75/109 SMITH PLACE

Cambridge, MA

Volume 03:

Energy Model Narrative

Traffic Impact Study Certification Letter

Traffic Impact Study

December 16, 2019

City of Cambridge
Inspectional Services Department

Energy Code Permit Review Criteria
Buildings using
ASHRAE 90.1 Appendix G Stretch Code Compliance

Project Name and Address: 101 Smith Place, Cambridge, MA

Energy Model Contact Person (name, email, phone): Brian Cook, Brian.Cook@jacobs.com, 617-963-3031

Energy Modelling Program used, version: eQuest 3.65 build 7175

A. Building Summary

Total Gross Floor Area (per building code)

Floor Level	Conditioned Area (sf)	Unconditioned area (sf)	Total Floor Area (sf)	Mechanical or other excluded area (sf)
Floor 1	46,309	0	46,309	582
Floor 2	45,620	0	45,620	1,563
Floor 3	45,620	0	45,620	1,563
Penthouse	15,045	0	15,045	0
Total (sf)	152,594	0	152,594	3,708

% Laboratory floor area by design: 46.1%
% Office floor area by design: 31.5%
% Other (list): Storage 1.7%, Mechanical 12.2%, Loading 2.3%, Corridor 3.8%, Stairwell 0.5%, Restrooms 1.8%

B. Ventilation

1. How are airflows derived for each space type in the building; how are office ventilation rates quantified in distinction from lab spaces? Show all assumptions for baseline and proposed.

Ventilation to the office area is provided to the design building model by four Air Handling Units with 41,500 CFM of supply air each with 100% outdoor air that will be modulated by VAV boxes within the ductwork. The amount of outdoor air serving the building is 166,000 CFM, which meets the minimum requirements of ASHRAE 62.1 and the requirements of ASHRAE 90.1-2013 section G3.1.2.6 which requires that the ventilation rates match the total outdoor air volume of the building system.

The amount of ventilation air serving the office and lobby space in the baseline model meets the requirements of ASHRAE 62.1 (0.06 CFM/SF of office space and 5 CFM/person). Ventilation is provided to the spaces in the baseline case by a separate air handler for each floor of the building. The amount of supply air to each thermal zone in the baseline model is auto sized to provide adequate thermal comfort.

Note: The information requested in this documentation is the minimal requirement that must be submitted prior to commencement of plan review. ISD may request additional documentation deemed necessary to determine compliance with applicable codes.

Please see Page 15 of the attached Minimum Energy Performance Calculator – Stretch Code 101 Smith Place in Appendix A for details of the ventilation rates for the baseline and design models.

2. Provide backup for baseline building fan power calculations.

Please see Page 15 of the attached Minimum Energy Performance Calculator – Stretch Code 101 Smith Place in Appendix A for the A factor calculation.

For Systems 5 through 8:

Pfan = bhp x 746 / Fan Motor Efficiency
Variable Volume
bhp= CFM x 0.0013 + A

Baseline System Name	Level 1 AHU
CFM	10,146
A (from Air-side HVAC Tab)	4.175308642
bhp	17.36510864
Fan Motor Efficiency	0.91
Pfan (watts)	14235.57258
Pfan(kW)	14.23557258

C. Energy Model

	Proposed Design	Baseline Design
Simulation Program & Version Used	eQuest 3-65	eQuest 3-65
Weather data	Boston, MA	Boston, MA
Principle heating fuel source	Natural Gas	Natural Gas

Date that currently energy model results were generated	12-9-19
% Floor Area of Spaces (relative to gross) that are not fit-out (ie. like core/shell)	22.4%
Version or % completeness of architectural drawings that are basis of energy model	03-18-19 Progress Set

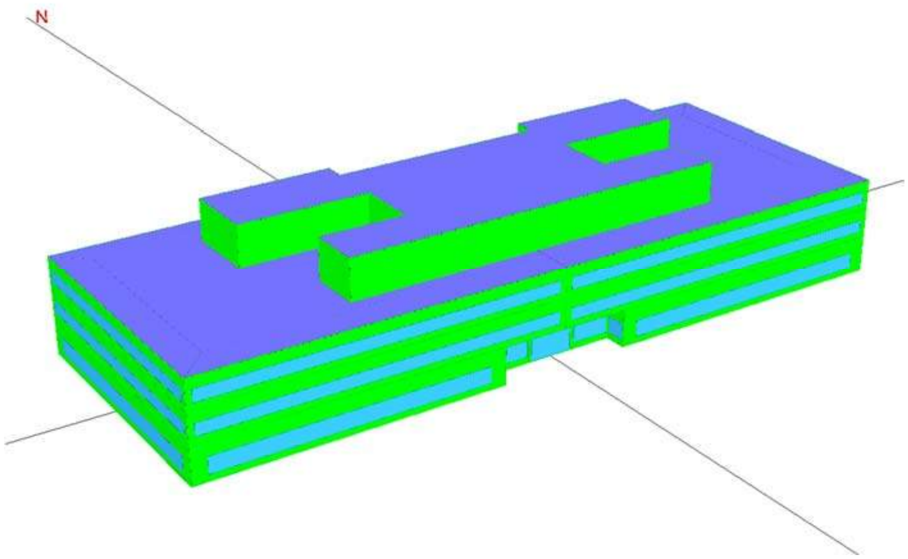
Modelling Program Advisory Messages

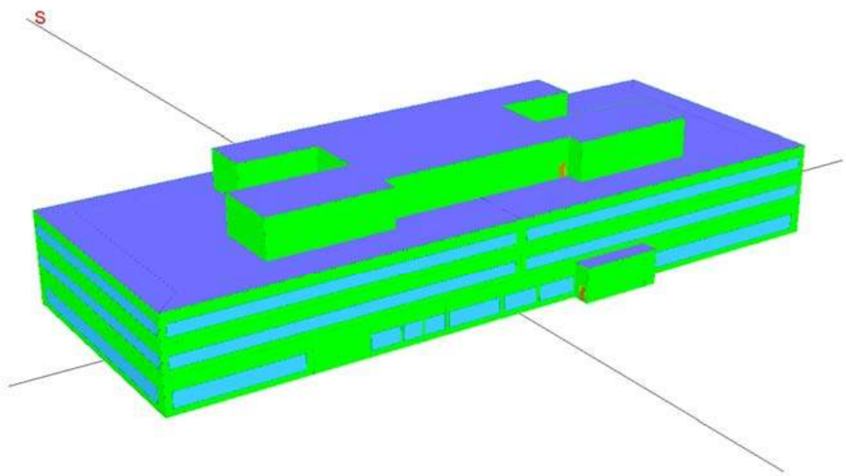
	Proposed Building Design	Baseline Building	Difference Proposed - Baseline
Number of hours heating loads not met (system/plant)	39	139	100
Number of hours cooling loads not met (system/plant)	0	2	2
Number of Warnings*	18	12	6
Number of Errors*	0	0	0
Number of defaults overridden	0	0	0

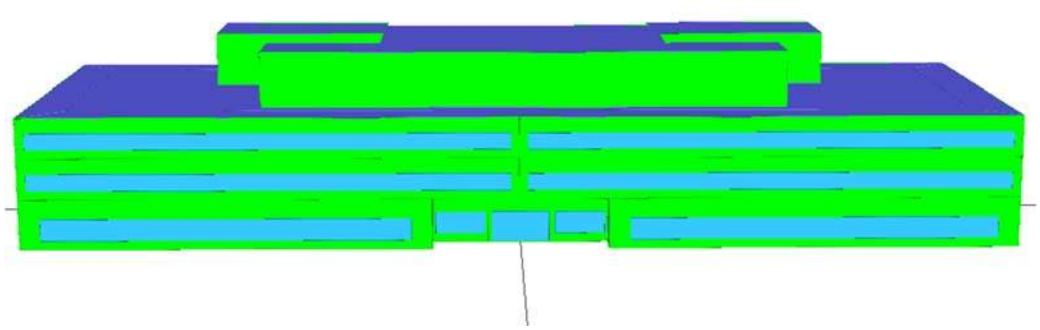
*Include screen prints validating information

Please see Appendix A Screenshots for validating errors. Unmet hours output is included in the BEPS and BEPU files below on pages 31-36.

1. Provide screen prints of 3D view of building from the actual energy model.







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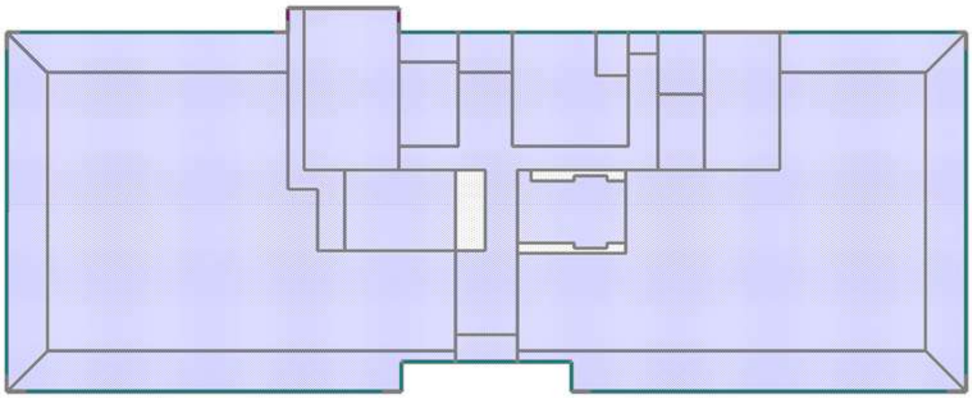
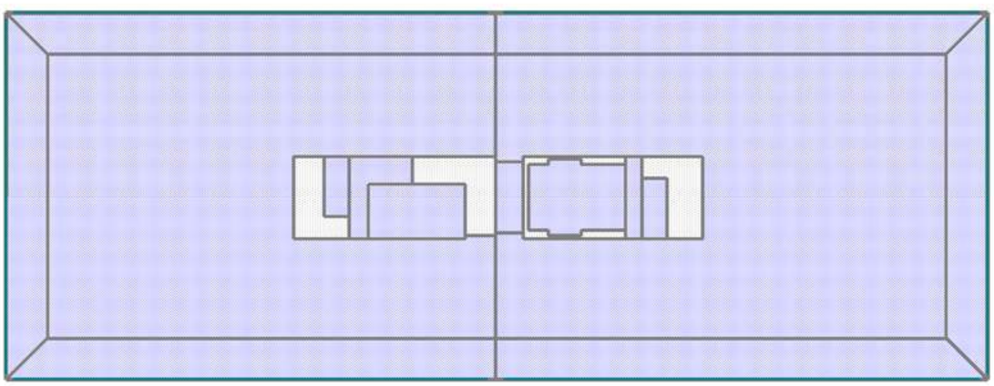
2. Provide thermal blocks for each floor in the format of screen prints from the actual energy model.



Thermal Zones: Ground Floor



Thermal Zones: Second and Third Floors

Thermal Zones: Mechanical Penthouse

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3. Provide occupancy schedule used for mechanical design.

Currently Active Day Schedule: 01- Bldg Occup WD — Type: Fraction

Day Schedule Name: 01- Bldg Occup WD

Type: Fraction

Hourly Values

Mdnt - 1:	0.0000	ratio	8-9 am:	0.9000	ratio	4-5 pm:	0.7020	ratio
1-2 am:	0.0000	ratio	9-10 am:	0.9000	ratio	5-6 pm:	0.2970	ratio
2-3 am:	0.0000	ratio	10-11 am:	0.9000	ratio	6-7 pm:	0.0990	ratio
3-4 am:	0.0000	ratio	11-noon:	0.5040	ratio	7-8 pm:	0.0990	ratio
4-5 am:	0.0000	ratio	noon-1:	0.5040	ratio	8-9 pm:	0.0990	ratio
5-6 am:	0.0000	ratio	1-2 pm:	0.9000	ratio	9-10 pm:	0.0990	ratio
6-7 am:	0.0990	ratio	2-3 pm:	0.9000	ratio	10-11 pm:	0.0000	ratio
7-8 am:	0.7020	ratio	3-4 pm:	0.9000	ratio	11-Mdnt:	0.0000	ratio

Weekday Occupancy Schedule

Currently Active Day Schedule: 01- Bldg Occup WEH — Type: Fraction

Day Schedule Name: 01- Bldg Occup WEH

Type: Fraction

Hourly Values

Mdnt - 1:	0.0000	ratio	8-9 am:	0.0000	ratio	4-5 pm:	0.0000	ratio
1-2 am:	0.0000	ratio	9-10 am:	0.0000	ratio	5-6 pm:	0.0000	ratio
2-3 am:	0.0000	ratio	10-11 am:	0.0000	ratio	6-7 pm:	0.0000	ratio
3-4 am:	0.0000	ratio	11-noon:	0.0000	ratio	7-8 pm:	0.0000	ratio
4-5 am:	0.0000	ratio	noon-1:	0.0000	ratio	8-9 pm:	0.0000	ratio
5-6 am:	0.0000	ratio	1-2 pm:	0.0000	ratio	9-10 pm:	0.0000	ratio
6-7 am:	0.0000	ratio	2-3 pm:	0.0000	ratio	10-11 pm:	0.0000	ratio
7-8 am:	0.0000	ratio	3-4 pm:	0.0000	ratio	11-Mdnt:	0.0000	ratio

Weekend Occupancy Schedule

Note: The information requested in this documentation is the minimal requirement that must be submitted prior to commencement of plan review. ISD may request additional documentation deemed necessary to determine compliance with applicable codes.

4. Provide U value tabulations for all building envelope components (showing appropriate derating for structural member bridging), including cut sheets of all proprietary building envelope systems, windows, curtainwall systems. U values must be coordinated with the architectural drawings and readily referenced therein.

The effective U value for the opaque assemblies and roof were determined by using tables A3.3.3.1 and A2.2.3 from ASHRAE 90.1-2013. The assemblies are not yet known at the time of this analysis. As a result, baseline values have been used for both the design and baseline models. The effective U-values for the glazing, wall and roof assemblies are summarized below.

Assembly	U-Value	Description
Unitized Curtain wall (Vision)	0.42	Vision Glass with adjacent framing and 1" IGU
Opaque Wall Assembly	0.055	Steel Frame Wall with R-13 cavity insulation (de-rated to R-6 due to thermal bridging), R-10 continuous insulation
Roof Assembly	0.032	Built up Roofing, R-30 continuous insulation

5. Provide BEPU/BEPS summary sheets directly from energy model, if using DOE software. If using other software provide comparable summaries. (note detailed modelling inputs & outputs may also be requested)

Baseline Model BEPS:

101 Smith_10-16-19_LEEDV4_Baseline DOE-2.2-50a 12/10/2019 15:18:11 BDL RUN 4

REPORT- BEPS Building Energy Performance WEATHER FILE- Boston MA TMY2

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	1821.0	0.0	4565.0	0.0	1143.0	23.9	915.3	3137.0	0.0	0.0	0.0	0.0	11606.0
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	10510.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	0.0	10526.0
MBTU	1821.0	0.0	4565.0	10510.0	1143.0	23.9	915.3	3137.0	0.0	0.0	11.1	0.0	22131.0

TOTAL SITE ENERGY 22131.40 MBTU 145.0 KBTU/SQFT-YR GROSS-AREA 145.0 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY 45342.70 MBTU 297.1 KBTU/SQFT-YR GROSS-AREA 297.1 KBTU/SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 1.61
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 2
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 139

NOTE: ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.

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Baseline Model BEPU:

101 Smith_10-16-19_LEEDV4_Baseline DOE-2.2-50a 12/10/2019 15:18:11 BDL RUN 4

REPORT- BEPU Building Utility Performance WEATHER FILE- Boston MA TMY2

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
KWH	533676.	0.	1337475.	0.	334986.	6993.	268178.	919145.	0.	0.	0.	0.	3400447.
FM1 NATURAL-GAS													
THERM	0.	0.	0.	105146.	0.	0.	0.	0.	0.	0.	111.	0.	105258.

TOTAL ELECTRICITY	3400447. KWH	22.284 KWH	/SQFT-YR GROSS-AREA	22.284 KWH	/SQFT-YR NET-AREA
TOTAL NATURAL-GAS	105258. THERM	0.690 THERM	/SQFT-YR GROSS-AREA	0.690 THERM	/SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 1.61
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 2
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 139

NOTE: ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.

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Design BEPS:

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101 Smith_10-16-19_LEEDV4_Baseline                          DOE-2.2-50a   12/10/2019    15:29:21  BDL RUN  1

REPORT- BEPS Building Energy Performance                            WEATHER FILE- Boston       MA TMY2
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	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
MBTU	1821.0	0.0	4565.0	27.1	499.8	7.1	432.4	3669.0	0.0	0.0	69.2	0.0	11091.0
FM1 NATURAL-GAS													
MBTU	0.0	0.0	0.0	7893.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7893.0
MBTU	1821.0	0.0	4565.0	7920.0	499.8	7.1	432.4	3669.0	0.0	0.0	69.2	0.0	18984.0

```
TOTAL SITE ENERGY      18984.00 MBTU    124.4 KBTU/SQFT-YR GROSS-AREA    124.4 KBTU/SQFT-YR NET-AREA
TOTAL SOURCE ENERGY    41166.00 MBTU    269.8 KBTU/SQFT-YR GROSS-AREA    269.8 KBTU/SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE =  0.45
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED                =  0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE                =     0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE                =    39

NOTE:  ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.
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Design BEPU:

101 Smith_10-16-19_LEEDV4_Baseline DOE-2.2-50a 12/10/2019 15:29:21 BDL RUN 1

REPORT- BEPU Building Utility Performance WEATHER FILE- Boston MA TMY2

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY													
KWH	533676.	0.	1337475.	7935.	146444.	2083.	126707.	1075088.	0.	0.	20263.	0.	3249663.
FM1 NATURAL-GAS													
THERM	0.	0.	0.	78930.	0.	0.	0.	0.	0.	0.	0.	0.	78930.

TOTAL ELECTRICITY 3249663. KWH 21.296 KWH /SQFT-YR GROSS-AREA 21.296 KWH /SQFT-YR NET-AREA
TOTAL NATURAL-GAS 78930. THERM 0.517 THERM /SQFT-YR GROSS-AREA 0.517 THERM /SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.45
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.00
HOURS ANY ZONE ABOVE COOLING THROTTLING RANGE = 0
HOURS ANY ZONE BELOW HEATING THROTTLING RANGE = 39

NOTE: ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.

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6. Provide target finder output (from Energy Star).

LEARN MORE AT energystar.gov

ENERGY STAR® Statement of Energy Design Intent (SEDI)[1]

101 Smith Place

91

ENERGY STAR® Design Score[2]

Primary Property Type: Office
Gross Floor Area (ft²): 152,594
Estimated Date of Certification of Occupancy: _________

Date Generated: December 10, 2019

1. This form is required when applying for Designed to Earn the ENERGY STAR recognition. It was generated from ENERGY STAR Portfolio Manager.
2. The ENERGY STAR 1 – 100 Score is based on total annual Source Energy. To be eligible for Designed to Earn the ENERGY STAR recognition you must score at least 75.

Property & Contact Information for Design Project

Property Address	Project Architect	Owner Contact
101 Smith Place 101 Smith Place Cambridge, Massachusetts 02138	___ _____ , (__)___-____	___ _____ , (__)___-____
Property ID: 9146892	**Architect Of Record**	**Property Owner**
	________ ________, __ ____ (__)___-____	________ , (__)___-____

Estimated Design Energy

Fuel Type	Usage	Energy Rate ($/Unit)
Electric - Grid	3,249,663 kBtu (thousand Btu)	$ 0.14/kBtu (thousand Btu)
Natural Gas	78,930 therms	$ 1.20/therms

Estimated Design Use Details

★ This Use Detail is used to calculate the 1-100 ENERGY STAR Score.

Office	
★Weekly Operating Hours	55
★Number of Workers on Main Shift	688
★Percent That Can Be Cooled	50 % or more
★Number of Computers	688
Percent That Can Be Heated	50 % or more
★Gross Floor Area	152,594 Sq. Ft.

Design Energy and Emission Results

Metric	Design Project	Median Property	Estimated Savings
ENERGY STAR Score (1-100)	**91**	50	N/A
Energy Reduction (from Median)(%)	**-53.3**	0	N/A
Source Energy Use Intensity (kBtu/ft²/yr)	**113**	244	131
Site Energy Use Intensity (kBtu/ft²/yr)	**73**	156	83
Source Energy Use (kBtu/yr)	**17,386,707**	37,237,804	19,851,097
Site Energy Use (kBtu/yr)	**11,142,663**	23,864,688	12,722,025
Energy Costs ($)	**549,668**	1,177,247	627,579
Total GHG Emissions (Metric Tons CO2e)	**662**	1,419	757

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7. LEED energy modelling input-output report.

Please See Appendix A for Model Input-Output Report.

8. Provide energy use summary from modelling outputs in tabular format (see attached).
    a. For each end use category that shows a savings in proposed building over baseline building, provide an explanation of how savings was attained in the proposed design.
    b. Drawings and specifications must clearly show all equipment efficiencies.

Energy Use Summary

	Energy Type / Units	Proposed Building		Baseline Building (average of 4 rotations)		Percent Improvement
		Energy Use	Peak Demand	Energy Use	Peak Demand	%
Interior lighting	Electricity	533,676	174.7	533,676	174.7	0.00%
Space Heating	Natural Gas	78,930	8,579	111,599	7,749	29.3%
Space Cooling	Electricity	146,444	277.4	352,147	327.0	58.4%
Pumps	Electricity	126,707	26.7	281,379	75.8	55.0%
Heat Rejection	Electricity	7,935	5.8	7,253	0	-9.4%
Fans – interior ventilation	Electricity	1,075,088	262.4	939,285	232.9	-14.5%
Service Water Heating	Natural Gas	0	0	111	1.2	100.00%
Receptacle/Equipment (unregulated)	Electricity	1,337,475	370.3	1,337,475	370.3	0.00%
Auxiliary (Electricity)	Electricity	27,852	3.6	0	0	-100.00%
Total Electricity	KWh	3,249,663		3,451,215		5.7%
Total Gas	therm	78,930		111,709		29.3%
Total Energy	(btu x 10^6)	18,984		71,651		17.2%
Savings %						
Total Regulated Energy Cost ($)						
Utility Rate						
Electricity ($)	0.14	$455,725		$483,170		5.7%
Fuel ($)	1.2	$94,716		$134,052		29.3%
Building Total ($)		$550,441		$617,222		10.8%

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Design Case Savings Explanation:

- The cooling savings is a result of efficient design case chilled water plant over baseline chilled water plant
- The heating savings is a result of the design case boiler efficiency of 89% over baseline 82%
- The service water heating is a result of heat pump gas water heater over baseline gas water heater

Appendix A

Modeling Input-Output

General Information

Project Name	101 Smith Place
Energy Code Used	ASHRAE 90.1-2013 Appendix G
Percent new construction (%)*	100.00%
Percent renovation/existing (%)*	0.00%
* Percentage based on floor area	
Project has multiple buildings?	No
Conditioned Building Area (Sft)	152,594
Unconditioned Building Area (Sft)	
Total Building Area (Sft)	152,594
Project has residential Dwelling Units?	No
Number of floors	4

Energy Model Information

Energy modeler	Andrew Jarrell
Simulation program	eQuest
Energy code used	ASHRAE 90.1-2013 Appendix G
Simulation weather file	Boston, MA
Climate zone	5A

ASHRAE 90.1 Addenda used in the energy model(s), if any.

☑ **Compliant energy simulation software.** The energy simulation software used for this project has all capabilities described in EITHER section "G2 Simulation General Requirements" in Appendix G of ASHRAE 90.1-2013 OR IECC 2015.

☑ **Compliant energy modeling methodology.** Energy simulation runs for both the baseline and proposed use the assumptions and modeling methodology described in EITHER ASHRAE 90.1-2013 Appendix G OR IECC 2015.

District Energy Systems

Is the project connected to a district or campus thermal energy system? ☐ Yes ☑ No

The district energy system includes (select all that apply) ☐ District Cooling ☐ District Heating ☐ CHP

Select how the district energy system has been modeled	
For DES Paths 2 or 3, identify the method for evaluating the district plant average efficiency.	
If using the DES Path 2 or 3 and the Modeling Method, describe how the average efficiency was determined. Include information about how the thermal distribution losses and distribution pump energy was accounted for. If using the modeling method, upload summary simulation files or spreadsheet calculations as supporting documentation.	

Unfinished Spaces

Select how any unfinished spaces have been modeled	
Refer to the Teant Lease and Sales Agreement section of the LEED Reference Guide. Upload all required documentation to substantiate the savings claimed for the unfinished spaces.	

Opaque Assemblies

Instructions: Complete the Opaque Building Envelope Requirements section, then describe each unique opaque building envelope construction on a separate row in the Opaque Building Envelope Constructions table. For any information not applicable to the project, simply enter "N/A".

Opaque Building Envelope Requirements

All residential spaces (guest rooms, living quarters, private living space, in-patient rooms, and sleeping quarters) have been modeled with the required residential construction types from Table 5.5	N/A (no residential spaces)
For existing spaces, have there been any changes to the space conditioning category (for example, previously unconditioned spaces becoming fully conditioned)?	N/A (no existing space)
All spaces qualifying as semiheated are not defined as heated per Table 3.2 or indirectly conditioned (see Section 3.2 definition of space).	N/A (no semiheated space)
Opaque envelope assemblies separating conditioned space from unconditioned or semiheated space in the baseline are modeled using semiheated envelope assemblies.	N/A (no opaque assemblies separating conditioned and semiheated/unconditioned space
All ***baseline new construction*** opaque envelope assemblies were modeled as required by ASHRAE Table 5.5 for the project's climate zone or IECC Table C402.1.3.	Yes
All baseline existing roofs, above-grade exterior walls, below-grade exterior walls, exposed floors, slab-on-grade floors, and opaque doors were modeled"," using the existing conditions prior to any revisions in spaces with unchanged space conditioning categories.	Yes
All ***proposed*** roofs, above-grade exterior walls, below-grade exterior walls, exposed floors, slab-on-grade floors, and opaque doors were modeled as-designed and with assembly U-factors, C-factors, and F-factors consistent with ASHRAE Appendix A values.	Yes
Infiltration rates and schedules have been modeled identically in the baseline and proposed.	Yes

Opaque Building Envelope Constructions

Roof Constructions

General Information		Baseline		Proposed		Roof Solar Reflectance and Thermal Emittance	
New or Existing Construction	Space-Conditioning Category	Description	Assembly U-factor	Description	Assembly U-factor	Baseline	Proposed
New	ASHRAE-Nonresidential	R-30 Insulation entirely above deck with a U-factor of 0.032	0.032	R-30 Insulation entirely above deck	0.032	Reflectance 0.3 / Emittance 0.9	Reflectance 0.3 / Emittance 0.9

Above-Grade Exterior Wall Constructions

General Information		Baseline		Proposed	
New or Existing Construction	Space-Conditioning Category	Description	Assembly U-factor	Description	Assembly U-factor
New	Nonresidential	ASHRAE-Steel-framed with R-13 cavity and R-10 continuous insulation with a U-factor of 0.055	0.055	Steel Frame Wall with R-13 Cavity insulation and R-10 Continuous insulation	0.055

Below-Grade Exterior Wall Constructions

General Information		Baseline		Proposed	
New or Existing Construction	Space-Conditioning Category	Description	Assembly C-factor	Description	Assembly C-factor
New	Nonresidential			N/A	

Exposed Floor Constructions

General Information		Baseline		Proposed	
New or Existing Construction	Space-Conditioning Category	Description	Assembly U-factor	Description	Assembly U-factor
New	Nonresidential			N/A	

Slab-On-Grade Floors

General Information		Baseline		Proposed	
New or Existing Construction	Space-Conditioning Category	Description	Assembly F-factor	Description	Assembly F-factor
New	Nonresidential	ASHRAE, NoRes, UnHeated- 6" concrete slab with R-15 insulation for 24 inch with F-factor of 0.520	0.52	R-15 Continuous Insulation for 24in vert	0.52

Opaque Doors

General Information		Baseline		Proposed	
New or Existing Construction	Space-Conditioning Category	Description	Assembly U-factor	Description	Assembly U-factor
New	Nonresidential	Swinging	0.5	Swinging	0.5

Additional notes:

Shading and Fenestration

Building Massing and Zoning

Instructions: Provide the following shading and orientation information. An example of the expected level of detail has been provided for each input. For any information not applicable to the project, simply enter "N/A".

Manual fenestration shading devices such as blinds or shades have been modeled or not modeled, the same as in the proposed.	Yes
Any shading by adjacent structures and terrain or manual shading devices have been modeled or not modeled, the same as in the proposed.	Yes
The baseline is modeled with the same shape and orientation as the proposed.	Yes
All baseline existing fenestration for spaces with unchanged space conditioning categories has been modeled using existing conditions prior to revisions that are part of the project scope of work.	N/A
Thermal Blocks were modeled identically in the Baseline and Proposed design models	Yes

Model Input Parameter		Baseline			Proposed		
	Orientation	Above-Grade Wall Area (Sq ft)	Vertical Glazing Area (sq ft)	Vertical Glazing Area (%)	Above-Grade Wall Area (Sq ft)	Vertical Glazing Area (sq ft)	Vertical Glazing Area (%)
Above-grade wall and vertical glazing area by orientation	North	23,025	6,304	27.4%	Identical to baseline	6,304	27.4%
	East	8,611	2,631	30.6%	Identical to baseline	2,631	30.6%
	South	23,025	6,868	29.8%	Identical to baseline	6,868	29.8%
	West	8,611	2,631	30.6%	Identical to baseline	2,631	30.6%
	Total	63,272	18,434	29.1%	63,272	18,434	29.1%
Roof and skylight area		Roof Area (sq ft)	Skylight Area (sq ft)	Skylight Area (%)	Roof Area (sq ft)	Skylight Area (sq ft)	Skylight Area (%)
		47,584	0	0.0%	Identical to baseline	0	0.0%
Number of Thermal Blocks		Conditioned	Semi-heated	Unconditioned	Conditioned	Semi-heated	Unconditioned
		50 to 100			Identical to baseline	Identical to baseline	Identical to baseline

Fenestration

Vertical Glazing

General Information		Baseline			Proposed			
New or Existing Construction	Space-Conditioning Category	Description	Assembly U-factor	SHGC	Description	Assembly U-factor	SHGC	VLT
New	Nonresidential	ASHRAE- Metal Framing, Fixed	0.42	0.4	Metal Framed - Fixed	0.42	0.4	72%

Skylights

General Information		Baseline			Proposed			
New or Existing Construction	Space-Conditioning Category	Description	Assembly U-factor	SHGC	Description	Assembly U-factor	SHGC	VLT

How were the proposed framed assembly fenestration U-factors determined?	Energy simulation includes separate frame and glazing

Additional notes:

Lighting

Interior Lighting

Interior Lighting Requirements

All lighting schedules have been modeled identically in the baseline and proposed and reflect the anticipated operating schedules of each space.	Yes
The proposed lighting power includes all lighting system components shown or provided for on the plans (including lamps and ballasts and task and furniture-mounted fixtures except where specifically exempted).	Yes
Baseline and proposed lighting is modeled using the automatic and manual controls required by Code including automated shutoff controls, daylighting controls, occupant sensor controls, etc. The energy modeling schedules account for these mandatory control requirements.	Yes
Ocupant sensors or timer switches are included in the proposed, and modeled in the baseline for classrooms, lecture halls, confrence rooms, meeting rooms, training rooms, employee lunch and break rooms, storage and supply rooms between 50 to 1,000 sq ft (15.24 to 304.8 sq m), copying and printing rooms, office spaces up to 250 sq ft (76.2 sq m), restrooms, dresssing rooms, locker rooms, fitting rooms, and parking garages per Section 9.4.1.2b and 9.4.1.3b.	Yes
Mandatory automatic daylighting controls are included in the proposed, and modeled in the baseline per Code requirements.	Yes

Categorization Procedure

Select the categorization procedure used to determine the lighting power density (LPD) in the proposed and baseline	☑ Building Area Method ☐ Space by Space Method

Building Area Method

Complete the table below in accordance with the Building Area Procedure.

General Information			Baseline	Proposed				
Building Area Type	Total Building Type Area (sq ft)		Modeled LPD (W/sq ft)	Design LPD (W/sq ft)	Automatic Lighting Controls and Space Types	Power Adjustment	Modelled LPD (W/sq ft)	Daylighting Controls
Total	0		0.00	0.00			0.00	

Add Rows

Space by Space Method

Are adjustments being taken for room geometry in the baseline? (Optional)	
Are adjustments being taken for automatic lighting controls beyond what is required by ASHRAE Section 9.4.1 in the proposed? (Optional)	

General Information			Baseline						Proposed		
				ASHRAE Section 9.6.4 Room Geometry Adjustment (Only complete if credit is taken for room geometry)							
Space Type	Total Space Type Area (sq ft)		Maximum Allowance (W/sq ft)	Luminaire Mounting Height (ft)	Work-plane (ft)	Room Perimeter Length (ft) Perimeter Length (m)")	Room Cavity Ratio	Total Baseline LPD Allowance (W/sq ft)	Design LPD (W/sq ft)	Describe Automatic Lighting Controls	Modeled Design LPD
Office- Open plan	59,813.00		0.98				0.0	0.98	0.98	As Req'd	0.98
Stairwell	792		0.69				0.0	0.69	0.69		0.69
Storage Room- All others	2,538		0.63				0.0	0.63	0.63		0.63
Electrical/ Mechanical Room	18,734		0.42				0.0	0.42	0.42		0.42
Corridors- All others	5,826		0.66				0.0	0.66	0.66		0.66
Laboratory- all others	58,599		1.81				0.0	1.81	1.81		1.81
Restroom- all others	2,764		0.98				0.0	0.98	0.98		0.98
Loading Dock, Interior Lobby- all other lobbies	3,528		0.90				0.0	0.90	0.90		0.90
Total	152,594		1.21					1.21	1.21		1.21

Section 9.6.2 Additional Lighting Power (if applicable)

Space Type		#NAME?	Additional Power Allowance (W)	Additional Lighting Power Description or Additional Control Method
Total		0	0	

Lighting equipment is installed in sales area for highlighting merchandise	
The additional lighting schedule has been modeled separately from the general lighting schedule to reflect the differing controls (May be modeled only when installed and automatically controlled, separately from the general lighting, to be turned off during non-business hours.)	
Additional lighting power has been modeled identically in the baseline and proposed up to the value allowed.	

Interior Process Lighting (if applicable)

Description	Exemption	Total Process Lighting Power (W)	Modeled Identically In Baseline?

Exterior Lighting

Exterior Lighting Requirements

No additional lighting power allowance has been claimed in the baseline for surfaces that are not provided with lighting in the actual design and lighting fixtures have not been double-counted for different exterior surfaces	

Table 9.4.3A Exterior Lighting Zone

Lighting Zone	Zone Description	Base Allowance (W)

Tradable Surfaces

General Information			Baseline		Proposed
Table 9.4.5 Tradable Exterior Lighting Application	Required Input (Area or Length)	Total Area (sq ft) or Length (ft)	Allowed LPD	Lighting Power Allowance (W)	Design Lighting Power (W)
				0	
Total tradable surface lighting allowance				0	0

Nontradable Surfaces

General Information			Baseline		Proposed
Table 9.4.2.2 Nontradable Exterior Lighting Application	Required Input	Quantity of Required Input for Project	Allowed LPD for Zone	Lighting Power Allowance (W)	Design Lighting Power (W)
Building facades	Area			0.00	
ATMs and night depositories	Number of ATMs				
Entrances and gatehouse inspection stations at guarded facilities	Uncovered Area			0.00	
Loading areas for law enforcement, fire, ambulance, and other emergency service vehicles	Uncovered Area			0.00	
Drive-through windows at fast food restaurants	Drive-throughs			0.00	
Parking near 24-hour retail entrances	Main Entries			0.00	
Total nontradable surface lighting allowance					0

Summary

Input Parameter	Baseline	Proposed
Total modeled exterior lighting power, including base allowance, based on inputs above (kW)	0.0	0.0

Additional notes:

Process Loads

Process Load Requirements

At least 50% of all 125 volt 15 and 20 Amper receptacles installed in private offices, open offices, and computer classrooms shall be controlled by an automatic device which functions on a scheduled basis, an occupant sensor, or a signal from another control system that indicates the area is unoccupied, in accordance with Section 8.4.2.	

All receptacle equipment and other process equipment designed or anticipated for the building have been accounted for in the energy models.	

Receptacle Equipment Modeling Method

Indicate whether the receptacle equipment was modeled using an average equipment power density for the building, equipment power densities by space type, or by entering the power associated with specific devices in each space. (select all that apply)	☐ Building average equipment power density ☑ Space by space equipment power density

Building Average Equipment Power Density

Building ID	Building Type	Total Building Type Area (sq ft)	Equipment Power Density (W/sq ft)	Equipment Included in Power Density	Baseline Modeled Identically
Totals		0	0.00		
Total power modeled using building average method (kW)					0.0

Note: Any credit for improved receptacle equipment must be submitted using the Exceptional Calculation Method.

OR

Space by Space Equipment Power Densities

Building ID	Building Type	Total Space Type Area (sq ft)	Equipment Power Density (W/sq ft)	Equipment Included in Power Density	Baseline Modeled Identically
101 Smith Place	Office- Open plan	59,813	0.50		Yes
	Stairwell	792	0.50		Yes
	Storage Room- All others	2,538	0.50		Yes
	Electrical/ Mechanical Room	18,734	1.50		Yes
	Corridors- All others	5,826	0.50		Yes
	Laboratory- all others	58,599	5.00		Yes
	Restroom- all others	2,764	0.50		Yes
	Loading Dock, Interior Lobby- all	3,528	0.50		Yes
Totals		152,594	2.35		
Total power modeled using space by space method (kW)					358.7

Note: Any credit for improved receptacle equipment must be submitted using the Exceptional Calculation Method.

Summary

Building ID	Input Parameter	kW
	Total power for receptacle equipment	358.73

Non-Receptacle Process Equipment

Building ID	Equipment Type	Energy Source	Energy Demand (kW for electricity) (Btuh for non-electricity)	Modeling Parameters	Baseline Modeled Identically

Note: Any credit for improved process equipment must be submitted using the Exceptional Calculation Method.

Garage Fan Power Calculation

No Credit is being taken.

Building ID	Total Design Fan Power (kW)	Total Base Fan Power (kW)	Ventilated Parking Area (square feet)	Proposed Airflow (CFM)	Baseline Airflow (CFM)	Design EFLH	Base EFLH
		Same as Design			Same as Design		Same as Design

Note: "
"1. The Baseline parking area must meet the requirements of ASHRAE 90.1-2013 Section 6.4.3.4.5 which establish mandatory Demand Controlled Ventilation (DCV).

Credit is being taken.

Building ID	Total Design Fan Power (kW)	Total Base Fan Power (kW)	Ventilated Parking Area (square feet)	Proposed Airflow (CFM)	Baseline Airflow (CFM)	Design EFLH	Base EFLH

Service Water Heating

Service Water Heaters

Model Input Parameter	Baseline	Proposed
System type and fuel	Gas Fired Storage Water Heater	Heat Pump
Input rating (kW, MBH, etc.)	458 MBH	55 MBH
Efficiency (EF, SL, %, etc.)	73%	EIR 0.27
Storage volume (gal)	343.87	343.87
Storage temperature (°F)	135°	135°
Peak hot water demand (gpm)	1.1 gpm	1.1 gpm
Condenser heat recovery		
Number of pumps		
Total pump power (kW)		
Type of pump		

Service Hot Water Flow

Average Cold Water Temperature (deg. F) 55

General Information				Baseline			Proposed		
Building ID (if multiple buildings)	Fixture Type	Fixture Outlet Temperature (°F)	Percent Hot Water (%)	Flow Rate (gpm or gpc)	Annual Total Water Consumption of Fixture (gallons/year)- From LEED v4 WE Calculator	Annual Fixture Hot Water Consumption (gallons/year)	Flow Rate (gpm or gpc)	Annual Total Water Consumption of Fixture (gallons/year)- From LEED v4 WE Calculator	Annual Fixture Hot Water Consumption (gallons/year)
	Lavatory	105	61%	0.5	129,187.0	49,252.5	0.5	129,187.0	49,252.5
						0.0			0.0
						0.0			0.0

Summary			Baseline			Proposed		
Building ID	DHW Equivalent Full Load Hours of Operation (Note 1)	DHW Supply Temperature from Water Heater (deg. F)	Total Annual Hot Water Consumption at Fixtures (gallons/year)	Total Annual DHW Heater Consumption (gallons/year)	Modeled Flow Rate (gallons/minute)	Total Annual Hot Water Consumption at Fixtures (gallons/year)	Total Annual DHW Heater Consumption (gallons/year)	Modeled Flow Rate (gallons/minute)
	1,547	135	49,252.5	49,252.5	0.000523	49,252.5	49,252.5	0.000523

Note (1): Enter this value first. Default eQuest for Office Building. Adjust for Residential and Other user types.

Additional notes:

General HVAC

Proposed HVAC System Type(s)

System Description	Spaces Modeled
Rooftop Packaged Air Handling Units (Chilled Water, Gas Heat)	All Spaces

Baseline HVAC System Type(s)

Model Input Parameter	Table G3.1.1A System Type (or Semiconditioned System Description)	G3.1.1 Exception (or Semiconditioned Capacity and Area)	Spaces Modeled
• Refer to Section G3.1.1-3 and Table G3.1.1-4 (including footnotes) for Primary HVAC System selection • System selection is based on the climate zone and not the fuel type.		• Conditioned: describe the exception from G3.1.1 used to model this additional Baseline system type	• List the spaces modeled with the primary system type (example: all spaces except kitchen)
Primary HVAC System	System 7- VAV with Reheat		All Spaces except mechanical
Other HVAC System	System 9- Heating and Ventilation		Mechanical

HVAC Modeling Requirements

Proposed HVAC Requirements

All ***proposed*** HVAC systems and related parameters, such as equipment capacities, efficiencies, airflows, fans, etc. have been modeled as designed and are consistent with supporting documentation.	Yes	Required for all systems
Each ***proposed*** HVAC thermal zone has been modeled as a separate thermal block except as allowed by Table Code.	Yes	Required for all systems
All ***proposed*** HVAC systems serving conditioned spaces have been modeled with heating and cooling as required by Table G3.1#1(b), with heating and/or cooling added as necessary identically to the ***baseline*** per Table G3.1#10(c&d) except where System types (9) or (10) have been modeled.	Yes	Required for all systems
All ***proposed*** HVAC systems and related parameters can be modeled directly in the energy simulation program used.	Yes	Required for all systems
All ***proposed*** fan part-load efficiency curves for variable volume fans have been modeled identically to the ***baseline*** curves for variable volume fans (if not, provide a description of the fan curves used in the space at the bottom of this table, and confirm that the proposed curves are representative of the actual building design).	Yes	Required for all systems

Baseline Air-Side HVAC Requirements

All ***baseline*** single zone systems have been modeled with a separate HVAC system for each thermal block per G3.1.1.	Yes	Required for Systems 1-4 & 9-13
All ***baseline*** VAV systems have been modeled with an HVAC system per floor, or one system per group of thermodynamically similar floors per G3.1.1.	Yes	Required for Systems 5-8
All applicable ***baseline*** exceptions to G3.1.1 have been implemented. Note that these exceptions are required, not optional.	N/A	Required for all systems
Where ***baseline or proposed*** efficiency ratings for DX cooling equipment, such as EER and COP, include fan energy, the descriptor is broken down into its components so that supply fan energy can be modeled separately per G3.1.2.1.	Yes	Required for Systems 1-6 Required for Systems 1, 3, and 5 if District Heating has been selected Not required if District Cooling has been slected
All ***baseline*** system cooling capacities auto-sized with 15% oversizing per G3.1.2.2 (at the system or plant level, but not both).	Yes	Required for all systems
All ***baseline*** system heating capacities auto-sized with 25% oversizing per G3.1.2.2 (at the system or plant level, but not both).	Yes	Required for all systems
If the ***proposed*** system has a preheat coil, it has been modeled and controlled in the same manner in the ***baseline*** system per G3.1.2.4.	N/A	Required for all systems
All ***baseline*** supply and return fans operate continuously when spaces are occupied and cycle when unoccupied per G3.1.2.5.	Yes	Required for all systems
Demand control ventilation is modeled in the ***baseline*** case for all spaces larger than 500 sq ft (50 sq m) that have a design occupancy for ventilation of greater than 25 people per 1,000 sq ft (100 sq m) of floor area (except for spaces served by ***baseline*** systems that do not have one of the following: an air-side economizer, automatic modulating control of the outdoor air damper, or a design outdoor airflow of greater than 3,000 cfm (1,400 L/s)) per G3.1.2.6 / 6.4.3.8.	N/A	Required for Systems 3-8
Per Section G3.1.2.6, the minimum baseline outdoor air ventilation rates are modeled using ASHRAE 62.1 minimum outside air volume or the minimum outside air volume required by local code. The proposed outdoor air ventilation rates are modeled as designed. The baseline outside air volume (equal to the sum of the baseline outside air volume per system) does not exceed the proposed outside air volume (equal to the sum of the outside air volume per system) except using schedule variations for spaces where demand control ventilation has been designed where its use is not required, or when providing Baseline and Proposed ASHRAE 62.1 calculations for systems where the Proposed system Ez > 1.0. Note that the Baseline outside air volume and Proposed outside air volume values must be reported consistently with the information provided in IEQ Prerequisite: Minimum Indoor Air Quality, or supplemental documentation must be provided to support the local OA volume requirements or Baseline calculations for systems with Ez > 1.0.	Yes	Required for all systems
For baseline systems serving only laboratory spaces that are prohibited from recirculating return air by code or accreditation standards, the baseline system shall be modeled as 100% outdoor air.	Yes	Required for all systems
All ***baseline*** systems are modeled with zero outside airflow when fans are cycled to meet unoccupied setback temperatures.	Yes	Required for all systems
All ***baseline*** supply airflows for Systems 1-8 have been auto-sized based on a 20°F (11.1°C) supply-air-to-room-air cooling temperature difference (or the airflow rate required to comply with applicable codes/standards, whichever is greater) per G3.1.2.9.1. Exceptions: (1) Laboratory spaces have been modeled with a 17°F (9.4°C) supply-air-to-room air temperature difference or the required ventilation air or makeup air, whichever is greater. (2) If the proposed design HVAC design airflow rate based on latent loads is greater than the design airflow rate based on sensible loads, then the same supply-air-to-room-air humidity ratio difference (gr/lb) used to calculate the proposed design airflow shall be used to calculate design airflow rates for the baseline building design.	Yes	Required for all systems except 9 and 10
All ***baseline*** supply airflows for systems 9-10 have been autosized based on the difference between a supply air temperature set point of 105°F (40.6°C) and the design space heating temperature set point (or the airflow rate required to comply with applicable codes/standards, whichever is greater) per G3.1.2.9.2.	Yes	Required for Systems 9 and 10
All ***baseline*** heat pumps modeled with electric auxiliary heat only energized below 40°F (4°C) and as the last thermostat stage per G3.1.3.1 (compressor still enabled below 40°F (4°C)). The compressor continues to operate in conjunction with the electric auxiliary heat as low as 17°F(-8.3°C), in accordance with the Baseline equipment efficiency ratings from ASHRAE 90.1 Section 6.8. See ASHRAE Interpretation 90.1-2007-09 for more information.	Yes	Required for Systems 2 and 4 Not required if District Heating and/or Cooling has been selected on the Cover tab
All ***baseline*** VAV systems modeled with supply air temperature reset of 5°F (2.3°C) under minimum cooling load conditions per G3.1.3.12.	Yes	Required for Systems 5-8

All ***baseline*** VAV reheat boxes modeled with a minimum flow setpoint of 30% of peak zone flow (or minimum outdoor airflow rate or code required rate) per G3.1.3.13.	Yes	Required for Systems 5 and 7
All ***baseline*** fans in parallel VAV fan-powered boxes sized for 50% of peak primary airflow and modeled with 0.35 W/cfm (0.74 W/L/s) fan power and a minimum flow setpoint of 30% of peak (or minimum ventilation rate) per G3.1.3.14.	Yes	Required for Systems 6 and 8
All ***baseline*** VAV fans (Systems 5-8) are modeled with VAV part-load performance curves consistent with Table G3.1.3.15 Method 1 or Method 2.	Yes	Required for Systems 5-8 and 11
Computer room equipment schedules were modeled as a constant fraction of the peak design load per Table G3.1.3.15 schedule.	Yes	Required for all systems
Minimum volume setpoint was modeled at 50% of the maximum design airflow rate, the minimum ventilation outdoor airflow rate, or the airflow rate required to comply with applicable codes or accreditation standards, whichever is larger. Fan volume was reset from 100% airflow at 100% cooling load to minimum airflow at 50% cooling load. Supply air temperature setpoint was reset from minimum supply air temperature at 50% cooling load and above to space temperature at 0% cooling load. In heating mode supply air temperature was modulated to maintain space temperature, and fan volume was fixed at the minimum airflow per G.3.1.3.17.	Yes	Required for System 11
If the proposed design HVAC system(s) have humidistatic controls, then the baseline building design was modeled using mechanical cooling for dehumidification and have reheat available to avoid overcooling per G.3.1.18.	Yes	Required for Systems 3-8

Baseline Water-Side HVAC Requirements

The ***baseline*** boiler(s) have been modeled as natural draft per G3.1.3.2 except as noted in G.3.1.1.1.	Yes	Required for Systems 1, 5, and 7 Required for Systems 1-2 and 5-8 if District Cooling has been selected Not required if District Heating has been selected
The ***baseline*** hot water design supply temperature has been modeled as 180°F (82°C)with a return temperature of 130°F (54°C) per G3.1.3.3.	Yes	Required for Systems 1, 5, and 7
The ***baseline*** hot water supply temperature reset schedule has been modeled as 180°F (82°C) at outdoor temperatures 20°F (-7°C) and below, 150°F (66°C) at outdoor temperatures 50°F (10°C) and above, and ramped linearly between 180°F (82°C) and 150°F (66°C) at outdoor temperatures between 20°F (-7°C) and 50°F (10°C) per G3.1.3.4.	Yes	Required for Systems 1, 5, and 7, 11 and 12
The ***baseline*** hot water pump power has been modeled as 19 W/gpm (301 kW/1,000 L/s) per G3.1.3.5.	Yes	Required for Systems 1, 5, and 7 Required for Systems 1-2 and 5-8 if District Cooling has been selected Not required if District Heating has been selected
Piping losses have not been modeled in the ***baseline*** for hot or chilled water per G3.1.3.6.	Yes	Required for Systems 1, 5, 7, and 8 and 11 Required for all Systems if District Heating and/or Cooling has been selected
The ***baseline*** chiller(s) quantity and type have been modeled as indicated in Table G3.1.3.7 per G3.1.3.7	Yes	Required for Systems 7 and 8, 11, 12 and 13 Not required if District Cooling has been selected
The ***baseline*** chilled water design supply temperature has been modeled as 44°F (6.7°C) with a return temperature of 56°F (13°C) per G3.1.3.8.	Yes	Required for Systems 7 and 8, 11 and 12 Not required if District Cooling has been selected
The ***baseline*** chilled water supply temperature reset schedule has been modeled as 44°F (7°C) at outdoor temperatures 80°F (27°C) and above, 54°F (12°C) at outdoor temperatures 60°F (16°C) and below, and ramped linearly between 44°F (7°C) and 54°F (12°C) at outdoor temperatures between 80°F (27°C) and 60°F (16°C) per G3.1.3.9. Exeption: If the baseline chilled-water system serves a computer room HVAC system, the supply chilledwater temperature was reset higher based on the HVAC system requiring the most cooling; i.e., the chilled-water setpoint is reset higher until one cooling- coil valve is nearly wide open. The maximum reset chilled-water supply temperature shall be 54°F.	Yes	Required for Systems 7, 8, 11, 12 and 13 Not required if District Cooling has been selected
The ***baseline*** chilled water pump power has been modeled as 22 W/gpm (349 kW/1,000 L/s) per G3.1.3.10. Recommended that the pump power be split as one-third (primary) and two-thirds (secondary). For computer room systems using System 11 with an integrated water-side economizer, the baseline building design primary chilled-water pump power shall be increased 5 W/gpm for flow associated with the water-side economizer. Exeption: The pump power for systems using purchased chilled water was modeled at 16 W/gpm.	Yes	Required for Systems 7, 8, and 11
The ***baseline*** cooling tower has been modeled with a two-speed axial fan per G3.1.3.11 with fan power per Table 6.8.1.7.	Yes	Required for Systems 7, 8, 9, 12 and 13
The ***baseline*** condenser water design supply temperature has been calculated using the cooling tower approach to the 0.4% evaporation design wet-bulb temperature as generated by the formula in G.3.1.3.11, with a design temperature rise of 10°F.per G3.1.3.11.	Yes	Required for Systems 7, 8, 9, 12 and 13
The ***baseline*** condenser water temperature reset schedule has been modeled to maintain a 70°F (21°C) leaving water temperature where weather permits, floating up to a leaving water temperature at design conditions per G3.1.3.11.	Yes	Required for Systems 7, 8, 9, 12 and 13
The ***baseline*** condenser water pump power has been modeled as 19 W/gpm (301 kW/1,000 L/s) per G3.1.3.11.	Yes	Required for Systems 7, 8, 9, 12 and 13

For each item entered as “No” above, describe the applicable ASHRAE 90.1 Appendix G exception(s) that apply, or the circumstances preventing the HVAC parameters from

Air-Side HVAC

For adding or deleting systems, select the whole column. For adding a new system, copy the whole column, right click and select "Insert Copied Cells. For deleting a system, again select the whole column, right-click and select "Delete".

Air-Side HVAC System Schedule

Model Input Parameter		Units	Totals		Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Proposed	Proposed	Proposed
			Baseline	Proposed	Building ID	Building ID	Building ID	Building ID	Building ID	Building ID	Building ID	Building ID	Building ID	Building ID
					* System type	* System type	* System type	* System type	* System type	* System type	* System type	* System type	* System type	* System type
					System 7- VAV with Reheat	System 7- VAV with Reheat	System 7- VAV with Reheat	System 7- VAV with Reheat	System 7- VAV with Reheat	System 7- VAV with Reheat	System 9- Heating and	System 7- VAV with Reheat	System 7- VAV with Reheat	System 9- Heating and
					System designation(s)	System designation(s)	System designation(s)	System designation(s)	System designation(s)	System designation(s)	System designation(s)	System designation(s)	System designation(s)	System designation(s)
					Level 1 AHU	Level 2 AHU	Level 3 AHU	Level 1 AHU Lab	Level 2 AHU Lab	Level 3 AHU Lab	Penthouse	AHUs 1-4	AHUs 1-4 Lab	Penthouse HV
					Number of similar systems	Number of similar systems	Number of similar systems	Number of similar systems	Number of similar systems	Number of similar systems	Number of similar systems	Number of similar systems	Number of similar systems	Number of similar systems
Total cooling capacity		tons	0	0										
* Table 6.8.1 Unitary Cooling (Systems 1 through 6)	Table 6.8.1 unitary cooling capacity range	tons												
	Unitary cooling efficiency													
	Unitary cooling part-load efficiency (if applicable)													
Total heating capacity			0	0										
* Table 6.8.1 Unitary Heating (Systems 2,	Table 6.8.1 unitary heating capacity range													
	Unitary heating efficiency													
* Fan control					Variable Speed	Variable Speed	Variable Speed	Variable Speed	Variable Speed	Variable Speed	Constant Volume	Variable Speed	Variable Speed	Variable Speed
Supply airflow		cfm	114,835	168,060	10,146	9,878	12,362	29,386	24,114	26,889	2,060	83,000	83,000	2,060
Outdoor airflow		cfm	114,835	168,060	10,146	9,878	12,362	29,386	24,114	26,889	2,060	83,000	83,000	2,060
Demand control ventilation		n/a			No	No	No	No	No	No	No	No	No	No
* Economizer high-limit shutoff					70	70	70	70	70	70	70			
* Supply air temperature reset		n/a			Supply air temperature reset of 5°F under minimum cooling load conditions	Supply air temperature reset of 5°F under minimum cooling load conditions	Supply air temperature reset of 5°F under minimum cooling load conditions	Supply air temperature reset of 5°F under minimum cooling load conditions	Supply air temperature reset of 5°F under minimum cooling load conditions	Supply air temperature reset of 5°F under minimum cooling load conditions	Supply air temperature reset of 5°F under minimum cooling load conditions			
* Energy Recovery per 6.5.6.1	For Baseline, any individual systems where supply airflow rate exceeds value in Table 6.5.6.1 based on climate zone and percent outdoor air? For proposed, indicate if energy recovery is modeled.	n/a			No	No	No	No	No	No	No	No	No	No
	Exhaust air energy recovery effectiveness or 6.5.6.1 exception claimed	6.5.61 exception claimed			n/a	n/a	n/a	n/a	n/a	n/a	n/a	87%	87%	85%
Fan Power	Supply fan power	kW			7.1	6.9	8.5	40.0	33.1	36.9	0.6	148.4	148.4	0.6
	Return or relief fan power	kW			7.1	6.9	8.5							
	Exhaust fan power	kW												
	System fan power	kW	156	297	14.2	13.8	17.0	40.0	33.1	36.9	0.6	148.4	148.4	0.6
	Allowed fan power	kW	**Start the calculations in "FanPower Calculations" Tab, then link to this cell.**		14.2	13.9	17.1	40.1	33.1	36.9	0.6	n/a	n/a	n/a
* Pressure Drop Adjustments (Systems 3 through 8)	For each pressure drop adjustment claimed, input the design airflow rate, CFMD, through each applicable device.													
	Fully ducted return and/or exhaust air systems	CFMD: cfm										n/a	n/a	n/a
		Adjustment: in. w. c.										n/a	n/a	n/a
	Return and/or exhaust airflow control devices	CFMD: cfm			10,146	9,878	12,362	29,386	24,114	26,889	2,060	n/a	n/a	n/a
		Adjustment: in. w. c.			0.50	0.50	0.50	0.50	0.50	0.50	0.50	n/a	n/a	n/a
	Exhaust filters, scrubbers, or other exhaust treatment	CFMD: cfm										n/a	n/a	n/a
		Adjustment: in. w. c.										n/a	n/a	n/a
	Particulate filtration credit: MERV 9 through 12	CFMD: cfm										n/a	n/a	n/a
		Adjustment: in. w. c.			0.50	0.50	0.50	0.50	0.50	0.50	0.50	n/a	n/a	n/a
	Particulate filtration credit: MERV 13 through 15	CFMD: cfm			10,146	9,878	12,362	29,386	24,114	26,889	2,060	n/a	n/a	n/a
		Adjustment: in. w. c.			0.90	0.90	0.90	0.90	0.90	0.90	0.90	n/a	n/a	n/a
	Particulate filtration credit: MERV 16 and greater and electronically enhanced filters	CFMD: cfm										n/a	n/a	n/a
		Adjustment: in. w. c.										n/a	n/a	n/a
	Carbon and other gas-phase air cleaners	CFMD: cfm										n/a	n/a	n/a
		Adjustment: in. w. c.										n/a	n/a	n/a
	Biosafety cabinet	CFMD: cfm										n/a	n/a	n/a
		Adjustment: in. w. c.										n/a	n/a	n/a
	Energy recovery device, other than coil runaround loop	CFMD: cfm										n/a	n/a	n/a
		Adjustment: in. w. c.										n/a	n/a	n/a
	Coil runaround loop	CFMD: cfm										n/a	n/a	n/a
		Adjustment: in. w. c.										n/a	n/a	n/a
	Evaporative humidifier/cooler in series with another cooling coil	CFMD: cfm										n/a	n/a	n/a
		Adjustment: in. w. c.										n/a	n/a	n/a
	Sound attenuation section	CFMD: cfm			20,292	19,756	24,724	58,772	48,228	53,778	4,120	n/a	n/a	n/a
		Adjustment: in. w. c.			0.15	0.15	0.15	0.15	0.15	0.15	0.15	n/a	n/a	n/a
	Exhaust system serving fume hoods	CFMD: cfm										n/a	n/a	n/a
		Adjustment: in. w. c.			0.35	0.35	0.35	0.35	0.35	0.35	0.35	n/a	n/a	n/a
	Laboratory and vivarium exhaust systems in high-rise buildings	CFMD: cfm										n/a	n/a	n/a
		Adjustment: in. w. c.										n/a	n/a	n/a
	Total Table 6.5.3.1.1B pressure drop adjustment (A)	bhp			4.2	4.1	5.1	12.1	9.9	11.1	0.8	n/a	n/a	n/a
Fan power adjustments (Systems 9 through	Non-mechanical cooling fan - additional fan power allowance	cfm										n/a	n/a	n/a
		fan power per cfm (kW)			0.000054	0.000054	0.000054	0.000054	0.000054	0.000054	0.000054	n/a	n/a	n/a

For Systems 5 through 8

Pfan = bhp x 746 / Fan Motor Efficiency
Variable Volume
bhp= CFM x 0.0013 + A

Basline System Name	level 1 AHU
CFM	10,146
A (from Air-side HVAC Tab)	4.175308642
bhp	17.36510864
Fan Motor Efficiency	0.91
Pfan (watts)	14235.57258
Pfan(kW)	14.23557258
	0.001403072
	0.000701536

Basline System Name	Level 2 AHU
CFM	9,878
A (from Air-side HVAC Tab)	4.065020576
bhp	16.90642058
Fan Motor Efficiency	0.91
Pfan (watts)	13859.54918
Pfan(kW)	13.85954918
	0.001403072
	0.000701536

Basline System Name	Level 3 AHU
CFM	12,362
A (from Air-side HVAC Tab)	5.087242798
bhp	21.1578428
Fan Motor Efficiency	0.924
Pfan (watts)	17081.98131
Pfan(kW)	17.08198131
	0.001381814
	0.000690907

Basline System Name	Level 1 AHU Lab
CFM	29,386
A (from Air-side HVAC Tab)	12.09300412
bhp	50.29480412
Fan Motor Efficiency	0.936
Pfan (watts)	40085.38875
Pfan(kW)	40.08538875
	0.001364098
	0.000682049

Basline System Name	Level 2 AHU Lab
CFM	24,114
A (from Air-side HVAC Tab)	9.92345679
bhp	41.27165679
Fan Motor Efficiency	0.93
Pfan (watts)	33106.08168
Pfan(kW)	33.10608168
	0.001372899

Basline System Name	Level 3 AHU Lab
CFM	26,889
A (from Air-side HVAC Tab)	11.0654321
bhp	46.0211321
Fan Motor Efficiency	0.93
Pfan (watts)	36915.87586
Pfan(kW)	36.91587586
	0.001372899

Allowed Fan Power (transfer to "Air-Side HVAC" tab)

Water-Side HVAC

Water-Side HVAC System Schedule

Chilled Water

Model Input Parameter	Units	Baseline	Proposed
Number and type of chillers (and capacity per chiller if more than one type or size of chiller)	n/a	2 water-cooled centrifugal chillers	3 water cooled centrifugal Chillers
Purchased chilled water rate (cost per unit energy)	$	NA	NA
Total chiller capacity	kBtu/h	11506	12305
Chiller efficiency - full load	kW/ton	0.56	0.62
Chiller efficiency - part load	IPLV	0.5	0.3959
Chilled water (CHW) supply temp	°F	44	42
CHW ΔT	°F	12	12
CHW supply temp reset parameters	n/a	44F @ 80 and above; 54 @ 60F and below	Load Reset
CHW loop configuration	n/a	Primary/Secondary	Primary/Secondary
Number of primary or DES plant CHW pumps	#	2	3
Primary or DES plant CHW pump power	W/gpm	7.471	20.402
Primary or DES plant CHW pump flow	gpm	1893.8	3000
Primary or DES plant CHW pump control	n/a	Constant Speed - each primary pump interlocked with associated chiller	Variable Speed
Number of secondary or building booster CHW pumps	#	1	3
Secondary or building booster CHW pump power	W/gpm	14.6	26.3
Secondary or building booster CHW pump flow	gpm	1226	2056
Secondary or building booster CHW pump control	n/a	Variable speed	Variable speed
Water-side economizer	n/a		
Water-side energy recovery	n/a		

Cooling Tower and Condenser Water

Model Input Parameter	Units	Baseline	Proposed
Number of cooling towers or fluid coolers	#	1	1
Cooling tower fan power	W/gpm	18.6	16.8 kW/gpm
Cooling tower fan control	n/a	Variable Speed	Variable Speed
Condenser water (CW) leaving temp	°F	85°F	85°F
CW ΔT	°F	10°	10°
CW loop temp reset parameters	n/a	70°	70°
Number of CW pumps	#	2	3
CW pump power	W/gpm	18.97	15.49
CW pump flow	gpm	2698.8	3210
CW pump control	n/a	Riding Pump Curve	Variable Speed Pump

Hot Water or Steam

Model Input Parameter	Units	Baseline	Proposed
Number and type of boilers	n/a	2 equally-sized natural draft hot water boilers	6 Condensing Boilers
Purchased heating rate (cost per unit energy)	$	NA	NA
Total boiler capacity		12033	17235
Boiler efficiency		80%	93%
Hot water or steam (HHW) supply temp	°F	180°	150°
HHW ΔT	°F	50°	30°
HHW temp reset parameters	n/a	OA Reset 180°@20°/150°@50°	Load Reset
HHW loop configuration	n/a	Primary	Primary
Number of primary or DES plant HHW pumps	#	1	1
Primary or DES plant HHW pump power	kW	3.746	2.544
Primary or DES plant HHW pump flow	gpm	191.6	287.9
Primary or DES plant HHW pump control	n/a	Variable speed	Variable speed
Number of secondary or building booster HHW pumps	#	0	1
Secondary or building booster HHW pump power	n/a		13.83
Secondary or building booster HHW pump flow	n/a		900
Secondary or building booster HHW pump control	n/a		Variable Speed

Performance Rating Method Outputs

Project Name	101 Smith Place

Energy Sources

First enter the utility rates at the bottom of this page,

Energy Type	Energy Consumption Units	Demand Units	Utility Rate Name	Utility Rate Structure	Unit Conversion Factors: Energy Type Consumption Units to Site Energy Consumption (Btu x 10^6)	Unit Conversion Factors: Energy Type Consumption Units to Source Energy Consumption (Btu x 10^6)
Electricity	kWh	kW			0.0034120	0.0107137
Natural Gas	therm	Btuh x 10^6			0.1000000	0.1050000
District Cooling	MWh	MW			3.4120000	3.4120000
Site energy consumption units used to report energy consumption totals (sum of energy types)					Btu x 10^6	
Source energy consumption units used to report energy consumption totals (sum of energy types)					Btu x 10^6	

Performance Rating Method Compliance Report

Table: Baseline energy summary by end use

End Use	Unregulated?	Energy Type	Units of Annual Energy and Peak Demand	Baseline 0° rotation	Baseline 90° rotation	Baseline 180° rotation	Baseline 270° rotation	Baseline Design Total (Average of 4 rotations)
Interior lighting		Electricity	Consumption (kWh)	533,676.0	533,676.0	533,676.0	533,676.0	533,676.0
			Demand (kW)					
Exterior lighting		Electricity	Consumption (kWh)					
			Demand (kW)					
Space heating		Natural Gas	Consumption (therm)	105,146.0	113,664.0	112,964.0	114,621.0	111,598.8
			Demand (Btuh x 10^6)					
Space cooling		Electricity	Consumption (kWh)	334,986.0	362,408.0	354,877.0	356,318.0	352,147.3
			Demand (kW)					
Pumps		Electricity	Consumption (kWh)	268,178.0	290,334.0	292,634.0	274,371.0	281,379.3
			Demand (kW)					
Heat rejection		Electricity	Consumption (kWh)	6,993.0	7,372.0	7,256.0	7,391.0	7,253.0
			Demand (kW)					
Fans - interior ventilation		Electricity	Consumption (kWh)	919,145.0	947,161.0	942,796.0	948,037.0	939,284.8
			Demand (kW)					
Fans - parking garage	x	Electricity	Consumption (kWh)					
			Demand (kW)					
Service water heating		Natural Gas	Consumption (therm)	111.0	111.0	111.0	111.0	111.0
			Demand (Btuh x 10^6)					
Receptacle equipment	x	Electricity	Consumption (kWh)	1,337,475.0	1,337,475.0	1,337,475.0	1,337,475.0	1,337,475.0
			Demand (kW)					
IT equipment	x	Electricity	Consumption (kWh)					
			Demand (kW)					
Interior lighting - process	x	Electricity	Consumption (kWh)					
			Demand (kW)					
Refrigeration equipment	x	Electricity	Consumption (kWh)					
			Demand (kW)					
Fans - Kitchen Ventilation	x	Electricity	Consumption (kWh)					
			Demand (kW)					
Cooking	x	Electricity	Consumption (kWh)					
			Demand (kW)					
Industrial Process	x	Electricity	Consumption (kWh)					
			Demand (kW)					
Elevators and escalators	x	Electricity	Consumption (kWh)					
			Demand (kW)					
Heat Pump Supplementary		Electricity	Consumption (kWh)					
			Demand (kW)					
Space Heating (Electricity)		Electricity	Consumption (kWh)					
			Demand (kW)					
Misc Equipment (Natural Gas)		Natural Gas	Consumption (therm)					
			Demand (Btuh x 10^6)					
Auxilary (Natural Gas)		Natural Gas	Consumption (therm)					
			Demand (Btuh x 10^6)					
Cooling (Natural Gas)		Natural Gas	Consumption (therm)					
			Demand (Btuh x 10^6)					
Total energy consumption by energy type		Electricity	kWh	3,400,453.0	3,478,426.0	3,468,714.0	3,457,268.0	3,451,215.3
		Natural Gas	therm	105,257.0	113,775.0	113,075.0	114,732.0	111,709.8
		District Cooling	MWh	0.0	0.0	0.0	0.0	0.0
Total site energy (Btu x 10^6)				22,128.0	23,245.9	23,142.8	23,269.4	22,946.5
Total source energy (Btu x 10^6)				47,483.4	49,213.2	49,035.6	49,087.0	48,704.8

Table: Baseline building annual energy cost by energy type

Energy Type		Baseline 0° rotation	Baseline 90° rotation	Baseline 180° rotation	Baseline 270° rotation	Baseline Design Total
Electricity	kWh	$ 476,063	$ 486,980	$ 485,620	$ 484,018	$ 483,170
Natural Gas	therm	$ 126,308	$ 136,530	$ 135,690	$ 137,678	$ 134,052
District Cooling	MWh					
Baseline annual energy cost		$ 602,372	$ 623,510	$ 621,310	$ 621,696	$ 617,222

Table: Proposed energy summary by end use

End Use	Unregulated?	Energy Type	Units of Annual Energy and Peak Demand	Baseline	Proposed	Energy / Demand Savings per End-Use	End Use Percent Contribution to Total Energy Savings	End Use Percent Contribution to Total Cost Savings	Percent of Total Proposed Site Energy Consumption
Interior lighting		Electricity	Consumption (kWh)	533,676	533,676	0.0%			9.6%
			Demand (kW)						
Exterior lighting		Electricity	Consumption (kWh)						0.0%
			Demand (kW)						
Space heating		Natural Gas	Consumption (therm)	111,599	78,930	29.3%			41.5%
			Demand (Btuh x 10^6)						
Space cooling		Electricity	Consumption (kWh)	352,147	146,444	58.4%			2.6%
			Demand (kW)						
Pumps		Electricity	Consumption (kWh)	281,379	126,707	55.0%			2.3%
			Demand (kW)						
Heat rejection		Electricity	Consumption (kWh)	7,253	7,935	-9.4%			0.1%
			Demand (kW)						
Fans - interior ventilation		Electricity	Consumption (kWh)	939,285	1,075,088	-14.5%			19.3%
			Demand (kW)						
Fans - parking garage	x	Electricity	Consumption (kWh)						0.0%
			Demand (kW)						
Service water heating		Natural Gas	Consumption (therm)	111		100.0%			0.0%
			Demand (Btuh x 10^6)						
Receptacle equipment	x	Electricity	Consumption (kWh)	1,337,475	1,337,475	0.0%			24.0%
			Demand (kW)						
IT equipment	x	Electricity	Consumption (kWh)						0.0%
			Demand (kW)						
Interior lighting - process	x	Electricity	Consumption (kWh)						0.0%
			Demand (kW)						
Refrigeration equipment	x	Electricity	Consumption (kWh)						0.0%
			Demand (kW)						
Fans - Kitchen Ventilation	x	Electricity	Consumption (kWh)						0.0%
			Demand (kW)						
Cooking	x	Electricity	Consumption (kWh)						0.0%
			Demand (kW)						
Industrial Process	x	Electricity	Consumption (kWh)						0.0%
			Demand (kW)						
Elevators and escalators	x	Electricity	Consumption (kWh)						0.0%
			Demand (kW)						
Heat Pump Supplementary		Electricity	Consumption (kWh)		20,263				0.4%
			Demand (kW)						
Space Heating (Electricity)		Electricity	Consumption (kWh)		7,589				0.1%
			Demand (kW)						
Misc Equipment (Natural Gas)		Natural Gas	Consumption (therm)						0.0%
			Demand (Btuh x 10^6)						
Auxilary (Natural Gas)		Electricity	Consumption (kWh)						0.0%
			Demand (kW)						
Cooling (Natural Gas)		Natural Gas	Consumption (therm)						0.0%
			Demand (Btuh x 10^6)						
			Consumption (therm)						
			Demand (Btuh x 10^6)						

Table: Performance rating energy consumption and cost by fuel type

Energy Type	Site Energy Units	Baseline			Proposed			Percent Savings	
		Site Energy Use (Units shown per energy type)	Source Energy Use (Btu x 10^6)	Cost	Site Energy Use (Units shown per energy type)	Source Energy Use (Btu x 10^6)	Cost	Site Energy Use	Cost
Electricity	kWh	3,451,215.3	36,975.3	$ 483,170	3,255,177.0	34,875.0	$ 455,725	5.7%	5.7%
Natural Gas	therm	111,709.8	11,729.5	$ 134,052	78,930.0	8,287.7	$ 94,716	29.3%	29.3%
District Cooling	MWh	0.0	0.0		0.0	0.0	0		
Energy model subtotal (Btu x 10^6)		22,946.5	48,704.8	$ 617,222	18,999.7	43,162.6	$ 550,441	17.2%	10.8%

Table: Virtual rate (average energy cost per unit energy)

Energy Type		Baseline	Proposed	Percent Variance
Electricity	$ / kWh	$0.140	$0.140	0.0%
Natural Gas	$ / therm	$1.200	$1.200	0.0%
District Cooling	$ / MWh	$0.000	$0.000	

Unmet Loads

Enter the non-coincident unmet load hours, consistent with the energy simulation output reports.

Unmet Loads	Baseline	Proposed
Number of hours heating loads not met	139	39
Number of hours cooling loads not met	2	0
Totals	141	39
Compliance	Yes	

Design Case Warning Messages:

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101 Smith_10-16-19_LEEDv4_Baseline                                           DOE-2.2-50a   12/10/2019   15:29:21  BDL RUN  1

REPORT- ATTN Simulation Messages For Review HVAC        Program                    WEATHER FILE- Boston       MA TMY2
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 **WARNING********************************************************************
           ZONE 01- North Perim Zn (G.N6)
           might have insufficient heating capability.
           Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
           ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
           specified DESIGN-HEAT-T for the calculated peak ZONE load
           (see LS-A or LS-B for the ZONE peak load.)

           SYSTEM AHUs 1-4
           which supplies the above listed ZONE, has a design heating
           coil exit temperature, HEAT-SET-T,(plus any zone reheat)
           below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
           might account for the insufficient heating capability.

           ZONE 01- North Perim Zn (G.N6)        has a THERMOSTAT-TYPE
           of REVERSE-ACTION, which, when added to the issues listed
           in the messages above, will cause excessive underheating.

 **WARNING********************************************************************
           ZONE 01- North Perim Zn (G.N7)
           might have insufficient heating capability.
           Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
           ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
           specified DESIGN-HEAT-T for the calculated peak ZONE load
           (see LS-A or LS-B for the ZONE peak load.)

           SYSTEM AHUs 1-4
           which supplies the above listed ZONE, has a design heating
           coil exit temperature, HEAT-SET-T,(plus any zone reheat)
           below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
           might account for the insufficient heating capability.

           ZONE 01- North Perim Zn (G.N7)        has a THERMOSTAT-TYPE
           of REVERSE-ACTION, which, when added to the issues listed
           in the messages above, will cause excessive underheating.

 **WARNING********************************************************************
           ZONE 01- North Perim Zn (G.N8)
           might have insufficient heating capability.
           Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
           ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
           specified DESIGN-HEAT-T for the calculated peak ZONE load
           (see LS-A or LS-B for the ZONE peak load.)

           SYSTEM AHUs 1-4
           which supplies the above listed ZONE, has a design heating
           coil exit temperature, HEAT-SET-T,(plus any zone reheat)
           below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
           might account for the insufficient heating capability.

           ZONE 01- North Perim Zn (G.N8)        has a THERMOSTAT-TYPE
           of REVERSE-ACTION, which, when added to the issues listed
           in the messages above, will cause excessive underheating.

 **WARNING********************************************************************
           ZONE 01- North Perim Zn (G.N10)
           might have insufficient heating capability.
           Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
           ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
           specified DESIGN-HEAT-T for the calculated peak ZONE load
           (see LS-A or LS-B for the ZONE peak load.)

           SYSTEM AHUs 1-4
           which supplies the above listed ZONE, has a design heating
           coil exit temperature, HEAT-SET-T,(plus any zone reheat)
           below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
           might account for the insufficient heating capability.

           ZONE 01- North Perim Zn (G.N10)       has a THERMOSTAT-TYPE
           of REVERSE-ACTION, which, when added to the issues listed
           in the messages above, will cause excessive underheating.
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**WARNING*********************************************************************
          ZONE 01- North Perim Zn (G.N11)
          might have insufficient heating capability.
          Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
          ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
          specified DESIGN-HEAT-T for the calculated peak ZONE load
          (see LS-A or LS-B for the ZONE peak load.)

          SYSTEM AHUs 1-4
          which supplies the above listed ZONE, has a design heating
          coil exit temperature, HEAT-SET-T, (plus any zone reheat)
          below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
          might account for the insufficient heating capability.

          ZONE 01- North Perim Zn (G.N11)       has a THERMOSTAT-TYPE
          of REVERSE-ACTION, which, when added to the issues listed
          in the messages above, will cause excessive underheating.

**WARNING*********************************************************************
          ZONE 01- North Perim Zn (G.N14)
          might have insufficient heating capability.
          Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
          ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
          specified DESIGN-HEAT-T for the calculated peak ZONE load
          (see LS-A or LS-B for the ZONE peak load.)

          SYSTEM AHUs 1-4
          which supplies the above listed ZONE, has a design heating
          coil exit temperature, HEAT-SET-T, (plus any zone reheat)
          below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
          might account for the insufficient heating capability.

          ZONE 01- North Perim Zn (G.N14)       has a THERMOSTAT-TYPE
          of REVERSE-ACTION, which, when added to the issues listed
          in the messages above, will cause excessive underheating.

**WARNING*********************************************************************
          ZONE 2/3-North Perim Zn (G.N3)
          might have insufficient heating capability.
          Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
          ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
          specified DESIGN-HEAT-T for the calculated peak ZONE load
          (see LS-A or LS-B for the ZONE peak load.)

          SYSTEM AHUs 1-4
          which supplies the above listed ZONE, has a design heating
          coil exit temperature, HEAT-SET-T, (plus any zone reheat)
          below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
          might account for the insufficient heating capability.

          ZONE 2/3-North Perim Zn (G.N3)        has a THERMOSTAT-TYPE
          of REVERSE-ACTION, which, when added to the issues listed
          in the messages above, will cause excessive underheating.

**WARNING*********************************************************************
          ZONE 2/3-North Perim Zn (T.N18)
          might have insufficient heating capability.
          Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
          ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
          specified DESIGN-HEAT-T for the calculated peak ZONE load
          (see LS-A or LS-B for the ZONE peak load.)

          SYSTEM AHUs 1-4
          which supplies the above listed ZONE, has a design heating
          coil exit temperature, HEAT-SET-T, (plus any zone reheat)
          below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
          might account for the insufficient heating capability.

          ZONE 2/3-North Perim Zn (T.N18)       has a THERMOSTAT-TYPE
          of REVERSE-ACTION, which, when added to the issues listed
          in the messages above, will cause excessive underheating.
```

```
**WARNING*************************************************************************
          PREHEAT/HEATING-CAPACITY in SYSTEM Penthouse HV
          is too low to provide the requested supply temperature for
          the calculated mixed air temperature using total ZONE loads
          (on LS-A/B) and SYSTEM design parameters, plus outside air
          conditions (on LS-C), and specified capacities & air flows.
          Requested temperature is 105.00 calculated is  55.00
          Check HEATING-CAPACITY, HEAT-SET-T, PRE-HEAT-T, MAX-SUPPLY-T,
          DESIGN-HEAT-T, and ZONE loads for consistency.

**WARNING*************************************************************************
          PREHEAT/HEATING-CAPACITY in SYSTEM AHU 1-4 - LAB
          is too low to provide the requested supply temperature for
          the calculated mixed air temperature using total ZONE loads
          (on LS-A/B) and SYSTEM design parameters, plus outside air
          conditions (on LS-C), and specified capacities & air flows.
          Requested temperature is  55.00 calculated is  12.52
          Check HEATING-CAPACITY, HEAT-SET-T, PRE-HEAT-T, MAX-SUPPLY-T,
          DESIGN-HEAT-T, and ZONE loads for consistency.

**WARNING*************************************************************************
          Pump: CW Loop Pump                 has a total user-specified flow
          of      1546. gpm, but the loop flow is      2935. gpm.

**WARNING*************************************************************************
          Pump: CW Loop Pump                 has a user-specified head
          of        22. feet, but the loop head is        42. feet.

**WARNING*************************************************************************
          Pump: BP-1                         has a total user-specified flow
          of       150. gpm, but the loop flow is       267. gpm.

**WARNING*************************************************************************
          Pump: BP-2                         has a total user-specified flow
          of       150. gpm, but the loop flow is       267. gpm.

**WARNING*************************************************************************
          Pump: BP-3                         has a total user-specified flow
          of       150. gpm, but the loop flow is       267. gpm.

**WARNING*************************************************************************
          Pump: BP-4                         has a total user-specified flow
          of       150. gpm, but the loop flow is       267. gpm.

**WARNING*************************************************************************
          Pump: BP-5                         has a total user-specified flow
          of       150. gpm, but the loop flow is       267. gpm.

**WARNING*************************************************************************
          Pump: BP-6                         has a total user-specified flow
          of       150. gpm, but the loop flow is       267. gpm.
```

City of Cambridge
Inspectional Services Department

Baseline Case Warning Messages:

```
101 Smith_10-16-19_LEEDV4_Baseline                              DOE-2.2-50a   12/10/2019    15:18:11  BDL RUN  4

REPORT- ATTN Simulation Messages For Review HVAC       Program              WEATHER FILE- Boston       MA TMY2
---------------------------------------------------------------------------------------------------------------


**WARNING*****************************************************************
           ZONE 01- North Perim Zn (G.N6)
           might have insufficient heating capability.
           Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
           ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
           specified DESIGN-HEAT-T for the calculated peak ZONE load
           (see LS-A or LS-B for the ZONE peak load.)

           SYSTEM Level 1 AHU
           which supplies the above listed ZONE, has a design heating
           coil exit temperature, HEAT-SET-T, (plus any zone reheat)
           below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
           might account for the insufficient heating capability.

           ZONE 01- North Perim Zn (G.N6)         has a THERMOSTAT-TYPE
           of REVERSE-ACTION, which, when added to the issues listed
           in the messages above, will cause excessive underheating.

**WARNING*****************************************************************
           ZONE 01- North Perim Zn (G.N7)
           might have insufficient heating capability.
           Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
           ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
           specified DESIGN-HEAT-T for the calculated peak ZONE load
           (see LS-A or LS-B for the ZONE peak load.)

           SYSTEM Level 1 AHU
           which supplies the above listed ZONE, has a design heating
           coil exit temperature, HEAT-SET-T, (plus any zone reheat)
           below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
           might account for the insufficient heating capability.

           ZONE 01- North Perim Zn (G.N7)         has a THERMOSTAT-TYPE
           of REVERSE-ACTION, which, when added to the issues listed
           in the messages above, will cause excessive underheating.

**WARNING*****************************************************************
           ZONE 01- North Perim Zn (G.N8)
           might have insufficient heating capability.
           Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
           ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
           specified DESIGN-HEAT-T for the calculated peak ZONE load
           (see LS-A or LS-B for the ZONE peak load.)

           SYSTEM Level 1 AHU
           which supplies the above listed ZONE, has a design heating
           coil exit temperature, HEAT-SET-T, (plus any zone reheat)
           below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
           might account for the insufficient heating capability.

           ZONE 01- North Perim Zn (G.N8)         has a THERMOSTAT-TYPE
           of REVERSE-ACTION, which, when added to the issues listed
           in the messages above, will cause excessive underheating.

**WARNING*****************************************************************
           ZONE 01- North Perim Zn (G.N10)
           might have insufficient heating capability.
           Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
           ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
           specified DESIGN-HEAT-T for the calculated peak ZONE load
           (see LS-A or LS-B for the ZONE peak load.)

           SYSTEM Level 1 AHU
           which supplies the above listed ZONE, has a design heating
           coil exit temperature, HEAT-SET-T, (plus any zone reheat)
           below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
           might account for the insufficient heating capability.

           ZONE 01- North Perim Zn (G.N10)        has a THERMOSTAT-TYPE
           of REVERSE-ACTION, which, when added to the issues listed
           in the messages above, will cause excessive underheating.
```

Note: The information requested in this documentation is the minimal requirement that must be submitted prior to commencement of plan review. ISD may request additional documentation deemed necessary to determine compliance with applicable codes.

```
**WARNING*********************************************************************
          ZONE 01- North Perim Zn (G.N11)
          might have insufficient heating capability.
          Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
          ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
          specified DESIGN-HEAT-T for the calculated peak ZONE load
          (see LS-A or LS-B for the ZONE peak load.)

          SYSTEM Level 1 AHU
          which supplies the above listed ZONE, has a design heating
          coil exit temperature, HEAT-SET-T,(plus any zone reheat)
          below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
          might account for the insufficient heating capability.

          ZONE 01- North Perim Zn (G.N11)       has a THERMOSTAT-TYPE
          of REVERSE-ACTION, which, when added to the issues listed
          in the messages above, will cause excessive underheating.

**WARNING*********************************************************************
          ZONE 01- North Perim Zn (G.N14)
          might have insufficient heating capability.
          Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
          ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
          specified DESIGN-HEAT-T for the calculated peak ZONE load
          (see LS-A or LS-B for the ZONE peak load.)

          SYSTEM Level 1 AHU
          which supplies the above listed ZONE, has a design heating
          coil exit temperature, HEAT-SET-T,(plus any zone reheat)
          below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
          might account for the insufficient heating capability.

          ZONE 01- North Perim Zn (G.N14)       has a THERMOSTAT-TYPE
          of REVERSE-ACTION, which, when added to the issues listed
          in the messages above, will cause excessive underheating.

**WARNING*********************************************************************
          PREHEAT/HEATING-CAPACITY in SYSTEM Level 1 AHU
          is too low to provide the requested supply temperature for
          the calculated mixed air temperature using total ZONE loads
          (on LS-A/B) and SYSTEM design parameters, plus outside air
          conditions (on LS-C), and specified capacities & air flows.
          Requested temperature is  55.00 calculated is  51.02
          Check HEATING-CAPACITY, HEAT-SET-T, PRE-HEAT-T, MAX-SUPPLY-T,
          DESIGN-HEAT-T, and ZONE loads for consistency.

**WARNING*********************************************************************
          ZONE 2/3-North Perim Zn (G.N3)
          might have insufficient heating capability.
          Check that the SYSTEM or ZONE HEATING-CAPACITY plus this
          ZONEs BASEBOARD-RATING is adequate to maintain the ZONE
          specified DESIGN-HEAT-T for the calculated peak ZONE load
          (see LS-A or LS-B for the ZONE peak load.)

          SYSTEM Level 2 AHU
          which supplies the above listed ZONE, has a design heating
          coil exit temperature, HEAT-SET-T,(plus any zone reheat)
          below its MAX-SUPPLY-T or the ZONE DESIGN-HEAT-T, which
          might account for the insufficient heating capability.

          ZONE 2/3-North Perim Zn (G.N3)        has a THERMOSTAT-TYPE
          of REVERSE-ACTION, which, when added to the issues listed
          in the messages above, will cause excessive underheating.

**WARNING*********************************************************************
          PREHEAT/HEATING-CAPACITY in SYSTEM Level 2 AHU
          is too low to provide the requested supply temperature for
          the calculated mixed air temperature using total ZONE loads
          (on LS-A/B) and SYSTEM design parameters, plus outside air
          conditions (on LS-C), and specified capacities & air flows.
          Requested temperature is  55.00 calculated is  44.44
          Check HEATING-CAPACITY, HEAT-SET-T, PRE-HEAT-T, MAX-SUPPLY-T,
          DESIGN-HEAT-T, and ZONE loads for consistency.
```

```
**WARNING*********************************************************************
          PREHEAT/HEATING-CAPACITY in SYSTEM Level 2 AHU
          is too low to provide the requested supply temperature for
          the calculated mixed air temperature using total SONE loads
          (on LS-A/B) and SYSTEM design parameters, plus outside air
          conditions (on LS-C), and specified capacities & air flows.
          Requested temperature is  55.00 calculated is  44.44
          Check HEATING-CAPACITY, HEAT-SET-T, PRE-HEAT-T, MAX-SUPPLY-T,
          DESIGN-HEAT-T, and SONE loads for consistency.

**WARNING*********************************************************************
          SONE 2/3-North Perim Sn (T.N18)
          might have insufficient heating capability.
          Check that the SYSTEM or SONE HEATING-CAPACITY plus this
          SONEs BASEBOARD-RATING is adequate to maintain the SONE
          specified DESIGN-HEAT-T for the calculated peak SONE load
          (see LS-A or LS-B for the SONE peak load.)

          SONE 2/3-North Perim Sn (T.N18)        has a THERMOSTAT-TYPE
          of REVERSE-ACTION, which, when added to the issues listed
          in the messages above, will cause excessive underheating.

**WARNING*********************************************************************
          PREHEAT/HEATING-CAPACITY in SYSTEM Penthouse HV
          is too low to provide the requested supply temperature for
          the calculated mixed air temperature using total SONE loads
          (on LS-A/B) and SYSTEM design parameters, plus outside air
          conditions (on LS-C), and specified capacities & air flows.
          Requested temperature is 105.00 calculated is  55.00
          Check HEATING-CAPACITY, HEAT-SET-T, PRE-HEAT-T, MAX-SUPPLY-T,
          DESIGN-HEAT-T, and SONE loads for consistency.

**WARNING*********************************************************************
          Pump: CW Loop Pump                      has a total user-specified flow
          of      1256. gpm, but the loop flow is      1350. gpm.
```

Transportation Impact Study

101 Smith Place
75/109 Smith Place Redevelopment

Cambridge, Massachusetts

PREPARED FOR

The Davis Companies
125 High Street, Suite 2111
Boston, MA 02110

PREPARED BY

vhb
99 High Street, 10th Floor
Boston, MA 02110
617.728.7777

September 27, 2019

UNDER THE DIRECTION OF

COMMONWEALTH OF MASSACHUSETTS
SEAN M. MANNING
CIVIL
No. 45812
REGISTERED PROFESSIONAL ENGINEER

Sean M. Manning, PE, PTOE
Massachusetts Registration No. 45812

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Introduction & Project Overview

On behalf of Davis Companies (the Owner), VHB, Inc. has conducted a Transportation Impact Study (TIS) for 101 Smith Place, the proposed redevelopment of 75/109 Smith Place (the Project Site) commercial property within the Quadrangle/Alewife area of Cambridge, Massachusetts. The proposed project will consist of 142,200 square feet of gross floor area for laboratory and supporting office space in a new, single building with supporting vehicle and bicycle parking and open space (the Proposed Project).

The TIS responds to (1) the scope dated March 15, 2019 defined by the City of Cambridge's Traffic, Parking and Transportation (TP&T) Department in response to VHB's Request for Scoping dated February 9, 2019, and (2) additional comments received by TP&T on May 31. Copies of the City's scoping letter and VHB's Request for Scoping are included in the Appendix. The TIS has been prepared in conformance with the current City of Cambridge guidelines for Transportation Impact Studies, as required under the Article 19 Special Permit Project Review.

This document is comprised of three components, as follows:

- Introduction and Project Overview – describing the framework in which the transportation component of this Project was evaluated;
- Transportation Impact Study (TIS) – presenting the technical information and analysis results as required under the guidelines; and,
- Planning Board Special Permit Criteria – summarizing the evaluation of the proposed Project as defined under the guidelines.

The required TIS Summary Sheets and Planning Board Criteria Performance Summary are also included. Supplementary data and analysis worksheets are provided in the Appendix. Electronic files for Automatic Traffic Recorder (ATR) Counts, Turning Movement Counts (TMCs), and Synchro analyses are included on an accompanying CD.

Project Overview

The Proposed Project will consider the development of up to approximately 142,200 gross square feet of laboratory/supporting office space in a new building on a 2.6+/- acre site on Smith Place in Cambridge, Massachusetts. The development will be supported by up to 155 parking spaces, 115 spaces contained in a subsurface garage beneath the building, and 40 spaces contained in surface parking lot (a net parking reduction of 10 spaces from the existing spaces), 50 long-term bicycle parking spaces, and 10 short-term bicycle parking spaces, in accordance with the City's Bicycle Parking Guidelines. (Refer to Figures A and B.)

Figures listed below illustrate details of the proposed project program:

- **Figure A** – a site location map
- **Figure B** – a neighborhood context map
- **Figure C** – the existing conditions of the development sites
- **Figure D** – the proposed site plan
- **Figure E** – the TIS study area
- **Figure F** – the proposed on-site parking layout
- **Figure G1 – G3** – the proposed bicycle parking layout

The site currently contains a single one-story warehouse building (75 Smith Place) and a single two-story office/manufacturing building (109 Smith Place), with a combined total of approximately 41,128 square feet, which will be demolished as part of the project. (Refer to Figure C.) The surface parking lots currently supporting the buildings (including the lot on 115 Smith Place) will also be demolished. The number of existing parking spaces on site differs from the number of parking spaces registered to the parcels on the project site. There are approximately 165 vehicle spaces on site, as surveyed by VHB in February 2019, and a total of 183 vehicle spaces are registered to 75, 109, and 115 Smith Place. The existing site conditions and uses are summarized in Table A below.

TABLE A EXISTING SITE CONDITIONS AND USES

Existing Building	Size / Quantity
Square Footage	
Building 1 (75 Smith Pl)	24,056 SF
Building 2 (109 Smith Pl)	17,072 SF
Total	41,128 SF
Land Use	
Building 1 (75 Smith Pl)	Warehouse
Building 2 (109 Smith Pl)	Office/Manufacturing
Percent Occupancy	100 % (Building 2)
# of Employees	8 On Site
	23 Off Site
# of Parking Spaces (Surveyed)	Approx. 165 Vehicle Spaces
# of Parking Spaces (Registered)	Approx. 183 Vehicle Spaces
	Approx. 0 Bike Spaces

The Owner proposes to build approximately 142,200 SF of office/lab space in one building, with 155 new parking spaces on site (resulting in a net parking loss of 10 parking spaces compared to the existing spaces). No retail is proposed as part of this project. (Figure D presents the proposed 101 Smith Place Development site plan and the program is summarized in Table B below.)

TABLE B PROPOSED DEVELOPMENT PROGRAM

Project Component	Size / Quantity
Office/Lab	142,200 SF
Vehicle Parking	155 spaces (1.09 spaces/ksf)
Bicycle Parking	50 long term spaces, and 10 short-term spaces

Consistency with Envision Cambridge and City Planning

Overview

The Concord Avenue-Alewife area of Cambridge is bounded by the Alewife Reservation to the north, Concord Avenue to the south, Blanchard Street to the west and Danehy Park to the east. The area includes four distinct neighborhoods or subdistricts: Triangle, Quadrangle (where this project is located), Cambridge Highlands, and Shopping Center.

In 2003 the City initiated a multidisciplinary planning study of this area and developed what is now known as the 2005 Concord-Alewife Planning Study (CAP). The Study created a plan for the Concord-Alewife area and addressed issues such as appropriate mix of uses, including housing, commercial, possible City uses, and open space; the character of future development; access and traffic; and zoning changes needed to accomplish City goals.

More recently, the City of Cambridge embarked on creating a citywide plan called *Envision Cambridge* "to create a more sustainable, equitable, and inclusive community." Envision Cambridge sets a framework for the Quadrangle, which is designated as an *evolving mixed-use district*, as a district that "should continue to accommodate the bulk of the city's growth and change, taking advantage of transit proximity, and positively transforming areas characterized by surface parking lots, automobile-oriented uses, and obsolete commercial buildings." The draft plan recommends that Cambridge should seek to enhance its multimodal network locally and expand connections to regional sustainable transportation. [*Envision Cambridge,* Executive Summary, p. 20 (envision.cambridgema.gov)]

In support of *Envision Cambridge*, the City has prepared a draft *Alewife District Design Guidelines*, which are "meant to inform property owners, business owners, developers, architects, and the general public about the desired character and form of the Alewife District."[1] Within the Quadrangle, these draft guidelines (from a transportation perspective) focus on increasing walkability of the district by improving the pedestrian environment and providing better connections within the area.

[1] http://envision.cambridgema.gov/wp-content/uploads/2018/11/Alewife-Design-Guidelines-DRAFT-20181130.pdf

Consistency with Envision

The Davis Companies is committed to the revitalization of the Quadrangle. TDC has worked with the City (including the departments of Community Development, Public Works, and Traffic, Parking, and Transportation) to ensure that the Proposed Project is consistent with the design guidelines and conforms with the Envision Cambridge goals and planning principles.

Several aspects of the proposed urban design (site and building design) support Envision goals. As proposed, the setback and siting of the building within the parcels allows for the Envision proposal to align Wilson Road and Fawcett Street to their future extensions west of Smith Place. The envisioned proposals intend to create new block structures in the Quadrangle.

Surface parking is situated behind the building, and structured parking is below ground. This creates a better streetscape and scale for engaging and active sidewalk use. The 40 spaces in the surface lot could be repurposed into open space or other uses in the future, if demand warrants the reduction.

The parking ratio for the Project is 1.09 vehicle parking spaces per thousand square feet of gross floor area. This ratio is below a proposed Envision maximum for office uses (1.1 spaces per ksf) and higher than the proposed Envision maximum for R&D uses (0.80 spaces per ksf). Today's zoning minimum calls for a parking ratio of 0.95 spaces per ksf, and the maximum is 1.90 spaces per ksf. The proposed Envision zoning maximum would be below today's zoning minimum for R&D commercial land uses.

The Project is also being designed to meet climate/resiliency objectives, such as flood protection/mitigation, through raised first floors and raised sidewalks (plinth).

TIS Study Area

The TIS study area for the Proposed Project, as defined by the City of Cambridge, is shown in Figure E. The study intersections include the following:

1. Concord Avenue / Smith Place
2. Concord Avenue / Moulton Street / Neville Manor (signalized)
3. Concord Avenue / Fawcett Street
4. Smith Place / Fawcett Street
5. Smith Place / Wilson Road / Adley Road
6. Concord Avenue / Blanchard Road / Griswold Street (signalized)

Planning Board Criteria Summary

Based on the TIS analysis, the Project has been evaluated within the context of the Planning Board Criteria to determine if the Project has any potential adverse transportation impacts. Exceeding one or more of the Criteria is indicative of a potentially adverse impact on the City's transportation network. However, the Planning Board will consider mitigation efforts, their anticipated effectiveness, and other information that identifies a reduction in adverse transportation impacts.

The Planning Board Criteria consider the Project's vehicular trip generation, impact to intersection level of service and queuing, as well as increase of volume on residential streets. In addition, pedestrian and bicycle conditions are considered. A discussion of the Criteria set forth by the Planning Board is presented in the final section of the TIS, and the Planning Board Criteria Performance Summary is presented below.

The Project has an estimated 19 exceedances out of 115 data entries. All exceedances pertain to existing pedestrian and bicycle infrastructure (14 under Criteria E and 5 under Criteria F). The Project's impacts do not exceed any of the criteria under Project Vehicle Trip Generation, Vehicular LOS, Traffic on Residential Streets, nor Lane Queues at Signalized Intersections.

PROJECT

Project Name:	101 Smith Place (75/109 Smith Place Redevelopment)
Project Address:	75/109 Smith Place Cambridge, MA 02138
Owner/Developer Name:	The Davis Companies
Contact Person:	Chris Chandor
Contact Address:	125 High Street, Suite 2111 Boston, MA 02110
Contact Phone Number:	617-451-1300

SIZE

ITE sq. ft.:	142,200 GSF
Land Use Type:	Research and Development

PARKING

Registered Parking Spaces:	183	Use: Warehouse/Office/Manufacturing
Existing Parking Spaces*:	165	Use: Warehouse/Office/Manufacturing
New Parking Spaces:	155	Use: Laboratory/R&D
Net New Parking Spaces:	-10	*(compared to existing)*

**Surveyed parking spaces*

TRIP GENERATION

	Daily	Morning Peak Hour	Evening Peak Hour
Total Person Trips	**1,880**	**68**	**68**
SOV	1,096	30*	30*
HOV	98	4	4
Transit	176	7	6
Walk	138	5	5
Bicycle	156	5	6
Other	216	8	8

**Net-New Project Generated Trips*

MODE SPLIT (Person Trips)

	R & D Use
SOV	56%
HOV	10%
Transit	9%
Walk	8%
Bike	7%
Other	11%

TRANSPORTATION CONSULTANT

Company Name:	VHB
Contact Name:	Sean M. Manning, PE, PTOE
Contact Phone Number:	617-728-7777

Date of Building Permit Approval: ______________________________

Planning Board Criteria

Total Data Entries = 115 **Total Number of Criteria Exceedances = 19**

Criteria A – Project Vehicle Trip Generation

Period	Criteria (trips)	Build	Exceeds Criterion?
Weekday Daily	2,000	1,194	No
Weekday Morning Peak Hour	240	44	No
Weekday Evening Peak Hour	240	44	No

Criteria B – Vehicular LOS

	Morning Peak Hour				Evening Peak Hour			
Intersection	Existing Condition	Build Condition	Traffic Increase	Exceeds Criterion?	Existing Condition	Build Condition	Traffic Increase	Exceeds Criterion?
Concord Avenue/ Smith Place	E	F	2.2%	No	E	F	2.5%	No
Concord Avenue/ Moulton Street/ Neville Manor	A	B	1.1%	No	B	B	1.2%	No
Concord Avenue/ Fawcett Street	E	E	0.9%	No	E	E	1.1%	No
Smith Place/ Fawcett Street	A	A	0.0%	No	B	B	0.0%	No
Smith Place/ Wilson Road/ Adley Road	B	B	16.9%	No	B	B	17.7%	No
Concord Avenue/ Blanchard Road/ Griswold Street	F	F	0.9%	No	F	F	0.8%	No

Criteria C – Traffic on Residential Streets

			Morning Peak Hour			Evening Peak Hour		
Roadway	**Segment**	**Amount of Residential**	**Existing[1]**	**Increase[2]**	**Exceeds Criterion?**	**Existing[1]**	**Increase[2]**	**Exceeds Criterion?**
Blanchard Road	Colby St to Concord Ave	1/2 or more	1002	5	No	1158	5	No
	Mannix Cir to Concord Ave	>1/3 but <1/2	884	5	No	1009	5	No
Griswold Street	Sunset Rd to Concord Ave	1/2 or more	57	0	No	34	0	No
Concord Avenue	Stewart Ter to Blanchard Rd	1/2 or more	682	8	No	754	6	No
	Blanchard Rd to Smith Pl	1/3 or less	1469	18	No	1291	17	No
	Smith Pl to Moulton St	1/2 or more	1444	17	No	1211	16	No
	Moulton St to Fawcett St	1/3 or less	1535	17	No	1236	16	No
	Fawcett St to Wheeler St	1/3 or less	1717	17	No	1366	16	No
Smith Place	Concord Ave to Adley Rd	1/3 or less	190	34	No	190	34	No
	Adley Rd to Fawcett St	1/3 or less	134	17	No	144	17	No
	Fawcett St to Mooney St	1/3 or less	104	0	No	110	0	No
Wilson Road	Smith Pl to Moutlon St	1/3 or less	48	0	No	37	0	No
Moulton Street	Wilson St to Concord Ave	1/3 or less	113	0	No	100	0	No
Fawcett Street	Concord Ave to Connecting Rd	>1/3 but <1/2	243	0	No	231	0	No
	Connecting Rd to Smith Pl	1/3 or less	110	0	No	64	0	No

Criteria D – Lane Queue (for signalized intersections)

Intersection	Lane	Morning Peak Hour 2019 Existing	Morning Peak Hour 2019 Build	Morning Peak Hour Exceeds Criterion?	Evening Peak Hour 2019 Existing	Evening Peak Hour 2019 Build	Evening Peak Hour Exceeds Criterion?
Neville Pl/ Moulton St at Concord Ave	Neville NB Left/Thru/Right	1	1	No	1	1	No
	Concord EB Left/Thru/Right	4	4	No	4	4	No
	Concord WB Left/Thru/Right	6	6	No	7	8	No
	Moulton SB Left/Right	2	2	No	2	3	No
Blanchard Rd St at Concord Ave	Blanchard NB Left/Thru	11	11	No	28	33	No
	Blanchard NB Right	3	3	No	3	3	No
	Concord EB Left/Thru/Right	9	9	No	13	15	No
	Concord WB Left	5	5	No	6	6	No
	Concord WB Thru	7	7	No	9	9	No
	Concord WB Right	4	4	No	5	5	No
	Blanchard SB Left/Thru/Right	66	66	No	20	23	No

Criteria E – Pedestrian Delay

		Morning Peak Hour			Evening Peak Hour		
Intersection	**Crosswalk**	**Existing**	**Build**	**Exceeds Criterion ?**	**Existing**	**Build**	**Exceeds Criterion ?**
Concord Avenue at Smith Place	West	F	F	Yes	F	F	Yes
	North	A	B	Yes	A	A	No
Concord Avenue at Moulton Street/Neville Manor	East	D	D	No	C	C	No
	North	D	D	No	C	C	No
	South	D	D	No	C	C	No
Concord Avenue at Fawcett Street	West	F	F	Yes	F	F	Yes
	North	B	B	No	B	B	No
Smith Place at Fawcett Street	East	A	A	No	A	A	No
	West	A	A	No	A	A	No
	North	A	A	No	A	A	No
	South	A	A	No	A	A	No
Smith Place at Wilson Road/ Adley Road	East	A	A	No	A	A	No
	West	A	A	No	A	A	No
	North	A	A	No	A	A	No
	South	A	A	No	A	B	Yes
Concord Avenue at Blanchard Road/Griswold Street	East	E	E	Yes	E	E	Yes
	West	E	E	Yes	E	E	Yes
	North	E	E	Yes	E	E	Yes
	South	E	E	Yes	E	E	Yes

Criteria F – Pedestrian and Bicycle Facilities

Adjacent Street	Link (between)	Sidewalk or Walkway Present	Exceeds Criteria?	Bicycle Facilities or Right of Ways Present	Exceeds Criteria?
Smith Place	Concord Avenue and Wilson Road/ Adley Road	No	Yes	No	Yes
	Wilson Road/ Adley Road and Fawcett Street	Yes	No	No	Yes
	Fawcett Street and Mooney Street	Yes	No	No	Yes
Fawcett Street	Smith Place and Concord Avenue	Yes	No	No	Yes
Concord Avenue	Blanchard Road and Fawcett Street	Yes	No	Yes	No

Transportation Impact Study

This Transportation Impact Study (TIS) for the proposed 101 Smith Place (75/109 Smith Place Redevelopment) (the Project) describes existing and future transportation conditions in the study area in accordance with the City of Cambridge Sixth Revision (November 28, 2011) of the Transportation Impact Study Guidelines. The study area for the TIS includes two signalized intersections and four unsignalized intersections (Figure E).

This section includes inventories of physical and operational conditions in the study area including roadways, intersections, crosswalks, sidewalks, on-street and off-street parking, transit facilities, and land uses in the study area. The section also presents the supporting transportation data that were collected and compiled, including automatic traffic recorder counts, intersection turning movement counts, pedestrian and bicycle counts, vehicle crash data, and transit service data.

1 Inventory of Existing Conditions

1.a Roadways

Figure E shows the roadway layout near the project site on Smith Place, which is located north of Concord Avenue, on the block between Fawcett Street and Wilson Road in the "Quadrangle" area of the Alewife neighborhood of Cambridge.

Concord Avenue (an urban principal arterial roadway) is an east-west roadway that connects to the Belmont Commuter Rail Station area (to the west) and Harvard Square in Cambridge (to the east). Smith Place is a north-south local street just east of the Project Site that connects the parking lot for the existing buildings to Concord Avenue. Figures 1.a.1 through 1.a.2 provide detailed plans of the main roadways surrounding the Project Site.

1.b Intersections

The project study area included the following six study intersections (please refer to Figure E and illustrated in Figures 1.b.1 through 1.b.6):

1. Concord Avenue / Smith Place
2. Concord Avenue / Moulton Street / Neville Manor
3. Concord Avenue / Fawcett Street
4. Smith Place / Fawcett Street
5. Smith Place / Wilson Road / Adley Road
6. Concord Avenue / Blanchard Road / Griswold Street

1.c Parking

On-Site Vehicle Parking

Combined, the existing two sites contain 165 parking spaces in surface lots: 81 spaces at 75 Smith Place and 84 spaces at 109 (and 115) Smith Place. (Refer to Table 1.c.1.)

TABLE 1.C.1 75 AND 109 SMITH PLACE EXISTING PARKING SUPPLY

	Parking Space Type	# of Parking Spaces
75 Smith Place	Accessible Spaces	0
	Undesignated Spaces	81
	Total	**81**
109 Smith Place	Accessible Spaces	4
	Undesignated Spaces	80
	Total	**84**
75 & 109 Smith Place	**Total**	**165**

Source: VHB Site Survey, January 2019

Based on field observations during the peak hours, not all these spaces were observed to be used exclusively by the tenants of 75 and 109 Smith Place and their visitors: some tenants (employees) and visitors of the building across the street at 100 Smith Place parked their vehicles in the lot at 109 Smith Place. The building at 75 Smith Place has recently been vacated; the parking lot appeared to be inactive during the field observations.

On-Site Bicycle Parking

No bicycle parking spaces are currently provided on site.

Off-Site Vehicle Parking

On-street parking is generally not available (parking is not permitted in several zones) on study area streets, except for 10 unstriped, unregulated on-street parking spaces (including one accessible space), along the east side of Smith Place, between Wilson Road and Fawcett Street. Most of the off-site parking in the area is accommodated in private off-street lots.

An on-street parking inventory and observations of utilization and turnover for Smith Place were conducted on Tuesday, April 2, 2019 from 7:00 AM to 7:00 PM. Figure 1.c.1 provides a summary of the existing curb use along Smith Place. The on-street parking turnover study is summarized in Table 1.c.2.

TABLE 1.C.2 SMITH PLACE ON-STREET PARKING TURNOVER – TUESDAY, APRIL 2, 2019

Section/Type of Parking	Total Daily Parked Vehicles (unique vehicles parked)	Less than 1 Hour (%)	More than 1 Hour (%)	More than 2 Hours (%)	More than 3 Hours (%)	More than 4 Hours (%)	More than 5 Hours (%)	Maximum Parking Time (hours)
Unregulated	12	8%	17%	8%	0%	0%	67%	12
Handicap	1	0%	0%	0%	0%	0%	100%	6
No Stopping/ Tow Zone	16	75%	6%	6%	6%	0%	6%	9

Source: VHB Observations April 2, 2019 7 AM to 7 PM

The maximum parking space occupancy for the unregulated on-street and accessible parking spaces during the weekday occurred between 4:00 and 5:00 PM with 140 percent of the on-street parking spaces occupied. (Refer to Table 1.c.3 and Figure 1.c.2.) During this time, vehicles were observed to be parked outside of the designated parking zones both to the north of Wilson Road near unregulated parking zones and to the south of Wilson Road in “no stopping” zones. In cases where the on-street parking occupancy is greater than 100 percent, vehicles were parked in tow zones or “no stopping” zones.

TABLE 1.C.3 SMITH PLACE – UNREGULATED ON-STREET AND ACCESSIBLE PARKING OCCUPANCY

Hour	Tuesday, April 2, 2019
7:00 AM	**120%**
8:00 AM	**120%**
9:00 AM	**120%**
10:00 AM	90%
11:00 AM	100%
12:00 PM	**120%**
1:00 PM	**110%**
2:00 PM	100%
3:00 PM	**110%**
4:00 PM	**140%**
5:00 PM	60%
6:00 PM	30%
7:00 PM	30%

Source: VHB Observations April 2, 2019 7 AM to 7 PM
An occupancy greater than 100 percent indicates more vehicles were parked on-street than the number of designated parking spaces.

Table 1.c.4 presents the average parking time and maximum parking time for each parking type regulation observed.

TABLE 1.C.4 APPROXIMATE PARKING DURATION

Section/Type of Parking	Average (hours)	Maximum (hours)
Unregulated	7.25	12
Handicap	7	7
No Stopping / Tow Zone	1.9	10

Source: VHB Observations April 2, 2019 7 AM to 7 PM

The parking turnover study indicates that Smith Place has a maximum observed parking space occupancy (unregulated parking and handicap parking) of 14 out of 10 available on-street parking spaces (as observed on April 2, 2019 at 4PM). More parking spaces become available throughout the later evening.

1.d Transit Services

Public Transit Services

The site is directly served by two Massachusetts Bay Transportation Authority (MBTA) bus routes, Routes 74 and 78. (Figure 1.d.1 illustrates existing services in the study area.) Both routes stop on Concord Avenue near the Project Site: the eastbound stop is to the west of the flashing signalized pedestrian crossing across Concord Avenue and provides a convenient protected crossing for bus users.

Routes 74 and 78 provide services to Harvard Square from Belmont Center and Arlmont Village, respectively. Transit connections at Harvard Square include routes: 1, 66, 68, 69, 71, 72, 73, 74, 75, 77, 78, 86, and 96 in addition to the MBTA Red Line service. Travel time from the project site to Harvard Square via bus routes 74 and 78 is approximately sixteen minutes (based on MBTA travel times) but varies based on traffic and time of day. Routes 74 and 78 operate on approximately 17 to 25-minute headways during peak times and have a varied schedule during off-peak periods.

Alewife Station, the terminal for the MBTA Red Line, is an approximately 1.2-mile walk from the project site along Alewife Brook Parkway. Buses that service Alewife Station include routes: 62, 67, 76, 79, 84, 350, and 351. A combined Braintree/Ashmont Red Line services is provided every 4.5 minutes during the peak rush hours and every 6-7 minutes off-peak.

The MBTA is advancing two major initiatives that will result in more frequent Red Line train service and greater passenger capacity. Under the Red Line Systemwide Improvement Program the MBTA has committed to implement through 2023 (as stated in its *Focus 40* document):

- Fleet Replacement and Maintenance Facility Upgrades
- Capacity and Reliability Improvements (3-Minute Headways)

The fleet replacement will begin this year and continue through 2023, increasing the fleet from 218 vehicles to 252. The elimination of older trains will reduce the occurrence of breakdowns and thus passengers should experience greater reliability than what they experience today.

Private Transit Services

The Alewife Shuttle operated by the Alewife TMA[2] conveniently connects the developments along Concord Avenue to Alewife Station with the use of 18-passenger, ADA equipped vehicles. The Alewife Shuttle route is shown with the shuttle stop locations in Figure 1.d.2.

Shared Mobility Services

No bikesharing or carsharing stations currently exist within the Quadrangle neighborhood. The closest stations include three BlueBikes stations (two at Alewife MBTA station and one station off Cambridgepark Drive) and Zipcar vehicles at the Alewife MBTA station (Figure 1.d.3).

1.e Land Use

The neighborhood surrounding the Project site is largely characterized by business, office and industrial uses, as shown in Figure 1.e.1.

[2] The Alewife Transportation Management Association (TMA) is a non-profit organization that provides alternative transportation to various areas from Alewife Station. Employers and property owners or developers can become a member by filling out an application and paying a corresponding membership fee according to the size of the development. The Alewife TMA provides emergency ride home, carpool, vanpool, and shuttle services.

2 Data Collection

2.a ATR Counts

48-hour Automatic Traffic Recorder (ATR) counts were conducted on Wednesday, March 27th and Thursday, March 28th, 2019, to capture existing daily vehicle volumes within the Project study area at the following locations:

- Smith Place, between Adley Road and Concord Avenue
- Concord Avenue, east of Smith Place

A traffic volume summary for the ATRs is presented in Tables 2.a.1 and 2.a.2; detailed count data sheets are included in the Appendix.

TABLE 2.A.1 EXISTING TRAFFIC VOLUME SUMMARY (MARCH 2019)

		Morning Peak Hour			Evening Peak Hour		
Location	**Daily[a]**	**Volume[b]**	**K[c]**	**Peak Dir**	**Volume**	**K**	**Peak Dir**
Smith Place *between Adley Road and Concord Avenue*	2,816	180	6%	54% NB	215	8%	60% SB
Concord Avenue *east of Smith Place*	16,380	1,389	8%	58% EB	1,158	7%	55% WB

a vehicles per day
b vehicles per peak hour
c percentage of daily traffic that occurs during the peak hour

TABLE 2.A.2 EXISTING AVERAGE DAILY TRAFFIC SUMMARY (MARCH 2019)

	Smith Place *between Adley Road and Concord Avenue*			Concord Avenue *east of Smith Place*		
Start Time	**NB**	**SB**	**Total**	**EB**	**WB**	**Total**
12:00 AM	4	5	9	41	41	82
1:00 AM	4	3	7	20	16	36
2:00 AM	4	3	7	13	8	21
3:00 AM	4	4	8	8	8	16
4:00 AM	12	6	18	23	31	54
5:00 AM	29	16	45	79	84	163
6:00 AM	130	28	158	250	297	547
7:00 AM	98	85	183	445	637	1,082
8:00 AM	94	79	173	582	801	1,383
9:00 AM	89	83	172	446	599	1,045
10:00 AM	87	88	175	476	525	1,001
11:00 AM	93	103	196	478	484	962
12:00 PM	112	103	215	581	500	1,081
1:00 PM	99	97	196	550	478	1,028
2:00 PM	68	98	166	579	454	1,033
3:00 PM	107	128	235	578	505	1,083
4:00 PM	97	132	229	551	470	1,021
5:00 PM	63	104	167	585	517	1,102
6:00 PM	69	82	151	624	493	1,117
7:00 PM	51	70	121	502	372	874
8:00 PM	26	65	91	362	338	700
9:00 PM	9	43	52	265	220	485
10:00 PM	6	21	27	171	128	299
11:00 PM	4	11	15	84	81	165
Total	**1,359**	**1,457**	**2,816**	**8,293**	**8,087**	**16,380**

2.b Pedestrian and Bicycle Counts

Twelve-hour pedestrian and bicycle counts were performed on Thursday, March 28, 2019, between 7:30 AM and 7:30 PM along Concord Avenue, near the Project site. Pedestrian count data are summarized in Table 2.b.1 and bicycle count data are presented in Table 2.b.2. The bicycle counts on Concord Avenue are separated by direction of travel and if they are riding in the street or riding in the cycle track or sidewalk.

TABLE 2.B.1 EXISTING 12-HOUR PEDESTRIAN VOLUMES (MARCH 2019)

	Smith Place *at Concord Avenue*						Concord Avenue *between Fawcett Street and Wheeler Street*		Concord Avenue *between Alewife Brook Parkway and Fresh Pond rotatories*		Concord Avenue *east of Spinelli Place*	
	North Cycle Track		**South Sidewalk**		**South Cycle Track**		**Crosswalk**		**Crosswalk**		**Crosswalk**	
Hour Start Time	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**
7:30 AM	7	11	8	8	0	0	15	18	11	14	3	0
8:30 AM	9	14	16	10	2	0	17	16	21	26	3	4
9:30 AM	10	9	3	7	0	0	24	12	16	17	0	4
10:30 AM	15	7	12	9	2	0	19	16	12	7	0	1
11:30 AM	18	12	15	10	1	2	13	21	20	18	0	4
12:30 PM	12	21	16	26	2	1	14	22	20	16	2	8
1:30 PM	19	18	16	10	4	0	12	31	19	23	4	4
2:30 PM	16	13	13	25	0	1	33	20	23	18	1	6
3:30 PM	17	7	9	6	1	1	24	28	21	20	4	8
4:30 PM	15	11	17	17	1	2	32	26	27	21	0	13
5:30 PM	9	11	12	14	5	0	25	36	27	36	1	4
6:30 PM	12	15	10	8	1	0	31	15	24	14	1	0
Total	**159**	**149**	**147**	**150**	**19**	**7**	**259**	**261**	**241**	**230**	**19**	**56**

TABLE 2.B.2 EXISTING 12-HOUR BICYCLE VOLUMES (MARCH 2019)

Hour Start Time	Smith Place *at Concord Avenue*						Concord Avenue *between Fawcett Street and Wheeler Street*		Concord Avenue *between Alewife Brook Parkway and Fresh Pond rotatories*		Concord Avenue *east of Spinelli Place*	
	North Cycle Track		**South Sidewalk**		**South Cycle Track**		**Crosswalk**		**Crosswalk**		**Crosswalk**	
	EB	**WB**	**EB**	**WB**	**EB**	**WB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**
7:30 AM	2	7	2	6	21	0	10	15	12	14	3	1
8:30 AM	0	5	1	0	25	0	12	9	15	11	1	2
9:30 AM	0	2	2	1	11	0	3	5	5	6	1	0
10:30 AM	0	7	1	1	3	0	7	0	5	3	0	2
11:30 AM	1	1	1	1	1	0	3	3	6	2	0	2
12:30 PM	0	5	0	0	1	0	4	2	1	4	0	0
1:30 PM	0	3	0	0	2	0	3	4	1	3	0	0
2:30 PM	4	4	2	1	5	3	8	5	3	1	0	2
3:30 PM	1	8	2	2	7	0	10	2	11	7	0	3
4:30 PM	1	9	1	3	4	1	18	7	17	11	0	1
5:30 PM	0	26	2	2	4	0	34	8	8	16	0	0
6:30 PM	0	11	2	1	2	1	14	1	6	10	0	0
Total	**9**	**88**	**16**	**18**	**86**	**5**	**126**	**61**	**90**	**88**	**5**	**13**

2.c Intersection Turning Movement Counts and Queues

Turning movement counts (TMC), including vehicles, pedestrians, and bicycles, were conducted at all study area intersections on Thursday, March 28, 2019. These turning movement counts for the morning and evening peak hours are used for the analysis at all intersections except for the evening peak hour at the intersection of Concord Avenue and Blanchard Road/Griswold Street. During the evening peak hour queue observations, an unusually low volume of vehicles was observed to head southbound at this intersection, apparently because of utility construction work occurring approximately 1,400 feet north of the intersection. To adjust for this discrepancy and to more accurately model a typical day condition, counts collected for the nearby 55 Wheeler Street project [SP PB#330] were used to represent existing traffic at this intersection for the evening peak hour only. (A comparison of the TMCs and ATR counts conducted in 2016 at this intersection and on Concord Avenue for the 55 Wheeler project and the counts conducted for this project in 2019, shows a slight decrease in the vehicular traffic in the area. Therefore, no adjustments were made to those higher counts from 2016 at the Concord Avenue and Blanchard Road/Griswold Street intersection.

The results of these counts indicate that the peak hours for vehicular traffic in the study area are:

- Morning Peak Hour – 7:30 AM – 8:30 AM
- Evening Peak Hour – 5:45 PM – 6:45 PM

The existing morning and evening peak hour vehicle, pedestrian, and bicycle turning movement volumes are presented in Figures 2.c.1 through 2.c.6. The raw count data are included in the Appendix.

VHB staff also conducted queue observations during the morning and evening peak hours at the signalized intersections on Thursday, March 28th, 2019 while TMCs were being captured. (Refer to Table 2.c.1.). As discussed earlier, utility construction work affected the vehicular volumes and queue observations during the evening peak hour on the southbound approach of the intersection of Concord Avenue at Blanchard Road/Griswold Street. To ensure a more typical day was included within the analyses of the TIS, VHB staff also conducted supplemental queue observations during the evening peak hours on April 2, 2019. These queue observations are used for the Synchro model calibration for the queue analysis and are presented below. (A detailed queue analysis is provided in Section 7 of this report.)

TABLE 2.C.1 SIGNALIZED INTERSECTION QUEUE OBSERVATIONS (# OF CARS)

Intersection	Lane	# of observed cars Morning Peak Hour	# of observed cars Evening Peak Hour
Neville Pl/Moulton St at Concord Ave	Neville NB Left/Thru/Right	0	0
	Concord EB Left/Thru/Right	3	2
	Concord WB Left/Thru/Right	4	3
	Moulton SB Left/Right	1	2
Blanchard Rd St at Concord Ave	Blanchard NB Left/Thru	6	26
	Blanchard NB Right	1	1
	Concord EB Left/Thru/Right	8	13
	Concord WB Left	3	8
	Concord WB Thru	5	8
	Concord WB Right	3	7
	Blanchard SB Left/Thru/Right	67	17[1]

Based on observations conducted by VHB on Thursday, March 28th, 2019

[1] Blanchard Road Southbound was closed due to utility work for a portion of the road approximately 1,500 to the north during the PM peak hours on March 28, 2019. Additional queue observations were performed April 2, 2019 and are reported here.

2.d Crash Analysis

Study area crash data were obtained from MassDOT's records for the most recent three-year period available, January 2014 through December 2016 (Table 2.d.1). The summary table includes the calculated crash rates (number of reported crashes per million entering vehicles) based on the evening peak traffic volumes. A detailed summary by crash type is presented in the Appendix.

TABLE 2.D.1 MASSDOT CRASH ANALYSIS (JANUARY 2014 – DECEMBER 2016)

Location	Total Crashes (3-year period)	Crashes Involving Pedestrians	Crashes Involving Bicycles	Calculated Crash Rate
Concord Avenue/ Smith Place	7	0	2	0.46
Concord Avenue/ Moulton Street/Neville Manor	6	0	0	0.40
Concord Avenue/ Fawcett Street	11	1	2	0.68
Smith Place/Fawcett Street	1	0	0	0.49
Smith Place/ Wilson Road	0	0	0	0.00
Concord Avenue/ Blanchard Road/Griswold Street	8	0	1	0.32

Source: MassDOT data. Crash rate expressed as crashes per million entering vehicles.

All the study area intersections, except for the unsignalized intersection of Concord Avenue and Fawcett Street, fall below the MassDOT District 6 roadways average for signalized or unsignalized intersections. For MassDOT District 6 municipalities (which includes Cambridge), the average crash rate per million entering vehicles is 0.70 for signalized intersections and 0.53 for unsignalized intersections.

2.e Public Transit

Transit stops and stations closest to the site are shown in Figure 1.d.1. Only the MBTA Routes 74 and 78 offer stops within reasonable walking distance (¼ mile for bus) to the site. Other bus routes are beyond a ½ mile walk, as is the closest subway train station at Alewife (for Red Line rapid transit service).

Daily weekday ridership, as well as operating hours and peak-hour headway data, are provided in Table 2.e.1 for the Red Line and area bus routes. (A more detailed transit analysis is provided in Section 10 of this report.)

TABLE 2.E.1 MBTA SERVICES

Route	Origin/Destination	Hours of Operation	Weekday Ridership[1]	Peak Hour Headways
Route 62	Bedford V.A. Hospital – Alewife Station	5:47AM – 9:04PM	1,316	~ 10-45 minutes
Route 67	Turkey Hill – Alewife Station	5:53AM – 8:32PM	667	~ 25-30 minutes
Route 74	Belmont Center/Harvard Station via Concord Ave.	5:20AM – 1:27AM	811	~ 20-30 minutes
Route 76	Hanscom/Lincoln Lab – Alewife Station	6:00AM – 10:39PM	1,014	~ 25-36 minutes
Route 78	Arlmont Village/Harvard Station via Park Circle	5:42AM – 12:53AM	1,556	~ 7-30 minutes
Route 79	Arlington Heights – Alewife Station	6:35AM – 10:03PM	1,156	~ 18-40 minutes
Route 84	Arlmont Village – Alewife Station	6:42AM – 6:59PM	375	~ 20-49 minutes
Route 350	North Burlington – Alewife Station	6:04AM – 11:00PM	1,616	~ 15-35 minutes
Route 351	EMD Serono/Bedford Woods – Alewife Station	6:15AM – 9:33AM & 3:35PM – 7:10PM	149	~ 50-60 minutes
Red Line[2]	Alewife/Ashmont-Braintree Combined	5:05AM - 1:05AM	264,328[3]	5-9 minutes

Sources: MBTA Schedule, Spring 2019
[1] MBTA Bus Ridecheck data from Fall and Spring FY 2018
[2] Ashmont/Braintree Ridership Data is combined, and includes all Red Line boardings
[3] April 2018 Average Weekday Ridership, MBTA Dashboard MBTA Bus Ridecheck data from Fall and Spring FY 2018

2.f Vehicle Yield Study

The flashing beacon crosswalk on Concord Avenue just east of Spinelli Place provides a pedestrian crossing representative of the area near the project site. Data collected at this crosswalk included pedestrian volumes and observations supporting a vehicle yield study.

A vehicle yield study was conducted at this crosswalk during the mid-day of Wednesday, June 12, 2019, to assess the yield behaviors of vehicles when a pedestrian is present at the crosswalk and attempting to cross the street. Weather conditions that day consisted of fair to mostly cloudy conditions, no precipitation, and temperatures in the range of 63- to 74-degrees Fahrenheit.

The study consisted of 60 trials (30 in each direction). Each trial consisted of a test pedestrian pushing the flashing beacon activation button and then stepping into the crosswalk as a vehicle reached the 75-foot dilemma zone marker. The vehicle's yielding behavior and distance yielded from the crosswalk was recorded.

The results of the study are shown in Figures 2.f.1 and 2.f.2, which summarize the percentage of vehicles that yielded when a pedestrian was present at the crosswalk and the yielding distance from the crosswalk, respectively.

Approximately 50 percent of the vehicles yielded to the pedestrian in the eastbound direction and 73 percent of the vehicles yielded to the pedestrian in the westbound direction. The difference in yield rates among the two directions of travel may be because reduced visibility of a waiting pedestrian due to heavy tree shade on the south side of the crossing. Also, of note is that the post and push button for the flashing beacon on the south side of the crossing is located farther away from the crosswalk than on the post/beacon on the opposite/north side of the street.

The average yielding distance from the crosswalk was 24 feet in the eastbound direction and 20 feet in the westbound direction, and the most often observed yielding distance was 20 feet among both directions.

FIGURE 2.F.1 MID-DAY PERIOD VEHICLE YIELD RATES AT PEDESTRIAN CROSSING (CONCORD AVENUE, EAST OF SPINELLI PLACE)

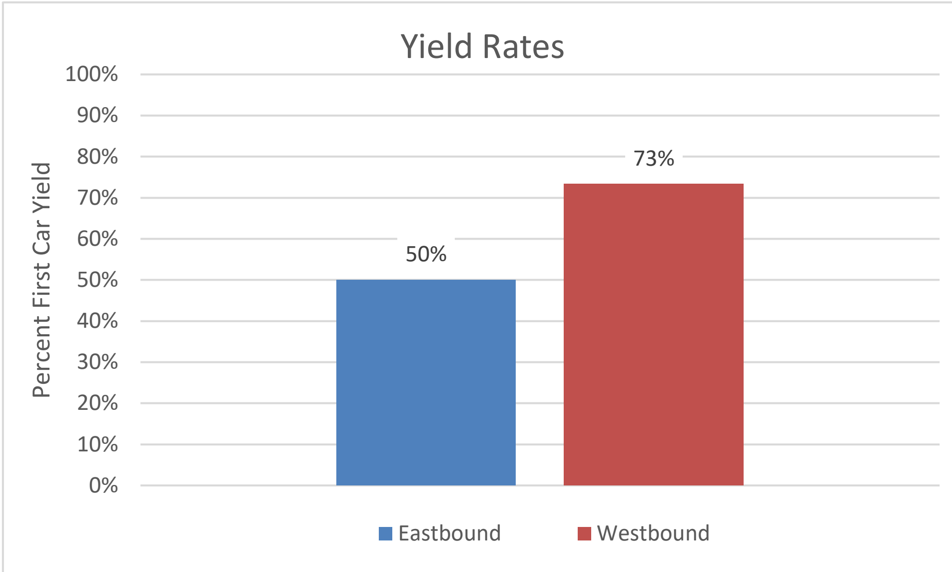
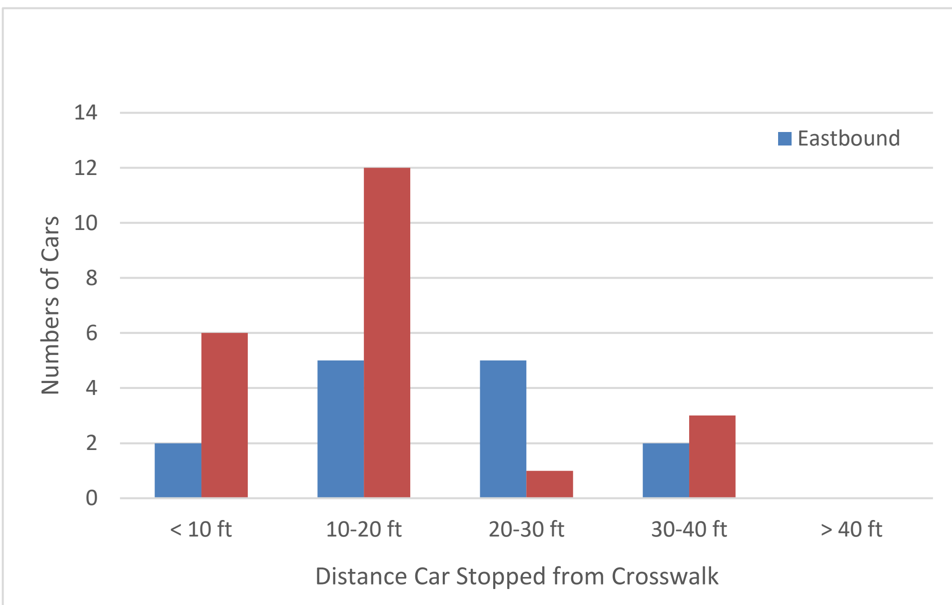


FIGURE 2.F.2 VEHICLE YIELDING DISTANCE FROM PEDESTRIAN CROSSWALK (CONCORD AVENUE, EAST OF SPINELLI PLACE)



3 Project Traffic

3.a Mode Share and Vehicle Occupancy Rates (VOR)

Mode shares for the Project (Table 3.a.1) were developed in coordination with the City of Cambridge, Traffic, Parking and Transportation Department (TP&T), based on average mode shares from the PTDM monitoring reports for 10 Wilson Avenue (2017) and 767 Concord (2018), which represent actual mode shares for similar, nearby Office/Lab uses in the area.

TABLE 3.A.1 MODE SHARE

Mode	Average Mode Share Applied to the Project Analysis
SOV	56%
HOV	10%
Transit	9%
Bike	8%
Walk	7%
Other	11%
Total	100%

Source:
*10 Wilson Ave 2017 and 767 Concord/Fayweather 2018 PTDM monitoring reports - provided by TP&T

Two local VORs were used for the Project: the SOV VOR is 1.0 while the HOV VOR was calculated to be 2.0 based on data from the 2013-2017 American Community Survey (ACS) 5-Year Estimates for the Census tract 3549, Middlesex County, MA.

3.b Trip Generation and Trip Credit for Existing Use on Site

Trip generation estimates were developed based on the Institute of Transportation Engineers (ITE) Trip Generation Manual (10th Edition) using the regression formulas and average rates for Land Use Code 760 (Research and Development Center). Unadjusted ITE vehicle trip rates were converted to person-trips by applying the National Average Vehicle Occupancy (AVO) rate of 1.18 for trips to/from work, based on the 2017 National household Travel Survey.[3]

The resulting project trip generation (before existing use credit) by mode for the proposed project is summarized in Table 3.b.1.

[3] The Federal Highway Administration *2017 National Household Travel Survey Summary of Travel Trends*

TABLE 3.B.1 TOTAL PROJECT GENERATED TRIPS (BEFORE EXISTING USE CREDIT)

	SOV Trips			HOV Trips			Transit Trips			Bicycle Trips			Walk Trips			Other Trips		
	Morning Peak	Evening Peak	Daily	Morning Peak	Evening Peak	Daily	Morning Peak	Evening Peak	Daily	Morning Peak	Evening Peak	Daily	Morning Peak	Evening Peak	Daily	Morning Peak	Evening Peak	Daily
Entering	30	6	548	3	1	49	5	1	69	4	1	78	4	1	69	6	1	108
Exiting	10	34	548	1	3	49	2	5	69	1	5	78	1	4	69	2	7	108
Total	40	40	1,096	4	4	98	7	6	138	5	6	156	5	5	138	8	8	216

Existing Use

Per standard practice, VHB investigated the vehicle trip activity at the existing site to determine if a vehicle trip generation credit could be applied. Vehicle trips associated with the existing buildings/uses will be removed from the roadway network and replaced by the new development. (The existing approximately 24,056 square foot warehouse and 17,072 square foot office/manufacturing building will be demolished as part of the project, replaced with a new building and use.) Accordingly, the vehicle trip credit was determined from actual driveway observations on February 5, 2019, during the morning and evening peak hour. Approximately 20 vehicle trips were observed to enter the site during the morning peak hour and 20 vehicle trips exited the site during the evening peak hour. However, not all that activity appeared to be generated by the existing building: Approximately 50 percent of the vehicles parking at 109 Smith Place were observed to be driven by employees at a building across the street. (There was no apparent activity at the warehouse at 75 Smith Place, as the building was recently vacated.) VHB adjusted the existing trips by one half to generate trip credits that could be reasonably attributed to the existing building activity on-site.

Trip credits (i.e. trips to be removed from roadway network due to removal of office building form existing site) are presented in Table 3.b.2 and the resulting "Net-New" trips used for this analysis are graphically illustrated in Figures 3.c.4 and 3.c.5 for the morning and evening peak hours, respectively.

TABLE 3.B.2 NET-NEW PROJECT GENERATED VEHICLE TRIPS

	Project Generated Trips	Credits (Negative Trips) *	Net New Trips
Morning Peak Hour			
In	33	-10	23
Out	11	-0	11
Evening Peak Hour			
In	7	-0	7
Out	37	-10	27

*negative trips or credits are vehicles currently on the roadways that are generated by the existing warehouse and office/manufacturing buildings on site – these trips will be removed from roadways with the demolition of the buildings

3.d Trip Distribution and Assignment

Vehicle trips were assigned to the roadway network according to the distribution presented by the Alewife Critical Sums Analysis (2017) for commercial developments in the. (Refer to Table 3.c.1 and Figure 3.c.1.)

TABLE 3.C.1 SUMMARY OF VEHICLE TRIP DISTRIBUTION

		Distribution	
Trip Assignment	Direction	Inbound	Outbound
Route 2	To/From Northwest	5%	5%
Route 16	To/from Northeast	7%	7%
Route 16 (Fresh Pond Parkway)	To/from South	25%	25%
Concord Avenue	To/From East	10%	10%
Concord Avenue	To/From West	20%	20%
Blanchard Street	To/From South	15%	15%
Blanchard Street	To/From North	15%	15%

Source: Proposed Trip Distributions: Alewife Critical Sums Analysis 2017, provided by TP&T

Because the site has an active existing use both "Total" Project Generated Trips as well as "Net-New" Project Generated Trips, are presented graphically in Figures 3.c.2 through 3.c.5.

3.e Service and Loading

The proposed project is expected to generate a limited number of delivery trips over the course of a typical day. Typical daily deliveries are expected to include mail and other delivery services, removal of waste, and lab sampling venders. These types of service activities will be directed to use the loading dock area on the north side of the building. Proposed service and loading facilities are presented in Figure 3.d.1. The loading dock is designed to accommodate a WB-40 truck.

The service and loading trip rate can be based on deliveries at other buildings of similar laboratory use in the Alewife area. The existing 87 Cambridgepark Drive building, which is approximately 63,800 GFA, is currently supported by between 8 to 14 deliveries per day, equivalent to 0.12 to 0.21 deliveries per ksf. Based on these service vehicle trip rates, the proposed building is expected to attract between 17 and 30 deliveries per day, including a variety of sizes of cars, vans and trucks.

4 Background Traffic

In accordance with the City's Scoping Letter and TIS Guidelines, a general background traffic growth of 0.5 percent per year was applied for five years to estimate the 2024 Future Condition.

In addition, expected trips associated with specific planned projects near the Project site were incorporated into the 2024 Future Condition analysis. These specific projects include:

- 671-675 Concord Avenue (HRI Concord Highlands)
- 87-95 Fawcett Street
- 55 Wheeler Street
- 605 Concord Avenue
- 35 Cambridgepark Drive renovation project
- 50 Cambridgepark Drive
- 88 Cambridgepark Drive
- 130 Cambridgepark Drive
- The Residences at Alewife Station (195 & 211 Concord Turnpike)
- 75 New Street

5 Traffic Analysis

Traffic networks were developed in accordance with the TIS Guidelines, for the 2019 Existing, 2019 Build, and 2024 Future Condition scenarios for both the morning and evening peak hours.

5.a 2019 Existing Condition

The 2019 Existing Condition analysis is based on existing vehicle, bicycle, and pedestrian counts at the study area intersections (see Section 2). The Existing Condition networks are shown in Figures 2.c.1 and 2.c.2.

5.b 2019 Build Condition

The 2019 Build Condition assumes full occupancy of the Project. The driveway counts for the Existing Condition were completed while 75/109 Smith Place was still occupied as warehouse and office/manufacturing spaces, and thus, these trips were subtracted from the network before adding the project-generated trips to the network. Therefore, the resulting 2019 Build network consists of the 2019 Existing volumes plus the net-new project generated trips. These networks are shown in Figures 5.b.1 and 5.b.2.

5.c 2024 Future Condition

The 2024 Future Condition consists of the project generated trips, background traffic growth and expected traffic from planned development projects. Background traffic growth was assumed to occur at 0.5 percent per year for five years. Additionally, volumes generated from background projects that are planned to be occupied during this five-year period were added to the network. The 2024 Future Condition networks are shown in Figures 5.c.1 and 5.c.2. In addition, Figure 5.c.3 shows evening cumulative impacts on study are roadways inclusive of both the proposed project as well as background projects planned to come on-line during the five-year period.

6 Vehicle Capacity Analysis

6.a Capacity Analysis

Synchro 9 software was used to determine the vehicle level of service (VLOS) for the ten signalized and unsignalized study area intersection. Synchro software is based on the 2000 Highway Capacity Manual.

Results for the 2019 Existing, 2019 Build, and 2024 Future conditions are presented in Table 6.a.1 and Table 6.a.2 for signalized intersections, and Table 6.a.3 and Table 6.a.4 for unsignalized intersections. The tables also show the difference in delay between the Existing and Build conditions (delay due to project impact) and between the Existing and Future delay (total delay from project and other background growth). Figures 6.a.1 and 6.a.2 illustrate the overall VLOS for each intersection for the morning and evening peak hour respectively. A summary of the analysis results follows.

Existing Conditions

The existing conditions of the signalized intersections during the morning peak hour operate at LOS A at the intersection of Concord Avenue at Moulton Street and Neville Manor, and at LOS F at the intersection of Concord Avenue and Blanchard Road. The unsignalized intersections primarily operate at a LOS C or better except for Concord Avenue at Smith Place and Concord Avenue at Fawcett Street which operate at LOS E.

The existing conditions of the signalized intersections during the evening peak hour operate at LOS B at the intersection of Concord Avenue at Moulton Street and Neville Manor, and at LOS F at the intersection of Concord Avenue and Blanchard Road. The unsignalized intersections primarily operate at a LOS C or better except for Concord Avenue at Smith Place and Concord Avenue at Fawcett Street which operate at LOS E.

Build Conditions

During both the morning and evening peak hour, the project impacts are no greater than 10 seconds of overall delay at the signalized intersections. The minor approach of the unsignalized intersection of Concord Avenue at Smith Place experiences a moderate increase in delay due to project impacts.

During the morning peak hour, Concord Avenue at Moulton Street and Neville Manor declines from LOS A to LOS B with an increase of 0.3 seconds in average delay. The increased average delay at Concord Avenue and Blanchard Road is 3.0 seconds. Concord Avenue at Smith Place declines from LOS E to and LOS F for its minor approach (Smith Place) with an increase of 17.1 seconds. Concord Avenue at Fawcett Street has an increased average delay of 2.1 seconds on the minor approach (Fawcett Street). Smith Place at Wilson Road has an increased average delay of 0.4 seconds on the westbound minor approach (Wilson Road) and an increased average delay of 0.2 seconds on the eastbound minor approach (Adley Road).

During the evening peak hour, the increased delay at Concord Avenue and Blanchard Road is 7.2 seconds. Concord Avenue at Smith Place has an increased delay of 14.5 seconds for its minor approach (Smith Place). Concord Avenue at Fawcett Street has an increased delay of 0.6 seconds on the minor approach (Fawcett Street). Smith Place at Wilson Road has an increased average delay of 0.4 seconds on the westbound minor approach (Wilson Road) and an increased average delay of 0.3 seconds on the eastbound minor approach (Adley Road).

TABLE 6.A.1 SIGNALIZED INTERSECTION LEVEL OF SERVICE RESULTS – MORING PEAK HOUR

		Existing (2019)			Build (2019)				Future (2024)			
Intersection	**Movement**	v/c	Delay	VLOS	v/c	Delay	VLOS	Difference in Delay	v/c	Delay	VLOS	Difference in Delay
Neville Pl/ Moulton St at Concord Ave	Neville NB Left/Thru/Right	0.01	29.0	C	0.01	29.0	C	0.0	0.01	29.0	C	0.0
	Concord EB Left/Thru/Right	0.50	6.3	A	0.50	6.3	A	0.0	0.51	6.4	A	0.1
	Concord WB Left/Thru/Right	0.74	12.2	B	0.76	13.0	B	0.4	0.83	15.8	B	3.6
	Moulton SB Left/Right	0.57	40.1	D	0.57	40.1	D	0.0	0.59	41.0	D	0.9
	Overall	**0.69**	**9.9**	**A**	**0.70**	**10.3**	**B**	**0.3**	**0.76**	**11.7**	**B**	**1.8**
Blanchard Rd/ Griswold St at Concord Ave	Blanchard NB Left/Thru	0.80	63.0	E	0.80	63.5	E	0.0	0.81	64.0	E	0.5
	Blanchard NB Right	0.19	0.3	A	0.19	0.3	A	0.0	0.19	0.3	A	0.0
	Concord EB Left/Thru/Right	1.46	275.3	F	1.48	282.9	F	7.6	1.50	293.9	F	18.6
	Concord WB Left	1.00	140.4	F	1.02	147.2	F	6.8	1.09	167.9	F	27.5
	Concord WB Thru	0.59	40.9	D	0.60	41.0	D	0.1	0.73	47.1	D	6.2
	Concord WB Right	0.35	36.3	D	0.35	36.4	D	0.1	0.36	36.6	D	0.3
	Blanchard SB Left/Thru/Right	1.37	215.3	F	1.38	218.5	F	3.2	1.40	228.7	F	13.4
	Griswold SWB Right *unsignalized*	0.24	20.3	C	0.25	20.7	C	0.4	0.29	23.7	C	3.4
	Overall	**1.23**	**152.2**	**F**	**1.24**	**155.2**	**F**	**3.0**	**1.26**	**160.4**	**F**	**7.8**

v/c = volume-to-capacity ratio; Delay = average delay expressed in seconds per vehicle; VLOS = vehicular level of service

TABLE 6.A.2 SIGNALIZED INTERSECTION LEVEL OF SERVICE RESULTS - EVENING PEAK HOUR

		Existing (2019)			Build (2019)				Future (2024)			
Intersection	**Movement**	v/c	Delay	VLOS	v/c	Delay	VLOS	Difference in Delay	v/c	Delay	VLOS	Difference in Delay
Neville Pl/ Moulton St at Concord Ave	Neville NB Left/Thru/Right	0.04	28.4	C	0.04	28.4	C	0.0	0.04	28.3	C	-0.1
	Concord EB Left/Thru/Right	0.38	8.1	A	0.39	8.2	A	0.1	0.43	8.7	A	0.5
	Concord WB Left/Thru/Right	0.73	15.3	B	0.74	15.4	B	0.1	0.74	15.6	B	0.2
	Moulton SB Left/Right	0.62	37.7	D	0.62	37.7	D	0.0	0.62	38.0	D	0.3
	Overall	**0.64**	**14.4**	**B**	**0.64**	**14.4**	**B**	**0.0**	**0.64**	**14.5**	**B**	**0.1**
Blanchard Rd/ Griswold St at Concord Ave	Blanchard NB Left/Thru	0.96	81.7	F	0.96	81.7	F	0.0	0.97	84.3	F	2.6
	Blanchard NB Right	0.08	0.1	A	0.08	0.1	A	0.0	0.08	0.1	A	0.0
	Concord EB Left/Thru/Right	1.66	370.2	F	1.66	370.2	F	0.0	1.87	465.1	F	94.9
	Concord WB Left	0.93	100.5	F	0.95	104.0	F	3.5	0.93	99.4	F	-1.1
	Concord WB Thru	0.78	47.3	D	0.79	48.2	D	0.9	0.81	50.4	D	3.3
	Concord WB Right	0.78	49.9	D	0.79	50.7	D	0.8	0.78	49.5	D	-0.4
	Blanchard SB Left/Thru/Right	1.09	116.3	F	1.09	117.0	F	0.7	1.13	130.0	F	13.7
	Griswold SWB Right *unsignalized*	0.12	22.7	C	0.12	23.2	C	0.5	0.12	23.1	C	0.4
	Overall	**1.13**	**127.0**	**F**	**1.13**	**134.2**	**F**	**7.2**	**1.19**	**152.7**	**F**	**25.7**

v/c = volume-to-capacity ratio; Delay = average delay expressed in seconds per vehicle; VLOS = vehicular level of service

TABLE 6.A.3 UNSIGNALIZED INTERSECTION LEVEL OF SERVICE RESULTS – MORNING PEAK HOUR

		Existing (2019)			Build (2019)				Future (2024)			
Intersection	**Approach**	v/c	Delay	VLOS	v/c	Delay	VLOS	Difference in Delay	v/c	Delay	VLOS	Difference in Delay
Concord Ave at Smith Pl	Smith SB Left/Right	0.54	47.1	E	0.67	64.2	F	17.1	0.86	110.6	F	63.5
Concord Ave at Fawcett St	Fawcett SB Left/Right	0.58	46.4	E	0.59	48.5	E	2.1	1.09	151.7	F	105.3
Smith Pl at Fawcett St	Fawcett St Left/Right	0.12	9.7	A	0.12	9.7	A	0	0.12	9.8	A	0.1
Smith Pl at Wilson R/ Adley Rd	Wilson Rd Left/Thru/Right	0.04	10.7	B	0.04	11.1	B	0.4	0.04	11.1	B	0.4
	Adley Rd Left/Thru/Right	0.05	9.3	A	0.05	9.5	A	0.2	0.05	9.5	A	0.2

TABLE 6.A.4 UNSIGNALIZED INTERSECTION LEVEL OF SERVICE RESULTS – EVENING PEAK HOUR

		Existing (2019)			Build (2019)				Future (2024)			
Intersection	**Approach**	v/c	Delay	VLOS	v/c	Delay	VLOS	Difference in Delay	v/c	Delay	VLOS	Difference in Delay
Concord Ave at Smith Pl	Smith SB Left/Right	0.63	37.7	E	0.77	52.2	F	14.5	0.8	57.4	F	19.7
Concord Ave at Fawcett St	Fawcett SB Left/Right	0.57	41.1	E	0.57	41.7	E	0.6	0.82	73.7	F	32.6
Smith Pl at Fawcett St	Fawcett St Left/Right	0.07	10.6	B	0.07	10.6	B	0	0.07	10.7	B	0.1
Smith Pl at Wilson Rd / Adley Rd	Wilson Rd Left/Thru/Right	0.03	10.8	B	0.03	11.2	B	0.4	0.03	11.2	B	0.4
	Adley Rd Left/Thru/Right	0.03	9.7	A	0.03	10	B	0.3	0.03	10	B	0.3

7 Queue Analysis

A queue analysis was performed in combination with the LOS analysis. Tables 7.a.1 and 7.a.2 show the results for the observed and modeled average queues (expressed as the number of vehicles) for each scenario for the morning and evening peak hour, respectively.

VHB staff conducted queue observations during the morning and evening peak. Because of utility construction work at the time of data collection, both TMC and queues were affected during the evening peak hours. Thus, additional queue observations were conducted on April 2, 2019, at this intersection and are reported below for the southbound approach.

The original 2019 modeled queue lengths based on industry standard best practices yield queue lengths lower than those observed in the field on Blanchard Road. This is a result of Synchro and SimTraffic's limitation to only model vehicles that are processed through the intersection, not those waiting in the queues.

As requested by TP&T, SimTraffic was used to approximate the queue conditions. The traffic model required calibration by adjusting the saturation flow rate and green times on the southbound and northbound approaches at the Concord Avenue at Blanchard Road signalized intersection to accurately reflect observed queuing conditions for the morning peak hour only. These adjustments are carried forward in the 2019 Build and 2024 Future conditions analyses. For the evening peak hour, these adjustments to green time and saturation flow rate were not required to match the observed queues.

TABLE 7.A.1 SIGNALIZED INTERSECTION QUEUE ANALYSIS - MORNING PEAK HOUR

		Average Queue in Vehicles						
Intersection	**Lane**	2019 Observed	2019 Modeled (Synchro)	2019 Modeled (Sim-Traffic)	2019 Modeled Adjusted (Synchro)	2019 Modeled Adjusted (Sim-Traffic)	2019 Build (Sim-Traffic)	2024 Future (Sim-Traffic)
Concord Avenue/ Moulton St/ Neville Manor	Neville NB Left/Thru/Right	0	0	1	0	1	1	1
	Concord EB Left/Thru/Right	3	3	4	3	4	4	4
	Concord WB Left/Thru/Right	4	6	6	6	6	6	8
	Moulton SB Left/Right	1	1	2	1	2	2	2
Concord Avenue/ Blanchard Road	Blanchard NB Left/Thru	6	9	16	8	11	11	14
	Blanchard NB Right	1	0	4	0	3	3	4
	Concord EB Left/Thru/Right	8	~13	9	~13	9	9	9
	Concord WB Left	3	~5	5	~5	5	5	5
	Concord WB Thru	5	9	7	8	7	7	8
	Concord WB Right	3	4	4	4	4	4	4
	Blanchard SB Left/Thru/Right	67	~26	19	~33	66	66	71

Note: Synchro provides queue data in feet, the table presents queue data in number of vehicles. As directed by the TIS guidelines 1 vehicle = 25 ft
~Volume exceeds capacity; queue is theoretically infinite.
+ Approximate queue length observed

TABLE 7.A.2 SIGNALIZED INTERSECTION QUEUE ANALYSIS - EVENING PEAK HOUR

		Average Queue in Vehicles				
Intersection	**Lane**	2019 Observed	2019 Modeled (Synchro)	2019 Modeled (SimTraffic)	2019 Build (SimTraffic)	2024 Future (SimTraffic)
Concord Avenue/ Moulton St/ Neville Manor	Neville NB Left/Thru/Right	0	0	1	1	1
	Concord EB Left/Thru/Right	2	2	4	4	4
	Concord WB Left/Thru/Right	3	5	7	8	8
	Moulton SB Left/Right	2	2	2	3	3
Concord Avenue/ Blanchard Road	Blanchard NB Left/Thru	26	15	28	33	34
	Blanchard NB Right	1	0	3	3	3
	Concord EB Left/Thru/Right	13	~12	13	15	24
	Concord WB Left	8	7	6	6	6
	Concord WB Thru	8	14	9	9	9
	Concord WB Right	7	11	5	5	5
	Blanchard SB Left/Thru/Right	17[1]	~20	20	23	25

Notes: [1] Blanchard Road Southbound was closed due to utility work for a portion of the road approximately 1,400 to the north during the PM peak hours on March 28, 2019. Queue observations for this approach were observed on April 2, 2019.

Synchro provides queue data in feet, the table presents queue data in number of vehicles. As directed by the TIS guidelines 1 vehicle = 25 ft.

~Volume exceeds capacity; queue is theoretically infinite.

8 Residential Street Volume Analysis

Of all the roadway segments in the study area, five of the ten segments identified are streets that have more than 1/3 of residential frontage, as determined by the existing first floor use. Roadway segments within the study area with residential street frontage are evaluated for increased volume on residential streets (a Planning Board criterion).

The peak hour traffic volumes (both directions) on the analyzed roadway segments are presented in Tables 8.a.1 and 8.a.2. For analyzed segments that are between study area intersections, the average volumes at these intersections were taken as the volume traveling along the segment. The analysis shows the percent increase in traffic along the residential roadway segments between Existing and Build volumes and Build and Future volumes.

TABLE 8.A.1 TRAFFIC ON STUDY AREA ROADWAYS – MORNING PEAK HOUR

Roadway	Segment	Amount of Residential	Existing[1]	Build	Increase[2]	Percent Increase	Future[3]	Increase	Percent Increase
Blanchard Road	Colby St to Concord Ave	1/2 or more	1002	1007	5	0.5%	1023	21	2.1%
	Mannix Cir to Concord Ave	>1/3 but <1/2	884	889	5	0.6%	908	24	2.7%
Griswold Street	Sunset Rd to Concord Ave	1/2 or more	57	57	0	0.0%	58	1	1.8%
Concord Avenue	Stewart Ter to Blanchard Rd	1/2 or more	682	690	8	1.2%	745	63	9.2%
	Blanchard Rd to Smith Pl	1/3 or less	1469	1487	18	1.2%	1552	83	5.7%
	Smith Pl to Moulton St	1/2 or more	1444	1461	17	1.2%	1530	86	6.0%
	Moulton St to Fawcett St	1/3 or less	1535	1552	17	1.1%	1628	93	6.1%
	Fawcett St to Wheeler St	1/3 or less	1717	1734	17	1.0%	1863	146	8.5%
Smith Place	Concord Ave to Adley Rd	1/3 or less	190	224	34	17.9%	229	39	20.5%
	Adley Rd to Fawcett St	1/3 or less	134	151	17	12.7%	155	21	15.7%
	Fawcett St to Mooney St	1/3 or less	104	104	0	0.0%	107	3	2.9%
Wilson Road	Smith Pl to Moutlon St	1/3 or less	48	48	0	0.0%	48	0	0.0%
Moulton Street	Wilson St to Concord Ave	1/3 or less	113	113	0	0.0%	115	2	1.8%
Fawcett Street	Concord Ave to Connecting Rd	>1/3 but <1/2	243	243	0	0.0%	316	73	30.0%
	Connecting Rd to Smith Pl	1/3 or less	110	110	0	0.0%	113	3	2.7%

1 Where driveways/on-street parking created a segment inflow/outflow volume imbalance, an average was calculated per direction and added
2 Net new project trips after trip credits are applied
3 Future accounts for area background project volumes, Project generated volumes, and a background growth rate of 0.5%

TABLE 8.A.2 TRAFFIC ON STUDY AREA ROADWAYS – EVENING PEAK HOUR

Roadway	Segment	Amount of Residential	Existing[1]	Build	Increase[2]	Percent Increase	Future[3]	Increase	Percent Increase
Blanchard Road	Colby St to Concord Ave	1/2 or more	1158	1163	5	0.4%	1178	20	1.7%
	Mannix Cir to Concord Ave	>1/3 but <1/2	1009	1014	5	0.5%	1036	27	2.7%
Griswold Street	Sunset Rd to Concord Ave	1/2 or more	34	34	0	0.0%	33	-1	-2.9%
Concord Avenue	Stewart Ter to Blanchard Rd	1/2 or more	754	760	6	0.8%	814	60	8.0%
	Blanchard Rd to Smith Pl	1/3 or less	1291	1308	17	1.3%	1357	66	5.1%
	Smith Pl to Moulton St	1/2 or more	1211	1227	16	1.3%	1281	70	5.8%
	Moulton St to Fawcett St	1/3 or less	1236	1252	16	1.3%	1313	77	6.2%
	Fawcett St to Wheeler St	1/3 or less	1366	1382	16	1.2%	1500	134	9.8%
Smith Place	Concord Ave to Adley Rd	1/3 or less	190	224	34	17.9%	228	38	20.0%
	Adley Rd to Fawcett St	1/3 or less	144	161	17	11.8%	165	21	14.6%
	Fawcett St to Mooney St	1/3 or less	110	110	0	0.0%	113	3	2.7%
Wilson Road	Smith Pl to Moutlon St	1/3 or less	37	37	0	0.0%	37	0	0.0%
Moulton Street	Wilson St to Concord Ave	1/3 or less	100	100	0	0.0%	102	2	2.0%
Fawcett Street	Concord Ave to Connecting Rd	>1/3 but <1/2	231	231	0	0.0%	311	80	34.6%
	Connecting Rd to Smith Pl	1/3 or less	64	64	0	0.0%	65	1	1.6%

1 Where driveways/on-street parking created a segment inflow/outflow volume imbalance, an average was calculated per direction and added
2 Net new project trips after trip credits are applied
3 Future accounts for area background project volumes, Project generated volumes, and a background growth rate of 0.5%

9 Parking Analysis

9.a Vehicle Parking

Supply

The existing Project site has 81 parking spaces serving 75 Smith Place and 84 parking spaces serving 109 Smith Place, for a total of 165 parking spaces, as surveyed by VHB in February 2019. According to TP&T's records, 75 Smith Place is registered for 76 parking spaces, 109 Smith Place is registered for 33 parking spaces, and 115 Smith Place (which a lot connected to 109 Smith Place) is registered for 74 parking spaces, for a total of 183 registered spaces. The Project is proposing to demolish both buildings on site and the associated surface parking lots and replace the two existing buildings with one new building that will provide approximately 142,200 square feet of GFA with 155 parking spaces (a net parking reduction of 10 parking spaces compared to existing spaces, and a reduction compared to registered spaces).

Demand

A parking demand analysis was conducted based on the expected number of employees and auto mode share to compare the demand to the City parking requirements (see Table 9.a.1). For this type of land use development, the expected number of employees may range between 2.0 and 2.5 employees per 1,000 GFA (which yields a total of 285 to 356 employees); applying an automobile mode share of 56 percent SOV and 10 percent HOV results in expected parking demand of 174 to 217 vehicle spaces. This range falls within the vehicle parking space requirements in the City of Cambridge's Vehicle Parking Zoning Ordinance (a range of 136 to 271 spaces).

TABLE 9.A.1 VEHICLE PARKING REQUIREMENTS BASED ON DIFFERENT PARKING RATES

	Minimum Expected Employees	Maximum Expected Employees	City of Cambridge Minimum Parking Requirement	City of Cambridge Maximum Parking Requirement	Parking Provided by Project
Rate	2.0 employees per 1,000 GFA	2.5 employees per 1,000 GFA	1 per 1,050 GFA	1 per 525 GFA	1 per 918 GFA
Parking Spaces	174	217	136	271	155

City of Cambridge Parking Requirements are stated in the Zoning Ordinance Article 6.0

Parking Management

The parking provided by the Project will be restricted to use by the tenant employees and visitors. Spaces will not be available for commercial (public parking) use.

9.b Bicycle Parking

The Project will provide 60 bicycle parking spaces (50 long term, including 6 tandem spaces, and 10 short term), exceeding the minimum requirements in the City of Cambridge's Bicycle Parking Zoning Ordinance (Table 9.b.1).

TABLE 9.B.1 BICYCLE PARKING

Type of Parking	Parking Rate	# of Bicycle Spaces Required	# of Bicycle Spaces Provided
Long Term	0.22 spaces per 1,000 sf	32	50
Short Term	0.06 spaces per 1,000 sf	9	10
	Total	**41**	**60**

Source: City of Cambridge Zoning Ordinance Article 6.0

Long term bicycle parking spaces will be provided in a ground level bike rooms within the building which will have direct access to the building exterior. The Project's short-term spaces for visitors will be located close to the building entrance. The project will provide inverted-U bicycle racks (manufactured by Cycle-Safe Classic U Rack[4]) in accordance with the City of Cambridge Bicycle Parking Guide on acceptable parking racks.

Figures G.1-G.3 illustrate the location and layout of the long-term and short-term bicycle parking spaces and associated amenities.

10 Transit Analysis

The transit analysis included a review of existing Red Line and bus operations and an assessment of the impacts of project-generated transit trips and future transit trips.

The following sections summarize existing transit services availability in the study area and provide an assessment of transit utilization and capacity for transit lines that may be used by travelers for the proposed Project. These services include the Red Line (accessed at Alewife Station) and MBTA Bus Lines 62, 67, 74, 76, 78, 79, 84, 350, and 351. Only the Route 74 and 78 buses have stops along Concord Avenue, whereas all other bus lines are accessed at Alewife Station.

This transit analysis was based on the following 8-step method:

1. Quantify the existing transit system capacity
2. Quantify the existing system ridership
3. Report on existing transit system utilization (ridership/capacity) – Existing Conditions
4. Develop and assign project-generated transit trips to the existing transit system
5. Report on project impacts to the transit system utilization - 2019 Build Conditions

[4] cyclesafe.com/bike-parking/bike-racks/classic-bike-u-rack/

6. Grow existing transit system ridership to year 2024
7. Compile area background project transit trips and assign to transit system network
8. Report on future transit system utilization (impacts from project as well as other background projects and general system growth) – 2024 Future Conditions

The V/C ratio (Volume to Capacity) is the resulting metric that, for the purposes of this study, is used to reflect the level of utilization for each transit service line. The V/C ratios (or utilization rates) are presented for the Existing Condition (2019), Build Condition (Existing + Project trips), and Future Condition (Existing + Project trips + background growth).

10.a Existing Transit System Capacity – STEP 1

The capacity of a transit line depends on the number of trains (or buses) operating during a specified period (frequency), the number of people that can be accommodated on a vehicle (a train car or bus), and the number of individual cars in each train.

The study period for this analysis includes the morning and evening transit peak hours defined as 7:30 AM to 8:30 AM and 5:45 PM to 6:45 PM, respectively.

Train and bus frequencies were compiled from latest published MBTA schedules[5] and MBTA Bus Ridecheck data from Fall and Spring 2018, as reported in Table 10.a.1.

For the purposes of this study, the vehicle load standards (i.e. number of people safely and comfortably riding on a train car of bus) are based on the MBTA's Service Delivery Policy[6] and the MBTA Blue Book 14th Edition data (Red Line policy capacity of 167 passengers per car, with a standard operation of 6-car trains; MBTA Bus policy capacity of 53 passengers per vehicle).

The average Red Line on-time performance was adjusted by 89%, based on the 30-day average (October 16 to November 14, 2019) provided by the MBTA Performance Dashboard. The on-time performance adjustment of 89% reduced the number of available trains during peak hour to account for schedule irregularities and resulting wait times experienced by the passengers. The MBTA Bus service capacity was not adjusted for on-time performance.

Table 10.a.1 shows the resulting system capacities for the Red Line and Bus Lines based on MBTA provided data.

[5] MBTA schedules, Spring 2019
[6] MBTA Service Delivery Policy, approved by the Board of Directors in June 2010

TABLE 10.A.1 SYSTEM PEAK HOUR CAPACITY (PER MBTA DATA)

Mode	Frequency(a)	OTP Factor(b)	# Passengers / Vehicle(c)	# Cars / Train	Resulting Capacity(d) (# Passengers / Peak Hour)
Red Line at Alewife Station					
Inbound	13	0.90	167	6	11,723
Outbound	13	0.90	167	6	11,723
MBTA Bus					
Route 62 Inbound	3.5	n/a	53	n/a	186
Route 62 Outbound	1	n/a	53	n/a	53
Route 67 Inbound	2.5	n/a	53	n/a	133
Route 67 Outbound	2	n/a	53	n/a	106
Route 74 Inbound	2	n/a	53	n/a	106
Route 74 Outbound	1.5	n/a	53	n/a	80
Route 76 Inbound	2	n/a	53	n/a	106
Route 76 Outbound	2	n/a	53	n/a	106
Route 78 Inbound	2.5	n/a	53	n/a	133
Route 78 Outbound	2.5	n/a	53	n/a	133
Route 79 Inbound	2.5	n/a	53	n/a	133
Route 79 Outbound	2.5	n/a	53	n/a	133
Route 84 Inbound	2.5	n/a	53	n/a	133
Route 84 Outbound	2	n/a	53	n/a	106
Route 350 Inbound	3	n/a	53	n/a	159
Route 350 Outbound	2	n/a	53	n/a	106
Route 351 Inbound	1	n/a	53	n/a	53
Route 351 Outbound	1	n/a	53	n/a	53

Notes:
(a) Number of vehicles per hour, per MBTA published schedules (Red Line) and MBTA Ridership Spring/Fall 2018 (Buses); average number of buses assumed where not same during morning and evening period
(b) On-Time Performance Factor from MBTA Dashboard as of April 22, 2019
(c) Number of policy level capacity per MBTA Blue Book 14th Edition (Red Line and Buses)
(d) Calculated Capacity = # of Trains x OTP Factor x # pax per vehicle x # of cars – shown as number of passengers per peak hour

10.b Existing Transit System Ridership and Utilization – Step 2 & 3

The MBTA Ridership data from Spring/Fall 2018 was used to obtain peak hour passenger loads for bus routes that are expected to be utilized by the future Project employees and residents. The ridership data was grown by 0.68% for 0.5 years to the existing 2019 condition based on system-wide MBTA growth projections for local buses prepared by CTPS for the Boston Metropolitan Planning Organization's Long-Range Transportation Plan.

Red Line ridership for this analysis was based on data for Alewife Station from Fall 2017. Inbound trains start their trip from Alewife Station and continue to Ashmont or Braintree, and Outbound trains end at Alewife Station from either Ashmont or Braintree. Passengers board the train serving the inbound Red Line and exit the outbound Red Line. Specific boarding and alighting volumes during the morning and evening peak hours are presented in the Appendix.

Combining the system capacity developed in Step 1 and the system ridership, the system's utilization rates were calculated and are presented in Table 10.b.1.

TABLE 10.B.1 EXISTING TRANSIT SERVICE UTILIZATION (PER MBTA DATA)

Route and Direction	Capacity	Morning Peak Hour Ridership	Evening Peak Hour Ridership	Morning Peak Hour V/C	Evening Peak Hour V/C
Red Line at Alewife Station					
Inbound Exiting Alewife	11,723	2,548	632	0.22	0.05
Outbound Entering Alewife	11,723	511	2,147	0.04	0.18
MBTA Bus					
Route 62 Inbound Entering	186	193	32	0.91	0.20
Route 62 Inbound Exiting	53	0	0	0.00	0.00
Route 62 Outbound Entering	133	0	0	0.00	0.00
Route 62 Outbound Exiting	106	19	37	0.36	0.70
Route 67 Inbound Entering	106	101	17	0.96	0.11
Route 67 Inbound Exiting	80	0	0	0.00	0.00
Route 67 Outbound Entering	106	0	0	0.00	0.00
Route 67 Outbound Exiting	106	10	24	0.06	0.44
Route 74 Inbound Entering	133	48	16	0.45	0.15
Route 74 Inbound Exiting	133	47	17	0.44	0.16
Route 74 Outbound Entering	133	21	17	0.20	0.31
Route 74 Outbound Exiting	133	18	16	0.17	0.31
Route 76 Inbound Entering	133	111	35	1.05	0.33
Route 76 Inbound Exiting	106	0	0	0.00	0.00
Route 76 Outbound Entering	159	0	0	0.00	0.00
Route 76 Outbound Exiting	106	57	85	0.54	0.80

Route 78 Inbound Entering	53	36	18	0.34	0.12
Route 78 Inbound Exiting	53	37	21	0.35	0.13
Route 78 Outbound Entering	186	48	44	0.30	0.42
Route 78 Outbound Exiting	53	32	43	0.20	0.41
Route 79 Inbound Entering	133	85	26	0.81	0.16
Route 79 Inbound Exiting	106	0	0	0.00	0.00
Route 79 Outbound Entering	106	0	0	0.00	0.00
Route 79 Outbound Exiting	80	5	68	0.05	0.43
Route 84 Inbound Entering	106	72	25	0.68	0.16
Route 84 Inbound Exiting	106	0	14	0.00	0.09
Route 84 Outbound Entering	133	0	0	0.00	0.00
Route 84 Outbound Exiting	133	2	51	0.02	0.48
Route 350 Inbound Entering	133	121	82	0.76	0.52
Route 350 Inbound Exiting	133	0	0	0.00	0.00
Route 350 Outbound Entering	133	0	0	0.00	0.00
Route 350 Outbound Exiting	106	54	57	0.51	0.54
Route 351 Inbound Entering	159	0	39	0.00	0.36
Route 351 Inbound Exiting	106	0	0	0.00	0.00
Route 351 Outbound Entering	53	0	0	0.00	0.00
Route 351 Outbound Exiting	53	45	0	0.42	0.00

As presented in Table 10.b.1, the existing Bus Routes are operating within MBTA capacity with V/C ratios below 1.0 except for the Route 76 Inbound entering Alewife Station (V/C = 1.05). This route begins to the west of Alewife Station in the Bedford/Lexington area near Interstate 95.

The existing Red Line at Alewife Station is operating with V/C ratios below 1.0 in the morning and evening inbound and outbound directions.

10.c Development of Transit Project Trips – Step 4

The Project is expected to generate 7 transit trips (5 entering, 2 exiting) during the morning peak hour and 6 transit trips (1 entering, 5 exiting) during the evening peak hour, according to the ITE trip generation calculations presented in Section 3 of this report. For a conservative analysis, no transit trip credits were taken from the existing building on site.

Project transit trip distribution, split between Red Line and Bus Lines, was developed based on the 2006-2010 American Community Survey 5-Year Estimates, which indicated that approximately 61% of transit riders use the subway (Red Line) and 39% use buses. The bus trips were distributed onto bus routes proportionally using existing ridership levels. A detailed transit distribution by line, direction, and peak hour is presented in Table 10.c.1.

TABLE 10.C.1 TRANSIT TRIP DISTRIBUTION

Route and Direction	Morning Peak Hour		Evening Peak Hour	
	% OUT	% IN	% OUT	% IN
Red Line at Alewife Station				
Inbound	100%	0.0%	100%	0.0%
Outbound	0.0%	100%	0.0%	100%
MBTA Bus				
Route 62 Inbound	0.0%	27.4%	0.0%	13.3%
Route 62 Outbound	9.8%	0.0%	11.4%	0.0%
Route 67 Inbound	0.0%	14.5%	0.0%	7.5%
Route 67 Outbound	5.2%	0.0%	7.3%	0.0%
Route 74 Inbound	0.0%	0.1%	0.3%	0.0%
Route 74 Outbound	0.0%	0.5%	0.0%	0.1%
Route 76 Inbound	0.0%	15.7%	0.0%	14.3%
Route 76 Outbound	29.4%	0.0%	26.2%	0.0%
Route 78 Inbound	0.7%	0.0%	0.8%	0.0%
Route 78 Outbound	0.0%	2.2%	0.0%	0.4%
Route 79 Inbound	0.0%	12.1%	0.0%	10.4%
Route 79 Outbound	2.5%	0.0%	20.9%	0.0%
Route 84 Inbound	0.0%	10.1%	0.0%	4.6%
Route 84 Outbound	1.2%	0.0%	15.6%	0.0%
Route 350 Inbound	0.0%	17.3%	0.0%	33.6%
Route 350 Outbound	28.1%	0.0%	17.5%	0.0%
Route 351 Inbound	0.0%	0.0%	0.0%	15.6%
Route 351 Outbound	23.1%	0.0%	0.0%	0.05
Total	100%	100%	100%	100%

Source: MBTA existing station ridership levels, Fall 2017 (Red Line), and Spring/Fall 2018 (Buses)

Transit distribution is then applied to the Project-generated transit trips in order to determine the Project-generated transit trips by line or route, as presented in Table 10.c.2.

TABLE 10.C.2 PROJECT-GENERATED TRANSIT TRIPS BY LINE

	Morning Peak Hour			Evening Peak Hour		
Route and Direction	Trips OUT (Boardings)	Trips IN (Alightings)	Trips Total	Trips OUT (Boardings)	Trips IN (Alightings)	Trips Total
Red Line at Alewife Station						
Inbound	1	0	1	3	0	3
Outbound	0	3	3	0	1	1
MBTA Bus						
Route 62 Inbound	0	0	0	0	0	0
Route 62 Outbound	0	0	0	0	0	0
Route 67 Inbound	0	0	0	0	0	0
Route 67 Outbound	0	0	0	0	0	0
Route 74 Inbound	0	0	0	1	0	1
Route 74 Outbound	0	1	1	0	0	0
Route 76 Inbound	0	0	0	0	0	0
Route 76 Outbound	0	0	0	0	0	0
Route 78 Inbound	1	0	1	1	0	1
Route 78 Outbound	0	1	1	0	0	0
Route 79 Inbound	0	0	0	0	0	0
Route 79 Outbound	0	0	0	0	0	0
Route 84 Inbound	0	0	0	0	0	0
Route 84 Outbound	0	0	0	0	0	0
Route 350 Inbound	0	0	0	0	0	0
Route 350 Outbound	0	0	0	0	0	0
Route 351 Inbound	0	0	0	0	0	0
Route 351 Outbound	0	0	0	0	0	0
Total*	1	2	3	2	0	2

*Total trips rounded to nearest whole number

10.d Build Transit System Utilization – Step 5

The Project-generated transit trips by line or route from Step 4 above are added to the existing route volumes to develop the "Build Condition" utilization scenario, where Existing + Project trips are assumed to be on the transit lines. Resulting v/c ratios are presented in Table 10.d.1.

TABLE 10.D.1 BUILD CONDITION TRANSIT SERVICE UTILIZATION (PER MBTA DATA)

Route and Direction	Policy Capacity (from Step 1)	Morning Peak Hour Ridership (Existing + Project Trips)	Evening Peak Hour Ridership (Existing + Project Trips)	Morning Peak Hour V/C	Evening Peak Hour V/C
Red Line at Alewife Station					
Inbound Exiting Alewife	11,723	2,549	635	0.22	0.05
Outbound Entering Alewife	11,723	514	2,148	0.04	0.18
MBTA Bus					
Route 62 Inbound Entering	186	193	32	0.91	0.20
Route 62 Inbound Exiting	53	0	0	0.00	0.00
Route 62 Outbound Entering	133	0	0	0.00	0.00
Route 62 Outbound Exiting	106	19	37	0.36	0.70
Route 67 Inbound Entering	106	101	17	0.96	0.11
Route 67 Inbound Exiting	80	0	0	0.00	0.00
Route 67 Outbound Entering	106	0	0	0.00	0.00
Route 67 Outbound Exiting	106	10	24	0.06	0.44
Route 74 Inbound Entering	133	48	16	0.45	0.15
Route 74 Inbound Exiting	133	47	18	0.44	0.17
Route 74 Outbound Entering	133	22	17	0.21	0.31
Route 74 Outbound Exiting	133	18	16	0.17	0.31
Route 76 Inbound Entering	133	111	35	1.05	0.33
Route 76 Inbound Exiting	106	0	0	0.00	0.00
Route 76 Outbound Entering	159	0	0	0.00	0.00
Route 76 Outbound Exiting	106	57	85	0.54	0.80
Route 78 Inbound Entering	53	36	18	0.34	0.12
Route 78 Inbound Exiting	53	38	22	0.35	0.14
Route 78 Outbound Entering	186	49	44	0.31	0.42
Route 78 Outbound Exiting	53	32	43	0.20	0.41
Route 79 Inbound Entering	133	85	26	0.81	0.16

Route 79 Inbound Exiting	106	0	0	0.00	0.00
Route 79 Outbound Entering	106	0	0	0.00	0.00
Route 79 Outbound Exiting	80	5	68	0.05	0.43
Route 84 Inbound Entering	106	72	25	0.68	0.16
Route 84 Inbound Exiting	106	0	14	0.00	0.09
Route 84 Outbound Entering	133	0	0	0.00	0.00
Route 84 Outbound Exiting	133	2	51	0.02	0.48
Route 350 Inbound Entering	133	121	82	0.76	0.52
Route 350 Inbound Exiting	133	0	0	0.00	0.00
Route 350 Outbound Entering	133	0	0	0.00	0.00
Route 350 Outbound Exiting	106	54	57	0.51	0.54
Route 351 Inbound Entering	159	0	39	0.00	0.36
Route 351 Inbound Exiting	106	0	0	0.00	0.00
Route 351 Outbound Entering	53	0	0	0.00	0.00
Route 351 Outbound Exiting	53	45	0	0.42	0.00

All the bus routes are expected to operate within MBTA policy capacity (with V/C ratios below 1.0) in the Build Condition, again, except for Route 76 Inbound entering Alewife Station (V/C = 1.05) during the morning peak hour (Table 10.d.1). Also, the analysis indicates that the Red Line is expected to operate at similar levels in the Build Condition as under Existing Conditions with only minor increases, if any, in the V/C ratios.

10.e Development of Future Transit Trips – Step 6

To analyze the 2024 Future Condition for transit, the MBTA existing ridership was grown to year 2024 based on a 1.89% growth rate for the Red Line as presented in the Boston Metropolitan Planning Organization/Central Transportation Planning Staff (CTPS) study of the impact of planned large developments in the Boston metropolitan area. An estimated average annual growth rate of 0.68% was applied for buses based on system-wide MBTA growth projections for local buses prepared by CTPS for the Boston Metropolitan Planning Organization's Long-Range Transportation Plan. The 2024 Future ridership is presented in Table 10.e.1.

TABLE 10.E.1 2024 FUTURE GROWTH TRANSIT SERVICE UTILIZATION (PER MBTA DATA)

Route and Direction	Policy Capacity	Morning Peak Hour Ridership	Evening Peak Hour Ridership	Morning Peak Hour V/C	Evening Peak Hour V/C
Red Line at Alewife Station (based on Existing Capacity)					
Inbound Exiting Alewife	11,723	2,905	720	0.25	0.06
Outbound Entering Alewife	11,723	583	2,447	0.05	0.21
Red Line at Alewife Station (based on Future Capacity)					
Inbound Exiting Alewife	18,900	2,905	720	0.17	0.05
Outbound Entering Alewife	18,900	583	2,447	0.04	0.15
MBTA Bus					
Route 62 Inbound Entering	186	201	34	0.95	0.21
Route 62 Inbound Exiting	53	0	0	0.00	0.00
Route 62 Outbound Entering	133	0	0	0.00	0.00
Route 62 Outbound Exiting	106	20	39	0.38	0.74
Route 67 Inbound Entering	106	105	17	0.99	0.11
Route 67 Inbound Exiting	80	0	0	0.00	0.00
Route 67 Outbound Entering	106	0	0	0.00	0.00
Route 67 Outbound Exiting	106	10	24	0.06	0.45
Route 74 Inbound Entering	133	49	17	0.46	0.16
Route 74 Inbound Exiting	133	48	18	0.45	0.17
Route 74 Outbound Entering	133	22	17	0.21	0.32
Route 74 Outbound Exiting	133	18	17	0.17	0.32
Route 76 Inbound Entering	133	115	37	1.08	0.35
Route 76 Inbound Exiting	106	0	0	0.00	0.00
Route 76 Outbound Entering	159	0	0	0.00	0.00
Route 76 Outbound Exiting	106	59	88	0.56	0.83
Route 78 Inbound Entering	53	37	19	0.35	0.12
Route 78 Inbound Exiting	53	38	22	0.36	0.14
Route 78 Outbound Entering	186	50	46	0.31	0.43
Route 78 Outbound Exiting	53	34	45	0.21	0.42
Route 79 Inbound Entering	133	89	27	0.84	0.17
Route 79 Inbound Exiting	106	0	0	0.00	0.00
Route 79 Outbound Entering	106	0	0	0.00	0.0
Route 79 Outbound Exiting	80	5	70	0.05	0.44
Route 84 Inbound Entering	106	74	26	0.70	0.16

Route 84 Inbound Exiting	106	0	14	0.00	0.09
Route 84 Outbound Entering	133	0	0	0.00	0.00
Route 84 Outbound Exiting	133	2	53	0.02	0.50
Route 350 Inbound Entering	133	126	85	0.79	0.53
Route 350 Inbound Exiting	133	0	0	0.00	0.00
Route 350 Outbound Entering	133	0	0	0.00	0.00
Route 350 Outbound Exiting	106	56	59	0.53	0.56
Route 351 Inbound Entering	159	0	40	0.00	0.38
Route 351 Inbound Exiting	106	0	0	0.00	0.00
Route 351 Outbound Entering	53	0	0	0.00	0.00
Route 351 Outbound Exiting	53	46	0	0.43	0.00

Notes: 2024 Future ridership counts were calculated using the 2017 MBTA Red Line data and were grown by 1.89% per year for 7 years, and Spring/Fall 2018 Ridership data (buses) were grown by 0.68% per year for 6 years

As presented in Table 10.e.1, all the bus routes are expected to operate within MBTA policy capacity (with V/C ratios below 1.0) in the Build Condition, again, except for Route 76 Inbound entering Alewife Station (V/C = 1.08), during the morning peak hour. All future ridership numbers were developed with the assumption that the bus routes would remain the same, and no additional buses would be added to the existing Spring 2019 schedule.

The table also indicates that because of the scheduled improvements, the Red Line is expected to operate in the Build Condition with V/C ratios better than under existing conditions.

10.f Compile and Assign Area Background Project Transit Trips – Step 7

In addition to growing the transit trips to 2024 Future Conditions, it is necessary to add transit trips from area projects that have not yet come on-line. The same projects listed in the traffic analysis were also used in this transit analysis. Transit trips for each background project, as presented in Table 10.f.1 below, were included in the Future analysis.

TABLE 10.F .1 BACKGROUND PROJECT TRANSIT TRIPS

	Morning Peak Hour			Evening Peak Hour		
Project	In	Out	Total	In	Out	Total
671-675 Concord Avenue	3	14	17	14	7	21
87-95 Fawcett Street	2	7	9	7	4	11
55 Wheeler Street	15	62	77	61	33	94
605 Concord Avenue	2	7	9	14	7	21
35 Cambridgepark Drive	13	2	15	5	13	18
50 Cambridgepark Drive	25	76	101	72	32	104
88 Cambridgepark Drive	20	89	109	109	59	168
130 Cambridgepark Drive	9	36	45	35	19	54
The Residences at Alewife Station	28	67	95	38	38	76
75 New Street	3	12	15	12	6	18
TOTAL	**120**	**372**	**492**	**367**	**218**	**585**

Similarly, to the project generated transit trips, 61% of the background transit trips were assigned to the Red Line and 38% were assigned to bus routes, when not specifically indicated. (For a detailed description of the transit distribution, refer to Table 10.d.2.)

10.g Future Transit System Utilization – Step 8

The 2024 Future transit scenario is based on grown ridership levels, combined with background project transit trips and Project-generated transit trips. The resulting transit ridership and calculated V/C ratios for morning and evening peak hours for 2024 Future Condition is shown in Table 10.g.1.

TABLE 10.G.1 2024 FUTURE CONDITION TRANSIT SERVICE UTILIZATION

Route and Direction	Policy Capacity (from Step 1)	Morning Peak Hour Ridership (2024 Future + Background Project Trips)	Evening Peak Hour Ridership (2024 Future + Background Project Trips)	Morning Peak Hour V/C (a)	Evening Peak Hour V/C (a)
Red Line at Alewife Station					
Inbound Exiting Alewife	11,723	3,229	911	0.28	0.08
Outbound Entering Alewife	11,723	694	2,759	0.06	0.24

Route and Direction	Policy Capacity (from Step 1)	Morning Peak Hour Ridership (2024 Future + Background Project Trips)	Evening Peak Hour Ridership (2024 Future + Background Project Trips)	Morning Peak Hour V/C (a)	Evening Peak Hour V/C (a)
MBTA Bus					
Route 62 Inbound Entering	186	202	37	0.95	0.24
Route 62 Inbound Exiting	53	0	0	0.00	0.00
Route 62 Outbound Entering	133	0	0	0.00	0.00
Route 62 Outbound Exiting	106	24	40	0.46	0.76
Route 67 Inbound Entering	106	105	18	0.99	0.12
Route 67 Inbound Exiting	80	0	0	0.00	0.00
Route 67 Outbound Entering	106	0	0	0.00	0.00
Route 67 Outbound Exiting	106	10	25	0.06	0.48
Route 74 Inbound Entering	133	49	17	0.46	0.16
Route 74 Inbound Exiting	133	65	35	0.61	0.33
Route 74 Outbound Entering	133	28	34	0.26	0.63
Route 74 Outbound Exiting	133	18	17	0.17	0.32
Route 76 Inbound Entering	133	116	40	1.10	0.38
Route 76 Inbound Exiting	106	0	0	0.00	0.00
Route 76 Outbound Entering	159	0	0	0.00	0.00
Route 76 Outbound Exiting	106	63	90	0.60	0.85
Route 78 Inbound Entering	53	37	19	0.35	0.12
Route 78 Inbound Exiting	53	56	39	0.53	0.25
Route 78 Outbound Entering	186	56	64	0.35	0.60
Route 78 Outbound Exiting	53	34	45	0.21	0.42
Route 79 Inbound Entering	133	89	29	0.84	0.19
Route 79 Inbound Exiting	106	0	0	0.00	0.00
Route 79 Outbound Entering	106	0	0	0.00	0.00
Route 79 Outbound Exiting	80	6	72	0.06	0.45
Route 84 Inbound Entering	106	75	26	0.71	0.17
Route 84 Inbound Exiting	106	0	14	0.00	0.09
Route 84 Outbound Entering	133	0	0	0.00	0.00
Route 84 Outbound Exiting	133	2	54	0.02	0.51
Route 350 Inbound Entering	133	127	89	0.80	0.56
Route 350 Inbound Exiting	133	0	0	0.00	0.00
Route 350 Outbound Entering	133	0	0	0.00	0.00

Route 350 Outbound Exiting	106	60	60	0.57	0.57
Route 351 Inbound Entering	159	0	41	0.00	0.39
Route 351 Inbound Exiting	106	0	0	0.00	0.00
Route 351 Outbound Entering	53	0	0	0.00	0.00
Route 351 Outbound Exiting	53	48	0	0.46	0.00

As presented in Table 10.g.1, all the bus routes are expected to operate within MBTA policy capacity (with V/C ratios below 1.0) in the Build Condition, again, except for Route 76 Inbound entering Alewife Station (V/C = 1.10).

All future ridership numbers were developed with the assumption that the bus routes would remain the same, and no additional bus trips would be added to the existing Spring 2019 schedule. Additionally, to present a "worst case" scenario for the MBTA Red Line and key bus routes all project-generated transit trips are assumed to use the MBTA rather than a private shuttle service such as the Alewife TMA.

10.h Private Transit Analysis

A utilization of the private transit services has also been conducted to support this Project. The analysis used existing Alewife TMA shuttle monthly ridership data (included in the Appendix).

The current site is served by the Alewife TMA shuttle at the 110 Fawcett Street and 733 Concord Avenue stops (see Figure 1.d.2). The shuttle operates as drop-off only in the morning and pick-up only in the evening at this location because it serves office buildings at this location. Inbound shuttles are destined from Alewife Station to the developments along Concord Avenue in the Quadrangle area, and outbound shuttles are destined to Alewife Station from Concord Avenue.

Table 10.h.1 shows the existing shuttle system's peak hour passenger capacity.

TABLE 10.H.1 ALEWIFE TMA SHUTTLE PEAK HOUR CAPACITY (PER ALEWIFE TMA DATA)

Mode	Frequency[(a)]	OTP Factor[(b)]	# Passengers / Vehicle[(c)]	# Cars / Train	Resulting Capacity[(d)] (# Passengers / Peak Hour)
Inbound	2	1.00	18	1	32
Outbound	2	1.00	18	1	32

Notes:
(a) Number of vehicles per hour, per Alewife TMA shuttle schedule
(b) On-Time Performance Factor assumed to be 1.00
(c) Capacity based on 18-passenger shuttle vehicles
(d) Calculated Capacity = # of Trains x OTP Factor x # pax per vehicle x # of cars – shown as number of passengers per peak hour

The Alewife TMA ridership data from March 2019 was used to represent average daily ridership and the peak hour passenger loads for the Alewife Shuttle. The resulting daily ridership at the Alewife stop was analyzed representing the highest passenger load by assuming that all shuttle users board at this location in the morning peak hour and the all shuttle users alight at this location in the evening peak hour. The corresponding shuttle service utilization at this stop is shown in Table 10.h.2.

TABLE 10.H.2 EXISTING ALEWIFE TMA SHUTTLE SERVICE UTILIZATION (PER ALEWIFE TMA DATA)

Direction	Capacity Peak Hour	Morning Peak Hour Ridership	Evening Peak Hour Ridership	Morning Peak Hour V/C	Evening Peak Hour V/CV/C
Inbound at Alewife	32	7.6	0	0.21	0.00
Outbound at Alewife	32	0	5.5	0.00	0.15

The data show that there the shuttle service has passenger seat availability at Alewife: the service has V/C ratios of 0.21 and 0.15 during the morning and evening peak hours, respectively.

11 Pedestrian Analysis

Pedestrian crossing volumes at study area intersections are presented in Figures 2.c.3 and 2.c.4. The results of pedestrian level of service (PLOS) analysis at intersection crosswalks are presented in Table 11.a.1 for signalized intersections and Table 11.a.2 for unsignalized intersections, and Figures 11.a.1 and 11.a.2 graphically illustrate the PLOS for the existing and build conditions for morning and evening peak hour. The intersections of Concord Avenue and Smith Place and Smith Place and Wilson Road show a decrease in PLOS from A to B during the morning peak hour and evening peak hour, respectively.

Pedestrian level of service at signalized intersections is dictated by the portion of the signal cycle dedicated to the pedestrian crossings. Accordingly, increasing pedestrian volumes does not alter pedestrian level of service at signalized intersections, and no changes in PLOS are projected under Build or Future conditions. It is assumed that the walk time and cycle length at these intersections will not change from existing and therefore PLOS will remain consistent.

For unsignalized intersections, the PLOS is calculated using the crosswalk length and the conflicting vehicle flow rates for morning and evening peak hours.

TABLE 11.A.1 SIGNALIZED INTERSECTION – PEDESTRIAN LOS SUMMARY

		Morning Peak Hour			Evening Peak Hour		
Intersection	Crosswalk	Existing 2019	Build 2019	Future 2024	Existing 2019	Build 2019	Future 2024
Concord Avenue at Moulton Street/Neville Manor	East	D	D	D	D	D	D
	North	D	D	D	D	D	D
	South	D	D	D	D	D	D
Concord Avenue at Blanchard Road/Griswold Street	East	E	E	E	E	E	E
	West	E	E	E	E	E	E
	North	E	E	E	E	E	E
	South	E	E	E	E	E	E

TABLE 11.A.2 UNSIGNALIZED INTERSECTION – PEDESTRIAN LOS SUMMARY

		Morning Peak Hour			Evening Peak Hour		
Intersection	Crosswalk	Existing 2019	Build 2019	Future 2024	Existing 2019	Build 2019	Future 2024
Concord Avenue at Smith Place	West	F	F	F	F	F	F
	North	A	B	B	A	A	B
Concord Avenue at Fawcett Street	West	F	F	F	F	F	F
	North	B	B	C	B	B	C
Smith Place at Fawcett Street	East	A	A	A	A	A	A
	West	A	A	A	A	A	A
	North	A	A	A	A	A	A
	South	A	A	A	A	A	A
Smith Place at Wilson Road	East	A	A	A	A	A	A
	West	A	A	A	A	A	A
	North	A	A	A	A	A	A

Intersection	Crosswalk	Morning Peak Hour Existing 2019	Morning Peak Hour Build 2019	Morning Peak Hour Future 2024	Evening Peak Hour Existing 2019	Evening Peak Hour Build 2019	Evening Peak Hour Future 2024
	South	A	A	B	A	B	B

12 Bicycle Analysis

12.a Conflicting Movements

Conflicting vehicle turning movements at the study area intersections are presented in Figure 2.c.5 and 2.c.6 and are summarized in Table 12.a.1 for Existing 2019, Build 2019, and Future 2024 conditions.

TABLE 12.A.1 CONFLICTING BICYCLE/VEHICLE MOVEMENTS AT STUDY INTERSECTIONS

			Existing Peak Hour	Conflicting Vehicle Movements					
				Existing 2019		Build 2019		Future 2024	
Intersection	Period	Bicycle Travel Direction	Bicycle Volume	Right Turn[a]	Left Turn[b]	Right Turn[a]	Left Turn[b]	Right Turn[a]	Left Turn[b]
Smith Place at Concord Avenue	Morning	EB	23	NA	NA	NA	NA	NA	NA
		WB	13	55	75	67	87	68	89
		SB	0	49	NA	55	NA	56	NA
	Evening	EB	3	NA	NA	NA	NA	NA	NA
		WB	20	27	38	30	42	31	43
		SB	0	87	NA	101	NA	103	NA
Neville Place /Moulton Street at Concord Avenue	Morning	EB	24	5	18	5	18	5	18
		WB	10	57	7	57	7	58	7
		NB	0	2	39	2	39	2	40
		SB	1	9	4	9	4	9	4
	Evening	EB	3	8	6	8	6	8	6
		WB	22	6	2	6	2	6	2
		NB	0	14	59	14	59	14	60
		SB	1	32	18	32	18	33	18
Concord Avenue at Fawcett Street	Morning	EB	1	NA	NA	NA	NA	NA	NA
		WB	15	135	15	135	15	148	16
		SB	1	16	NA	16	NA	25	NA
	Evening	EB	3	NA	NA	NA	NA	NA	NA
		WB	16	103	27	103	27	144	35
		SB	1	24	NA	24	NA	28	NA

			Existing Peak Hour	Conflicting Vehicle Movements					
				Existing 2019		Build 2019		Future 2024	
Intersection	**Period**	**Bicycle Travel Direction**	**Bicycle Volume**	**Right Turn[a]**	**Left Turn[b]**	**Right Turn[a]**	**Left Turn[b]**	**Right Turn[a]**	**Left Turn[b]**
Smith Place at Fawcett Street	Morning	EB	0	2	37	2	37	2	38
		WB	0	32	0	32	0	33	0
		NB	0	30	7	30	7	31	7
		SB	0	0	0	0	0	0	0
	Evening	EB	1	3	20	3	20	3	21
		WB	0	10	0	10	0	10	0
		NB	4	9	14	9	14	9	14
		SB	3	0	26	0	26	0	27
Smith Place at Wilson Road	Morning	EB	0	20	8	20	8	21	8
		WB	0	4	0	4	0	4	0
		NB	1	9	17	9	17	9	17
		SB	0	2	20	2	20	2	21
	Evening	EB	0	12	8	12	8	12	8
		WB	0	4	0	4	0	4	0
		NB	3	10	8	10	8	10	8
		SB	2	1	11	1	11	1	11
Concord Avenue at Blanchard Road / Griswold Street	Morning	EB	26	14	101	14	103	14	109
		WB	6	111	10	113	10	114	10
		NB	2	235	351	238	354	238	356
		SB	1	16	4	16	4	16	4
		SWB	0	10	0	10	0	10	0
	Evening	EB	1	32	163	32	167	33	163
		WB	16	283	49	287	49	278	49
		NB	1	104	131	105	132	112	136
		SB	0	15	6	15	6	15	6
		SWB	0	6	1	6	1	6	1

a Advancing volume
b Opposing volume
NA Movement not available

13 Transportation Demand Management

The Project Proponent is committed to minimizing auto travel and encouraging alternative travel modes. The Proponent will support a program of transportation demand management (TDM) actions to reduce single occupancy vehicle (SOV) automobile trips, support carpooling, and encourage the use of transit, biking and walking.

Although the current occupant of 109-115 Smith Place (Thomas G. Gallagher, Inc., a mechanical contractor company) has a PTDM plan (F-35/F-36), the plan is oriented to a small set of employees.[7] The PTDM plan (approved in 2004, with amendments in 2010 and 2018) requires a secure, weather-protected bike parking space, a transit pass subsidy for employees, and a monitoring program to ensure the site meets SOV trip share targets; the plan does not require shuttle service to Alewife.

According to Section 10.18.050 (g) of the PTDM ordinance, the Proponent will not operate under the existing PTDM plan and instead will elect to consult with the PTDM Planning Officer on appropriate revisions to the existing plan.

The following TDM programs are proposed for inclusion in the Project's PTDM plan (to be reviewed by the City's PTDM Officer) to encourage Project employees and visitors to use alternative travel modes to SOV (drive alone) travel:

- Establish membership in the Alewife TMA, which provides employees with the benefit of free access to the shuttle buses operated by the TMA, ride-matching services, and access to emergency ride home to all employees who use alternative commute modes.
- Require tenants to provide a minimum 50 percent transit pass subsidy to employees.
- Provide Bluebikes corporate membership (minimum Gold level) paid by employer for employees who choose to become Bluebikes members. (A new bike share station is planned for 10 Wilson Road (the property across the street) by The Davis Companies. Other nearby stations are located at/near Alewife Station.)
- Dedicate carpool/vanpool parking spaces on site. Monitor the use of the carpool/vanpool spaces to add additional spaces as needed to satisfy demand.
- Provide air pumps and bike repair tools, provided at a bicycle repair station.

[7] According to a letter from T. G. Gallagher, Inc., to the PTDM Officer, only 8 of 31 employees are positioned at their office location at this site, whereas the remaining 23 (consisting of construction executives, project managers, estimators, coordinators, service managers) require their vehicle to perform their daily operations.

- Designate a Transportation Coordinator for the site responsible for:
  - Aggressively promoting and marketing non-SOV modes of transportation to employees, including posting information on the Project's web site, social media, and property newsletters
  - Informing employees about dynamic carpool (ridesharing) services
  - Performing annual transportation surveys
  - Coordinating with the Alewife TMA
  - Providing up to date information to all new employees through a New Employee Packet
  - Responding to individual requests for information

14 Transportation Mitigation

The proposed Project exceeds 19 out of 115 possible data entries, resulting in a 16.5 percent exceedance rate. As requested by the TP&T Department, Table 15.a.1 provides a listing of all Planning Board Special Permit Exceedances and indicates how transportation mitigation measures will or cannot mitigate the Project Exceedances.

TABLE 14.A.1 EXCEEDANCE MITIGATION SUMMARY TABLE

#	Location		Reason for Exceedance	Mitigation
	Criteria E-1 Pedestrian Delay			
1 2	Concord Avenue at Smith Place	West Crosswalk – Morning West Crosswalk – Evening	Existing and Build PLOS = F. Threshold is PLOS D with the project.	Existing PLOS conditions are maintained at this location with the construction of the Project and do not deteriorate in the Build Condition.
3		North Crosswalk - Morning	Existing PLOS = A and Build PLOS = B. Threshold is PLOS A with the project.	No mitigation proposed
4 5	Concord Avenue at Fawcett Street	West Crosswalk – Morning West Crosswalk – Evening	Existing and Build PLOS = F. Threshold is PLOS D with the project.	Existing PLOS conditions are maintained at this location with the construction of the Project and do not deteriorate in the Build Condition.

#	Location		Reason for Exceedance	Mitigation
6	Smith Place at Wilson Road/Adley Road	South Crosswalk – Evening	Existing PLOS = A and Build PLOS = B. Threshold is PLOS A with the project.	No mitigation proposed
7 8 9 10 11 12 13 14	Concord Avenue at Blanchard Road/ Griswold Street	East Crosswalk – Morning East Crosswalk – Evening West Crosswalk – Morning West Crosswalk – Evening North Crosswalk – Morning North Crosswalk – Evening South Crosswalk – Morning South Crosswalk – Evening	Existing and Build PLOS = E. Threshold is PLOS D with the project.	Existing PLOS conditions are maintained at this location with the construction of the Project and do not deteriorate in the Build Condition.
	Criteria E – 2 & 3 – Pedestrian and Bicycle Facilities			
15 16	Smith Place between Concord Avenue and Wilson Road/ Adley Road	No Sidewalk or walkway present	No Bicycle facilities or rights of way present	No mitigation proposed
17	Smith Place between Wilson Road/ Adley Road and Fawcett Street		No Bicycle facilities or rights of way present	Bicycle lanes (5' wide, one in each direction) are proposed with the redesign of Smith Place.
18	Smith Place between Fawcett Street and Mooney Street		No Bicycle facilities or rights of way present	No mitigation proposed
19	Fawcett Street between Smith Place and Concord Avenue		No Bicycle facilities or rights of way present	No mitigation proposed

Planning Board Special Permit Criteria

Criterion A – Project Vehicle Trip Generation

Table A-1 presents the Project vehicle trip generation criterion. Project vehicle trip generation is based on ITE trip rates, adjusted for local mode split and vehicle occupancy rates as discussed previously.

TABLE A-1 PROJECT VEHICLE TRIP GENERATION

Time Period	Criterion (trips)	Build (trips)	Exceeds Criterion?
Weekday Daily	2,000	1,194	No
Weekday Morning Peak Hour	240	44	No
Weekday Evening Peak Hour	240	44	No

The Project is not expected to exceed the Planning Board Criteria for daily, morning peak, and evening peak Project vehicle trip generation under the Build program.

Criterion B – Vehicle LOS

The criteria for a Project's impact to traffic operations at signalized intersections are summarized in Table B-1 below. These criteria are evaluated for each signalized study-area intersection and presented in Table B-2.

TABLE B-1 CRITERION - VEHICULAR LEVEL OF SERVICE

Existing	With Project
VLOS A	VLOS C
VLOS B, C	VLOS D
VLOS D	VLOS D or 7% roadway volume increase
VLOS E	7% roadway volume increase
VLOS F	5% roadway volume increase

TABLE B-2 VEHICULAR LEVEL OF SERVICE

	Morning Peak Hour				Evening Peak Hour			
Intersection	Existing Condition	Build Condition	Traffic Increase	Exceeds Criterion?	Existing Condition	Build Condition	Traffic Increase	Exceeds Criterion?
Concord Avenue/ Smith Place	E	F	2.2%	No	E	F	2.5%	No
Concord Avenue/Moulton Street/ Neville Manor	A	B	1.1%	No	B	B	1.2%	No
Concord Avenue/ Fawcett Street	E	E	0.9%	No	E	E	1.1%	No
Smith Place/ Fawcett Street	A	A	0.0%	No	B	B	0.0%	No
Smith Place/ Wilson Road/ Adley Road	B	B	16.9%	No	B	B	17.7%	No
Concord Avenue/ Blanchard Road/ Griswold Street	F	F	0.9%	No	F	F	0.8%	No

Criterion C – Traffic on Residential Streets

This criterion considers the magnitude of Project vehicle trip generation during any peak hour that may reasonably be expected to arrive and/or depart by traveling on a residential street. The criteria, based on a Project-induced traffic volume increase on any two-block residential street segment in the study area, are summarized in Table C-1.

TABLE C-1 CRITERION – TRAFFIC ON RESIDENTIAL STREETS

Parameter 1: Amount of Residential[1]	Parameter 2: Current Peak Hour Street Volume (two-way vehicles)		
	< 150 VPH	150-400 VPH	> 400 VPH
1/2 or more	20 VPH[2]	30 VPH[2]	40 VPH[2]
>1/3 but <1/2	30 VPH[2]	45 VPH[2]	60 VPH[2]
1/3 or less	No Max.	No Max.	No Max

1 - Amount of residential for a two block segment as determined by first floor frontage
2 - Additional Project vehicle trip generation in vehicles per lane, both directions
VPH - Vehicles per hour

6 of the 15 roadway segments in the study area identified as street segments which have more than 1/3 of residential frontage and are therefore evaluated against the traffic volume criteria. The results are presented in Table C-2.

TABLE C-2 TRAFFIC ON RESIDENTIAL STREETS

			Morning Peak Hour			Evening Peak Hour		
Roadway	Segment	Amount of Residential	Existing[1]	Increase[2]	Exceeds Criterion?	Existing[1]	Increase[2]	Exceeds Criterion?
Blanchard Road	Colby St to Concord Ave	1/2 or more	1002	5	No	1158	5	No
	Mannix Cir to Concord Ave	>1/3 but <1/2	884	5	No	1009	5	No
Griswold Street	Sunset Rd to Concord Ave	1/2 or more	57	0	No	34	0	No
Concord Avenue	Stewart Ter to Blanchard Rd	1/2 or more	682	8	No	754	6	No
	Blanchard Rd to Smith Pl	1/3 or less	1469	18	No	1291	17	No
	Smith Pl to Moulton St	1/2 or more	1444	17	No	1211	16	No
	Moulton St to Fawcett St	1/3 or less	1535	17	No	1236	16	No
	Fawcett St to Wheeler St	1/3 or less	1717	17	No	1366	16	No
Smith Place	Concord Ave to Adley Rd	1/3 or less	190	34	No	190	34	No

			Morning Peak Hour			Evening Peak Hour		
Roadway	**Segment**	**Amount of Residential**	**Existing[1]**	**Increase[2]**	**Exceeds Criterion?**	**Existing[1]**	**Increase[2]**	**Exceeds Criterion?**
	Adley Rd to Fawcett St	1/3 or less	134	17	No	144	17	No
	Fawcett St to Mooney St	1/3 or less	104	0	No	110	0	No
Wilson Road	Smith Pl to Moulton St	1/3 or less	113	0	No	37	0	No
Moulton Street	Wilson St to Concord Ave	1/3 or less	243	0	No	100	0	No
Fawcett Street	Concord Ave to Connecting Rd	>1/3 but <1/2	110	0	No	231	0	No
	Connecting Rd to Smith Pl	1/3 or less	110	0	No	64	0	No

Note: Volume interpolated from nearest data available in study area

1 Where driveways/on-street parking created a segment inflow/outflow volume imbalance, an average was calculated per direction and added

2 Net new project trips after trip credits are applied

Criterion D – Lane Queue

The criteria for a project's impact to queues at signalized intersections are summarized in Table D-1 below. These criteria are evaluated for each lane group at study-area signalized intersections and presented in Table D-2.

TABLE D-1 CRITERION – VEHICULAR QUEUES AT SIGNALIZED INTERSECTIONS

Existing	With Project
Under 15 vehicles	Under 15 vehicles, or 15+ vehicles with an increase of 6 vehicles
15 or more vehicles	Increase of 6 vehicles

TABLE D-2 LENGTH OF VEHICULAR QUEUES AT SIGNALIZED INTERSECTIONS

		Morning Peak Hour			Evening Peak Hour		
Intersection	**Lane**	2019 Existing	2019 Build	Exceeds Criterion?	2019 Existing	2019 Build	Exceeds Criterion?
Neville Pl/Moulton St at Concord Ave	Neville NB Left/Thru/Right	1	1	No	1	1	No
	Concord EB Left/Thru/Right	4	4	No	4	4	No
	Concord WB Left/Thru/Right	6	6	No	7	8	No
	Moulton SB Left/Right	2	2	No	2	3	No
Blanchard Rd St at Concord Ave	Blanchard NB Left/Thru	11	11	No	28	33	No
	Blanchard NB Right	3	3	No	3	3	No
	Concord EB Left/Thru/Right	9	9	No	13	15	No
	Concord WB Left	5	5	No	6	6	No
	Concord WB Thru	7	7	No	9	9	No
	Concord WB Right	4	4	No	5	5	No
	Blanchard SB Left/Thru/Right	66	66	No	20	23	No

Criterion E – Pedestrian and Bicycle Facilities

Criteria 1: Pedestrian Delay

Pedestrian delay is a measure of the pedestrian crossing delay on a crosswalk during the peak hour as determined by the pedestrian level of service (PLOS) analysis in the HCM 2000.

Table E-1 presents the indicators for this criterion. Tables E-2 present the evaluation of PLOS criteria for each crosswalk at study area intersections under existing and full build conditions.

TABLE E-1 CRITERION – PLOS INDICATORS

Existing	With Project
PLOS A	PLOS A
PLOS B	PLOS B
PLOS C	PLOS C
PLOS D	PLOS D or increase of 3 seconds
PLOS E, F	PLOS D

TABLE E-2 STUDY AREA INTERSECTIONS PLOS SUMMARY

		Morning Peak Hour			Evening Peak Hour		
Intersection	Crosswalk	Existing	Build	Exceeds Criterion?	Existing	Build	Exceeds Criterion?
Concord Avenue at Smith Place	West	F	F	Yes	F	F	Yes
	North	A	B	Yes	A	A	No
Concord Avenue at Moulton Street/Neville Manor	East	D	D	No	C	C	No
	North	D	D	No	C	C	No
	South	D	D	No	C	C	No
Concord Avenue at Fawcett Street	West	F	F	Yes	F	F	Yes
	North	B	B	No	B	B	No
Smith Place at Fawcett Street	East	A	A	No	A	A	No
	West	A	A	No	A	A	No
	North	A	A	No	A	A	No
	South	A	A	No	A	A	No
Smith Place at Wilson Road/ Adley Road	East	A	A	No	A	A	No
	West	A	A	No	A	A	No
	North	A	A	No	A	A	No
	South	A	A	No	A	B	Yes
Concord Avenue at Blanchard Road/Griswold Street	East	E	E	Yes	E	E	Yes
	West	E	E	Yes	E	E	Yes
	North	E	E	Yes	E	E	Yes
	South	E	E	Yes	E	E	Yes

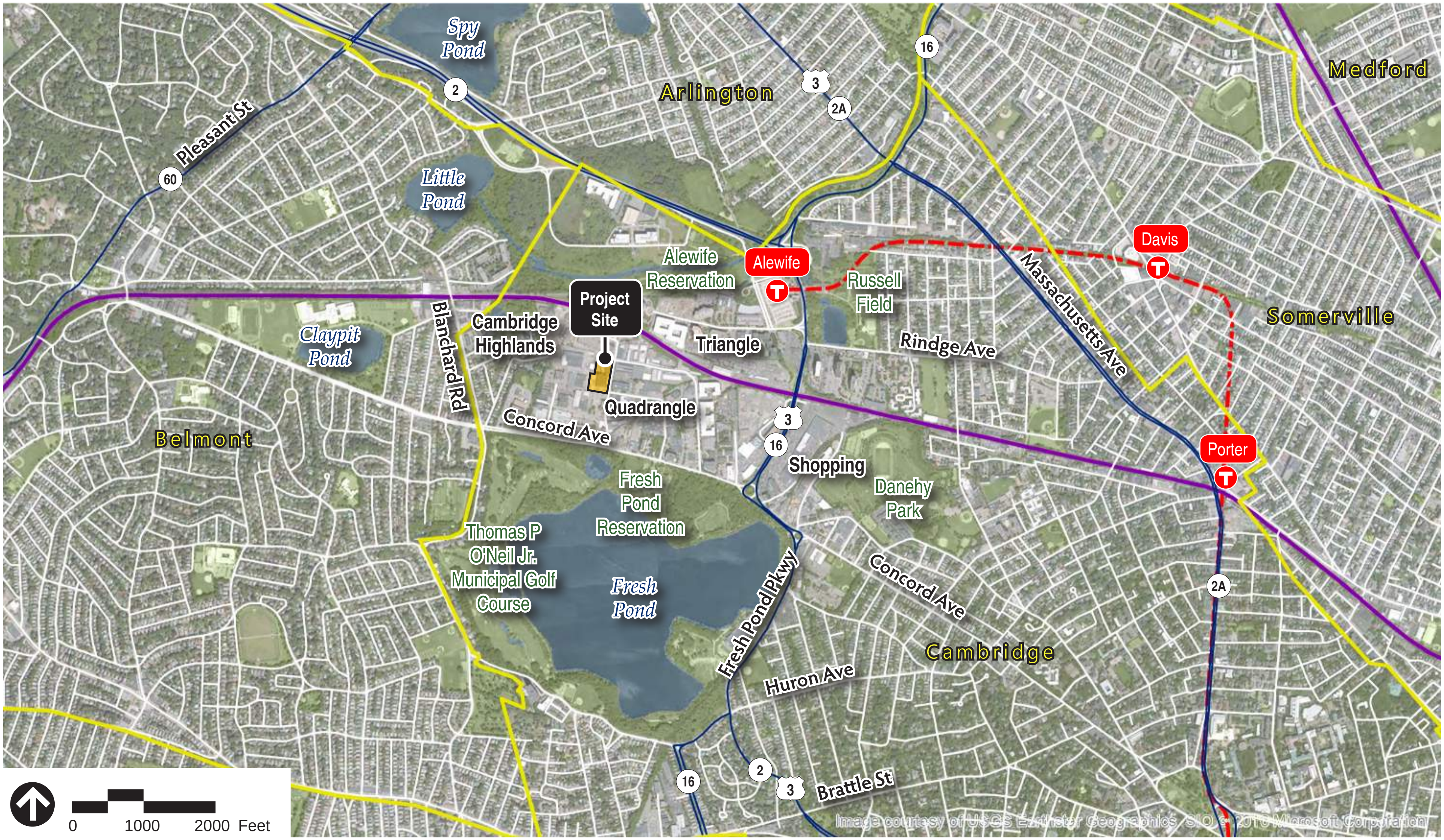
Criteria 2 & 3: Safe Pedestrian and Bicycle Facilities

Safe pedestrian and bicycle facilities are off-road or non-street bicycle lanes and sidewalks that are along a publicly-accessible street.

Table E-3 presents the indicators for this criterion. The evaluation of sidewalks or walkways and bicycle facilities are displayed.

TABLE E-3 PEDESTRIAN AND BICYCLE FACILITIES

Adjacent Street	Link (between)	Sidewalk or Walkway Present	Exceeds Criterion?	Bicycle Facilities or Right of Ways Present	Exceeds Criterion?
Smith Place	Concord Avenue and Wilson Road/ Adley Road	No	Yes	No	Yes
	Wilson Road/ Adley Road and Fawcett Street	Yes	No	No	Yes
	Fawcett Street and Mooney Street	Yes	No	No	Yes
Fawcett Street	Smith Place and Concord Avenue	Yes	No	No	Yes
Concord Avenue	Blanchard Road and Fawcett Street	Yes	No	Yes	No



Source: Bing Aerial

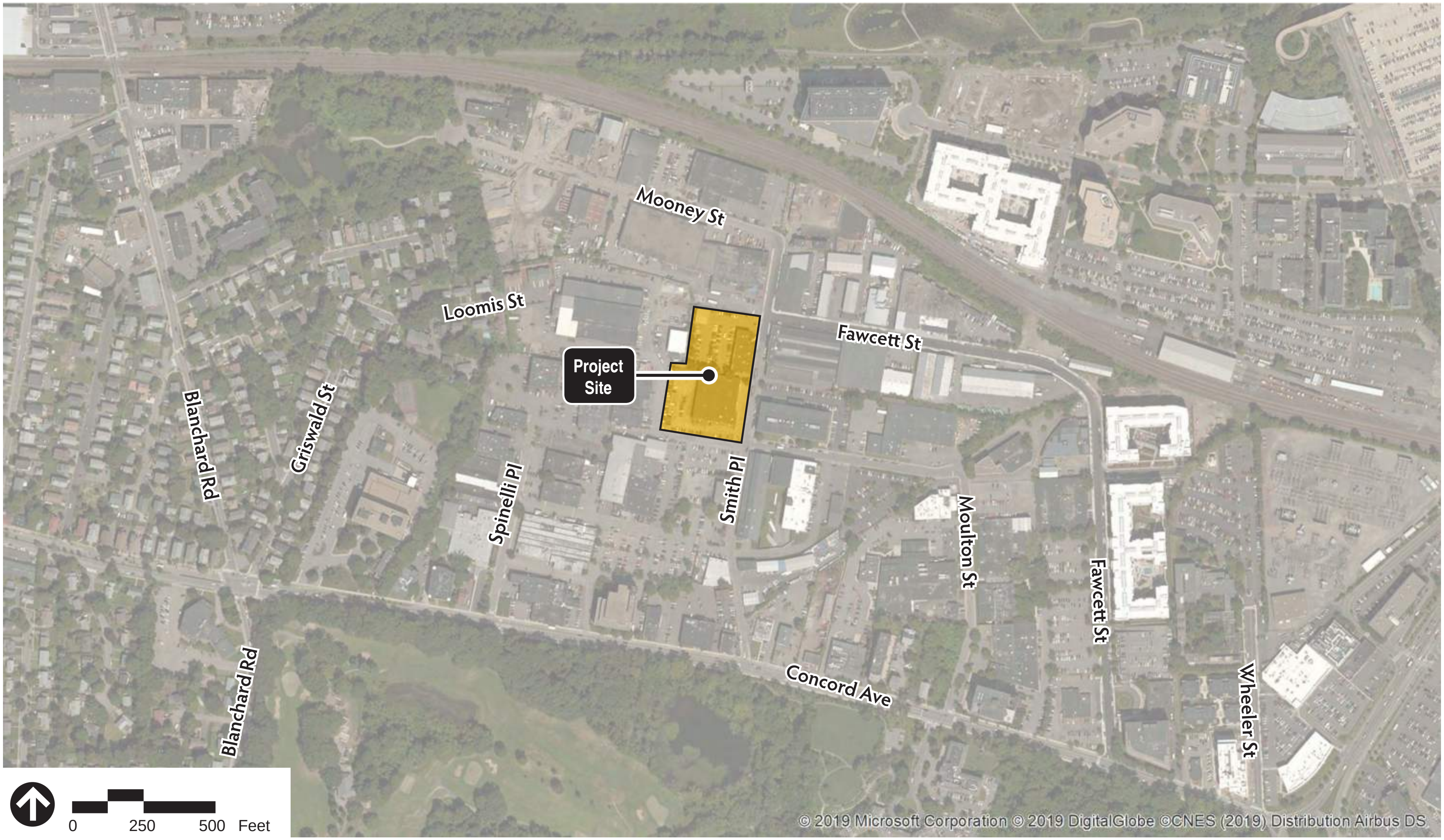
Key Regional Roadways
MBTA Red Line
MBTA Commuter Rail

vhb

Figure A

Site Location Map

75/109 Smith Place Project
Cambridge, Massachusetts

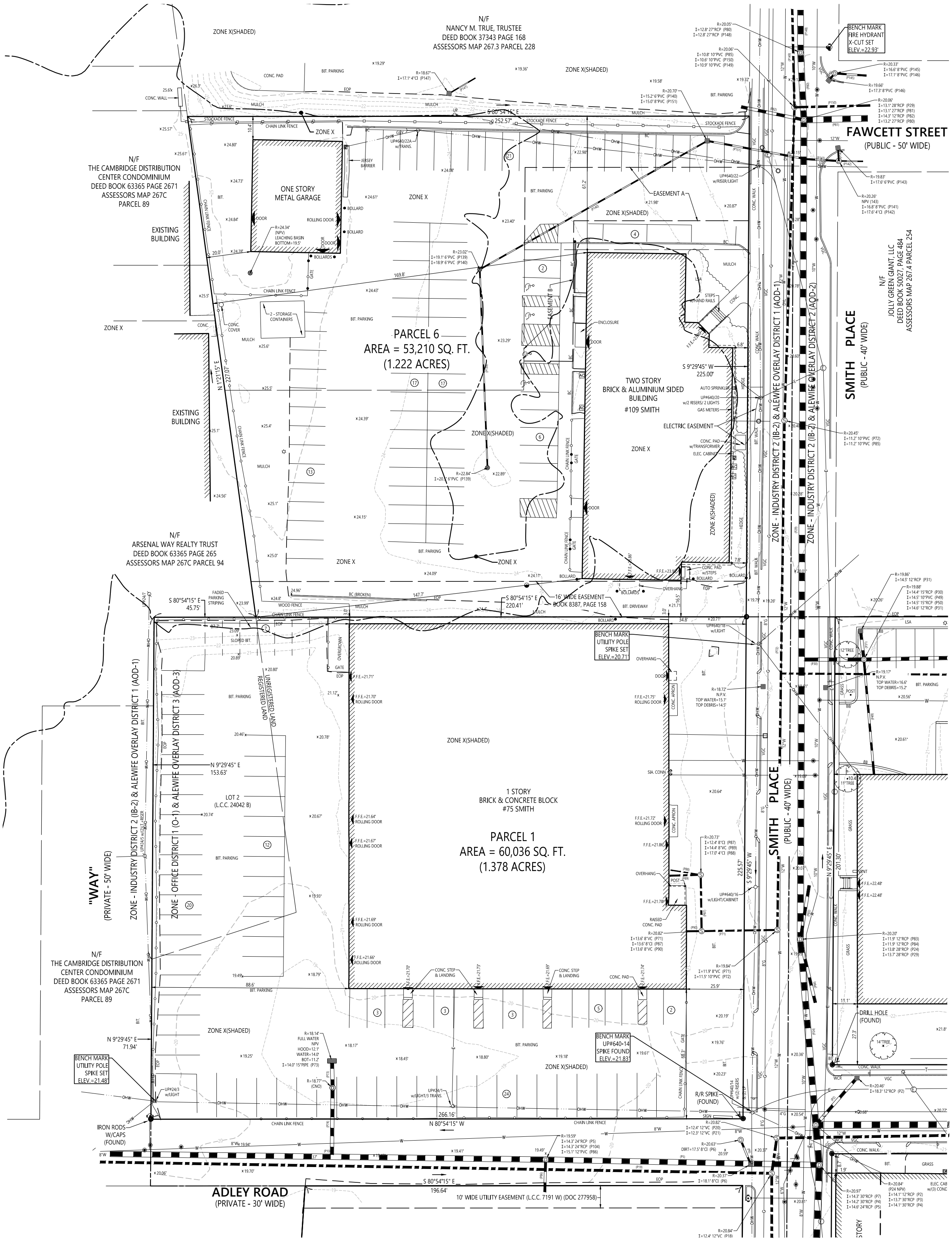


Source: Bing Aerial

Figure B

Project Site

75/109 Smith Place Project
Cambridge, Massachusetts

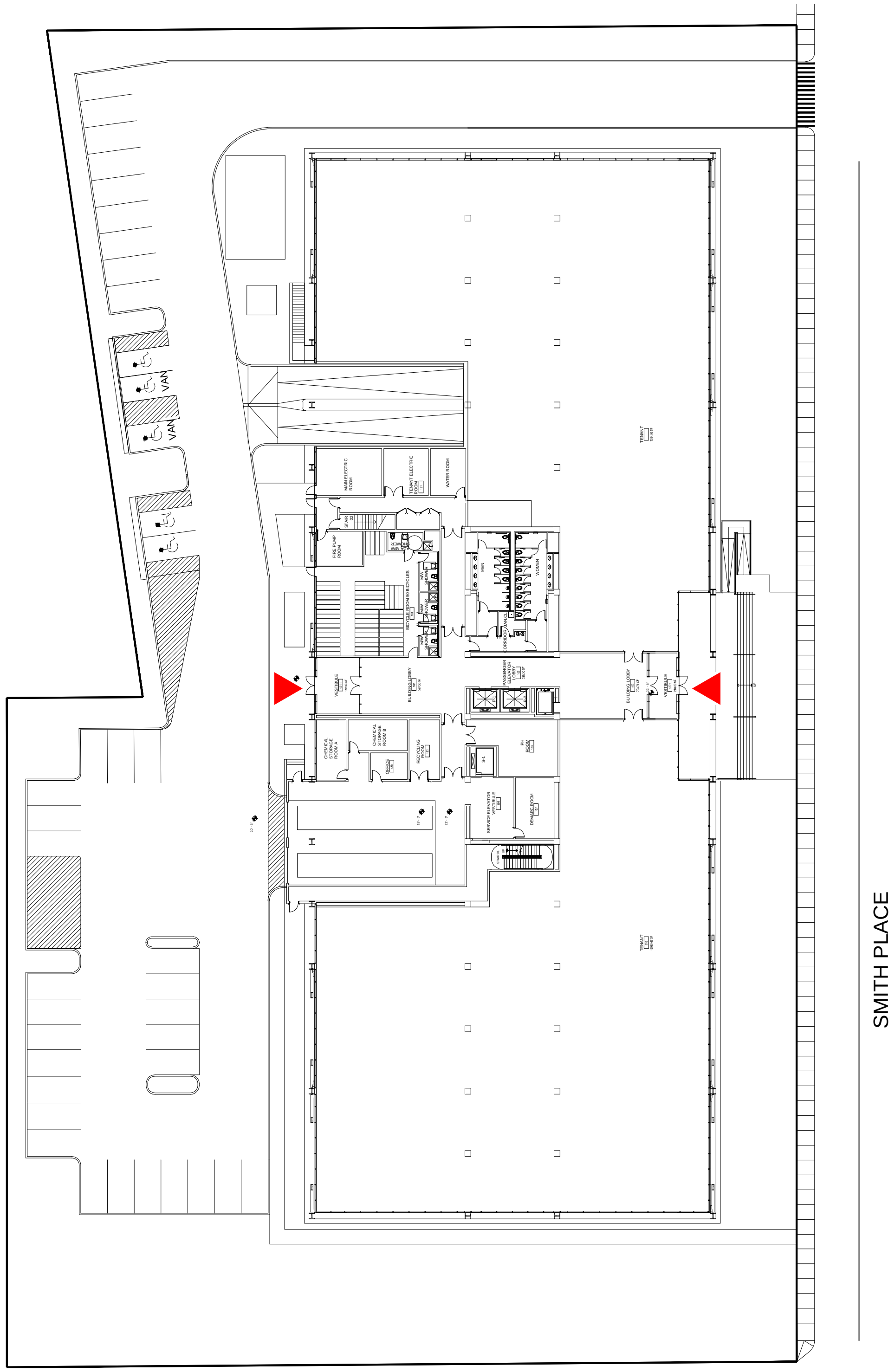


Note: No trees are present on site

Figure C

Existing Conditions

75/109 Smith Place Project
Cambridge, Massachusetts



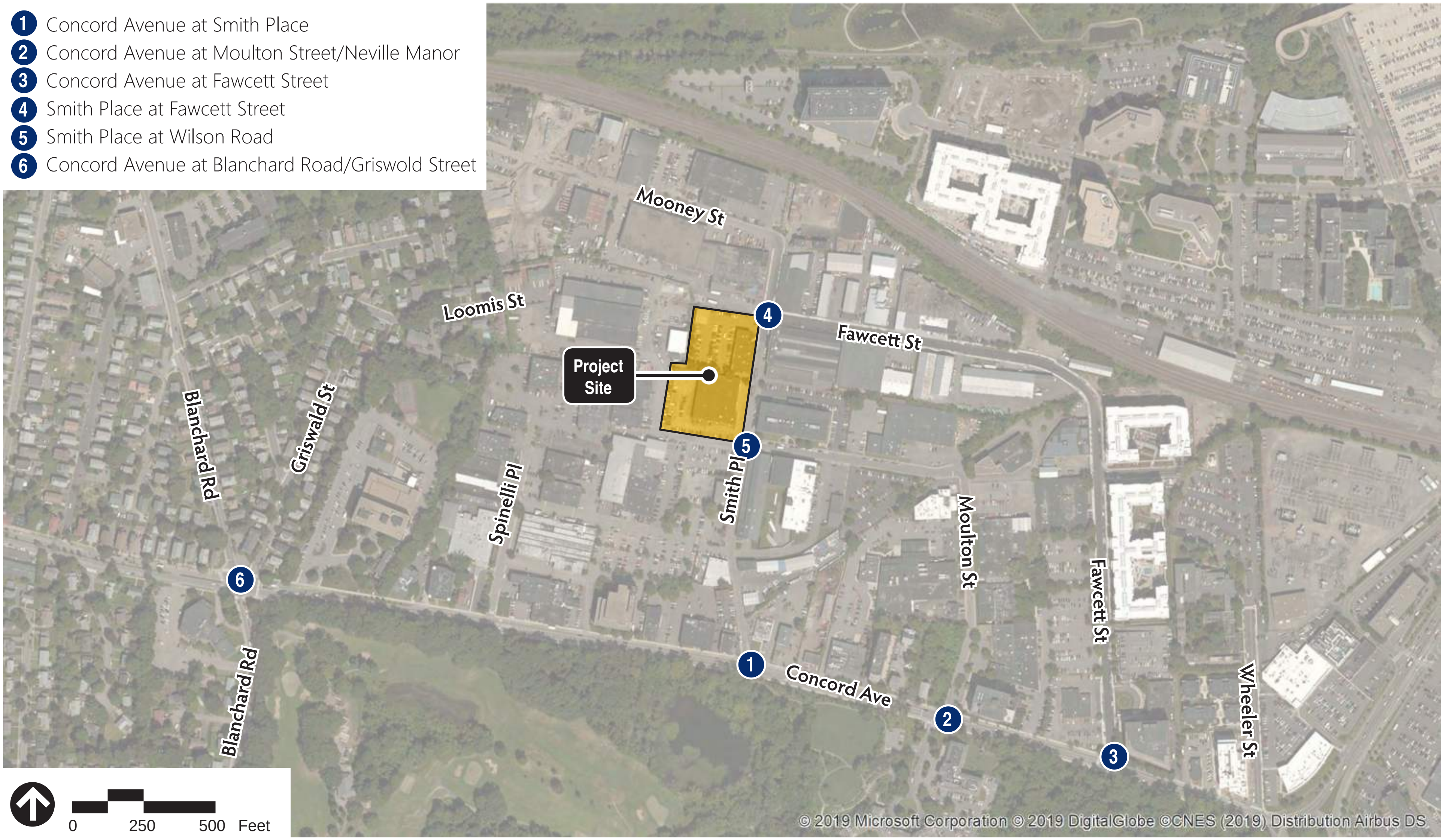
Source: Jacobs Consultants, Inc.

▶ Building Access

Figure D

Site Plan

75/109 Smith Place Project
Cambridge, Massachusetts

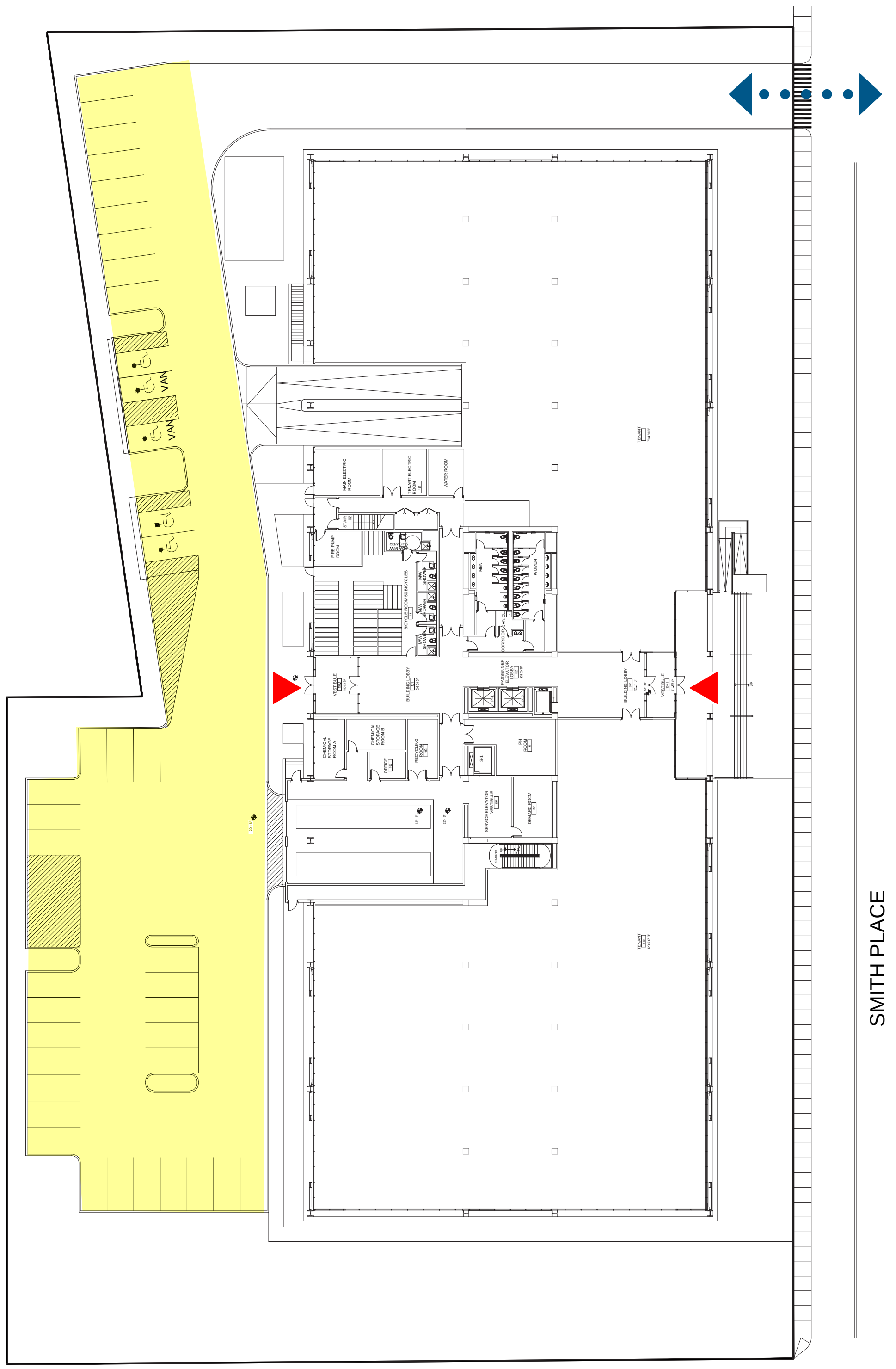


Source: Bing Aerial

Figure E

TIS Study Area Intersections

75/109 Smith Place Project
Cambridge, Massachusetts



Source: Jacobs Consultants, Inc.

Building Access

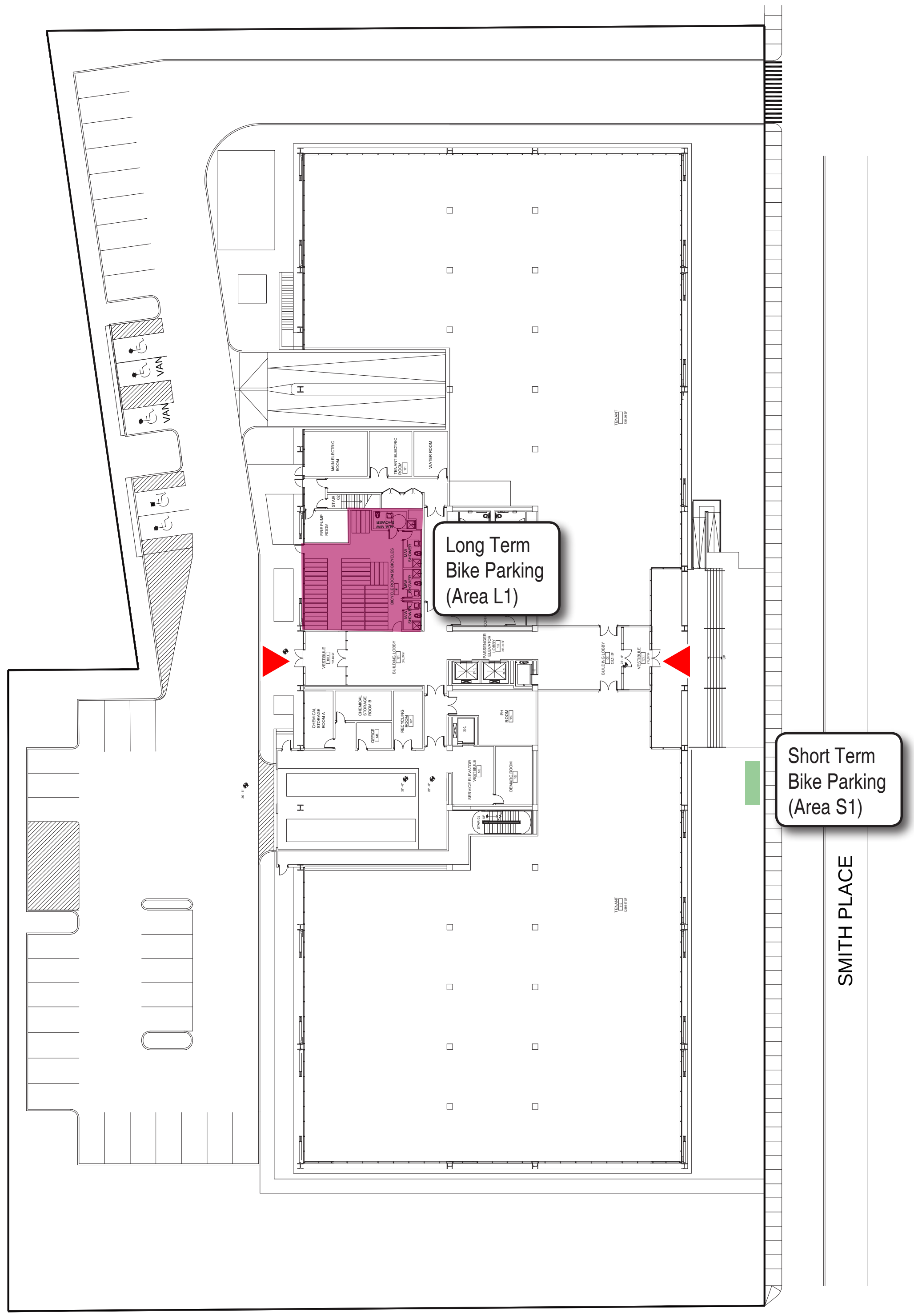
Vehicle Access

Vehicle Parking (155 Spaces)
115 Spaces in Garage & 40 Surface Spaces

Figure F

Proposed Vehicle Parking

75/109 Smith Place Project
Cambridge, Massachusetts



Source: Jacobs Consultants, Inc.

Building Access

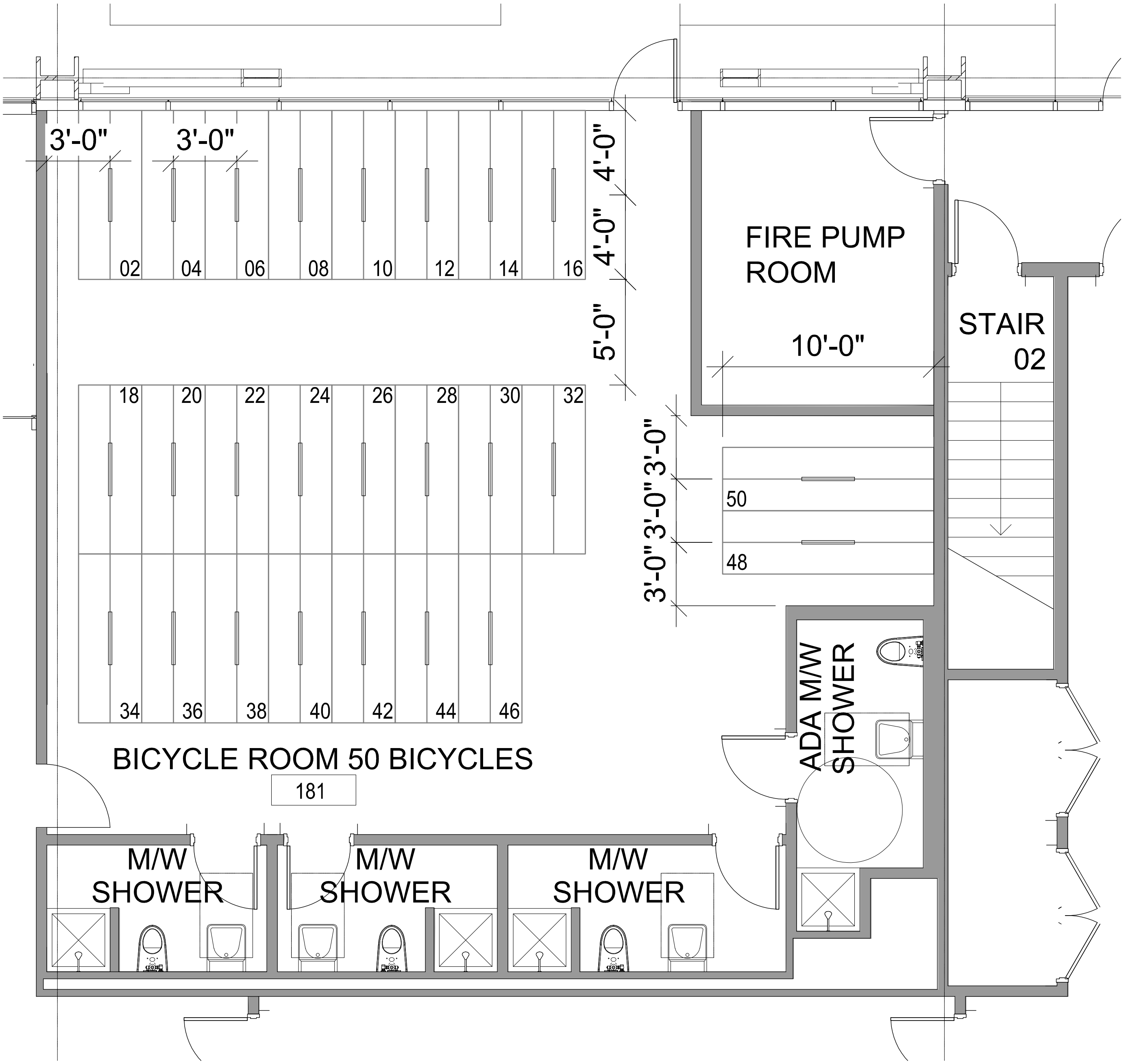
Short Term Bike Parking (10 Spaces)

Long Term Bike Parking (50 Spaces)

Figure G.1

Proposed Bike Parking Key Plan

75/109 Smith Place Project
Cambridge, Massachusetts

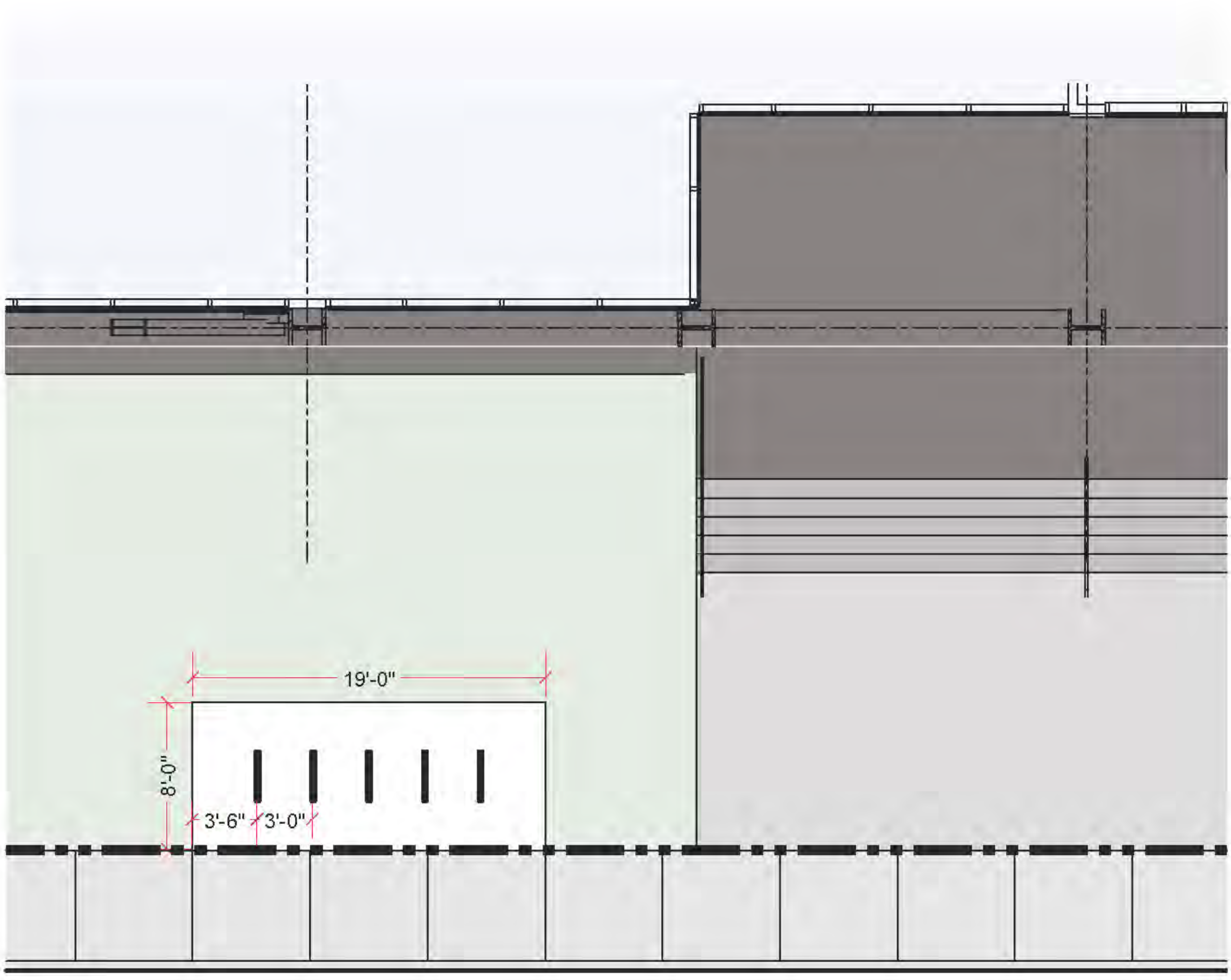


Source: Jacobs Consultants, Inc.

Figure G.2

Proposed Long Term Bicycle Parking

75/109 Smith Place Project
Cambridge, Massachusetts

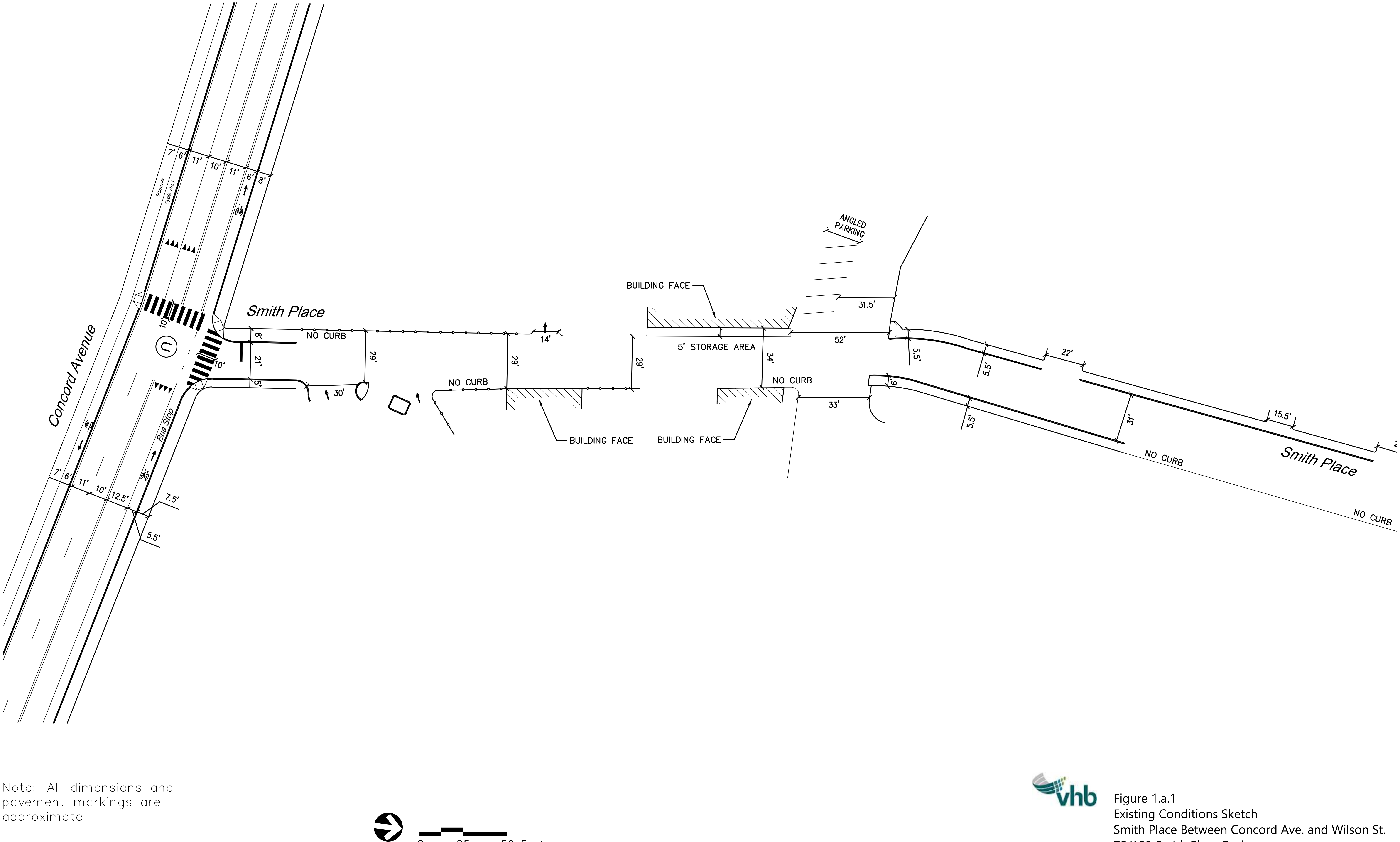


Source: Jacobs Consultants, Inc.

Figure G.3

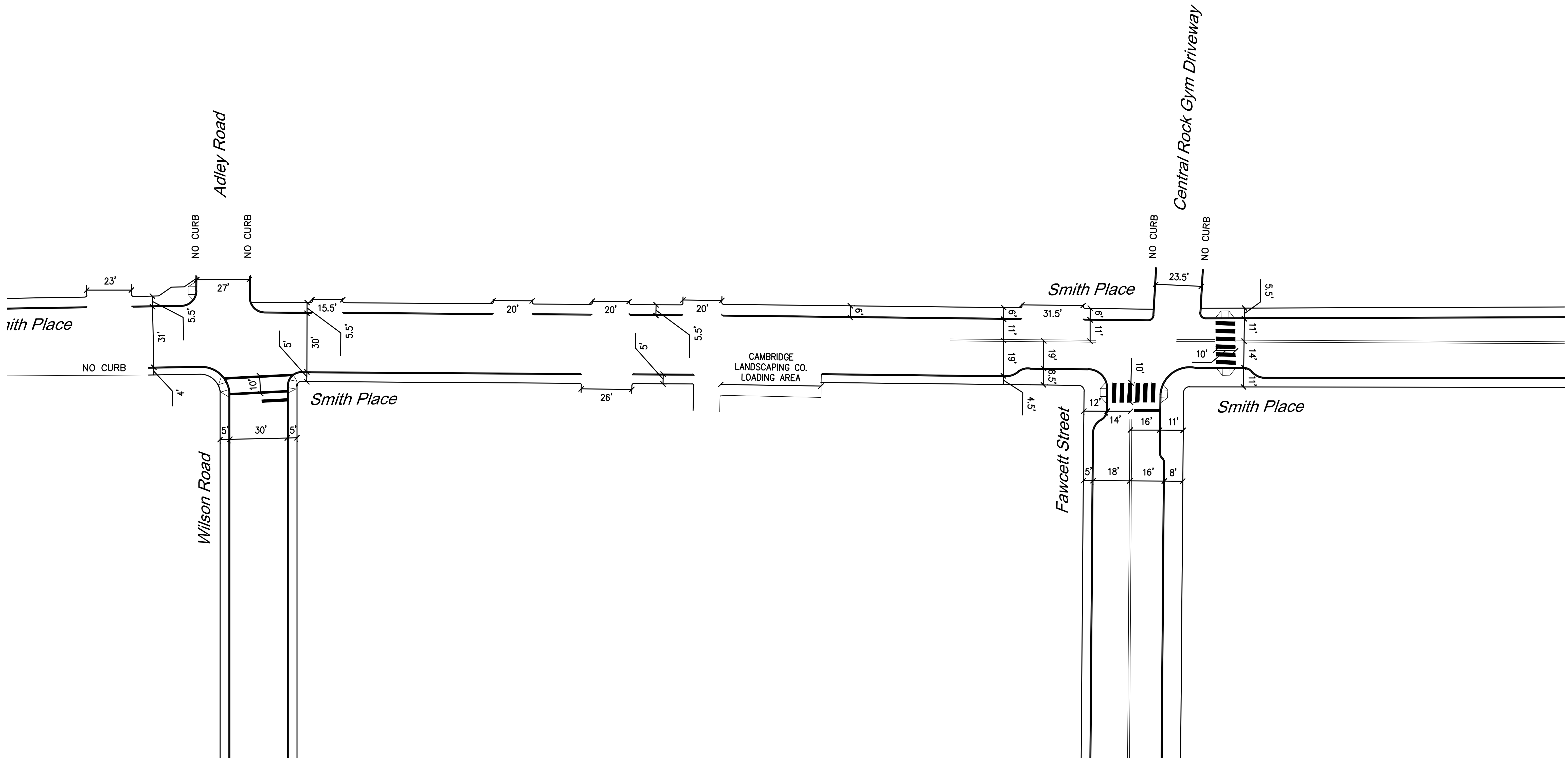
Proposed Short Term Bicycle Parking

75/109 Smith Place Project
Cambridge, Massachusetts



Note: All dimensions and pavement markings are approximate

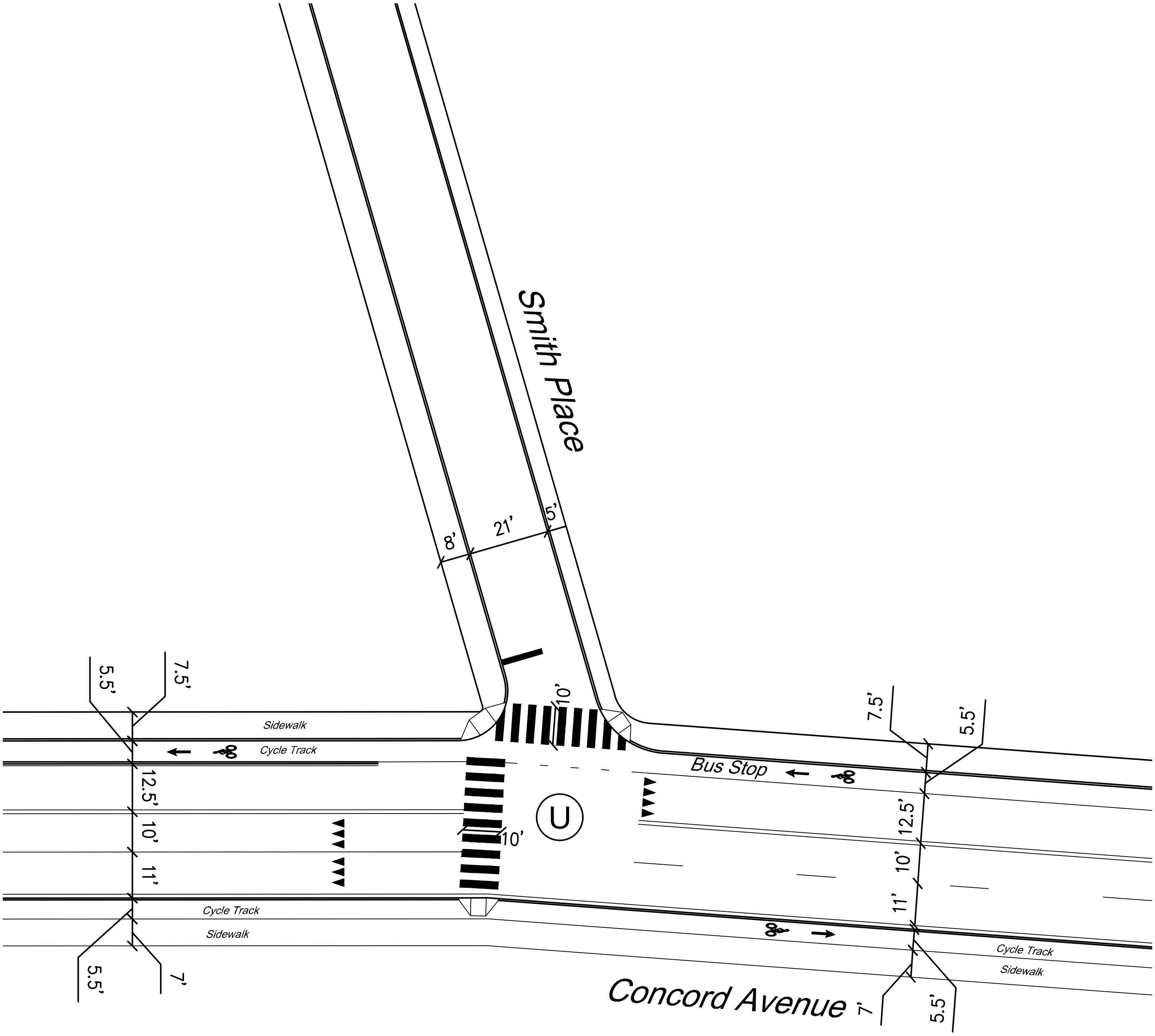
Figure 1.a.1
Existing Conditions Sketch
Smith Place Between Concord Ave. and Wilson St.
75/109 Smith Place Project



Note: All dimensions and pavement markings are approximate

0 25 50 Feet

Figure 1.a.2
Existing Conditions Sketch
Smith Place Between Wilson St. and Fawcett St.
75/109 Smith Place Project



Note: All dimensions and pavement markings are approximate

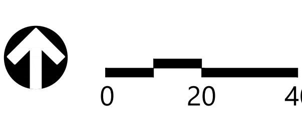
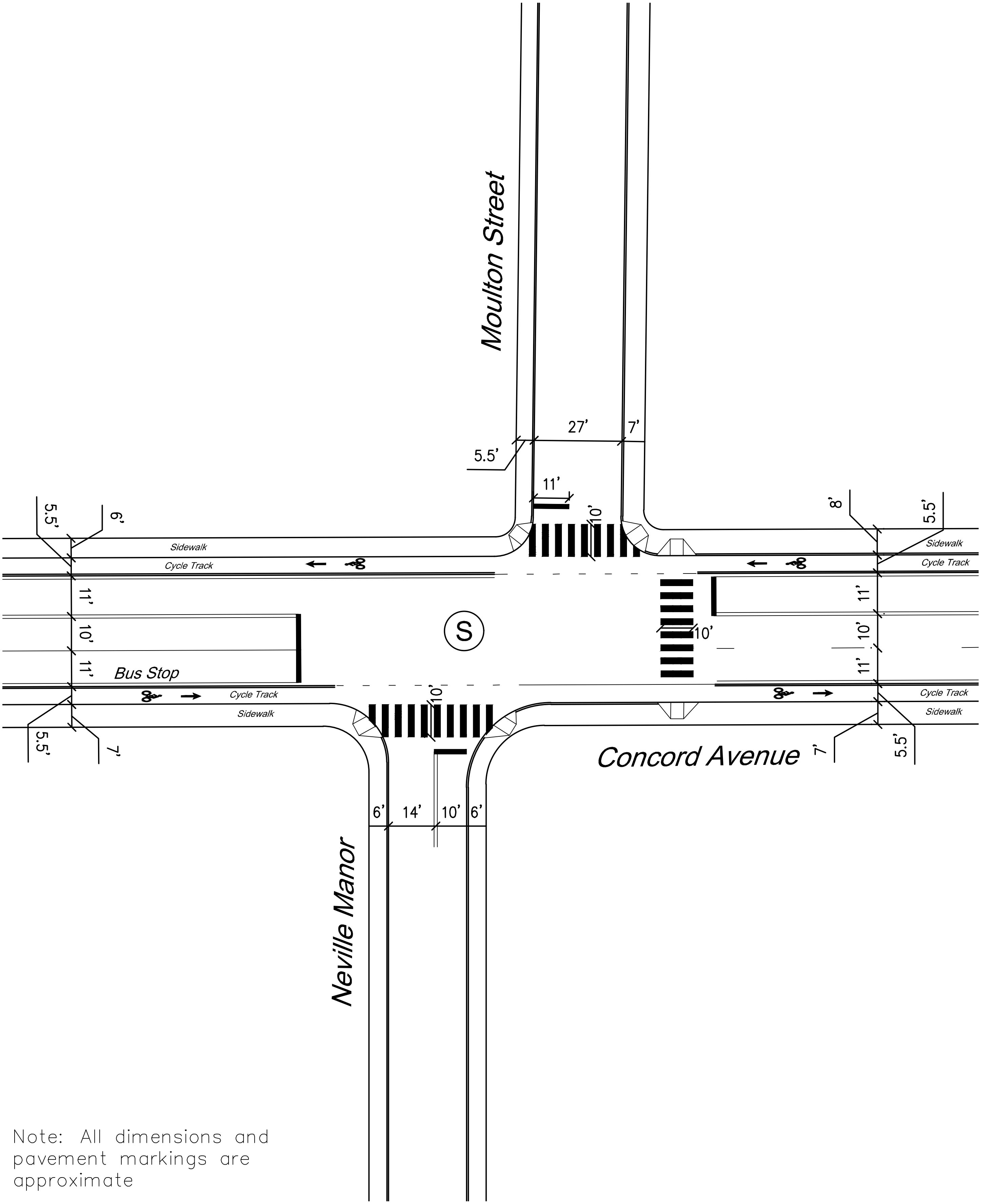
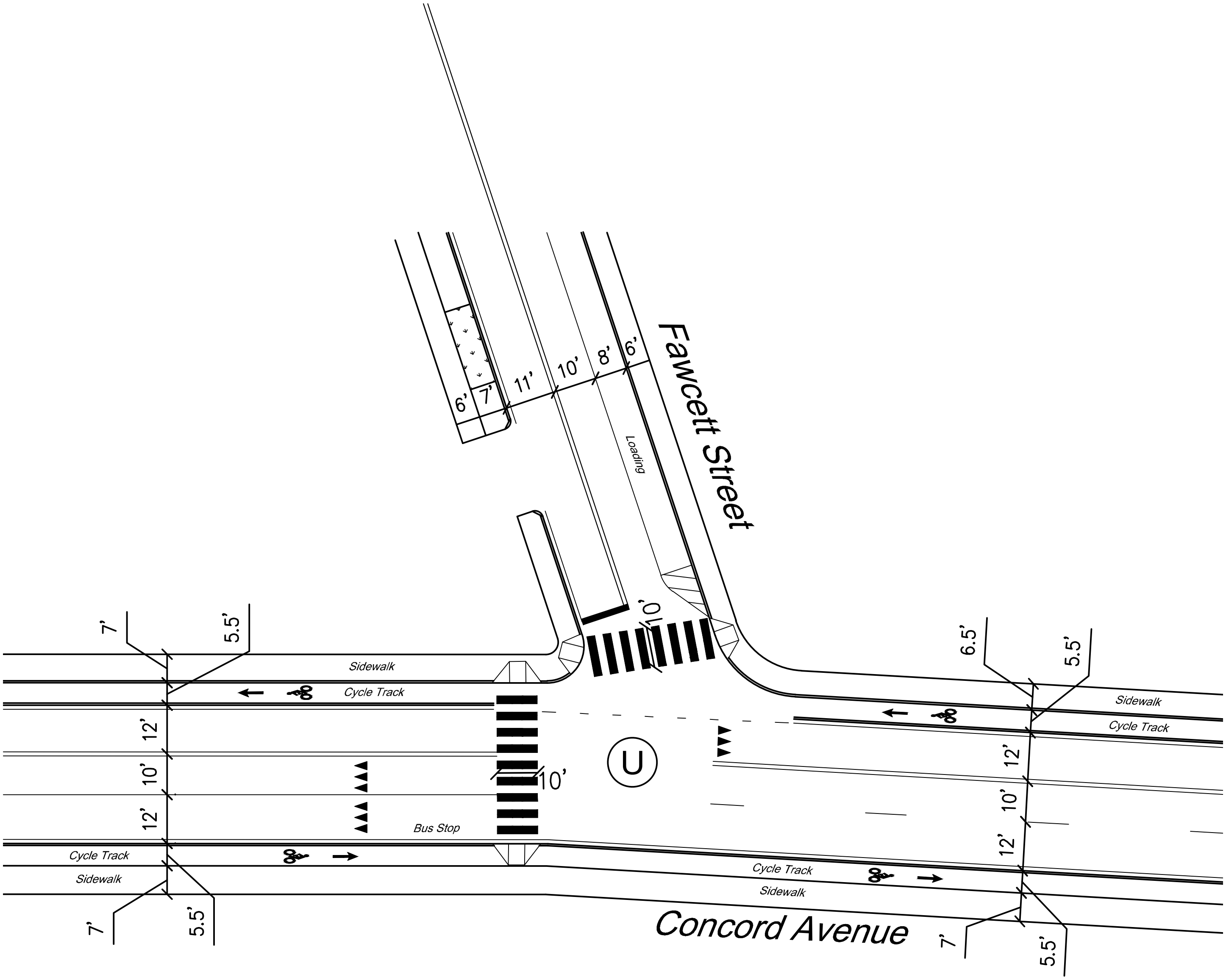


Figure 1.b.1
Existing Condition Intersection Sketch
Concord Avenue at Smith Place
75/109 Smith Place Project



Note: All dimensions and pavement markings are approximate

Figure 1.b.2
Existing Condition Intersection Sketch
Concord Avenue at Neville Manor/Moulton Street
75/109 Smith Place Project



Note: All dimensions and pavement markings are approximate

Figure 1.b.3
Existing Condition Intersection Sketch
Concord Avenue at Fawcett Street
75/109 Smith Place Project

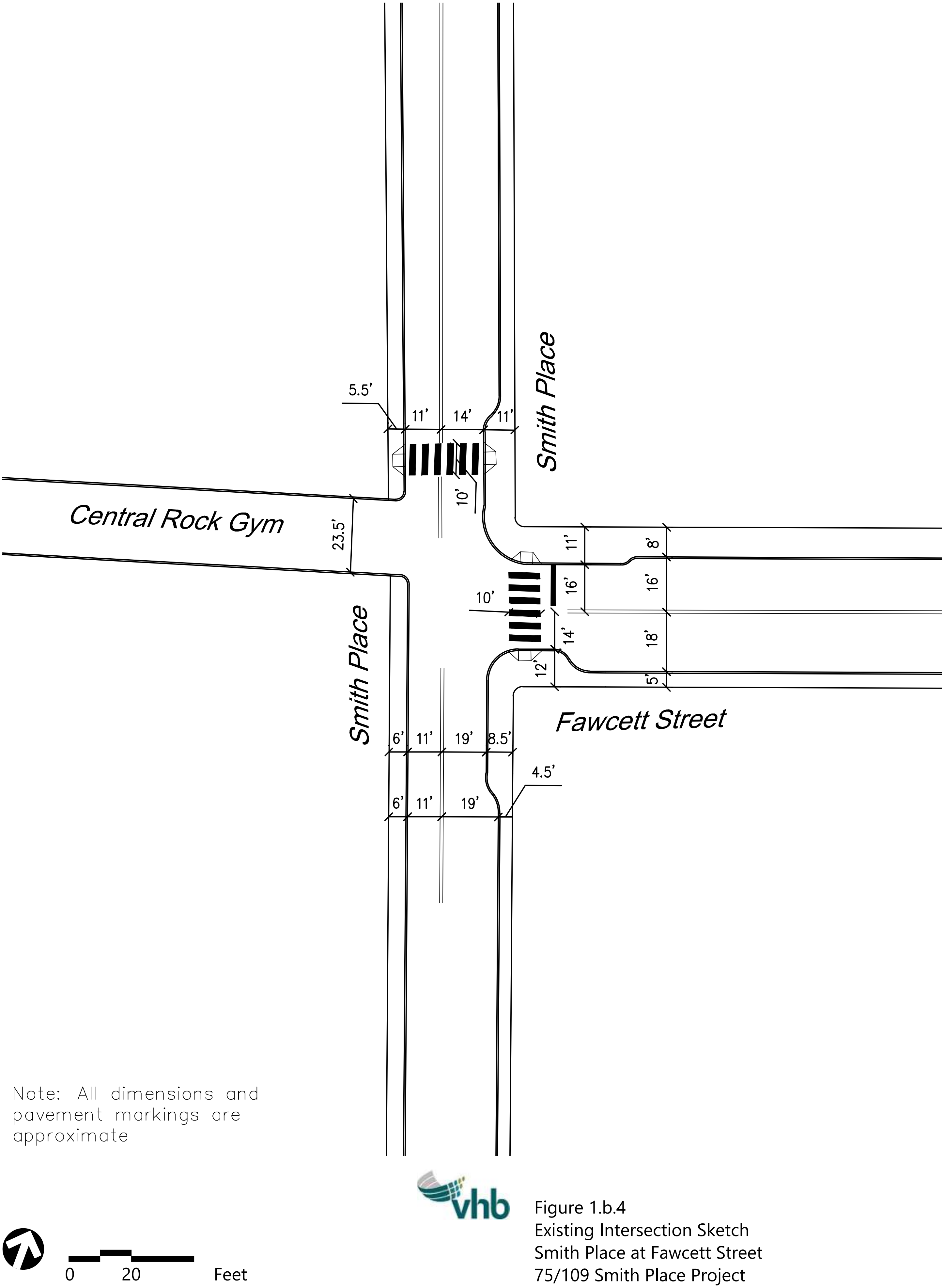
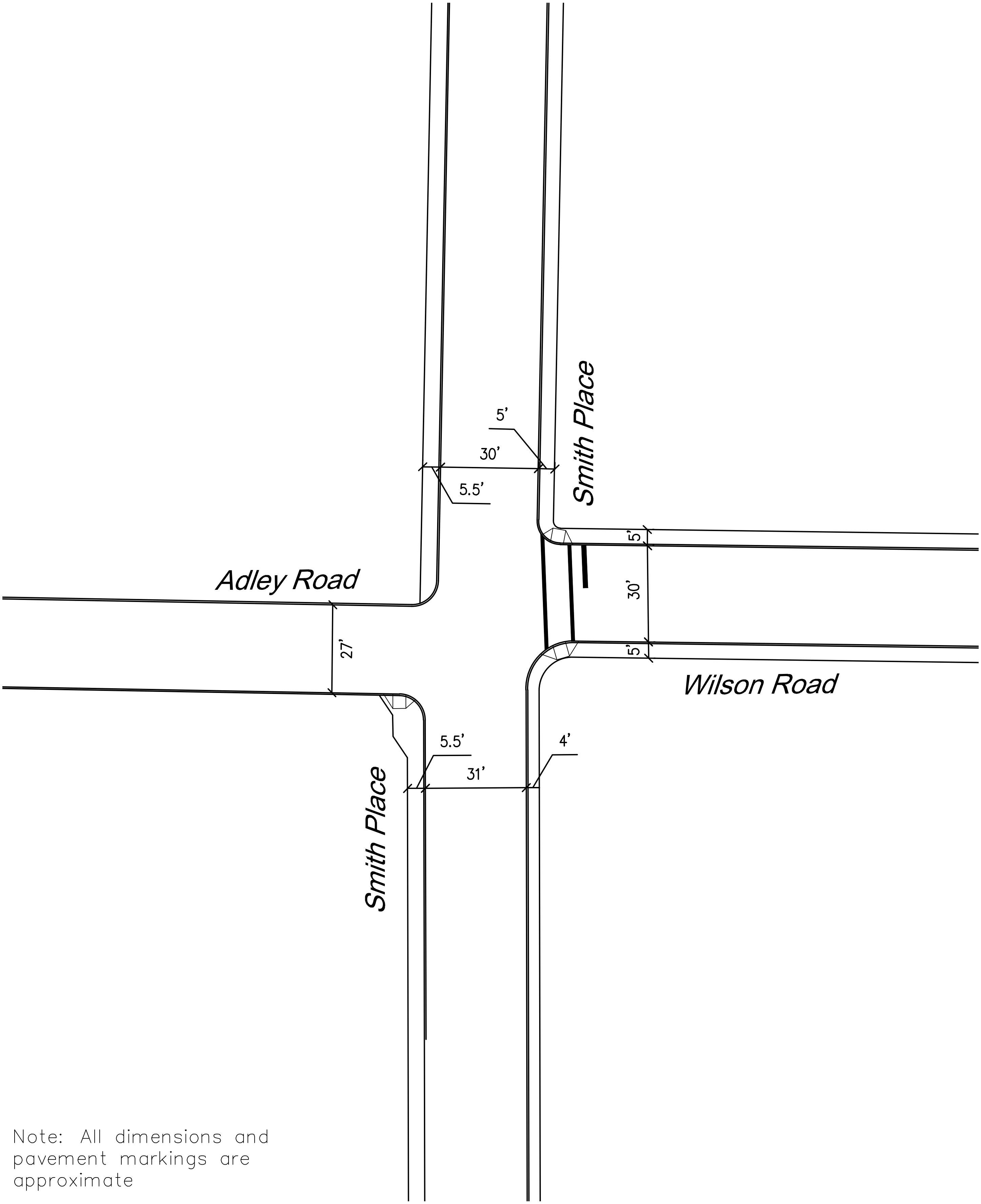


Figure 1.b.4
Existing Intersection Sketch
Smith Place at Fawcett Street
75/109 Smith Place Project



Note: All dimensions and pavement markings are approximate

Figure 1.b.5
Existing Intersection Sketch
Smith Place at Wilson Road/Adley Road
75/109 Smith Place Project

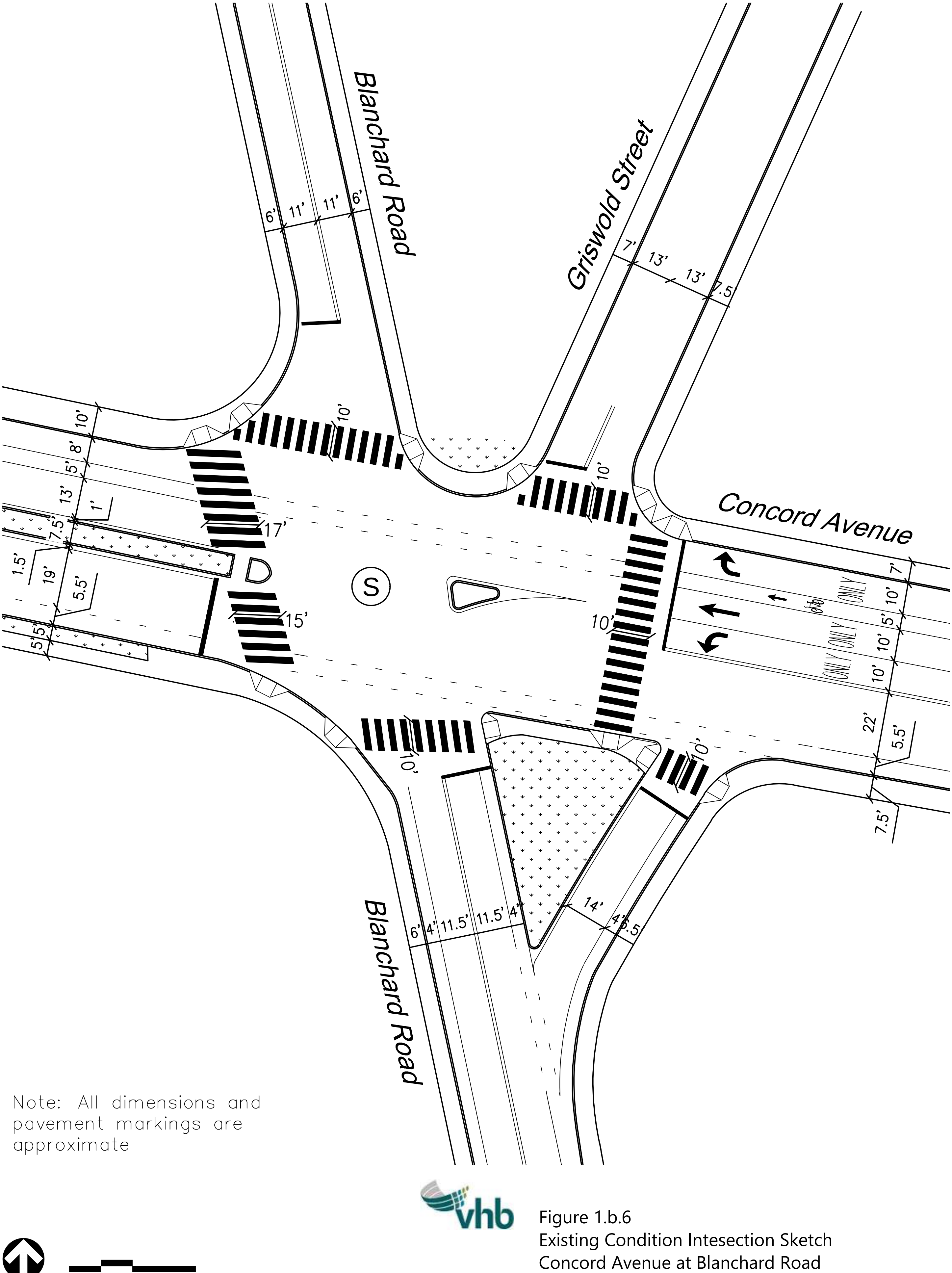
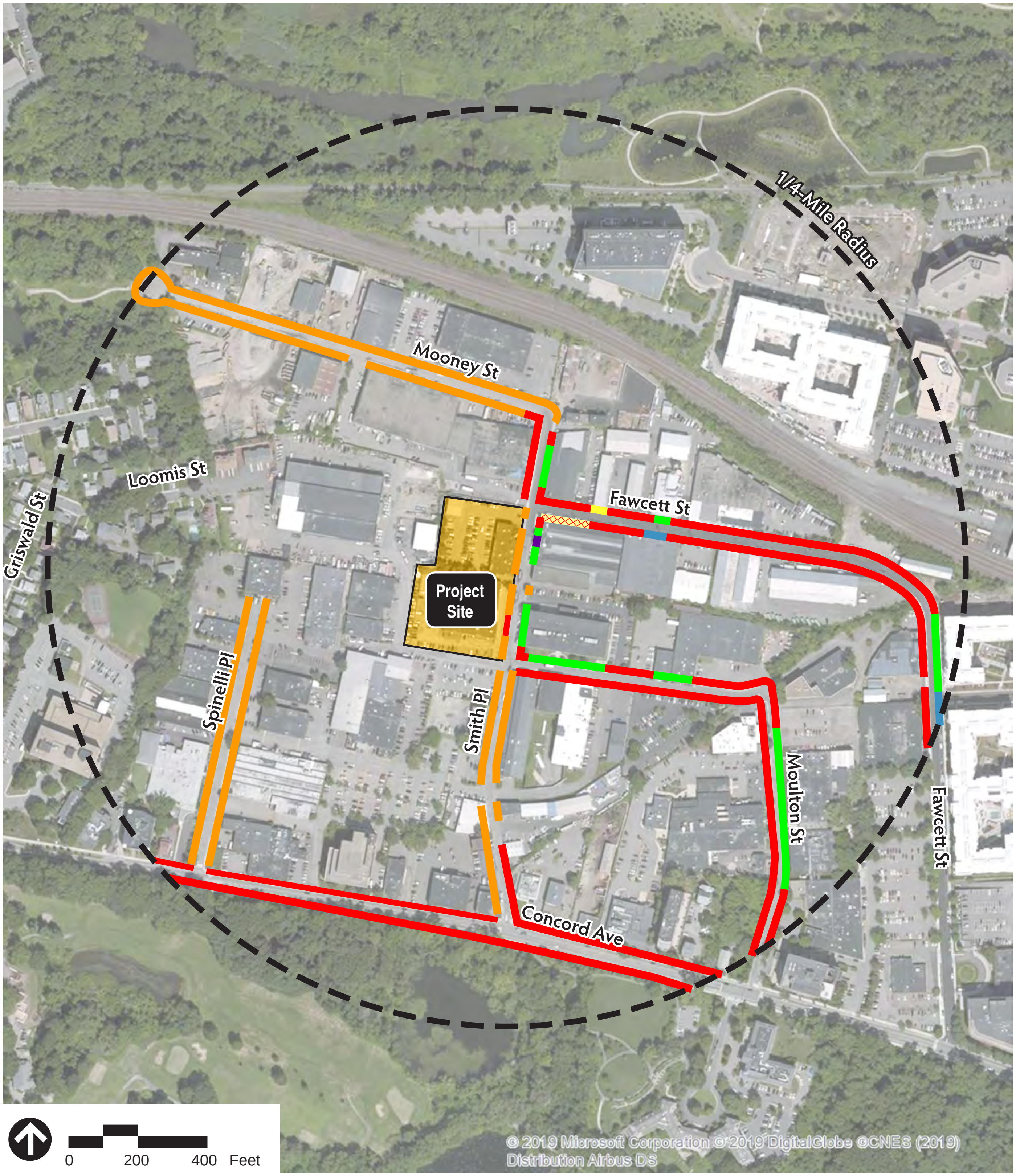


Figure 1.b.6
Existing Condition Intesection Sketch
Concord Avenue at Blanchard Road
75/109 Smith Place Project



Source: Bing Aerial

- 2-Hour Parking
- Cambridge Resident Permit Parking
- No Parking
- Handicapped Parking Space
- Unregulated Parking
- Fire Department Parking
- No Stopping

Figure 1.c.1

Summary of On-Street Parking Regulations

75/109 Smith Place Project
Cambridge, Massachusetts

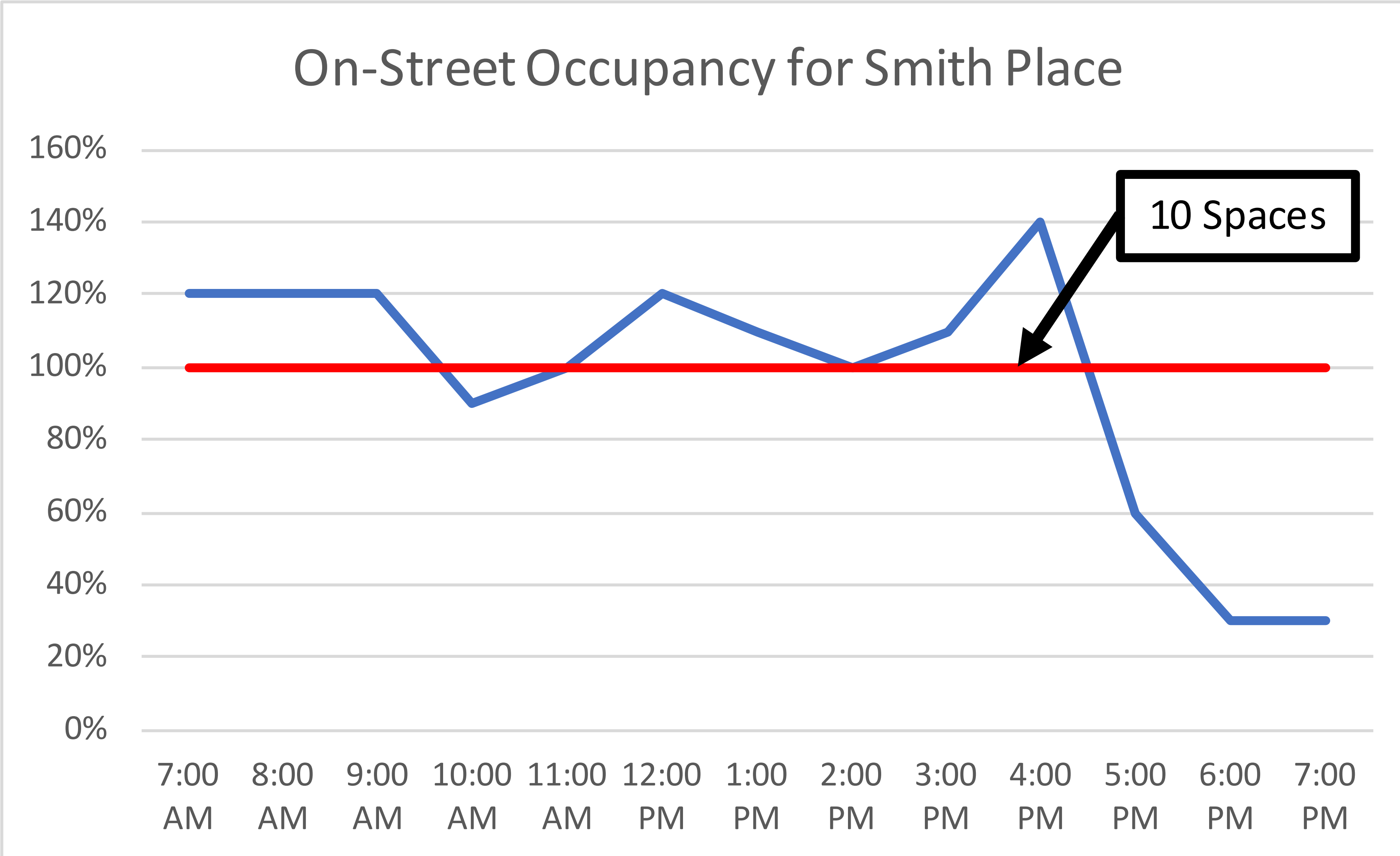
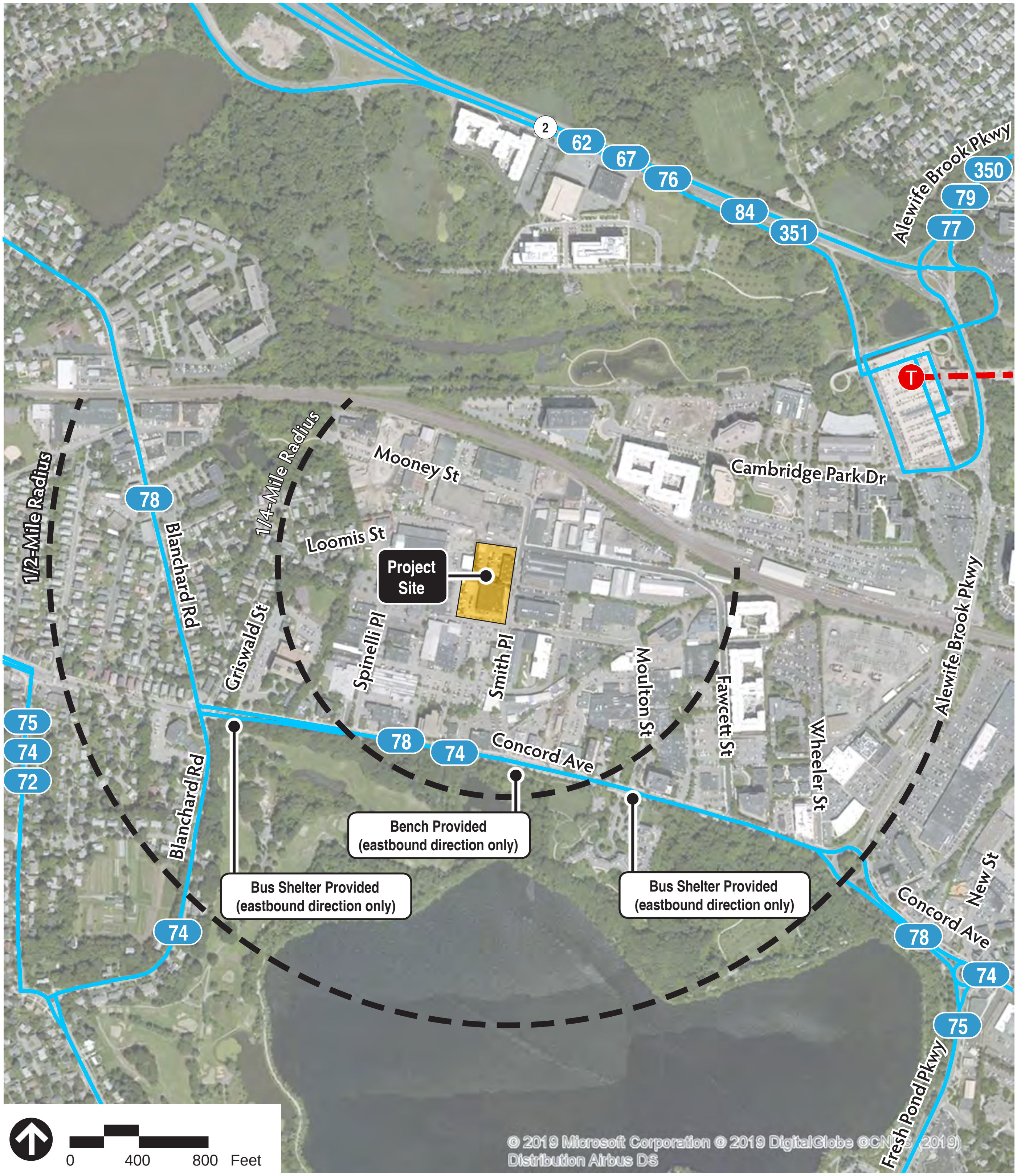


Figure 1.c.2

On Street Parking Summary

75/109 Smith Place Project
Cambridge, Massachusetts

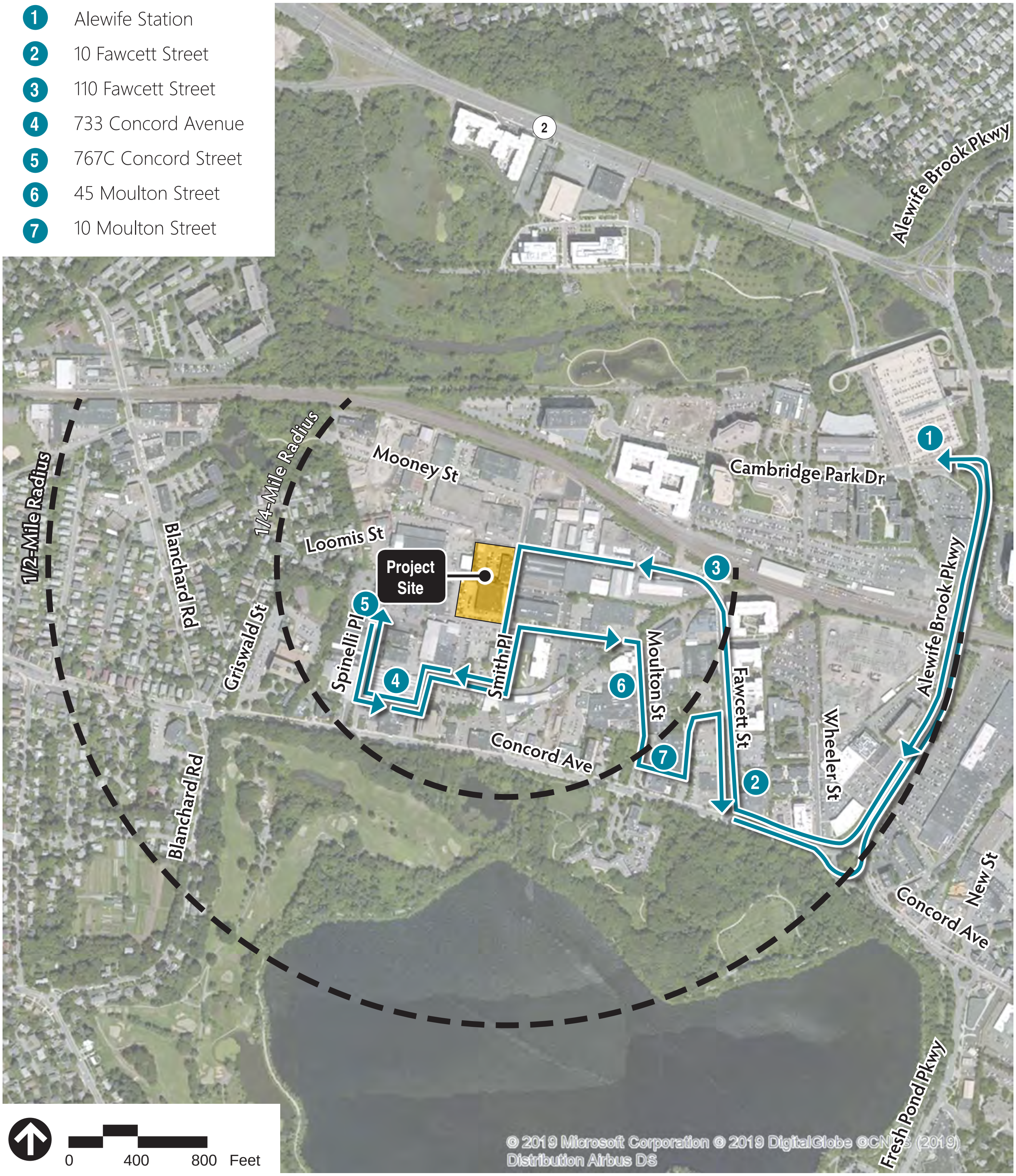


Source: Bing Aerial, MBTA

Figure 1.d.1

Public Transit

75/109 Smith Place Project
Cambridge, Massachusetts

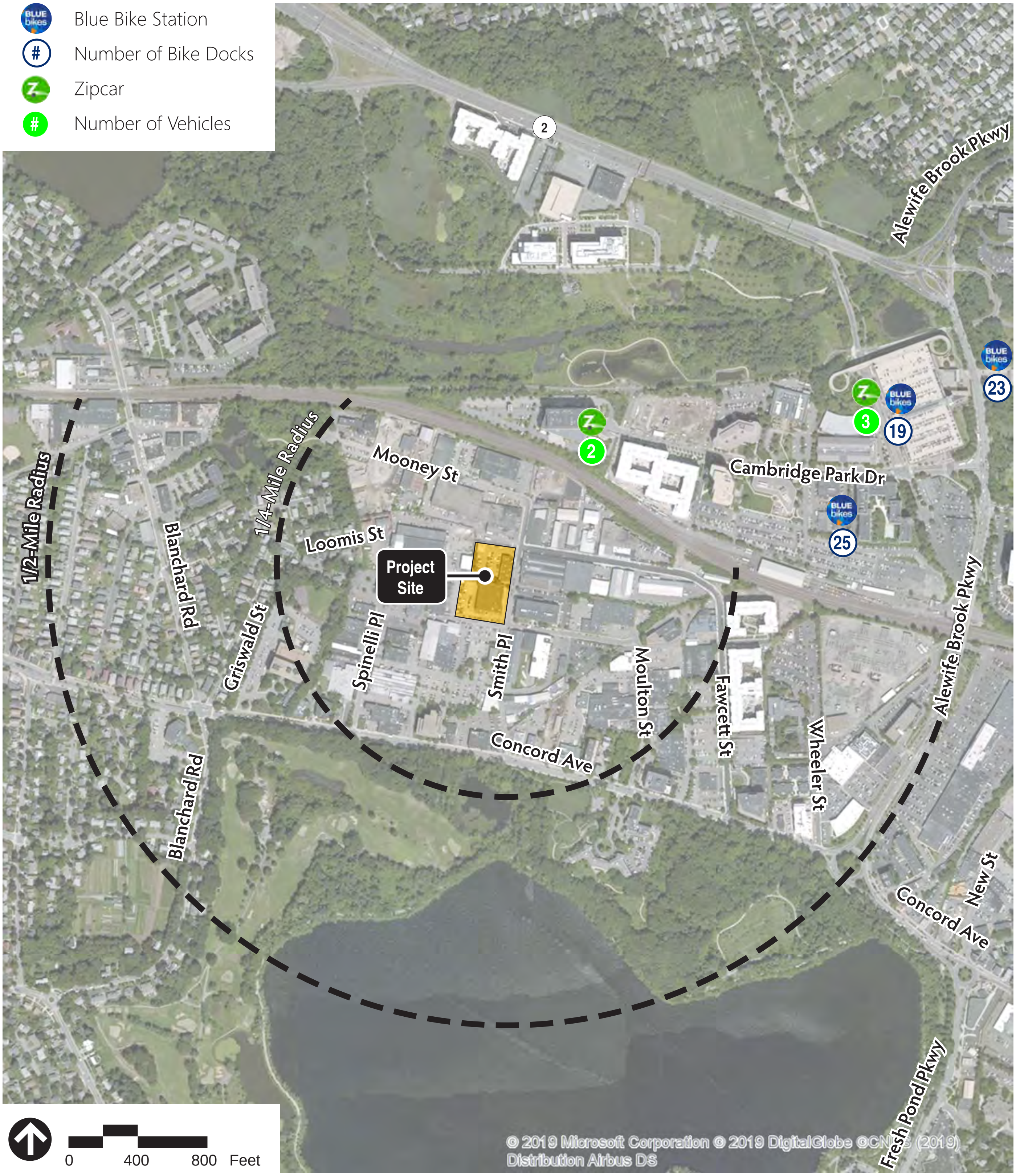


Source: Bing Aerial, Alewifetma.org

Figure 1.d.2

Private Transit Services (Alewife TMA)

75/109 Smith Place Project
Cambridge, Massachusetts

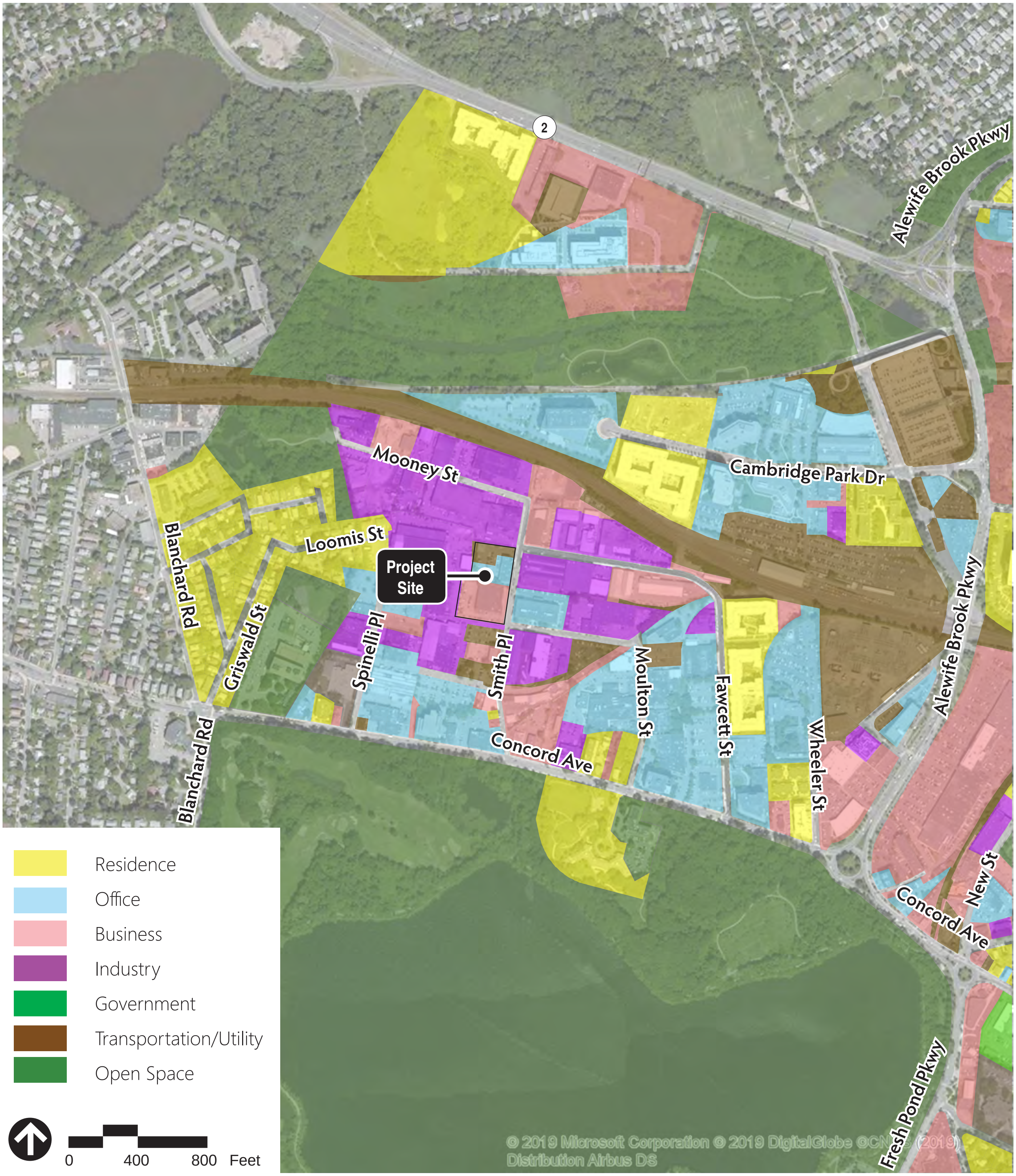


Source: Bing Aerial, Alewifetma.org

Figure 1.d.3

Bike and Car Sharing Services

75/109 Smith Place Project
Cambridge, Massachusetts

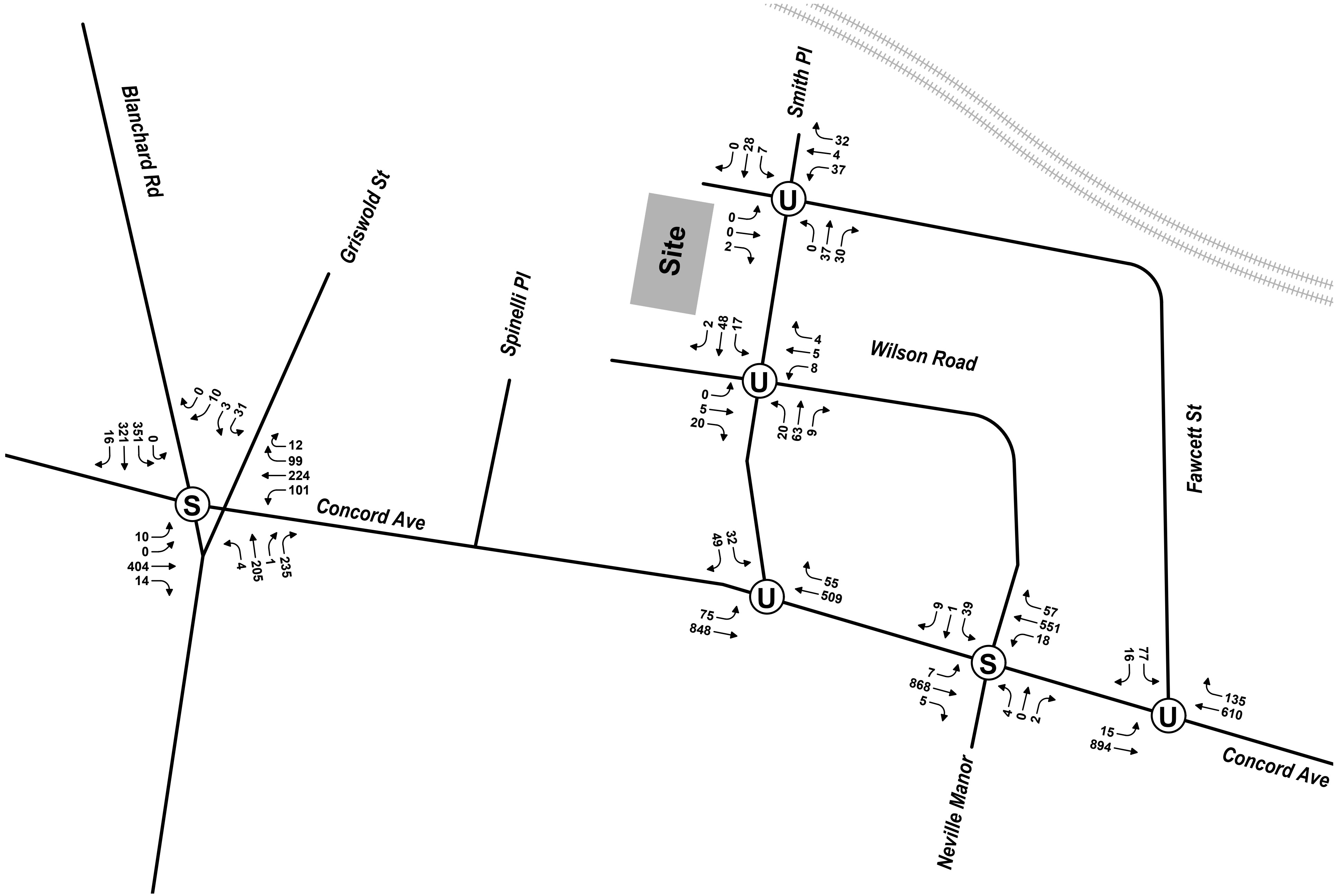


Source: Bing Aerial 2014, City of Cambridge GIS

Figure 1.e.1

Land Use

75/109 Smith Place Project
Cambridge, Massachusetts

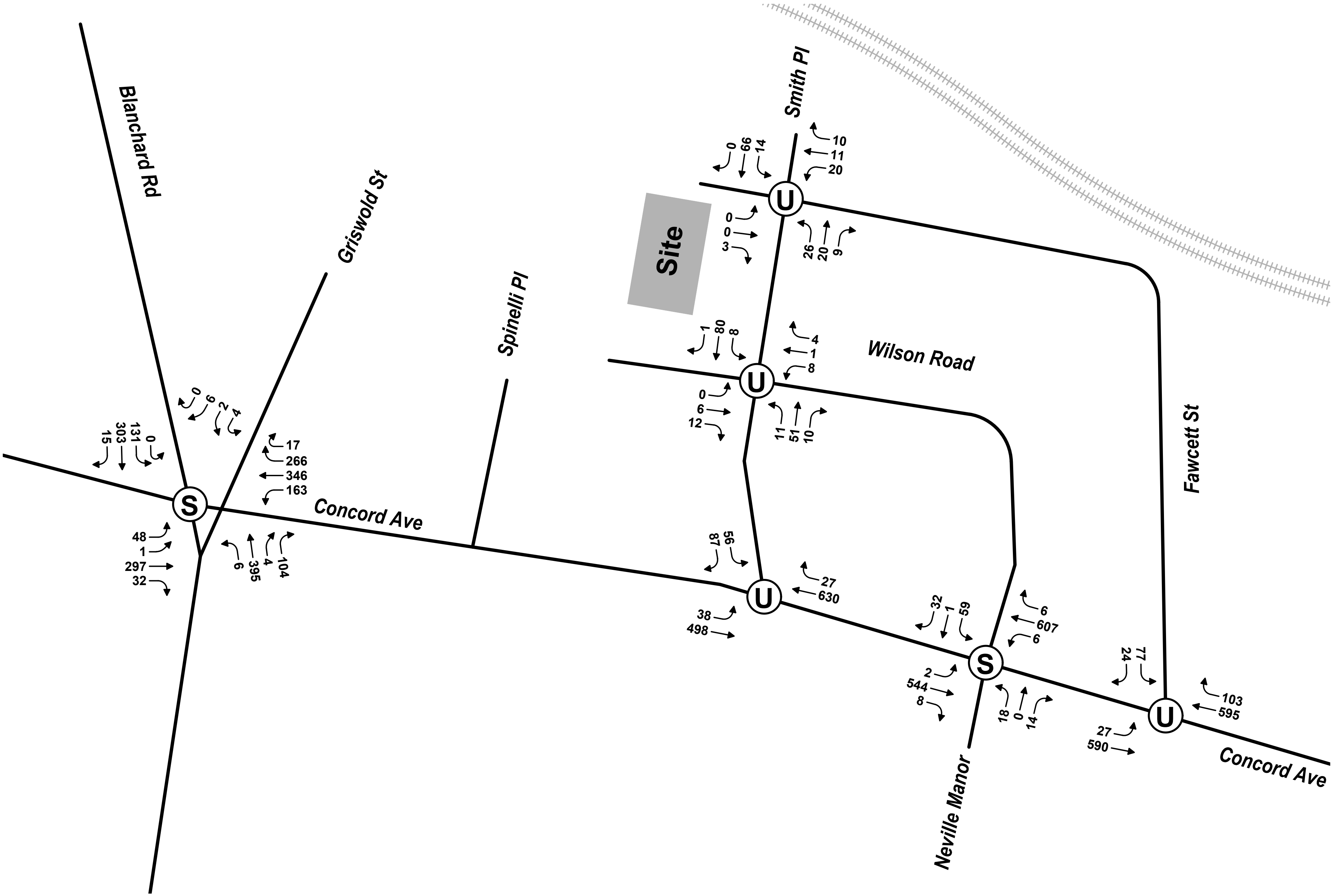


Counts conducted on March 28, 2019

Not to Scale

75/109 Smith Place Project
2019 Existing Conditions
AM Peak Hour (7:30-8:30 AM)
Vehicle Volumes

Figure 2.c.1



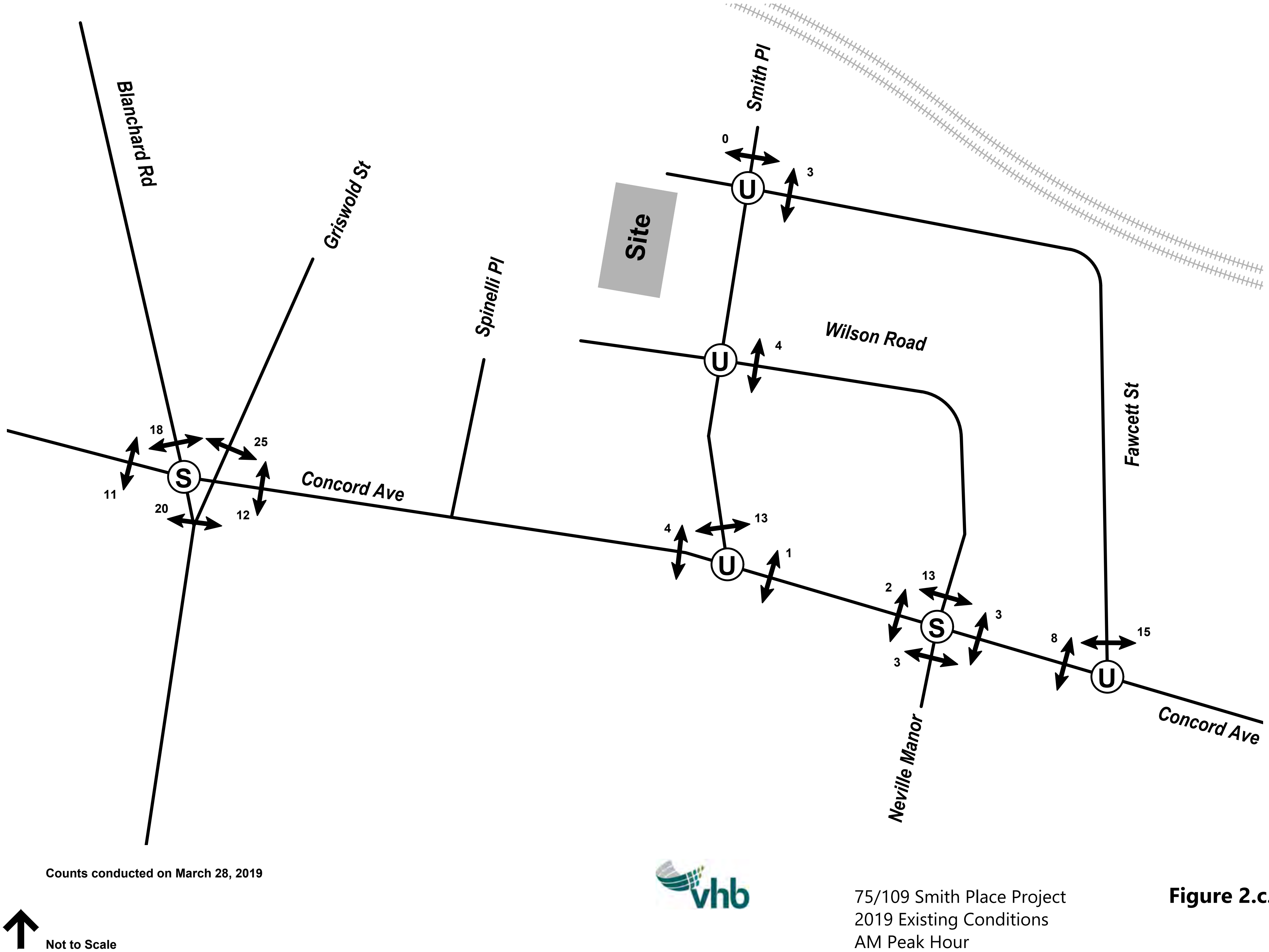
Note: Counts conducted on March 28, 2019

Concord Ave. / Blanchard Street intersection counts conducted on October 5, 2016 for the 55 Wheeler Street Project

Not to Scale

75/109 Smith Place Project
2019 Existing Conditions
PM Peak Hour (5:45-6:45 PM)
Vehicle Volumes

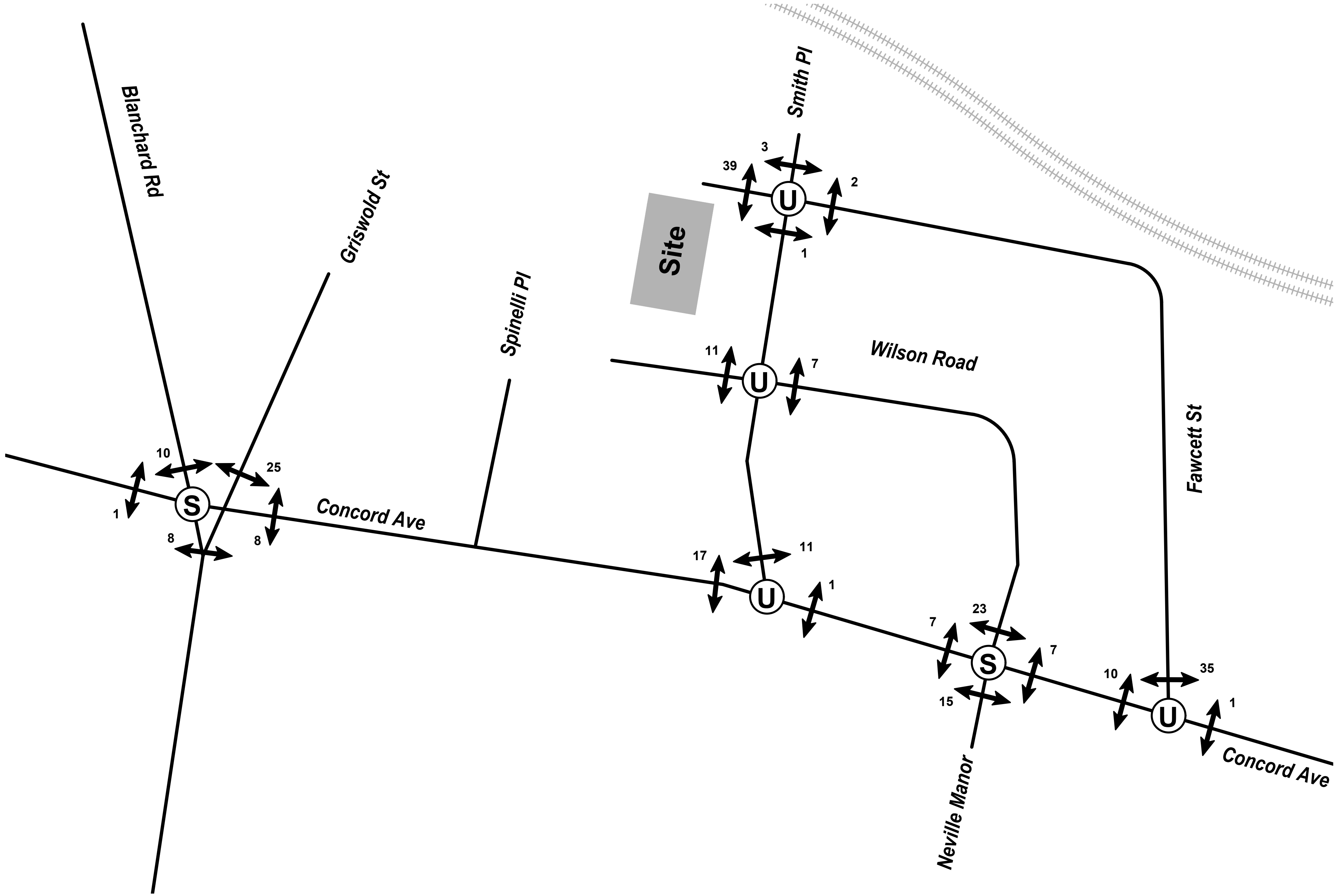
Figure 2.c.2



Counts conducted on March 28, 2019

75/109 Smith Place Project
2019 Existing Conditions
AM Peak Hour
Pedestrian Volumes

Figure 2.c.3

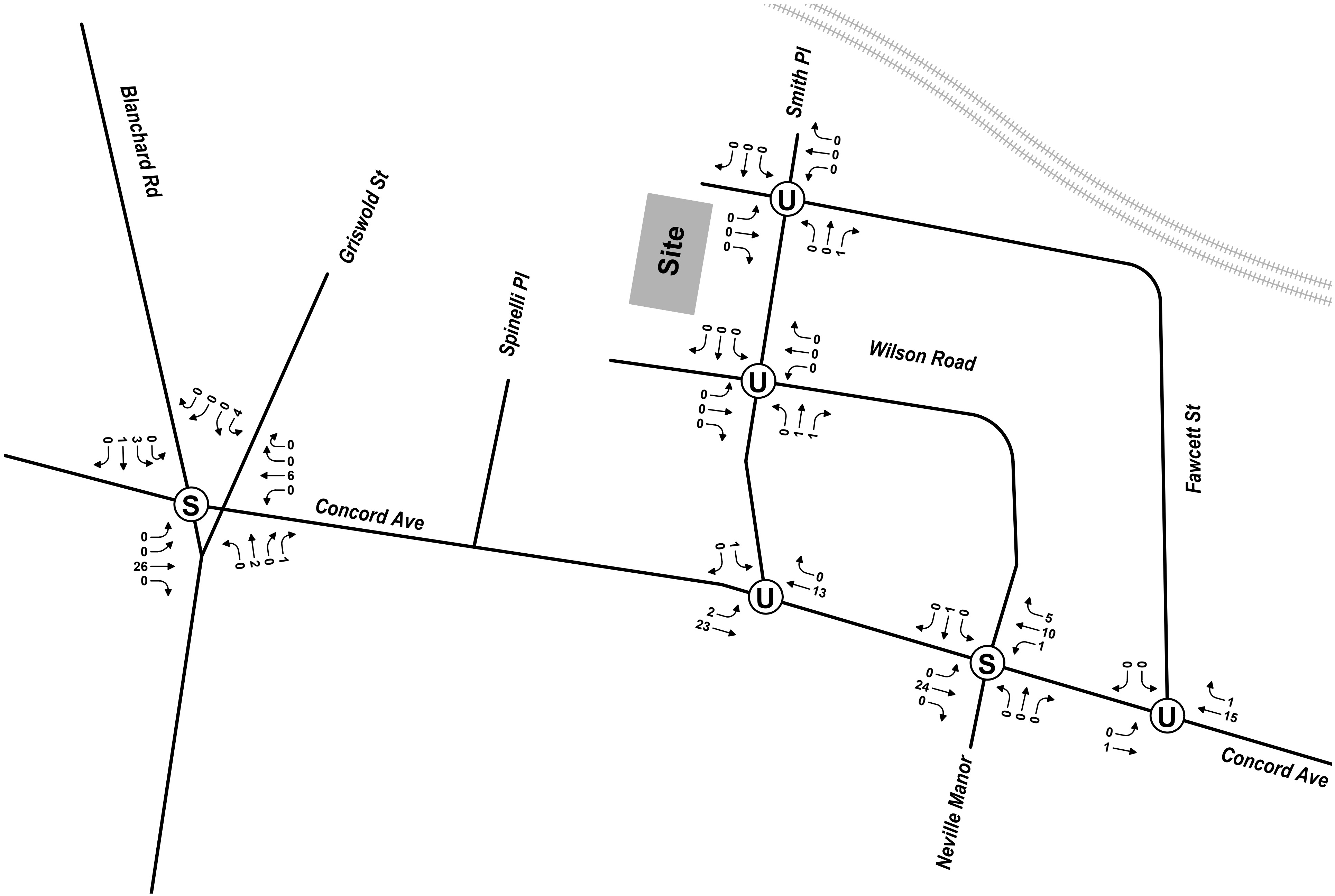


Counts conducted on March 28, 2019

Not to Scale

75/109 Smith Place Project
2019 Existing Conditions
PM Peak Hour
Pedestrian Volumes

Figure 2.c.4

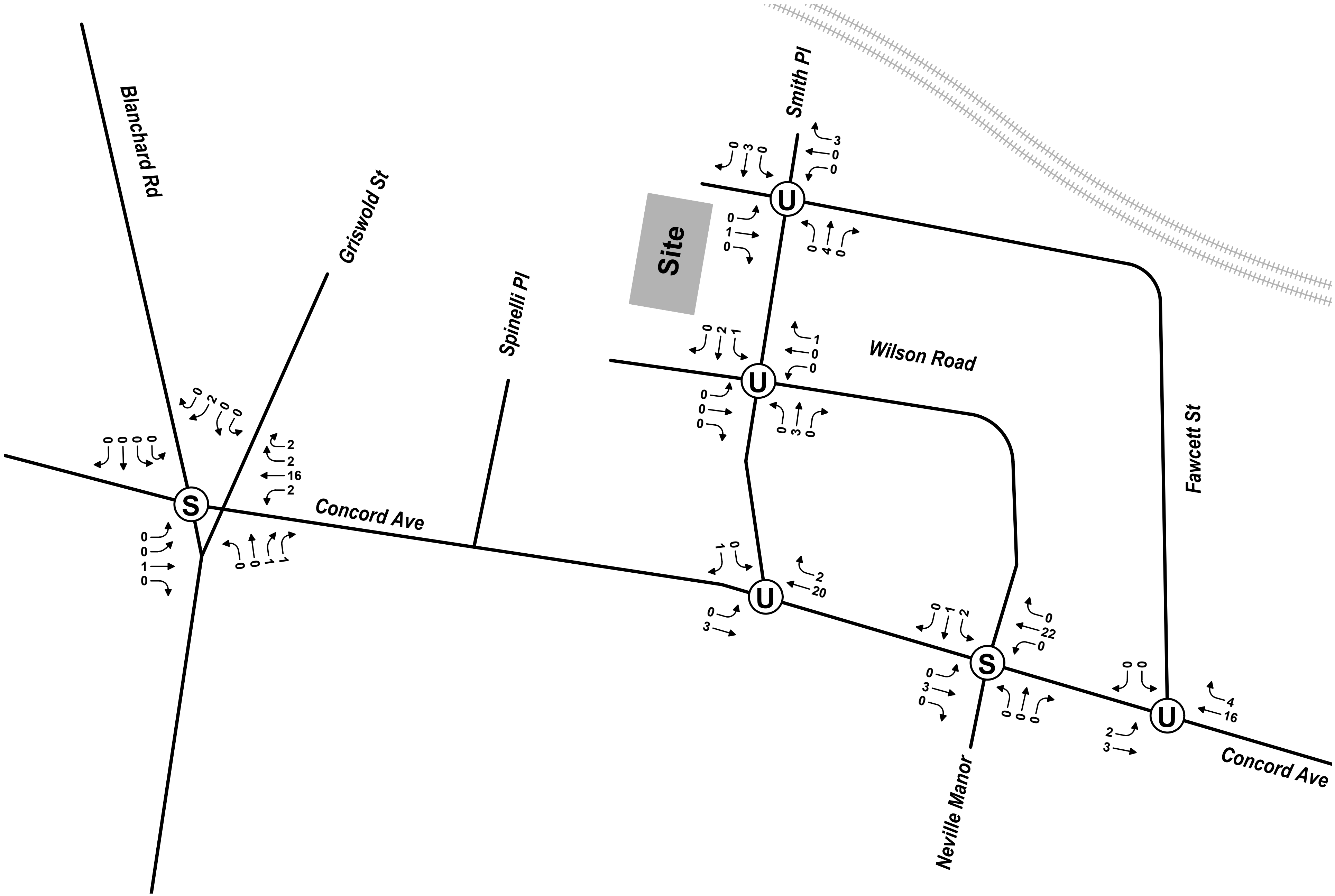


Counts conducted on March 28, 2019

Not to Scale

75/109 Smith Place Project
2019 Existing Conditions
AM Peak Hour
Bicycle Volumes

Figure 2.c.5

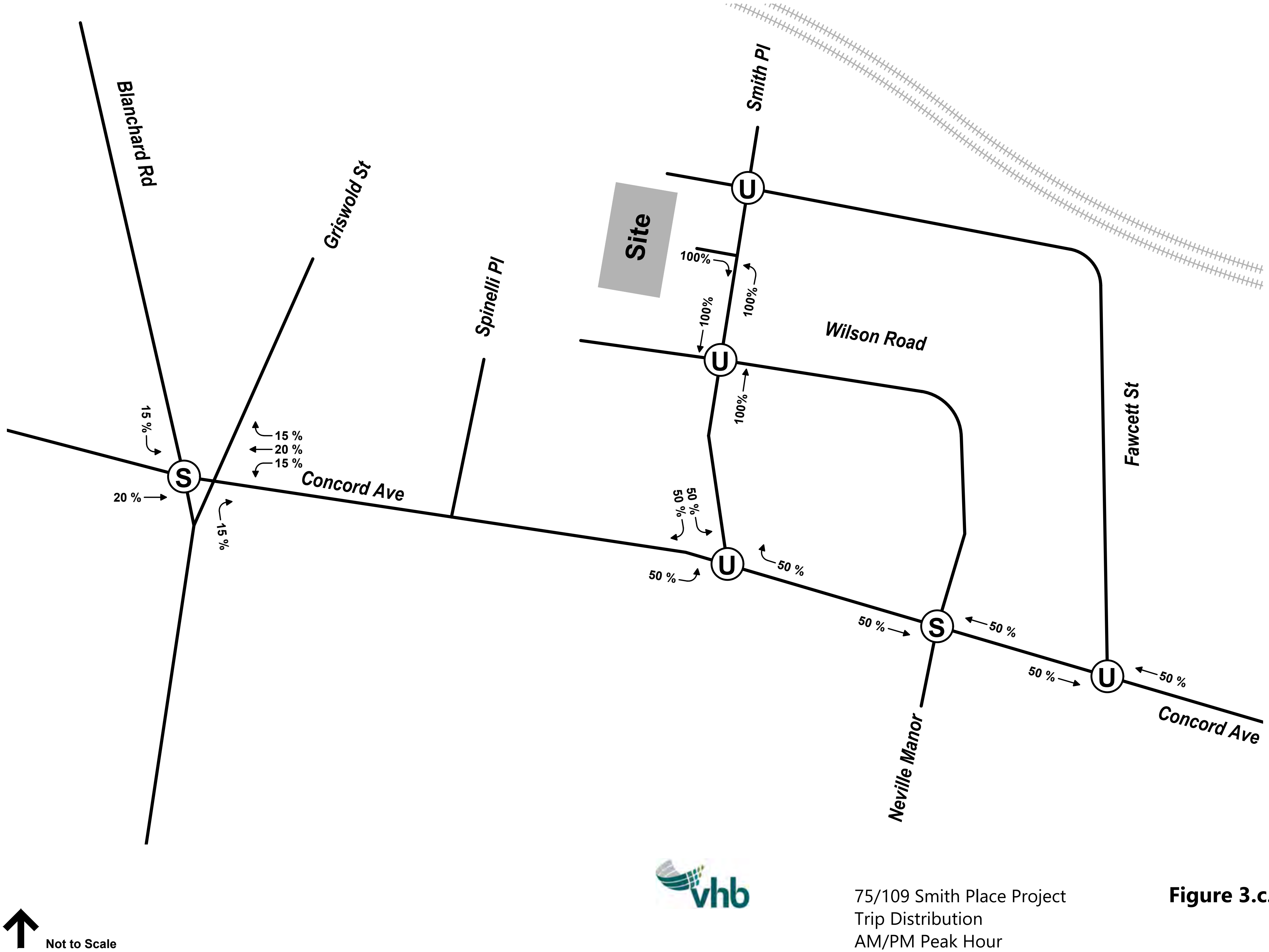


Counts conducted on March 28, 2019

Not to Scale

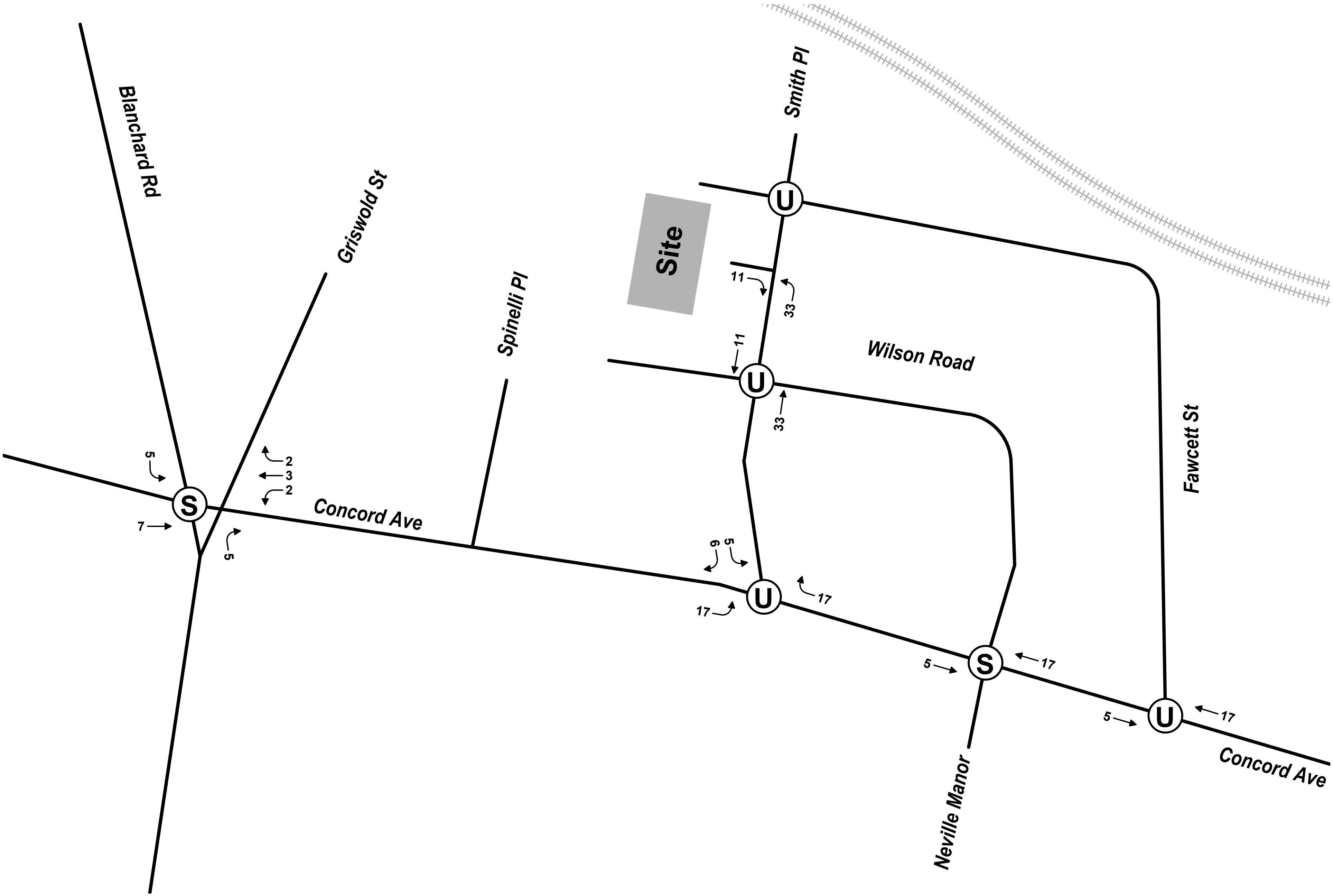
75/109 Smith Place Project
2019 Existing Conditions
PM Peak Hour
Bicycle Volumes

Figure 2.c.6



75/109 Smith Place Project
Trip Distribution
AM/PM Peak Hour
Vehicle Volumes

Figure 3.c.1

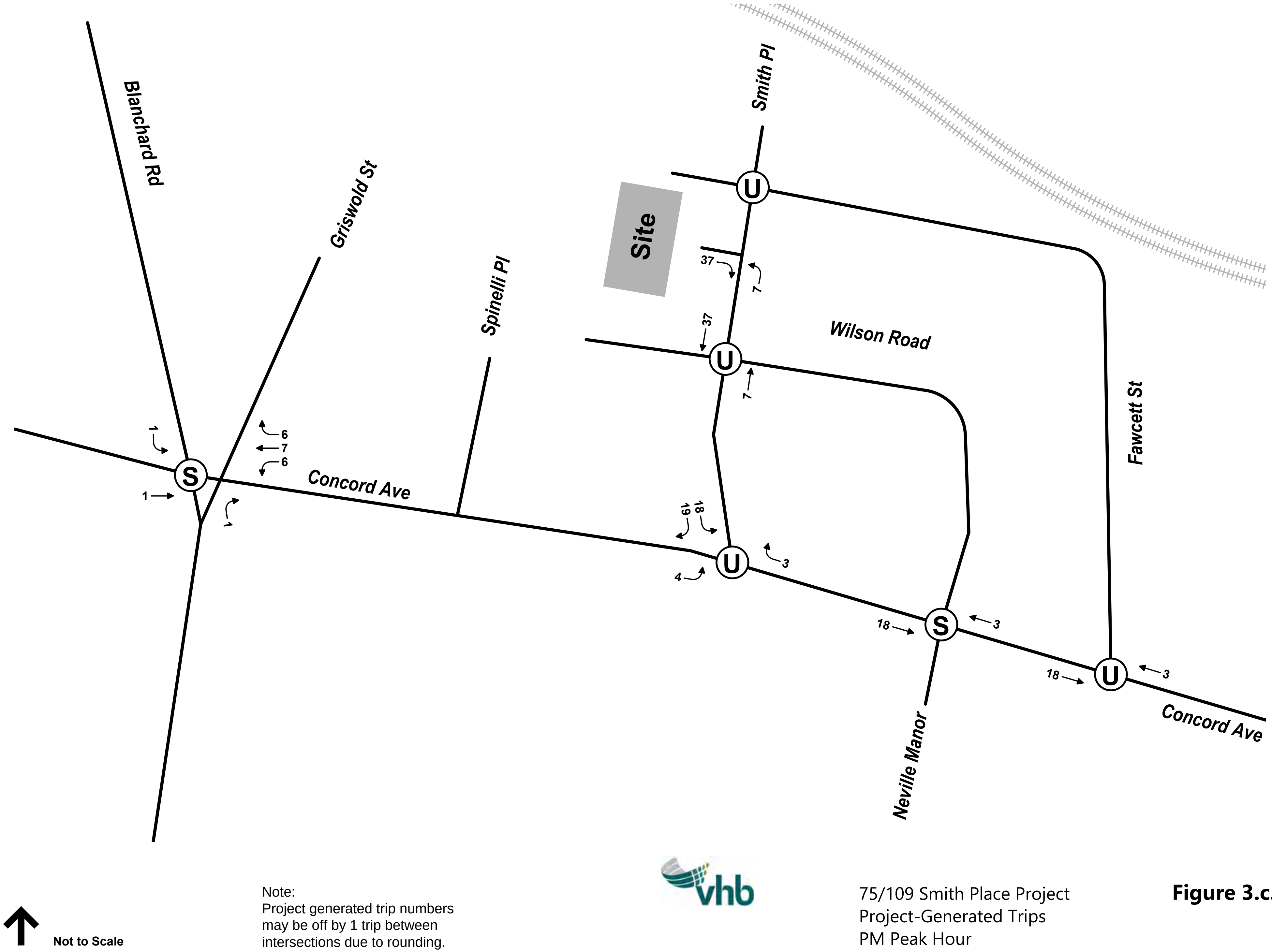


Not to Scale

Note:
Project generated trip numbers may be off by 1 trip between intersections due to rounding.

75/109 Smith Place Project
Project-Generated Trips
AM Peak Hour
Vehicle Volumes

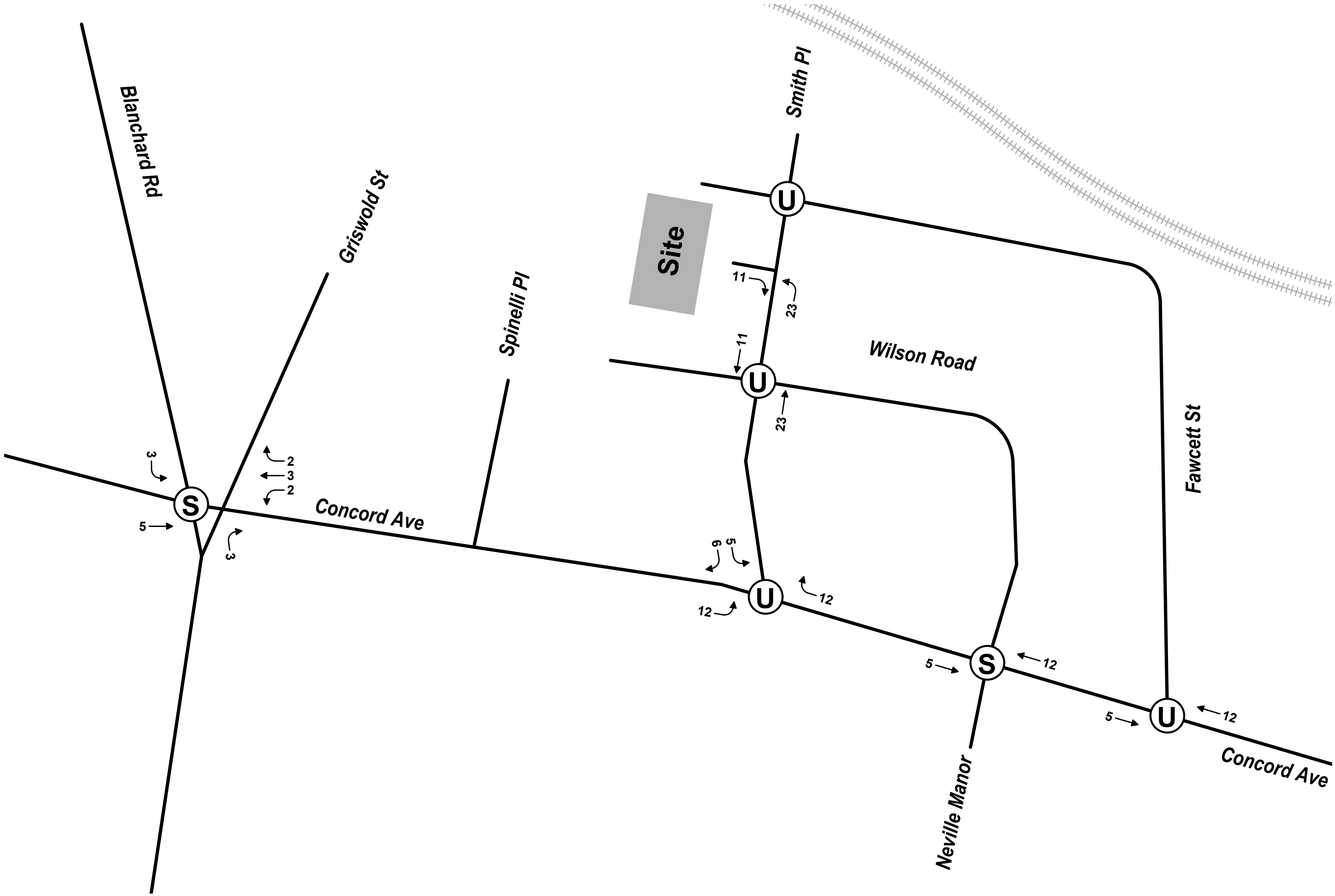
Figure 3.c.2



Note:
Project generated trip numbers may be off by 1 trip between intersections due to rounding.

75/109 Smith Place Project
Project-Generated Trips
PM Peak Hour
Vehicle Volumes

Figure 3.c.3

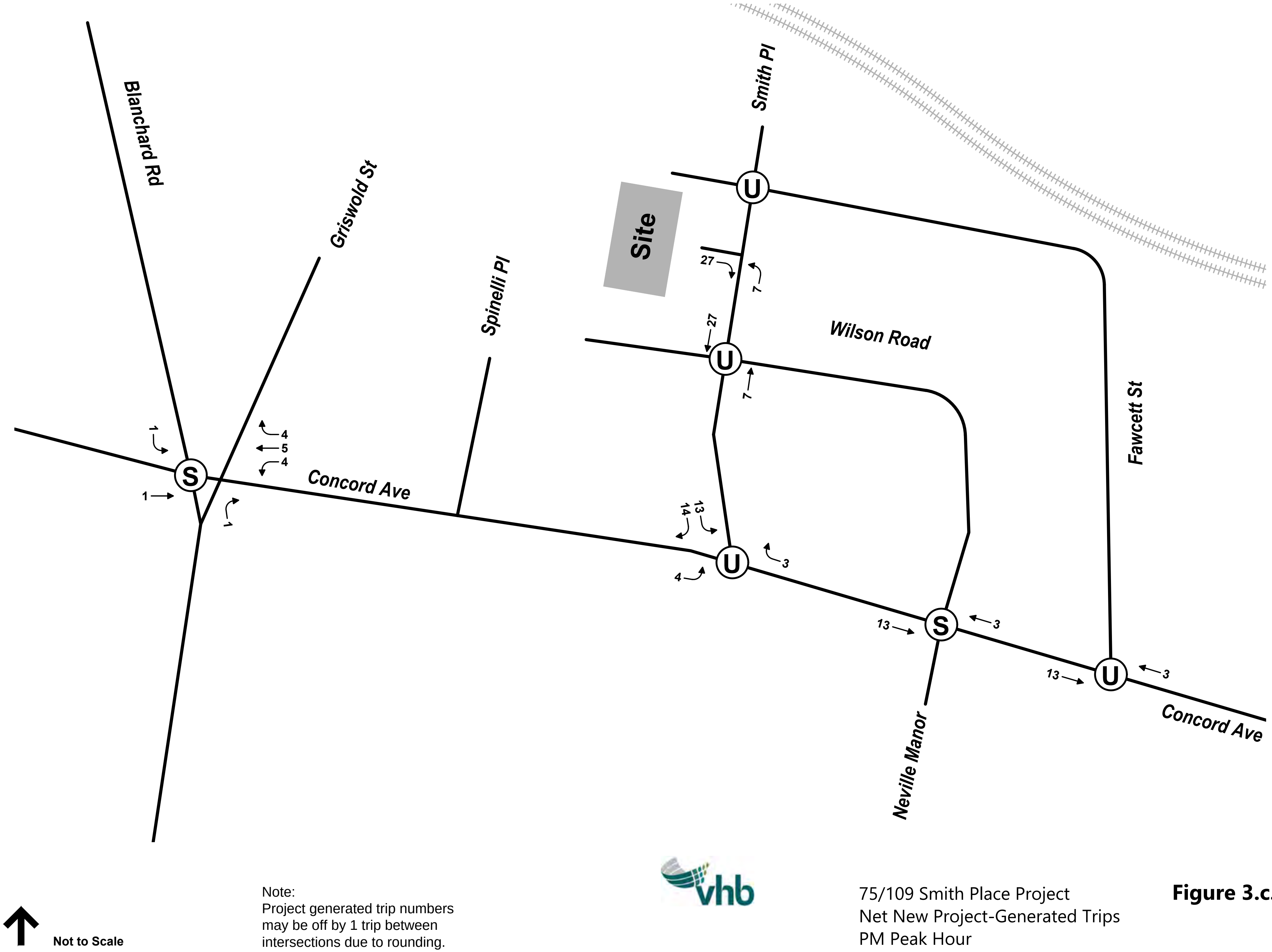


Not to Scale

Note:
Project generated trip numbers may be off by 1 trip between intersections due to rounding.

75/109 Smith Place Project
Net New Project-Generated Trips
AM Peak Hour
Vehicle Volumes

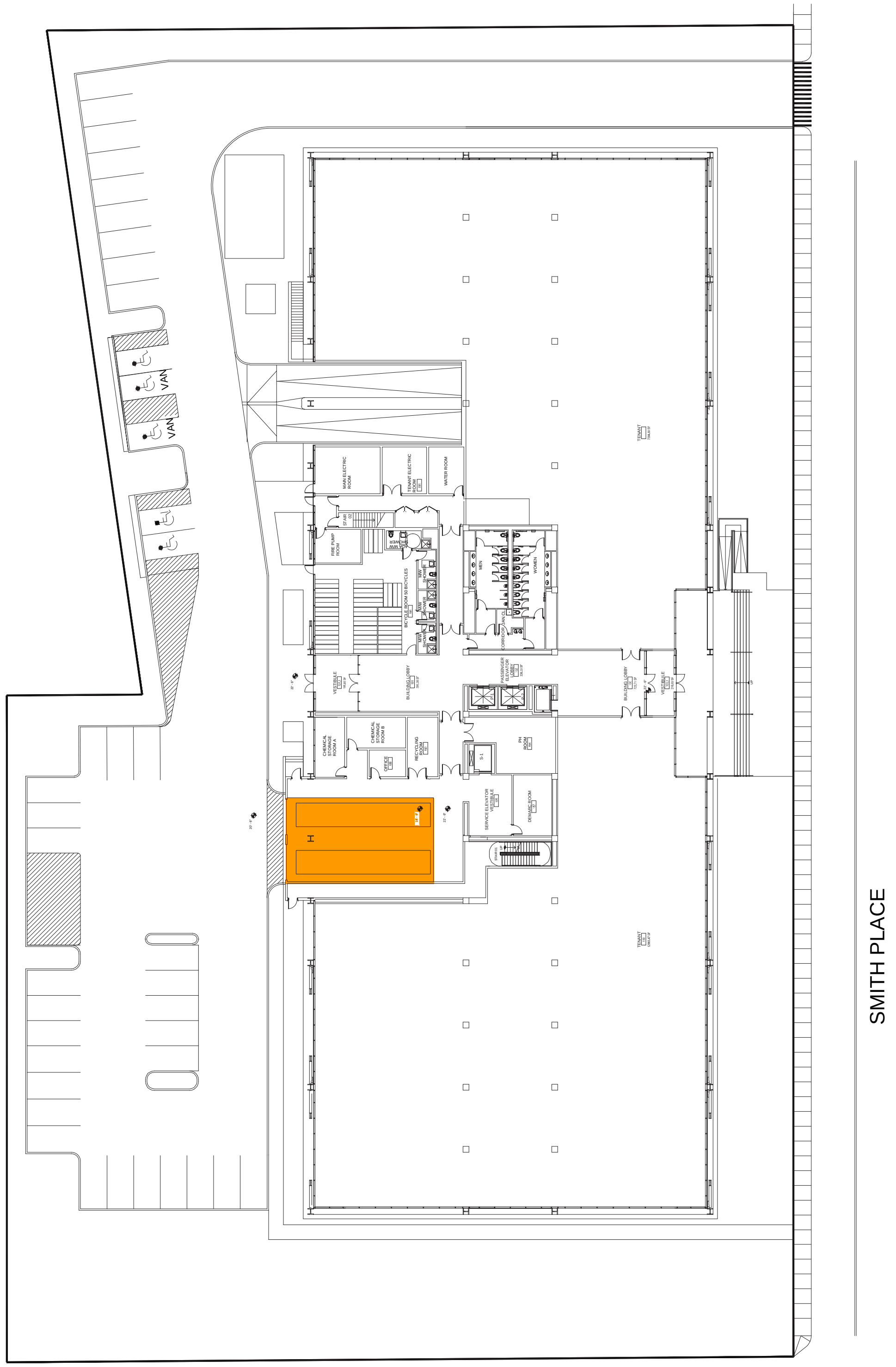
Figure 3.c.4



Note:
Project generated trip numbers may be off by 1 trip between intersections due to rounding.

75/109 Smith Place Project
Net New Project-Generated Trips
PM Peak Hour
Vehicle Volumes

Figure 3.c.5



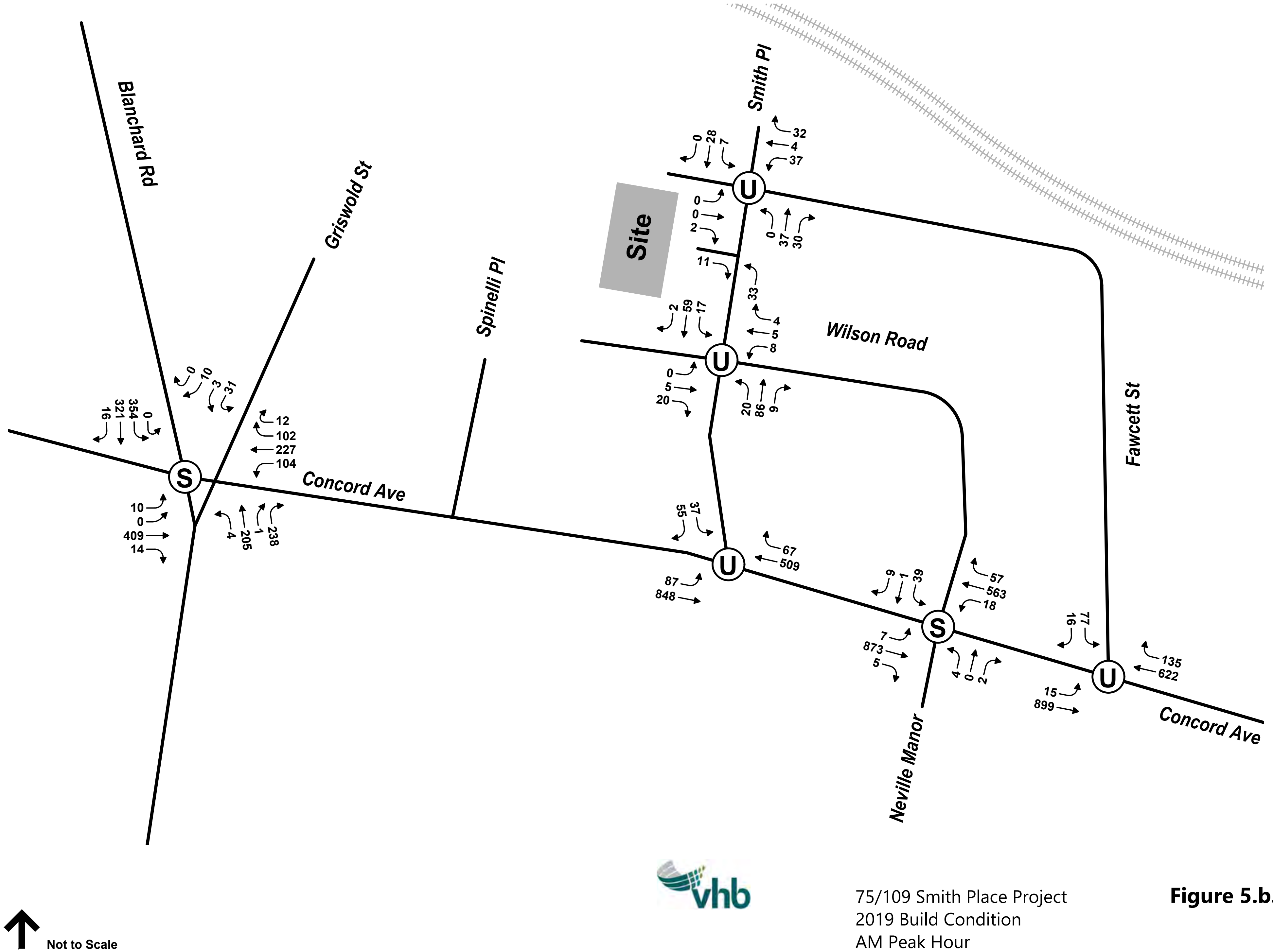
Source: Jacobs Consultants, Inc.

Loading

Figure 3.d.1

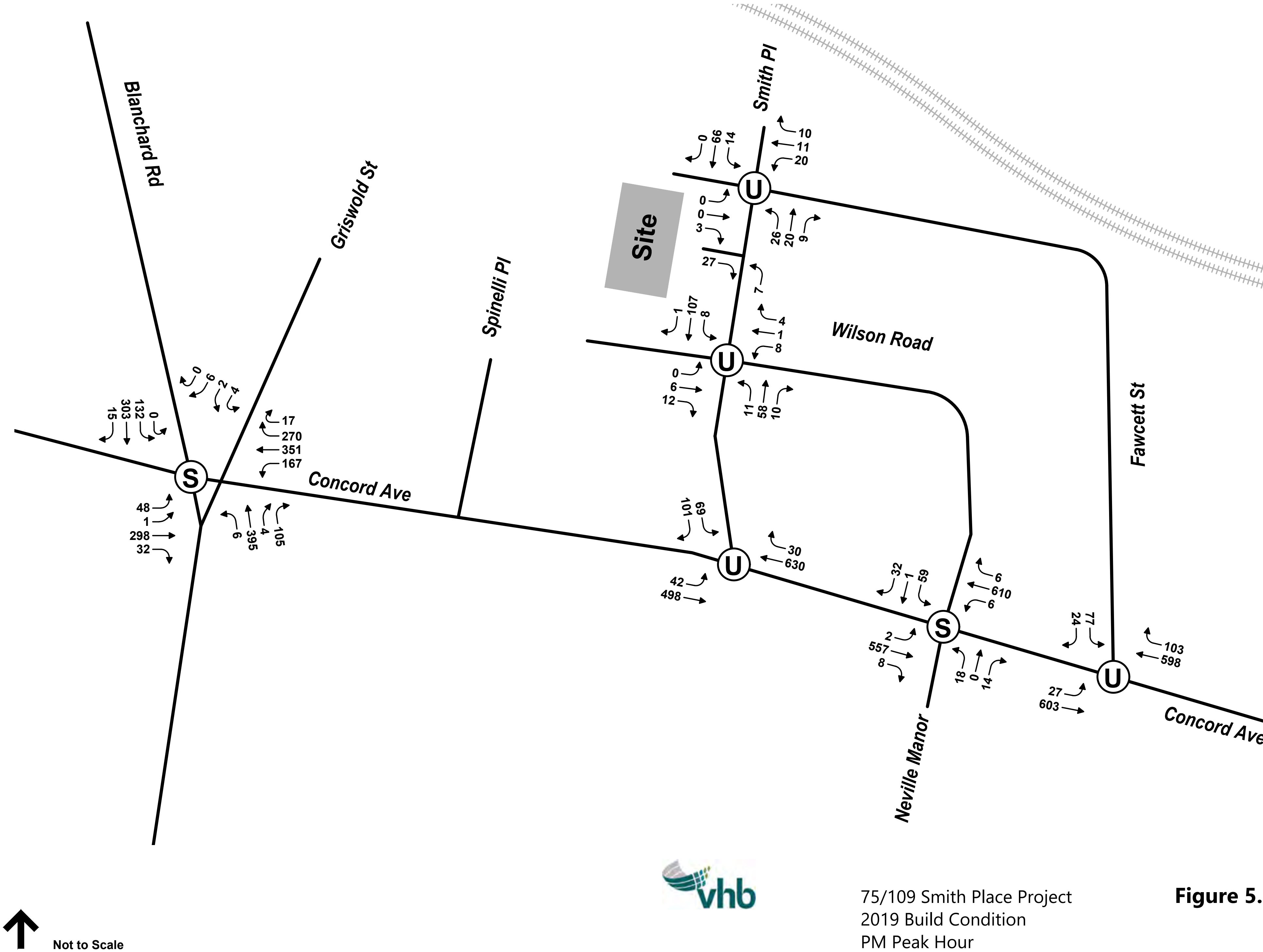
Loading and Service Areas

75/109 Smith Place Project
Cambridge, Massachusetts



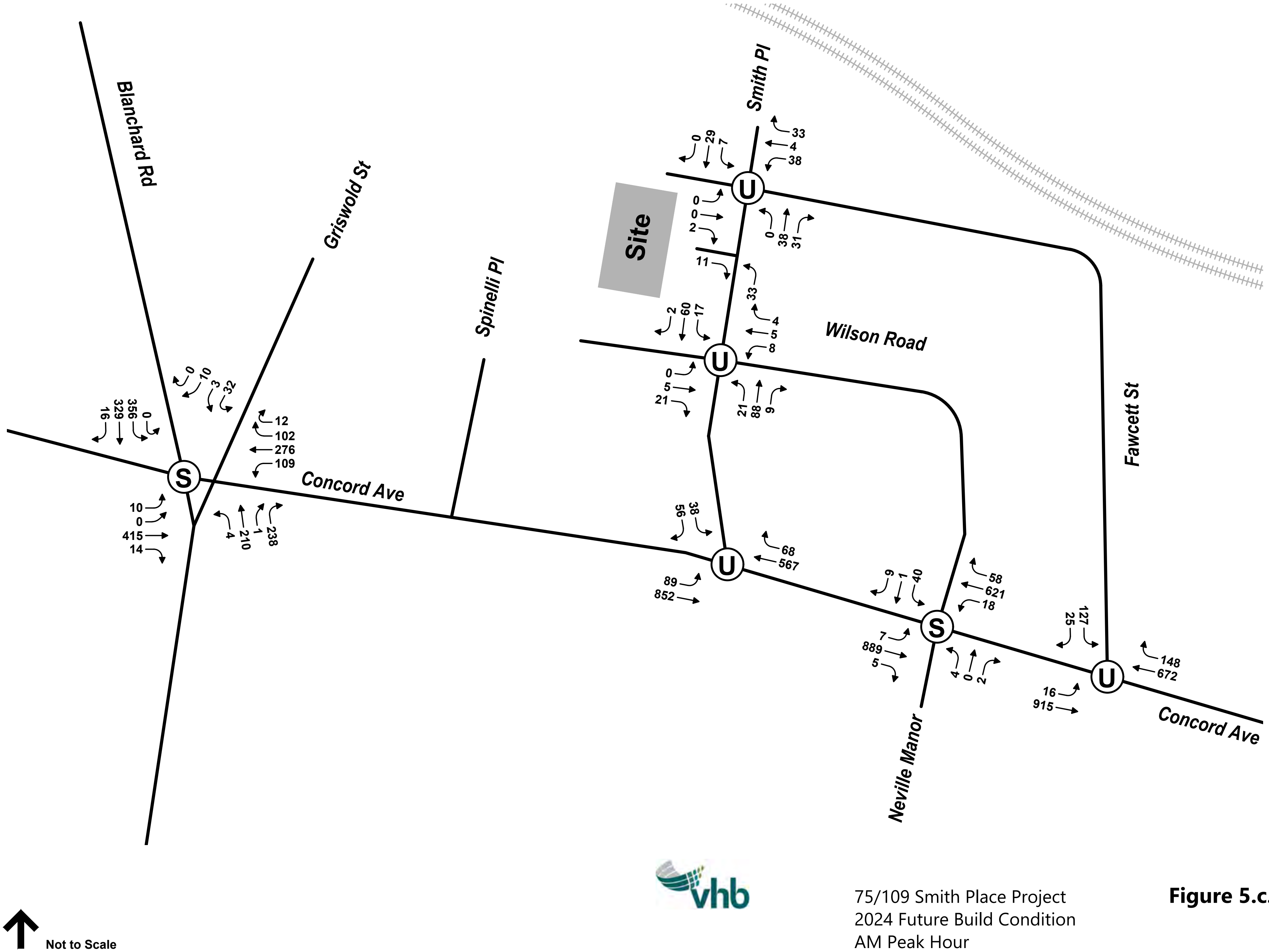
75/109 Smith Place Project
2019 Build Condition
AM Peak Hour
Vehicle Volumes

Figure 5.b.1



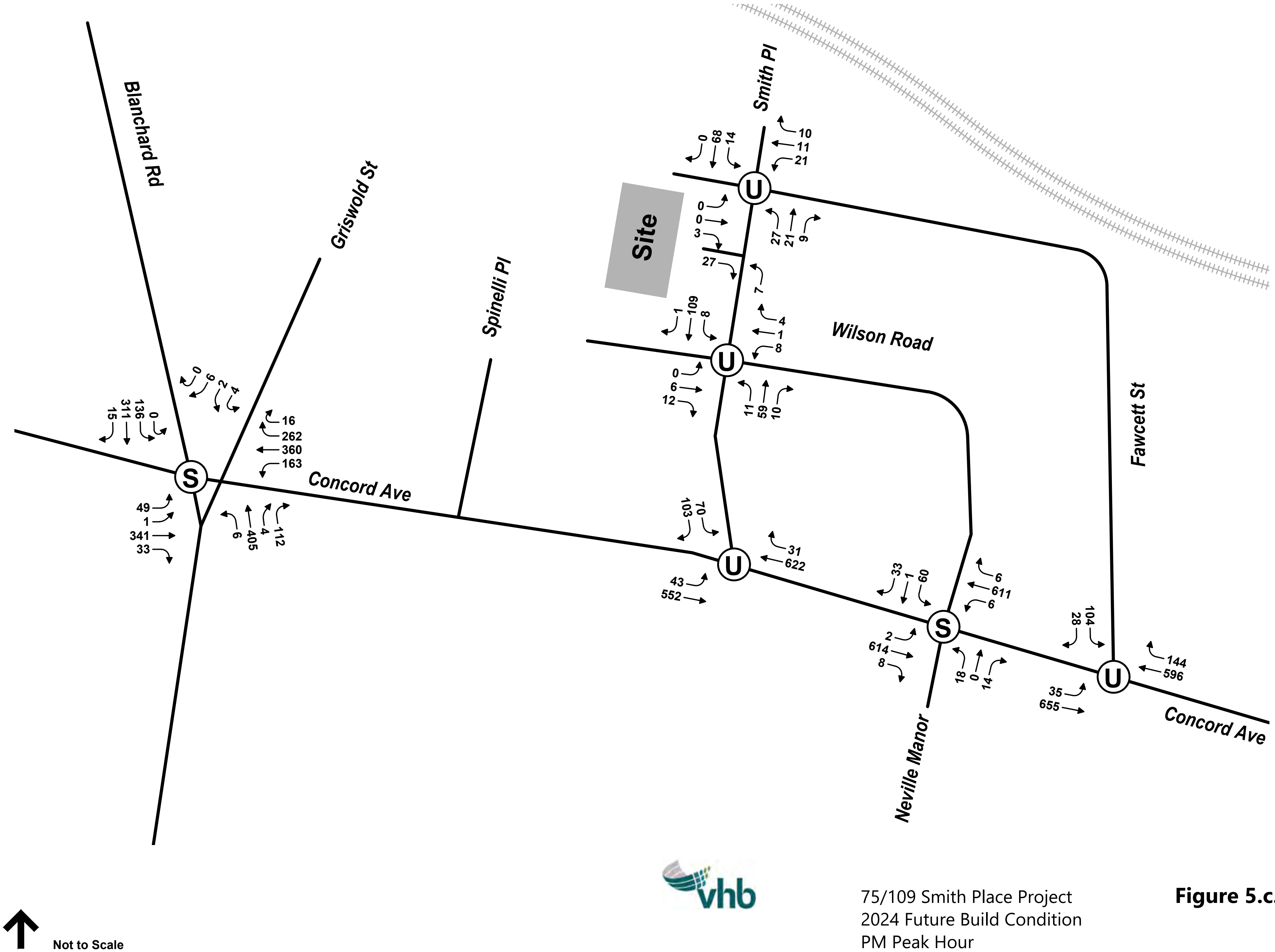
75/109 Smith Place Project
2019 Build Condition
PM Peak Hour
Vehicle Volumes

Figure 5.b.2



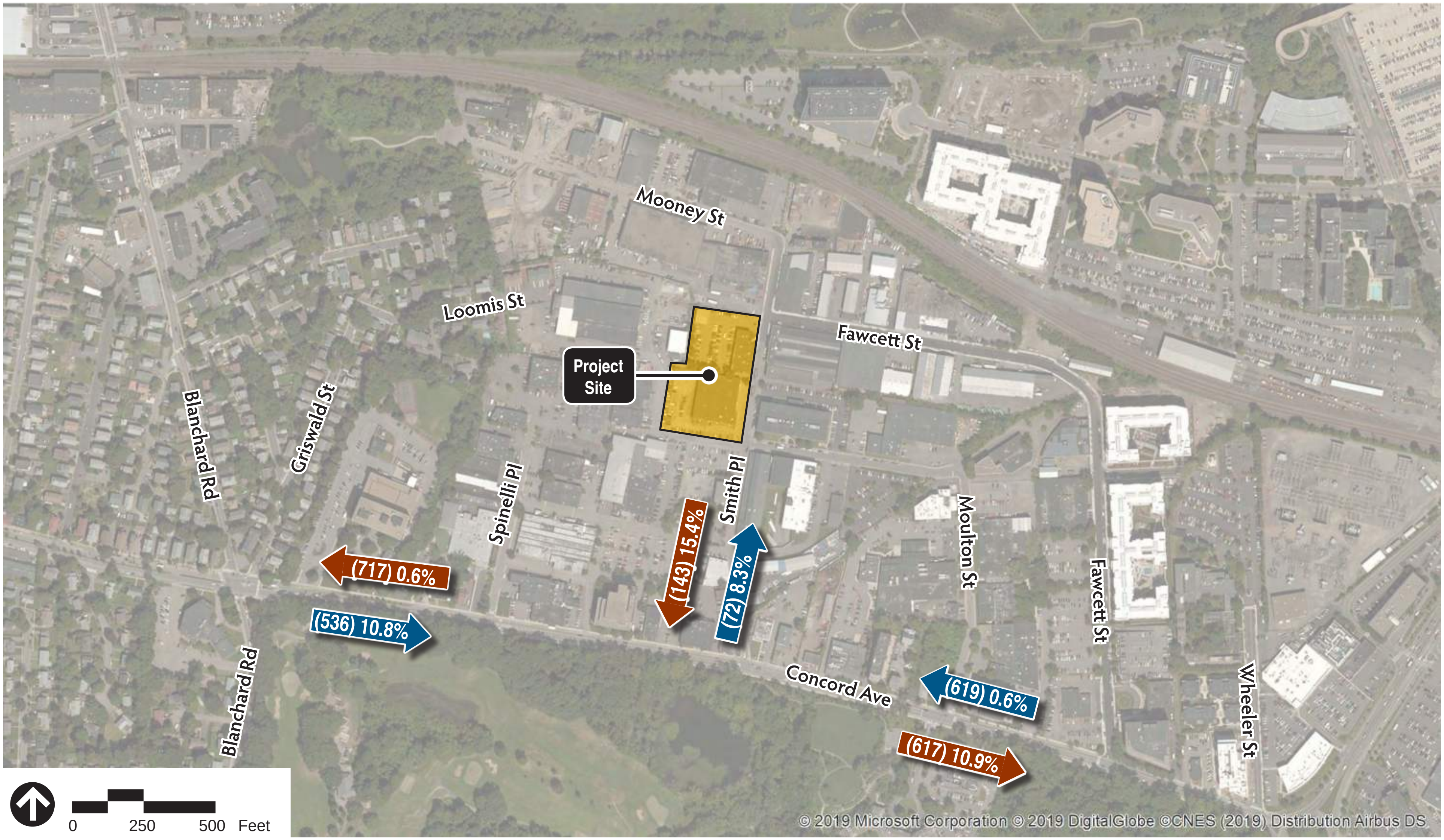
75/109 Smith Place Project
2024 Future Build Condition
AM Peak Hour
Vehicle Volumes

Figure 5.c.1



75/109 Smith Place Project
2024 Future Build Condition
PM Peak Hour
Vehicle Volumes

Figure 5.c.2

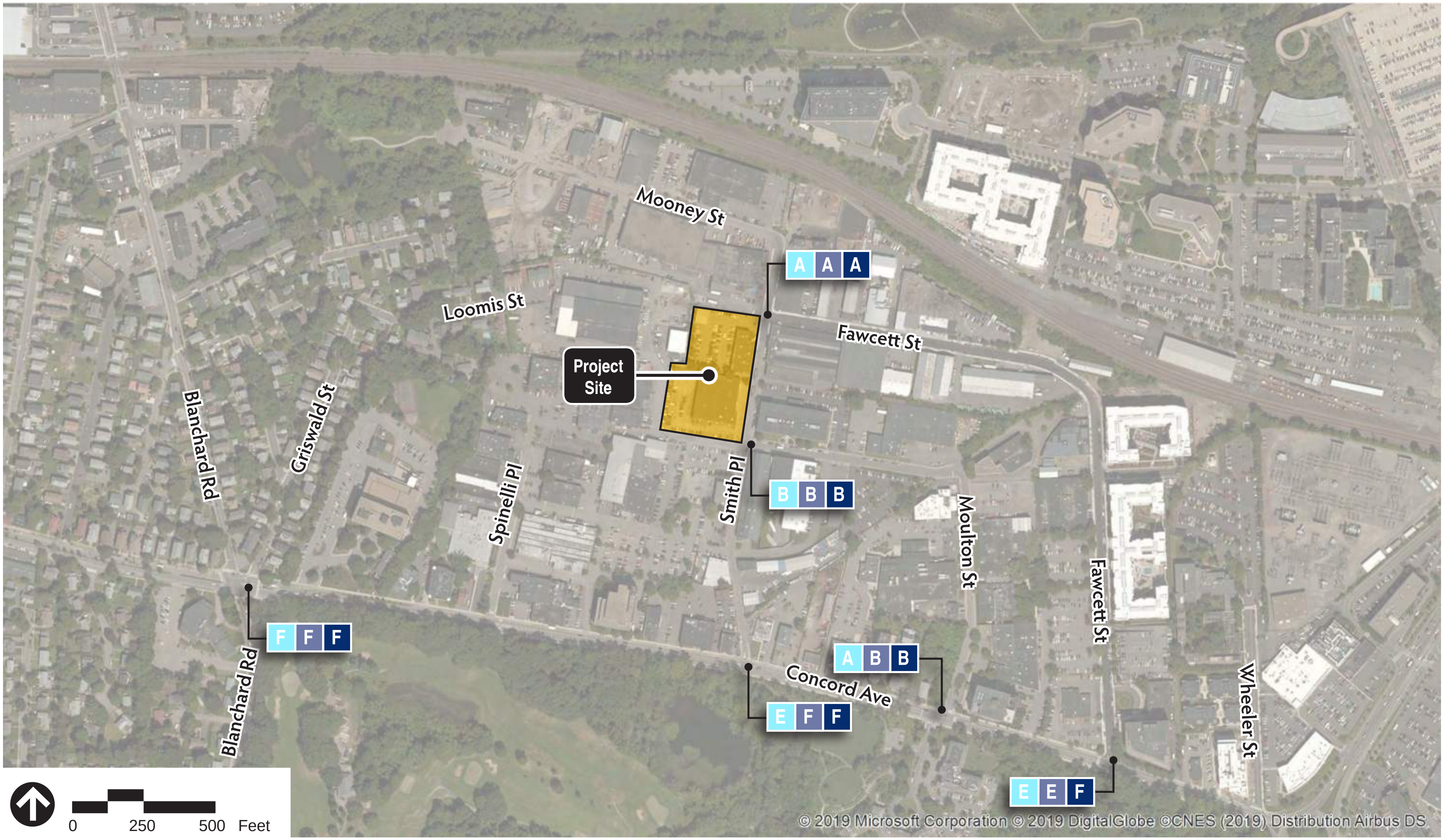


Source: Bing Aerial

(#) % Inbound
(Existing) Percent Increase

(#) % Outbound
(Existing) Percent Increase

Figure 5.c.3
Estimated 2024 Future Cumulative Area Development Impact
Evening Peak Hour Vehicle Volumes
75/109 Smith Place Project
Cambridge, Massachusetts



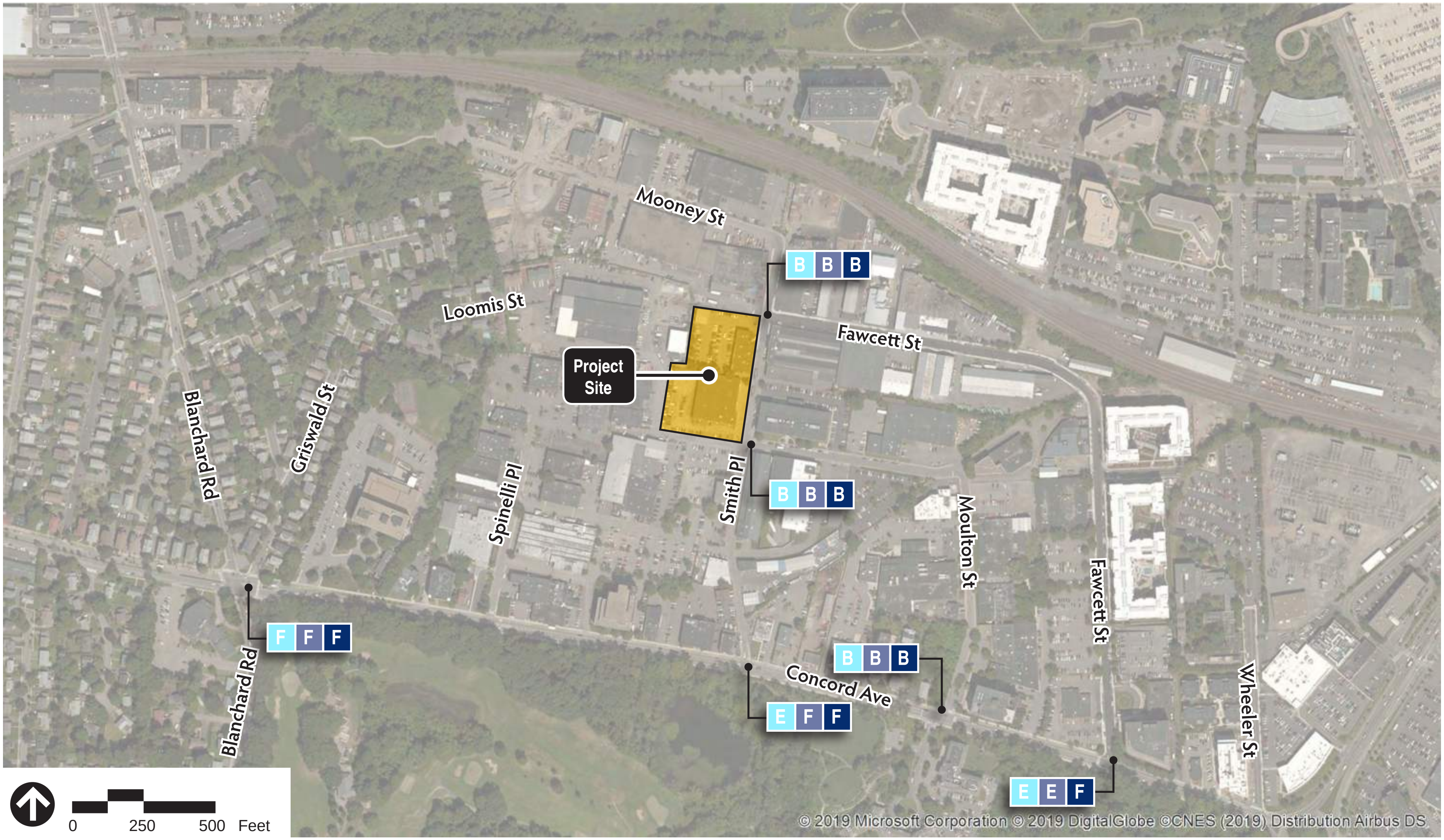
Source: Bing Aerial

2019 Existing | 2019 Build | 2024 Future

Figure 6.a.1

AM Peak Hour Vehicular Level of Service Comparison Table

75/109 Smith Place Project
Cambridge, Massachusetts



Source: Bing Aerial

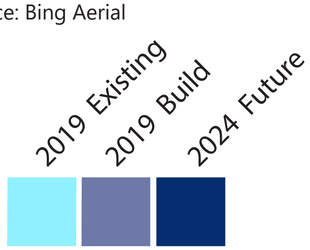
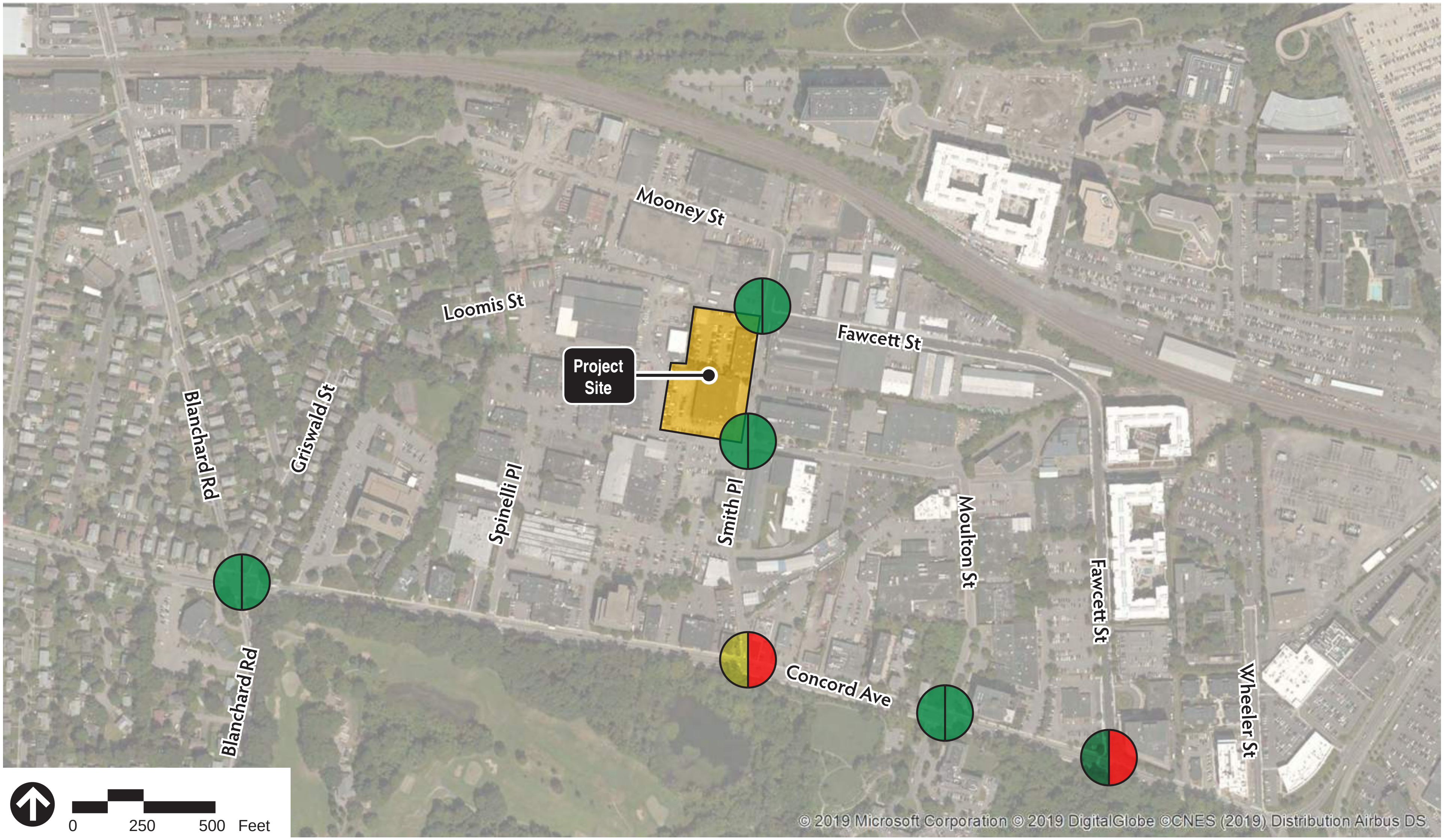


Figure 6.a.2

PM Peak Hour Vehicular Level of Service Comparison Table

75/109 Smith Place Project
Cambridge, Massachusetts



Source: Bing Aerial

Net Delay from Existing to Build (Project Impact)

Net Delay from Existing to Future (impact due to all other development in the region)

Added Delay of 10 Seconds or Less

Added Delay of 10.1 to 20 Seconds

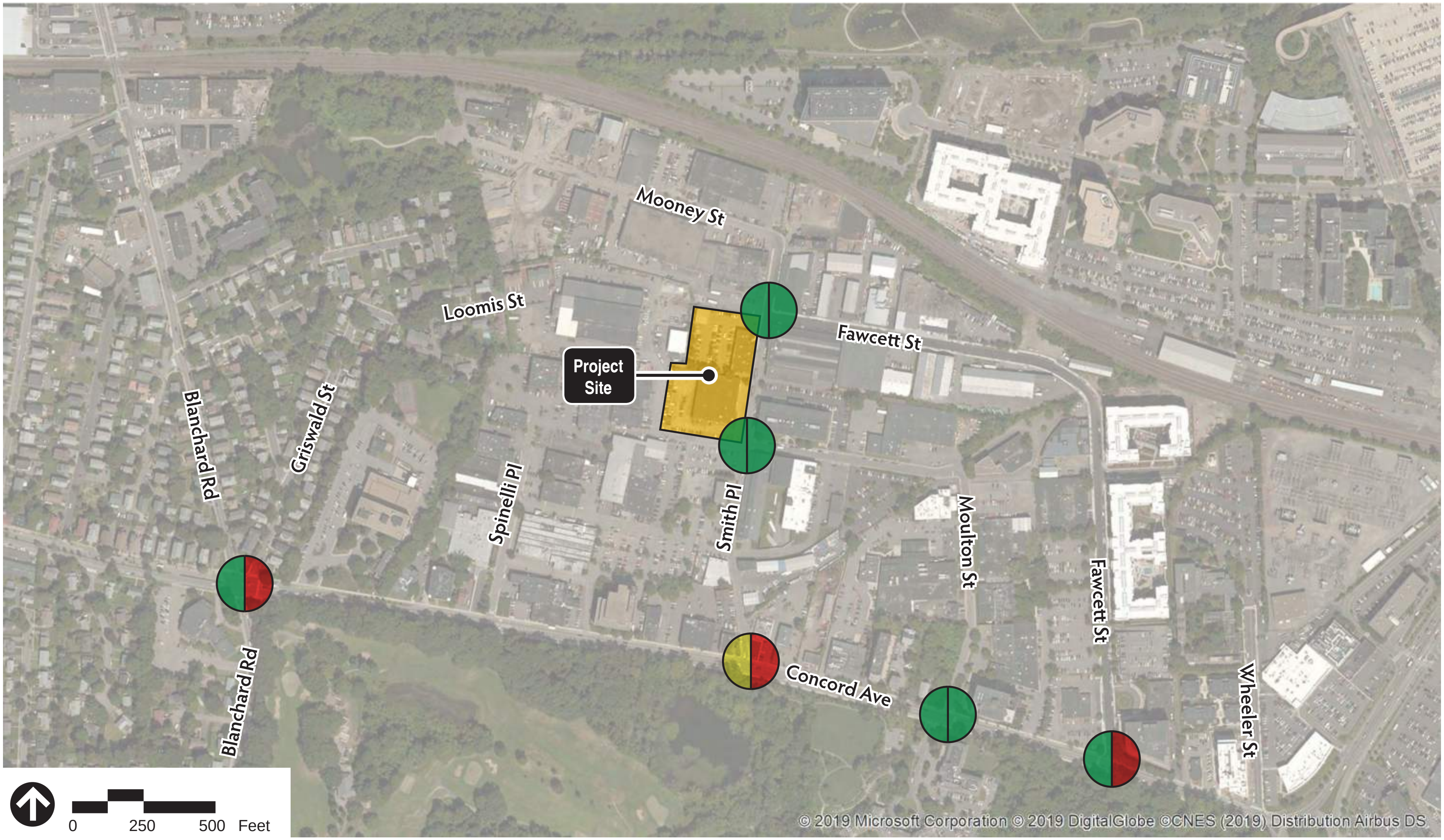
Added Delay of more than 20 Seconds

vhb

Figure 6.b.1

Net Change in Vehicular Delay
AM Peak Hour

75/109 Smith Place Project
Cambridge, Massachusetts



Source: Bing Aerial

Net Delay from Existing to Build (Project Impact)

Net Delay from Existing to Future (impact due to all other development in the region)

Added Delay of 10 Seconds or Less

Added Delay of 10.1 to 20 Seconds

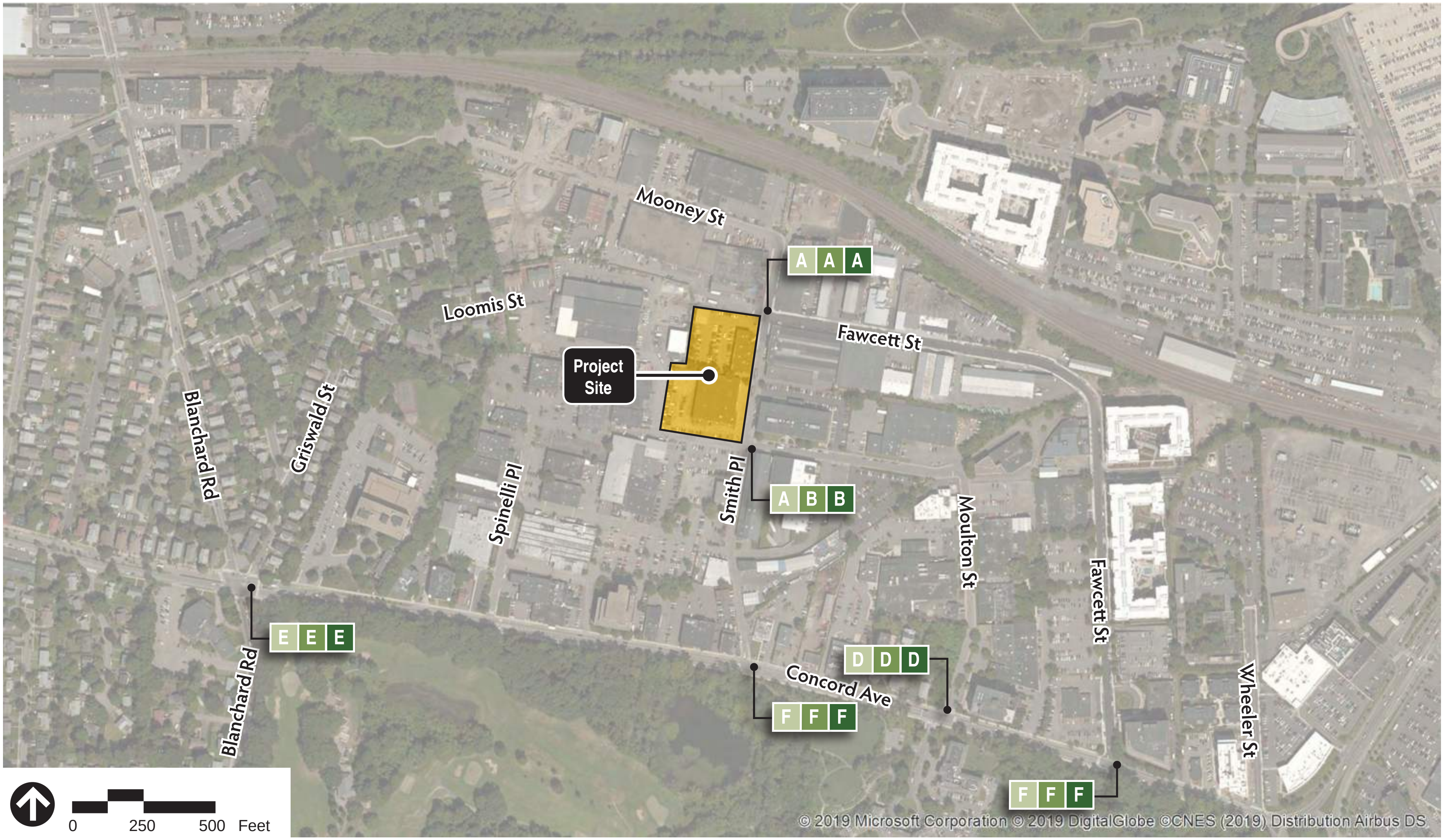
Added Delay of more than 20 Seconds

vhb

Figure 6.b.2

Net Change in Vehicular Delay
PM Peak Hour

75/109 Smith Place Project
Cambridge, Massachusetts



Source: Bing Aerial

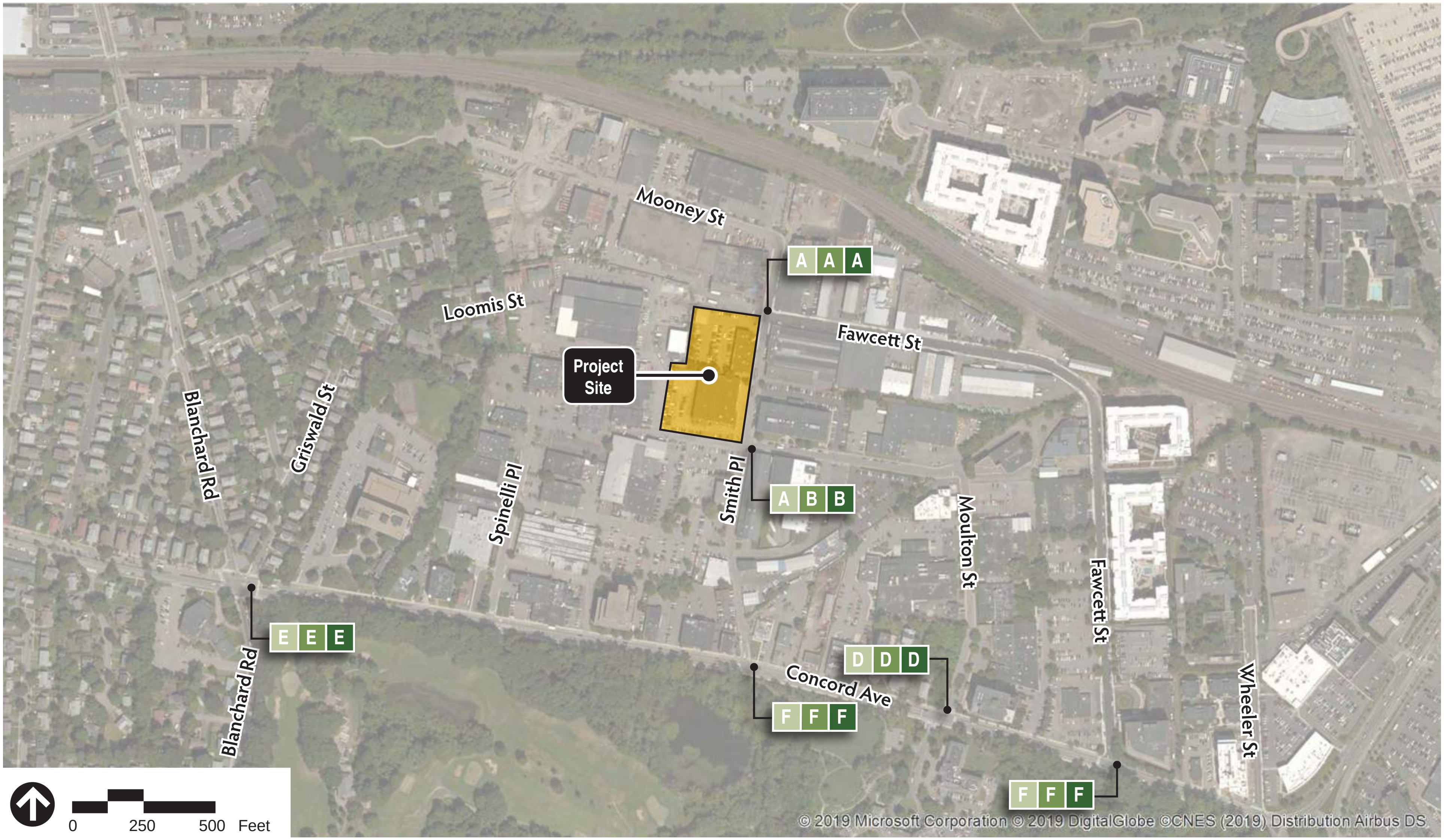
2019 Existing | 2019 Build | 2024 Future

Note: LOS represented the pedestrian crosswalk with the longest delay time at that intersection location

Figure 11.a.1

AM Peak Hour Pedestrian Level of Service Comparison Table

75/109 Smith Place Project
Cambridge, Massachusetts



Source: Bing Aerial

2019 Existing | 2019 Build | 2024 Future

Note: LOS represented the pedestrian crosswalk with the longest delay time at that intersection location

Figure 11.a.2

PM Peak Hour Pedestrian Level of Service Comparison Table

75/109 Smith Place Project
Cambridge, Massachusetts