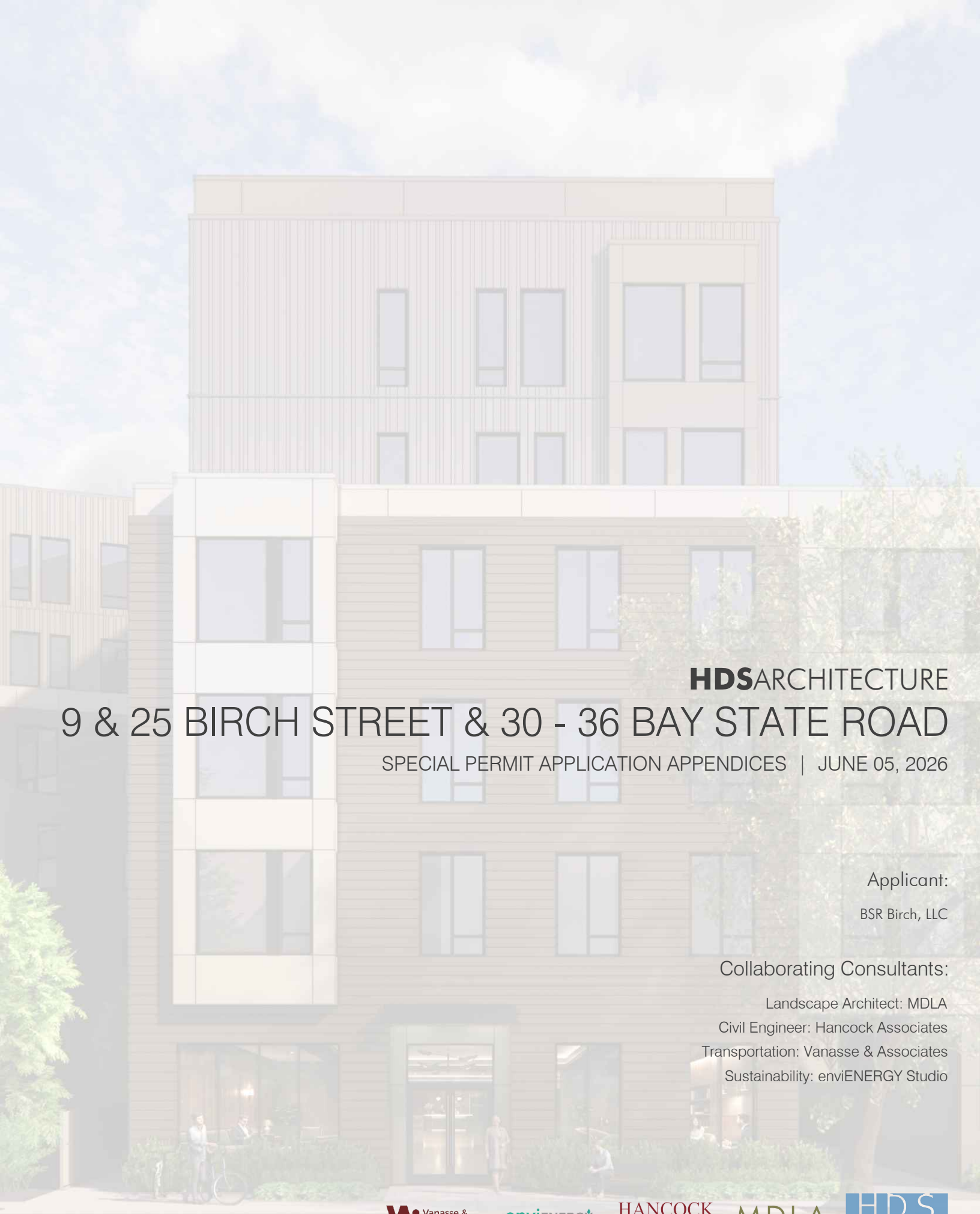

HDSARCHITECTURE

9 & 25 BIRCH STREET & 30 - 36 BAY STATE ROAD

SPECIAL PERMIT APPLICATION APPENDICES | JUNE 05, 2026

Applicant:

BSR Birch, LLC

Collaborating Consultants:

Landscape Architect: MDLA
Civil Engineer: Hancock Associates
Transportation: Vanasse & Associates
Sustainability: enviENERGY Studio

HDS ARCHITECTURE
625 Mount Auburn Street, Cambridge, MA 02138
www.hdsarchitecture.com | 617.714.5870

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Appendix 06	Noise Mitigation Narrative
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Appendix 11	Flood Resistance Plan
Appendix 12	Utility and Drainage Plan

CDD Determination for Special Permit submission

The Community Development Department (CDD) received the Green Factor (GF) documentation for the Special Permit stage. Pursuant to Section 22.96 of the Zoning Ordinance, CDD staff have reviewed the project's GF documentation and provide the following Determination and Summary of Compliance.

CDD Determination: The documentation provided by the Applicant is adequate and demonstrates compliance with the Green Factor Standard applicable to the Special Permit stage.

Summary of Compliance:

- Solar Reflectance Index of Roof – 85
- Solar Reflectance Index of Paving – n/a
- Cool Score – 1.17

Green Factor Report

9&25 Birch Street and 30-36 Bay State Road

Cambridge, MA

Prepared by: **enviENERGY Studio**
Date: **April 7, 2026**

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: 9&25 Birch Street and 36 Bay State Road, Cambridge, MA

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

Developer Name and Contact Information

Name: Seth Grady/ BSR Birch LLC

Mailing Address: 36 Bay State Road, Cambridge MA 02138

Email Address: sethgrady@aol.com

Telephone #: 617-429-5795

Applicability: Section 22.92 & Section 5.22.5

Is this project subject to Green Building Requirements (Section 22.20)?	☒ Yes ☐ No
Does this project involve the construction of a new building?	☒ Yes ☐ No
Does this project enlarge an existing building's footprint by at least 50%?	☐ Yes ☒ No
Does this project involve the creation of new surface parking area?	☒ Yes ☐ 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?	☒ Yes ☐ 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]	☐ Yes ☐ No ☒ N/A

Last Updated: March 2024

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]	16,560
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]	85

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]	1.17
What is the Cool Score of the existing site? [Only answer 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]	

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?	□ Received SP (date: _____) □ Seeking SP ☒ No modification

Seth Grady

Digitally signed by Seth Grady
DN: cn=Seth Grady, o, ou, email=sethgrady@aol.com, c=US
Date: 2026.03.24 13:39:17 -04'00'

3/24/26

Signature of Applicant Date

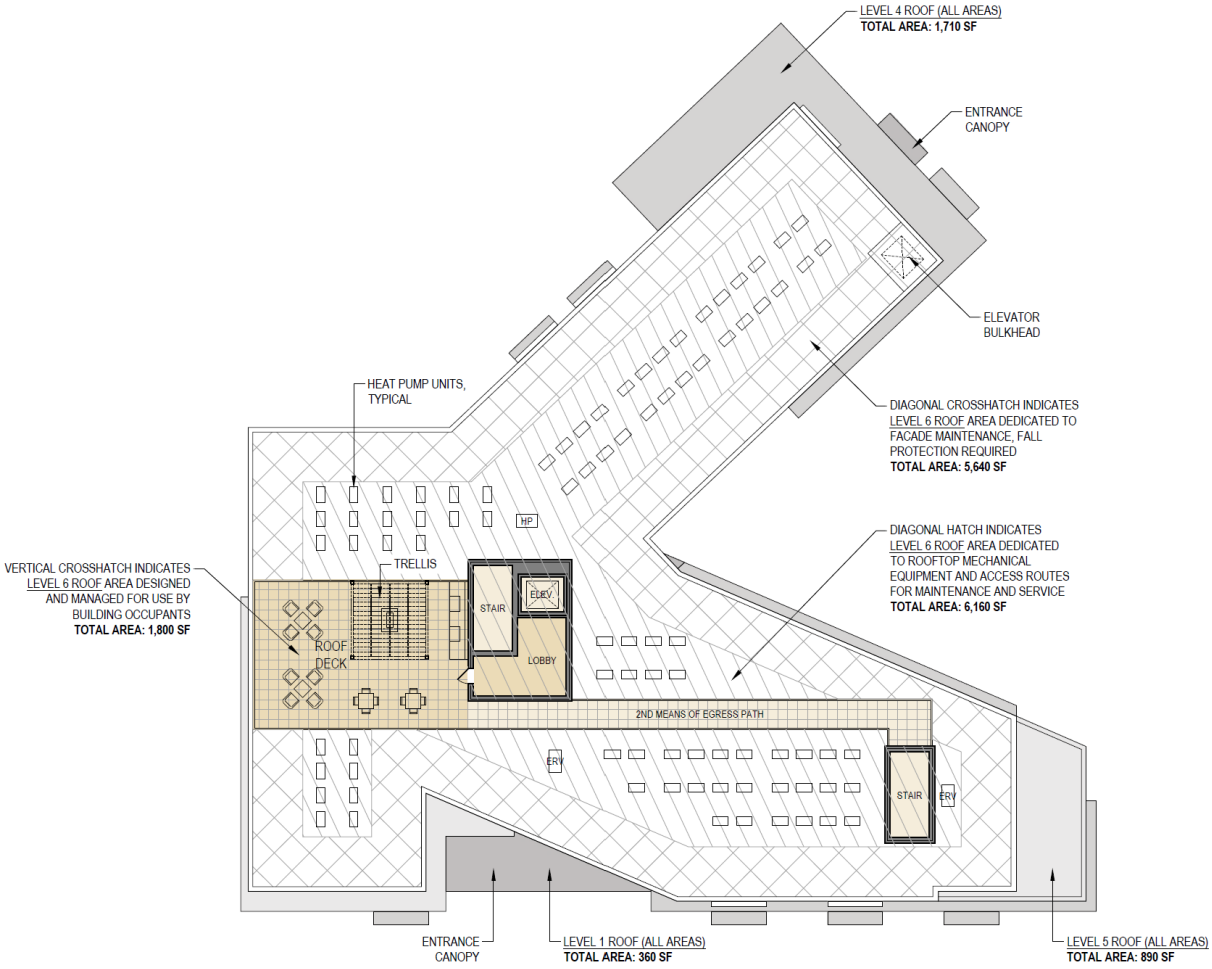
Green Factor Checklist

Project Phase	Required Submissions
☐ **Special Permit/Design Review (if applicable)**	☒ Green Factor Certification Form ☒ Cool Score Sheet ☒ Site and Roof Plans
☐ **Building Permit**	☐ Green Factor Certification Form (updated from prior version) ☐ Cool Score Sheet (updated from prior version) ☐ Site and Roof Plans (updated from prior version) ☐ Catalog of plant species including height and canopy spread of trees and height and soil depth of high and low planting areas ☐ Specifications of roof surface material including initial Solar Reflectivity Index (SRI) ☐ Specifications of paving material including SRI (if applicable) ☐ Specifications of green roof installation with operations and maintenance plan (if applicable)
☐ **Certificate of Occupancy**	***All materials updated based on as-built conditions:*** ☐ Green Factor Certification Form (updated from prior version) ☐ Cool Score Sheet (based on as-built conditions) ☐ Site and Roof Plans (based on as-built conditions) ☐ Catalog of plant species including height and canopy spread of trees and height and soil depth of high and low planting areas ☐ Specifications of roof surface material including initial Solar Reflectivity Index (SRI) ☐ Specifications of paving material including SRI (if applicable) ☐ Specifications of green roof installation with operations and maintenance plan (if applicable)

Last Updated: March 2024

Green Factor

In accordance with Section 22.93.1, new building roof membrane should have an initial SRI of at least 82. The 36 Bay State Road project is targeting an SRI value of 85 which exceeds these requirements. Since project is all-electric, there is a limited area on the roof to provide green roof. As is shown below, a significant portion of the roof will be dedicated to mechanical equipment or façade maintenance fall protection area. The project achieves a Cool Factor of 1.17 which exceeds the minimum requirements of 1.0, and therefore, the Green Factor requirements are met. Please refer to page 6 for detailed Cool Factor calculations.



City of Cambridge **Cool Score Sheet** **4/7/2024**

Project Address	Special Permit Number	Total Lot Area (SF)
9&25 Birch Street and 36 Bay State Road	PB-XXX	24,775
Applicant Name	**Phone Number**	**Open Space Requirement (%)**
Seth Grady/ BSR Birch LLC	617-429-5795	20%
Applicant Contact / Address	**Email Address**	**Zoning District**
36 Bay State Road, Cambridge, MA 02138	sethgrady@aol.com	Residence C-1A MXR
Project Description		**Result**
Sample run to demonstrate how the form works.		**Pass**

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

When entering strategies that are within 20' of the street (including sidewalks), do not also enter them in column H.

			Outside 20' of Street	Value Factor		Within 20' of Street	Value Factor	Contributing Area
Trees		**Preserved Existing Trees**						
Enter the number of trees in each category. Count each tree only once on this form.	A1	Understory tree currently <10' canopy spread	0	0.80	+	0	1.60	-
	A2	Understory tree currently >10' canopy spread	0	1.00	+	0	2.00	-
	A3	Canopy tree currently <15' canopy spread	0	0.80	+	0	1.60	-
	A4	Canopy tree currently between 15' and 25' canopy spread	0	1.00	+	0	2.00	-
	A5	Canopy tree currently >25' canopy spread	3	1.20	+	0	2.40	2,520
		New or Transplanted Trees						
	A6	Understory tree	3	0.60	+	2	1.20	630
	A7	Canopy tree	1	0.70	+	0	1.40	490
Planting Areas	B1	Lawn Area	0	0.30	+	0	0.60	-
Enter area in square feet of each component in the box provided	B2	Low Planting Area	1,440	0.40	+	497	0.80	974
	B3	High Planting Area	542	0.50	+	930	1.00	1,201
Green Roofs & Facades	C1	Green Façade	0	0.10	+	0	0.20	-
For definitions, see reference document.	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	-
Paving & Structures	D1	Low Slope Roof	16,560	N/A				
	D2	High-SRI Paving	0	0.1				-
	D3	Shaded Area	0	0.2	+	0	0.40	-

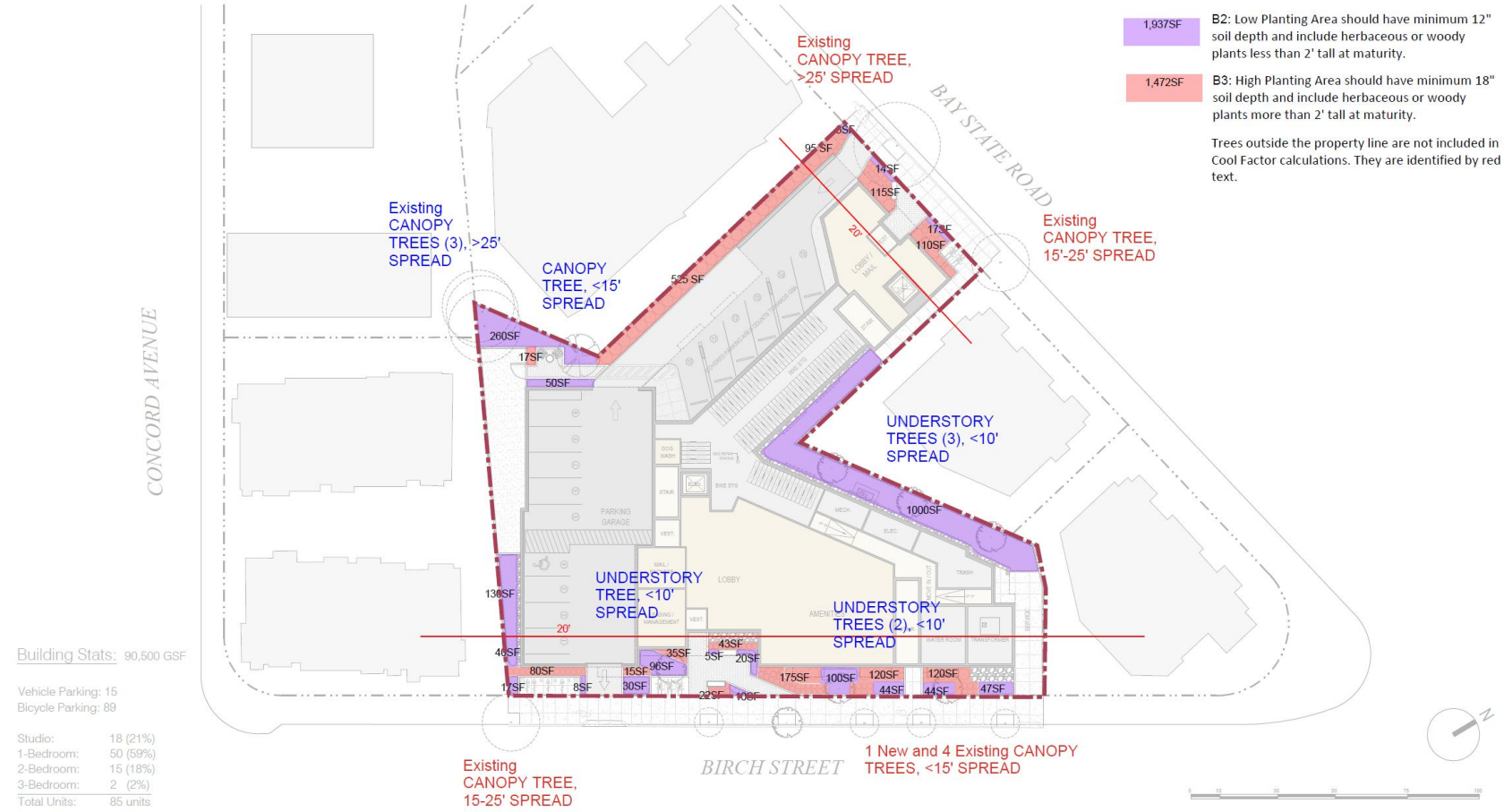
High-SRI Paving areas within 20' of a Street do not count towards the Cool Score

Project Summary

Portion of lot area utilizing green strategies	*23%*
Portion of score from green strategies	*100%*
Portion of score from trees	*63%*
Portion of score contributing to public realm cooling	*29%*

Total Contributing Area	**5,815**
Total Area Goal	**4,955**
COOL FACTOR SCORE	**1.17**

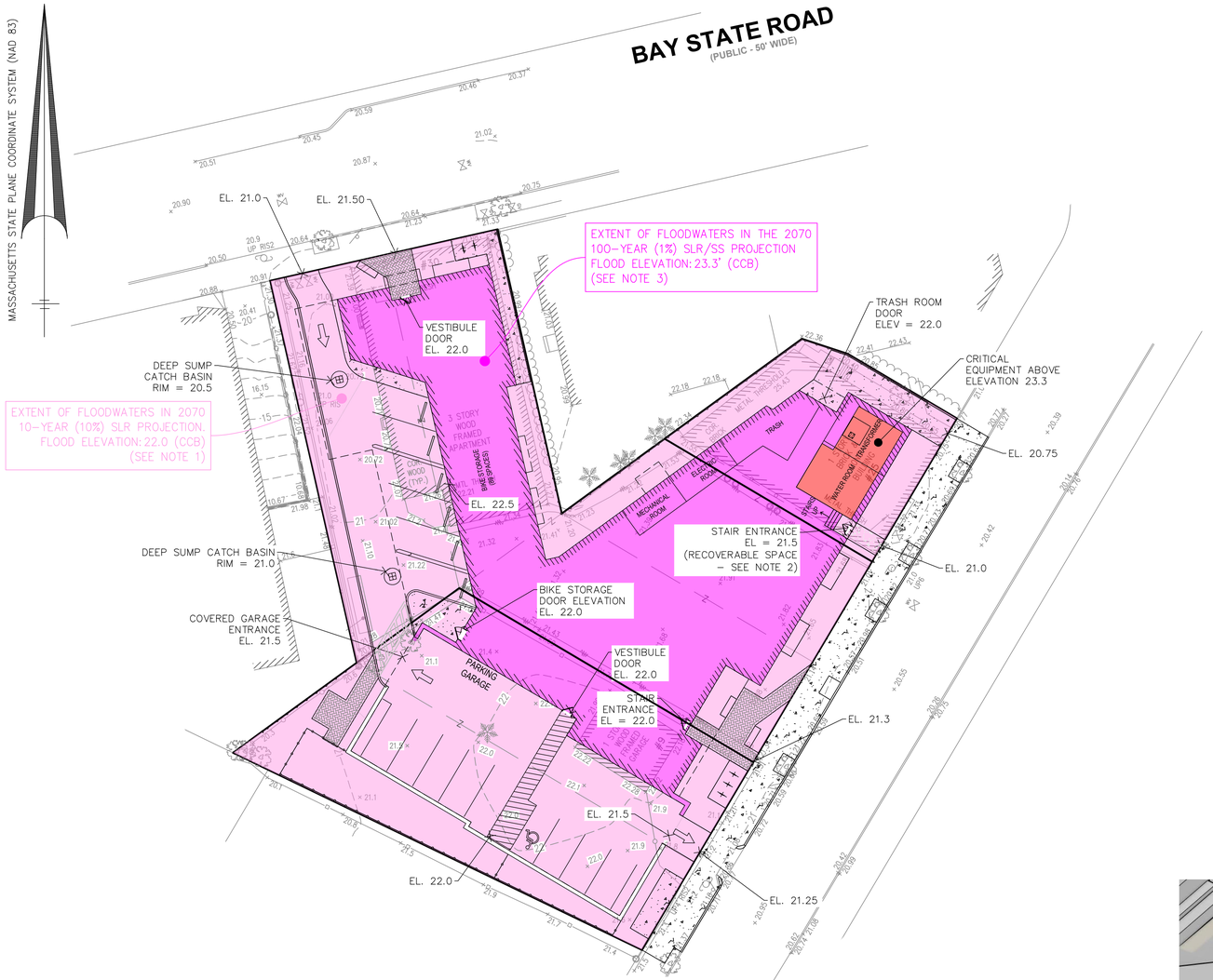
If your project scores 1 or above, you have successfully met the requirements of the Cool Factor.



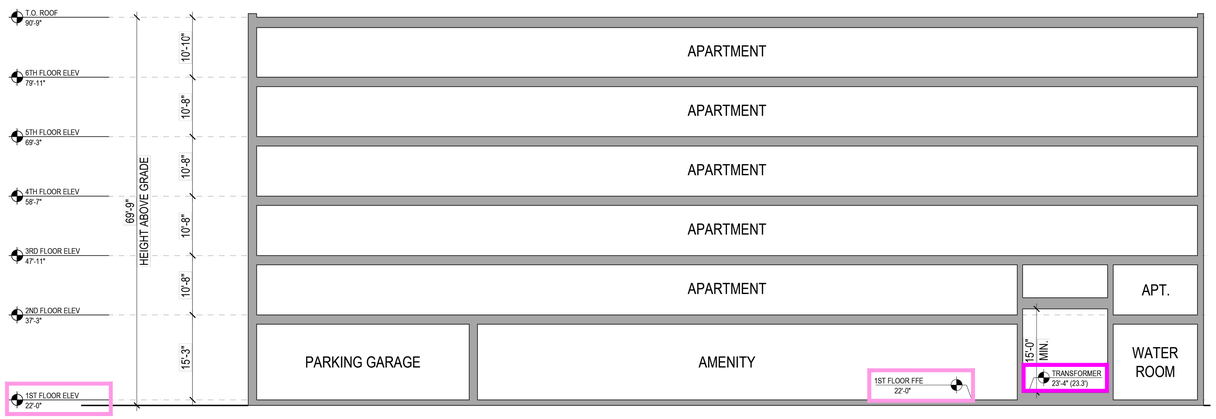
9 & 25 Birch Street & 36 Bay State Road — First Floor Plan Diagram

Cambridge, MA | February 06, 2026 — 1/32" = 1'-0"

MDLA HDS ARCHITECTURE 625 Mount Auburn Street, Cambridge, MA 02138 www.hdsarchitecture.com | 617.714.5870



PLAN VIEW
(SCALE: 1"=20')



BUILDING PROFILE VIEW
(NOT TO SCALE)

PER CAMBRIDGE ZONING ORDINANCE 22.84.1

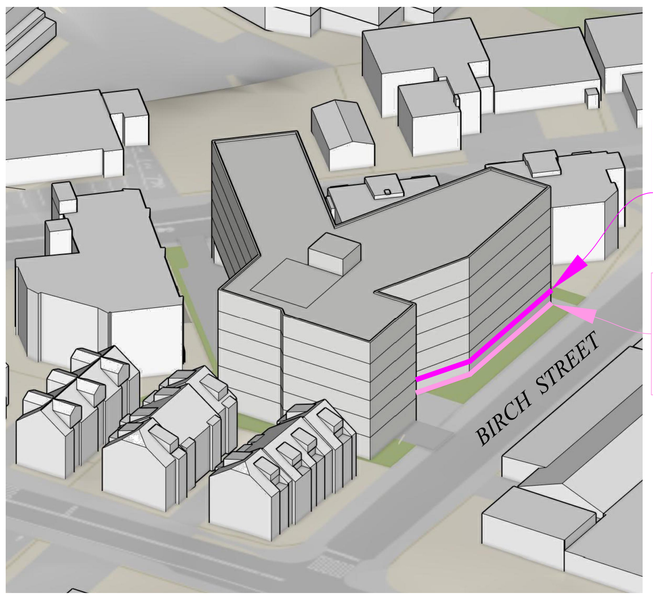
1. ALL OCCUPIABLE SPACES SHALL BE PROTECTED TO THE 10%–LONG TERM FLOOD ELEVATION (10%–LTFE) ELEVATION OF 22.0'(CCB)
   - 1.1. ALL ENTRANCES TO OCCUPIABLE SPACES LOCATED ON THE FIRST FLOOR ARE SET AT OR ABOVE THE 10% LTFE OF ELEVATION 22.0'.
2. SMALL ENTRYWAYS BELOW THE 10%–LTFE WITH STAIRS THAT ALLOW ACCESS TO PROTECTED AREAS SHALL BE ALLOWED NOT TO BE PROTECTED PROVIDED THEY MEET THE STANDARDS FOR RECOVERY. RECOVERABLE AREAS ARE THOSE THAT ALLOW FLOOD WATER TO ENTER AND EXIT WITHOUT CAUSING DAMAGE THAT CANNOT BE READILY REPAIRED.
   - 2.1. ALL ENTRANCES BELOW THE 10%–LTFE ARE RECOVERABLE.
3. ALL LIVABLE SPACES SHALL BE PROTECTED TO THE 1% LONG TERM FLOOD ELEVATION (1%–LTFE) ELEVATION OF 23.3' (CCB).
   - 3.1 ALL LIVABLE SPACES ARE LOCATED ON FLOORS 2 THROUGH 6. FLOOR 2 IS AT ELEVATION 37.25. THERE WILL BE NO LIVABLE SPACES LOCATED ON THE GROUND FLOOR OR BELOW ELEVATION 23.3'.
4. CRITICAL EQUIPMENT WITHIN THE BUILDING SHALL BE PROTECTED TO THE 1% LONG TERM FLOOD ELEVATION (1%–LTFE) ELEVATION OF 23.3' (CCB).
   - 4.1 ALL CRITICAL EQUIPMENT IS LOCATED WITHIN THE BUILDING AND IS SET ABOVE THE 1%–LTFE OF 23.3'

100 YEAR (1%) LTFE →
10 YEAR (10%) LTFE →

Flood Elevation Data

2070 - 1% - SLR/SS	23.3
2070 - 1% - Precip	21.1
2070 - 10% - SLR/SS	22
2070 - 10% - Precip	N/A
2050 - 1% - SLR/SS	N/A
2050 - 1% - Precip	21
2050 - 10% - SLR/SS	N/A
2050 - 10% - Precip	N/A
Present Day - 1% - Precip	20.9
Present Day - 10% - Precip	N/A
FEMA 500-Year	22.3
FEMA 100-Year	N/A

Long-Term Flood Elevations
1% - LTFE: **23.3**
10% - LTFE: **22**



3D RENDERING OF PROPOSED BUILDING
(NOT TO SCALE)

9 & 25 BIRCH STREET & 30 BAY STATE ROAD

Cambridge, Massachusetts 02138

PREPARED FOR:

DON LAW MANAGEMENT

38 Bay State Road
Cambridge, Massachusetts 02138

HANCOCK ASSOCIATES

Civil Engineers

Land Surveyors

Wetland Scientists

185 CENTRE STREET, DANVERS, MA 01923
VOICE (978) 777-3050, FAX (978) 774-7816
WWW.HANCOCKASSOCIATES.COM

NO.	BY	APP	DATE	ISSUE/REVISION DESCRIPTION

DATE:	04/20/2026	DESIGN BY:	OMR
SCALE:	AS NOTED	DRAWN BY:	OMR
APPRVD. BY:	KAC	CHECK BY:	AD

FLOOD RESISTANCE PLAN

PLOT DATE: Apr 22, 2026 12:55 pm
PATH: U:\x2_vol1\Civil 3D Projects\28494 DLM-Cambridge\Eng\DWG\

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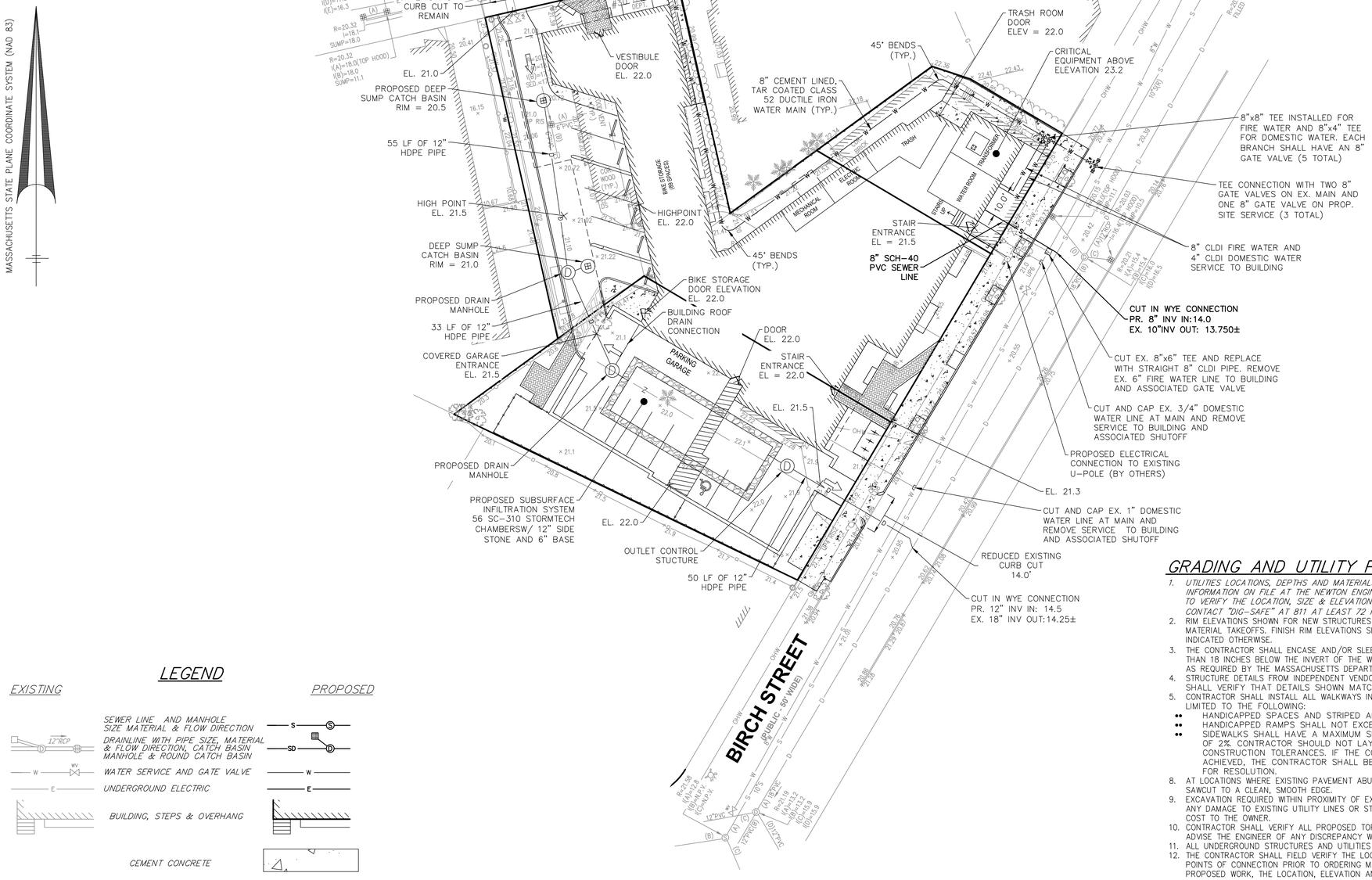
LAYOUT: EC
SHEET: 1 OF 2

C1

PROJECT NO.: 28559



LEGEND

EXISTING		PROPOSED
12"RCP	SEWER LINE AND MANHOLE SIZE MATERIAL & FLOW DIRECTION	S
D	DRAINLINE WITH PIPE SIZE, MATERIAL & FLOW DIRECTION, CATCH BASIN MANHOLE & ROUND CATCH BASIN	SD D
W WV	WATER SERVICE AND GATE VALVE	W
E	UNDERGROUND ELECTRIC	E
	BUILDING, STEPS & OVERHANG	
	CEMENT CONCRETE	
	RETAINING WALL	
	FENCING	

GRADING AND UTILITY PLAN NOTES

1. *UTILITIES LOCATIONS, DEPTHS AND MATERIALS WERE PROVIDED BY HANCOCK ASSOCIATES AND FROM AVAILABLE RECORD INFORMATION ON FILE AT THE NEWTON ENGINEERING OFFICES. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE LOCATION, SIZE & ELEVATION OF ALL UTILITIES WITHIN THE AREA OF PROPOSED WORK AND TO CONTACT "DIG-SAFE" AT 811 AT LEAST 72 HOURS PRIOR TO ANY EXCAVATION, DEMOLITION OR CONSTRUCTION.*
2. RIM ELEVATIONS SHOWN FOR NEW STRUCTURES ARE APPROXIMATE AND ARE PROVIDED TO ASSIST CONTRACTOR WITH MATERIAL TAKEOFFS. FINISH RIM ELEVATIONS SHOULD MATCH PAVEMENT, GRADING OR LANDSCAPING, UNLESS SPECIFICALLY INDICATED OTHERWISE.
3. THE CONTRACTOR SHALL ENCASE AND/OR SLEEVE SEWER AND WATER MAINS WHERE THE CROWN OF THE SEWER PIPE IS LESS THAN 18 INCHES BELOW THE INVERT OF THE WATER PIPE AND WHERE THE HORIZONTAL SEPARATION IS LESS THAN 10 FEET, AS REQUIRED BY THE MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION.
4. STRUCTURE DETAILS FROM INDEPENDENT VENDORS ARE CONSTANTLY CHANGING. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL VERIFY THAT DETAILS SHOWN MATCH CURRENT DETAILS AND SPECIFICATIONS FROM VENDORS.
5. CONTRACTOR SHALL INSTALL ALL WALKWAYS IN ACCORDANCE WITH APPLICABLE ADA REQUIREMENTS, INCLUDING BUT NOT LIMITED TO THE FOLLOWING:
   - HANDICAPPED SPACES AND STRIPED AREA SLOPES SHALL NOT EXCEED 2% IN ANY DIRECTION.
   - HANDICAPPED RAMPS SHALL NOT EXCEED 8% FOR A MAXIMUM VERTICAL DISTANCE OF 6 INCHES.
   - SIDEWALKS SHALL HAVE A MAXIMUM SLOPE IN THE PATH OF TRAVEL OF 5% AND A MAXIMUM CROSS SLOPE OF 2%. CONTRACTOR SHOULD NOT LAYOUT SLOPES EXCEEDING 4.5% AND 1.5% RESPECTIVELY TO ALLOW FOR CONSTRUCTION TOLERANCES. IF THE CONTRACTOR DETERMINES THAT THE REQUIRED SLOPES CANNOT BE ACHIEVED, THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPORTING THE INFORMATION TO THE ENGINEER FOR RESOLUTION.
8. AT LOCATIONS WHERE EXISTING PAVEMENT ABUTS NEW CONSTRUCTION, THE EDGE OF THE EXISTING PAVEMENT SHALL BE SAWCUT TO A CLEAN, SMOOTH EDGE.
9. EXCAVATION REQUIRED WITHIN PROXIMITY OF EXISTING UTILITY LINES SHALL BE DONE BY HAND. CONTRACTOR SHALL REPAIR ANY DAMAGE TO EXISTING UTILITY LINES OR STRUCTURES INCURRED DURING CONSTRUCTION OPERATIONS AT NO ADDITIONAL COST TO THE OWNER.
10. CONTRACTOR SHALL VERIFY ALL PROPOSED TOP OF CURB ELEVATIONS BEFORE PROCEEDING WITH ANY CONSTRUCTION AND ADVISE THE ENGINEER OF ANY DISCREPANCY WHICH MAY IMPACT DESIGN.
11. ALL UNDERGROUND STRUCTURES AND UTILITIES SHALL BE CAPABLE OF WITHSTANDING H20 WHEEL LOADS.
12. THE CONTRACTOR SHALL FIELD VERIFY THE LOCATION, SIZE, INVERTS AND TYPES OF EXISTING PIPES AT ALL PROPOSED POINTS OF CONNECTION PRIOR TO ORDERING MATERIALS. WHERE AN EXISTING UTILITY IS FOUND TO CONFLICT WITH THE PROPOSED WORK, THE LOCATION, ELEVATION AND SIZE OF THE UTILITY SHALL BE ACCURATELY DETERMINED WITHOUT DELAY AT NO ADDITIONAL COST BY THE CONTRACTOR, AND THE INFORMATION FURNISHED IN WRITING TO THE OWNER'S REPRESENTATIVE FOR THE RESOLUTION OF THE CONFLICT.
13. INVERT OF THE EXISTING SEWER MANHOLE AT THE INTERSECTION OF BIRCH STREET AND BAY STATE ROAD WAS TAKEN FROM AS BUILT DRAWINGS PREPARED BY CE MAGUIRE, INC AND ISSUED 11/26/1974.
14. EXISTING WATER LINE SIZES AND LOCATIONS RECEVED FROM THE CAMBRIDGE WATER DEPARTMENT.

9 & 25 BIRCH STREET & 30 BAY STATE ROAD

Cambridge, Massachusetts 02138

PREPARED FOR:

DON LAW MANAGEMENT

38 Bay State Road
Cambridge, Massachusetts 02138

HANCOCK ASSOCIATES

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CATHERINE A. CRAIG
CIVIL
No. 51084
REGISTERED PROFESSIONAL ENGINEER

NO.	BY	APP	DATE	ISSUE/REVISION DESCRIPTION

DATE:	04/20/2026	DESIGN BY:	OMR
SCALE:	AS NOTED	DRAWN BY:	OMR
APPRVD. BY:	KAC	CHECK BY:	AD

UTILITY AND DRAINAGE PLAN

PLOT DATE: Apr 22, 2026 3:10 pm
PATH: U:\s2_vol1\Civil 3D Projects\28494 DLM-Cambridge\Eng\DWG\

DWG:	*25814_gdu.dwg*
LAYOUT:	*util*
SHEET:	2 OF 2

C2

PROJECT NO.: 28559

APPENDIX 01

Transportation Impact Study (TIS) and TP+T Certification

SUBMITTED APRIL 02, 2026

CITY OF CAMBRIDGE | **Department of Transportation**

MEMORANDUM

To: Derek Roach, Vanasse & Associates inc.

From: Brooke McKenna, Commissioner

Date: April 16, 026

Subject: 25 Birch Street Transportation Impact Study (TIS)

The Cambridge Department of Transportation (DOT) received your updated Transportation Impact Study (TIS) on April 2, 2026, for the proposed 25 Birch Street development project by BSR Birch LLC, located at 9 & 25 Birch Street and 36 Bay State Road.

After reviewing the updated TIS, we certify that the study is accurate and complete, pending the corrections listed below. Please resubmit the TIS with the following revisions:

- Update Figure C.1 to reflect the latest site plan.
- Revise the bike rack layout shown in Figure 9.c.5. It currently depicts a 24-inch clearance from a wall, while City guidelines require a minimum of 36 inches.
- Clarify or expand upon the comment on page 39 regarding the volume-to-capacity ratio calculation for the Red Line and why it may not reflect rider experience.

DOT appreciates the effort that has gone into preparing this TIS and looks forward to continuing to work with you as the project advances through the development review process.

If you have any questions or would like to schedule a meeting regarding next steps—including development of the final transportation mitigation program—please contact Adam Shulman on my staff at 617-349-4745.

Brooke McKenna
Transportation Commissioner

Annex Building, 344 Broadway
Cambridge, MA 02139

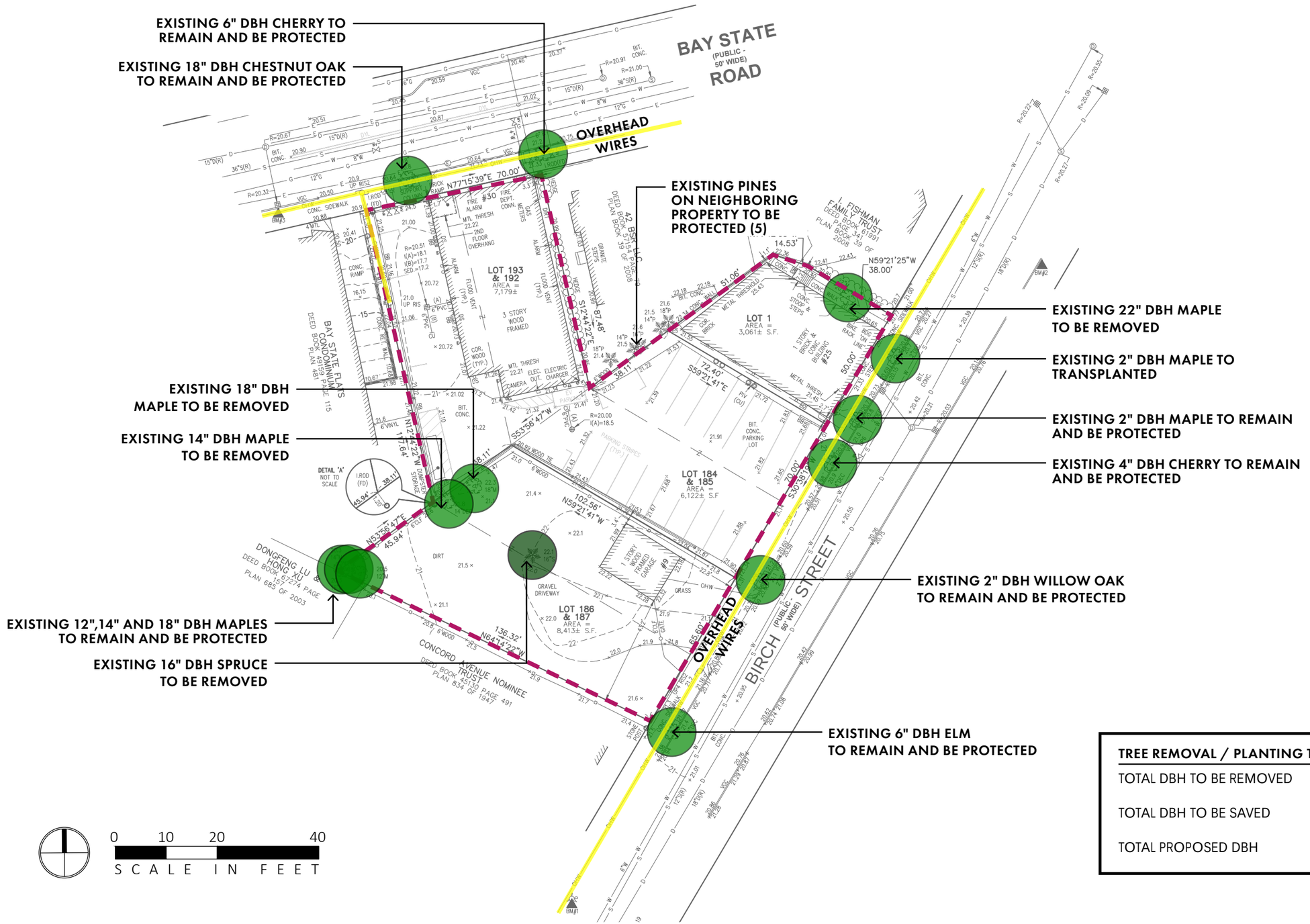
Ph. 617-349-4700 | **Email.** cambridgema.gov/traffic
Visit. www.cambridgema.gov

4/08/26

9 & 25 BIRCH STREET, 30 BAY STATE ROAD

TREE STUDY

MDLA



TREE REMOVAL / PLANTING TOTALS	
TOTAL DBH TO BE REMOVED	70" (4 TREES)
TOTAL DBH TO BE SAVED	84" (10 TREES)
TOTAL PROPOSED DBH	27" (9 TREES)

9 & 25 BIRCH STREET, 30 BAY STATE ROAD TREE PROTECTION & REMOVAL PLAN

CAMBRIDGE, MA

MDLA

481 CONCORD AVENUE

20-24 BAY STATE ROAD

BONNY'S GARDEN CENTER
41 BAY STATE ROAD

473,475,477 CONCORD AVENUE

459, 461, 463, 465 CONCORD AVENUE

CONCORD AVENUE

1,3,5,7 BIRCH STREET

42 BAY STATE ROAD

54 BAY STATE ROAD

BAY STATE ROAD

PROPERTY LINE

PROPERTY LINE

PROPOSED BUILDING

BIRCH STREET

OHW

EXISTING 18" DBH CHESTNUT OAK

EXISTING 6" DBH CHERRY

EXISTING 12",14" AND 18" DBH MAPLES TO REMAIN AND BE PROTECTED

PROPOSED 3.5"-4" DBH ARMSTRONG MAPLE

PROPOSED 8-10' HT SERVICEBERRY (4)

PROPOSED 8-10' HT SERVICEBERRY

PROPOSED 8-10' HT SERVICEBERRY (2)

EXISTING 6" DBH ELM

EXISTING 2" DBH WILLOW OAK

TRANSPLANTED 2" DBH MAPLE

EXISTING 2" DBH MAPLE

EXISTING 4" DBH CHERRY

PROPOSED 3.5"-4" DBH RED MAPLE

9 & 25 BIRCH STREET, 30 BAY STATE ROAD PROPOSED TREE PLAN

CAMBRIDGE, MA

0 15 30 60

SCALE IN FEET

MDLA

On Thu, Mar 12, 2026 at 8:11 AM Putnam, Andrew <aputnam@cambridgema.gov> wrote:

> Hi Swaathi,
>
> I have reviewed the Tree Study for the special permit project at 9 & 25 Birch Street and 30 Bay State Road. It meets all the requirements needed for certification by the City Arborist as defined in 8.66.030. The project will mitigate for tree loss with a combination of replanting and payment into the Tree Fund. The project has 43" of DBH to mitigate after proposed planting and will require payment of $36,550.00 to the Tree Fund. I will update you once a Tree Removal Permit is approved for the project and payment has been received.
>
> Please let me know if you have any questions,
>
> Thank you,
>
> Andrew Putnam
> Superintendent of Urban Forestry & Landscapes
> MCA | TRAQ | NOFA Accredited Organic Land Care Professional
> City of Cambridge
> (617)-349-6722

Sewer Service Infrastructure Narrative

1. Introduction and Project Description

This narrative has been prepared in support of a Special Permit Application to the Cambridge Planning Board for the proposed residential building development at 9 & 25 Birch Street and 30-36 Bay State Road. It evaluates the sewer flow from the proposed six-story, 85-unit residential building and its connection to the City of Cambridge sewer system infrastructure.

2. Proposed Sewer Service Design

The proposed building will connect to the existing public sanitary sewer system via a new connection at the existing 10" main in Birch Street. The main is shown on as-built plans dated 1975 and prepared by CE Maguire, Inc.

The new service will be 8" SCH-40 PVC and the size of the proposed line will be determined by the plumbing engineer as design progresses. The proposed service will connect to the existing main in Brich Street via a cut in wye connection per Cambridge regulations. All sanitary flow generated by the building will be discharged to the municipal system and will not be combined with stormwater discharges associated with the project including site drainage, roof drain collection systems, and/or foundation drains. No on-site wastewater treatment, including grease traps or oil-water separators, is proposed. All existing sewer connections serving the site will be properly cut and capped at the main in accordance with City standards. All sewer work within the public way will be performed under permit and supervision of the City of Cambridge Department of Public Works (DPW). Kara Falise, senior engineer of the DPW, gave preliminary approval of the design in a meeting on 03/31/2026.

3. Estimated Daily Sanitary Sewer Flow

Daily sanitary sewer flow has been estimated using the Massachusetts Title 5 (310 CMR 15.00) residential design flow criteria.

- Number of residential bedrooms: **105 bedrooms**
- Average daily water use: **110 gallons per day**

$$105 \text{ units} \times 110 \text{ gpcd} = 11{,}550 \text{ gallons per day (gpd)}$$

4. Construction and Testing

All sanitary sewer infrastructure associated with the proposed development will be constructed in accordance with the City of Cambridge Department of Public Works (DPW) standards, the Massachusetts State Plumbing Code, and applicable MWRA requirements. All work within the public way will be performed by licensed and bonded contractors under permit and inspection by the City of Cambridge. Proper trenching, bedding, backfill, and compaction will be provided in accordance with City standards to ensure long-term performance of roadways and sidewalks. New sanitary sewer piping will be inspected by the City prior to backfilling. Sewer connections will be tested for watertightness in accordance with City requirements which include dye testing and pressure tests. Final acceptance of the sewer connection will be subject to City approval following successful inspection and testing.

5. Anticipated Impact on Municipal Sewer System

Based on preliminary discussions with the Cambridge Engineering Department the existing 10" main has sufficient capacity to service the proposed building. No off-site sanitary sewer upgrades are anticipated to be required to support the project. Additionally, CCTV footage of the existing sewer system can be obtained to verify the integrity of the system.

6. Conclusion: Special Permit Findings – Cambridge Zoning Ordinance §19.20

Section 19.20 of the Cambridge Zoning Ordinance requires the Planning Board to find that the proposed development will not result in undue adverse impacts on municipal systems and that adequate public services are available to support the project. Based on the information presented in this Sewer Service Infrastructure Impact Narrative, the project satisfies the applicable findings of §19.20

Water Service Infrastructure Narrative

1. Introduction and Project Description

This narrative has been prepared in support of a Special Permit Application to the Cambridge Planning Board for the proposed residential building development at 9 & 25 Birch Street and 30-36 Bay State Road. It evaluates the anticipated impacts of the proposed six-story, 85-unit residential building on the City of Cambridge water supply infrastructure. The analysis addresses domestic water demand, fire protection requirements, system redundancy, compliance with Cambridge Water Department (CWD) standards, and potential infrastructure improvements associated with the development.

The project site will be serviced by an existing 8" ductile iron water main in Brich Street and an existing 12" ductile iron water main in in Bay State Road, both of which were installed in 2018 per a Utility Construction Plan prepared by Stantec. The proposed design incorporates redundant water service connections to enhance reliability and operational flexibility.

2. Proposed Water Service Design

The proposed building will be served by two independent water service connections in Birch Street and Bay State Road to provide redundancy. Each connection to the existing mains will include a three-way valve allowing isolation of either feed without interruption of service. All proposed pipes will be cement line, tar coated ductile iron class 52. Connections to existing mains shall be cut in tees. Dual feeds will ensure uninterrupted service during maintenance, emergency shutdowns, or localized main outages

The 4" domestic water service to the building will connect to the proposed 8" water service line that is connected to the mains in Birch Street and Bay State Road. The size will be coordinated with the plumbing engineer and shall be metered in accordance with CWD requirements for multi-residential buildings. Valves will be installed on all branches of the tee connection to ensure redundancy.

The building will be equipped with a fully compliant fire protection system designed to meet applicable NFPA standards and City of Cambridge Fire Department requirements. Fire protection piping, valves, and backflow prevention devices will be designed by the plumbing engineer and installed per CWD and Fire Department standards. The 8" fire water service to the building will connect to the proposed 8" water service line that is connected to the mains in Birch Street and Bay State Road. The fire service line will have a connection to the service line independent from

the domestic water service. Valves will be installed on all branches of the tee connection to ensure redundancy.

Preliminary approval for the design was given by Richie Holly, distribution manager, and Innocent Lugumamu, Manager of Engineering, of the water department on 04/21/2026.

3. Estimated Domestic Water Demand

Estimated daily domestic water demand for the proposed development has been calculated using standard the standard flow per day provided in Section 15.203 of MA 319 CMR 15.00

- Number of residential bedrooms: **105 bedrooms**
- Average daily water use: **110 gallons per day**

1.1x(105 units $\times$ 110 gpcd) $=$ 12,700 gallons per day (gpd)

4. Construction and Testing

Once installed, all new water services will undergo pressure and leakage testing in accordance with Section 22 of the City of Cambridge Construction and Operating Procedures. Testing will be witnessed and Cambridge Water Department prior to being placed into service. All new piping will be disinfected and flushed in with City standards and under CWD supervision.

5. Anticipated Impact on City of Cambridge Water System

Based on preliminary discussions with the Cambridge Engineering Department the existing 8" mains have sufficient capacity to service the proposed building. No off-site water infrastructure upgrades are anticipated to be required to support the project. Additionally, Hydrant Flow Tests will be performed to verify the integrity of the system.

6. Conclusions: Special Permit Findings – Cambridge Zoning Ordinance §19.20

Section 19.20 of the Cambridge Zoning Ordinance requires the Planning Board to find that the proposed development will not result in undue adverse impacts on municipal systems and that adequate public services are available to support the project. Based on the information presented in this Water Service Infrastructure Impact Narrative, the project satisfies the applicable findings of §19.20.

Stormwater Infrastructure Narrative

1. Introduction and Project Description

This narrative has been prepared in support of a Special Permit Application to the Cambridge Planning Board for the proposed residential building development at 9 & 25 Birch Street and 30-36 Bay State Road. It describes the stormwater management system that will service the proposed six-story, 85-unit residential building and its connection to the City of Cambridge stormwater conveyance infrastructure. The narrative also describes compliance with Cambridge's stormwater standards. The project has been designed to reduce stormwater runoff, improve water quality, and minimize impacts to the City's stormwater system through on-site detention, infiltration, and controlled discharge.

The project site is served by the City of Cambridge municipal stormwater drainage system. An 18-inch storm drain located in Birch Street and a 15-inch storm drain in Bay State Road collects stormwater overflow from the site in the existing conditions. There is currently a series of catch basins and drain manholes which collect parking lot runoff before it is routed to the municipal storm conveyance system. There is currently no infiltration or detention system that receives stormwater runoff from the project site.

2. Proposed Stormwater Service Design

Stormwater runoff from building roof areas will be collected via internal roof drains and leaders. Roof runoff will be directed to a subsurface infiltration system consisting of Stormtech SC-31 chambers. Stormwater from paved areas will be directed toward deep sump catch basins, which will provide initial pretreatment through sediment and trash removal. Pretreated runoff will then be routed to the subsurface stormwater system. The Subsurface system provides stormwater detention, peak flow attenuation, groundwater recharge, and further water quality treatment in accordance with City stormwater performance standards.

During large storm events exceeding the design capacity of the infiltration system, an outlet control overflow device will discharge treated stormwater to the 18" storm drain in Birch Street. Connection to the existing main will be via a cut in wye connection pursuant to the City of Cambridge Standards.

3. City of Cambridge Stormwater Regulations

Stormwater management for the proposed development is regulated by the City of Cambridge Wastewater and Stormwater Drainage Use Regulations and the associated Stormwater Management Guidance Document, as amended 2021. The proposed project is subject to City

stormwater regulations because it requires a Special Permit from the Planning Board and exceeds 50,000 square feet of gross floor area.

City regulations require that stormwater systems be designed to control the rate and volume of stormwater runoff to prevent downstream flooding and system surcharge, provide stormwater quality treatment through structural and non-structural best management practices (BMPs), minimize adverse impacts to the municipal stormwater drainage system and receiving waters and promote groundwater recharge where feasible through infiltration practices. Specifically, the system will be designed to infiltrate the first 1" of stormwater over the total post construction impervious area, remove 80% of Total Suspended Solids (TSS), remove 65% of the annual total phosphorus load, retain the difference in volume between the 25 year storm post construction runoff and the 2 year storm pre construction runoff, and reduce peak discharge rates in the post-development conditions in the 2, 10, 25, and 100 year 24 hour storm events.

Drainage design is contingent on the findings in a site-specific Geotechnical report, particularly soil composition and groundwater elevations. McPhail Associates will be preparing the geotechnical report which will be used as the basis for the design of the system and to confirm compliance with the City and State regulations.

4. Anticipated Impact on City of Cambridge Stormwater System

The proposed stormwater management system will result in an improvement over the existing conditions through the recharge of groundwater, reduction in flow rate and volume to the system in Birch Street, and treatment of runoff pollutants. Stormwater quality will be improved through deep sump catch basins and infiltration practices that provide removal of suspended solids and pollutants like Phosphorus prior to discharge.

Based on preliminary review, no off-site stormwater infrastructure improvements are anticipated to be required to support the proposed development as the volume and rate of flow of stormwater runoff from the site will be reduced for all storm events in the post development conditions. Additionally, the doghouse manhole connection will ensure that damage to the existing main is limited and that pipe downstream and upstream of the connection remains intact.

5. Conclusions: Special Permit Findings – Cambridge Zoning Ordinance §19.20

Section 19.20 of the Cambridge Zoning Ordinance requires the Planning Board to find that the proposed development will not result in undue adverse impacts on municipal systems and that adequate public services are available to support the project. Based on the information presented in this Stormwater Infrastructure Impact Narrative, the project satisfies the applicable findings of §19.20.

ACENTECH
ACOUSTICS TECHNOLOGY VIBRATION

1 April 2026

Hans D. Strauch, LEED AP
Principal
HDS Architecture
625 Mt. Auburn Street
Cambridge, MA 02138
hstrauch@hdsarchitecture.com

Subject: **Preliminary MEP Equipment Exterior Noise Assessment**
9 & 25 Birch Street & 30 Bay State Road, Cambridge, MA
Acentech Project Number J639320

Dear Hans:

This report presents our assessment of the exterior noise emitted from the preliminary selections of MEP equipment for your project located at 9 and 25 Birch Street and 30 Bay State Road in Cambridge, Massachusetts. We base this assessment on the drawings and equipment sound data that you sent to us on January 29, February 4, March 16, and March 17 of this year.

NOISE ORDINANCE

The Cambridge noise control ordinance limits noise levels at residential receivers in residential zones to 60 dBA during the daytime (7:00 am to 6:00 pm each day, except Sundays and holidays), and to 50 dBA during other times. The subject project's neighboring properties are residential and we believe that the zone is residential as well.

EQUIPMENT SOUND LEVELS

The following table lists the tag, basis of design, location, number, and total sound level of each type of equipment for the project.

Tag	Equipment BOD	Location	Number	Total Sound Level at 3.3 feet (dBA)
HP-A/B	Daikin RZA18 – 48AAVJU	Roof	85	78.3
HP-1	Daikin RXYA120AATJA / AAYDA	Roof	1	61.0
HP-2	Daikin REYA240AATJA / AAYDA	Ground	1	69.0
ERV-1,2	RenewAire HE 07, Standard EC Motor	Roof	2	47.0

ASSESSMENT AND RECOMMENDATIONS

1. Rooftop mechanical equipment: Our calculations indicate that the total attenuation due to distance loss and roof edge shielding, from the subject building's rooftop to a position 5 feet above the ground at the property line, will be approximately 35.6 dBA or more. Therefore, the total sound level emitted from the roof is expected to be no greater than 42.8 dBA, which complies with the noise control ordinance.

2. Ground-mounted mechanical equipment: HP-2 is shown on grade, within approximately 6 feet of the property line. Our calculations indicate that this piece of equipment will comply with the noise control ordinance so long as the wall along the property line is solid (i.e., no gaps between the wood slats) and tall enough to comfortably break the line of sight from HP-2 to the surrounding residential units, including those on upper levels. Furthermore, our calculations indicate that, given the wall height described above, this piece of equipment will be suitably quiet in the middle of the neighboring yard. If a shorter wall is preferred, or if greater attenuation is desired, then a modest acoustical enclosure can be provided for HP-2 easily enough.

In summary, presuming the standard acoustical coordination discussed above for ground-mounted mechanical equipment, **we expect the project to comply with the noise control ordinance**.

* * * * * *

This concludes our report. Please do not hesitate to call my cell phone (617-957-7560) with any questions.

Sincerely yours,

ACENTECH INCORPORATED

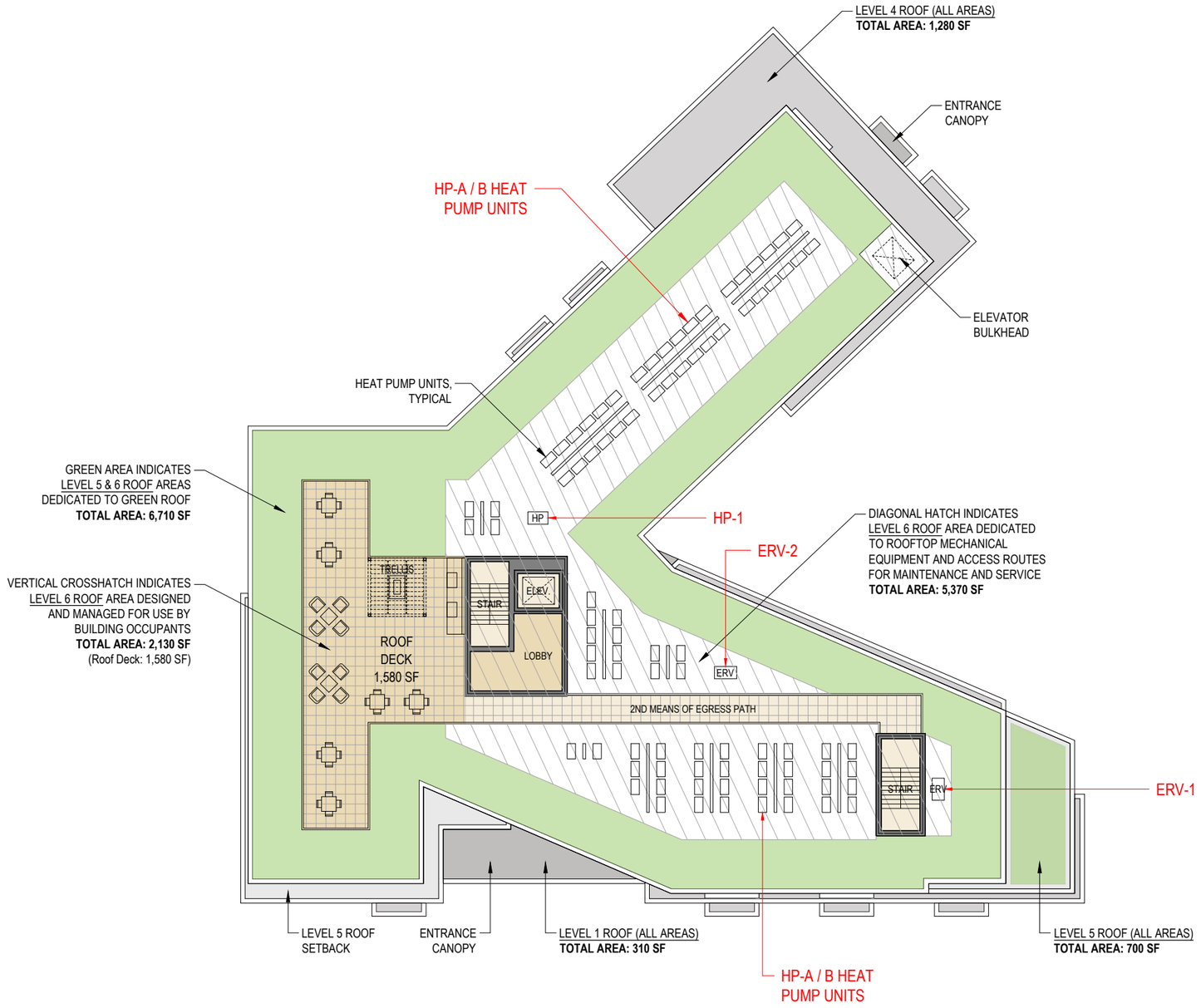
Thomas J. McGraw, LEED AP
Principal, Architectural Acoustics

9 & 25 Birch St & 30 - 36 Bay State Rd 1st Floor Exterior Mechanical Unit

Cambridge, MA | June 05, 2026

MDLA

HDS ARCHITECTURE
625 Mount Auburn Street, Cambridge, MA 02138
www.hdsarchitecture.com | 617.714.5870



9 & 25 Birch St & 30 - 36 Bay State Rd Roof-Top Mechanical Equipment

Cambridge, MA | June 05, 2026

MDLA
HDS ARCHITECTURE
625 Mount Auburn Street, Cambridge, MA 02138
www.hdsarchitecture.com | 617.714.5870

JUNE 21, 9AM

JUNE 21, NOON

JUNE 21, 3PM

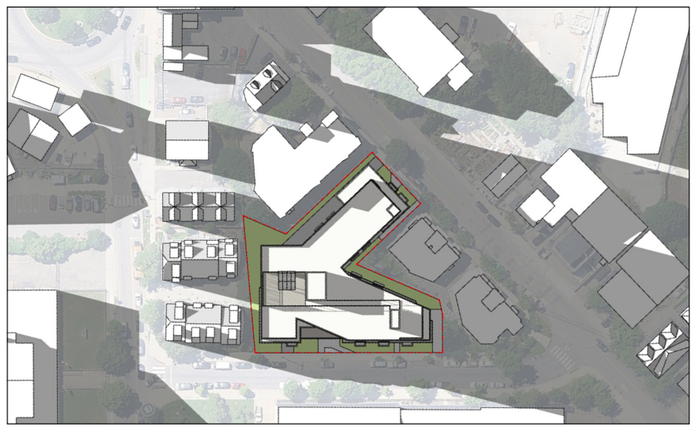
MARCH 21 & SEPTEMBER 21, 9AM

MARCH 21 & SEPTEMBER 21, NOON

MARCH 21 & SEPTEMBER 21, 3PM

DECEMBER 21, 9AM

DECEMBER 21, NOON



DECEMBER 21, 3PM

9 & 25 Birch Street & 30 - 36 Bay State Road

Shadow Study

Cambridge, MA | June 05, 2026

HDS ARCHITECTURE
625 Mount Auburn Street, Cambridge, MA 02138
www.hdsarchitecture.com | 617.714.5870

Flood Plain Documentation Narrative

This narrative has been prepared in support of a Special Permit Application for the residential building development at 9 & 25 Birch Street and 30-36 Bay State Road and documents the compliance with the City of Cambridge Flood Resilience Standards (Article 22.80 of the Zoning Ordinance) using the currently promulgated 2070 Long-Term Flood Elevations (LTFEs), expressed in the Cambridge City Base (CCB) datum.

1. Applicable Long-Term Flood Elevations

Based on data promulgated by the City Engineer and published on the Cambridge FloodViewer Map, the project site is subject the standards associated with the following projected flood elevations: 2070 10%-Probability Long-Term Flood Elevation (10%-LTFE) which designates areas with flood waters up to elevation 22.0 feet (CCB) and the 2070 1%-Probability Long-Term Flood Elevation (1%-LTFE) which designates areas with flood waters up elevation 23.2 feet (CCB). The Cambridge Resilience Standards require the occupiable floor space to be at or above the 10%-LTFE flood elevation and the habitable/livable floor areas to be at or above the 1%-LTFE flood elevation. The LTFE's reflect future flood risk projections associated with increased precipitation, sea level rise, and storm surge action in accordance with Section 22.83 of the Zoning Ordinance.

2. Building Design and Floor Elevations

The proposed building has been designed to meet or exceed the applicable flood resilience standards. All ground floor entrances to occupiable spaces are located at 22.0 feet (CCB), thereby meeting the 10%-LTFE protection standard in accordance with Section 22.84.1(a). All habitable/livable areas are located on floors 2-6 which will be above the 1%-LTFE elevation of 23.2 feet (CCB). Floor 2 is set at elevation 37.25', satisfying the 1%-LTFE protection standard pursuant to Section 22.84.1(b). Critical building systems associated with mechanical, electrical, plumbing, and life-safety equipment are located within the building and are required to be above the 1%-LTFE. All Critical equipment will be at elevation 23.2' which satisfies the requirement pe section 22.84.1(c).

Small entryways below the 10%-LTFE that consist solely of stairs which lead to protected areas of the building are designed to be recoverable per section 22.84.2. There is one stairwell entrance on the east side which will be at elevation 21.5'. This entrance is deemed recoverable as it will allow flood water to enter and exit without causing damage that cannot be readily repaired.

Preliminary approval of the building design and site elevations was given by Kara Falise, senior engineer of the DPW, on 03/31/2026.

3. Flood Protection and Resilience Strategy

The building is considered fully protected from flooding under Section 22.84.1 because all occupiable and habitable spaces are elevated above the applicable LTFE Flood elevations or are deemed recoverable. This eliminates the need for flood barriers or deployable protection at entry points and provides uninterrupted safe access during flood events. The proposed development is consistent with the intent and requirements of Article 22.80, which seeks to promote building designs that are resilient to projected future flood conditions. As a result, the project proactively addresses long-term flood risk and climate resilience. The required flood documentation, including elevations and cross-sections identifying the 10%-LTFE and 1%-LTFE, will be submitted to the Department of Public Works for administrative review in accordance with Section 22.85 prior to Building Permit issuance. The attached Flood Resistance Plan shows the building door elevations, floor profiles, and areas subject to the 10%-LTFE and 1%-LTFE.

CDD Determination for Special Permit submission

The Community Development Department (CDD) received the final update of the Green Building Report (GBR) for the Special Permit stage of 30 Bay State Rd and 9 & 25 Birch St, per Section 22.25.1 of the Zoning Ordinance, on 4/9/2026. CDD staff have reviewed the Report and provide the following Determination and Summary of Compliance.

CDD Determination: The documentation provided by the Applicant is adequate and demonstrates compliance with the Green Building Requirements applicable to the Special Permit stage.

Summary of Compliance:

- Rating System: Passive House – PHIUS CORE 2024
- Based on the documents submitted, the project is expected to achieve the minimum criteria for certification. The applicant is pursuing Passive House certification.
- Green Building Professional Affidavit Certification: Hans D. Strauch, LEED AP of HDS Architecture, Inc. has been identified as the Green Building Professional for the project. The affidavit states that this professional has reviewed all relevant documents for this project and confirms that those documents indicate that the project is designed to achieve the requirements of Section 22.24 under Article 22.000 of the Cambridge Zoning Ordinance.

Article 22 Green Building Report

9&25 Birch Street and 30-36 Bay State Road

Cambridge, MA

Prepared by: enviENERGY Studio
Date: April 7, 2026

Green Building Project Checklist

Green Building
Project Location: 9&25 Birch Street and 30-36 Bay State Road, Cambridge, MA

Applicant

Name: Seth Grady/ BSR Birch LLC
Address: 36 Bay State Road, Cambridge MA 02138
Contact Information
Email Address: sethgrady@aol.com
Telephone #: 617-429-5795

Project Information (select all that apply):

- ☒ New Construction – GFA: 91,585 s.f.
- ☐ 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: PHIUS CORE 2024
  - ☒ PHIUS+
  - ☐ Passivhaus Institut (PHI)
  - ☐ Other: _____
- ☐ Enterprise Green Communities – Version: _____

Project Phase

☐ SPECIAL PERMIT/

DEVELOPMENT REVIEW

Review Section 22.25.1 of the Cambridge Zoning Ordinance. Attach the supporting materials listed.

Required Submissions

All rating programs:

☐ Rating system checklist (Not Applicable)

☒ 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/ Development Review)

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Rating System Narrative

The Project is a new six-story, 85-unit residential building in Cambridge, MA, designed to achieve high-performance standards. Sustainability is a central priority for the development team, which has evaluated and implemented strategies to reduce energy and water consumption, extend the efficiency and service life of building systems and infrastructure, and minimize impacts on city services, the environment, and public health.

The project is subject to the City of Cambridge Article 22 and the Opt-In Specialized Code Passive House requirements. In accordance with Section 22.20 of the Zoning Ordinance, the project demonstrates compliance with the following:

- **22.23 Green Building Rating Programs:** Per Section 22.23.1, three programs are authorized - LEED, Passive House, and Enterprise Green Communities. The project will pursue Passive House certification (PHIUS CORE 2024) through the Passive House Institute US (PHIUS), thereby meeting this requirement. Please refer to the Passive House report on Page 6.
- **22.24.2 Green Commissioning:** The project team will engage a Commissioning Team to perform enhanced commissioning services, equivalent to LEED v4 Enhanced Commissioning, and consistent with Passive House verification procedures. The team will verify and document that all building systems and assemblies are planned, designed, installed, tested, and operated to meet the Green Commissioning requirements.
- **22.24.5 Flood Resilience:** Project complies with these requirements. Please refer to the Flood Plain Documentation Narrative.
- **22.24.6 Green Factor:** The project will comply with the requirements of Section 22.90 – Green Factor Standard. Please refer to the Green Factor report.

The project will pursue Passive House Certification under the PHIUS 2024 standard, underscoring its commitment to minimizing energy loads and optimizing indoor environmental quality for residents. This approach aligns with the City of Cambridge's and the Commonwealth of Massachusetts' broader decarbonization goals. Compliance with the Massachusetts Stretch and Specialized Energy Codes will be achieved through the all-electric and Certified Performance Standard pathways. As a Phius-certified building, the project will optimize energy performance while reducing stress on the local electricity grid during peak demand. Design features include continuous insulation with minimal thermal bridge, uninterrupted air sealing, and high-performance windows. Energy recovery ventilation will deliver filtered outdoor air to all living spaces, while cold-climate air-source heat pumps will provide efficient heating and cooling. The water heating system will be all-electric heat pump.

The enviENERGY Studio team, including two Certified Passive House Consultants (CPHCs), provide Passive House and sustainability consulting services, overseeing compliance with state and local codes, and ensuring that the client's sustainability goals are achieved. As design progresses, the project team will continue to work collaboratively by holding regular sustainability-focused design workshops to ensure sustainability goals are achieved during design and construction.

Passive House Feasibility Report

30-36 Bay State Road
Cambridge, MA

Prepared by: **enviENERGY Studio**

1. EXECUTIVE SUMMARY

enviENERGY Studio is providing Passive House Institute US (Phius) consulting services for the 30-36 Bay State Rd and Birch Road project. This study evaluates the project's compliance with the 2023/2025 Massachusetts Stretch Energy Code and the Specialized Opt-In Energy Code, utilizing the Certified Performance Standard pathway. The proposed project consists of a new, 6-story 91,585 square-foot multifamily building in Cambridge, Massachusetts. This analysis does not include the parking garage.

This project will meet all the requirements of Phius CORE 2024, which requires the design to comply with annual and peak heating and cooling load requirements, as well as limits on source energy usage and air infiltration. The building performance simulations were developed utilizing the provided Schematic Design drawings, mechanical equipment narratives, and the Phius 2024 Passive Building Standard Certified Guidebook v25.1.0.

The study and analysis presented in this report focus on aspects of the building envelope and mechanical equipment performance to enhance thermal comfort, mitigate moisture and condensation risk, lower annual and peak loads from heating and cooling, and reduce energy consumption by the proposed building.

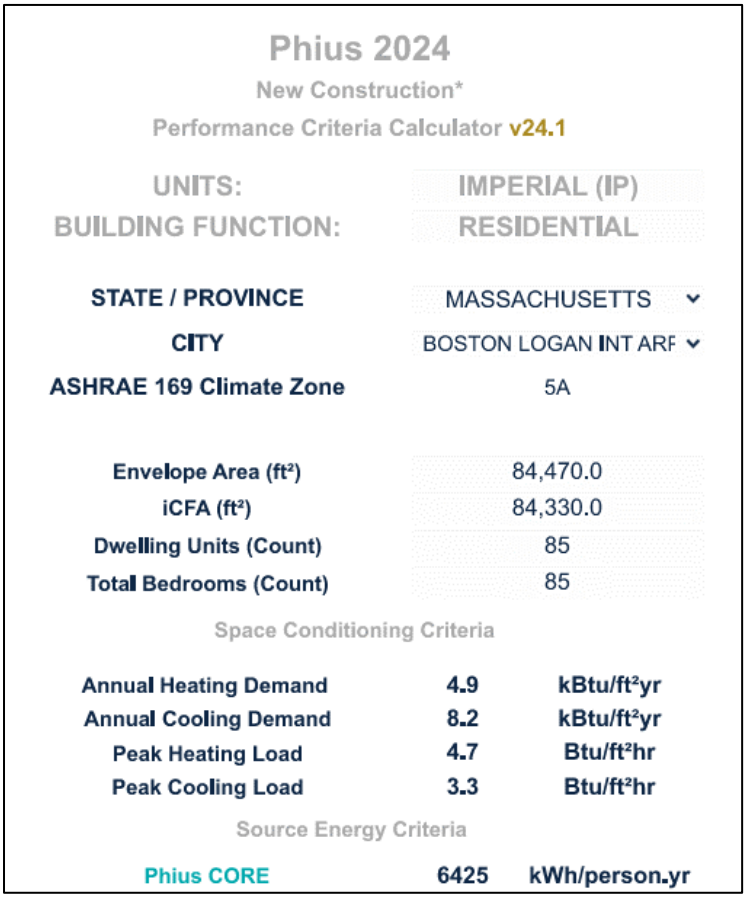
Table 1.1: Phius CORE 2024 Results Summary

30-36 Bay State Road			
Phius CORE 2024 Criteria	**Target**	**Specific**	**Margin (%)**
Heating Demand (kBtu/ft²yr)	**4.9**	4.52	**7.8%**
Cooling Demand (kBtu/ft²yr)	**8.2**	5.71	**30.4%**
Peak Heating Load (Btu/ft²hr)	**4.7**	4.05	**13.8%**
Peak Cooling Load (Btu/ft²hr)	**3.3**	3.05	**7.6%**
Source Energy (kWh/person.yr)	**6,425**	5,647	**12.1%**
Site Energy (kBtu/ft²yr)	*N/A*	19.4	
iCFA* (ft²)	*N/A*	84,330	

*iCFA = interior conditioned floor area, measured from the interior dimension of exterior walls.

Note: WUFI Passive is an envelope compliance tool rather than an energy estimation tool. This report's predicted energy use intensity (pEUI) does not necessarily represent actual building energy performance. Phius uses default values for interior lighting and miscellaneous equipment and do not align with the ASHRAE energy modeling procedures.

Figure 1.2: Phius CORE 2024 Performance Criteria Calculator



2. ENERGY MODELING ASSUMPTIONS AND APPROACH

Using the guidelines outlined in the Phius 2024 Passive Building Standard Certified Guidebook v25.1.0, the model was defined using the provided Schematic Design drawings, mechanical narratives and cut sheets. Design scenarios were modeled in accordance with Phius energy modeling protocol in Section 1.4.4 of the Guidebook, covering the building envelope, HVAC systems, domestic hot water (DHW) system, lighting, miscellaneous loads, and occupancy and equipment schedules. The proposed design scenarios represent a pathway to Phius CORE 2024 certification through energy conservation and peak load mitigation measures.

At this stage, a 5-10% buffer is recommended in all compliance criteria to hedge against future design modifications and the impact of thermal bridging, which is yet not captured in this study.

2.1 Building Envelope

The modeled building performance assumes a thermally robust and airtight envelope. The vertical elements of the envelope consist of steel-framed walls at the podium (first floor only) with wood-framed insulated walls on the upper floors. Ground level glazing consists primarily of storefront windows, while the upper levels feature a combination of fixed and casement windows. The tables below summarize the thermal performance of the proposed building envelope in compliance with Phius performance requirements. The estimated window-to-wall ratio and proposed U/R values are based on early design and massing plans. As the design progresses, the project team will continue to evaluate technologies and approaches to optimize the envelope performance.

Table 2-1: Exterior Opaque Assembly Performance

Exterior Envelope Component	30-36 Bay State Road
Roof	R-40 c.i. above deck
Exterior Walls	R-21 cavity + R-8.6 c.i. (podium and wood frame)
Exposed Floors	R-38 cavity (R-28 derated)
Slab on Grade	R-10 for 24” below + R-5 c.i. full slab

Table 2-2: Exterior Transparent Assembly Performance

Exterior Envelope Component	30-36 Bay State Road
Punch Windows (U-value / SHGC) *	U_w-0.17 (U-0.10 COG) / $SHGC_w$-0.12 (SHGC-0.23 COG)
Storefront (U-value / SHGC)	U_w-0.21 / $SHGC_w$-0.38
Entryways (U-value / SHGC)	U_w-0.56 / $SHGC_w$-0.33
WWR (%)	22.5%

*U_w-value and $SHGC_w$-value refer to the effective thermal resistance and solar heat gain when considering framing and other assembly components of the whole window. COG (Center of Glass) values do not include the effect of framing. Punch windows are modeled with Intus Supera CW Casement (W-101221) component-level performance data.

2.2 Building Airtightness

The Phius requirement for the maximum allowable air leakage rate of the building envelope is 0.06 CFM/ft^2 @ 50 Pascals (Pa). This is significantly lower than the Massachusetts Stretch Energy Code maximum rate of 0.23 CFM/ft^2 @ 50 Pa of pressure. Note that a 10%+ buffer has been captured in the WUFI Passive model for this feasibility study.

The detailed drawings will include a clear definition of the building's continuous air barrier, as well as individual details of all building component connections, penetrations, and window installations. To meet these stringent requirements, the design and construction team will ensure that all joints, penetrations, and openings are adequately taped or sealed. The Phius Verifier will conduct blower door testing at the end of construction to confirm the project's compliance with air leakage requirements.

2.3 Thermal Bridging

Thermal bridging was not accounted for in this feasibility study, as it is not required at this stage of modeling. However, the impact of thermal bridging will be included in the WUFI Passive model used for Design Certification through 2-D THERM analysis. Problematic thermal bridges can be mitigated with better-insulated and thermally broken constructions at critical junctions in the building envelope. If necessary, iterative design and modeling will be performed to optimize these building envelope connections and minimize the impact of unnecessary thermal bridging.

2.4 Occupancy

According to Section 1.3.4.2 of the Phius 2024 Guidebook v25.1.0, residential building loads and ventilation rates are established under the assumption that these systems will operate continuously. The peak occupancy density is calculated as the number of bedrooms plus one for residential spaces where studio apartments are counted as 0-bedroom units.

Table 2-3: Phius 2024 Occupancy Inputs

Category	30-36 Bay State Road
Design Occupancy	170
Number of Units	85
Number of Bedrooms*	85

** Studio units are counted as zero-bedroom units*

2.5 Internal Loads

Phius requires that the lighting and plug loads used in the WUFI Passive model be calculated using the Phius Multifamily Lighting & MEL (Miscellaneous Electric Loads) Calculator. The calculated values for interior and exterior lighting and MELs were then input into the model. All lighting is assumed to be LED, and common areas are assumed to have occupancy sensors. All equipment, such as washer machines, dryers, and dishwashers, assume the national average for ENERGY STAR-rated appliances. These values must be updated as equipment is specified for the project.

Table 2-4: Lighting and Plug Loads

Load Source	30-36 Bay State Rd
Interior Lighting	74,437 kWh/yr
Exterior Lighting	2,301 kWh/yr
MEL *(Misc. Electric Loads)*	92,184 kWh/yr

2.6 Setpoints

The setpoints are modeled to match the required temperature setpoints for Phius certification. Below are the modeled temperature setpoints.

Heating set point: 68 ˚F Cooling set point: 77 ˚F

2.7 Space Heating and Cooling

Heating and cooling equipment were modeled in accordance with cut sheets provided by the design team, which include DAIKIN mini splits for residential units and VRV Emerion for common spaces.

To model the proposed equipment in WUFI Passive, the Phius Heat Pump Performance Estimator v25.1.1 calculated the following weighted averages for all equipment efficiencies and capacities:

Table 2-5: WUFI Passive Cooling Equipment Inputs

Equipment Parameter (Cooling)	30-36 Bay State Rd
Modeled Cooling Capacity/System	623 kBtu/hr
Modeled Cooling COP	4.62
Number of Systems Needed	3

Table 2-6: WUFI Passive Heating Equipment Inputs

Equipment Parameter (Heating)	30-36 Bay State Rd
Rated COP (17˚F)	2.05
Rated COP (47˚F)	2.27

2.8 Mechanical Ventilation

The proposed energy recovery systems include centralized packaged rooftop ERUs, which distribute preconditioned air to the common areas, and unitary ERVs for each individual dwelling unit. Building ventilation rates at this stage were estimated based on Phius ventilation requirements for dwelling units in multifamily buildings and IMC 2021 minimum requirements for non-residential spaces. Note that the ventilation rates have been increased by 10% as a buffer to account for future design or tested penalties.

Table 2-7: Mechanical Ventilation Systems

ERV Specifications	Unitary ERVs*	Central ERUs**
Sensible Heat Recovery (%)	77% (1-bath) / 65% (2-bath)	75%
Latent Heat Recovery (%)	71% (1-bath) / 59% (2-bath)	50%
Fan Power (W/cfm)	0.8-0.9 W/cfm	1.58 W/cfm

*If HVI-certified ratings are less than the specified CFM, a deration of 12% has been applied to the sensible and latent energy recovery effectiveness at the HVI-rated airflow of 85 CFM.
**If no third-party verification data is available, a deration of 12% must be applied to energy recovery efficiencies.

Table 2-8: Ventilation Airflow

Unit Sizes	Model Input
1 Bathroom	85 CFM
2 Bathrooms	110 CFM

A 10% safety factor has been incorporated into ventilation rates to hedge again variance during verification. It is important to note that the total measured supply and exhaust airflows must be within 10% of each other. Additionally, the proposed ERV equipment must meet the following requirements for indoor air quality:

- Install MERV 8 filter on the supply intake ductwork (recommend MERV 13 or higher).
- Install MERV 8 filter on the exhaust ductwork.

2.9 Domestic Hot Water

The proposed domestic hot water systems will be unitary heat pump tanks per dwelling unit. The modeled efficiency is based on the Navien NWP500 65-gallon tank with a UEF (Uniform Energy Factor) of 4.03.

Table 2-9: DHW Systems

Design Scenario	Model Input
Unitary Heat Pump DHW	Unitary Storage Tanks (UEF 4.03)

In addition to the proposed DHW design, the following criteria must be met:

- Minimum of R-4 insulation on all DHW distribution pipes (R-8 recommended).
- Pass the EPA WaterSense Hot Water Delivery requirement; a maximum of 1.8 gallons of water stored in the longest run of DHW piping to the fixture for multifamily projects with individual water heaters.

2.11 DOE Zero Energy Ready Homes (ZERH)

Solar-Ready

Because this project will be all-electric with no fossil fuel usage, compliance with the Specialized Opt-in Code requirement to install on-site solar PV is not required. However, for Phius CORE 2024 certification, a project must comply with the DOE Zero Energy Ready Home Multifamily PV-Ready Checklist. This includes reserving 40% of the roof area for future solar photovoltaic (PV) installation, providing the necessary blocking for the future solar array, and marking its location in a design drawing.

Electric Vehicle-Ready

This project must also comply with the U.S. DOE Zero Energy Ready Home Multifamily EV-Ready Checklist. This requires 10% of the parking allocated to the residential building to be EV-ready and 10% of parking allocated for the full installation of Electric Vehicle Supply Equipment (EVSE).

2.12 ENERGY STAR Multifamily New Construction (MFNC)

This building must meet the co-requisite requirements for ENERGY STAR Multifamily New Construction (MFNC). This entails two potential pathways for compliance:

ASHRAE Path

If the project chooses to pursue the ASHRAE Path to compliance, the source energy requirement must be lowered by 15% from the threshold established by the Phius Performance Criteria Calculator without renewable energy. However, the proposed design does not meet the 15% reduction over the source energy requirement, so design changes would have to be made to meet this threshold.

ERI Path

If the project cannot meet the performance threshold of the ASHRAE Path, it may pursue the ERI Path. This requires each individual unit's HERS rating to be equivalent to the minimum requirements of the ENERGY STAR Multifamily Reference Design as assessed by an EPA-recognized Home Certification Organization (HCO).

Net Zero Narrative

Project Profile

Development Characteristics

Lot Area (sq.ft.):	24,755
Existing Land Use(s) and Gross Floor Area (sq.ft.), by Use:	Multiple existing buildings and parking lot
Proposed Land Use(s) and Gross Floor Area (sq.ft.), by Use:	Residential; 91,585 SF
Proposed Building Height(s) (ft. and stories):	69.8’
Proposed Dwelling Units:	85
Proposed Open Space (sq.ft.):	7,017 SF
Proposed Parking Spaces:	15
Proposed Bicycle Parking Spaces (Long-Term and Short-Term):	89

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:	N/A	***Seeking Certification?****	Yes	**No**	TBD
Rating Level:		***# of Points:***			

Enterprise Green Communities					
Rating System & Version:	N/A	***Seeking Certification?****	Yes	**No**	TBD
Rating Level:		***# of Points:***			

Passive House Institute US (PHIUS) or Passivhaus Institut (PHI)					
Rating System & Version:	PHIUS CORE 2024	***Seeking Certification?****	**Yes**	No	TBD

**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:

Roof:	*R-40 c.i. above deck*
Foundation:	*R-10 for 24" below + R-5 c.i. full slab*
Exterior Walls:	*R-21 cavity + R-8.6 c.i.*
Windows:	*Punch: U-0.17/SHGC-0.12* *Storefront: U-0.21/ SHGC-0.38*
Window-to-Wall Ratio:	*22.5%*
Other Components:	*Entryways: U-0.56/ SHGC-0.33*

Envelope Performance:

[Project Team Comment: Project is pursuing Passive House certification pathway for energy code compliance. There is no baseline to compare to. Additionally, Passive House envelope design is significantly better than IECC 2021 prescriptive requirements.]

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.

	Proposed		***Baseline***	
	Area (sf)	*U-value*	*Area (sf)*	*U-Value*
Window				
Wall				
Roof				

Envelope Commissioning Process:

Project pursues Passive House certification. Envelope review and verification are requirements of Passive House certification.

Building Mechanical Systems

Systems Descriptions:

Space Heating:	*High-efficiency mini split heat pump*
Space Cooling:	*High-efficiency mini split heat pump*
Heat Rejection:	*N/A*
Pumps & Auxiliary:	*N/A*
Ventilation:	*Central Energy Recovery system for common areas and unitary ERUs for residential units*
Domestic Hot Water:	*Unitary heat pump water heaters per residential units*
Interior Lighting:	*All LED and meets IECC 2021 requirements*
Exterior Lighting:	*LED and meets IECC 2021 requirements*
Other Equipment:	*All appliances will be Energy Star certified*

Systems Commissioning Process:

The project team will engage a Commissioning Team to perform enhanced commissioning services, equivalent to LEED v4 Enhanced Commissioning, and consistent with Passive House verification procedures. The team will verify and document that all building systems and assemblies are planned, designed, installed, tested, and operated to meet the Green 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 site has been previously developed . The selected site will provide access to public transportation, bicycle network and facilities.*
Building Orientation and Massing:	*The building orientation is largely dictated by the site and surrounding buildings; however, it has been optimized to the extent possible to reduce heating and cooling loads.*
Envelope Systems:	*The building envelope is designed to Passive House standards and incorporates continuous insulation and a highly airtight system.*
Mechanical Systems:	*All-electric building incorporating high-efficiency heat pump for heating and cooling and Energy Recovery Units (ERUS) for ventilation.*
Renewable Energy Systems:	*None*
District-Wide Energy Systems:	*N/A*
Other Systems:	*Project meets the EV charging requirements*

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 project team includes several Certified Passive House Consultants (CPHC), who will lead the sustainability efforts and initiatives throughout the design and construction process. Sustainable design and energy efficiency goals were established early and will be evaluated in each phase as the project develops. Strategies associated with the building envelope attributes, lighting design, thermal comfort ranges, plug and process loads, and operational parameters and their impact on the building energy performance were explored and discussed in an early-design WUFI model. An early design WUFI Passive model was developed and used as an interactive and dynamic platform to evaluate systems synergies and the various pathways for achieving the targeted heating and cooling load and demand and required performance improvements in the most cost-effective manner.

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.

Project is registered with Mass Save Passive House Incentives program.

Net Zero Scenario Transition

Describe the technical framework by which the project can be transitioned to net zero greenhouse gas emissions prior to 2050, 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:	*The building envelop will be designed and constructed to Passive House standards. High-performance and air-tight envelope.*	*The project envelope design is already in compliance with Net Zero Carbon goals.*
HVAC Systems:	*The building HVAC system will be all-electric, utilizing high-efficiency Heat Pump systems.*	*The current design is Zero Carbon Ready.*
Domestic Hot Water:	*The domestic hot water system will be all-electric high-efficiency heat pump system. Low-flow pluming fixtures will be used.*	*The current design is Zero Carbon Ready.*
Lighting:	*All LED light fixtures will be used throughout the building.*	*The current design is Zero Carbon Ready.*
Renewable Energy Systems:	*Due to limited roof area, on-site renewable system is not feasible.*	*Project will be Solar Ready*
Other Strategies:	*N/A*	*N/A*

Energy Systems 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 project is all-electric and extremely efficient.

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	Majority of roof area will be covered by mechanical equipment and therefore, no area will be available to study solar PV
Solar Hot Water:		X	
Ground-Source Heat Pumps (Geothermal):		X	Due to challenges with site-related logistics and feasibility, geothermal analysis will not be pursued.

Water-Source Heat Pumps:		X	Not ideal for Passive House project and this size building.
Air-Source Heat Pumps:	X		Basis of design
Non-Carbon-Fuel District Energy:		X	
Other Non-Carbon-Fuel Systems:		X	

Non-Carbon-Fuel Scenario

Project is all-electric and doesn't use any fossil fuel.

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.):	*16,560*
Unshaded Roof Area (sq. ft.):	*Majority of roof area will be occupied by mechanical equipment because project is all-electric.*
Structural Support:	*N/A*
Electrical Infrastructure:	*N/A*
Other Roof Appurtenances:	*N/A*
Solar-Ready Roof Area (sq. ft.):	*No enough area available on the roof.*
Capacity of Solar Array:	*N/A*
Financial Incentives:	*N/A*
Cost Feasibility:	*N/A*

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)				
Total Building Energy System Cost				

Project is all-electric and doesn't use any fossil fuel.

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.

This project will meet all the requirements of Phius CORE 2024, which requires the design to comply with annual and peak heating and cooling load requirements, as well as limits on source energy usage and air infiltration. The building performance simulations were developed utilizing the provided Schematic Design drawings, mechanical equipment narratives, and the Phius 2024 Passive Building Standard Certified Guidebook v25.1.0.

30-36 Bay State Road			
Phius CORE 2024 Criteria	**Target**	**Specific**	**Margin (%)**
Heating Demand (kBtu/ft²yr)	**4.9**	4.52	**7.8%**
Cooling Demand (kBtu/ft²yr)	**8.2**	5.71	**30.4%**
Peak Heating Load (Btu/ft²hr)	**4.7**	4.05	**13.8%**
Peak Cooling Load (Btu/ft²hr)	**3.3**	3.05	**7.6%**
Source Energy (kWh/person.yr)	**6,425**	5,647	**12.1%**
Site Energy (kBtu/ft²yr)	*N/A*	19.4	
iCFA* (ft²)	*N/A*	84,330	

*iCFA = interior conditioned floor area, measured from the interior dimension of exterior walls.

Note: WUFI Passive is an envelope compliance tool rather than an energy estimation tool. This report's predicted energy use intensity (pEUI) does not necessarily represent actual building energy performance. Phius uses default values for interior lighting and miscellaneous equipment and do not align with the ASHRAE energy modeling procedures.

Annual Projected Energy Consumption and Greenhouse Gas (GHG) Emissions

[Project Team Comment: Project is pursuing Passive House certification pathway for energy code compliance. There is no baseline to compare to. The basis of design is all-electric, utilizing high-performance systems and it is net zero carbon ready and therefore, no additional scenarios were studied.]

The preliminary energy modeling results should be shown in a concluding table format similar to what is shown on the next page. It should compare the "baseline building" (Massachusetts Stretch Energy Code) to the proposed design, as well as the "net zero" scenario projected by 2050 and described later in this narrative.

	Baseline Building		***Proposed Design***		***Future Net Zero Scenario***		***Non-Carbon-Fuel Scenario***	
	kWh or Therms	*% of Total*	*kWh or Therms*	*% of Total*	*kWh or Therms*	*% of Total*	*kWh or Therms*	*% of Total*
Space Heating								
Space Cooling								
Heat Rejection								
Pumps & Aux.								
Ventilation								
Domestic Hot Water								
Interior Lighting								
Exterior Lighting								
Misc. Equipment								
	$US, kBTU, kBTU/SF		*$US, kBTU, kBTU/SF*	*% Reduction from Baseline*	*$US, kBTU, kBTU/SF*	*% Reduction from Baseline*	*$US, kBTU, kBTU/SF*	*% Reduction from Baseline*
Site EUI								
Source EUI								
Total Energy Use								
Total Energy Cost								
	kWh or Therms	*% Total Energy*	*kWh or Therms*	*% Total Energy*	*kWh or Therms*	*% Total Energy*	*kWh or Therms*	*% Total Energy*
On-Site Renewable Energy Generation								
Off-Site Renewable Energy Generation								
	Tons CO_2 [/SF]		*Tons CO_2 [/SF]*	*% Reduction from Baseline*				
GHG Emissions								
GHG Emissions per SF								

It may be helpful to present this information in a chart or graph. The following page provides examples.

CITY OF CAMBRIDGE EMBODIED CARBON REPORTING TEMPLATE

City of Cambridge Zoning Ordinance Amendment to Section 22.25.1(c) of Article 22, entitled Sustainable Design and Development (Ordinance No. 2022-20), Section 7. Embodied Emissions:

"A whole building lifecycle analysis of the estimated emissions generated by the construction of the Green Building Project. The Assistant City Manager for Community Development shall promulgate regulations for how these estimated emissions are to be reported.

Such regulations shall include at minimum the required reporting of estimated lifecycle emissions generated by the use of major building materials, including but not limited to wood, concrete, steel, aluminum and glass, using embodied emissions modeling software and industry standards acceptable to CDD staff. This paragraph will become effective on the date of final promulgation of the regulations for Green Building Projects that have not yet completed the initial stage of administrative review by such date, and shall not impose a requirement on any building project that does not meet the standard threshold for project review special permit of 50,000 square feet or includes housing

Applicability: For Projects after date of final promulgation of regulations (01/01/2024)

Is this project subject to Green Building Requirements (Section 22.20)?	X Yes ☐ No
Does this project meet the threshold for Project Review special permit (Section 19.23)?	X Yes ☐ No
Is the gross floor area of this project 50,000 square feet or more?	X Yes ☐ No
Does this project exclude dwelling units?	☐ Yes X No

Complete this reporting template if the answer is "Yes" to ALL of the above

Appendix

Affidavit

WUFI Passive Verification Report

Affidavit Form for Green Building Professional Special Permit/Development Review

Green Building
Project Location: 9 & 25 Birch Street and 30-36 Bay State Road, Cambridge MA

Green Building Professional

Name: Hans D. Strauch, LEED AP

☒ Architect
☐ Engineer

License Number: 5747
Company: HDS Architecture, Inc.
Address: 625 Mount Auburn Street, Cambridge MA 02138
Contact Information
Email Address: hstrauch@hdsarchitecture.com
Telephone Number: 617-714-5870

I, Hans D. Strauch, 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.

Hans D. Strauch 2/27/26

(Signature) *(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.

phius certified consultant

Elizabeth Venuti

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.

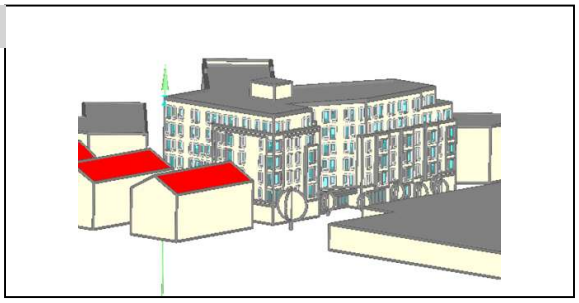
Buildings designed, modeled and constructed to meet the Phius standards are ultra-efficient and characterized by superior indoor air quality, thermal comfort, resilience and durability.

117608	06/03/24	06/04/27
Phius ID	Date Issued	Valid Through

Executive Director

BUILDING INFORMATION

Category:	**Residential**
Status:	**In planning**
Building type:	**New construction**
Year of construction:	
Units:	**85**
Number of occupants:	**170 (Design)**
Occupant density:	**496.1** ft²/Person



Boundary conditions

Climate:	**BOSTON LOGAN INT ARPT MA**
Internal heat gains:	**1.3** Btu/hr ft²
Interior temperature:	**68** °F
Overheat temperature:	**77** °F

Building geometry

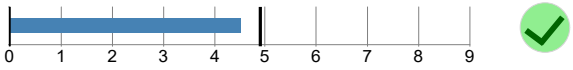
Enclosed volume:	**1,033,822.4** ft³
Net-volume:	**785,705** ft³
Total area envelope:	**84,470.4** ft²
Area/Volume Ratio:	**0.1** 1/ft
Floor area:	**84,330** ft²
Envelope area/iCFA:	**1.002**

PASSIVEHOUSE REQUIREMENTS

Certificate criteria: **Phius CORE 2021**

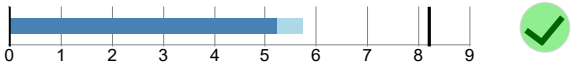
Heating demand

specific:	**4.52** kBtu/ft²yr
target:	**4.9** kBtu/ft²yr
total:	381,499.01 kBtu/yr



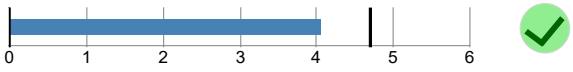
Cooling demand

sensible:	**5.22** kBtu/ft²yr
latent:	**0.49** kBtu/ft²yr
specific:	**5.71** kBtu/ft²yr
target:	**8.2** kBtu/ft²yr
total:	481,870.34 kBtu/yr



Heating load

specific:	**4.05** Btu/hr ft²
target:	**4.7** Btu/hr ft²
total:	341,228.21 Btu/hr



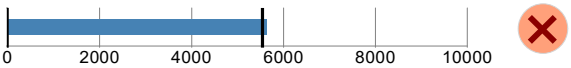
Cooling load

specific:	**3.05** Btu/hr ft²
target:	**3.3** Btu/hr ft²
total:	257,236.57 Btu/hr

WUFI Passive software has not been updated to reflect Phius 2024 Source Energy criteria. The actual target is **6,425** kWh/Person, as indicated in the Performance Criteria Calculator.

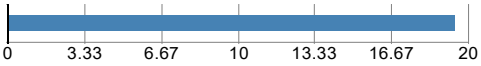
Source energy

total:	**959,985.93**	kWh/yr
specific:	**5,647**	kWh/Person yr
target:	**5,525**	kWh/Person yr
total:	**3,275,284.66**	kBtu/yr
specific:	38.84	kBtu/ft²yr



Site energy

total:	1,637,642.33	kBtu/yr
specific:	19.42	kBtu/ft²yr
total:	479,992.97	kWh/yr
specific:	5.69	kWh/ft²



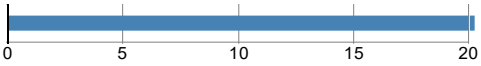
A 10%+ air tightness buffer is modeled as a safety factor for early stage modeling.

Air tightness

ACH50:	**0.52**	1/hr
CFM50 per envelope area:	**0.08**	cfm/ft²
target:	**0.39**	1/hr
target CFM50:	**0.06**	cfm/ft²

PASSIVEHOUSE RECOMMENDATIONS

Sensible recovery efficiency:	**73.7**	%
Frequency of overheating: Cooling system is required	**47.4**	%



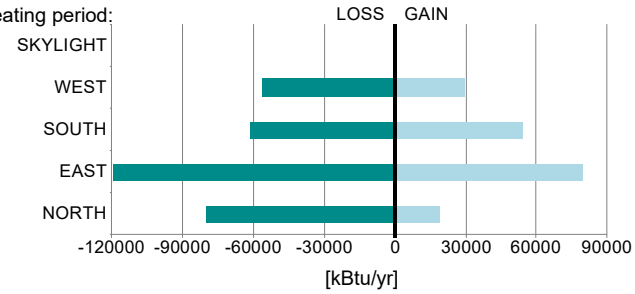
Frequency of overheating only applies if there is not a [properly sized] cooling system installed.

BUILDING ELEMENTS

Windows

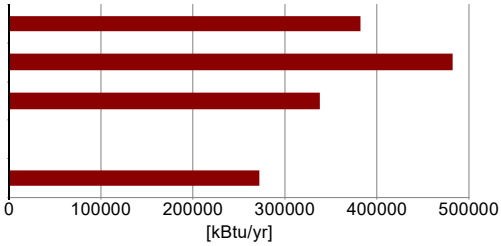
Average SHGC:	**0.24**	
Average solar reduction factor heating:	**0.45**	
Average solar reduction factor cooling:	**0.48**	
Average U-value:	**0.176**	Btu/hr ft² °F
Total glazing area:	**10,028.4**	ft²
Total window area:	**12,775.2**	ft²

Heat gain/loss heating period:



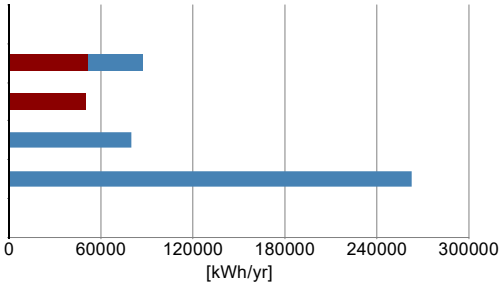
HVAC

Total heating demand:	**381,499**	kBtu/yr
Total cooling demand:	**481,870**	kBtu/yr
Total DHW energy demand:	**337,721**	kBtu/yr
Solar DHW contribution:	**0**	kBtu/yr
Auxiliary electricity:	**272,814**	kBtu/yr



Electricity

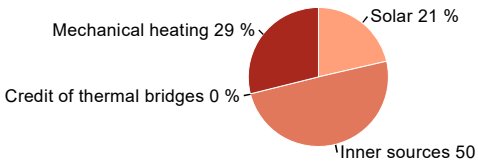
Direct heating / DHW:	**0**	kWh/yr
Heatpump heating:	**87,271**	kWh/yr
Cooling:	**49,650**	kWh/yr
HVAC auxiliary energy:	**79,962**	kWh/yr
Appliances:	**263,110**	kWh/yr
Renewable generation, coincident production and use:	**0**	kWh/yr
Total electricity demand:	**479,993**	kWh/yr



HEAT FLOW - HEATING PERIOD

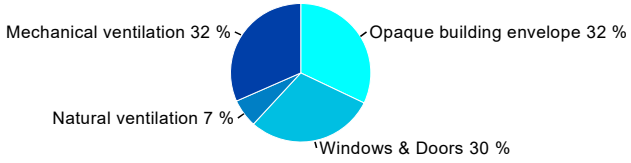
Heat gains

Solar:	**242,483**	kBtu/yr
Inner sources:	**564,802**	kBtu/yr
Credit of thermal bridges:	**0**	kBtu/yr
Mechanical heating:	**381,499**	kBtu/yr



Heat losses

Opaque building envelope:	**382,494**	kBtu/yr
Windows & Doors:	**351,148**	kBtu/yr
Natural ventilation:	**78,577**	kBtu/yr
Mechanical ventilation:	**376,566**	kBtu/yr

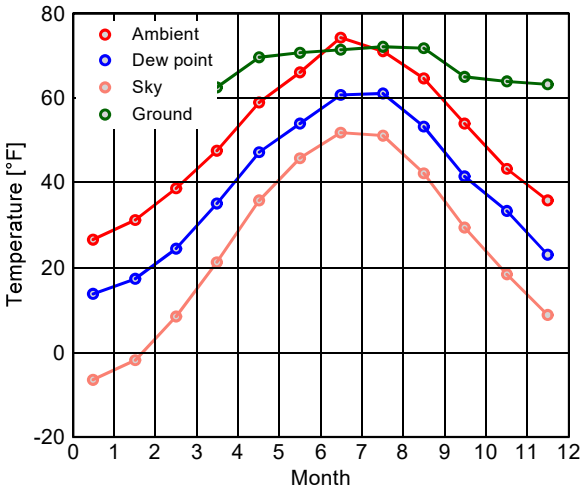


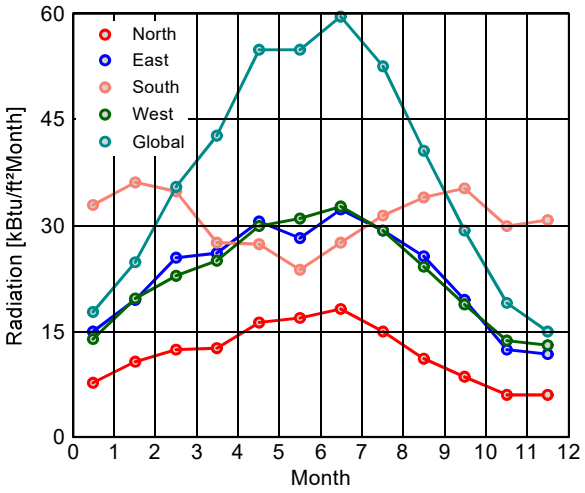
CLIMATE

Latitude:	**42.4**	°
Longitude:	**-71**	°
Elevation of weather station:	**19.7**	ft
Elevation of building site:	**11**	ft
Heat capacity air:	**0.018**	Btu/ft³F
Daily temperature swing summer:	**14.8**	°F
Average wind speed:	**13.1**	ft/s

Ground

Average ground surface temperature:	**52.8**	°F
Amplitude ground surface temperature:	**55.8**	°F
Ground thermal conductivity:	**1.2**	Btu/hr ft °F
Ground heat capacity:	**29.8**	Btu/ft³F
Depth below grade of groundwater:	**9.8**	ft
Flow rate groundwater:	**0.2**	ft/d





Calculation parameters

Length of heating period	**243**	days/yr
Heating degree hours	**141**	kFh/a
Phase shift months	**1.1**	mths
Time constant heating demand	**106**	hr
Time constant cooling demand	**0**	hr
Time constant cooling demand with night ventilation	**0**	hr

Climate for	Heating load 1	Heating load 2	Cooling
Temperature [°F]	16.9	31.6	83.5
Solar radiation North [Btu/hr ft²]	12	7.9	27.6
Solar radiation East [Btu/hr ft²]	22.8	13.3	61.5
Solar radiation South [Btu/hr ft²]	49.5	27.3	41.8
Solar radiation West [Btu/hr ft²]	22.2	11.4	53.3
Solar radiation Global [Btu/hr ft²]	26.9	16.5	101.4

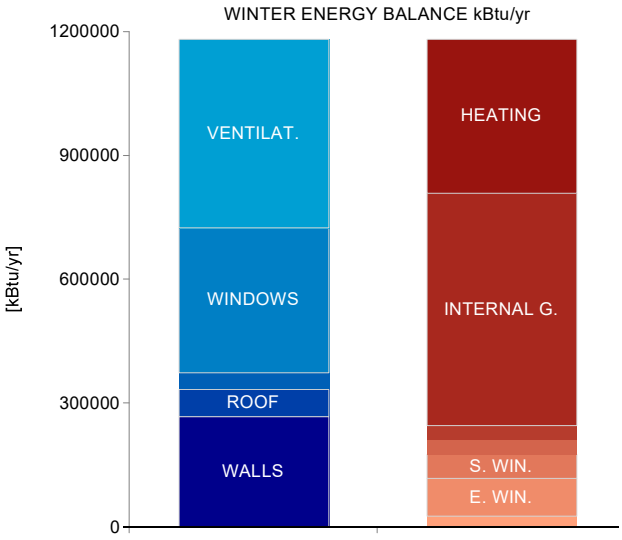
Relevant boundary conditions for heating load calculation: Heating load 1

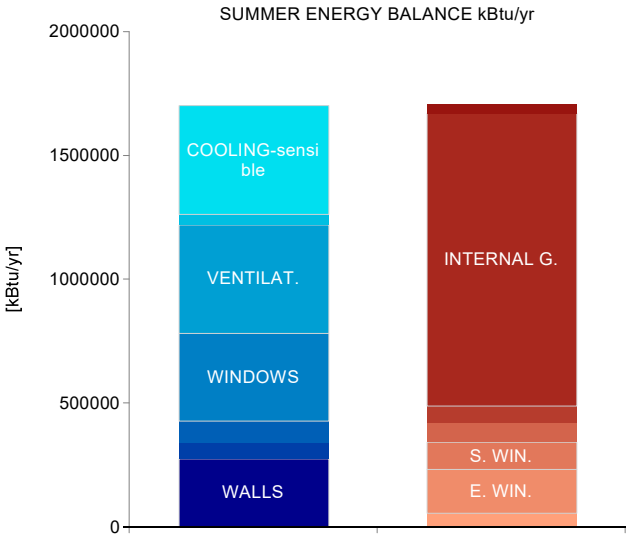
ANNUAL HEAT DEMAND

Transmission losses :	**733,642**	kBtu/yr
Ventilation losses:	**455,143**	kBtu/yr
Total heat losses:	**1,188,784**	kBtu/yr
Solar heat gains:	**282,304**	kBtu/yr
Internal heat gains:	**657,555**	kBtu/yr
Total heat gains:	**939,859**	kBtu/yr
Utilization factor:	**85.9**	%
Useful heat gains:	**807,285**	kBtu/yr
Annual heat demand:	**381,499**	kBtu/yr
Specific annual heat demand:	**4,524.3**	Btu/ft²yr

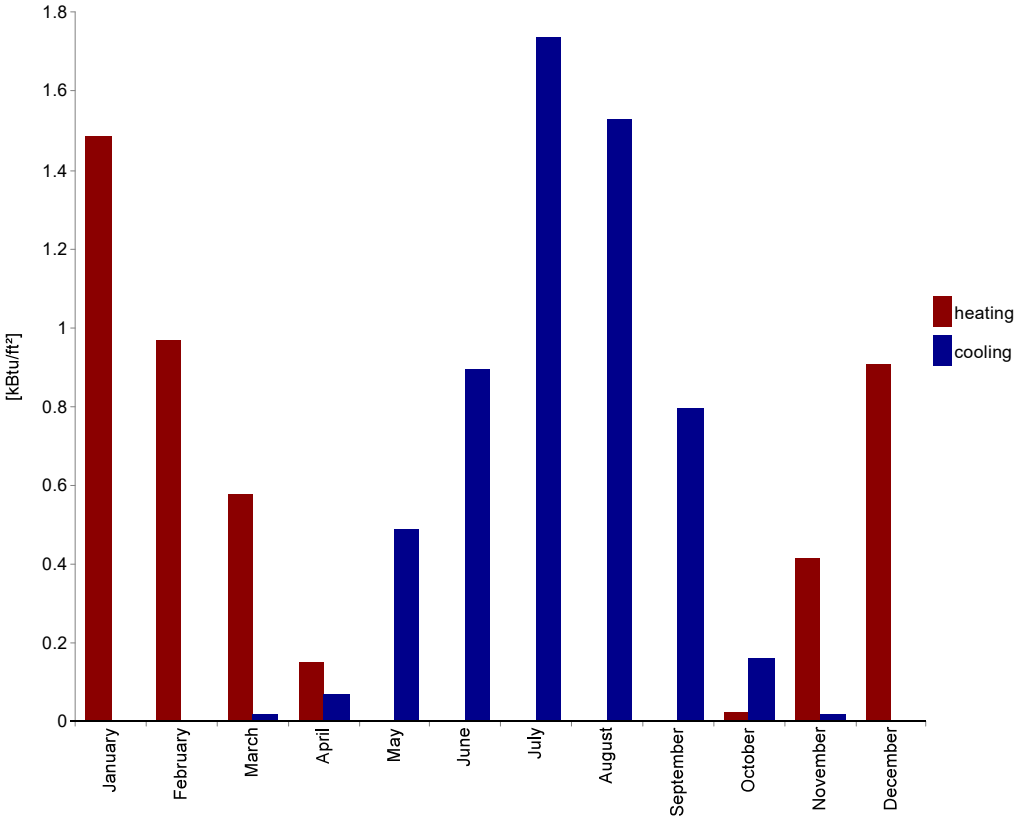
ANNUAL COOLING DEMAND

Solar heat gains:	**482,335**	kBtu/yr
Internal heat gains:	**1,183,112**	kBtu/yr
Total heat gains:	**1,665,448**	kBtu/yr
Transmission losses :	**1,191,684**	kBtu/yr
Ventilation losses:	**659,306**	kBtu/yr
Total heat losses:	**1,850,990**	kBtu/yr
Utilization factor:	**66.2**	%
Useful heat losses:	**1,225,208**	kBtu/yr
Cooling demand - sensible:	**440,240**	kBtu/yr
Cooling demand - latent:	**41,631**	kBtu/yr
Annual cooling demand:	**481,870**	kBtu/yr
Specific annual cooling demand:	**5.7**	kBtu/ft²yr





SPECIFIC HEAT/COOLING DEMAND MONTHLY



Month	Heating [kBtu/ft²]	Cooling [kBtu/ft²]
January	1.5	0
February	1	0
March	0.6	0
April	0.1	0.1
May	0	0.5
June	0	0.9
July	0	1.7
August	0	1.5
September	0	0.8
October	0	0.2
November	0.4	0
December	0.9	0

HEATING LOAD

	First climate	Second climate
Transmission heat losses:	**234,887** Btu/hr	**169,554.4** Btu/hr
Ventilation heat losses:	**187,180.6** Btu/hr	**133,105.2** Btu/hr
Total heat loss:	**422,067.6** Btu/hr	**302,659.6** Btu/hr
Solar heat gain:	**38,067.4** Btu/hr	**21,328.1** Btu/hr
Internal heat gain:	**42,771.9** Btu/hr	**42,771.9** Btu/hr
Total heat gains heating:	**80,839.3** Btu/hr	**64,100** Btu/hr
Heating load:	**341,228.2** Btu/hr	**238,559.6** Btu/hr

Relevant heating load: **341,228.2** Btu/hr

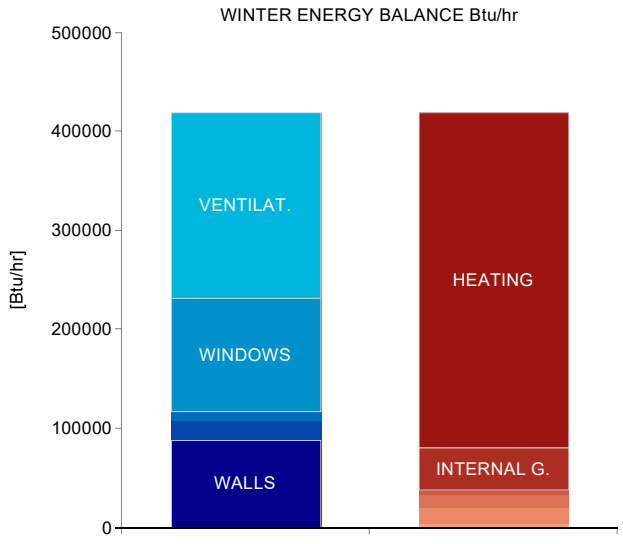
Specific heating load: **4** Btu/hr ft²

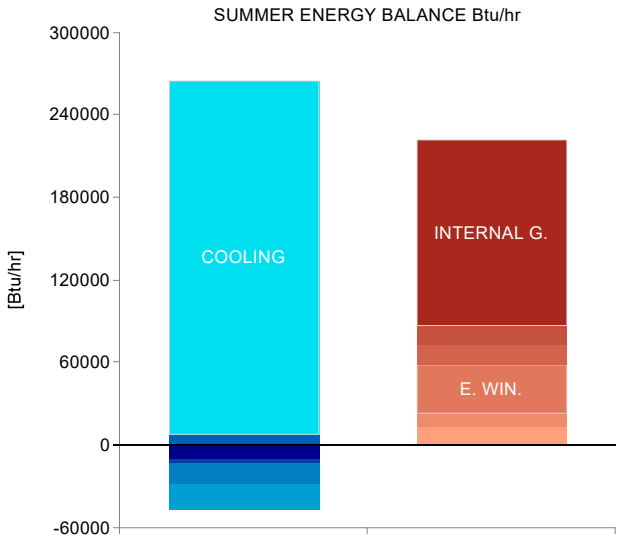
COOLING LOAD

Solar heat gain:	**86,930.7** Btu/hr
Internal heat gain:	**135,071.8** Btu/hr
Total heat gains cooling:	**222,002.4** Btu/hr
Transmission heat losses:	**-16,293.8** Btu/hr
Ventilation heat losses:	**-18,940.3** Btu/hr
Total heat loss:	**-35,234.1** Btu/hr
Cooling load - sensible:	**257,236.6** Btu/hr
Cooling load - latent:	**0** Btu/hr

Relevant cooling load: **257,236.6** Btu/hr

Specific maximum cooling load: **3.1** Btu/hr ft²





AREAS

Name	Area [ft²]	Average U-value [Btu/hr ft² °F]	Absorption coefficient	Emission coefficient	Reduction factor shading [%]	Transmission losses heating [kBtu/yr]	Transmission losses cooling [kBtu/yr]
VC.1: Exposed Floor: Horizontal (22 ft², width 10.189 ft)	22	0.033	0.4	0.9	100	114	174.6
VC.1: Exposed Floor: Horizontal (22 ft², width 4.12 ft)	22	0.033	0.4	0.9	100	114	174.6
VC.1: Exposed Floor: Horizontal (69.62 ft², width 16.112 ft)	69.6	0.033	0.4	0.9	100	360.9	552.6
VC.1: Exposed Floor: Horizontal (22 ft², width 4.12 ft)	22	0.033	0.4	0.9	100	114	174.6
VC.1: Exposed Floor: Horizontal (62.83 ft², width 10.754 ft)	62.8	0.033	0.4	0.9	100	325.7	498.7
VC.1: Exposed Floor: Horizontal (19.05 ft², width 9.552 ft)	19	0.033	0.4	0.9	100	98.7	151.2
VC.1: Exposed Floor: Horizontal (6538.69 ft², width 114.857 ft)	6538.7	0.033	0.4	0.9	100	33895.3	51899.1
VC.1: Exposed Floor: Horizontal (22 ft², width 10.189 ft)	22	0.033	0.4	0.9	100	114	174.6
VC.1: Exposed Floor: Horizontal (22 ft², width 7.537 ft)	22	0.033	0.4	0.9	100	114	174.6
VC.1: Exposed Floor: Horizontal (22 ft², width 7.537 ft)	22	0.033	0.4	0.9	100	114	174.6
VC.1: Exposed Floor: Horizontal (1101.77 ft², width 42.002 ft)	1101.8	0.033	0.4	0.9	100	5711.4	8745
VC.2: Roof: Horizontal (190.55 ft², width 61.5 ft)	190.6	0.024	0.4	0.9	100	711.8	1089.9
VC.2: Roof: Horizontal (304.58 ft², width 51.056 ft)	304.6	0.024	0.4	0.9	100	1137.8	1742.1
VC.2: Roof: Horizontal (11.03 ft², width 32.515 ft)	11	0.024	0.4	0.9	100	41.2	63.1
VC.2: Roof: Horizontal (1071.71 ft², width 65.309 ft)	1071.7	0.024	0.4	0.9	100	4003.5	6129.9
VC.2: Roof: Horizontal (22.16 ft², width 9.618 ft)	22.2	0.024	0.4	0.9	100	82.8	126.8
VC.2: Roof: Horizontal (340 ft², width 25.975 ft)	340	0.024	0.4	0.9	100	1270.1	1944.7
VC.2: Roof: Horizontal (13958.95 ft², width 160.594 ft)	13959	0.024	0.4	0.9	100	52145	79842.2
VC.2: Roof: Horizontal (457.48 ft², width 67.906 ft)	457.5	0.024	0.4	0.9	100	1708.9	2616.7
VC.2: Roof: Horizontal (508.39 ft², width 38.862 ft)	508.4	0.024	0.4	0.9	100	1899.1	2907.9
VC.2: Roof: Horizontal (22 ft², width 4.12 ft)	22	0.024	0.4	0.9	100	82.2	125.8
VC.2: Roof: Horizontal (22 ft², width 4.12 ft)	22	0.024	0.4	0.9	100	82.2	125.8
VC.2: Roof: Horizontal (2.78 ft², width 3.903 ft)	2.8	0.024	0.4	0.9	100	10.4	15.9
VC.2: Roof: Horizontal (5.06 ft², width 10.182 ft)	5.1	0.024	0.4	0.9	100	18.9	28.9
VC.2: Roof: Horizontal (3.87 ft², width 4.159 ft)	3.9	0.024	0.4	0.9	100	14.5	22.2
VC.2: Roof: Horizontal (175.5 ft², width 17.502 ft)	175.5	0.024	0.4	0.9	100	655.6	1003.8
VC.2: Roof: Horizontal (22 ft², width 4.12 ft)	22	0.024	0.4	0.9	100	82.2	125.8
VC.2: Roof: Horizontal (12.64 ft², width 12.006 ft)	12.6	0.024	0.4	0.9	100	47.2	72.3
VC.2: Roof: Horizontal (1.39 ft², width 1.144 ft)	1.4	0.024	0.4	0.9	100	5.2	7.9
VC.2: Roof: Horizontal (22 ft², width 4.12 ft)	22	0.024	0.4	0.9	100	82.2	125.8
VC.2: Roof: Horizontal (11.44 ft², width 18.519 ft)	11.4	0.024	0.4	0.9	100	42.8	65.5
VC.2: Roof: Horizontal (22 ft², width 7.537 ft)	22	0.024	0.4	0.9	100	82.2	125.8
VC.2: Roof: Horizontal (14.33 ft², width 36.61 ft)	14.3	0.024	0.4	0.9	100	53.5	82
VC.3: Slab-on-Grade: Horizontal (8999.62 ft², width 155.522 ft)	8999.6	0.154	0	0	0	40398.8	128652.6
VC.3: Slab-on-Grade: Horizontal (81.95 ft², width 12.289 ft)	82	0.154	0	0	0	367.9	1171.5
VC.3: Slab-on-Grade: Horizontal (79.88 ft², width 11.188 ft)	79.9	0.154	0	0	0	358.6	1142
VC.4: Elevator Pit BG Walls: SE (A122.1°, 9.83 ft², width 9.83 ft)	9.8	0.105	0	0	0	30.2	96
VC.4: Elevator Pit BG Walls: SW (A212.1°, 8.34 ft², width 8.337 ft)	8.3	0.105	0	0	0	25.6	81.4
VC.4: Elevator Pit BG Walls: NW (A302.1°, 9.83 ft², width 9.83 ft)	9.8	0.105	0	0	0	30.2	96
VC.4: Elevator Pit BG Walls: NE (A32.1°, 8.34 ft², width 8.337 ft)	8.3	0.105	0	0	0	25.6	81.4
VC.4: Elevator Pit BG Walls: East (A78.7°, 8.17 ft², width 8.173 ft)	8.2	0.105	0	0	0	25.1	79.8
VC.4: Elevator Pit BG Walls: South (A168.7°, 9.77 ft², width 9.774 ft)	9.8	0.105	0	0	0	30	95.5
VC.4: Elevator Pit BG Walls: West (A258.7°, 8.17 ft², width 8.173 ft)	8.2	0.105	0	0	0	25.1	79.8
VC.4: Elevator Pit BG Walls: North (A348.7°, 9.77 ft², width 9.774 ft)	9.8	0.105	0	0	0	30	95.5
VC.5: Wall to Garage: SW (A212.2°, 499.87 ft², width 42.846 ft)	499.9	0.054	0	0	0	4011	6141.5
VC.5: Wall to Garage: SW (A212.2°, 424.98 ft², width 36.427 ft)	425	0.054	0	0	0	3410.2	5221.5
VC.5: Wall to Garage: NW (A302.1°, 68.06 ft², width 5.833 ft)	68.1	0.054	0	0	0	546.1	836.2
VC.6: Floor Over Trash Room: Horizontal (116.43 ft², width 16.927 ft)	116.4	0.032	0	0	0	559.7	857
VC.7: Wall to Trash Room: NE (A32.1°, 157.75 ft², width 13.521 ft)	157.7	0.054	0	0	0	1265.8	1938.2
VC.8: Podium Walls: NE (A32.1°, 70 ft², width 6 ft)	70	0.056	0.4	0.9	100	608	931

Transmission heat losses - areas (continue)

Name	Area [ft²]	Average U-value [Btu/hr ft² °F]	Absorption coefficient	Emission coefficient	Reduction factor shading [%]	Transmission losses heating [kBtu/yr]	Transmission losses cooling [kBtu/yr]
VC.8: Podium Walls: NW (A302.1°, 84.2 ft², width 40.417 ft)	84.2	0.056	0.4	0.9	100	731.4	1119.9
VC.8: Podium Walls: South (A168.7°, 27.08 ft², width 13 ft)	27.1	0.056	0.4	0.9	100	235.3	360.2
VC.8: Podium Walls: North (A348.7°, 23.96 ft², width 11.5 ft)	24	0.056	0.4	0.9	100	208.1	318.6
VC.8: Podium Walls: East (A78.7°, 65 ft², width 6.5 ft)	65	0.056	0.4	0.9	100	564.6	864.5
VC.8: Podium Walls: South (A168.7°, 41.25 ft², width 3 ft)	41.2	0.056	0.4	0.9	100	358.3	548.6
VC.8: Podium Walls: North (A348.7°, 55.7 ft², width 4.051 ft)	55.7	0.056	0.4	0.9	100	483.8	740.8
VC.8: Podium Walls: NW (A325.4°, 23.37 ft², width 11.215 ft)	23.4	0.056	0.4	0.9	100	203	310.8
VC.8: Podium Walls: NW (A302.1°, 4.17 ft², width 2 ft)	4.2	0.056	0.4	0.9	100	36.2	55.4
VC.8: Podium Walls: NE (A32.1°, 8.46 ft², width 4.061 ft)	8.5	0.056	0.4	0.9	100	73.5	112.5
VC.8: Podium Walls: SE (A122.1°, 40.63 ft², width 19.5 ft)	40.6	0.056	0.4	0.9	100	352.9	540.3
VC.8: Podium Walls: SE (A122.1°, 60.76 ft², width 29.167 ft)	60.8	0.056	0.4	0.9	100	527.8	808.2
VC.8: Podium Walls: SE (A122.1°, 377.76 ft², width 58.833 ft)	377.8	0.056	0.4	0.9	100	3281.4	5024.3
VC.8: Podium Walls: SE (A122.1°, 104.08 ft², width 24 ft)	104.1	0.056	0.4	0.9	100	904.1	1384.3
VC.8: Podium Walls: SW (A212.1°, 148.87 ft², width 12 ft)	148.9	0.056	0.4	0.9	100	1293.1	1979.9
VC.8: Podium Walls: SE (A145.4°, 61.86 ft², width 29.69 ft)	61.9	0.056	0.4	0.9	100	537.3	822.7
VC.8: Podium Walls: SE (A122.1°, 100.23 ft², width 18.549 ft)	100.2	0.056	0.4	0.9	100	870.7	1333.1
VC.8: Podium Walls: SE (A122.1°, 28.61 ft², width 13.731 ft)	28.6	0.056	0.4	0.9	100	248.5	380.5
VC.8: Podium Walls: NE (A32.1°, 33.33 ft², width 16 ft)	33.3	0.056	0.4	0.9	100	289.5	443.3
VC.8: Podium Walls: SE (A122.1°, 7.29 ft², width 3.5 ft)	7.3	0.056	0.4	0.9	100	63.3	97
VC.8: Podium Walls: NE (A32.1°, 60.42 ft², width 29 ft)	60.4	0.056	0.4	0.9	100	524.8	803.5
VC.8: Podium Walls: NW (A325.4°, 31.76 ft², width 15.243 ft)	31.8	0.056	0.4	0.9	100	275.8	422.4
VC.8: Podium Walls: NE (A32.1°, 4.54 ft², width 2.178 ft)	4.5	0.056	0.4	0.9	100	39.4	60.3
VC.8: Podium Walls: NW (A325.4°, 330.06 ft², width 24.004 ft)	330.1	0.056	0.4	0.9	100	2867	4389.8
VC.8: Podium Walls: NW (A325.4°, 307.08 ft², width 24 ft)	307.1	0.056	0.4	0.9	100	2667.4	4084.2
VC.8: Podium Walls: NW (A325.4°, 223.01 ft², width 17.886 ft)	223	0.056	0.4	0.9	100	1937.2	2966.1
VC.8: Podium Walls: East (A78.7°, 689.79 ft², width 53.5 ft)	689.8	0.056	0.4	0.9	100	5991.7	9174.3
VC.8: Podium Walls: East (A78.7°, 445.14 ft², width 36.667 ft)	445.1	0.056	0.4	0.9	100	3866.6	5920.4
VC.8: Podium Walls: North (A348.7°, 354.93 ft², width 48.167 ft)	354.9	0.056	0.4	0.9	100	3083	4720.6
VC.8: Podium Walls: West (A258.7°, 65 ft², width 6.5 ft)	65	0.056	0.4	0.9	100	564.6	864.5
VC.8: Podium Walls: North (A348.7°, 16.78 ft², width 9.667 ft)	16.8	0.056	0.4	0.9	100	145.7	223.1
VC.8: Podium Walls: West (A258.7°, 95.57 ft², width 45.875 ft)	95.6	0.056	0.4	0.9	100	830.2	1271.1
VC.8: Podium Walls: West (A258.7°, 23.87 ft², width 11.458 ft)	23.9	0.056	0.4	0.9	100	207.4	317.5
VC.8: Podium Walls: West (A258.7°, 10.42 ft², width 5 ft)	10.4	0.056	0.4	0.9	100	90.5	138.5
VC.8: Podium Walls: West (A258.7°, 40.07 ft², width 19.235 ft)	40.1	0.056	0.4	0.9	100	348.1	533
VC.8: Podium Walls: SW (A212.1°, 108.93 ft², width 52.289 ft)	108.9	0.056	0.4	0.9	100	946.2	1448.8
VC.8: Podium Walls: West (A258.7°, 11.47 ft², width 5.505 ft)	11.5	0.056	0.4	0.9	100	99.6	152.5
VC.8: Podium Walls: SW (A212.1°, 85.27 ft², width 40.929 ft)	85.3	0.056	0.4	0.9	100	740.7	1134.1
VC.8: Podium Walls: West (A259.4°, 807.44 ft², width 69.209 ft)	807.4	0.056	0.4	0.9	100	7013.7	10739.1
VC.8: Podium Walls: NW (A302.1°, 155.81 ft², width 13.355 ft)	155.8	0.056	0.4	0.9	100	1353.4	2072.3
VC.8: Podium Walls: South (A197.9°, 298.72 ft², width 25.604 ft)	298.7	0.056	0.4	0.9	100	2594.8	3973
VC.8: Podium Walls: West (A257.9°, 209.15 ft², width 17.927 ft)	209.1	0.056	0.4	0.9	100	1816.7	2781.7
VC.8: Podium Walls: NE (A32.1°, 36.03 ft², width 3.088 ft)	36	0.056	0.4	0.9	100	313	479.2
VC.8: Podium Walls: NE (A32.1°, 339.43 ft², width 29.094 ft)	339.4	0.056	0.4	0.9	100	2948.4	4514.5
VC.8: Podium Walls: SE (A122.1°, 74.27 ft², width 6.366 ft)	74.3	0.056	0.4	0.9	100	645.1	987.8
VC.9: Wood-frame Exterior Walls: North (A348.7°, 14.06 ft², width 1.833 ft)	14.1	0.037	0.4	0.9	100	81	124.1
VC.9: Wood-frame Exterior Walls: East (A78.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: East (A78.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: East (A78.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: East (A78.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: East (A78.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1

Transmission heat losses - areas (continue)

Name	Area [ft²]	Average U-value [Btu/hr ft² °F]	Absorption coefficient	Emission coefficient	Reduction factor shading [%]	Transmission losses heating [kBtu/yr]	Transmission losses cooling [kBtu/yr]
VC.9: Wood-frame Exterior Walls: East (A78.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: East (A78.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: East (A78.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: East (A78.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 6.39 ft², width 0.833 ft)	6.4	0.037	0.4	0.9	100	36.8	56.4
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 10.22 ft², width 1.333 ft)	10.2	0.037	0.4	0.9	100	58.9	90.2
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 4 ft², width 0.667 ft)	4	0.037	0.4	0.9	100	23.1	35.3
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: West (A258.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: West (A258.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: West (A258.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: West (A258.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: West (A258.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: West (A258.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: South (A168.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: South (A168.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: South (A168.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 3.67 ft², width 0.478 ft)	3.7	0.037	0.4	0.9	100	21.1	32.4
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 3.67 ft², width 0.478 ft)	3.7	0.037	0.4	0.9	100	21.1	32.4
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 3.67 ft², width 0.478 ft)	3.7	0.037	0.4	0.9	100	21.1	32.4
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 3.67 ft², width 0.478 ft)	3.7	0.037	0.4	0.9	100	21.1	32.4
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 10.22 ft², width 1.333 ft)	10.2	0.037	0.4	0.9	100	58.9	90.2
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 10.22 ft², width 1.333 ft)	10.2	0.037	0.4	0.9	100	58.9	90.2
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 6.39 ft², width 0.833 ft)	6.4	0.037	0.4	0.9	100	36.8	56.4
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 6.39 ft², width 0.833 ft)	6.4	0.037	0.4	0.9	100	36.8	56.4
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 8.94 ft², width 1.167 ft)	8.9	0.037	0.4	0.9	100	51.6	79
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 8.94 ft², width 1.167 ft)	8.9	0.037	0.4	0.9	100	51.6	79
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 8.94 ft², width 1.167 ft)	8.9	0.037	0.4	0.9	100	51.6	79

Transmission heat losses - areas (continue)

Name	Area [ft²]	Average U-value [Btu/hr ft² °F]	Absorption coefficient	Emission coefficient	Reduction factor shading [%]	Transmission losses heating [kBtu/yr]	Transmission losses cooling [kBtu/yr]
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: North (A348.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: North (A348.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: North (A348.7°, 5.11 ft², width 0.667 ft)	5.1	0.037	0.4	0.9	100	29.5	45.1
VC.9: Wood-frame Exterior Walls: North (A348.7°, 14.06 ft², width 1.833 ft)	14.1	0.037	0.4	0.9	100	81	124.1
VC.9: Wood-frame Exterior Walls: North (A348.7°, 14.06 ft², width 1.833 ft)	14.1	0.037	0.4	0.9	100	81	124.1
VC.9: Wood-frame Exterior Walls: East (A78.7°, 862.75 ft², width 32.5 ft)	862.7	0.037	0.4	0.9	100	4973.6	7615.4
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 72.4 ft², width 2.178 ft)	72.4	0.037	0.4	0.9	100	417.4	639.1
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 814.54 ft², width 35.219 ft)	814.5	0.037	0.4	0.9	100	4695.7	7189.9
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 240.68 ft², width 51.812 ft)	240.7	0.037	0.4	0.9	100	1387.5	2124.4
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 312.3 ft², width 35.09 ft)	312.3	0.037	0.4	0.9	100	1800.3	2756.6
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 946.01 ft², width 82.095 ft)	946	0.037	0.4	0.9	100	5453.6	8350.3
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 105.11 ft², width 15.667 ft)	105.1	0.037	0.4	0.9	100	606	927.8
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 284.44 ft², width 35.667 ft)	284.4	0.037	0.4	0.9	100	1639.8	2510.8
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 21.33 ft², width 2 ft)	21.3	0.037	0.4	0.9	100	123	188.3
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 181.45 ft², width 19.636 ft)	181.5	0.037	0.4	0.9	100	1046	1601.7
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 19.01 ft², width 6.167 ft)	19	0.037	0.4	0.9	100	109.6	167.8
VC.9: Wood-frame Exterior Walls: North (A348.7°, 184.11 ft², width 9.333 ft)	184.1	0.037	0.4	0.9	100	1061.4	1625.1
VC.9: Wood-frame Exterior Walls: North (A348.7°, 473.82 ft², width 9.107 ft)	473.8	0.037	0.4	0.9	100	2731.5	4182.4
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 204.67 ft², width 11 ft)	204.7	0.037	0.4	0.9	100	1179.9	1806.6
VC.9: Wood-frame Exterior Walls: SW (A235.4°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: NE (A55.4°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: NW (A302.1°, 14.08 ft², width 0.333 ft)	14.1	0.037	0.4	0.9	100	81.2	124.3
VC.9: Wood-frame Exterior Walls: West (A258.7°, 88.6 ft², width 5.047 ft)	88.6	0.037	0.4	0.9	100	510.8	782.1
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 1285.19 ft², width 43 ft)	1285.2	0.037	0.4	0.9	100	7409	11344.3
VC.9: Wood-frame Exterior Walls: North (A348.7°, 716.53 ft², width 43.667 ft)	716.5	0.037	0.4	0.9	100	4130.7	6324.7
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 565.53 ft², width 16 ft)	565.5	0.037	0.4	0.9	100	3260.2	4991.9
VC.9: Wood-frame Exterior Walls: West (A258.7°, 623.77 ft², width 37.208 ft)	623.8	0.037	0.4	0.9	100	3595.9	5505.9
VC.9: Wood-frame Exterior Walls: NW (A302.1°, 66.5 ft², width 2 ft)	66.5	0.037	0.4	0.9	100	383.4	587
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 297.21 ft², width 12.167 ft)	297.2	0.037	0.4	0.9	100	1713.4	2623.4
VC.9: Wood-frame Exterior Walls: North (A348.7°, 180.83 ft², width 5.741 ft)	180.8	0.037	0.4	0.9	100	1042.5	1596.2
VC.9: Wood-frame Exterior Walls: NW (A302.1°, 1520.18 ft², width 40.417 ft)	1520.2	0.037	0.4	0.9	100	8763.6	13418.5
VC.9: Wood-frame Exterior Walls: South (A168.7°, 10.5 ft², width 0.333 ft)	10.5	0.037	0.4	0.9	100	60.5	92.7
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 1778.4 ft², width 93 ft)	1778.4	0.037	0.4	0.9	100	10252.3	15697.8
VC.9: Wood-frame Exterior Walls: West (A258.7°, 60.74 ft², width 1.827 ft)	60.7	0.037	0.4	0.9	100	350.2	536.2
VC.9: Wood-frame Exterior Walls: West (A258.7°, 10.5 ft², width 0.333 ft)	10.5	0.037	0.4	0.9	100	60.5	92.7
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 141.51 ft², width 4.256 ft)	141.5	0.037	0.4	0.9	100	815.8	1249.1
VC.9: Wood-frame Exterior Walls: North (A348.7°, 235.69 ft², width 59.333 ft)	235.7	0.037	0.4	0.9	100	1358.7	2080.5
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 417.28 ft², width 31.061 ft)	417.3	0.037	0.4	0.9	100	2405.6	3683.3
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 332.74 ft², width 13.731 ft)	332.7	0.037	0.4	0.9	100	1918.2	2937
VC.9: Wood-frame Exterior Walls: SE (A145.4°, 1339.18 ft², width 54.699 ft)	1339.2	0.037	0.4	0.9	100	7720.2	11820.8
VC.9: Wood-frame Exterior Walls: South (A168.7°, 89.56 ft², width 2.667 ft)	89.6	0.037	0.4	0.9	100	516.3	790.5
VC.9: Wood-frame Exterior Walls: West (A258.7°, 1149.64 ft², width 45.875 ft)	1149.6	0.037	0.4	0.9	100	6627.5	10147.8
VC.9: Wood-frame Exterior Walls: North (A348.7°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: East (A78.7°, 204.67 ft², width 11 ft)	204.7	0.037	0.4	0.9	100	1179.9	1806.6

Transmission heat losses - areas (continue)

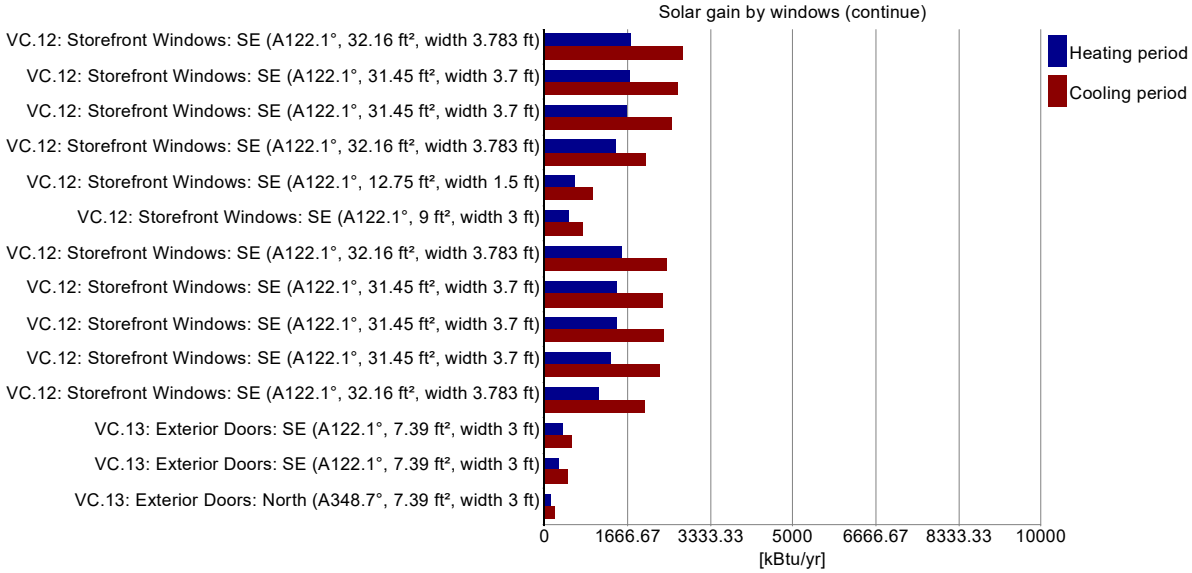
Name	Area [ft²]	Average U-value [Btu/hr ft² °F]	Absorption coefficient	Emission coefficient	Reduction factor shading [%]	Transmission losses heating [kBtu/yr]	Transmission losses cooling [kBtu/yr]
VC.9: Wood-frame Exterior Walls: South (A168.7°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 225.19 ft², width 43.333 ft)	225.2	0.037	0.4	0.9	100	1298.2	1987.8
VC.9: Wood-frame Exterior Walls: East (A78.7°, 72.7 ft², width 2.374 ft)	72.7	0.037	0.4	0.9	100	419.1	641.7
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 324.92 ft², width 13 ft)	324.9	0.037	0.4	0.9	100	1873.1	2868
VC.9: Wood-frame Exterior Walls: East (A78.7°, 204.67 ft², width 11 ft)	204.7	0.037	0.4	0.9	100	1179.9	1806.6
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 1572.99 ft², width 88.566 ft)	1573	0.037	0.4	0.9	100	9068.1	13884.7
VC.9: Wood-frame Exterior Walls: East (A78.7°, 1685.67 ft², width 53.5 ft)	1685.7	0.037	0.4	0.9	100	9717.7	14879.3
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 170 ft², width 17 ft)	170	0.037	0.4	0.9	100	980	1500.6
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 200 ft², width 20 ft)	200	0.037	0.4	0.9	100	1153	1765.4
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 200 ft², width 20 ft)	200	0.037	0.4	0.9	100	1153	1765.4
VC.9: Wood-frame Exterior Walls: NW (A302.1°, 170 ft², width 17 ft)	170	0.037	0.4	0.9	100	980	1500.6
VC.9: Wood-frame Exterior Walls: West (A258.7°, 0.69 ft², width 0.333 ft)	0.7	0.037	0.4	0.9	100	4	6.1
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 75.39 ft², width 2.268 ft)	75.4	0.037	0.4	0.9	100	434.6	665.5
VC.9: Wood-frame Exterior Walls: South (A168.7°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: North (A348.7°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: South (A168.7°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: West (A258.7°, 204.67 ft², width 11 ft)	204.7	0.037	0.4	0.9	100	1179.9	1806.6
VC.9: Wood-frame Exterior Walls: North (A348.7°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 14.08 ft², width 0.333 ft)	14.1	0.037	0.4	0.9	100	81.2	124.3
VC.9: Wood-frame Exterior Walls: North (A348.7°, 720.41 ft², width 33.093 ft)	720.4	0.037	0.4	0.9	100	4153.1	6359
VC.9: Wood-frame Exterior Walls: West (A258.7°, 72.7 ft², width 2.374 ft)	72.7	0.037	0.4	0.9	100	419.1	641.7
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 28.78 ft², width 9.333 ft)	28.8	0.037	0.4	0.9	100	165.9	254
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 28.78 ft², width 9.333 ft)	28.8	0.037	0.4	0.9	100	165.9	254
VC.9: Wood-frame Exterior Walls: West (A258.7°, 3.63 ft², width 0.474 ft)	3.6	0.037	0.4	0.9	100	20.9	32
VC.9: Wood-frame Exterior Walls: West (A258.7°, 3.63 ft², width 0.474 ft)	3.6	0.037	0.4	0.9	100	20.9	32
VC.9: Wood-frame Exterior Walls: West (A258.7°, 3.63 ft², width 0.474 ft)	3.6	0.037	0.4	0.9	100	20.9	32
VC.9: Wood-frame Exterior Walls: West (A258.7°, 3.63 ft², width 0.474 ft)	3.6	0.037	0.4	0.9	100	20.9	32
VC.9: Wood-frame Exterior Walls: North (A348.7°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: West (A258.7°, 204.67 ft², width 11 ft)	204.7	0.037	0.4	0.9	100	1179.9	1806.6
VC.9: Wood-frame Exterior Walls: South (A168.7°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: SW (A235.4°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: NE (A55.4°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: NW (A325.4°, 204.67 ft², width 11 ft)	204.7	0.037	0.4	0.9	100	1179.9	1806.6
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 750.61 ft², width 34.333 ft)	750.6	0.037	0.4	0.9	100	4327.2	6625.6
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 302.75 ft², width 12.333 ft)	302.7	0.037	0.4	0.9	100	1745.3	2672.4
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 204.67 ft², width 11 ft)	204.7	0.037	0.4	0.9	100	1179.9	1806.6
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 654.06 ft², width 29 ft)	654.1	0.037	0.4	0.9	100	3770.5	5773.3
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 204.67 ft², width 11 ft)	204.7	0.037	0.4	0.9	100	1179.9	1806.6
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 19.01 ft², width 6.167 ft)	19	0.037	0.4	0.9	100	109.6	167.8
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 302.75 ft², width 12.333 ft)	302.8	0.037	0.4	0.9	100	1745.3	2672.4
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 204.67 ft², width 11 ft)	204.7	0.037	0.4	0.9	100	1179.9	1806.6
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 14.08 ft², width 0.333 ft)	14.1	0.037	0.4	0.9	100	81.2	124.3
VC.9: Wood-frame Exterior Walls: SW (A212.1°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8
VC.9: Wood-frame Exterior Walls: NE (A32.1°, 70.67 ft², width 2 ft)	70.7	0.037	0.4	0.9	100	407.4	623.8

Transmission heat losses - areas (continue)

Name	Area [ft²]	Average U-value [Btu/hr ft² °F]	Absorption coefficient	Emission coefficient	Reduction factor shading [%]	Transmission losses heating [kBtu/yr]	Transmission losses cooling [kBtu/yr]
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 322.49 ft², width 19.5 ft)	322.5	0.037	0.4	0.9	100	1859.1	2846.6
VC.9: Wood-frame Exterior Walls: SE (A122.1°, 204.67 ft², width 11 ft)	204.7	0.037	0.4	0.9	100	1179.9	1806.6
VC.9: Wood-frame Exterior Walls: South (A168.7°, 252.58 ft², width 13 ft)	252.6	0.037	0.4	0.9	100	1456.1	2229.5
VC.9: Wood-frame Exterior Walls: East (A78.7°, 114.94 ft², width 36.333 ft)	114.9	0.037	0.4	0.9	100	662.6	1014.6
VC.9: Wood-frame Exterior Walls: East (A78.7°, 483.19 ft², width 27.667 ft)	483.2	0.037	0.4	0.9	100	2785.5	4265.1
VC.9: Wood-frame Exterior Walls: West (A258.7°, 1788.51 ft², width 57.693 ft)	1788.5	0.037	0.4	0.9	100	10310.5	15787

Degree hours [kFh/a]

	Heating	Cooling
Ambient heating	86.9	133.1
Ground heating	16.2	51.6



Summary building envelope

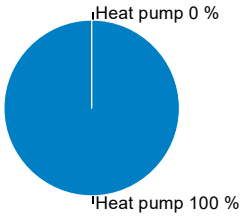
	Total area / length	Average U-value / Psi value	Transmission losses
Exterior wall ambient:	**43,992.5** ft²	**0.039** Btu/hr ft² °F	**267,095.3** kBtu/yr
Exterior wall ground:	**72.2** ft²	**0.105** Btu/hr ft² °F	**221.5** kBtu/yr
Basement:	**9,161.5** ft²	**0.154** Btu/hr ft² °F	**41,125.3** kBtu/yr
Roof:	**17,201.9** ft²	**0.024** Btu/hr ft² °F	**64,259.2** kBtu/yr
Windows:	**12,775.2** ft²	**0.176** Btu/hr ft² °F	**351,147.5** kBtu/yr
Doors:	**0** ft²	**0** Btu/hr ft² °F	**0** kBtu/yr
Thermal bridge ambient:	**0** ft	**0** Btu/hr ft °F	**0** kBtu/yr
Thermal bridge perimeter:	**0** ft	**0** Btu/hr ft °F	**0** kBtu/yr
Thermal bridge floor slab:	**0** ft	**0** Btu/hr ft °F	**0** kBtu/yr

Shading

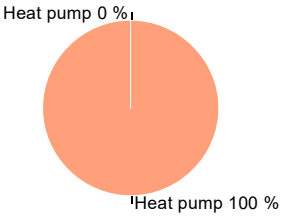
	Heating	Cooling
Reduction factor North:	**61.2** %	**58.6** %
Reduction factor East:	**72.1** %	**73.4** %
Reduction factor South:	**79.2** %	**78.7** %
Reduction factor West:	**77** %	**79.7** %
Reduction factor Horizontal:	**100** %	**100** %

System	DHW			Heating			Total		
	Covered DHW demand [%]	Estimated solar fraction [%]	Final energy demand [kBtu/yr]	Covered heating demand [%]	Estimated solar fraction [%]	Final energy demand [kBtu/yr]	Performance ratio	CO2 equivalent emissions [lb/yr]	Source energy demand [kBtu/yr]
Heat pump, Navien NWP500-65	0	0	0	100	0	175,831.6	0	77,261,011.4	351,663.3
Heat pump, Navien NWP500-65	100	0	121,918.5	0	0	0	0.4	53,571,391.2	243,837
Σ	100	0	121,918.5	100	0	175,831.6		130,832,402.5	595,500.3

DHW - final energy



Heating - final energy



COOLING UNITS

	sensible	latent
Air cooling:	**0** kBtu/ft²yr	**0** kBtu/ft²yr
Recirculation cooling:	**5.2** kBtu/ft²yr	**4.1** kBtu/ft²yr
Additional dehumidification:		**0** kBtu/ft²yr
Panel cooling:	**0** kBtu/ft²yr	
Sum:	**5.2** kBtu/ft²yr	**4.1** kBtu/ft²yr

VENTILATION

Energy transportable by supply air

Heating energy

transportable: **2.26** W/ft²
load: **1.19** W/ft²

Cooling energy

transportable: **1.31** W/ft²
load: **0.89** W/ft²

Infiltration pressure test ACH50: **0.52** 1/hr
Total extract air demand: **8,610** cfm
Supply air per person: **18** cfm
Occupancy: **170**

Average air flow rate: **8,610** cfm
Average air change rate: **0.66** 1/hr
Effective ACH ambient: **0.21** 1/hr
Effective ACH ground: **0** 1/hr
Energetically effective air exchange: **0.21** 1/hr
Infiltration air change rate: **0.04** 1/hr
Infiltration air change rate (heating load): **0.09** 1/hr

Type of ventilation system: **Balanced PH ventilation**
Wind screening coefficient (e): **0.07**
Wind exposure factor: **15**
Wind shield factor: **0.05**

Ventilation heat losses: **410,184.25** kBtu/yr

Devices

Name	Sensible recovery efficiency [-]	Electric efficiency [W/cfm]	Heat recovery efficiency SHX [-]	Effective recovery efficiency [-]
Panasonic ERV (85 CFM)	0.8	0.05	0	0.8
Panasonic ERV (110 CFM)	0.7	0.05	0	0.6
Central ERV	0.8	0.09	0	0.8
Altogether	0.7	0.05	0	0.7

Ducts

Name	Length (total) [ft]	Clear cross-section [ft²]	U-value [Btu/hr ft² °F]	Assigned ventilation units
In-Unit Supply	5	0.1963	0.72	Panasonic ERV (85 CFM), Panasonic ERV (110 CFM)
In-Unit Exhaust	5	0.1963	0.72	Panasonic ERV (85 CFM), Panasonic ERV (110 CFM)
Common Supply	10	0.7854	0.74	Central ERV
Common Exhaust	10	0.7854	0.74	Central ERV
Σ	30			

*length * quantity ** thermal conductivity / thickness

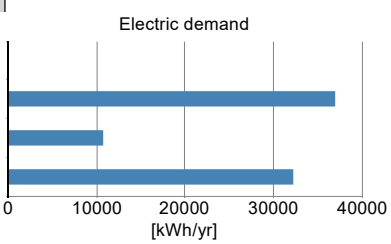
SUMMER VENTILATION

Preferred minimum indoor temperature for night ventilation: **68** °F

Overheating temperature: **77** °F

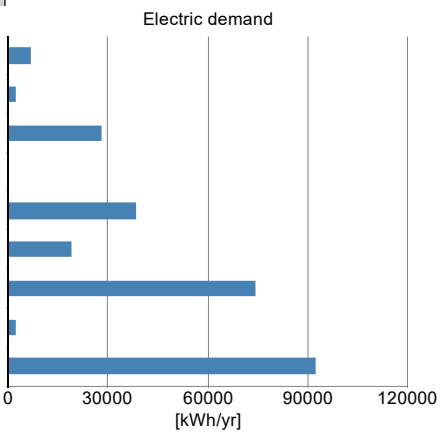
ELECTRICITY DEMAND - AUXILIARY ELECTRICITY

Type	Quantity	Indoor	Norm demand	Electric demand [kWh/yr]	Source energy [kBtu/yr]
Other	1	no	0 W	0	0
Ventilation winter	1	yes	0.9 W/cfm	36969.6	252266.2
Ventilation Defrost	1	yes	45,852 W	10760.3	73424.3
Ventilation summer	1	yes	0.9 W/cfm	32231.8	219937
Σ				79961.7	545627.5



ELECTRICITY DEMAND RESIDENTIAL BUILDING

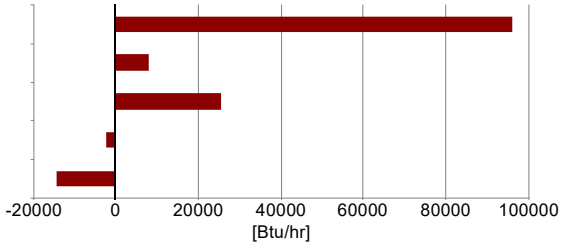
Type	Quantity	Indoor	Norm demand	Electric demand [kWh/yr]	Non-electric demand [kWh/yr]	Source energy [kBtu/yr]
Kitchen dishwasher	1	yes	1.1	6793.2	0	46354.3
Laundry - washer	1	yes	0.3	2310.5	0	15765.7
Laundry - dryer	1	yes	2.7	28049.7	0	191400.5
Energy consumed by evaporation	0	yes	3.1	0	2355.2	16071.1
Kitchen fridge/freeze combo	1	yes	1.2	38335	0	261583.1
Kitchen cooking	1	yes	0.2	18700	0	127601.5
User defined lighting	1	yes	74,437	74437	0	507929
User defined lighting	1	no	2,301	2301	0	15701.1
User defined MELs	1	yes	92,184	92184	0	629027.6
Σ	8			263110.4	2355.2	1811433.9



INTERNAL HEAT GAINS

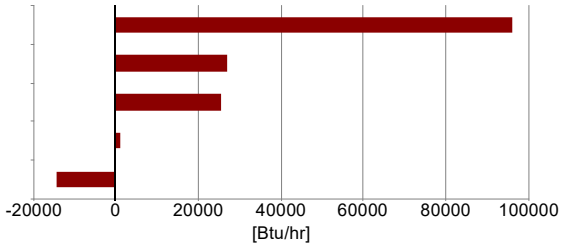
Heating season

Electricity total:	**96,258.5**	Btu/hr
Auxiliary electricity:	**7,845.5**	Btu/hr
People:	**25,522.8**	Btu/hr
Cold water:	**-2,364.6**	Btu/hr
Evaporation:	**-14,501.6**	Btu/hr
Σ:	**112,760.5**	Btu/hr
Specific internal heat gains:	**1.3**	Btu/hr ft²



Cooling season

Electricity total:	**96,258.5**	Btu/hr
Auxiliary electricity:	**26,954.9**	Btu/hr
People:	**25,522.8**	Btu/hr
Cold and hot water:	**837.2**	Btu/hr
Evaporation:	**-14,501.6**	Btu/hr
Σ:	**112,760.5**	Btu/hr
Specific internal heat gains:	**1.3**	Btu/hr ft²



DHW AND DISTRIBUTION

DHW consumption per person per day:	**6.6**	gal/Person/day
Average cold water temperature supply:	**52.8**	°F
Useful heat DHW:	**321,694.9**	kBtu/yr
Specific useful heat DHW:	**3,815.1**	Btu/ft²yr
Total heat losses of the DHW system:	**16,025.7**	kBtu/yr
Specific losses of the DHW system:	**190.1**	Btu/ft²yr
Performance ratio DHW distribution system and storage:	**1**	
Utilization ratio DHW distribution system and storage:	**1**	
Total heat demand of DHW system:	**337,720.7**	kBtu/yr
Total specific heat demand of DHW system:	**4,005.1**	Btu/ft²yr
Total heat losses of the hydronic heating distribution:	**0**	kBtu/yr
Specific losses of the hydronic heating distribution:	**0**	Btu/ft²yr
Performance ratio of heat distribution:	**100**	%

Region	Length [ft]	Annual heat loss [kBtu/yr]
Hydronic heating distribution pipes		
Σ	0	0
DHW circulation pipes		
In conditioned space	0	0
Σ	0	0
Individual pipes		
In conditioned space		0
Σ		0
Water storage		
Σ		0