

**WALDEN SQUARE APARTMENTS**  
CAMBRIDGE, MA



**WinnCompanies**



# OTHER SUBMISSIONS VOLUME



PCA

Architecture  
Interiors  
+ Planning

## INDEX

**01 Green Building Requirements**

**02 Flood Resilience and Green Factor Standards**



Community-Based Sustainable Development

City of Cambridge Community Development Department  
344 Broadway  
Cambridge, MA 02139

August 15, 2023

**Subject: Walden Square Apartments Article 22 Initial Filing Green Building Report**

Dear Cambridge Community Development Department:

The Walden Square Apartments project team is excited to share the attached documents, collectively the Article 22 Green Building Report, documenting the currently planned building sustainability features for this highly efficient 100% affordable multifamily development. Currently in schematic design, the project is targeting Passive House certification under the Phius 2021 rating system. Walden Square is designed for resilience and incorporates a number of sustainable features including all-electric heating and cooling systems and rooftop-mounted solar photovoltaic systems.

The following documents contained herein demonstrate that Walden Square Apartments is in compliance with Article 22 preliminary submission requirements:

- Green Building Checklist
- Net Zero Narrative
- Rating System Narrative
- Green Building Professional Affidavit

The project team expects Walden Square to earn full certification as a Passive House under the Phius 2021 rating system. The project team will continue to update the WUFI energy modeling as design progresses and the project seeks pre-certification with Phius, and will share an updated report with CDD in the forthcoming building permit Article 22 submission.

This project will be MA Specialized Energy Code compliant, following the commercial building requirements at 225 CMR 23.00 Appendix CC. The project will demonstrate compliance through the Phius certification pathway and by following section CC104, the All Electric Building Performance Standard. As shown in the attached Net Zero Narrative, the project is currently estimated to exceed MA Stretch Energy Code performance requirements by approximately 32%.

As part of the Phius requirements, the project will also earn the EPA Indoor airPLUS certification and the ENERGY STAR Multifamily New Construction certifications. The EPA Indoor airPLUS certification program focuses on high quality indoor air and low or no emissions from building materials (low/no VOCs). The project will include MERV 13 filters to maintain indoor air quality. In addition to these certification requirements, this project will follow all Massachusetts Department of Housing and Community Development (DHCD) design requirements. As the building design progresses, the project team will continue to explore opportunities to reduce the environmental impact of the project including exploration of additional on-site solar PV capacity, potential green roof areas, zero VOC indoor finishes, and lower embodied carbon materials.

# NEW ECOLOGY



Community-Based Sustainable Development

The resulting building will be an exceptionally high performance structure demonstrating a careful focus on energy and emissions performance and high quality indoor air. The project team looks forward to creating an affordable, resilient, and high-performing building and to sharing future updates on project progress with CDD.

## Green Building Project Checklist

### Green Building

Project Location: Walden Square Apartments, Building A

### Applicant

Name: WinnDevelopment Company Limited Partnership

Address: One Washington Mall, Suite Boston, Boston MA 02108

#### Contact Information

Email Address: mrobayna@winnco.com

Telephone #: 617-532-2185

### Project Information (select all that apply):

- New Construction - GFA: 91,892 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: \_\_\_\_\_
- Building Design + Construction (BD+C) - Subcategory: \_\_\_\_\_
- Residential BD+C - Subcategory: \_\_\_\_\_
- Interior Design + Construction (ID+C) - Subcategory: \_\_\_\_\_
- Other: \_\_\_\_\_
- Passive House - Version: 2021
- PHIUS+
- Passivhaus Institut (PHI)
- Other: \_\_\_\_\_
- Enterprise Green Communities - Version: \_\_\_\_\_



## 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)

# WALDEN SQUARE APARTMENTS – Building A Net Zero Narrative

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Cambridge, MA  
August 15, 2023



Submitted to  
Cambridge Community Development Department  
344 Broadway  
Cambridge, MA 02139



Prepared by  
New Ecology, Inc.  
294 Washington Street Suite 830  
Boston, MA 02108

## Table of Contents

Project Profile.....	3
Proposed Project Design Characteristics .....	3
<i>Envelope Commissioning Process</i> .....	4
Building Mechanical Systems.....	4
<i>Mechanical Systems Commissioning Process</i> .....	4
Building Energy Performance Measures.....	5
Integrative Design Process.....	5
Green Building Incentive Program Assistance.....	5
Net Zero Scenario Transition .....	5
Energy Systems Comparison .....	6
Assumptions .....	6
<i>Non-Carbon Fuel Scenario</i> .....	7
Solar-Ready Roof Assessment .....	7
Figure 1: PV Detailed Layout .....	8
Results.....	8
Anticipated Energy Loads and GHG Emissions .....	9
<i>Assumptions</i> .....	9
<i>Annual Projected Energy Consumption</i> .....	9
<i>Annual Projected GHG Emissions</i> .....	10



## Project Profile

Table 1: Development Characteristics	
Lot area (sf)	319,049 sf
Existing land use(s) and current GFA (sf) by use	Parking, GFA =13,042 SF
Proposed land use(s) and total GFA (sf) by use	Residential GFA = 266,523 SF (183,161 sf (e) + 84,442 sf (new bldg. A) – not including garage – 7,450 sf
Proposed land use(s) and net new GFA (sf) by use	Residential, GFA = 84,442 SF
Proposed new building height(s) (ft and stories)	80'-0" & 7 stories
Proposed new dwelling units	60
Proposed open space (sf)	TOTAL = 87,793 SF (or 28% of the site)
Proposed parking spaces	10
Proposed bicycle parking (long- and short-term spaces)	20 LONG-TERM @BLDG A ( 84 LONG-TERM SITEWIDE, 42 SHORT-TERM SITEWIDE)

Table 2: Green Building Rating System			
Passive House Institute US (PHIUS) or Passivhaus Institut (PHI)			
Rating system & version	Phius 2021 CORE	Seeking certification?	<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> TBD

## Proposed Project Design Characteristics

Table 3: Building Envelope Assembly Descriptions	
Roof	Assembly R-50
Foundation	Assembly R-29 (concrete slab-on-deck) Assembly R-11 (concrete slab-on-grade)
Exterior walls	Steel-framed walls: R-14 (3" continuous mineral wool, no cavity insulation) Wood-framed walls: R-29 (2" continuous mineral wool, with cavity insulation)
Windows	Triple-pane windows: U-0.20, SHGC 0.30
Window-to-wall ratio	28.5%

Table 4: Building Envelope Performance		
	Baseline	Proposed
	U-value	U-value
Window	0.32	0.20
Wall	0.06	Steel-framed – 0.07, Wood-framed – 0.03

Roof	0.026	0.019
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As of June 1, 2022, preliminary WUFI modeling is complete. The areas for windows, walls, and roof will be updated as design progresses and once PHIUS pre-certification modeling is complete.

### Envelope Commissioning Process

The Project team will test and verify the envelope air barrier and air infiltration rates using bi-directional blower door testing both at construction midpoint and again after construction completion. Two (2) inspections will be performed after framing and air-sealing are complete but before insulation is installed, in order to identify any potential areas of thermal bridging and/or air infiltration. These inspections will be documented with site photos. Once installed, the air barrier will be tested with a bi-directional whole building blower door test conducted to Phius CORE standards. At the end of construction, the whole building blower door test will be repeated to confirm air-tightness, and 15 units will be blower door tested for air infiltration rates per RESNET sampling protocols. In addition, an inspection using a thermal imaging camera will be conducted to show compliance with thermal bridging and air sealing protocols.

### Building Mechanical Systems

Table 5: Building Mechanical Systems Description	
Space heating	VRF air-source heat pump with in-unit fan coils.
Space cooling	VRF air-source heat pump with in-unit fan coils
Heat rejection	See above systems.
Pumps & auxiliary	See above space conditioning and below DHW systems.
Ventilation	Central ERV with air-source heat pump
Domestic hot water	Central, air-source heat pump domestic hot water plant with recirculation loop.
Interior lighting	In-unit lighting will be all LED; common area lighting will be all LED with occupancy sensors
Exterior lighting	All exterior lighting will be LED with outdoor lighting controls.

### Mechanical Systems Commissioning Process

The project will retain a licensed commissioning agent (CxA) who will develop a detailed commissioning plan based on the building specifications and systems. The CxA will develop a functional performance test sheet for each system to be commissioned, and will commission the following systems: mechanical systems and equipment including Energy Recovery Ventilation (ERV) systems, central VRF air-source heat pump systems, a sample of apartment fan coils, and all direct digital controls. For lighting systems, all common space lighting control systems including occupancy sensors will be commissioned and sampled at the appropriate rate. For plumbing systems, the domestic hot water heating system, including central plant, storage tanks, circulating pumps, thermostatic mixing valves, and controls will be reviewed for compliance with sequence of operation and control setpoints per project specifications.

## Building Energy Performance Measures

Table 6: Building Energy Performance Measures	
Land uses	Housing development promoting walking and bicycling, located close to multiple public transportation modes (bus, subway, commuter rail), close to groceries, schools, daycare, and other necessities, and close to parks. Bicycle storage and parking provided on site.
Building orientation and massing	Primary building axis is optimized as East-West, with all units provided with multiple operable windows to allow passive ventilation.
Envelope systems	Continuous insulation, high performance glazing, and, high SRI roofs.
Mechanical systems	Energy recovery ventilators will be provided for ventilation. VRF distribution system will be designed to minimize energy losses.
Renewable energy systems	A preliminary solar PV layout for a roof-mounted system is complete. The project team will continue to evaluate solar PV layout and capacity potential as design progresses.
District-wide energy systems	N/A

### Integrative Design Process

As part of the integrative design process, the developer, architect, and mechanical engineer participated in an early-stage MEP- and envelope-focused Passive House charrette. During the kick-off meeting, the Project Team considered preliminary design concepts and began to define a comprehensive greening strategy that meets City of Cambridge Article 22, Stretch Energy Code, and Phius 2021 CORE requirements. The Project Team, including builder and Phius verifier, will continue to hold integrative design meetings throughout design development to ensure a thoughtful approach to designing and constructing the Project in accordance with its high-performance goals.

### Green Building Incentive Program Assistance

The project anticipates incremental project costs associated with certain high-performance systems and design features, including its energy efficient building envelope and electric heating and cooling system. The project will enroll in the MassSave Passive House incentive program to help offset a portion of the project's additional soft and hard costs associated with meeting the Passive House standards. The project team plans to fully certify the building in order to be eligible for the full incentive package offered by MassSave.

### Net Zero Scenario Transition

Table 7: Net Zero Scenario Transition		
	Net Zero Condition	Transition Process
Building envelope	The building envelope will be built to Phius Passive House standards, making it an ideal structure to achieve Net Zero in the future with on and off-site renewables. The envelope will be well-insulated and have a low level of air infiltration which will be tested and verified at construction.	This system will be a zero (site) emissions system at installation.

HVAC Systems	A VRF system is currently included in the proposed HVAC design for the building.  Central energy recovery ventilation will be used to capture energy from the ventilation system and will be installed at construction.	VRF in current design will be a zero emissions system at installation.  ERVs in current design will be a zero emissions system at installation.
Domestic Hot Water	A central air-source domestic hot water plant will be included at construction. The plant will be located within a rooftop mechanical room.	This system will be a zero (site) emissions system at installation.
Lighting	The project will use LED lighting throughout at construction. The building energy model for this project, will factor in Lighting Power Density as a calculation in overall building energy consumption. Fixtures will be modeled and will be specified in project documents to meet or exceed the energy requirement of the WUFI model.	The building and management team will include updated technology as it is available and will update systems at the end of service life of the lighting systems.
Renewable Energy Systems	The project will be solar-ready at construction.	The project will be solar-ready and will include PV panels as necessary to meet PH requirements at time of construction.
Other Strategies	The project is actively considering and modeling the use of window reveals and glazing tuning to reduce building energy consumption during summer months, while also allowing solar thermal gains during winter months.	N/A

## Energy Systems Comparison

The Project team evaluated the greenhouse gas emissions impacts and financial feasibility of one (1) design scenario, “Proposed” which is synonymous with the “NZ Scenario” with the exception of the use of renewable energy credits for all off-site electricity requirements, for the Walden Square Apartments project Building A. Operational and performance costs were estimated using the results of the preliminary WUFI model conceptual construction pricing, and per-square-foot maintenance cost estimates provided by WinnCompanies.

## Assumptions

Table 8 Energy Systems Included/Excluded in Analysis			
	Included in Analysis?		Describe systems analyzed or explain why it was excluded from analysis
	Yes	No	
Solar photovoltaics	X		PV is assumed to be included in design, but will likely be procure through a PPA. Exact amount of PV required to meet needs is to be determined via WUFI model results.

Solar hot water heater		X	In combination with potential PV solar panels, there is not enough space on the roofs to justify both technologies.
Ground-source heat pumps		X	Due to the limited space of the site, GSHP was determined to be cost-prohibitive at this time.
Water-source heat pumps		X	Focus was on the ASHP VRF as the most feasible option.
Air-source heat pumps	X		High-efficiency ASHP VRF
Non-carbon fuel district energy		X	Building energy loads are expected to be too low for district energy system application.
Other non-carbon fuel systems	X		Purchase of renewable energy credits would be included for the NZ scenario should the City of Cambridge require them in the future.

### Non-Carbon Fuel Scenario

One non-carbon, all-electric scenario was examined. The tables below provide descriptions of each scenario.

Table 9: LCCA Scenario Description by Key Components		
Scenario	Proposed	NZ Scenario
Heating & cooling	VRF ASHP, in-unit FCU	Same as proposed
Ventilation	Central ERV	Same as proposed
DHW	Central ASHP	Same as proposed
Envelope	PH (as described in Table 3)	Same as proposed
Window	PH (U-0.20)	Same as proposed
Renewable Energy Credits	No	Yes
Co-gen	No	No

The project team has researched and evaluated a central air-source heat pump system (ASHP) approach for generating domestic hot water (DHW) for the Walden Square project. There is emerging ASHP technology from several manufacturers that will be capable of meeting the DHW requirements for this building at the time of construction. Therefore, the DHW system for Walden Square will be designed as an ASHP central plant. This design requires additional roof space for ASHP units as well as additional space inside the building for the heat exchanger, storage tanks and pumps that are required for an ASHP system, relative to a conventional, central gas-fired system.

### Solar-Ready Roof Assessment

The Project will be designed to be solar ready and will continue evaluating incorporating solar PV, which may be developed by a third party PPA provider. Results from the solar PV assessment presented below will be added to the future pre-certification WUFI model.

Table 10: Solar-Ready Roof Assessment	
Total roof area (sf)	12,312 SF
Unshaded roof area (sf)	6,900 SF
Structural support	DUNNAGE
Electrical infrastructure	(1) Trinergy Plus-60kW (400V) Inverter
Other roof appurtenances	Mechanical pads, stair and elevator overhangs. Designated mechanical areas are located on the East and West sides of the roof. The stair and elevator overhangs are located toward the South side of the roof structure.
Solar-ready roof area (sf)	2,900sf
Capacity of solar array	42.0 kW
Financial incentives	TBD
Cost feasibility	TBD

Figure 1: PV Detailed Layout

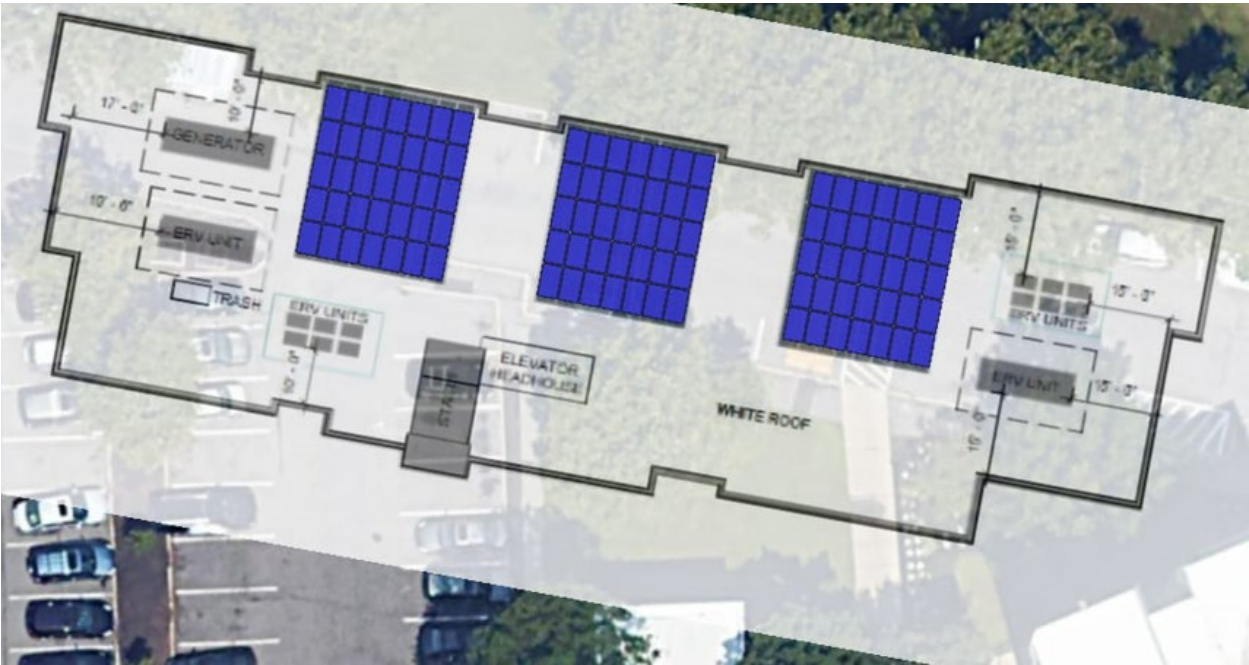


Figure 1 shows the detailed layout generated using the Helioscope PV system planning tool. PV arrays were designed to maximize available solar ready roof spaces.

**Results**

Preliminary cost estimates for both the proposed design and net zero scenario are presented below.

Table 11: Installation and Maintenance Cost Comparisons				
	Proposed Design		Non-Carbon-Fuel Scenario	
	Installation cost	Maintenance	Installation cost	Maintenance

Space heating	\$577,146.99	\$44.33	Same as proposed	Same as proposed
Space cooling	\$577,146.99	\$19.00	Same as proposed	Same as proposed
Heat rejection	N/A	N/A	Same as proposed	Same as proposed
Pump & auxiliary	\$81,453.79	\$44.33	Same as proposed	Same as proposed
Ventilation	\$585,347.77	\$44.33	Same as proposed	Same as proposed
Domestic hot water	\$125,313.79	\$35.00	Same as proposed	Same as proposed
(Financial incentives)	(\$180,000.00)	N/A	Same as proposed	Same as proposed
Total building energy system cost	\$1,766,409.32	\$187.00	Same as proposed	Same as proposed

### Anticipated Energy Loads and GHG Emissions

Petersen Engineering completed preliminary WUFI modeling for the project and will continue to refine the modeling as design development progresses. Final modeling results for Article 22 compliance will be updated in future submissions as the project design progresses.

### Assumptions

The project will pursue Passive House certification and utilize WUFI energy modeling to demonstrate energy loads and energy use. The anticipated baseline building (10% better than ASHRAE 90.1-2013) energy use is indicated in the table below. Building heating and cooling loads, hot water heating load, in unit and common space lighting, appliances and plug loads, as well as miscellaneous system loads were included in this preliminary energy model.

### Annual Projected Energy Consumption

The below table summarizes the energy use for the baseline, proposed, and net zero scenarios based on preliminary WUFI modeling.

Table 12: Annual Anticipated Baseline and Proposed Building Energy Use					
	Baseline	Proposed		Non-Carbon-Fuel Scenario	
	Energy Use and Cost	Energy Use and Cost	% Reduction from Baseline	Energy Use and Cost	% Reduction from Baseline
Site EUI (kBtu/sf/yr)*	39.51	26.88	32 %	Same as proposed	Same as proposed
Source EUI (kBtu/sf/yr)*	62.05	48.38	22 %	Same as proposed	Same as proposed
Electricity (kWh)*	687,369	655,791	5 %	Same as proposed	Same as proposed
Gas (therms)	9,433	0	100 %	Same as proposed	Same as proposed
Total Site Energy Use (kBtu/yr)*	3,286,956	2,236,247	32 %	Same as proposed	Same as proposed

Total Energy Cost*	\$160,475	\$151,765	5	Same as proposed	Same as proposed
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\*Site EUI, Source EUI, Electricity, Total Site Energy Use, and Total Energy Cost are net of on-site solar PV energy production.

Table 13: Annual Projected Renewable Generation						
	Baseline		Proposed		Non-Carbon-Fuel Scenario	
	Energy Generation	% Total Energy	Energy Generation	% Total Energy	Energy Generation	% Total Energy
On-site Renewable Energy Generation (kWh)	0	0%	50,577	7.2%	50,577	7.2%
Off-site Renewable Energy Generation and Carbon Offsets (site kWh and/or therms)	687,369 kWh, 9,433 therms	100%	605,214 kWh	92.8%	605,214 kWh	92.8%

### Annual Projected GHG Emissions

The annual expected CO<sub>2</sub> emissions for the proposed building based on the preliminary WUFI energy model are provided in the table below.

Table 14: Annual CO <sub>2</sub> and CO <sub>2</sub> e Emissions					
	Baseline	Proposed		Non-Carbon-Fuel Scenario	
	Emissions	Emissions	% Reduction from Baseline	Emissions	% Reduction from Baseline
Total GHG Emissions (mtCO <sub>2</sub> and CO <sub>2</sub> e/yr)	255.24	195.73	23 %	Same as proposed	Same as proposed
GHG Emissions per SF (mtCO <sub>2</sub> and CO <sub>2</sub> e/sf/yr)	3.07	2.35	23%	Same as proposed	Same as proposed



# Walden Square Apartments Rating System Narrative Phius 2021

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Cambridge, MA  
August 15, 2023



Submitted to  
Community Development Department  
City of Cambridge  
344 Broadway  
Cambridge, MA 02138



Prepared by  
New Ecology, Inc.  
294 Washington Street Suite 830  
Boston, MA 02108

## Project Description

The Walden Square Apartments project (the Project) complies with the City of Cambridge Zoning Article 22: Sustainable Design and Development requirements. The Project will be designed and constructed under the guidelines of the Passive House Institute U.S. (Phius). The building will meet the design, construction, and testing requirements of the certification program and will be certified as a Passive House project. The building will be certified using Phius 2021.

The Project is comprised of two (2) multifamily residential buildings to be constructed above an existing parking lot of a previously developed site located in the Walden Square Apartments site.

Integral to Phius certification is compliance with ENERGY STAR Multifamily New Construction and EPA Indoor airPLUS requirements. In combination with third-party, RESNET-approved quality assurance and control testing, the building will exceed the Cambridge Green Building Requirements as outlined in Article 22.20. New Ecology will serve as the Project's Phius Verifier.

## Phius 2021 Rating System Requirements

### Phius 2021 OVERVIEW

The Project team will pursue Passive House certification to the standards set by the Passive House Institute US (Phius) for their Phius 2021 rating system as well as certifying through the ENERGY STAR and EPA Indoor airPLUS programs. The Phius 2021 rating system includes stringent and verified building performance metrics as well as professional testing of the building envelopes and air sealing at two stages during building construction. EPA Indoor airPLUS certification includes verification of indoor air quality (IAQ) quality control measures including but not limited to: moisture control, HVAC venting and sealing, and use of low VOC materials in construction. ENERGY STAR requires prescriptive performance and testing for a variety of mechanical and envelope systems. The project team believes that these three ratings systems will result in a highly efficient building which protect occupant health through excellent indoor air quality, as well as exceptional passive resilience to extreme heat events.

While there is no rating system checklist for Phius 2021, there is a Phius Verifier workbook that will be completed as part of the field verification process as well as multiple ENERGY STAR checklists and an EPA Indoor airPLUS checklist completed during construction. The metrics measured and inspected by the Phius Verifier include:

- Building Envelope Air Infiltration (whole building) & Compartmentalization (units)
- Ventilation Air Flow Rates
- Heating and Cooling Equipment & Air Filtration Verification
- Domestic Hot Water System Specification and Performance Verification
- Appliance Energy Consumption Verification
- Indoor Air Quality Verification using the EPA Indoor airPLUS Verification Checklist

The Phius 2021 rating system includes feasibility modeling to reach specified building performance metrics early in design, which are presented below in table format. The Phius verification process for the building energy model includes review and comments by a model evaluator from the Phius organization during subsequent rounds of review. This upcoming review of the model will examine building assumptions for the envelope and mechanical systems, and is known to be a thorough and rigorous examination of building systems. The project team expects that the outcome of this modeling and review process, combined with envelope and air infiltration testing, will lead to a very high-performance building with greatly reduced heating and cooling needs as compared with a baseline building.

## TECHNICAL AND DESIGN APPROACHES

The Project design will follow a performance pathway using WUFI Passive modeling software to guide the material, assemblies, and equipment selection, as required to meet the certification metrics. The information below is an accurate estimation of the design and assumptions made by the design team at this early stage of the process and may change based on further design development. Once complete, the success of the design, construction, and compliance with City of Cambridge Article 22 will be measured by:

- Results of the WUFI Passive energy model during design
- Registration with and precertification by Phius (acceptance of the design)
- Performance testing by a Phius verifier (New Ecology) and update to energy model based on results
- Certification by Phius (acceptance of design and construction)

The Project has implemented the following approaches to comply with Article 22 and Phius requirements:

### Envelope

- The WUFI model currently considers two wall assemblies: Steel-framed wall with 3” continuous mineral wool and no cavity insulation with an estimated R-value of 14, and a wood framed wall with 2” continuous mineral wool and cavity insulation with an estimated R-value of 28.
- Sheet-applied weather resistive air barrier to help meet rigorous Phius infiltration criteria and to control bulk water and vapor drive. Current WUFI model utilizes “combustible” infiltration criteria of 0.06 CFM<sub>50</sub>/ft<sup>2</sup>. Applicable infiltration criteria to be determined by Phius at the time of pre-certification.
- Roof insulation will be above deck and is currently shown with an estimated R-value of 50
- Slab-on-deck will be fully-insulated and is currently shown with an estimated R-value of 40
- Windows will be high performance and are currently shown with an estimated U-value of 0.20, while SHGC, window reveals, and shading devices will be dictated by subsequent modeling iterations.
- The Project team will review opportunities to eliminate thermal bridging throughout.

### Heating, Cooling, and Ventilation

- Heating will be designed to meet efficiency requirements dictated by the energy model and will be provided via a central high-efficiency, VRF air-source heat pump (ASHP).
- Cooling will be provided to the buildings through the central VRF ASHP.
- Domestic hot water will be generated via a central gas-fired system with a recirculation loop. System will be roof-mounted and the buildings will be designed with sufficient mechanical penthouse space, structural capacity, and electric service capacity to allow future conversion to a central air-to-water heat pump domestic hot water system.
- Ventilation will be provided using centralized energy recovery ventilators (ERVs) meeting ASHRAE 62.2-2016 and 62.1-2016 serving residential and common/commercial areas, respectively.

### Phius 2021-CERTIFIED BUILDINGS REQUIREMENTS

Phius sets strict standards for building certification under its Phius rating system. Phius sets requirements for building metrics in five areas: heating demand, cooling demand, heating load, cooling load and source energy consumption based on the expected number of residents. These 5 metrics are modeled, measured and verified by Phius using WUFI Passive modeling. Ongoing design development will continue to integrate all Phius requirements, ensuring the Project satisfies each performance category described herein.

#### Field-Tested Air-Tightness Standard

A rigorous and field-tested air-tightness standard is also applied to buildings seeking certification. The building envelope is tested twice using whole building blower door testing. The first test is conducted after the installation of the air barrier, and the second at the completion of construction.

The Phius Passive House Air Tightness Standard is as follows:

- Residential Units air leakage: 0.30 CFM50 per sq. ft. of unit enclosure area, or less, demonstrated through blower door testing performed by the Phius Verifier following Phius sampling protocols.
- Whole Building air leakage: 0.06 CFM50 per sq. ft. of building enclosure area, or less, demonstrated through a blower door test performed by the Phius Verifier.

#### Field Inspections During Construction

A credentialed Phius Verifier will inspect, document and confirm the following features of the building envelopes and building performance:

- Air Infiltration Testing: Blower door testing will be done at project mid-point for the whole building and at project completion for both the units (sampled per RESNET protocols) and the whole building in order to ensure compliance with the requirements outlined above.
- Thermal Bridging and Air Infiltration Inspection: The project will be inspected after framing, but before insulation installation to inspect construction and identify potential areas of thermal bridging and air infiltration.

- Thermal Bridging Inspection: Thermal imaging inspection with an infrared camera to review and show compliance with thermal bridging and air sealing protocols.
- EPA Indoor airPLUS Review: Review of compliance and documentation.
- ENERGY STAR HVAC Review: Review of the HVAC functional test checklist, and additional site visits to observe testing and balancing of the HVAC systems as required by Phius.

## EPA INDOOR airPLUS-CERTIFIED BUILDINGS REQUIREMENTS

While most ENERGY STAR requirements are met and exceeded by Phius requirements, the EPA Indoor airPLUS certification is an additional set of requirements intended to ensure healthy indoor environments for future building occupants. Indoor airPLUS is checklist-based and focuses on building techniques that improve indoor air quality both through the construction process and throughout the lifetime of the building. Requirements are mainly focused on using low VOC materials, using proper procedures when constructing ductwork and systems, and following building procedures to prevent future water damage and/or mold growth. The EPA Indoor airPLUS certification is integral to Phius certification, and it will be independently reviewed and verified by NEI and Phius.

The EPA Indoor airPLUS checklist requirements are assembled into the following categories: moisture control, radon, pests, HVAC systems, combustion pollutants, materials and final (inspection). The program requirements are outlined in the [EPA Indoor airPLUS Construction Specifications Version 1 \(Rev 04\)](#) and are summarized below. All requirements will be verified and confirmed by the qualified verifier and/or builder.

- Moisture Control
  - Drain or sump pump installed in basements and crawlspaces as applicable. In EPA Radon Zone 1, check valve also installed.
  - Layer of aggregate or sand (4 in.) with geotextile matting installed below slabs AND radon techniques used in EPA Radon Zone 1.
  - Basements/crawlspaces insulated, sealed and conditioned.
  - Protection from water splash damage if no gutters.
  - Supply piping in exterior walls insulated with pipe wrap, as applicable.
  - Hard-surface flooring in kitchens, baths, entry, laundry, and utility rooms
- Radon
  - Radon-resistant features installed in Radon Zone 1 homes in accordance with Construction Specification 2.1.
- Pests
  - Corrosion-proof rodent/bird screens installed at all openings that cannot be fully sealed. (Not required for clothes dryer vents.)
- HVAC Systems
  - Duct systems protected from construction debris AND no building cavities used as air supplies or returns.
  - No air-handling equipment or ductwork installed in garage.
  - Clothes dryers vented to the outdoors or plumbed to a drain according to manufacturer's instructions.

- Central forced-air HVAC system(s) have minimum MERV 8 filter for in-unit heating and cooling equipment (fan coil units), MERV 13 filter for ventilation supply air systems AND no ozone generators in home. Temporary filter installed to protect unit from construction dust.
- Combustion Pollutants
  - Emissions standards met for fuel-burning and space-heating appliances.
  - CO alarms installed in each sleeping zone (e.g., common hallway) according to NFPA 720.
  - Multifamily buildings: Smoking restrictions implemented AND ETS transfer pathways minimized.
- Materials
  - All composite wood products certified low-emission.
  - Interior paints and finishes certified low-emission.
  - Carpet, carpet adhesives, and carpet cushion certified low-emission.
- Final (Inspection)
  - HVAC system and ductwork verified to be dry and clean AND new filter installed.
  - Equipment manuals, Indoor airPLUS label, and certificate provided for owner/occupant.

The Project team looks forward to the construction of highly efficient buildings with a focus on reducing energy consumption and protecting resident health. The Project team is confident that the design of Walden Square Apartments, including its integration of Phius, ENERGY STAR, and EPA Indoor airPLUS standards, will result in a high-quality community for years to come.



Community-Based Sustainable Development

City of Cambridge Community Development Department  
344 Broadway  
Cambridge, MA 02139

August 15, 2023

**Subject: Walden Square Apartments Article 22 Initial Filing Green Building Report**

Dear Cambridge Community Development Department:

The Walden Square Apartments project team is excited to share the attached documents, collectively the Article 22 Green Building Report, documenting the currently planned building sustainability features for this highly efficient 100% affordable multifamily development. Currently in schematic design, the project is targeting Passive House certification under the Phius 2021 rating system. Walden Square is designed for resilience and incorporates a number of sustainable features including all-electric heating and cooling systems and rooftop-mounted solar photovoltaic systems.

The following documents contained herein demonstrate that Walden Square Apartments is in compliance with Article 22 preliminary submission requirements:

- Green Building Checklist
- Net Zero Narratives
- Rating System Narrative
- Green Building Professional Affidavit

The project team expects Walden Square to earn full certification as a Passive House under the Phius 2021 rating system. The project team will continue to update the WUFI energy modeling as design progresses and the project seeks pre-certification with Phius, and will share an updated report with CDD in the forthcoming building permit Article 22 submission.

This project will be MA Specialized Energy Code compliant, following the commercial building requirements at 225 CMR 23.00 Appendix CC. The project will demonstrate compliance through the Phius certification pathway and by following section CC104, the All Electric Building Performance Standard. As shown in the attached Net Zero Narrative, the project is currently estimated to exceed MA Stretch Energy Code performance requirements by approximately 20%.

As part of the Phius requirements, the project will also earn the EPA Indoor airPLUS certification and the ENERGY STAR Multifamily New Construction certifications. The EPA Indoor airPLUS certification program focuses on high quality indoor air and low or no emissions from building materials (low/no VOCs). The project will include MERV 13 filters to maintain indoor air quality. In addition to these certification requirements, this project will follow all Massachusetts Department of Housing and Community Development (DHCD) design requirements. As the building design progresses, the project team will continue to explore opportunities to reduce the environmental impact of the project including exploration of additional on-site solar PV capacity, potential green roof areas, zero VOC indoor finishes, and lower embodied carbon materials.

# NEW ECOLOGY



Community-Based Sustainable Development

The resulting building will be an exceptionally high performance structure demonstrating a careful focus on energy and emissions performance and high quality indoor air. The project team looks forward to creating an affordable, resilient, and high-performing building and to sharing future updates on project progress with CDD.



## Green Building Project Checklist

### Green Building

Project Location: Walden Square Apartments, Building B

### Applicant

Name: WinnDevelopment Company Limited Partnership

Address: One Washington Mall, Suite Boston, Boston MA 02108

#### Contact Information

Email Address: mrobayna@winnco.com

Telephone #: 617-532-2185

### Project Information (select all that apply):

- New Construction - GFA: 41,077 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: \_\_\_\_\_
- Building Design + Construction (BD+C) - Subcategory: \_\_\_\_\_
- Residential BD+C - Subcategory: \_\_\_\_\_
- Interior Design + Construction (ID+C) - Subcategory: \_\_\_\_\_
- Other: \_\_\_\_\_
- Passive House - Version: 2021
- PHIUS+
- Passivhaus Institut (PHI)
- Other: \_\_\_\_\_
- Enterprise Green Communities - Version: \_\_\_\_\_



## 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)

# WALDEN SQUARE APARTMENTS – Building B

## Net Zero Narrative

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Cambridge, MA  
August 15, 2023



Submitted to  
Cambridge Community Development Department  
344 Broadway  
Cambridge, MA 02139



Prepared by  
New Ecology, Inc.  
294 Washington Street Suite 830  
Boston, MA 02108

## Table of Contents

Project Profile.....	3
Proposed Project Design Characteristics .....	3
<i>Envelope Commissioning Process</i> .....	4
Building Mechanical Systems.....	4
<i>Mechanical Systems Commissioning Process</i> .....	4
Building Energy Performance Measures.....	5
Integrative Design Process.....	5
Green Building Incentive Program Assistance.....	5
Net Zero Scenario Transition .....	5
Energy Systems Comparison .....	6
Assumptions .....	6
<i>Non-Carbon Fuel Scenario</i> .....	7
Solar-Ready Roof Assessment .....	7
Figure 1: PV Detailed Layout .....	8
Results.....	8
Anticipated Energy Loads and GHG Emissions .....	9
<i>Assumptions</i> .....	9
<i>Annual Projected Energy Consumption</i> .....	9
<i>Annual Projected GHG Emissions</i> .....	10

## Project Profile

Table 1: Development Characteristics	
Lot area (sf)	319,049 sf
Existing land use(s) and current GFA (sf) by use	Open Space / Playground , GFA = 8,122 SF
Proposed land use(s) and total GFA (sf) by use	Residential, GFA = 226,964 SF (183,161 sf (e) + 35,681 sf (new bldg. B) – not including garage – 5,396 sf
Proposed land use(s) and net new GFA (sf) by use	Residential, GFA = 35,681 SF (not including garage sf) Garage SF = 5,396 sf
Proposed new building height(s) (ft and stories)	70'-3" & 5 STORIES
Proposed new dwelling units	35
Proposed open space (sf)	TOTAL = 87,793 SF (or 28% of the site)
Proposed parking spaces	15
Proposed bicycle parking (long- and short-term spaces)	12 LONG TERM @BLDG B ( 84 LONG-TERM SITEWIDE, 42 SHORT-TERM SITEWIDE)

Table 2: Green Building Rating System				
Passive House Institute US (PHIUS) or Passivhaus Institut (PHI)				
Rating system & version	Phius 2021 CORE	Seeking certification?	<input checked="" type="radio"/> Yes	No TBD

## Proposed Project Design Characteristics

Table 3: Building Envelope Assembly Descriptions	
Roof	Assembly R-50
Foundation	Assembly R-29 (concrete slab-on-deck) Assembly R-11 (concrete slab-on-grade)
Exterior walls	Steel-framed walls: R-14 (3" continuous mineral wool, no cavity insulation) Wood-framed walls: R-29 (2" continuous mineral wool, with cavity insulation)
Windows	Triple-pane windows: U-0.20, SHGC 0.35
Window-to-wall ratio	23.9%

Table 4: Building Envelope Performance		
	Baseline	Proposed
	U-value	U-value
Window	0.32	0.20

Wall	0.06	Steel-framed – 0.07, Wood-framed – 0.03
Roof	0.026	0.019

As of June 1, 2022, preliminary WUFI modeling is complete. The areas for windows, walls, and roof will be updated as design progresses and once PHIUS pre-certification modeling is complete.

### Envelope Commissioning Process

The Project team will test and verify the envelope air barrier and air infiltration rates using bi-directional blower door testing both at construction midpoint and again after construction completion. Two (2) inspections will be performed after framing and air-sealing are complete but before insulation is installed, in order to identify any potential areas of thermal bridging and/or air infiltration. These inspections will be documented with site photos. Once installed, the air barrier will be tested with a bi-directional whole building blower door test conducted to Phius CORE standards. At the end of construction, the whole building blower door test will be repeated to confirm air-tightness, and 15 units will be blower door tested for air infiltration rates per RESNET sampling protocols. In addition, an inspection using a thermal imaging camera will be conducted to show compliance with thermal bridging and air sealing protocols.

### Building Mechanical Systems

Table 5: Building Mechanical Systems Description	
Space heating	VRF air-source heat pump with in-unit fan coils.
Space cooling	VRF air-source heat pump with in-unit fan coils
Heat rejection	See above systems.
Pumps & auxiliary	See above space conditioning and below DHW systems.
Ventilation	Central ERV with air-source heat pump
Domestic hot water	Central, air-source heat pump domestic hot water plant with recirculation loop.
Interior lighting	In-unit lighting will be all LED; common area lighting will be all LED with occupancy sensors
Exterior lighting	All exterior lighting will be LED with outdoor lighting controls.

### Mechanical Systems Commissioning Process

The project will retain a licensed commissioning agent (CxA) who will develop a detailed commissioning plan based on the building specifications and systems. The CxA will develop a functional performance test sheet for each system to be commissioned, and will commission the following systems: mechanical systems and equipment including Energy Recovery Ventilation (ERV) systems, central VRF air-source heat pump systems, a sample of apartment fan coils, and all direct digital controls. For lighting systems, all common space lighting control systems including occupancy sensors will be commissioned and sampled at the appropriate rate. For plumbing systems, the domestic hot water heating system, including central plant, storage tanks, circulating pumps, thermostatic mixing valves, and controls will be reviewed for compliance with sequence of operation and control setpoints per project specifications.

## Building Energy Performance Measures

Table 6: Building Energy Performance Measures	
Land uses	Housing development promoting walking and bicycling, located close to multiple public transportation modes (bus, subway, commuter rail), close to groceries, schools, daycare, and other necessities, and close to parks. Bicycle storage and parking provided on site.
Building orientation and massing	Primary building axis is optimized as North-South, with all units provided with multiple operable windows to allow passive ventilation.
Envelope systems	Continuous insulation, high performance glazing, and, high SRI roofs.
Mechanical systems	Energy recovery ventilators will be provided for ventilation. VRF distribution system will be designed to minimize energy losses.
Renewable energy systems	A preliminary solar PV layout for a roof-mounted system is complete. The project team will continue to evaluate solar PV layout and capacity potential as design progresses.
District-wide energy systems	N/A

### Integrative Design Process

As part of the integrative design process, the developer, architect, and mechanical engineer participated in an early-stage MEP- and envelope-focused Passive House charrette. During the kick-off meeting, the Project Team considered preliminary design concepts and began to define a comprehensive greening strategy that meets City of Cambridge Article 22, Stretch Energy Code, and Phius 2021 CORE requirements. The Project Team, including builder and Phius verifier, will continue to hold integrative design meetings throughout design development to ensure a thoughtful approach to designing and constructing the Project in accordance with its high-performance goals.

### Green Building Incentive Program Assistance

The project anticipates incremental project costs associated with certain high-performance systems and design features, including its energy efficient building envelope and electric heating and cooling system. The project will enroll in the MassSave Passive House incentive program to help offset a portion of the project's additional soft and hard costs associated with meeting the Passive House standards. The project team plans to fully certify the building in order to be eligible for the full incentive package offered by MassSave.

### Net Zero Scenario Transition

Table 7: Net Zero Scenario Transition		
	Net Zero Condition	Transition Process
Building envelope	The building envelope will be built to Phius Passive House standards, making it an ideal structure to achieve Net Zero in the future with on and off-site renewables. The envelope will be well-insulated and have a	This system will be a zero (site) emissions system at installation.

	low level of air infiltration which will be tested and verified at construction.	
HVAC Systems	A VRF system is currently included in the proposed HVAC design for the building.  Central energy recovery ventilation will be used to capture energy from the ventilation system and will be installed at construction.	VRF in current design will be a zero emissions system at installation.  ERVs in current design will be a zero emissions system at installation.
Domestic Hot Water	A central air-source domestic hot water plant will be included at construction. The plant will be located within a rooftop mechanical room.	This system will be a zero (site) emissions system at installation.
Lighting	The project will use LED lighting throughout at construction. The building energy model for this project, will factor in Lighting Power Density as a calculation in overall building energy consumption. Fixtures will be modeled and will be specified in project documents to meet or exceed the energy requirement of the WUFI model.	The building and management team will include updated technology as it is available and will update systems at the end of service life of the lighting systems.
Renewable Energy Systems	The project will be solar-ready at construction.	The project will be solar-ready and will include PV panels as necessary to meet PH requirements at time of construction.
Other Strategies	The project is actively considering and modeling the use of window reveals and glazing tuning to reduce building energy consumption during summer months, while also allowing solar thermal gains during winter months.	N/A

### Energy Systems Comparison

The Project team evaluated the greenhouse gas emissions impacts and financial feasibility of one (1) design scenario, “Proposed” which is synonymous with the “NZ Scenario” with the exception of the use of renewable energy credits for all off-site electricity requirements, for the Walden Square Apartments project Building A. Operational and performance costs were estimated using the results of the preliminary WUFI model conceptual construction pricing, and per-square-foot maintenance cost estimates provided by WinnCompanies.

### Assumptions

Table 8 Energy Systems Included/Excluded in Analysis			
	Included in Analysis?		Describe systems analyzed or explain why it was excluded from analysis
	Yes	No	



Solar photovoltaics	X		PV is assumed to be included in design, but will likely be procure through a PPA. Exact amount of PV required to meet needs is to be determined via WUFI model results.
Solar hot water heater		X	In combination with potential PV solar panels, there is not enough space on the roofs to justify both technologies.
Ground-source heat pumps		X	Due to the limited space of the site, GSHP was determined to be cost-prohibitive at this time.
Water-source heat pumps		X	Focus was on the ASHP VRF as the most feasible option.
Air-source heat pumps	X		High-efficiency ASHP VRF
Non-carbon fuel district energy		X	Building energy loads are expected to be too low for district energy system application.
Other non-carbon fuel systems	X		Purchase of renewable energy credits would be included for the NZ scenario should the City of Cambridge require them in the future.

### Non-Carbon Fuel Scenario

One non-carbon, all-electric scenario was examined. The tables below provide descriptions of each scenario.

Table 9: LCCA Scenario Description by Key Components		
Scenario	Proposed	NZ Scenario
Heating & cooling	VRF ASHP, in-unit FCU	Same as proposed
Ventilation	Central ERV	Same as proposed
DHW	Central ASHP	Same as proposed
Envelope	PH (as described in Table 3)	Same as proposed
Window	PH (U-0.20)	Same as proposed
Renewable Energy Credits	No	Yes
Co-gen	No	No

The project team has researched and evaluated a central air-source heat pump system (ASHP) approach for generating domestic hot water (DHW) for the Walden Square project. There is emerging ASHP technology from several manufacturers that will be capable of meeting the DHW requirements for this building at the time of construction. Therefore, the DHW system for Walden Square will be designed as an ASHP central plant. This design requires additional roof space for ASHP units as well as additional space inside the building for the heat exchanger, storage tanks and pumps that are required for an ASHP system, relative to a conventional, central gas-fired system.

### Solar-Ready Roof Assessment

The Project will be designed to be solar ready and will continue evaluating incorporating solar PV, which may be developed by a third party PPA provider. Results from the solar PV assessment presented below will be added to the future pre-certification WUFI model.

Table 10: Solar-Ready Roof Assessment	
Total roof area (sf)	7,290 SF
Unshaded roof area (sf)	4,400 SF
Structural support	DUNNAGE
Electrical infrastructure	(1) Trinergy Plus-60kW (400V) Inverter
Other roof appurtenances	Mechanical pads, stair and elevator overheads. Designated mechanicals areas are located toward the East side of the roof structure.
Solar-ready roof area (sf)	2,175 sf RECALCULATE !
Capacity of solar array	48 kW
Financial incentives	TBD
Cost feasibility	TBD

Figure 1: PV Detailed Layout



Figure 1 shows the detailed layout generated using the Helioscope PV system planning tool. PV arrays were designed to maximize available solar ready roof spaces.

Results

Preliminary cost estimates for both the proposed design and net zero scenario are presented below.

Table 11: Installation and Maintenance Cost Comparisons

	Proposed Design		Non-Carbon-Fuel Scenario	
	<i>Installation cost</i>	<i>Maintenance</i>	<i>Installation cost</i>	<i>Maintenance</i>
Space heating	\$336,669.08	\$44.33	Same as proposed	Same as proposed
Space cooling	\$336,669.08	\$19.00	Same as proposed	Same as proposed
Heat rejection	N/A	N/A	Same as proposed	Same as proposed
Pump & auxiliary	\$47,514.71	\$44.33	Same as proposed	Same as proposed
Ventilation	\$341,452.86	\$44.33	Same as proposed	Same as proposed
Domestic hot water	\$73,099.71	\$35.00	Same as proposed	Same as proposed
(Financial incentives)	(\$105,000.00)	N/A	Same as proposed	Same as proposed
Total building energy system cost	\$1,030,405.44	\$187.00	Same as proposed	Same as proposed

### Anticipated Energy Loads and GHG Emissions

Petersen Engineering completed preliminary WUFI modeling for the project and will continue to refine the modeling as design development progresses. Final modeling results for Article 22 compliance will be updated in future submissions as the project design progresses.

### Assumptions

The project will pursue Passive House certification and utilize WUFI energy modeling to demonstrate energy loads and energy use. The anticipated baseline building (10% better than ASHRAE 90.1-2013) energy use is indicated in the table below. Building heating and cooling loads, hot water heating load, in unit and common space lighting, appliances and plug loads, as well as miscellaneous system loads were included in this preliminary energy model.

### Annual Projected Energy Consumption

The below table summarizes the energy use for the baseline, proposed, and net zero scenarios based on preliminary WUFI modeling.

Table 12: Annual Anticipated Baseline and Proposed Building Energy Use

	Baseline	Proposed		Non-Carbon-Fuel Scenario	
	Energy Use and Cost	Energy Use and Cost	% Reduction from Baseline	Energy Use and Cost	% Reduction from Baseline
Site EUI (kBtu/sf/yr)*	39.51	20.91	47%	Same as proposed	Same as proposed
Source EUI (kBtu/sf/yr)*	62.05	37.64	39%	Same as proposed	Same as proposed
Electricity (kWh)*	429,270	376,390	12%	Same as proposed	Same as proposed

Gas (therms)	5,8918	0	100%	Same as proposed	Same as proposed
Total Site Energy Use (kBtu/yr)*	2,052,742	1,086,385	47%	Same as proposed	Same as proposed
Total Energy Cost*	\$100,219	\$79,943	20%	Same as proposed	Same as proposed

\*Site EUI, Source EUI, Electricity, Total Site Energy Use, and Total Energy Cost are net of on-site solar PV energy production.

Table 13: Annual Projected Renewable Generation						
	Baseline		Proposed		Non-Carbon-Fuel Scenario	
	Energy Generation	% Total Energy	Energy Generation	% Total Energy	Energy Generation	% Total Energy
On-site Renewable Energy Generation (kWh)	0	0%	57,802	15.4%	57,802	15.4%
Off-site Renewable Energy Generation and Carbon Offsets (site kWh and/or therms)	429,270 kWh, 5,891 therms	100%	318,588 kWh	84.6%	318,588 kWh	84.6%

### Annual Projected GHG Emissions

The annual expected CO<sub>2</sub> emissions for the proposed building based on the preliminary WUFI energy model are provided in the table below.

Table 14: Annual CO <sub>2</sub> and CO <sub>2e</sub> Emissions					
	Baseline	Proposed		Non-Carbon-Fuel Scenario	
	Emissions	Emissions	% Reduction from Baseline	Emissions	% Reduction from Baseline
Total GHG Emissions (mtCO <sub>2</sub> and CO <sub>2e</sub> /yr)	159.40	95.09	40%	Same as proposed	Same as proposed
GHG Emissions per SF (mtCO <sub>2</sub> and CO <sub>2e</sub> /sf/yr)	3.07	1.83	40%	Same as proposed	Same as proposed

# Walden Square Apartments Rating System Narrative Phius 2021

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Cambridge, MA  
August 15, 2023



Submitted to  
Community Development Department  
City of Cambridge  
344 Broadway  
Cambridge, MA 02138



Prepared by  
New Ecology, Inc.  
294 Washington Street Suite 830  
Boston, MA 02108

## Project Description

The Walden Square Apartments project (the Project) complies with the City of Cambridge Zoning Article 22: Sustainable Design and Development requirements. The Project will be designed and constructed under the guidelines of the Passive House Institute U.S. (Phius). The building will meet the design, construction, and testing requirements of the certification program and will be certified as a Passive House project. The building will be certified using Phius 2021.

The Project is comprised of two (2) multifamily residential buildings to be constructed above an existing parking lot of a previously developed site located in the Walden Square Apartments site.

Integral to Phius certification is compliance with ENERGY STAR Multifamily New Construction and EPA Indoor airPLUS requirements. In combination with third-party, RESNET-approved quality assurance and control testing, the building will exceed the Cambridge Green Building Requirements as outlined in Article 22.20. New Ecology will serve as the Project's Phius Verifier.

## Phius 2021 Rating System Requirements

### Phius 2021 OVERVIEW

The Project team will pursue Passive House certification to the standards set by the Passive House Institute US (Phius) for their Phius 2021 rating system as well as certifying through the ENERGY STAR and EPA Indoor airPLUS programs. The Phius 2021 rating system includes stringent and verified building performance metrics as well as professional testing of the building envelopes and air sealing at two stages during building construction. EPA Indoor airPLUS certification includes verification of indoor air quality (IAQ) quality control measures including but not limited to: moisture control, HVAC venting and sealing, and use of low VOC materials in construction. ENERGY STAR requires prescriptive performance and testing for a variety of mechanical and envelope systems. The project team believes that these three ratings systems will result in a highly efficient building which protect occupant health through excellent indoor air quality, as well as exceptional passive resilience to extreme heat events.

While there is no rating system checklist for Phius 2021, there is a Phius Verifier workbook that will be completed as part of the field verification process as well as multiple ENERGY STAR checklists and an EPA Indoor airPLUS checklist completed during construction. The metrics measured and inspected by the Phius Verifier include:

- Building Envelope Air Infiltration (whole building) & Compartmentalization (units)
- Ventilation Air Flow Rates
- Heating and Cooling Equipment & Air Filtration Verification
- Domestic Hot Water System Specification and Performance Verification
- Appliance Energy Consumption Verification
- Indoor Air Quality Verification using the EPA Indoor airPLUS Verification Checklist

The Phius 2021 rating system includes feasibility modeling to reach specified building performance metrics early in design, which are presented below in table format. The Phius verification process for the building energy model includes review and comments by a model evaluator from the Phius organization during subsequent rounds of review. This upcoming review of the model will examine building assumptions for the envelope and mechanical systems, and is known to be a thorough and rigorous examination of building systems. The project team expects that the outcome of this modeling and review process, combined with envelope and air infiltration testing, will lead to a very high-performance building with greatly reduced heating and cooling needs as compared with a baseline building.

## TECHNICAL AND DESIGN APPROACHES

The Project design will follow a performance pathway using WUFI Passive modeling software to guide the material, assemblies, and equipment selection, as required to meet the certification metrics. The information below is an accurate estimation of the design and assumptions made by the design team at this early stage of the process and may change based on further design development. Once complete, the success of the design, construction, and compliance with City of Cambridge Article 22 will be measured by:

- Results of the WUFI Passive energy model during design
- Registration with and precertification by Phius (acceptance of the design)
- Performance testing by a Phius verifier (New Ecology) and update to energy model based on results
- Certification by Phius (acceptance of design and construction)

The Project has implemented the following approaches to comply with Article 22 and Phius requirements:

### Envelope

- The WUFI model currently considers two wall assemblies: Steel-framed wall with 3” continuous mineral wool and no cavity insulation with an estimated R-value of 14, and a wood framed wall with 2” continuous mineral wool and cavity insulation with an estimated R-value of 28.
- Sheet-applied weather resistive air barrier to help meet rigorous Phius infiltration criteria and to control bulk water and vapor drive. Current WUFI model utilizes “combustible” infiltration criteria of 0.06 CFM<sub>50</sub>/ft<sup>2</sup>. Applicable infiltration criteria to be determined by Phius at the time of pre-certification.
- Roof insulation will be above deck and is currently shown with an estimated R-value of 50
- Slab-on-deck will be fully-insulated and is currently shown with an estimated R-value of 40
- Windows will be high performance and are currently shown with an estimated U-value of 0.20, while SHGC, window reveals, and shading devices will be dictated by subsequent modeling iterations.
- The Project team will review opportunities to eliminate thermal bridging throughout.

### Heating, Cooling, and Ventilation

- Heating will be designed to meet efficiency requirements dictated by the energy model and will be provided via a central high-efficiency, VRF air-source heat pump (ASHP).
- Cooling will be provided to the buildings through the central VRF ASHP.
- Domestic hot water will be generated via a central gas-fired system with a recirculation loop. System will be roof-mounted and the buildings will be designed with sufficient mechanical penthouse space, structural capacity, and electric service capacity to allow future conversion to a central air-to-water heat pump domestic hot water system.
- Ventilation will be provided using centralized energy recovery ventilators (ERVs) meeting ASHRAE 62.2-2016 and 62.1-2016 serving residential and common/commercial areas, respectively.

### Phius 2021-CERTIFIED BUILDINGS REQUIREMENTS

Phius sets strict standards for building certification under its Phius rating system. Phius sets requirements for building metrics in five areas: heating demand, cooling demand, heating load, cooling load and source energy consumption based on the expected number of residents. These 5 metrics are modeled, measured and verified by Phius using WUFI Passive modeling. Ongoing design development will continue to integrate all Phius requirements, ensuring the Project satisfies each performance category described herein.

#### Field-Tested Air-Tightness Standard

A rigorous and field-tested air-tightness standard is also applied to buildings seeking certification. The building envelope is tested twice using whole building blower door testing. The first test is conducted after the installation of the air barrier, and the second at the completion of construction.

The Phius Passive House Air Tightness Standard is as follows:

- Residential Units air leakage: 0.30 CFM50 per sq. ft. of unit enclosure area, or less, demonstrated through blower door testing performed by the Phius Verifier following Phius sampling protocols.
- Whole Building air leakage: 0.06 CFM50 per sq. ft. of building enclosure area, or less, demonstrated through a blower door test performed by the Phius Verifier.

#### Field Inspections During Construction

A credentialed Phius Verifier will inspect, document and confirm the following features of the building envelopes and building performance:

- Air Infiltration Testing: Blower door testing will be done at project mid-point for the whole building and at project completion for both the units (sampled per RESNET protocols) and the whole building in order to ensure compliance with the requirements outlined above.
- Thermal Bridging and Air Infiltration Inspection: The project will be inspected after framing, but before insulation installation to inspect construction and identify potential areas of thermal bridging and air infiltration.



- Thermal Bridging Inspection: Thermal imaging inspection with an infrared camera to review and show compliance with thermal bridging and air sealing protocols.
- EPA Indoor airPLUS Review: Review of compliance and documentation.
- ENERGY STAR HVAC Review: Review of the HVAC functional test checklist, and additional site visits to observe testing and balancing of the HVAC systems as required by Phius.

## EPA INDOOR airPLUS-CERTIFIED BUILDINGS REQUIREMENTS

While most ENERGY STAR requirements are met and exceeded by Phius requirements, the EPA Indoor airPLUS certification is an additional set of requirements intended to ensure healthy indoor environments for future building occupants. Indoor airPLUS is checklist-based and focuses on building techniques that improve indoor air quality both through the construction process and throughout the lifetime of the building. Requirements are mainly focused on using low VOC materials, using proper procedures when constructing ductwork and systems, and following building procedures to prevent future water damage and/or mold growth. The EPA Indoor airPLUS certification is integral to Phius certification, and it will be independently reviewed and verified by NEI and Phius.

The EPA Indoor airPLUS checklist requirements are assembled into the following categories: moisture control, radon, pests, HVAC systems, combustion pollutants, materials and final (inspection). The program requirements are outlined in the [EPA Indoor airPLUS Construction Specifications Version 1 \(Rev 04\)](#) and are summarized below. All requirements will be verified and confirmed by the qualified verifier and/or builder.

- Moisture Control
  - Drain or sump pump installed in basements and crawlspaces as applicable. In EPA Radon Zone 1, check valve also installed.
  - Layer of aggregate or sand (4 in.) with geotextile matting installed below slabs AND radon techniques used in EPA Radon Zone 1.
  - Basements/crawlspaces insulated, sealed and conditioned.
  - Protection from water splash damage if no gutters.
  - Supply piping in exterior walls insulated with pipe wrap, as applicable.
  - Hard-surface flooring in kitchens, baths, entry, laundry, and utility rooms
- Radon
  - Radon-resistant features installed in Radon Zone 1 homes in accordance with Construction Specification 2.1.
- Pests
  - Corrosion-proof rodent/bird screens installed at all openings that cannot be fully sealed. (Not required for clothes dryer vents.)
- HVAC Systems
  - Duct systems protected from construction debris AND no building cavities used as air supplies or returns.
  - No air-handling equipment or ductwork installed in garage.
  - Clothes dryers vented to the outdoors or plumbed to a drain according to manufacturer's instructions.

- Central forced-air HVAC system(s) have minimum MERV 8 filter for in-unit heating and cooling equipment (fan coil units), MERV 13 filter for ventilation supply air systems AND no ozone generators in home. Temporary filter installed to protect unit from construction dust.
- Combustion Pollutants
  - Emissions standards met for fuel-burning and space-heating appliances.
  - CO alarms installed in each sleeping zone (e.g., common hallway) according to NFPA 720.
  - Multifamily buildings: Smoking restrictions implemented AND ETS transfer pathways minimized.
- Materials
  - All composite wood products certified low-emission.
  - Interior paints and finishes certified low-emission.
  - Carpet, carpet adhesives, and carpet cushion certified low-emission.
- Final (Inspection)
  - HVAC system and ductwork verified to be dry and clean AND new filter installed.
  - Equipment manuals, Indoor airPLUS label, and certificate provided for owner/occupant.

The Project team looks forward to the construction of highly efficient buildings with a focus on reducing energy consumption and protecting resident health. The Project team is confident that the design of Walden Square Apartments, including its integration of Phius, ENERGY STAR, and EPA Indoor airPLUS standards, will result in a high-quality community for years to come.

## Green Factor Certification Form

This is for projects that are subject to the Green Factor Standard in Section 22.90 of the Cambridge Zoning Ordinance, which requires site and landscape design features that reduce urban heat.

*Review Section 22.90 of the Cambridge Zoning Ordinance and the Cambridge Cool Score Information and Guidelines before completing this form. When submitting a completed form, attach the supporting materials listed in the Green Factor Checklist.*

**Project Address/Location:** 21 Walden Square Road, Cambridge MA

**Planning Board (PB) and/or Board of Zoning Appeal (BZA) case number (if applicable):** \_\_\_\_\_

**Developer Name and Contact Information**

Name: WinnDevelopment Company LP

Mailing Address: 6 Faneuil Hall Marketplace, Boston MA 02109

Email Address: mrobayna@winco.com

Telephone #: 617-532-2185

**Applicability: Section 22.92 & Section 5.22.5**

Is this project subject to Green Building Requirements (Section 22.20)?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Does this project involve the construction of a new building?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Does this project enlarge an existing building’s footprint by at least 50%?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Does this project involve the creation of new surface parking area?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

*Answer the questions below if the answer is “Yes” to any of the above*

**Requirements**

*Cool Roof Requirement*

Does this project involve the construction of a new building roof or replacement of more than 50% of an existing roof?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Has this project received a Certificate of Appropriateness from the Cambridge Historical Commission or a Neighborhood Conservation District Commission, or a determination of adverse effect by the Executive Director of the Cambridge Historical Commission? [if “Yes,” attach the document to your submission]	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Last Updated: April, 2023

How much of the new or replaced roof area (in sq. ft.) has a slope (rise:run) of less than 2:12? [Cool Roof Requirement is not applicable to roof area with a 2:12 or steeper slope]	100% Bldg A = 12,198 SF Bldg B = 7,644 SF
What is the initial Solar Reflectance Index (SRI) of the proposed roof surface material for the area described above, excluding any solar energy systems or green roof area? [Minimum is 82]	82

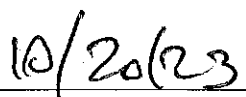
*Cool Score – Base information on the attached Cool Score Sheet and Site/Roof Plan*

What is the Cool Score of the proposed site design? [Minimum is 1.0 except per below]	2.64
What is the Cool Score of the existing site? [If the project does not involve a new building or enlargement of a building footprint, the proposed Cool Score must not be less than the Cool Score of the existing site]	2.65

*Modifications to Requirements*

Has the project received, or will the project seek, a special permit from the Planning Board to modify the Green Factor Standard for this proposal?	<input type="checkbox"/> Received SP (date: _____) <input type="checkbox"/> Seeking SP <input checked="" type="checkbox"/> No modification
---	--

  
 \_\_\_\_\_  
 Signature of Applicant

  
 \_\_\_\_\_  
 Date

## Green Factor Checklist

Project Phase	Required Submissions
<input checked="" type="checkbox"/> <b>Special Permit (if applicable)</b>	<input checked="" type="checkbox"/> Green Factor Certification Form <input checked="" type="checkbox"/> Cool Score Sheet <input checked="" type="checkbox"/> Site and Roof Plans
<input type="checkbox"/> <b>Building Permit</b>	<input type="checkbox"/> Green Factor Certification Form (updated from prior version) <input type="checkbox"/> Cool Score Sheet (updated from prior version) <input type="checkbox"/> Site and Roof Plans (updated from prior version) <input type="checkbox"/> Specifications of roof surface material including initial Solar Reflectivity Index (SRI) <input type="checkbox"/> Catalog of landscape materials including plant species and pavement (including SRI) <input type="checkbox"/> Specifications of green roof installation with operations and maintenance plan (if applicable)
<input type="checkbox"/> <b>Certificate of Occupancy</b>	<p><b><i>All materials updated based on as-built conditions:</i></b></p> <input type="checkbox"/> Green Factor Certification Form (updated from prior version) <input type="checkbox"/> Cool Score Sheet (based on as-built conditions) <input type="checkbox"/> Site and Roof Plans (based on as-built conditions) <input type="checkbox"/> Specifications of roof surface material including initial Solar Reflectivity Index (SRI) <input type="checkbox"/> Catalog of landscape materials including plant species and pavement (including SRI) <input type="checkbox"/> Specifications of green roof installation with operations and maintenance plan (if applicable)

Last Updated: April, 2023

Project Address 102 Sherman Street	Special Permit Number PB-XXX	Total Lot Area (SF) 325170
Applicant Name Winn Development	Phone Number 000-000-0000	Open Space Requirement (%) 20%
Applicant Contact / Address Sample	Email Address sample@sample.com	
Project Description New Apartment Buildings		Result Pass

Enter minimum required open space ratio. If the ratio is less than 20%, enter 20 here.

		Outside 20' of PROW	Value Factor		Within 20' of PROW	Value Factor	Contributing Area															
<b>Trees</b> Enter the number of trees in each category. Count each tree only once on this form.	<b>Preserved Existing Trees</b>																					
	A1	Understory tree currently <10' canopy spread	15	0.80	+	0	1.60	1,800														
	A2	Understory tree currently >10' canopy spread	0	1.00	+	0	2.00	-														
	A3	Canopy tree currently <15' canopy spread	7	0.80	+	0	1.60	3,920														
	A4	Canopy tree currently between 15' and 25' canopy spread	25	1.00	+	0	2.00	17,500														
	A5	Canopy tree currently >25' canopy spread	116	1.20	+	8	2.40	110,880														
	<b>New or Transplanted Trees</b>																					
	A6	Understory tree	0	0.60	+	0	1.20	-														
A7	Canopy tree	0	0.70	+	0	1.40	-															
<b>Planting Areas</b> Enter area in square feet of each component in the box provided	B1	Lawn Area	111964	0.30	+	2436	0.60	35,051														
	B2	Low Planting Area- less than 2' tall	3287	0.40	+	3	0.80	1,317														
	B3	High Planting Area-+2' tall	2940	0.50	+	360	1.00	1,830														
<b>Green Roofs &amp; Facades</b> For definitions, see reference document.	C1	Green Façade	0	0.10	+	0	0.20	-														
	C2	Living Wall	0	0.30	+	0	0.60	-														
	C3	Green Roof Area	0	0.30	+	0	0.60	-														
	C4	Short Intensive Green Roof Area	0	0.50	+	0	1.00	-														
	C5	Intensive Green Roof Area	0	0.60	+	0	1.20	-														
<b>Paving &amp; Structures</b>	D1	High-SRI Roof	Required	N/A																		
	D2	High-SRI Paving-.33 +	0	0.1				-														
	D3	Shaded Area - under shade canopy/min. 50% open sides	0	0.2	+	0	0.40	-														
<b>Project Summary</b>	<table border="1"> <tr> <td>Portion of lot area utilizing green strategies . . . . .</td> <td>53%</td> </tr> <tr> <td>Portion of score from green strategies . . . . .</td> <td>99%</td> </tr> <tr> <td>Portion of score from trees . . . . .</td> <td>77%</td> </tr> <tr> <td>Portion of score contributing to public realm cooling . . . . .</td> <td>9%</td> </tr> </table>						Portion of lot area utilizing green strategies . . . . .	53%	Portion of score from green strategies . . . . .	99%	Portion of score from trees . . . . .	77%	Portion of score contributing to public realm cooling . . . . .	9%	<table border="1"> <tr> <td><b>Total Contributing Area</b></td> <td><b>172,298</b></td> </tr> <tr> <td><b>Total Area Goal</b></td> <td><b>65,034</b></td> </tr> <tr> <td><b>COOL FACTOR SCORE</b></td> <td><b>2.65</b></td> </tr> </table>		<b>Total Contributing Area</b>	<b>172,298</b>	<b>Total Area Goal</b>	<b>65,034</b>	<b>COOL FACTOR SCORE</b>	<b>2.65</b>
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<b>COOL FACTOR SCORE</b>	<b>2.65</b>																					

When entering strategies that are within 20' of the public right of way (column L), do not also enter them in column H.

High-SRI roofs are a prerequisite of the Cool Factor and therefore are not assigned a point value.

If your project scores 1 or above, you have successfully met the requirements of the Cool Factor.

Project Address <b>102 Sherman Street</b>	Special Permit Number <b>PB-XXX</b>	Total Lot Area (SF) <b>325170</b>
Applicant Name <b>Winn Development</b>	Phone Number <b>617-532-2185</b>	Open Space Requirement (%) <b>20%</b>
Applicant Contact / Address <b>Proposed Residential Development</b>	Email Address <a href="mailto:mrrobayna@winnco.com">mrrobayna@winnco.com</a>	
Project Description <b>New Apartment Buildings</b>		Result <b>Pass</b>

Enter minimum required open space ratio. If the ratio is less than 20%, enter 20% here.

		Outside 20' of PROW	Value Factor		Within 20' of PROW	Value Factor	Contributing Area															
<b>Trees</b> Enter the number of trees in each category. Count each tree only once on this form.	<b>Preserved Existing Trees</b>																					
	A1	Understory tree currently <10' canopy spread	15	0.80	+	0	1.60	1,800														
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	<b>New or Transplanted Trees</b>																					
	A6	Understory tree	110	0.60	+	8	1.20	11,340														
A7	Canopy tree	35	0.70	+	0	1.40	17,150															
<b>Planting Areas</b> Enter area in square feet of each component in the box provided	B1	Lawn Area	105035	0.30	+	2281	0.60	32,879														
	B2	Low Planting Area- less than 2' tall	6474	0.40	+	178	0.80	2,732														
	B3	High Planting Area-+2' tall	4538	0.50	+	465	1.00	2,734														
<b>Green Roofs &amp; Facades</b> For definitions, see reference document.	C1	Green Façade	0	0.10	+	0	0.20	-														
	C2	Living Wall	0	0.30	+	0	0.60	-														
	C3	Green Roof Area	0	0.30	+	0	0.60	-														
	C4	Short Intensive Green Roof Area	0	0.50	+	0	1.00	-														
	C5	Intensive Green Roof Area	0	0.60	+	0	1.20	-														
<b>Paving &amp; Structures</b>	D1	High-SRI Roof	Required	N/A																		
	D2	High-SRI Paving-.33 +	46,870	0.1				4,687														
	D3	Shaded Area - under shade canopy/min. 50% open sides	0	0.2	+	0	0.40	-														
<b>Project Summary</b>	<table border="1"> <tr> <td>Portion of lot area utilizing green strategies . . . . .</td> <td>51%</td> </tr> <tr> <td>Portion of score from green strategies . . . . .</td> <td>96%</td> </tr> <tr> <td>Portion of score from trees . . . . .</td> <td>74%</td> </tr> <tr> <td>Portion of score contributing to public realm cooling . . . . .</td> <td>9%</td> </tr> </table>						Portion of lot area utilizing green strategies . . . . .	51%	Portion of score from green strategies . . . . .	96%	Portion of score from trees . . . . .	74%	Portion of score contributing to public realm cooling . . . . .	9%	<table border="1"> <tr> <td><b>Total Contributing Area</b></td> <td><b>171,462</b></td> </tr> <tr> <td><b>Total Area Goal</b></td> <td><b>65,034</b></td> </tr> <tr> <td><b>COOL FACTOR SCORE</b></td> <td><b>2.64</b></td> </tr> </table>		<b>Total Contributing Area</b>	<b>171,462</b>	<b>Total Area Goal</b>	<b>65,034</b>	<b>COOL FACTOR SCORE</b>	<b>2.64</b>
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High-SRI roofs are a prerequisite of the Cool Factor and therefore are not assigned a point value.

If your project scores 1 or above, you have successfully met the requirements of the Cool Factor.

## Affidavit Form for Green Building Professional Building Permit

Green Building  
Project Location: 21 Walden Square Rd, Cambridge, MA

### Green Building Professional

Name: Laura Homich, AIA LEED AP BD+C

Architect

Engineer

License Number: 20496

Company: Prellwitz Chilinski Associates

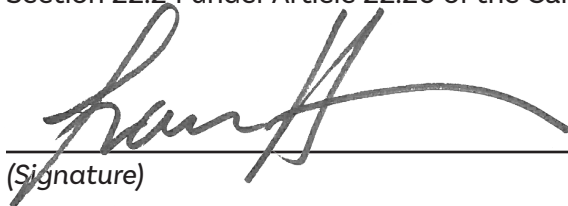
Address: 221 Hampshire Street, Cambridge, MA 02139

### Contact Information

Email Address: lhomich@pcadesign.com

Telephone Number: 617-547-8120

I, Laura Homich, 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)

10/25/2023

(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 BUSINESS CERTIFICATION INC. CERTIFIES THAT

**Laura Homich**

HAS ATTAINED THE DESIGNATION OF

**LEED AP<sup>®</sup> Building Design + Construction**

by demonstrating the knowledge and understanding of green building practices and principles needed to support the use of the LEED<sup>®</sup> green building program.

**10224104-AP-BD+C**

CREDENTIAL ID

**29 JUL 2011**

ISSUED

**26 NOV 2023**

VALID THROUGH

A handwritten signature in black ink that reads 'Peter Templeton'.

PETER TEMPLETON  
PRESIDENT & CEO

U.S. GREEN BUILDING COUNCIL & GREEN BUSINESS CERTIFICATION INC.



phius  
certified  
consultant

**DiAnn Tufts**

has fulfilled the requirements for becoming a

# Phius Certified Consultant: CPHC®

This certificate hereby attests that the above-named Consultant has completed training provided by Phius (Passive House Institute US) relating to construction of buildings that can meet the criteria of the Phius standards for all climate zones and has passed Phius' examination.

Buildings designed, modeled and constructed to meet the Phius standards are ultra-efficient and characterized by superior indoor air quality, thermal comfort, resilience and durability.

**115745**

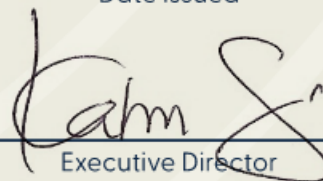
Phius ID

**Jun 1, 2023**

Date Issued

**Jun 1, 2026**

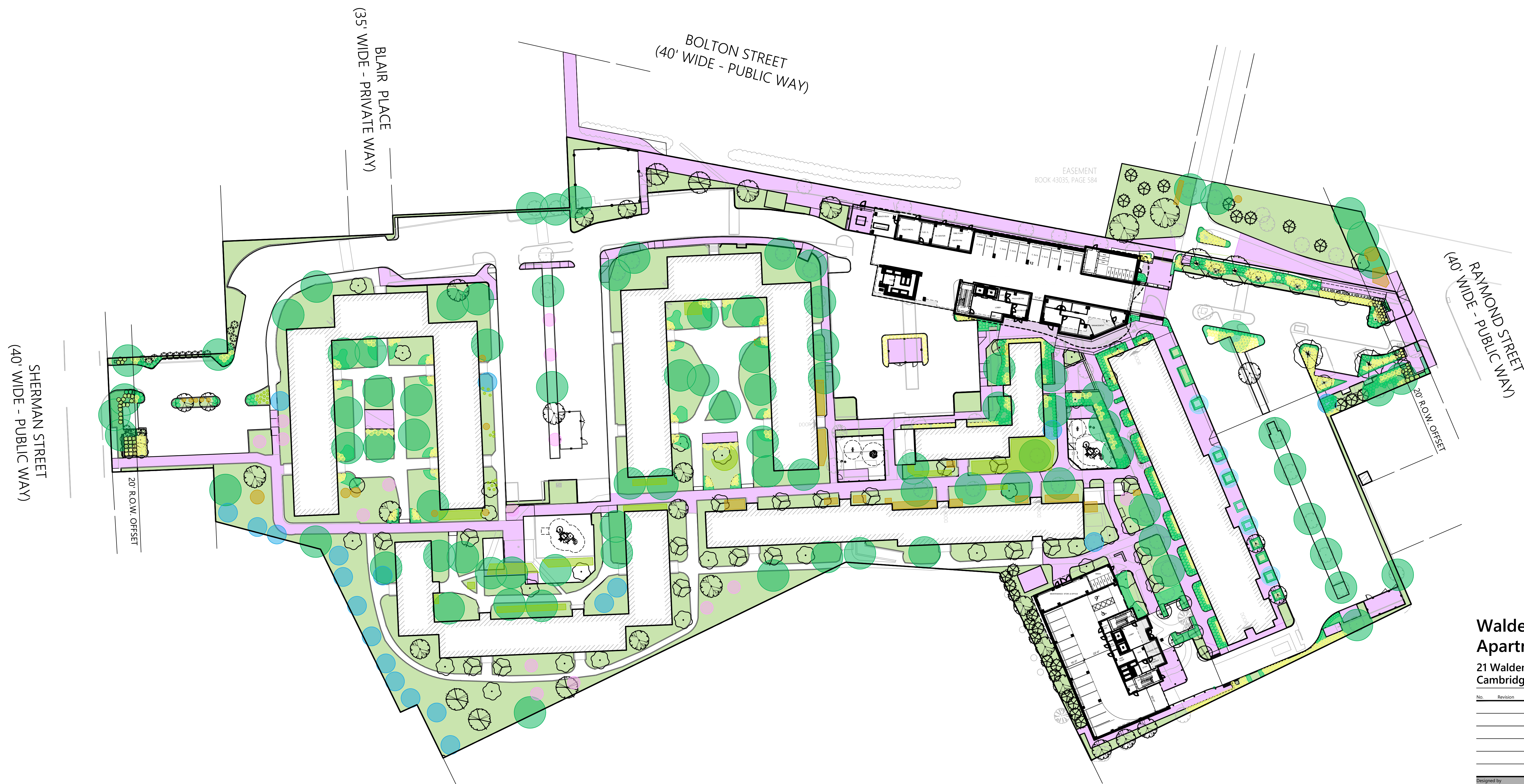
Valid Through



Executive Director



101 Walnut Street  
PO Box 9151  
Watertown, MA 02471  
617.924.1770



- HIGH SRI PAVING
- LAWN AREA
- EXISTING LOW PLANTING AREA
- EXISTING HIGH PLANTING AREA
- EXISTING UNDERSTORY TREE <10' CANOPY
- EXISTING UNDERSTORY TREE >10' CANOPY
- EXISTING CANOPY TREE <15' CANOPY
- EXISTING CANOPY TREE 15' - 25' CANOPY
- EXISTING CANOPY TREE >25' CANOPY
- PROPOSED LOW PLANTING AREA
- PROPOSED HIGH PLANTING AREA
- PROPOSED UNDERSTORY TREE
- PROPOSED CANOPY TREE

### Walden Square Apartments

21 Walden Square Road  
Cambridge, MA

No.	Revision	Date	Appr'd.

Designed by	Checked by

Issued for	Date
Local Approvals	August, 2023

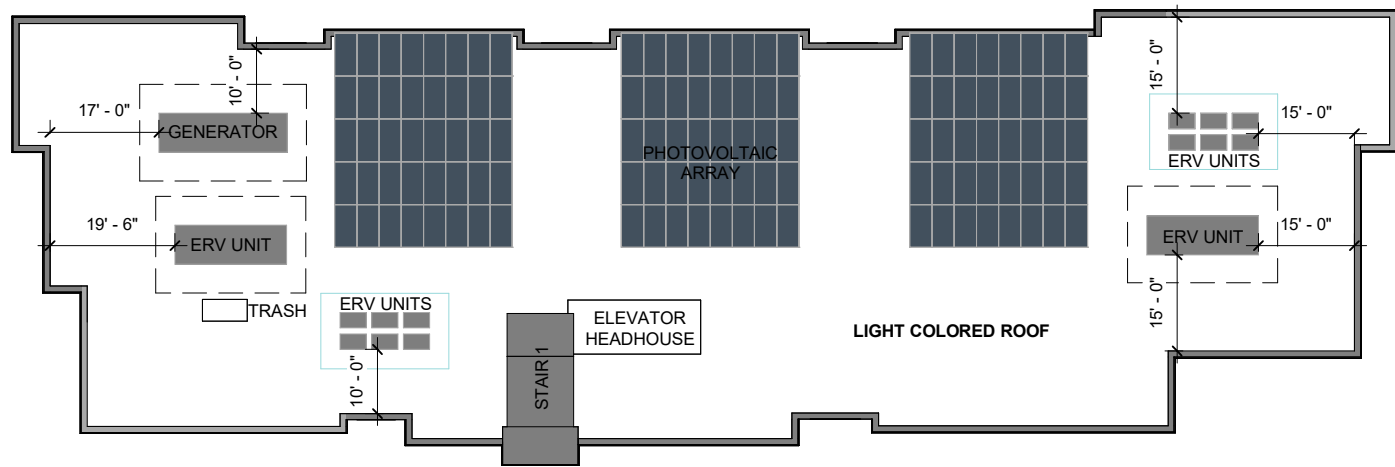
Not Approved for Construction  
Cool Factor Plan

Drawing Number

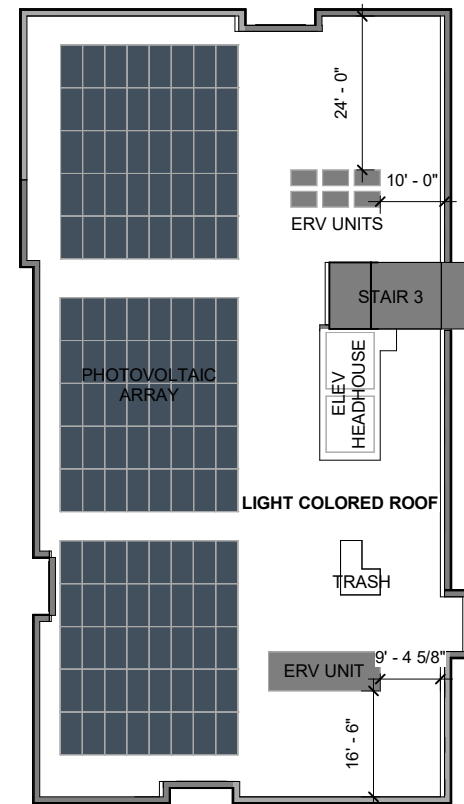
# CF-1

Sheet 1 of 1

Project Number  
15190.00



**ROOF PLAN**  
BUILDING A



**ROOF PLAN**  
BUILDING B

