4. Supporting Materials

MIT Volpe C3

Article 22 Submission

02/17/23

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INTRODUCTION

Continuing MIT's commitment to sustainable development in the Kendall Square area, the Volpe district will be one of the largest LEED developments in the Cambridge and Boston areas. The Volpe C3 building ("Volpe C3" or "C3") is committed to achieving a minimum LEED Gold rating under the LEED version 4 system.

The Volpe Masterplan will register an overall LEED Master Site, that will take advantage of combined site, landscape, and transportation strategies. Then, Volpe C3 will achieve the remaining credits required for a Gold rating under either the LEED v4 for Core and Shell system or LEED v4 for New Construction. The site will be registered with the USGBC and target several credits which span the nine LEED version 4 categories (Integrative Process, Location & Transportation, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation in Design Process and the additional Regional Priority Credits) to enable the project to meet the zoning requirements.

The C3 building will meet the requirements for these credits with shared and local amenities to ensure minimum requirements are met for each building's designated occupants and visitors.

Consistent with Section 22.25.1 of the Cambridge Zoning Ordinance, MIT has prepared this Green Building Report package to include the following:

- Green Building Checklist
- Green Building Rating System Narrative + Scorecard
- Net Zero Narrative
- Credentials of the Green Building Project's designated Green Building Professional and affidavit

Consistent with Sections 22.25.2 and 22.25.3 of the Cambridge Zoning Ordinance, updated versions of these documents will be provided before applications for a building permit and for a certificate of occupancy.

EXECUTIVE SUMMARY

This executive summary highlights the key sustainable design categories discussed in the report with references to the sections and page numbers where additional information can be found.

GREEN BUILDING REQUIREMENTS

The C3 project is pursuing LEED v4 BD+C: Core and Shell certification targeting LEED Gold at a minimum. With 70-75 LEEDv4 points in the 'high probability' category, C3 exceeds well beyond the LEEDv4 Gold certification requirements. The team is substituting LEED v4.1 credit pathways where applicable. As the design progresses, the project team is committed to exploring opportunities to pursue additional credits under the Energy & Atmosphere, Water Efficiency, and Indoor Environmental Quality categories as a potential path to LEED platinum. MIT will pursue enhanced commissioning, including envelope and monitoring based commissioning to maintain performance and ensure maximum energy savings and emissions reductions as outlined in LEED v4 Enhanced Commissioning Requirements.

See following sections on more information:

- Green Building Rating System Narrative + Scorecard – page 11
- GBR Narrative – 7. Building Certification – page 29

ENERGY PERFORMANCE - ENERGY SOURCES + EFFICIENCY

MIT has designed a best-in-class laboratory building in terms of energy performance, with a projected 47% reduction in energy use over the baseline, in addition to being all-electric ready for future conversion. The building conversion timeline depends on grid reliability as Eversource prepares to expand capacity for the local grid. Limited natural gas use will be required until the grid reliability is sufficient for operations. As designed, efficient electrification with heat pumps allows the C3 building to take advantage of renewable energy and the increasingly renewable regional electrical grid to reduce carbon emissions every year. The current design shows a 28% reduction in operational carbon today, which is anticipated to increase to 41% by 2035 with further greening of the grid. If 100% renewable electricity is purchased, there would be a 99% carbon reduction by 2035. MIT is committed to the purchase of green power, RECs, and/or offsets.

The project is committed to achieving at least a 10% reduction in embodied carbon compared to the baseline. Current studies show a nearly 20% reduction, and the embodied carbon analysis will be refined further in the Construction Documents phase.

See following sections on more information:

- GBR Narrative - Energy + Emissions – page 19
- GBR Narrative – Building Efficiency – page 21
- GBR Narrative - Embodied Carbon – page 22
- Zero Net Narrative – page 31

POTENTIAL FOR SOLAR ENERGY GENERATION

The C3 design team is exploring all potential rooftop locations for solar photovoltaic (PV) to provide on-site renewable energy systems where feasible. As designed, the roof houses cooling towers, generators, stair pressurization H&V units, exhaust fans, and air source heat pumps, as well as space identified for installing future air source heat pumps and all-electric equipment, resulting in limited space available for renewable installations. The team has identified the top of the elevator penthouse as a potential surface that could support PV installation. The team will continue to explore additional potential areas on the rooftop for PV, such as above the rooftop equipment (where feasible) given the limitations around vent stacks and access clearances.

See following sections on more information:

- GBR Narrative - Renewable Energy – page 20
- Zero Net Narrative – Solar Ready Rooftop Assessment – page 39

HEAT RESILIENCE

C3 and the Volpe development are committed to mitigating heat risk and the urban heat island effect by providing green spaces throughout the site and selecting highly reflective paving and roofing materials. C3 addresses the heat island effect by maximizing green space on the roof where feasible and optimizing the façade for solar radiation. A reduced window-to-wall ratio of 48% with some self-shading from the thickness of opaque areas optimizes seasonal solar heat gain. Furthermore, shading and solar heat gain is addressed by selecting high-performance glass coatings combined with interior roller shades to reduce glare and allow for a comfortable working environment.

See following sections on more information:

- GBR Narrative - Heat Risk + Urban Heat Island – page 28
- Zero Net Narrative – Building Energy Performance Measures – page 34

GREEN BUILDING CHECKLIST

GREEN BUILDING PROJECT CHECKLIST • ARTICLE 22.000 • GREEN BUILDING REQUIREMENTS

Green Building Project Checklist

Green Building Project Location: 75 Broadway, Cambridge, MA 02142

Applicant

Name: David Manfredi

Address: 25 Drydock Avenue, Floor 7, Boston, MA 02210

Contact Information

Email Address: dmanfredi@elkus-manfredi.com

Telephone #: 617 426 1300

Project Information (select all that apply):

☒ New Construction – GFA: approximately 450,221 SF

☐ Addition – GFA of Addition: ______

☐ Rehabilitation of Existing Building – GFA of Rehabilitated Area: ______

☐ Existing Use(s) of Rehabilitated Area: ______

☐ Proposed Use(s) of Rehabilitated Area: ______

☐ Requires Planning Board Special Permit approval

☐ Subject to Section 19.50 Building and Site Plan Requirements

☐ Site was previously subject to Green Building Requirements

Green Building Rating Program/System:

☒ Leadership in Energy and Environmental Design (LEED) – Version: v4 Gold

☐ Building Design + Construction (BD+C) – Subcategory: Core & Shell

☐ Residential BD+C – Subcategory: ______

☐ Interior Design + Construction (ID+C) – Subcategory: ______

☐ Other: ______

☐ Passive House – Version: ______

☐ PHIUS+

☐ Passivhaus Institut (PHI)

☐ Other: ______

☐ Enterprise Green Communities – Version: ______

Last Updated: May, 2020

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GREEN BUILDING PROJECT CHECKLIST • ARTICLE 22.000 • GREEN BUILDING REQUIREMENTS

Project Phase

☒ **SPECIAL PERMIT**

Before applying for a building permit, submit this documentation to CDD for review and approval.

Required Submissions

All rating programs:

- ☒ Rating system checklist
- ☒ Rating system narrative
- ☒ Net zero narrative (see example template for guidance)
- ☒ Affidavit signed by Green Building Professional with attached credentials – use City form provided (Special Permit)

Last Updated: May, 2020

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GREEN BUILDING AFFIDAVIT

ELKUS | MANFREDI ARCHITECTS

February 17, 2023

City of Cambridge
795 Massachusetts Avenue
Cambridge MA 02139

Re: Volpe Redevelopment Project Parcel 1A "South Parcel" Building C3

Dear City of Cambridge:

As CEO and Founding Principal of Elkus Manfredi Architects, I am leading the planning and design of Volpe South Parcel Building C3. I, David Manfredi, certify that I am knowledgeable of the project's green building strategies, designs, plans and details and to the best of my knowledge this project has been planned and designed to meet the prerequisites and earn the credits necessary to achieve Gold level (minimum of 60 points) using the LEED BD+C for Core and Shell and New Construction v4 Rating Systems. The referenced project is being planned to meet the Green Building Project requirements under Article 22 of the Cambridge Zoning Ordinance.

Sincerely,

David Manfredi FAIA, LEED AP
CEO & Founding Principal
Elkus Manfredi Architects Ltd.

ELKUS MANFREDI ARCHITECTS LTD
[address] 25 DRYDOCK AVENUE BOSTON MASSACHUSETTS 02210 [tel] 617.426.1300 [web] WWW.ELKUS-MANFREDI.COM

GBCI

November 4, 2020

Dear David Manfredi,

The Green Business Certification Institute's records indicate that you passed the LEED® Professional Exam™. Please see the details for your exam achievement, below:

Exam Track	Exam Date	Status
LEED AP Legacy	September 29, 2008	Active – No Expiration

In passing the LEED AP exam, you became recognized as a LEED AP by GBCI. For your reference, your GBCI # is 0010235886.

Thank you for your participation in the LEED® Professional Credentialing program. We wish you all the best in your work to create and sustain a thriving built environment.

Sincerely,

Green Business Certification Inc. (GBCI)

GREEN BUSINESS CERTIFICATION INC. 2101 L Street, NW Suite 500 Washington, DC 20037 T: 800.795.1746 F: 202.828.5110 gbci.org

Affidavit Form for Green Building Professional Special Permit

Green Building Project Location: Volpe Redevelopment Project Parcel 1A "South Parcel" Building C3

Green Building Professional

Name: David Manfredi FAIA, LEED AP

☒ Architect

☐ Engineer

License Number: 5553

Company: Elkus Manfredi Architects Ltd

Address: 25 Drydock Ave., Fl 7, Boston, MA 02210

Contact Information

Email Address: dmanfredi@elkus-manfredi.com

Telephone Number: (617) 426-1300

I, David Manfredi, as the Green Building Professional for this Green Building Project, have reviewed all relevant documents for this project and confirm to the best of my knowledge that those documents indicate that the project is being designed to achieve the requirements of Section 22.24 under Article 22.20 of the Cambridge Zoning Ordinance.

(Signature) February 17, 2023 (Date)

Attach either:

☒ Credential from the applicable Green Building Rating Program indicating advanced knowledge and experience in environmentally sustainable development in general as well as the applicable Green Building Rating System for this Green Building Project.

☐ If the Green Building Rating Program does not offer such a credential, evidence of experience as a project architect or engineer, or as a consultant providing third-party review, on at least three (3) projects that have been certified using the applicable Green Building Rating Program.

GREEN BUILDING RATING SYSTEM NARRATIVE + SCORECARD

The project will pursue the LEED v4 BD+C: Core and Shell (CS) rating system, which is tailored for buildings that include exterior shell and core mechanical, electrical, and plumbing units, without a complete interior fit-out within the project scope. MIT is committed to achieving LEED Gold certification which requires the project to earn all 12 prerequisites and at least 60 credit points.

The LEED Scorecard provided in the following section serves as a platform for tracking the project's targeted LEED strategies and credit status throughout design and construction. Currently, the LEED Appraisal indicates the following point breakdown:

- High probability: 75 points
- Medium probability: 23 points
- Not possible: 13 points

With seventy-five (75) LEEDv4 points in the 'high probability' category, the project is poised to exceed the LEEDv4 Gold certification requirements. As the design progresses, the project team is committed to exploring opportunities to pursue additional credits under the Energy & Atmosphere, Water Efficiency, and Indoor Environmental Quality categories.

LEED CREDIT NARRATIVES – MASTER SITE

The project will meet the LEED v4 Minimum Program Requirements and each of the required Prerequisites. All credit points described below are being pursued with the probability of achievement noted as 'High, Medium, or Low' next to each credit. All items captured in the LEED credits will also adhere to the requirements of the Special Permit where requirements exceed LEED.

Location & Transportation

The Volpe Development site is a previously developed site in urban Cambridge, close to several public transportation services including an MBTA transit stop and public bus services. Occupants shall have access to bicycle racks and showers, as well as preferred parking for electric, hybrid and/or low- emitting vehicles.

Credit 3: High Priority Site - High

- McPhail has identified various locations across the site that are contaminated. Site remediation will be completed in accordance with applicable laws including LEED requirements.

Credit 6: Bicycle Facilities – High

- Short-term and long-term bicycle parking will be provided for occupants and visitors. In addition, showers will be located in each building to serve their full-time occupants (R1-R3 will provide at least 1 shower, C1- 6 showers, C2-12 showers, and C3-16 showers). Site and roadway access will be provided to further enhance the City of Cambridge's already extensive bicycle network.

Credit 7: Reduced Parking Footprint – Medium

- The parking area is designed to meet the code requirement, but with reduced capacity compared to the Institute of Transportation Engineers' Transportation Planning Handbook. 5% of the total parking spaces will provide preferred parking for carpools to meet the credit's requirements.

Credit 8: Green Vehicles - High

- The design will provide at least 10% of total parking spaces are EVSE ready or will provide installed EVSE charging stations at 5% of total parking spaces.

Sustainable Site

MIT is taking a comprehensive approach to site, landscape, habitat creation, stormwater management, and human use.

Credit 1: Site Assessment - High

- The civil and landscape teams have conducted a comprehensive site survey to study topography, hydrology, climate, vegetation, soils, human use, and human health effects to achieve credit requirements. A credit template has been circulated to the design teams.

Credit 2: Site Development: Protect or Restore Habitat - Low

- The design strives to restore landscape by maximizing opportunities for native and adapted vegetation while improving tree canopy. Green roofs are being studied to further add green space to the site.

Credit 3: Open Space - High

- Based on the current design, the open space will exceed the 30% credit threshold for this credit requirement. Additional vegetated and tree canopy overhead in the community areas helps to achieve 30% of the open space as vegetated, over the 25% threshold for vegetated open space. Credit is anticipated.

Credit 4: Rainwater Management - Med

- The current design for stormwater management collects roof and site water to be directed into infiltration areas for phosphorous removal and ground water recharge. The stormwater management systems are designed such that the mechanical and/or green technologies meet the LEED v4 requirement as well as local watershed requirements. The blackwater system does not contribute to the stormwater system and thus does not impact this credit requirement.

Credit 5: Heat Island Reduction - High

- Roofs are designed with high-albedo materials to reflect heat and mitigate urban heat island effects. The site design includes high SRI and permeable pavers, which complies with the credit's requirements. Trees and shading elements are optimized to further reduce heat island effects on hard scape areas.

Credit 6: Light Pollution Reduction - High

- All exterior luminaires are carefully selected and designed to improve nighttime visibility, and to avoid light pollution.

Water Efficiency

Water Efficiency credits are mostly pursued on a building-by-building approach. However, the Master Site area uses a single approach to outdoor water use for the shared open space.

Prerequisite 1 and Credit 1: Outdoor Water Use Reduction - High

- The target reduction of outdoor water use will be achieved by native plants with low water demand, as well as efficient irrigation systems.

Credit 3: Cooling Tower Water Use (v4)/ Cooling Tower and Process Water Use (v4.1) - High

- Water analysis will be used to optimize cooling tower cycles to meet the credit's requirement of >10 cycles or 20% non-potable water use.

Materials and Resources

Prerequisite 2: Construction and Demolition Waste Management Planning

- The construction team will develop a construction and demolition waste management plan to reduce waste disposed of in landfills by recovering, reusing, and recycling materials. The development will create a global Construction and Demolition Waste Management specification section and sample plans to the CM.

Indoor Environmental Quality

Prerequisite 2: Environmental Tobacco Smoke (ETS) Control

- The prerequisite will be documented at the Master Site when smoking is prohibited site-wide within 25 ft of major entrances or air intakes.

LEED SCORECARD – MASTER SITE CREDITS

LEED v4 for BD+C: Core and Shell
Project Checklist - Master Site

Project Name: Volpe Master Site
Date: 2/14/23

5	1	0		Location and Transportation	6
3			Credit	High Priority Site	3
1			Credit	Bicycle Facilities	1
	1		Credit	Reduced Parking Footprint	1
1			Credit	Green Vehicles	1
6	2	2		Sustainable Sites	10
1			Credit	Site Assessment	1
		2	Credit	Site Development - Protect or Restore Habitat	2
1			Credit	Open Space	1
1	2		Credit	Rainwater Management	3
2			Credit	Heat Island Reduction	2
1			Credit	Light Pollution Reduction	1
2	4	0		Water Efficiency	6
Y			Prereq	Outdoor Water Use Reduction	Required
1	2		Credit	Outdoor Water Use Reduction	3
1	2		Credit	Cooling Tower Water Use	3
1	0	0		Energy and Atmosphere	1
Y			Prereq	Fundamental Commissioning and Verification	Required
1			Credit	Enhanced Refrigerant Management	1
0	0	0		Materials and Resources	
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
0	0	0		Indoor Environmental Quality	
Y			Prereq	Environmental Tobacco Smoke Control	Required
5	0	0		Innovation	5
1			Credit	Innovation - Green Education	1
1			Credit	Innovation - O+M Starter Kit	1
1			Credit	Innovation - Purchasing Lamps	1
1			Credit	Innovation - Exemplary Performance, TBD	1
1			Credit	Innovation - Pilot Credit, TBD	1
2	0	0		Regional Priority	2
1			Credit	Regional Priority: High Priority Site	1
1			Credit	Regional Priority: Rainwater Management	1
21	7	2		TOTALS	Possible Points: 30

Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110

LEED CREDIT NARRATIVES – BUILDING CREDITS

Integrative Process

The C3 project will be involved in integrative processes at multiple levels - the individual project level as well as district level coordination. The Integrative Process credit will be targeted at the individual project level.

Credit 1: Integrative Process – High

- Both a “simple box” energy model and water budget analysis showing reductions in indoor and outdoor water use were completed before the end of the Schematic Design phase. Narratives describing how these preliminary analyses informed design decisions will be documented in the OPR and BOD.

Location & Transportation

The Volpe Development site is a previously developed site in urban Cambridge, close to several public transportation services including an MBTA transit stop and public bus services.

Credit 2: Sensitive Land Protection – High

- The C3 tower is located on a previously developed site and meets the credit intent. This credit will be achieved.

Credit 4: Surrounding Density and Diverse Uses (v4.1) – High

- The surrounding density of the built land within ¼ mile of the project site exceeds the LEED threshold of 35,000 sf/acre of buildable land. The project is located within ½ mile walking distance of at least 8 diverse uses.

Credit 5: Access to Quality Transit – High

- There are a total of 541 daily weekday trips and 325 daily weekend trips from compliant nearby transit options. Future construction of additional public transportation infrastructure is planned to begin in early 2023 and will supplement the existing nearby transit stops.

Sustainable Sites

MIT is taking a comprehensive approach to site, landscape, habitat creation, stormwater management, and human use. Many of the Sustainable Site’s credits are being coordinated at the district level, but the C3 team will be integrating localized strategies wherever feasible.

Credit 7: Tenant Design and Construction Guidelines – High

- Design Team will work with MIT to provide guidelines for implementing sustainability features in tenant buildout spaces. The tenant design and construction guidelines will be published for tenants in an illustrated document and provided to tenants prior to signing the tenant landlord agreement.

Water Efficiency

The C3 design team will reduce indoor water use through efficiency of fixtures and monitoring of water use.

Credit 2: Indoor Water Use Reduction – Medium

- The design team will select low-flow fixtures to target indoor water use reduction at least 35% below the EPA baseline. Flow rates specified in the Volpe Commercial BOD result in a 42% water use reduction. Ultra-low flow fixtures can achieve up to a 45% reduction in water use.

Credit 4: Water Metering – High

- The design will include submetering for at least two end uses of water subsystems. Typical end uses that are submetered in commercial and/or laboratory buildings include indoor plumbing fixtures, DHW, cooling tower make-up water, boiler water, or other process water, such as sterilization.

Energy and Atmosphere

The C3 design will prioritize reduced energy consumption and clean energy sources through various energy efficiency measures (EEMs), energy metering of building end uses, grid harmonization, renewable energy production, and green power.

Credit 1: Enhanced Commissioning – High

- The commissioning agent's scope of work will include enhanced systems commissioning, monitoring-based commissioning, and envelope commissioning.

Credit 2: Optimize Energy Performance – High

- The project design includes energy efficiency measures such as decoupled HVAC, high performance lighting, sensor-based air change (ACH) controls, and variable-air-volume (VAV). Design team will conduct energy modeling to demonstrate percentage in improvement in energy performance from the ASHRAE 90.1-2010 baseline.

Credit 3: Advanced Energy Metering – Medium

- The design team will consider including building level metering and submetering for all energy uses that consume more than 10% of total building energy.

Credit 4: Grid Harmonization (v4.1) – Low

- Team will continue to evaluate strategies for demand response, but credit is not likely to be achieved.

Credit 5: Renewable Energy Production – Medium

- Design team is exploring all potential solar zone areas for solar photovoltaic (PV) to provide on-site renewable energy systems where feasible.

Credit 7: Green Power and Carbon Offsets – High

- Credit likely. MITIMCO to coordinate purchase of green power, RECs, and/or offsets.

Materials and Resources

The C3 design team will minimize environmental burden and maximize occupant well-being by conducting a Whole-Building Life-Cycle Analysis and selecting healthy, responsibly sourced, low-emitting sustainable materials for permanently installed building products.

Credit 1: Building Life-Cycle Impact Reduction – High

- The C3 design team will conduct a Whole-Building Life-Cycle Assessment (WBLCA) of the project's structure and enclosure that demonstrates a minimum 10% reduction in global warming potential and in at least 2 additional impact categories, as well as a 10% reduction in embodied carbon from the LEED methodology baseline.

Credit 2: Building Product Disclosure & Optimization: Environmental Product Declarations (v4.1) – High

- Design team will select at least 20 permanently installed products with Environmental Product Declarations (EPDs), such as paints, gypsum, steel, concrete, etc.

Credit 3: Building Product Disclosure & Optimization: Sourcing of Raw Materials (v4.1) – High

- At least 15% of all permanently installed building products will have sustainable sourcing attributes such as recycled content, FSC wood, and bio-based materials. The design team seeks to exceed this target of 15% for all installed building products with sustainable attributes.

Credit 4: Building Product Disclosure & Optimization: Material Ingredients (v4.1) – High

- Design team will select at least 20 permanently installed products with Health Product Declarations (HPDs), Declare Labels, or Cradle to Cradle certificates.

Credit 5: Construction and Demolition Waste Management (v4.1) – High

- The project will divert at least 75% of construction and demolition waste from landfills. The project will also track for total waste reduction over the project boundary to determine the pounds of waste generated per square foot of development.

Indoor Environmental Quality

The C3 design team will prioritize indoor environmental quality (air quality, thermal comfort, visual comfort, etc.) to promote the health, well-being, and productivity of building occupants. The design team will refine the project's materials approach in the Design Development (DD) phase and C3 is expected to achieve these credits.

Credit 1: Enhanced Air Quality Strategies – High

- The C3 design includes MERV 13 filters at each ventilation system that supplies outdoor air to occupied spaces and permanent entryway systems to capture dirt and particulates entering the building. Additional indoor air quality measures will be further discussed.

Credit 2: Low-Emitting Materials (v4.1) – High

- The C3 design team will select low-emitting interior materials in at least 3 product categories. Atelier Ten recommends tracking paints and coatings, flooring, and composite wood products.

Credit 3: Construction IAQ Management Plan – High

- The C3 design team will develop and implement an indoor air quality (IAQ) management plan to promote the well-being of construction workers and building occupants by minimizing IAQ problems associated with construction and renovation.

Credit 4: Daylight (v4.1) – Low

- The C3 design team will consider strategies that maximize special daylight autonomy (sDA) and annual sunlight exposure in regularly occupied spaces. The design team ran daylight analysis in the Schematic Design (SD) phase, but the depth of the floorplate makes this credit difficult to achieve.

Credit 5: Quality Views – Medium

- The C3 design team will design for quality views in regularly occupied spaces and consider which non-regularly occupied or non-occupied spaces should be placed in the building's core to prioritize which spaces benefit from quality views.

LEED SCORECARD – BUILDING CREDITS

LEED v4 for BD+C: Core and Shell
Project Checklist - C3

Project Name: Volpe C3
Date: 2/14/23

Y	?	N			
1			Credit	Integrative Process	1
19	**1**	**0**		**Location and Transportation**	**19**
2			Credit	Sensitive Land Protection	1
			Credit	High Priority Site	2
6			Credit	Surrounding Density and Diverse Uses	6
6			Credit	Access to Quality Transit	6
			Credit	Bicycle Facilities	1
	1		Credit	Reduced Parking Footprint	1
			Credit	Green Vehicles	1
7	**2**	**2**		**Sustainable Sites**	**11**
Y			Prereq	Construction Activity Pollution Prevention	Required
			Credit	Site Assessment	1
			Credit	Site Development - Protect or Restore Habitat	2
			Credit	Open Space	1
	2		Credit	Rainwater Management	3
			Credit	Heat Island Reduction	2
			Credit	Light Pollution Reduction	1
1			Credit	Tenant Design and Construction Guidelines	1
5	**7**	**1**		**Water Efficiency**	**13**
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
	2		Credit	Outdoor Water Use Reduction	2
2	3	1	Credit	Indoor Water Use Reduction	6
	2		Credit	Cooling Tower Water Use	2
1			Credit	Water Metering	1
22	**6**	**5**		**Energy and Atmosphere**	**33**
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
6			Credit	Enhanced Commissioning	6
13		5	Credit	Optimize Energy Performance	18
	1		Credit	Advanced Energy Metering	1
	2		Credit	Grid Harmonization	2
	3		Credit	Renewable Energy Production	3
			Credit	Enhanced Refrigerant Management	1
2			Credit	Green Power and Carbon Offsets	2
8	**4**	**2**		**Materials and Resources**	**13**
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
3	1	2	Credit	Building Life-Cycle Impact Reduction	5
1	1		Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
1	1		Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
1	1		Credit	Building Product Disclosure and Optimization - Material Ingredients	2
2			Credit	Construction and Demolition Waste Management	2
5	**2**	**3**		**Indoor Environmental Quality**	**10**
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
2			Credit	Enhanced Indoor Air Quality Strategies	2
2	1		Credit	Low-Emitting Materials	3
1			Credit	Construction Indoor Air Quality Management Plan	1
		3	Credit	Daylight	3
	1		Credit	Quality Views	1
6	**0**	**0**		**Innovation**	**6**
			Credit	Innovation	5
1			Credit	LEED Accredited Professional	1
2	**2**	**0**		**Regional Priority**	**4**
			Credit	Regional Priority: High Priority Site	1
	1		Credit	Regional Priority: Indoor Water Use Reduction	1
			Credit	Regional Priority: Rainwater Management	1
	1		Credit	Regional Priority: Building Life-Cycle Impact Reduction	1
75	**24**	**13**		**TOTALS** Possible Points:	**110**

Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110

GREEN BUILDING REPORT

1. Project + Sustainability Overview

The C3 tower is a high-performance lab/office commercial building of approximately 450,220 GFA located on the southwest corner of the Massachusetts Institute of Technology's (MIT) Volpe redevelopment district. The building is a core and shell lab project that incorporates ground-floor retail to encourage a vibrant mixed-use district with access to below-grade parking.

The building will be designed with high-performance building strategies to meet or exceed the City of Cambridge's Article 22 Special Green Building Permit and Planning Unit Development (PUD) District 7 zoning requirements. Further, the building will be designed to meet or exceed the energy efficiency standards of the Massachusetts (MA) Stretch Energy Code and will incorporate net zero carbon emissions, district black water reuse, and a path to future electrification.

The project is pursuing LEED v4 Core and Shell certification and will be part of a LEED Master Site along with two other commercial buildings and three residential towers.

Integrated Design

The C3 design team will use an integrated design process to support efficient and cost-effective project outcomes through an iterative analysis of the interrelationships among systems. The C3 design team coordinates on a weekly basis to discuss design developments and associated considerations. Frequent communication among design team members ensures that each sustainability goal is met efficiently and at lowest possible cost. Beyond the regular team meetings and discussions incorporating sustainability concepts, the design process included numerous workshops centered on sustainability.

- C3 Sustainability Workshop – July 26, 2022
- Global Sustainability Workshop – August 10, 2022
- Façade Meeting – August 9, 2022
- Daylight Meeting - August 22, 2022
- Exterior Shading Coordination - August 31, 2022
- Façade Embodied Carbon Meeting – September 7, 2022
- MEP and Envelope Backstop Meeting – September 14, 2022
- Sustainability/ LEED Approach Meeting – September 26, 2022
- Energy Modeling and Efficiency Meeting – October 3, 2022
- Article 22 Coordination Meeting – October 12, 2022
- Envelope Energy, Carbon, Daylight, and Views Meeting – October 26, 2022
- Photovoltaic Renewables Meeting – November 29, 2022
- Energy and Envelope Coordination – Weekly consultant coordination meetings

Code Requirements & Evolving Standards

The C3 project will be designed in alignment with the City of Cambridge sustainability initiatives and requirements of Section 13.96.4 of the Planned Unit Development 7 District and Article 22 of the Cambridge Zoning Ordinance.

As required under the PUD-7 Zoning Regulations from the City of Cambridge, the buildings shall achieve a minimum of LEED Gold. As a part of the Volpe Masterplan design process, MIT is exploring district energy heating and cooling systems as well as individual building and site level energy conservation measures. The district system analysis includes the evaluation of potential on-site energy generation within the PUD-7 District.

In addition, MIT continues to enthusiastically engage in the City's numerous ongoing sustainability initiatives such as the City of Cambridge Net Zero Action Plan. The Volpe Project's approach to energy, future electrification, and resilience is consistent with the goals and objectives of the City of Cambridge.

The team has been tracking the progress of the Specialized Code and is aware that the City Council adopted the Specialized Stretch Code on January 23rd, 2023, with an effective date of July 1, 2023. The design team is evaluating the different pathways available for compliance for commercial construction under 225 CMR 23 Appendix CC, as applicable.

Further, the C3 tower will be designed to meet or exceed the Massachusetts Stretch Energy code through an optimized, high-performance building design and highly efficient active systems. Either the 9th Edition of the code based on IECC 2018, or the 10th Edition of the code based on IECC 2021 will be met based on the project filing date. We anticipate filing before July 1st, 2023, and in such, the building will demonstrate compliance with the 9th edition of the code. If filed after July 1st, 2023, the project will demonstrate compliance with the code in effect for such filing date (potentially the 10th edition of the code including the Specialized Stretch Code). The design team is coordinating closely to ensure the code, envelope backstop, and the net-zero energy requirements of the MA Stretch Energy code can be met depending on the applicable code iteration.

2. Energy + Emissions

The Volpe C3 Tower will be designed to meet the ambitious requirements of the Massachusetts Stretch Energy Code (9th or 10th Edition) and the City of Cambridge's Net Zero Action Plan. Beyond code requirements, the performance of the building systems will have environmental and financial benefits because reducing energy use for the project will lessen associated carbon emission offsets and operating costs. District energy systems, future electrification, high-performance lighting, decoupled HVAC, radiant floors, heat recovery, sensor-based ACH controls, and variable air volume (VAV) are some of the many energy efficiency measures (EEMs) being considered in C3's basis of design.

District Energy

As a part of the Volpe Masterplan design process, MIT is exploring district energy heating and cooling systems as well as individual building and site-level energy conservation measures. The district system analysis includes the evaluation of potential on-site geothermal, the use of vicinity steam for Day-1 heating prior to feasibility of full electrification, and a district condenser water loop. The design team evaluated these district energy opportunities on the basis of efficiency improvements, carbon emissions, feasibility, and construction and operating costs. Given the competing infrastructure below grade, such as the Eversource electric transmission line, I&I culvert, and groundwater infiltration tanks (see Figure 1), the feasibility of ground source heat pumps is limited at the site. The team will continue to investigate advances in technologies that may provide district solutions; however, a standalone approach for efficiency and resiliency will be pursued in line with flexibility in construction timeline and ownership factors.

Figure 1 - District Utility Plan

Electrification

The C3 tower energy targets include the design for an all-electric future by providing flexibility to accommodate all-electric MEP equipment in the coming decades when the makeup of the Massachusetts energy grid is anticipated to shift more towards renewable energy sources. This approach will not only prevent a costly design change, but also will avoid the use of excess materials and associated embodied carbon.

The design involves all-electric base heating and cooling on Day 1 with natural gas boilers used only for supplemental heating on peak cold days. The natural gas supplemental heating will eventually be phased out for an all-electric Day 1 scenario.

Renewable Energy

The City of Cambridge is committed to addressing climate change which includes an interest in pursuing PV on all new development. Due to limited availability on the roof, the project team has been exploring all opportunities for photovoltaic installations where feasible, including at the top of the elevator penthouse. In addition, the team is reviewing the Green Roof Ordinance to meet its requirements.

MIT is committed to purchasing green power, RECs, and/or offsets. The project team will evaluate carbon offsets from venders with third-party verification including Green-e certified offsets.

Energy Storage

Opportunity exists for project to utilize on-site energy storage strategies as part of a holistic all-electric system. Energy storage systems, especially battery storage, could be phased into excess below grade spaces as the demand for automobile parking decreases. The team continues to evaluate infrastructure needs to accommodate future flexibility in below grade spaces.

Building Efficiency

The C3 tower will incorporate hybrid electrification with 2-pipe air source heat pumps, dedicated outside air system with premium efficiency glycol run-around energy recovery system energy, and at least one heat recovery chiller to offer high energy efficiency and reduce the need for natural gas consumption. EEMs being incorporated into the base building's design include, but are not limited to:

Architectural

- Highly efficient insulation with a roof construction assembly with effective R-40
- The majority of glazing utilizes triple pane glass; with a solar heat gain coefficient (SHGC) of 0.30, assembly U-0.23
- Operable windows for natural ventilation are not recommended for lab program due to the tightly controlled thermal environment required.

Electrical

- Daylighting dimming controls
- 10% lighting power density (LPD) reductions from 9th Edition baseline
- Occupancy sensors
- Receptacle controls

Mechanical

- Dedicated outside air system with energy recovery system
- Heat recovery chiller for base heating and cooling
- Air-to-water heat pumps for 25% of the building's peak heating capacity
- High efficiency condensing gas-fired boilers to supplement air-to-water heat pumps and heat recovery chiller
- Premium efficiency water-cooled chiller plant
- Tenants will be required to include supplemental cooling and heating at each zone in their fit-out, such that loads do not drive primary airflow as set forth in tenant-landlord agreement.

Controls

- Smart building automation system
- Reset air handling unit supply and return fan pressure setpoints
- Discharge air temperature reset
- Required minimum ventilation rates in non-lab zones that do not exceed ASHRAE 90.1-2016 values by more than 35% in both the base building and tenant fit outs
- Tenants will be required to meet lab setbacks to 50% and office setbacks to 30% of peak airflow during unoccupied modes per tenant landlord agreement.

Energy Efficiency

C3 is a best-in-class large laboratory building in terms of energy performance. Energy analysis conducted at the end of the Schematic Design phase indicates the basis of design (BOD) achieves a 47% reduction in overall site energy compared to the 2023 MA stretch code (10th Ed.) baseline (see figure 2) which is equivalent to a 40% reduction in overall site energy compared to the 2020 Stretch Code (9th Ed.) (see Figure 3) by incorporating the energy efficiency measures listed above, which correspond to an overall Energy Use Intensity (EUI) of 113 kBtu/sf-yr. Note, the EUI of 113 kBtu/sf-yr. is based on the design team's 50% design documentation, and the energy model will continue to be refined throughout the design process. The results are considered best-in-class performance for a laboratory-intensive building, targeting an approximately 98% reduction in fossil fuel consumption (see Figure 4) and a 54% reduction in overall site energy compared to the average existing lab buildings in Cambridge and nearby Boston built since 2012. C3's design will offer high energy efficiency and reduce the need for natural gas consumption.

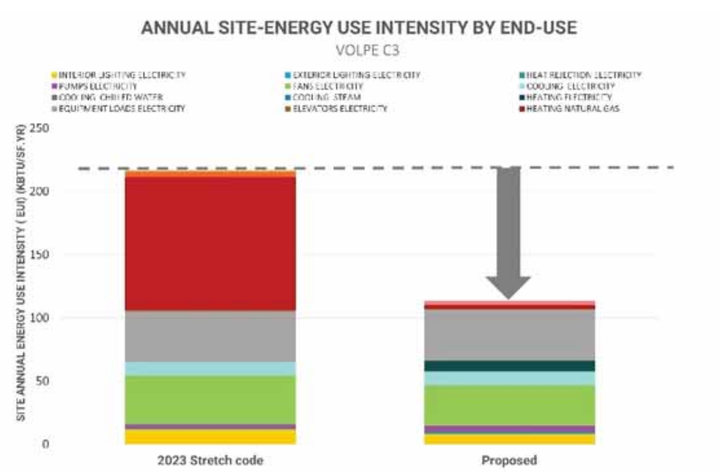

Figure 2 – Annual Site-Energy by End-Use (2023 MA Stretch Code)

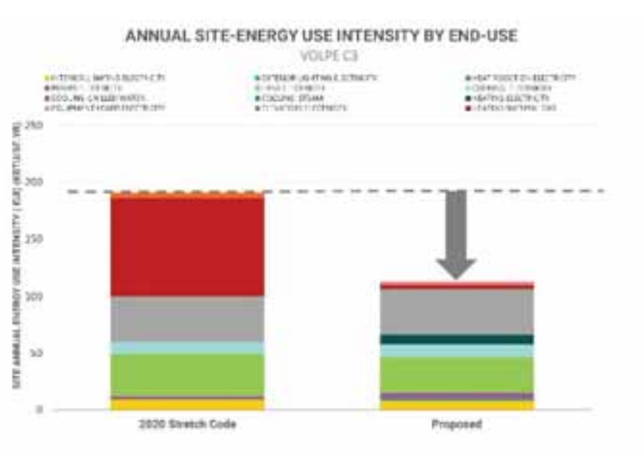

Figure 3 - Annual Site-Energy Use Intensity by End-Use (2020 MA Stretch Code)

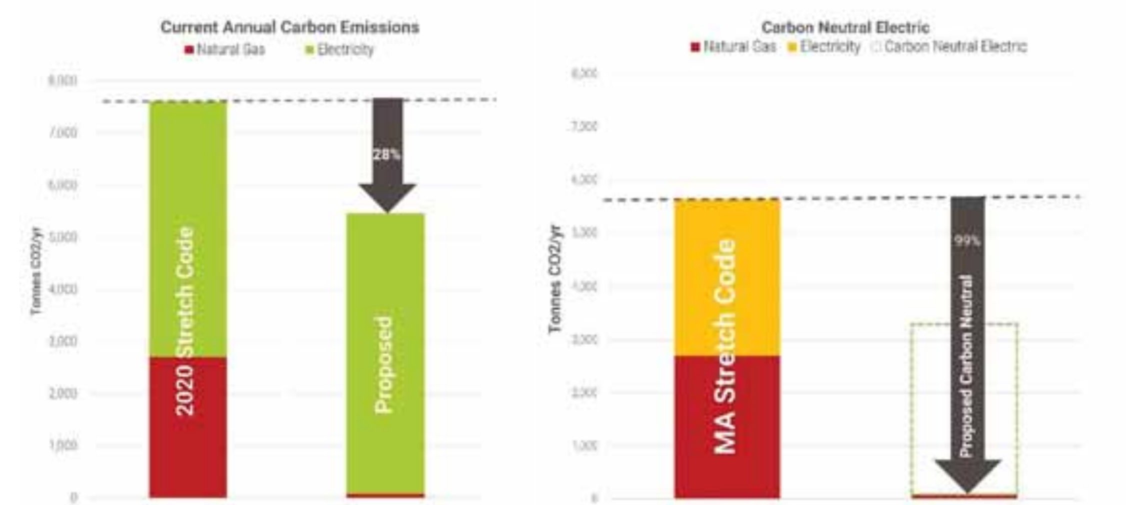

Figure 4 – Annual Carbon Emissions and Carbon Reduction (2020 MA Stretch Code)*

** Figure 4 is based on the current 2020 Stretch Code, as most state and local targets are based on this reference. Due to the difference in modeling methodology, comparison to the 2023 Stretch Code baseline is not a useful benchmark for comping carbon emissions to similar projects.*

The chart on the left reflects today's electric grid emissions factor and the chart on the right show if 100% renewable electricity is purchased, there would be 99% carbon reduction by 2035.

Monitoring

C3 intends to be proactive in energy use management and identifying opportunities for additional energy savings through installation of energy meters and smart building controls. C3 will provide electricity meters to monitor all whole-building energy sources used by the building as well as tenant submeters. MIT will continue to explore feasibility of installing further sub-metering broken down by end use for significant energy demands.

Embodied Carbon

To minimize the embodied carbon impacts of building materials used in the construction of C3, the design team is conducting a Whole Building Life Cycle Assessments (WBLCA) of the project's structure and enclosure targeting a minimum 10% reduction.

Impact Reduction Measures (IRMs) will be incorporated into the design to find and specify low-carbon alternatives to baseline materials and reduce material quantities whenever possible. Potential IRMs under consideration include selecting an optimized concrete mix that entails considerable carbon reductions from the National Ready Mix Concrete Association (NRMCA) Eastern Baseline. Strategies for cement include selecting products that include higher supplementary cementitious materials (SCMs) such as fly ash or slag, using Portland-limestone cement to reduce intensive cement ingredients, and using carbon injection technology such as CarbonCure.

Similarly, the design team will select structural steel and rebar products that have responsible sourcing, manufacturing, and low-carbon ingredients. Strategies for structural steel and rebar selection include buying from steel mills that have recycled content that meets or exceeds industry average values, considering production methods to ensure steel is produced using an electric arc furnace (EAF) rather than a basic oxygen furnace (BOF), prioritizing products that use renewable energy in manufacturing processes, and targeting nearby sourcing locations.

Based on these IRMs, an up to 20% reduction in embodied carbon from the baseline may be possible (see Figure 5), equating to an avoidance of 6,300 MTCO2e which amounts to the carbon used to power 1,225 homes for one year. Additional carbon reductions may be feasible through enclosure optimization, as well, and will be coordinated during the design process.

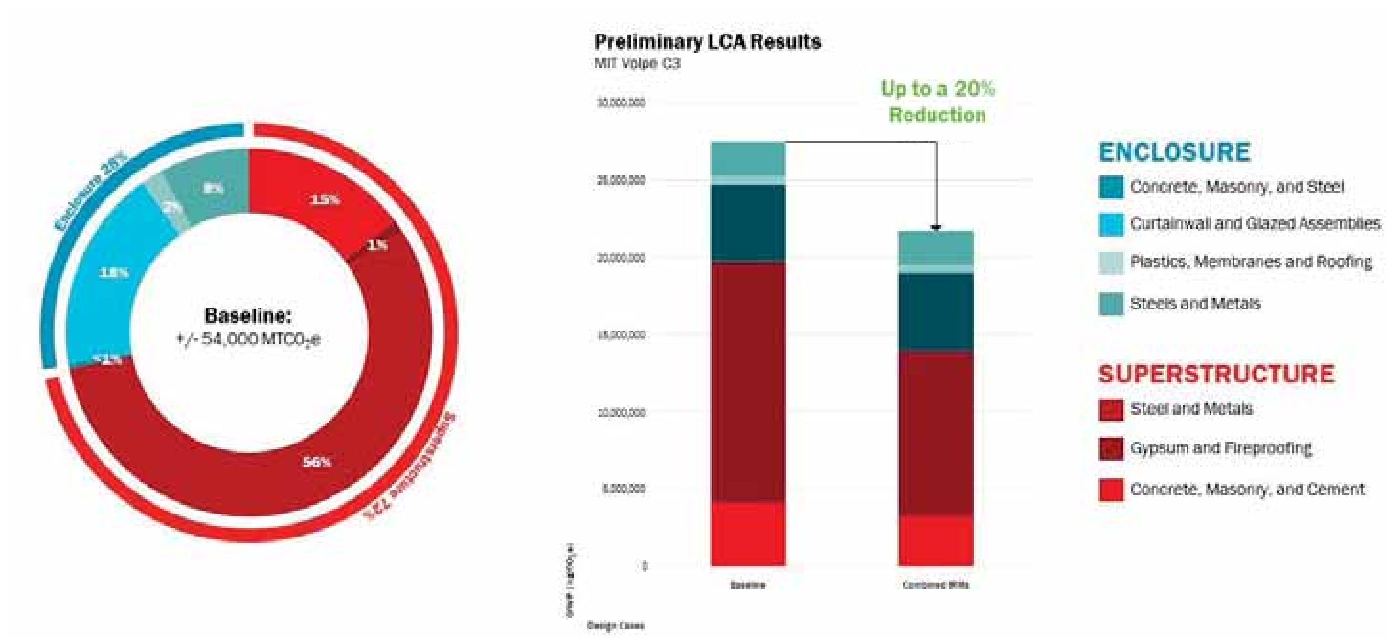

Figure 5 - Preliminary Embodied Carbon Lifecycle Analysis Results

3. Water Use Reduction

In the U.S., buildings use about 14 percent of all potable water which equates to approximately 15 trillion gallons of water per year. Water efficiency and reduction efforts in green building design can serve to drastically reduce this metric. The C3 tower will exceed the average green building's water use reduction to contribute to water conservation and reuse even more substantially.

Water Efficiency

The C3 tower will utilize the "Efficiency First" approach to water use reduction through the selection of low flow plumbing fixtures, targeting a minimum 35% reduction from the EPA baseline through efficiency alone. The design team will be selecting a combination of low flow and ultra-low flow fixtures during the Design Development phase to meet this plumbing fixture goal. Through the use of low flow and ultra-low flow fixtures, the project reduces both its water use and energy use associated with the project's plumbing fixtures. Additionally, potable water use reduction will be further supported by specifying ENERGY STAR appliances and installing cooling towers equipped with makeup water meters, conductivity controllers and overflow alarms, and efficient drift eliminators.

Water Reuse

The MIT Volpe Redevelopment represents an impressive case study in water reuse as the design includes the largest urban district-scale blackwater treatment plant in the northeast and will reuse all building water on-site. The C3 tower will contribute to and benefit from the district blackwater system which will collect and recycle all building water (except lab wastewater) from both commercial and residential towers (see Figure 6).

While the design of the blackwater system is still being coordinated on the global-project level, the intent is to collect water from all building plumbing fixtures to be reused to meet the commercial building's cooling tower make-up water demand. Ultimately, the C3 building will have a day-tank that will receive a non-potable water supply from the district reuse system to divert the water to the reuse demand of its choosing. In the case of the C3 tower, most of this water will be directed toward cooling tower makeup supply, however, additional non-potable water allocation to meet plumbing fixtures and irrigation demand is under consideration.

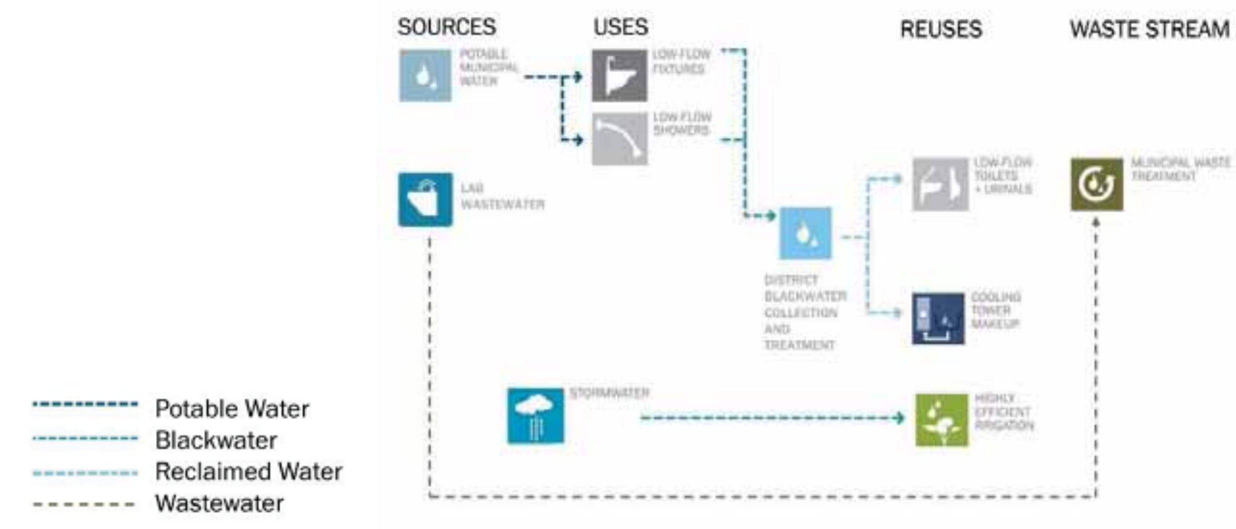

Figure 6 - C3 Water Flow Diagram

4. Health + Wellness

Buildings with improved indoor environmental quality protect the health and comfort of occupants and are known to enhance productivity, decrease absenteeism, and increase the building's value. For commercial office facilities in particular, the creation of healthy interiors is paramount to the physical and mental wellness of those who will occupy the space daily. The C3 Tower will integrate daylight, views of the natural environment, a healthy selection of materials, and noise mitigation to promote occupant health, productivity, and comfort.

Daylight + Views

The project is designed to enhance natural daylight and quality views while mitigating glare. The building's balanced window-to-wall ratio of 48% allows access to daylight and views in regularly occupied spaces while minimizing glare and reducing energy use. The design team conducted multiple, iterative daylight analyses throughout schematic design as part of the data-driven façade design process. The regularly occupied areas of the floorplate to the south and west and around the perimeter of the building receive useful daylight illuminance throughout the year, though the depth of the floorplate while surrounding buildings limit the extent to which daylight can penetrate the core. Glare mitigation is achieved through a minimized window-to-wall ratio (WWR) and a well calibrated façade.

Materials

A healthy and sustainable material palette will be specified for permanently installed products in order to improve air quality, reduce embodied carbon, and avoid chemicals of concern. The C3 design team will examine materials in Design Development to ensure products are specified that create healthy indoor environments. Materials will be low emitting, avoiding hazardous chemicals often found in building materials, and selected based on their potential to reduce embodied emissions.

The team is targeting at least 1 point under LEED's Building Product Disclosure and Optimization credit for Material Ingredients.

Air Quality

The C3 tower will be designed to meet or exceed ASHRAE Standard 62.1-2010 or the local equivalent, whichever is more stringent, to provide enhanced air quality. Lab exhaust rates have been optimized to allow for various tenant programs while minimizing energy consumption. Additional air quality measures include, but are not limited to, providing entryway systems, such as walk-off mats, to reduce exterior pollutants in interior spaces by capturing dirt and particulates from entering the building. The project will also provide measures against interior cross-contamination in spaces where hazardous gases or chemicals are present: not only in labs, but also copy and printing rooms, loading dock entries, and cleaning supplies storage spaces.

Noise Mitigation

The C3 design team will incorporate acoustic performance considerations in the building design to promote occupants' well-being, productivity, and communications. Occupied spaces will be prioritized in acoustic performance provisions, including criteria such as minimized HVAC background noise, acoustic privacy, and reverberation time to comply with 2011 HVAC Handbook, HVAC applications, Chapter 48, Table 1.

5. Site + Transportation

The Volpe site will revitalize publicly beneficial open space and create a landscape that provides habitat and pedestrian tree canopy cover, active outdoor recreation areas, and incorporates stormwater management and reuse strategies. Similarly, design measures will be provided to encourage alternative transportation by enhancing bicycle networks, supporting carpool/carshare, and improving pedestrian connectivity to public transit stations. While many of these strategies are being coordinated at the district-level, the C3 tower will support these aims through localize site strategies, for example by providing bicycle facilities on site.

Surrounding Site Strategies

The project will feature infiltration tanks located below grade on multiple areas of the site, as well as integrated green infrastructure, efficient drip irrigation, and native and adapted vegetation throughout the site. The C3 project will also directly benefit from the adjacent Sixth Street Park immediately to the west of the building including multiple different types of play spaces, passive parks, a half basketball court, and a dog park.

Outdoor Comfort

MIT has engaged RWDI to assess predicted wind conditions on-site for the Volpe development. RWDI conducted a pedestrian wind assessment for the proposed Volpe Master plan and issued a report on 1/19/23. The wind conditions have been tested based on wind-tunnel testing of the project with partial and full buildout configurations along with landscaping based on local wind conditions. Based on the results of these studies, the majority of areas around the C3 building are in the comfortable range for sitting and standing pedestrians. The design strives to contribute to a comfortable outdoor microclimate.

Bicycle Facilities

Cambridge, MA is the host of an expansive bike network that is continuously being improved. The C3 tower is planning to provide 105 long-term and 37 short-term bike parking spaces as well as 16 shower facilities to encourage occupant's use of the existing bicycle network with the aim of reducing reliance on motor vehicles for transportation to and from work. Bike facilities for C3's occupants will be provided in the below-grade parking garage.

Surrounding Connections

The C3 tower is located nearby numerous transit stations served by the Red Line rapid transit service, MBTA buses, and an EZ ride stop. Occupants will have the option to take the Red Line at the Kendall/MIT station and ride downtown to Boston as a final destination or as a connection point to the Green, Orange, or Silver Lines. The transit services currently available within walking distance of the site provide 541 daily weekday trips and 325 daily weekend trips (see Figure 7) and will increase as a result of a forthcoming bus line expected to begin construction in early 2023. Additionally, the Volpe redevelopment district is within a 0.5-mile walking distance of many diverse services such as the MIT museum, Bright Horizons Childcare Center, and Brothers Marketplace.

Figure 7: Existing Surrounding Transit Connections

Green Roof

The team is continuing to identify areas to incorporate additional vegetation to achieve Sustainable Sites LEED Credits and comply with the City of Cambridge Green Roof Ordinance. Under the Green Roof Ordinance, the team estimates that over 4,600 SF of the roof will be devoted to Green Roof Area, Biosolar Green Roof Area, or Solar Energy Systems. This is an area of at least 80% of the roof area of the building, subject to the exclusions for areas such as mechanical areas that are identified in the Green Roof Ordinance itself.

Green Roof Ordinance – Section 22.30
For any new building > 25,000 SF, at least 80% of the building's roof area (excluding areas accessed only for maintenance purposes, mechanical equipment, areas required for clearance, etc), shall be devoted to Green Roof Area, Biosolar Green Roof Area, or Solar Energy Systems

GBO REQUIREMENT	
Gross Roof Area	32,365
Exemptions for Roof Area	
• Base Building Mechanical Equipment	-3,979
• Tenant Equipment	-3,961
• Access Pathways	-17,181
• Elevator Bulkhead	-1,484
Applicable Roof Area	+/- 5,750
80% of Applicable Roof Area	+/- 4,600

C3 PROPOSED	Area (sf)
Proposed Green Roof Area	+/- 3,800
Proposed PV Area	+/- 800
Total	+/- 4,600

Figure 8 – C3 Roof Area

6. Resilience

The C3 project will embrace climate resilient strategies including elevating critical equipment, incorporating stormwater mitigation strategies, providing standby power for critical equipment, and mitigating urban heat island through integrated site and building strategies.

Water

The project will be designed to manage at least the 100-year 2070 precipitation storm event so that it is prepared for future flooding. The majority of C3's building footprint is located within the future 2070 100-year precipitation floodplain as per the Cambridge Flood Viewer. Elevating MEP infrastructure will be critical for designing the project to withstand such a storm. The C3 design will prioritize passive flood mitigation systems such as floodgates as part of site-wide resilience efforts in addition to below-grade infiltration tanks (See Figure 9).

Figure 9: C3 Ground Floor Plan, Flood Mitigation Strategies

Additionally, the project's access to reused blackwater will contribute to resilience efforts since the building's reliance on potable water resources will decrease. Reducing C3's dependence on municipal resources in tandem with self-sufficient systems will promote a sustainable semi-closed loop water cycle.

Heat Risk + Urban Heat Island

C3 will contribute to mitigating heat risk and the urban heat island effect by providing green spaces throughout the site and selecting highly reflective paving and roofing materials. Heat risk is a substantial threat to thermal comfort, human health, and can be deadly in extreme cases. C3 will address the heat island effect by maximizing green space in the site landscape in addition to optimizing the façade for solar radiation (See Figure 10). The design team conducted extensive façade and solar radiation analysis during schematic design to optimize strategies that improve thermal comfort, shade building glazing for reduced solar gain, and increase passive survivability in the event of power-outage.

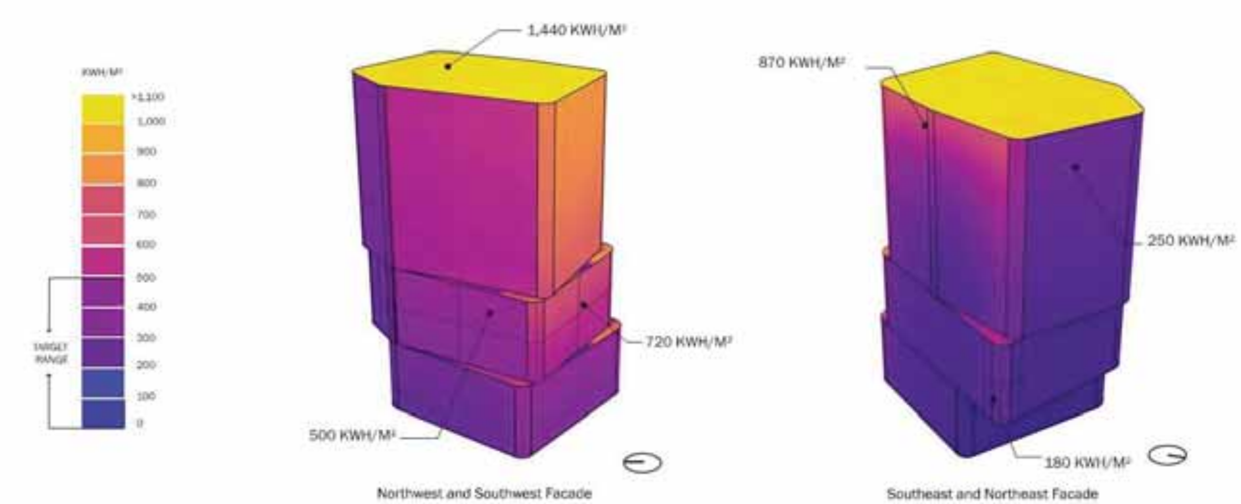

Figure 10: Annual Solar Radiation

7. Building Certification

Sustainable buildings consume 30-50% less energy, consume 40% less water, produce 35-40% less carbon dioxide, and produce 50-70% less solid waste than conventionally constructed buildings.[1] In addition to these reductions, LEED certified buildings are proven to increase efficiency, save money, and create healthier spaces for people. The C3 tower will pursue LEED certification in alignment with these goals.

LEED

The C3 project will pursue the LEED Version 4 Building Design + Construction (BD+C): Core and Shell (CS) rating system along with the other Volpe Redevelopment parcels at the Master Site (MS) level. Based on a preliminary LEED assessment, Atelier Ten has established a current estimate of 75 high-achievability points, 23 medium-achievability points, and 13 low-achievability points. Currently, 21 high-achievability points are being pursued at the MS level, with the remaining 54 high-achievability points set to be pursued at the project-level. The minimum threshold to achieve LEED Gold is 60 points.

In addition, the project will explore opportunities to utilize LEED v4.1 credit substitutions to take advantage of clarified and updated achievement pathways where viable.

WELL

A primary goal of the C3 project is to foster health and well-being among its occupants through building design as well as policies and protocols that promote these values. While the C3 project team is not pursing *certification* for the WELL rating system the design team is evaluating and integrating aspects of WELL into the project as a complement and a supplement to LEED design interventions. Additionally, the C3 project is evaluating certification and alignment with the FitWel healthy building standard.

Below are a few examples of WELL credits that the C3 project is aligned with:

- Smoke Free Environment
- Construction Pollution Management
- Enhanced Ventilation
- Thermal Performance
- Hazardous Material Abatement
- Integrative Design

[1] *Environmental Protection Agency. (n.d.). Greenhouse Gas Equivalencies Calculator: Convert emissions or energy data into concrete terms you can understand – such as the annual CO2 emissions of cars, households, and power plants. EPA. Retrieved October 24, 2022, from https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results*

8. Above and Beyond

The C3 tower will be designed to exceed the energy efficiency standards of the Massachusetts (MA) Stretch Energy Code and will include district blackwater reuse, future electrification, and advanced flood mitigation strategies.

Water Reuse

As noted, the MIT Volpe Redevelopment will be the host to the largest urban district-scale blackwater treatment plant in the northeast. All building water (except lab wastewater) will be reused on site. The water will first be collected in infiltration tanks below grade and will be distributed to storage tanks allocated to individual buildings. The C3 design team is at liberty to decide where to direct its allocated treated blackwater, as are the remaining district parcels. It is C3's intent to allocate a majority of this water supply toward cooling towers as makeup water, significantly reducing required potable water for cooling tower processes.

All Electric Day 1 Feasibility

The Cambridge Net Zero Action Plan requires buildings be at least all-electric ready for a streamlined transition in future adoption of an all-electric building system. The C3 tower intends to exceed code requirements by exploring all-electric heating and cooling on Day 1. A lab/office space is not the typical candidate for an all-electric design due to critical peak heating demands, therefore backup gas connections for emergency use will be provided in instances where peak energy demand exceeds the capacity of the building's electric system.

Advanced Resilience Measures

The C3 electrical vault and other MEP infrastructure will be elevated above the flood plain so in the event of a flood, these critical building components are protected. Master Site flood mitigation strategies go above and beyond elevated infrastructure through the incorporation of flood gates at critical flood locations, and elevated ground floor program areas where most applicable. Strategies for passive mitigation are being studied to protect against 3-4 ft storm surges.

NET ZERO NARRATIVE

PROJECT PROFILE

The information included in this Net Zero narrative submission incorporates the latest design information from 50% Design Development phase where applicable. Performance values and systems included in this documentation are subject to change through the final design.

Development Characteristics

Lot Area (sq.ft.):	+/- 383,894 sf (master plan area) +/- 53,834 sf (C3 parcel area)
Existing Land Use(s) and Gross Floor Area (sq.ft.), by Use:	Government Operations: 312,746 sf
Proposed Land Use(s) and Gross Floor Area (sq.ft.), by Use:	Retail: ~10,433 SF General Office: ~187,040 SF Lab: ~280,560 SF
Proposed Building Height(s) (ft. and stories):	250ft (top of occupied space), 16 occupied floors
Proposed Dwelling Units:	0
Proposed Open Space (sq.ft.):	Approx. 3.5 acres (master plan area)
Proposed Parking Spaces:	Approx. 353 spaces provided (proposed parking will be shared with other uses in the future)
Proposed Bicycle Parking Spaces (Long-Term and Short-Term):	Longterm: 105 Short-Term: 37

Green Building Rating System

Choose the Rating System selected for this project:

LEED-Leadership in Energy & Environmental Design (U.S. Green Building Council)			
Rating System & Version:	LEED Core and Shell v4	Seeking Certification?*	Yes
Rating Level:	Gold	# of Points:	75 points

Enterprise Green Communities			
Rating System & Version:		Seeking Certification?*	No
Rating Level:		# of Points:	

Passive House Institute US (PHIUS) or Passivhaus Institut (PHI)			
Rating System & Version:		Seeking Certification?*	No

*(*NOTE: Certification is not required through the Green Building Requirements. However, you may choose to indicate if the Project Team intends to pursue formal certification through these Green Building Rating Programs (or their affiliates).)*

PROPOSED PROJECT DESIGN CHARACTERISTICS

Building Envelope

Assembly Descriptions: Note that the following description reflects 50% DD

Roof:	High albedo roof membrane over underlayment board and R-40 polystyrene insulation
Foundation:	Concrete slurry wall with rigid insulation at base of building to 4' below grade.
Exterior Walls:	At opaque areas, custom curtain wall consists of terra cotta tiles with aluminum panel, 8" minimum mineral fiber insulation, and galvanized steel air barrier.
Windows:	Vision areas of curtain wall include triple insulating glass with two low-e coatings structurally glazed to thermally broken aluminum framing.
Window-to-Wall Ratio:	48%
Other Components:	

Envelope Performance:

(Provide estimates of the thermal transmittance (U-value) for the building envelope compared to "Baseline" standards required by the Massachusetts Stretch Energy Code, latest adopted edition.)
Note: Baseline values refer to 9th edition code. Proposed value refer to 50% DD.

	Proposed		Baseline	
	Area (sf)	U-value	Area (sf)	U-value
Window	+/- 97,300	0.23 (SHGC: 0.30)	+/- 97,300	Fixed: 0.38 (SHGC: 0.38) Operable: 0.45 (SHGC: 0.38)
Wall	+/- 104,900	0.097	+/- 104,900	0.064
Roof	+/- 32,400	0.025	+/- 32,400	0.032

Envelope Commissioning Process:

MIT understands the lasting value of strong commissioning practices. MIT will pursue envelope commissioning in line with LEED v4 Enhanced Commissioning Requirements, including Envelope Commissioning. To ensure the building is constructed in alignment with the design and energy efficiency goals, MIT will engage a Building Envelope Commissioning Agent, (BECxA). The BECxA will review the project documents, provide suggestions to the design team, and conduct on-site testing to confirm the constructed building envelope meets the Owner's project requirements.

Building Mechanical Systems

Systems Descriptions:

Airside Systems:	- (6) 90,000 CFM Hydronic Dedicated outdoor air supply (DOAS) unit for ventilation air - (8) 67,500 CFM Exhaust units with high efficiency energy recovery coils. - FCUs for space conditioning for Office and Lab spaces (by tenant) - Variable air volume terminal units for lobbies - Water-source heat pump/Packaged single zone units for retail spaces (by tenant)
Space Heating:	- (1) 350-ton modular heat recover chiller installed as the first stage of heating - Modular Air Source Heat Pumps installed as the second stage of heating - (8) 6,000 MBH gas fired condensing boilers, each capable of handling 14% of the load (N+1 redundancy) as the third stage of heating
Space Cooling:	- Chilled water (CHW) from (4) 900-ton high efficiency centrifugal chillers each with VFD drives
Heat Rejection:	- (4) 900-ton evaporative open cooling towers w/ variable speed fan motors - Dedicated 400-ton open loop cooling tower serving tenant CW loop
Pumps & Auxiliary:	- Variable Speed pumps for CHW, HW, CW, PCW, and GLYW
Ventilation:	- Ventilation requirements based on ASHRAE 62.1-2016 - Dedicated outside air units with energy recovery providing ventilation
Domestic Hot Water:	- (2) 30 gallon electric water heaters for P1 and level 1 - (15) 50 gallon electric water heaters for typical tenant floors
Interior Lighting:	- All LED lighting fixtures with occupancy and daylight controls - LPDs based on MA 2020 Stretch Code w/10% reduction
Exterior Lighting:	- All LED lighting fixtures with installed capacity of ~3.0 kW
Other Equipment:	- Elevators

Systems Commissioning Process:

MIT will commission building systems to maintain performance and ensure maximum energy savings and emissions reductions as outlined in LEED v4 Enhanced Commissioning Requirements.

BUILDING ENERGY PERFORMANCE MEASURES

Overview

(Broadly describe the ways in which building energy performance has been integrated into the following aspects of the project's planning, design, engineering, and commissioning. More detail on specific measures can be provided in appendices.)

Land Uses:	The building will include commercial office and/or lab uses on the upper floors, retail and active uses on the Ground Floor, and below-grade parking. The open space will promote connections with the environment, encourage retail spill-out from the building, and engage outdoor activities. The project will provide bicycle infrastructure and connectivity to multimodal public transportations to promote walking and bicycling throughout the development. Site connectivity and careful planning of loading and servicing of buildings enhances pedestrian-friendly circulation. To reduce stormwater runoff, the site will collect, reuse, and infiltrate excess stormater that falls within the boundary of the development.
Building Orientation and Massing:	The massing of the building is intended to complement the ensemble of buildings within the Volpe development. The base volume is oriented in a slightly west-leaning north-south direction with its primary edge along Broadway to reinforce pedestrian connectivity to the Charles River and MIT Campus. The upper volumes are rotated to relieve pressure on surrounding context while providing opportunities to utilize the resulting terrace space. Building footprints defined by street grid, which has been designed to allow connectivity through a previous super-block site. From there, setbacks have been designed to maximize daylight to the street level, while park areas have been located to take advantage of the best solar exposures and daylight.
Envelope Systems:	The building's exterior envelope is composed of triple-insulated high-performance glazing in an aluminum curtain wall system. Thermal breaks are incorporated into aluminum framing and terra cotta attachments. Shading and Solar Heat Gain is addressed through selection of high-performance glass coatings, in combination with interior roller shades to reduce glare and allow for a comfortable working environment. Additional insulation at mechanical levels (and spandrel zones) provided to improve thermal performance of opaque areas.
Mechanical Systems:	- High-performance on-site chiller and boiler plant - Heat recovery chiller - Air to water heat pumps - High-performance run-around glycol energy recovery coil for the lab exhaust - Higher supply air temperature reset for the DOAS AHUs to reduce the reheat energy - DOAS units for ventilation and FCUs for conditioning the tenant spaces - Variable speed exhaust fan system
Renewable Energy Systems:	MIT is working to identify areas of the building that would most benefit from Photovoltaic systems.
District-Wide Energy Systems:	The team will continue to investigate advances in technologies that may provide district solutions; however, a standalone approach for efficiency and resiliency will be pursued in line with flexibility in construction timeline and ownership factors. Given the competing infrastructure below grade, such as the Eversource electric transmission line, I&I culvert, and groundwater infiltration tanks (see Figure 1), the feasibility of ground source heat pumps is limited at the site.
Other Systems:	Approximately 180 EV spaces in the garage south of Potter Street to be shared between all 6 buildings

Integrative Design Process

(Describe how different parties in the development process (owners, developers, architects, engineers, contractors, commissioning agents) have collaborated in the design. Include the Basis of Design and Owner's Project Requirements and describe how they have been informed by planning activities such as meetings or design charettes. Describe how continuing collaborative processes will inform Schematic/Design and Construction Documents.)

The design team has pursued an integrated design process that includes continuous participation from the technical experts to enhance and improve the overall design. This comprehensive approach allows the development to incorporate sustainability best practices in design and operation, stormwater capture and reuse, transportation, and landscape strategies.

The team conducted a preliminary energy analysis and water budget before the completion of the Schematic Design (SD) phase, and both will be documented in the buildings' OPR & BOD.

MIT, Elkus Manfredi, Heintges, BR+A, and Atelier Ten engaged in robust conversations on sustainability. Beyond the regular team meetings and discussions incorporating sustainability concepts, the design process included numerous workshops centered on sustainability.

- C3 Sustainability Workshop – July 26, 2022
- Global Sustainability Workshop – August 10, 2022
- Façade Meeting – August 9, 2022
- Daylight Meeting - August 22, 2022
- Façade Embodied Carbon Meeting – September 7, 2022
- Sustainability/ LEED approach meeting – September 26, 2022
- Energy Modeling and Efficiency Meeting – October 3, 2022
- Article 22 Coordination Meeting – October 12, 2022
- Envelope Energy, Carbon, Daylight, and Views Meeting – October 26, 2022
- Photovoltaic Renewables Meeting – November 29, 2022
- Energy and Envelope Coordination – Weekly consultant coordination meetings

MIT has continued to employ an integrative team process throughout the design development phase to maintain focus on sustainability and building performance.

Green Building Incentive Program Assistance

(Describe any programs applicable to this project that would support improved energy performance or reduced greenhouse gas emissions, and which of those programs have been contacted and may be pursued. Programs may be offered by utility companies, government agencies, and other organizations, and might include rebates, grants, financing, technical assistance, and other incentives.)

The project team is considering incentives available through Mass Save. Applicable programs include the Commercial New Construction and Major Renovations program. MIT is familiar working with Eversource for the Mass Save program through other projects such as the Residences at 165 Main Street (Kendall Square Site 1), Commercial building at 238 Main street (Kendall Square Site 3), Academic administrative offices at Buildings E37, E38 (Kendall Square Site 4), and Commercial building at 314 Main Street (Kendall Square Site 5).

The Commercial New Construction and Major Renovations program offers multiple pathways for achieving financial support. Path 2: Whole Buildings Energy Use Intensity (EUI) Reduction has been identified as the most applicable pathway for this project. The program provides financial incentives based on percent EUI reductions beyond the Mass Save Baseline and provides cost share for technical assistance (up to 75%) as well as financial incentives to help projects achieve the EUI goal. Projects begin earning incentives for a 10% EUI reduction relative to the Mass Save Baseline. In addition, an optional Verification Incentive will be explored which would provide financial support to assist projects in ensuring the EUI target set during design is achieved post occupancy. The project team will investigate these incentive opportunities further to ensure the project is eligible for the maximum incentive benefit possible.

The team will continue to evaluate the applicable incentive programs as the design progresses. MIT will review opportunities for the Mass Save program with Eversource following the January 17, 2023 meeting with the City of Cambridge.

NET ZERO SCENARIO TRANSITION

(Describe the technical framework by which the project can be transitioned to net zero greenhouse gas emissions in the future, acknowledging that such a transition might not be economically feasible at first. This description should explain the future condition and the process of transitioning from the proposed design to the future condition.)

	Net Zero Condition:	Transition Process:
Building Envelope:	Limited opportunity to impact envelope in future. Potential upgrades at time of significant system replacement may be possible, but likely a long term strategy.	N/A
HVAC Systems:	Heat recovery chiller(s) + ASHPs + Exhaust source heat pumps shall supply (100%) of the building's peak heating load at the ASHRAE 99.6% winter climatic design condition. Electric boilers for supplemental heating on peak demand days. Condensing boilers will be in place as a backup.	Exhaust source heat pump chillers, additional ASHPs, and electric boilers will be added to provide supplemental heating during peak demand days.
Domestic Hot Water:	Electric water heaters to meet DHW loads	N/A
Lighting:	LPD will continue to evolve with TI and renovation cycle as new technologies develop.	LPD will continue to evolve with TI and renovation cycle as new technologies develop.
Renewable Energy Systems:	An estimated 15 kW PV array system will be added via roof top panels at the penthouse.	N/A
Other Strategies:	Electrical infrastructure in the BOD shall be designed to handle the future all-electric HVAC infrastructure	N/A

ENERGY SYSTEM COMPARISON

Overview

(This section should describe the results of an analysis comparing the technical and financial feasibility to meet the projected HVAC and domestic hot water demands of the building using energy systems that do not consume carbon-based fuels on-site compared to code-compliant energy systems that consume carbon based fuels on-site.)

The non-carbon fuel scenario is identical to the net zero scenario. Please refer to the information above for the Net Zero scenario for a description of how the building would operate without combustion-based fuels for non-backup equipment.

Assumptions

(Describe what building energy systems were included and excluded in your analysis and why.)

	Included in analysis?		Describe the systems for which this was analyzed or explain why it was not included in the analysis:
	Yes	No	
Solar Photovoltaics:	X		Solar Photovoltaics are included in the Proposed Design.
Solar Hot Water:		X	Excluded. The rooftop area is fully utilized for active building mechanical systems
Ground-Source Heat Pumps (Geothermal):		X	Geothermal capacity within feasible area of the project site boundary would not meet the demand of project. A demonstration installation of GSHPs is being considered within the Volpe district, but may not be attributed to this proejct.
Water-Source Heat Pumps:	X		Description in Net Zero Scenario above.
Air-Source Heat Pumps:	X		Description in Net Zero Scenario above.
Non-Carbon Fuel District Energy:		X	Building is owned and operated independently of adjacent buildings
Other Non Carbon-Fuel Systems:		N/A	N/A

Non-Carbon-Fuel Scenario

The non-carbon fuel scenario is identical to the net zero scenario. Please refer to the information above for the Net Zero scenario for a description of what systems would be used in a non-carbon fuel scenario. Future Proposed design has been optimized to become 100% electric and resulting in no fossil fuel consumption. This offers great opportunity for carbon neutrality, LEED Certification, and overall savings on operations. Volpe C3 future Net Zero plan can be achieved by on-site and off-site renewable energy options.

Solar-Ready Roof Assessment

(The purpose of this assessment is to determine the technical feasibility of solar energy system installation, either as part of the proposed project or in the future. It is helpful to supplement this narrative with a plan depicting the information provided.)

Total Roof Area (sq. ft.):	+/- 32,400 sf
Unshaded Roof Area (sq. ft.):	+/- 32,400 sf
Structural Support:	PV installations to be hosted on roof of penthouse.
Electrical Infrastructure:	The PV output will be connected to the building's 4000A, 480V Main Switchboard with a dedicated circuit breaker in the Penthouse. The connection will be in accordance with Article 705.12 of the MA Electric Code.
Other Roof Appurtenances:	The roof houses cooling towers, generators, stair pressurization H&V units, exhaust fans, and air source heat pumps, limiting the available roof area for photovoltaic (PV) panels. Space is identified for installing future air source heat pumps and future all electric equipment as well. Future equipment for electrification further limits the available space on the roof top.
Solar-Ready Roof Area (sq. ft.):	Based on information above, the design team identified the top of the elevator penthouse as alternative building surfaces that could support PV installations. The team is exploring additional potential solar zone areas on the rooftop for PV. +/- Approximately 800 sf of roof top PV array
Capacity of Solar Array:	Based on the PV area described above, the total installed energy capacity of the proposed PV array is 15 KW (0.1% of the building's annual energy consumption). This is an estimate. Final PV capacity to be determined based on product selection.
Financial Incentives:	MIT will investigate financial incentive programs to reduce the first cost of the proposed PV array.
Cost Feasibility:	The design team is currently evaluating cost feasibility for the array as described. This section will be updated as the design progresses prior to subsequent submissions.

Results

(Briefly summarize the results of the analysis and how it has informed the design of the project. Also include figures for the "Non-Carbon-Fuel Scenario" in the concluding Summary Table at the end of the Net Zero Narrative. Attachments can be provided with more specific figures and metrics regarding installation, maintenance, and upkeep costs (exclusive of operating fuel expenses), but a full report is not necessary.)

	Proposed Design		Non-Carbon-Fuel Scenario	
	Installation Cost	Maintenance Cost	Installation Cost	Maintenance Cost
Space Heating				
Space Cooling				
Heat Rejection				
Pumps & Aux.				
Ventilation				
Domestic Hot Water				
(Financial Incentives)	TBD		TBD	
Total Building Energy System Cost	Estimate under development		Estimate under development	

The design team is encouraged by the reduction in operational energy, specifically heating energy exhibited by the heat pump chillers and air-source heating equipment. The additional cost of heating will be evaluated against the potential decrease in future carbon emissions to determine what measures could be included in the final design.

MIT and the design team are excited about the future of electrification, the team is conscious of the realities on the use and reliability of an all-electric lab building. As utility grid emissions improve for increased electricity generation and renewable sources, the ASHPs/ Electric boilers can be installed to make a significant reduction in operational carbon emissions. The design team is committed to preparing for an all-electric future and is evaluating in greater depth the potential feasibility for the hybrid solution with a heat-pump chiller at the site. The heat pump chiller would be designed similarly to the full-electrification scenario and would serve the primary heating demand however, natural gas boilers would provide secondary heating loads and heating in power-loss situations. MIT and the design team will ensure the project will have the capability to transition to all-electric in the future.

ANTICIPATED ENERGY LOADS AND GREENHOUSE GAS EMISSIONS

Assumptions

(Describe the assumptions and methodology used to conduct preliminary energy modeling and set energy targets for the project. Specifically describe what components of the building were included and excluded.)

The project will demonstrate energy code compliance by adhering to the 9th Edition – Revised of the Massachusetts Building Code - 780 CMR, Chapter 13.00 - Energy Efficiency, including Appendix AA (MA Stretch Code). The baseline building is modeled to adhere to the methodology described by ASHRAE 90.1-2013 Appendix G, with MA Amendments. The model considers current design assumptions about occupancy, hours of operation, internal loads, envelope criteria, and mechanical system design. Tenant areas were modeled assuming a 60/40 distribution of lab and office areas with generic space layouts, consistent with the building design criteria.

In addition, to comply with Section C406 of MA Energy Code, the baseline and proposed buildings capture the energy use reductions associated with at least three of the following C406 measures:

- C406.2: More efficient HVAC performance
- C406.3: Reduced Lighting Power Density
- C406.4: Enhanced Digital Lighting Controls
- C406.5: On-site supply of renewable energy
- C406.6: Provision of a dedicated outdoor air system for certain HVAC equipment
- C406.7: High efficiency service water heating
- C406.8: Enhanced envelope performance
- C406.9: Reduced air-infiltration
- C406.10: Renewable space heating
- C406.11: Type IV Heavy timber construction

The anticipated energy analysis results included in this documentation are based on the 50% Design Development phase drawings and are subject to change through the final design. Updated energy results will be performed with each major design submission. The model considers current design assumptions about occupancy, hours of operation, internal loads, envelope criteria, and mechanical system design. Tenant areas were modeled assuming a 60/40 distribution of lab and office areas with generic space layouts, consistent with the building design criteria.

Annual Projected Energy Consumption and Greenhouse Gas (GHG) Emissions

The preliminary energy modeling results should be shown in a table format similar to what is shown below. It should compare the "baseline building" (Massachusetts Stretch Energy Code) to the proposed design, as well as the future "net zero" scenario described later in this narrative.

	Baseline Building		Proposed Design		Non-Carbon-Fuel Scenario	
	MMBTU	*% of Total*	*MMBTU*	*% of Total*	*MMBTU*	*% of Total*
Space Heating	47,780	45%	6,475	10%	5,550	9%
Space Cooling	5,590	5%	6,140	10%	6,170	10%
Heat Rejection	180	0%	1,020	2%	920	1%
Pumps & Aux.	1,480	1%	2,725	4%	2,730	4%
Ventilation	21,120	20%	17,790	28%	17,790	28%
Domestic Hot Water	2,530	2%	1,760	3%	1,760	3%
Interior Lighting	5,040	5%	4,520	7%	4,520	7%
Exterior Lighting	75	0%	75	0%	75	0%
Misc. Equipment	22,960	22%	22,960	36%	22,960	37%
	$US, MMBTU, kBTU/SF		*$US, MMBTU, kBTU/SF*	*% Reduction from Baseline*	*$US, MMBTU, kBTU/SF*	*% Reduction from Baseline*
Site EUI	192		113	41%	115	42%
Source EUI	378		312	17%	322	17%
Total Energy Use	106,755		63,465	41%	67,830	41%
Total Energy Cost	~$3.3 M		~$3.063 M	8%	~$3.34M	7%
	kWh or Therms	*% of Total Energy*	*kWh or Therms*	*% of Total Energy*	*kWh or Therms*	*% of Total Energy*
On-Site Renewable Energy Generation	N/A	0	20,000 kWh/yr.	0	20,000 kWh/yr.	0
Off-Site Renewable Energy Generation	N/A	N/A	N/A	N/A	N/A	N/A

	Baseline Building	Proposed Design	
	Tons CO2 [/SF]	*Tons CO2 [/SF]*	*% Reduction from Baseline*
GHG Emissions	7,610	5,465	28%
GHG Emissions per SF	0.01359	0.00976	278

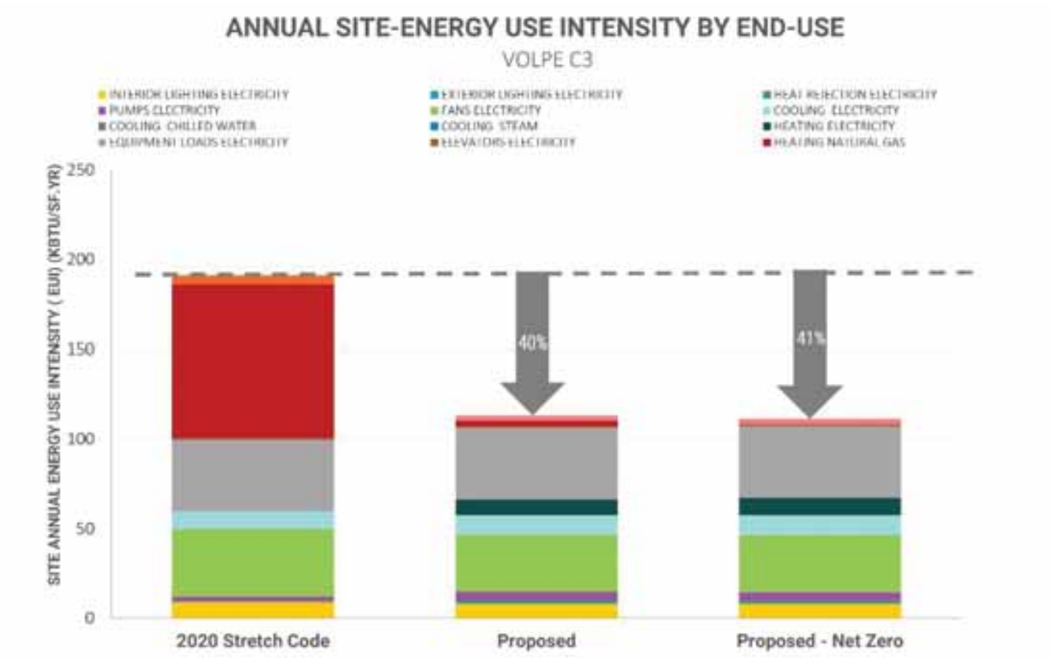

Figure 11: 50% DD Annual Site-Energy Use Intensity by End-Use

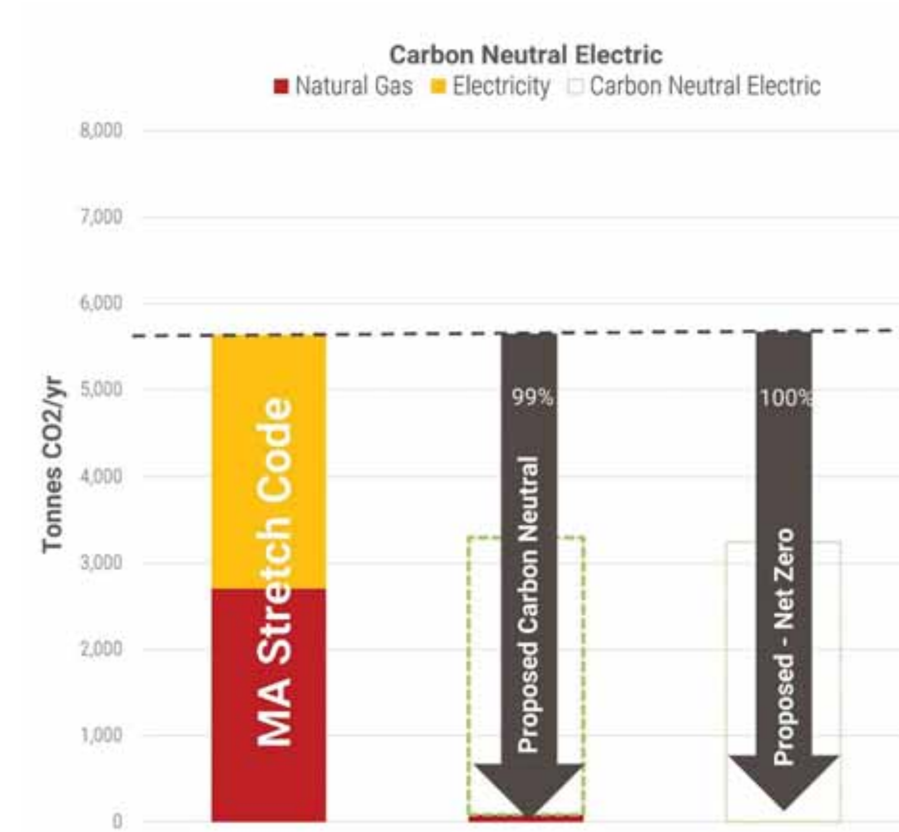

Figure 13: 50%DD Carbon Neutral Electric

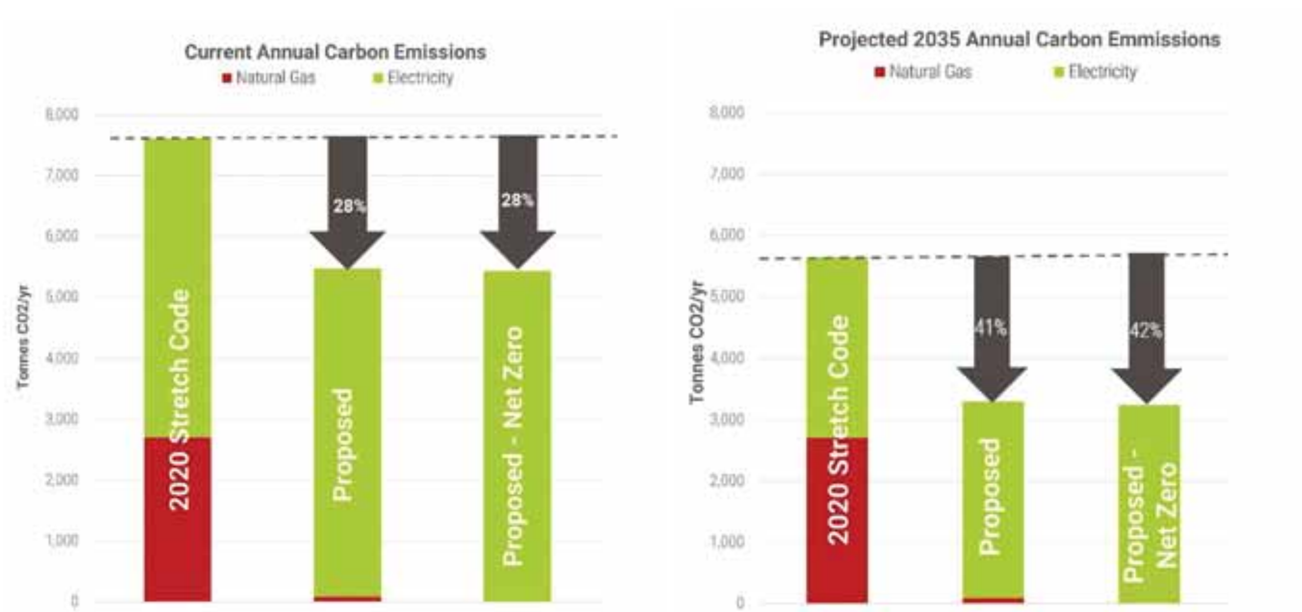

Figure 12: 50% DD Annual Current Carbon and Projected 2035 Carbon Emissions

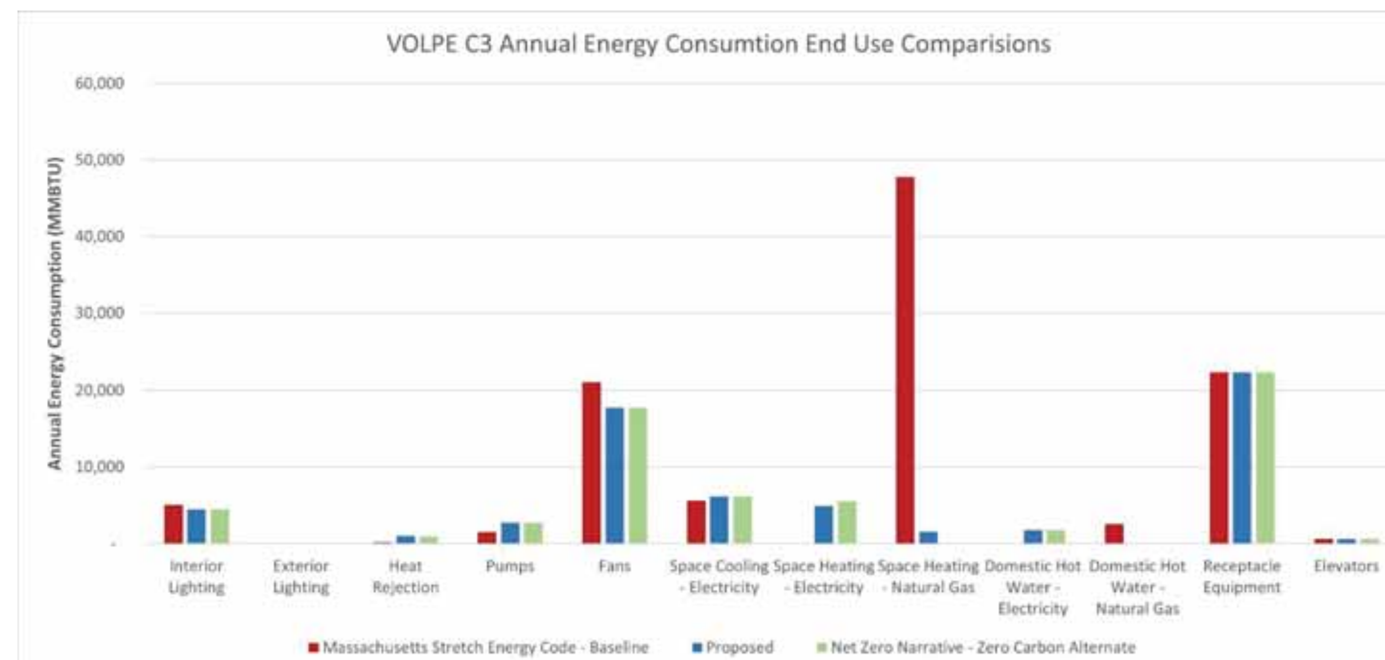

Figure 14: 50% DD - Annual Energy Use Comparison

LEED v4 for BD+C: Core and Shell

Project Checklist - C3

Project Name: Volpe C3
Date: 2/15/23

Y	?	N			
1			Credit	Integrative Process	1

Y	?	N			
19	**1**	**0**		**Location and Transportation**	**20**
2			Credit	Sensitive Land Protection	2
3			Credit	High Priority Site	3
6			Credit	Surrounding Density and Diverse Uses	6
6			Credit	Access to Quality Transit	6
1			Credit	Bicycle Facilities	1
	1		Credit	Reduced Parking Footprint	1
1			Credit	Green Vehicles	1

Y	?	N			
7	**2**	**2**		**Sustainable Sites**	**11**
Y			Prereq	Construction Activity Pollution Prevention	Required
1			Credit	Site Assessment	1
		2	Credit	Site Development - Protect or Restore Habitat	2
1			Credit	Open Space	1
1	2		Credit	Rainwater Management	3
2			Credit	Heat Island Reduction	2
1			Credit	Light Pollution Reduction	1
1			Credit	Tenant Design and Construction Guidelines	1

Y	?	N			
5	**6**	**1**		**Water Efficiency**	**12**
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
1	1		Credit	Outdoor Water Use Reduction	2
2	3	1	Credit	Indoor Water Use Reduction	6
1	2		Credit	Cooling Tower Water Use	3
1			Credit	Water Metering	1

Y	?	N			
22	**6**	**5**		**Energy and Atmosphere**	**33**
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
6			Credit	Enhanced Commissioning	6
13		5	Credit	Optimize Energy Performance	18
	1		Credit	Advanced Energy Metering	1
	2		Credit	Grid Harmonization	2
	3		Credit	Renewable Energy Production	3
1			Credit	Enhanced Refrigerant Management	1
2			Credit	Green Power and Carbon Offsets	2

Y	?	N			
8	**4**	**2**		**Materials and Resources**	**13**
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
3	1	2	Credit	Building Life-Cycle Impact Reduction	5
1	1		Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
1	1		Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
1	1		Credit	Building Product Disclosure and Optimization - Material Ingredients	2
2			Credit	Construction and Demolition Waste Management	2

Y	?	N			
5	**2**	**3**		**Indoor Environmental Quality**	**10**
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
2			Credit	Enhanced Indoor Air Quality Strategies	2
2	1		Credit	Low-Emitting Materials	3
1			Credit	Construction Indoor Air Quality Management Plan	1
		3	Credit	Daylight	3
	1		Credit	Quality Views	1

Y	?	N			
6	**0**	**0**		**Innovation**	**6**
5			Credit	Innovation	5
1			Credit	LEED Accredited Professional	1

Y	?	N			
2	**2**	**0**		**Regional Priority**	**4**
1			Credit	Regional Priority: High Priority Site	1
	1		Credit	Regional Priority: Indoor Water Use Reduction	1
1			Credit	Regional Priority: Rainwater Management	1
	1		Credit	Regional Priority: Building Life-Cycle Impact Reduction	1

Y	?	N			
75	**23**	**13**	**TOTALS**	Possible Points:	**110**

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

ACENTECH

33 Moulton Street
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617 499 8000
acentech.com

April 7, 2023

Joe Pryse
Elkus Manfredi Architects
25 Drydock Avenue
Boston, MA 02210

Email: jpryse@elkus-manfredi.com

Subject: **Environmental Noise Study**
Volpe Site Redevelopment – Building C3
Cambridge, MA
Acentech Project No. J636220

Dear Joe:

This report presents our evaluation of exterior mechanical equipment noise for Building C3 of the Volpe Site Redevelopment, based on the 100% DD drawings dated February 21, 2023 and our meeting with the design team on March 6, 2023.

EXECUTIVE SUMMARY

We have estimated the noise levels generated by specified project mechanical equipment at properties surrounding the project site based on the most recent design drawings and mechanical sound data.

As currently specified, all project mechanical equipment will comply with City of Cambridge noise regulations at all nearby properties.

APPLICABLE NOISE CRITERIA

COMMONWEALTH OF MASSACHUSETTS

The Commonwealth of Massachusetts has enacted regulations for the control of air pollution (310 CMR 7.10). To enforce these regulations, MassDEP has issued criteria to limit the level of project-generated noise transmitted to adjacent properties as follows:

a) not to increase the residual ambient sound level by more than 10 dBA and

b) not to produce a pure tone condition, where the sound pressure level in one octave band exceeds the levels in the two adjacent octave bands by 3 dB or more.

CITY OF CAMBRIDGE

The City of Cambridge Code of Ordinances, Chapter 8.16: Noise Control Ordinance defines the maximum allowable noise limits generated by project equipment. These noise limits are enforced at adjacent property lines, and are defined in A-weighted sound pressure levels (dBA) and by frequency bands, based on zoning districts. Residential zones (which the project area is within) have the most stringent noise criteria, with maximum daytime (7 AM – 6 PM) limits of 60 dBA and nighttime (6 PM – 7 AM) limits of 50 dBA. These standards are enforced only for the source sound levels as a project owner has no control over the ambient sound levels.

We understand based on discussions with the City of Cambridge that an emergency generator in a commercial area with no residences nearby does not need to meet the City's noise requirements. And if there is a nearby residence, the emergency generator should meet the residential daytime limits and be tested during daytime hours.

PROJECT SOUND GOALS

Based on noise monitoring results performed at the project site, the City of Cambridge noise requirements are the more stringent of the two applicable regulations. Therefore, we will use these noise level limits of 60 dBA during daytime hours and 50 dBA during nighttime hours as the basis of design.

EQUIPMENT EVALUATION

Based on information that you provided us, we developed a sound model with a widely-accepted computer software program (Cadna/A) to estimate the contributions of various project sources to the community sound levels.

EQUIPMENT

We modeled noise generated by C3 mechanical equipment based on basis-of-design documents sent to us on February 1, 2023 and updated information provided in our design meeting on March 6, 2023.
The equipment includes:

- Air-source heat pumps (ASHPs, qty. 36 modules total)
- Air handling units (AHUs, qty. 6)
- Exhaust air handling units (EAHUs, qty. 8; discharge fans qty. 24)
- Cooling towers (CT-1 – 4, qty. 4)
- Cooling towers (CT-5, qty. 1)
- Emergency Generators, Base Building 2500 kW (qty. 1) and Tenant 1750 kW (qty. 1)

NOISE MITIGATION PROVIDED FOR EQUIPMENT

The following noise mitigation strategies have been incorporated into the architectural and mechanical design of the project to comply with the City of Cambridge noise requirements:

- The building façade will extend one story above the roof level, including curtain wall glazing, which will obscure all rooftop mechanical equipment from view at ground level and most elevated locations from neighboring buildings. The façade will act as an acoustical barrier, reducing transmission of noise generated by rooftop mechanical equipment to the surrounding community.
- The ASHPs will be provided with the manufacturer's discharge sound attenuators and acoustical compressor wraps.
- The AHUs will be provided with sound attenuators for the outside air inlet ductwork.
- The EAHUs will be provided with sound attenuators for the exhaust stacks.
- The cooling towers will be equipped with the manufacturer's reduced noise fans and variable-frequency drives.
- Additional fans will be provided with sound attenuators, as needed, to meet community noise criteria.
- The emergency generators will be provided with weather-proof sound-reducing enclosures.

RESULTING COMMUNITY NOISE LEVELS

The total community noise levels produced by the specified project mechanical equipment is listed in TABLE 1. Associated receiver locations are shown in FIGURE 1. The receivers are conservatively located near the upper floors of each building. Some of these receivers are positioned at the façades of future Volpe residential developments. Emergency generator noise levels are not included in Table 1 (generators are discussed in the following section).

MEP SYSTEMS EVALUATION

Based on the equipment and noise mitigation strategies listed above, all airside mechanical equipment will comply with MassDEP and City of Cambridge noise regulations at all nearby properties as currently specified.

TABLE 1. Predicted Sound Levels from Community Noise Model
Including Recommended Noise Mitigation

Receiver	Receiver Zoning Usage	Sound Level (dBA) Daytime (7 AM – 6 PM)	Sound Level (dBA) Nighttime (6 PM – 7 AM)
Rec 1	Residential	38	31
Rec 2	Commercial	42	35
Rec 3	Commercial	45	38
Rec 4	Commercial	29	23
Rec 5	Residential	28	22
Rec 6	Residential	37	29
Rec 7	Residential	26	18
Rec 8	Commercial	23	15
Rec 9	Commercial	29	21
Rec 10	Residential	38	30
Rec 11	Commercial	39	32
Rec 12	Residential	56	46
Rec 13	Residential	50	42
Rec 14	Residential	45	38
Rec 15	Residential	44	37
Maximum Allowable Noise Requirements		**60 dBA**	**50 dBA**

Emergency Generators

Emergency generator noise levels were not included in TABLE 1. With the inclusion of weather-proof sound attenuating enclosures provided for the base building and tenant generators, each emergency generator is estimated to produce community noise levels of 58 dBA or less during monthly testing at the nearest residential receiver. Generator noise levels at all other nearby neighbors are estimated to be quieter than this receiver location. These estimated levels assume individual testing of each generator and are inclusive of daytime noise generated by building mechanical equipment. Nighttime testing of the emergency generator will not be conducted.

As currently specified, the base building and tenant emergency generators will comply with MassDEP and City of Cambridge noise regulations at all nearby properties.

FIGURE 1. MODELED RECEIVER LOCATIONS

****

I hope that you will find this information useful and will be pleased to answer any related questions.

Sincerely,

Jay Bliefnick, PhD
Senior Consultant
Direct: 617-499-8072
jbliefnick@acentech.com

cc: Rose Mary Su, Alex Roehl, Alex Odom, Jim Barnes (Acentech)

FINAL REPORT

VOLPE C3

CAMBRIDGE, MA

PEDESTRIAN WIND STUDY
RWDI # 2206579
April 13, 2023

SUBMITTED TO

Elkus Manfredi
25 Drydock Avenue
Boston, MA 02210

SUBMITTED BY

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RWDI
600 Southgate Drive
Guelph, Ontario, Canada
N1G 4P6

EXECUTIVE SUMMARY

RWDI was retained to conduct a pedestrian wind assessment for the proposed C3 building in the Volpe Development which is situated in Cambridge, MA (Image 1). The potential wind conditions have been assessed for several site configurations represented as:

A. No Build: the existing project site along with existing surroundings,

B. Build C3: the proposed C3 with the local proposed landscaping along with the addition of the approved MDX developments and 585 3rd street building,

C. Full Build: the above Build configuration with the addition of the Volpe buildings C1, C2, C4, R1, R2, R3 and R4 along with proposed landscaping throughout the development.

The results of the assessment are shown on site plans in Figures 1A through 2C, while the associated wind speeds are listed in Tables 1 and 2.

The key findings on wind conditions around C3 are summarized as follows:

Effective Gust

- In all configurations studied, wind speeds are expected to meet the effective gust criterion at all locations assessed around C3 building on annual basis.

Mean Speed

- The existing and proposed landscaping on this project features deciduous trees, which shed leaves in winter, thereby providing reduced wind protection during cold months. Therefore, the assessment herein is based on modelling the worst-case scenario (i.e., the trees were modeled in their winter form, without leaves).
- Existing on-site wind conditions are suitable for passive activities.
- The addition of C3 will increase wind speeds near building corners facing prevailing winds. The wind speeds will remain suitable for the intended usage at most areas except a few locations on the walkway near the northwest building corner where uncomfortable wind speeds are expected. This is a temporary condition though, since C3 will only be isolated for a short period of time.
- With the addition of the remaining buildings in the Volpe development, along with the proposed landscaping throughout the site, will improve the wind comfort conditions and reduce the wind speeds in the abovementioned areas. Any further improvements in the wind conditions can be explored as buildings C3 and R3 advance in design.

- During the summer months, when the outdoor spaces will be in use the most by pedestrians, the wind speeds will be comfortable for passive activities. Additionally, the trees will be in full foliage and the wind speeds are expected to be lower than what is presented in this report.
- The main entrances of C3 are well sheltered and wind speeds near entry ways are expected to be suitable throughout the year.

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PEDESTRIAN WIND STUDY
VOLPE C3
RWDI #2206579
April 13, 2023

1 INTRODUCTION

RWDI was retained to conduct a pedestrian wind assessment for the proposed building C3 of the Volpe Development project in Cambridge, MA. This report presents the project objectives, background and approach, and discusses of the results from RWDI's assessment and provides conceptual wind control measures, where necessary.

The project (site shown in Image 1A) is part of a 10-acre development (Volpe Redevelopment Project) that will introduce eight new mixed-use buildings in Cambridge, MA. The focus of this report is on the C3 laboratory/office building, which is a 20-story (~316') building located at the intersection of Broadway and Loughrey Walkway (Images 1).

The objective of the study was to assess local wind conditions in pedestrian areas and provide recommendations for wind control, if needed. The focus of this report is on nearby walkways around the C3 building.

Image 1: Aerial View of Site and Surroundings (Photo Courtesy of Google™ Earth)

2 BACKGROUND AND APPROACH

2.1 Methodology

To assess the wind environment around the proposed project, a 1:300 scale model of the project site and surroundings was constructed for the wind tunnel tests of the following configurations:

A. No Build: Existing site and surroundings,
B. Build C3: The proposed C3 with the local proposed landscaping along with addition of future MDX developments and 585 3rd street building,
C. Full Build: Addition of buildings C1, C2, C4, R1, R2, R3 and R4 with full proposed landscaping.

The wind tunnel model included all relevant surrounding buildings and topography within an approximately 1200 ft radius of the study site. The wind and turbulence profiles in the atmospheric boundary layer beyond the modelled area were also simulated in RWDI's wind tunnel. To measure the wind speeds, 233 specially designed wind speed sensors was used to measure mean and gust speeds at a full-scale height of approximately 5 ft above local grade in pedestrian areas throughout the study site.

Wind speeds were measured for 36 directions in a 10-degree increment. The measurements at each sensor location were recorded in the form of ratios of local mean and gust speeds to the mean wind speed at a reference height above the model. The placement of wind measurement locations was based on our experience and understanding of the pedestrian usage for this site and reviewed by the design team.

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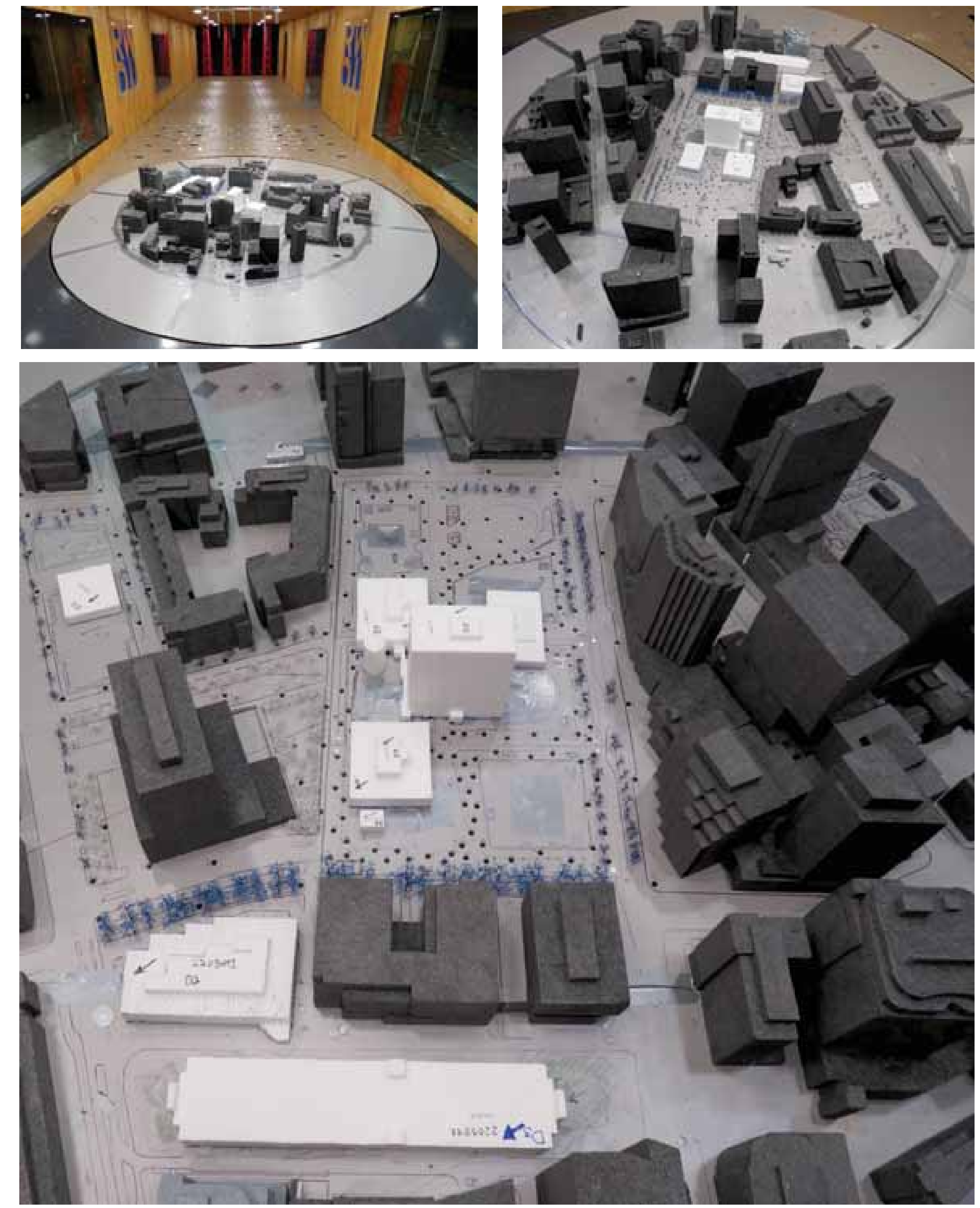


Image 2A: Wind Tunnel Study Model – No Build Configuration

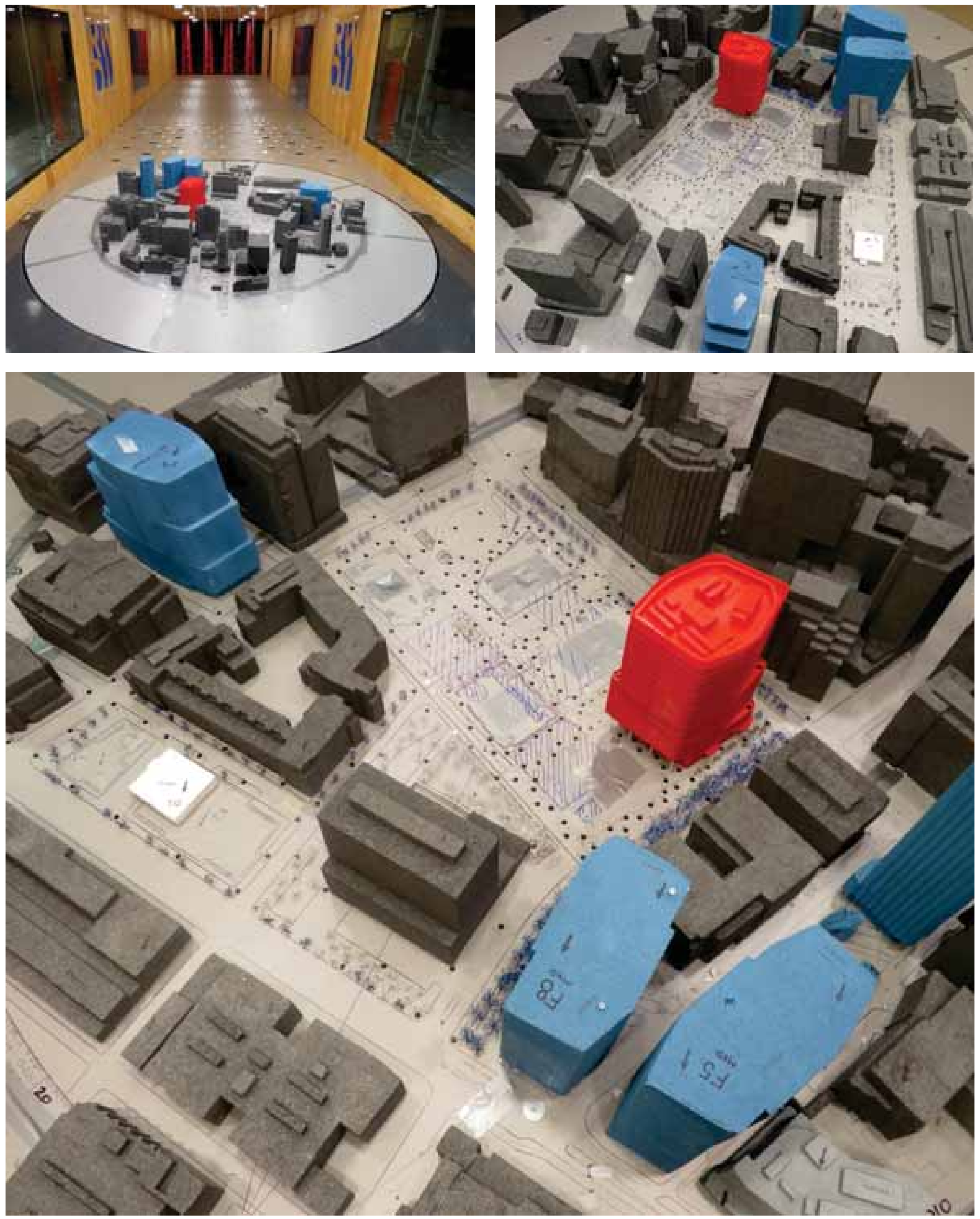


Image 2B: Wind Tunnel Study Model – Build C3 Configuration

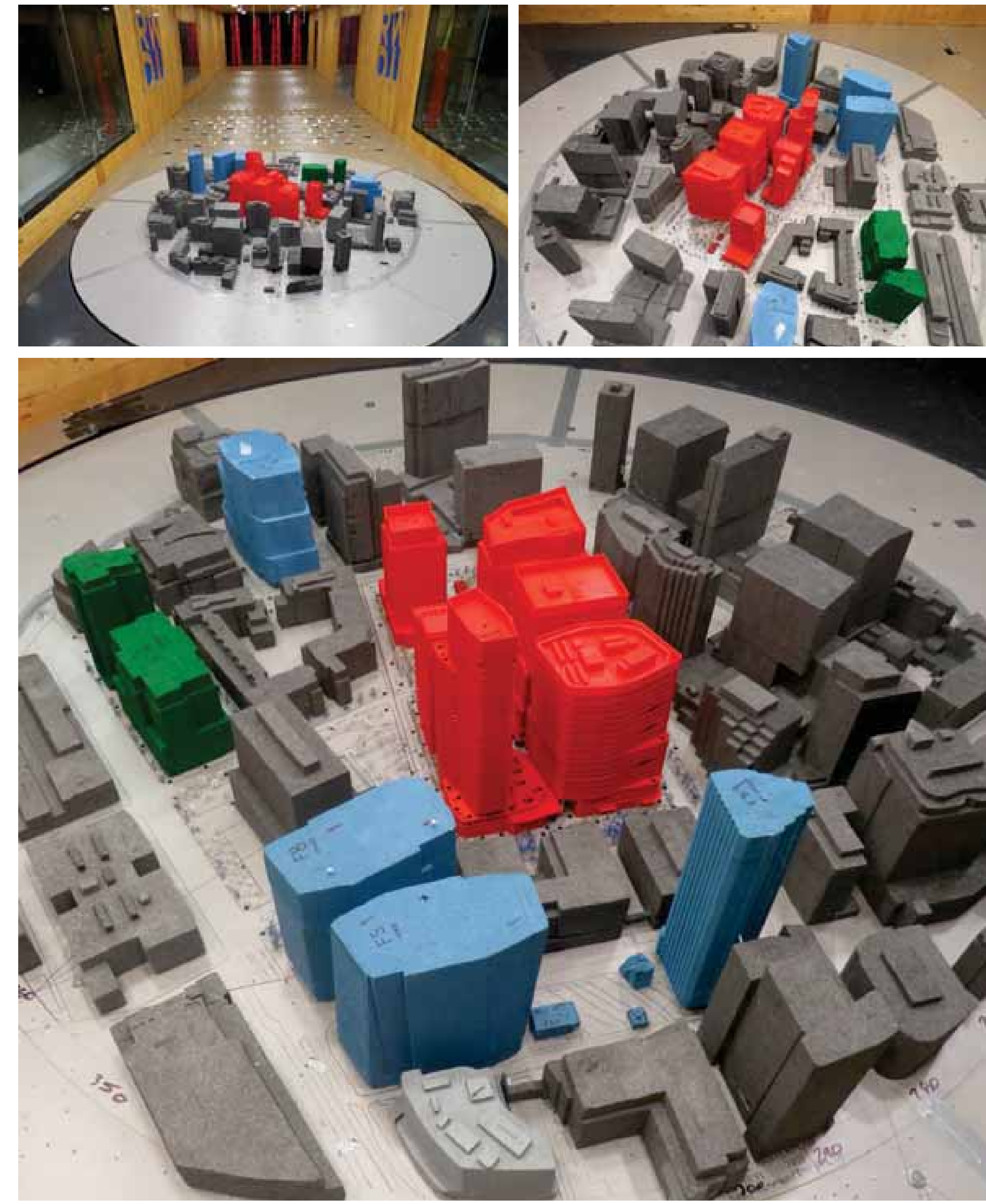
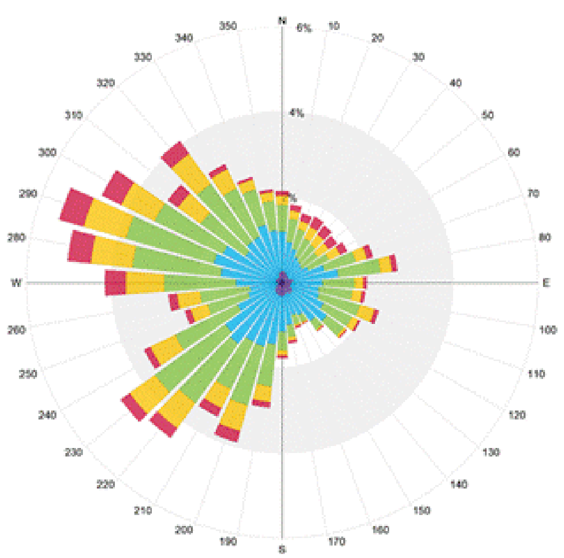


Image 2C: Wind Tunnel Study Model – Full Build

2.2 Meteorological Data

The data from the wind tunnel tests was combined with long-term meteorological data recorded during the years from 1995 through 2020 at Boston Logan International Airport to predict full scale wind conditions. The analysis was performed separately for the entire year and for each of the four seasons. Images 3 and 4 present "wind roses", summarizing the annual and seasonal wind climates in the Boston area, respectively, based on the data from Logan Airport.

On an annual basis, the most common wind directions are those between north-northwest and south-southwest. Winds from the east-northeast to the east-southeast are also relatively common. In the case of strong winds, west-northwest, northwest, west and northeast are the dominant wind directions. A similar directional distribution is seen in the seasonal wind roses as well (Image 4).



Wind Speed (mph)	Probability (%) Annual
Calm	3.0
1-5	7.9
6-10	32.5
11-15	35.3
16-20	14.5
>20	6.8

Image 3: Annual Directional distribution of winds approaching Boston Logan International Airport from 1995 through 2020

PEDESTRIAN WIND STUDY
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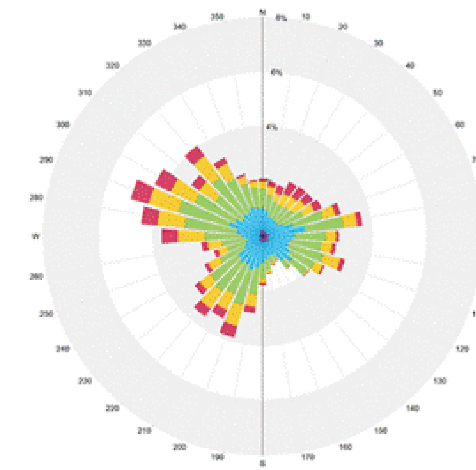
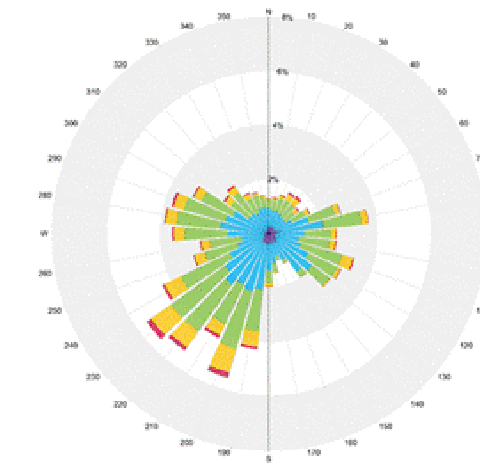
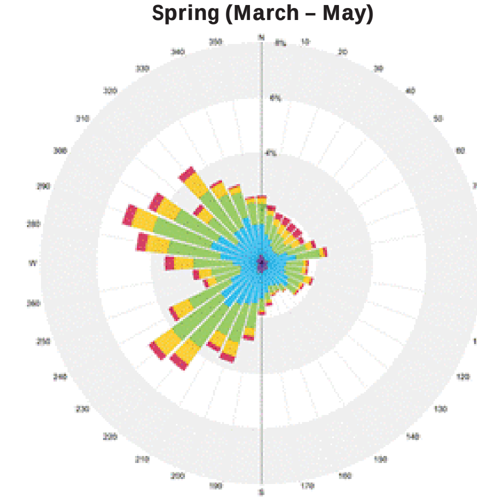


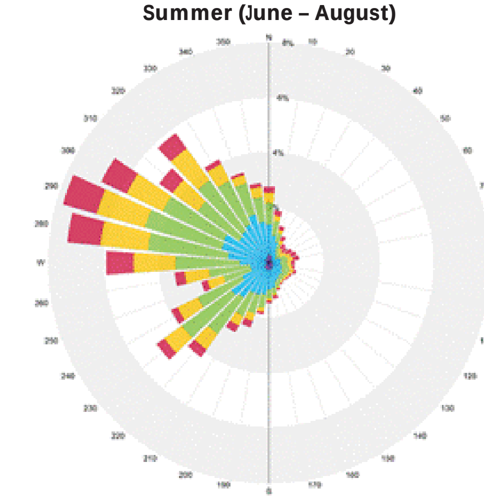
Spring (March – May)



Summer (June – August)



Fall (September – November)



Winter (December – February)

Wind Speed (mph)	Probability (%) Spring	Summer	Fall	Winter
Calm	2.7	3.1	3.4	2.6
1-5	6.8	9.5	8.7	6.6
6-10	28.6	38.9	34.5	28.2
11-15	35.9	36.7	34.6	34.2
16-20	17.2	9.9	13.0	17.7
>20	8.8	1.9	5.9	10.7

Image 4: Seasonal Directional Distribution of Winds Approaching Boston Logan International Airport from 1995 through 2020

2.3 Wind Criteria

Two standards for assessing the relative wind comfort of pedestrians have been used. Wind speeds have been assessed for the impact on pedestrian safety and comfort.

Pedestrian safety relates to high wind gusts that are infrequent, but important to assess as they impact peoples' balance and footing. The criterion is that the effective gust velocity (hourly mean wind speed +1.5 times the root-mean-square wind speed) of 31 mph should not be exceeded more than 1% of the time (Wind Safety / Acceptability).

The second set of criteria is used to determine the relative level of pedestrian wind comfort for activities such as sitting, standing, or walking. The criteria are expressed in terms of benchmarks for the 1-hour mean wind speed exceeded 1% of the time.

Wind Acceptability	Effective Gust Speed (mph)
Acceptable	≤ 31
Unacceptable	> 31
Comfort Category	**Mean Wind Speed (mph)**
Comfortable for Sitting	< 12
Comfortable for Standing	≤ 15
Comfortable for Walking	≤ 19
Uncomfortable for Walking	> 19
Dangerous	> 27

**Effective gust and mean wind speeds are based on a 1% exceedance or 99 percentile wind speeds.

These metrics are used by the Boston Planning and Development Agency (BPDA) and have been generally accepted by the planning department in Cambridge as well.

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

This study involved state-of-the-art measurement and analysis techniques to predict wind conditions. Nevertheless, some uncertainty remains in predicting wind comfort, and this must be kept in mind. For example, the sensation of comfort among individuals can be quite variable. Variations in age, individual health, clothing, and other human factors can change a particular response of an individual. The comfort limits used in this report represent an average for the total population. Also, unforeseen changes in the project area, such as the construction or removal of buildings, can affect the conditions experienced at the site. Finally, the prediction of wind speeds is necessarily a statistical procedure. The wind speeds reported are for the frequency of occurrence stated (1% of the time). Higher wind speeds will occur but on a less frequent basis.

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2.4 Generalized Wind Flows

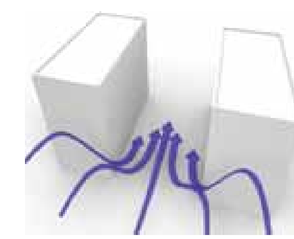
In our discussion of wind conditions, reference is made to the following generalized wind flows (Image 5):

DOWNWASHING

Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level. This is often the main cause for wind accelerations around large buildings at the pedestrian level.

CORNER ACCELERATION

When winds approach at an oblique angle to a tall façade and are deflected down, a localized increase in the wind activity or corner acceleration can be expected around the exposed building corners at pedestrian level.



CHANNELING EFFECT

When two buildings are situated side by side, wind flow tends to accelerate through the space between the buildings due to channeling effect caused by the narrow gap.

Image 5: Generalized Wind Flows

3 RESULTS AND DISCUSSION

The predicted wind conditions in terms of mean and effective gust speeds pertaining to the assessed configurations through out the site are graphically depicted in Figures 1A through 2C located in the "Figures" section of this report, while wind conditions and associated wind speeds are listed in Tables 1 and 2.

3.1 Pedestrian Wind Safety

Wind at all areas assessed on and around the project site are expected to meet the effective gust criterion for pedestrian safety on annual basis in all the configurations considered (Figures 2A through 2C).

In Configuration B, wind gusts near Locations 139 and 140 on the walkway to the northwest of the site are expected to potentially exceed the safety criterion seasonally during the winter (Table 2).

In Configuration C, gust speeds can exceed the wind safety limit near Location 145 during the winter at the plaza to the north of Building C3 (Table 2).

3.2 Pedestrian Wind Comfort

Generally, wind conditions comfortable for walking are appropriate for sidewalks and walkways as pedestrians will be active and less likely to remain in one area for prolonged periods of time. Lower wind speeds conducive to standing are preferred at main entrances where pedestrians are apt to linger. Wind speeds comfortable for sitting are ideal during the summer for areas intended for prolonged periods of passive activities.

In all areas assessed around Building C3, dangerous wind conditions are not predicted on either an annual or seasonal basis in all the configurations considered.

The following discussion of pedestrian wind comfort is based on the annual winds for each configuration tested and is mostly focused on wind conditions at nearby areas around the Building C3. Typically, the summer and fall winds tend to be more comfortable than the annual winds while the winter and spring winds are less comfortable than the annual winds. The existing and proposed landscaping on this project features deciduous trees, which shed leaves in winter, thereby providing reduced wind protection during cold months. Therefore, the assessment herein is based on modelling the worst-case scenario (i.e., the trees were modeled in their winter form, without leaves).

3.2.1 No Build / Configuration A

Mean wind speeds in the No Build site configuration are predicted to be calm and comfortable for sitting or standing on annual basis around the proposed Building C3 footprint (Figure 1A).

3.2.2 Build C3 / Configuration B

As Building C3 is taller than existing buildings in the immediate surroundings, it will increase the wind speeds on-site, particularly near the building corners exposed to the prevailing winds and the walkway to the north due to corner acceleration and downwashing flows. The resulting wind speeds would be comfortable for walking or lower

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at most areas (Figure 1B). However, uncomfortable wind speeds can occur at some locations on the walkways near the northwest corner of C3 on annual basis (Locations 139, 140, 144, and 177). Uncomfortable wind speeds can also occur seasonally during the winter near Locations 141, 142, and 143 that are in the same area (Table 2). With that said, this is a temporary condition though since C3 will only be isolated for a short period of time.

Wind speeds at main entrances of the building (near Locations 160 and 164) are expected to be comfortable for sitting, which is appropriate.

3.2.3 Full Build / Configuration C

In this site configuration, the combined effect of the proposed landscaping and blockage afforded by the other buildings in the Volpe masterplan would lead into lower wind speeds that are generally expected to be comfortable for sitting or standing in most areas around the Building C3, which are suitable for the intended usage.

Higher wind speeds that are comfortable for walking are expected on annual basis in the plaza between Buildings C3 and R3 due to westerly winds and channeling effects. Winds at Location 145 in this area can be uncomfortable on annual basis (Figure 1C). During the winter, wind speeds near Locations 141, 144, 146, and 147 at the west end of the plaza and Location 177 on the walkway to the west of the Building C3 can be potentially uncomfortable (Table 2). During the summer when this plaza is expected to be used most frequently by pedestrians, wind speeds are expected to be mostly comfortable for sitting or standing. Moreover, the landscaping on-site and adjacent to the site will be in full foliage, the wind speeds are expected to be lower than what is presented in this report. If reduced wind speeds are desired in colder months of the year RWDI is prepared to investigate local wind mitigation strategies at this plaza including possible design articulations to Building R3 at later stages of design.

4 STATEMENT OF LIMITATIONS

Limitations

This report was prepared by Rowan Williams Davies & Irwin, Inc. ("RWDI") for Elkus Manfredi ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein ("Project"). The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.

Design Assumptions

RWDI confirms that the pedestrian wind assessment (the "**Assessmen**t") discussed herein was performed by RWDI in accordance with generally accepted professional standards at the time when the Assessment was performed and in the location of the Project. No other representations, warranties, or guarantees are made with respect to the accuracy or completeness of the information, findings, recommendations, or conclusions contained in this Report. This report is not a legal opinion regarding compliance with applicable laws.

The findings and recommendations set out in this report are based on the following information disclosed to RWDI. Drawings and information listed below were received from Elkus Manfredi and used to construct the scale model of the Volpe C3 Building ("**Project Data**").

File Name	File Type	Date Received (dd/mm/yyyy)
22_1121 Building C3.3dm	Rhino	22/11/2022
23_0315 plans	PDF	15/03/2023

The recommendations and conclusions are based on the assumption that the Project Data and Climate Data are accurate and complete. RWDI assumes no responsibility for any inaccuracy or deficiency in information it has received from others. In addition, the recommendations and conclusions in this report are partially based on historical data and can be affected by a number of external factors, including but not limited to Project design, quality of materials and construction, site conditions, meteorological events, and climate change. As such, the conclusions and recommendations contained in this report do not list every possible outcome.

The opinions in this report can only be relied upon to the extent that the Project Data and Project Specific Conditions have not changed. Any change in the Project Data or Project Specific Conditions not reflected in this report can impact and/or alter the recommendations and conclusions in this report. Therefore, it is incumbent upon the Client and/or any other third party reviewing the recommendations and conclusions in this report to contact RWDI in the event of any change in the Project Data and Project Specific Conditions in order to determine whether any such change(s) may impact the assumptions upon which the recommendations and conclusions were made.

FIGURES

Pedestrian Wind Conditions - Mean Speed
No Build
Annual

Volpe C3 - Cambridge, MA

True North

Project #2205891

Drawn by:	GRE	Figure:	1A
Approx. Scale:	1"=150'		
Date Revised:	Apr. 4, 2023		

Pedestrian Wind Conditions - Mean Speed
Build
Annual

Volpe C3 - Cambridge, MA

True North

Project #2205891

Drawn by: GRE	Figure: 1B
Approx. Scale:	1"=150'
Date Revised:	Apr. 4, 2023

Pedestrian Wind Conditions – Mean Speed (C3 Buildout, Annual)

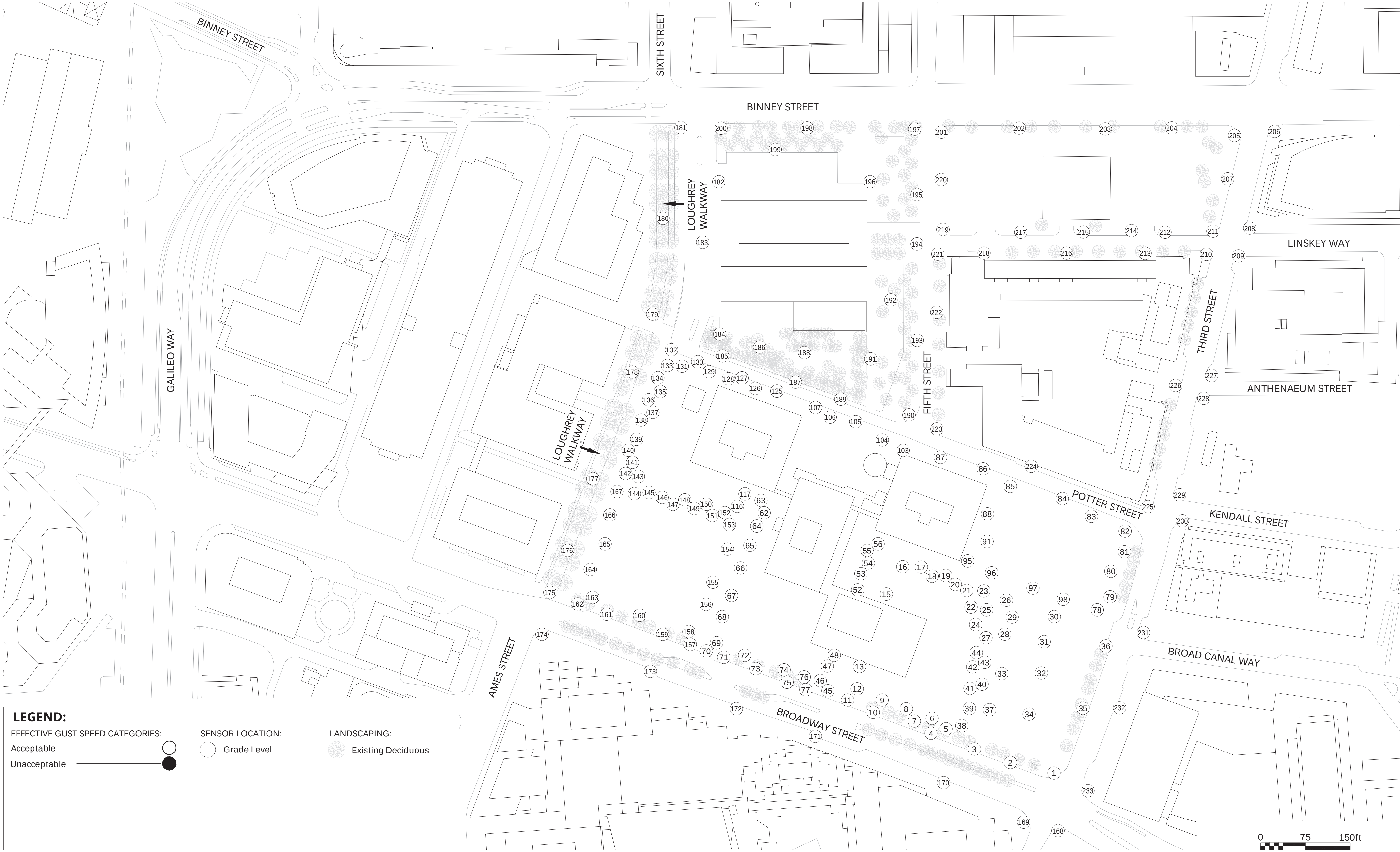
Pedestrian Wind Conditions - Mean Speed
Full Build
Annual

Volpe C3 - Cambridge, MA

True North

Project #2205891

Drawn by: GRE	Figure: 1C
Approx. Scale:	1"=150'
Date Revised:	Apr. 4, 2023



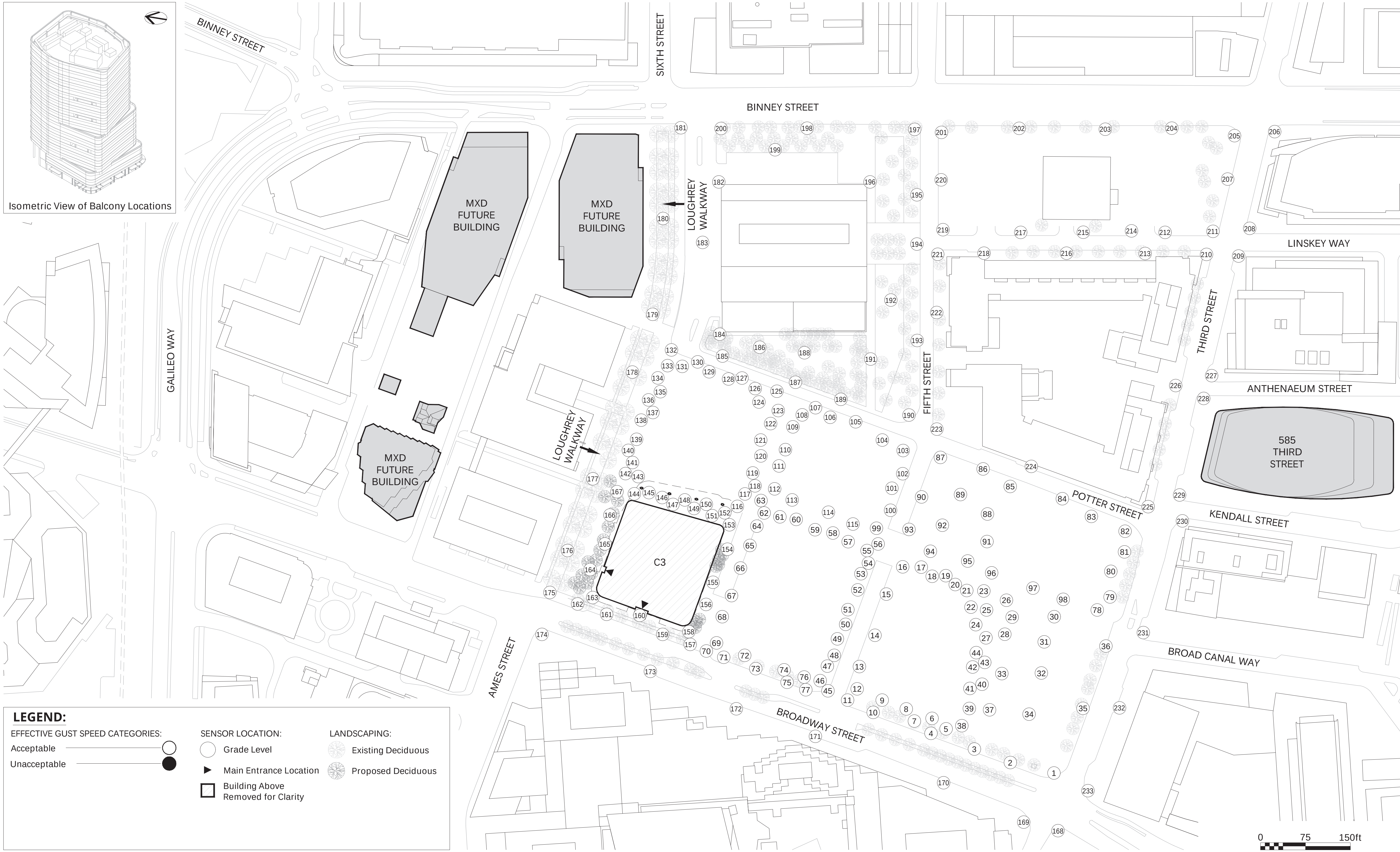
Pedestrian Wind Conditions - Effective Gust Speed
No Build
Annual

Volpe C3 - Cambridge, MA

True North

Project #2205891

Drawn by: GRE	Figure: 2A
Approx. Scale:	1"=150'
Date Revised:	Apr. 4, 2023



Pedestrian Wind Conditions - Effective Gust Speed
Build
Annual

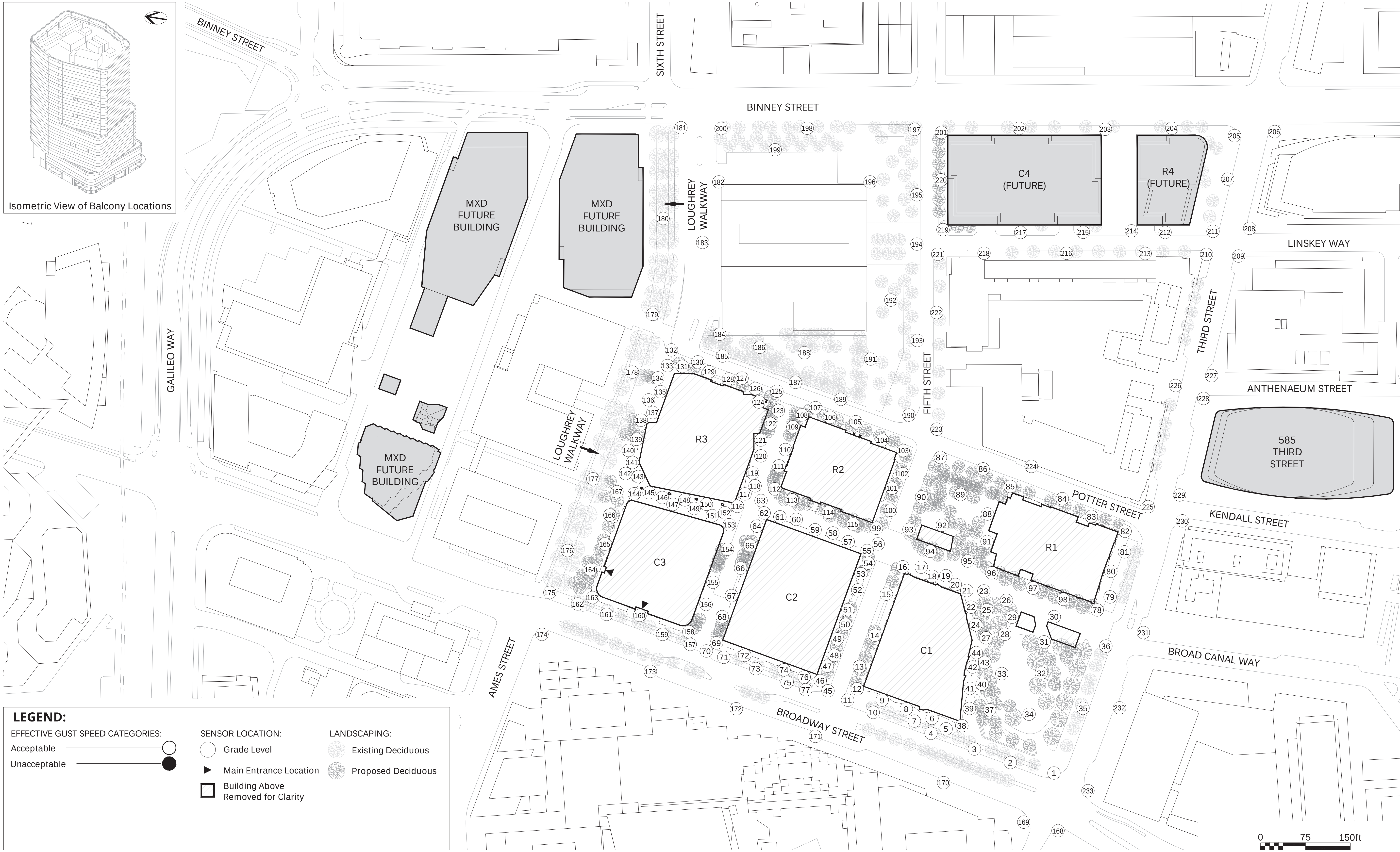
Volpe C3 - Cambridge, MA

True North

Project #2205891

Drawn by: GRE	Figure: 2B
Approx. Scale:	1"=150'
Date Revised:	Apr. 4, 2023

Pedestrian Wind Conditions – Effective Gust Speed (C3 Buildout, Annual)



Pedestrian Wind Conditions - Effective Gust Speed
Full Build
Annual

Volpe C3 - Cambridge, MA

True North

Project #2205891

Drawn by: GRE	Figure: 2C
Approx. Scale: 1"=150'	
Date Revised: Apr. 4, 2023	

TABLES

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed: Speed (mph)	Mean Wind Speed: % Change	Mean Wind Speed: Rating	Effective Gust Wind Speed: Speed (mph)	Effective Gust Wind Speed: % Change	Effective Gust Wind Speed: Rating
1	No Build	Annual	15		Standing	23		Acceptable
	Build C3	Annual	14		Standing	21		Acceptable
	Full Build	Annual	11	-27%	Sitting	16	-30%	Acceptable
2	No Build	Annual	13		Standing	20		Acceptable
	Build C3	Annual	12		Sitting	18		Acceptable
	Full Build	Annual	11	-15%	Sitting	16	-20%	Acceptable
3	No Build	Annual	11		Sitting	18		Acceptable
	Build C3	Annual	10		Sitting	16	-11%	Acceptable
	Full Build	Annual	12		Sitting	18		Acceptable
4	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	12	20%	Sitting	17		Acceptable
5	No Build	Annual	9		Sitting	14		Acceptable
	Build C3	Annual	8	-11%	Sitting	13		Acceptable
	Full Build	Annual	12	33%	Sitting	18	29%	Acceptable
6	No Build	Annual	9		Sitting	16		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	10	11%	Sitting	15		Acceptable
7	No Build	Annual	10		Sitting	17		Acceptable
	Build C3	Annual	9		Sitting	15	-12%	Acceptable
	Full Build	Annual	12	20%	Sitting	17		Acceptable
8	No Build	Annual	10		Sitting	17		Acceptable
	Build C3	Annual	9		Sitting	15	-12%	Acceptable
	Full Build	Annual	8	-20%	Sitting	13	-24%	Acceptable
9	No Build	Annual	11		Sitting	17		Acceptable
	Build C3	Annual	9	-18%	Sitting	15	-12%	Acceptable
	Full Build	Annual	11		Sitting	16		Acceptable
10	No Build	Annual	11		Sitting	18		Acceptable
	Build C3	Annual	9	-18%	Sitting	16	-11%	Acceptable
	Full Build	Annual	12		Sitting	18		Acceptable
11	No Build	Annual	13		Standing	20		Acceptable
	Build C3	Annual	10	-23%	Sitting	17	-15%	Acceptable
	Full Build	Annual	12		Sitting	18		Acceptable
12	No Build	Annual	11		Sitting	17		Acceptable
	Build C3	Annual	9	-18%	Sitting	15	-12%	Acceptable
	Full Build	Annual	12		Sitting	17		Acceptable
13	No Build	Annual	7		Sitting	12		Acceptable
	Build C3	Annual	9	29%	Sitting	15	25%	Acceptable
	Full Build	Annual	14	100%	Standing	19	58%	Acceptable
14	No Build	Annual	-		-	-		-
	Build C3	Annual	13		Standing	19		Acceptable
	Full Build	Annual	15		Standing	20		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
15	No Build	Annual	8		Sitting	13		Acceptable
	Build C3	Annual	9	12%	Sitting	15	15%	Acceptable
	Full Build	Annual	11	38%	Sitting	16	23%	Acceptable
16	No Build	Annual	7		Sitting	13		Acceptable
	Build C3	Annual	9	29%	Sitting	15	15%	Acceptable
	Full Build	Annual	11	57%	Sitting	16	23%	Acceptable
17	No Build	Annual	8		Sitting	13		Acceptable
	Build C3	Annual	9	12%	Sitting	15	15%	Acceptable
	Full Build	Annual	9	12%	Sitting	14		Acceptable
18	No Build	Annual	7		Sitting	12		Acceptable
	Build C3	Annual	9	29%	Sitting	15	25%	Acceptable
	Full Build	Annual	7		Sitting	11		Acceptable
19	No Build	Annual	7		Sitting	12		Acceptable
	Build C3	Annual	8	14%	Sitting	14	17%	Acceptable
	Full Build	Annual	11	57%	Sitting	16	33%	Acceptable
20	No Build	Annual	7		Sitting	12		Acceptable
	Build C3	Annual	9	29%	Sitting	15	25%	Acceptable
	Full Build	Annual	9	29%	Sitting	15	25%	Acceptable
21	No Build	Annual	7		Sitting	12		Acceptable
	Build C3	Annual	8	14%	Sitting	14	17%	Acceptable
	Full Build	Annual	13	86%	Standing	18	50%	Acceptable
22	No Build	Annual	7		Sitting	12		Acceptable
	Build C3	Annual	9	29%	Sitting	15	25%	Acceptable
	Full Build	Annual	11	57%	Sitting	17	42%	Acceptable
23	No Build	Annual	7		Sitting	12		Acceptable
	Build C3	Annual	9	29%	Sitting	15	25%	Acceptable
	Full Build	Annual	14	100%	Standing	18	50%	Acceptable
24	No Build	Annual	8		Sitting	13		Acceptable
	Build C3	Annual	9	12%	Sitting	14		Acceptable
	Full Build	Annual	11	38%	Sitting	16	23%	Acceptable
25	No Build	Annual	7		Sitting	12		Acceptable
	Build C3	Annual	9	29%	Sitting	14	17%	Acceptable
	Full Build	Annual	11	57%	Sitting	16	33%	Acceptable
26	No Build	Annual	7		Sitting	13		Acceptable
	Build C3	Annual	9	29%	Sitting	15	15%	Acceptable
	Full Build	Annual	13	86%	Standing	18	38%	Acceptable
27	No Build	Annual	8		Sitting	14		Acceptable
	Build C3	Annual	9	12%	Sitting	15		Acceptable
	Full Build	Annual	8		Sitting	12	-14%	Acceptable
28	No Build	Annual	8		Sitting	14		Acceptable
	Build C3	Annual	9	12%	Sitting	15		Acceptable
	Full Build	Annual	10	25%	Sitting	14		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
29	No Build	Annual	8		Sitting	13		Acceptable
	Build C3	Annual	9	12%	Sitting	15	15%	Acceptable
	Full Build	Annual	8		Sitting	12		Acceptable
30	No Build	Annual	9		Sitting	15		Acceptable
	Build C3	Annual	10	11%	Sitting	16		Acceptable
	Full Build	Annual	7	-22%	Sitting	12	-20%	Acceptable
31	No Build	Annual	9		Sitting	15		Acceptable
	Build C3	Annual	10	11%	Sitting	16		Acceptable
	Full Build	Annual	7	-22%	Sitting	10	-33%	Acceptable
32	No Build	Annual	9		Sitting	15		Acceptable
	Build C3	Annual	10	11%	Sitting	15		Acceptable
	Full Build	Annual	8	-11%	Sitting	12	-20%	Acceptable
33	No Build	Annual	9		Sitting	15		Acceptable
	Build C3	Annual	10	11%	Sitting	15		Acceptable
	Full Build	Annual	8	-11%	Sitting	13	-13%	Acceptable
34	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	11		Sitting	16		Acceptable
	Full Build	Annual	10		Sitting	15		Acceptable
35	No Build	Annual	11		Sitting	18		Acceptable
	Build C3	Annual	10		Sitting	17		Acceptable
	Full Build	Annual	11		Sitting	16	-11%	Acceptable
36	No Build	Annual	13		Standing	19		Acceptable
	Build C3	Annual	13		Standing	19		Acceptable
	Full Build	Annual	13		Standing	19		Acceptable
37	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	10		Sitting	16		Acceptable
38	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	15	50%	Standing	20	25%	Acceptable
39	No Build	Annual	9		Sitting	15		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	7	-22%	Sitting	11	-27%	Acceptable
40	No Build	Annual	9		Sitting	15		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	6	-33%	Sitting	10	-33%	Acceptable
41	No Build	Annual	9		Sitting	14		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	7	-22%	Sitting	11	-21%	Acceptable
42	No Build	Annual	9		Sitting	14		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	6	-33%	Sitting	10	-29%	Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed: Speed (mph)	Mean Wind Speed: % Change	Mean Wind Speed: Rating	Effective Gust Wind Speed: Speed (mph)	Effective Gust Wind Speed: % Change	Effective Gust Wind Speed: Rating
43	No Build	Annual	9		Sitting	15		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	8	-11%	Sitting	12	-20%	Acceptable
44	No Build	Annual	9		Sitting	14		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	8	-11%	Sitting	12	-14%	Acceptable
45	No Build	Annual	13		Standing	20		Acceptable
	Build C3	Annual	10	-23%	Sitting	16	-20%	Acceptable
	Full Build	Annual	12		Sitting	17	-15%	Acceptable
46	No Build	Annual	13		Standing	19		Acceptable
	Build C3	Annual	10	-23%	Sitting	16	-16%	Acceptable
	Full Build	Annual	14		Standing	18		Acceptable
47	No Build	Annual	11		Sitting	17		Acceptable
	Build C3	Annual	9	-18%	Sitting	15	-12%	Acceptable
	Full Build	Annual	8	-27%	Sitting	12	-29%	Acceptable
48	No Build	Annual	8		Sitting	12		Acceptable
	Build C3	Annual	9	12%	Sitting	15	25%	Acceptable
	Full Build	Annual	10	25%	Sitting	15	25%	Acceptable
49	No Build	Annual	-		-	-		-
	Build C3	Annual	9		Sitting	14		Acceptable
	Full Build	Annual	10		Sitting	14		Acceptable
50	No Build	Annual	-		-	-		-
	Build C3	Annual	8		Sitting	14		Acceptable
	Full Build	Annual	9		Sitting	13		Acceptable
51	No Build	Annual	-		-	-		-
	Build C3	Annual	8		Sitting	14		Acceptable
	Full Build	Annual	10		Sitting	14		Acceptable
52	No Build	Annual	6		Sitting	11		Acceptable
	Build C3	Annual	9	50%	Sitting	15	36%	Acceptable
	Full Build	Annual	8	33%	Sitting	12		Acceptable
53	No Build	Annual	7		Sitting	11		Acceptable
	Build C3	Annual	10	43%	Sitting	15	36%	Acceptable
	Full Build	Annual	10	43%	Sitting	13	18%	Acceptable
54	No Build	Annual	8		Sitting	12		Acceptable
	Build C3	Annual	9	12%	Sitting	15	25%	Acceptable
	Full Build	Annual	10	25%	Sitting	14	17%	Acceptable
55	No Build	Annual	8		Sitting	14		Acceptable
	Build C3	Annual	9	12%	Sitting	16	14%	Acceptable
	Full Build	Annual	9	12%	Sitting	13		Acceptable
56	No Build	Annual	8		Sitting	14		Acceptable
	Build C3	Annual	10	25%	Sitting	16	14%	Acceptable
	Full Build	Annual	9	12%	Sitting	13		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed: Speed (mph)	Mean Wind Speed: % Change	Mean Wind Speed: Rating	Effective Gust Wind Speed: Speed (mph)	Effective Gust Wind Speed: % Change	Effective Gust Wind Speed: Rating
57	No Build	Annual	-		-	-		-
	Build C3	Annual	10		Sitting	16		Acceptable
	Full Build	Annual	7		Sitting	12		Acceptable
58	No Build	Annual	-		-	-		-
	Build C3	Annual	9		Sitting	16		Acceptable
	Full Build	Annual	8		Sitting	13		Acceptable
59	No Build	Annual	-		-	-		-
	Build C3	Annual	10		Sitting	17		Acceptable
	Full Build	Annual	10		Sitting	16		Acceptable
60	No Build	Annual	-		-	-		-
	Build C3	Annual	11		Sitting	18		Acceptable
	Full Build	Annual	10		Sitting	16		Acceptable
61	No Build	Annual	-		-	-		-
	Build C3	Annual	11		Sitting	18		Acceptable
	Full Build	Annual	10		Sitting	14		Acceptable
62	No Build	Annual	10		Sitting	17		Acceptable
	Build C3	Annual	12	20%	Sitting	18		Acceptable
	Full Build	Annual	13	30%	Standing	18		Acceptable
63	No Build	Annual	12		Sitting	19		Acceptable
	Build C3	Annual	11		Sitting	17	-11%	Acceptable
	Full Build	Annual	12		Sitting	17	-11%	Acceptable
64	No Build	Annual	11		Sitting	18		Acceptable
	Build C3	Annual	13	18%	Standing	20	11%	Acceptable
	Full Build	Annual	10		Sitting	14	-22%	Acceptable
65	No Build	Annual	13		Standing	20		Acceptable
	Build C3	Annual	11	-15%	Sitting	17	-15%	Acceptable
	Full Build	Annual	9	-31%	Sitting	12	-40%	Acceptable
66	No Build	Annual	14		Standing	22		Acceptable
	Build C3	Annual	9	-36%	Sitting	14	-36%	Acceptable
	Full Build	Annual	8	-43%	Sitting	13	-41%	Acceptable
67	No Build	Annual	16		Walking	23		Acceptable
	Build C3	Annual	10	-38%	Sitting	15	-35%	Acceptable
	Full Build	Annual	7	-56%	Sitting	11	-52%	Acceptable
68	No Build	Annual	14		Standing	21		Acceptable
	Build C3	Annual	10	-29%	Sitting	15	-29%	Acceptable
	Full Build	Annual	7	-50%	Sitting	10	-52%	Acceptable
69	No Build	Annual	12		Sitting	19		Acceptable
	Build C3	Annual	11		Sitting	16	-16%	Acceptable
	Full Build	Annual	8	-33%	Sitting	12	-37%	Acceptable
70	No Build	Annual	11		Sitting	18		Acceptable
	Build C3	Annual	11		Sitting	16	-11%	Acceptable
	Full Build	Annual	7	-36%	Sitting	11	-39%	Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
71	No Build	Annual	12		Sitting	19		Acceptable
	Build C3	Annual	11		Sitting	16	-16%	Acceptable
	Full Build	Annual	7	-42%	Sitting	12	-37%	Acceptable
72	No Build	Annual	14		Standing	22		Acceptable
	Build C3	Annual	10	-29%	Sitting	16	-27%	Acceptable
	Full Build	Annual	9	-36%	Sitting	13	-41%	Acceptable
73	No Build	Annual	12		Sitting	20		Acceptable
	Build C3	Annual	9	-25%	Sitting	16	-20%	Acceptable
	Full Build	Annual	8	-33%	Sitting	13	-35%	Acceptable
74	No Build	Annual	13		Standing	20		Acceptable
	Build C3	Annual	10	-23%	Sitting	15	-25%	Acceptable
	Full Build	Annual	11	-15%	Sitting	15	-25%	Acceptable
75	No Build	Annual	13		Standing	20		Acceptable
	Build C3	Annual	11	-15%	Sitting	17	-15%	Acceptable
	Full Build	Annual	12		Sitting	17	-15%	Acceptable
76	No Build	Annual	12		Sitting	19		Acceptable
	Build C3	Annual	8	-33%	Sitting	13	-32%	Acceptable
	Full Build	Annual	12		Sitting	16	-16%	Acceptable
77	No Build	Annual	14		Standing	21		Acceptable
	Build C3	Annual	11	-21%	Sitting	17	-19%	Acceptable
	Full Build	Annual	13		Standing	17	-19%	Acceptable
78	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	10		Sitting	16		Acceptable
	Full Build	Annual	8	-20%	Sitting	14	-12%	Acceptable
79	No Build	Annual	12		Sitting	19		Acceptable
	Build C3	Annual	11		Sitting	17	-11%	Acceptable
	Full Build	Annual	10	-17%	Sitting	15	-21%	Acceptable
80	No Build	Annual	12		Sitting	19		Acceptable
	Build C3	Annual	9	-25%	Sitting	15	-21%	Acceptable
	Full Build	Annual	9	-25%	Sitting	14	-26%	Acceptable
81	No Build	Annual	13		Standing	21		Acceptable
	Build C3	Annual	9	-31%	Sitting	15	-29%	Acceptable
	Full Build	Annual	10	-23%	Sitting	16	-24%	Acceptable
82	No Build	Annual	12		Sitting	21		Acceptable
	Build C3	Annual	9	-25%	Sitting	15	-29%	Acceptable
	Full Build	Annual	12		Sitting	16	-24%	Acceptable
83	No Build	Annual	7		Sitting	12		Acceptable
	Build C3	Annual	8	14%	Sitting	13		Acceptable
	Full Build	Annual	10	43%	Sitting	14	17%	Acceptable
84	No Build	Annual	8		Sitting	13		Acceptable
	Build C3	Annual	8		Sitting	13		Acceptable
	Full Build	Annual	10	25%	Sitting	14		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
85	No Build	Annual	8		Sitting	13		Acceptable
	Build C3	Annual	7	-12%	Sitting	12		Acceptable
	Full Build	Annual	9	12%	Sitting	12		Acceptable
86	No Build	Annual	12		Sitting	19		Acceptable
	Build C3	Annual	10	-17%	Sitting	15	-21%	Acceptable
	Full Build	Annual	10	-17%	Sitting	15	-21%	Acceptable
87	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	10		Sitting	15		Acceptable
	Full Build	Annual	11		Sitting	17		Acceptable
88	No Build	Annual	6		Sitting	11		Acceptable
	Build C3	Annual	9	50%	Sitting	14	27%	Acceptable
	Full Build	Annual	6		Sitting	11		Acceptable
89	No Build	Annual	-		-	-		-
	Build C3	Annual	10		Sitting	15		Acceptable
	Full Build	Annual	8		Sitting	13		Acceptable
90	No Build	Annual	-		-	-		-
	Build C3	Annual	9		Sitting	14		Acceptable
	Full Build	Annual	11		Sitting	16		Acceptable
91	No Build	Annual	6		Sitting	11		Acceptable
	Build C3	Annual	9	50%	Sitting	15	36%	Acceptable
	Full Build	Annual	7	17%	Sitting	12		Acceptable
92	No Build	Annual	-		-	-		-
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	8		Sitting	12		Acceptable
93	No Build	Annual	-		-	-		-
	Build C3	Annual	9		Sitting	14		Acceptable
	Full Build	Annual	9		Sitting	13		Acceptable
94	No Build	Annual	-		-	-		-
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	9		Sitting	13		Acceptable
95	No Build	Annual	7		Sitting	11		Acceptable
	Build C3	Annual	9	29%	Sitting	15	36%	Acceptable
	Full Build	Annual	11	57%	Sitting	16	45%	Acceptable
96	No Build	Annual	7		Sitting	11		Acceptable
	Build C3	Annual	8	14%	Sitting	14	27%	Acceptable
	Full Build	Annual	13	86%	Standing	17	55%	Acceptable
97	No Build	Annual	8		Sitting	13		Acceptable
	Build C3	Annual	10	25%	Sitting	15	15%	Acceptable
	Full Build	Annual	7	-12%	Sitting	11	-15%	Acceptable
98	No Build	Annual	8		Sitting	14		Acceptable
	Build C3	Annual	10	25%	Sitting	16	14%	Acceptable
	Full Build	Annual	8		Sitting	11	-21%	Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
99	No Build	Annual	-		-	-		-
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	8		Sitting	12		Acceptable
100	No Build	Annual	-		-	-		-
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	9		Sitting	14		Acceptable
101	No Build	Annual	-		-	-		-
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	8		Sitting	12		Acceptable
102	No Build	Annual	-		-	-		-
	Build C3	Annual	9		Sitting	14		Acceptable
	Full Build	Annual	10		Sitting	15		Acceptable
103	No Build	Annual	9		Sitting	16		Acceptable
	Build C3	Annual	9		Sitting	14	-12%	Acceptable
	Full Build	Annual	11	22%	Sitting	16		Acceptable
104	No Build	Annual	12		Sitting	19		Acceptable
	Build C3	Annual	9	-25%	Sitting	15	-21%	Acceptable
	Full Build	Annual	7	-42%	Sitting	12	-37%	Acceptable
105	No Build	Annual	12		Sitting	19		Acceptable
	Build C3	Annual	9	-25%	Sitting	15	-21%	Acceptable
	Full Build	Annual	8	-33%	Sitting	13	-32%	Acceptable
106	No Build	Annual	12		Sitting	20		Acceptable
	Build C3	Annual	9	-25%	Sitting	15	-25%	Acceptable
	Full Build	Annual	7	-42%	Sitting	13	-35%	Acceptable
107	No Build	Annual	10		Sitting	17		Acceptable
	Build C3	Annual	10		Sitting	17		Acceptable
	Full Build	Annual	10		Sitting	16		Acceptable
108	No Build	Annual	-		-	-		-
	Build C3	Annual	10		Sitting	17		Acceptable
	Full Build	Annual	12		Sitting	17		Acceptable
109	No Build	Annual	-		-	-		-
	Build C3	Annual	13		Standing	17		Acceptable
	Full Build	Annual	14		Standing	17		Acceptable
110	No Build	Annual	-		-	-		-
	Build C3	Annual	10		Sitting	17		Acceptable
	Full Build	Annual	11		Sitting	16		Acceptable
111	No Build	Annual	-		-	-		-
	Build C3	Annual	10		Sitting	17		Acceptable
	Full Build	Annual	11		Sitting	16		Acceptable
112	No Build	Annual	-		-	-		-
	Build C3	Annual	10		Sitting	16		Acceptable
	Full Build	Annual	10		Sitting	15		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
113	No Build	Annual	-		-	-		-
	Build C3	Annual	8		Sitting	13		Acceptable
	Full Build	Annual	10		Sitting	14		Acceptable
114	No Build	Annual	-		-	-		-
	Build C3	Annual	10		Sitting	16		Acceptable
	Full Build	Annual	6		Sitting	10		Acceptable
115	No Build	Annual	-		-	-		-
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	6		Sitting	10		Acceptable
116	No Build	Annual	14		Standing	22		Acceptable
	Build C3	Annual	13		Standing	19	-14%	Acceptable
	Full Build	Annual	15		Standing	19	-14%	Acceptable
117	No Build	Annual	13		Standing	21		Acceptable
	Build C3	Annual	11	-15%	Sitting	18	-14%	Acceptable
	Full Build	Annual	11	-15%	Sitting	16	-24%	Acceptable
118	No Build	Annual	-		-	-		-
	Build C3	Annual	12		Sitting	19		Acceptable
	Full Build	Annual	12		Sitting	18		Acceptable
119	No Build	Annual	-		-	-		-
	Build C3	Annual	12		Sitting	19		Acceptable
	Full Build	Annual	11		Sitting	16		Acceptable
120	No Build	Annual	-		-	-		-
	Build C3	Annual	12		Sitting	19		Acceptable
	Full Build	Annual	12		Sitting	17		Acceptable
121	No Build	Annual	-		-	-		-
	Build C3	Annual	13		Standing	21		Acceptable
	Full Build	Annual	9		Sitting	13		Acceptable
122	No Build	Annual	-		-	-		-
	Build C3	Annual	13		Standing	21		Acceptable
	Full Build	Annual	9		Sitting	13		Acceptable
123	No Build	Annual	-		-	-		-
	Build C3	Annual	13		Standing	20		Acceptable
	Full Build	Annual	13		Standing	19		Acceptable
124	No Build	Annual	-		-	-		-
	Build C3	Annual	14		Standing	21		Acceptable
	Full Build	Annual	4		Sitting	7		Acceptable
125	No Build	Annual	11		Sitting	17		Acceptable
	Build C3	Annual	13	18%	Standing	20	18%	Acceptable
	Full Build	Annual	11		Sitting	17		Acceptable
126	No Build	Annual	12		Sitting	17		Acceptable
	Build C3	Annual	15	25%	Standing	23	35%	Acceptable
	Full Build	Annual	10	-17%	Sitting	16		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
127	No Build	Annual	11		Sitting	16		Acceptable
	Build C3	Annual	13	18%	Standing	21	31%	Acceptable
	Full Build	Annual	10		Sitting	16		Acceptable
128	No Build	Annual	11		Sitting	17		Acceptable
	Build C3	Annual	15	36%	Standing	22	29%	Acceptable
	Full Build	Annual	11		Sitting	13	-24%	Acceptable
129	No Build	Annual	13		Standing	19		Acceptable
	Build C3	Annual	15	15%	Standing	23	21%	Acceptable
	Full Build	Annual	7	-46%	Sitting	11	-42%	Acceptable
130	No Build	Annual	18		Walking	25		Acceptable
	Build C3	Annual	14	-22%	Standing	22	-12%	Acceptable
	Full Build	Annual	8	-56%	Sitting	14	-44%	Acceptable
131	No Build	Annual	16		Walking	23		Acceptable
	Build C3	Annual	16		Walking	24		Acceptable
	Full Build	Annual	8	-50%	Sitting	13	-43%	Acceptable
132	No Build	Annual	16		Walking	23		Acceptable
	Build C3	Annual	15		Standing	21		Acceptable
	Full Build	Annual	11	-31%	Sitting	16	-30%	Acceptable
133	No Build	Annual	16		Walking	22		Acceptable
	Build C3	Annual	15		Standing	22		Acceptable
	Full Build	Annual	13	-19%	Standing	19	-14%	Acceptable
134	No Build	Annual	12		Sitting	17		Acceptable
	Build C3	Annual	15	25%	Standing	22	29%	Acceptable
	Full Build	Annual	14	17%	Standing	20	18%	Acceptable
135	No Build	Annual	13		Standing	19		Acceptable
	Build C3	Annual	18	38%	Walking	26	37%	Acceptable
	Full Build	Annual	8	-38%	Sitting	13	-32%	Acceptable
136	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	18	80%	Walking	26	62%	Acceptable
	Full Build	Annual	15	50%	Standing	21	31%	Acceptable
137	No Build	Annual	12		Sitting	18		Acceptable
	Build C3	Annual	19	58%	Walking	27	50%	Acceptable
	Full Build	Annual	9	-25%	Sitting	13	-28%	Acceptable
138	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	19	90%	Walking	27	69%	Acceptable
	Full Build	Annual	17	70%	Walking	23	44%	Acceptable
139	No Build	Annual	9		Sitting	14		Acceptable
	Build C3	Annual	20	122%	Uncomfortable	29	107%	Acceptable
	Full Build	Annual	18	100%	Walking	25	79%	Acceptable
140	No Build	Annual	8		Sitting	12		Acceptable
	Build C3	Annual	21	162%	Uncomfortable	30	150%	Acceptable
	Full Build	Annual	18	125%	Walking	27	125%	Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
141	No Build	Annual	9		Sitting	14		Acceptable
	Build C3	Annual	19	111%	Walking	26	86%	Acceptable
	Full Build	Annual	18	100%	Walking	26	86%	Acceptable
142	No Build	Annual	8		Sitting	13		Acceptable
	Build C3	Annual	18	125%	Walking	25	92%	Acceptable
	Full Build	Annual	14	75%	Standing	22	69%	Acceptable
143	No Build	Annual	9		Sitting	14		Acceptable
	Build C3	Annual	19	111%	Walking	26	86%	Acceptable
	Full Build	Annual	12	33%	Sitting	19	36%	Acceptable
144	No Build	Annual	8		Sitting	13		Acceptable
	Build C3	Annual	21	162%	Uncomfortable	28	115%	Acceptable
	Full Build	Annual	18	125%	Walking	25	92%	Acceptable
145	No Build	Annual	9		Sitting	15		Acceptable
	Build C3	Annual	17	89%	Walking	24	60%	Acceptable
	Full Build	Annual	21	133%	Uncomfortable	29	93%	Acceptable
146	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	14	40%	Standing	24	50%	Acceptable
	Full Build	Annual	19	90%	Walking	26	62%	Acceptable
147	No Build	Annual	10		Sitting	17		Acceptable
	Build C3	Annual	11		Sitting	17		Acceptable
	Full Build	Annual	18	80%	Walking	25	47%	Acceptable
148	No Build	Annual	11		Sitting	17		Acceptable
	Build C3	Annual	13	18%	Standing	20	18%	Acceptable
	Full Build	Annual	16	45%	Walking	23	35%	Acceptable
149	No Build	Annual	12		Sitting	18		Acceptable
	Build C3	Annual	13		Standing	19		Acceptable
	Full Build	Annual	15	25%	Standing	21	17%	Acceptable
150	No Build	Annual	13		Standing	20		Acceptable
	Build C3	Annual	13		Standing	19		Acceptable
	Full Build	Annual	14		Standing	19		Acceptable
151	No Build	Annual	13		Standing	20		Acceptable
	Build C3	Annual	11	-15%	Sitting	16	-20%	Acceptable
	Full Build	Annual	14		Standing	19		Acceptable
152	No Build	Annual	14		Standing	22		Acceptable
	Build C3	Annual	13		Standing	19	-14%	Acceptable
	Full Build	Annual	12	-14%	Sitting	17	-23%	Acceptable
153	No Build	Annual	14		Standing	22		Acceptable
	Build C3	Annual	13		Standing	19	-14%	Acceptable
	Full Build	Annual	10	-29%	Sitting	14	-36%	Acceptable
154	No Build	Annual	14		Standing	22		Acceptable
	Build C3	Annual	8	-43%	Sitting	12	-45%	Acceptable
	Full Build	Annual	14		Standing	18	-18%	Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
155	No Build	Annual	13		Standing	21		Acceptable
	Build C3	Annual	8	-38%	Sitting	13	-38%	Acceptable
	Full Build	Annual	8	-38%	Sitting	12	-43%	Acceptable
156	No Build	Annual	13		Standing	20		Acceptable
	Build C3	Annual	9	-31%	Sitting	14	-30%	Acceptable
	Full Build	Annual	8	-38%	Sitting	13	-35%	Acceptable
157	No Build	Annual	11		Sitting	17		Acceptable
	Build C3	Annual	13	18%	Standing	18		Acceptable
	Full Build	Annual	8	-27%	Sitting	13	-24%	Acceptable
158	No Build	Annual	10		Sitting	17		Acceptable
	Build C3	Annual	15	50%	Standing	20	18%	Acceptable
	Full Build	Annual	8	-20%	Sitting	13	-24%	Acceptable
159	No Build	Annual	10		Sitting	17		Acceptable
	Build C3	Annual	10		Sitting	16		Acceptable
	Full Build	Annual	9		Sitting	13	-24%	Acceptable
160	No Build	Annual	9		Sitting	15		Acceptable
	Build C3	Annual	7	-22%	Sitting	12	-20%	Acceptable
	Full Build	Annual	6	-33%	Sitting	10	-33%	Acceptable
161	No Build	Annual	11		Sitting	18		Acceptable
	Build C3	Annual	14	27%	Standing	19		Acceptable
	Full Build	Annual	12		Sitting	18		Acceptable
162	No Build	Annual	13		Standing	19		Acceptable
	Build C3	Annual	14		Standing	21	11%	Acceptable
	Full Build	Annual	14		Standing	21	11%	Acceptable
163	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	15	50%	Standing	22	38%	Acceptable
	Full Build	Annual	17	70%	Walking	22	38%	Acceptable
164	No Build	Annual	9		Sitting	14		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	9		Sitting	15		Acceptable
165	No Build	Annual	9		Sitting	14		Acceptable
	Build C3	Annual	10	11%	Sitting	16	14%	Acceptable
	Full Build	Annual	10	11%	Sitting	15		Acceptable
166	No Build	Annual	9		Sitting	14		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	9		Sitting	14		Acceptable
167	No Build	Annual	8		Sitting	14		Acceptable
	Build C3	Annual	17	112%	Walking	23	64%	Acceptable
	Full Build	Annual	14	75%	Standing	20	43%	Acceptable
168	No Build	Annual	17		Walking	25		Acceptable
	Build C3	Annual	16		Walking	24		Acceptable
	Full Build	Annual	11	-35%	Sitting	17	-32%	Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
169	No Build	Annual	17		Walking	24		Acceptable
	Build C3	Annual	17		Walking	24		Acceptable
	Full Build	Annual	11	-35%	Sitting	18	-25%	Acceptable
170	No Build	Annual	10		Sitting	17		Acceptable
	Build C3	Annual	11		Sitting	18		Acceptable
	Full Build	Annual	13	30%	Standing	18		Acceptable
171	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	12	20%	Sitting	17		Acceptable
172	No Build	Annual	12		Sitting	18		Acceptable
	Build C3	Annual	12		Sitting	18		Acceptable
	Full Build	Annual	11		Sitting	16	-11%	Acceptable
173	No Build	Annual	11		Sitting	17		Acceptable
	Build C3	Annual	15	36%	Standing	21	24%	Acceptable
	Full Build	Annual	13	18%	Standing	20	18%	Acceptable
174	No Build	Annual	14		Standing	19		Acceptable
	Build C3	Annual	15		Standing	20		Acceptable
	Full Build	Annual	14		Standing	19		Acceptable
175	No Build	Annual	12		Sitting	18		Acceptable
	Build C3	Annual	13		Standing	19		Acceptable
	Full Build	Annual	14	17%	Standing	22	22%	Acceptable
176	No Build	Annual	8		Sitting	13		Acceptable
	Build C3	Annual	15	88%	Standing	20	54%	Acceptable
	Full Build	Annual	14	75%	Standing	19	46%	Acceptable
177	No Build	Annual	8		Sitting	14		Acceptable
	Build C3	Annual	21	162%	Uncomfortable	28	100%	Acceptable
	Full Build	Annual	18	125%	Walking	25	79%	Acceptable
178	No Build	Annual	9		Sitting	14		Acceptable
	Build C3	Annual	15	67%	Standing	21	50%	Acceptable
	Full Build	Annual	13	44%	Standing	18	29%	Acceptable
179	No Build	Annual	17		Walking	23		Acceptable
	Build C3	Annual	13	-24%	Standing	19	-17%	Acceptable
	Full Build	Annual	15	-12%	Standing	21		Acceptable
180	No Build	Annual	14		Standing	22		Acceptable
	Build C3	Annual	14		Standing	20		Acceptable
	Full Build	Annual	14		Standing	19	-14%	Acceptable
181	No Build	Annual	13		Standing	21		Acceptable
	Build C3	Annual	19	46%	Walking	25	19%	Acceptable
	Full Build	Annual	19	46%	Walking	25	19%	Acceptable
182	No Build	Annual	19		Walking	27		Acceptable
	Build C3	Annual	18		Walking	25		Acceptable
	Full Build	Annual	17	-11%	Walking	24	-11%	Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
183	No Build	Annual	14		Standing	21		Acceptable
	Build C3	Annual	17	21%	Walking	24	14%	Acceptable
	Full Build	Annual	16	14%	Walking	23		Acceptable
184	No Build	Annual	21		Uncomfortable	28		Acceptable
	Build C3	Annual	13	-38%	Standing	19	-32%	Acceptable
	Full Build	Annual	11	-48%	Sitting	17	-39%	Acceptable
185	No Build	Annual	12		Sitting	17		Acceptable
	Build C3	Annual	13		Standing	20	18%	Acceptable
	Full Build	Annual	9	-25%	Sitting	13	-24%	Acceptable
186	No Build	Annual	10		Sitting	14		Acceptable
	Build C3	Annual	10		Sitting	15		Acceptable
	Full Build	Annual	10		Sitting	15		Acceptable
187	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	11		Sitting	18	12%	Acceptable
	Full Build	Annual	10		Sitting	17		Acceptable
188	No Build	Annual	13		Standing	19		Acceptable
	Build C3	Annual	10	-23%	Sitting	15	-21%	Acceptable
	Full Build	Annual	9	-31%	Sitting	15	-21%	Acceptable
189	No Build	Annual	12		Sitting	18		Acceptable
	Build C3	Annual	9	-25%	Sitting	16	-11%	Acceptable
	Full Build	Annual	10	-17%	Sitting	17		Acceptable
190	No Build	Annual	9		Sitting	15		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	12	33%	Sitting	18	20%	Acceptable
191	No Build	Annual	14		Standing	21		Acceptable
	Build C3	Annual	14		Standing	20		Acceptable
	Full Build	Annual	9	-36%	Sitting	15	-29%	Acceptable
192	No Build	Annual	16		Walking	21		Acceptable
	Build C3	Annual	15		Standing	20		Acceptable
	Full Build	Annual	12	-25%	Sitting	17	-19%	Acceptable
193	No Build	Annual	11		Sitting	17		Acceptable
	Build C3	Annual	11		Sitting	18		Acceptable
	Full Build	Annual	13	18%	Standing	21	24%	Acceptable
194	No Build	Annual	15		Standing	23		Acceptable
	Build C3	Annual	15		Standing	21		Acceptable
	Full Build	Annual	19	27%	Walking	25		Acceptable
195	No Build	Annual	14		Standing	22		Acceptable
	Build C3	Annual	16	14%	Walking	22		Acceptable
	Full Build	Annual	18	29%	Walking	25	14%	Acceptable
196	No Build	Annual	17		Walking	24		Acceptable
	Build C3	Annual	18		Walking	24		Acceptable
	Full Build	Annual	19	12%	Walking	25		Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
197	No Build	Annual	17		Walking	24		Acceptable
	Build C3	Annual	16		Walking	22		Acceptable
	Full Build	Annual	15	-12%	Standing	21	-12%	Acceptable
198	No Build	Annual	16		Walking	23		Acceptable
	Build C3	Annual	15		Standing	22		Acceptable
	Full Build	Annual	12	-25%	Sitting	19	-17%	Acceptable
199	No Build	Annual	16		Walking	23		Acceptable
	Build C3	Annual	14	-12%	Standing	20	-13%	Acceptable
	Full Build	Annual	13	-19%	Standing	19	-17%	Acceptable
200	No Build	Annual	16		Walking	23		Acceptable
	Build C3	Annual	17		Walking	24		Acceptable
	Full Build	Annual	17		Walking	23		Acceptable
201	No Build	Annual	14		Standing	20		Acceptable
	Build C3	Annual	14		Standing	19		Acceptable
	Full Build	Annual	16	14%	Walking	22		Acceptable
202	No Build	Annual	14		Standing	20		Acceptable
	Build C3	Annual	12	-14%	Sitting	18		Acceptable
	Full Build	Annual	9	-36%	Sitting	14	-30%	Acceptable
203	No Build	Annual	13		Standing	19		Acceptable
	Build C3	Annual	11	-15%	Sitting	16	-16%	Acceptable
	Full Build	Annual	13		Standing	19		Acceptable
204	No Build	Annual	13		Standing	19		Acceptable
	Build C3	Annual	12		Sitting	17	-11%	Acceptable
	Full Build	Annual	18	38%	Walking	24	26%	Acceptable
205	No Build	Annual	14		Standing	20		Acceptable
	Build C3	Annual	13		Standing	19		Acceptable
	Full Build	Annual	15		Standing	21		Acceptable
206	No Build	Annual	18		Walking	25		Acceptable
	Build C3	Annual	16	-11%	Walking	23		Acceptable
	Full Build	Annual	14	-22%	Standing	20	-20%	Acceptable
207	No Build	Annual	12		Sitting	18		Acceptable
	Build C3	Annual	11		Sitting	17		Acceptable
	Full Build	Annual	16	33%	Walking	23	28%	Acceptable
208	No Build	Annual	12		Sitting	19		Acceptable
	Build C3	Annual	12		Sitting	18		Acceptable
	Full Build	Annual	13		Standing	20		Acceptable
209	No Build	Annual	11		Sitting	16		Acceptable
	Build C3	Annual	10		Sitting	15		Acceptable
	Full Build	Annual	13	18%	Standing	19	19%	Acceptable
210	No Build	Annual	12		Sitting	18		Acceptable
	Build C3	Annual	11		Sitting	16	-11%	Acceptable
	Full Build	Annual	15	25%	Standing	20	11%	Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
211	No Build	Annual	11		Sitting	17		Acceptable
	Build C3	Annual	11		Sitting	17		Acceptable
	Full Build	Annual	16	45%	Walking	22	29%	Acceptable
212	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	10		Sitting	16		Acceptable
	Full Build	Annual	18	80%	Walking	24	50%	Acceptable
213	No Build	Annual	7		Sitting	12		Acceptable
	Build C3	Annual	8	14%	Sitting	13		Acceptable
	Full Build	Annual	13	86%	Standing	18	50%	Acceptable
214	No Build	Annual	9		Sitting	15		Acceptable
	Build C3	Annual	10	11%	Sitting	15		Acceptable
	Full Build	Annual	17	89%	Walking	24	60%	Acceptable
215	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	11		Sitting	16		Acceptable
	Full Build	Annual	11		Sitting	18	12%	Acceptable
216	No Build	Annual	10		Sitting	17		Acceptable
	Build C3	Annual	11		Sitting	17		Acceptable
	Full Build	Annual	16	60%	Walking	22	29%	Acceptable
217	No Build	Annual	11		Sitting	17		Acceptable
	Build C3	Annual	11		Sitting	17		Acceptable
	Full Build	Annual	8	-27%	Sitting	13	-24%	Acceptable
218	No Build	Annual	10		Sitting	17		Acceptable
	Build C3	Annual	10		Sitting	16		Acceptable
	Full Build	Annual	24	140%	Uncomfortable	30	76%	Acceptable
219	No Build	Annual	15		Standing	23		Acceptable
	Build C3	Annual	13	-13%	Standing	20	-13%	Acceptable
	Full Build	Annual	19	27%	Walking	24		Acceptable
220	No Build	Annual	14		Standing	22		Acceptable
	Build C3	Annual	15		Standing	21		Acceptable
	Full Build	Annual	9	-36%	Sitting	14	-36%	Acceptable
221	No Build	Annual	16		Walking	23		Acceptable
	Build C3	Annual	15		Standing	21		Acceptable
	Full Build	Annual	17		Walking	23		Acceptable
222	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	9		Sitting	15		Acceptable
	Full Build	Annual	13	30%	Standing	19	19%	Acceptable
223	No Build	Annual	10		Sitting	16		Acceptable
	Build C3	Annual	10		Sitting	15		Acceptable
	Full Build	Annual	11		Sitting	17		Acceptable
224	No Build	Annual	7		Sitting	11		Acceptable
	Build C3	Annual	6	-14%	Sitting	11		Acceptable
	Full Build	Annual	10	43%	Sitting	15	36%	Acceptable

Table 1: Mean Speed and Effective Gust Categories - Annual

Location	Configuration	Season	Mean Wind Speed			Effective Gust Wind Speed		
			Speed (mph)	% Change	Rating	Speed (mph)	% Change	Rating
225	No Build	Annual	15		Standing	21		Acceptable
	Build C3	Annual	11	-27%	Sitting	17	-19%	Acceptable
	Full Build	Annual	10	-33%	Sitting	16	-24%	Acceptable
226	No Build	Annual	10		Sitting	15		Acceptable
	Build C3	Annual	12	20%	Sitting	19	27%	Acceptable
	Full Build	Annual	13	30%	Standing	19	27%	Acceptable
227	No Build	Annual	11		Sitting	16		Acceptable
	Build C3	Annual	15	36%	Standing	22	38%	Acceptable
	Full Build	Annual	16	45%	Walking	22	38%	Acceptable
228	No Build	Annual	13		Standing	19		Acceptable
	Build C3	Annual	19	46%	Walking	25	32%	Acceptable
	Full Build	Annual	18	38%	Walking	25	32%	Acceptable
229	No Build	Annual	17		Walking	25		Acceptable
	Build C3	Annual	14	-18%	Standing	21	-16%	Acceptable
	Full Build	Annual	13	-24%	Standing	19	-24%	Acceptable
230	No Build	Annual	16		Walking	23		Acceptable
	Build C3	Annual	13	-19%	Standing	20	-13%	Acceptable
	Full Build	Annual	12	-25%	Sitting	17	-26%	Acceptable
231	No Build	Annual	15		Standing	23		Acceptable
	Build C3	Annual	14		Standing	21		Acceptable
	Full Build	Annual	14		Standing	21		Acceptable
232	No Build	Annual	8		Sitting	13		Acceptable
	Build C3	Annual	7	-12%	Sitting	12		Acceptable
	Full Build	Annual	15	88%	Standing	20	54%	Acceptable
233	No Build	Annual	16		Walking	23		Acceptable
	Build C3	Annual	15		Standing	22		Acceptable
	Full Build	Annual	13	-19%	Standing	19	-17%	Acceptable

Configurations		Mean Wind Criteria Speed (mph)		Effective Gust Criteria (mph)	
No Build	Existing site and surrounding	≤ 12	Comfortable for Sitting	≤ 31	Acceptable
		13 - 15	Comfortable for Standing	> 31	Unacceptable
Build C3	Proposed C3 building with local proposed landscaping along with future MDX developments and 585 3rd street building	16 - 19	Comfortable for Walking		
		20 - 27	Uncomfortable for Walking		
		> 27	Dangerous Conditions		
Full Build	C3 building with addition of C1, C2, C4 R1, R2, R3 & R4 buildings with full proposed landscaping				

Notes

1) Wind Speeds are for a 1% probability of exceedance

2) % Change is based on comparison with No Build configuration

3) % changes less than 10% are excluded

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
1	No Build	16	12	15	16	24	18	22	24
	Build C3	15	12	14	15	23	17	21	23
	Full Build	11	10	11	11	17	14	16	17
2	No Build	15	11	14	13	22	16	20	20
	Build C3	14	10	13	12	20	15	19	19
	Full Build	11	9	11	12	17	14	16	18
3	No Build	13	9	12	11	20	14	18	17
	Build C3	12	8	10	10	18	13	17	16
	Full Build	13	11	12	13	18	16	18	19
4	No Build	12	8	10	10	18	13	17	16
	Build C3	10	8	10	10	17	12	15	16
	Full Build	12	10	11	13	18	14	17	18
5	No Build	9	7	9	9	15	12	14	15
	Build C3	9	7	8	8	14	11	14	14
	Full Build	13	11	12	13	20	16	18	19
6	No Build	10	8	10	10	17	12	16	16
	Build C3	10	7	9	9	16	12	15	15
	Full Build	10	8	10	11	15	12	14	16
7	No Build	12	8	10	10	19	13	17	17
	Build C3	10	7	9	10	17	12	15	16
	Full Build	12	9	11	14	17	13	16	18
8	No Build	11	9	11	11	19	13	17	18
	Build C3	10	8	9	10	16	13	16	16
	Full Build	8	7	8	9	13	11	13	13
9	No Build	11	8	11	11	18	13	17	18
	Build C3	10	7	9	10	16	12	15	16
	Full Build	12	9	11	13	16	13	16	18
10	No Build	12	9	11	12	20	14	18	19
	Build C3	10	7	9	10	17	12	16	16
	Full Build	13	11	12	13	19	16	18	19
11	No Build	14	10	13	13	22	16	20	20
	Build C3	11	8	10	10	19	13	18	17
	Full Build	13	11	12	13	19	16	18	19
12	No Build	12	9	11	11	19	14	18	18
	Build C3	10	7	9	10	16	12	15	16
	Full Build	13	11	12	12	18	16	17	17
13	No Build	7	6	7	7	12	9	11	12
	Build C3	9	8	9	9	15	12	15	16
	Full Build	14	11	13	16	20	16	18	21
14	No Build	-	-	-	-	-	-	-	-
	Build C3	13	10	12	14	20	15	18	20
	Full Build	15	12	14	17	20	15	18	22

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
15	No Build	8	6	8	8	14	10	13	14
	Build C3	10	8	9	10	15	12	15	16
	Full Build	11	9	11	13	17	13	16	18
16	No Build	8	6	7	8	13	10	13	13
	Build C3	9	7	9	9	16	12	15	16
	Full Build	12	9	11	12	17	13	16	18
17	No Build	8	6	8	8	14	10	13	14
	Build C3	9	8	9	10	16	12	15	16
	Full Build	9	8	9	9	15	12	14	14
18	No Build	8	6	7	8	13	10	12	13
	Build C3	9	7	9	9	15	12	14	16
	Full Build	7	6	7	7	12	9	11	12
19	No Build	8	6	7	8	13	10	12	13
	Build C3	9	7	8	9	14	11	13	14
	Full Build	12	10	11	12	17	15	16	17
20	No Build	8	5	7	7	13	9	12	13
	Build C3	9	7	9	9	15	11	14	16
	Full Build	10	8	9	9	16	13	14	15
21	No Build	7	5	7	7	12	9	12	13
	Build C3	9	7	8	9	15	11	14	15
	Full Build	14	11	13	14	19	15	18	19
22	No Build	8	6	7	8	13	10	12	13
	Build C3	10	7	9	9	16	12	15	16
	Full Build	12	9	11	12	18	13	17	17
23	No Build	8	6	7	7	13	9	12	13
	Build C3	10	7	9	9	16	12	15	16
	Full Build	15	11	14	15	20	14	18	19
24	No Build	8	6	8	8	14	10	13	14
	Build C3	9	7	9	9	16	11	15	15
	Full Build	12	8	11	11	17	12	16	17
25	No Build	8	6	7	8	13	10	12	13
	Build C3	9	7	9	9	15	11	14	15
	Full Build	12	9	11	12	16	12	15	17
26	No Build	8	6	7	8	14	10	13	14
	Build C3	10	7	9	9	17	12	15	16
	Full Build	14	10	13	14	19	14	17	19
27	No Build	9	7	8	9	15	11	14	15
	Build C3	10	7	9	9	16	12	15	15
	Full Build	9	6	8	9	13	10	12	13
28	No Build	9	7	8	9	15	11	13	15
	Build C3	10	7	9	9	16	12	15	15
	Full Build	10	8	9	10	15	11	14	15

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
29	No Build	8	6	8	8	14	11	13	14
	Build C3	10	7	9	9	16	12	15	15
	Full Build	8	6	8	8	12	9	11	12
30	No Build	9	7	9	9	15	12	15	16
	Build C3	11	8	10	10	17	13	17	17
	Full Build	8	6	7	8	12	10	12	13
31	No Build	10	8	9	10	15	12	14	16
	Build C3	11	8	10	10	17	12	16	16
	Full Build	7	7	7	7	11	9	10	11
32	No Build	10	8	9	10	16	12	14	16
	Build C3	11	8	10	10	17	12	15	16
	Full Build	8	7	8	8	13	11	12	13
33	No Build	10	8	9	10	16	12	15	16
	Build C3	11	8	10	10	17	12	16	16
	Full Build	8	7	8	8	13	11	13	13
34	No Build	11	8	10	10	18	13	17	17
	Build C3	12	8	11	11	18	13	17	17
	Full Build	10	9	10	11	16	13	16	16
35	No Build	11	8	10	12	19	14	17	20
	Build C3	10	8	10	11	18	13	16	18
	Full Build	11	9	10	12	17	13	16	18
36	No Build	14	11	13	14	20	16	19	21
	Build C3	13	11	13	14	19	16	19	20
	Full Build	13	10	13	15	19	15	18	21
37	No Build	10	8	10	10	17	12	16	16
	Build C3	10	8	10	10	16	12	16	16
	Full Build	11	9	10	11	17	15	16	17
38	No Build	11	8	10	10	17	13	16	16
	Build C3	10	8	10	10	16	12	15	15
	Full Build	16	13	15	17	21	17	20	22
39	No Build	10	7	9	10	16	12	15	16
	Build C3	10	7	9	9	16	12	15	15
	Full Build	7	6	7	7	11	9	11	12
40	No Build	10	8	9	10	16	12	15	16
	Build C3	10	8	9	10	16	12	15	16
	Full Build	6	5	6	6	10	8	10	10
41	No Build	10	7	9	10	15	12	14	15
	Build C3	10	7	9	9	16	12	15	15
	Full Build	7	6	7	8	11	9	11	12
42	No Build	9	7	9	9	15	11	14	15
	Build C3	10	7	9	10	16	12	15	16
	Full Build	6	6	6	7	10	9	10	11

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
43	No Build	10	8	9	10	16	12	14	16
	Build C3	10	8	9	10	17	12	15	16
	Full Build	8	6	8	8	13	10	12	13
44	No Build	9	7	8	9	15	11	14	15
	Build C3	10	7	9	10	16	12	15	16
	Full Build	8	7	8	9	13	10	12	13
45	No Build	14	10	13	13	22	16	20	20
	Build C3	11	8	10	10	18	12	17	17
	Full Build	12	10	12	13	18	16	17	18
46	No Build	14	10	12	13	21	15	19	21
	Build C3	10	8	10	10	17	12	16	16
	Full Build	14	11	13	15	18	14	18	19
47	No Build	12	9	11	12	18	13	17	18
	Build C3	10	7	9	10	16	12	15	16
	Full Build	9	7	9	9	13	11	13	13
48	No Build	8	6	8	8	13	10	12	13
	Build C3	9	7	9	9	15	12	15	16
	Full Build	11	9	10	10	16	14	15	15
49	No Build	-	-	-	-	-	-	-	-
	Build C3	9	7	9	9	15	12	14	15
	Full Build	11	9	10	10	15	12	15	15
50	No Build	-	-	-	-	-	-	-	-
	Build C3	9	7	8	9	14	11	14	15
	Full Build	9	8	9	9	14	12	13	14
51	No Build	-	-	-	-	-	-	-	-
	Build C3	9	7	8	9	15	11	14	15
	Full Build	10	8	10	10	14	11	14	15
52	No Build	7	5	7	7	12	9	12	12
	Build C3	9	7	9	9	15	12	15	16
	Full Build	9	7	8	9	13	10	13	13
53	No Build	7	5	7	7	12	8	11	12
	Build C3	10	8	9	10	16	12	15	17
	Full Build	11	8	10	11	14	11	13	14
54	No Build	8	6	8	8	13	10	12	13
	Build C3	10	8	9	10	16	12	15	16
	Full Build	11	8	10	11	15	11	14	15
55	No Build	8	6	8	8	15	11	14	14
	Build C3	10	7	9	10	16	12	15	17
	Full Build	9	7	8	9	13	10	13	14
56	No Build	9	6	8	8	15	11	14	14
	Build C3	10	8	9	10	16	13	16	17
	Full Build	10	7	9	9	14	10	13	14

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
57	No Build	-	-	-	-	-	-	-	-
	Build C3	10	7	9	11	16	12	15	17
	Full Build	8	6	7	8	13	9	12	13
58	No Build	-	-	-	-	-	-	-	-
	Build C3	10	7	9	10	16	12	16	17
	Full Build	8	6	8	9	14	10	13	14
59	No Build	-	-	-	-	-	-	-	-
	Build C3	10	8	10	11	17	13	17	18
	Full Build	11	8	10	11	16	12	15	17
60	No Build	-	-	-	-	-	-	-	-
	Build C3	12	8	11	12	19	13	18	20
	Full Build	11	9	10	11	16	13	16	17
61	No Build	-	-	-	-	-	-	-	-
	Build C3	12	8	11	12	19	13	17	19
	Full Build	10	8	10	11	14	11	14	15
62	No Build	11	8	10	11	18	13	17	19
	Build C3	12	9	12	13	19	14	18	20
	Full Build	13	10	13	15	18	14	17	19
63	No Build	12	9	11	13	20	15	18	21
	Build C3	12	8	11	12	18	13	17	19
	Full Build	13	9	12	14	17	13	16	19
64	No Build	12	9	11	12	19	14	18	20
	Build C3	13	9	12	14	21	15	19	21
	Full Build	11	9	10	11	15	11	14	15
65	No Build	13	10	12	14	21	16	19	23
	Build C3	12	8	11	12	18	13	17	19
	Full Build	10	7	9	10	13	10	12	13
66	No Build	14	11	13	16	22	16	20	24
	Build C3	10	8	9	10	15	12	14	16
	Full Build	8	6	8	9	13	10	12	14
67	No Build	16	12	14	17	23	17	22	26
	Build C3	11	8	10	11	16	12	15	16
	Full Build	7	6	7	8	11	9	11	12
68	No Build	14	10	13	15	22	16	20	24
	Build C3	11	9	10	11	16	12	15	17
	Full Build	7	5	6	7	10	8	10	11
69	No Build	12	9	11	13	20	14	18	21
	Build C3	11	9	10	12	17	13	16	17
	Full Build	8	7	8	8	12	11	12	13
70	No Build	12	8	11	12	19	14	18	19
	Build C3	12	9	11	12	17	13	16	18
	Full Build	7	6	7	8	11	9	11	12

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
71	No Build	13	9	12	13	20	15	18	20
	Build C3	11	9	10	11	17	13	16	17
	Full Build	7	6	7	8	12	10	11	13
72	No Build	15	10	13	15	22	16	20	23
	Build C3	11	8	10	11	17	13	16	17
	Full Build	9	7	9	10	14	10	13	15
73	No Build	14	10	13	13	22	16	20	21
	Build C3	10	7	9	9	17	12	16	16
	Full Build	8	6	8	9	13	10	13	14
74	No Build	14	10	13	14	21	15	19	21
	Build C3	10	8	9	10	16	12	15	16
	Full Build	11	8	10	12	15	12	15	17
75	No Build	14	10	13	14	22	15	20	21
	Build C3	12	8	11	11	18	13	17	18
	Full Build	12	9	12	13	17	13	16	18
76	No Build	13	9	12	12	21	15	19	19
	Build C3	8	6	8	8	15	11	14	13
	Full Build	12	9	11	13	16	13	16	18
77	No Build	15	11	13	14	23	16	21	21
	Build C3	12	8	11	11	19	13	18	18
	Full Build	13	10	13	14	18	14	17	19
78	No Build	10	9	10	10	17	14	16	17
	Build C3	11	9	10	10	17	15	16	17
	Full Build	8	7	8	9	14	11	14	15
79	No Build	13	10	12	12	20	16	19	21
	Build C3	12	11	11	11	18	16	18	18
	Full Build	10	7	9	11	15	12	14	16
80	No Build	12	9	12	12	20	15	19	21
	Build C3	9	7	9	9	15	12	15	16
	Full Build	9	7	9	10	14	12	14	15
81	No Build	15	10	13	14	23	16	21	22
	Build C3	10	8	9	10	16	13	15	16
	Full Build	10	9	10	11	16	13	16	17
82	No Build	13	9	12	13	22	16	20	22
	Build C3	9	7	9	9	15	12	15	16
	Full Build	12	10	12	13	17	14	16	18
83	No Build	7	6	7	8	13	10	12	13
	Build C3	8	7	7	8	14	12	13	14
	Full Build	11	8	10	10	15	12	14	15
84	No Build	8	7	7	8	14	11	13	13
	Build C3	8	7	8	8	14	12	13	14
	Full Build	11	9	10	10	15	13	14	15

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
85	No Build	8	6	7	8	14	10	12	14
	Build C3	8	6	7	8	12	10	11	12
	Full Build	10	8	9	10	13	10	12	13
86	No Build	13	9	12	13	19	14	18	20
	Build C3	11	8	10	10	17	13	15	16
	Full Build	10	8	10	11	16	12	15	17
87	No Build	11	8	10	11	17	12	16	17
	Build C3	11	8	10	11	16	12	15	16
	Full Build	12	9	11	12	18	13	17	18
88	No Build	7	5	6	7	12	9	11	11
	Build C3	10	8	9	9	16	12	14	14
	Full Build	7	5	6	7	11	9	11	12
89	No Build	-	-	-	-	-	-	-	-
	Build C3	11	8	10	10	16	12	15	16
	Full Build	9	6	8	9	14	10	13	14
90	No Build	-	-	-	-	-	-	-	-
	Build C3	10	7	9	10	15	12	14	16
	Full Build	11	8	10	12	17	13	16	18
91	No Build	7	5	6	7	12	9	11	12
	Build C3	10	8	9	9	16	12	15	16
	Full Build	8	6	7	8	12	10	11	12
92	No Build	-	-	-	-	-	-	-	-
	Build C3	10	8	9	10	15	12	14	16
	Full Build	8	7	8	9	12	10	12	13
93	No Build	-	-	-	-	-	-	-	-
	Build C3	9	7	9	9	15	12	14	16
	Full Build	9	8	9	10	14	11	13	14
94	No Build	-	-	-	-	-	-	-	-
	Build C3	9	7	9	9	15	11	14	16
	Full Build	9	7	9	10	13	10	13	14
95	No Build	8	6	7	7	12	9	12	12
	Build C3	10	7	9	9	16	12	15	16
	Full Build	12	10	12	12	17	14	16	17
96	No Build	7	5	7	7	12	9	11	12
	Build C3	9	7	9	9	15	11	14	15
	Full Build	14	11	13	14	18	14	17	19
97	No Build	9	7	8	9	14	11	13	14
	Build C3	11	8	10	10	16	13	15	16
	Full Build	7	5	6	7	11	9	11	12
98	No Build	9	7	8	9	15	12	14	15
	Build C3	10	8	10	10	17	13	16	16
	Full Build	8	6	8	9	11	9	11	12

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
99	No Build	-	-	-	-	-	-	-	-
	Build C3	9	7	9	10	16	12	15	16
	Full Build	9	7	8	9	13	10	12	13
100	No Build	-	-	-	-	-	-	-	-
	Build C3	9	7	9	10	15	12	15	16
	Full Build	9	7	9	10	14	11	13	15
101	No Build	-	-	-	-	-	-	-	-
	Build C3	9	7	9	10	15	12	14	16
	Full Build	8	6	8	8	12	9	12	12
102	No Build	-	-	-	-	-	-	-	-
	Build C3	9	7	9	9	15	11	14	15
	Full Build	11	8	10	10	17	12	16	16
103	No Build	10	7	9	10	17	12	15	18
	Build C3	10	7	9	10	15	11	14	15
	Full Build	12	9	11	12	17	13	16	18
104	No Build	12	9	11	13	19	14	18	21
	Build C3	10	7	9	10	15	12	15	16
	Full Build	8	6	7	8	13	9	12	13
105	No Build	12	9	11	13	19	14	18	21
	Build C3	9	7	9	9	15	11	14	16
	Full Build	8	6	8	8	14	10	13	14
106	No Build	12	9	11	14	20	15	19	23
	Build C3	9	7	9	10	15	12	15	17
	Full Build	8	6	7	8	13	10	12	14
107	No Build	11	8	10	11	18	13	17	19
	Build C3	10	8	10	12	17	13	16	19
	Full Build	11	9	10	11	17	13	16	17
108	No Build	-	-	-	-	-	-	-	-
	Build C3	10	8	10	11	17	13	16	19
	Full Build	12	10	11	13	18	14	16	18
109	No Build	-	-	-	-	-	-	-	-
	Build C3	14	11	13	14	17	13	16	18
	Full Build	14	11	13	15	17	13	16	18
110	No Build	-	-	-	-	-	-	-	-
	Build C3	11	8	10	12	18	13	17	19
	Full Build	11	9	11	12	17	13	16	18
111	No Build	-	-	-	-	-	-	-	-
	Build C3	11	8	10	11	18	13	17	19
	Full Build	12	9	11	12	17	12	16	18
112	No Build	-	-	-	-	-	-	-	-
	Build C3	11	8	10	11	17	12	16	18
	Full Build	11	7	10	11	16	11	15	16

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
113	No Build	-	-	-	-	-	-	-	-
	Build C3	8	6	8	9	13	10	13	14
	Full Build	10	8	10	11	14	11	13	15
114	No Build	-	-	-	-	-	-	-	-
	Build C3	10	7	10	11	17	12	16	18
	Full Build	6	5	6	7	10	8	9	11
115	No Build	-	-	-	-	-	-	-	-
	Build C3	9	7	9	10	16	12	15	16
	Full Build	7	5	6	7	11	9	10	11
116	No Build	14	10	13	15	22	16	20	24
	Build C3	14	10	13	14	20	15	19	21
	Full Build	15	11	14	16	20	15	18	20
117	No Build	13	10	12	15	21	16	19	23
	Build C3	12	9	11	12	18	13	17	19
	Full Build	12	9	11	12	17	13	16	18
118	No Build	-	-	-	-	-	-	-	-
	Build C3	13	9	12	13	20	14	19	21
	Full Build	13	9	12	13	18	14	17	19
119	No Build	-	-	-	-	-	-	-	-
	Build C3	13	9	12	13	20	15	19	21
	Full Build	12	9	11	12	17	13	16	17
120	No Build	-	-	-	-	-	-	-	-
	Build C3	12	9	11	13	20	14	18	21
	Full Build	13	10	12	13	18	14	17	19
121	No Build	-	-	-	-	-	-	-	-
	Build C3	13	10	12	14	22	16	20	23
	Full Build	9	7	8	9	13	11	12	14
122	No Build	-	-	-	-	-	-	-	-
	Build C3	13	10	12	14	21	16	20	23
	Full Build	9	8	9	10	14	11	13	15
123	No Build	-	-	-	-	-	-	-	-
	Build C3	13	9	12	14	20	15	19	22
	Full Build	13	12	13	14	19	16	18	20
124	No Build	-	-	-	-	-	-	-	-
	Build C3	14	10	13	16	22	16	20	24
	Full Build	4	4	4	4	8	6	7	7
125	No Build	12	9	11	12	18	13	16	18
	Build C3	13	10	12	15	20	15	19	23
	Full Build	12	10	11	12	18	15	17	18
126	No Build	12	9	11	12	18	13	16	18
	Build C3	15	11	14	17	23	17	21	25
	Full Build	11	8	10	10	17	12	15	16

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
127	No Build	11	8	10	12	17	13	16	18
	Build C3	14	10	12	15	21	15	19	23
	Full Build	11	8	10	11	17	13	16	17
128	No Build	11	8	10	12	18	13	16	18
	Build C3	15	11	14	17	23	17	21	25
	Full Build	11	9	11	12	14	11	13	14
129	No Build	13	10	12	14	19	14	18	20
	Build C3	15	11	14	17	23	17	21	25
	Full Build	7	5	7	7	12	9	11	12
130	No Build	19	14	17	20	26	19	23	28
	Build C3	15	11	14	16	23	17	21	24
	Full Build	9	7	8	9	15	11	14	14
131	No Build	17	12	15	18	24	17	21	26
	Build C3	16	12	15	18	24	18	22	27
	Full Build	9	7	8	9	14	10	13	14
132	No Build	17	12	15	18	24	17	21	26
	Build C3	15	11	13	17	21	16	19	23
	Full Build	11	8	10	12	17	12	16	18
133	No Build	16	12	14	18	23	17	21	25
	Build C3	15	11	14	17	22	16	20	25
	Full Build	14	10	13	14	20	14	18	20
134	No Build	12	8	11	13	18	13	16	19
	Build C3	16	11	14	18	23	17	21	25
	Full Build	15	10	14	15	21	15	19	22
135	No Build	13	10	12	15	20	14	18	22
	Build C3	18	13	17	20	26	19	24	29
	Full Build	9	7	8	9	13	10	12	14
136	No Build	10	8	9	11	16	12	15	18
	Build C3	18	13	17	21	27	20	24	29
	Full Build	15	11	14	17	22	16	20	24
137	No Build	13	9	11	14	18	14	17	20
	Build C3	19	14	17	21	27	20	25	30
	Full Build	9	9	9	10	13	11	13	14
138	No Build	10	8	10	11	16	12	15	17
	Build C3	19	14	17	21	27	20	25	30
	Full Build	17	12	16	19	23	17	22	26
139	No Build	9	7	8	10	14	11	13	15
	Build C3	20	15	19	23	29	21	27	32
	Full Build	18	13	16	20	26	19	23	28
140	No Build	8	6	7	9	13	10	12	14
	Build C3	21	16	20	24	30	22	28	34
	Full Build	18	13	17	20	27	20	25	30

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
141	No Build	9	7	8	10	15	11	13	16
	Build C3	19	14	17	21	27	20	25	30
	Full Build	18	13	16	20	27	20	24	30
142	No Build	8	6	8	9	13	10	12	14
	Build C3	18	13	17	20	25	19	24	28
	Full Build	14	11	13	16	23	17	21	25
143	No Build	9	7	8	10	14	10	13	15
	Build C3	19	14	18	21	26	19	24	29
	Full Build	12	9	11	13	19	14	17	21
144	No Build	8	6	8	9	14	10	13	15
	Build C3	21	15	20	24	28	21	26	31
	Full Build	18	14	17	21	25	19	24	28
145	No Build	9	7	9	10	15	11	14	16
	Build C3	17	13	16	19	25	18	23	27
	Full Build	21	16	19	24	29	22	27	33
146	No Build	10	7	9	11	16	12	15	18
	Build C3	15	11	14	16	24	18	22	26
	Full Build	19	14	17	21	26	19	24	29
147	No Build	10	8	10	12	17	12	16	19
	Build C3	12	8	11	12	18	13	17	18
	Full Build	18	13	16	20	25	19	23	28
148	No Build	11	8	10	12	18	13	16	20
	Build C3	13	9	12	14	21	15	19	21
	Full Build	17	12	15	18	23	17	21	26
149	No Build	12	9	11	13	19	14	17	21
	Build C3	14	10	13	14	21	15	19	21
	Full Build	15	11	14	17	21	16	20	24
150	No Build	13	9	12	14	20	15	19	23
	Build C3	13	10	12	14	20	15	19	20
	Full Build	14	10	13	16	19	14	18	21
151	No Build	13	9	12	14	20	15	19	22
	Build C3	11	8	10	11	17	13	16	17
	Full Build	14	10	13	15	20	14	18	21
152	No Build	14	10	13	15	22	16	20	24
	Build C3	14	10	13	14	20	14	19	21
	Full Build	12	9	11	13	17	13	16	18
153	No Build	14	10	13	16	22	17	20	25
	Build C3	14	10	13	14	20	14	19	20
	Full Build	10	8	10	11	14	11	13	15
154	No Build	14	10	13	15	22	16	20	24
	Build C3	9	7	8	9	13	10	12	14
	Full Build	15	11	13	15	19	14	17	19

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
155	No Build	13	10	12	15	21	15	19	23
	Build C3	8	6	7	8	13	10	12	14
	Full Build	9	6	8	9	13	9	12	13
156	No Build	13	10	12	15	21	15	19	23
	Build C3	10	8	9	10	14	11	13	15
	Full Build	9	7	8	9	13	10	13	14
157	No Build	12	8	11	11	19	13	17	18
	Build C3	14	10	12	14	19	14	17	19
	Full Build	8	6	8	9	13	10	12	14
158	No Build	11	8	10	11	18	13	17	18
	Build C3	16	12	15	16	21	16	20	22
	Full Build	8	7	8	8	13	10	12	14
159	No Build	12	8	11	11	18	12	17	17
	Build C3	11	8	10	11	17	13	16	17
	Full Build	9	7	8	10	13	10	12	14
160	No Build	10	7	9	10	16	11	15	16
	Build C3	7	6	7	8	12	10	11	13
	Full Build	6	5	6	7	10	8	10	11
161	No Build	12	10	11	12	18	15	17	19
	Build C3	14	11	13	15	20	16	19	21
	Full Build	13	10	12	13	18	15	17	20
162	No Build	13	11	12	14	19	16	18	20
	Build C3	15	12	14	16	22	17	20	23
	Full Build	15	11	13	16	21	16	20	23
163	No Build	11	9	10	11	17	14	16	18
	Build C3	16	12	14	17	22	17	20	24
	Full Build	17	12	15	18	23	17	21	25
164	No Build	10	8	9	10	15	13	14	15
	Build C3	10	7	9	10	15	12	14	16
	Full Build	10	8	9	10	15	12	14	16
165	No Build	9	7	8	9	14	11	13	15
	Build C3	11	7	10	11	16	12	15	17
	Full Build	11	8	10	11	15	11	14	16
166	No Build	9	7	8	10	14	11	13	15
	Build C3	10	7	9	10	16	11	14	16
	Full Build	10	7	9	10	15	11	14	15
167	No Build	8	6	8	9	14	11	13	15
	Build C3	18	13	16	19	24	17	22	26
	Full Build	14	10	13	16	20	15	19	23
168	No Build	19	14	17	18	27	20	25	26
	Build C3	18	13	17	16	27	19	24	24
	Full Build	12	10	11	12	18	15	17	18

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
169	No Build	19	14	18	18	27	19	25	25
	Build C3	19	13	17	17	26	19	24	24
	Full Build	12	10	12	12	19	16	18	18
170	No Build	11	9	10	11	19	14	17	18
	Build C3	12	9	11	11	19	14	18	18
	Full Build	13	11	12	13	19	15	18	19
171	No Build	10	8	10	11	17	13	16	17
	Build C3	10	7	9	10	16	12	15	16
	Full Build	12	10	12	12	17	14	17	18
172	No Build	13	9	12	12	20	14	19	18
	Build C3	13	9	12	11	21	14	18	18
	Full Build	11	8	11	12	17	13	16	18
173	No Build	12	8	11	12	18	13	16	19
	Build C3	15	11	14	16	22	17	20	23
	Full Build	14	10	13	15	20	15	19	22
174	No Build	14	12	14	15	20	17	19	21
	Build C3	15	12	14	16	21	17	20	22
	Full Build	14	12	13	14	20	16	18	20
175	No Build	12	10	12	13	19	15	18	20
	Build C3	13	11	13	14	20	16	19	21
	Full Build	15	12	14	16	23	19	22	24
176	No Build	8	7	8	8	13	12	13	13
	Build C3	15	11	14	16	21	15	19	23
	Full Build	14	10	13	16	20	15	18	22
177	No Build	9	7	8	9	14	12	13	15
	Build C3	21	15	19	23	28	21	26	31
	Full Build	18	13	17	20	25	19	24	28
178	No Build	10	7	9	10	15	11	14	16
	Build C3	15	11	14	17	21	16	19	23
	Full Build	13	9	12	14	18	14	17	20
179	No Build	17	12	15	18	24	18	22	26
	Build C3	13	11	12	13	20	16	18	20
	Full Build	15	14	15	16	21	18	20	22
180	No Build	15	11	14	15	23	16	21	23
	Build C3	15	11	14	15	22	16	20	21
	Full Build	15	11	14	14	21	15	19	20
181	No Build	16	11	14	13	24	16	22	20
	Build C3	20	15	18	21	26	20	24	27
	Full Build	20	15	18	21	26	20	24	28
182	No Build	21	15	19	20	29	21	27	28
	Build C3	20	14	18	18	28	19	26	25
	Full Build	19	13	18	18	26	19	24	25

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
183	No Build	15	10	13	15	23	16	21	22
	Build C3	18	13	17	18	26	19	24	26
	Full Build	17	13	16	17	25	18	23	24
184	No Build	21	16	19	23	29	21	26	31
	Build C3	14	10	13	14	20	15	19	20
	Full Build	12	9	11	12	18	14	17	18
185	No Build	13	9	12	14	18	13	16	19
	Build C3	13	10	12	15	20	15	19	22
	Full Build	9	7	8	9	15	11	13	14
186	No Build	10	7	9	11	15	11	14	15
	Build C3	10	7	9	11	15	11	14	17
	Full Build	11	8	10	10	17	12	15	16
187	No Build	11	8	10	11	17	12	15	17
	Build C3	12	9	11	13	18	14	17	20
	Full Build	11	9	10	11	18	14	17	18
188	No Build	13	10	12	14	19	14	18	21
	Build C3	10	7	9	11	16	12	14	17
	Full Build	10	7	9	10	16	12	15	15
189	No Build	12	9	11	13	19	14	17	20
	Build C3	10	7	9	11	16	12	15	18
	Full Build	11	8	10	11	18	13	17	18
190	No Build	9	7	9	10	15	12	15	17
	Build C3	10	7	9	10	15	12	15	15
	Full Build	12	9	11	13	19	14	18	20
191	No Build	15	12	14	15	22	17	20	22
	Build C3	15	11	13	15	22	16	20	22
	Full Build	10	8	9	10	16	12	14	16
192	No Build	17	13	15	17	23	18	21	23
	Build C3	16	12	15	16	22	16	20	22
	Full Build	12	9	11	12	18	14	16	18
193	No Build	11	9	10	12	18	14	17	19
	Build C3	12	9	11	13	18	14	17	19
	Full Build	14	10	12	15	22	16	19	23
194	No Build	16	12	15	16	24	18	22	24
	Build C3	15	11	14	16	22	17	21	23
	Full Build	20	14	17	21	26	19	24	28
195	No Build	15	11	14	15	23	17	21	23
	Build C3	16	12	15	17	23	17	21	23
	Full Build	19	14	17	20	27	19	24	28
196	No Build	18	13	17	18	25	19	24	26
	Build C3	19	14	18	20	26	19	24	26
	Full Build	20	15	19	21	26	19	24	27

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
197	No Build	18	13	16	19	24	18	22	26
	Build C3	16	12	15	17	23	17	21	24
	Full Build	16	11	14	16	23	16	20	23
198	No Build	17	12	16	17	25	18	23	25
	Build C3	16	11	15	15	23	17	21	23
	Full Build	14	10	12	13	21	15	19	20
199	No Build	17	12	15	18	24	18	22	25
	Build C3	15	11	14	15	21	16	20	21
	Full Build	14	10	12	14	20	15	18	20
200	No Build	17	12	16	17	25	18	23	24
	Build C3	18	13	16	19	25	18	22	26
	Full Build	18	13	16	19	24	18	22	26
201	No Build	15	11	13	16	21	15	19	22
	Build C3	14	11	13	15	20	15	18	21
	Full Build	18	12	16	16	24	17	22	22
202	No Build	15	11	13	16	21	15	19	22
	Build C3	13	10	12	13	19	14	17	19
	Full Build	10	7	9	10	15	11	14	16
203	No Build	13	10	12	14	19	14	18	20
	Build C3	12	9	11	12	18	13	16	17
	Full Build	14	10	13	15	20	15	19	21
204	No Build	14	10	12	14	19	14	18	20
	Build C3	13	9	12	13	18	13	17	18
	Full Build	18	14	17	20	25	18	23	26
205	No Build	15	10	14	14	21	15	20	21
	Build C3	15	10	14	14	21	14	19	20
	Full Build	16	13	14	15	23	18	21	23
206	No Build	19	13	17	20	26	18	23	27
	Build C3	17	12	15	17	24	17	22	25
	Full Build	15	12	14	15	22	17	20	21
207	No Build	14	9	12	12	21	14	18	19
	Build C3	13	9	11	11	19	13	17	18
	Full Build	17	13	16	17	24	19	22	24
208	No Build	13	9	12	13	20	14	18	20
	Build C3	13	9	11	13	19	14	18	20
	Full Build	14	10	13	14	21	16	20	22
209	No Build	11	8	11	11	17	13	16	17
	Build C3	10	7	10	11	16	12	15	16
	Full Build	14	10	13	14	20	15	19	20
210	No Build	14	10	12	13	19	14	18	19
	Build C3	12	9	11	11	18	13	16	17
	Full Build	16	13	14	16	22	17	20	21

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
211	No Build	12	9	11	12	18	14	17	19
	Build C3	12	8	11	12	18	13	16	18
	Full Build	17	14	15	16	24	20	22	24
212	No Build	11	8	10	11	17	13	16	17
	Build C3	11	8	10	11	17	12	16	17
	Full Build	18	14	17	19	25	19	23	26
213	No Build	8	5	7	8	13	9	12	13
	Build C3	8	6	8	8	14	10	13	14
	Full Build	14	11	12	13	19	16	17	19
214	No Build	10	7	9	10	17	12	15	16
	Build C3	11	8	10	11	17	12	15	16
	Full Build	17	13	16	18	25	19	23	26
215	No Build	11	8	10	11	18	13	16	17
	Build C3	12	8	11	11	17	13	16	16
	Full Build	12	9	11	12	20	14	18	19
216	No Build	11	8	10	11	18	13	17	18
	Build C3	12	9	11	12	18	13	16	17
	Full Build	17	12	16	17	24	17	22	23
217	No Build	12	9	11	11	19	14	17	18
	Build C3	12	9	10	12	18	13	16	18
	Full Build	8	6	8	8	13	10	12	14
218	No Build	11	8	10	11	19	13	17	17
	Build C3	11	8	10	10	19	13	16	17
	Full Build	25	18	22	27	32	23	28	33
219	No Build	15	12	14	16	23	18	22	24
	Build C3	14	11	13	14	22	17	20	22
	Full Build	20	14	17	21	25	18	22	26
220	No Build	15	11	14	16	22	17	21	24
	Build C3	16	12	15	17	22	17	21	23
	Full Build	10	7	9	9	16	11	14	15
221	No Build	17	13	16	17	24	18	22	25
	Build C3	17	12	16	16	23	17	21	22
	Full Build	18	13	16	19	24	18	22	25
222	No Build	10	8	10	11	16	12	15	18
	Build C3	9	7	9	10	15	11	15	16
	Full Build	13	10	12	14	20	14	18	21
223	No Build	11	8	10	11	16	12	15	17
	Build C3	11	8	10	11	16	12	16	17
	Full Build	12	9	11	12	18	13	17	18
224	No Build	7	6	6	7	12	10	11	12
	Build C3	7	6	6	6	12	10	11	11
	Full Build	10	8	10	10	16	12	15	16

Table 2: Mean Speed and Effective Gust Categories - Seasonal

Location	Configuration	Mean Wind Speed (mph)				Effective Gust Wind Speed (mph)			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
225	No Build	16	11	14	17	22	16	20	23
	Build C3	11	8	11	11	18	13	16	18
	Full Build	10	8	10	11	16	13	16	17
226	No Build	10	8	9	11	16	12	15	17
	Build C3	13	9	12	13	20	14	18	20
	Full Build	15	10	13	12	21	14	19	19
227	No Build	11	9	10	12	17	13	16	18
	Build C3	16	11	14	16	24	17	22	24
	Full Build	18	12	16	16	25	17	23	23
228	No Build	13	10	12	14	19	15	18	20
	Build C3	21	14	19	19	28	19	25	26
	Full Build	21	14	19	18	28	19	25	25
229	No Build	18	13	16	19	26	19	24	27
	Build C3	15	11	13	14	23	16	21	22
	Full Build	14	10	13	13	21	15	19	20
230	No Build	17	12	16	17	24	17	22	25
	Build C3	14	10	13	14	20	15	19	21
	Full Build	13	9	12	12	18	13	17	18
231	No Build	16	12	15	16	23	18	23	24
	Build C3	15	13	15	15	22	18	21	22
	Full Build	14	11	14	15	21	17	20	22
232	No Build	8	6	7	8	14	10	13	14
	Build C3	7	5	7	8	13	10	12	13
	Full Build	15	11	14	17	20	15	19	23
233	No Build	17	13	16	18	24	19	22	25
	Build C3	16	13	15	16	23	18	22	24
	Full Build	13	12	13	13	19	16	19	20

Seasons	Months	Mean Wind Criteria Speed (mph)		Effective Gust Criteria (mph)	
Spring	March - May	≤ 12	Comfortable for Sitting	≤ 31	Acceptable
Summer	June - August	13 - 15	Comfortable for Standing	> 31	Unacceptable
Fall	September - November	16 - 19	Comfortable for Walking		
Winter	December - February	20 - 27	Uncomfortable for Walking		
Annual	January - December	> 27	Dangerous Conditions		

Configurations

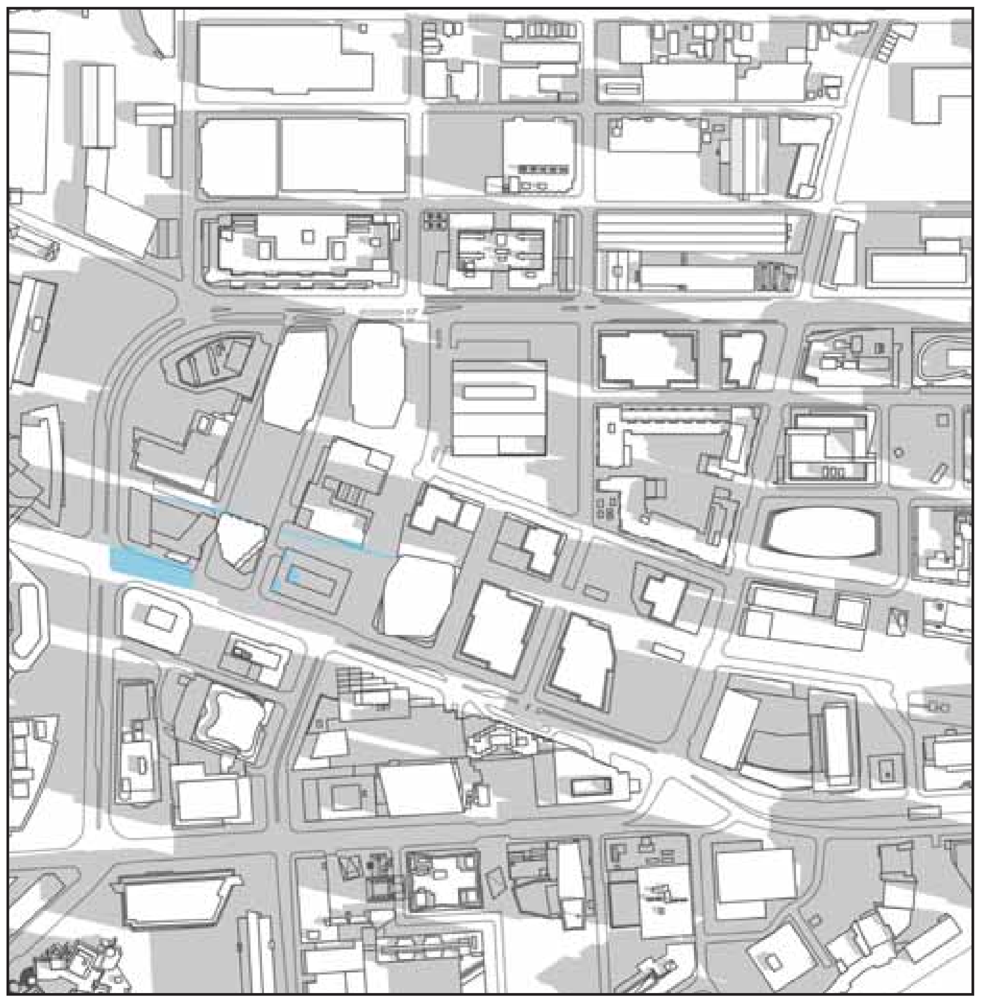
No Build Existing site and surrounding

Build Proposed C3 building with local proposed landscaping along with future MDX developments and 585 3rd street building

Full Build C3 building with addition of C1, C2, C4, R1, R2, R3 & R4 buildings with full proposed landscaping

Notes

1) Wind Speeds are for a 1% probability of exceedance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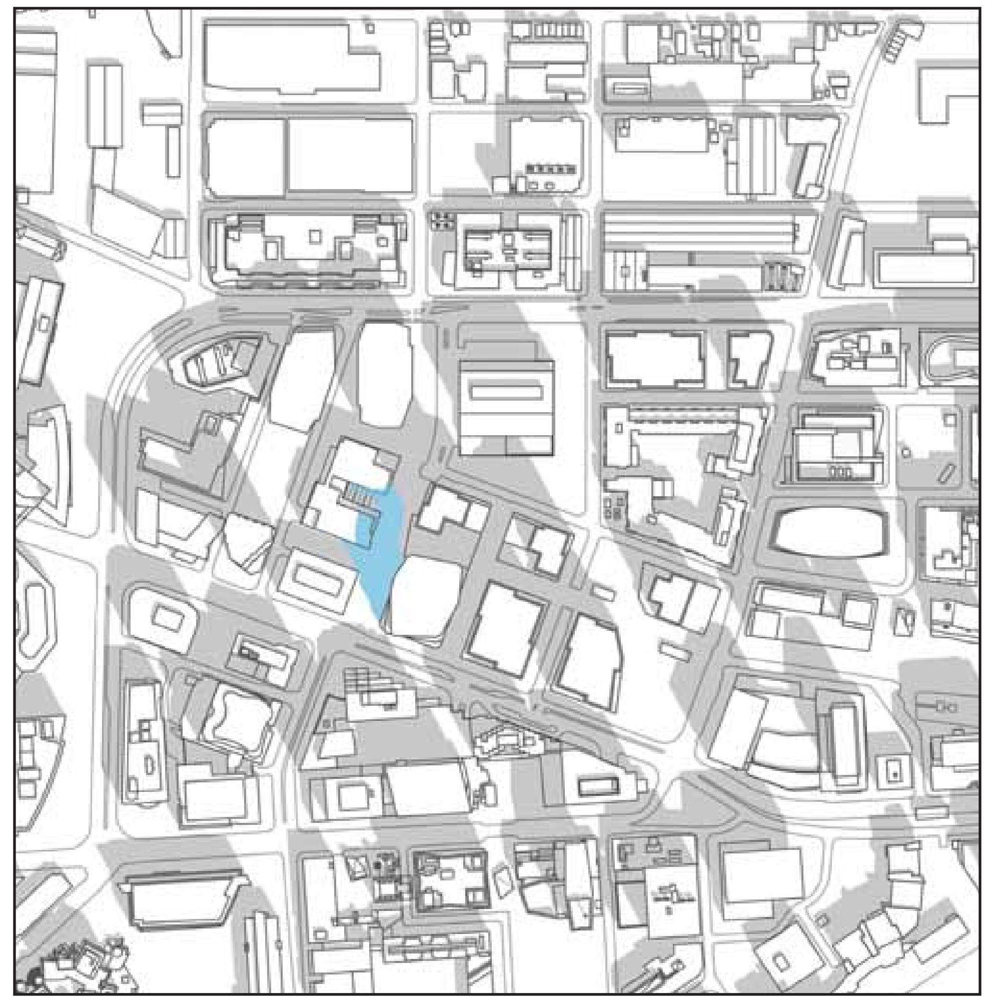
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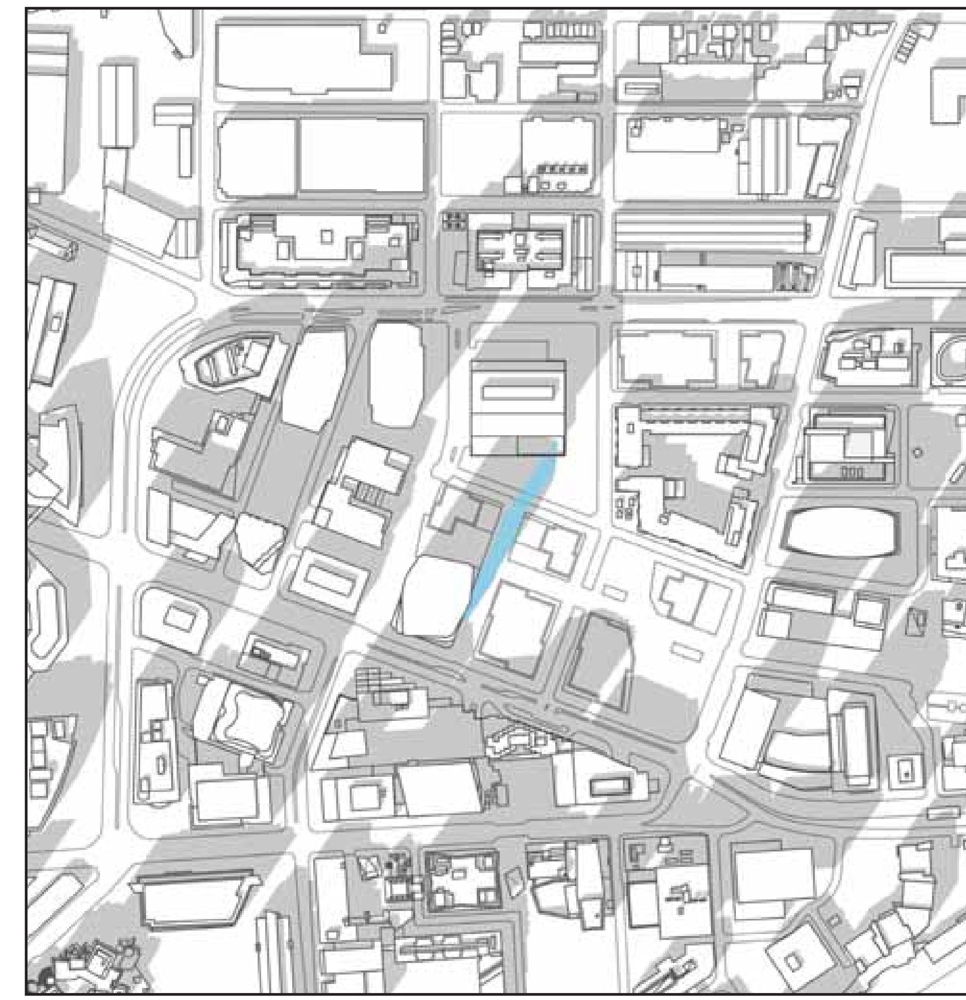
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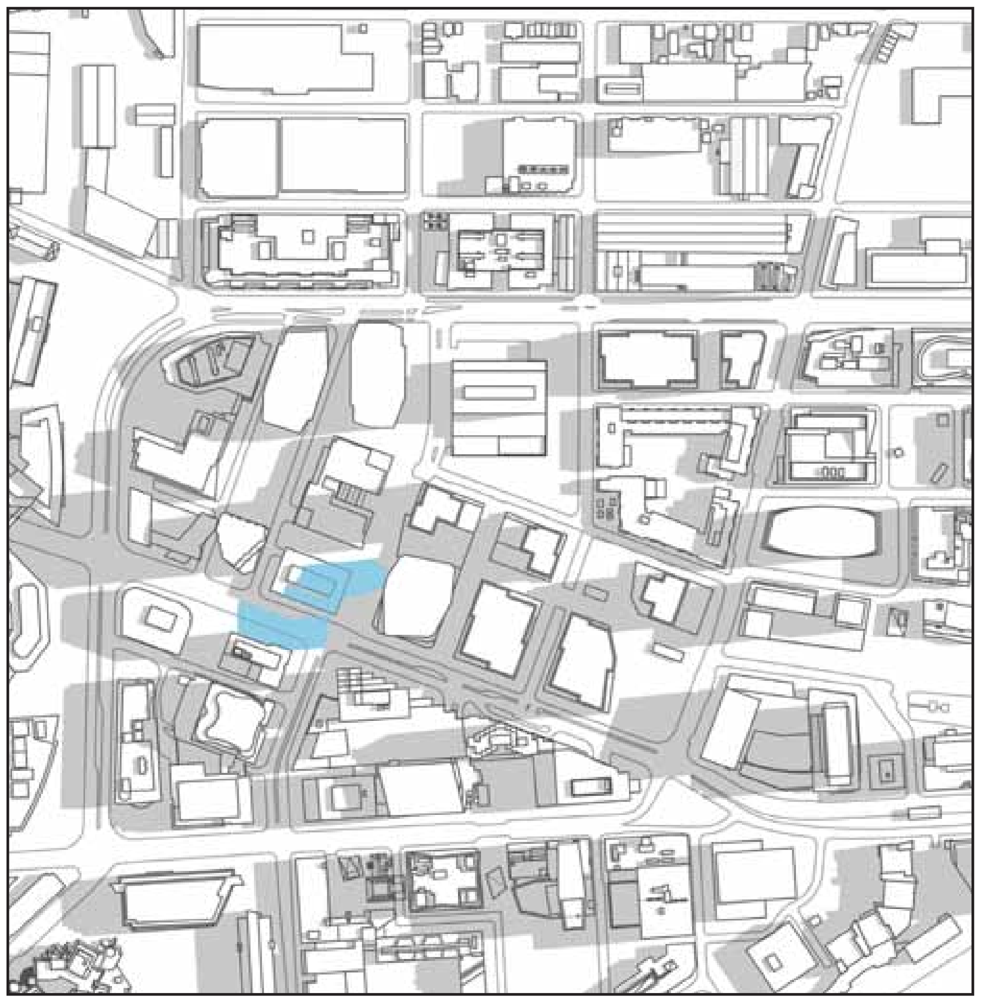
NET NEW SHADOWS

N

Shadow Study: Net New Shadows—March 21/Sept. 21



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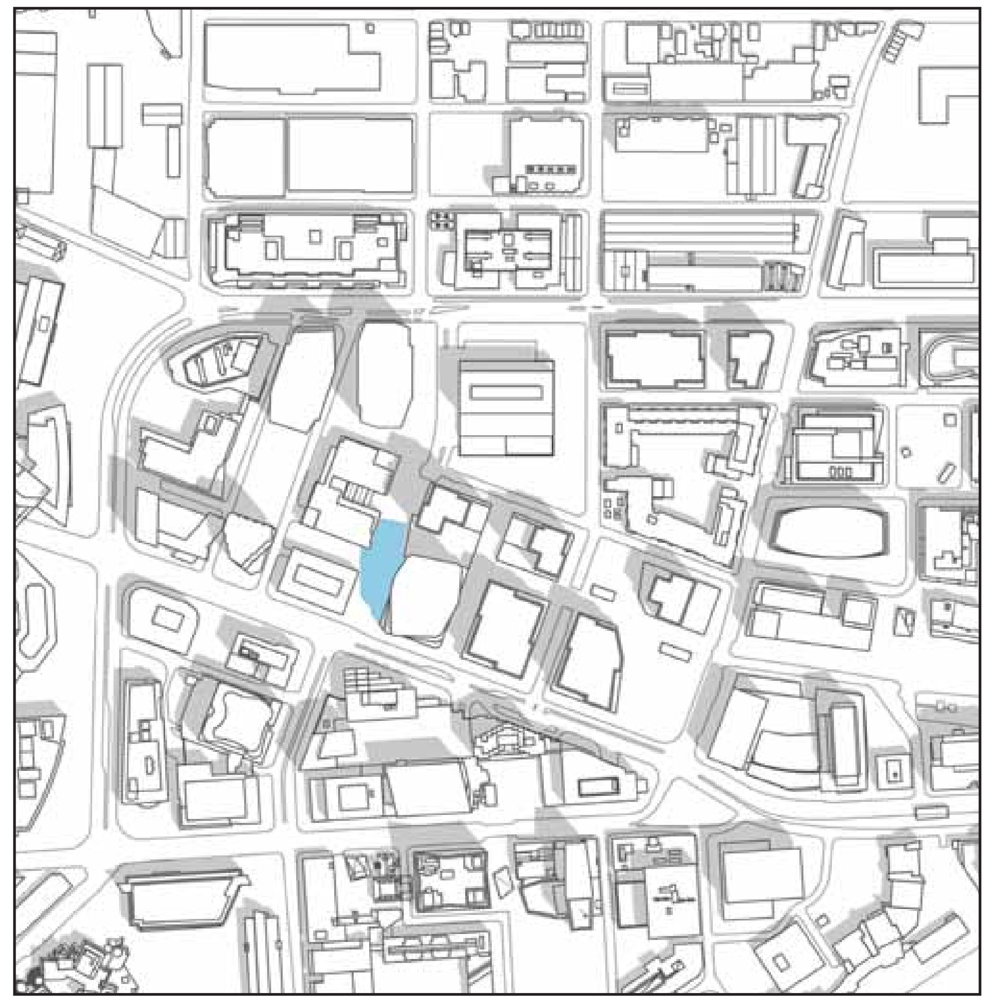

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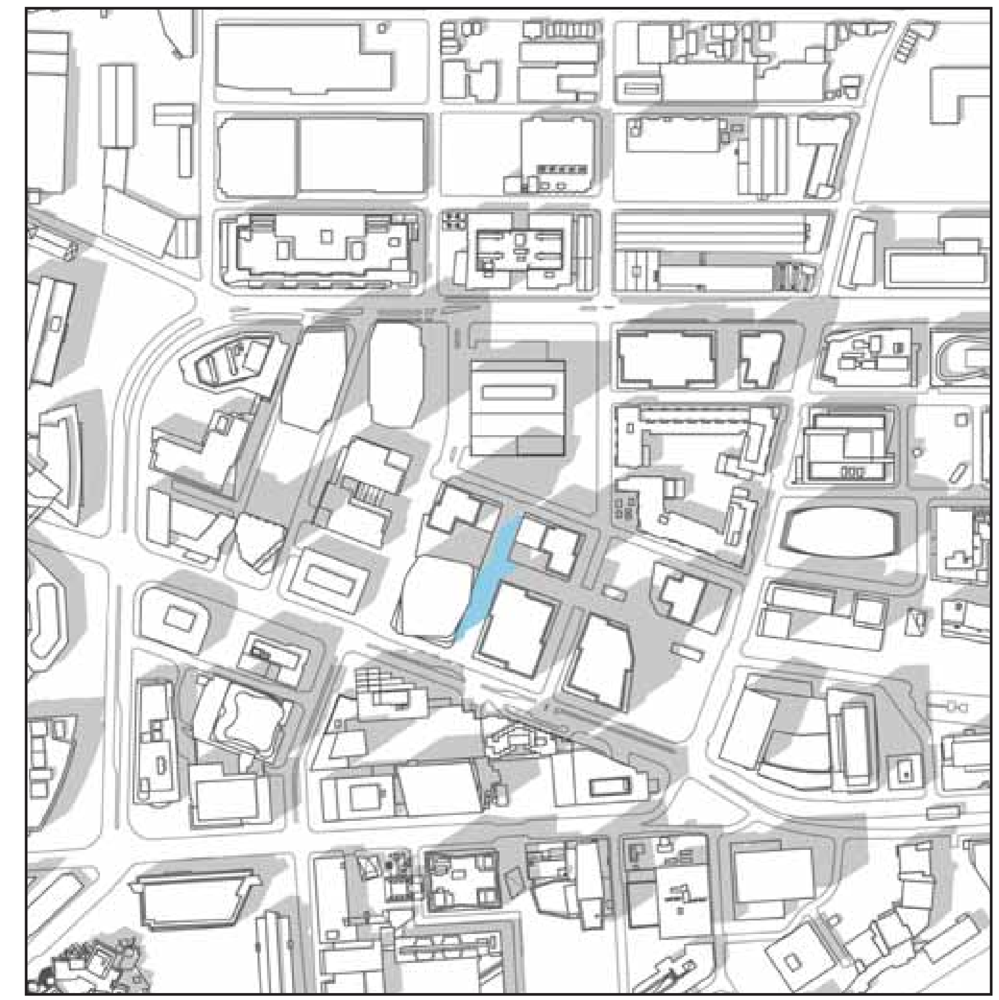
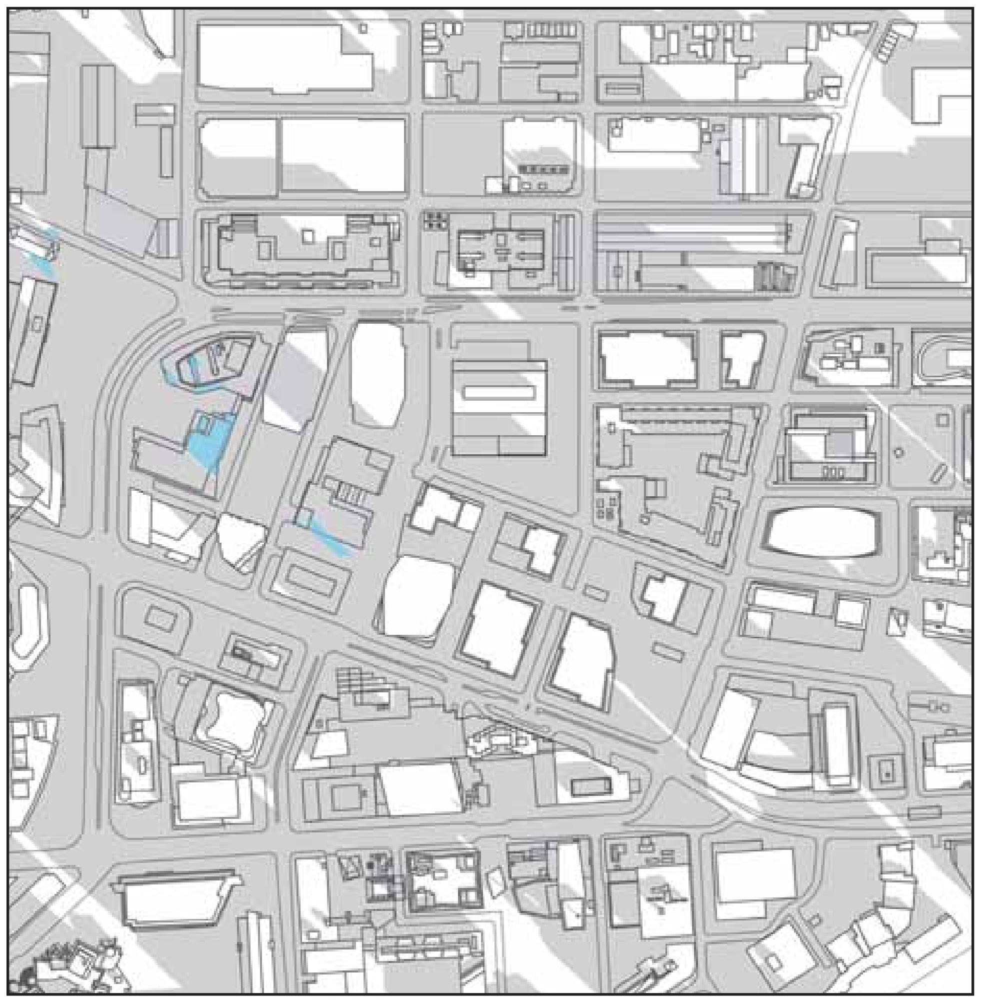


3PM

Shadow Study: Net New Shadows–June 21



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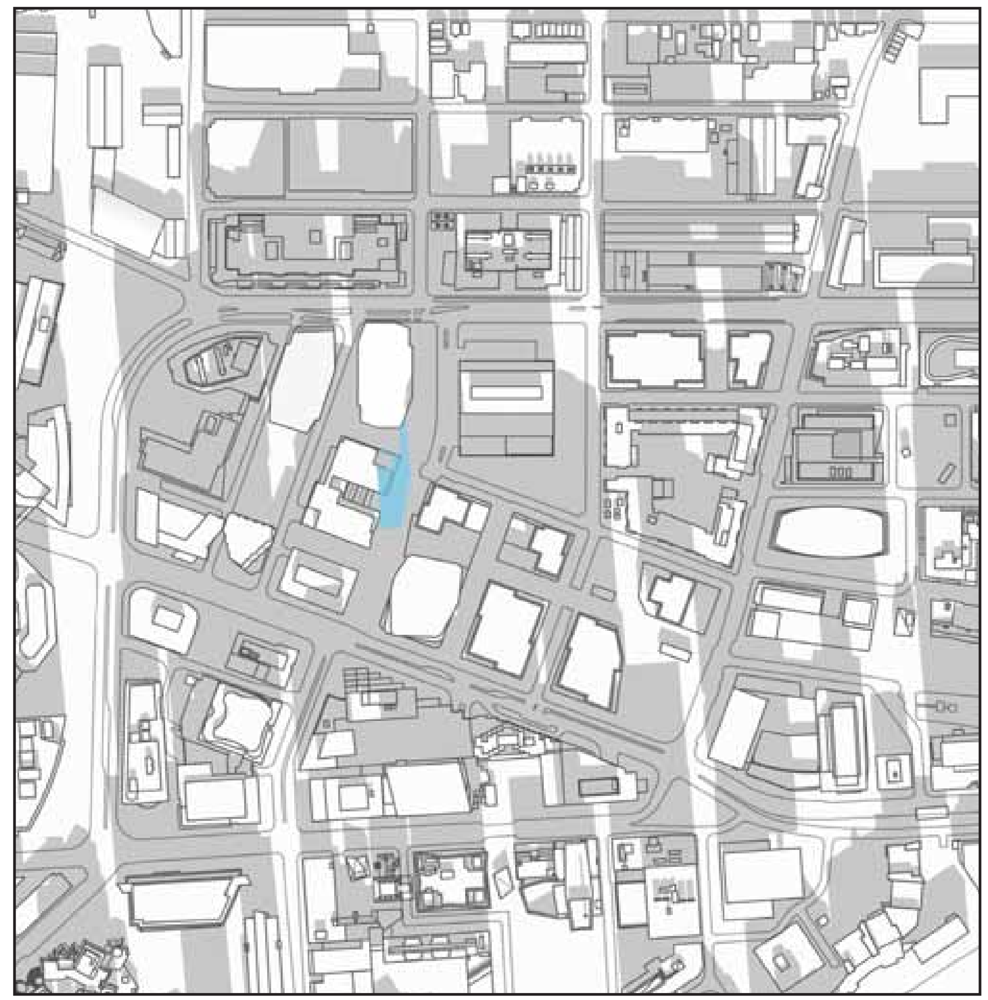

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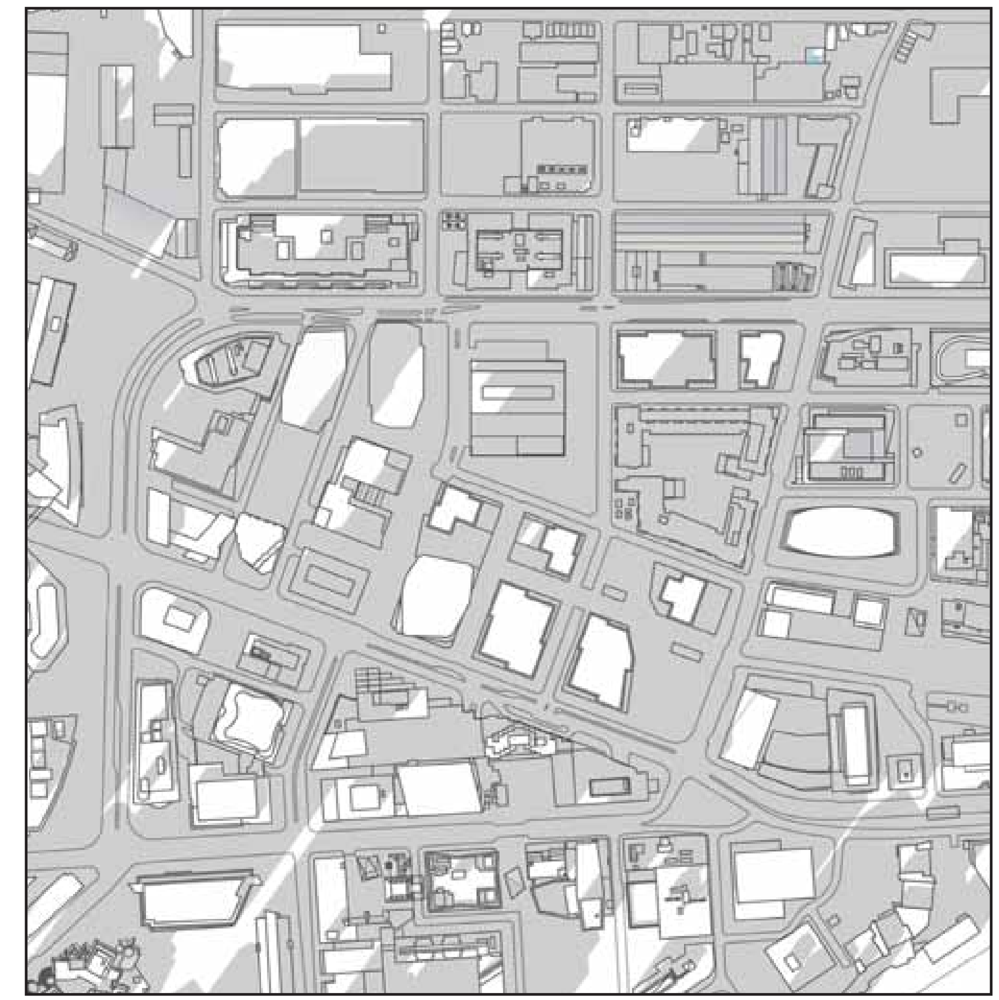

3PM

NET NEW SHADOWS

N

Shadow Study: Net New Shadows—December 21