FORM: CRM (August 2022)
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CITY OF SOMERVILLE

Inspectional Services • Planning Board • Zoning Board of Appeals

CERTIFICATION OF REQUIRED MATERIALS
BY CITY OF SOMERVILLE DEPARTMENT OF SUSTAINABILITY & ENVIRONMENT

Development Site Address:	620 Broadway, Somerville (P&Z# 21-145, Stage 1)
Applicant Name:	Brian O'Donovan (bodonovan6@gmail.com)

As required by the City of Somerville's Development Review Submittal Requirements, I certify that I have received and approved the following development review materials for the development proposal identified above:

- ■ Sustainable & Resilient Building Questionnaire
- N/A ☐ Low Load Buildings Energy Input Form
- N/A ☐ Net-Zero Ready Building: PHIUS+
  - Building Resilience & Sustainability Narrative
  - Copy of signed PHIUS+ Certification Contract
  - Copy of signed PHIUS+ Certification Fee Receipt
- N/A ☐ Net-Zero Ready Building: Zero Carbon
  - Building Resilience & Sustainability Narrative
  - Evidence of ILFI Premium Membership
  - Evidence of ILFI New Zero Carbon Project Registration
- N/A ☐ LEED Certifiability
  - LEED Gold or Platinum checklist
  - LEED Narrative
  - Signed affidavit by LEED accredited professional

Signature: ______________________ Date: 9/15/2022
Sustainability & Environment Representative

SustainaVille
creating a resilient & carbon neutral somerville

City of Somerville
Sustainable & Resilient
Buildings Questionnaire
Updated December 28, 2021
Discontinue prior versions

INTRODUCTION

This document outlines Development Review Application requirements in relation to the long-term environmental sustainability and climate resilience of buildings within Somerville. Development proposals that require Site Plan Approval by the Somerville Zoning Ordinance must include a completed Sustainable & Resilient Buildings Questionnaire (Questionnaire) with the required Development Review Application. A Development Review Application is considered incomplete unless a completed questionnaire is submitted with the application. It is strongly recommended that the development team meets with staff from the Office of Sustainability and Environment prior to submitting the Development Review Application.

The purpose of this Questionnaire is to minimize the adverse environmental impacts in the design, construction, and occupancy of buildings in Somerville and to ensure that the impacts of future climate conditions are carefully evaluated.

Please review the following documents before completing the Questionnaire:

- **Somerville Climate Change Vulnerability Assessment**
- **Carbon Neutrality Pathway Assessment**
- **Somerville Climate Forward**
- **High Resolution Flood Vulnerability Maps**

PROCEDURE:

A completed Sustainable & Resilient Buildings Questionnaire must be submitted with a Development Review Application for all development proposals that require Site Plan Approval. New construction or alterations to existing structures of 25,000 square feet or more must also submit an updated Questionnaire prior to the issuance of the first Building Permit and prior to the issuance of the first Certificate of Occupancy to identify any design changes made subsequent to Site Plan Approval or additional information determined as the development process unfolds.

BACKGROUND: CARBON NEUTRALITY

Understanding the global imperative to reduce greenhouse gas emissions in order to prevent extreme changes to the climate, Mayor Joseph A. Curtatone set a goal for Somerville to become carbon neutral by the year 2050. Carbon neutrality is defined as the net-zero release of carbon dioxide and other greenhouse gases (GHG) within Somerville's municipal boundary. Reducing greenhouse gas emissions is critical to avoiding the worst impacts of climate change and to protecting the health, safety, and welfare of current and future generations. In 2017, the Somerville Board of Aldermen passed a resolution reaffirming the city's carbon neutrality goal. And In 2018, Somerville released its first community-wide climate action plan, Somerville Climate Forward.

To achieve carbon neutrality by 2050 and to minimize adverse environmental impacts, Somerville will need to drastically reduce greenhouse gas emissions from electricity, buildings, transportation, and waste disposal. To meet these goals, all buildings within the city will need to pursue net zero emissions. New development should be designed to maximize envelope performance and energy efficiency, produce or procure renewable energy, and phase out fossil fuel use through electrification of building systems. The City of Somerville recognizes that as technology advances, incorporating design elements to mitigate carbon emissions and increase resilience may become more feasible. Applicants are asked to devise strategies that permit building systems to adapt and evolve over time to further reduce GHG emissions and to avoid path dependency that perpetuates reliance on fossil fuels.

BACKGROUND: CLIMATE CHANGE VULNERABILITY

Despite efforts to minimize greenhouse gas emissions, climate change is already impacting Somerville and changes to the climate will continue to intensify. The City of Somerville's Climate Change Vulnerability Assessment analyses vulnerabilities associated with Somerville's key climate stressors: increased precipitation, sea level rise and storm surge, and higher temperatures. The analysis recommends that new development consider these climate impacts and take appropriate measures to address the projected climatic conditions described in the assessment.

Several areas of Somerville are already prone to flooding from intense precipitation. With climate change, precipitation events will become more intense—meaning that a greater volume of rain will fall in a shorter period of time. Somerville is projected to experience more than a 30% increase in rainfall during a 100-year 24-hour event. This increase in precipitation will increase the risk of flooding in areas where the drainage system does not have sufficient capacity.

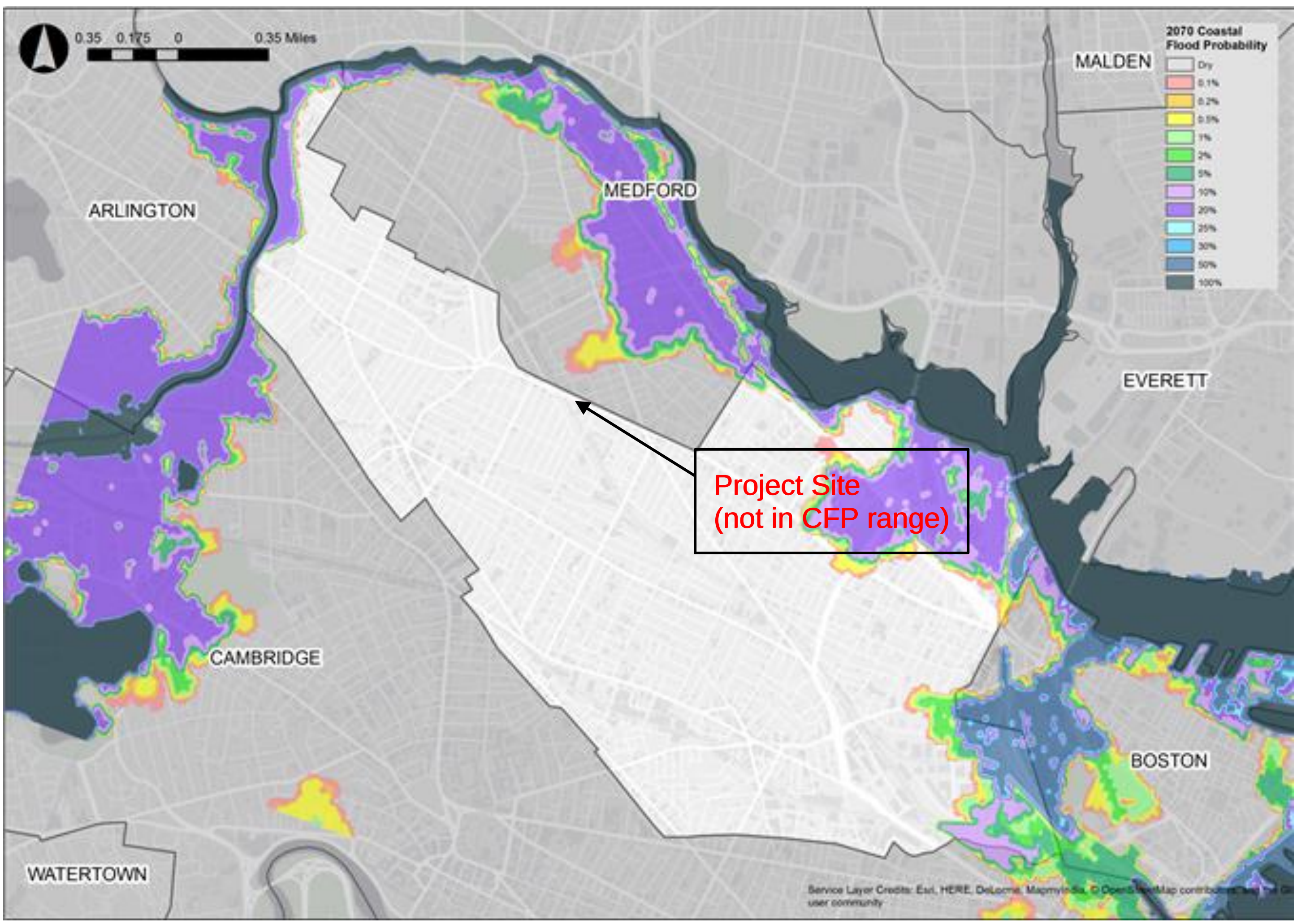
In addition to flooding from precipitation, sea level rise and storm surge are already potential concerns for areas of East Somerville and by 2035-2040 the Amelia Earhart Dam could be regularly flanked by storms, resulting in flooding for areas of Assembly Square, Ten Hills, and Winter Hill.

As the climate continues to change, average seasonal temperatures are also expected to increase and the number of days above 90 degrees Fahrenheit (historically about 10 a year) could rise to 40 days by 2030, a third of the summer, and 90 days by 2070, nearly the entire summer. In 2018 there were 23 days over 90 degrees.
As temperatures increase, Somerville will become more susceptible to the urban heat island effect which causes hotter temperatures due to paved surfaces and waste heat generated by energy use when compared to less developed areas. Increasing average temperatures can have wide-ranging

impacts on human life, the built environment, and natural ecosystems. Rising temperatures and more intense heat waves present significant public health concerns and can contribute toward kidney, lung, and heart problems. Vulnerable populations are particularly susceptible to heat-induced illness and mortality. There will also be increasing demand for indoor cooling.

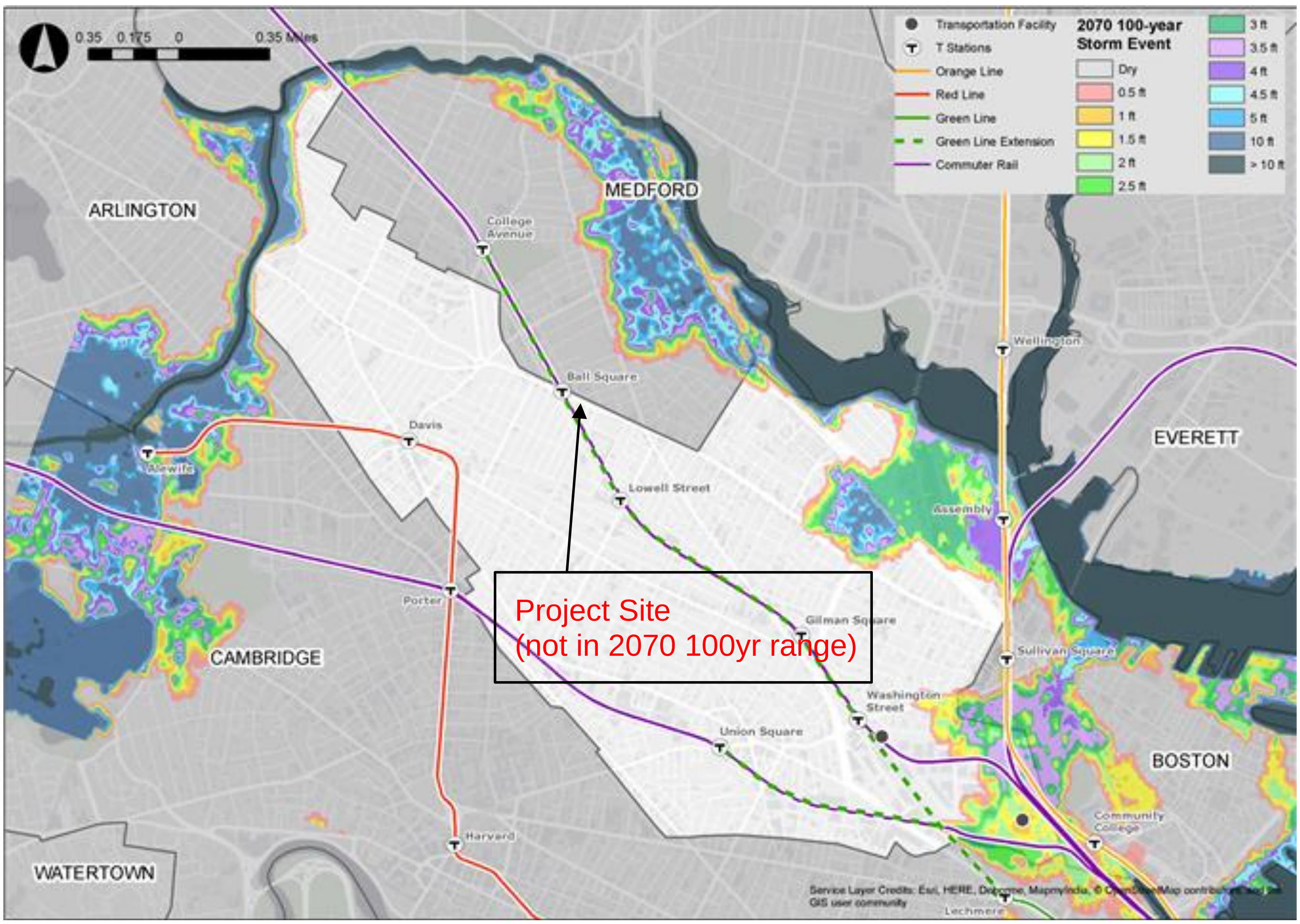
The following maps and figures provide an overview of projected climate exposure. Please review the Climate Change Vulnerability Assessment for more detailed analysis on Somerville's exposure, vulnerability, and risk to climate change. **For higher resolution maps and GIS files, please click the link to visit www.somervillema.gov/floodready or contact the Office of Sustainability & Environmental staff at ose@somervillema.gov.**

2070 Coastal Flood Probability



This map shows the annual chance of flooding from coastal storm events and sea level rise in 2070. A 100% chance of flooding means that there is a nearly certain chance that the area will flood at least once in a given year, while a 50% chance means that there is an equal chance that it may or may not flood in a given year. A 1% chance of flooding corresponds with a 100-year event. A 0.1% chance corresponds with a 1000-year event. This map does not account for drainage (Somerville Climate Change Vulnerability Assessment, 2017)

2070 Coastal Flood Depth from 2070 100-year Storm Event



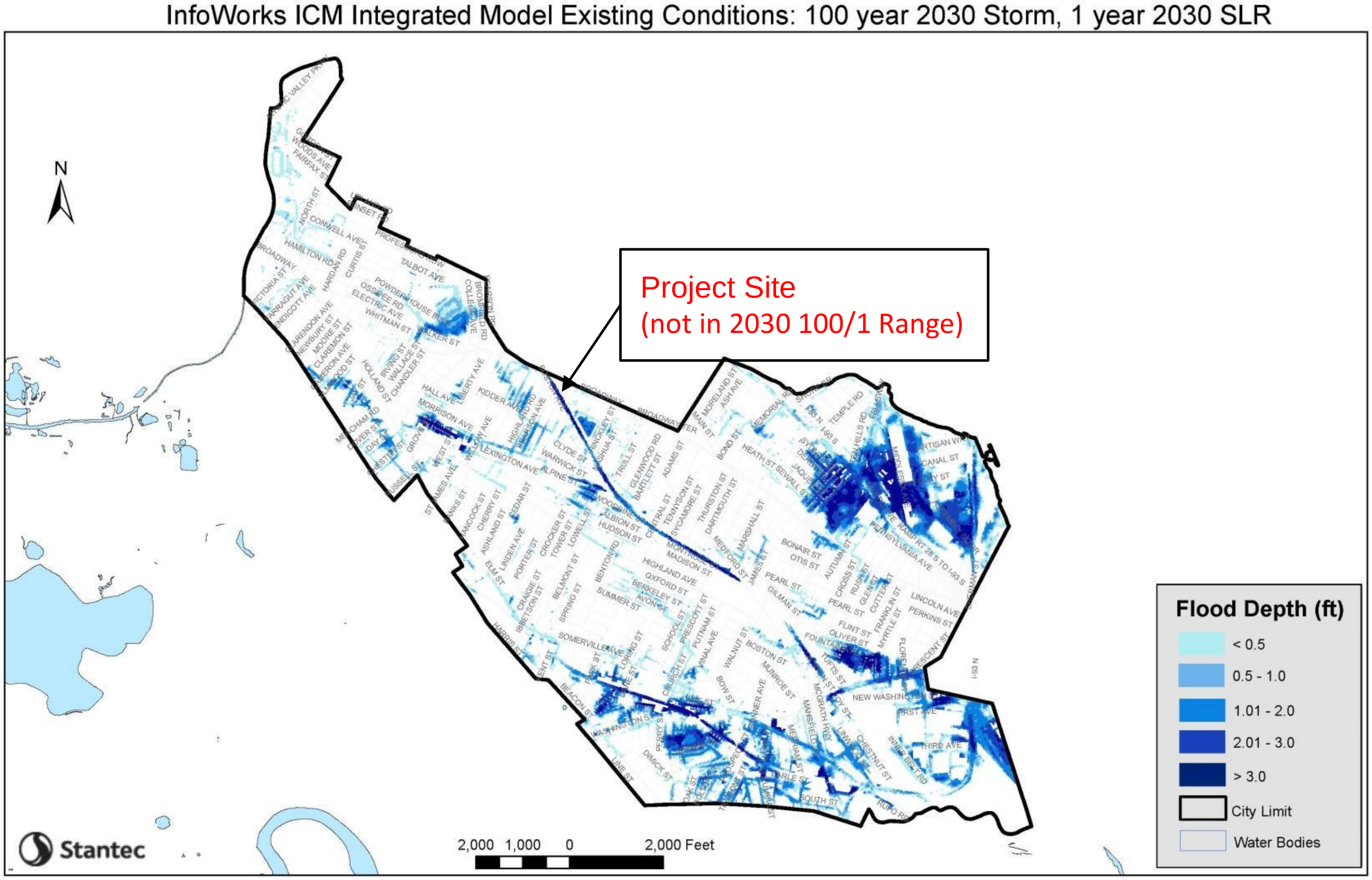
This map shows the projected flood depths of a 100-year coastal storm event in 2070 along with public transportation infrastructure assets. This map does not account for drainage (Somerville Climate Change Vulnerability Assessment, 2017).

Precipitation Projections

Precipitation-based flooding is projected to increase in Somerville and is currently more of an immediate and widespread threat than sea level rise and storm surge. The intensification of both the frequency and intensity of rainfall events is likely to cause increased risk of flooding during rain events.

Storm Type	Present-day Rainfall	2030 Rainfall	2070 Rainfall
10-year (10% annual chance), 24-hour	4.9 in	5.6 in	6.4 in
100-year (1% annual chance), 24-hour	8.9 in	10.2 in	11.7 in

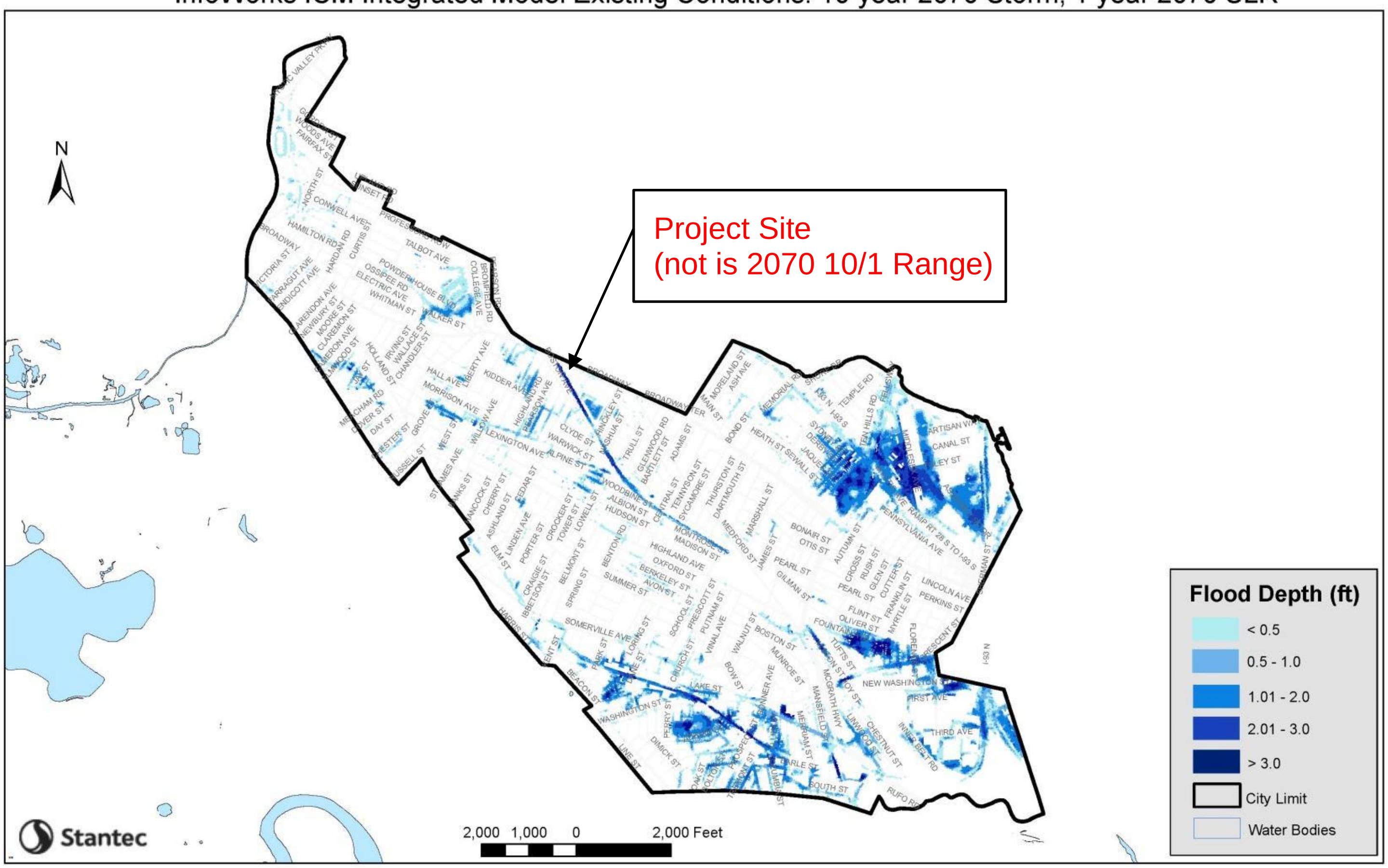
InfoWorks ICM Integrated Model Existing Conditions: 100 year 2030 Storm, 1 year 2030 SLR



This map shows the impact of both precipitation-based flooding and sea level rise and storm surge.

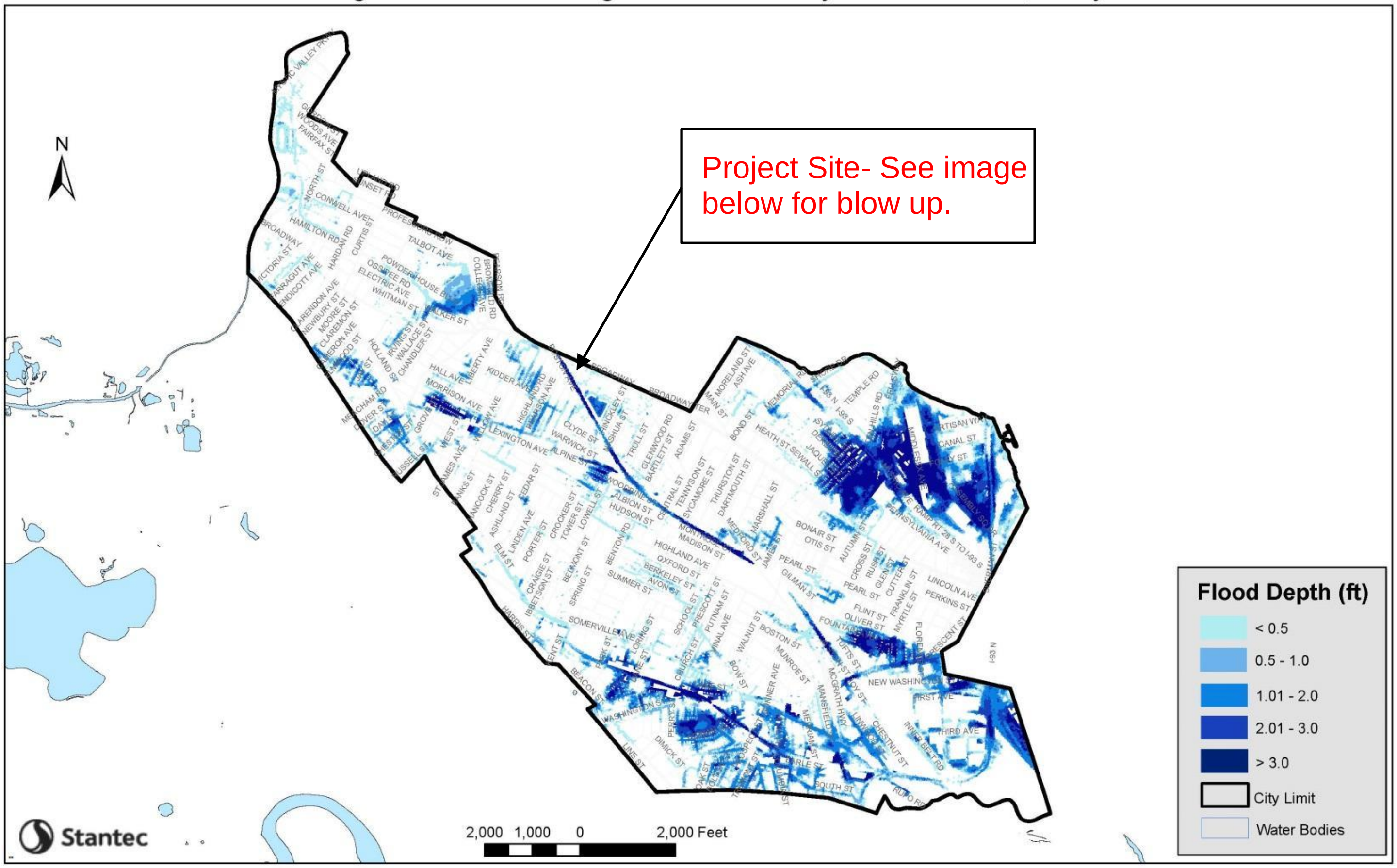
This map shows the modeled flood depths of a 100-year, 24-hour Design Storm with 1-year storm surge and sea level rise projections in 2030. Unlike the maps above, this includes modeling of the drainage system, which takes into account how water will be conveyed out of the city. The model is based on how the system is designed to function, so actual areas of flooding and depth of flooding could vary (Stantec, 2019).

InfoWorks ICM Integrated Model Existing Conditions: 10 year 2070 Storm, 1 year 2070 SLR



This map shows the impact of both precipitation-based flooding and sea level rise and storm surge. This map shows the modeled flood depths of the 10-year, 24-hour Design Storm with 1-year storm surge and sea level rise projections in 2070. This map includes modeling of the drainage system, which takes into account how water will be conveyed out of the city. The model is based on how the system is designed to function, so actual areas of flooding and depth of flooding could vary (Stantec, 2019).

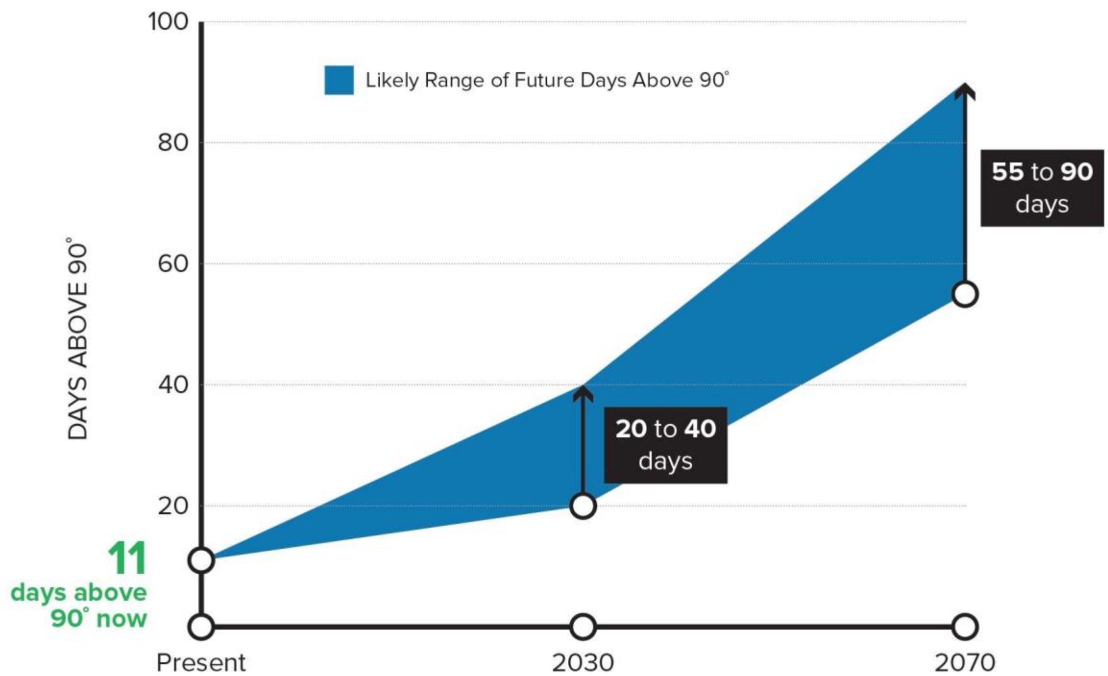
InfoWorks ICM Integrated Model Existing Conditions: 100 year 2070 Storm, 100 year 2070 SLR



This map shows the impact of both precipitation-based flooding and sea level rise and storm surge. This map shows the modeled flood depths of 2070 100-year, 24-hour Design Storm with 100-year storm surge and sea level rise projections in 2070. This map includes modeling of the drainage system, which takes into account how water will be conveyed out of the city. The model is based on how the system is designed to function, so actual areas of flooding and depth of flooding could vary (Stantec, 2019).

Blow up of project site area from previous flood map.

Temperature Projections



(Somerville Climate Change Vulnerability Assessment 2017)

Temperature	1971-2000 (average)	2030 (low)	2030 Avg. (high)	2070 (low)	2070 Avg. (high)
Annual	50.0º F	53.3º F	53.5º F	55.8º F	58.7º F
Summer	70.6º F	74.5º F	74.8º F	77.4º F	80.6º F
Winter	29.8º F	32.2º F	33.0º F	34.6º F	38.0º F

RESOURCES:

For information on net-zero and resilient building and site design, please review the following resources:

- **Passive House Principles**
- **Architecture 2030 Palette (Net-zero design tools)**
- **Zero Energy Buildings in Massachusetts: Saving Money from the Start**
- **Building Resilience in Boston**

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- **Enhancing Resilience in Boston**
- **A Better City's Resiliency Toolkit**
- **Ready to Respond: Strategies for Multifamily Building Resilience**

For additional information visit www.somervillema.gov/sustainaville

SUSTAINABLE & RESILIENT BUILDINGS QUESTIONNAIRE

Section 1: Proposal Information

Proposal Name	Redevelopment of 620 Broadway
Address	620 Broadway, Somerville, MA 02145
Developer	The 620 Broadway, LLC
Business Address	741 Broadway, Somerville, MA 02145
Designated Contact	Brian O'Donovan
Telephone Number	(617) 629-8888
Contact's Email Address	bodonovan6@gmail.com
Date Submitted	07/14/2022
Filing Type (Development review application, Building Permit, or CoA)	Development Review Application for SPA and SP (Planning Bd)
Is this a revised Questionnaire?	No
Is MEPA Approval Required?	No

Section 2: Building & Site Details

2.1 Building Information

Building Uses	Commercial incl Retail
Gross Floor Area	Approximate 6,961 Gross Square feet
Expected Life of Building	100 years
Please describe the following	
Building heating plant and distribution System	Split Heat-pump system
Building cooling plant and distribution system	Split Heat-pump system

Ventilation system	Natural when possible and integrated w split system
Domestic hot water system	For restrooms: mini electric tank. For tenant: TBD
2.2. Green Building	
Green Building Professional(s): Name(s) and contact information	N. A.
Professional Credentials: Green Building Program Certification(s)	
Building LEED Rating	Certifiable/Silver/Gold/Platinum
Building LEED Point Score	
Will you pursue LEED certification through the USGBC?	No
Are any other green building certifications being pursued? (Passive House, Enterprise Green Communities, etc.). Please describe.	Mass Save Path 4: Systems Assistance and Incentives for Small Projects under 20K-SF
2.3. Electric Vehicle Parking	The number of electric vehicles (EVs) in Somerville is expected to increase significantly over the next decade with more electric vehicles coming to market than ever before. Conservative estimates based on historical trends alone suggest 20% of personal vehicles in Somerville will be electric by 2040. Installing capacity for EV supply equipment (EVSE) has been shown to be more feasible and cost effective during construction than when retrofitting parking areas to support the installation of EVSE in the future[1]. Providing EVSE can increase the property value, become a future revenue source, and provide an amenity that more tenants and commuters will be looking

[1] http://evchargingpros.com/wp-content/uploads/2017/04/City-of-SF-PEV-Infrastructure-Cost-Effectiveness-Report-2016.pdf; https://www.richmond.ca/__shared/assets/Residential_EV_Charging_Local_Government_Guide51732.pdf

	for. It is recommended that parking facilities be designed to allow for the most flexibility to adapt to future needs of electric vehicles and changing mobility needs. **The City of Somerville recommends 25% of spaces have installed charging access and up to 100% of spaces be "EV Ready"** (everything but the station installed). Eversource currently has a program to pay the associated infrastructure costs of EV charging, including infrastructure needed to be "EV ready." Please consult with Eversource to determine if any installation costs could be covered through their Make Ready Program.
Total # of Parking Spaces	#0
EVSE Plugs (number and voltage/ level of plugs)	#0
EV Ready Spaces (everything but station is installed)	#0
Please share any other information on your EV strategy. Have you spoken with Eversource? Are you talking with EVSE providers? Have you considered EVSE needs in conjunction with your parking and mobility management plans?	N/A

2.4 Energy Input Form – Not Applicable (project size)

Required for projects over 25,000 SF, optional for all other projects

Download a copy of the Somerville Low Load Building Energy Input Form and follow the instructions included in the spreadsheet.

Pre-Submittal Phase

- Complete the 'PRE-SUBMITTAL INFO' tab of the Energy Input Form and submit to the Office of Sustainability and Environment (ose@somervillema.gov) 1 week prior to your pre-submittal meeting with OSE.

Development Review Phase

- Complete the 'DEVELOPMENT REVIEW INFO' tab of the Energy Input Form and submit to the Office of Sustainability and Environment (ose@somervillema.gov) at least 3 weeks prior to your application submittal for Board review.
- Projects pursuing Passive House certification from PHIUS or PHI do not have to complete the Development Review Info tab.

Continue onto next page.

2.5 Net Zero Carbon Building Compliance
The City of Somerville encourages projects to eliminate the incorporation of fossil fuels in their building operations. Please explain the proposed building's electric heating system capacity and confirm it is consistent with Row 24 in 'Energy Input Form – Pre-submittal Dashboard Tab' or Row 28 if the project is a laboratory building. If the project intends to incorporate fossil fuels, please provide a rationale below and explain provisions that your project is taking to electrify base building systems in the future.

EIF is not applicable to this project due to project size. However, the base building HVAC system provided by the building owner will be all electric split heat pump system.

2.6 Describe any and all incentives, rebates, grants provided by utilities, government organizations, and other organizations being pursued to maximize building efficiency and to reduce emissions. Description must include any incentives that were considered but are not being pursued, including reasoning for each decision.

- Mass Save Path 4: Systems

2.7 Evaluate feasibility of on-site renewable generation. Please describe your analysis and findings. Analysis should consider incentives available. Will any renewable energy generation be incorporated into the project? If so, please describe (system type and capacity). If no, could it be added in the future? And will any off-site renewable energy be purchased?

The roof of the project is designed to provide approx. 4-5,000-SF of solar ready roof area. The system has not yet been designed or contracted.

Section 4: Climate Change Risk and Vulnerability

4.1 Climate Vulnerability Exposure (check all that apply)	• Sea Level Rise & Storm Surge • Precipitation Induced Flooding • Heat • Other(s):

4.2 How is your site vulnerable to projected climate change impacts?

The site falls outside of any of the projected major flood/surge range indicated above.

The next two sections ask specific questions about how the project is designed to manage climate-related risks from heat, coastal and inland flooding.

Section 5: Managing Heat Risks

5.1 Describe all building features that will keep building occupants safe and comfortable during extreme heat, including mechanical systems and non-mechanical design elements to cool building (orientation, envelope, operable windows, etc.).

- Most of the East and South facing facades have minimal windows, which will minimize heat gain inside the building. The remaining North and West sides are glazed with insulated glazing and thermally brake glazing frames throughout.
- Where strong western light can affect heat gain in glazed areas, significant plantings have been provided to project shade.
- Operable doors and windows are proposed in some retail spaces where security allows.
- Mechanical equipment will also provide conditioned air/heat to each of the interior spaces, zoned separately and controlled individually. Supply air is tempered primarily though a heat exchange system.
- Both the roof and the building's walls will be insulated on the exterior to provide a superior continuous insulation envelope.

5.2 How has increased demand for indoor cooling been factored into the building design and energy management strategy?

Base HVAC equipment will be provided by the building owner for the tenants use and zoned separately for each of the retail spaces. The systems will be designed to provide usage analysis and smart-controls for the individual tenants.

5.3 List any indoor spaces without cooling and their uses.

N/A

5.4 What design features will be implemented on site to minimize the site's contribution to the urban heat island effect? Please describe any and all design elements. Strategies could include, but are not be limited to, the following:

- High albedo pavement or roof materials
- Passive cooling or increased ventilation capacity
- Green roofs or walls
- Heat resistant trees and plants
- Additional landscaped areas

- The site incorporates a minimum paved areas and provides significant landscaped area around the site.
- The proposed roof will be a roof membrane with reflective albedo properties (white or light gray).
- The plantings proposed are heat and drought resistant.

Section 6: Managing Flood Risks

6.1 Is the site susceptible to flooding from sea level rise and storm surge and/or rain events now or during the building's expected lifetime? Please refer to the Somerville Climate Change Vulnerability Assessment and the updated stormwater flooding maps provided in the Background section of this Questionnaire. Additional maps and data are available at www.somervillema.gov/floodready or by request (email ose@somervillema.gov).

No, this site falls outside of a major flood impact event based on the storm flooding maps provided. It is not anticipated to be susceptible to sea level rise implications now or in the expected lifetime of the building.

If you answered YES to the previous question, please complete the remainder of Section 6. Otherwise, you have completed the Questionnaire. Thank you.

6.2 Flooding Design Considerations

Proposed Site Elevation - Low	(ft)	Proposed Site Elevation - High	(ft)
Lowest elevation of life-safety systems	(ft)	Proposed First Floor Elevation	(ft)
Nearest flood elevation for the 2070 10-year storm		Nearest flood elevation for the 2070 100-year storm	

6.3 What are the first floor uses of the building? Are there any below ground stories of the building? If so, what uses are located below ground?

6.4 Are there any flood-sensitive assets, utilities, mechanical equipment, or life-safety systems located in areas of the building that are at risk of flooding? What measures will protect building systems during a flood or severe storm? These might include, but may not be limited to, the following:

- Elevation of utilities and mechanical systems
- Water tight utility conduits
- Waste water back flow prevention
- Storm water back flow prevention
- Systems located above the ground floor
- Securing objects at risk of becoming dislodged

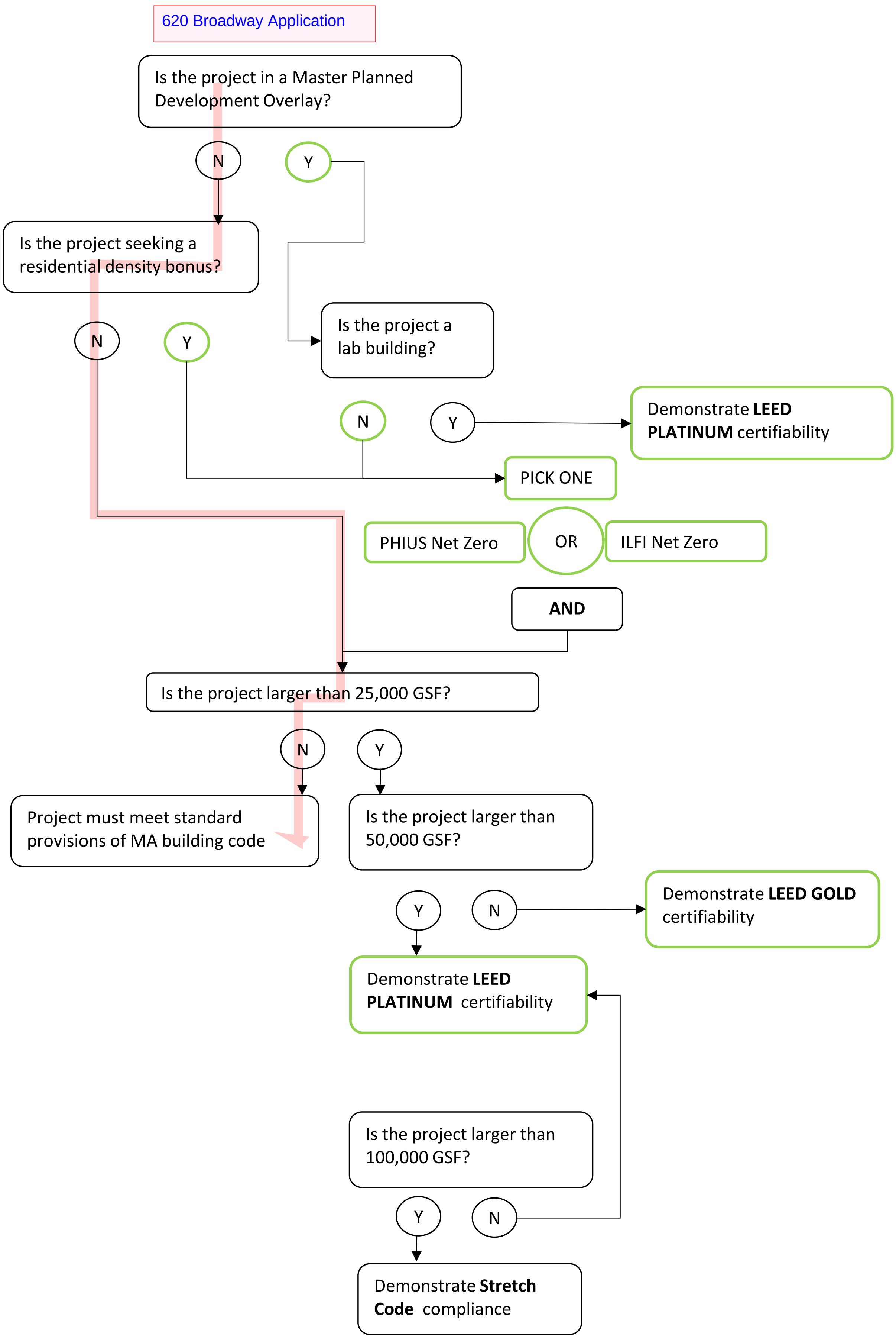
6.5. Residential and commercial buildings should be designed to maintain regular operations during a 10-year storm in 2070. **Describe how the site and building have been designed to maintain regular operations--meaning all systems will remain operational and all occupied spaces are protected from flooding-- during the 2070 10-year storm.** Please refer to both the 2070 coastal flood probability map and the 2070 10-year storm and 1-year sea level rise scenario (pages 3 and 6). Resilience measures might include, but may not be limited to, the following:

- Elevation of the site
- Structural elevation of the building
- Non-structural elevation of the ground floor
- Energy storage and backup generation
- Wet flood-proofing (allowing water to flow through building envelope)
- Dry flood-proofing (preventing water from entering building)

6.6 Residential buildings should be designed to allow occupants to shelter in place during a catastrophic storm (100-year event) today and in the future, this means all life-safety systems should be above the 2070 100-year flood elevation. **How will your site and building be impacted by the 2070 100-year, 24-hour storm and how will your site and building be designed to protect against those impacts?** Please evaluate impact based on both the 2070 coastal flood depth model for the 100-year storm and the 2070 100-year, 100-year sea level rise model (pages 4 and 7). Summarize anticipated pre- and post-event policies, strategies, and actions necessary to facilitate post-flood recovery.

6.7 Will hazardous or toxic material be stored on site? Where will it be stored? How will you protect hazardous or toxic material from flooding?

6.8 Will the site be accessible by a typical vehicle during a 10-year event (up to 6 inches of water) and by emergency vehicles (up to 12 inches of water) during a 100-year event?


620 Broadway Application
Is the project in a Master Planned Development Overlay?
N
Y
Is the project seeking a residential density bonus?
N
Y
Is the project a lab building?
N
Y
Demonstrate **LEED PLATINUM** certifiability
PICK ONE
PHIUS Net Zero
OR
ILFI Net Zero
AND
Is the project larger than 25,000 GSF?
N
Y
Project must meet standard provisions of MA building code
Is the project larger than 50,000 GSF?
Y
N
Demonstrate **LEED GOLD** certifiability
Demonstrate **LEED PLATINUM** certifiability
Is the project larger than 100,000 GSF?
Y
N
Demonstrate **Stretch Code** compliance

Somerville Low Load Buildings Energy Input Form

Updated 12/6/2021

Context:

Somerville Climate Forward, Somerville's Community Climate Action Plan, identifies the need for new devleopment to meet net zero emissions standards to support the citywide goal of achieving
New buildings and extensive renovations should ideally be designed to achieve operational carbon neutrality and to minimize embodied carbon in construction materials.
Reducing heating loads is the single-most important step towards designing a cost-effective, zero-carbon building in Somerville.
This calculator provides an easy way to assess and reduce your building's loads.

The purpose of the Low Load Building Energy Input Form is to:

- Quantify the heating loads of the Proposed building and compare them to: 1) a low load scenario and 2) the MA minimum code requirements.
- Support consistency and transparency in the development and review of a project's approach to cost effective zero-carbon design.

Encourage practical and cost effective design decisions that enable the efficient electrification of commercial buildings

The Calculator compares four building scenarios:

- Proposed Building: The building as-designed.
- ASHRAE 2013: A code compliant equivalent to the as-designed building
- Low Load Building: The building with low heating load components, targeting cost-effective Zero Net Carbon (ZNC).

How to use this workbook:

- The table below outlines the primary steps.

All inputs required by the user are highlighted in blue cells.

Step	Tab	Inputs	Outputs	Opportunities
1	PRE-SUBMITTAL INFO	Enter Proposed Building Parameters	Review Envelope Outputs and Heating load of the Proposed building and compare to Low Load building and MA Code Minimum building.	If the Proposed Heating Load is equal to or less than the Low Load Target *AND* the proposed design is all electric, then you are done. There is no need to submit energy model results for development review. FOR LABS AND HEALTHCARE ONLY: If the Proposed Heating Load is equal to or less than the Low Load Target *AND* the Proposed Electric Heat Pump Heating Capacity is equal to or greater than the 35°F Ambient Suggested Minimum Heat Pump Heating Capacity, then you are done. There is no need to submit energy model results for development review.
2	DEVELOPMENT REVIEW INFO	Enter Energy Model Results	Review the outputs in the Development Review Dashboard to determine LEED Point Earnings. Confirm that your EAc1 point totals are consistent with your LEED checklist.	

PRE-SUBMITTAL LOAD ASSESSMENT

Reducing heating loads is the single-most important step towards designing a cost-effective zero-carbon building in Somerville.
This calculator provides an easy way to assess and reduce your building's loads.

Instructions:

1. Fill in the blue cells with your project information: All user inputs in blue are required.
2. Review Pre-Submittal Dashboard tab.
3. Compare the Proposed heating load to the heating load of a MA Code Minimum design, and to a Low Load design.
4. For more details, review the 'Detailed Loads' tab. It provides a summary of the assumptions in the MA Code and Low Load options.
5. Consider strategies to cost-effectively reduce the heating load and heating capacity of the Proposed design.

Project Name	620 Broadway	
Project Address	620 Broadway, Somerville, MA 02144	
Submission date	8/24/2022	
Filing	P&Z 21-145	
Individual responsible of submission	Peter Quinn AIA	
Firm responsible for submission	Peter Quinn Architects LLC	
Project team		
Owner	620 Broadway, LLC	
Architect	Peter Quinn Architects LLC	
MEP Consultant	Zade Associates, LLC	
Energy Performance Consultant		*if applicable*
Envelope Consultant		*if applicable*
Summary of submission	The Application is for a one-story commercial building with tenant fit-outs to be completed by others. The building will be set up by the Applicant for a high level of energy efficiency and air quality for the future tenants. All base building mechanical systems will be specified as all-electric. Onsite electrical generation is anticipated by way of a planned rooftop solar array. Base building materials are being selected for their recyclability and, where possible, their low-carbon footprint. Overall, the development constitutes the redevelopment of a former gas station with site cleanup. Anticipated tenants include a retail cannabis operation, a small art-gallery type user, and a third tenant could be a retailer or small cafe.	*Outline key project goals, progress to date and major takeaways from this submission.*

General Project Inputs			User Comments	Instructions
Number of Stories Above Grade	1			Do not include mechanical penthouse or unconditioned rooftop amenity spaces as a story.
Total Building Gross Floor Area	6,961	GSF		Automatically calculated, based on sum of individual building types input below. Confirm that the value correctly aligns with the total building value.
Total Building Net Occupiable Floor Area	6,646	NSF		Automatically calculated, based on sum of individual building types input below.
Total Building Vertical Façade Area	7,855	SF		Automatically calculated, based on sum of individual building types input below.
Roof Area	6,646	SF		Include total roof area as seen from above. Includes mechanical penthouse roofs and spaces throughout the building where ambient air is located outside of the ceiling plane (even if not on top of building).

Primary Building Type			User Comments	Instructions
Primary Building Type	Retail (stand alone)			Select from menu. Primary building type is the use type representing the greatest % of total building floor area. If the specific type of the Proposed building is not listed in the menu, select the type that is most similar. NOTE: if a single development includes multiple separate buildings, project teams are encouraged to use a separate CNBA calculator for each building. Otherwise, the daylight area and code-reference window area calculations will be incorrect. In such cases: the user must provide a separate a summary spreadsheet with total results summary tables and charts similarly formatted to this spreadsheet, including load, construction cost, and emissions summary, combining of all buildings in the development.
Gross Square Feet	6,961	GSF		Input gross square feet associated with the Primary Building Type. Do not include outdoor unconditioned areas or unconditioned garage spaces. If there are more than 3 building use types, input the total value that does not fall under Secondary and Tertiary categories below.
Vertical Façade Area	7,855	SF		Input total exterior facade area associated with the Primary Building Type, including exterior wall and window area, as defined by IECC 2018. Include only facade areas that separate interior conditioned/heated space from the exterior. Exclude other areas, such as: screen walls, parapets, mechanical louvers, and areas that separate non-conditioned space from the exterior. If there are more than 3 building use types, input the total value that does not fall under Secondary and Tertiary categories below.
Window Area (SF)	1,798	SF		Input window area associated with primary building. Calculated by measuring the rough opening of the window assembly. Spandrel area that does not allow light into the interior of the building is excluded. If there are more than 3 building use types, input the total value that does not fall under Secondary and Tertiary categories below.

Secondary Building Type			User Comments	Instructions
Secondary Building Type				Secondary building type is the use type representing the second greatest % of total building floor area.
Gross Square Feet		GSF		Provide inputs for the Secondary Building Type, similar to the process used for the Primary Building Type, defined above.
Vertical Façade Area		SF		Provide inputs for the Secondary Building Type, similar to the process used for the Primary Building Type, defined above.
Window Area (SF)		SF		Provide inputs for the Secondary Building Type, similar to the process used for the Primary Building Type, defined above.

Tertiary Building Type			User Comments	Instructions
Tertiary Building Type				Tertiary building type is the use type representing the third greatest % of total building floor area.
Gross Square Feet		GSF		Provide inputs for the Tertiary Building Type, similar to the process used for the Primary Building Type, defined above.
Vertical Façade Area		SF		Provide inputs for the Tertiary Building Type, similar to the process used for the Primary Building Type, defined above.
Window Area (SF)		SF		Provide inputs for the Tertiary Building Type, similar to the process used for the Primary Building Type, defined above.

Envelope Parameters			User Comments	Instructions
Window Assembly U-value	0.38	Btu/h-F-sf		U-value times Area (UxA) weighted average for all windows. [(U-value window type 1) x (Area window type 1) + (U-value window type 2) x (Area window type 2) ....] / [Total window area]
Wall Assembly U-value	0.064	Btu/h-F-sf		UxA weighted average for all walls. [(U-value wall type 1) x (Area wall type 1) + (U-value wall type 2) x (Area wall type 2) ....] / [Total wall area]. For assembly U-values see ASHRAE 90.1-2016 Normative Appendix A
Roof Assembly U-value	0.021	Btu/h-F-sf		UxA weighted average for all roofs. [(U-value roof type 1) x (Area roof type 1) + (U-value roof type 2) x (Area roof type 2) ....] / [Total roof area] For assembly U-values see ASHRAE 90.1-2016 Normative Appendix A
Infiltration - Maximum at Blower Door Test	0.25	cfm/sf at 75pa		IECC 2018 requires 0.25 cfm/sf @ 75 Pa

HVAC Parameters			User Comments	Instructions
Minimum Outdoor Airflow + Make-Up Rate	17	CFM	Per Person	Input the minimum outdoor airflow rate required by ASHRAE 62.1 and/or ASHRAE 170 (licensed healthcare facilities), or minimum make-up airflow required. Make-up airflow is applicable to spaces with required minimum air-change rates (such as laboratories) or make-up is required due to a dedicated exhaust system (such as fume hoods, kitchen exhaust, etc.).
Proposed Outdoor Airflow + Make-Up Rate	17	CFM	Per Person	Input the as-designed outdoor airflow quantity.
IF LAB OR HEATHCARE Class 3 and 4 Exhaust (CFM)		CFM		Class 3 and 4 Exhaust is defined as exhaust meeting the definition of Class 3 and 4 air in ASHRAE/ASHE Standard 62.1-2019, including laboratory fume hood exhaust, laboratory general exhaust when combined with laboratory fume hood exhaust, exhaust where energy recovery is not allowed by ASHRAE/ASHE Standard 170 for use in energy recovery systems with leakage potential, and systems exhausting toxic, flammable, paint or corrosive fumes or dust. The Class 3 and 4 Exhaust system must be capable of reducing exhaust and makeup airflow rates to 50% of the zone design values or the minimum required to maintain pressurization relationship requirements. Excludes Exempt Exhaust. Excludes Class 2 Exhaust. Exludes Class 1 Exhaust: for example, exludes office exhaust, even when the Proposed design has a combined office and laboratory exhaust system.
IF EXEMPT SPECIALTY EXHAUST OR COMMERCIAL KITCHENS INCLUDED Exempt Exhaust (CFM)		CFM		Exempt Exhaust is defined as exhaust where energy recovery systems are prohibited by 780 CMR or the International Mechanical Code. This includes exhaust from commercial kitchen hoods used for collecting and removing grease vapors and smoke. It also includes radioactive isotope exhaust. If exhaust heat recovery is included in the proposed design, the exhaust should not be classified as Exempt.
IF MECHANICALLY HUMIDIFIED Humidification Load		MBH		If the building, or a portion of the building is humidified, input the humidification load here. This value is carried consistently across all options.
IF APPLICABLE Process Heating Load		MBH		If the building heating plant supplies heating energy for process loads, input the total of all process loads supplied by the building heating system, such as: pool heating, sterilization, domestic hot water. Do NOT include process loads supplied by systems other than the building heating plant. This value is carried consistently across all options.
Ventilation Heating Sensible Recovery Effectiveness		%	TBD	Sensible Energy Recovery Effectiveness is defined as the change in the dry-bulb temperature of the outdoor air supply achieved by the heat recovery device, divided by the difference between the outdoor air and entering exhaust air dry-bulb temperatures, at 0˚F winter design condition, expressed as a percentage. For buildings with multiple types of exhaust heat recovery, this value shall be the cfm-weighted average value.
Ventilation Cooling Total Enthalpy Recovery Effectiveness		%	TBD	Enthalpy Energy Recovery Effectiveness is defined as the change in the enthalpy of the outdoor air supply achieved by the heat recovery device, divided by the difference between the outdoor air and entering exhaust air enthalpy, at summer design condition, expressed as a percentage. For buildings with multiple types of exhaust heat recovery, this value shall be the cfm-weighted average value.
Class 3 and 4 Exhaust Sensible Recovery Effectiveness		%	TBD	Sensible Energy Recovery Effectiveness is defined above. For buildings with multiple types of exhaust heat recovery, this value shall be the cfm-weighted average value.
Electric Space Heating Plant Capacity (at 35°F ambient)		MBH	TBD	Input the proposed capacity (useful heating output at 35°F ambient condition) of the building's electric space heating system (heat pump for labs and healthcare; heat pump or electric resistance for all other building types). EXCLUDE the capacity of redundant equipment that is intended to operate only when heating equipment fails (commonly referred to as an N+1 configuration). Also EXCLUDE the capacity of redundant equipment that is intended to operate when ventilation heat recovery devices fail. This can be generated from preliminary calculations used to size the heating plant in the conceptual stages of design. EXCLUDE humidification and process heating loads (these are accounted for separately below).
Non-Electric Space Heating Plant Capacity	NA	MBH	NA	Input the proposed capacity (useful heating output at design conditions) of the building's non-electric space heating system (e.g. fossil-fuel or district steam). EXCLUDE the capacity of redundant equipment that is intended to operate only when heating equipment fails (commonly referred to as an N+1 configuration). Also EXCLUDE the capacity of redundant equipment that is intended to operate when ventilation heat recovery devices fail. This can be generated from preliminary calculations used to size the heating plant in the conceptual stages of design. EXCLUDE humidification and process heating loads (these are accounted for separately below).
Total (Non-Redundant) Space Heating Plant Capacity		MBH	TBD	If the electric + non-electric heating system does not include redundancy, add rows 79 and 80. EXCLUDE the capacity of redundant equipment that is intended to operate only when other equipment fails (commonly referred to as an N+1 configuration). If there is redundancy between electric + non-electric heating systems, EXCLUDE redundant capacity. For example, if the non-electric heating plant is designed to handle the entire heating load, and the electric heating plant is redundant, then only enter the non-electric heating plant capacity. This can be generated from preliminary calculations used to size the heating plant in the conceptual stages of design.
Will the building's heating system be 100% electric?	Yes			This aligns with the City of Somerville's goals for carbon neutral ready buildings
Will the building's DHW be 100% electric?	Yes			This aligns with the City of Somerville's goals for carbon neutral ready buildings
Cooling Plant Capacity		Tons		Input the proposed cooling system capacity. This may include capacity for all uses such as: space cooling, dehumidification, process cooling loads, etc.

Envelope Outputs			User Comments	Instructions
Window-to-wall ratio	23%			Automatically calculated value. Review and confirm this aligns with the design intent. If inputs above are correct, this is the value following IECC 2018 protocol. Note: this is a simplified calculation and does not account for some envelope components, such as foundations and exposed floor areas.
Average Envelope U-value (UxA / A) - Design	0.083	Btu/h-F-sf		Automatically calculated value. Review and confirm this aligns with the design intent. If inputs above are correct, this is the value following IECC 2018 protocol. Note: this is a simplified calculation and does not account for some envelope components, such as foundations and exposed floor areas.
Average Envelope U-value (UxA / A) - Maximum per Code	0.089	Btu/h-F-sf		Automatically calculated value. If inputs above are correct, this is the approximate maximum allowable value following IECC 2018 protocol. Note: this is a simplified calculation and does not account for some envelope components, such as foundations and exposed floor areas.
Average Envelope U-value (UxA / A) - Aligns with Code?	Yes	Btu/h-F-sf		If "NO" is shown in red, the envelope likely does not comply with MA Energy Code (780 CMR revised 9th edition / IECC 2018, mandatory as of January 2021) and should be revised. Note: this is a simplified calculation and does not account for some envelope components, such as foundations and exposed floor areas. Therefore, it is not proof or equivalence of the envelope backstop code compliance.

Heating Capacity			User Comments	Instructions
Low Load Building - Heating Plant Capacity	12.3	Btu/h-sf		Automatically calculated value. Indicates a Low-Load target value, intended to optimize cost-effective electrification and procurement of renewable energy to achieve Zero Net Carbon (ZNC).
Proposed Building - Heating Plant Capacity	-	Btu/h-sf		Automatically calculated value. Indicates the Proposed Design value, per the inputs above. Design teams should pursue low-load, cost-effective solutions to meet the City of Somerville's Climate Action goals.
MA Code Minimum Building - Heating Plant Capacity	19.1	Btu/h-sf		Automatically calculated value. Indicates the value for a building that meets the MA Code Minimum envelope and exhaust heat recovery performance.

DEVELOPMENT REVIEW INFO

New buildings and extensive renovations should ideally be designed to achieve operational carbon neutrality and to minimize embodied carbon in construction materials.
This calculator provides an easy way to assess the operational emissions of your proposed design.

Instructions:

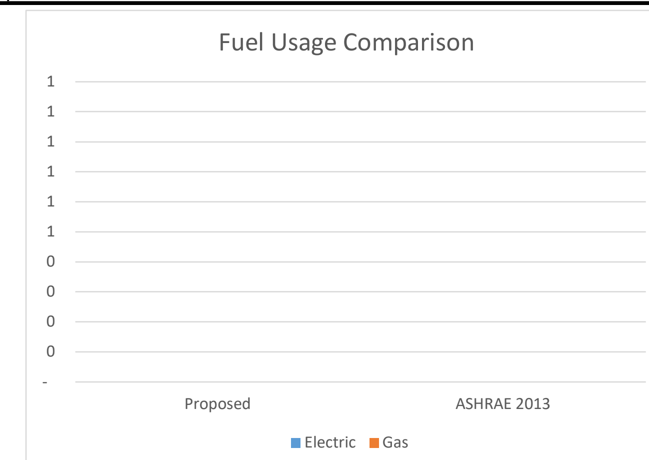
1 Fill in the blue cells with the required information: All user inputs in blue are required.
2 Review the Development Review Dashboard tab.
3 Compare the Proposed design to that of the MA Code Minimum design, and the 'Low Load' design.
4 Consider strategies to cost-effectively reduce the loads of the Proposed design to bring it closer in line to the Low Load building.

Energy Use Inputs	Site Annual Energy Consumption (MMBtu/yr)			Energy Use Intensity (kBtu/sf/yr)						
End Use Breakdown	Zero Carbon	Proposed	ASHRAE 2013	Low Load	Proposed	ASHRAE 2013	Fuel Type (drop-down menu)	Instructions	User Comments	Somerville Comments
Lighting					-	-				
Plug Loads					-	-				
Fans					-	-				
Pumps					-	-				
Cooling					-	-				
Heating - Non-Electric 1					-	-				
Heating - Non-Electric 2					-	-				
Heating - Electric					-	-				
DHW - Non-Electric 1					-	-				
DHW - Non-Electric 2					-	-				
DHW - Electric	not required			not required	-	-				
Process 1					-	-		Process loads may include: pool heating, sterilization, humidification, etc.		
Process 2					-	-				
Process 3					-	-				
Process 4					-	-				
On-site Renewables (negative)					-					
Off-Site Renewables (negative)					-			Off-Site Renewable energy is limited to MA Class I RECs and minimum 15-year power purchase agreements for new renewable energy systems (installed within last 3 years) from grid regions with emissions factors at least as high as ISO-NE.		
TOTAL without Renewable Energy		-	-		-	-				
TOTAL with Renewable Energy		-	-		-	-				

(if cogen is part of the proposed design, charge fuel consumption to Heating and credit electricity generation proportionally to all electric end uses)

Emissions Outputs	Energy Consumption by Fuel (MMBtu/yr)			Current Carbon Emissions (metric tons CO2e/yr)			2035 Carbon Emissions (metric tons CO2e/yr)		
Fuel Type	Low Load	Proposed	ASHRAE 2013	Zero Carbon	Proposed	ASHRAE 2013	Zero Carbon	Proposed	ASHRAE 2013
Renewable Electric Credit		-	-		-	-			
Electric		-	-		-	-		-	-
Gas		-	-		-	-		-	-
Oil		-	-		-	-			
Propane	not required	-	-	not required	-	-	not required		
Other District Heating		-	-		-	-			
District Cooling		-	-		-	-			
Other Fuel 1		-	-		-	-			
Other Fuel 2		-	-		-	-			
TOTAL without Renewable Energy	-	-	-	0	-	-	0	-	-
TOTAL with Renewable Energy	-	-	-	0	-	-	0	-	-
Energy Use Intensity (kBtu/sf/yr)		-	-						

Emissions Intensity Outputs	Carbon Emissions Intensity (lbCO2e/yr-sf)		
	Low Load	Proposed	ASHRAE 2013
TOTAL Without Renewable Energ	not required	-	-
Renewable Energy Credit		-	-
TOTAL with Renewable Energy	-	-	-



Carbon Emissions Factors for City of Somerville		
Fuel Type	lbCO2e/MMBtu	Value is based on:
Renewable Electric Credit	155	
Electric	155	*Portfolio Manager Region Emissions Inensity. Note: this value will not match MEPA/DOER submissions, but it is used for LEED points.*
Electric 2035	115	
Gas	117	*US EIA value*
Oil	161	*US EIA value*
Propane	139	*US EIA value*
Other District Heating		*User to calculate and input custom value.*
District Cooling		*User to calculate and input custom value, based on the specific district chilled water system.*
Other Fuel 1		*User to calculate and input value for Other fuel type.*
Other Fuel 2		*User to calculate and input value for Other fuel type.*
		User to input description of Other Fuel type.

Footnotes:

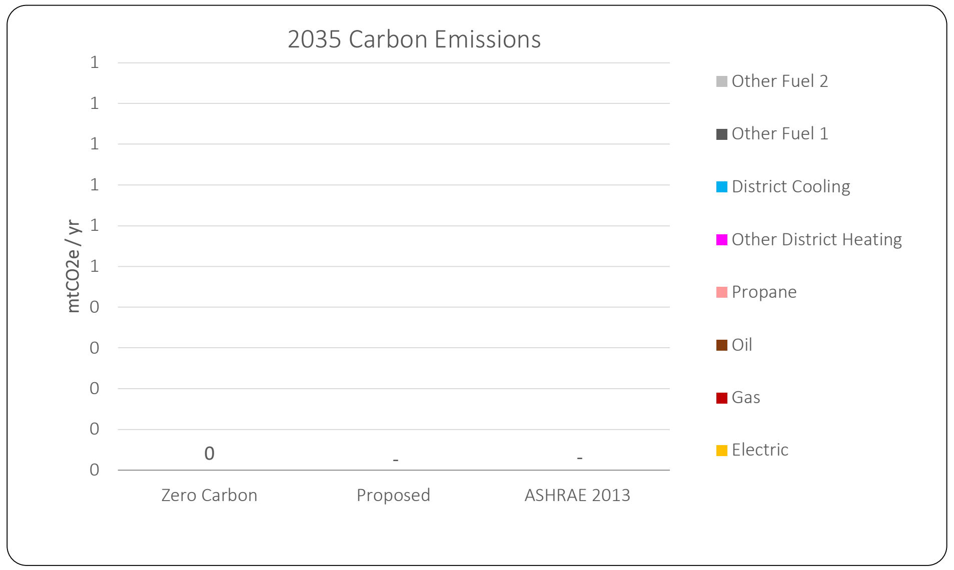
1. Based on the latest ISO-NE Emissions Report. Should be updated as more recent ISO-NE Emissions Reports are available.

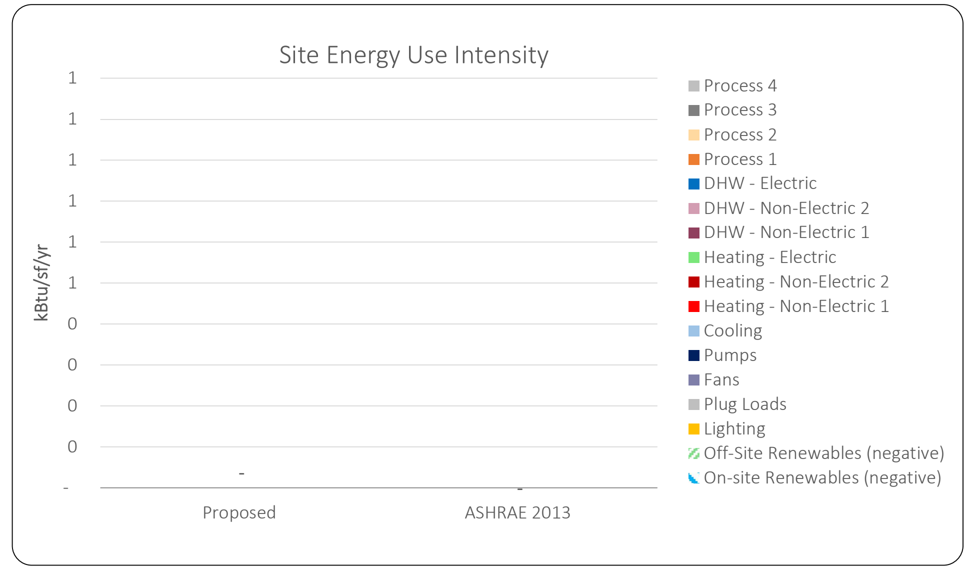
DEVELOPMENT REVIEW DASHBOARD

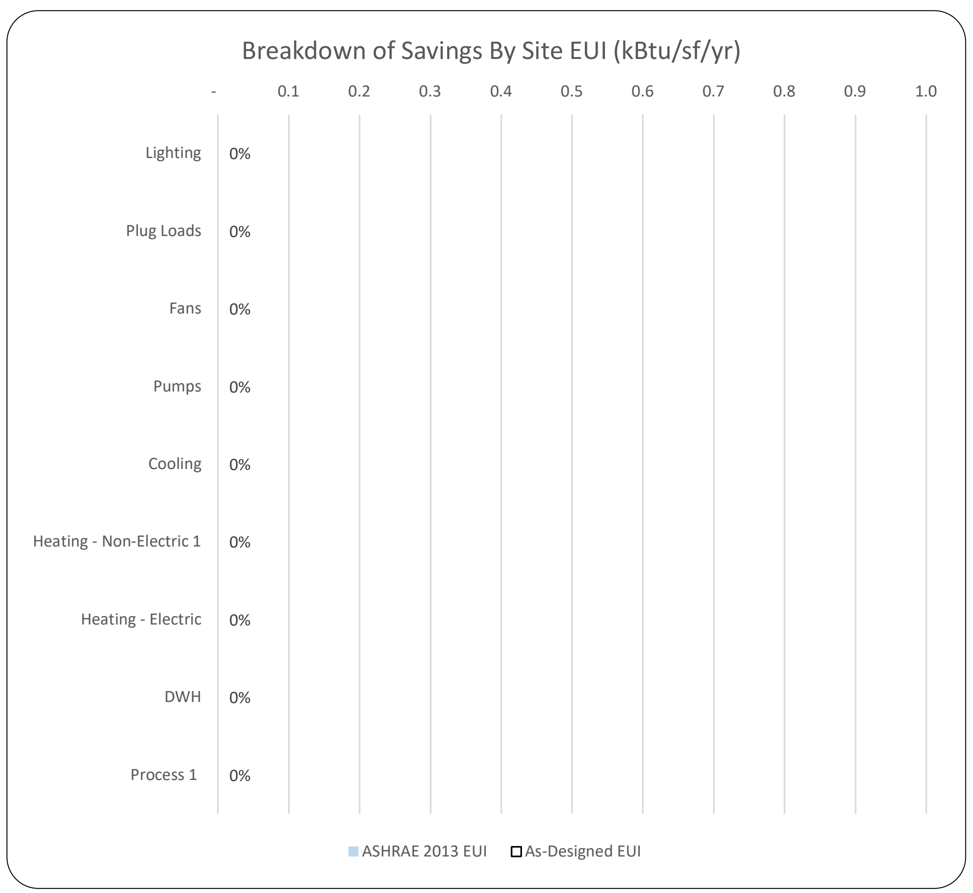
	Proposed	ASHRAE 2013	% Savings
Current Carbon Emissions Intensity (lbCO2e/yr-sf)	0.0	0.0	#DIV/0!
Site Energy Use (kBtu/sf/yr)	0.0	0.0	#DIV/0!
Source Energy Use (kBtu/sf/yr)	0.0	0.0	#DIV/0!
Annual Carbon Offsets to achieve ZNC (metric tons CO2e/yr)	0	0	
2035 Carbon Emissions Intensity (lbCO2e/yr-sf)*	0	0	#DIV/0!

LEED EAc1 Optimize Energy Performance Point Calculator**

Please Select Rating system	LEED NC CS	
Please Select Building Type	All Other	
Points earned	#DIV/0!	Min 10 pts***







** A 40% savings CO2e emissions target (using 2035 emissions factors) has been established based on the findings of Built Environment Plus' "Massachusetts is Ready for Net Zero 2021 Report." The report surveyed over 7 Million GSF of Net-Zero buildings spanning a range of building types including K-12, Higher Education, Healthcare, Laboratory, Office, and Multifamily buildings in Massachusetts. The report findings indicate that a 40% savings in CO2e emissions, based on 2035 ISO-NE emissions rates, is a readily acheivable benchmark for high-performance buildings within the Greater Boston Area. The target represents the building-level operational carbon emissions reductions expected by the City of Somerville prior to the purchase of onsite or offsite renewable energy, or carbon offsets.*

***The City of Somerville requires projects to use the Alterntative Energy Performance Metric Pilot Credit EApc95 (https://www.usgbc.org/credits/eapc95v4). This compliance path allows projects to document performance improvements using Option 1 Whole Building Simulation and leverage an average of source energy and carbon emissions as an indicator of performance. The City prefers this compliance path as the considerations for CO2e emissions aligns with the City's Net Zero Performance goals.*

**** An EAc1 earning of at least 10 points is best poised to align with the City's CO2e and energy performance goas.*

Per ASHRAE 90.1-2019 Appendix G with MA Amendments (780 CMR revised 9th edition, mandatory as of January 2021)

Building Area Types Baseline Building Gross Above-Grade % Glazing	%
Grocery store	7%
Healthcare (outpatient)	21%
Hospital	27%
Hotel/motel (≤75 rooms)	24%
Hotel/motel (>75 rooms)	34%
Office or Laboratory Building (≤5000 ft2)	19%
Office or Laboratory Building (5000 to 50,000 ft2)	31%
Office or Laboratory Building (>50,000 ft2)	40%
Restaurant (quick service)	34%
Restaurant (full service)	24%
Retail (stand alone)	11%
Retail (strip mall)	20%
School (primary)	22%
School (secondary and university)	22%
Warehouse (non-refrigerated)	6%
Multifamily	24%

Approximate value, based on technology available in 2020.

Heat Pump Electrical Infrastructure Design Demand Conversion Factor	COP
VRF	2.0
Air to Water	1.7
Exhaust-Source	1.9

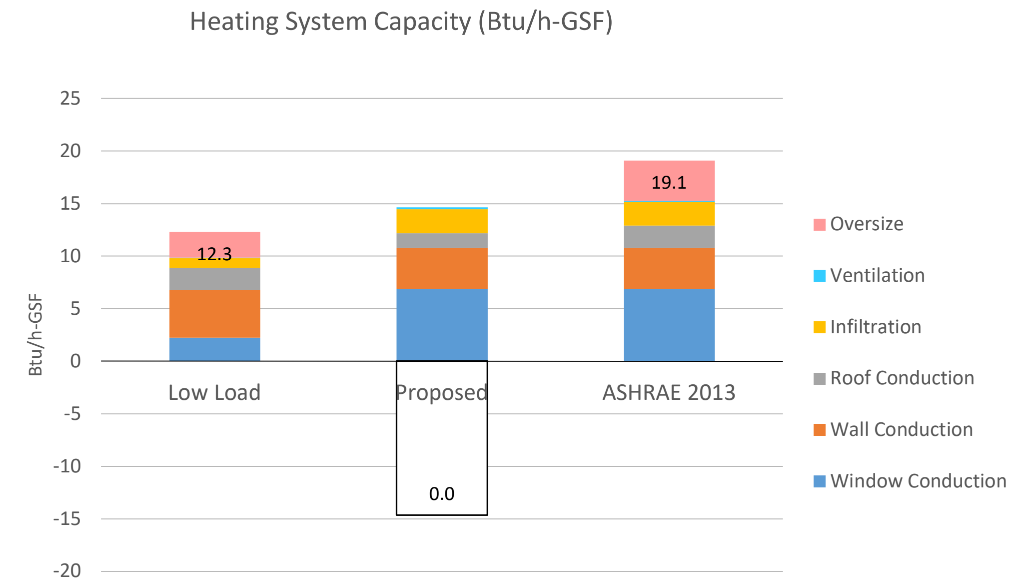
LOAD CALCULATIONS

This tab automatically creates the 'ZNC' and 'MA Code' options.
It then calculates the heating load associated with each option.

It also calculates the ventilation cooling load credit for the ZNC option.

Instructions:

1 This tab must remain locked for submission to the City of Somerville



Heating Load Outputs (Btu/h-GSF)	Low Load	Proposed	ASHRAE 2013
Window Conduction	2.3	6.9	6.9
Wall Conduction	4.5	3.9	3.9
Roof Conduction	2.1	1.4	2.1
Infiltration	0.9	2.3	2.3
Ventilation	0.0	0.2	0.1
Oversize	2.5	-14.6	3.8
Total Space Heating System Load	**12.3**	**0.0**	**19.1**
TOTAL Conduction	8.9	12.2	12.9
TOTAL Envelope	9.8	14.4	15.2
NON-Space-Heating Plant Load	47.8	47.8	47.8

Summary of Automatic Changes to Proposed Design	Low Load	Proposed	ASHRAE 2013
Total Building - Window to Wall Ratio	11%	23%	23%
Window Average Assembly U-value (Btu/h-ΔT-sf)	0.26	0.38	0.38
Wall Average Assembly U-value (Btu/h-ΔT-sf)	0.064	0.064	0.064
Roof Average Assembly U-value (Btu/h-ΔT-sf)	0.032	0.021	0.032
Infiltration - Maximum at Blower Door Test (cfm/sf at 75pa)	0.10	0.25	0.25
Proposed Outdoor Airflow Rate (CFM)	17	17	17
Ventilation Heating Sensible Recovery Efficiency	80%	0%	50%
Class 3 and 4 Exhaust Sensible Recovery Efficiency	55%	0%	0%
Electric Heating System Capacity (Btu/h-gsf)	0.0	0.0	0.0
Oversize Factor: Heating System Capacity / Heating Load (%)	125%	0%	125%

General Information	Low Load	Proposed	ASHRAE 2013
Number of Stories Above Grade	1	1	1
Total Building Gross Floor Area	6,961	6,961	6,961
Total Building Net Occupiable Floor Area	6,646	6,646	6,646
Daylight Area (per IECC 2018)	-	-	-
Total Building Vertical Façade Area	7,855	7,855	7,855
Roof Area	6,646	6,646	6,646

Primary Building Type	Low Load	Proposed	ASHRAE 2013
Primary Building Type	Retail (stand alone)	Retail (stand alone)	Retail (stand alone)
Gross Square Feet	6,961	6,961	6,961
Vertical Façade Area	7,855	7,855	7,855
Window Area	n/a	1,798	n/a

Secondary Building Type	Low Load	Proposed	ASHRAE 2013
Secondary Building Type	-	-	-
Gross Square Feet	-	-	-
Vertical Façade Area	-	-	-
Window Area	n/a	-	n/a

Tertiary Building Type	Low Load	Proposed	ASHRAE 2013
Tertiary Building Type	-	-	-
Gross Square Feet	-	-	-
Vertical Façade Area	-	-	-
Window Area	n/a	-	n/a

Daylight Area	Low Load	Proposed	ASHRAE 2013
% Daylight Area	0%	0%	0%
Daylight Area >25%? (or >50% if building is <3 stories above grade)	No	No	No

Envelope	Low Load	Proposed	ASHRAE 2013
Total Vertical Façade Area	7,855	7,855	7,855
Primary Building - Window to Wall Ratio	11%	23%	n/a
Secondary Building - Window to Wall Ratio	0%	0%	n/a
Tertiary Building - Window to Wall Ratio	0%	0%	n/a
Total Building - Window to Wall Ratio	11%	23%	23%
Total Window Area	864	1,798	1,798
Window Average Assembly U-value (Btu/h-ΔT-sf)	0.26	0.38	0.38
Wall Area (SF)	6,991	6,057	6,057
Wall Average Assembly U-value (Btu/h-ΔT-sf)	0.064	0.064	0.064
Roof Area (SF)	6,646	6,646	6,646
Roof Average Assembly U-value (Btu/h-ΔT-sf)	0.032	0.021	0.032
Infiltration - Maximum at Blower Door Test (cfm/sf at 75pa)	0.1	0.25	0.25
Infiltration - Maximum at Blower Door Test (cfm at 75pa)	1,500	3,600	3,600
Infiltration - Design (cfm)	84	210	210
Average UxA Value[2]	0.061	0.083	0.089

Ventilation	**Low Load**	**Proposed**	**ASHRAE 2013**
Minimum Outdoor Airflow Rate (CFM)	17	17	17
Minimum Outdoor Airflow Rate (CFM/Net SF)	0.00	0.00	0.00
Proposed Outdoor Airflow Rate (CFM)	17	17	17
Proposed Outdoor Airflow Rate (CFM/Net SF)	n/a	0.00	n/a
Exhaust/Relief Air (not including Class 3 and 4 and Exempt Exhaust)	17	17	17
Ventilation Heating Sensible Recovery Efficiency	80%	0%	50%
Class 3 and 4 Exhaust (CFM)	-	-	-
Class 3 and 4 Exhaust Sensible Recovery Efficiency	55%	0%	0%
Exempt Exhaust (CFM)	-	-	-
Exempt Exhaust Heat Recovery Efficiency	0%	0%	0%
Average Exhaust Heat Recovery Efficiency	80%	0%	50%

Heating Load	**Low Load**	**Proposed**	**ASHRAE 2013**
Delta-T (˚F Outdoor - ˚F Indoor)	70	70	70
Window Conduction Heating Load (MBH)	16	48	48
Wall Conduction Heating Load (MBH)	31	27	27
Roof Conduction Heating Load (MBH)	15	10	15
Envelope Infiltration Heating Load (MBH)	6	16	16
Ventilation Heating Load (MBH)	0	1	1
Safety Factor (MBH)	17	(102)	27
TOTAL Space Heating System Load (MBH)	86	-	133
Total Envelope Conduction Heating Load (MBH)	62	85	90
Maximum Electric Heating System Capacity (Btu/h-gsf)	n/a	n/a	n/a
Electric Heating System Capacity (Btu/h-gsf)	-	-	-
Electric Heating System Capacity (MBH)	-	-	n/a
Other Heating System Capacity (MBH)	86	NA	133
TOTAL Heating System Capacity (MBH)	n/a	-	n/a
Oversize Factor: Heating System Capacity / Heating Load (%)	125%	0%	125%
NON-Space-Heating Plant Capacity (MBH)	333	333	333

Ventilation Cooling Load	**Low Load**	**Proposed**	**ASHRAE 2013**
Outdoor Air - Temperature (F)	91	91	91
Outdoor Air - Wet Bulb (F)	73	73	73
Outdoor Air - Enthalpy (Btu/lb)	36.48	36.48	36.48
Indoor Air - Temperature (F)	75	75	75
Indoor Air - Relative Humidity (%)	55%	55%	55%
Indoor Air - Enthalpy (Btu/lb)	29.13	29.13	29.13
Ventilation Cooling Enthalpy Recovery Efficiency (%)	78%	0%	50%
Ventilation Air after Energy Recovery - Enthalpy (Btu/lb)	30.78	36.48	32.81
Ventilation Discharge Air Enthalpy (Btu/lb)	22.13	22.13	22.13
Ventilation Delta H (Btu/cfm)	8.65	14.35	10.68
Ventilation Cooling Load (Btu/cfm)	39	65	48
Ventilation Cooling Load (Tons)	0	0	0
Class 3 and 4 Exhaust Sensible Heat Recovery Efficiency (%)	55%	0%	0%
Class 3 and 4 Exhaust Make Up - Temperature after Energy Recovery (F)	82	91	91
Class 3 and 4 Exhaust Make-Up Load Reduction (Tons)	0	0	0
Total Load Reduction (Tons)	0	-	0

LOAD CALCULATIONS

This tab automatically creates the 'ZNC' and 'MA Code' options.
It then calculates the heating load associated with each option.

It also calculates the ventilation cooling load credit for the ZNC option.

Instructions:

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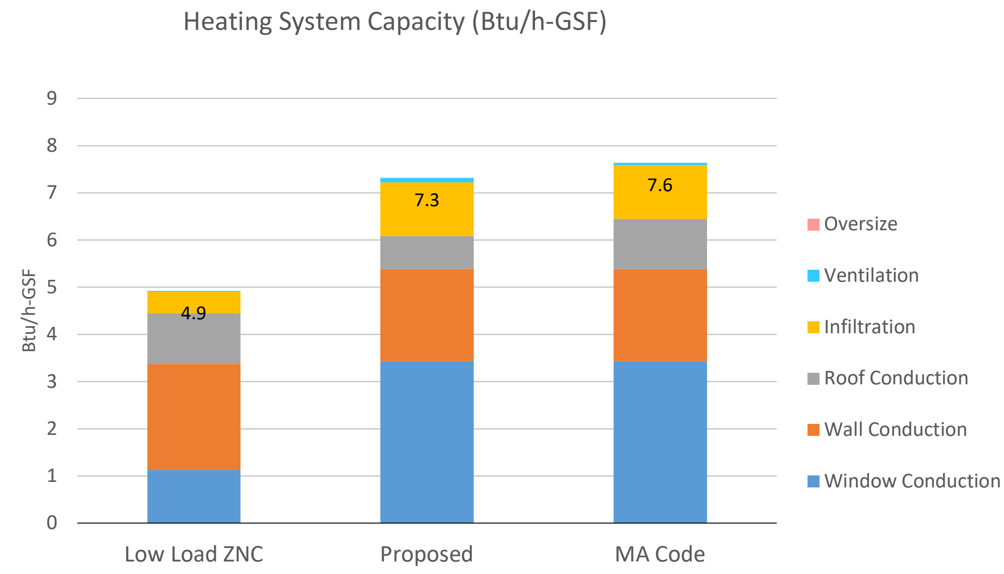

Heating Load Outputs (Btu/h-GSF)	Low Load ZNC	Proposed	MA Code
Window Conduction	1.1	3.4	3.4
Wall Conduction	2.2	1.9	1.9
Roof Conduction	1.1	0.7	1.1
Infiltration	0.5	1.1	1.1
Ventilation	0.0	0.1	0.0
Oversize	0.0	0.0	0.0
Total Space Heating System Capacity	**4.9**	**7.3**	**7.6**
TOTAL Conduction	4.4	6.1	6.5
TOTAL Envelope	4.9	7.2	7.6
NON-Space-Heating Plant Capacity	47.8	47.8	47.8

Summary of Automatic Changes to Proposed Design	Low Load ZNC	Proposed	MA Code
Total Building - Window to Wall Ratio	11%	23%	23%
Window Average Assembly U-value (Btu/h-ΔT-sf)	0.26	0.38	0.38
Wall Average Assembly U-value (Btu/h-ΔT-sf)	0.064	0.064	0.064
Roof Average Assembly U-value (Btu/h-ΔT-sf)	0.032	0.021	0.032
Infiltration - Maximum at Blower Door Test (cfm/sf at 75pa)	0.10	0.25	0.25
Proposed Outdoor Airflow Rate (CFM)	17	17	17
Ventilation Heating Sensible Recovery Efficiency	80%	0%	50%
Class 4 Exhaust Sensible Recovery Efficiency	60%	0%	0%
Electric Heating System Capacity (Btu/h-gsf)	3.9	0.0	0.0
Oversize Factor: Heating System Capacity / Heating Load (%)	125%	125%	125%

General Information	Low Load ZNC	Proposed	MA Code
Number of Stories Above Grade	1	1	1
Total Building Gross Floor Area	6,961	6,961	6,961
Total Building Net Occupiable Floor Area	6,646	6,646	6,646
Daylight Area (per IECC 2018)	-	-	-
Total Building Vertical Façade Area	7,855	7,855	7,855
Roof Area	6,646	6,646	6,646

Primary Building Type	Low Load ZNC	Proposed	MA Code
Primary Building Type	Retail (stand alone)	Retail (stand alone)	Retail (stand alone)
Gross Square Feet	6,961	6,961	6,961
Vertical Façade Area	7,855	7,855	7,855
Window Area	n/a	1,798	n/a

Secondary Building Type	Low Load ZNC	Proposed	MA Code
Secondary Building Type	-	-	-
Gross Square Feet	-	-	-
Vertical Façade Area	-	-	-
Window Area	n/a	-	n/a

Tertiary Building Type	Low Load ZNC	Proposed	MA Code
Tertiary Building Type	-	-	-
Gross Square Feet	-	-	-
Vertical Façade Area	-	-	-
Window Area	n/a	-	n/a

Daylight Area	Low Load ZNC	Proposed	MA Code
% Daylight Area	0%	0%	0%
Daylight Area >25%? (or >50% if building is <3 stories above grade)	No	No	No

Envelope	Low Load ZNC	Proposed	MA Code
Total Vertical Façade Area	7,855	7,855	7,855
Primary Building - Window to Wall Ratio	11%	23%	n/a
Secondary Building - Window to Wall Ratio	0%	0%	n/a
Tertiary Building - Window to Wall Ratio	0%	0%	n/a
Total Building - Window to Wall Ratio	11%	23%	23%
Total Window Area	864	1,798	1,798
Window Average Assembly U-value (Btu/h-ΔT-sf)	0.26	0.38	0.38
Wall Area (SF)	6,991	6,057	6,057
Wall Average Assembly U-value (Btu/h-ΔT-sf)	0.064	0.064	0.064
Roof Area (SF)	6,646	6,646	6,646
Roof Average Assembly U-value (Btu/h-ΔT-sf)	0.032	0.021	0.032
Infiltration - Maximum at Blower Door Test (cfm/sf at 75pa)	0.1	0.25	0.25
Infiltration - Maximum at Blower Door Test (cfm at 75pa)	1,500	3,600	3,600
Infiltration - Design (cfm)	84	210	210
Average UxA Value[2]	0.061	0.083	0.089

Ventilation	Low Load ZNC	Proposed	MA Code
Minimum Outdoor Airflow Rate (CFM)	17	17	17
Minimum Outdoor Airflow Rate (CFM/Net SF)	0.00	0.00	0.00
Proposed Outdoor Airflow Rate (CFM)	17	17	17
Proposed Outdoor Airflow Rate (CFM/Net SF)	n/a	0.00	n/a
Exhaust/Relief Air (not including Class 4 and Exempt Exhaust)	17	17	17
Ventilation Heating Sensible Recovery Efficiency	80%	0%	50%
Class 4 Exhaust (CFM)	-	-	-
Class 4 Exhaust Sensible Recovery Efficiency	60%	0%	0%
Exempt Exhaust (CFM)	-	-	-
Exempt Exhaust Heat Recovery Efficiency	0%	0%	0%
Average Exhaust Heat Recovery Efficiency	80%	0%	50%

Heating Load	Low Load ZNC	Proposed	MA Code
Delta-T (˚F Outdoor - ˚F Indoor)	35	35	35
Window Conduction Heating Load (MBH)	8	24	24
Wall Conduction Heating Load (MBH)	16	14	14
Roof Conduction Heating Load (MBH)	7	5	7
Envelope Infiltration Heating Load (MBH)	3	8	8
Ventilation Heating Load (MBH)	0	1	0
Safety Factor (MBH)	-	-	-
TOTAL Space Heating System Capacity (MBH)	34	51	53
Total Envelope Conduction Heating Load (MBH)	31	42	45
Maximum Electric Heating System Capacity (Btu/h-gsf)	10	n/a	n/a
Electric Heating System Capacity (Btu/h-gsf)	3.9	-	-
Electric Heating System Capacity (MBH)	27	-	n/a
Other Heating System Capacity (MBH)	7	NA	53
TOTAL Heating System Capacity (MBH)	n/a	-	n/a
Oversize Factor: Heating System Capacity / Heating Load (%)	125%	125%	125%
NON-Space-Heating Plant Capacity (MBH)	333	333	333

Ventilation Cooling Load	Low Load ZNC	Proposed	MA Code
Outdoor Air - Temperature (F)	91	91	91
Outdoor Air - Wet Bulb (F)	73	73	73
Outdoor Air - Enthalpy (Btu/lb)	36.48	36.48	36.48
Indoor Air - Temperature (F)	75	75	75
Indoor Air - Relative Humidity (%)	55%	55%	55%
Indoor Air - Enthalpy (Btu/lb)	29.13	29.13	29.13
Ventilation Cooling Enthalpy Recovery Efficiency (%)	78%	0%	50%
Ventilation Air after Energy Recovery - Enthalpy (Btu/lb)	30.78	36.48	32.81
Ventilation Discharge Air Enthalpy (Btu/lb)	22.13	22.13	22.13
Ventilation Delta H (Btu/cfm)	8.65	14.35	10.68
Ventilation Cooling Load (Btu/cfm)	39	65	48
Ventilation Cooling Load (Tons)	0	0	0
Class 4 Exhaust Sensible Heat Recovery Efficiency (%)	60%	0%	0%
Class 4 Exhaust Make Up - Temperature after Energy Recovery (F)	81	91	91
Class 4 Exhaust Make-Up Load Reduction (Tons)	0	0	0
Total Load Reduction (Tons)	0	-	0

Electricity CO2e Emissions Comparison

Source	Listed Units	Listing
Portfolio Manager	kg/Mbtu*	70.13
ISO-NE 2019	lbs/MWh	633
ISO-NE 2035 (projected per city of Boston proposed Zero Carbon Zoning)	kg/MMBtu	52

Table 1-1
2018 and 2019 ISO New England System Emissions (ktons) and Emission Rates (lbs/MWh)

Annual System[(a)] Emissions						
	2018 Emissions (ktons)	2019 Emissions (ktons)	Change in Emissions (%)	2018 Emission Rate (lbs/MWh)	2019 Emission Rate (lbs/MWh)	Change in Emission Rate (%)
NO_x	15.61	12.87	-17.6	0.30	0.26	-13.3
SO_2	4.96	2.34	-52. 8	0.10	0.05	-50.0
CO_2	34,096	30,997	-9.1	658	633	-3.8

(a) The term "system" refers to native generation here and throughout the report.

[4] Net energy for load (NEL) is calculated by summing the metered output of native generation, price-responsive demand, and net interchange (imports minus exports). It excludes the electric energy required to fill/refill pumped storage plants.

[5] In this report, "generation" refers to energy production and not capacity.

lb/MMBtu
155
186
115

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Figure 5 – Indirect Greenhouse Gas Emission Factors for Electricity in th

eGRID Regional Description	eGRID Acronym	$CO2_{eq}$ Emissions (kg/MBtu)
South/Central Alaska	AKGD	138.92
Most of Alaska	AKMS	70.05
Southwest US	AZNM	136.60
Southwest Coast	CAMX	66.29
Most of TX	ERCT	124.44
Most of Florida	FRCC	124.45
HI excluding Oahu	HIMS	148.76
Oahu Island	HIOA	223.68
Eastern WI	MROE	224.61
Upper Midwest	MROW	166.06
New England	NEWE	70.13
Northwest US	NWPP	85.53
New York City	NYCW	79.46
Long Island, NY	NYLI	158.60
Upstate NY	NYUP	33.75
Mid Atlantic	RFCE	95.71
Most of Michigan	RFCM	175.63
Ohio Valley	RFCW	156.07
CO-Eastern WY	RMPA	170.41
KS-Western MO	SPNO	155.75
TX Panhandle-OK	SPSO	155.90
Lower Mississippi	SRMV	114.11
Middle Mississippi	SRMW	222.90
SE US, Gulf Coast	SRSO	137.38
Tennessee Valley	SRTV	138.00
Virginia/Carolina	SRVC	99.37
National Average		**126.67**

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2.2 CARBON EMISSION FACTORS

It is recommended that both Carbon Emission Intensity and Carbon Emission reductions shall be ca using both "occupancy year one" and 2035 electricity emission factors to more accurately represent emissions from buildings built in the near future, at a point where the ISO-NE grid electricty carbon er to be approximately equal to those of natural gas (2035 represents the 12.5-year mid-point of typical M lifespan (25-years) for a building built in 2022/2023).

Note: The working group considers that choosing 2035 as a target date is a conservative approximation of a g credit to utility-scale improvements in addition building-level efficiency measures.

It is recommended that the emission factors listed in Table 2 are used for all other emissions factors, to program.

Table 2: BERDO-Aligned Carbon Emission Factors

Fuel type	Emission factor (kg CO_2e/MMBtu)
Natural Gas	53.11
Fuel Oil (No. 1)	73.50
Fuel Oil (No. 2)	74.21
Fuel Oil (No. 4)	75.29
Diesel Oil	74.21
District Steam	66.40
District Hot Water	66.40
Electric Driven Chiller	52.70
Absorption Chiller using Natural Gas	73.89
Engine-Driven Chiller Natural Gas	49.31

Note:

1. For service in Boston, DOER has recently calculated the District Steam Emission Factor to be 87.54 kg
2. For Grid Electricity, the 2035 Emission Factor is 52 kg CO2e/MMBtu

Phasing

These carbon emission factors should be updated every 5 years (e.g. in 2025, it would be updated to value for 2040), in alignment with the 5-year periods within the BERDO program.

ılculated and reported
t the lifespan average
nissions are predicted
IEP system equipment

greening grid that offers

align with the BERDO

CO2e/MMBtu

the ISO-NE projected