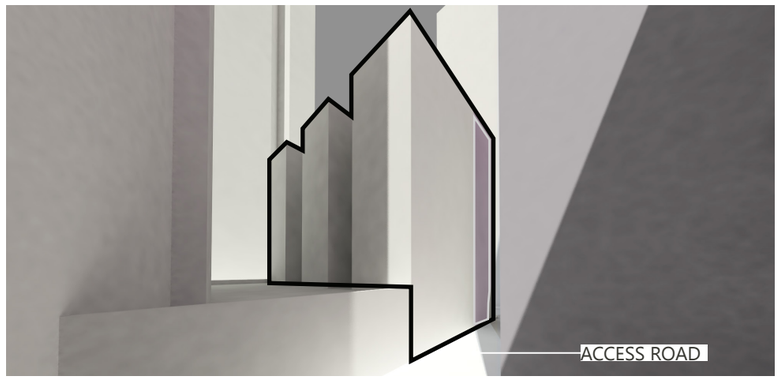
Garage East casts net new shadow on portions of the South and Western Facades of the YWCA Building from **8:50am to 2:20pm for a total of 5 Hours and 30 Minutes.**



9:05am EDT



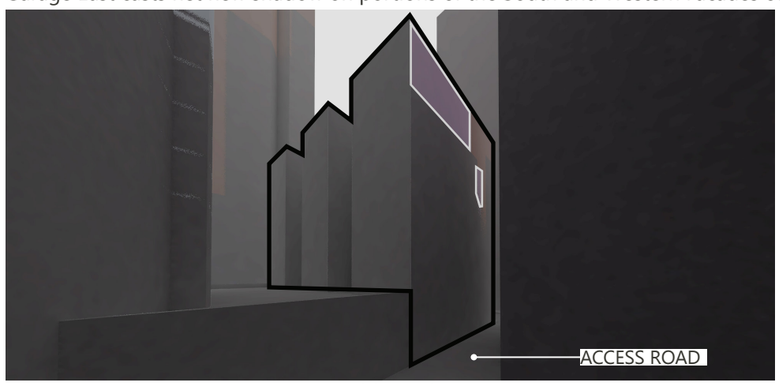
12:35pm EDT



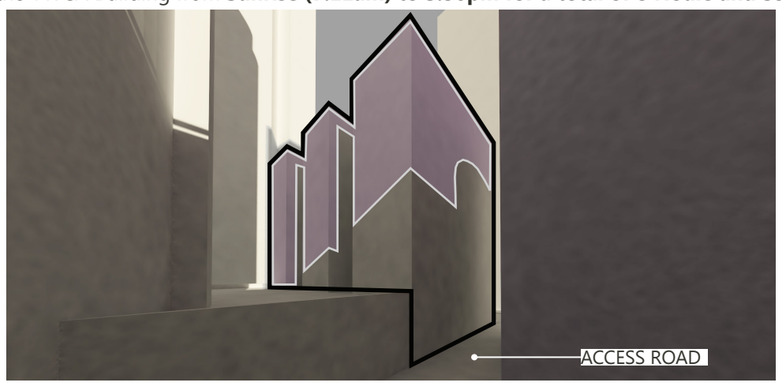
2:05pm EDT

DECEMBER 21 (Solstice)

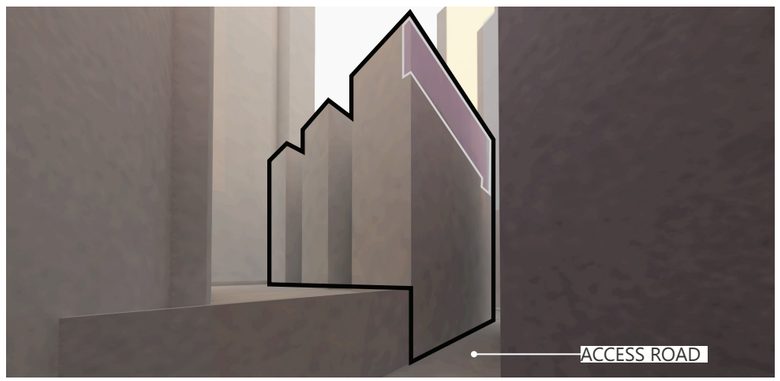
Garage East casts net new shadow on portions of the South and Western Facades of the YWCA Building from **Sunrise (7:11am) to 3:50pm for a total of 8 Hours and 39 Minutes.**



7:26am EST



11:30am EST



3:35pm EST

Legend | Area Of Existing Shadow | Area Of Net New Shadow From Proposed Office Building | Area Of Net New Shadow From Proposed Residential Buildings