



Energy and Environmental Assessment Report

Elfrida Secondary Plan

April 24 2026

prepared for:

Elfrida Community
Builders Inc.

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1. Introduction

BuildABILITY Corp. has been retained by the Elfrida Community Builders Group Inc. to develop an Energy and Environmental Assessment Report (the “EEA Report”) for the Elfrida Urban Boundary Expansion Area (“Elfrida Area”) to be submitted to the City of Hamilton as part of its Secondary Plan application. The EEA Report will be prepared “to demonstrate the impact of the potential settlement area expansion on the City’s ability to achieve carbon neutrality and demonstrate the opportunities to reduce climate change impacts and avoid climate change risks.”¹

1.1 What is an Energy and Environmental Assessment Report?

Energy efficiency and greenhouse gas (GHG) emissions reduction are critical strategies in addressing climate change, an increasingly urgent priority as its impacts becomes more apparent every year. While climate change is a global challenge, its effects are felt at a local level. The City of Hamilton has long been at the forefront of climate action. In 2019, Council declared a climate change emergency, leading to the formation of a Corporate Climate Change Task Force tasked with identifying actions to reach net zero by 2050.²

Within the context of the Elfrida Area, this EEA Report provides a strategic framework for aligning the proposed development with the City’s climate change objectives, unique to its built environment. This report will enable Elfrida’s communities to integrate energy and emissions considerations early in land-use and infrastructure planning.

With a strong commitment to sustainability and low environmental impact, the Elfrida Area will be developed with a focus on both mitigating and adapting to the effects of climate change. In addition, the EEA Report outlines a path toward building a low-carbon community that remains mindful of affordability for homebuyers. Ultimately, it aims to demonstrate that growth can be achieved affordably without placing an unreasonable burden on the environment at a price that homebuyers can continue to afford.

1.2 Living Document

As outlined in the original submission, the purpose of the Phase 1 EEA Report is to demonstrate how the proposed urban expansion can support the City’s long-term objectives for carbon neutrality, climate change mitigation, and climate risk avoidance without committing to specific actions. This initial assessment provides a high-level strategic framework consistent with the expectations of a Phase 1 submission; it does not present detailed quantitative modelling or

committed implementation strategies. While the review acknowledges the high-level nature of the Phase 1 report, this Phase 2 report presents more detailed analysis, particularly a quantitative analysis as provided. At the time of the Phase 1 report, this detailed analysis was not possible. Phase 1 was intentionally developed to include policy-aligned strategies based on the best available information at that early planning stage.

The absence of the elements cited in the peer review of the Phase 1 report by Dillon Consulting retained by City of Hamilton, was not a shortcoming, but a reflection of that stage in the planning process, where inputs such as unit counts, housing mix, servicing infrastructure, and build-out sequencing were not yet defined. Moving past the early conceptual stage, the scenario analyses and long-term projections are now available. These have been developed in Phase 2, as originally intended, where the technical foundation support robust modelling, GHG forecasts, renewable energy feasibility assessments, and the defining of implementation strategies. The Phase 1 report appropriately set the groundwork for this next stage of work.

As planning has advanced, including the definition of the community unit mix, housing typologies, unit counts, and servicing approaches, the Phase 1 report has been updated to reflect site-specific information and stakeholder input. Recognizing that detailed modelling, quantifiable targets, and firm commitments are developed and refined through this Phase 2 report.

At this time, the Phase 2 EEA Report provides a high-level plan for the community in support of the Secondary Plan and providing greater detail reflecting the Secondary Plan's unit mix, housing types, unit counts, and local infrastructure.

This EEA Report is a living document that will evolve and adapt through ongoing review, monitoring and consultations as the community builds out. Updates will be undertaken at various phases of the development approvals process to address any necessary changes resulting from innovations in technology, new trends, and any changes in the market and regulations.

1.3 Location and Description of the Lands

The lands subject to this EEA Report are generally bound by Upper Centennial Parkway, Mud Street East, Second Road East/Hendershot Road, Golf Club Road, Trinity Church Road and a Hydro Corridor (see Figure 1.1). The subject lands have an area of approximately 1,209 hectares and includes many individual properties that vary considerably in size, shape, and land use.

The current Concept Plan, dated February 17, 2026 includes the following land uses (refer to Concept Plan in Appendix A):

- Residential and Mixed-Use Designations
 - o Low Density Area
 - o Medium Density Area
 - o Medium Density – Mixed Use Area
 - o High Density – Mixed Use Area
- Parks and Open Space Designations

- o Community Park
- o Neighbourhood Park
- o General Open Space
- o Natural Open Space
- o Storm Water Pond Facility
- Institutional Designations
 - o Elementary and Secondary School
- Existing Developed Industrial / Commercial Uses

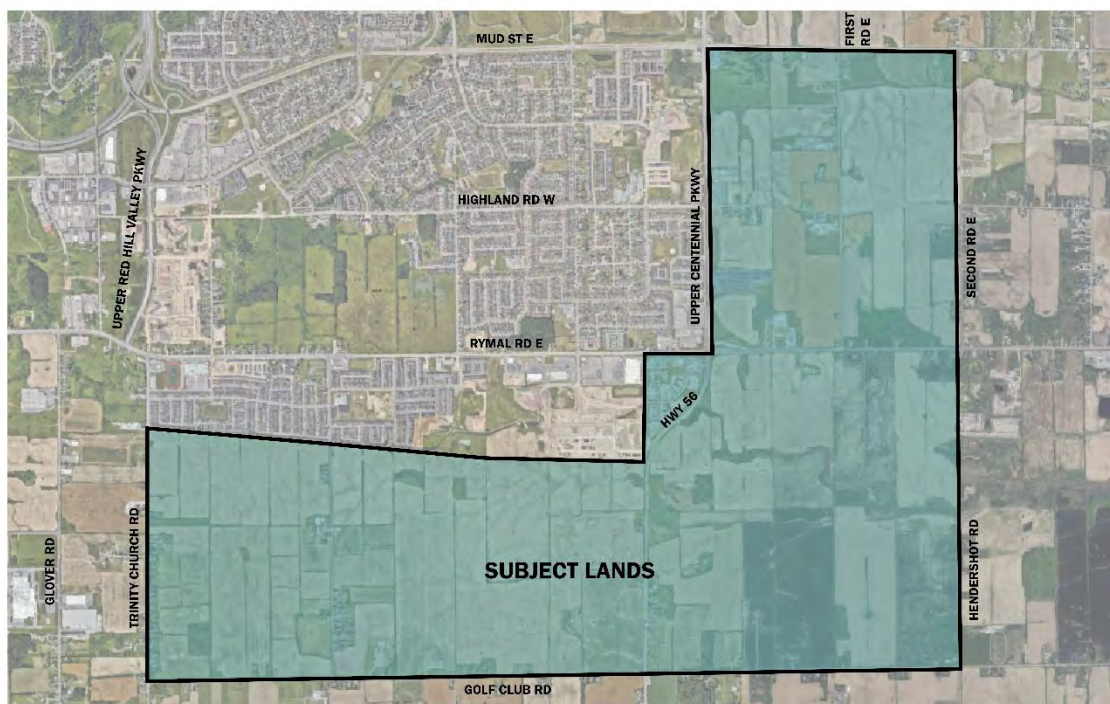


Figure 1.1. Location of subject lands.

1.4 Policy Context

The EEA Report aligns with, and reflects, the common goals, policies and recommendations described in local, regional and provincial planning policies.

1.3.1 City of Hamilton Plans

ReCharge Hamilton: Community Energy and Emissions Plan (2022)

Recharge Hamilton: Community Energy and Emissions Plan (CEEP) identifies a pathway for the City to become net-zero by 2050, outlining strategies and actions to reduce greenhouse gas emissions, increase the resiliency of the energy systems and improves economic prosperity in the City. It identifies five Low-carbon Transformations to support the transition, namely:

- (1) Innovating our Industry,
- (2) Transforming Our Buildings,
- (3) Changing How We Move,
- (4) Revolutionizing Renewables, and
- (5) Growing Green.

In Hamilton, industrial emissions make up the largest portion of the city's total emissions, with transportation coming in a distant second and residential emissions third. This EEA Report focuses on reducing GHG emissions in the residential and transportation sectors within the built environment of Elfrida subject lands.³

The net-zero scenario within the building sector puts precedence and priority on energy efficiency in order to minimize the societal and environmental costs of the low-carbon transition, emphasizing that fuel switching to low-carbon/renewable energy sources could only be considered once energy efficiency measures are in place. **The CEEP establishes a target for new dwellings to be 60% more energy efficient in 2031, compared to 2016 levels, and commercial buildings to be 60% lower in energy use than 2016 levels by 2050.**⁴ This EEA Report is structured around the CEEP's five Low-Carbon Transformations. They directly inform the guiding principles in Section 2.1 and each area of impact covered in Sections 3 through 7.

Hamilton Climate Change Impact Adaptation Plan (2022)

The Hamilton Climate Change Impact Adaptation Plan (CCIAP) presents a plan for Hamilton to become more resilient to impacts of the changing climate. In Hamilton, the impacts of climate change have become increasingly evident, with extreme heat events, waterfront flooding, escarpment erosion, extended power outages, among other challenges. Following the City's declaration of a Climate Emergency in 2019, the CCIAP draws on the latest climate projections to identify all of the ways that climate change may affect the City operations and the community at large. Four Resilient Themes are identified in the plan: (1) Built Environment, (2) People and Health, (3) Natural Environment, Water and Agriculture, and (4) Energy and Economy.⁵ Each theme outlines various actions, action details, and supporting actions that will be reflected in this EEA Report. The four Resilience Themes directly shape the climate resilience strategies in Section 7 and the natural environment measures in Section 6 of this report.

The CCIAP establishes a vision that “the City of Hamilton will be a national leader on Climate Adaptation; namely, as a healthy, equitable, vibrant, and sustainable community that responds to the needs of residents, businesses and institutions, and is resilient in the face of a changing climate.”⁶

The methodological approach applied in this assessment is consistent with the analytical framework typically used to evaluate greenhouse gas emissions associated with new community development. The assessment establishes a baseline profile of projected energy use and greenhouse gas emissions based on the proposed land use structure and anticipated population and employment. Scenario analysis is then used to evaluate potential opportunities to reduce emissions through improved building performance, renewable energy integration, and

sustainable transportation patterns.⁷ This approach aligns with the City of Hamilton's planning objectives related to energy efficiency, emissions reduction, and sustainable community design.

Urban Hamilton Official Plan (2024)

The EEA Report will align with the Urban Hamilton Official Plan (UHOP) policies. Complete communities require a mix of land uses, including housing, which provide goods and services, and a range of transportation modes including public transit, all of which depend on energy.⁸ Policy 3.7.2 promotes the efficient use of energy and the environmentally-friendly development through the following:

- a) approval of planning applications, including applications for zoning by-law amendments, site plan approval, and plans of subdivision or condominium, as appropriate;
- b) the use of environmental building rating systems such as certification under the Leadership in Energy and Environmental Design (LEED) program, R-2000 Home, Passive House, Canadian Green Building Council's Zero Carbon Standard, or an equivalent rating system or building techniques for upgrading/retrofitting of existing development and new development; (OPA 167)
- c) designs which use renewable energy systems or alternative energy systems;
- d) designs which use cogeneration energy systems;
- e) designs which minimize building heat loss and capture or retain solar heat energy in winter, and minimize solar heat penetration in summer. Consideration shall be given to such measures as green roofs or reflective roofs, discouraging excessive surface parking, allowing direct access to sunlight, and effective landscaping;
- f) building or structure orientations that maximize solar or wind energy designs that encourage sustainable forms of transportation, including active transportation, transit, as well as alternative fuel and energy conserving vehicles; (OPA 167)
- g) designs that facilitate cooperation/joint energy efficiency between developments to optimize the efficient use of resources, including district energy systems; (OPA 167)
- h) energy conservation initiatives, including energy demand management;
- i) water and storm water conservation/management practices and low impact development techniques, such as green roofs, water recycling systems, urban storm water swales, etc.; (OPA 167)
- j) promoting building conservation and adaptive reuse; (OPA 167)
- k) encouraging the use of locally sourced and reclaimed building materials to reduce the amount of embodied carbon as appropriate; (OPA 167)
- l) pilot projects and community energy plans as appropriate; and,
- m) other environmental development standards that encourage energy efficiency and environmental design as contained in the City's approved engineering policies and

standards and master planning studies, and are supported by the City's financial incentive programs.⁹

Hamilton City-Wide Green Building Standards (2024)

The City of Hamilton City-Wide Green Building Standards (GBS) were endorsed by Council on October 9th, 2024. To achieve net zero greenhouse gas emissions by 2050, the GBS establishes sustainability performance requirements and metrics applicable to all new residential, institutional, commercial and industrial uses in the urban area. These standards apply to all site plans and aim to promote energy-efficient, sustainable communities. Although this EEA Report pertains specifically to the Secondary Plan application, it is crucial to recognize the GBS requirements, which will be applicable at later stages of the planning process.

The GBS is structured into two Tiers: Tier 1, which includes mandatory requirements, and Tier 2, which consists of voluntary targets. These standards are further organized into five key Impact Categories

1. Energy and Carbon
2. Ecology and Biodiversity
3. Water
4. Waste and Management and Materials
5. Community and Urban Design¹⁰

1.3.2 Provincial Plans

Provincial Planning Statement (2024)

The Provincial Planning Statement (PPS), effective October 20, 2024, replaces the Provincial Policy Statement, 2020, and A Place to Grow: Growth Plan for the Greater Golden Horseshoe, consolidating both into a single land use policy document. Policy 2.9 requires planning authorities to plan to reduce GHG emissions and prepare for the impacts of a changing climate. Approaches that could be taken include:

- supporting the achievement of compact, transit-supportive, and complete communities;
- promoting energy conservation and efficiency;
- encouraging green infrastructure, low-impact development, and active transportation; and,
- building community resilience to the impacts of a changing climate.¹¹

The methodology of this EEA Report is structured around the frameworks established in these policies. Specifically, the CEEP's five Low-Carbon Transformations form the organizational backbone of the report's guiding principles (Section 2.1), with each area of impact in the following sections to come, corresponding to one or more Transformations. The CCIAP's four Resilience Themes: Built Environment, People and Health, Natural Environment and Agriculture, and Energy

and Economy, are addressed through the climate resilience strategies in Section 9 and the natural environment measures in Section 8. The GBS metrics (TEUI, TEDI, GHGI) establish the quantitative benchmarks that will be used in Phase 2 modeling. Together, these frameworks ensure that the development strategy is not simply consistent with City policy, but actively shaped by it at each stage of planning.



2. The Vision

The vision for the Elfrida Area is to develop a complete, transit-supportive, mixed-use community that is compact, well connected and both environmentally and economically sustainable. It aims to establish a new vibrant mixed-use community that respects neighboring land uses, promotes sustainability and increases both walkability and opportunities for active transportation and transit use. The development will promote and protect existing natural heritage features, minimize impacts and consumption of agriculture lands, and be compatible with adjacent planned and existing land uses.

2.1 Guiding Principles

This EEA Report is founded on the Low-carbon Transformations as described in the City of Hamilton's Community Energy and Emissions Plan. The guiding principles of this EEA Report are as follows:

1. Transforming our buildings

Objectives that support improving the energy efficiency and GHG profile of new buildings.

2. Revolutionizing renewables

Objectives that encourage renewable energy generation.

3. Changing how we move

Objectives that promote active transportation and reduce the number of trips taken with single-occupancy vehicles to reduce GHG emissions.

4. Growing green

Objectives that promote carbon sequestration through the growth of tree canopies and preserving existing natural heritage features.

Transformation 1: Innovating Our Industry from the CEEP is not included in this EEA Report guiding principles, as there will be little to no heavy industrial uses (e.g. steel mills) within the Elfrida subject lands.

2.2 Areas of Impact

To align with local and provincial policies, this EEA Report will focus on the following areas of impact:

1. Energy and Carbon

This section address energy efficiency and carbon reduction efforts to align with the emission targets, established in the CEEP. Key areas addressed are Site Design, Land Use Pattern, Building Design, and Overall GHG Emissions.

2. Low-carbon Energy Solutions

This report will explore opportunities for low-carbon energy solutions, such as reduced use of carbon fuels, solar, air and ground-source heat pumps, fuel switching, and district energy systems, that may be feasible and appropriate to the built environment of Elfrida.

3. Sustainable Mobility and Active Transportation

A sustainable community is one that reduces car dependency, facilitates active transportation, and supports public transit. Emphasis on mobility not only reduces energy use and GHG emissions, but also contributes to improved public health and quality of life. This Report, along with the Transportation Management Study by C.F. Crozier & Associates Inc, will explore opportunities to promote sustainable modes of transportation.

4. Natural Environment and Water

The Elfrida Lands include a variety of Natural Heritage features that run through the development. It is the intent of the development to protect and enhance existing natural heritage features, minimize impacts and consumption of agricultural lands, and be compatible with adjacent planned and existing land uses.

5. Climate Resilience

Resilience in the context of emergency preparedness and climate change adaptation refers to a building's ability to withstand extreme weather events while ensuring occupant safety and comfort. Achieving this requires a holistic, integrative design process that views the building as a system and addresses foreseeable challenges. This section will explore resilience strategies through the built environment and building enclosure.

3. Energy Use and Carbon Emission Scenarios

Energy use and emissions scenarios are used to establish effective and viable energy and emission reduction targets for the proposed development. The scenarios together with various building archetypes used in the development form the foundation for the Elfrida EEA Report.

3.1 Building Archetypes

Building archetypes are intended to best represent the various building types that will be constructed on the subject lands. Various scenarios are presented to reflect the many design specifications that could be used to achieve a particular energy use and carbon emissions target. The building archetypes used in this EEA Report, reflect only the buildings on the site that are to be built under Part 9 of the Ontario Building Code (OBC).

An Archetype House was used to reflect the performance of all low-rise residential buildings constructed on the subject lands. The Archetype House was developed by using the actual house characteristics of a sample of 312 houses gathered from Natural Resources Canada (NRCan) from recent houses built across the province. The Archetype House is a representation of the characteristics of an average house built in the proposed community. It combines the characteristics of each housing form (i.e., detached, semi-detached, and row house) using the Elfrida unit counts as shown in Table 3.1. The Elfrida Archetype House was created by using Elfrida's dwelling type splits. Refer to Appendix B for more details.

The Archetype House has been used in the energy modelling of various energy efficiency and greenhouse gas emission scenarios.

Table 3.1 Projected Unit Counts by DWU Types

Elfrida Projected Unit Counts by Dwelling Type				
	Singles	Semis	Row	Total
Units	4,708	1,177	10,369	16,253
Percentage	29%	7%	64%	

3.2 Energy Use and Carbon Emissions Scenario Targets

ReCharge Hamilton is a Community Energy and Emissions Plan (CEEP) that forms a key component of the City of Hamilton's strategy to address the climate emergency. The plan establishes targets for improving energy performance in the residential sector, including a goal that by 2031, new dwellings will be 60% more energy efficient than those built to 2016 standards. In addition, the plan aims to shift housing development patterns so that by 2050, only 20% of new residential construction consists of single-detached homes, encouraging higher-density and more energy-efficient housing forms.

Three scenarios (see Figure 3.2) were developed and used to establish a potential target for the development on the subject lands.

- Baseline scenario (Scenario 1) - where residential buildings are constructed to the specification contained in SB-12 of Part 9 of the Ontario Building Code.
- Higher Performance (Scenario 2) – where residential building performance reflects ReCharge Hamilton's metrics
- Net (Near) Zero Scenario (Scenario 3) – where buildings are built to net zero (or net zero ready) energy or near zero greenhouse gas emissions.

The Baseline scenario represents a case where buildings are built to the 2016 OBC minimum standards. For reference, a baseline scenario is also presented where buildings are built to the current (2024) OBC.

The Higher Performance scenario reflects building performance that meets the targets as outlined in ReCharge Hamilton (2022) of 60% more energy efficient.

Scenarios that reflect net zero energy ready construction and near zero greenhouse gas emissions have also been presented, Net zero ready reflects the configuration of residential buildings that would permit rooftop solar to generate all of the on-site energy required by the building.

Table 3.2 Energy Modelling Scenario Targets

Energy Modelling Scenario Targets	
Scenario 1a: Baseline	2016 OBC SB-12 Energy Efficiency Compliance - Package J
Scenario 1b:	2024 OBC SB-12 Energy Efficiency Compliance - Package 1A1
Scenario 2a:	2024 OBC SB-12 Energy Efficiency Compliance - Package 1A1 + Air Source Heat Pump + Electric Domestic Water Heater
Scenario 3a:	Net Zero Energy Ready
Scenario 3b:	Near Zero Emissions



4. Achieving Scenario Targets

This section identifies on-site building measures to meet the scenario targets described previously, in section 3.

4.1 Energy Conservation and Demand Reduction in Buildings

Buildings on the subject lands will be designed and constructed to conserve energy, reduce carbon emissions, and increase resiliency. This will be achieved through highly efficient building envelopes and mechanical systems. Potential measures and combinations of measures are described below.

4.2 Performance Modelling for Each Scenario

Measures for Low-Rise Buildings (Archetype House)

Within the Ontario Building Code (OBC), there are requirements for how energy efficient a newly constructed home must be. These provisions can be found in Supplementary Standard SB-12 of the Code. Builders can pick from various energy efficiency compliance packages for a home to satisfy the SB-12 energy efficiency requirements.

To evaluate the emissions reduction target, Package J from Supplementary Standard SB-12 (2016) was used as the reference performance level in Scenario 1A. Chapter 2 of SB-12 contains the compliance packages introduced under the 2016 amendment to the Ontario Building Code (OBC), including Package J. The City of Hamilton has established 2016 as the baseline year for residential energy performance and requires new dwellings to achieve energy efficiency levels that are 60% better than the 2016 standard. Accordingly, the 2016 SB-12 packages were used as the benchmark for comparison. SB-12 includes specifications for building insulation, windows, and heating and ventilating systems.

As an additional reference, Scenario 1B has been presented that reflects the current building code from Chapter 3 of SB-12. One of the most commonly used compliance packages (A1 compliance package) was used in the energy modelling for this report.

In Scenario 2A, the archetype house is modeled with an HVAC upgrade relative to the base case (Package 1A1, Scenario 1B). An air-source heat pump is installed for space heating, and the gas-fired domestic hot water heater is replaced with an electric unit. A gas-fueled furnace remains in place as a backup heating system.

Scenario 3A demonstrates even higher energy efficiency compared to Scenario 2, where homes are built to be Net Zero Energy Ready (NZER) labelled under the CHBA Net Zero Labelling program or equivalent performance. A NZER home continues to generate carbon emissions, albeit at significantly lower levels. It is built such that its energy use equals to potential future installation of onsite renewable generation. The reduction in energy use is intended to allow roof top photovoltaic (PV) to account for the energy that's used, provided the typical available roof top area for the PV array. Net Zero Ready Homes that have sufficient on-site generation ability have been designed and constructed to easily install renewable energy systems in the future whenever the homeowner is ready.

Scenario 3B is similar to 3A, however, mechanical systems for the house produce little to no GHG emissions. This is called a Near Zero Emissions (NZE) home. It eliminates the use of natural gas, relying primarily on electricity for heating and cooling.

See Appendix C for a summary of the incremental measures from Scenario 1 to Scenarios 2, for low-rise residential buildings.

Performance Modelling for Each Scenario

Low-rise residential buildings were simulated using the NRCan HOT2000 energy modelling tool. For the purposes of this modelling exercise, the Ontario Archetype House was used to represent an amalgam of the various housing typologies on the site.

Calculations were based on the projected unit counts (Table 3.1) and the performance of the archetype buildings. It should be noted that the performance of each scenario in this modelling exercise is for buildings only, and is unaffected by transportation associated measures.

All assumptions associated with the community performance model can be found in Appendix B.

The following table shows a summary of energy consumption results per unit in megajoules for each scenario.

Table 4.1 Elfrida Energy Consumption Results (Per Unit)

Elfrida Energy Consumption Results (Per Unit)					
	Space heating (MJ)	DHW Heating (MJ)	Ventilator Electrical consumption (MJ)	Baseload consumption (MJ)	Total Energy consumption (MJ/year)
Scenario 1a:	45135	18993	1069	25623	90820
Scenario 1b:	39418	15458	1069	25623	81568
Scenario 2a:	20687	15377	1069	25623	62756
Scenario 3a:	7683	1069	15444	25623	49818
Scenario 3b:	8212	1069	11998	25623	46902

The following table shows the summary of carbon emissions in tonnes per unit for each scenario and its reduction from scenario 1A.

Table 4.2 Elfrida Greenhouse Gas Emission Results (Per Unit)

Elfrida Annual Carbon Emission (in Tonnes) Results (Per Unit)				
	Natural gas factor t/m3	Electricity factor t / kWh	Carbon emission (In Tonnes) = Natural gas * 0.00192 + Electricity *0.000059	Carbon Emission Reduction from Scenario 1A
	0.00192	0.000059		
	Natural gas (m3)	Electricity (kWh)		
Scenario 1a:	1699	7712	3.7	0%
Scenario 1b:	1453	7687	3.2	13%
Scenario 2a:	195	16917	1.4	63%
Scenario 3a:	420	11367	1.5	60%
Scenario 3b:	0	14826	0.9	76%

(For full GHG emissions calculation assumptions breakdown see Appendix D)

Table 4.3 shows the Design heat loss for each scenario.

Table 4.3 Design Heat Loss

Elfrida Design Heat Loss		
		Design Heat Loss (Watts)
Scenario 1a:	2016 OBC SB-12 Energy Efficiency Compliance - Package J	9145
Scenario 1b:	2024 OBC SB-12 Energy Efficiency Compliance - Package 1A1	8533
Scenario 2a:	2024 OBC SB-12 Energy Efficiency Compliance - Package 1A1 + Air Source Heat Pump + Electric Domestic Water Heater	8533
Scenario 3a:	Net Zero Energy Ready	5144
Scenario 3b:	Near Zero Emissions	5248

Performance of buildings in the subject land for Scenario 1A

The performance of buildings within the subject lands, if all buildings were to be built to the 2016 Ontario Building Code minimum, is described in Table 4.4.

Table 4.4 Scenario 1A energy consumption and GHG emissions

Scenario 1A	
Number of units	16253
Energy Consumption per unit (GJ)	91
GHG Emissions (tonnes of CO2) Per Unit	3.72
Total Energy Consumption (GJ)	1476093
Total GHG emissions (tonnes of CO2)	60413

Performance of Buildings in the Subject Land for Scenario 1B

The performance of buildings within the subject lands, if all buildings were to be built to the Ontario Building Code minimum, is described in Table 4.5.

Table 4.5 Scenario 1B energy consumption and GHG emissions

Scenario 1B	
Number of units	16253
Energy Consumption per unit (GJ)	82
GHG Emissions (tonnes of CO ₂) Per Unit	3.24
Total Energy Consumption (GJ)	1325723
Total GHG emissions (tonnes of CO ₂)	52723

Performance of Buildings in the Subject Land for Scenario 2A

The performance of buildings within the subject lands, if low-rise residential were built to ReCharge Hamilton target of 60% more efficient.

Table 4.6 Scenario 2A energy consumption and GHG emissions

Scenario 2A	
Number of units	16253
Energy Consumption per unit (GJ)	63
GHG Emissions (tonnes of CO ₂) Per Unit	1.37
Total Energy Consumption (GJ)	1019971
Total GHG emissions (tonnes of CO ₂)	22320

Performance of Buildings in the Subject Land for Scenario 3A

The performance of buildings within the subject lands, if low-rise residential were built to be Net Zero Energy Ready and satisfies ReCharge Hamilton's target.

Table 4.8 Scenario A energy consumption and GHG emissions

Scenario 3A	
Number of units	16253
Energy Consumption per unit (GJ)	50
GHG Emissions (tonnes of CO2) Per Unit	1.48
Total Energy Consumption (GJ)	809697
Total GHG emissions (tonnes of CO2)	24003

Net Zero Energy Scenario:

Under this scenario, photovoltaic (PV) panels are proposed to offset the building's annual energy consumption. As shown in Table 4.1, the total annual energy consumption for scenario 3a is 49,818 MJ per unit. To offset this demand, 19 PV panels per unit would be required. The combined installation area for these panels is approximately 49 m² (528 ft²). The estimated cost of the PV panels and battery storage system is approximately \$22,696 per household. Based on the total number of units, the estimated total cost would be \$368,878,088.

See Appendix F for the detailed assumptions and calculation breakdown.

Performance of Buildings in the Subject Land for Scenario 3B

The performance of buildings within the subject lands, if low-rise residential were built to be Near Zero Emissions.

Table 4.9 Scenario 3B energy consumption and GHG emissions

Scenario 3B	
Number of units	16253
Energy Consumption per unit (GJ)	47
GHG Emissions (tonnes of CO2) Per Unit	0.87
Total Energy Consumption (GJ)	762306
Total GHG emissions (tonnes of CO2)	14217



5. Energy and Carbon

At full build-out, the Elfrida Area is projected to include over **60,000 housing units**, as a compact, mixed-use, transit-supported, active transportation friendly, and complete community in support of the City's growth. The Elfrida Area represents a unique opportunity to promote sustainable urban growth by integrating thoughtful energy efficiency and emissions strategies from the initial planning stages through to construction and occupancy.

The City of Hamilton established a target that, by 2031, new dwellings are 60% more energy efficient relative to 2016 and that only 20% of new dwelling are single detached by 2050.¹² For commercial buildings, the City set a target to achieve 60% lower energy use intensity than 2016 by 2050.¹³ This section explores how the Elfrida Area will advance local and provincial policies on energy-efficient, low-carbon communities.

5.1 Site Design

It is the objective of the Elfrida Area to monitor, maintain and improve the diversity and resiliency of urban trees and forests to mitigate the urban heat island effect (CCIAP Objective 8). The existing Natural Heritage System within the subject area, as delineated by Stantec, will be protected in a manner that is consistent with the PPS 2024. The development will aim to use green infrastructure, including parklands, stormwater management systems, and street trees, to maintain and increase carbon sequestration (CEEP 6.5). Elfrida will consider the implementation of the City's Urban Forest Strategy (2021) to maintain a healthy and resilient urban forest (CCIAP Action 8.2).

In addition, the Elfrida Area will also be designed to mitigate urban heat island effect. The urban heat island effect is a phenomenon where urban areas experience higher temperatures than surrounding rural areas due to factors like reduced vegetation and increase heat absorption by buildings and pavement. The Elfrida Area will consider measures, such as designing buildings with green roofs or cool roofs, increase tree canopies along for shade, and using paving materials with high solar reflectance index (SRI) (GBS CD6.1).

5.2 Land Use Pattern

The Concept Plan for the Elfrida Area envisions a Potential Intensification Hub with high-density residential areas and a Potential Intensification Corridor with medium-density residential areas that extend along the east-west and north-south axes of the subject area. Commercial Uses may be permitted on the ground floor of the buildings in these designations, providing residents with amenities within safe and convenient walking distances. This compact urban form promotes

easier access to destinations, encourages active transportation, reduces vehicular travel, and lowers GHG emissions (UHOP B3.3.2.8). In addition, the Elfrida Area will aim to construct a network of cycling facilities and multi-use paths, providing safe and direct routes that encourage walking and cycling (GBS CD1.2). Active Transportation is further explored in Section 5.

5.3 Building Design

"Transforming Our Buildings" is a key pillar of the CEEP, highlighting energy efficiency as the top priority for reducing GHG emissions in the building sector (CEEP 6.2). Buildings within the subject lands will aim to achieve better than Code energy efficiency and conservation levels.

Applicable to Draft Plan / Site Plan Applications, the development will aim to align with the requirements of the Council-approved Hamilton Green Building Standards. This involves designing, constructing, and labeling Part 9 low-rise residential to meet ENERGY STAR for New Homes (ESNH) v17.1, enabling new homes to be approximately 20% more energy efficient than a typical home built to Code minimum (GBS EC1.1). An ESNH certified home typically features more energy efficient space conditioning systems, ENERGY STAR certified fenestration products, higher levels of insulation, enhanced airtightness, and reduced energy loads.

In addition, energy use and GHG emissions in large buildings will also aim to meet the targets outlined in the GBS. This applies to buildings that exceed 600m² and are under the scope of Part 3 of the Ontario Building Code (OBC), including those within the Potential Intensification Hub and Potential Intensification Corridor. Key considerations include meeting the specified Total Energy Use Intensity (TEUI), Thermal Demand Use Intensity (TEDI), and Greenhouse Gas Emissions Intensity (GHGI) (GBS EC1.3). Achieving lower values of these key metrics reduces the environmental impact of building operations.

While GHGI focuses on operational carbon, embodied carbon should also be given consideration, as outlined by the GBS. Embodied carbon refers to the carbon emissions associated with the manufacture and supply of all of the materials, components, and systems used in the construction of a house, building, or community. It is encouraged that a Materials Emissions Assessment and a whole building life cycle assessment be conducted to measure carbon emissions generated at different phases of the material's life (GBS EC2.1).

Furthermore, to promote the use of electric cars and lower GHG emissions, the development could consider constructing building parking spaces in residential buildings that are EV-ready (GBS EC11.1). This involves providing a rough in for the future installation of EV charging stations.

5.4 Overall Carbon Emissions

The estimated total overall carbon emissions of the community at full build out could be modelled to assess alignment with the City's emission targets. Once building archetypes and unit counts are established, this modelling process could include an analysis of energy consumption and carbon emissions across various whole-community scenarios. This analysis can be included in a Community Energy Plan as required by the GBS (GBS EC5.1).

Each modeled scenario represents incremental improvements in energy efficiency and carbon reduction, with the Ontario Building Code minimum requirements serving as the baseline and Net Zero Energy and Near Zero Emissions as the most ambitious targets—a goal set by the CEEP by 2050. These scenarios are defined by building measures and practices for each building archetype, incorporating a range of potential technologies and strategies. Consideration must also be given to the economic and technical feasibility of each scenario to ensure that increased energy efficiency and low-carbon measures do not compromise homebuyer affordability.

By comparing the energy and emissions outcomes of each scenario, developers and builders could identify a pathway to align with the City of Hamilton’s energy and emissions targets effectively.



6. Low Carbon Energy Solutions

In addition to improved energy efficiency and GHG reduction measures, the Elfrida Area could consider alternative energy solutions that can provide low-carbon energy solutions to the community and potentially the surrounding area.

The City of Hamilton set a target that starting in 2031, all new homes will have 30% of its annual load covered by solar PV, before the introduction of heat pumps. In addition, starting in 2026, all new commercial buildings will include rooftop solar PV panels.¹⁴

6.1 Solar

Low-rise homes may benefit from roof-mounted solar PV technologies. Due to large roof areas, the energy benefits may offset a good portion of the home's energy consumption. High-rise on the other hand, have little roof space and high energy use. If solar energy were to be implemented in the community, installation of roof-mounted solar photovoltaic (PV) on low-rise homes could be prioritized. A key barrier to on-site generation in many communities is the ability of the local electric company to utilize the site generated electricity.

The City of Hamilton's Green Building Standards outlines that all new buildings must be designed and constructed to be solar-ready (GBS EC5.2).¹⁵ A solar-ready home is one that is built to allow for the installation of a future solar PV system. Under NRCan's guidelines, it includes design considerations for roof space, solar PV conduits, plumbing connections to a hot water heater, an electrical outlet, mechanical room floor space and mechanical / electrical room wall space.¹⁶ In addition, the GBS requires builders to include an opt-in for new owners to install solar PV or thermal systems at the new owner's expense, where applicable (GBS EC5.2).

Building-integrated Photovoltaics (BIPV) offers an innovative solution for high-rise buildings, where there is limited roof space but ample façade surface area available for solar installations. In recent years, BIPV technologies have become more advanced and cost-effective, making them a viable option. Beyond reducing operational energy costs and enhancing energy supply resiliency, BIPV systems have the potential to generate excess energy that can be sold back to the grid, creating a direct profit stream for building owners while significantly increasing property value.¹⁷

Additional opportunities for solar deployment may exist at the community scale provided they are acceptable to the local electricity distribution company. Low-rise housing forms including, single-detached and townhouse dwellings, typically provide sufficient roof area to accommodate rooftop PV systems and offer opportunities for distributed solar generation. Larger institutional, commercial, and mixed-use buildings may also provide suitable roof space for solar installations

where feasible. The extent to which solar energy systems are implemented will depend on factors such as building orientation, roof configuration, electrical infrastructure capacity, and coordination with the local electricity distribution company.

6.2 Ground-source Heat Pump

Ground-source heat pumps (GSHP), also known as geo-exchange heat pumps, are electric heat pumps that transfer heat between the building and the ground, which maintains a relatively constant temperature of around 10 degrees Celsius throughout the year. In Ontario, residential homes benefit from electric heat pumps as they are among the most cost-effective and climate-aligned technologies available for space and water heating.¹⁸ The installation of ground-source heat pump is encouraged but not mandated by the GBS Tier 2 metric (GBS EC5.3).

In the context of the Elfrida Area, installing GSHPs in each low-rise unit may be impractical due to the community's scale. Given the scale of development anticipated, which is planned to accommodate approximately 58,000 residents and 8,500 jobs at a density of approximately 70 persons and jobs per hectare, opportunities may exist to explore shared or centralized geo-exchange systems serving multiple buildings. A more viable option is to install GSHP systems underneath the high-density residential buildings in the Potential Intensification Hub. A study suggests that GSHPs in multi-unit residential buildings (MURBs) can achieve a 33% reduction in annual energy use and a 47% decrease in GHG emissions compared to conventional 2-pipe fan coil unit HVAC systems.¹⁹ A feasibility study conducted in later planning stages could be considered to assess heating and cooling loads of the building(s), evaluate site conditions to understand if GSHP systems are a good fit, and explore potential ownership or operational models.

One of the main advantages of GSHP systems is their high efficiency throughout the year. Engaging with a third-party entity to own and operate GSHP systems in larger buildings may help reduce upfront capital costs. In addition, opportunities for government-initiated incentives, such as the Clean Technology (CT) Investment Tax Credit (ITC), could be explored to support the implementation of geo-exchange systems.

6.3 District Energy

When tackling carbon emissions, it is crucial to address on space heating and domestic water heating. Space heating was reported to have the highest share of emissions by end use in the residential sector, followed by water heating.²⁰ A District Energy (DE) system, which consists of a network of pipes distributing thermal energy to multiple buildings within a community, sources this energy from a centralized heating and cooling center.

A district energy system is not unfamiliar in the Hamilton Region. The McMaster Innovation Park (MIP) DE system provides a centralized heating and cooling plant for three MIP buildings with a total GFA of 441,000 sqft., which generates, extracts, and shared thermal energy through the use of highly efficient geothermal and combined heat and power (CHP) engines, and mechanical

equipment.²¹ The captured thermal energy is distributed through a network of underground pipes where it is used for space and water heating.

To evaluate the potential for a district energy system in the Elfrida Area (GBS EC6.1), a comprehensive feasibility study could be conducted by the City's DE company. This study would assess the technical and economic viability of the system, analyze the community's thermal energy demand, and involve active engagement with developers, the City of Hamilton, and potentially third-party organizations to oversee ownership and/or operations of the system.

Given the scale of development proposed within the Elfrida Area, opportunities for district energy systems may be most viable in areas where higher development densities allow multiple buildings to connect to a shared thermal energy network. District energy systems are generally most effective in areas where buildings are located in close proximity and where sufficient thermal demand exists to support centralized heating and cooling infrastructure.²² Within the Elfrida Area, mixed-use nodes, institutional buildings, and higher-density residential developments may provide suitable anchor loads that could support the operation of a district energy system. The feasibility of such systems typically depends on several factors, including development density, clustering of buildings that can share thermal infrastructure, the presence of anchor loads with consistent energy demand, and the ability to coordinate system installation with municipal servicing and infrastructure phasing. A preliminary evaluation of these factors during future planning stages may help determine whether district energy systems can be practically implemented within portions of the community. In general, the establishment of a district energy utility is beyond the control of Elfrida builders and developers.

7. Sustainable Mobility and Active Transportation

The City of Hamilton set a long-term target to lower the share of daily trips made by single-occupant vehicles from the 2011 baseline if 67% to 53% by 2031 (see Figure 5.1).²³

It is the intent of the development to create a transit-supportive community that is compact and well-connected to increase both walkability and opportunities for active transportation. Measures to promote active transportation will reduce trips made by single-occupancy vehicles, leading to lower carbon emissions, and improved air quality and health benefits.

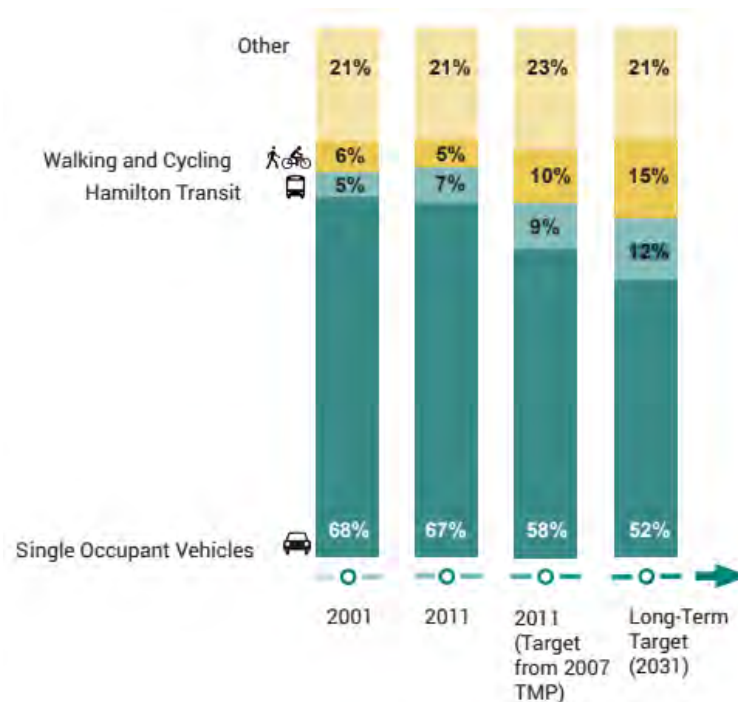


Figure 7.1. Share of daily trips made by different modes of travel.
Source: City of Hamilton

7.1 Active Transportation

The Elfrida Area will aim to provide safe and direct routes that encourage the use of active transportation modes (GBS CD1.3). The Elfrida Area will include a network of suitable cycling facilities and multi-use paths which also connects to the bicycle network (GBS CD1.2).

Sections 4 and 5 of the Transportation Management Study by C.F. Crozier & Associates Inc. highlight Elfrida's Future Active Transportation Infrastructure and Initiatives.

The City plans to incorporate bike routes along Highland Road, and multi-use paths along Regional Road 56 and First Road East.

Additionally, Crozier proposes the following:

“Improved cycling infrastructure on Rymal Road would be desirable to maximize active transportation shares from Elfrida and other new growth areas. One major opportunity outlined in GRIDS 2 that could support greater levels of active transportation under the ambitious density scenario is the development of a major east-west spine pathway system. The major east-west spine would follow the hydro corridor between Rymal Road and Twenty Road, as envisioned in the Recreational Trails Master Plan.”

The proposed Hydro Corridor Active Transportation Route can connect to the Chippewa Trail to the west and the Natural Heritages Systems throughout the Subject Lands. Potential Active Infrastructure Routes are provided in Figure 7.2.

In addition, the Elfrida Area will aim to meet the GBS target of providing long-term and short-term bicycle parking space that meet or exceed the minimum rates identified (GBS CD3.1).

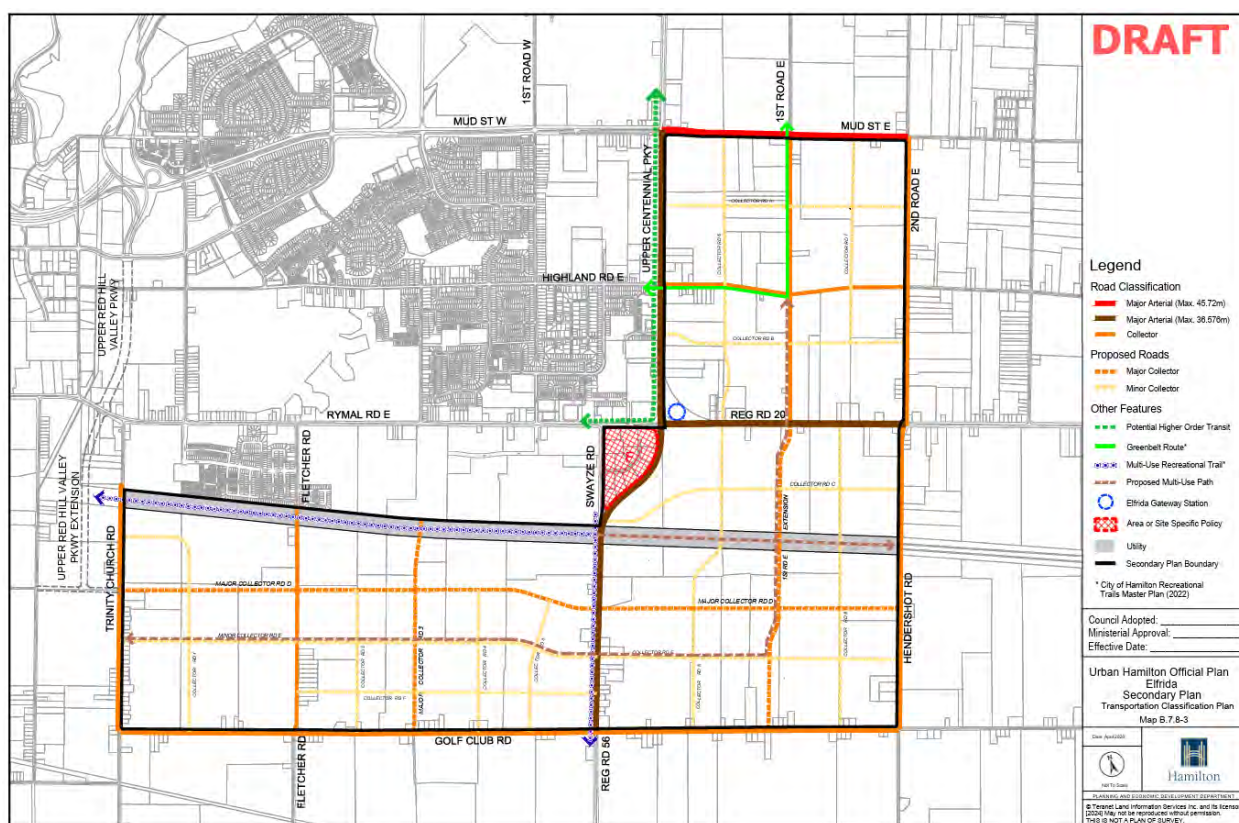


Figure 7.2. Potential active transportation network. Source: City of Hamilton.

7.2 Transit Infrastructure

The City of Hamilton set a long-term target to achieve 12% of daily trips being made by Hamilton Transit by 2031.²⁴ It is the intent of the Elfrida lands to develop a transit-supportive community that is compact and well-connected.

Sections 5.2 and 5.3 of the Transportation Management Study by C.F. Crozier & Associates Inc. highlight Elfrida's Future Transit Infrastructure and Initiatives. This seven-year phased program launching in Fall 2026 outlines planned transit improvements in the Elfrida Area under the HSR Next Network Plan. As per the City's Rail Ready System Map, the City envisions the development of major transit hubs across the City, including a hub located at Rymal Road East and Upper Centennial Parkway labeled as the Elfrida Gateway. Preliminary designs illustrate four off-street bus bays and a two-unit public washroom. The Elfrida Gateway is described as the "central hub for the community"²⁵, being a connection point linking Elfrida residents and visitors to destinations across Hamilton. The future Route 40 E Line bus rapid transit service is planned to run between Heritage and Greene Terminal and Confederation GO via Upper Centennial Parkway, stopping at the Gateway with 10-minute weekday peak headways by 2032.

Two additional transit options are also on the horizon for the Elfrida Area. The future Route 36 Rymal would connect Meadowlands Terminal to the Elfrida Gateway via Rymal Road, with stops at the Red Hill Loop and Heritage Greene Terminal, targeting 20-minute mid-day weekday headways by 2032. The Heritage Greene myRide on-demand service would cover the broader area, including both the Gateway and Heritage Greene Terminal.

The BLAST Network is a plan for a frequent rapid transit system across the City, consisting of five different lines that are envisioned as either light rail transit (LRT) services or bus rapid transit (BRT) services. The S-Line of the network is envisioned as BRT system that would run across the Elfrida Area, connecting the community to the rest of the BLAST network and with the GO station, located at the end point of the S-line. The target densities of the Elfrida Area would support the investments in the S-line. However, no specific timeline has been provided regarding the S-line, despite the target deadline for the line was originally 2041.

Taken together, these improvements are intended to make transit more accessible and appealing to people living and working in the Elfrida Area. At the neighbourhood level, emissions from transportation could fall over time through a mix of supportive land uses, connected streets, well-placed transit stops, and integrated service. Walkable, mixed-use areas with transit-supportive densities can encourage people to leave their cars behind and shorten the trips they do take. Pedestrian and cycling infrastructure, along with EV-readiness, can further reduce carbon emissions. Future development planning may factor in EV-ready parking, secure bike storage, multi-use pathways, and direct connections between homes, transit stops, parks, schools, and local destinations (see Figure 7.3) (GBS CD1.2).

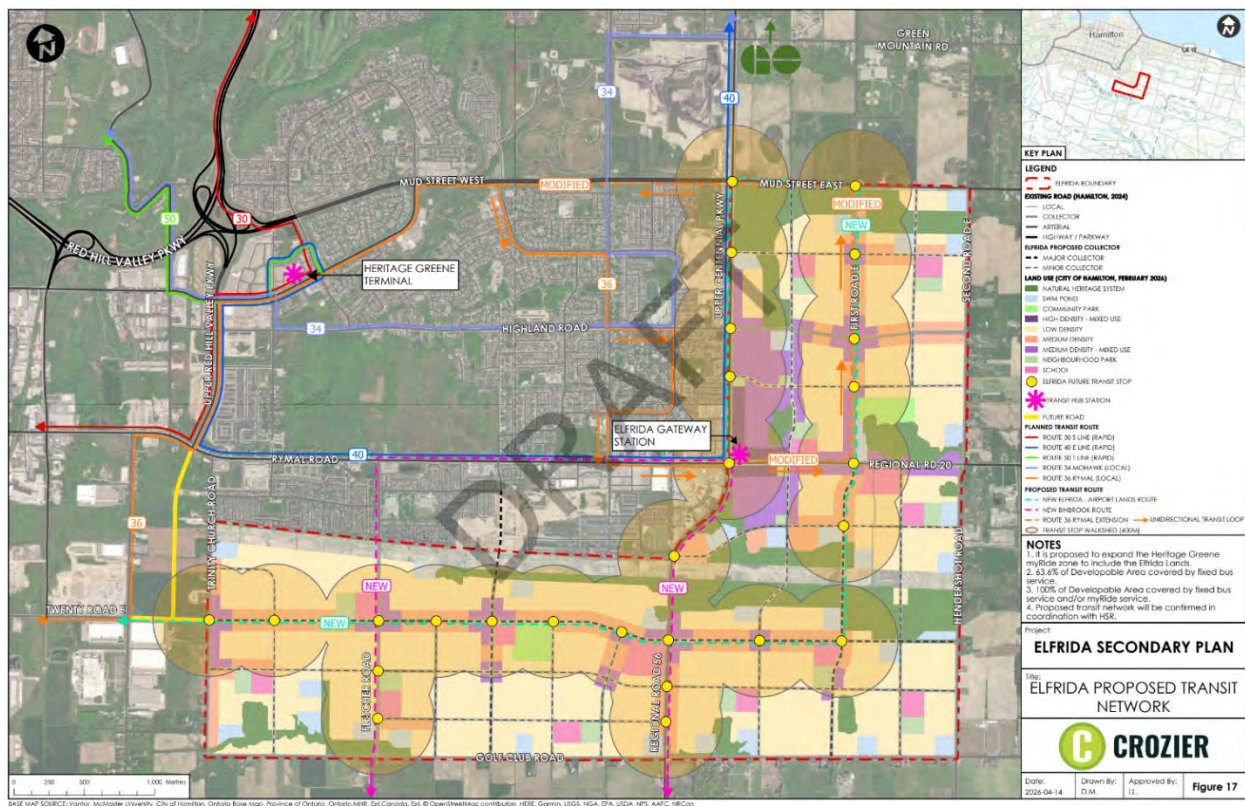


Figure 7.3. Potential transit stop location at intersections. Source: C.F. Crozier & Associates Inc.

Transportation represents a significant source of greenhouse gas emissions in new communities; particularly where development patterns result in high levels of private vehicle use. The Elfrida Secondary Plan incorporates several land uses and transportation planning elements that may help reduce long-term transportation emissions relative to conventional suburban development patterns.

The Elfrida Area's transportation network also creates strong opportunities for active transportation. Pedestrian and cycling connections are proposed throughout, linking residential, schools, parks, community facilities, mixed-use areas, and the Elfrida Gateway transit hub. The Crozier study identifies new and upgraded arterial and collector roads that would include dedicated cycling facilities on both sides, significantly expanding the cycling network. It also proposes extending the multi-use trail along the hydro corridor through the eastern Elfrida Area, connecting Highway 56 to Henderson Road. See Figure 7.4.

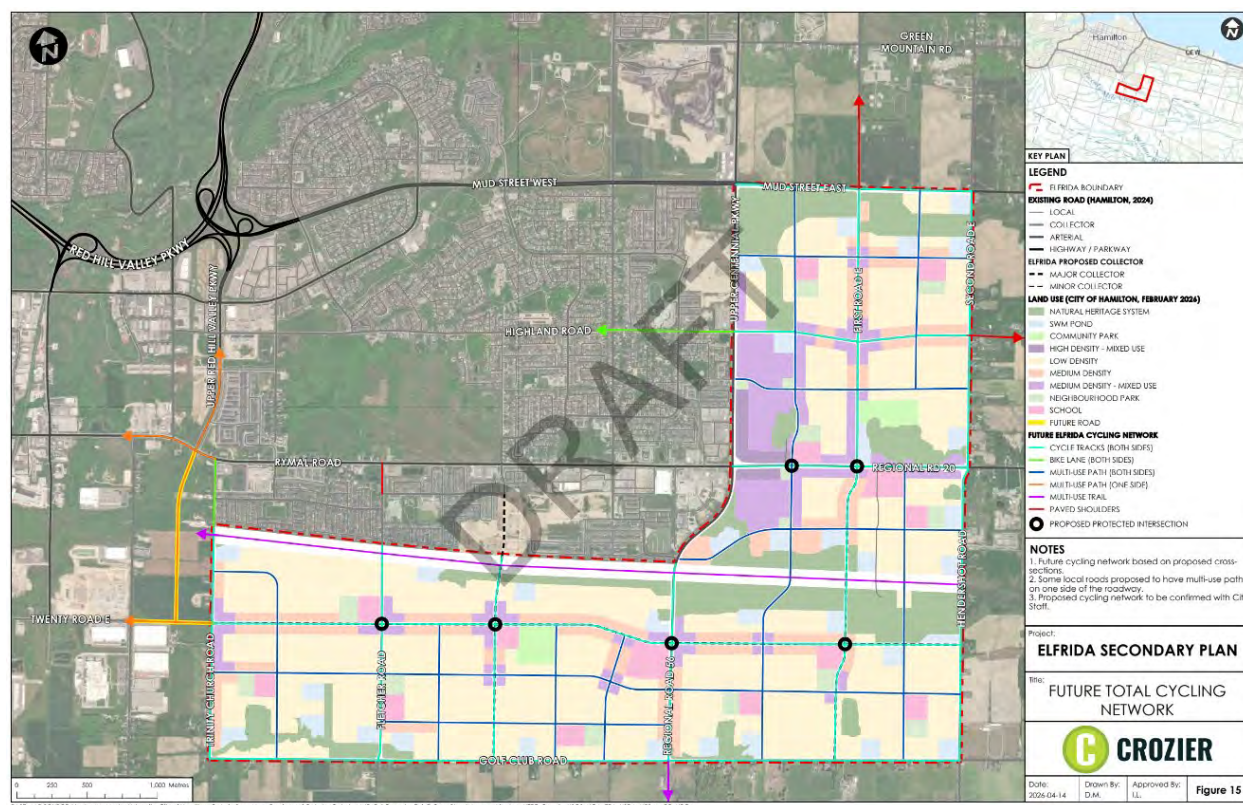


Figure 7.4. Potential total cycling network. Source: C.F. Crozier & Associates Inc.

At key destinations like schools and transit hubs, protected intersections may be warranted to reduce conflicts between cyclists, pedestrians, and vehicles. Consistent with Hamilton's Complete Streets Design Guidelines, these could include bicycle signals, leading pedestrian and cycling intervals, and corner refuge islands. A safe, connected active transportation network makes walking and cycling more practical for shorter trips, improves access to transit, and can gradually reduce the area's reliance on private vehicles.

In addition to land use and network design considerations, electrification of transportation represents another potential pathway for reducing greenhouse gas emissions associated with personal vehicles. As electric vehicle adoption increases, opportunities may emerge to integrate EV charging infrastructure within residential, commercial, and institutional developments. Furthermore, to promote the use of electric cars and lower GHG emissions, the development could consider constructing building parking spaces in residential buildings that are EV-ready (GBS EC11.1). This involves providing a rough in for the future installation of EV charging stations.

Studies of transit-supportive and mixed-use communities suggest that integrated land use and transportation planning can reduce vehicle kilometers travelled (VKT) and associated emissions compared to conventional auto-oriented development patterns. Research indicates that compact, mixed-use development patterns can reduce VKT by approximately 10-30% compared to conventional suburban development patterns.²⁶ While detailed transportation modelling will be undertaken through future transportation studies, the planning framework for the Elfrida Area may support a gradual shift toward more sustainable patterns over time.



8. Natural Environment and Water

8.1 Protect and Enhance the Natural Heritage System

The Elfrida Area includes a variety of Natural Heritage features, including woodlands, wetlands, and streams. The largest such Natural Heritage feature is located in the approximate centre of the site and is bisected by the hydro corridor, creating a large natural heritage corridor between Hendershot Road in the east and approaching Fletcher Road in the west. These areas of Natural Heritage and associated Linkage Areas are identified on the Structure Plan based environmental mapping prepared by Stantec, including subsequent site-specific development applications, additional field work and more detailed mapping to identify and confirm the limits of these features and their associated buffers.

The Elfrida Area will be developed in a manner that is sensitive to the natural environment as per the UHOP and the PPS. The Preliminary Opportunities and Constraints Mapping report concludes that the subject site can be developed in a responsible manner to minimize impacts and provide a net ecological benefit to the natural heritage features and constraints that exist within the subject site.

Furthermore, an Agricultural Impact Assessment (AIA) for the Elfrida Lands have been undertaken by Colville Consulting Inc. The AIA states that prime agricultural areas cannot be avoided to accommodate the identified land needs for the City's projected population growth. The subject lands are lower priority agricultural lands within a prime agricultural area and represent a reasonable located inclusion into the City's urban boundary. The report concluded that potential impacts associated with the Elfrida Area are primarily limited to the loss of prime agriculture land, cultivatable land, agricultural infrastructure, and agricultural land improvement. Recommendations have been proposed to ensure potential impacts will be avoided or mitigated to the extent possible. The net indirect impacts will be negligible with the implementation of the recommended mitigation measures.

8.2 Low Impact Development

Low Impact Development (LID) encompasses a range of strategies to increase the infiltration of rainwater into the ground to reduce the impact of contaminated runoff flowing into water streams. These strategies not only address stormwater management, but also provide social and economic benefits, including health benefits, and improved property aesthetics and property value.²⁷

Key LID best practices include bio-retention / rain gardens, permeable pavements, green roofs, bio-swales, and rainwater harvesting. By leveraging landscape-based development and green infrastructure, LID supports stormwater flow control, promotes the creation of native habitats, and boosts local biodiversity.

Aligned with the Green Building Standards (GBS), the Elfrida Area will comply with the Green Standards and Guidelines for Low Impact Development to meet the City's stormwater quantity and quality requirements.

8.3 Water

It is the intent of the Elfrida Area to support efficient and sustainable use of water resources, including water conservation (GBS). The development will consider incorporating rainwater capture systems in residential development for water capture/irrigation and/or local food growing, aligning with the City's CCIAP.²⁸ Buildings within the development will aim to conserve water use by using efficient water fixtures, balanced irrigation practices, and through ongoing monitoring, reporting and benchmarking (GBS W1,2,3).



9. Climate Resilience

Resilience can be understood in the context of emergency preparedness and climate change adaptation.²⁹ It refers to the ability of buildings, infrastructures, and communities to withstand disruptions caused by extreme weather events, while continuously providing shelter that ensures occupants are safe and comfortable until conditions are restored. Building resiliency must be taken into consideration through an integrative process involving all key players and stakeholders. It is important to approach building design through a holistic building-as-a-system principles, ensuring that all reasonably foreseeable challenges have been considered, and that buildings are durable, energy efficient, and can perform under extreme weather events (such as rainfall, flooding, and increasing temperatures).³⁰ Key measures that the Elfrida Area could consider are described below.

9.1 Built Environment Resilience Strategies

- **Community Planning, Infrastructure and Services:** Critical considerations at the community scale include the planning of detours and evacuation routes in the event of automobile accidents, chemical spills, fires or flooding.³¹
- **Low Impact Development (LID) and Building Sites:** Natural landscapes are more resilient and adaptable than man-made infrastructure. LID is a stormwater management strategy designed to mitigate runoff and mimic natural water absorption processes. LID practices that could be considered include, but are not limited to, rain gardens (bio-retention basins), bio-swales, green roofs, and permeable pavements.³²

9.2 Building Enclosure Resilience Strategies

- **Resilient Building Envelope:** Building enclosures serve as the first line of defense against extreme weather events. A high-performing building envelope has the ability to regulate temperature, keeping heat both in during colder months and out during warmer ones. They are able to utilize heating inertia, passively maintaining occupant comfort for extended period, even during power outages.³³
- **Basement flooding and sewer backup protection:** Climate change has increased the frequency and severity of extreme rainfall events, resulting to increased risks of basement flooding. Key considerations include installing backwater valves to prevent sewer backups, ensuring proper drainage in basements, and grading the lot to direct runoff away from the building.

9.3 Integration of Climate Resilience into Community Planning and Infrastructure

Consistent with Hamilton's Climate Change Impact Adaptation Plan, planning and design of the Elfrida Secondary Plan area should consider climate-related risks that may affect buildings, infrastructure, and community services. These include increased precipitation intensity and flooding, changes in rainfall intensity-duration-frequency (IDF) characteristics, extreme heat events, and other hazards such as ice storms and windstorms that can disrupt mobility and power reliability.³⁴

In addition to built infrastructure considerations, natural systems and ecosystems services play an important role in supporting climate resilience at the landscape scale. The Elfrida Area is located within the upper reaches of several local sub watersheds, including Upper Davis Creek, Hannon Creek, Twenty Mile Creek, Sink Hole Creek, and Stoney Creek. Existing agricultural and natural landscapes contribute to ecosystem functions such as stormwater attenuation, groundwater recharge, and habitat connectivity. Consistent with the City of Hamilton's Climate Action Strategy Biodiversity Action Plan, and Urban Forest Strategy, planning for the Secondary Plan area should consider how natural heritage systems, vegetative cover, and green infrastructure can continue to support biodiversity and watershed performance as development occurs. Detailed evaluation of natural heritage systems and watershed function will be undertaken through the environmental, sub watershed, and stormwater management studies required as part of the Secondary Plan process, which will help inform how development is designed while maintaining climate resilience objectives. Refer to Stantec's sub watershed study for further details.

At the community scale, flood risk mitigation and stormwater resilience may be supported by integrating LID and green infrastructure approaches that manage rain where it falls and promote infiltration and retention, consistent with provincial and municipal stormwater directions. In alignment with the City's site servicing guidance, stormwater strategies may incorporate distributed source controls (e.g., bioretention, rain gardens, bioswales, tree trenches, permeable pavement, green roofs, and cisterns) as part of a treatment train, with preliminary design and long-term operations and maintenance considerations identified as early as the site plan stage.³⁵

To improve robustness under future rainfall conditions, stormwater design criteria and modelling assumptions should account for climate change rather than relying solely on historical rainfall data, recognizing that IDF relationships are expected to shift over time. Hamilton's climate science work notes that heavy rainfall is expected to become more intense and frequent and that stormwater systems rely on IDF curves that will change; therefore, future planning stages should apply climate-adjusted rainfall information and confirm design storms through the appropriate municipal standards and technical studies.³⁶

In alignment with the City's Green Standards and applicable stormwater servicing objectives, stormwater management strategies for the Elfrida Area may be structured around the proposed criteria developed through ongoing engineering analysis from Stantec.³⁷ Preliminary criteria include water quantity controls based on maintaining 100-year post-development peak flows at pre-development levels, water quality treatment consistent with MECP Enhanced Level 1

standards (80% total suspended solids removal), and water balance targets established on a subwatershed basis through post-to pre-development discrete event analysis.

In addition, runoff volume control measures may incorporate extended detention criteria, including 48-hour detention of a 25 mm 4-hour Chicago storm event, subject to refinement through detailed hydrologic and hydraulic modelling. These approaches are intended to support objectives related to flood resilience, water quality protection, climate adaptation, and downstream watershed performance. Final criteria and implementation measures should be confirmed through the subwatershed, master drainage, and stormwater management studies provided by Stantec.

Urban design and landscape strategies may also play an important role in addressing extreme heat and improving outdoor thermal comfort. Approaches may include preserving and enhancing vegetative cover, increasing tree canopy, and integrating shaded open spaces and green infrastructure. Hamilton's Urban Forest Strategy identifies shade and evapotranspiration as mechanisms that can lower air temperatures and reduce urban heat island effects, while also contributing to stormwater benefits. In addition, the City's Green Building Standards framework (draft content) includes examples of heat island reduction strategies (e.g., cool roofs, green roofs, and solar PV over a significant portion of roof area) and a tree canopy target at the site scale, which may inform future detailed design expectations for higher-performing development.³⁸

To improve continuity of essential services during extreme weather events and power disruptions, building and infrastructure resilience measures may be integrated into detailed design, particularly in higher-density building forms. Examples are included in the ICLR Report in Appendix G (pages 203-223 in the report), offering a list of measures that may be offered, if feasible, by builders for resilient home options. Further examples include incorporating refuge/amenity areas capable of maintaining safe indoor conditions and providing backup power to essential systems for a defined duration during outages, consistent with the City's emerging resilience-oriented building standards. Resilience measures should be confirmed through future planning and design stages and documented in submissions such as stormwater management reporting (including infiltration requirements, hazard/wetland considerations, and overland flow routes) and broader drainage/master servicing studies (including implementation and monitoring plans), ensuring that climate resilience is embedded within infrastructure design, construction practices, and long-term operations.³⁹

9.4 Economic and Feasibility

Implementation of low-carbon and climate resilience measures must be considered not only in terms of emissions reduction potential, but also in terms of capital cost, lifecycle cost, constructability, and coordination with municipal servicing and development phasing. At the Phase 2 stage, financial feasibility is appropriately considered at a preliminary level using broad cost ranges and publicly available guidance, while detailed costing and business case analysis are typically undertaken through subsequent technical studies.

Measures such as rooftop solar, geo-exchange systems, district energy, electric vehicle infrastructure, and LID may offer long-term benefits including reduced energy use, lower greenhouse gas emissions, improved resilience, and avoided infrastructure or operating costs. However, the economic performance of these measures is highly dependent on site-specific conditions, development density, phasing, ownership structure, utility requirements, and detailed engineering design.

Accordingly, this assessment recognizes that more detailed financial evaluation may be required through future studies, including district energy feasibility assessments, geo-exchange feasibility studies, transportation and EV infrastructure studies, and sub watershed, master drainage, or stormwater management studies, as applicable. Potential funding and financing opportunities may also be explored at later stages through applicable federal, provincial, municipal, and utility programs. This approach is consistent with the Phase 2 planning level of the EEA Report and avoids reliance on assumptions that would be more appropriately confirmed through subsequent design and feasibility work.

10. Stakeholder Consultation and Engagement

The development of the EEA Report for the Elfrida Area has been informed through ongoing coordination with the broader planning process. Engagement undertaken as part of the planning process has included consultation with municipal staff, technical consultants, landowners, and other stakeholders involved in infrastructure planning, land use planning, and environmental studies.

Technical input has been gathered from engineering and planning consultants, informing assumptions related to land use structure, transportation networks, infrastructure servicing, and stormwater management studies. These inputs informed the evaluation of potential energy, emissions, and resilience strategies considered within this assessment.

In particular, feedback from infrastructure and servicing consultants has informed the discussion of stormwater management strategies and LID measures that support climate resilience objectives. Similarly, land use planning inputs related to development density, mixed-use areas, and transportation networks have informed the assessment of opportunities for reducing transportation emissions.

The preparation of this assessment has also taken into account the broader policy direction established by the City of Hamilton, including the CEEP and the CCIAP, which reflect input from community stakeholders and technical experts.

Further consultations with stakeholders, including developers, infrastructure providers, and municipal staff, will continue. Additional studies, such as transportation impact studies, district energy feasibility assessments, and stormwater management studies, will provide further opportunities for stakeholder input and refinement of climate and energy strategies.

11. Conclusion and Next Steps

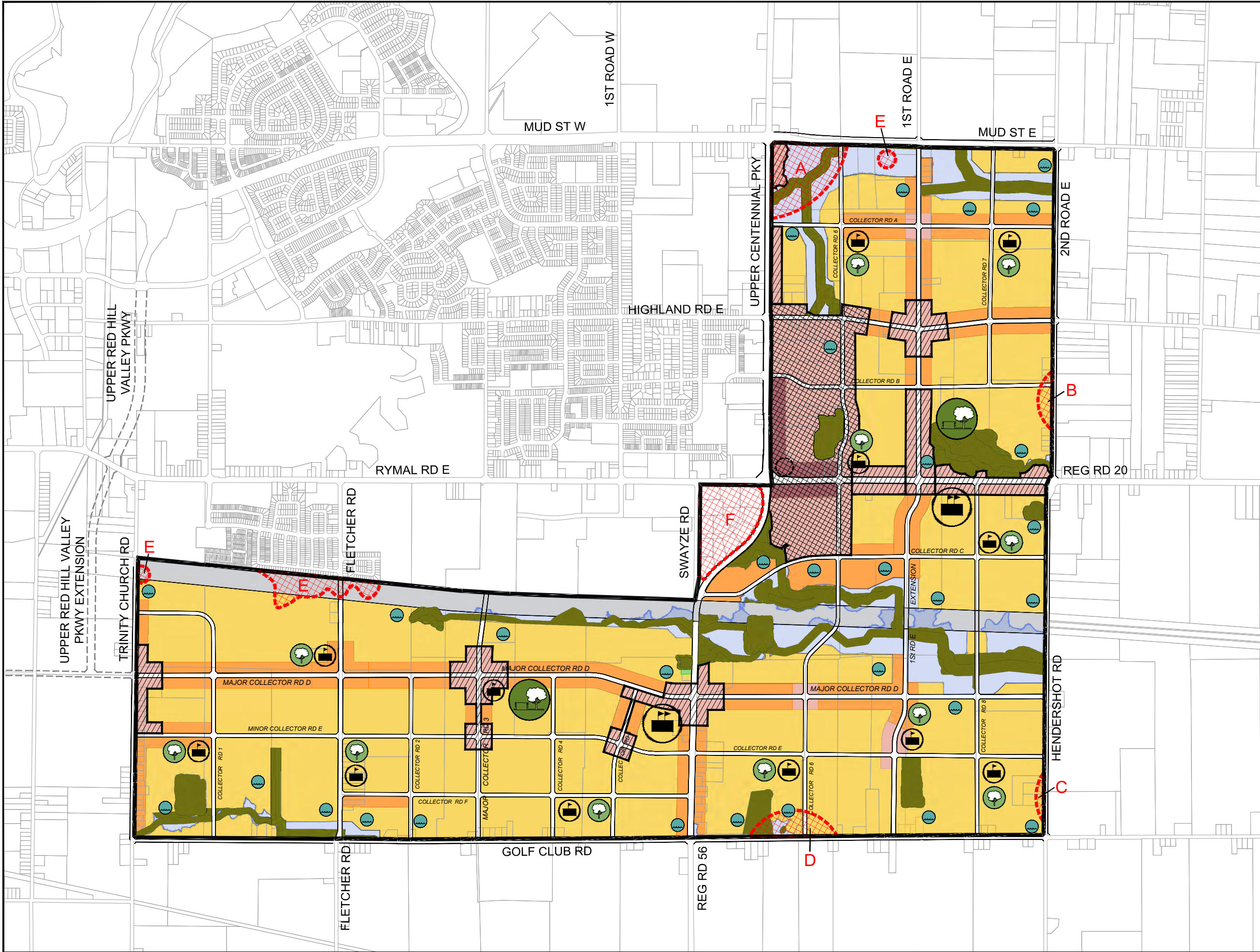
The Energy and Environmental Assessment Report provides a roadmap for the Elfrida Area to develop an energy-efficient, low-carbon community that aligns with local and regional policies and targets. Through five Areas of Impact, the ECCA Report demonstrates that growth can be achieved affordably without placing an unreasonable burden on the environment at a price that homebuyers can continue to afford.

This report will be a living document that will go through multiple iterations, with greater clarity and detail in each iteration. Through an iterative process, involving many stakeholders, including developers, builders, planner, and City staff, the EEA Report will guide the development of the Elfrida Area community into a complete, transit-supportive, mixed-use area. The report will ensure the development is compact, well-connected and both environmentally and economically sustainable, all while promoting and protecting existing natural heritage features, minimize impacts and consumption of agricultural lands, and be compatible with adjacent planned and existing land uses.

Appendix A

Elfrida Secondary Plan Concept

Date: February 17, 2026



Legend

- Residential Designations
- Low Density Residential
 - Medium Density Residential
- Commercial and Mixed Use Designations
- Mixed Use - Medium Density
 - Mixed Use - High Density
 - Local Retail Node Overlay
 - Community Retail Node Overlay
- Parks and Open Space Designations
- Community Park
 - Neighbourhood Park
 - General Open Space
- Natural Heritage System & Floodplain
- Natural Heritage System (Including Buffers and VPZ)
 - Proposed Floodplain (Including Buffers)
- Other Designations
- Utility
 - Elementary School
 - Secondary School
 - Storm Water Management
- Other Features
- Area or Site Specific Policy
 - Elfrida Gateway Station
 - Secondary Plan Boundary

Council Adopted: _____
Ministerial Approval: _____
Effective Date: _____

Urban Hamilton Official Plan
Elfrida
Secondary Plan
Land Use Plan
Map B.7.8-1



PLANNING AND ECONOMIC DEVELOPMENT DEPARTMENT

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Appendix B

Archetype House

An archetype house is a representation of a “typical” house. There are archetypes for detached houses, row houses, stacked houses, and combinations of all types. Archetype houses are commonly used for energy efficiency modelling, where it can be impossible to individually model every type of house. The objective of this type of modelling is to understand the general impact of upgrades and changes to insulation levels and mechanical equipment. Archetype houses have been utilized by the federal and provincial governments across Canada in the development of regulation and voluntary housing programs.

Data Gathering

Natural Resources Canada (NRCan) was contacted about house geometry and configuration data that it collects. NRCan possesses HOT2000 files and house information as part of its Energy Star for New Homes (ESNH) and EnerGuide existing and new house voluntary programs. For this project HOT2000 modelling data for houses built during the 2020 to 2025 Ontario Building Code cycle was sought from NRCan. The data request was limited to the current OBC cycle so the new archetype could reflect the latest house designs in Ontario.

The data that was provided included the physical and equipment configurations of the houses that were modeled in HOT2000. The house data included basement floor area, basement wall area above grade, basement wall area below grade, ceiling area, door areas, and window area. The NRCan data consisted of 312 HOT2000 house files organized in an Excel (.xlsx) file format.

Built Housing Forms

The dataset provided by Bousfields Inc. was used to establish the housing type distribution. The dataset includes projected totals for single-detached, semi-detached, and row dwelling units, as shown in Table B.1. For the purposes of this report, street townhouses, block townhouses, and back-to-back (B2B) units are collectively categorized as row housing. Stacked townhouses and apartment units are excluded from the archetype house analysis, as these building forms are not typically constructed under Part 9 of the Ontario Building Code.

Table B.1 Projected Unit Counts Per Dwelling Type

Summary	Total
Singles	4708
Semis	1177
Street Towns	7202
Block Towns	1878
B2B	1289
Stacked	1289
Apartments	4454

The envelope areas of the 312 houses were consolidated into a single set of house measurements for all detached (173 house files), semi-detached (24 house files), and row houses (37 house files). The attributes of each house in the set are shown in Table B.2.

Table B.2 Average Housing Attributes by Dwelling Type

Hot2000 Component	NRCan Files for Single/Semi and Row		
	Single Detached Homes 57%	Double or Semi 6%	Row House 37%
	count: 173	count: 24	count: 115
FloorArea	396.9	240.3	265.3
Footprint	157.5	80.1	99.5
HSEVOL	834.4	600.7	653.4
Ceiling area	160.6	87.9	94.6
Exposedfloor area	14.4	16.9	16.9
Slab area	6.7	0.0	8.9
Ponywall area	29.3	1.8	7.9
Mainwall area	233.2	188.2	147.3
Buildingsurface area	703.3	449.2	415.4
HouseVolume without CS	992.3	600.7	664.1
Bsmt AG	27.5	17.5	14.8
Bsmt BG	107.0	80.5	85.2
Bsmt Slab Area	136.3	63.2	73.8
Bsmt Header Area	12.4	7.6	5.1
Win_MF_S	7.0	2.4	3.3
Win_MF_SE	1.9	0.0	0.9
Win_MF_E	5.8	11.6	4.0
Win_MF_NE	1.7	0.0	2.3
Win_MF_N	6.8	3.5	3.8
Win_MF_NW	1.8	0.0	1.0
Win_MF_W	5.7	10.4	3.9
Win_MF_SW	1.4	0.0	2.2
Win_Bsmt_S	1.4	0.1	0.3
Win_Bsmt_SE	0.2	0.0	0.0
Win_Bsmt_E	1.2	0.3	0.3
Win_Bsmt_NE	0.2	0.0	0.1
Win_Bsmt_N	1.2	0.4	0.5
Win_Bsmt_NW	0.2	0.0	0.1
Win_Bsmt_W	1.3	1.0	0.2
Win_Bsmt_SW	0.3	0.0	0.1

NUMWINDOWS	18.9	18.0	17.9
NUMDOORS	3.0	3.2	2.9
Door area	2.8	4.2	2.8

The average energy results for the detached, semi-detached, and row house archetypes were then combined using the weighted distribution provided by Bousfields Inc. This combined archetype reflects the projected dwelling mix of 29% detached, 7% semi-detached, and 64% row housing. (Refer to Table B.3)

Table B.3 Projected Unit Counts by DWU Types

Elfrida Projected Unit Counts by Dwelling Type				
	Singles	Semis	Row	Total
Units	4,708	1,177	10,369	16,253
Percentage	29%	7%	64%	

Design Assumptions

The data acquired from NRCAN did not contain certain inputs required for modelling in HOT2000, such as house orientation, wall height, roof slope, etc. Some assumptions were made in regard to construction. For example, the wall height for the main and second floor was assumed to be 2.44 m (8 feet), the header height was 250 mm (10 inches), roof overhand was 600 mm (2 feet). Other assumptions were made to enable energy modelling such as house location, house orientation and year built. All assumptions are detailed in Table B.4.

Table B.4 Design Assumptions

Elfrida Archetype House Design Assumptions		
Component	Assumption	Rationale
House Location	Toronto, ON	The largest number of houses were located in the Toronto region
House orientation	North	The orientation of each house was not included in the HOT2000 data available. North was therefore assumed to be the archetype house's front orientation
Year built	2026	

Wall height (main and 2nd floors) m (ft)	2.44 (8')	Typical floor clearance height
Header height m (inches)	0.254 (10")	Typical header height
Roof overhang M (ft)	0.61 (2')	Typical overhang length
Roof slope	6/12	Typical roof slope
Ceiling type	Attic Gable	Typical attic design

HOT2000 WEATHER DATA SET

The Elfrida archetype house was modelled using the “Wth2020” weather data set.

ELFRIDA ARCHETYPE HOUSE PHYSICAL ATTRIBUTES RESULT

Below, as shown in Table B.5, are the weighted average results of the physical attributes of the Elfrida archetype house.

Table B.5 *Elfrida Archetype House*

Elfrida Archetype House	
Hot2000 Component	Area in m ²
	Total: 16253
FloorArea	301.7
Footprint	114.9
HSEVOL	702.0
Ceiling area	113.3
Exposedfloor area	16.2
Slab area	7.6
Ponywall area	13.6
Mainwall area	175.1
Buildingsurface area	501.3
HouseVolume without CS	754.6
Bsmt AG	18.7
Bsmt BG	91.2
Bsmt Slab Area	91.1
Bsmt Header Area	7.4
Win_MF_S	4.3
Win_MF_SE	1.1
Win_MF_E	5.1
Win_MF_NE	2.0

Win_MF_N	4.6
Win_MF_NW	1.1
Win_MF_W	4.9
Win_MF_SW	1.8
Win_Bsmt_S	0.6
Win_Bsmt_SE	0.0
Win_Bsmt_E	0.5
Win_Bsmt_NE	0.2
Win_Bsmt_N	0.7
Win_Bsmt_NW	0.1
Win_Bsmt_W	0.6
Win_Bsmt_SW	0.1
NUMWINDOWS	18.2
NUMDOORS	3.0
Door area	2.9

Appendix C

Elfrida Scenario Packages Outlined

Elfrida Scenario Packages Outlined						
Key measure		Scenario 1A	Scenario 1B	Scenario 2A:	Scenario 3A:	Scenario 3B:
Ceiling with Attic Space	Min. Nominal R	8.81 (R50)	60	60	—	10.56 +HH (60 +HH)
	Max. U	—	0.017	0.017	—	0.095 (0.016)
	Min. Effective R	—	59.22	59.22	—	10.55 (50.90)
Ceiling Without Attic Space	Min. Nominal R	5.46 (R31)	31	31	—	5.46 (31)
	Max. U	—	0.036	0.036	—	0.205 (0.036)
	Min. Effective R	—	27.65	27.65	—	4.87 (27.65)
Exposed Floor	Min. Nominal R	5.46 (R31)	31	31	R31 + 5	5.46 (31)
	Max. U	—	0.034	0.034	—	0.19 (0.034)
	Min. Effective R	—	29.8	29.8	—	5.25 (29.9)
Walls Above Grade	Min. Nominal R	3.87 (R22)	22	22	R24 + 10ci	3.34 + 1.76 ci (19 + 10 ci)
	Max. U	—	0.059	0.059	—	0.224 (0.040)
	Min. Effective R	—	17.03	17	—	4.46 (25.32)
Basement Walls	Min. Nominal R	2.11 (R12)	20 ci	20 ci	R20 + 10 ci	3.52 + 1.40 ci (20 + 8 ci)
	Max. U	—	0.047	0.047	—	0.25 (0.044)
	Min. Effective R	—	21.12	21.12	—	4 (22.71)
	Min. Nominal R	—	—	—	R10	1.32 (7.5)

Below Grade Slab Entire Surface > 600 mm Below Grade	Max. U	—	—	—	—	0.658 (0.116)
	Min. Effective R	—	—	—	—	1.52 (8.63)
Heated Slab or Slab ≤ 600 mm Below Grade	Min. Nominal R	1.76 (R10)	10	10	—	1.76 (10)
	Max. U	—	0.09	0.09	—	0.51 (0.090)
	Min. Effective R	—	11.13	11.13	—	1.96 (11.13)
Edge of Below Grade Slab ≤ 600 mm Below Grade	Min. Nominal R	1.76 (R10)	10	10		1.76 (10)
Windows and Sliding Glass Doors	Max. U	1.8	0.28	1.6	0.18 (1.02 u)	1.4 (0.25)
	Energy Rating	—	25	25	—	29 (29)
Skylights	Max. U	2.8	0.49	0.49	—	2.8 (0.49)
Glazing Ratio	—	—	—	—	—	—
Space Heating Equipment	Min. AFUE	94%	96%	92%	Air Source Heat Pump + Electric furnace back up	—
	Min. HSPF	—	—	7.1	—	—
HRV	Min. SRE	60%	75%	75%	HRV 81% SRE @ 0°C	81%
Domestic Water Heater	Min. EF	0.67	0.8	-	Gas water heater	-
Envelope Air Tightness	ACH	3.0	3.0	3.0	1.0 ACH	3.0
Duct Sealing	—	—	—	—	-	—
Lights	—	—	—	—	75% LEDs	—
Drain water heat recovery	—	—	—	—	42%	—

Appendix D

Greenhouse Gas (GHG) Emissions Calculation Assumptions

Greenhouse gas emissions were calculated manually rather than using the default NRCan's Hot2000 emission factors. Hot2000 emission factors are based on a five-year average derived from the National Inventory Report. For this analysis, these values were compared against emission factors obtained through independent research.

Natural Gas Factor

For Ontario, the natural gas emission factors closely aligned, with only a marginal difference between the Hot2000 value (0.001932355) and the value used in this study (0.001921)¹.

Electricity Factor

In contrast, electricity emission factors differed significantly. Research based on the 2024 Carbon Emissions Inventory Report indicates that Ontario's grid carbon intensity increased to 73.8 gCO₂e/kWh in 2024, representing an approximately 25% increase from 2023². This increase was attributed to higher electricity demand and increased reliance on natural gas generation associated with nuclear plant refurbishments.

While the 2024 value reflects atypically high emissions due to these conditions, the NRCan electricity emission factor (0.00002740) was determined to be unrepresentative of recent grid performance. As a result, the 2023 electricity emission factor was selected for this analysis. A five-year average electricity emission intensity of 57.9 gCO₂e/kWh was calculated using data from the TAF Carbon Emissions Inventory. The 2023 value of 59.0 gCO₂e/kWh was adopted, as it modestly adjusts the average upward to account for pandemic-era anomalies while remaining representative of recent conditions.

¹ Environment and Climate Change Canada, "Emission Factors and Reference Values version 3.0" published October 2025. (table 4.1 fossil fuel combustion)

² (2024 GTHA Carbon Emissions Inventory)

Appendix E

HOT2000 Report – Elfrida Phase 2

HOT2000

Natural Resources CANADA
Version 11.13



File: Elfrida_Scenario 1A.h2k
House

Weather Library: C:\HOT2000 v11.13b13\Dat\Wth2020.dir
Weather Data for: TORONTO INTL, ONTARIO

Builder Code:

Data Entry by: Si Jia Wang
Date of entry: 2026-03-09

Company: buildABILITY

Client name: ,

Street address:

City: **Region:** ONTARIO

Postal code: **Telephone:**

Mailing address:

City: **Region:** ONTARIO

Postal Code:

GENERAL HOUSE CHARACTERISTICS

House type: Single Detached

Number of storeys: Two storeys

Plan shape:

Front orientation: North

Year House Built: 2025

Wall colour: Default

Absorptivity: 0.40

Roof colour: Default

Absorptivity: 0.40

Soil Condition: Normal conductivity (dry sand, loam, clay)

Water Table Level: Normal (7-10m/23-33ft)

House Thermal Mass Level: (A) Light, wood frame

Effective mass fraction 1.000

Occupants :
2 Adults for 50.0% of the time
1 Children for 50.0% of the time
0 Infants for 0.0% of the time

**Sensible Internal Heat
Gain From Occupants:** 2.00 kWh/day

HOUSE TEMPERATURES

Heating Temperatures

Main Floor	Daytime Setpoint:	21.0 °C
	Nighttime Setpoint:	18.0 °C
	Nighttime Setback Duration:	8.0 Hours
	24 Hour Average:	20.0 °C
Basement	Setpoint:	19.0 °C
	TEMP. Rise from 20.0 °C:	5.5 °C
Basement is- Heated:Yes Cooled: No		Separate T/S: No
Fraction of internal gains released in basement :		0.150
Indoor design temperatures for equipment sizing		
	Heating:	22.0 °C
	Cooling:	24.0 °C

WINDOW CHARACTERISTICS

Label	Location	#	Overhang Width (m)	Header Height (m)	Tilt deg	Curtain Factor	Shutter (RSI)
South							
South	Main Floor	1	0.00	0.00	90.0	1.00	0.00
South	Top Floor	1	0.00	0.00	90.0	1.00	0.00
South	1 Foundation	1	0.00	0.00	90.0	1.00	0.00
Southeast							
Southeast	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Southeast	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Southeast	1 Foundation	1	0.00	0.00	90.0	1.00	0.00
East							
East	Main Floor	1	0.00	0.00	90.0	1.00	0.00
East	Top Floor	1	0.00	0.00	90.0	1.00	0.00
East	1 Foundation	1	0.00	0.00	90.0	1.00	0.00
Northeast							
Northeast	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Northeast	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Northeast	1 Foundation	1	0.00	0.00	90.0	1.00	0.00

North

North	Top Floor	1	0.00	0.00	90.0	1.00	0.00

North	Main Floor	1	0.00	0.00	90.0	1.00	0.00

North	1 Foundation	1	0.00	0.00	90.0	1.00	0.00

Northwest

Northwest	Main Floor	1	0.00	0.00	90.0	1.00	0.00

Northwest	Top Floor	1	0.00	0.00	90.0	1.00	0.00

Northwest	1 Foundation	1	0.00	0.00	90.0	1.00	0.00

West

West	Top Floor	1	0.00	0.00	90.0	1.00	0.00

West	Main Floor	1	0.00	0.00	90.0	1.00	0.00

West	1 Foundation	1	0.00	0.00	90.0	1.00	0.00

Southwest

Southwest	Main Floor	1	0.00	0.00	90.0	1.00	0.00

Southwest	Top Floor	1	0.00	0.00	90.0	1.00	0.00

Southwest	1 Foundation	1	0.00	0.00	90.0	1.00	0.00

Label**Type****#****Window Width (m)****Window Height (m)****Total Area (m²)****Window RSI****SHGC****ER*****South**

South	DG-U1.8	1	1.47	1.47	2.16	0.563	0.3076	17.2

South	DG-U1.8	1	1.47	1.47	2.16	0.563	0.3076	17.2

South	DG-U1.8	1	0.77	0.77	0.59	0.507	0.2433	4.7

Southeast

Southeast	DG-U1.8	1	0.76	0.76	0.57	0.505	0.2410	4.2

Southeast	DG-U1.8	1	0.76	0.76	0.57	0.505	0.2410	4.2

Southeast	DG-U1.8	1	0.22	0.22	0.05	0.438	0.0309	- 81.9

East

East	DG-U1.8	1	1.58	1.58	2.50	0.569	0.3130	18.1

East	DG-U1.8	1	1.58	1.58	2.50	0.569	0.3130	18.1

East	DG-U1.8	1	0.74	0.74	0.55	0.503	0.2380	3.5

Northeast

Northeast	DG-U1.8	1	0.99	0.99	0.99	0.530	0.2727	10.7

Northeast	DG-U1.8	1	0.99	0.99	0.99	0.530	0.2727	10.7

Northeast	DG-U1.8	1	0.39	0.39	0.15	0.449	0.1362	- 24.6

North

North	DG-U1.8	1	1.52	1.52	2.30	0.566	0.3101	17.6
North	DG-U1.8	1	1.52	1.52	2.30	0.566	0.3101	17.6
North	DG-U1.8	1	0.83	0.83	0.69	0.514	0.2523	6.6
Northwest								
Northwest	DG-U1.8	1	0.76	0.76	0.57	0.505	0.2412	4.2
Northwest	DG-U1.8	1	0.76	0.76	0.57	0.505	0.2412	4.2
Northwest	DG-U1.8	1	0.32	0.32	0.10	0.440	0.0969	- 40.0
West								
West	DG-U1.8	1	1.57	1.57	2.46	0.569	0.3125	18.0
West	DG-U1.8	1	1.57	1.57	2.46	0.569	0.3125	18.0
West	DG-U1.8	1	0.76	0.76	0.58	0.506	0.2418	4.3
Southwest								
Southwest	DG-U1.8	1	0.96	0.96	0.91	0.527	0.2686	9.9
Southwest	DG-U1.8	1	0.96	0.96	0.91	0.527	0.2686	9.9
Southwest	DG-U1.8	1	0.35	0.35	0.12	0.443	0.1142	- 32.7

*ER Window Energy Rating (ER 2009) estimated for actual dimensions, and Air tightness type: CSA - A1;
Leakage rate = 1.86 L/s.m²

Above grade fraction of wall area occupied by windows: 12.9 %

***** TYPE 2 USER DEFINED WINDOW CODES *****

Code Label	Description	Glazing Type	Fill Gas	Thermal Resistance	SHGC	Window Style	Low -E Coating	Frame Height
DG_U1.8		Double/double with 1 coat	Argon	1.8000 W/m2-C	0.3000	Picture	Soft Coat	80.00
DG_U1.8		Double/double with 1 coat	Argon	1.8000 W/m2-C	0.3000	Picture	Soft Coat	80.00
DG_U1.8		Double/double with 1 coat	Argon	1.8000 W/m2-C	0.3000	Picture	Soft Coat	80.00
DG_U1.8		Double/double with 1 coat	Argon	1.8000 W/m2-C	0.3000	Picture	Soft Coat	80.00
DG_U1.8		Double/double with 1 coat	Argon	1.8000 W/m2-C	0.3000	Picture	Soft Coat	80.00
DG_U1.8		Double/double with 1 coat	Argon	1.8000 W/m2-C	0.3000	Picture	Soft Coat	80.00
DG_U1.8		Double/double with 1 coat	Argon	1.8000 W/m2-C	0.3000	Picture	Soft Coat	80.00
DG_U1.8		Double/double with 1 coat	Argon	1.8000 W/m2-C	0.3000	Picture	Soft Coat	80.00

DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00
DG_U1.8	Double/double Argon with 1 coat	1.8000	0.3000	Picture	Soft Coat	80.00

BUILDING PARAMETER DETAILS

CEILING COMPONENTS

	Construction Type	Code Type	Roof Slope	Heel Ht. (m)	Section Area (m ²)	R. Value (RSI)
Ceiling - 1	Attic/gable	R50	6.000/12	0.14	113.30	8.40

MAIN WALL COMPONENTS

Label	Lintel Type	Fac. Dir	Number of Corn.	Number of Inter.	Height (m)	Perim. (m)	Area (m ²)	R. Value (RSI)
Main Floor Type: R22	100	N/A	4	4	2.44	35.88	87.55	3.04

Top Floor	100	N/A	4	4	2.44	35.88	87.55	3.17
Type: R22								
Floor Header - 1		N/A	4	4	0.25	40.58	10.15	4.18
Type: R-22								

WALL CODE SCHEDULE

Name	Internal Code	Description (Structure, typ/size, Spacing, Insull, 2, Int., Sheathing, Exterior, Studs)
R22	1211401240	Wood frame, 38x140 mm (2x6 in), 400 mm (16 in), RSI 3.87 @ 140 mm (R 22 @ 5.5") batt, None, 12 mm (0.5 in) gypsum board, Waferboard/OSB 11.1 mm (7/16 in), Brick, 2 studs
R-22	1800400040	Floor header, N/A, N/A, RSI 3.87 @ 140 mm (R 22 @ 5.5") batt, None, N/A, None, Brick, N/A

EXPOSED FLOORS

Label	Floor Code Type	Area (m²)	R. Value (RSI)
Exposed Floor	R31	16.20	5.52

EXPOSED FLOOR SCHEDULE

Name	Internal Code	Description (Structure, typ/size, Spacing, Insull, 2, Int., Sheathing, Exterior, Studs)
R31	3231L08210	Wood frame, 38x235 mm (2x10 in), 400 mm (16 in), RSI 5.46 @ 241 mm (R 31 @ 9.5") batt, None, Carpet & underpad, Waferboard/OSB 11.1 mm (7/16 in), Wood (lapped), No

DOORS

Label	Type	Height (m)	Width (m)	Gross Area (m²)	R. Value (RSI)
Door - 1	Steel polystyrene core	2.07	0.81	1.68	0.10
Loc: Main Floor					
Door - 2	Steel polystyrene core	2.07	0.81	1.68	0.10
Loc: Main Floor					
Door - 3	Steel polystyrene core	2.07	0.81	1.68	0.10
Loc: Main Floor					

USER-DEFINED STRUCTURE CODES SCHEDULE

Name	Description
21R50	

FOUNDATIONS

Foundation Name:	1 Foundation	Volume:	307.7 m ³
Foundation Type:	Basement	Opening to Main Floor:	1.56 m ²
Data Type:	Library		
Total Wall Height:	2.80 m	Non-Rectangular	

Depth Below Grade: 2.28 m		Floor Perimeter:	45.00 m
		Floor Area:	109.90 m ²
Interior wall type:	User specified	R-value:	2.11 RSI
Exterior wall type:	User specified	R-Value:	0.00 RSI
Number of corners :	4		
Lintel type:	LL000000000000000000000000000000		
Added to slab type :	N/A	R-Value:	0.00 RSI
Floors Above Found.:	common	R-Value:	0.82 RSI

Exposed areas for: 1 Foundation
Exposed Perimeter: 45.00 m

Configuration: BCIN_1
 - concrete walls and floor
 - interior surface of wall insulated over full-height
 - any first storey construction type

FOUNDATION CODE SCHEDULE

Floors Above Foundation

Name	Internal Code	Description (Structure, typ/size, Spacing, Insul1, 2, Int., Sheathing, Exterior, Drop Framing)
common	4231006310	Wood frame, 38x235 mm (2x10 in), 400 mm (16 in), None, None, Wood, Waferboard/OSB 15.9 mm (5/8 in), 12 mm (0.5 in) Gypsum board, No

FOUNDATION FLOOR HEADER COMPONENTS

Label	Lintel Type	Fac. Dir	Number of Corn.	Number of Inter.	Height (m)	Perim. (m)	Area (m ²)	R. Value (RSI)
Floor Header - 1 (Location:1 Foundation) Type: R-22	N/A	N/A	4	4	0.19	39.00	7.41	4.18

Foundation Floor Header Code Schedule

Name	Internal Code	Description (Structure, typ/size, Spacing, Insul1, 2, Int., Sheathing, Exterior, Studs)
R-22	1800400040	Floor header, N/A, N/A, RSI 3.87 @ 140 mm (R 22 @ 5.5") batt, None, None, None, Tile-linoleum, No

Lintel Code Schedule

Name	Code	Description (Type, Material, Insulation)

100 100 Double, Wood, None

ROOF CAVITY INPUTS

Gable Ends		Total Area:	18.88 m ²
Sheathing Material	Plywood/Part. bd 9.5 mm (3/8 in)		0.08 RSI
Exterior Material:	Hollow metal/vinyl cladding		0.11 RSI
Sloped Roof		Total Area:	126.67 m ²
Sheathing Material	Plywood/Part. bd 12.7 mm (1/2 in)		0.11 RSI
Exterior Material:	Asphalt shingles		0.08 RSI
Total Cavity Volume:	123.1 m ³	Ventilation Rate:	0.50 ACH/hr

BUILDING ASSEMBLY DETAILS

Label	Construction Code	Nominal (RSI)	System (RSI)	Effective (RSI)
CEILING COMPONENTS				
Ceiling - 1	R50	0.00	0.00	8.40
MAIN WALL COMPONENTS				
Main Floor	R22	0.00	0.00	3.04
Top Floor	R22	0.00	0.00	3.17
Floor Header - 1	R-22	0.00	0.00	4.18
EXPOSED FLOORS				
Exposed Floor	R31	0.00	0.00	5.52
FLOORS ABOVE BASEMENTS				
1 Foundation	common	0.00	0.00	0.82

BUILDING PARAMETERS SUMMARY
ZONE 1 : Above Grade

Component	Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ	% Annual Heat Loss
Ceiling	113.30	113.30	8.40	3804.38	4.77
Main Walls	185.24	155.28	3.16	16402.82	20.59
Doors	5.03	5.03	0.98	1886.03	2.37
Exposed floors	16.20	16.20	5.52	989.57	1.24
South Windows	4.31	4.31	0.56	2811.02	3.53
Southeast Windows	1.15	1.15	0.50	833.95	1.05
East Windows	5.00	5.00	0.57	3227.75	4.05
Northeast Windows	1.97	1.97	0.53	1366.77	1.72
North Windows	4.60	4.60	0.57	2988.27	3.75
Northwest Windows	1.15	1.15	0.51	835.95	1.05
West Windows	4.92	4.92	0.57	3182.16	3.99
Southwest Windows	1.83	1.83	0.53	1275.12	1.60
ZONE 1 Totals:				39603.80	49.70

INTER-ZONE Heat Transfer : Floors Above Basement

Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ
109.90	109.90	0.817	10368.73

ZONE 2 : Basement

Component	Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ	% Annual Heat Loss
Walls above grade	23.40	20.56	-	3778.44	4.74
South windows	0.59	0.59	0.51	376.96	0.47
Southeast windows	0.05	0.05	0.44	36.47	0.05
East windows	0.55	0.55	0.50	349.93	0.44
Northeast windows	0.15	0.15	0.45	110.45	0.14
North windows	0.69	0.69	0.51	430.03	0.54
Northwest windows	0.10	0.10	0.44	74.83	0.09
West windows	0.58	0.58	0.51	369.02	0.46
Southwest windows	0.12	0.12	0.44	88.85	0.11
Basement floor header	7.41	7.41	4.18	724.49	0.91
Below grade foundation	212.50	212.50	-	19661.92	24.68
ZONE 2 Totals:				26001.38	32.63

Air Leakage and Mechanical Ventilation

House Volume	Air Change	Heat Loss MJ	% Annual Heat Loss
702.00 m ³	0.133 ACH	14076.477	17.67

AIR LEAKAGE AND MECHANICAL VENTILATION

Building Envelope Surface Area: 558.05 m²

Air Leakage Test Results at 50 Pa. 3.00 ACH
(0.2 in H₂O) =

Equivalent Leakage Area @ 10 Pa 786.38 cm²
=

Terrain Description

			Height (m)
@ Weather Station :	Open flat terrain, grass	Anemometer:	10.0
@ Building site :	Suburban, forest	Height of the highest ceiling:	5.5

Local Shielding:

Walls: Heavy

Flue : Light

Leakage Fractions-

Ceiling: 0.200

Walls: 0.650

Floors: 0.150

Normalized Leakage Area @ 10 Pa: 1.4091 cm²/m²

Estimated Airflow to cause a 5 Pa 125 L/s

Pressure Difference:

Estimated Airflow to cause a 10 Pa 196 L/s

Pressure Difference:

F326 VENTILATION REQUIREMENTS

Kitchen, Living Room, Dining Room	3 rooms @ 5.0 L/s: 15.0 L/s
Utility Room	1 rooms @ 5.0 L/s: 5.0 L/s
Bedroom	1 rooms @ 10.0 L/s: 10.0 L/s
Bedroom	1 rooms @ 5.0 L/s: 5.0 L/s
Bathroom	1 rooms @ 5.0 L/s: 5.0 L/s
Basement Rooms	10.0 L/s

CENTRAL VENTILATION SYSTEM

System Type: HRV

Manufacturer:

Model Number:

Fan and Preheater Power at 0.0 °C: 125 Watts

Fan and Preheater Power at -25.0 °C: 125 Watts

Preheater Capacity: 0 Watts

Sensible Heat Recovery Efficiency at 0.0 °C 60%

Sensible Heat Recovery Efficiency at -25.0 °C 55%

Total Heat Recovery Efficiency in Cooling Mode 25%

Low Temperature Ventilation Reduction: 0%

Low Temperature Ventilation Reduction: 0 L/s (0.0%)
Airflow Adjustment

Vented combustion appliance depressurization limit: 5.00 Pa.

Ventilation Supply Duct

Location:	Main floor	Type:	Flexible
Length:	1.5 m	Diameter:	152.4 mm
Insulation:	0.7 RSI	Sealing Characteristics:	Sealed

Ventilation Exhaust Duct

Location:	Main floor	Type:	Flexible
Length:	1.5 m	Diameter:	152.4 mm
Insulation:	0.7 RSI	Sealing Characteristics:	Sealed

SECONDARY FANS & OTHER EXHAUST APPLIANCES

	Control	Supply (L/s)	Exhaust (L/s)
Other Fans	Continuous	0.00	0.00
Dryer	Continuous	-	1.49

Dryer is vented outdoors

Rated Fan Power 0.00 Watts

NEW ERS VENTILATION DATA**Whole House Systems**

Air Distribution/circulation type: Forced air heating ductwork

Air Distribution/circulation fan power: 100.00 Watts

Operation schedule: 480.00 min/day

System # 1 Type: HRV/ERV

Manufacturer:

Model:

Airflow Supply Rate: 28.00 L/s **Exhaust:** 28.00 L/s **Fan Power:** 125.00 Watts
28.00 L/s

Supplementary Systems

System # 1 Type: Dryer

Manufacturer:

Model:

Airflow Supply Rate: 0.00 L/s **Exhaust:** 38.00 L/s **Fan Power:** 0.00 Watts
L/s

Operation schedule: 56.50 min/day

AIR LEAKAGE AND MECHANICAL VENTILATION SUMMARY

F326 Required continous ventilation: 50.000 L/s (0.26 ACH)

Central Ventilation Supply Rate (): 28.000 L/s (0.14 ACH)

Other Continuous Supply Flow Rates: 0.000 L/s (0.00 ACH)

Other Continuous Exhaust Flow Rates: 0.000 L/s (0.00 ACH)

Total house ventilation is Balanced

Gross Air Leakage and Mechanical Ventilation Energy Load: 14007.291 MJ

Seasonal Heat Recovery Ventilator Efficiency: 58.407 %

Estimated Ventilation Electrical Load: Heating Hours: 1068.891 MJ

Estimated Ventilation Electrical Load: Non-Heating Hours: 244.863 MJ

Net Air Leakage and Mechanical Ventilation Load: 14610.923 MJ

SPACE HEATING SYSTEM

PRIMARY Heating Fuel: Natural Gas
Equipment: Condensing furnace/boiler
Manufacturer:
Model:
Specified Output Capacity: 9.50 kW

AFUE: 94.00
Steady State Efficiency: 95.98
Fan Mode: Auto
ECM Motor: No
Low Speed Fan Power: 0 watts
High Speed Fan Power: 184 watts

DOMESTIC WATER HEATING SYSTEM

PRIMARY Water Heating Fuel: Natural gas
Water Heating Equipment: Direct vent (sealed)
Energy Factor: 0.670
Manufacturer:
Model:

Tank Capacity: 189.3 Litres **Tank Blanket Insulation:** 0.0 RSI
Tank Location: Basement
Pilot Energy : 0.0 MJ/day **Flue Diameter:** 0.0 mm

Drain Water Heat Recovery for Primary System
Manufacturer: Power-Pipe
Model: R4-32
Shower Temperature: Warm 41°C (106°F)
Showers per day: 2.23
Length of showers: 6.50 minutes
Shower head type: Low Flow(6.5 L/min, 1.4 lgpm, 1.7 USgpm)
Configuration: Preheated cold water delivered to hot water heater only
Efficiency at 9.5 L/Min: 36.9%
Number of units connected to drain water heat recovery: N/A

ANNUAL DOMESTIC WATER HEATING SUMMARY

Daily Hot Water Consumption:	190.0 Litres
Hot Water Temperature:	55.0 °C
Estimated Domestic Water Heating Load:	13234 MJ
Reduction in Hot Water load due to DWHR:	1094 MJ
Primary Domestic Water Heating Energy Consumption:	18993 MJ
Primary System Seasonal Efficiency:	63.9%

ANNUAL SPACE HEATING SUMMARY

Gross Space Heat Loss:	79682 MJ
Gross Space Heating Load:	76764 MJ
Usable Internal Gains:	22403 MJ
Usable Internal Gains Fraction:	28.1 %
Usable Solar Gains:	11009 MJ
Usable Solar Gains Fraction:	13.8 %
Auxiliary Energy Required:	43352 MJ
Space Heating System Load:	43352 MJ
Furnace/Boiler Seasonal efficiency:	96.1 %
Furnace/Boiler Annual Energy Consumption:	44310 MJ

DESIGN SPACE HEATING AND COOLING LOADS

Design Heat Loss* at -18.3 °C (13.03 Watts / m3):	9145 Watts
Design Cooling Load* for July at (31.5 °C):	4368 Watts

* Please refer to notes at the end of this report.

BASE LOADS SUMMARY

	kwh/day	Annual kWh
Interior Lighting	2.60	949.00
Appliances	6.30	2299.50
Other	9.70	3540.50
Exterior Use	0.90	328.50
HVAC Fans		
HRV/Exhaust	1.00	364.93
Space Heating	0.63	229.18
Space Cooling	0.00	0.00
Total Average Electrical Load	21.13	7711.61

FAN OPERATION SUMMARY (kWh)

Hours	HRV/Exhaust Fans	Space Heating	Space Cooling
Heating	296.9	229.2	0.0
Neither	68.0	0.0	0.0
Cooling	0.0	0.0	0.0
Total	364.9	229.2	

ENERGY CONSUMPTION SUMMARY REPORT

Estimated Annual Space Heating Energy Consumption	= 45134.91 MJ	= 12537.47 kWh
Ventilator Electrical Consumption: Heating Hours	= 1068.89 MJ	= 296.91 kWh
Estimated Annual DHW Heating Energy Consumption	= 18992.91 MJ	= 5275.81 kWh
ESTIMATED ANNUAL SPACE + DHW ENERGY CONSUMPTION	= 65196.71 MJ	= 18110.20 kWh
Estimated Greenhouse Gas Emissions	9.480 tonnes/year	

ESTIMATED ANNUAL FUEL CONSUMPTION SUMMARY

Fuel	Space Heating	Space Cooling	DHW Heating	Baseloads	Ventilation	Total
Natural Gas (m3)	1189.2	0.0	509.8	0.0	0.0	1699.0
Electricity (kWh)	229.2	0.0	0.0	7117.5	364.9	7711.6

ESTIMATED ANNUAL FUEL CONSUMPTION COSTS

Fuel Costs Library = Embedded

RATE	Electricity (Ottawa97)	Natural Gas (Ottawa97)	Oil (Ottawa97)	Propane (Ottawa97)	Wood (Sth Ont)	Total
\$	750.46	469.26	0.00	0.00	0.00	1219.71

Fuel Costs Library Listing

Filename = Embedded

Record # 1	Fuel: Electricity		
Rate ID = Ottawa97	Hydro Rate Block		
Rate Block		Dollars	Charge
	kWhr	Per kWhr	(\$)
Minimum	0.0		10.000
1	250.0	0.0999	
2	99999.0	0.0702	
Record # 2	Fuel: Natural Gas		

Rate ID = Ottawa97	Gas Rate Block		
Rate Block		Dollars	Charge
	m3	Per m3	(\$)
Minimum	0.0		8.000
1	30.0	0.2285	
2	85.0	0.2215	
3	170.0	0.2171	
4	99999.0	0.2133	
Record # 3	Fuel: Oil		
Rate ID = Ottawa97	Oil Rate Block		
Rate Block		Dollars	Charge
	Litre	Per Litre	(\$)
Minimum	0.0		10.000
1	99999.0	0.4055	
Record # 4	Fuel: Propane		
Rate ID = Ottawa97	Propane Rate Block		
Rate Block		Dollars	Charge
	Litre	Per Litre	(\$)
Minimum	0.0		0.000
1	99999.0	0.4500	
Record # 5	Fuel: Wood		
Rate ID = Sth Ont	Cord Rate		
Rate Block		Dollars	Charge
	Cord	Per Cord	(\$)
Minimum	0.0		0.000
1	99999.0	210.0000	

MONTHLY ENERGY PROFILE

Month	Energy Load (MJ)	Internal Gains (MJ)	Solar Gains (MJ)	Aux. Energy (MJ)	HRV Eff. %
Jan	13971.5	2395.4	1238.6	10337.5	58.7
Feb	12315.0	2159.0	1551.3	8604.7	58.8
Mar	10802.8	2398.9	1975.4	6428.5	58.9
Apr	6905.6	2339.7	1637.5	2928.4	59.1
May	3775.8	2391.2	1206.6	177.9	56.7
Jun	1200.6	1088.8	111.8	0.0	59.6
Jul	555.3	549.9	5.4	0.0	53.5
Aug	559.4	553.8	5.6	0.0	54.2
Sep	1510.0	1288.4	221.7	0.0	59.5
Oct	5297.6	2463.9	1163.6	1670.2	59.1
Nov	8126.9	2360.5	934.0	4832.4	59.0
Dec	11743.9	2413.6	957.5	8372.8	58.9
Ann	76764.3	22403.0	11009.0	43352.4	58.4

FOUNDATION ENERGY PROFILE

Month	Heat Loss (MJ)				Total
	Crawl Space	Slab	Basement	Walkout	
Jan	0.0	0.0	2068.7	0.0	2068.7
Feb	0.0	0.0	1724.7	0.0	1724.7
Mar	0.0	0.0	1288.5	0.0	1288.5
Apr	0.0	0.0	586.9	0.0	586.9
May	0.0	0.0	35.6	0.0	35.6
Jun	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	334.7	0.0	334.7
Nov	0.0	0.0	968.6	0.0	968.6
Dec	0.0	0.0	1678.2	0.0	1678.2
Ann	0.0	0.0	8686.0	0.0	8686.0

FOUNDATION TEMPERATURES & VENTILATION PROFILE

Month	Temperature (Deg °C)			Air Change Rate		Heat Loss (MJ)
	Crawl Space	Basement	Walkout	Natural	Total	

Jan	0.0	18.4	0.0	0.174	0.198	3096.3
Feb	0.0	18.2	0.0	0.173	0.196	2684.8
Mar	0.0	18.0	0.0	0.151	0.174	2124.1
Apr	0.0	18.1	0.0	0.121	0.145	1098.5
May	0.0	18.7	0.0	0.082	0.106	385.2
Jun	0.0	20.3	0.0	0.061	0.085	62.4
Jul	0.0	21.9	0.0	0.055	0.079	-36.1
Aug	0.0	21.4	0.0	0.052	0.076	-20.7
Sep	0.0	20.0	0.0	0.064	0.088	145.1
Oct	0.0	18.8	0.0	0.100	0.124	742.7
Nov	0.0	18.6	0.0	0.128	0.152	1403.1
Dec	0.0	18.5	0.0	0.158	0.182	2391.1
Ann	0.0	19.3	0.0	0.110	0.133	14076.5

SPACE HEATING SYSTEM PERFORMANCE

Month	Space Heating Load (MJ)	Furnace Input (MJ)	Pilot Light (MJ)	Indoor Fans (MJ)	Heat Pump Input (MJ)	Total Input (MJ)	System Cop
Jan	10337.5	10565.8	0.0	196.7	0.0	10762.6	0.961
Feb	8604.7	8794.8	0.0	163.8	0.0	8958.5	0.961
Mar	6428.5	6570.4	0.0	122.3	0.0	6692.8	0.961
Apr	2928.4	2993.1	0.0	55.7	0.0	3048.8	0.961
May	177.9	181.9	0.0	3.4	0.0	185.3	0.961
Jun	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Sep	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Oct	1670.2	1707.0	0.0	31.8	0.0	1738.8	0.961
Nov	4832.4	4939.2	0.0	92.0	0.0	5031.1	0.961
Dec	8372.8	8557.7	0.0	159.3	0.0	8717.0	0.961
Ann	43352.4	44309.9	0.0	825.0	0.0	45134.9	0.961

MONTHLY ESTIMATED ENERGY CONSUMPTION BY DEVICE (MJ)

Month	Space Heating		DHW Heating		Lights & Appliances	HRV & FANS	Air Conditioner
	Primary	Secondary	Primary	Secondary			
Jan	10565.8	0.0	1736.3	0.0	2176.2	308.3	0.0

Feb	8794.8	0.0	1587.0	0.0	1965.6	264.6	0.0
Mar	6570.4	0.0	1740.6	0.0	2176.2	234.0	0.0
Apr	2993.1	0.0	1634.9	0.0	2106.0	163.7	0.0
May	181.9	0.0	1613.4	0.0	2176.2	115.0	0.0
Jun	0.0	0.0	1490.9	0.0	2106.0	108.0	0.0
Jul	0.0	0.0	1489.3	0.0	2176.2	111.6	0.0
Aug	0.0	0.0	1470.4	0.0	2176.2	111.5	0.0
Sep	0.0	0.0	1441.2	0.0	2106.0	108.0	0.0
Oct	1707.0	0.0	1542.4	0.0	2176.2	143.4	0.0
Nov	4939.2	0.0	1562.0	0.0	2106.0	199.9	0.0
Dec	8557.7	0.0	1684.5	0.0	2176.2	270.9	0.0
Ann	44309.9	0.0	18992.9	0.0	25623.0	2138.8	0.0

ESTIMATED FUEL COSTS (Dollars)

Month	Electricity	Natural Gas	Oil	Propane	Wood	Total
Jan	65.87	79.66	0.00	0.00	0.00	145.53
Feb	60.91	68.66	0.00	0.00	0.00	129.58
Mar	64.42	56.81	0.00	0.00	0.00	121.23
Apr	61.68	35.55	0.00	0.00	0.00	97.23
May	62.10	18.88	0.00	0.00	0.00	80.99
Jun	60.60	17.07	0.00	0.00	0.00	77.67
Jul	62.04	17.06	0.00	0.00	0.00	79.10
Aug	62.04	16.95	0.00	0.00	0.00	78.99
Sep	60.60	16.78	0.00	0.00	0.00	77.38
Oct	62.66	27.52	0.00	0.00	0.00	90.17
Nov	62.39	46.45	0.00	0.00	0.00	108.84
Dec	65.14	67.86	0.00	0.00	0.00	133.01
Ann	750.46	469.26	0.00	0.00	0.00	1219.71

The calculated heat losses and energy consumptions are only estimates, based upon the data entered and assumptions within the program. Actual energy consumption and heat losses will be influenced by construction practices, localized weather, equipment characteristics and the lifestyle of the occupants.

HOT2000
Natural Resources CANADA
Version 11.13



File: Elfrida_Scenario 1B.h2k
House

Weather Library: C:\HOT2000 v11.13b13\Dat\Wth2020.dir
Weather Data for: TORONTO INTL, ONTARIO

Builder Code:

Data Entry by: Si Jia Wang
Date of entry: 2026-03-09

Company: buildABILITY

Client name: ,

Street address:

City:

Region: ONTARIO

Postal code:

Telephone:

Mailing address:

City:

Region: ONTARIO

Postal Code:

GENERAL HOUSE CHARACTERISTICS

House type: Single Detached

Number of storeys: Two storeys

Plan shape:

Front orientation: North

Year House Built: 2025

Wall colour: Default

Absorptivity: 0.40

Roof colour: Default

Absorptivity: 0.40

Soil Condition: Normal conductivity (dry
sand, loam, clay)

Water Table Level: Normal (7-10m/23-33ft)

House Thermal Mass Level: (A) Light, wood frame

Effective mass fraction 1.000

Occupants :
2 Adults for 50.0% of the time
1 Children for 50.0% of the time
0 Infants for 0.0% of the time

Sensible Internal Heat Gain 2.00 kWh/day
From Occupants:

HOUSE TEMPERATURES

Heating Temperatures

Main Floor	Daytime Setpoint:	21.0 °C
	Nighttime Setpoint:	18.0 °C
	Nighttime Setback Duration:	8.0 Hours
	24 Hour Average:	20.0 °C
Basement	Setpoint:	19.0 °C
	TEMP. Rise from 20.0 °C:	5.5 °C
Basement is- Heated:	Yes	
Cooled:	No	
Separate T/S:	No	
Fraction of internal gains released in basement :		0.150
Indoor design temperatures for equipment sizing		
	Heating:	22.0 °C
	Cooling:	24.0 °C

WINDOW CHARACTERISTICS

Label	Location	#	Overhang Width (m)	Header Height (m)	Tilt deg	Curtain Factor	Shutter (RSI)
South							
South	Main Floor	1	0.00	0.00	90.0	1.00	0.00
South	Top Floor	1	0.00	0.00	90.0	1.00	0.00
South	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
Southeast							
Southeast	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Southeast	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Southeast	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
East							
East	Main Floor	1	0.00	0.00	90.0	1.00	0.00
East	Top Floor	1	0.00	0.00	90.0	1.00	0.00
East	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
Northeast							
Northeast	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Northeast	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Northeast	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
North							
North	Top Floor	1	0.00	0.00	90.0	1.00	0.00
North	Main Floor	1	0.00	0.00	90.0	1.00	0.00
North	Foundation	1	0.00	0.00	90.0	1.00	0.00

- 1

Northwest

Label	Type	#	Window Width (m)	Window Height (m)	Total Area (m ²)	Window RSI	SHGC	ER*
Northwest	Main Floor	1	0.00	0.00	90.0	1.00	0.00	

Northwest	Top Floor	1	0.00	0.00	90.0	1.00	0.00	

Northwest	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00	

West

West	Top Floor	1	0.00	0.00	90.0	1.00	0.00	

West	Main Floor	1	0.00	0.00	90.0	1.00	0.00	

West	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00	

Southwest

Southwest	Main Floor	1	0.00	0.00	90.0	1.00	0.00	

Southwest	Top Floor	1	0.00	0.00	90.0	1.00	0.00	

Southwest	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00	

Label**Type****#****Window Width (m)****Window Height (m)****Total Area (m²)****Window RSI****SHGC****ER*****South**

South	SliderU1.6SHGC0.30F15	1	1.47	1.47	2.16	0.627	0.3012	20.8

South	SliderU1.6SHGC0.30F15	1	1.47	1.47	2.16	0.627	0.3012	20.8

South	PicU1.6SHGC0.30F15	1	0.77	0.77	0.59	0.600	0.2900	14.1

Southeast

Southeast	SliderU1.6SHGC0.30F15	1	0.76	0.76	0.57	0.598	0.2865	13.5

Southeast	SliderU1.6SHGC0.30F15	1	0.76	0.76	0.57	0.598	0.2865	13.5

Southeast	PicU1.6SHGC0.30F15	1	0.22	0.22	0.05	0.522	0.2352	- 62.1

East

East	SliderU1.6SHGC0.30F15	1	1.58	1.58	2.50	0.630	0.3023	21.2

East	SliderU1.6SHGC0.30F15	1	1.58	1.58	2.50	0.630	0.3023	21.2

East	PicU1.6SHGC0.30F15	1	0.74	0.74	0.55	0.598	0.2890	13.4

Northeast

Northeast	SliderU1.6SHGC0.30F15	1	0.99	0.99	0.99	0.611	0.2937	17.4

Northeast	SliderU1.6SHGC0.30F15	1	0.99	0.99	0.99	0.611	0.2937	17.4

Northeast	PicU1.6SHGC0.30F15	1	0.39	0.39	0.15	0.558	0.2679	-7.5

North

North	SliderU1.6SHGC0.30F15	1	1.52	1.52	2.30	0.628	0.3017	21.0

North	SliderU1.6SHGC0.30F15	1	1.52	1.52	2.30	0.628	0.3017	21.0

North	PicU1.6SHGC0.30F15	1	0.83	0.83	0.69	0.604	0.2917	15.3

Northwest

Northwest	SliderU1.6SHGC0.30F15	1	0.76	0.76	0.57	0.598	0.2866	13.6

Northwest	SliderU1.6SHGC0.30F15	1	0.76	0.76	0.57	0.598	0.2866	13.6

Northwest	PicU1.6SHGC0.30F15	1	0.32	0.32	0.10	0.544	0.2579	- 21.1

West

West	SliderU1.6SHGC0.30F15	1	1.57	1.57	2.46	0.629	0.3022	21.2
West	SliderU1.6SHGC0.30F15	1	1.57	1.57	2.46	0.629	0.3022	21.2
West	PicU1.6SHGC0.30F15	1	0.76	0.76	0.58	0.600	0.2897	13.9
Southwest								
Southwest	SliderU1.6SHGC0.30F15	1	0.96	0.96	0.91	0.610	0.2928	17.0
Southwest	SliderU1.6SHGC0.30F15	1	0.96	0.96	0.91	0.610	0.2928	17.0
Southwest	PicU1.6SHGC0.30F15	1	0.35	0.35	0.12	0.550	0.2625	- 14.6

*ER Window Energy Rating (ER 2009) estimated for actual dimensions, and Air tightness type: CSA - A1; Leakage rate = 1.86 L/s.m²

Above grade fraction of wall area occupied by windows: 12.9 %

***** TYPE 2 USER DEFINED WINDOW CODES *****

Code Label	Description	Glazing Type	Fill Gas	Thermal Resistance	SHGC	Window Style	Low-E Coating	Frame Height
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00

	with 1 coat	W/m2-C	Slider	Coat	
SliderU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Picture	Soft Coat	15.00

BUILDING PARAMETER DETAILS

CEILING COMPONENTS

	Construction Type	Code Type	Roof Slope	Heel Ht. (m)	Section Area (m ²)	R. Value (RSI)
Ceiling - 1	Attic/gable	R60 blown cellulose	6.000/12	0.14	113.00	10.15

MAIN WALL COMPONENTS

Label	Lintel Type	Fac. Dir	Number of Corn.	Number of Inter.	Height (m)	Perim. (m)	Area (m ²)	R. Value (RSI)
Main Floor Type: R22	100	N/A	4	4	2.44	35.88	87.55	3.04
Top Floor Type: R22	100	N/A	4	4	2.44	35.88	87.55	3.17
Floor Header - 1 Type: R-22		N/A	4	4	0.25	40.58	10.15	4.18

WALL CODE SCHEDULE

Name	Internal Code	Description (Structure, typ/size, Spacing, Insull, 2, Int., Sheathing, Exterior, Studs)
R22	1211401240	Wood frame, 38x140 mm (2x6 in), 400 mm (16 in), RSI 3.87 @ 140 mm (R 22 @ 5.5") batt, None, 12 mm (0.5 in) gypsum board, Waferboard/OSB 11.1 mm (7/16 in), Brick, 2 studs
R-22	1800400040	Floor header, N/A, N/A, RSI 3.87 @ 140 mm (R 22 @ 5.5") batt, None, N/A, None, Brick, N/A

EXPOSED FLOORS

Label	Floor Code Type	Area (m ²)	R. Value (RSI)
Exposed Floor	R31	16.20	5.52

EXPOSED FLOOR SCHEDULE

Name	Internal Code	Description (Structure, typ/size, Spacing, Insull, 2, Int., Sheathing, Exterior, Studs)
R31	3231L08210	Wood frame, 38x235 mm (2x10 in), 400 mm (16 in), RSI 5.46 @ 241 mm (R 31 @ 9.5") batt, None, Carpet & underpad, Waferboard/OSB 11.1 mm (7/16 in), Wood (lapped), No

DOORS

Label	Type	Height (m)	Width (m)	Gross Area (m²)	R. Value (RSI)
Door - 1 Loc: Main Floor	Steel polystyrene core	2.07	0.81	1.68	0.10
Door - 2 Loc: Main Floor	Steel polystyrene core	2.07	0.81	1.68	0.10
Door - 3 Loc: Main Floor	Steel polystyrene core	2.07	0.81	1.68	0.10

USER-DEFINED STRUCTURE CODES SCHEDULE

Name	Description
21R60 blown cellulose	

FOUNDATIONS

Foundation Name:	Foundation - 1	Volume:	307.7 m ³
Foundation Type:	Basement	Opening to Main Floor:	1.56 m ²
Data Type:	Library		
Total Wall Height:	2.80 m	Non-Rectangular	
Depth Below Grade:	2.28 m	Floor Perimeter:	45.00 m
		Floor Area:	109.90 m ²
Interior wall type:	R20	R-value:	3.52 RSI
Exterior wall type:	User specified	R-Value:	0.00 RSI
Number of corners :	4		
Lintel type:	LL00000000000000000000000000000000		
Added to slab type :	N/A	R-Value:	0.00 RSI
Floors Above Found.:	common	R-Value:	0.82 RSI

Exposed areas for: Foundation - 1
Exposed Perimeter: 45.00 m

Configuration: BCIN_1
 - concrete walls and floor
 - interior surface of wall insulated over full-height
 - any first storey construction type

FOUNDATION CODE SCHEDULE

Floors Above Foundation

Name	Internal Code	Description (Structure, typ/size, Spacing, Insul1, 2, Int., Sheathing, Exterior, Drop Framing)
common	4231006310	Wood frame, 38x235 mm (2x10 in), 400 mm (16 in), None, None, Wood, Waferboard/OSB 15.9 mm (5/8 in), 12 mm (0.5 in) Gypsum board, No

FOUNDATION FLOOR HEADER COMPONENTS

Label	Lintel Type	Fac. Dir	Number of Corn.	Number of Inter.	Height (m)	Perim. (m)	Area (m ²)	R. Value (RSI)
Floor Header - 1 (Location:Foundation - 1) Type: R-22	N/A	N/A	4	4	0.19	39.00	7.41	4.18

Foundation Floor Header Code Schedule

Name	Internal Code	Description (Structure, typ/size, Spacing, Insul1, 2, Int., Sheathing, Exterior, Studs)
R-22	1800400040	Floor header, N/A, N/A, RSI 3.87 @ 140 mm (R 22 @ 5.5") batt, None, None, None, Tile-linoleum, No

Lintel Code Schedule

Name	Code	Description (Type, Material, Insulation)
100	100	Double, Wood, None

ROOF CAVITY INPUTS

Gable Ends		Total Area:	18.83 m ²
Sheathing Material	Plywood/Part. bd 9.5 mm (3/8 in)		0.08 RSI
Exterior Material:	Hollow metal/vinyl cladding		0.11 RSI
Sloped Roof		Total Area:	126.34 m ²
Sheathing Material	Plywood/Part. bd 12.7 mm (1/2 in)		0.11 RSI
Exterior Material:	Asphalt shingles		0.08 RSI
Total Cavity Volume: 122.6 m ³		Ventilation Rate:	0.50 ACH/hr

BUILDING ASSEMBLY DETAILS

Label	Construction Code	Nominal (RSI)	System (RSI)	Effective (RSI)
CEILING COMPONENTS				
Ceiling - 1	R60 blown cellulose	0.00	0.00	10.15
MAIN WALL COMPONENTS				
Main Floor	R22	0.00	0.00	3.04
Top Floor	R22	0.00	0.00	3.17
Floor Header - 1	R-22	0.00	0.00	4.18
EXPOSED FLOORS				
Exposed Floor	R31	0.00	0.00	5.52
FLOORS ABOVE BASEMENTS				
Foundation - 1	common	0.00	0.00	0.82

BUILDING PARAMETERS SUMMARY
ZONE 1 : Above Grade

Component	Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ	% Annual Heat Loss
Ceiling	113.00	113.00	10.15	3156.78	4.27
Main Walls	185.24	155.28	3.16	16402.82	22.18
Doors	5.03	5.03	0.98	1886.03	2.55
Exposed floors	16.20	16.20	5.52	989.57	1.34
South Windows	4.31	4.31	0.63	2525.89	3.42
Southeast Windows	1.15	1.15	0.60	704.32	0.95
East Windows	5.00	5.00	0.63	2917.91	3.95
Northeast Windows	1.97	1.97	0.61	1185.52	1.60
North Windows	4.60	4.60	0.63	2692.42	3.64
Northwest Windows	1.15	1.15	0.60	706.10	0.95
West Windows	4.92	4.92	0.63	2874.94	3.89
Southwest Windows	1.83	1.83	0.61	1101.97	1.49
ZONE 1 Totals:				37144.28	50.23

INTER-ZONE Heat Transfer : Floors Above Basement

Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ
109.90	109.90	0.817	10616.61

ZONE 2 : Basement

Component	Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ	% Annual Heat Loss
Walls above grade	23.40	20.56	-	2562.51	3.46
South windows	0.59	0.59	0.60	317.61	0.43
Southeast windows	0.05	0.05	0.52	30.57	0.04

East windows	0.55	0.55	0.60	293.67	0.40
Northeast windows	0.15	0.15	0.56	88.74	0.12
North windows	0.69	0.69	0.60	364.88	0.49
Northwest windows	0.10	0.10	0.54	60.36	0.08
West windows	0.58	0.58	0.60	310.57	0.42
Southwest windows	0.12	0.12	0.55	71.40	0.10
Basement floor header	7.41	7.41	4.18	802.58	1.09
Below grade foundation	212.50	212.50	-	18417.13	24.90
ZONE 2 Totals:				23320.03	31.53

Air Leakage and Mechanical Ventilation

House Volume	Air Change	Heat Loss MJ	% Annual Heat Loss
702.00 m ³	0.134 ACH	13490.186	18.24

AIR LEAKAGE AND MECHANICAL VENTILATION

Building Envelope Surface Area: 557.75 m²

Air Leakage Test Results at 50 Pa.(0.2 3.02 ACH
in H₂O) =

Equivalent Leakage Area @ 10 Pa = 791.62 cm²

Terrain Description

@ Weather Station :	Open flat terrain, grass	Anemometer:	Height (m) 10.0
@ Building site :	Suburban, forest	Height of the highest ceiling:	5.5

Local Shielding:

Walls:	Heavy
Flue :	Light

Leakage Fractions-

Ceiling:	0.200
Walls:	0.650
Floors:	0.150

Normalized Leakage Area @ 10 Pa: 1.4193 cm²/m²

Estimated Airflow to cause a 5 Pa Pressure Difference: 126 L/s

Estimated Airflow to cause a 10 Pa Pressure Difference: 198 L/s

F326 VENTILATION REQUIREMENTS

Kitchen, Living Room, Dining Room	3 rooms @ 5.0 L/s: 15.0 L/s
Utility Room	1 rooms @ 5.0 L/s: 5.0 L/s
Bedroom	1 rooms @ 10.0 L/s: 10.0 L/s
Bedroom	1 rooms @ 5.0 L/s: 5.0 L/s
Bathroom	1 rooms @ 5.0 L/s: 5.0 L/s
Basement Rooms	10.0 L/s

CENTRAL VENTILATION SYSTEM

System Type: HRV
 Manufacturer:
 Model Number:

Fan and Preheater Power at 0.0 °C: 125 Watts
 Fan and Preheater Power at -25.0 °C: 125 Watts
 Preheater Capacity: 0 Watts
 Sensible Heat Recovery Efficiency at 0.0 °C 75%

Sensible Heat Recovery Efficiency at -25.0 °C 60%
Total Heat Recovery Efficiency in Cooling Mode 25%

Low Temperature Ventilation Reduction: 0%
Low Temperature Ventilation Reduction: 0 L/s (0.0%)
Airflow Adjustment

Vented combustion appliance depressurization limit: 5.00 Pa.

Ventilation Supply Duct

Location:	Main floor	Type:	Flexible
Length:	1.5 m	Diameter:	152.4 mm
Insulation:	0.7 RSI	Sealing Characteristics:	Sealed

Ventilation Exhaust Duct

Location:	Main floor	Type:	Flexible
Length:	1.5 m	Diameter:	152.4 mm
Insulation:	0.7 RSI	Sealing Characteristics:	Sealed

SECONDARY FANS & OTHER EXHAUST APPLIANCES

	Control	Supply (L/s)	Exhaust (L/s)
Other Fans	Continuous	0.00	0.00
Dryer	Continuous	-	1.49

Dryer is vented outdoors

Rated Fan Power 0.00 Watts

NEW ERS VENTILATION DATA

Whole House Systems

Air Distribution/circulation type: Forced air heating ductwork
Air Distribution/circulation fan power: 100.00 Watts
Operation schedule: 480.00 min/day

System # 1 Type: HRV/ERV
Manufacturer:
Model:
Airflow Supply Rate: 28.00 L/s **Exhaust:** 28.00 L/s **Fan Power:** 125.00 Watts

Supplementary Systems

System # 1 Type: Dryer
Manufacturer:
Model:
Airflow Supply Rate: 0.00 L/s **Exhaust:** 38.00 L/s **Fan Power:** 0.00 Watts
Operation schedule: 56.50 min/day

AIR LEAKAGE AND MECHANICAL VENTILATION SUMMARY

F326 Required continous ventilation: 50.000 L/s (0.26 ACH)
Central Ventilation Supply Rate (): 28.000 L/s (0.14 ACH)
Other Continuous Supply Flow Rates: 0.000 L/s (0.00 ACH)
Other Continuous Exhaust Flow Rates: 0.000 L/s (0.00 ACH)
Total house ventilation is Balanced
Gross Air Leakage and Mechanical Ventilation Energy Load: 14088.730 MJ
Seasonal Heat Recovery Ventilator Efficiency: 72.840 %
Estimated Ventilation Electrical Load: 1068.891 MJ
Heating Hours:
Estimated Ventilation Electrical Load: Non-Heating Hours: 244.863 MJ
Net Air Leakage and Mechanical Ventilation Load: 14024.632 MJ

SPACE HEATING SYSTEM

PRIMARY Heating Fuel: Natural Gas
Equipment: Condensing furnace/boiler
Manufacturer:
Model:
Specified Output Capacity: 9.50 kW

AFUE: 96.00
Steady State Efficiency: 98.04
Fan Mode: Auto
ECM Motor: No
Low Speed Fan Power: 0 watts
High Speed Fan Power: 184 watts

DOMESTIC WATER HEATING SYSTEM

PRIMARY Water Heating Fuel: Natural gas
Water Heating Equipment: Direct vent (sealed)
Energy Factor: 0.800
Manufacturer:
Model:

Tank Capacity: 189.3 Litres
Tank Location: Basement
Pilot Energy : 0.0 MJ/day

Tank Blanket Insulation: 0.0 RSI
Flue Diameter: 0.0 mm

Drain Water Heat Recovery for Primary System
Manufacturer: Power-Pipe
Model: R4-40
Shower Temperature: Warm 41°C (106°F)
Showers per day: 2.23
Length of showers: 6.50 minutes
Shower head type: Low Flow(6.5 L/min, 1.4 Igpm, 1.7 USgpm)
Configuration: Preheated cold water delivered to hot water heater only
Efficiency at 9.5 L/Min: 42.4%
Number of units connected to drain water heat recovery: N/A

ANNUAL DOMESTIC WATER HEATING SUMMARY

Daily Hot Water Consumption: 190.0 Litres

Hot Water Temperature:	55.0 °C
Estimated Domestic Water Heating Load:	13234 MJ
Reduction in Hot Water load due to DWHR:	1237 MJ
Primary Domestic Water Heating Energy Consumption:	15457 MJ
Primary System Seasonal Efficiency:	77.6%

ANNUAL SPACE HEATING SUMMARY

Gross Space Heat Loss:	73954 MJ
Gross Space Heating Load:	71411 MJ
Usable Internal Gains:	21581 MJ
Usable Internal Gains Fraction:	29.2 %
Usable Solar Gains:	11159 MJ
Usable Solar Gains Fraction:	15.1 %
Auxiliary Energy Required:	38671 MJ
Space Heating System Load:	38671 MJ
Furnace/Boiler Seasonal efficiency:	98.1 %
Furnace/Boiler Annual Energy Consumption:	38692 MJ

DESIGN SPACE HEATING AND COOLING LOADS

Design Heat Loss* at -18.3 °C (12.16 Watts / m3):	8533 Watts
Design Cooling Load* for July at (31.5 °C):	4330 Watts

* Please refer to notes at the end of this report.

BASE LOADS SUMMARY

	kwh/day	Annual kWh
Interior Lighting	2.60	949.00
Appliances	6.30	2299.50
Other	9.70	3540.50
Exterior Use	0.90	328.50
HVAC Fans		
HRV/Exhaust	1.00	364.93
Space Heating	0.56	204.43
Space Cooling	0.00	0.00
Total Average Electrical Load	21.06	7686.86

FAN OPERATION SUMMARY (kWh)

Hours	HRV/Exhaust Fans	Space Heating	Space Cooling
Heating	296.9	204.4	0.0
Neither	68.0	0.0	0.0
Cooling	0.0	0.0	0.0
Total	364.9	204.4	

ENERGY CONSUMPTION SUMMARY REPORT

Estimated Annual Space Heating Energy Consumption	= 39428.20 MJ	= 10952.28 kWh
Ventilator Electrical Consumption: Heating Hours	= 1068.89 MJ	= 296.91 kWh
Estimated Annual DHW Heating Energy Consumption	= 15457.48 MJ	= 4293.74 kWh
ESTIMATED ANNUAL SPACE + DHW ENERGY CONSUMPTION	= 55954.57 MJ	= 15542.94 kWh
Estimated Greenhouse Gas Emissions	8.983 tonnes/year	

ESTIMATED ANNUAL FUEL CONSUMPTION SUMMARY

Fuel	Space Heating	Space Cooling	DHW Heating	Baseloads	Ventilation	Total
Natural Gas (m3)	1038.5	0.0	414.9	0.0	0.0	1453.3
Electricity (kWh)	204.4	0.0	0.0	7117.5	364.9	7686.9

ESTIMATED ANNUAL FUEL CONSUMPTION COSTS

Fuel Costs Library = Embedded

RATE	Electricity (Ottawa97)	Natural Gas (Ottawa97)	Oil (Ottawa97)	Propane (Ottawa97)	Wood (Sth Ont)	Total
\$	748.72	416.26	0.00	0.00	0.00	1164.97

Fuel Costs Library Listing

Filename = Embedded

Record # 1	Fuel: Electricity		
Rate ID = Ottawa97	Hydro Rate Block		
Rate Block		Dollars	Charge
	kWhr	Per kWhr	(\$)
Minimum	0.0		10.000
1	250.0	0.0999	
2	99999.0	0.0702	
Record # 2	Fuel: Natural Gas		
Rate ID = Ottawa97	Gas Rate Block		
Rate Block		Dollars	Charge
	m3	Per m3	(\$)

Minimum	0.0		8.000
1	30.0	0.2285	
2	85.0	0.2215	
3	170.0	0.2171	
4	99999.0	0.2133	

Record # 3

Fuel: Oil

Rate ID = Ottawa97

Oil Rate Block

Rate Block		Dollars	Charge
	Litre	Per Litre	(\$)
Minimum	0.0		10.000
1	99999.0	0.4055	

Record # 4

Fuel: Propane

Rate ID = Ottawa97

Propane Rate Block

Rate Block		Dollars	Charge
	Litre	Per Litre	(\$)
Minimum	0.0		0.000
1	99999.0	0.4500	

Record # 5

Fuel: Wood

Rate ID = Sth Ont

Cord Rate

Rate Block		Dollars	Charge
	Cord	Per Cord	(\$)
Minimum	0.0		0.000
1	99999.0	210.0000	

MONTHLY ENERGY PROFILE

Month	Energy Load (MJ)	Internal Gains (MJ)	Solar Gains (MJ)	Aux. Energy (MJ)	HRV Eff. %
Jan	12885.6	2264.1	1265.5	9356.0	72.9
Feb	11354.6	2039.5	1580.6	7734.5	73.2
Mar	9955.9	2265.8	2005.4	5684.7	73.6
Apr	6377.0	2211.2	1653.2	2512.5	73.8
May	3534.8	2243.4	1178.8	112.6	70.7
Jun	1230.8	1110.1	120.7	0.0	74.3
Jul	667.6	654.8	12.8	0.0	66.7
Aug	664.4	651.9	12.5	0.0	67.5
Sep	1509.6	1288.1	221.5	0.0	74.2
Oct	4919.9	2334.6	1174.6	1410.7	73.8
Nov	7492.1	2234.5	954.1	4303.5	73.7
Dec	10818.7	2282.9	979.3	7556.6	73.5
Ann	71411.0	21580.9	11158.9	38671.1	72.8

FOUNDATION ENERGY PROFILE

Month	Heat Loss (MJ)				Total
	Crawl Space	Slab	Basement	Walkout	
Jan	0.0	0.0	1682.6	0.0	1682.6
Feb	0.0	0.0	1392.1	0.0	1392.1
Mar	0.0	0.0	1023.1	0.0	1023.1
Apr	0.0	0.0	452.2	0.0	452.2
May	0.0	0.0	20.2	0.0	20.2
Jun	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	253.9	0.0	253.9
Nov	0.0	0.0	774.5	0.0	774.5
Dec	0.0	0.0	1360.0	0.0	1360.0
Ann	0.0	0.0	6958.6	0.0	6958.6

FOUNDATION TEMPERATURES & VENTILATION PROFILE

Month	Temperature (Deg °C)			Air Change Rate		Heat Loss (MJ)
	Crawl Space	Basement	Walkout	Natural	Total	
Jan	0.0	18.5	0.0	0.176	0.199	3006.1
Feb	0.0	18.3	0.0	0.174	0.197	2602.5
Mar	0.0	18.1	0.0	0.152	0.176	2046.7

Apr	0.0	18.1	0.0	0.122	0.146	1044.9
May	0.0	18.7	0.0	0.083	0.106	353.6
Jun	0.0	20.2	0.0	0.062	0.085	46.6
Jul	0.0	21.7	0.0	0.055	0.079	-46.2
Aug	0.0	21.2	0.0	0.053	0.076	-31.7
Sep	0.0	19.9	0.0	0.064	0.088	124.5
Oct	0.0	18.8	0.0	0.101	0.125	696.8
Nov	0.0	18.6	0.0	0.129	0.153	1339.3
Dec	0.0	18.6	0.0	0.159	0.183	2307.3
Ann	0.0	19.2	0.0	0.111	0.134	13490.2

SPACE HEATING SYSTEM PERFORMANCE

Month	Space Heating Load (MJ)	Furnace Input (MJ)	Pilot Light (MJ)	Indoor Fans (MJ)	Heat Pump Input (MJ)	Total Input (MJ)	System Cop
Jan	9356.0	9361.1	0.0	178.1	0.0	9539.1	0.981
Feb	7734.5	7738.7	0.0	147.2	0.0	7885.9	0.981
Mar	5684.7	5687.8	0.0	108.2	0.0	5796.0	0.981
Apr	2512.5	2513.9	0.0	47.8	0.0	2561.7	0.981
May	112.6	112.7	0.0	2.1	0.0	114.9	0.981
Jun	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Sep	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Oct	1410.7	1411.5	0.0	26.8	0.0	1438.3	0.981
Nov	4303.5	4305.8	0.0	81.9	0.0	4387.7	0.981
Dec	7556.6	7560.7	0.0	143.8	0.0	7704.5	0.981
Ann	38671.1	38692.3	0.0	735.9	0.0	39428.2	0.981

MONTHLY ESTIMATED ENERGY CONSUMPTION BY DEVICE (MJ)

Month	Space Heating		DHW Heating		Lights & Appliances	HRV & FANS	Air Conditioner
	Primary	Secondary	Primary	Secondary			
Jan	9361.1	0.0	1419.4	0.0	2176.2	289.6	0.0
Feb	7738.7	0.0	1297.4	0.0	1965.6	248.0	0.0
Mar	5687.8	0.0	1421.3	0.0	2176.2	219.8	0.0
Apr	2513.9	0.0	1332.7	0.0	2106.0	155.8	0.0
May	112.7	0.0	1313.5	0.0	2176.2	113.8	0.0
Jun	0.0	0.0	1210.8	0.0	2106.0	108.0	0.0
Jul	0.0	0.0	1206.3	0.0	2176.2	111.6	0.0
Aug	0.0	0.0	1189.9	0.0	2176.2	111.5	0.0

Sep	0.0	0.0	1167.4	0.0	2106.0	108.0	0.0
Oct	1411.5	0.0	1252.4	0.0	2176.2	138.4	0.0
Nov	4305.8	0.0	1271.6	0.0	2106.0	189.9	0.0
Dec	7560.7	0.0	1374.8	0.0	2176.2	255.4	0.0
Ann	38692.3	0.0	15457.5	0.0	25623.0	2049.7	0.0

ESTIMATED FUEL COSTS (Dollars)

Month	Electricity	Natural Gas	Oil	Propane	Wood	Total
Jan	65.51	70.95	0.00	0.00	0.00	136.45
Feb	60.59	60.96	0.00	0.00	0.00	121.55
Mar	64.15	49.93	0.00	0.00	0.00	114.08
Apr	61.53	31.00	0.00	0.00	0.00	92.53
May	62.08	16.69	0.00	0.00	0.00	78.77
Jun	60.60	15.41	0.00	0.00	0.00	76.01
Jul	62.04	15.38	0.00	0.00	0.00	77.42
Aug	62.04	15.28	0.00	0.00	0.00	77.32
Sep	60.60	15.15	0.00	0.00	0.00	75.75
Oct	62.56	24.05	0.00	0.00	0.00	86.61
Nov	62.19	41.08	0.00	0.00	0.00	103.28
Dec	64.84	60.38	0.00	0.00	0.00	125.22
Ann	748.72	416.26	0.00	0.00	0.00	1164.97

The calculated heat losses and energy consumptions are only estimates, based upon the data entered and assumptions within the program. Actual energy consumption and heat losses will be influenced by construction practices, localized weather, equipment characteristics and the lifestyle of the occupants.

HOT2000

Natural Resources CANADA
Version 11.13



File: Elfrida_Scenario 2A.h2k
House

Weather Library: C:\HOT2000 v11.13b13\Dat\Wth2020.dir
Weather Data for: TORONTO INTL, ONTARIO

Builder Code:

Data Entry by: Si Jia Wang
Date of entry: 2026-03-09

Company: buildABILITY

Client name: ,

Street address:

City:

Region: ONTARIO

Postal code:

Telephone:

Mailing address:

City:

Region: ONTARIO

Postal Code:

GENERAL HOUSE CHARACTERISTICS

House type: Single Detached

Number of storeys: Two storeys

Plan shape:

Front orientation: North

Year House Built: 2025

Wall colour: Default

Absorptivity: 0.40

Roof colour: Default

Absorptivity: 0.40

Soil Condition: Normal conductivity (dry
sand, loam, clay)

Water Table Level: Normal (7-10m/23-33ft)

House Thermal Mass Level: (A) Light, wood frame

Effective mass fraction 1.000

Occupants :
2 Adults for 50.0% of the time
1 Children for 50.0% of the time
0 Infants for 0.0% of the time

Sensible Internal Heat Gain 2.00 kWh/day
From Occupants:

HOUSE TEMPERATURES

Heating Temperatures

Main Floor	Daytime Setpoint:	21.0 °C
	Nighttime Setpoint:	18.0 °C
	Nighttime Setback Duration:	8.0 Hours
	24 Hour Average:	20.0 °C
Basement	Setpoint:	19.0 °C
	TEMP. Rise from 20.0 °C:	5.5 °C

Cooling Temperature: Main Floor : 25.00 °C

Basement is- Heated: Yes Cooled: No Separate T/S: No
 Fraction of internal gains released in basement : 0.150

Indoor design temperatures for equipment sizing

Heating:	22.0 °C
Cooling:	24.0 °C

WINDOW CHARACTERISTICS

Label	Location	#	Overhang Width (m)	Header Height (m)	Tilt deg	Curtain Factor	Shutter (RSI)
South							
South	Main Floor	1	0.00	0.00	90.0	1.00	0.00
South	Top Floor	1	0.00	0.00	90.0	1.00	0.00
South	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
Southeast							
Southeast	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Southeast	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Southeast	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
East							
East	Main Floor	1	0.00	0.00	90.0	1.00	0.00
East	Top Floor	1	0.00	0.00	90.0	1.00	0.00
East	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
Northeast							
Northeast	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Northeast	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Northeast	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
North							
North	Top Floor	1	0.00	0.00	90.0	1.00	0.00
North	Main Floor	1	0.00	0.00	90.0	1.00	0.00

North	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
Northwest							
Northwest	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Northwest	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Northwest	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
West							
West	Top Floor	1	0.00	0.00	90.0	1.00	0.00
West	Main Floor	1	0.00	0.00	90.0	1.00	0.00
West	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
Southwest							
Southwest	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Southwest	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Southwest	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00

Label	Type	#	Window Width (m)	Window Height (m)	Total Area (m²)	Window RSI	SHGC	ER*
South								
South	SliderU1.6SHGC0.30F15	1	1.47	1.47	2.16	0.627	0.3012	20.8
South	SliderU1.6SHGC0.30F15	1	1.47	1.47	2.16	0.627	0.3012	20.8
South	PicU1.6SHGC0.30F15	1	0.77	0.77	0.59	0.600	0.2900	14.1
Southeast								
Southeast	SliderU1.6SHGC0.30F15	1	0.76	0.76	0.57	0.598	0.2865	13.5
Southeast	SliderU1.6SHGC0.30F15	1	0.76	0.76	0.57	0.598	0.2865	13.5
Southeast	PicU1.6SHGC0.30F15	1	0.22	0.22	0.05	0.522	0.2352	- 62.1
East								
East	SliderU1.6SHGC0.30F15	1	1.58	1.58	2.50	0.630	0.3023	21.2
East	SliderU1.6SHGC0.30F15	1	1.58	1.58	2.50	0.630	0.3023	21.2
East	PicU1.6SHGC0.30F15	1	0.74	0.74	0.55	0.598	0.2890	13.4
Northeast								
Northeast	SliderU1.6SHGC0.30F15	1	0.99	0.99	0.99	0.611	0.2937	17.4
Northeast	SliderU1.6SHGC0.30F15	1	0.99	0.99	0.99	0.611	0.2937	17.4
Northeast	PicU1.6SHGC0.30F15	1	0.39	0.39	0.15	0.558	0.2679	-7.5
North								
North	SliderU1.6SHGC0.30F15	1	1.52	1.52	2.30	0.628	0.3017	21.0
North	SliderU1.6SHGC0.30F15	1	1.52	1.52	2.30	0.628	0.3017	21.0
North	PicU1.6SHGC0.30F15	1	0.83	0.83	0.69	0.604	0.2917	15.3
Northwest								
Northwest	SliderU1.6SHGC0.30F15	1	0.76	0.76	0.57	0.598	0.2866	13.6
Northwest	SliderU1.6SHGC0.30F15	1	0.76	0.76	0.57	0.598	0.2866	13.6
Northwest	PicU1.6SHGC0.30F15	1	0.32	0.32	0.10	0.544	0.2579	- 21.1

West

West	SliderU1.6SHGC0.30F15	1	1.57	1.57	2.46	0.629	0.3022	21.2
West	SliderU1.6SHGC0.30F15	1	1.57	1.57	2.46	0.629	0.3022	21.2
West	PicU1.6SHGC0.30F15	1	0.76	0.76	0.58	0.600	0.2897	13.9
Southwest								
Southwest	SliderU1.6SHGC0.30F15	1	0.96	0.96	0.91	0.610	0.2928	17.0
Southwest	SliderU1.6SHGC0.30F15	1	0.96	0.96	0.91	0.610	0.2928	17.0
Southwest	PicU1.6SHGC0.30F15	1	0.35	0.35	0.12	0.550	0.2625	- 14.6

*ER Window Energy Rating (ER 2009) estimated for actual dimensions, and Air tightness type: CSA - A1; Leakage rate = 1.86 L/s.m²

Above grade fraction of wall area occupied by windows: 12.9 %

***** TYPE 2 USER DEFINED WINDOW CODES *****

Code Label	Description	Glazing Type	Fill Gas	Thermal Resistance	SHGC	Window Style	Low -E Coating	Frame Height
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00

	with 1 coat	W/m2-C	Slider	Coat	
SliderU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Single Slider	Soft Coat	15.00
SliderU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Single Slider	Soft Coat	15.00
PicU1.6SHGC0.30F15	Double/double Argon with 1 coat	1.6000 0.3000 W/m2-C	Picture	Soft Coat	15.00

BUILDING PARAMETER DETAILS

CEILING COMPONENTS

	Construction Type	Code Type	Roof Slope	Heel Ht. (m)	Section Area (m ²)	R. Value (RSI)
Ceiling - 1	Attic/gable	R60 blown cellulose	6.000/12	0.14	113.00	10.15

MAIN WALL COMPONENTS

Label	Lintel Type	Fac. Dir	Number of Corn.	Number of Inter.	Height (m)	Perim. (m)	Area (m ²)	R. Value (RSI)
Main Floor Type: R22	100	N/A	4	4	2.44	35.88	87.55	3.04
Top Floor Type: R22	100	N/A	4	4	2.44	35.88	87.55	3.17
Floor Header - 1 Type: R-22		N/A	4	4	0.25	40.58	10.15	4.18

WALL CODE SCHEDULE

Name	Internal Code	Description (Structure, typ/size, Spacing, Insull, 2, Int., Sheathing, Exterior, Studs)
R22	1211401240	Wood frame, 38x140 mm (2x6 in), 400 mm (16 in), RSI 3.87 @ 140 mm (R 22 @ 5.5") batt, None, 12 mm (0.5 in) gypsum board, Waferboard/OSB 11.1 mm (7/16 in), Brick, 2 studs
R-22	1800400040	Floor header, N/A, N/A, RSI 3.87 @ 140 mm (R 22 @ 5.5") batt, None, N/A, None, Brick, N/A

EXPOSED FLOORS

Label	Floor Code Type	Area (m ²)	R. Value (RSI)
Exposed Floor	R31	16.20	5.52

EXPOSED FLOOR SCHEDULE

Name	Internal Code	Description (Structure, typ/size, Spacing, Insull, 2, Int., Sheathing, Exterior, Studs)
R31	3231L08210	Wood frame, 38x235 mm (2x10 in), 400 mm (16 in), RSI 5.46 @ 241 mm (R 31 @ 9.5") batt, None, Carpet & underpad, Waferboard/OSB 11.1 mm (7/16 in), Wood (lapped), No

DOORS

Label	Type	Height (m)	Width (m)	Gross Area (m²)	R. Value (RSI)
Door - 1 Loc: Main Floor	Steel polystyrene core	2.07	0.81	1.68	0.10
Door - 2 Loc: Main Floor	Steel polystyrene core	2.07	0.81	1.68	0.10
Door - 3 Loc: Main Floor	Steel polystyrene core	2.07	0.81	1.68	0.10

USER-DEFINED STRUCTURE CODES SCHEDULE

Name	Description
21R60 blown cellulose	

FOUNDATIONS

Foundation Name:	Foundation - 1	Volume:	307.7 m ³
Foundation Type:	Basement	Opening to Main Floor:	1.56 m ²
Data Type:	Library		
Total Wall Height:	2.80 m	Non-Rectangular	
Depth Below Grade:	2.28 m	Floor Perimeter:	45.00 m
		Floor Area:	109.90 m ²
Interior wall type:	R20	R-value:	3.52 RSI
Exterior wall type:	User specified	R-Value:	0.00 RSI
Number of corners :	4		
Lintel type:	LL00000000000000000000000000000000		
Added to slab type :	N/A	R-Value:	0.00 RSI
Floors Above Found.:	common	R-Value:	0.82 RSI

Exposed areas for: Foundation - 1
Exposed Perimeter: 45.00 m

Configuration: BCIN_1
 - concrete walls and floor
 - interior surface of wall insulated over full-height
 - any first storey construction type

FOUNDATION CODE SCHEDULE

Floors Above Foundation

Name	Internal Code	Description (Structure, typ/size, Spacing, Insul1, 2, Int., Sheathing, Exterior, Drop Framing)
common	4231006310	Wood frame, 38x235 mm (2x10 in), 400 mm (16 in), None, None, Wood, Waferboard/OSB 15.9 mm (5/8 in), 12 mm (0.5 in) Gypsum board, No

FOUNDATION FLOOR HEADER COMPONENTS

Label	Lintel Type	Fac. Dir	Number of Corn.	Number of Inter.	Height (m)	Perim. (m)	Area (m ²)	R. Value (RSI)
Floor Header - 1 (Location:Foundation - 1) Type: R-22	N/A	N/A	4	4	0.19	39.00	7.41	4.18

Foundation Floor Header Code Schedule

Name	Internal Code	Description (Structure, typ/size, Spacing, Insul1, 2, Int., Sheathing, Exterior, Studs)
R-22	1800400040	Floor header, N/A, N/A, RSI 3.87 @ 140 mm (R 22 @ 5.5") batt, None, None, None, Tile-linoleum, No

Lintel Code Schedule

Name	Code	Description (Type, Material, Insulation)
100	100	Double, Wood, None

ROOF CAVITY INPUTS

Gable Ends		Total Area:	18.83 m ²
Sheathing Material	Plywood/Part. bd 9.5 mm (3/8 in)		0.08 RSI
Exterior Material:	Hollow metal/vinyl cladding		0.11 RSI
Sloped Roof		Total Area:	126.34 m ²
Sheathing Material	Plywood/Part. bd 12.7 mm (1/2 in)		0.11 RSI
Exterior Material:	Asphalt shingles		0.08 RSI
Total Cavity Volume: 122.6 m ³		Ventilation Rate:	0.50 ACH/hr

BUILDING ASSEMBLY DETAILS

Label	Construction Code	Nominal (RSI)	System (RSI)	Effective (RSI)
CEILING COMPONENTS				
Ceiling - 1	R60 blown cellulose	0.00	0.00	10.15
MAIN WALL COMPONENTS				
Main Floor	R22	0.00	0.00	3.04
Top Floor	R22	0.00	0.00	3.17
Floor Header - 1	R-22	0.00	0.00	4.18
EXPOSED FLOORS				
Exposed Floor	R31	0.00	0.00	5.52
FLOORS ABOVE BASEMENTS				
Foundation - 1	common	0.00	0.00	0.82

BUILDING PARAMETERS SUMMARY
ZONE 1 : Above Grade

Component	Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ	% Annual Heat Loss
Ceiling	113.00	113.00	10.15	3156.78	4.27
Main Walls	185.24	155.28	3.16	16402.82	22.20
Doors	5.03	5.03	0.98	1886.03	2.55
Exposed floors	16.20	16.20	5.52	989.57	1.34
South Windows	4.31	4.31	0.63	2525.89	3.42
Southeast Windows	1.15	1.15	0.60	704.32	0.95
East Windows	5.00	5.00	0.63	2917.91	3.95
Northeast Windows	1.97	1.97	0.61	1185.52	1.60
North Windows	4.60	4.60	0.63	2692.42	3.64
Northwest Windows	1.15	1.15	0.60	706.10	0.96
West Windows	4.92	4.92	0.63	2874.94	3.89
Southwest Windows	1.83	1.83	0.61	1101.97	1.49
ZONE 1 Totals:				37144.28	50.26

INTER-ZONE Heat Transfer : Floors Above Basement

Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ
109.90	109.90	0.817	9946.77

ZONE 2 : Basement

Component	Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ	% Annual Heat Loss
Walls above grade	23.40	20.56	-	2557.78	3.46
South windows	0.59	0.59	0.60	319.67	0.43
Southeast windows	0.05	0.05	0.52	30.77	0.04

East windows	0.55	0.55	0.60	295.58	0.40
Northeast windows	0.15	0.15	0.56	89.32	0.12
North windows	0.69	0.69	0.60	367.24	0.50
Northwest windows	0.10	0.10	0.54	60.75	0.08
West windows	0.58	0.58	0.60	312.58	0.42
Southwest windows	0.12	0.12	0.55	71.87	0.10
Basement floor header	7.41	7.41	4.18	801.10	1.08
Below grade foundation	212.50	212.50	-	18432.85	24.94
ZONE 2 Totals:				23339.50	31.58

Air Leakage and Mechanical Ventilation

House Volume	Air Change	Heat Loss MJ	% Annual Heat Loss
702.00 m ³	0.134 ACH	13414.337	18.15

AIR LEAKAGE AND MECHANICAL VENTILATION

Building Envelope Surface Area: 557.75 m²

Air Leakage Test Results at 50 Pa.(0.2 3.02 ACH
in H₂O) =

Equivalent Leakage Area @ 10 Pa = 791.62 cm²

Terrain Description

@ Weather Station :	Open flat terrain, grass	Anemometer:	Height (m)
			10.0
@ Building site :	Suburban, forest	Height of the highest ceiling:	5.5

Local Shielding:

Walls:	Heavy
Flue :	Light

Leakage Fractions-

Ceiling:	0.200
Walls:	0.650
Floors:	0.150

Normalized Leakage Area @ 10 Pa: 1.4193 cm²/m²

Estimated Airflow to cause a 5 Pa Pressure Difference: 126 L/s

Estimated Airflow to cause a 10 Pa Pressure Difference: 198 L/s

F326 VENTILATION REQUIREMENTS

Kitchen, Living Room, Dining Room	3 rooms @ 5.0 L/s: 15.0 L/s
Utility Room	1 rooms @ 5.0 L/s: 5.0 L/s
Bedroom	1 rooms @ 10.0 L/s: 10.0 L/s
Bedroom	1 rooms @ 5.0 L/s: 5.0 L/s
Bathroom	1 rooms @ 5.0 L/s: 5.0 L/s
Basement Rooms	10.0 L/s

CENTRAL VENTILATION SYSTEM

System Type: HRV
 Manufacturer:
 Model Number:

Fan and Preheater Power at 0.0 °C: 125 Watts
 Fan and Preheater Power at -25.0 °C: 125 Watts
 Preheater Capacity: 0 Watts
 Sensible Heat Recovery Efficiency at 0.0 °C 75%

Sensible Heat Recovery Efficiency at -25.0 °C 60%
Total Heat Recovery Efficiency in Cooling Mode 25%

Low Temperature Ventilation Reduction: 0%
Low Temperature Ventilation Reduction: 0 L/s (0.0%)
Airflow Adjustment

Vented combustion appliance depressurization limit: 5.00 Pa.

Ventilation Supply Duct

Location:	Main floor	Type:	Flexible
Length:	1.5 m	Diameter:	152.4 mm
Insulation:	0.7 RSI	Sealing Characteristics:	Sealed

Ventilation Exhaust Duct

Location:	Main floor	Type:	Flexible
Length:	1.5 m	Diameter:	152.4 mm
Insulation:	0.7 RSI	Sealing Characteristics:	Sealed

SECONDARY FANS & OTHER EXHAUST APPLIANCES

	Control	Supply (L/s)	Exhaust (L/s)
Other Fans	Continuous	0.00	0.00
Dryer	Continuous	-	1.49

Dryer is vented outdoors

Rated Fan Power 0.00 Watts

NEW ERS VENTILATION DATA

Whole House Systems

Air Distribution/circulation type: Forced air heating ductwork
Air Distribution/circulation fan power: 100.00 Watts
Operation schedule: 480.00 min/day

System # 1 Type: HRV/ERV
Manufacturer:
Model:
Airflow Supply Rate: 28.00 L/s **Exhaust:** 28.00 L/s **Fan Power:** 125.00 Watts

Supplementary Systems

System # 1 Type: Dryer
Manufacturer:
Model:
Airflow Supply Rate: 0.00 L/s **Exhaust:** 38.00 L/s **Fan Power:** 0.00 Watts
Operation schedule: 56.50 min/day

AIR LEAKAGE AND MECHANICAL VENTILATION SUMMARY

F326 Required continous ventilation: 50.000 L/s (0.26 ACH)
Central Ventilation Supply Rate (): 28.000 L/s (0.14 ACH)
Other Continuous Supply Flow Rates: 0.000 L/s (0.00 ACH)
Other Continuous Exhaust Flow Rates: 0.000 L/s (0.00 ACH)
Total house ventilation is Balanced
Gross Air Leakage and Mechanical Ventilation Energy Load: 14008.803 MJ
Seasonal Heat Recovery Ventilator Efficiency: 72.840 %
Estimated Ventilation Electrical Load: 1068.891 MJ
Heating Hours:
Estimated Ventilation Electrical Load: Non-Heating Hours: 244.863 MJ
Net Air Leakage and Mechanical Ventilation Load: 13948.781 MJ

SPACE HEATING SYSTEM

PRIMARY Space Heating Fuel:	Electricity
Space Heating Equipment:	Air Source Heat Pump
Manufacturer:	
Model:	
Capacity at 8.3 °C:	7.0 kW
HSPF at 8.3 °C:	7.10
COP at 8.3 °C:	3.45
Crankcase Heater Power:	60.00 watts
Heat Pump Temperature Cut-Off:	Balance point
SECONDARY Heating Fuel:	Natural Gas
Equipment:	Condensing furnace/boiler
Manufacturer:	
Model:	
Specified Output Capacity:	9.50 kW
AFUE:	96.00
Steady State Efficiency:	98.04
Fan Mode:	Auto
ECM Motor:	No
Low Speed Fan Power:	0 watts
High Speed Fan Power:	327 watts

AIR CONDITIONING SYSTEM

System Type:	Central split system		
Manufacturer:			
Model:			
Capacity:	4168 Watts		
SEER	14.00	Rated COP	3.038
Sensible Heat Ratio:	0.76		
Indoor Fan Flow Rate:	254.46 L/s	Fan Power (watts)	197.21
Ventilator Flow Rate:	0.00 L/s	Crankcase Heater Power (watts):	60.00
Fraction of windows Openable:	0.000	ECM Motor:	No
Cooling system capacity sizing factor:	1.000		
Economizer control:	N/A	Indoor Fan Operation:	Auto

Air Conditioner is integrated with the Heating System

DOMESTIC WATER HEATING SYSTEM

PRIMARY Water Heating Fuel:	Electricity		
Water Heating Equipment:	Conventional tank		
Energy Factor:	0.822		
Manufacturer:			
Model:			
Tank Capacity:	189.3 Litres	Tank Blanket Insulation:	0.0 RSI
Tank Location:	Basement		
Drain Water Heat Recovery for Primary System			
Manufacturer:	Power-Pipe		
Model:	R4-40		
Shower Temperature:	Warm 41°C (106°F)		
Showers per day:	2.23		
Length of showers:	6.50 minutes		
Shower head type:	Low Flow(6.5 L/min, 1.4 Igpm, 1.7 USgpm)		
Configuration:	Preheated cold water delivered to hot water heater only		
Efficiency at 9.5 L/Min:	42.4%		
Number of units connected to drain water heat recovery:	N/A		

ANNUAL DOMESTIC WATER HEATING SUMMARY

Daily Hot Water Consumption:	190.0 Litres
Hot Water Temperature:	55.0 °C
Estimated Domestic Water Heating Load:	13234 MJ
Reduction in Hot Water load due to DWHR:	1237 MJ
Primary Domestic Water Heating Energy Consumption:	15384 MJ
Primary System Seasonal Efficiency:	78.0%

ANNUAL SPACE HEATING SUMMARY

Gross Space Heat Loss:	73898 MJ
Gross Space Heating Load:	70980 MJ
Usable Internal Gains:	21791 MJ
Usable Internal Gains Fraction:	29.5 %
Usable Solar Gains:	11010 MJ
Usable Solar Gains Fraction:	14.9 %
Auxiliary Energy Required:	38179 MJ
Space Heating System Load:	38179 MJ
Heat Pump and Furnace Annual COP:	1.846
Heat Pump Annual Energy Consumption:	11326 MJ

Furnace/Boiler Annual Energy Consumption: 7279 MJ
 Annual Space Heating Energy Consumption: 18605 MJ

DESIGN SPACE HEATING AND COOLING LOADS

Design Heat Loss* at -18.3 °C (12.16 Watts / m³): 8533 Watts

Design Cooling Load* for July at (31.5 °C): 4330 Watts

* Please refer to notes at the end of this report.

ANNUAL SPACE COOLING SUMMARY

Design Sensible Heat Ratio: 0.769
 Estimated Annual Space Cooling Energy: 1439.23 kWh
 Seasonal COP (May to October): 2.575

BASE LOADS SUMMARY

	kwh/day	Annual kWh
Interior Lighting	2.60	949.00
Appliances	6.30	2299.50
Other	9.70	3540.50
Exterior Use	0.90	328.50
HVAC Fans		
HRV/Exhaust	1.00	364.93
Space Heating	1.58	578.01
Space Cooling	0.57	208.24
Total Average Electrical Load	22.65	8268.69

FAN OPERATION SUMMARY (kWh)

Hours	HRV/Exhaust Fans	Space Heating	Space Cooling
Heating	296.9	578.0	0.0
Neither	29.1	0.0	0.0
Cooling	38.9	0.0	208.2
Total	364.9	578.0	

ENERGY CONSUMPTION SUMMARY REPORT

Estimated Annual Space Heating Energy Consumption	= 20685.68 MJ	= 5746.02 kWh
Ventilator Electrical Consumption: Heating Hours	= 1068.89 MJ	= 296.91 kWh
Estimated Annual DHW Heating Energy Consumption	= 15383.78 MJ	= 4273.27 kWh
ESTIMATED ANNUAL SPACE + DHW ENERGY CONSUMPTION	= 37138.36 MJ	= 10316.21 kWh
Estimated Greenhouse Gas Emissions	13.948 tonnes/year	

ESTIMATED ANNUAL FUEL CONSUMPTION SUMMARY

Fuel	Space Heating	Space Cooling	DHW Heating	Baseloads	Ventilation	Total
Natural Gas (m3)	195.4	0.0	0.0	0.0	0.0	195.4
Electricity (kWh)	3724.1	1439.2	4273.3	7117.5	364.9	16919.0

ESTIMATED ANNUAL FUEL CONSUMPTION COSTS

Fuel Costs Library = Embedded

RATE	Electricity (Ottawa97)	Natural Gas (Ottawa97)	Oil (Ottawa97)	Propane (Ottawa97)	Wood (Sth Ont)	Total
\$	1396.82	139.87	0.00	0.00	0.00	1536.69

Fuel Costs Library Listing

Filename = Embedded

Record # 1	Fuel: Electricity		
Rate ID = Ottawa97	Hydro Rate Block		
Rate Block		Dollars	Charge
	kWhr	Per kWhr	(\$)
Minimum	0.0		10.000
1	250.0	0.0999	
2	99999.0	0.0702	
Record # 2	Fuel: Natural Gas		
Rate ID = Ottawa97	Gas Rate Block		
Rate Block		Dollars	Charge
	m3	Per m3	(\$)

Minimum	0.0		8.000
1	30.0	0.2285	
2	85.0	0.2215	
3	170.0	0.2171	
4	99999.0	0.2133	

Record # 3

Fuel: Oil

Rate ID = Ottawa97

Oil Rate Block

Rate Block		Dollars	Charge
	Litre	Per Litre	(\$)
Minimum	0.0		10.000
1	99999.0	0.4055	

Record # 4

Fuel: Propane

Rate ID = Ottawa97

Propane Rate Block

Rate Block		Dollars	Charge
	Litre	Per Litre	(\$)
Minimum	0.0		0.000
1	99999.0	0.4500	

Record # 5

Fuel: Wood

Rate ID = Sth Ont

Cord Rate

Rate Block		Dollars	Charge
	Cord	Per Cord	(\$)
Minimum	0.0		0.000
1	99999.0	210.0000	

MONTHLY ENERGY PROFILE

Month	Energy Load (MJ)	Internal Gains (MJ)	Solar Gains (MJ)	Aux. Energy (MJ)	HRV Eff. %
Jan	12912.9	2360.0	1265.5	9287.4	72.9
Feb	11384.5	2126.8	1580.8	7676.9	73.2
Mar	9991.5	2362.6	2005.4	5623.6	73.6
Apr	6401.8	2305.1	1650.6	2446.0	73.8
May	3540.5	2325.9	1135.8	78.8	70.7
Jun	1093.4	1010.2	83.2	0.0	74.3
Jul	442.2	441.1	1.1	0.0	66.7
Aug	499.4	496.5	2.9	0.0	67.5
Sep	1408.6	1227.4	181.2	0.0	74.2
Oct	4941.0	2429.8	1170.4	1340.7	73.8
Nov	7515.9	2327.0	954.1	4234.8	73.7
Dec	10848.4	2378.4	979.3	7490.7	73.5
Ann	70980.0	21790.8	11010.3	38178.8	72.8

FOUNDATION ENERGY PROFILE

Month	Heat Loss (MJ)				Total
	Crawl Space	Slab	Basement	Walkout	
Jan	0.0	0.0	1586.5	0.0	1586.5
Feb	0.0	0.0	1310.3	0.0	1310.3
Mar	0.0	0.0	962.0	0.0	962.0
Apr	0.0	0.0	418.4	0.0	418.4
May	0.0	0.0	13.5	0.0	13.5
Jun	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	229.3	0.0	229.3
Nov	0.0	0.0	724.4	0.0	724.4
Dec	0.0	0.0	1281.4	0.0	1281.4
Ann	0.0	0.0	6525.8	0.0	6525.8

FOUNDATION TEMPERATURES & VENTILATION PROFILE

Month	Temperature (Deg °C)			Air Change Rate		Heat Loss (MJ)
	Crawl Space	Basement	Walkout	Natural	Total	
Jan	0.0	18.6	0.0	0.176	0.199	3006.7
Feb	0.0	18.4	0.0	0.174	0.197	2603.3
Mar	0.0	18.2	0.0	0.152	0.176	2047.4

Apr	0.0	18.2	0.0	0.122	0.146	1045.1
May	0.0	18.7	0.0	0.083	0.106	349.5
Jun	0.0	20.1	0.0	0.062	0.085	32.0
Jul	0.0	21.2	0.0	0.055	0.079	-80.2
Aug	0.0	21.0	0.0	0.053	0.076	-51.6
Sep	0.0	19.9	0.0	0.064	0.088	117.5
Oct	0.0	18.9	0.0	0.101	0.125	696.8
Nov	0.0	18.7	0.0	0.129	0.153	1339.7
Dec	0.0	18.7	0.0	0.159	0.183	2308.0
Ann	0.0	19.2	0.0	0.111	0.134	13414.3

SPACE HEATING SYSTEM PERFORMANCE

Month	Space Heating Load (MJ)	Furnace Input (MJ)	Pilot Light (MJ)	Indoor Fans (MJ)	Heat Pump Input (MJ)	Total Input (MJ)	System Cop
Jan	9287.4	3713.7	0.0	474.2	2067.7	6255.7	1.485
Feb	7676.9	2271.4	0.0	421.8	2022.1	4715.4	1.628
Mar	5623.6	434.3	0.0	329.6	1911.4	2675.2	2.102
Apr	2446.0	3.7	0.0	124.9	864.3	992.9	2.463
May	78.8	0.2	0.0	3.5	84.1	87.7	0.898
Jun	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Sep	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Oct	1340.7	5.3	0.0	63.1	478.3	546.8	2.452
Nov	4234.8	16.3	0.0	227.4	1476.0	1719.7	2.463
Dec	7490.7	834.0	0.0	436.3	2422.0	3692.4	2.029
Ann	38178.9	7279.0	0.0	2080.8	11325.9	20685.7	1.846

AIR CONDITIONING SYSTEM PERFORMANCE

Month	Sensible Load (MJ)	Latent Load (MJ)	AirCond Energy (kWh)	Fan Energy (kWh)	Ventilator Energy (kWh)	Crankcase Heater (kWh)	Total Energy (kWh)	COP	Av.RH %
May	1144.9	71.7	111.3	19.7	0.0	0.0	130.9	2.6	37.7
Jun	2421.9	311.3	248.5	42.7	0.0	3.1	294.3	2.6	41.9
Jul	3409.5	489.0	356.2	60.0	0.0	0.2	416.4	2.6	42.6
Aug	2965.2	466.1	312.2	53.1	0.0	0.5	365.8	2.6	43.2
Sep	1615.5	233.7	169.0	29.3	0.0	9.8	208.1	2.5	42.4
Oct	185.6	27.7	20.1	3.5	0.0	0.0	23.7	2.5	42.5
Ann	11742.5	1599.5	1217.3	208.2	0.0	13.7	1439.2	2.6	41.9

MONTHLY ESTIMATED ENERGY CONSUMPTION BY DEVICE (MJ)

Month	Space Heating		DHW Heating		Lights &	HRV &	Air
	Primary	Secondary	Primary	Secondary	Appliances	FANS	Conditioner
Jan	2067.7	3713.7	1401.7	0.0	2176.2	585.7	0.0
Feb	2022.1	2271.4	1280.6	0.0	1965.6	522.7	0.0
Mar	1911.4	434.3	1404.7	0.0	2176.2	441.2	0.0
Apr	864.3	3.7	1321.7	0.0	2106.0	232.9	0.0
May	84.1	0.2	1307.2	0.0	2176.2	186.0	400.5
Jun	0.0	0.0	1210.4	0.0	2106.0	261.7	905.6
Jul	0.0	0.0	1210.9	0.0	2176.2	327.4	1283.1
Aug	0.0	0.0	1196.2	0.0	2176.2	302.6	1126.0
Sep	0.0	0.0	1171.8	0.0	2106.0	213.4	643.7
Oct	478.3	5.3	1252.0	0.0	2176.2	187.5	72.6
Nov	1476.0	16.3	1265.1	0.0	2106.0	335.4	0.0
Dec	2422.0	834.0	1361.5	0.0	2176.2	547.9	0.0
Ann	11325.9	7279.0	15383.8	0.0	25623.0	4144.3	4431.5

ESTIMATED FUEL COSTS (Dollars)

Month	Electricity	Natural Gas	Oil	Propane	Wood	Total
Jan	138.94	30.22	0.00	0.00	0.00	169.16
Feb	130.35	21.71	0.00	0.00	0.00	152.06
Mar	133.13	10.66	0.00	0.00	0.00	143.79
Apr	105.66	8.02	0.00	0.00	0.00	113.68
May	98.43	8.00	0.00	0.00	0.00	106.43
Jun	104.86	8.00	0.00	0.00	0.00	112.86
Jul	114.88	8.00	0.00	0.00	0.00	122.88
Aug	111.04	8.00	0.00	0.00	0.00	119.04
Sep	98.06	8.00	0.00	0.00	0.00	106.06
Oct	98.68	8.03	0.00	0.00	0.00	106.71
Nov	118.48	8.10	0.00	0.00	0.00	126.58
Dec	144.32	13.11	0.00	0.00	0.00	157.44
Ann	1396.82	139.87	0.00	0.00	0.00	1536.69

The calculated heat losses and energy consumptions are only estimates, based upon the data entered and assumptions within the program. Actual energy consumption and heat losses will be influenced by construction practices, localized weather, equipment characteristics and the lifestyle of the occupants.

HOT2000

Natural Resources CANADA
Version 11.13



File: Elfrida_Scenario 3A.h2k
House

Weather Library: C:\HOT2000 v11.13b13\Dat\Wth2020.dir
Weather Data for: TORONTO INTL, ONTARIO

Builder Code:

Data Entry by: Si Jia Wang
Date of entry: 2026-03-10

Company: buildABILITY

Client name: ,

Street address:

City: **Region:** ONTARIO

Postal code: **Telephone:**

Mailing address:

City: **Region:** ONTARIO

Postal Code:

GENERAL HOUSE CHARACTERISTICS

House type: Single Detached

Number of storeys: Two storeys

Plan shape:

Front orientation: North

Year House Built: 2025

Wall colour: Default

Absorptivity: 0.40

Roof colour: Default

Absorptivity: 0.40

Soil Condition: Normal conductivity (dry sand, loam, clay)

Water Table Level: Normal (7-10m/23-33ft)

House Thermal Mass Level: (A) Light, wood frame

Effective mass fraction 1.000

Occupants :
2 Adults for 50.0% of the time
1 Children for 50.0% of the time
0 Infants for 0.0% of the time

**Sensible Internal Heat
Gain From Occupants:** 2.00 kWh/day

HOUSE TEMPERATURES

Heating Temperatures

Main Floor	Daytime Setpoint:	21.0 °C
	Nighttime Setpoint:	18.0 °C
	Nighttime Setback Duration:	8.0 Hours
	24 Hour Average:	20.0 °C
Basement	Setpoint:	19.0 °C
	TEMP. Rise from 20.0 °C:	5.5 °C

Cooling Temperature: Main Floor : 25.00 °C

Basement is- Heated:Yes Cooled: No	Separate T/S: No
Fraction of internal gains released in basement :	0.150

Indoor design temperatures for equipment sizing

Heating:	22.0 °C
Cooling:	24.0 °C

WINDOW CHARACTERISTICS

Label	Location	#	Overhang Width (m)	Header Height (m)	Tilt deg	Curtain Factor	Shutter (RSI)
South							
South	Main Floor	1	0.00	0.00	90.0	1.00	0.00
South	Top Floor	1	0.00	0.00	90.0	1.00	0.00
South	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
Southeast							
Southeast	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Southeast	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Southeast	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
East							
East	Main Floor	1	0.00	0.00	90.0	1.00	0.00
East	Top Floor	1	0.00	0.00	90.0	1.00	0.00
East	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
Northeast							
Northeast	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Northeast	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Northeast	Foundation	1	0.00	0.00	90.0	1.00	0.00

- 1

North

North	Top Floor	1	0.00	0.00	90.0	1.00	0.00

North	Main Floor	1	0.00	0.00	90.0	1.00	0.00

North	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00

Northwest

Northwest	Main Floor	1	0.00	0.00	90.0	1.00	0.00

Northwest	Top Floor	1	0.00	0.00	90.0	1.00	0.00

Northwest	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00

West

West	Top Floor	1	0.00	0.00	90.0	1.00	0.00

West	Main Floor	1	0.00	0.00	90.0	1.00	0.00

West	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00

Southwest

Southwest	Main Floor	1	0.00	0.00	90.0	1.00	0.00

Southwest	Top Floor	1	0.00	0.00	90.0	1.00	0.00

Southwest	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00

Label**Type****#****Window Width (m)****Window Height (m)****Total Area (m²)****Window RSI****SHGC****ER*****South**

South	TG-U1.02	1	1.47	1.47	2.16	0.976	0.3013	33.3

South	TG-U1.02	1	1.47	1.47	2.16	0.976	0.3013	33.3

South	TG-U1.02	1	0.95	0.95	0.90	0.999	0.2944	31.0

Southeast

Southeast	TG-U1.02	1	0.76	0.76	0.57	1.015	0.2896	28.7

Southeast	TG-U1.02	1	0.76	0.76	0.57	1.015	0.2896	28.7

Southeast	TG-U1.02	1	0.32	0.32	0.10	1.112	0.2572	-1.5

East

East	TG-U1.02	1	1.58	1.58	2.50	0.973	0.3022	33.5

East	TG-U1.02	1	1.58	1.58	2.50	0.973	0.3022	33.5

East	TG-U1.02	1	0.89	0.89	0.80	1.003	0.2933	30.5

Northeast

Northeast	TG-U1.02	1	0.99	0.99	0.99	0.996	0.2953	31.4

Northeast	TG-U1.02	1	0.99	0.99	0.99	0.996	0.2953	31.4

Northeast	TG-U1.02	1	0.45	0.45	0.20	1.066	0.2732	16.9

North

North	TG-U1.02	1	1.52	1.52	2.30	0.975	0.3017	33.4
North	TG-U1.02	1	1.52	1.52	2.30	0.975	0.3017	33.4
North	TG-U1.02	1	0.95	0.95	0.90	0.999	0.2944	31.0
Northwest								
Northwest	TG-U1.02	1	0.76	0.76	0.57	1.015	0.2896	28.8
Northwest	TG-U1.02	1	0.76	0.76	0.57	1.015	0.2896	28.8
Northwest	TG-U1.02	1	0.32	0.32	0.10	1.112	0.2572	-1.5
West								
West	TG-U1.02	1	1.57	1.57	2.46	0.973	0.3021	33.5
West	TG-U1.02	1	1.57	1.57	2.46	0.973	0.3021	33.5
West	TG-U1.02	1	0.95	0.95	0.90	0.999	0.2944	31.0
Southwest								
Southwest	TG-U1.02	1	0.96	0.96	0.91	0.998	0.2946	31.1
Southwest	TG-U1.02	1	0.96	0.96	0.91	0.998	0.2946	31.1
Southwest	TG-U1.02	1	0.45	0.45	0.20	1.066	0.2732	16.9

*ER Window Energy Rating (ER 2009) estimated for actual dimensions, and Air tightness type: CSA - A1;
Leakage rate = 1.86 L/s.m²

Above grade fraction of wall area occupied by windows: 13.4 %

***** TYPE 2 USER DEFINED WINDOW CODES *****

Code Label	Description	Glazing Type	Fill Gas	Thermal Resistance	SHGC	Window Style	Low -E Coating	Frame Height
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00

	with 1 coat		W/m2-C			Coat	
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	1.0200	0.3000	Picture	Soft Coat	15.00

BUILDING PARAMETER DETAILS

CEILING COMPONENTS

	Construction Type	Code Type	Roof Slope	Heel Ht. (m)	Section Area (m ²)	R. Value (RSI)
Ceiling - 1	Attic/gable	R60 blown cellulose	6.000/12	0.14	113.00	10.15

MAIN WALL COMPONENTS

Label	Lintel Type	Fac. Dir	Number of Corn.	Number of Inter.	Height (m)	Perim. (m)	Area (m ²)	R. Value (RSI)
Main Floor Type: 24+10ci	100	N/A	4	4	2.44	35.88	87.55	4.94
Top Floor Type: 24+10ci	100	N/A	4	4	2.44	35.88	87.55	5.08

Floor Header - 1	N/A	4	4	0.25	35.88	8.97	6.20
Type: header							
r24+10ci							

WALL CODE SCHEDULE

Name	Internal Code	Description (Structure, typ/size, Spacing, Insull, 2, Int., Sheathing, Exterior, Studs)
24+10ci	1211ZI1240	Wood frame, 38x140 mm (2x6 in), 400 mm (16 in), RSI 4.23 @ 140 mm (R 24 @ 5.5") batt, 51 mm (2 in) XTPS IV, 12 mm (0.5 in) gypsum board, Waferboard/OSB 11.1 mm (7/16 in), Brick, 2 studs
header r24+10ci	1800ZI0040	Floor header, N/A, N/A, RSI 4.23 @ 140 mm (R 24 @ 5.5") batt, 51 mm (2 in) XTPS IV, N/A, None, Brick, N/A

EXPOSED FLOORS

Label	Floor Code Type	Area (m²)	R. Value (RSI)
Exposed Floor	R31+5 ci	16.20	6.40

EXPOSED FLOOR SCHEDULE

Name	Internal Code	Description (Structure, typ/size, Spacing, Insull, 2, Int., Sheathing, Exterior, Studs)
R31+5 ci	3231LB8210	Wood frame, 38x235 mm (2x10 in), 400 mm (16 in), RSI 5.46 @ 241 mm (R 31 @ 9.5") batt, 25 mm (1 in) XTPS IV, Carpet & underpad, Waferboard/OSB 11.1 mm (7/16 in), Wood (lapped), No

DOORS

Label	Type	Height (m)	Width (m)	Gross Area (m²)	R. Value (RSI)
Door - 1	Steel polystyrene core	2.07	0.81	1.68	0.10
Loc: Main Floor					
Door - 2	Steel polystyrene core	2.07	0.81	1.68	0.10
Loc: Main Floor					
Door - 3	Steel polystyrene core	2.07	0.81	1.68	0.10
Loc: Main Floor					

USER-DEFINED STRUCTURE CODES SCHEDULE

Name	Description
21R60 blown cellulose	
@R20 +10 ci	New code description

FOUNDATIONS

Foundation Name: Foundation - 1
Foundation Type: Basement
Data Type: Library

Volume: 307.7 m³
Opening to Main Floor: 1.56 m²

Total Wall Height:	2.80 m	Non-Rectangular	
Depth Below Grade:	2.28 m	Floor Perimeter:	45.00 m
		Floor Area:	109.90 m ²
Interior wall type:	R20 +10 ci	R-value:	5.29 RSI
Exterior wall type:	User specified	R-Value:	0.00 RSI
Number of corners :	4		
Lintel type:	LL000000000000000000000000000000		
Added to slab type :	N/A	R-Value:	1.76 RSI
Floors Above Found.:	common	R-Value:	0.82 RSI

Exposed areas for: Foundation - 1
Exposed Perimeter: 45.00 m

Configuration: BCIB_1
 - concrete walls and floor
 - interior surface of wall insulated over full-height
 - sub-surface of floor slab fully insulated but no insulation under footings
 - any first storey construction type

FOUNDATION CODE SCHEDULE

Interior Wall

Name	Code	Description (Fram., Spac., Studs, Ins/fram., Xtra ins, Int)
R20 +10 ci	@R20 +10 ci	N/A, N/A, 4 studs, None, N/A, N/A, N/A, None, N/A

Floors Above Foundation

Name	Internal Code	Description (Structure, typ/size, Spacing, Insul1, 2, Int., Sheathing, Exterior, Drop Framing)
common	4231006310	Wood frame, 38x235 mm (2x10 in), 400 mm (16 in), None, None, Wood, Waferboard/OSB 15.9 mm (5/8 in), 12 mm (0.5 in) Gypsum board, No

FOUNDATION FLOOR HEADER COMPONENTS

Label	Lintel Type	Fac. Dir	Number of Corn.	Number of Inter.	Height (m)	Perim. (m)	Area (m ²)	R. Value (RSI)
Floor Header - 1 (Location:Foundation - 1) Type: R-22	N/A	N/A	4	4	0.25	37.59	9.40	4.18

Foundation Floor Header Code Schedule

Name	Internal	Description

	Code	(Structure, typ/size, Spacing, Insul1, 2, Int., Sheathing, Exterior, Studs)
R-22	1800400040	Floor header, N/A, N/A, RSI 3.87 @ 140 mm (R 22 @ 5.5") batt, None, None, None, Tile-linoleum, No

Lintel Code Schedule

Name	Code	Description (Type, Material, Insulation)
100	100	Double, Wood, None

ROOF CAVITY INPUTS

Gable Ends		Total Area:	18.83 m ²
Sheathing Material	Plywood/Part. bd 9.5 mm (3/8 in)		0.08 RSI
Exterior Material:	Hollow metal/vinyl cladding		0.11 RSI
Sloped Roof		Total Area:	126.34 m ²
Sheathing Material	Plywood/Part. bd 12.7 mm (1/2 in)		0.11 RSI
Exterior Material:	Asphalt shingles		0.08 RSI
Total Cavity Volume:	122.6 m ³	Ventilation Rate:	0.50 ACH/hr

BUILDING ASSEMBLY DETAILS

Label	Construction Code	Nominal (RSI)	System (RSI)	Effective (RSI)
CEILING COMPONENTS				
Ceiling - 1	R60 blown cellulose	0.00	0.00	10.15
MAIN WALL COMPONENTS				
Main Floor	24+10ci	0.00	0.00	4.94
Top Floor	24+10ci	0.00	0.00	5.08
Floor Header - 1	header r24+10ci	0.00	0.00	6.20
EXPOSED FLOORS				
Exposed Floor	R31+5 ci	0.00	0.00	6.40
FLOORS ABOVE BASEMENTS				
Foundation - 1	common	0.00	0.00	0.82

BUILDING PARAMETERS SUMMARY
ZONE 1 : Above Grade

Component	Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ	% Annual Heat Loss
Ceiling	113.00	113.00	10.15	3156.78	6.77
Main Walls	184.06	154.10	5.07	10142.19	21.75
Doors	5.03	5.03	0.98	1886.03	4.04
Exposed floors	16.20	16.20	6.40	863.11	1.85
South Windows	4.31	4.31	0.98	1622.45	3.48
Southeast Windows	1.15	1.15	1.01	415.03	0.89
East Windows	5.00	5.00	0.97	1887.64	4.05
Northeast Windows	1.97	1.97	1.00	727.57	1.56
North Windows	4.60	4.60	0.97	1734.98	3.72
Northwest Windows	1.15	1.15	1.01	416.17	0.89
West Windows	4.92	4.92	0.97	1858.52	3.99
Southwest Windows	1.83	1.83	1.00	672.77	1.44
ZONE 1 Totals:				25383.24	54.43

INTER-ZONE Heat Transfer : Floors Above Basement

Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ
109.90	109.90	0.817	6472.54

ZONE 2 : Basement

Component	Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ	% Annual Heat Loss
Walls above grade	23.40	19.30	-	1762.55	3.78
South windows	0.90	0.90	1.00	301.19	0.65
Southeast windows	0.10	0.10	1.11	29.99	0.06
East windows	0.80	0.80	1.00	266.26	0.57
Northeast windows	0.20	0.20	1.07	62.59	0.13
North windows	0.90	0.90	1.00	301.19	0.65
Northwest windows	0.10	0.10	1.11	29.99	0.06
West windows	0.90	0.90	1.00	301.19	0.65
Southwest windows	0.20	0.20	1.07	62.59	0.13
Basement floor header	9.40	9.40	4.18	1109.35	2.38
Below grade foundation	212.50	212.50	-	12848.56	27.55
ZONE 2 Totals:				17075.48	36.61

Air Leakage and Mechanical Ventilation

House Volume	Air Change	Heat Loss MJ	% Annual Heat Loss
702.00 m ³	0.056 ACH	4179.021	8.96

AIR LEAKAGE AND MECHANICAL VENTILATION

Building Envelope Surface Area: 558.56 m²

Air Leakage Test Results at 50 Pa. 1.00 ACH
(0.2 in H₂O) =

Equivalent Leakage Area @ 10 Pa 262.13 cm²
=

Terrain Description

			Height (m)
@ Weather Station :	Open flat terrain, grass	Anemometer:	10.0
@ Building site :	Suburban, forest	Height of the highest ceiling:	5.5

Local Shielding:

Walls:	Heavy
Flue :	Light

Leakage Fractions-

Ceiling:	0.200
Walls:	0.650
Floors:	0.150

Normalized Leakage Area @ 10 Pa: 0.4693 cm²/m²

Estimated Airflow to cause a 5 Pa Pressure Difference: 42 L/s

Estimated Airflow to cause a 10 Pa Pressure Difference: 66 L/s

F326 VENTILATION REQUIREMENTS

Kitchen, Living Room, Dining Room	3 rooms @ 5.0 L/s: 15.0 L/s
Utility Room	1 rooms @ 5.0 L/s: 5.0 L/s
Bedroom	1 rooms @ 10.0 L/s: 10.0 L/s
Bedroom	1 rooms @ 5.0 L/s: 5.0 L/s
Bathroom	1 rooms @ 5.0 L/s: 5.0 L/s
Basement Rooms	10.0 L/s

CENTRAL VENTILATION SYSTEM

System Type: HRV
Manufacturer:

Model Number:**Fan and Preheater Power at 0.0 °C:** 125 Watts**Fan and Preheater Power at -25.0 °C:** 125 Watts**Preheater Capacity:** 0 Watts**Sensible Heat Recovery Efficiency at 0.0 °C** 81%**Sensible Heat Recovery Efficiency at -25.0 °C** 76%**Total Heat Recovery Efficiency in Cooling Mode** 25%**Low Temperature Ventilation Reduction:** 0%**Low Temperature Ventilation Reduction:** 0 L/s (0.0%)
Airflow Adjustment

Vented combustion appliance depressurization limit: 5.00 Pa.

Ventilation Supply Duct**Location:** Main floor**Length:** 1.5 m**Insulation:** 0.7 RSI**Type:** Flexible**Diameter:** 152.4 mm**Sealing Characteristics:** Sealed**Ventilation Exhaust Duct****Location:** Main floor**Length:** 1.5 m**Insulation:** 0.7 RSI**Type:** Flexible**Diameter:** 152.4 mm**Sealing Characteristics:** Sealed

SECONDARY FANS & OTHER EXHAUST APPLIANCES

	Control	Supply (L/s)	Exhaust (L/s)
Other Fans	Continuous	0.00	0.00
Dryer	Continuous	-	1.49

Dryer is vented outdoors**Rated Fan Power** 0.00 Watts**NEW ERS VENTILATION DATA****Whole House Systems****Air Distribution/circulation type:** Forced air heating ductwork**Air Distribution/circulation fan power:** 100.00 Watts

Operation schedule: 480.00 min/day

System # 1 Type: HRV/ERV

Manufacturer:

Model:

Airflow Supply Rate: 28.00 L/s **Exhaust:** 28.00 L/s **Fan Power:** 125.00 Watts
28.00 L/s

Supplementary Systems

System # 1 Type: Dryer

Manufacturer:

Model:

Airflow Supply Rate: 0.00 L/s **Exhaust:** 38.00 L/s **Fan Power:** 0.00 Watts
L/s

Operation schedule: 56.50 min/day

AIR LEAKAGE AND MECHANICAL VENTILATION SUMMARY

F326 Required continous ventilation: 50.000 L/s (0.26 ACH)

Central Ventilation Supply Rate (): 28.000 L/s (0.14 ACH)

Other Continuous Supply Flow Rates: 0.000 L/s (0.00 ACH)

Other Continuous Exhaust Flow Rates: 0.000 L/s (0.00 ACH)

Total house ventilation is Balanced

Gross Air Leakage and Mechanical Ventilation Energy Load: 5811.234 MJ

Seasonal Heat Recovery Ventilator Efficiency: 78.748 %

Estimated Ventilation Electrical Load: Heating Hours: 1068.891 MJ

Estimated Ventilation Electrical Load: Non-Heating Hours: 244.863 MJ

Net Air Leakage and Mechanical Ventilation Load: 4713.466 MJ

SPACE HEATING SYSTEM

PRIMARY Space Heating Fuel:	Electricity
Space Heating Equipment:	Air Source Heat Pump
Manufacturer:	
Model:	
Capacity at 8.3 °C:	7.0 kW
HSPF at 8.3 °C:	7.10
COP at 8.3 °C:	3.45
Crankcase Heater Power:	60.00 watts
Heat Pump Temperature Cut-Off:	Restricted Cut-off at -20.00 °C
SECONDARY Heating Fuel:	Natural Gas
Equipment:	Condensing furnace/boiler
Manufacturer:	
Model:	
Specified Output Capacity:	9.50 kW
AFUE:	96.00
Steady State Efficiency:	98.04
Fan Mode:	Auto
ECM Motor:	No
Low Speed Fan Power:	0 watts
High Speed Fan Power:	327 watts

AIR CONDITIONING SYSTEM

System Type:	Central split system		
Manufacturer:			
Model:			
Capacity:	3825 Watts		
SEER	14.00	Rated COP	3.038
Sensible Heat Ratio:	0.76		
Indoor Fan Flow Rate:	324.50 L/s	Fan Power (watts)	251.50
Ventilator Flow Rate:	0.00 L/s	Crankcase Heater Power (watts):	60.00
Fraction of windows Openable:	0.000	ECM Motor:	No
Cooling system capacity sizing factor:	1.000		
Economizer control:	N/A	Indoor Fan Operation:	Auto

Air Conditioner is integrated with the Heating System

DOMESTIC WATER HEATING SYSTEM

PRIMARY Water Heating Natural gas

Fuel:

Water Heating Equipment: Direct vent (sealed)

Energy Factor: 0.800

Manufacturer:

Model:

Tank Capacity: 189.3 Litres

Tank Blanket Insulation: 0.0 RSI

Tank Location: Basement

Pilot Energy : 0.0 MJ/day

Flue Diameter: 0.0 mm

Drain Water Heat Recovery **for Primary System**

Manufacturer: Power-Pipe

Model: R4-40

Shower Temperature: Warm 41°C (106°F)

Showers per day: 2.23

Length of showers: 6.50 minutes

Shower head type: Low Flow(6.5 L/min, 1.4 Igpm, 1.7 USgpm)

Configuration: Preheated cold water delivered to hot water heater only

Efficiency at 9.5 L/Min: 42.4%

Number of units N/A

connected to drain water heat recovery:

ANNUAL DOMESTIC WATER HEATING SUMMARY

Daily Hot Water Consumption: 190.0 Litres

Hot Water Temperature: 55.0 °C

Estimated Domestic Water Heating Load: 13234 MJ

Reduction in Hot Water load due to DWHR: 1237 MJ

Primary Domestic Water Heating Energy Consumption: 15444 MJ

Primary System Seasonal Efficiency: 77.7%

ANNUAL SPACE HEATING SUMMARY

Gross Space Heat Loss:	46638 MJ
Gross Space Heating Load:	43186 MJ
Usable Internal Gains:	17900 MJ
Usable Internal Gains Fraction:	38.4 %
Usable Solar Gains:	9348 MJ
Usable Solar Gains Fraction:	20.0 %
Auxiliary Energy Required:	15939 MJ
Space Heating System Load:	15939 MJ
Heat Pump and Furnace Annual COP:	2.075
Heat Pump Annual Energy Consumption:	6412 MJ
Furnace/Boiler Annual Energy Consumption:	201 MJ
Annual Space Heating Energy Consumption:	6614 MJ

DESIGN SPACE HEATING AND COOLING LOADS

Design Heat Loss* at -18.3 °C (7.28 Watts / m3):	5114 Watts
Design Cooling Load* for July at (31.5 °C):	3923 Watts

* Please refer to notes at the end of this report.

ANNUAL SPACE COOLING SUMMARY

Design Sensible Heat Ratio:	0.769
Estimated Annual Space Cooling Energy:	1806.09 kWh
Seasonal COP (May to October):	2.486

BASE LOADS SUMMARY

	kwh/day	Annual kWh
Interior Lighting	2.60	949.00
Appliances	6.30	2299.50
Other	9.70	3540.50
Exterior Use	0.90	328.50
HVAC Fans		
HRV/Exhaust	1.00	364.93

Space Heating	0.81	296.95
Space Cooling	0.90	329.70
Total Average Electrical Load	22.22	8109.08

FAN OPERATION SUMMARY (kWh)

Hours	HRV/Exhaust Fans	Space Heating	Space Cooling
Heating	296.9	297.0	0.0
Neither	29.1	0.0	0.0
Cooling	38.9	0.0	329.7
Total	364.9	297.0	

ENERGY CONSUMPTION SUMMARY REPORT

Estimated Annual Space Heating Energy Consumption	= 7682.66 MJ	= 2134.07 kWh
Ventilator Electrical Consumption: Heating Hours	= 1068.89 MJ	= 296.91 kWh
Estimated Annual DHW Heating Energy Consumption	= 15443.76 MJ	= 4289.93 kWh
ESTIMATED ANNUAL SPACE + DHW ENERGY CONSUMPTION	= 24195.31 MJ	= 6720.92 kWh
Estimated Greenhouse Gas Emissions	9.930 tonnes/year	

ESTIMATED ANNUAL FUEL CONSUMPTION SUMMARY

Fuel	Space Heating	Space Cooling	DHW Heating	Baseloads	Ventilation	Total
Natural Gas (m3)	5.4	0.0	414.5	0.0	0.0	419.9
Electricity (kWh)	2078.1	1806.1	0.0	7117.5	364.9	11366.6

ESTIMATED ANNUAL FUEL CONSUMPTION COSTS

Fuel Costs Library = Embedded

RATE	Electricity (Ottawa97)	Natural Gas (Ottawa97)	Oil (Ottawa97)	Propane (Ottawa97)	Wood (Sth Ont)	Total
\$	1007.04	191.53	0.00	0.00	0.00	1198.57

Fuel Costs Library Listing

Filename = Embedded

Record # 1	Fuel: Electricity		
Rate ID = Ottawa97	Hydro Rate Block		
Rate Block		Dollars	Charge
	kWhr	Per kWhr	(\$)
Minimum	0.0		10.000
1	250.0	0.0999	
2	99999.0	0.0702	
Record # 2	Fuel: Natural Gas		

Rate ID = Ottawa97	Gas Rate Block		
Rate Block		Dollars	Charge
	m3	Per m3	(\$)
Minimum	0.0		8.000
1	30.0	0.2285	
2	85.0	0.2215	
3	170.0	0.2171	
4	99999.0	0.2133	
Record # 3	Fuel: Oil		
Rate ID = Ottawa97	Oil Rate Block		
Rate Block		Dollars	Charge
	Litre	Per Litre	(\$)
Minimum	0.0		10.000
1	99999.0	0.4055	
Record # 4	Fuel: Propane		
Rate ID = Ottawa97	Propane Rate Block		
Rate Block		Dollars	Charge
	Litre	Per Litre	(\$)
Minimum	0.0		0.000
1	99999.0	0.4500	
Record # 5	Fuel: Wood		
Rate ID = Sth Ont	Cord Rate		
Rate Block		Dollars	Charge
	Cord	Per Cord	(\$)
Minimum	0.0		0.000
1	99999.0	210.0000	

MONTHLY ENERGY PROFILE

Month	Energy Load (MJ)	Internal Gains (MJ)	Solar Gains (MJ)	Aux. Energy (MJ)	HRV Eff. %
Jan	8092.6	2263.1	1302.0	4527.5	79.2
Feb	7150.5	2038.4	1586.0	3526.1	79.3
Mar	6338.7	2264.3	1915.8	2158.6	79.5
Apr	4113.9	2200.2	1404.8	508.9	79.7
May	1630.1	1370.7	259.4	0.0	76.3
Jun	430.6	429.5	1.1	0.0	80.1
Jul	0.0	0.0	0.0	0.0	71.9
Aug	0.0	0.0	0.0	0.0	72.9
Sep	642.1	630.1	12.0	0.0	80.0
Oct	3150.0	2188.1	883.3	78.6	79.7
Nov	4788.5	2233.4	967.3	1587.8	79.6
Dec	6849.3	2281.8	1016.2	3551.3	79.5
Ann	43186.4	17899.6	9347.9	15938.8	78.7

FOUNDATION ENERGY PROFILE

Month	Heat Loss (MJ)				Total
	Crawl Space	Slab	Basement	Walkout	
Jan	0.0	0.0	954.9	0.0	954.9
Feb	0.0	0.0	744.7	0.0	744.7
Mar	0.0	0.0	455.8	0.0	455.8
Apr	0.0	0.0	107.4	0.0	107.4
May	0.0	0.0	0.0	0.0	0.0
Jun	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	16.6	0.0	16.6
Nov	0.0	0.0	335.3	0.0	335.3
Dec	0.0	0.0	750.0	0.0	750.0
Ann	0.0	0.0	3364.7	0.0	3364.7

FOUNDATION TEMPERATURES & VENTILATION PROFILE

Month	Temperature (Deg °C)			Air Change Rate		Heat Loss (MJ)
	Crawl Space	Basement	Walkout	Natural	Total	

Jan	0.0	18.7	0.0	0.054	0.077	1019.8
Feb	0.0	18.6	0.0	0.053	0.076	882.1
Mar	0.0	18.4	0.0	0.046	0.069	682.4
Apr	0.0	18.6	0.0	0.036	0.060	327.1
May	0.0	19.5	0.0	0.023	0.047	74.3
Jun	0.0	20.9	0.0	0.017	0.040	-42.5
Jul	0.0	22.1	0.0	0.014	0.038	-88.5
Aug	0.0	21.8	0.0	0.014	0.037	-76.3
Sep	0.0	20.6	0.0	0.017	0.041	-10.0
Oct	0.0	19.2	0.0	0.029	0.053	201.3
Nov	0.0	18.9	0.0	0.038	0.062	434.3
Dec	0.0	18.8	0.0	0.048	0.072	775.1
Ann	0.0	19.7	0.0	0.032	0.056	4179.0

SPACE HEATING SYSTEM PERFORMANCE

Month	Space Heating Load (MJ)	Furnace Input (MJ)	Pilot Light (MJ)	Indoor Fans (MJ)	Heat Pump Input (MJ)	Total Input (MJ)	System Cop
Jan	4527.5	139.3	0.0	329.6	1826.2	2295.1	1.973
Feb	3526.1	38.7	0.0	253.5	1448.0	1740.1	2.026
Mar	2158.6	9.8	0.0	139.0	868.5	1017.2	2.122
Apr	508.9	1.0	0.0	26.7	218.0	245.6	2.072
May	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Jun	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Sep	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Oct	78.6	0.4	0.0	3.8	70.3	74.4	1.057
Nov	1587.8	3.4	0.0	86.9	589.9	680.1	2.334
Dec	3551.3	9.0	0.0	229.7	1391.3	1630.1	2.179
Ann	15938.8	201.5	0.0	1069.0	6412.2	7682.7	2.075

AIR CONDITIONING SYSTEM PERFORMANCE

Month	Sensible Load (MJ)	Latent Load (MJ)	AirCond Energy (kWh)	Fan Energy (kWh)	Ventilator Energy (kWh)	Crankcase Heater (kWh)	Total Energy (kWh)	COP	Av.RH %

May	1959.1	102.7	185.9	43.3	0.0	2.4	231.6	2.5	40.5
Jun	2968.1	277.8	293.8	65.8	0.0	0.0	359.7	2.5	42.7
Jul	3658.1	370.3	370.1	80.8	0.0	0.0	450.8	2.5	43.1
Aug	3324.0	365.5	336.7	74.3	0.0	0.0	411.0	2.5	43.4
Sep	2269.3	234.7	227.3	51.6	0.0	0.4	279.3	2.5	43.2
Oct	581.7	51.9	59.7	14.0	0.0	0.0	73.7	2.4	42.7
Ann	14760.4	1402.8	1473.5	329.7	0.0	2.9	1806.1	2.5	42.6

MONTHLY ESTIMATED ENERGY CONSUMPTION BY DEVICE (MJ)

	Space Heating		DHW Heating		Lights &	HRV &	Air
Month	Primary	Secondary	Primary	Secondary	Appliances	FANS	Conditioner
Jan	1826.2	139.3	1418.1	0.0	2176.2	441.1	0.0
Feb	1448.0	38.7	1296.1	0.0	1965.6	354.3	0.0
Mar	868.5	9.8	1419.4	0.0	2176.2	250.6	0.0
Apr	218.0	1.0	1330.3	0.0	2106.0	134.7	0.0
May	0.0	0.0	1312.0	0.0	2176.2	267.3	678.0
Jun	0.0	0.0	1210.8	0.0	2106.0	344.9	1058.0
Jul	0.0	0.0	1206.3	0.0	2176.2	402.4	1332.2
Aug	0.0	0.0	1189.9	0.0	2176.2	378.9	1212.2
Sep	0.0	0.0	1167.4	0.0	2106.0	293.6	819.8
Oct	70.3	0.4	1249.9	0.0	2176.2	165.7	214.8
Nov	589.9	3.4	1270.2	0.0	2106.0	194.8	0.0
Dec	1391.3	9.0	1373.5	0.0	2176.2	341.3	0.0
Ann	6412.2	201.5	15443.8	0.0	25623.0	3569.7	5315.0

ESTIMATED FUEL COSTS (Dollars)

Month	Electricity	Natural Gas	Oil	Propane	Wood	Total
Jan	104.07	17.47	0.00	0.00	0.00	121.54
Feb	90.90	16.14	0.00	0.00	0.00	107.04
Mar	81.68	16.71	0.00	0.00	0.00	98.39
Apr	65.37	16.12	0.00	0.00	0.00	81.49
May	78.30	16.01	0.00	0.00	0.00	94.30
Jun	85.85	15.41	0.00	0.00	0.00	101.26
Jul	93.69	15.38	0.00	0.00	0.00	109.07
Aug	90.89	15.28	0.00	0.00	0.00	106.17
Sep	80.20	15.15	0.00	0.00	0.00	95.35
Oct	68.65	15.64	0.00	0.00	0.00	84.29

Nov	73.79	15.78	0.00	0.00	0.00	89.58
Dec	93.65	16.43	0.00	0.00	0.00	110.08
Ann	1007.04	191.53	0.00	0.00	0.00	1198.57

The calculated heat losses and energy consumptions are only estimates, based upon the data entered and assumptions within the program. Actual energy consumption and heat losses will be influenced by construction practices, localized weather, equipment characteristics and the lifestyle of the occupants.

HOT2000

Natural Resources CANADA
Version 11.13



File: Elfrida_Scenario 3B.h2k
House

Weather Library: C:\HOT2000 v11.13b13\Dat\Wth2020.dir
Weather Data for: TORONTO INTL, ONTARIO

Builder Code:

Data Entry by: Si Jia Wang
Date of entry: 2026-03-10

Company: buildABILITY

Client name: ,

Street address:

City:

Region: ONTARIO

Postal code:

Telephone:

Mailing address:

City:

Region: ONTARIO

Postal Code:

GENERAL HOUSE CHARACTERISTICS

House type: Single Detached

Number of storeys: Two storeys

Plan shape:

Front orientation: North

Year House Built: 2025

Wall colour: Default

Absorptivity: 0.40

Roof colour: Default

Absorptivity: 0.40

Soil Condition: Normal conductivity (dry sand, loam, clay)

Water Table Level: Normal (7-10m/23-33ft)

House Thermal Mass Level: (A) Light, wood frame

Effective mass fraction 1.000

Occupants :
2 Adults for 50.0% of the time
1 Children for 50.0% of the time
0 Infants for 0.0% of the time

Sensible Internal Heat Gain 2.00 kWh/day
From Occupants:

HOUSE TEMPERATURES

Heating Temperatures

Main Floor	Daytime Setpoint:	21.0 °C
	Nighttime Setpoint:	18.0 °C
	Nighttime Setback Duration:	8.0 Hours
	24 Hour Average:	20.0 °C
Basement	Setpoint:	19.0 °C
	TEMP. Rise from 20.0 °C:	5.5 °C
Cooling Temperature: Main Floor : 25.00 °C		
Basement is- Heated:Yes Cooled: No		Separate T/S: No
Fraction of internal gains released in basement :		0.150
Indoor design temperatures for equipment sizing		
Heating:		22.0 °C
Cooling:		24.0 °C

WINDOW CHARACTERISTICS

Label	Location	#	Overhang Width (m)	Header Height (m)	Tilt deg	Curtain Factor	Shutter (RSI)
South							
South	Main Floor	1	0.00	0.00	90.0	1.00	0.00
South	Top Floor	1	0.00	0.00	90.0	1.00	0.00
South	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
Southeast							
Southeast	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Southeast	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Southeast	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
East							
East	Main Floor	1	0.00	0.00	90.0	1.00	0.00
East	Top Floor	1	0.00	0.00	90.0	1.00	0.00
East	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
Northeast							
Northeast	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Northeast	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Northeast	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
North							
North	Top Floor	1	0.00	0.00	90.0	1.00	0.00
North	Main Floor	1	0.00	0.00	90.0	1.00	0.00

North	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
Northwest							
Northwest	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Northwest	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Northwest	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
West							
West	Top Floor	1	0.00	0.00	90.0	1.00	0.00
West	Main Floor	1	0.00	0.00	90.0	1.00	0.00
West	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00
Southwest							
Southwest	Main Floor	1	0.00	0.00	90.0	1.00	0.00
Southwest	Top Floor	1	0.00	0.00	90.0	1.00	0.00
Southwest	Foundation - 1	1	0.00	0.00	90.0	1.00	0.00

Label	Type	#	Window Width (m)	Window Height (m)	Total Area (m²)	Window RSI	SHGC	ER*
South								
South	TG-U1.02	1	1.47	1.47	2.16	0.976	0.3013	33.3
South	SliderU1.6SHGC0.30F15	1	1.47	1.47	2.16	0.627	0.3012	20.8
South	TG-U1.02	1	0.95	0.95	0.90	0.999	0.2944	31.0
Southeast								
Southeast	SliderU1.6SHGC0.30F15	1	0.76	0.76	0.57	0.598	0.2865	13.5
Southeast	TG-U1.02	1	0.76	0.76	0.57	1.015	0.2896	28.7
Southeast	TG-U1.02	1	0.32	0.32	0.10	1.112	0.2572	-1.5
East								
East	TG-U1.02	1	1.58	1.58	2.50	0.973	0.3022	33.5
East	SliderU1.6SHGC0.30F15	1	1.58	1.58	2.50	0.630	0.3023	21.2
East	TG-U1.02	1	0.89	0.89	0.80	1.003	0.2933	30.5
Northeast								
Northeast	SliderU1.6SHGC0.30F15	1	0.99	0.99	0.99	0.611	0.2937	17.4
Northeast	TG-U1.02	1	0.99	0.99	0.99	0.996	0.2953	31.4
Northeast	TG-U1.02	1	0.45	0.45	0.20	1.066	0.2732	16.9
North								
North	SliderU1.6SHGC0.30F15	1	1.52	1.52	2.30	0.628	0.3017	21.0
North	TG-U1.02	1	1.52	1.52	2.30	0.975	0.3017	33.4
North	TG-U1.02	1	0.95	0.95	0.90	0.999	0.2944	31.0
Northwest								
Northwest	TG-U1.02	1	0.76	0.76	0.57	1.015	0.2896	28.8
Northwest	SliderU1.6SHGC0.30F15	1	0.76	0.76	0.57	0.598	0.2866	13.6
Northwest	TG-U1.02	1	0.32	0.32	0.10	1.112	0.2572	-1.5
West								

West	SliderU1.6SHGC0.30F15	1	1.57	1.57	2.46	0.629	0.3022	21.2
West	TG-U1.02	1	1.57	1.57	2.46	0.973	0.3021	33.5
West	TG-U1.02	1	0.95	0.95	0.90	0.999	0.2944	31.0
Southwest								
Southwest	TG-U1.02	1	0.96	0.96	0.91	0.998	0.2946	31.1
Southwest	SliderU1.6SHGC0.30F15	1	0.96	0.96	0.91	0.610	0.2928	17.0
Southwest	TG-U1.02	1	0.45	0.45	0.20	1.066	0.2732	16.9

*ER Window Energy Rating (ER 2009) estimated for actual dimensions, and Air tightness type: CSA - A1; Leakage rate = 1.86 L/s.m²

Above grade fraction of wall area occupied by windows: 13.3 %

***** TYPE 2 USER DEFINED WINDOW CODES *****

Code Label	Description	Glazing Type	Fill Gas	Thermal Resistance	SHGC	Window Style	Low -E Coating	Frame Height
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
TG_U1.02		Triple/triple with 1 coat	Argon	1.0200 W/m2-C	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15		Double/double with 1 coat	Argon	1.6000 W/m2-C	0.3000	Single Slider	Soft Coat	15.00

TG_U1.02	with 1 coat Triple/triple with 1 coat	Argon	W/m2-C 1.0200	0.3000	Slider Picture	Coat Soft Coat	15.00
SliderU1.6SHGC0.30F15	Double/double with 1 coat	Argon	W/m2-C 1.6000	0.3000	Single Slider	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	W/m2-C 1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	W/m2-C 1.0200	0.3000	Picture	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	W/m2-C 1.0200	0.3000	Picture	Soft Coat	15.00
SliderU1.6SHGC0.30F15	Double/double with 1 coat	Argon	W/m2-C 1.6000	0.3000	Single Slider	Soft Coat	15.00
TG_U1.02	Triple/triple with 1 coat	Argon	W/m2-C 1.0200	0.3000	Picture	Soft Coat	15.00

BUILDING PARAMETER DETAILS

CEILING COMPONENTS

	Construction Type	Code Type	Roof Slope	Heel Ht. (m)	Section Area (m ²)	R. Value (RSI)
Ceiling - 1	Attic/gable	R60 blown cellulose	6.000/12	0.14	113.00	10.15

MAIN WALL COMPONENTS

Label	Lintel Type	Fac. Dir	Number of Corn.	Number of Inter.	Height (m)	Perim. (m)	Area (m ²)	R. Value (RSI)
Main Floor Type: 24+10ci	100	N/A	4	4	2.44	35.88	87.55	4.94
Top Floor Type: 24+10ci	100	N/A	4	4	2.44	35.88	87.55	5.08
Floor Header - 1 Type: header r22+5ci		N/A	4	4	0.25	40.58	10.15	5.07

WALL CODE SCHEDULE

Name	Internal Code	Description (Structure, typ/size, Spacing, Insull, 2, Int., Sheathing, Exterior, Studs)
24+10ci	1211ZI1240	Wood frame, 38x140 mm (2x6 in), 400 mm (16 in), RSI 4.23 @ 140 mm (R 24 @ 5.5") batt, 51 mm (2 in) XTPS IV, 12 mm (0.5 in) gypsum board, Waferboard/OSB 11.1 mm (7/16 in), Brick, 2 studs
header r22+5ci	18004B0040	Floor header, N/A, N/A, RSI 3.87 @ 140 mm (R 22 @ 5.5") batt, 25 mm (1 in) XTPS IV, N/A, None, Brick, N/A

EXPOSED FLOORS

Label	Floor Code Type	Area (m ²)	R. Value (RSI)
Exposed Floor	R31+5 ci	16.20	6.40

EXPOSED FLOOR SCHEDULE

Name	Internal Code	Description (Structure, typ/size, Spacing, Insull, 2, Int., Sheathing, Exterior, Studs)
R31+5 ci	3231LB8210	Wood frame, 38x235 mm (2x10 in), 400 mm (16 in), RSI 5.46 @ 241 mm (R 31 @ 9.5") batt, 25 mm (1 in) XTPS IV, Carpet & underpad, Waferboard/OSB 11.1 mm (7/16 in), Wood (lapped), No

DOORS

Label	Type	Height (m)	Width (m)	Gross Area (m ²)	R. Value (RSI)
Door - 1 Loc: Main Floor	Steel polystyrene core	2.07	0.81	1.68	0.10
Door - 2 Loc: Main Floor	Steel polystyrene core	2.07	0.81	1.68	0.10
Door - 3 Loc: Main Floor	Steel polystyrene core	2.07	0.81	1.68	0.10

USER-DEFINED STRUCTURE CODES SCHEDULE

Name	Description
21R60 blown cellulose	

FOUNDATIONS

Foundation Name:	Foundation - 1	Volume:	307.7 m ³
Foundation Type:	Basement	Opening to Main Floor:	1.56 m ²
Data Type:	Library		
Total Wall Height:	2.80 m	Non-Rectangular	
Depth Below Grade:	2.28 m	Floor Perimeter:	45.00 m
		Floor Area:	109.90 m ²
Interior wall type:	R20	R-value:	3.52 RSI
Exterior wall type:	User specified	R-Value:	1.76 RSI
Number of corners :	4		
Lintel type:	LL00000000000000000000000000000000		
Added to slab type :	N/A	R-Value:	1.76 RSI
Floors Above Found.:	common	R-Value:	0.82 RSI

Exposed areas for: Foundation - 1
Exposed Perimeter: 45.00 m

Configuration: BCCB_4
 - concrete walls and floor
 - interior surface of wall insulated over full-height
 - exterior surface of wall insulated over full-height
 - sub-surface of floor slab fully insulated but no insulation under footings
 - thermal-break between walls and floor slab
 - any first storey construction type

FOUNDATION CODE SCHEDULE

Floors Above Foundation

Name	Internal Code	Description (Structure, typ/size, Spacing, Insul1, 2, Int., Sheathing, Exterior, Drop Framing)
common	4231006310	Wood frame, 38x235 mm (2x10 in), 400 mm (16 in), None, None, Wood, Waferboard/OSB 15.9 mm (5/8 in), 12 mm (0.5 in) Gypsum board, No

FOUNDATION FLOOR HEADER COMPONENTS

Label	Lintel Type	Fac. Dir	Number of Corn.	Number of Inter.	Height (m)	Perim. (m)	Area (m ²)	R. Value (RSI)
Floor Header - 1 (Location:Foundation - 1) Type: header r22+5ci	N/A	N/A	4	4	0.25	37.59	9.40	5.07

Foundation Floor Header Code Schedule

Name	Internal Code	Description (Structure, typ/size, Spacing, Insul1, 2, Int., Sheathing, Exterior, Studs)
header r22+5ci	18004B0040	Floor header, N/A, N/A, RSI 3.87 @ 140 mm (R 22 @ 5.5") batt, 25 mm (1 in) XTPS IV, None, None, Tile-linoleum, No

Lintel Code Schedule

Name	Code	Description (Type, Material, Insulation)
100	100	Double, Wood, None

ROOF CAVITY INPUTS

Gable Ends		Total Area:	18.83 m ²
Sheathing Material	Plywood/Part. bd 9.5 mm (3/8 in)		0.08 RSI
Exterior Material:	Hollow metal/vinyl cladding		0.11 RSI
Sloped Roof		Total Area:	126.34 m ²
Sheathing Material	Plywood/Part. bd 12.7 mm (1/2 in)		0.11 RSI
Exterior Material:	Asphalt shingles		0.08 RSI
Total Cavity Volume:	122.6 m ³	Ventilation Rate:	0.50 ACH/hr

BUILDING ASSEMBLY DETAILS

Label	Construction Code	Nominal (RSI)	System (RSI)	Effective (RSI)
CEILING COMPONENTS				
Ceiling - 1	R60 blown cellulose	0.00	0.00	10.15
MAIN WALL COMPONENTS				
Main Floor	24+10ci	0.00	0.00	4.94
Top Floor	24+10ci	0.00	0.00	5.08
Floor Header - 1	header r22+5ci	0.00	0.00	5.07
EXPOSED FLOORS				
Exposed Floor	R31+5 ci	0.00	0.00	6.40
FLOORS ABOVE BASEMENTS				
Foundation - 1	common	0.00	0.00	0.82

BUILDING PARAMETERS SUMMARY
ZONE 1 : Above Grade

Component	Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ	% Annual Heat Loss
Ceiling	113.00	113.00	10.15	3156.78	6.68
Main Walls	185.24	155.28	5.02	10327.65	21.86
Doors	5.03	5.03	0.98	1886.03	3.99
Exposed floors	16.20	16.20	6.40	863.11	1.83
South Windows	4.31	4.31	0.76	2074.17	4.39
Southeast Windows	1.15	1.15	0.75	559.67	1.18
East Windows	5.00	5.00	0.76	2402.77	5.09
Northeast Windows	1.97	1.97	0.76	956.55	2.03
North Windows	4.60	4.60	0.76	2213.70	4.69
Northwest Windows	1.15	1.15	0.75	561.13	1.19
West Windows	4.92	4.92	0.76	2366.73	5.01
Southwest Windows	1.83	1.83	0.76	887.37	1.88
ZONE 1 Totals:				28255.68	59.82

INTER-ZONE Heat Transfer : Floors Above Basement

Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ
109.90	109.90	0.817	6329.57

ZONE 2 : Basement

Component	Area m ² Gross	Area m ² Net	Effective (RSI)	Heat Loss MJ	% Annual Heat Loss
Walls above grade	23.40	19.30	-	1914.87	4.05
South windows	0.90	0.90	1.00	302.25	0.64
Southeast windows	0.10	0.10	1.11	30.10	0.06

East windows	0.80	0.80	1.00	267.19	0.57
Northeast windows	0.20	0.20	1.07	62.81	0.13
North windows	0.90	0.90	1.00	302.25	0.64
Northwest windows	0.10	0.10	1.11	30.10	0.06
West windows	0.90	0.90	1.00	302.25	0.64
Southwest windows	0.20	0.20	1.07	62.81	0.13
Basement floor header	9.40	9.40	5.07	993.34	2.10
Below grade foundation	212.50	212.50	-	10529.64	22.29
ZONE 2 Totals:				14797.63	31.33

Air Leakage and Mechanical Ventilation

House Volume	Air Change	Heat Loss MJ	% Annual Heat Loss
702.00 m ³	0.056 ACH	4181.246	8.85

AIR LEAKAGE AND MECHANICAL VENTILATION

Building Envelope Surface Area: 559.74 m²

Air Leakage Test Results at 50 Pa.(0.2 1.00 ACH
in H₂O) =

Equivalent Leakage Area @ 10 Pa = 262.13 cm²

Terrain Description

@ Weather Station :	Open flat terrain, grass	Anemometer:	Height (m) 10.0
@ Building site :	Suburban, forest	Height of the highest ceiling:	5.5

Local Shielding:

Walls:	Heavy
Flue :	Light

Leakage Fractions-

Ceiling:	0.200
Walls:	0.650
Floors:	0.150

Normalized Leakage Area @ 10 Pa: 0.4683 cm²/m²

Estimated Airflow to cause a 5 Pa
Pressure Difference: 42 L/s

Estimated Airflow to cause a 10 Pa
Pressure Difference: 66 L/s

F326 VENTILATION REQUIREMENTS

Kitchen, Living Room, Dining Room	3 rooms @ 5.0 L/s: 15.0 L/s
Utility Room	1 rooms @ 5.0 L/s: 5.0 L/s
Bedroom	1 rooms @ 10.0 L/s: 10.0 L/s
Bedroom	1 rooms @ 5.0 L/s: 5.0 L/s
Bathroom	1 rooms @ 5.0 L/s: 5.0 L/s
Basement Rooms	10.0 L/s

CENTRAL VENTILATION SYSTEM

System Type: HRV
 Manufacturer:
 Model Number:

Fan and Preheater Power at 0.0 °C: 125 Watts
 Fan and Preheater Power at -25.0 °C: 125 Watts
 Preheater Capacity: 0 Watts
 Sensible Heat Recovery Efficiency at 0.0 °C 81%

Sensible Heat Recovery Efficiency at -25.0 °C 75%
Total Heat Recovery Efficiency in Cooling Mode 25%

Low Temperature Ventilation Reduction: 0%
Low Temperature Ventilation Reduction: 0 L/s (0.0%)
Airflow Adjustment

Vented combustion appliance depressurization limit: 5.00 Pa.

Ventilation Supply Duct

Location:	Main floor	Type:	Flexible
Length:	1.5 m	Diameter:	152.4 mm
Insulation:	0.7 RSI	Sealing Characteristics:	Sealed

Ventilation Exhaust Duct

Location:	Main floor	Type:	Flexible
Length:	1.5 m	Diameter:	152.4 mm
Insulation:	0.7 RSI	Sealing Characteristics:	Sealed

SECONDARY FANS & OTHER EXHAUST APPLIANCES

	Control	Supply (L/s)	Exhaust (L/s)
Other Fans	Continuous	0.00	0.00
Dryer	Continuous	-	1.49

Dryer is vented outdoors

Rated Fan Power 0.00 Watts

NEW ERS VENTILATION DATA

Whole House Systems

Air Distribution/circulation type: Forced air heating ductwork
Air Distribution/circulation fan power: 100.00 Watts
Operation schedule: 480.00 min/day

System # 1 Type: HRV/ERV
Manufacturer:
Model:
Airflow Supply Rate: 28.00 L/s **Exhaust:** 28.00 L/s **Fan Power:** 125.00 Watts

Supplementary Systems

System # 1 Type: Dryer
Manufacturer:
Model:
Airflow Supply Rate: 0.00 L/s **Exhaust:** 38.00 L/s **Fan Power:** 0.00 Watts
Operation schedule: 56.50 min/day

AIR LEAKAGE AND MECHANICAL VENTILATION SUMMARY

F326 Required continuous ventilation: 50.000 L/s (0.26 ACH)
Central Ventilation Supply Rate (): 28.000 L/s (0.14 ACH)
Other Continuous Supply Flow Rates: 0.000 L/s (0.00 ACH)
Other Continuous Exhaust Flow Rates: 0.000 L/s (0.00 ACH)
Total house ventilation is Balanced
Gross Air Leakage and Mechanical Ventilation Energy Load: 5814.335 MJ
Seasonal Heat Recovery Ventilator Efficiency: 78.738 %
Estimated Ventilation Electrical Load: 1068.891 MJ
Heating Hours:
Estimated Ventilation Electrical Load: Non-Heating Hours: 244.863 MJ
Net Air Leakage and Mechanical Ventilation Load: 4715.691 MJ

SPACE HEATING SYSTEM

PRIMARY Space Heating Fuel:	Electricity
Space Heating Equipment:	Air Source Heat Pump
Manufacturer:	
Model:	
Capacity at 8.3 °C:	7.0 kW
HSPF at 8.3 °C:	7.10
COP at 8.3 °C:	3.45
Crankcase Heater Power:	60.00 watts
Heat Pump Temperature Cut-Off:	Restricted Cut-off at -20.00 °C
SECONDARY Heating Fuel:	Electricity
Equipment:	Electric furnace
Manufacturer:	
Model:	
Specified Output Capacity:	9.50 kW
Steady State Efficiency:	100.00 %
Fan Mode:	Auto
ECM Motor:	No
Low Speed Fan Power:	0 watts
High Speed Fan Power:	327 watts

AIR CONDITIONING SYSTEM

System Type:	Central split system		
Manufacturer:			
Model:			
Capacity:	3900 Watts		
SEER	14.00	Rated COP	3.038
Sensible Heat Ratio:	0.76		
Indoor Fan Flow Rate:	324.50 L/s	Fan Power (watts)	251.50
Ventilator Flow Rate:	0.00 L/s	Crankcase Heater Power (watts):	60.00
Fraction of windows Openable:	0.000	ECM Motor:	No
Cooling system capacity sizing factor:	1.000		
Economizer control:	N/A	Indoor Fan Operation:	Auto

Air Conditioner is integrated with the Heating System

DOMESTIC WATER HEATING SYSTEM

PRIMARY Water Heating Electricity

Fuel:
Water Heating Equipment: Heat pump
Energy Factor: 1.901
Manufacturer:
Model:
Drain Water Heat Recovery for Primary System
Manufacturer: Power-Pipe
Model: R4-40
Shower Temperature: Warm 41°C (106°F)
Showers per day: 2.23
Length of showers: 6.50 minutes
Shower head type: Low Flow(6.5 L/min, 1.4 lgpm, 1.7 USgpm)
Configuration: Preheated cold water delivered to hot water heater only
Efficiency at 9.5 L/Min: 42.4%
Number of units connected to drain water heat recovery: N/A

ANNUAL DOMESTIC WATER HEATING SUMMARY

Daily Hot Water Consumption: 190.0 Litres
Hot Water Temperature: 55.0 °C
Estimated Domestic Water Heating Load: 13234 MJ

Reduction in Hot Water load due to DWHR: 1237 MJ
Primary Domestic Water Heating Energy Consumption: 11998 MJ
Primary System Seasonal Efficiency: 100.0%

ANNUAL SPACE HEATING SUMMARY

Gross Space Heat Loss: 47235 MJ

Gross Space Heating Load: 44362 MJ
Usable Internal Gains: 17593 MJ
Usable Internal Gains Fraction: 37.2 %
Usable Solar Gains: 9626 MJ
Usable Solar Gains Fraction: 20.4 %
Auxiliary Energy Required: 17143 MJ

Space Heating System Load: 17143 MJ
Heat Pump and Furnace Annual COP: 2.088
Heat Pump Annual Energy Consumption: 6847 MJ
Furnace/Boiler Annual Energy Consumption: 220 MJ
Annual Space Heating Energy Consumption: 7067 MJ

DESIGN SPACE HEATING AND COOLING LOADS

Design Heat Loss* at -18.3 °C (7.48 Watts / m3): 5248 Watts

Design Cooling Load* for July at (31.5 °C): 3980 Watts

* Please refer to notes at the end of this report.

ANNUAL SPACE COOLING SUMMARY

Design Sensible Heat Ratio: 0.769
 Estimated Annual Space Cooling Energy: 1729.71 kWh
 Seasonal COP (May to October): 2.480

BASE LOADS SUMMARY

	kwh/day	Annual kWh
Interior Lighting	2.60	949.00
Appliances	6.30	2299.50
Other	9.70	3540.50
Exterior Use	0.90	328.50
HVAC Fans		
HRV/Exhaust	1.00	364.93
Space Heating	0.87	318.12
Space Cooling	0.85	310.62
Total Average Electrical Load	22.22	8111.17

FAN OPERATION SUMMARY (kWh)

Hours	HRV/Exhaust Fans	Space Heating	Space Cooling
Heating	296.9	318.1	0.0
Neither	29.1	0.0	0.0
Cooling	38.9	0.0	310.6
Total	364.9	318.1	

ENERGY CONSUMPTION SUMMARY REPORT

Estimated Annual Space Heating Energy Consumption	= 8212.24 MJ	= 2281.18 kWh
Ventilator Electrical Consumption: Heating Hours	= 1068.89 MJ	= 296.91 kWh
Estimated Annual DHW Heating Energy Consumption	= 11998.34 MJ	= 3332.87 kWh
ESTIMATED ANNUAL SPACE + DHW ENERGY CONSUMPTION	= 21279.46 MJ	= 5910.96 kWh
Estimated Greenhouse Gas Emissions	11.891 tonnes/year	

ESTIMATED ANNUAL FUEL CONSUMPTION SUMMARY

Fuel	Space Heating	Space Cooling	DHW Heating	Baseloads	Ventilation	Total
Electricity (kWh)	2281.2	1729.7	3332.9	7117.5	364.9	14826.2

ESTIMATED ANNUAL FUEL CONSUMPTION COSTS

Fuel Costs Library = Embedded

RATE	Electricity (Ottawa97)	Natural Gas (Ottawa97)	Oil (Ottawa97)	Propane (Ottawa97)	Wood (Sth Ont)	Total
\$	1249.90	0.00	0.00	0.00	0.00	1249.90

Fuel Costs Library Listing

Filename = Embedded

Record # 1	Fuel: Electricity		
Rate ID = Ottawa97	Hydro Rate Block		
Rate Block		Dollars	Charge
	kWhr	Per kWhr	(\$)
Minimum	0.0		10.000
1	250.0	0.0999	
2	99999.0	0.0702	
Record # 2	Fuel: Natural Gas		
Rate ID = Ottawa97	Gas Rate Block		
Rate Block		Dollars	Charge
	m3	Per m3	(\$)
Minimum	0.0		8.000

1	30.0	0.2285
2	85.0	0.2215
3	170.0	0.2171
4	99999.0	0.2133

Record # 3

Fuel: Oil

Rate ID = Ottawa97

Oil Rate Block

Rate Block		Dollars	Charge
	Litre	Per Litre	(\$)
Minimum	0.0		10.000
1	99999.0	0.4055	

Record # 4

Fuel: Propane

Rate ID = Ottawa97

Propane Rate Block

Rate Block		Dollars	Charge
	Litre	Per Litre	(\$)
Minimum	0.0		0.000
1	99999.0	0.4500	

Record # 5

Fuel: Wood

Rate ID = Sth Ont

Cord Rate

Rate Block		Dollars	Charge
	Cord	Per Cord	(\$)
Minimum	0.0		0.000
1	99999.0	210.0000	

MONTHLY ENERGY PROFILE

Month	Energy Load (MJ)	Internal Gains (MJ)	Solar Gains (MJ)	Aux. Energy (MJ)	HRV Eff. %
Jan	8186.3	2129.1	1304.9	4752.3	79.2
Feb	7244.5	1916.8	1596.6	3731.2	79.3
Mar	6423.0	2129.2	1945.3	2348.6	79.5
Apr	4173.7	2076.8	1461.6	635.3	79.7
May	1790.8	1454.1	336.7	0.0	76.3
Jun	576.5	569.1	7.4	0.0	80.1
Jul	85.2	85.2	0.0	0.0	71.9
Aug	126.9	126.9	0.0	0.0	72.9
Sep	781.9	755.7	26.2	0.0	80.0
Oct	3211.1	2097.4	955.9	157.8	79.7
Nov	4843.9	2104.5	974.1	1765.3	79.6
Dec	6917.8	2148.3	1017.1	3752.5	79.5
Ann	44361.7	17592.9	9625.8	17143.0	78.7

FOUNDATION ENERGY PROFILE

Month	Heat Loss (MJ)				Total
	Crawl Space	Slab	Basement	Walkout	
Jan	0.0	0.0	776.8	0.0	776.8
Feb	0.0	0.0	609.4	0.0	609.4
Mar	0.0	0.0	383.4	0.0	383.4
Apr	0.0	0.0	103.8	0.0	103.8
May	0.0	0.0	0.0	0.0	0.0
Jun	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0
Oct	0.0	0.0	25.8	0.0	25.8
Nov	0.0	0.0	288.3	0.0	288.3
Dec	0.0	0.0	612.9	0.0	612.9
Ann	0.0	0.0	2800.3	0.0	2800.3

FOUNDATION TEMPERATURES & VENTILATION PROFILE

Month	Temperature (Deg °C)			Air Change Rate		Heat Loss (MJ)
	Crawl Space	Basement	Walkout	Natural	Total	
Jan	0.0	18.9	0.0	0.054	0.077	1020.7
Feb	0.0	18.8	0.0	0.053	0.076	882.8
Mar	0.0	18.6	0.0	0.046	0.069	682.8

Apr	0.0	18.7	0.0	0.036	0.060	327.2
May	0.0	19.5	0.0	0.023	0.047	74.3
Jun	0.0	20.7	0.0	0.017	0.040	-42.6
Jul	0.0	21.9	0.0	0.014	0.038	-88.7
Aug	0.0	21.6	0.0	0.014	0.037	-76.5
Sep	0.0	20.5	0.0	0.017	0.041	-10.1
Oct	0.0	19.3	0.0	0.029	0.053	201.3
Nov	0.0	19.0	0.0	0.038	0.062	434.5
Dec	0.0	19.0	0.0	0.048	0.072	775.5
Ann	0.0	19.7	0.0	0.032	0.056	4181.2

SPACE HEATING SYSTEM PERFORMANCE

Month	Space Heating Load (kWh)	Furnace Input (kWh)	Pilot Light (kWh)	Indoor Fans (kWh)	Heat Pump Input (kWh)	Total Input (kWh)	System Cop
Jan	1320.1	42.3	0.0	95.9	528.8	667.1	1.979
Feb	1036.4	11.7	0.0	74.5	423.5	509.7	2.033
Mar	652.4	2.9	0.0	42.0	261.0	305.9	2.133
Apr	176.5	0.3	0.0	9.2	73.1	82.6	2.136
May	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Jun	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Sep	0.0	0.0	0.0	0.0	0.0	0.0	0.000
Oct	43.8	0.2	0.0	2.1	27.1	29.4	1.491
Nov	490.4	1.0	0.0	26.8	181.3	209.1	2.345
Dec	1042.4	2.6	0.0	67.5	407.2	477.4	2.184
Ann	4762.0	61.1	0.0	318.1	1902.0	2281.2	2.088

AIR CONDITIONING SYSTEM PERFORMANCE

Month	Sensible Load (MJ)	Latent Load (MJ)	AirCond Energy (kWh)	Fan Energy (kWh)	Ventilator Energy (kWh)	Crankcase Heater (kWh)	Total Energy (kWh)	COP	Av.RH %
May	1766.2	100.6	169.6	38.7	0.0	4.3	212.6	2.4	40.8
Jun	2856.3	275.6	284.8	62.7	0.0	0.2	347.7	2.5	42.8
Jul	3603.0	370.2	366.0	78.7	0.0	0.0	444.6	2.5	43.1
Aug	3248.8	364.7	330.8	71.8	0.0	0.0	402.7	2.5	43.5
Sep	2125.7	230.1	215.0	47.9	0.0	1.5	264.4	2.5	43.4
Oct	451.6	47.6	47.0	10.8	0.0	0.0	57.7	2.4	43.5
Ann	14051.7	1388.8	1413.1	310.6	0.0	6.0	1729.7	2.5	42.8

MONTHLY ESTIMATED ENERGY CONSUMPTION BY DEVICE (MJ)

Month	Space Heating		DHW Heating		Lights &	HRV &	Air
	Primary	Secondary	Primary	Secondary	Appliances	FANS	Conditioner
Jan	1903.8	152.2	1113.1	0.0	2176.2	456.9	0.0
Feb	1524.5	42.2	1018.3	0.0	1965.6	369.0	0.0
Mar	939.7	10.4	1113.1	0.0	2176.2	262.8	0.0
Apr	263.0	1.2	1039.2	0.0	2106.0	141.2	0.0
May	0.0	0.0	1020.0	0.0	2176.2	251.0	625.9
Jun	0.0	0.0	934.7	0.0	2106.0	333.8	1025.8
Jul	0.0	0.0	926.0	0.0	2176.2	394.7	1317.5
Aug	0.0	0.0	911.3	0.0	2176.2	370.2	1191.0
Sep	0.0	0.0	896.1	0.0	2106.0	280.5	779.4
Oct	97.5	0.7	965.8	0.0	2176.2	157.9	169.1
Nov	652.7	3.7	987.1	0.0	2106.0	204.5	0.0
Dec	1465.9	9.5	1073.8	0.0	2176.2	354.7	0.0
Ann	6847.1	219.9	11998.3	0.0	25623.0	3577.2	5108.7

ESTIMATED FUEL COSTS (Dollars)

Month	Electricity	Natural Gas	Oil	Propane	Wood	Total
Jan	130.57	0.00	0.00	0.00	0.00	130.57
Feb	113.36	0.00	0.00	0.00	0.00	113.36
Mar	105.22	0.00	0.00	0.00	0.00	105.22
Apr	86.66	0.00	0.00	0.00	0.00	86.66
May	96.85	0.00	0.00	0.00	0.00	96.85
Jun	103.23	0.00	0.00	0.00	0.00	103.23
Jul	111.31	0.00	0.00	0.00	0.00	111.31
Aug	108.07	0.00	0.00	0.00	0.00	108.07
Sep	96.63	0.00	0.00	0.00	0.00	96.63
Oct	86.99	0.00	0.00	0.00	0.00	86.99
Nov	94.53	0.00	0.00	0.00	0.00	94.53
Dec	116.49	0.00	0.00	0.00	0.00	116.49
Ann	1249.90	0.00	0.00	0.00	0.00	1249.90

The calculated heat losses and energy consumptions are only estimates, based upon the data entered and assumptions within the program. Actual energy consumption and heat losses will be influenced by construction practices, localized weather, equipment characteristics and the lifestyle of the occupants.

Appendix F

Assumptions for PV panels:

For this simulation, the Maple Leaf 640W 5N N-Type TOPCon Bifacial Dual Glass Ultra Black solar panel was selected as a representative product commonly available on the market. The panel has a cost of \$269.99 per unit and dimensions of 2282 mm × 1134 mm × 30 mm.³

In addition, the EP Cube 16.6 kWh home battery system was selected for the simulation as a representative residential battery storage product available on the market. The battery storage system as has a cost of \$17,566.36.⁴

Please note prices may vary over time due to changes in market supply and demand as well as broader macroeconomic conditions.

Calculations are shown below:

Step 1: Convert MJ to KWh.

Conversion factor: 1 MJ = 0.2778 kWh.

Calculation:

$49,818 \text{ MJ} \times 0.2778 = 13,840 \text{ kWh/year.}$

Step 2: Calculate Required system Size (kW)

“According to data from Natural Resources Canada, the average solar system in Ontario can produce 1,166 kilowatt-hours of electricity per kilowatt of solar panels per year.”⁵

Formula: System Size (kW)= Annual Energy (kWh)/Toronto Production Factor (kWh/kW)

Calculation: $13,840 / 1,166 = \sim 12 \text{ kW.}$

Step 3: Convert kW to W

1kW= 1000 W

$12 \times 1000 = 12,000 \text{ W}$

³ <https://solarpowerstore.ca/collections/featured-solar-power-deals/products/maple-leaf-640w-n-type-topcon-bifacial-solar-panels>

⁴ https://cdnsolar.ca/products/ep-cube-16-6-kwh-home-battery-system-7-6-kw-hybrid-inverter?variant=50960689103146&country=CA&currency=CAD&utm_medium=product_sync&utm_source=google&utm_content=sag_organic&utm_campaign=sag_organic&srltid=AfmBOoqZA-MI9-qkbj3s6u94dtp_fG31jewm79bFFztGukGAnn27yINOILU

⁵ <https://www.ontario.ca/page/solar-energy-farms>

Step 4: Determine Size of Panels

model/ brand: Maple Leaf 640W 5N N-Type TOPCon Bifacial Dual Glass Ultra Black Solar Panel
| High-Efficiency N-Type Solar Module with 30-Year Power Warranty

Dimensions: 2282mm x 1134 mm x 30mm

Cost: \$269.99/solar panel

Length x Width = Area

$2.282 \times 1.134 \text{ m} = 2.58 \text{ m}^2$

So, $12,000 \text{ W} / 640 \text{ W per panel} = 18.75 =$ we need 19 panels.

Therefore, we need roughly 19 Photovoltaic Panels to offset the energy consumption of 22,943 MJ.

Total area= $2.58 \text{ m}^2 \times 19 = 49 \text{ m}^2$ or 528 ft²

Cost per household for Solar panels = $19 \times \$269.99 = \$5,129.81$

Step 5: Determine entire system cost per household.

Currently EP Cube 16.6k kWh Home Battery system Costs \$17, 566.36.

Therefore, the total Cost of Solar panels + Battery Storage System is

$\$5,129 + \$17,566.36 = \$22,696$

Step 6: Determine total cost for all projected units

$\$22,696/\text{unit} \times 16,253 \text{ units} = \$368,878,088.$

Appendix G

Unconvinced, Unprepared, and Out of Money, Canadians React to the Impact of Weather Extremes on Their Homes by Consumers Council of Canada by Consumers Council of Canada, March 2025

Unconvinced, Unprepared, and Out of Money

**Canadians React to the Impact of Weather
Extremes on Their Homes
RESEARCH**

March 2025



Unconvinced, Unprepared, and Out of Money

Abstract

This research report outlines the actions that homeowners could take to adapt and protect their homes from climate change and the barriers to action that exist.

Despite readily available information, homeowners are not undertaking adaptation actions. This was highlighted in a homeowner survey conducted as part of this research, where 75% of respondents took no actions to protect their home from potential damage from extreme weather events. In the homeowner survey and in focus groups, homeowners said they lacked time and knowledge, did not trust information sources, and lacked the funds to undertake adaptation actions. Many homeowners represent themselves as unconvinced, unprepared, and out of money to adapt their homes to climate change.

Keywords: climate change, adaptation, housing, consumer protection, consumer empowerment

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Version: 2025-05-22-2:20:06 PM EDT

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Acknowledgements

This research was conducted on behalf of Consumers Council of Canada by buildABILITY Corporation. Authors: Ceara Allen and Michael Lio.

Consumers Council of Canada has received funding from Innovation, Science and Economic Development Canada's Contributions Program for Non-profit Consumer and Voluntary Organizations. The views expressed in this report are not necessarily those of Innovation, Science and Economic Development Canada or of the Government of Canada.

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Executive Summary

In the past, the image of climate change was the polar bear on the melting iceberg, but perhaps now it should be flooded homes, wildfires, and extreme wind events.

– interview participant

In the end, we all want a roof over our head, dry feet, and nothing on fire.

– interview participant

The time for action is now so that homeowners are not suffering through disasters, emergencies, and trauma.

– interview participant

As climate change progresses, we ask more from our houses than was anticipated in their design. Yet, we expect our houses to withstand extreme weather events and keep us and our possessions safe and sound. In the face of weather extremes, many of our houses will fail. The extreme weather events that homes face, include hazards from:

- wind that can arise from strong thunderstorms, hurricanes, and tornadoes,
- water from flooding, snow, ice, and hail,
- wildfires,
- extreme cold or heat, and

- thawing permafrost.

These events are occurring with increasing frequency and severity, and can have catastrophic and long-lasting consequences for affected homeowners and communities. This includes the burden of:

- repeated damage,
- higher insurance premiums,
- lower insurance caps, or even lack of insurance coverage,
- stigma of owning a high-risk home,
- lower home values, and
- difficulty selling the home or obtaining a mortgage.

(See Sections 1.1 and 1.2 and Appendix A for details)

This report outlines the actions that homeowners could take to adapt and protect their homes (See Section 1.3 and Appendix B) and the barriers to action that exist.

Despite readily available information, homeowners are not undertaking adaptation actions. This was highlighted in the homeowner survey, where 75% of respondents took no actions to protect their home from potential damage from extreme weather events (See Section 3). In the homeowner survey and focus groups, homeowners have said that they lack the time, lack the knowledge, do not trust the information sources, and lack the funds to undertake adaptation actions. Homeowners are unconvinced, unprepared, and out of money.

Unconvinced

The survey showed that only 28% believe that it is likely or extremely likely that an extreme weather event will negatively impact their home.

Homeowners are currently *unconvinced* that they need to take adaptation actions. Homeowners need consistent, repeating information from a variety of trusted sources to tell them about their risk and to convince them that they need to take adaptation action.

Homeowners need information regarding the risk to their homes from extreme weather events, the damage that can occur, their responsibility to protect their house, and the actions they can take. (See Section 1.4 and Section 2.3)

Updated and future-looking flood maps and property-level risk information are urgently needed through a free, online portal (See Section 1.4 and 2.3). Risk maps should be available to realtors and home buyers at the time of sale. And the liability of not disclosing known risks at the time of sale must be made clear. The risk maps need to be paired with information on adaptation measures that the homeowner can undertake.

Unprepared

Despite high levels of general awareness of extreme weather and climate change, shown in the homeowner survey (See Section 3), only 25% of those surveyed claimed to have made changes to their homes to protect them from extreme weather.

As a result, homeowners are *unprepared* for extreme weather events and climate change. Homeowners need support to take action to adapt and prepare their homes for extreme weather events including easy access to trained professionals and reliable contractors to undertake the work. Homeowners need information on the adaptation options

available for their property, the available products and services, and the costs and benefits of those options (See Section 1.4).

Homeowners want and need the information to come at them from a variety of trusted sources and media formats, acknowledging their preferences as highlighted by the homeowner survey and focus groups. Everyone who interacts with homeowners needs to be engaged with supporting them. These various stakeholders would need adaptation training, and information and resources that can be shared with the homeowner. The information disseminated to homeowners needs to be consistent in messaging and tone. The coordination of this messaging should be a central role of government. More information on best practices and recommendations for messaging can be found in Section 1.4 and Section 2.3.

Often towns and rural communities are left with the responsibility to raise risk awareness, but they often lack the expertise, capacity, and financial resources to sustain the communication efforts required. Communities will need increased financial and logistical support to develop and deploy risk awareness and adaptation communication. More opportunities are needed to bring together different departments and levels of government to share knowledge, experiences, approaches, and resources on risk communication. Efforts need to be coordinated. And while communications need to be tailored to the local conditions, larger coordination can reduce overlap, inconsistencies, and gaps, and establish priorities and goals, establish roles and responsibilities, measure progress, identify useful policies, and coordinate financing. Governments can hold the various

stakeholders accountable for their decisions and actions (See Section 1.4).

In addition to information, homeowners also need program support to accomplish the adaptation actions. Programs need to go beyond providing information, and must aim to provide homeowners with additional tools and resources aimed at taking action, including physical assistance, connecting homeowners to trained and qualified contractors, and connecting homeowners to financial supports. The programs must have simplified application processes. Critically important, the programs need to be friendly to homeowners, and need to be easy to understand and adopt.

Not explored in this report is the importance of quality workmanship by contractors and trades. Additional research and consumer supports are required regarding this.

Out of Money

The research found that cost is a huge barrier to action for homeowners, and many do not have the available disposable income to enable adaptation. The homeowner survey showed that the second most anticipated challenge to taking adaptation action was cost. The homeowner focus group named cost as the major reason for not undertaking larger adaptation actions. Homeowners are *out of money*. Homeowners need financial support to complete adaptation actions.

Homeowners need to know that programs, information resources, and financial supports exist. Access to these supports needs to be straightforward and the timeline must not be lengthy. More

information on financial and fiscal support can be found in Section 1.4 and Section 2.3.

Insurance companies should recognize that homeowners can help them to reduce potential payouts from damage claims. It is in their interest to inform homeowners and help them pay for actions to mitigate damage. There should be build-back-better plans that are promoted after disasters by insurers. Homeowners need clear information on their insurance policies and their coverage. See Section 1.4 and Section 2.3.

An opportunity exists for proactive strategic relocation. Various best practices and recommendations are listed in Section 1.4. that should be considered.

Additional research is needed to examine the cost effectiveness of providing funding to adopt adaptation measures to individuals versus communities.

Other Support from Stakeholders

Stakeholders, including governments, can take actions to support homeowners, including the development of policy and regulations, outlined below and in Sections 1.4 and 2.3.

Work is underway on Canadian codes and standards to address adaptation measures to extreme weather for homes, as outlined in Section 1.4. and Section 2.3. The federal and provincial governments should act on the June 2024 recommendations from the Task Force for Housing and Climate. Additional research should be undertaken to adapt the building code to varying risk profiles, for example mandating greater adaptation requirements in high-risk areas. High-risk areas

would need to be better identified, particularly on risk maps (See Section 1.4 and Section 2.3).

Further study is needed on how to best address overheating of existing buildings.

Various best practices and recommendations for the National Flood Insurance program can be found in Section 1.4. Homeowners currently assume and expect government financial assistance after disasters. There will need to be an overhaul of the government disaster financial assistance program when the National Flood Insurance program is established. Both programs must be rationalized and better communicated to homeowners.

Permafrost thaw is a crisis that needs more data and collaborative solutions. Entire communities are built on permafrost that will need to be completely rebuilt. Many communities do not have the capacity to start over again, and support of the North will be needed. The North urgently needs additional research on permafrost thaw and related geological processes, including a better understanding of the benefits and limitations of adaptation strategies. These must be developed collaboratively with Indigenous communities. See Appendix A, Appendix B, Section 1.4, and Section 2.4.

Flood plains are designed to flood, and homes should not be built on them. There needs to be improved land-use planning with an immediate need to stop building on flood plains and in other high-risk areas. Municipalities can also influence the climate adaptation in their communities through zoning and planning decisions, local construction requirements, guidelines, and programs, and through building code enforcement that targets local vulnerabilities. It must be

clear what redress options are available to homeowners where municipalities choose to allow building on flood plains. See Section 1.4 and Section 2.3.

The following recommendations can help to support and facilitate homeowner action.

Recommendations – Information Needs

1. Adaptation efforts need to be coordinated with a whole-of-society approach, including all levels of government, non-government organizations, the insurance industry, and homeowners. Government should take the lead in coordinating the effort.
2. Homeowners need information regarding the risk level of various extreme weather events to their home, the damage that can occur, their responsibility to protect their house, the adaptation options available for their property, the available products and services, and the costs and benefits of those options. The information disseminated to homeowners needs to be consistent in messaging and tone. Homeowners want and need the information to come at them from a variety of trusted sources. Consider best practice recommendations for messaging (see Section 1.4). The various stakeholders would need adaptation training, and information and resources that can be shared with the homeowner. Coordinated, consistent messaging from government, insurance companies, NGOs, and contractors is needed and should be an output of work under Recommendation 1.
3. Updated and future-looking flood maps and property-level risk information are urgently needed, as well as the development of

these materials for other hazards, which should be available through a free, online portal. Various best practices for risk maps are listed in Section 1.4 and should be acted on. Provincial and municipal governments should lead this effort.

4. When and where available, the risk maps should be available to realtors and home buyers at the time of sale. The risk maps need to be paired with information on adaptation measures that the homeowner can undertake. The liability of not disclosing known risks must be made clear at the time of sale. Real estate sales associations (national, provincial, and local) should lead this effort by informing their members.

Recommendations – Program and Financial Support

5. Homeowners need program support to accomplish the adaptation actions. These programs need to go beyond providing information, and must aim to provide homeowners with additional tools and resources to taking action, including physical assistance, connecting homeowners to trained and qualified contractors, and connecting homeowners to financial supports. The programs must have simplified application processes. Critically, the programs need to be friendly to homeowners, and need to be easy to understand and adopt. Program support should extend to communities who need increased financial and logistical support to develop and deploy risk awareness and adaptation communication. Homeowners need financial support. Economically vulnerable homeowners should be a priority for financial support and investment. As with programs, financial supports need to be easy to understand and

adopt. The application process needs to be straightforward and the timeline to access these supports must not be lengthy.

Governments and insurance companies should coordinate efforts to provide financial support and to undertake this recommendation.

6. Best practices and recommendations for the National Flood Insurance program should be considered by government (see Section 1.4). There will need to be an overhaul to the government disaster financial assistance programs when the National Flood Insurance program is established. Both programs must be rationalized and better communicated to homeowners.

Recommendations – Insurance Companies

7. Insurance companies should recognize that homeowners can help them to reduce potential payouts from claims, and that it is in their interest to keep homeowners informed and help them to overcome financial challenges.
8. Homeowners need clear information on their insurance policies and their coverage, and they need to be aware of their risks so that they can make informed decisions of which insurance policies they need.
9. There should be build-back-better plans that are promoted by insurers after disasters.

Recommendations – Codes and Standards and Land-Use Planning

10. Work on Canadian codes and standards to address adaptation measures to extreme weather for homes must continue.

- a. Additional research should be undertaken to extend and better align building code requirements to high-risk areas.
 - b. Further study is needed on how to address overheating in existing buildings.
- 11. The federal and provincial governments should consider the June 2024 recommendations from the Task Force for Housing and Climate.
- 12. Municipalities can influence the climate adaptation in their communities through zoning and planning decisions, local construction requirements, guidelines, and programs, and through building code enforcement that targets local vulnerabilities. There needs to be improved land-use planning with an immediate need to stop building on flood plains and in other high-risk areas. It must be clear what redress options are available to homeowners where municipalities choose to allow building on flood plains. Municipal governments have an important role to play.

Recommendations – the North

- 13. Support of the North will be needed. The North urgently needs additional research on permafrost thaw and related geological processes, and better understanding of the benefits and limitations of adaptation strategies. These must be developed collaboratively with Indigenous communities. See Appendix A, Appendix B, Section 1.4, and Section 2.4. Federal and Territorial governments should consider this recommendation.

Recommendation – Additional Research

14. Additional research is required regarding:
 - a. the importance of workmanship by contractors and trades,
 - b. proactive strategic relocation (see various best practices and recommendations in Section 1.4),
 - c. the cost effectiveness of providing funding to adopt adaptation measures to individuals versus communities.

Introduction

Houses are not just buildings. Houses are homes. We watch our families grow in them. We store our keepsakes in them. And, for many of us, houses are our biggest financial asset.

A range of houses provide homes in Canada. They vary in age, style, and upkeep, and can differ across the many conditions found across the country's vast geography.

As climate change progresses, we ask more from our houses than was anticipated in their design. They will face stronger winds, more water (from sky and ground), hotter days, raging wildfires, and, in the North, thawing ground beneath their foundations. Yet, we expect our houses will withstand events like this and keep us and our possessions safe and sound.

Many of our houses will fail to do so. And that understanding led to the research question: **What can homeowners do to adapt their homes to climate change risks, and what supports will they need to act?**

This report focuses on the specific climate change risks of wind, water in various forms, wildfires, permafrost thaw, and extreme temperature. It adds to the existing body of knowledge on climate change adaptation, but from a homeowner's perspective.

The scope of the work is restricted to:

- an examination of the climate change risks to houses,
- potential adaptation measures that homeowners could implement,
- homeowner awareness and interest in these adaptation measures, and

- support that homeowners will need to enable action.

Climate change is a *whole-of-society* problem that will require many responses. This report will not consider or evaluate the science of climate change, climate change mitigation efforts, rental housing and communal living buildings, impacts beyond housing (e.g. impacts related to physical and mental health, or economy), community level adaptation measures, or infrastructure or industry adaptation measures. Also, the report will not attempt to determine risk levels faced by homeowners. While important considerations, these are beyond the scope of this research and report, and typically, they lie beyond what individual homeowners can capably address today.

This report is divided into five main sections:

1. a literature review,
2. a summary of findings from key informant interviews,
3. the results of a homeowner survey,
4. the results of homeowner focus groups, and
5. the findings and conclusions.

The literature review includes: a review of how the climate is changing; a review of the threats facing homes as a result of the changing climate; a catalogue of various adaptation measures that homeowners could adopt where applicable; and a review of the potential tools available to support homeowners undertake these adaptations measures. Key informants consulted included representatives from various levels of governments, academics and researchers, a realtor organization, a home builder, and organizations supporting homeowners to adapt their homes. The key informant interviews helped to validate findings of the literature review and expand the insights. The homeowner survey provided insight into homeowner knowledge and awareness of extreme weather events, actions taken to adapt to their effects, and the

likelihood of taking actions in the future. Two online homeowner focus groups gathered feedback from consumers on their experiences with these flooding, wildfires, and high-wind events, as well as on home maintenance, insurance, and information resources. The focus groups augmented the survey and helped to clarify its results. A standard interview guide was used for the two focus groups.

The combination of the literature review, key informant interviews, homeowner survey, and focus groups provided the necessary evidence to understand the issues, risks, potential homeowner adaptation measures, and homeowner supports. The research findings led to the study's conclusions and recommendations.

Literature Review

“These events are escalating at a shocking rate and Canada is simply not prepared.”

– Celyeste Power, President and CEO, Insurance Bureau of Canada, September 2024 (Insurance Bureau of Canada 2024)

1.1 What is going on with the climate?

Across Canada, extreme climate events featured prominently in news headlines throughout 2022, 2023, and 2024. The country’s Atlantic provinces were devastated by multiple events: post-tropical storm Fiona, drought, wildfires, and flooding when three months-worth of rain fell within 24 hours (Jones 2023) (Weber 2023). In August of 2023, 72 mm of rain fell on Ottawa in 90 minutes (Browne 2023). Large sections of Canada experienced drought and extreme heat, with Kelowna, British Columbia having 36 days with temperatures reaching greater than 30 degrees Celsius, compared to a usual 16 days, and the Northwest Territories setting a new temperature record of 38 degrees Celsius (Weber 2023). Wildfires across the country forced tens of thousands of people to evacuate their homes, with every province and territory affected by the fires and/or smoke (Weber 2023). The Canadian Climate Institute’s Ryan Ness called 2023, “a seismic shift into a new realm of unpredictability and volatility” (Ness

2024). In 2024, a hailstorm in Calgary damaged an estimated one in every five homes, and is second only to the 2016 Fort McMurray fires in damage costs (Farooqui 2024). The town of Jasper lost 30% of its structures in the 2024 wildfire (Previl 2024). The Insurance Bureau of Canada has stated that 2024 is “the most-destructive season in Canadian history for insured losses due to severe weather” (Insurance Bureau of Canada 2024).

Natural disasters are increasing in intensity and frequency (Sawyer, et al. 2020). Much of this results from climate change and is a consequence of global fossil fuel emissions (carbon dioxide and methane) (Bush and Lemmen 2019) (United Nations n.d.). The likely severity of climate change is difficult to determine exactly and depends on the world’s future greenhouse gas emissions (Bush and Lemmen 2019). The Government of Canada publications, *Canada’s Changing Climate Report (2019)*, and *Canada’s National Adaptation Strategy Building Resilient Communities and a Strong Economy (2023)*, as well as numerous other sources, summarize the overall climate change reality for Canada: more extreme heat leading to heatwaves, drought and wildfires, less extreme cold, shorter snow and ice cover seasons, thinning glaciers, thawing permafrost, rising sea level, coastal erosion, increased precipitation, floods, and intensified weather extremes (Bush and Lemmen 2019) (Canada 2023a) (Moudrak 2020) (Richardson 2010).

Canada – due to its sheer size and varied landscape – will experience a wide range of climate change problems (Council of Canadian Academies 2019), and they will not affect everyone the same. Some regions and peoples will be affected far more than others (Warren and Lulham 2021). It will be experienced in both gradual, slow-onset impacts, such as a year-over-year increases in average precipitation or temperature or in permafrost thaw, and also through sudden events, such as short but intense rainfalls or an intense heat wave

(Canada 2023a) (Lepage 2021). Climate change impacts can range from inconvenience to loss of life, loss of homes and property, or loss of entire communities (Canada 2023a).

Canada has 15 million households, 59% of which are single-family detached homes (Canada a). About 21% were built before 1960 and 55% before 1984 (Canada b). Climate change can subject homes to:

1. sudden and severe damage from, for example, flooding, wildfire, winds, and snow load;
2. deterioration over time through humidity, rainfall, and freezing and thawing; and
3. impacts on homeowner comfort, for example from extreme heat (National Research Council of Canada 2019).

The emotional, physical, and financial hardships of damage from these disasters are endured by Canadian homeowners (Canada 2022a). Housing decisions have relied on historical climate data. However, past climate data will not reflect the new reality of climate change (Canada 2023a) (Warren and Lulham 2021) (National Research Council of Canada 2019). Homeowners will be confronted with the need to repeatedly repair damage to their homes from recurring climate change events, or to live in damaged homes if they cannot afford the repairs and adaptation measures (Center for Climate and Energy Solutions 2021). A 2024 report from the National Academies of Sciences, Engineering, and Medicine used the term “perpetual disaster recovery” (National Academies of Sciences, Engineering, and Medicine 2024). Climate change effects are not only damaging housing but creating dangerous living conditions. They are lowering house values (and thus individual wealth), and increasing present and probable future mortgage defaults, insurance premiums, losses of valuable possessions, and displacements of communities, outlined in

the following Sections. Human health and well-being, culture, livelihoods, and even our identities, will all suffer, resulting in more and even larger economic implications (Canada 2023a) (Moudrak 2020) (Warren and Lulham 2021) (Beckett 2021) (Ness, Clark, et al. 2021) (Thistlethwaite, Henstra and Brown, et al. 2017).

Reactive approaches to dealing with natural disasters are starting to shift to proactive approaches as governments work to reduce risk and increase resiliency against future disasters (Canada 2022a). Two concepts are highlighted in the discussion about climate change action: one is *mitigation* – actions to reduce greenhouse gas emissions – and the other is *adaptation* – actions to modify our environment, including our homes, to withstand the risks that climate change brings (Lepage 2021).

Adaptation involves anticipating the impacts of climate change and taking action now to be better able to prevent, reduce damage from, respond to, and recover from those impacts (Sawyer, et al. 2020) (Canada 2023a). Adaptation efforts are dependent on local context and circumstances (Pianet 2024). Adaptation also includes the monitoring and continual improvement of the actions (Canada 2023a). Climate change could be slowed by mitigation efforts (Bakos 2022), and mitigation of climate change is important, but adaptation assumes change is here to stay for many years (Insurance Bureau of Canada 2019). And adaptation efforts address the climate change effects that we are now and will continue to experience (Wallace 2019). Adaptation has been started by governments, Indigenous Peoples, the private sector, academics, non-governmental organizations, as well as many individuals, but more effort, investment, and coordination are needed (Canada 2023a). In a 2024 Globe and Mail article, a spokesperson with the Insurance Bureau of Canada pointed out that:

People want homes that aren't going to flood or burn. That's more important to people in high-risk areas than energy efficiency, and so a shift of thinking where we're focused on both issues has to happen. (Farooqui 2024)

Two quotes stand out from the Global Alliance for Building Construction's 2024 report *Achieving Resilience in the Building Environment: Why Are We Not Adapting?*:

The truth is inescapable: climate change is no longer a distant threat, but an immediate reality.

We understand that the task before us is formidable, but the imperative is clear: adapt, or face the consequences. (Pianet 2024)

1.2 How will houses be affected?

This Section is divided into two main sub-sections: one is an overview of the hazards and potential damage to houses, including wind, water, wildfires, extreme temperature, and permafrost thaw; the other sub-section examines a range of potential indirect impacts, including to insurance, mortgages, government assistance, and home value.

Overview of the Hazards and Potential Damage to Houses

In a 2022 survey conducted by Leger for Environment and Climate Change Canada, 86% of Canadians said they considered climate change an important issue, with 53% considering it a very important issue (Leger Marketing 2023). About 13% did not consider it an important issue (Leger Marketing 2023). A 2024 survey by Nanos for DMG Events found that 75% of those surveyed expected more emergencies like extreme weather events, wildfires, floods, power disruptions and other natural disasters in Canada in the future (Nanos 2024).

However, the occurrence of climate change is not enough to move homeowners to adapt their homes. They need to understand 1) how they could be impacted, and 2) what they can do about it. How they could be impacted is

informed by their risk. Many of the reviewed sources for this report reference the Intergovernmental Panel on Climate Change's risk definition, that risk is a result of the interaction of climate **hazard, exposure, and vulnerability** (Intergovernmental Panel on Climate Change 2022). Hazard is the potential for an event that can cause health impacts, damage, and destruction. Exposure, as it relates to this report, is the proximity of people and houses to the hazard. Vulnerability is the degree of adverse exposure (Intergovernmental Panel on Climate Change 2022) (Thistlethwaite, Henstra and Brown, et al. 2017). Hazard exposure can be determined using historical flood records, modelling of future climate scenarios, and integrating expert opinions (Thistlethwaite, Henstra and Ziolecki 2020). The risks from climate change combine the likelihood of the hazards with what is exposed and what the impact could be (Canada 2022a). The risk of many natural events is changing because of climate change as the hazards increase in likelihood and severity (Lepage 2021). Adaptation efforts can work to reduce exposure and vulnerability, but must be feasible and are not limitless (Intergovernmental Panel on Climate Change 2022). Often multiple adaptation options with various costs and effort are available. However, sometimes options are limited, for example to prevent rising sea levels (Council of Canadian Academies 2019). Feasibility can be limited by the size of the affected area, cost, time, ability and willingness to take action, and collaboration needed (Council of Canadian Academies 2019). Canada's Task Force on Flood Insurance and Relocation's report *Adapting to Rising Flood Risk: An Analysis of Insurance Solutions for Canada* provides a concise example:

For example, projected increases in extreme precipitation due to climate change may increase the flood hazard by increasing the amount of water expected during flood events, and if this additional flood water is in contact with exposed assets, overall flood risk increases. Similarly, by increasing the exposure of people and assets to flooding by developing floodplains, flood risk increases. It is also possible to reduce flood risk by

reducing the physical exposure of structures (e.g., relocation) or the vulnerability of populations to flooding (e.g., by building resilient infrastructure). (Canada 2022a)

Appendix A describes wind hazards, water hazards of various sources, wildfire hazards, permafrost thaw hazards, and extreme temperature hazards that can impact Canadian houses. The objective of Appendix A is to provide an overview of the hazards, but it does not describe the science relating to the hazards.

Indirect Impacts: Insurance, Disaster Relief, Property Values, and Mortgages

Homeowners across Canada can acquire insurance for damages that occur to their homes. This provides peace of mind that financial support will be available for repairs and rebuilding, and sometimes temporary rehousing, should homeowners be affected by a disaster (Oakley 2018). As it relates to natural disasters, home insurance can cover damages from fire (including wildfire), wind, lightning, hail, snow, rain, and floods, but insurance policies can range from basic to comprehensive, and some coverage must be purchased separately and added to the policy, such as for sewer backup and overland flooding (Institute for Catastrophic Loss Reduction a) (Khan 2023). While 90% of homeowners can purchase some level of additional insurance against flooding (Insurance Bureau of Canada 2023a), estimates say only 40-60% of homeowners have done so, and this has been mainly for homes in low- and medium-risk areas that account for only 5-10% of expected residential flood damage (Canada 2022a) (Institute for Catastrophic Loss Reduction 2024). Infiltration from groundwater is generally not covered except by a few companies (Institute for Catastrophic Loss Reduction a). Coverage of salt-water coastal flooding is not widely offered (Institute for Catastrophic Loss Reduction a).

The Canadian Disaster Database has recorded the frequency, cost, and people evacuated for significant weather-related hazards since 1970; the most

frequently reported disaster events include floods (40%), severe thunderstorms (18%), wildfires (15%), winter storms (9%), with hail, wind, and ice events also recorded (Sawyer, et al. 2020). The Insurance Bureau of Canada provided a list of the costliest insurance payouts for natural disasters in Canada as of 2022, as listed below:

1. Fort McMurray Wildfires 2016, \$4 billion
2. Eastern Ice Storm 1998, \$2.3 billion
3. Southern Alberta Floods 2013, \$1.8 billion
4. Alberta Hailstorm 2020, \$1.2 billion
5. Toronto Floods 2013, \$1 billion
6. Ontario Quebec Windstorm 2022, \$875 million
7. Toronto Flood 2005, \$780 million
8. Ontario Windstorm 2018, \$695 million
9. BC Flood 2021, \$675 million
10. Hurricane Fiona 2022, \$660 million

(Insurance Bureau of Canada 2022a)

This list only captures insurance payouts, not total losses. The list does not include losses from 2023 or 2024, with recent data showing that 2024 was Canada's costliest year on record for insured losses from severe weather events at \$8.5 billion, two thirds of which were related to personal property (Contant 2025). Some estimates put the 2013 floods in Toronto and Calgary at over \$7 billion in combined damages, and the 2016 Fort McMurray wildfires at an economic cost of almost \$11 billion (Ness, Clark, et al. 2021). It has been estimated that, for every dollar paid out by insurance companies, three to four dollars are paid by governments, businesses, and homeowners for repairing and rebuilding (Moudrak 2020) (Warren and Lulham 2021). Homeowners must cover the losses that are not covered by insurance or government assistance (Canada

2022a). Polling from August 2023 found that 47% of Canadians are living paycheck to paycheck (Leger 2023) – these households may not have the resources to afford repairs and rebuilds, particularly if they experience recurring damage from multiple events (Moudrak 2020). Homeowners have taken large mortgages in relation to their income levels, which leaves them less able to deal with unexpected expenses (Press 2021) (Bourque 2021). One estimate suggests that property owners are paying almost \$600 million out-of-pocket every year to cover the costs of uninsured flood damage alone (Ziolecki and Thistlethwaite 2019). Many of the houses affected by post-tropical storm Fiona in 2022 did not have access to flood insurance coverage because they were located in high-risk flood areas where coverage is not usually offered, so most of the costs for this event were paid out by government and property owners (Insurance Bureau of Canada 2022a). So, although adaptation measures will cost money to implement, the cost of inaction is not nothing; homeowners, governments (taxpayers), and insurance companies (premium payers) pay for this unpreparedness every year (Berkow 2021).

Estimates of risk for overland flooding and sewer backup identify 20% of homes in Canada as at high risk and 10% – almost 2 million homes – as at very high risk (Feltmate, Evans and Moudrak 2017). About 89% of the cost of flood damage is estimated to be concentrated in the top 10% highest-risk homes, and that 34% of these costs are concentrated in the top 1% of highest risk homes (Canada 2022a). This observation has been made, also, for the United States, where properties with the National Flood Insurance Program (NFIP) that have had recurring flooding represent 1% of NFIP insured properties but 25-30% of the flood claims (Beckett 2021). As insurance companies pay out more and more for losses in certain areas, the cost of home insurance rises (Center for Climate and Energy Solutions 2021) (Ness, Clark, et al. 2021) (Khan 2023)

(Bourque 2021) (Lerner 2022), or coverage could be limited or even stopped being offered (Farooqui 2024) (Ness, Clark, et al. 2021) (Feltmate, Evans and Moudrak 2017) (Bourque 2021). In the United States, insurance companies have started to limit coverage or have stopped offering coverage altogether in some States, including in Florida, California, and Louisiana (McDaniel 2023) (CBS News 2024). One analysis estimated that average home insurance premiums increased by 63% in Ontario and 140% in Alberta between 2011 and 2021, whereas inflation was only 17% across those years (Berkow 2021). These increases in premiums are indicative of the risks, and point to the need for action to lower the risk (Canada 2022a). Some predict that insurance rates could rise to the point of being too expensive for homeowners to afford (Center for Climate and Energy Solutions 2021). One source described an area in United States that is at risk for wildfires where only one insurance company is offering coverage, and it can cost tens of thousands of dollars per year (Ellis 2020). A June 2024 article from the Task Force for Housing and Climate captured the fear: "... imagine that: no more safety net. If your home is lost in a wildfire or a flood, you're on your own" (Iveson 2024).

High risk homeowners will be faced not only with the burden of repeated damages, but also potentially with higher insurance premiums, lower insurance caps, or even lack of insurance coverage, potential stigma of owning a high risk home, lower home value, and difficulty selling the home (Center for Climate and Energy Solutions 2021) (Bakos 2022) (Lerner 2022) (Andrasko 2021) (Iveson 2024). Homeowners that can afford high insurance premiums have less funds to pay for adaptation measures, and those who cannot afford insurance are left to cover the full costs of damage (Bourque 2021). A June 2024 article from the Task Force for Housing and Climate highlights, "The most unaffordable home is the

one that needs to be repaired or rebuilt after an extreme weather event” (Iveson 2024).

Many homeowners expect government assistance after a major disaster (Canada 2022a). Governments often provide assistance to homeowners after major climate disasters, usually organized at a provincial or territorial level through Disaster Financial Assistance (DFA) programs that often receive reimbursement for eligible disaster costs from federal Disaster Financial Assistance Arrangements (DFAA) (Canada 2022a). The provinces and territories design and administer the DFA programs, and the programs vary in coverage and capacity (Canada 2022a). Since the 1970s, the federal DFAA has paid over \$8 billion to provinces and territories (Institute for Catastrophic Loss Reduction 2024). From 2009 to 2015, the DFAA reimbursed provinces and territories more than in the previous 39 years, and flooding represented more than 75% of the reimbursements (Moudrak 2020) (Institute for Catastrophic Loss Reduction 2024). The DFAA program’s annual expected costs are more than \$900 million (Moudrak 2020). However, limits, exclusions, and restrictions on program eligibility exist, for example, if insurance was readily and reasonably available; a homeowner may not qualify for assistance for the portion that could have been insured, even if they had not purchased the insurance or knew that the insurance was available (Insurance Bureau of Canada 2019) (Financial Consumer Agency of Canada 2023) (McGillivray 2017). In the face of increasing disaster and payouts, since 2015 governments have been changing the programs to lower the amount that they will payout after a disaster as flood insurance was available to homeowners (Thistlethwaite, Henstra and Brown, et al. 2017) (Bourque 2021). It can take years for a homeowner to receive reimbursement from these programs (Financial Consumer Agency of Canada 2023).

High risk areas may see homeowners choosing to move away (Lerner 2022) (Nathan 2019), or being forced to move if they cannot afford to rebuild (Moudrak 2020) (Nathan 2019). If homes in high-risk areas drop in value, this could attract budget conscious buyers (Ellis 2020), who may be vulnerable, because they are less able to afford insurance or repairs (Nathan 2019). Homes at risk may be undesirable and lose value, while those in climate-resilient neighbourhoods may be more desirable and increase in value (Nathan 2019). The risks will become known either through updated risk maps made available by governments, through insurance and mortgage lenders, or through growing public awareness after repeated events (Ness, Clark, et al. 2021). One report described repeated damage as making homes uninsurable, unsalable, and unlivable (Beckett 2021), another described these homes as less insurable and less creditworthy (Iveson 2024). For many homeowners, their home is their biggest investment, their largest asset (at 41% of average household wealth), and even sometimes their retirement fund – their home losing value would greatly impact personal wealth (Ness, Clark, et al. 2021) (Bakos 2022).

The Intact Centre on Climate Adaptation's 2022 report *Treading Water: Impact of Flooding on Canada's Residential Housing Market* revealed that, for the six months following a catastrophic flooding, the number of houses offered for sale fell by 44.3% (Bakos 2022). The number of days houses were on the market increased by 19.8% (Bakos 2022). The average selling price of houses was reduced 8.2% (Bakos 2022). The increased time on the market was attributed to a perception by homeowners that their home would be valued less, homeowners waiting for the stigma to pass, or the time needed to repair the damage (Bakos 2022). The report did not examine if the market rebounded after the six-month post-flood period. However, the report did observe a real estate market in which the impacts of flood on house value appeared to be

permanently incorporated (Bakos 2022). The house prices of Fredericton, N.B., were analyzed for the report. That city had experienced 10 large flood events in the eleven years leading up to the study, and no changes in average house price or days on the market were observed (Bakos 2022). The same report also analyzed mortgage arrears and defaults in the six months following a flood event, but found that, for the two cities analyzed, the rates fell within market norms (Bakos 2022). An American study found that, two years after Hurricane Harvey, damaged houses with flood insurance had an increased rate of prepayment on their mortgages after a climate event, whereas damaged houses without flood insurance had an increased rate of needing a loan modification, having late mortgage payments, or being in mortgage default (Kousky, Palim and Pan 2020). The increase in prepayment was perceived to be because the homeowners used the insurance payouts to pay off their mortgages, or they were more willing to sell their houses to investors knowing any drop in house value was mitigated by the insurance payout (Kousky, Palim and Pan 2020). The same study noted after Hurricane Harvey hit the United States, more investors bought damaged homes, to repair them for resale or to be rented. (Kousky, Palim and Pan 2020).

Some note that the banking industry and mortgage lenders are starting to discuss reflecting potential climate change impacts in mortgages. Concern exists for an increase in mortgage arrears and defaults because homeowners may not have enough funds to pay for repairs and/or high insurance premiums (Moudrak 2020) (Beckett 2021) (Ness, Clark, et al. 2021) (Bakos 2022) (Lerner 2022). A scenario can be imagined where banks decline mortgages for high-risk homes (Center for Climate and Energy Solutions 2021). Lenders may have limited interest in offering mortgages for homes that cannot obtain insurance (Beckett 2021) (Bourque 2021) (Florez Bossio and Ness 2024). CBC News reported in

March 2024 that Desjardins Group is no longer offering new mortgages for homes in Quebec high-risk flood zones, considered zero to twenty year floodplains, citing that those homes are uninsurable because of risks that need to be considered (Shingler 2024). Another scenario describes property values declining due to high risk, and homeowners facing challenges when renewing and refinancing their mortgages (Ness, Clark, et al. 2021).

1.3 What can homeowners do?

This Section is divided into two main sub-sections: one is a catalogue of potential adaptation measures homeowners could undertake to protect their homes from the hazards outlined in Section 1.2 and Appendix A, including for wind, water, wildfires, extreme temperature, and permafrost thaw; the other sub-section examines some of the challenges and barriers that homeowners face in implementing these adaptation measures.

There are a significant number of potential adaptation measures of varying complexity that homeowners can undertake, some of which conflict with one another. Skill is required when communicating action items to a homeowner.

A 2024 survey by Nanos for DMG Events found that 41% of those surveyed said they were not prepared or somewhat not prepared at home to deal with emergencies like extreme weather events, wildfires, floods, power disruptions and other natural disasters (Nanos 2024). In a 2022 survey of Canadians by Leger for Environment and Climate Change Canada:

- 68% of respondents said they were afraid of climate change's impact on their community,
- 67% said they were afraid of its impact on them, their friends, and their loved ones' lives,

- 83% said that they were motivated to do what they could to protect themselves, their family, their community, and their house,
- 53% felt sad and 52% felt helpless regarding climate change,
- 25% said that they were not concerned,
- 61% felt confident that there will be solutions,
- 77% felt that they could do more to adapt to the future impact of climate change (Leger Marketing 2023).

Catalogue of Adaptation Actions and Information

“Over \$20 million was spent reacting to my [wild]fire, not to mention the insurance losses, which could triple that. What could we have accomplished if we used that same amount of money proactively? We’re spending the money on the wrong end of the problem.”

- *West Kelowna fire chief Jason Borlund to the United Nations in September 2023 (Peters 2023).*

Appendix B is a collection of potential adaptation measures for homeowners, as collected from a variety of the reviewed sources. It does not include a detailed background analysis of the science behind the recommendations, or the effectiveness of the adaptation measures themselves. It is meant to be a catalogue of potential actions a homeowner could take to protect their house against climate change hazards. The applicability of the adaptation measures for each house would need to be determined based on the location, risks, type of construction, age, and upkeep, for example. The adaptation measures range in cost and level of difficulty. This catalogue does not represent a ‘how-to’ guide or recommendations for homeowners. It does not replace advice from professionals. It provides general information only. Homeowners should contact

professionally licensed and insured experts and their local municipal government about their circumstances, with any questions, to find out what is and is not allowed in their jurisdiction, and to obtain building permits and inspections as applicable. There is no implied guarantee that implementing these measures will prevent damages (Insurance Bureau of Canada 2019).

Additional resources, including those directed specifically to homeowners, can be found in Appendix C.

Many of the adaptation measures may have co-benefits, including improving comfort, well-being and mental health, lowering energy bills, and enhancing property values (J. L. Eyquem 2022).

Challenges and Barriers

Although numerous sources outline the potential hazards that climate change brings to houses, including numerous sources guiding homeowners on how to adapt their properties to reduce their vulnerability, homeowners face challenges and barriers to implementing those adaptation actions.

In a 2018 survey of residents of the city of Windsor, and a second survey of residents of Dufferin, the top barriers that prevented respondents from implementing adaptation actions included:

- too expensive,
- not important,
- not effective to protect my home or family,
- don't know how to do this,
- takes too much time/effort, and
- not my responsibility (St. Amour-Gomes, Heldsinger and Peddle 2018).

This section focuses on the challenges and barriers related to adaptation measures for extreme wind, water, wildfire, and extreme temperatures; see Section 1.4 for permafrost thaw. The literature review revealed that

homeowners have a great need for more information and education, particularly regarding:

- the risk to their homes,
- the available adaptation measures, and
- the roles and responsibilities of homeowners, insurance companies, and various levels of government.

In addition, the literature review revealed a need for support during the implementation of the adaptation measures. These needs are explored in greater depths in the following sub-sections.

Decision-Making Process

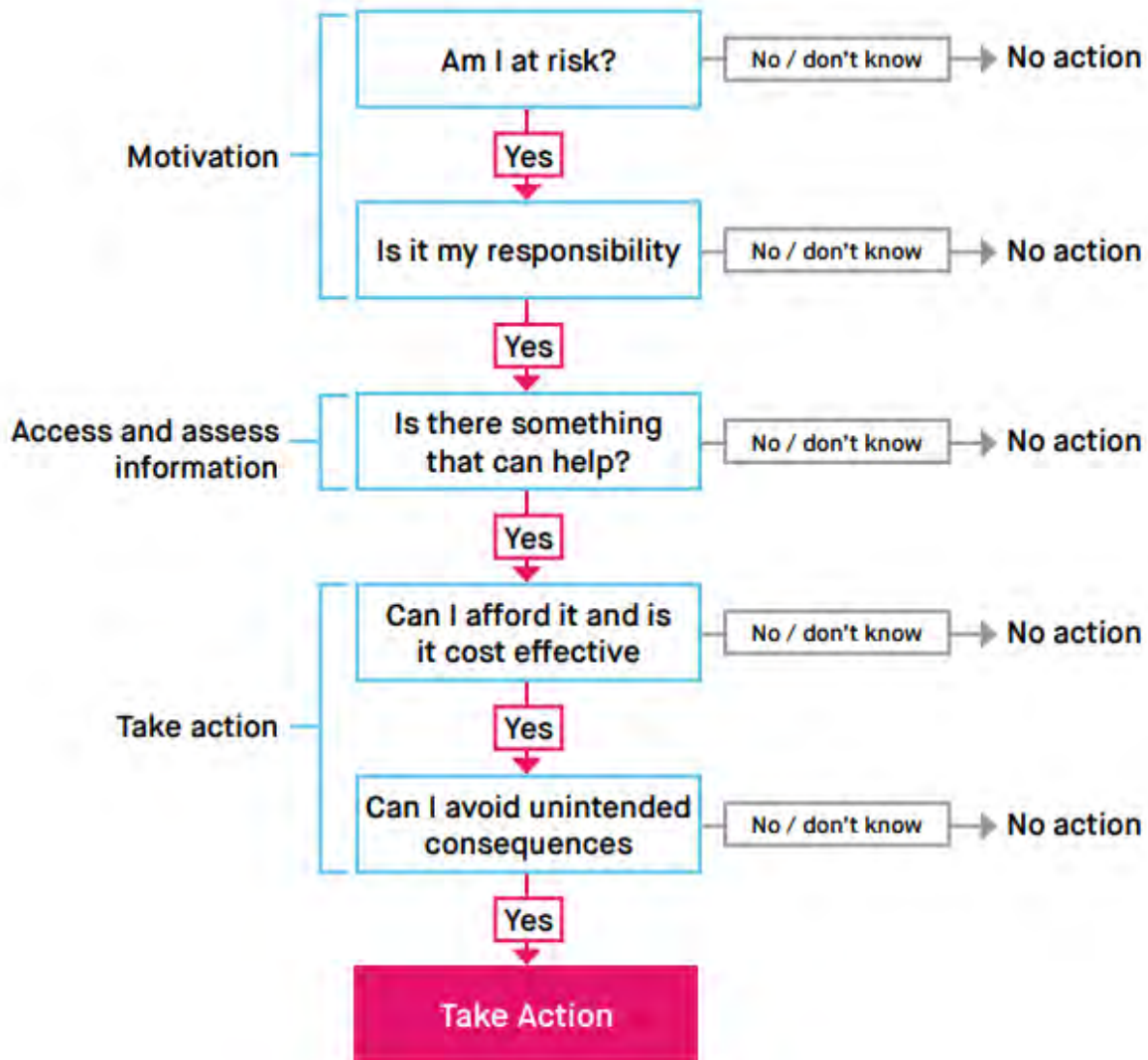
The challenges and barriers can be divided into three categories depending on the stage of the decision-making process: motivation, information on the adaptation process, and action (Oakley 2018).

Motivation barriers relate to the appraisal by homeowners that the house is at risk, that damage can occur, and that they are responsible to protect their house (Oakley 2018). These are primarily information-based barriers, with homeowners having insufficient information on the risk and their responsibility, or lacking trust in the information and its source (Oakley 2018). This can relate to *threat appraisal*, discussed below.

Information on the adaptation process relates to homeowners understanding the adaptation options available for their property, the available products and services, and the costs and benefits of those options (Oakley 2018). These information-based barriers involve homeowners having insufficient information (Oakley 2018). This can relate to *coping appraisal*, discussed below.

Barriers to action relate to homeowners' ability to adapt, including lacking necessary skills and financial resources to act, and being able to weigh the costs, benefits, and unintended consequences of their decisions (Oakley 2018).

The following figure, taken from the United Kingdom's Social Market Foundation's 2018 report *Incentivising Household Action on Flooding: Options for Using Incentives to Increase the Take Up of Flood Resilience and Resistance Measures*, outlines a potential homeowner decision-making process and how the challenges and barriers could prevent action:



(Oakley 2018)

Information and Education Needs: Risk

A 2024 survey by Nanos for DMG Events found that 87% of those surveyed were interested or somewhat interested in doing a better job preparing for possible

emergencies like extreme weather events, power disruptions and other natural disasters, but 57% felt too little quality information was publicly available about emergency preparedness overall for natural disasters such as floods, wildfires, smoke or other unexpected extreme weather events (Nanos 2024).

Easy-to-digest risk information for homeowners on current and future climate change hazards is lacking; this limits the understanding of the need for adaptation actions (Moudrak 2020) (Warren and Lulham 2021) (Ness, Clark, et al. 2021) (Ziolecki and Thistlethwaite 2019). Evidence of this is found in surveys, for example, one conducted in 2020 by Ziolecki et al., which found that among people living in designated flood risk areas vulnerable to severe and recurrent flooding:

- only 6% of respondents knew that they were living in a designated flood risk area,
- 63% did not think that the flood risk to their home would change over the next 25 years,
- 47% of respondents were not concerned about flood risk to their home, and
- only 8% were moderately or extremely concerned about the flood risk to their home (Ziolecki, Thistlethwaite and Henstra, et al. 2020).

These findings were echoed in an earlier survey by Thistlethwaite et al. in 2016 that targeted those living in high flood risk communities, which found:

- only 6% thought that they lived in a designated flood risk area,
- 13% thought that they lived in an area vulnerable to floods,
- 50% were not concerned about their current flood risk,
- 30% were slightly concerned,
- 12% were somewhat concerned,
- 8% were moderately or extremely concerned, and

- 75% did not feel their risk would increase over the next 25 years (Thistlethwaite, Henstra and Brown, et al. 2017).

A lack of easy-to-digest risk information also limits consideration of risks when purchasing a home (Warren and Lulham 2021) (Ness, Clark, et al. 2021) (St. Amour-Gomes, Heldsinger and Peddle 2018) (Ziolecki and Thistlethwaite 2019) (Lerner 2022). A 2023 survey by Leger conducted on behalf of BNN Bloomberg and Rates.ca found that just 35% of homeowners considered the potential risks of climate-induced weather patterns when buying a home (Khan 2023).

Information on climate hazards and risk as they relate to homes is urgently needed (Chopik and Stewart 2022). Gaps exist, also, in information regarding how to assess and calculate the costs of those risks (Warren and Lulham 2021) (Ness, Clark, et al. 2021). Therefore, many homeowners are not aware of or motivated to reduce their risk due to a perceived lack of urgency (Ness, Clark, et al. 2021) (Canada 2020a) (Evans and Feltmate 2019). Being aware of the risk is a pre-requisite to taking action (Oakley 2018). Evidence of this comes from the uptake of the Home Flood Protection Program, described in Section 1.4, where enrolment was highest in neighbourhoods with a history of flooding, at 68%, compared to 32% in neighbourhoods not impacted by flooding. (Feltmate, Evans and Moudrak 2017).

Without an understanding of the risks, homeowners may believe:

- they are not vulnerable or are less vulnerable than others (Andrasko 2021),
- their vulnerability has been reduced after a recent disaster because they believe there are long intervals between local disasters (1-in-100 years) (Oakley 2018) (McFarlane, McGee and Faulker 2011), or
- if they had experienced a minor event, that all future events will be just as minor (McGee, McFarlane and Varghese 2009).

In contrast, homeowners who experience a great loss after an event may believe that no adaptation measures would be effective to prevent damage (McGee, McFarlane and Varghese 2009); although research from the Netherlands, Germany, Japan, and Scotland have found a relationship between experiencing a flood and homeowners then adopting or having increased interest in adopting protective measures (Thistlethwaite, Henstra and Brown, et al. 2017).

Homeowners must also navigate different household members having different opinions on risk and the effectiveness of the adaptation strategies (McFarlane, McGee and Faulker 2011) (Faulkner, McFarlane and McGee 2009). Even if information is available, homeowners may not be interested in becoming informed, may not trust who supplied the information, or may not trust the information itself (Oakley 2018) (Andrasko 2021). Or homeowners may not understand the available information. For example, a 2016 survey by Partners for Action found that just 30% of respondents identified that a 1-in-100-year flood zone has a roughly 25% chance of being flooded over the course of a 25-year mortgage (Ziolecki and Thistlethwaite 2019).

An area of academic research has developed that is dedicated to risk perception and applying the theories to flood risk perception and wildfire risk perception. Risk perception is the internalization of the hazard, exposure, and vulnerability, where homeowners interpret how much danger they face (Thistlethwaite, Henstra and Brown, et al. 2017). Many of the theories relate to the Protection Motivation Theory (PMT), which seeks to understand how *threat appraisal* and *coping appraisal* influence behaviour to take protection and self-preservation action (Andrasko 2021) (Wouter Botzen, et al. 2019). *Threat appraisal*, for a homeowner, refers to the perception that a disaster is likely and will damage their home enough to warrant adaptation (Andrasko 2021)

(McFarlane, McGee and Faulker 2011). *Coping appraisal*, for a homeowner, refers to the perception that adaptation efforts will be effective in reducing the risk, that the homeowner can be effective in implementing the adaptation actions, and that the adaptation actions are worth the time, money, and effort (Andrasko 2021) (McFarlane, McGee and Faulker 2011) (Wouter Botzen, et al. 2019). The theory assumes that if both threat and coping appraisals are high, then homeowners will adopt protective behaviours, but if one is not high, then homeowners will not act (Andrasko 2021). Different researchers have modified PMT by examining the influence of additional factors such as trust, sense of responsibility, temporal changes, emotions, personal experience with the hazard, personal characteristics, personal resources (skills and money), public policy, social norms, and social support (Andrasko 2021) (McFarlane, McGee and Faulker 2011) (Wouter Botzen, et al. 2019).

People tend to struggle to make decisions in situations with uncertainty, for example when risk is involved (Oakley 2018). Often, people deny the threat is real or will affect them (Andrasko 2021). The perceived and actual risks can be misaligned (Andrasko 2021). People want to feel secure in their home, which leads to the dismissal, ignoring, and explaining away of risk, or to believing the responsibility to respond falls to others, such as government (Oakley 2018). Otherwise, homeowners would accept that they and their homes are in danger (Oakley 2018). Homeowners can, for example, judge a wildfire as probable, but that firefighters will protect their home or that the damage to their home will be minor (McFarlane, McGee and Faulker 2011). Or homeowners can judge a wildfire to be very damaging, but of low likelihood to occur, so they do not believe it necessary to spend money and effort on removing or maintaining trees and vegetation (McFarlane, McGee and Faulker 2011).

A gap exists between the intent to act and actually doing so. This can result from a lack of resources, including time, money, and social support, leading a homeowner to discount the benefits of adoption (Thistlethwaite, Henstra and Brown, et al. 2017). It is reasoned that poor uptake of adaptation actions can be attributed to underestimating the risks, a lack of a sense of personal responsibility, and perceived high costs (Thistlethwaite, Henstra and Brown, et al. 2017).

Ultimately, a homeowner must perceive the risk to their home, determine the risk to be significant, believe adaptation to be effective, and believe that the benefits of action outweigh the costs and unintended consequences (Oakley 2018) (McFarlane, McGee and Faulker 2011). Homeowners will discount the risk, downplay the threat, and minimize the danger if they believe adaptation costs outweigh the benefits, or if the benefits of living in a place are heavily weighted, even in the face of high awareness of risk (Oakley 2018) (McFarlane, McGee and Faulker 2011) (Lechowska 2018). Incentives, such as social pressure, financial charges, or subsidies, can help to overcome barriers to adaptation (Andrasko 2021).

Information and Education Needs: Adaptation Measures

Awareness is lacking about adaptation choices and their effectiveness, costs, and benefits (Warren and Lulham 2021) (Canada 2020a) (Ziolecki and Thistlethwaite 2019) (McFarlane, McGee and Faulker 2011). In the 2016 survey, Thistlethwaite et al. found, among 11 common flood protection measures, the highest reported implementation rates were for:

- grading the property away from the house, at 24%,
- moving expensive items from the basement, at 19%, and
- installing exterior foundation drainage, at 18% (Thistlethwaite, Henstra and Brown, et al. 2017).

Ziolecki et al. in 2020 also found low levels of adaptation (Ziolecki, Thistlethwaite and Henstra, et al. 2020).

Homeowners may not believe their actions outweigh perceived negatives. For example, they may not want to cut down a tree to reduce wildfire risk, because it would reduce privacy, wind breaks, shade, wildlife, and aesthetics, or they may not want to move away from a river because of the perceived benefits (Canada 2020a) (Andrasko 2021) (McFarlane, McGee and Faulker 2011) (Faulkner, McFarlane and McGee 2009). Homeowners would need to balance the benefits, for example, of living in a forested area, against the probability of a disastrous wildfire occurring (Faulkner, McFarlane and McGee 2009).

Homeowners may not understand the costs or the value for money of various adaptation measures, which includes an understanding of the potential costs of damage from the risk and the cost of adaptation (Oakley 2018). Homeowners may not want to spend money on prevention if they do not know about or understand the benefits (St. Amour-Gomes, Heldsinger and Peddle 2018). Homeowners may only be interested in low-cost, low-effort action, such as moving wood piles or watering the grass, rather than larger actions such as removing trees or large changes to the house such as a fire-resistant roof (Andrasko 2021) (McFarlane, McGee and Faulker 2011) (Faulkner, McFarlane and McGee 2009).

Homeowners may not want to differ from neighbourhood norms of acceptable landscaping aesthetics (McFarlane, McGee and Faulker 2011). Inversely, homeowners are more likely to act if they know friends and neighbours have taken action (Wouter Botzen, et al. 2019). Related to norms, homeowners may hesitate to adapt if they believe doing so would a signal risk and past damage at time of sale of their property, affecting the number of interested buyers or property value (Oakley 2018).

Information and Education Needs: Roles and Responsibility of Homeowners, Insurance, and Government

Homeowners' understanding of insurance coverage and of the level of assistance governments provide after a disaster is limited (Warren and Lulham 2021). Ziolecki et al. found:

- 50% of respondents did not know if their insurance policy would cover damage from different types of flooding, and
- only 26% reported that their insurance representative had discussed flood insurance options with them (Ziolecki, Thistlethwaite and Henstra, et al. 2020).

Ziolecki et al. asked who had the most responsibility to pay for damages from floods:

- 76% said insurance companies,
- 36% said local governments,
- 34% said homeowners,
- 34% said provincial governments, and
- 40% said government disaster assistance should pay the full cost of flood damages (Ziolecki, Thistlethwaite and Henstra, et al. 2020).

In the same survey, 52% responded that, if government disaster assistance was no longer offered, then they would purchase overland flood insurance (Ziolecki, Thistlethwaite and Henstra, et al. 2020). Without being aware of the risks, homeowners may not purchase sufficient insurance, particularly for flood risk (Canada 2022a). Or homeowners may assume that flooding is covered by standard home insurance policies (Canada 2022a).

Some homeowners may believe the government is responsible to protect their homes from climate change hazards, particularly wildfires and flooding (Oakley 2018) (Andrasko 2021) (McFarlane, McGee and Faulker 2011) (Kovacs, Guilbault

and Sandink 2014). In addition to government, insurance companies, researchers, planners, firefighters, civil protection services, and neighbouring communities can be seen as responsible parties (Andrasko 2021). This can lead to a false sense of security by homeowners that first responders and government will take care of them and mitigate the risk, and can result in the homeowners being less likely to adapt (St. Amour-Gomes, Heldsinger and Peddle 2018) (McFarlane, McGee and Faulker 2011) (Faulkner, McFarlane and McGee 2009). For example, homeowners may think all wildfires can be extinguished and that failures to do so are the fault of protection agencies, rather than their own (St. Amour-Gomes, Heldsinger and Peddle 2018) (McFarlane, McGee and Faulker 2011). Homeowners often view local governments as responsible for keeping wastewater and stormwater from private properties, although, in fact, homeowners are expected to take steps to protect their property (Kovacs, Guilbault and Sandink 2014). Homeowners living near an embankment, dam, or levee may underestimate their flood risk and not adapt their homes, because they believe the embankment, dam, or levee will protect their home (Andrasko 2021) (Lechowska 2018). Ziolecki et al. asked respondents who had the most responsibility to protect homes from flooding:

- 62% said municipal governments,
- 57% said homeowners, and
- 50% said provincial government (Ziolecki, Thistlethwaite and Henstra, et al. 2020).

A 2022 survey of home insurance policyholders by the Insurance Bureau of Canada found that 85% of respondents believed that protecting Canadians from current natural disasters due to climate change should be a priority for governments (Insurance Bureau of Canada 2022b).

Support Needs During Implementation of Adaptation Measures

Homeowners also face resource barriers and challenges to taking action:

- a lack of money,
- a lack of time,
- a lack of personal skills and expertise,
- difficulty finding qualified contractors,
- the receipt of conflicting advice to tackle a problem, and
- difficulty finding practical solutions, with an example given of wanting to extend a downspout but realizing it would be a tripping hazard. (St.

Amour-Gomes, Heldsinger and Peddle 2018) (Evans and Feltmate 2019)

Homeowners may have difficulty finding contractors who can complete their work in a timely manner, and may have difficulties finding contractors for smaller jobs (Evans and Feltmate 2019).

Although some support programs and financial assistance exists, homeowners can be discouraged by the application processes and length of time required to access the support (Oakley 2018).

1.4 What are the tools to drive action?

This Section is divided into three main sub-sections that describe potential tools to help homeowners take adaptation action, including information and education support, financial and fiscal support, and support from government policy and regulation.

To prevent being inundated by climate change damage to homes, Canada must act now to prevent loss and damage (Ness, Clark, et al. 2021). *Canada's National Adaptation Strategy: Building Resilient Communities and a Strong Economy* has set the target that by 2025 60% of Canadians, including northerners and Indigenous Peoples, will be aware of the disaster risks facing

their household, and 50% of Canadians will have taken concrete actions to better prepare for and respond to climate change risks facing their households (Canada 2023a). Homeowners will need various support and assistance to overcome the challenges and barriers listed in Section 1.3 to be able to take action and implement adaptation measures. As mentioned in Section 1.3, it is reasoned that the poor uptake of adaptation actions is attributed to underestimating the risks, lacking a sense of personal responsibility, and perceived high costs (Thistlethwaite, Henstra and Brown, et al. 2017).

Although there are uncertainties in understanding of the effects of climate change, it is necessary to learn how to cope with the uncertainties and variability in order to adapt to the new and changing climate (Warren and Lulham 2021). Two quotes stand out from the Canadian Climate Institute's 2020 report *Tip of the Iceberg: Navigating the Known and Unknown Costs of Climate Change for Canada*,

While the awareness of the need for climate change adaptation in Canada is growing and more and more individuals and organizations are considering new risks in their day-to-day choices, action so far remains insufficient to substantially reduce Canada's vulnerabilities. While there are many promising examples of adaptation being implemented, progress is inconsistent across different regions, communities, economic sectors, and governments. In the meantime, economic, social, and environmental costs continue to spiral...

The path forward may be shrouded in fog, but standing still is not an option.

(Sawyer, et al. 2020)

Information and Education Supports

Several of the homeowner challenges and barriers described in Section 1.3 relate to the need for information to raise homeowner awareness, and education to increase the capacity to implement adaptation measures.

The objective should be to make homeowners across Canada aware of their risks and understand the action they can take to reduce their vulnerability (Oakley 2018) (Partners for Action n.d.). The messaging should move homeowners:

- to being aware of the risks to their homes,
- to identifying what they can do to reduce the risks,
- to completing a series of adaptation actions, including
- to seasonally maintain their houses (Evans 2023).

A wide range of approaches, as opposed to one single strategy, are required (Oakley 2018).

Homeowner awareness of the risks and adaptation measures appears low despite the existing informational and educational materials developed by different organizations including government, academic institutions, research groups, and insurance companies (referenced in Section 1.3, Appendix A, Appendix B, and Appendix C) (Bakos 2022) (St. Amour-Gomes, Heldsinger and Peddle 2018). Canadian homeowners are constantly exposed to information competing for their attention, making it difficult to develop effective messages that will reach the right audiences (Ziolecki and Thistlethwaite 2019). When presented with information, consumers and homeowners will ask themselves the following questions:

- Is the information trustworthy? Do I trust who shared it? Do I trust the sources of the information?
- Is the information highly relevant to me? Is it written in a language I understand? Is this relevant to my home and neighbourhood? Do I have the authority to take action? Do I have the resources to take action (money, skills, access to contractors)?
- Do I need to deal with this now or can I put it off until later? (Evans 2023)

At the outset, it is important to establish the goals of the communication effort. In general, it is difficult to measure the effectiveness of communication efforts, particularly where they are not evaluated and measured against the goals (Seifert-Dähnn 2018). To maximize effectiveness, a series of pilot test messages can be developed and evaluated to determine how to best communicate them and to whom before widespread deployment (Oakley 2018). Communication strategies should seek feedback on what is going well and what could be improved and then update them as required (Evans 2023). Consultation with experts in the behavioural sciences is recommended to help navigate the challenges and barriers (Oakley 2018).

A number of communication best practices and recommendations are captured in the sub-sections below. Many best practices are outlined and discussed further in the Intact Centre on Climate Adaptation's report *Water on the Rise: Protecting Canadian Homes from the Growing Threat of Flooding*, and Partners for Action's reports:

- *Communicating Flood Risk to Canadians: Understanding the Challenges and Developing Best Practices Findings from A Research Workshop*,
- *Awareness To Action: Effectively Communicating Flood Risk to Canadians Final Report*, and
- *Flood Risk Reduction in Canada: The Road to Becoming a Trusted Source for Preparedness Information*.

Communication Content

Communication messaging is needed that targets:

- the risk,
- the audience,
- homeowner responsibility,
- simple, positive messages, and

- financial support.

The accurate perception of risk needs to increase (Thistlethwaite, Henstra and Brown, et al. 2017). Homeowners need information on the risks, on adaptation opportunities and why actions are important, and on available support and funding, to inform their decision-making (Canada 2022a) (St. Amour-Gomes, Heldsinger and Peddle 2018) (Ziolecki and Thistlethwaite 2019) (Minano and Peddle 2018). A focus should be communicating the authenticity and urgency of risks, describing past experiences with disasters, and providing risk maps (Evans and Feltmate 2019). Messaging should be limited to the most relevant information for the specific type of risk that is being focused on and that is relevant to the specific community/neighbourhood (St. Amour-Gomes, Heldsinger and Peddle 2018) (Chopik and Stewart 2022) (Evans and Feltmate 2019) (Partners for Action n.d.). The adaptation suggestions should be specific to individual houses (Evans and Feltmate 2019). Materials should be honest in communicating that the adaptation measures reduce but do not eliminate a given risk (McGee, McFarlane and Varghese 2009), and that some residual risk will continue to exist (Andrasko 2021).

Generic information may be ignored (Partners for Action n.d.). Recent communication theory does not assume that the passive distribution of hazard and risk information is enough to motivate action, and instead indicates more targeted and persuasive outreach is required (Ziolecki and Thistlethwaite 2019). The materials need to be tailored to the audience, including their demographics, past experiences with the hazards, attitudes, values, needs, and current behaviours, which can help officials understand why a homeowner might not take action (St. Amour-Gomes, Heldsinger and Peddle 2018) (Ziolecki and Thistlethwaite 2019). Homeowners want to see themselves and their needs in the messaging, and the messages should be customized to targeted audiences

to increase relevance (Partners for Action n.d.). Messages need to be translated into multiple languages (St. Amour-Gomes, Heldsinger and Peddle 2018).

A focus is required on homeowners' responsibility and opportunity to take action to protect their homes, and that the actions they take at home complement the actions taken by governments and insurance companies (Evans and Feltmate 2019). Communication should emphasize the shared responsibility between local governments and homeowners to address the risks, and that homeowner efforts can make a difference (McFarlane, McGee and Faulker 2011) (Kovacs, Guilbault and Sandink 2014). As part of communicating the role and responsibility that homeowners have to protect their properties, municipalities must communicate: the state of their infrastructure and what it can and cannot accomplish, the resource limitations, the protection measures they implement at the community level, and the role of local authorities during an event, such as among fire agencies during a wildfire (Blakelock 2019) (St. Amour-Gomes, Heldsinger and Peddle 2018) (McFarlane, McGee and Faulker 2011).

Community-based social marketing experts noted that people are more likely to do what they see others doing (Ziolecki and Thistlethwaite 2019). Adaptations are not always obvious to others compared to things like recycling, so it can be more challenging to influence social norms (Wouter Botzen, et al. 2019). Messaging should highlight the actions taken by community members to develop social norms to encourage action (Partners for Action n.d.). Research found that in communities that defined risk as a prevention issue, homeowners were more likely to undertake adaptations compared to communities that defined risk as a response issue (Faulkner, McFarlane and McGee 2009). The social norms of the community informed and influenced the risk response by individual homeowners (Faulkner, McFarlane and McGee 2009). For example,

governments can work towards setting new social norms and standards for wildfires through vegetation management, infrastructure modifications like widening access routes, bylaws and policies, emergency management plans, firefighter training, and education programs for homeowners (Faulkner, McFarlane and McGee 2009). These new standards influence homeowner decisions and motivate action, and as more homeowners do so, they continue to set new standards for the community (Faulkner, McFarlane and McGee 2009). Materials should share real-life actions taken by others to encourage action, and homeowners should be reminded about the importance of their contributions, as the cumulative efforts of homeowners contribute to reducing the vulnerability of communities (Canada 2022a) (St. Amour-Gomes, Heldsinger and Peddle 2018) (Ziolecki and Thistlethwaite 2019).

In the 2022 survey by Leger for Environment and Climate Change Canada, 49% said that better understanding the positive and direct impacts of changing some of their habits would help them adapt to climate change (Leger Marketing 2023). About 52% of respondents said they would like to obtain a list of actions that they can take to help them adapt to climate change (Leger Marketing 2023). Messages, it has been found, should include specific actions that homeowners can accomplish and explain why they are important (Partners for Action n.d.). Experts in community-based social marketing have noted that materials need to identify specific actions that homeowners should take, explain why they are important, and make the messages memorable (Ziolecki and Thistlethwaite 2019). Instructions should be simple (St. Amour-Gomes, Heldsinger and Peddle 2018). The information provided must be accurate (Evans and Feltmate 2019). Materials should describe small, tangible, incremental steps that homeowners can take to avoid information overload (St. Amour-Gomes, Heldsinger and Peddle 2018) (Ziolecki and Thistlethwaite 2019). Linking risk reduction to action

can motivate and empower (St. Amour-Gomes, Heldsinger and Peddle 2018). Messages should aim to decrease the real and perceived barriers to action and increase the perceived benefits, while increasing perceived barriers to competing behaviour, such as choosing to delay the action, and decreasing the competing behaviour's perceived benefits (Ziolecki and Thistlethwaite 2019). It may be desirable to have a flow chart of the steps to implement adaptation actions, for example, to help homeowners answer the question of what to do next (St. Amour-Gomes, Heldsinger and Peddle 2018). Language and terminology should be consistent across various sources (St. Amour-Gomes, Heldsinger and Peddle 2018) (Chopik and Stewart 2022).

Ensure materials are simple and easy to understand (Evans and Feltmate 2019). Messages should not use technical language, but instead use plain language to increase understanding (St. Amour-Gomes, Heldsinger and Peddle 2018) (Partners for Action n.d.) (St. Amour-Gomes, Heldsinger and Peddle 2018) (Ziolecki and Thistlethwaite 2019). Messages can focus on the impacts of flooding and connect to personal stories and anecdotes, with the faces and stories of others being more impactful than an overload of numbers (St. Amour-Gomes, Heldsinger and Peddle 2018). Material should interpret confusing terminology used to describe risk, such as 100-year flood (Partners for Action n.d.). To increase understanding, risk can be communicated over a meaningful time period, such as over a 25- or 30- year mortgage lending period (Wouter Botzen, et al. 2019) (Partners for Action n.d.). This is done in Alberta's new Flood Awareness Map Application that illustrates cumulative flood risk over 30 years in its Flood Likelihood maps (Alberta n.d.). Examples of wording changes include changing "proximity to" to "near", "comply with" to "follow", "in the near future" to "soon", "is authorized to" to "may", "magnitude" to "size", "monitor" to "watch", and "numerous" to "many" (Ziolecki and Thistlethwaite 2019).

Ensure homeowners have the necessary information to make informed decisions, and have the skills and support they need to act (St. Amour-Gomes, Heldsinger and Peddle 2018) (Evans and Feltmate 2019). Homeowners are more likely to act if they believe they have the ability to act (Evans and Feltmate 2019). Homeowners need to know the effectiveness and importance of the action they take, how easy some measures can be adopted, and understand the required time, effort, and cost (Thistlethwaite, Henstra and Brown, et al. 2017) (St. Amour-Gomes, Heldsinger and Peddle 2018) (Wouter Botzen, et al. 2019).

Messages that are developed with an optimistic and helpful tone can be more likely to garner attention and persuade homeowners to take action (Partners for Action n.d.). Research has shown that messages are more likely to be ignored or discounted if they evoke negative emotions, as they can make people feel discouraged, powerless, helpless, and overwhelmed (Ziolecki and Thistlethwaite 2019). Positive and hopeful messages can nudge homeowners to act (Ziolecki and Thistlethwaite 2019). Examples of positive and hopeful messages include action-oriented statements that explain what a homeowner should do and why, images of homeowners helping themselves and taking action, using humour and catchy phrases, and showcasing success stories (Ziolecki and Thistlethwaite 2019). Messages should focus on motivators such as on reducing damage to property, eliminating unsafe conditions, and reducing stress and worry (St. Amour-Gomes, Heldsinger and Peddle 2018).

Homeowners want to know if installations related to adaptation will provide a reasonable return on investment relative to the risk (St. Amour-Gomes, Heldsinger and Peddle 2018) (Evans and Feltmate 2019). Materials should encourage actions to reduce personal financial risk, and describe the role of and qualification conditions for insurance and disaster assistance (St. Amour-Gomes, Heldsinger and Peddle 2018) (Partners for Action n.d.). Homeowners need to

know when low-cost and low-time options are available (St. Amour-Gomes, Heldsinger and Peddle 2018) (Oakley 2018), and that adaptation measures not only protect against the next hazard event, but for every event that follows (Moudrak 2020). Messages should emphasize the need to “protect your asset” (Chopik and Stewart 2022). Messages should provide information on available financial assistance and subsidies (St. Amour-Gomes, Heldsinger and Peddle 2018), and potential insurance benefits.

Communication Channels

Communication channels are needed that utilize:

- trusted sources,
- a variety of sources, and
- ongoing and timed messages.

Creating education materials is not enough, outreach through many channels of communication is required (Blakelock 2019). Determining the most appropriate, trusted messengers for the information is crucial (Pianet 2024). Materials from trusted sources increase the chance that people will pay attention and act (Ziolecki and Thistlethwaite 2019). The materials must come from a wide variety of trusted sources including federal, provincial, and municipal governments, conservation authorities, employers, non-governmental organizations, and the media, and be vetted by trusted individuals such as family, friends, neighbours, coworkers, contractors, and retailers (St. Amour-Gomes, Heldsinger and Peddle 2018) (Evans and Feltmate 2019) (Partners for Action n.d.). Materials should encourage talking to friends, family, and neighbours about risks and adaptation actions to raise awareness, as social networks can be very influential (Ziolecki and Thistlethwaite 2019) (Oakley 2018) (Faulkner, McFarlane and McGee 2009).

Of particular importance are messages from local officials and sources within the municipality, including fire departments (Partners for Action n.d.). It is anticipated that local officials are best positioned to understand the specific risks of their communities, identify the challenges of their communities, and be able to target messages (Partners for Action n.d.). In the United Kingdom, the Environment Agency provides funding for the development of community-based flood action groups, which provide information on flood risk and adaptation measures, the required resources, and insurance (Thistlethwaite, Henstra and Brown, et al. 2017). Community members can also volunteer to become flood wardens, helping others in high-risk areas to prepare for flood events (United Kingdom Environment Agency 2021). Another key stakeholder in communication is the Canadian Red Cross, because Canadians trust it as a source of disaster information (St. Amour-Gomes, Heldsinger and Peddle 2018).

Training and information are required for home inspectors, realtors, insurance and mortgage brokers, not-for-profit staff members, contractors, local hardware stores, and others who may support and engage homeowners in risk reduction education (Oakley 2018) (Evans and Feltmate 2019). See *Information from Contractors and Other Housing Professionals* below.

Ziolecki et al. found that the survey respondents believed the responsibility of communicating flood risk falls to multiple stakeholders including all levels of government, insurance companies, and real estate professionals (Ziolecki, Thistlethwaite and Henstra, et al. 2020). All stakeholders involved in the housing supply chain have a responsibility to communicate to homeowners (Chopik and Stewart 2022). Partnerships and alliances among organizations are needed to align, strengthen, expand, and increase risk communication (Oakley 2018) (Ziolecki and Thistlethwaite 2019) (Partners for Action n.d.).

Free access is required to a variety of third-party communication materials, including fact sheets, how-to videos, case studies, self-assessment checklists, seasonal maintenance checklists, questions to ask insurance providers, tips for selecting contractors, and tips for accessing local subsidies (St. Amour-Gomes, Heldsinger and Peddle 2018) (Evans and Feltmate 2019). Homeowners need to know all of the resources and solutions available to them, including financial incentives and supports (St. Amour-Gomes, Heldsinger and Peddle 2018). These can be distributed in property tax bill inserts, newsletters from councillors, social media posts, community centres, and hand-delivered flyers (Moudrak 2020) (St. Amour-Gomes, Heldsinger and Peddle 2018). Some Canadian organizations have developed home adaptation information and infographics that other stakeholders can distribute (Moudrak 2020). The Intact Centre on Climate Adaptation has also developed a check-up app for flood risk that homeowners can complete in 10 minutes and that identifies vulnerabilities and adaptation actions for their home (Moudrak 2020). It includes links to relevant sources, questions for insurance companies, and information on subsidies (Moudrak 2020). In the 2022 survey by Leger for Environment and Climate Change Canada:

- 28% said that a website or mobile application could help them plan their adaptation approach,
- 18% said they would like information from an expert or receive training, and
- 16% said they would like to be part of a group where they can ask questions and received advice when they are having difficulties (Leger Marketing 2023).

Communication needs to be a process and not a single event (Ziolecki and Thistlethwaite 2019). Homeowners will need regular reminders on their risk and

the need for and importance of adaptation measures, including repeated seasonal maintenance activities (Evans and Feltmate 2019) (Minano and Peddle 2018). It is anticipated that continual communication efforts will be needed, perhaps even continued across decades (St. Amour-Gomes, Heldsinger and Peddle 2018) (Kovacs, Guilbault and Sandink 2014) (Seifert-Dähnn 2018). Research for the Home Flood Protection Program, described in *Programs* below, found that the best time for promoting flood adaptation measures is from March to June, which aligns with spring melts and heavy rains, and also when many homeowners undertake renovation and garden projects (Feltmate, Evans and Moudrak 2017). It will take effort to coordinate the delivery of materials at key times throughout the year (Partners for Action n.d.).

Opportunities will need to be created for homeowners to participate in discussions and decision making (Evans and Feltmate 2019). Homeowners are more likely to act if they feel they have made well-informed decisions rather than being told what to do (Evans and Feltmate 2019). Changing behaviour, fostering confidence in actions, identifying opportunities, and generating a sense of ownership over the problems may require collaborative problem-solving with professionals and community members (Thistlethwaite, Henstra and Brown, et al. 2017).

An expert workshop hosted by Partners for Action in 2019 identified Canadian youth as an important target audience, as they communicate what they learn with the adults in their life and can encourage households to take action (Ziolecki and Thistlethwaite 2019) (Partners for Action n.d.).

Information from Contractors and Other Housing Professionals

This Section identified the importance of homeowners receiving information and education support from a variety of sources including home inspectors, realtors, insurance and mortgage brokers, not-for-profit staff members,

contractors, renovators, and local hardware stores. These groups will require education and resources to be able to effectively engage homeowners and encourage them to reduce their risk (Moudrak 2020) (Evans and Feltmate 2019). Home inspectors will require training to integrate climate risk considerations into their home inspections (Evans and Feltmate 2019). Contractors, renovators, and staff at hardware stores should also be able to provide homeowners with information on available subsidies (Evans and Feltmate 2019). As contractor knowledge and understanding increase, this would facilitate them incorporating low cost and no cost adaptation measures as part of the work they normally do particularly where they do not impact the aesthetics of their work (Oakley 2018).

As part of the Home Flood Protection Program, described in *Programs* below, a 5-day and a 2-day in-person training program was developed for assessors (Feltmate, Evans and Moudrak 2017). The program was developed with the engagement of specialists in municipal engineering, landscaping, and home inspection (Feltmate, Evans and Moudrak 2017). The assessors had to achieve 80% on their tests and complete two assessments and reports (Feltmate, Evans and Moudrak 2017).

Seneca College and Fleming College developed a 14-week online course based on *CSA Z800 Guideline on Basement Flood Protection and Risk Reduction*, which was released in 2018 (Moudrak 2020). The course was intended for home and property inspectors, insurance brokers and adjusters, mortgage professionals, engineers and planners, emergency managers and first responders, real estate brokers and agents, landscapers, and home builders and renovators (Moudrak 2020). The objective of the course was to increase knowledge and understanding on common vulnerabilities from property flooding and how to address them (Moudrak 2020). A condensed, 1.5-hour version of the course was developed for industry associations, which has been offered by the Insurance Brokers

Association of Canada, Mortgage Professionals Canada, Canadian Association of Home & Property Inspectors, and Carson Dunlop (Moudrak 2020).

Homeowners may be required to engage with multiple contractors, for example foundation specialists, plumbers, landscape professionals, and eavestrough contractors, with no guarantee or quality control (Blakelock 2019). An opportunity exists for various contractors to offer the installation and maintenance of adaptation measures (Evans and Feltmate 2019). 54% of participants of the Home Flood Protection Program wanted increased access to trusted service providers, and 41% wanted help in selecting qualified contractors (Evans and Feltmate 2019). The participants had challenges finding qualified contractors and contractors for smaller jobs (Evans and Feltmate 2019). In addition, often construction companies have trouble innovating or absorbing new information due to a lack of capacity (National Research Council of Canada 2019). Effort is clearly required to increase the number of qualified contractors (Evans and Feltmate 2019), and organize them into trusted and effective business and service delivery units.

In 2024, the Canadian Home Builders' Association and the Institute for Catastrophic Loss Reduction started the *Resilient Homes Task Force*, with the goal to test efficient and cost-effective solutions for basement flooding, wildfire, hail, and high wind risks to homes (Canadian Home Builders' Association and the Institute for Catastrophic Loss Reduction 2024). The goal is to be able to develop resources and guides for both homeowners and the residential construction industry to reduce risks from those hazards (Canadian Home Builders' Association and the Institute for Catastrophic Loss Reduction 2024).

Data, Mapping, and Disclosure

The reviewed sources mentioned the lack of easy-to-digest risk information for homeowners and the great need for such information as a pre-requisite for

action, see Sections 1.3 *Challenges and Barriers* and 1.4 *Information and Education Supports*. This sub-section examines risk data, mapping, and disclosure.

Available Canadian Data

The Government of Canada's Canadian Centre for Climate Services (CCCS) Library of Climate Resources provides climate datasets, tools, guidance, and other resources to Canadians, with the objective to help Canadians find, understand, and use climate data, information, and tools while planning for and taking action towards adaptation (Bush and Lemmen 2019). Climate data is currently available to all Canadians through the website ClimateData.ca, which is a collaboration between Environment and Climate Change Canada (ECCC), the Computer Research Institute of Montréal (CRIM), CLIMAtlantic, Ouranos, the Pacific Climate Impacts Consortium (PCIC), the Prairie Climate Centre (PCC), and HabitatSeven, (Climate Data a). The objective of the ClimateData.ca website is to provide historical climate data and future climate projections to assist in accessing, visualizing, and analyzing relevant information while planning for and taking action towards adaptation (Climate Data a). The website also provides support tools, case studies, and other relevant information (Climate Data b). However, while the data is available to all Canadians, it is aimed at building and industry practitioners, and is not tailored to communicating risk to homeowners.

Understanding climate risks and vulnerabilities is key to making informed decisions regarding adaptation (Canada 2023a). Currently, homeowners do not have access to climate risk information for their homes, preventing them from understanding and addressing their risk and making informed decisions (Re/Max 2022) (Ness, Clark, et al. 2021) (Institute for Catastrophic Loss Reduction b) (Miller and Carriere 2024). Without relevant information on risks, costs, and

processes, a way to guide homeowners and society towards adaptation is lacking (Sawyer, et al. 2020).

Risk maps are critical tools to inform communities (Minano and Peddle 2018), and to be effective, the maps must be current. New, updated Canadian maps are needed to inform decision-making and encourage adoption of adaptation measures (St. Amour-Gomes, Peddle and Heldsinger 2018). Canada's federal government led the Flood Damage Reduction Program (FDRP) between 1975 and 1995 to manage the development of flood hazard mapping, in which all but Prince Edward Island and the Yukon participated (Lyle, Fang and Hund 2023). Many of these government-produced flood maps still exist today. However, most of them are now 20 years or more out of date, difficult to obtain, incomplete, inconsistent between areas, provide insufficient details, use differing technical methods, are from decentralized sources using multiple databases, and do not address changing risk due to climate change (Warren and Lulham 2021) (Ness, Clark, et al. 2021) (Re/Max 2022) (Re/Max 2022) (Lyle, Fang and Hund 2023). Many government departments and agencies and other stakeholders are responsible for flood maps, which can make it difficult for homeowners to determine where they should go to access the maps (Institute for Catastrophic Loss Reduction b). Access ranges from full access to the FDRP maps and some modern maps in Alberta and Quebec, to effectively no public access in Nova Scotia and the Northwest Territories (Lyle, Fang and Hund 2023). Even bigger gaps exist in risk information for homeowners on other climate hazards, such as wildfires (Ness, Clark, et al. 2021) (Bourque 2021). Ziolecki et al. 2020 found that 90% of their survey respondents thought that flood risk maps produced by governments should be publicly available (Ziolecki, Thistlethwaite and Henstra, et al. 2020).

Risk maps for the public are different than risk maps for experts (Minano and Peddle 2018). The different types of flood maps: *inundation maps* show floodwater extent, and aid in the management of emergency preparedness; *flood hazard maps* show the areas that could be flooded under different scenarios, and are used for regulatory and planning purposes; *flood risk maps* show the potential impacts of floods such as social, economical, environmental, and cultural consequences during specific scenarios; and *flood awareness maps* show the public the history of flooding in their community, the potential for future floods, the risks the flooding poses, and provide a narrative along with the map (Institute for Catastrophic Loss Reduction b) (Minano and Peddle 2018) (Re/Max 2022). Most existing maps are technical and for land use planning and engineering, rather than intended to inform homeowners (Re/Max 2022). Also, the existing maps usually only show flooding besides coasts and rivers, and rarely the damaging flash flooding of streets and sewers in urban areas (Ness, Clark, et al. 2021) (Institute for Catastrophic Loss Reduction b).

A homeowner may only be interested in the map to obtain information on their property, and if the map does not provide information at this level of detail, homeowners may lose interest and the map will not be effective to motivate action (Minano and Peddle 2018). It was also noted that simply developing and providing access to risk maps is no guarantee that the public will access or use them (Lyle, Fang and Hund 2023). Risk maps are most effective for public risk communication if they:

- are tailored for specific audiences and purposes,
- are paired with local information, including information about historical floods,
- are simple to understand, avoiding technical terminology,
- are provided online, through traditional media, and at public meetings,

- are promoted regularly through awareness campaigns,
- use property-specific, searchable web mapping services, and
- are paired with information on the consequences of flooding, actions homeowners can take to protect their homes, and who homeowners can contact for more information and assistance (Minano and Peddle 2018) (Lyle, Fang and Hund 2023).

More details can be found in Partners for Action's 2018 report *Using Flood Maps for Community Risk Communication*.

St. Amour-Gomes, Peddle and Heldsinger 2018 recommend actively engaging the community in the development of flood mapping to help with data collection, hazard identification, priority setting, and risk assessment (St. Amour-Gomes, Peddle and Heldsinger 2018). They put together a list of best practices for flood map community engagement:

- Listen to the needs and wants for each community as each community is unique. Project leaders should reach out to communities to determine community requests and sensitivities, explain the purpose of the process and maps, and design an engagement process.
- Engagement tools should be interactive, including interactive online maps, videos, animations, or hands-on activities, which increase engagement, comprehension, and interest.
- Use multiple tools and platforms, which assists with reaching different groups of people and demographics. This also helps address accessibility needs. Methods can include town halls, public meeting, information booths, websites, social media updates, workshops, focus groups, and map calibration using local and traditional knowledge.
- Ensure good facilitation to gain a meaningful engagement. Engineers and technical staff may not be best suited, and instead have a facilitator that

specializes in consultation and communication. It is critical that the general public understands the information being presented.

- Ensure the project information, resources, and deliverables are available to the public online or as traditional media if preferred. This keeps the public informed and interested, and shows accountability and transparency. (St. Amour-Gomes, Peddle and Heldsinger 2018)

Updated and future-looking flood maps and property-level risk information are urgently needed, and the development of these materials for other hazards, which should be available through a free, online portal (Moudrak 2020) (Bakos 2022) (Chopik and Stewart 2022). It was suggested to have a single source of risk disclosure data that is open, transparent, reliable, and accessible, and that includes the ability to incorporate feedback about the risk and adaptation efforts for individual properties (Chopik and Stewart 2022). The data needs to be accessible and targeted to the needs of different users and locations (Canada 2023a). Flood maps must be reviewed and updated regularly, with the European Union and the US FEMA suggesting every 5-6 years (Minano and Peddle 2018).

The Government of Canada in 2015 launched the National Disaster Mitigation Program that created flood hazard mapping guidelines and provided funding for mapping activities that followed those guidelines (Warren and Lulham 2021) (Canada 2016). Efforts are being made by federal agencies, provinces, territories, municipalities, conservation authorities, and Indigenous organizations to develop and provide flood maps for the entire country, and a flood risk portal for homeowners, municipalities, and provincial/territorial governments is in the process of being developed, using existing flood maps, scientific data, and new mapping initiatives, with \$15.3 million over three years being allocated in Budget 2023 (Browne 2023) (Warren and Lulham 2021) (Contant 2022) (Canada 2023b). The portal would provide Canadians with flood risk information and

guidance on how to protect their homes (Canada 2023b). *Canada's National Adaptation Strategy Building Resilient Communities and a Strong Economy* has set the target that, by 2028, the federal government, provinces, and territories have worked collaboratively to prioritize at least 200 higher-risk flood areas for new flood hazard maps and regional level modelling (Canada 2023a). In addition, the province of British Columbia is developing a hazard and risk data platform for its residents that will display risks at a provincial, regional, and local level (Climate Ready BC n.d.). Work is also underway in Nunavut to produce permafrost hazard maps for planners, in conjunction with the Canadian Space Agency, which can detect shifts in the ground via satellites (Schreiber 2018). The data is supported with land-based research (Schreiber 2018). These maps can inform where to build next and which houses are at risk of damage (Schreiber 2018).

International Examples

Flood maps are publicly available through online portals, often at a national scale, in European countries including Czechia, Germany, the United Kingdom, Luxembourg, Austria, and Sweden (Minano and Peddle 2018). The United States FEMA also provides this information (Minano and Peddle 2018). The United States also has several companies that have developed risk information for each property, including ClimateCheck, Risk Factor, Attom Data Solutions Home Disclosure Report, and CoreLogic's RiskMeter (Lerner 2022). These searchable websites provide property specific risk data for hazards including floods, wildfires, extreme wind, and extreme heat (Lerner 2022). This data can feed directly into the buying and selling process of homes, and prominent platforms, including realtor.com, include flood risk information in their listings (Moudrak 2020) (Lerner 2022).

Risk Disclosure at Time of Sale

Several of the reviewed sources mentioned the potential to integrate climate risk data into the home buying and selling process to help homebuyers assess the risks of properties they consider buying (Bakos 2022) (Re/Max 2022) (St. Amour-Gomes, Heldsinger and Peddle 2018) (Bourque 2021) (Ziolecki and Thistlethwaite 2019) (Iveson 2024) (Chopik and Stewart 2022) (McNutt 2022) (Davidson, et al. 2022) (Florez Bossio and Ness 2024). Examples included sharing risk information through a disclosure process, developing climate risk scores similar to walkability scores, or through assessments and performance certificates, see below. Currently, without climate risk information, homeowners and home buyers are victims of circumstance (Bakos 2022). Ziolecki et al. 2020 found that 89% of their survey respondents agreed that sellers should be required to advise potential buyers if the property is located in a flood risk area, and 90% indicated that, when selling properties in designated flood risk areas, real estate professionals should be required by law to inform potential buyers (Ziolecki, Thistlethwaite and Henstra, et al. 2020). The Insurance Bureau of Canada in their 2022 survey found that 88% of respondents agreed that home buyers should have access to a database that provides information on flood risk in surrounding areas and 61% support a publicly available flood portal (Insurance Bureau of Canada 2022b).

Arguments against including this risk data include reducing property values and creating stigma, although experiencing disasters such as flooding also impacts property values and length of time on the market (Canada 2022a) (Chopik and Stewart 2022) (Lyle, Fang and Hund 2023), see Section 1.2. It was noted, also, that the disclosure of flood maps does not change the actual risk for homes (Lyle, Fang and Hund 2023). Arguments for including this risk data include increasing risk awareness, ensuring transparency and information

equity for buyers and sellers, equitable and unbiased information dissemination, informing the purchase of additional insurance, allowing for a consistent response, identifying communities of resilience, driving additional investment, potentially lowering insurance premiums, and a step towards homeowners reducing their vulnerability and financial losses by increasing adoption of protection measures (Canada 2022a) (Re/Max 2022) (Chopik and Stewart 2022) (Re/Max 2022) (Lyle, Fang and Hund 2023). It would also allow the climate risk to be known not only to the homeowner but also the mortgage industry, and can inform discussions on the impacts climate change will have on the value of the property, creating a market that accounts for the value of climate change risk, pricing the risk at time of purchase and sale (Ness, Clark, et al. 2021) (C. Chopik 2022). However, the risk data must first exist, and be current and robust (Re/Max 2022), see the above section *Available Canadian Data*. Some States require the disclosure of various climate risks when selling a home; two examples include New York State, which requires disclosures regarding FEMA floodplains and federal flood insurance requirements (Sahn 2024), and California, which requires disclosures regarding fire hazard severity zones (California 2023).

One example of climate risk disclosure in Canada is found in Calgary, where the housing market was affected by fluvial river flood risk (C. Chopik 2022). The municipality and local real estate boards created a listing and selling resource that provided flood mapping alongside the walkability and transit scores (C. Chopik 2022). In another example, the American company ClimateCheck started working in 2023 with Montreal based Local Logic to offer climate scores in Canada, which are available on Royal LePage, Sotheby's International Realty Canada, and REW.ca (M. Warren 2023) (ClimateCheck 2023). They offer a 1 to 100 score on extreme heat and storms, and scores for fire, flood, and drought are

planned to be added soon (M. Warren 2023). Higher scores indicate higher risk of the climate-related hazards, and are based on future risk and how much the risk will change over time (ClimateCheck 2023). At the seller's or agent's request, Royal LePage can suppress the information from the listing (M. Warren 2023). It's not clear to what extent this information is well understood, is not confusing, and is indeed trusted by consumers.

Climate change risk will change as the climate shifts, infrastructure is adapted, and homeowners adapt their homes (McNutt 2022), so finding a way to capture and communicate changing risk and vulnerability is important. One suggestion was to develop a flood performance certificate that would be informed by an assessment of the property, and would indicate common adaptation measures already taken (Oakley 2018). The suggestion came from the United Kingdom, and is related to their Energy Performance Certificates, which provide information on a home's energy use and costs, and provide recommendations on how to reduce energy use (Oakley 2018). This certificate would work to normalize and incentivize adaptation measures and reduce stigma that the presence of the measures reveals risk and past damage, with the presence of the measures even potentially increasing the home's value (Oakley 2018). However, a downfall of this would be the cost of the assessment, and it was suggested that perhaps only homes in high-risk areas be required to have the assessment and certificate (Oakley 2018). A cost-benefit analysis would be required (Oakley 2018).

Programs

Another type of informational and educational support for homeowners includes the development of programs that establish a pathway to adaptation implementation, described below.

Flood Programs and Supports

The Intact Centre on Climate Adaptation at the University of Waterloo developed and piloted a Home Flood Protection Program (Intact Centre on Climate Adaptation a). The objective was to provide homeowners with practical information to help identify their risk and take action to reduce that risk both outside and inside their home (Evans and Feltmate 2019) (Intact Centre on Climate Adaptation a). The program was piloted in Toronto, Burlington, Ontario, and Saskatoon, Saskatchewan, with 510 completed assessments (Evans and Feltmate 2019). Each community had a unique outreach strategy developed based on the flood risk reduction goals, timelines, and available resources (Evans and Feltmate 2019). The program was promoted in collaboration with local municipalities, conservation authorities, community groups, and insurance providers (Evans and Feltmate 2019). Free online resources were provided as part of the program, such as fact sheets and video links and local information including how to select local contractors (Evans and Feltmate 2019). Outreach included targeted campaigns, such as community events, door-to-door delivery of program information, door hangers, and broad-based marketing campaigns, such as traditional media, social media, municipal websites, paid advertising, and engagement with community leaders, real estate agents, and insurance brokers (Feltmate, Evans and Moudrak 2017).

A Home Flood Protection Assessment of each home was conducted by a trained assessor, lasting 60-90 minutes, and examined 50 potential ways that water could enter a home, leading to an easy-to-read summary report and optional conversation with the assessor (Feltmate, Evans and Moudrak 2017) (Evans and Feltmate 2019). The Assessments cost \$450, but homeowners paid between \$0-\$125, depending on the community, for the pilot program (Evans and Feltmate 2019). Participants reported they would pay between \$50 to \$750

for an assessment, with the average being \$150, highlighting that a subsidy would be required for future assessments (Evans and Feltmate 2019). 72% of the homeowners participated in a follow-up study that captured the actions they completed to reduce their flood risk (Evans and Feltmate 2019):

- 79% of homeowners reported completing at least one new action to reduce their flood risk at three months, and
- 71% of homeowners reported completing at least one additional action at six months (Evans and Feltmate 2019).

The findings from the program were used to develop their guidance materials for homeowners referenced in Section 1.3, Appendix B, and linked in Appendix C (Evans and Feltmate 2019). They also developed an app called the *Home Flood Protection Check-Up*, which provides a report on risks and actions, and also includes information on insurance discounts, subsidies and discounts, and links to how-to-videos and fact sheets (Intact Centre on Climate Adaptation a).

Findings from the Home Flood Protection Program showed that:

- 71% of participants felt that conversations with the assessors were a key resource,
- 68% felt that their assessment report was a key resource,
- 27% felt that conversations with family, friends, and neighbours were important key decisions-making sources of information,
- 23% felt that conversations with local contractors were key decisions-making sources of information,
- 10% said that advice from staff at the local hardware store was a key decision-making source of information,
- 24% referred to education materials they found online, and
- 9% referred to newspapers, books, and magazines (Evans and Feltmate 2019).

The homeowner participants indicated that they would like more financial supports, access to qualified contractors, and trustworthy, third-party information resources (Evans and Feltmate 2019).

Two similar programs to this are the RAIN Home Visit by Green Communities Canada, which was a precursor to the Home Flood Protection Program (Blakelock 2019), and the Resilient Home Retrofit program by Clean Foundation (Clean Foundation n.d.). The Resilient Home Retrofit program currently offers to implement the adaptation upgrades at no cost to the homeowner (Clean Foundation n.d.). Some municipalities also offer similar services, either formally or informally, where municipal staff will provide advice to a homeowner on the cause of their flooding issues (Blakelock 2019).

Wildfire Programs and Supports

FireSmart Canada has developed resources and materials to help Canadians increase resilience to wildfires (FireSmart Canada a). It was founded 20 years ago and operates under a mandate from the Canadian Interagency Forest Fire Centre (FireSmart Canada a). It has developed an app for homeowners to undertake a self-assessment, which can be followed by the Home Assessment Program, where a trained assessor visits the property and reviews key areas in the home ignition zone (FireSmart Canada b). The assessment leads to a report that identifies areas of risk and provides recommendations for actions and upgrades (FireSmart Canada b).

In the United States, homeowners who undertake certain wildfire adaptation steps can apply for a Wildfire Prepared Home designation (Wildfire Prepared a). The process includes an inspection process after homeowners have completed the adaptation steps, and also includes an annual review and three-year recertification (Wildfire Prepared b). Currently it is not recognized by the insurance industry to apply for discounts, but the certificate can be offered when

selling a home (Wildfire Prepared a). The Town of Paradise, California, is requiring all new homes meet this designation, and they are working to create a path for all homes to be able to achieve this designation (Insurance Institute for Business & Home Safety n.d.).

General Programs

Programs that include assessments from knowledgeable, impartial third-party assessors can help homeowners identify which adaptation measures are required for their home and which measures will provide the most value for money (Blakelock 2019). However, in-person assessments are not welcomed by everyone as Thistlethwaite et al. 2017 found in their survey, where 37% of respondents were not interested in having a contractor visit to give confidential advice about property level protection measures, 25% were neutral, and 38% were interested (Thistlethwaite, Henstra and Brown, et al. 2017).

BC Housing is leading the development of the Mobilizing Building Adaptation and Resilience (MBAR) project, which will provide homeowners and the construction industry with tools and resources for the design, construction, renovation, and training required to increase climate resiliency, minimizing the impacts of climate change, in BC homes (British Columbia a). This will help to make climate-ready communities, creating homes that are safe, comfortable, and resilient even when faced with extreme temperatures, heavy rainfall, wildfires, flooding, and windstorms (British Columbia a) (British Columbia b) (BC Housing n.d.). MBAR is developing this new knowledge about adaptation through pilot projects (British Columbia a).

In Florida, homeowners can participate in the *My Safe Florida Home* program, where owners of single-family homes can receive a free hurricane inspection, conducted by a licensed inspector and paid for by the State, and be provided with a report that outlines recommended improvements to increase the

strength of the home against hurricanes (My Safe Florida Home n.d.). As part of the same program, Florida is also providing grants of up to 2/3 the cost of eligible strengthening improvements for the roof, structure, and openings, up to \$10,000 (My Safe Florida Home n.d.). The program also provides a list of participating contractors from which homeowners can choose (My Safe Florida Home n.d.).

Another concept is the one-stop-shop, which support consumers throughout the whole journey and with several products and services (Bealby-Wright and Mayoux n.d.). This can include:

- raising awareness,
- guiding consumers regarding available options,
- providing various types of support the consumer needs,
- assisting consumers in accessing financing,
- assisting with coordinating installation,
- building confidence in the solutions, and
- can also be involved in maintenance and repair (Bealby-Wright and Mayoux n.d.).

One-stop-shops have the capacity to develop a consistent journey, foster cooperation between various stakeholders, and provide consumer confidence by pre-qualifying installers and products (Bealby-Wright and Mayoux n.d.). This concept has been used to assist consumers through expensive and in-depth building renovations (Bealby-Wright and Mayoux n.d.). One-stop-shops have been developed by the public sector, consumer advocacy groups, and the private sector (Bealby-Wright and Mayoux n.d.). However, assurance may be needed that one-stop-shops do not narrow market choices for consumers (Bealby-Wright and Mayoux n.d.).

Regulatory, Financial, and Fiscal Supports

The public sector has various responsibilities to protect Canadian homeowners from climate hazards, including but not limited to investing in upgraded infrastructure and strategies, and investing in restoring natural wetlands to reduce risk (Insurance Bureau of Canada 2019). This section describes public sector responsibility regarding the building code and standards, national flood insurance, permafrost thaw, and land-use planning. It also outlines financial and fiscal supports that can be provided to homeowners to accomplish adaptation actions.

Financial and Fiscal Support

Even if homeowners have a perfect understanding of their risks and adaption options, they may not be able to afford to implement them (Oakley 2018). Half of the participants of the Home Flood Protection Program, described in *Programs* above, said they would like financial support to complete the implementation of the adaptation measures (Evans and Feltmate 2019). It is anticipated that improving financial supports would encourage homeowners to take action (Oakley 2018). Some say economically vulnerable homeowners should be a priority for financial support and investment (Ness, Clark, et al. 2021). Financial and fiscal supports can include tax breaks, on-bill financing, grants, subsidies, low interest loans, lower insurance premiums, and buy-outs. Any number of fiscal measures and opportunities to provide tax relief or tax incentives could be considered as ways to support adaptative actions.

Subsidies and rebates are available from some municipalities for taking steps towards adapting houses, for example, many municipal governments offer subsidies and rebates for the installation of a backwater valve (Warren and Lulham 2021) (Financial Consumer Agency of Canada 2023). Although many municipalities offer these subsidies, few homeowners have accessed them - less

than 10%, even in places that have experienced extreme climate events (Moudrak 2020) (Blakelock 2019). To be more successful, the subsidy processes may need to change (Oakley 2018). Challenges include:

- if homeowners must pay for the adaptation measures upfront before receiving reimbursement,
- if the application paperwork is lengthy or confusing or complex, or
- if community outreach is limited, homeowners will be less likely to access these financial supports (Blakelock 2019) (Evans and Feltmate 2019).

The subsidies should have application processes that require little or no time to complete, provide instant rebates, and provide application support (Evans and Feltmate 2019). Homeowner participants of the Home Flood Protect Program recommended a streamlined process to access subsidies, for example instant rebates at retail stores for products such as downspout extensions and sump pump backup systems (Evans and Feltmate 2019).

One success story is found in the City of Saskatoon, where 50% of targeted homeowners took advantage of a subsidy to install a backwater valve (Blakelock 2019) (Kovacs, Guilbault and Sandink 2014). Saskatoon's approach included targeted outreach to high-risk properties, engaging plumbing contractors, and providing the option to have the city pay the contractor directly (Blakelock 2019). Saskatoon offered the program following flooding events, and this may have attributed to the higher participation rates (Kovacs, Guilbault and Sandink 2014). Another factor that attributed to the success of the program was the partnership with local plumbing and restoration professionals, who can identify and develop a strategy to address the unique risks for each home (Kovacs, Guilbault and Sandink 2014).

Another success story is in Quebec City. The city wanted homeowners to disconnect their downspouts from the municipal system, although it took much

effort across three years (Kovacs, Guilbault and Sandink 2014). First, the city provided letters explaining why disconnection was important and offering to cover the costs, which led to 25% of homeowners participating (Kovacs, Guilbault and Sandink 2014). Next, the city made the program mandatory, and wrote again to the target homeowners, this time also offering a free rain barrel (Kovacs, Guilbault and Sandink 2014). 60% of the outstanding homeowners agreed to participate (Kovacs, Guilbault and Sandink 2014). The city then wrote five more times to the remaining homeowners, explaining the importance of the disconnection, and warning that a \$300 fine may be imposed if they did not disconnect their downspouts (Kovacs, Guilbault and Sandink 2014). This approach finally achieved 100% participation (Kovacs, Guilbault and Sandink 2014).

Another success story is the City of Calgary's 2021 impact resistant roof cover rebate program that followed the severe 2020 hailstorm (Pianet 2024) (Sandink 2023). It subsidized the installation of impact resistant roof cover on approximately 1,600 houses by the time the program ended in 2022 (Pianet 2024) (Sandink 2023). More than 1,600 homes are now on a waitlist for potential future programs (Sandink 2023). Its success was attributed to the simplicity of switching roofing material and the low marginal cost (Pianet 2024). The program also included public education and working with the local roofing contractors' association to increase their ability to educate homeowners on the benefits of an impact resistant roof (Sandink 2023).

As outlined in Section 1.3, upfront costs can be a barrier to implementing energy efficiency upgrades, including high borrowing and transaction costs (Davidson, et al. 2022). To reduce these barriers, some sources suggested on-bill financing, where a utility company would provide the upfront costs of the upgrades to the homeowner, and then charge back the costs through the utility

bill (Davidson, et al. 2022). This works well for energy efficiency upgrades because the upgrades should result in a reduction in energy usage, lowering the utility bills, and thus the upgrades almost pay for themselves through their savings (Davidson, et al. 2022). One city that has been successful with this financing strategy is the City of Nelson in British Columbia, which started an energy retrofits program as a pilot more than 10 years ago, but goes beyond simply offering on-bill financing and financing through local credit unions (Proctor 2023). They attribute their success to the customized support they offer homeowners, from start to finish, starting with a welcome to the program, providing information on rebates, local contractors, and permit requirements (Proctor 2023). After an initial EnerGuide evaluation, the program team will call a homeowner to ensure they understand the recommendations, and offer the homeowner continued assistance (Proctor 2023). The program team ensures they are up to date on the changing requirements and deadlines of available rebates and grants to be able to guide homeowners through the process (Proctor 2023). They also offer homeowner and contractor training courses, information sessions, and attend green trade shows (Proctor 2023). They recommend preparing the community before launching a program, ensuring realtors, hardware stores, contractors, and community groups know the program details so homeowners can learn about the program from someone they trust (Proctor 2023). They found that sending written content is insufficient, and homeowners need a follow up call or email, otherwise they may miss deadlines, not save receipts, or may not implement the measures (Proctor 2023). They found, over the past 10 years, that when rebates were higher, participation increased (Proctor 2023).

In 2021, the federal government announced the intention to develop a Climate Adaptation Home Rating Program, which would help homeowners to navigate

the adaptation retrofit process (Bakos 2022) (Tudreau 2021). It could expand on the Canada Mortgage and Housing Corporation's deep home retrofit program and the Canada Greener Home Grants to include climate resilience and adaptation measures, and act as a companion to the EnerGuide home energy audits (Bakos 2022) (Tudreau 2021). As of early 2024, the Canada Greener Homes Grant was no longer accepting new applicants as the funding had been fully committed (Canada 2024a). The Government of Canada's Budget 2024 announced funding for a new Canada Greener Homes Affordability Program (Canada 2024b).

Some insurance companies may offer discounts on premiums for undertaking home adaptation measures (Financial Consumer Agency of Canada 2023), this is discussed further in *Insurance Industry* below. Another example of homeowners being rewarded for acting is in Kitchener and Waterloo, where property owners who reduce their demand on the public storm water infrastructure by keeping stormwater on their property can receive a tax credit (Kovacs, Guilbault and Sandink 2014). 85% of survey respondents from the Insurance Bureau of Canada's 2022 survey supported providing tax rebates to those who proactively protect their homes (Insurance Bureau of Canada 2022b).

Insurance Industry

Various sources discussed potential actions that the insurance industry could implement, beyond providing information, to encourage homeowners to adopt adaptation measures. This section captures findings from the literature review and does not examine the applicability of these suggestions for the home insurance industry in Canada.

Home insurance in Canada could start to appropriately incorporate climate change-related risk into the cost of home insurance premiums, cap the compensation amount for certain perils, increase deductibles to reflect risk or

past claims, and limit availability of insurance for high-risk homes (Sandink 2016) (Oakley 2018) (Seifert-Dähnn 2018). Some precedents for adjusting premiums and deductibles exist, for example, house insurance can already be influenced by the presence of burglar alarms installed in the home, and car insurance can be influenced by applications that collect data on driving performance (Oakley 2018). However, home insurance that accounts for risk could become unaffordable, leading homeowners to lack insurance (Seifert-Dähnn 2018). And adjustments to deductibles or setting caps on the compensation amount may not be effective in motivating homeowners, because they are only affected by these after an event (Seifert-Dähnn 2018). It is anticipated that, while these can assist in raising awareness of their risk and could encourage action, they will not lead to significant outcomes (Canada 2022a) (Oakley 2018).

Homeowners could have their insurance coverage restricted if they do not undertake adaptation actions after an event, as is the case for Denmark and Iceland (Oakley 2018) (Seifert-Dähnn 2018). A concern was noted, though, that homeowners who cannot afford adaptation measures would be faced with higher insurance costs without being able to do anything about them (Oakley 2018) (Seifert-Dähnn 2018).

Rewarding homeowners for their adaptation actions through incentives such as discounts on home insurance premiums is yet another alternative (Canada 2022a) (Seifert-Dähnn 2018). In Germany, homeowners can receive improved access to flood insurance after a risk assessment of their home, which leads to a building certificate related to the flood protection measures of the house (Minano and Peddle 2018) (Seifert-Dähnn 2018). The building certificate can also be used in negotiations with banks for mortgages (Seifert-Dähnn 2018). The potential discounts may be small though, and homeowners may not be sensitive

to changes in premiums and deductibles unless the effect is quite large (Oakley 2018). The upfront costs of the adaptation measures may take a long time to be recovered through lower premiums (Seifert-Dähnn 2018).

A different strategy would be build-back-better plans that are implemented with insurance companies, as it makes little sense to restore houses to pre-disaster conditions knowing that they will experience similar disasters again within a few years (Pianet 2024) (Farooqui 2024). For example, when repairing a home after a disaster, the insurance company could automatically include low- and no-cost adaptation measures that do not have an impact on aesthetics, without needing a conversation with the homeowner (Oakley 2018). If financial supports are available for adopting these adaptation measures, the insurance company could claim the financial support, without needing an application from the homeowner (Oakley 2018).

In 2024, Intact Financial Corporation announced the development of a pilot project to limit wildfire risk and damage to houses (Intact Financial Corporation 2024). It is automatically included at no additional cost for eligible properties in Alberta and BC (Intact Financial Corporation 2024). When a wildfire is less than five kilometres away, trained professionals are sent to the eligible properties for loss prevention services, which can include:

- removing materials from around the property that may fuel a fire, including firewood, propane tanks, furniture, and grass clippings,
- covering exterior vents, closing exterior doors, windows, and garage doors, and
- setting up temporary sprinkler systems. (Intact Financial Corporation 2024)

When the wildfire threat has passed, the trained professional will move items back and remove any temporary sprinkler systems or coverings (Intact Financial

Corporation 2024). The goal is to build resilient communities and help adapt to the impacts of wildfires and other severe weather events (Intact Financial Corporation 2024).

Relocation

Climate change may increase hazards to beyond the point where it is practical or economical for insurance and government disaster relief to cover frequent and repeated damage (Beckett 2021). Insurance cannot be provided if its price becomes too high, if it is impossible to estimate the risk, or if the hazard is no longer a risk but a certainty (Beckett 2021) (Insurance Bureau of Canada a). For some communities, implementing adaptation measures, or even installing infrastructure efforts such as sand dunes or flood walls, will not be enough to prevent being inundated (Beckett 2021). Lower income homeowners may be unable to leave high risk areas and be trapped in vulnerable homes (Center for Climate and Energy Solutions 2021). Not only could they require financial assistance to undertake adaptation measures, but it may also become necessary for governments to buy their home and help them to relocate (Center for Climate and Energy Solutions 2021). This may mean entire communities need to be relocated (Council of Canadian Academies 2019) (Beckett 2021). This is often known as strategic retreat or property buyout programs, usually involving expenditure of public funds to buy the properties in the highest risk areas, so those buildings can be demolished and the land reverted back to a natural state or less vulnerable uses such as a park (Canada 2022a) (Ness, Clark, et al. 2021) (Thistlethwaite, et al. 2023). Strategic retreat reduces risk by moving high risk communities to lower-risk areas (Canada 2022a) (Saunders-Hastings, Barnard and Doberstein 2020). This eliminates their exposure to the hazard (Canada 2022a). Strategic retreat is a permanent solution and does not require ongoing

operations or maintenance that other strategies such as dams, dikes, or natural infrastructure may require (Ness, Clark, et al. 2021).

In 2022, post-tropical-storm Fiona washed away or severely damaged 80 homes and crumbled the shoreline in the town of Port aux Basques in Newfoundland (Smellie 2023). The town has now established a high impact zone, where the remaining 57 homes that still stand after Fiona will be bought out so the homeowners can move out of the high-risk zone (Smellie 2023). However, they are leaving behind homes that were built years ago by their family members (Smellie 2023). Other countries, including Australia and the United States, have started to implement strategic relocation programs (Thistlethwaite, et al. 2023). The Canadian Climate Institute estimates that building and moving houses out of high-risk areas can reduce the cost of coastal flooding by 2100 up to 90%, or up to \$1 billion every year (Ness, Clark, et al. 2021). Some other examples of buy-out programs exist in Canada for homes in chronic, high risk flood zones, for example in Gatineau, Quebec following floods in 2019 (Warren and Lulham 2021) (Re/Max 2022). The Government of Canada and the Government of Quebec offered building buybacks, and also placed a limit on disaster assistance payouts (Warren and Lulham 2021). British Columbia and New Brunswick have also implemented relocation programs (Ziolecki, Thistlethwaite and Henstra, et al. 2020). A call for governments exists, particularly the federal government, to not only ensure homeowners have access to affordable insurance, but also move homeowners out of harm's way (Insurance Bureau of Canada 2019). In 2019, the Ministry of Public Safety and Emergency Preparedness was instructed by the Prime Minister to develop a national action plan to assist homeowners with potential relocation (Ziolecki, Thistlethwaite and Henstra, et al. 2020).

Canadian buyout programs have so far been rare and limited in scope, ad hoc, improvised, and haphazard, only being developed after a disaster (Canada 2022a) (Thistlethwaite, et al. 2023). These programs are challenging, time-consuming, and expensive, and currently a shortage of housing in Canada endures (Canada 2022a). Past cases of strategic retreat have only occurred after multiple disasters impacted a community, a long time transpired before implementation, and often resulted in inequities (Saunders-Hastings, Barnard and Doberstein 2020). Internationally, programs have ranged in compensation from 80% in Austria to 110% in Iowa, and can sometimes include moving expenses or demolition costs, though homeowners have reported challenges finding comparable houses for the same price (Thistlethwaite, et al. 2023). Strategic retreat can be a painful, stressful, and a hard process for homeowners who give up their homes, and may be resisted (Saunders-Hastings, Barnard and Doberstein 2020). Other reasons for resistance to accepting this approach may stem from financial reasons, community cohesion, concern for individual well-being, and political concerns (Saunders-Hastings, Barnard and Doberstein 2020). Although it may be a difficult process to proactively relocate, homeowners being forced out from a disaster is more dangerous and traumatic (Smellie 2023). Effort is required to inform homeowners of the financial and safety benefits for relocating out of high-risk areas (Ziolecki, Thistlethwaite and Henstra, et al. 2020). Additionally, as Canada's Task Force on Flood Insurance and Relocation's report *Adapting to Rising Flood Risk: An Analysis of Insurance Solutions for Canada* stated:

The cultural connections of Indigenous peoples to water and land must be respected. Indigenous knowledge, culture and perspectives on the natural world must be respected, and should be recognized as foundational in informing how all stakeholders can approach flood risk management across Canada. Further engagement with and learning from Indigenous communities, governments, organizations and individuals,

including in the form of healing and sharing circles, would help to ensure that FRM [Flood Risk Management] initiatives are informed by Indigenous voices. (Canada 2022a)

Ziolecki et al. 2020 found in their survey that 49% of the respondents agreed that homes at risk of repeat flooding should be offered buyouts before flooding happens; however 32% were unsure; 68% of respondents believed buyouts should be voluntary; and 59% indicated that the costs should be distributed across the three levels of government (Ziolecki, Thistlethwaite and Henstra, et al. 2020). 55% of the respondents who had experienced flooding reported that they would accept a government buyout, citing financial cost of flood recovery at 39% and risk to personal safety at 37% as the top reasons for doing so (Ziolecki, Thistlethwaite and Henstra, et al. 2020). 42% would only accept an offer at pre-flood market value (Ziolecki, Thistlethwaite and Henstra, et al. 2020). Those who were less inclined to accept a buyout cited unfair compensation at 34% and not wanting another home at 29% as the reasons why (Ziolecki, Thistlethwaite and Henstra, et al. 2020). 75% somewhat or strongly agree that financial support for other transition costs is important (Ziolecki, Thistlethwaite and Henstra, et al. 2020). The Insurance Bureau of Canada found in their 2022 survey that 70% of respondents in high-risk areas would be willing to relocate if the government paid fair market value for their home (Insurance Bureau of Canada 2022b). ICLR in their 2024 survey found that 58% agreed that Canadian governments should offer to buy out, at a fair market price, the one percent of homes in areas with extreme risk of flood, while 23% had no opinion, and 14% disagreed (Institute for Catastrophic Loss Reduction 2024). The same survey found that 54% agreed that homeowners at extreme risk of flooding should be required to sell their home to governments at a fair market price, while 25% had no opinion, and 15% disagreed (Institute for Catastrophic Loss Reduction 2024).

An opportunity exists for proactive strategic relocation (Canada 2022a). Research is being undertaken to identify success factors and common problems

of strategic retreat strategies (Thistlethwaite, et al. 2023) (Saunders-Hastings, Barnard and Doberstein 2020). Saunders-Hastings, Barnard and Doberstein 2020 examine strategic retreat in their report *Planned Retreat Approaches to Support Resilience to Climate Change in Canada*, as do Thistlethwaite and Le Geyt 2023 in their report *Buying Out the Floodplain: Recommendations for Strategic Relocation Programs in Canada*, and also in the Government of Canada's report *Adapting to Rising Flood Risk: An Analysis of Insurance Solutions for Canada*. Thistlethwaite and Le Geyt 2023 identified three main challenges to buyout program implementation: cost efficiency, social acceptability, and political feasibility (Thistlethwaite, et al. 2023). They made the following recommendations for the design and administration of buyout programs in Canada:

1. “Develop a buyout program that is ready for implementation before a disaster;
2. Engage early and often;
3. Provide on-the-ground support and dedicated resources;
4. Increase compensation caps to reflect regional pre-flood market values of homes;
5. Create pathways for consensus and support among community partners;
6. Establish a federal buyout program with funding to support provincial or municipal relocation programs;
7. Improve intergovernmental coordination and dialogue; and
8. Align buyout program design with existing disaster assistance, adaptation, and risk reduction policy.”

(Thistlethwaite, et al. 2023)

Building Codes and Standards

Some adaptation measures can be implemented through policy and regulations – for example standards, codes, and by-laws (Canada 2023a) (Pianet 2024). Without updates to the building codes and standards, housing could be built that is based on old climatic data rather than the climate expected during their existence (Ness, Clark, et al. 2021) (Pianet 2024). Some adaptation measures, for example hurricane straps, can only be installed during

construction (Kopp 2021). Some adaptation measures could be included in new home construction at low cost (Beckett 2021) (Oakley 2018). For new approaches to be considered, though, they first must demonstrate that they result in savings that exceed costs over time (Warren and Lulham 2021). The presence of these measures as a standard in new construction would contribute to changing social norms (Oakley 2018). In the Task Force for Housing and Climate’s 2023 survey of Canadians, 84% believed that it is important to develop new housing in a way that is resilient to climate change impacts (Abacus Data 2023). A June 2024 article from the Task Force for Housing and Climate stated that, *“new homes must be resilient to the extreme weather we’re going to see in the decades ahead – anything less would be negligence,”* and calls on governments to *“urgently require climate-proof structures through adoption of stronger building and safety codes”* (Iveson 2024). This call comes at a time when Canada is racing to build millions of new houses in the next few years (Miller and Carriere 2024).

Standards establish best practices and help ensure consistent results (Canada 2022b). Without industry standards and certification, practices and recommendations can be inconsistent (Oakley 2018). Without standards, it is difficult to have a basis for understanding the cost effectiveness of suggested adaptation measures, or their expected performance (Oakley 2018). Most existing building and infrastructure standards were developed assuming a stable climate or the climate of the past, not a climate evolving rapidly into the future (Canada 2022b). Work is under way in Canada to update existing standards and develop new standards that consider the changing climate (Canada 2022b). The *2021-2026 Standards to Support Resilience in Infrastructure Program* is working to develop and advance 36 new standards and technical guidance (Canada 2023c). The National Research Council launched the *Climate-Resilient Buildings and Core*

Public Infrastructure (CRBCPI) Initiative in 2016 (funded by Infrastructure Canada), and, over the last few years, a number of climate-smart documents have been developed, listed in Appendix D.

Codes, which are mandated through regulation, govern the safety, health, accessibility, and structural protection of infrastructure and buildings (Canada 2022b). They are reviewed and updated at least every five years (Canada 2022b) (Canada 2023c). Codes consider climate parameters, including long-term average patterns of temperature and precipitation, for example the six hottest hours in July, the largest amount of rain in a 15-minute period, and the maximum wind gust that a structure needs to safely withstand (Canada 2022b). Work is underway to update the National Building Code climate design values to consider future changes (Canada 2022b) (Canada 2022c). The intention is to also submit National Building Code change requests that are partially based on some of the guidelines listed in Appendix D (Canada 2022c). Additional, related work is being undertaken by the National Research Council (Canada 2022b). The goal is to incorporate climate resilience into engineering and design processes (Canada 2022b). A newly updated National Building Code will be released in 2025, after which provinces and territories will need to individually adopt the National Code as their own – if they choose to do so (Ness, Clark, et al. 2021) (Canada 2023c).

As outlined in Section 1.2 and Appendix A, while places throughout Canada have legislation for minimum indoor temperatures, currently no equivalent legislation for maximum indoor temperatures exists (Rutgers 2023) (Wong 2023) (Hogan 2023). The main focus in Canada has been on the heating season, ensuring sufficient heat. However, climate change is now requiring a focus on the cooling season to prevent overheating (National Research Council of Canada 2019). Indoor cooling has been regarded as a luxury as opposed to a necessity (Action Canada 2023). A call has been made for a maximum indoor temperature

to prevent more deaths (Action Canada 2023). British Columbia has recently changed its provincial building code to require new homes to be able to maintain an indoor temperature of not more than 26 degrees Celsius in at least one space in each dwelling unit, which can be achieved through mechanical cooling or passive design measures where achievable (British Columbia c).

In a June 2024 article, the Task Force for Housing and Climate made the following recommendations for the federal and provincial government:

“Federal

- *Immediately overhaul the National Model Building Codes to simplify and harmonize requirements and add new code provisions designed to integrate physical climate resilience measures, such as passive/active cooling requirements and safe maximum indoor temperature limits.*
- *Ensure the Codes support integration with local building performance standards to reflect changing regional climate risks such as floods, fires, extreme heat, and permafrost melt, and add physical resilience as a building codes objective.*
- *Design and adopt national standards for Climate Resilience Residential Rating and Community Resilience.*

Provincial

- *Mandate proven and high-priority housing resilience improvements through provincial building codes, including:*
 - *Strengthening roofs for high winds and hail through roofing underlayment.*
 - *Better wall-to-wall connections.*
 - *Impact resistant roofing.*
 - *Defending buildings from wildfires through non-combustible doors, exterior walls, fences and roofing.*
 - *Directing stormwater runoff away from buildings to green infrastructure on site (e.g. rain gardens, bioretention areas).*
- *Allow municipalities to exceed building code provisions for climate resilience and energy efficiency so long as they can show rapid permitting and cost savings to the building occupant.” (Iveson 2024)*

All of these changes, however, will only affect new houses, and their effects will take time to be evident. Meanwhile, homeowners are experiencing impacts now (Rutgers 2023). Implementing adaptation measures in existing houses is voluntary (Warren and Lulham 2021). However, incorporating adaptation measures in Codes will mean that those homeowners would need to undertake fewer adaptation measures themselves in the future, for example not having to install backflow valves (Sandink 2016).

National Flood Insurance

As outlined in Section 1.2, estimates place 20% of homes in Canada as high risk for overland flooding and sewer backup, and 10%, almost 2 million homes, at very high risk (Feltmate, Evans and Moudrak 2017). It is estimated that 89% of the cost of flood damage is concentrated in the top 10% highest risk homes, and that 34% is concentrated in the top 1% of highest risk homes (Canada 2022a). And estimates say that 10% of Canadian homes today are already uninsurable for floods because they are in the highest risk areas (Ness, Clark, et al. 2021) (Re/Max 2022) (Insurance Bureau of Canada 2023a) (D'Souza, McDonald and Cowley 2021). If insurance is even available, risk-based insurance premiums for these high-risk homes can be \$10,000-\$15,000 or more for flood endorsements, not including the other home insurance costs (Canada 2022a). These homeowners must draw upon their own resources or the limited disaster assistance programs to recover and repair after a flood disaster (Canada 2022a). The homeowners face both “rising rates and rising waters” (Florez Bossio and Ness 2024).

In 2024, ICLR, an insurance founded research institute, completed a study examining homeowner willingness to pay for flood insurance, which included a survey of Canadians (Institute for Catastrophic Loss Reduction 2024). More details can be found in their report. Their key findings are included below, which can be a starting point for further discussion:

- Of the homeowners at extreme flood risk, 85% were willing to pay \$1,000 annually for flood insurance, 48% would pay up to \$5,000, 29% would pay up to \$9,000, and 12% would pay more than \$13,000.
- Take-up would be 20% higher for flood insurance if it is included with basic coverage (with an opt-out option provided).
- About 91% of homeowners said that, if they knew their houses were at extreme risk of flooding, they would be willing to pay for flood insurance priced at \$1,000 annually. About 78% said they would pay \$3,000.
- Disaster financial assistance coverage must be removed so that consumers do not have an alternative to insurance.
- Homeowners who are at extreme risk may be unwilling to pay a high enough premium to make coverage feasible. Therefore, other solutions, such as elevating the home, physically protecting the home, and relocating the home, should be explored and in some cases may be the preferable option to insurance. (Institute for Catastrophic Loss Reduction 2024)

With the longest coastline in the world, Canada has about 6.5 million people living in coastal communities, which will face rising sea levels, coastal erosion, saltwater intrusion, and increasing storm surges (Council of Canadian Academies 2019). The federal government, provincial and territorial governments, and the insurance industry led by the Insurance Bureau of Canada, are working to create affordable public-private flood insurance solutions for the highest risk homes, so that all Canadian have access to flood insurance, and at the same time is creating a national action plan to relocate houses where necessary (Canada 2022a) (Institute for Catastrophic Loss Reduction a) (Insurance Bureau of Canada 2023a) (Canada Mortgage and Housing Corporation 2020) (Insurance Bureau of Canada a). That will cover the

1.54 million high risk homes that either do not have flood insurance available to them or do not have an affordable flood insurance option (Canada 2022a) (Insurance Bureau of Canada a). This insurance must be affordable to protect lower income vulnerable homeowners (Bourque 2021). A new national flood insurance program would help speed up recovery and rebuilding after a disaster, and would reduce disaster costs for the federal and provincial governments (Insurance Bureau of Canada 2023b). Ziolecki et al. 2020 found in their survey that 56% of respondents strongly agreed that homeowners living in designated flood risk areas should be required to purchase flood insurance (Ziolecki, Thistlethwaite and Henstra, et al. 2020). As of 2023, the national flood insurance program was anticipated to launch in the next 2 years, with one source saying it would launch in 2025 (Browne 2023) (Insurance Bureau of Canada 2023b). The Government of Canada's Budget 2024 described the intention for "a low-cost flood insurance program for high-risk properties within the next twelve months" (Canada 2024b). Further discussion can be found in the Government of Canada's report *Adapting to Rising Flood Risk: An Analysis of Insurance Solutions for Canada*.

A 2024 article by Florez Bossio and Ness outlined three design measures that should be considered for the National Flood Insurance program to help ensure it does not unintentionally increase risk and cost:

- That the program only includes homes that are built before the program comes into effect in order to limit the number of insured properties and to discourage building new homes in high-risk areas.
- That the program subsidizes premiums to start, with the intention to transition to risk-base premiums over time to provide time for increasing homeowner awareness and undertake actions to reduce their risk. It was

noted, however, that continued support for low-income households would be necessary.

- That the program provides incentives for homeowners and communities that undertake actions to reduce their risk. (Florez Bossio and Ness 2024)

The Insurance Bureau of Canada found in their 2022 survey that 64% of respondents agreed that governments should provide financial support to those whose homes have been damaged regardless of whether they have insurance coverage or not (Insurance Bureau of Canada 2022b). However, the government disaster financial assistance programs have been described as a moral hazard or charity hazard, since their existence means homeowners are not incentivized to undertake adaptation measures to reduce their risk or to purchase insurance if available because they feel any future losses are already covered (Canada 2022a) (Oakley 2018) (Andrasko 2021) (Wouter Botzen, et al. 2019) (Seifert-Dähnn 2018) (Florez Bossio and Ness 2024). Essentially, governments provide free financial assistance after a disaster irrespective of adaptation efforts by the homeowner (Canada 2022a). In another sense, these homeowners either get free insurance in the form of the government disaster assistance, or bear the full cost of damages themselves (Canada 2022a). In addition, the disaster financial assistance programs outline that properties must be restored to pre-disaster conditions, which results in public funding rebuilding high risk areas, possibly leading to repetitive losses (Thistlethwaite and Henstra 2024). For the insurance system to be successful, the government disaster programs would need to no longer be available for flooding, or be restructured (Canada 2022a). *Canada's National Adaptation Strategy Building Resilient Communities and a Strong Economy* set the target that, by 2025, a modernization of the Disaster Financial Assistance Arrangement occurs which incentivizes disaster risk reduction (Canada 2023a) (Canada 2023b). However, the insurance system would need to

be affordable and may need incentives and mandates to maximize participation (Canada 2022a).

Permafrost Thaw Remediation

Large scale efforts are required to address permafrost thaw in the North. Strategies and plans will need to be developed for every community and every house. Accurate and practical information is needed about climate risks to Northern infrastructure, including not only permafrost thaw, but also wildfires, changes to wind, and thunderstorms, and should prioritize the information that is important to Northern and Indigenous decisions makers and communities (Clark 2022). Research is required on how to monitor and evaluate homes to inform repair and replacement decisions, on how to adapt construction methods and technologies, and on how to maintain and retrofit homes where possible (Sawyer, et al. 2020) (Clark 2022) (CBC News 2023). Building codes, standards, and policies will need to continue to be updated to address these new methods to ensure new infrastructure is built for the future climate (Clark 2022). Infrastructure replacements, with planned failure or managed retreat, rather than repair and protection, may be more effective, efficient, cost effective, and sustainable (Clark 2022). New strategies must also address new issues that arise, for example if communities rebuild in locations where there is solid bedrock, this can create disjointed and sprawling cities (Schreiber 2018). All of these efforts must involve local communities in the process, incorporate local knowledge, and ensure that Indigenous youth are involved (Canada 2020b). Northerners must make these decisions (Clark 2022). As the Canadian Climate Institute's 2022 report *Due North: Facing the costs of climate change for Northern infrastructure* states,

All infrastructure development and adaptation policies should be implemented in a manner that is consistent with the principles outlined in Canada's Truth and Reconciliation Report. By working with Indigenous Peoples through a process of

partnership and equal collaboration, federal, provincial, and territorial governments have an opportunity to fundamentally rethink the way infrastructure is built in the North to better serve the needs of Indigenous Peoples. (Clark 2022)

... Northern adaptation should emphasize replacement of the infrastructure that is not practical to maintain with new technologies or approaches that are more durable and environmentally sustainable. Federal, provincial, and territorial governments will need to work closely with Northerners and Northern Indigenous governments to reimagine climate-resilient infrastructure that supports long-term well-being, prosperity, and self-determination. (Clark 2022)

Land-Use Planning and Municipal Governments

Land-use planning needs to be improved (Canada 2022a) (Insurance Bureau of Canada 2019) (Florez Bossio and Ness 2024) (Insurance Bureau of Canada a) (Miller and Carriere 2024). Building on flood plains and in other high-risk areas must be immediately stopped (Insurance Bureau of Canada 2019) (Iveson 2024). Updated flood risk maps should be referenced when available for making land use decisions (Bakos 2022). Despite the existence of the Flood Damage Reduction Program maps from the 1970s to 1990s, examples exist of development in floodplains still occurring (Lyle, Fang and Hund 2023). Ziolecki et al. 2020 found that 68% of their survey respondents believed that, when a municipality issues a building permit in a designated flood risk area, it is their responsibility to protect the property from flood damage and even compensate the owner for flood damages (Ziolecki, Thistlethwaite and Henstra, et al. 2020). ICLR in their 2024 survey found that 88% of surveyed Canadians agreed that Canadian governments should prohibit construction of new buildings in areas with high or extreme risk of flood where there is a greater than 10 percent chance of flooding over the next 10 years (Institute for Catastrophic Loss Reduction 2024). Local governments often make land-use decisions, sometimes allowing homes to be built on floodplains for example, but it is the federal, provincial, and territorial governments who cover up to 90% of the public costs

to recover and rebuild after a flood, leading to an inherent disconnect (Canada 2022a). Without closer municipal scrutiny, federal and provincial governments provide what is effectively free financial assistance after a disaster irrespective of development decisions that placed homes in high-risk areas (Canada 2022a) (Florez Bossio and Ness 2024). The June 2024 article by the Task Force for Housing and Climate calls on municipal governments to, “*incorporate climate resilience into urban planning and development approvals to ensure that new developments are designed with risk mitigation in mind*” (Iveson 2024).

Municipalities can also influence the climate adaptation in their communities through zoning and planning decisions, resiliency programs, and through better building code enforcement that targets local vulnerabilities (Climate Data b). For example, in certain Edmonton neighbourhoods that are at risk of flooding, electrical panels cannot be located in basements, and in Langley, zoning bylaws require the first floor of new homes to only be used for parking and storage if located near the river (Iveson 2024).

Other Government Support

Some suggest that the challenges and barriers to implementing adaptation measures are so great, that enhanced incentives and mandatory measures may be warranted (Oakley 2018), such as, risk disclosure at the time of sale as discussed in Section 1.4 *Data, Mapping, and Disclosure*.

Many are involved in managing risk before and recovery after a disaster. For example, in Ontario, depending on the location, different levels of government or wastewater utilities may oversee the wastewater and stormwater systems, conservation authorities are responsible for floodplain management and watershed issues but not the stormwater infrastructure, the provincial government guides stormwater policy and land use planning, and the federal government administers the disaster assistance programs (Blakelock 2019). A

whole-of-society approach is required to increase Canada's resiliency, including all levels of government, nongovernment organizations, the insurance industry, and homeowners (Insurance Bureau of Canada 2024) (Canada 2023a) (Ziolecki, Thistlethwaite and Henstra, et al. 2020).

In England and Germany, mass information campaigns have been developed to educate the public about flooding, to encourage homeowners to get appropriate insurance, and to provide information on how homeowners can protect their homes (Minano and Peddle 2018). Currently, in Canada, public engagement on risk awareness and reduction is often under-resourced (Partners for Action n.d.). Often towns and rural communities are handed the responsibility to raise risk awareness, but they often lack the expertise, capacity, and financial resources to sustain the communication efforts required (Ziolecki, Thistlethwaite and Henstra, et al. 2020). Meanwhile, municipal budgets are impacted from repairing after disasters and trying to protect against future events (MacDonald 2023). Communities will need increased financial and logistical support to develop and deploy risk awareness and adaptation communication (Partners for Action n.d.). More opportunities are needed to bring together different departments and levels of government to share knowledge, experiences, approaches, and resources on flood risk communication (Ziolecki and Thistlethwaite 2019). The risks and needs go beyond administrative, geographic, and sectoral boundaries (Sawyer, et al. 2020). Efforts need to be coordinated (Ziolecki and Thistlethwaite 2019). And while communications need to be tailored to the local conditions, larger coordination can reduce overlap, inconsistencies, and gaps, and establish priorities and goals, establish roles and responsibilities, measure progress, identify useful policies, and coordinate finance (Sawyer, et al. 2020).

Governments can hold the various stakeholders accountable for their decisions and actions (Ziolecki, Thistlethwaite and Henstra, et al. 2020).

Key Informant Interviews

A series of key informant interviews

A series of key informant interviews were conducted during November and December 2023. The primary objectives for these interviews were to gather insights into the awareness and interest of homeowners as it relates to climate change risks and adaptation measures; actions that homeowners are taking; various supports that homeowners may need to increase awareness and interest levels and action; and examples from other jurisdictions.

The key informants were assured that their comments would be gathered without specific attribution. The interview questions were generally the same for all of the key informants and are listed in Appendix E. Individuals from the following organizations were interviewed:

- National Research Council of Canada
- Environment and Climate Change Canada
- BC Ministry of Housing
- City of Kitchener
- Insurance Bureau of Canada
- University of Western Ontario

- Intact Centre on Climate Adaptation
- Partners for Action
- FireSmart Canada
- Institute for Catastrophic Loss Reduction
- Canadian Climate Institute
- Ontario Real Estate Association
- Clean Foundation
- Energy Storage Canada
- A home builder experienced with climate-resilient homes

What follows is a summary of what was said.

2.1 Homeowner Awareness and Interest

The key informants were asked about the awareness level of homeowners regarding climate change risks to their homes and adaptations measures that can be undertaken to improve and protect their homes. In addition, they were asked about gaps in the information, new approaches that could be tried to increase awareness, and what may be preventing homeowners from being more informed. In a separate set of questions, the key informants were asked about the interest level of homeowners in adapting to climate change, what could increase their interest, and what inhibits their interest. Significant overlap existed in the answers provided to the awareness and interest questions, with some key informants citing that the two are intertwined, and so the write up has combined the findings into one section.

In general, the key informants felt that homeowners have a general awareness of climate change which is slowly increasing, especially after the number of negative climate and weather events in 2022 and 2023, but that a low awareness exists of specific climate change risks to their homes and adaptations of their

houses they can adopt. Some key informants felt that more homeowners have a growing awareness of the impacts as they note or experience floods and wildfires, but they may not link the risk to climate change. The following were cited as reasons for the low awareness, lack of interest, or simple inaction from homeowners:

- A lack of available information on the risks that individual homeowners face today, let alone as the climate changes,
- Not wanting to become more aware for fear of negatively impacting the value their home,
- Not understanding the difference between climate change mitigation and adaptation,
- Not knowing about the adaptation measures,
- Not believing the adaptation measures will be effective,
- Not understanding the information that is available,
- Not trusting the sources of the information,
- Being faced with competing messages for other, unrelated risks,
- Not understanding how their house works, what performance standards it was built to, how the adaptation measures work, or how to install the adaptation measures,
- Being focused on day-to-day issues like if the garbage is not picked up, but not being focused on climate change effects,
- Having an aversion to climate change risk information because it is scary and difficult to understand, and they believe there is little hope,
- Believing that negative events happen to other people but will not happen to them,
- Feeling uncertain, stressed, or anxious about what to do, leading to inaction,

- Believing adaptation measures are expensive and hard to implement,
- Being uncertain if they will qualify for grant programs or subsidies,
- Not wanting contractors in their homes,
- Believing actions are already being taken to ‘deal with climate change’, such as reducing emissions and driving electric cars,
- Not believing they have a responsibility in adapting to climate change, believing instead it is the government or insurance companies who should be protecting them and paying for damages,
- When buying a home, being more concerned about affordability and quality of the neighbourhood, particularly in the absence of easy-to-understand risk information at time of sale.

Several key informants mentioned that awareness and interest levels are constantly changing depending on whether negative events occur, suggesting that if smoke is in the air, then people care about wildfires, but when the smoke goes, awareness and interest levels go, too. Another key informant mentioned awareness and interest levels will vary depending on the frequency of the negative events being shown in the media. It was also mentioned that awareness levels will vary from place to place depending on the risks and past events. One key informant mentioned that, when homeowners are aware of an issue, often they have a keen interest in wanting to take some level of control to adapt to the risk and be better prepared.

One key informant mentioned, when speaking to home buyers about additional structural measures of a home to protect against severe winds, the buyers questioned the need for the measures saying that tornadoes do not happen near them, not realizing the uncertainty of where tornadoes could hit or the benefit of adopting the proactive measures.

Several key informants mentioned that a pathway to awareness and interest is experiencing a climate change related disaster where the home is negatively affected. However, this occurs after damage has been done. It was mentioned that, even years and decades later, homeowners can experience very strong emotions about big climate and weather events they experienced. Another pathway to awareness was homeowners being faced with higher and higher insurance rates.

Some key informants believed that it may not be realistic to expect homeowners to ever be very aware of climate change risks, or for many to be proactive about implementing adaptation measures, but instead they need a system of support from other stakeholders. Some key informants highlighted that it is not necessary to communicate information about climate change or greenhouse gas emissions or millimetres of precipitation to homeowners, but instead to focus on the need for and benefits of the adaptation measures and taking action.

2.2 Homeowner Action

The key informants were asked how effective efforts have been in getting homeowners to adopt adaptation measures or to want to purchase climate-resilient homes. They were asked about barriers to action, and the support homeowners might need.

The key informants felt that most homeowners are not taking action to adapt their homes to climate change risks. The following were cited as reasons for inaction by homeowners:

- Low awareness and interest, and not understanding the level of risk they are exposed to, what can be done about it, their responsibilities, and the costs associated with those adaptation measures, and other reasons cited

in the *Homeowner Awareness and Interest* section above. One key informant stated that awareness is a key component to taking action. However, even if homeowners are aware, it does not mean that they will take action.

- Having specific ideas about the aesthetics for their back/front yards and landscape that are not aligned with recommended adaptation measures, for example wanting trees and shrubs close to their house instead of creating a non-combustible zone around their house, or wanting a traditional front lawn with grass instead of one that can stop rainfall runoff.
- Not being able to install the adaptation measures themselves.
- Difficult application processes for grant programs and subsidies with no certainty that they will qualify or be approved.
- Not being able to find contractors who they trust and who will install the adaptation measures.
- Challenges related to working with contractors, including getting and evaluating quotes, poor workmanship and management of completion schedule, needing to take time off of work, and simply not wanting contractors in their home.

The key informants suggested that we can do all the research in the world on adaptation measures, but if it is not being implemented, then it does not matter. Many mentioned the need for a change in societal attitudes to start to see an increase in awareness, interest, and action.

2.3 Support

The key informants were then asked what could be done by public sector, private sector, and not-for-profit stakeholders to support an increase in

awareness, interest, and action by homeowners. The key informants were also asked about strategies pursued in other jurisdictions to increase adoption of adaptation measures and if they could be applicable to Canada. The types of support that were described have been organized into three categories that align with the available tools to help homeowners take action: information and education supports, financial and fiscal supports, and support from governments and regulation. One key informant mentioned how support organizations try to solve problems that the homeowners don't even know they have.

Information and Education Supports

The key informants mentioned several messaging and communication strategies they believe could help increase awareness, interest, and action, as listed below:

- Messaging should be delivered to homeowners from many different sources during regular communication times and through already established communication channels, including by insurance companies and brokers (at renewal times), mortgage companies (at renewal times), realtors (when purchasing property), home inspectors (when purchasing property), municipalities (when sending property tax information or during seasonal event such as “spring clean up”), community organizations (during community events), appraisers (when appraising the property), contractors (when replacing furnace or roof), even ads when waiting for a bus. It was mentioned that, if many different sources all tell homeowners the same thing, it will lead to increased awareness, interest, and action. These various stakeholders would need adaptation training, and information and resources that can be shared with the homeowner.

- Messaging needs to be targeted and specific to the audience, understanding what homeowners already know and where they are on their journey to implementing the adaptation measures (for example, just beginning, halfway through, or completed main upgrades but need seasonal reminders for maintenance). It also needs to be targeted to different income levels, languages, technical understanding, and location. The messaging must be locally specific for it to be useful.
- Messaging should be positive in tone.
- Communication must happen both ways, including listening to the lived experiences of communities, allowing for bidirectional sharing of knowledge.
- Messaging of risks needs to be more accessible and ‘easy-to-digest’, for example, it is difficult to understand the meaning of a 1-in-100-year flood, or even that they have a 1% chance of flooding every year.
- Describe how the risks can affect homeowners, not only in damages to the home, but also in repair costs, displacement, and social stresses.
- Pair messaging about risks with messaging about options for reducing risk through the adaptation strategies.
- Focus messaging on the fact that adaptation strategies will help homeowners to protect their home, protect the value of their assets, that the adaptation measures are a smart investment, and the time to act is now.
- Provide clear lists of adaptation measures with how-to videos, case studies, potential costs, and available resources and financial assistance.
- Some houses will require unique adaptation strategies and will require tailored guidance, but many houses share the same characteristics, and

general information can be provided that can be applied to a cohort of homes.

- Focus messaging on the additional benefits of adopting adaptations strategies, such as better indoor air quality for their family, or lower utility bills, or not needing to replace the roof as frequently.
- Describe various levels of adaptation measures, including those that are more expensive and require a contractor to install, but focus messaging on simple, easy to do interventions that are applicable to their local conditions.
- Provides nudges throughout the process to help them move forward with implementing the adaptation measures.
- Share personal homeowner stories of success. Show homeowners that their neighbours are taking action.
- Share success stories from early adopter businesses who are championing best practices and adaptation measures.
- The information needs to be credible and from trusted sources with proof that the adaptation measures work.
- Have one place to easily access information that is trusted.
- Have a phone number that homeowners can call to have their questions answered.
- Align messaging and explain reasons for different options if applicable.
- Utilize popular culture such as HGTV or The Home Network to accelerate change, mainstreaming and normalizing adaptation measures.
- Be prepared to share information at key times/ windows of opportunity, such as during or immediately after a negative event occurs or during periods of recurring seasonal activity or events.

When asked who should be producing and disseminating the messages, the key informants described the potential role for the following stakeholders:

- Federal government: produce an accessible flood mapping portal that coordinates the mapping efforts done by provincial and municipal governments.
- Municipal governments: are well positioned to organize local programs and communication efforts, have insights into local risks and construction methods, have a lot of local responsibility for maintaining infrastructure, provide key services, determine the construction of new homes, are the first response when disasters occur, and it is believed this level of government has more perceived trust. They also have existing channels of direct communication through town halls and community events. It was also mentioned that sometimes individual property adaptation is insufficient to address the full risk, with a community response being necessary, directly connecting the municipality to the risk mitigation. One key informant said that municipal governments have the biggest role to play, and it cannot be done federally or provincially. Instead, federal and provincial governments must support and fund the work of municipal governments in promoting resilient communities. It was mentioned that local governments are under-appreciated and under-funded. It was mentioned that some municipalities may be too small, and may require a collaborative effort from other jurisdictions.
- Contractors and trades: are often the ones recommending what work needs to be done or what products to use, and homeowners will often choose those recommendations. The contractor in front of the homeowner is very influential. One key informant shared a story of homeowners who wanted a heat pump installed in their house and were

told by multiple contractors not to install one, with the moral of the story being: if this is what educated and aware homeowners had to go through to get a heat pump, then unsure or unaware homeowners will not succeed. Key informants mentioned that contractors who recommend products that are more expensive may lose jobs in competitive markets, but one key informant mentioned the benefit if the contractors can recommend superior products while also guiding homeowners to grants and subsidies to offset the costs.

- Hardware stores: are often times the front lines in providing guidance to homeowners on repairing their home and implementing adaptation measures. It is where homeowners go when they need to fix their homes. One key informant suggested perhaps programs be offered through hardware stores to be both proactive and reactive.
- Community groups, community organizations, and not-for-profit organizations: can be good sources of credible information and can speak with a less bureaucratic voice. They can provide in-person guidance for homeowners, helping connect neighbours and local businesses. In-person recommendations from neighbours are very influential. One key informant even suggested that they can even help homeowners to fill out paperwork, which is seen as a huge benefit. These organizations need to be armed with the resources they need to distribute to the community. It was suggested that there should be a larger, even national, coordination of these local, community groups to share information and strategies.

One key informant described the importance of collecting feedback from homeowners on their experiences implementing the adaptation measures, the barriers they faced, how they overcame those barriers, and how programs and

outreach efforts can be improved. This is invaluable information that should be used to constantly refine and improve the programs.

Examples were provided of municipalities hosting community awareness days to increase homeowner awareness of the risks and adaptation measures. It was suggested that municipalities could apply for funding from not-for-profit organizations, and partner with insurance companies, to conduct events.

Discussion turned to climate change risk disclosure when buying and selling a house. Some key informants mentioned that home buyers would greatly benefit from understanding the climate change risks for houses they are considering purchasing, and that realtors should be a source of this information. An example was provided of a home buyer telling their realtor that they did not want to consider homes in flood plains or on the ocean coast, but was still sent listings for those types of homes over and over by the realtor. One idea provided was for a climate score that could be developed for homes that discloses the risk of various climate hazards and describes potential adaptation measures that could be implemented to address the risks. However, it was also mentioned that this risk information does not currently exist, so work would be needed to first produce this risk information. Concern was also expressed about any increase in the costs to buy and sell a house, for example if a mandatory audit was required, and the impacts that risk information could have on the value of homes that are deemed high risk. Key informants highlighted that there would be growing pains if such data became available, and the sudden loss of value in their greatest asset, if found to be at high risk, would be a very emotional thing for homeowners.

An example was provided of neighbourhood ambassadors for reducing wildfire risk, where one homeowner or a group of neighbours become interested in implementing adaptation measures in their homes. These ambassadors become

educated on adaptation measures or ask a trained assessor to do an assessment of their homes, then share the information with other neighbours, and work together to reduce their risk. This is particularly important for wildfire risk where one property's risk affects the neighbours. This can act as a first exposure to build awareness and interest, and then the organizations can work with homeowners in a more meaningful way towards action and implementation. It was mentioned that people are more receptive to information when it comes from people they know and trust, instead of authorities that they don't have a connection with or don't trust, such as politicians. It is anticipated to be a more effective means of raising awareness than brochures in the mail.

An example was provided of a fire department providing a chainsaw safety demonstration, knowing that homeowners will be using chainsaws after major wind events to clean up trees. This example highlights the importance of local support for homeowners on various aspects of home maintenance. And it also highlights the importance of support from neighbours, in the form of skills sharing, because knowing the neighbour with the chainsaw after a windstorm or a pump after a flood is very important. Community support and connections are very important.

Data and Mapping

Many of the key informants discussed climate change risk data, mapping, and disclosure. Several key informants mentioned that very little risk information is available to homeowners. They cited that the best risk information available are flood maps which are inconsistently available across the country, are often out of date or based on past flood information and not future risk, are difficult for homeowners to obtain, and are difficult for homeowners to understand. It was mentioned that little to no information is available for other risks such as extreme heat, hailstorms, wildfire, or high winds. It was also mentioned that

insurance and mortgage companies have access to some of this risk data that they use to set their rates, but homeowners do not have access to this information to inform their decisions. Another key informant mentioned that it is not part of the regular business practice of many professionals that homeowners rely on and trust, such as realtors, inspectors, or appraisers, to seek out or share risk information with homeowners. The key informants highlighted that the homeowner is therefore the most vulnerable party with the most to lose but is the least informed.

Much of the data that exists in Canada is not easy to use and interpret. One would have to be a climate scientist to know how to use and interpret the data. However, the Climatedata website does aggregate available data from regional hubs and other organizations, and is vetted by experts. It was mentioned that the data from this website can be used to inform high level discussions on what would happen if negative climate events occurred with greater frequency.

Discussion with some key informants turned to risk mapping similar to the American Flood Factor. One key informant said that caution is needed when developing products such as that, for one because climate observations in Canada do not have sufficient resolution, and also because often some climate events are not understood well enough to be able to inform prediction, for example with tornadoes and high wind events. ‘Garbage in, garbage out’, and ‘not feasible in Canada’, were used to describe the idea of this type of mapping in Canada. It is unclear if data of sufficient resolution exists for specific areas (like urban centres) that could be used to better protect Canadians.

One key informant shared an example of asking homeowners at a town hall meeting to draw on a map the known flooding areas in town, sharing local knowledge. This works to both gather knowledge and helps to get homeowner interest and buy-in.

Some key informants mentioned that user-friendly risk data and mapping would be of great benefit to inform homeowners and home buyers in their decision making, starting conversations about upgrading their properties to address the risks. One key informant stated that without flood maps, how are people supposed to know what their risk is, that why would a homeowner mitigate a risk that they don't have, and that risk information is the thing that is going to help drive action. It was stressed, however, that simply stating the risk level is insufficient, and it must be paired with information on appropriate adaptation measures that the homeowner can undertake. When asked who is best suited to develop risk data, multiple key informants mentioned that government is best suited because it would allow for fair access, there was anticipated higher quality control, and that the data must be reviewed with the public interest in mind so that errors do not adversely affect homeowners. It was mentioned that governments are starting to work towards developing flood maps/models that are accessible to homeowners, developing protocols for methods to make the maps, and funding mapping projects. One key informant mentioned that, before it was possible to develop flood maps and risks, it was first necessary to map the terrain of the land, which is a huge challenge because Canada is such a large country. And that new maps are in the process of being produced that facilitate flood mapping and risk calculations.

Other key informants felt that, although not much risk data is currently available for homeowners, we should not wait for additional data to start acting. They expressed that the readily available solutions should start to be implemented now. There are simple measures that all homeowners should implement now, like sealing window and doors, or cleaning gutters, instead of waiting for more data.

Programs

Multiple key informants mentioned a concept such as a ‘one-stop-shop’ for climate change risks and adaptation measures, which would include providing information resources, connecting homeowners to trained and qualified contractors, and connecting homeowners to financial supports that have simplified, and even unified, application processes. Some described it being run by a third party with a mission to work with homeowners to drive action, thus decreasing the burden on homeowners. It was mentioned the benefit of looking at upgrades with a wholistic adaptation approach, instead of separate challenges of wildfire, and flooding, and wind, etc. Another key informant mentioned that homeowners will need assistance in prioritizing which adaptation measures to implement first. One key informant highlighted that simply providing information is not effective, and that serious and successful programs will offer financial support, physical assistance, and qualified contractors. One key informant mentioned that the programs cannot be overwhelming for homeowners or else nothing will get done. Another key informant mentioned that it might be useful to integrate adaptation measures into existing programs for energy efficiency, helping to ensure there are not competing programs.

Insights were provided on some existing programs where trained professionals review homes for risks and provide guidance to homeowners on adaptation measures. Sometimes these assessments are paid for by homeowners, sometimes they are partially subsidized, and sometimes there is no cost to the homeowner. Different scales exist for such programs, with some being a general assessment and report, others include coordinating contractors to complete adaptation upgrades, and others including follow up assessments that can lead to insurance discounts. The larger programs require a lot of time, energy,

funding, and manpower, and often the teams offering the programs are one person or a small group of people. Funding is always a challenge. With more funding, more advertising for the programs can be done, more assessors can be available, and more assessments can be done. It was also mentioned that interest in such programs can change depending on homeowner interest, and when interest is low, it is difficult to justify continuing to offer training for the assessors, and that the contractors are not excited about offering the service. However, training and program materials exist and can perhaps be deployed at a larger scale when in demand. It was mentioned that such programs find great success when the assessments are heavily or fully subsidized so that the homeowner pays very little.

Insurance, Contractors, and Other Housing Professionals

Contractors are needed who are more knowledgeable about building adaptation measures and not just building the status quo. There will be an increasing demand for knowledgeable contractors as more homeowners implement adaptation measures and need repairs from damage. Several examples were provided where contractors can act as the champions of the adaptation measures. One was for permeable driveways, where contractors can describe the benefits of a permeable driveway when providing a quote, and can then guide homeowners to grants and subsidies to offset the additional costs. This way, the municipality only needs to work with 20-30 contractors instead of 60,000 homeowners. Another example was a program for upgraded roofs that was spearheaded by a city, who brought the contractor association together and provided training to ensure quality installations. The contractors are now able to encourage homeowners to install better roofs. Another example was training for landscaping professionals to understand how to avoid high risk landscape plans for homes located in the wildland-urban interface.

An example was provided of a builder wanting to implement wildfire adaptation measures and wanting to advertise the new housing development as including these measures. However, another example was provided of a town that was devastated by wildfire, and there was pushback from the builders to voluntarily include wildfire best practices when rebuilding because of the additional cost. One key informant provided an example of home buyers pushing back on the option to include climate change adaptation measures on a new home, with the home buyers questioning why the measures were not default if they were so beneficial. However, when the adaptation measures were offered as part of the standard design of a new home, the conversation with home buyers then changes to the value and importance of the measures, allowing them to feel even better about their purchase. The key informant highlighted the importance of the house still meeting the other needs of the home buyers in terms of aesthetics, square footage, good community, etc., or the home buyer won't want it.

Referencing the more than 600 deaths in BC after the 2021 heat wave, one key informant mentioned that the home building industry is not doing a good enough job if the occupants are dying, and we must build better. The key informant even referenced the Hippocratic mantra *do no harm* when it comes to building houses, highlighting the need to build well-designed homes.

Financial and Fiscal Support

Financial supports such as tax breaks, on-bill financing, grants, subsidies, and low-interest loans were suggested by many key informants, which currently exist for energy efficiency measures. It was mentioned that the existing energy efficiency subsidies present options to homeowners that they may never have considered themselves, for example installing a heat pump instead of replacing their furnace. Another key informant mentioned that financial supports should

be focused on priority homes and have an income cap to be most effective in assisting the homeowners who need it the most. It was stressed by multiple key informants that financial supports need to come with minimal red tape and regulation. One key informant suggested that it may be most effective and efficient for financial supports to leverage existing financial channels, where the money is already flowing, such as tax returns and property taxes, instead of creating new channels. Another key informant mentioned that financial supports from governments are justified because of the societal benefits from having more resilient homes, for example less money is paid out through disaster recovery funds, and the economy is less impacted after a disaster if people can resume their lives quicker. One key informant mentioned that we cannot afford not to act, as the cost of inaction is greater than the cost to adapt.

Examples

One example was provided of a city introducing a separate charge for storm water services on the property tax bills. They also introduced a credit policy for homeowners and businesses to be able to reduce the storm water charge if they have stormwater management on their property. They streamlined the application process by developing a logic matrix to automatically approve most applications, with a human assessment only required for the ones that were not automatically approved. They implemented an audit process of a percentage of properties every year and have found that the vast majority are in compliance with the requirements. They remind homeowners every year through property tax bills that the credit program exists. It was mentioned that many homeowners are proud of the work they had done to reduce storm runoff on their property. The project team learned that, when the storm water services were first called out on the property tax bill, there were many phone calls to the city from homeowners upset at the charge, and the city staff explained to the

homeowners why it was happening and what homeowners can do. Despite notifying people ahead of time that the charge was coming, many one-on-one conversations were still required.

It was mentioned that some municipalities are giving away rain barrels to homeowners in an effort to increase storm water retention on private property.

An example was provided of rebate programs in communities that were affected by wildfires, where donations that were provided for that community were turned into rebates that homeowners could apply for to implement the recommendations provided by trained assessors, for example to help homeowners pay to remove a tree or change their landscaping or hire a contractor to fix their siding. In another example related to rebates, some adaptation recommendations may overlap with some efforts to increase energy efficiency that have existing rebate programs, such as windows or heat pumps, so interest exists in cross promoting those upgrades.

Programs

Several key informants were critical of many of the existing programs, believing them to be difficult for homeowners to navigate, both from an administrative and paperwork standpoint and also obtaining audits, and believing it to be unfortunate that homeowners have to put out the money upfront and then have to try to get the money back while they could be paying interest on thousands of dollars on their credit lines. One key informant said that they have heard from many that they felt the bureaucracy of a program was not worth their time. It was believed that many of the existing subsidy programs, for sump pumps, for example, have very little uptake. The key informants were keen to stress that programs for homeowners must be useful, accessible, easy to navigate, and easy to obtain the funding quickly. One key informant highlighted the importance of having a system in place to constantly seek feedback on

available programs, asking participants what works, what does not work, and adjusting the program as required to improve. This helps those designing the programs to understand the needs and experiences of the homeowners. Another key informant mentioned that good programs will reduce all barriers for homeowners.

An example was provided of a downspout disconnection program, making sure downspouts are not connected to the municipal sewer system, where contractors with all of the necessary materials will drive around neighbourhoods and knock on doors to disconnect downspouts. It was mentioned that the program is well received.

Insurance, Contractors, and Other Housing Professionals

Some key informants provided examples of homeowners receiving credit for implementing adaptation measures through lower insurance rates, better mortgage basis points, or a reduction in property taxes. Several key informants mentioned examples from the United States of America where insurance companies may lower insurance rates if homeowners adopt adaptation and resiliency measures, which is confirmed through an evaluation. This recognizes and rewards the efforts made by homeowners. However, it was mentioned that often times, at least for the Canadian examples, the credits and savings are so low that it may take years to pay back just the simple measures. So, while it is a perk, it may not be enough incentive if the homeowner does not already have a problem, such as a wet basement, to address. However, it would contribute to raising awareness and lowering overall risk.

Two key informants described a new approach of insurance companies funding ‘building back better’ after a disaster occurs. For example, installing hail resistance roofing instead of regular roofs after a hailstorm, or installing sump pumps after flooding. Insurance companies would incorporate these adaptation

measures into their rebuild expenses, which was anticipated to be a slight increase in cost but would contribute to less loss after future storms. It was suggested that if the large insurance companies start offering this strategy, other companies would likely follow suit, such as when overland insurance was introduced in 2015. However, this is not a proactive strategy, and a homeowner would first need to experience a loss. It was noted as well that home insurance is typically a one-year product, so insurance companies could be hesitant to offer build-back-better options because they could lose their investment if the homeowners choose a different company for the next year's insurance. Another fundamental challenge of insurance companies offering build back better is that insurance is meant to compensate the homeowner for their loss, not to leave them better off - this is also often the case for the disaster relief funds offered by governments. That being said, some insurance companies are looking into these strategies.

One key informant mentioned it could be of benefit to provide financial incentives to new home builders to include adaptation measures in their new homes in order to start transitioning the industry to building better.

Support from Government

Some key informants discussed the building codes, standards, regulations, and the role of government in relation to climate change related risks to houses.

Meaningful, independent test standards for the durability performance of products against climate change risks (for example against hail and fire) were called for. One key informant mentioned the impact that crash test results and ratings for cars had for adopting seat belts and air bags, highlighting that, for many climate change risks, it is in fact the products that fail (for example siding or roofs), and stronger testing standards can impact consumer choice and lead to better homes.

The project team learned that research is being done at the federal level to look at the science behind resilient residential retrofit technologies, and to develop certification criteria for the durability and resilience of materials and products, for example against wildfire or decay. These findings can inform the development of future Codes and Standards, and could become requirements for federal buildings or buildings constructed with federal funding, working to mainstream the resiliency (both adaptation and energy efficiency) practices. It was mentioned, however, that homebuilder representatives and consumer representatives are needed during the development of new Codes and Standards to ensure that the developed requirements are practical, achievable, reasonable, and cost effective.

The findings from the federal research can also feed into the development of the announced Climate Adaptation Home Rating Program or a modified Canada Greener Homes Grant program. The project team learned that work was being done to modify this national program, with the idea being that if an energy auditor is already in the house providing an inspection, then they can also provide guidance on adaptation measures. Several key informants also mentioned that idea, that energy auditors, who are already in homes providing guidance, could also be sources of adaptation guidance. One key informant mentioned the importance of looking at adaptation measures at the same time as mitigation measures, to help ensure that homeowners are not fully insulating their basement just to have it flood during the next storm, or are not needing to navigate if they should implement energy efficiency measures or adaptation measures first, but instead have access to a comprehensive plan.

It was mentioned, however, that although this research is being undertaken that can feed into future code development, discussions are required to determine the role of the building code as it relates to climate change risks. For

example, building codes are a minimum standard with the objective to ensure the occupants can escape and get to safety in an emergency, but not to ensure the buildings are undamaged after negative climate events. The code has requirements that address fire starting inside a house, but it does not have requirements that address preventing fire starting outside the house, such as a wildfire, from affecting the house. Multiple key informants mentioned that homeowners may be under the impression that their house was built to withstand negative climate and weather events, and that after these events they can go back into their homes and continue their lives. Another discussion that is required relates to the durability of materials, and if the Code should require more durable materials at the time of construction knowing that the houses will likely be adversely affected by climate events over the course of their existence, and that more durable materials could prevent or reduce damage.

If the building codes were to address negative climate events, it would first require changes to be made to the objectives and functional statements. It must be decided how much climate risk is acceptable, knowing that every house cannot be built like a fortress and that additional measures could increase costs to home buyers; although some measures to adapt to climate change are aligned with measures to mitigate climate change, for example heat pumps, which can help with justifying additional costs. It also must be assured that the requirements in the Code are attainable by the building industry and that the products are readily available.

If the Code includes adaptation measures as default for new homes, it removes a burden from homeowners to have to make decisions to adapt and protect their homes, and comes with a number of benefits to society. These discussions are ongoing for the 2030 National Building Code of Canada. It was mentioned, however, that whatever measures the building code adopts, they will only be

applicable for new houses, and do not address existing houses unless they undergo a major renovation. And it was mentioned that Code development cycles are very long, and waiting for Code to require adaptation measures may be too late. Action is needed sooner, and early adopters are needed to lead the way. It was also mentioned that only so many risks can be mitigated through the building code, and land use planning is important as it relates to flooding and wildfires.

Several key informants mentioned certain jurisdictions in the United States of America that require additional protections above and beyond their building code to be built into new homes based on the local risks, whether it be high wind, wildfire, or hail.

Separate from the discussion on building regulations, multiple key informants mentioned the importance of municipalities and regulatory bodies ensuring that new houses are not built on flood plains or on the coast. Referencing the housing shortage, it was mentioned that municipalities are being asked to build more and more homes. However, flood plains are designed to flood, and homes should not be built on them. One key informant stated that we should know better. In a similar sentiment, one key informant highlighted that local bylaws should not require measures that increase risk to home, with examples provided of some cities requiring cedar shakes for the roofing materials, or trees to be planted in certain areas, which are not aligned with best practices to prevent wildfires. Multiple key informants highlighted that local governments who are making these bad decisions of where and how to build become somewhat insulated against consequences because provincial and federal aid will be provided if/when a disaster does occur.

It was also mentioned that governments must spearhead buyout programs for high-risk properties instead of continuing to rescue and repair after disasters. It was pointed out that this will be emotional and very difficult, but must happen.

One key informant mentioned that it can be difficult to convince homeowners to pay for the adaptation measures for which they may never see the benefits. However, there are benefits to insurance, local government, hospitals, and other aspects of society when these measures are adopted by homeowners. Regulation may be needed to say: we can no longer afford not to do something. Bold and brave policy may be needed to protect people.

Another key informant mentioned that the public sector can only do so much to protect homes and communities, that only the homeowner can do some things on their property, and that the public sector has a responsibility to help homeowners know what to do. One key informant provided an example of a city receiving a lot of complaints of flooding in houses after a large storm. A city representative will go out to help homeowners understand why the flooding happened, and if the flood was because of an infrastructure problem or a problem with the private property. Homeowners need assistance to understand their roles and responsibilities. Another key informant described the inverse problem, that a homeowner can only do so much to protect their home, and that a full assessment must include learning and understanding what is happening at a community level, highlighting a need to work with both municipalities and homeowners to work towards adaptation.

It was also mentioned that putting measures into bylaws and codes will take time and won't be well received everywhere, highlighting the importance of working with many stakeholders: homeowners, contractors, local government, community groups, etc.

The insights provided by the key informants highlighted the need for a whole society approach in tackling climate change risks, with effort from every jurisdiction and stakeholder. This includes having alliance between all levels of government and between different ministries or departments of the same level of government. Different portions of government are responsible for different information, different decisions, different programs, and different disaster responses. Climate change crosses jurisdictional boundaries in ways that nothing else has before, and there needs to be an aligned, all of government response. It must be ensured that efforts done by one level of government do not undermine others. It was mentioned the challenge of governments tackling climate change, which can often be a political item. Politicians can receive a lot of publicity in coming to the rescue after a disaster, whereas proactive adaptation is not as flashy. It was also mentioned that climate change efforts can be dependent on available funding.

2.4 The North

Regarding the permafrost thaw in northern Canada, it was mentioned that entire communities are built on permafrost, where the houses are falling apart, that will need to be completely rebuilt. Many communities do not have the capacity to start over again, and Canada needs to come together to support the north. An existing housing shortage in the north was also mentioned, so this may be an opportunity to rebuild to better meet the needs of those communities. It was stated that the time for action is now instead of waiting for more available data, because we know something must be done about all buildings on permafrost. Do not wait until there is a state of emergency.

2.5 Other Considerations

The key informants mentioned several considerations that have not been captured above:

- Climate change is global but is experienced locally,
- In the past, the image of climate change was the polar bear on the melting iceberg, but perhaps now it should be flooded homes, wildfires, and extreme wind events,
- Different parts of the country have very different risk when it comes to climate change, and many of the risks are not well understood,
- The time between major climate events seems to be less and less, with even some concurrent events, so less time exists to repair and prepare for the next event,
- For all the statistics of the insurance claims after each disaster, the costs do not include the damages that were not covered by insurance where the homeowner is paying the difference,
- In some cases, a homeowner cannot do anything to reduce their risk, and those houses, once identified, would need to be covered by strategic retreat instead of rescuing people and rebuilding over and over,
- Insurance is for “if” something happens, not “when” something happens. If climate change alters risks so the negative event is inevitable, that will have impacts on insurance.
- As risks and events increase, it will become harder and harder for homeowners to be unaware,
- Every time homeowners experience a disaster, mental health impacts, social impacts, and economic impacts result,
- Impacts on property values are often not captured in cost analysis of adaptation measures,

- Many houses in Canada are old and not well maintained, making it challenging and expensive to adopt adaptation measures,
- With the housing shortage facing Canada, we need to keep every house in as good a state as possible,
- With the housing shortage in Canada, we need to ensure that the new houses being built will be durable,
- Every homeowner will have different needs and are facing different life issues and challenges,
- Often significant solid waste is produced after a disaster during cleanup which is rarely considered or discussed,
- Appropriately trained and available contractors are needed to assist homeowners implement these adaptation measures, otherwise even aware and interested homeowners might not be able to act,
- These natural events need to be understood and appreciated in a new way, for example, flood plains are meant to flood, and wildfire is good for natural ecosystems and can help to minimize worse fires later on, so how can we live with and plan around these natural events so that we are not fighting them all of the time,
- We need to balance risk, adaptation measures, and affordability,
- We need solutions that are creative and simple and don't complicate matters,
- We still hear of car accidents where someone was not wearing a seat belt: it takes a long time to change people's thinking,
- If we wait for the data and programs to be perfect, it will take too long; action should be as soon as possible, not as smooth as possible,
- The time for action is now so that homeowners are not suffering through disasters, emergencies, and trauma,

- We need to learn from each other's mistakes and build off them, because we don't have time for everyone to make the same mistakes,
- In the end, we all want a roof over our head, dry feet, and nothing on fire.



Homeowner Survey

A national omnibus survey

A national omnibus survey was conducted during May 2024 to provide insight into homeowner knowledge and awareness of extreme weather events, actions taken to adapt to their effects, and the likelihood of taking actions in the future. Oraclepoll Research Ltd. was hired to conduct a telephone survey of 1,000 homeowners across Canada. The margin of error is +/- 3.1%, 19/20 times. Error rates vary and are larger for geographic and demographic sub-samples of the survey population.

The answers to the questions are shown in chart format in Appendix F. A summary of the answers is provided below.

Respondents were screened to ensure that they were Canadian, 18 years of age or older, a homeowner, and one of the decision makers at their residence. The following preamble was then read to each participant:

We will be asking a series of questions on your home and extreme weather events. These events include flooding and water entering your home, wildfires, very strong winds, very high temperatures, and very low temperatures. We will be calling all of these “extreme weather events”.

Question 1

Have you ever considered how your home might be affected by extreme weather events and how you might protect it?

More than six in 10 (63%) answered that they have taken extreme weather into consideration. Those living in Atlantic Canada (71%), Quebec (74%) and BC (68%) were more likely to say yes, as were 35-54 (74%) and 18-34-year-olds (64%), university graduates (66%) and the highest earners in the \$90,000+ cohort (79%).

Question 2

Have you ever made changes to a home that you owned to protect it from potential damage from extreme weather events?

One-quarter (25%) claimed to have made changes to a home. Results were highest among Atlantic Canadians (43%), 18-34-year-olds (31%), and those earning \$90,000 a year or more (43%).

Those that answered yes in Q2 were asked in Q3A about the reasons for making changes, while those saying no in Q2 were questioned in Q3B about why changes were not made. Multiple responses were accepted for each of the follow-up probes and the results illustrated are the percentage of cases or each time an area was mentioned.

Question 3A

What were your top three reasons for making changes to protect your home?

Reason	Percentage of Responses
I want to protect my possessions	49%
Don't want home to be damaged/want to protect	48%
Had extreme weather damage / prevent future	30%
I want to maintain the value of my home	11%
Regular maintenance / owning / my responsibility	10%

Insurance won't cover the cost to repair damages	7%
For the health and safety of me and my family	3%
Family, friends, neighbours recommended it	2%
I want to reduce time away from school or work	1%
I love my home	1%

Question 3B

Why have you not made changes to protect your home?

Don't know what to do or what's effective	31%
Never thought about it before	22%
No problem with extreme weather events	15%
Home won't be affected / I have low risk	15%
Low priority / not important to me	10%
Don't have time to do it / I'm too busy	8%
Not my responsibility, insurance / gov't responsible	7%
My house is well constructed	6%
I'll take my chances	3%
I don't know anyone else who is acting	2%
It's too stressful or scary	1%
Don't like / want contractors in house	1%
It would lower the value / ability to sell my home	<1%
Difficult to find a contractor	<1%

Question 4

Have you ever experienced damage from an extreme weather event at a home that you owned?

Seventeen percent claimed that they have at one time experienced damage to their home because of an extreme weather event. Atlantic Canadians were most likely to have experienced damage at 57%, next followed by a far lesser number

of those living in BC (20%), Alberta (17%), Manitoba/Saskatchewan (16%), Quebec (14%) and then Ontario (10%).

Question 5

In your opinion, how likely is it that an extreme weather event will negatively impact your home?

Extremely Likely	19%
Likely	9%
Neutral	28%
Unlikely	17%
Extremely Unlikely	17%
Unsure	11%

Twenty-eight percent answered that it is likely or extremely likely that an extreme weather event will negatively impact their home. Atlantic residents were most likely to say likely or extremely likely (69%), as were university graduates (34%) those earning \$90,000+ (39%) and 35–54-year-olds (32%).

Question 6

How would you rank your concern of an extreme weather event damaging your home in the next year?

Very Concerned	26%
Concerned	10%
Somewhat Concerned	23%
Not Concerned	25%
Unsure	16%

In total, 36% percent said that they are concerned or very concerned over an extreme weather event damaging their home over the next 12 months.

Residents of Atlantic Canada (87%) and BC (45%) were most concerned or very concerned.

Question 7

What could prompt you the most to start taking steps to protect your home from extreme weather events?

In a question allowing for multiple responses, all of those surveyed were read a list and were asked if the list items would motivate them to start taking steps to protect their home from extreme weather events. Displayed below are the percentage of cases for each time an issue was mentioned.

Having more information	36%
Experiencing an event or damage from an event	29%
Being told by a trusted source or news story that steps need to be taken	25%
An increase in extreme weather events (frequency, intensity)	23%
Having more time or money	15%
I wouldn't take action to protect my home	14%
Family / friends taking steps to protect their homes	1%

Question 8

What challenges do you think you might encounter or have encountered when making changes to your home to protect it from extreme weather events?

In an open-ended probe allowing for multiple responses, all respondents were next asked to identify the challenges they may face when making changes to their home. Displayed below are the percentage of cases for each time an issue was mentioned.

I don't have time to do it / I'm too busy	26%
Cost	24%
I don't know how to do it / don't have the skills to do it	12%
Not applicable / I wouldn't take steps to protect my home	12%
I don't know what to do	11%
Low priority / not important to me / I have other things to deal with	10%
I don't trust the information that is available	7%
It is difficult to find a contractor	5%
Don't want contractors in house / don't want to deal with contractors	1%
Concern that it would lower the value of home / ability to sell my home	1%
It's too stressful or scary	<1%
Other members of my household might not agree	<1%
Might not like how my house or yard looks afterwards	<1%

Question 9

What could or would have helped you to overcome those challenges to protecting your home from extreme weather events?

In the final open probe in this section allowing for multiple responses, all respondents were asked to name what could or would help them overcome challenges to protecting their home. Displayed below are the percentage of cases or each time an issue was mentioned.

Help understanding what to do	23%
Availability of financial support (grants, subsidies, rebates, loans)	22%
Talking to trained professionals / contractors / hardware store	17%
More information on the costs	13%

I wouldn't take steps to protect my home	12%
Help understanding how to do it	11%
Nothing / don't need any help	10%
More money	7%
List of qualified contractors	7%
More time	5%
Talking to friends, family, and neighbours	<1%

Question 10A

In Question 10, all respondents were first asked if they would want a trusted source to tell them about the specific vulnerability of their home to an extreme weather event and how to protect it. The 73% or n=734 that answered yes were then asked in Q10B to name those trusted sources. Q10B allowed for multiple responses and the results displayed are the percentage of cases or each time an area was named.

Would you want a trusted source to tell you about the specific vulnerability of your home and how to protect it from an extreme weather event?

Nearly three-quarters or 73% said they would want a trusted source to provide them with information.

Question 10B

Who would those trusted sources be?

Certified professionals giving assessment / realtors	43%
Government (federal, provincial, or municipal)	27%
Online resources, brochures, social media, TV, news	16%
Insurance or mortgage company or bank	14%
Independent consumer organizations	11%
Hardware store, contractors, and tradespeople	10%

Family, friends, neighbours, local community groups	2%

Question 11

How well informed are you about extreme weather events, the potential impacts on your home, and the actions you could take to protect your home?

Slightly more than a quarter or 26% said they are well informed, compared to four in ten not well informed, while 34% answered somewhat informed. Those most likely to say well informed were from the Atlantic (47%), BC (40%) and Quebec (35%), younger 18-34 (34%), university educated (30%) and higher earners in the \$90,000 cohort (43%).

Question 12

Do you live in an area that is vulnerable to extreme weather events, such as a coastal area, a flood plain, or a wooded area?

Twenty-three percent claim they live in an area vulnerable to extreme weather events, with results highest in the Atlantic region (70%), then followed by BC (29%), Manitoba / Saskatchewan (24%) and Quebec (23%).

Question 13

Do you think that extreme weather events like flooding or wildfires are increasing because of climate change?

Nine in 10 surveyed are of the opinion that extreme weather events are increasing as a result of climate change.

IV

Homeowner Focus Groups

Oraclepoll Research Ltd.

Oraclepoll Research Ltd. conducted two online focus groups in October 2024 on consumer perspectives related to the risk to their homes from flooding, wildfires, and high winds, including their experiences with these events. As well, participants were asked about home maintenance, insurance, and information resources in relation to these weather events. Participants were randomly recruited from across Canada for each session and were screened to ensure that they were:

- 18 years of age or older,
- non-condominium homeowners,
- aware of extreme weather events causing damage to homes,
- a mix of those who had and had not experienced damage to their home from flooding, wildfires, and high winds, and
- a mix of those who were willing to or had taken preventative measures to protect their home from future damage.

Each of the two groups included participants from British Columbia, Alberta, Ontario, Quebec, and Atlantic Canada. The full set of questions posed in the

focus groups is found in Appendix G of this study while the Oraclepoll report is included in Appendix H.

The following summaries were developed from the recordings of the two sessions and the Oraclepoll report. The results are qualitative in nature and may not be representative of the broader population.

Experience with Flooding, Wildfires, and High Winds

Participants were asked about any experiences that they had with flooding, wildfires, or high winds. While all participants in the sessions had experienced extreme weather events, roughly half reported damage of varying extent to their properties or residences. The events they reported included downed trees, wildfires, wind damage to roofs or siding, flooding, and water damage. Most of those who experienced these events did not go through their insurance company, rather performing the remedial work themselves. Generally, those who made insurance claims had a positive experience with their provider or those doing the repair work. There were two participants who said their insurance did not cover all the repairs while others noted hefty deductibles and shoddy craftsmanship.

When asked if they would do anything different next time, there was a consensus that more could be done to prepare their yards by cutting brush, trimming trees, and removing dead trees and other objects that would be blown by high winds.

Notable quotes include:

- “Insurance companies [are] a lot of hassle ... just doing it myself without going through insurance.”
- “Make sure you know your [insurance] coverage.”
- “Not much you can predict.”

- “It was almost tornado winds, so I couldn’t do anything about it.”
- “Hopefully if ever anything happens, I will have more money aside.”

Risk Assessment

Participants were asked how they knew if their home was at risk and how they assess risk. There was a consensus that it is difficult to determine if homes are at risk. What participants did say is that previous storms that caused damage made them aware – for instance to check that sump pumps are working, and that loose objects are secure. It was also mentioned by some that they check weather websites and TV channels, and also the weather alerts on their phones.

Notable quotes include:

- *How do you know if your home is at risk?* “You don’t.”
- “Make sure everything is in working order.”
- “Knowing the neighbourhood that you’re in... I made sure that I was higher up further than my neighbours, so flooding is not going to be an issue for me little bit of research on the neighbourhood that I was moving too.”
- “Keep myself educated about the things around that could possibly happen.”

Preventative Actions Taken

Participants were asked what preventative actions they would consider if they believed they were at high risk. Responses varied and included checking to see if sump pumps work, that yards are cleared / clean / secured, trees are trimmed, and gutters and down spouts checked, as well as windows and doors are sealed.

Notable quotes include:

- “Not too much actions you can do I guess.”

- “Every spring and fall we do a check list, so we check the sump pump, we make sure the eavestroughs are clear, faucets outside are turned off so we don’t have damage there, we follow simple check list.”
- “Just a matter of trying to catch it in time.”

Information and Resources

Participants were asked a series of questions on information resources as they related to flooding, wildfires, and high winds, including:

- who they have turned to in the past to learn about the actions they could take to address their risk,
- how else they are currently getting information about this topic,
- if they are interested in becoming more informed on floods, wildfires, and high winds, the vulnerability of their home, and the actions they could take to protect their home,
- what kinds of information they would want and how they would want to receive it,
- who would they most trust to provide them with reliable information, and
- if they would value getting information from not-for-profits, like a consumer advocacy organization.

In the past, participants have looked to social media, web searches, the weather channel, home improvement shows, flyers sent by insurance companies, hardware stores, and, most commonly, advice from family and neighbours.

All participants expressed interest in becoming more informed, however their preferred sources of information varied. Some preferred electronic methods such as email and websites and opposed having mailings which they said they would never read. Some favoured paper mailings or bill inserts with a link to a

website – but the information needs to be concise. It was mentioned that it is preferable if the information is geared towards the risks for certain areas and types of construction. One participant mentioned an online quiz with a small home safety prize could engage her and make learning fun.

When asked who they would want to receive information from, insurance companies were most referenced followed by government websites, while other mentions included reputable restoration companies, the Weather Network, and experts at hardware stores. There was concern, however, that if insurance companies provided the information, they could later deny claims if the homeowner had not followed the suggested preventative actions, and one participant mentioned not trusting insurance companies. Value was seen for having not-for-profits or community groups providing them with information as they were seen as being neutral and non-profit oriented, but they would need to be legitimate and reputable experts. When asked if they felt this information would be trustworthy, most concurred if they are experts.

Notable quotes include:

- “Talk to your neighbours.”
- “Always tip and tricks on Facebook that you see.”
- “My neighbour is in construction and has really helped me with some information ... I’m slowly learning from other people’s knowledge.”
- “Talked to lots of my neighbours to see what [weather] they had faced.”
- “Some people call it junk mail, but some people need it.”
- “When your [insurance] renewal comes, an annual reminder of how to make sure your home is safe.”
- “Most people have the weather network app on the phone ... click here for tips and tricks on how to secure your house ... because a lot of people are looking at it anyway, so it would be an easy... refresher.”

- “Have a hard time with people coming to my home and actually sitting down at the table and chit chatting with them, so honestly if it’s to have somebody else in my house then probably not.”
- “Wouldn’t really trust them unless they were a really well-known company.”
- “I like stuff that is so clear, if it’s too long I don’t want to read it... maybe a little checklist, or little points of check this, worry about this.”
- “Something that demonstrates different types of dwelling, structures, what to look for, in regards to how they are put together, elevation, there are so many different factors that play a role in whether something is safe or has the potential to be a catastrophe.”
- “I like the idea of a flyer especially if geared to my area, I don’t like to read long winded letters, so checkpoints, fall is coming, here is your preventative checklist.”
- “If the research is kind of done for me that could be a bonus, as long as they can get info from people that are known and more knowledgeable.”

Interest in Preventative Actions

Participants were then asked to discuss potential actions that homeowners take to protect their homes, and asked which potential actions from a supplied list they would be most interested in undertaking and if they have ever undertaken any of those actions before. Participants were also asked why a homeowner might not undertake any of those actions, and anything that could help encourage homeowners to undertake more of these actions.

Most reacted favourably to the list of actions that were displayed, and some were pleased to have a checklist. It was seen as preventative maintenance, that is, the actions could prevent higher costs if their home needed repairs from a

damaging event. Most participants preferred items with lower cost and effort to complete, such as cleaning gutters and their yard, stacking firewood at a distance, anchoring items, and storing valuables in waterproof containers.

Most participants had done yard work, roof repairs (out of necessity), and have taken other low-cost actions, and most said the experience was positive. When asked about barriers to undertaking the actions, cost was named as the major reason for not undertaking a specific action, followed by lack of knowledge and a lack of time. Procrastination was also mentioned. It was suggested that upgrade programs or loans be made available to make actions more affordable.

Notable quotes include:

- “With following this list, your insurance might come back and say, well I did give you a list, did you follow it, did you happen to follow through with these?”
- “To be safe, you never know what can happen.”
- “Would be a lot more expensive if you don’t [follow this list].”
- “The insurance are going be saying, it’s up to you to do that, if not, well, we warned you.”
- “I’m not being ignorant, I’m not being too good for it, it’s just something that I can’t afford.”
- “If there was a program in place that said, hey, this might help you with some of your issues, let us help you offset the cost by this amount, at least something to help, something to show, we understand this is an issue, let us help you in this way to make it more affordable.”
- “Scared for any future disasters.”
- “In perfect world all these things are done, but it costs money... it’s always cost vs. risk, would like to cover every base, but it can get pretty costly...”

it's always a roll of the dice between finances and risk, just hope to get the right roll every time.”

- “A lot I would have never known to do.”
- “Some people might not even know they are at risk, so that’s preventing them [from acting].”
- “It would have to happen to one of you to open the eyes to the other neighbours... then you would think, oh my goodness that could happen to me, so I better look into it.”
- “Somebody that would be available to do some of this for me, because I don’t really see myself checking my roof... I would rather pay someone to do some of this for me.”

Interest in Professional Risk Assessment

Participants were asked if they would be interested in having a risk assessment done of their home by a certified professional that could provide them with recommendations to protect their home from potential damage. Participants were not opposed to having an assessment but there would have to be certain conditions. The assessor would have to be reputable and accredited, and some participants wanted to know if it would help reduce insurance costs. Cost was also mentioned as a barrier, so if not free, the assessment would need to be reasonably priced, or a government subsidy would be needed.

Notable quotes include:

- “Maybe to give me a list of things that I could do to prevent, but it doesn’t mean it’s going to get done because of the cost.”
- “There are so many scams out there, you have to be careful who you could choose.”

- “Wouldn’t want to feel pressured or wouldn’t want to have that thought of, oh my god the house is going to collapse or whatever it may be, based on the information they find.”
- “As long as they are not connected to the government... I don’t need my personal data on file.”
- “With all the scams... I don’t know that if I would feel comfortable with someone coming and looking around my house.”

At the Time of Sale

Participants were asked if adopting resiliency measures could increase the value of their home to potential buyers.

Participants were split on this issue. It was mentioned that it could increase the value of the home because it would show the home was well maintained, it will be easier to take care of, and has already been updated. However, it was also mentioned that home buyers are not looking for these things, buyers only care if they like the house, no upgrade actions would matter, and some buyers just want to have a house. One mentioned that first time buyers may not care, but home buyers who have experienced damages in the past would be willing to pay more for those resiliency measures.

Participants were also asked if they had discussed flooding, wildfire, or high wind risks with a realtor, lawyer, home inspector, or insurer before they purchased a home.

One person asked a realtor, and another had a home inspection. Other participants mentioned not asking because they had not been aware of it or hadn’t thought to ask. The participant who had asked their realtor mentioned that the weather had changed since asking, so the information provided by the realtor is no longer relevant.

Experience with Home Insurance

Participants were asked about their overall experience with insurance coverage and its cost, as well as about any problems they had securing affordable insurance, or if their insurer had reached out to them about protecting their home.

Some participants had issues with their insurance company not paying full cost or having delayed or substandard work completed by the company the insurer sent for repairs, while others had no issues. Others who have not had a claim referenced the high and rising cost of insurance, and not being aware of their deductible. There were issues securing affordable insurance by younger and older participants. One participant noted that after a claim, the insurance company decided not to offer coverage in their area any longer, and they had to find another insurance company.

Only one person said their insurance company reached out to them about protecting their home. As mentioned earlier, there was a divide on the issue of how they want to receive information resources. This included social media, emails, and an app by some, while others still prefer paper.

Barriers to Action

Finally, participants were asked about the biggest barriers that stop them from taking action to protect their home from flooding, wildfires, and high winds. While one participant mentioned physical barriers of not being physically able to undertake any actions, the main barriers to action that were repeatedly highlighted were high cost, lack of time, and lack of knowledge, awareness, or experience.

Notable quotes include:

- “Life is really busy and everybody is working so much... having a hard time having any leisure time, and they don’t think of it.”
- “People don’t want to spend the time doing all this stuff, the research, people work too hard, too many long hours, unfortunately it has to happen to them, disaster has to happen to open people’s eyes.”
- “Some people just don’t care, they don’t, they really don’t care.”
- “I’m probably the biggest barrier, I’m not very knowledgeable, I don’t have the experience, nobody really taught me.”
- “Would have never thought about a tree being a problem, I was more concerned about what was going on with the bathrooms and how’s the place put together.”
- “Don’t have the budget in my household for extra than what I’m doing right now.”

Findings and Conclusions

In the past, the image of climate change was the polar bear on the melting iceberg, but perhaps now it should be flooded homes, wildfires, and extreme wind events.

– interview participant

In the end, we all want a roof over our head, dry feet, and nothing on fire.

– interview participant

The time for action is now so that homeowners are not suffering through disasters, emergencies, and trauma.

– interview participant

It is not known which homes that extreme weather will affect next, or how those homes will be affected. **Sections 1.1 and 1.2 and Appendix A provided an overview of various types of extreme weather events that homes face, including hazards from:**

- wind that can arise from strong thunderstorms, hurricanes, and tornadoes,
- water from flooding, snow, ice, and hail,
- wildfires,

- extreme cold and heat, and
- thawing permafrost.

These events are occurring with increasing frequency and severity, and can have catastrophic and long-lasting consequences for affected homeowners and communities. This includes the burden of:

- repeated damage,
- higher insurance premiums,
- lower insurance caps, or even lack of insurance coverage,
- stigma of owning a high-risk home,
- lower home values, and
- difficulty selling the home or obtaining a mortgage (Center for Climate and Energy Solutions 2021) (Bakos 2022) (Lerner 2022) (Andrasko 2021) (Iveson 2024).

This situation is not sustainable, and a shift in thinking is required from reacting to and cleaning up after these disasters to proactive adaptation, preparation, and building back better. A process of continual monitoring and improving is necessary. Adaptation efforts need to be coordinated with a whole-of-society approach, that includes all levels of government, non-government organizations, the insurance industry, and homeowners (Insurance Bureau of Canada 2024) (Canada 2023a) (Ziolecki, Thistlethwaite and Henstra, et al. 2020).

This report outlined the actions that homeowners could take to adapt and protect their homes (Section 1.3 and Appendix B) and the barriers to action that exist. Despite available adaptation information, homeowners are not undertaking these adaptation actions. This was highlighted in the homeowner survey, Section 3, where 75% of respondents took no actions to protect a home from potential damage from extreme weather events (Question 2). The top reasons given in the survey (Question 3B) for lack of action included:

- not knowing what to do,
- having never thought about it before,
- not having a problem with extreme weather, and
- not finding it important.

Also from the survey (Question 8), homeowners answered that the top challenges they expect to face when taking action to adapt their home to extreme weather are:

- not knowing what to do,
- lack of trust in the available information,
- finding it a low priority,
- the cost, and
- not having time.

The top barriers to action captured from the homeowner focus groups, Section 4, were:

- lack of knowledge, awareness, or experience,
- high cost, and
- lack of time.

Homeowners have said that they lack the time, lack the knowledge, do not trust the information sources, and lack the funds to undertake adaptation actions. Homeowners are unconvinced, unprepared, and out of money.

Unconvinced

Life is really busy and everybody is working so much... having a hard time having any leisure time, and they don't think of it.

– focus group participant

Some people might not even know they are at risk, so that's preventing them [from acting].

– focus group participant

Homeowners are ultimately the ones who determine if and when they will start taking action. The survey showed that only 28% believe that it is likely or extremely likely that an extreme weather event will negatively impact their home (Question 5). **Homeowners are currently unconvinced that they need to take adaptation actions. Homeowners need consistent, repeating information from a variety of trusted sources to tell them about their risk and to convince them that they need to take adaptation action.** A homeowner must perceive the risk to their home, determine the risk to be significant, believe adaptation actions to be effective, and believe that the benefits of adaptation actions outweigh the costs and unintended consequences (Oakley 2018) (McFarlane, McGee and Faulker 2011). Homeowners must also realize that they have a responsibility to protect their home (Oakley 2018), and should not rely on governments to protect them, or government and insurance to pay to repair damages.

These are primarily information-based barriers, with homeowners having insufficient information on the risk and their responsibility, or homeowners lacking trust in the information and its source (Oakley 2018). There may also be a lack of incentive against inaction (Oakley 2018). Homeowners need information regarding the risk to their homes from extreme weather events, the damage that can occur, their responsibility to protect their house, and the actions they can take. Homeowners would also benefit from more knowledge to improve their home maintenance skills so that they could perhaps implement a number of the actions themselves. Communicating these messages must be key objectives in information for homeowners, as outlined in Section 1.4 and Section 2.3.

Updated and future-looking flood maps and property-level risk information are urgently needed, as well as the development of these materials for other

hazards, which should be available through a free, online portal (Moudrak 2020) (Bakos 2022) (Chopik and Stewart 2022). The data needs to be accessible and targeted to the needs of different users and locations (Canada 2023a). These risk maps must be reviewed and updated regularly. Various best practices are listed in Section 1.4 and Section 2.3. Throughout the report, it was mentioned that homeowners understanding their risk is the thing that is going to help drive action. Risk maps should be available to realtors and home buyers at the time of sale. And the liability of not disclosing known risks at the time of sale must be made clear. The risk maps need to be paired with information on adaptation measures that the homeowner can undertake.

Unprepared

I'm probably the biggest barrier, I'm not very knowledgeable, I don't have the experience, nobody really taught me.

– focus group participant

If the research is kind of done for me that could be a bonus, as long as they can get info from people that are known and more knowledgeable.

– focus group participant

There are so many scams out there, you have to be careful who you could choose.

– focus group participant

Wouldn't really trust them unless they were a really well-known company.

– focus group participant

The homeowner survey, Section 3, showed that general knowledge of extreme weather events and climate change are high, with nine in 10 surveyed Canadians of the opinion that extreme weather events are increasing as a result of climate change (Question 13). The survey also showed that homeowners are thinking about impacts on their homes, as six in 10 answered that they have considered how extreme weather events could affect their home (Question 1). Despite this

high general awareness, only 25% of those surveyed claimed to have made changes to their home to protect them from extreme weather (Question 2). **As a result, homeowners are unprepared for extreme weather events and climate change. Homeowners need support to take action to adapt and prepare their homes for extreme weather events including easy access to trained professionals and reliable contractors to undertake the work.**

Homeowners not only need to be convinced that they need to take action, but also need to know what to do and how to do it. Only twenty-six percent of those surveyed said that they are well informed on how extreme weather could impact their home and what they could do to protect it (Question 11). The homeowner focus groups, Section 4, showed that all participants expressed interest in becoming more informed. In the homeowner survey, when asked what could help them overcome barriers to action, four of the top six answers were for more information of various types and sources (Question 9).

Homeowners need information on the adaptation options available for their property, the available products and services, and the costs and benefits of those options (Oakley 2018). There are a significant number of potential adaptation measures of varying complexity that homeowners can undertake, some of which conflict with one another. Skill is required when communicating action items to a homeowner.

Homeowners want and need the information to come at them from a variety of trusted sources, acknowledging their preferences as highlighted by the homeowner survey and focus groups. Some homeowners want only digital resources, some want only mailings, some want both. Some homeowners trust insurance companies, some trust government, some only trust third party organizations, some only trust construction professionals, trades, and hardware store employees. The information needs to be in a wide variety of media formats

and everyone who interacts with homeowners needs to be engaged with supporting them. These various stakeholders would need adaptation training, and information and resources that can be shared with the homeowner. The information disseminated to homeowners needs to be consistent in messaging and tone. **The coordination of this messaging should be a central role of government.** Messaging should be delivered to homeowners from many different sources during regular communication times and through already established communication channels. More information on best practices and recommendations for messaging can be found in Section 1.4 and Section 2.3.

Three main times exist to engage homeowners about adaptation measures:

- before an event, for example as part of annual home maintenance or when upgrading parts of their home (such as new siding or new roof),
- when an extreme weather event is approaching or is nearby to prepare for impact, and
- after a disaster happens when homeowners are confronted with damages to their homes or the homes of friends and family.

Information for homeowners will need to be tailored to engage them at these three different times listed above, as messaging for annual maintenance is different than imminent preparation for an extreme weather event, for example. These must also be key objectives in communications to homeowners, see Section 1.4 and Section 2.3.

Information needs to be available so that homeowners can answer all of the questions outlined in the United Kingdom's Social Market Foundation's 2018 report *Incentivising household action on flooding: Options for using incentives to increase the take up of flood resilience and resistance measures*:

1. Am I at risk?
2. Is it my responsibility?

3. Is there something that can help?
4. Can I afford it and is it cost effective?
5. Can I avoid unintended consequences? (Oakley 2018)

Often towns and rural communities are left with the responsibility to raise risk awareness, but they often lack the expertise, capacity, and financial resources to sustain the communication efforts required (Ziolecki, Thistlethwaite and Henstra, et al. 2020). Communities will need increased financial and logistical support to develop and deploy risk awareness and adaptation communication (Partners for Action n.d.). More opportunities are needed to bring together different departments and levels of government to share knowledge, experiences, approaches, and resources on risk communication (Ziolecki and Thistlethwaite 2019). Efforts need to be coordinated (Ziolecki and Thistlethwaite 2019). And while communications need to be tailored to the local conditions, larger coordination can reduce overlap, inconsistencies, and gaps, and establish priorities and goals, establish roles and responsibilities, measure progress, identify useful policies, and coordinate finance (Sawyer, et al. 2020).

Governments can hold the various stakeholders accountable for their decisions and actions (Ziolecki, Thistlethwaite and Henstra, et al. 2020).

In addition to information, homeowners also need program support to accomplish the adaptation actions. Programs need to go beyond providing information, and must aim to provide homeowners with additional tools and resources aimed at taking action, including physical assistance, connecting homeowners to trained and qualified contractors, and connecting homeowners to financial supports. The programs must have simplified application processes. Critically important, the programs need to be friendly to homeowners, and need to be easy to understand and adopt.

Not explored in this report is the importance of quality workmanship by contractors and trades. Additional research and consumer supports are required regarding this.

Out of Money

Maybe to give me a list of things that I could do to prevent, but it doesn't mean its going to get done because of the cost.

– focus group participant

I'm not being ignorant, I'm not being too good for it, it's just something that I can't afford.

– focus group participant

Don't have the budget in my household for extra than what I'm doing right now.

– focus group participant

The research found that cost is a huge barrier to action for homeowners, and many do not have the available disposable income to enable adaptation. The homeowner survey showed that the second most anticipated challenge to taking adaptation action was cost (Question 8). The homeowner focus group named cost as the major reason for not undertaking larger adaptation actions.

Homeowners are out of money. Homeowners need financial support to complete adaptation actions.

Financial and fiscal supports can include tax breaks, on-bill financing, grants, subsidies, low interest loans, lower insurance premiums, and buy-outs. Economically vulnerable homeowners should be a priority for financial support and investment (Ness, Clark, et al. 2021). As with programs, financial supports need to be friendly to homeowners, including easy to understand and adopt. Access to these supports needs to be straightforward and the timeline must not be lengthy. The subsidies should have application processes that require little or no time to complete, provide instant rebates, and provide application support (Evans and Feltmate 2019). Homeowners need to know that these programs

exist, and information resources should list and reference available financial supports. More information on financial and fiscal support can be found in Section 1.4 and Section 2.3.

Insurance companies should recognize that homeowners can help them to reduce potential payouts from damage claims. It is in their interest to inform homeowners and help them pay for actions to mitigate damage. Homeowners need clear information on their insurance policies and their coverage. They need to be aware of their risks so that they can make an informed decisions of which insurance policies they need. There should be build-back-better plans that are promoted after disasters by insurers (Pianet 2024) (Farooqui 2024). See Section 1.4 and Section 2.3.

An opportunity exists for proactive strategic relocation (Canada 2022a). Various best practices and recommendations are listed in Section 1.4 that should be considered.

Additional research is needed to examine the cost effectiveness of providing funding to adopt adaptation measures to individuals versus communities.

Other Support from Stakeholders

Stakeholders, including governments, can take actions to support homeowners, including the development of policy and regulations, outlined below and in Sections 1.4 and 2.3.

Work is underway on Canadian codes and standards to address adaptation measures to extreme weather for homes, as outlined in Section 1.4. and Section 2.3. The federal and provincial governments should act on the June 2024 recommendations from the Task Force for Housing and Climate. Additional research should be undertaken to adapt the building code to varying risk profiles, for example mandating greater adaptation requirements in high-risk

areas. High-risk areas would need to be better identified, particularly on risk maps (See Section 1.4 and Section 2.3).

Further study is needed on how to best address overheating of existing buildings.

Various best practices and recommendations for the National Flood Insurance program can be found in Section 1.4. Homeowners currently assume and expect government financial assistance after disasters. There will need to be an overhaul to the government disaster financial assistance program when the National Flood Insurance program is established, as outlined in Section 1.4. Both programs must be rationalized and better communicated to homeowners.

Permafrost thaw is a crisis that needs more data and collaborative solutions. Entire communities are built on permafrost that will need to be completely rebuilt. Many communities do not have the capacity to start over again, and support of the North will be needed. The North urgently needs additional research on permafrost thaw and related geological processes, including a better understanding of the benefits and limitations of adaptation strategies. These must be developed collaboratively with Indigenous communities (Sawyer, et al. 2020). See Appendix A, Appendix B, Section 1.4, and Section 2.4.

Flood plains are designed to flood, and homes should not be built on them. There needs to be improved land-use planning (Canada 2022a) (Insurance Bureau of Canada 2019) (Florez Bossio and Ness 2024) (Insurance Bureau of Canada a) (Miller and Carriere 2024), with an immediate need to stop building on flood plains and in other high risk areas (Insurance Bureau of Canada 2019) (Iveson 2024). Municipalities can also influence the climate adaptation in their communities through zoning and planning decisions, local construction requirements, guidelines, and programs, and through building code enforcement that targets local vulnerabilities (Climate Data b). It must be clear

what redress options are available to homeowners where municipalities choose to allow building on flood plains. See Section 1.4 and Section 2.3.

Final Thoughts and Recommendations

Homeowners have said that they lack the time, lack the knowledge, do not trust the information sources, and lack the funds to undertake adaptation actions. Homeowners are unconvinced, unprepared, and out of money.

Unconvinced: Homeowners need consistent, repeating information from a variety of trusted sources to tell them about their risk and to convince them that they need to take adaptation action.

Unprepared: Homeowners need support to take action to adapt and prepare their homes for extreme weather events including easy access to trained professionals and reliable contractors to undertake the work.

Out of Money: Homeowners need financial support to complete adaptation actions.

The following recommendations can help to support and facilitate homeowner action.

Recommendations – Information Needs

1. Adaptation efforts need to be coordinated with a whole-of-society approach, including all levels of government, non-government organizations, the insurance industry, and homeowners. Government should take the lead in coordinating the effort.
2. Homeowners need information regarding the risk level of various extreme weather events to their home, the damage that can occur, their responsibility to protect their house, the adaptation options available for their property, the available products and services, and the costs and benefits of those options. The information disseminated to homeowners

needs to be consistent in messaging and tone. Homeowners want and need the information to come at them from a variety of trusted sources. Consider best practice recommendations for messaging (see Section 1.4). The various stakeholders would need adaptation training, and information and resources that can be shared with the homeowner. Coordinated, consistent messaging from government, insurance companies, NGOs, and contractors is needed and should be an output of work under Recommendation 1.

3. Updated and future-looking flood maps and property-level risk information are urgently needed, as well as the development of these materials for other hazards, which should be available through a free, online portal. Various best practices for risk maps are listed in Section 1.4 and should be acted on. Provincial and municipal governments should lead this effort.
4. When and where available, the risk maps should be available to realtors and home buyers at the time of sale. The risk maps need to be paired with information on adaptation measures that the homeowner can undertake. The liability of not disclosing known risks must be made clear at the time of sale. Real estate sales associations (national, provincial, and local) should lead this effort by informing their members.

Recommendations – Program and Financial Support

5. Homeowners need program support to accomplish the adaptation actions. These programs need to go beyond providing information, and must aim to provide homeowners with additional tools and resources to taking action, including physical assistance, connecting homeowners to trained and qualified contractors, and connecting homeowners to financial supports. The programs must have simplified application

processes. Critically, the programs need to be friendly to homeowners, and need to be easy to understand and adopt. Program support should extend to communities who need increased financial and logistical support to develop and deploy risk awareness and adaptation communication. Homeowners need financial support. Economically vulnerable homeowners should be a priority for financial support and investment. As with programs, financial supports need to be easy to understand and adopt. The application process needs to be straightforward and the timeline to access these supports must not be lengthy. Governments and insurance companies should coordinate efforts to provide financial support and to undertake this recommendation.

6. Best practices and recommendations for the National Flood Insurance program should be considered by government (see Section 1.4). There will need to be an overhaul to the government disaster financial assistance programs when the National Flood Insurance program is established. Both programs must be rationalized and better communicated to homeowners.

Recommendations – Insurance Companies

7. Insurance companies should recognize that homeowners can help them to reduce potential payouts from claims, and that it is in their interest to keep homeowners informed and help them to overcome financial challenges.
8. Homeowners need clear information on their insurance policies and their coverage, and they need to be aware of their risks so that they can make informed decisions of which insurance policies they need.
9. There should be build-back-better plans that are promoted by insurers after disasters.

Recommendations – Codes and Standards and Land-Use Planning

10. Work on Canadian codes and standards to address adaptation measures to extreme weather for homes must continue.
 - a. Additional research should be undertaken to extend and better align building code requirements to high-risk areas.
 - b. Further study is needed on how to address overheating in existing buildings.
11. The federal and provincial governments should consider the June 2024 recommendations from the Task Force for Housing and Climate.
12. Municipalities can influence the climate adaptation in their communities through zoning and planning decisions, local construction requirements, guidelines, and programs, and through building code enforcement that targets local vulnerabilities. There needs to be improved land-use planning with an immediate need to stop building on flood plains and in other high-risk areas. It must be clear what redress options are available to homeowners where municipalities choose to allow building on flood plains. Municipal governments have an important role to play.

Recommendations – the North

13. Support of the North will be needed. The North urgently needs additional research on permafrost thaw and related geological processes, and better understanding of the benefits and limitations of adaptation strategies. These must be developed collaboratively with Indigenous communities. See Appendix A, Appendix B, Section 1.4, and Section 2.4. Federal and Territorial governments should consider this recommendation.

Recommendation – Additional Research

14. Additional research is required regarding:
 - a. the importance of workmanship by contractors and trades,
 - b. proactive strategic relocation (see various best practices and recommendations in Section 1.4),
 - c. the cost effectiveness of providing funding to adopt adaptation measures to individuals versus communities.

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Appendices

Appendix A

Overview of the Hazards and Potential Damage to Houses

This section will describe wind hazards, water hazards of various sources, wildfire hazards, permafrost thaw hazards, and extreme temperature hazards that can impact Canadian houses. The objective of this section is to provide an overview of the hazards, but this section does not describe the science relating to the hazards.

Wind

Strong winds can arise from strong thunderstorms, hurricanes, and tornadoes. Climate change will increase the severity and frequency of these storms, which could affect a larger area of houses with great impact. The most common damage to houses from extreme wind is to the roof, walls, and windows (First Street Foundation 2023). Windows can break, and cladding and shingles can come off. Strong winds can result in tremendous uplift on the roof, causing the roof itself to fly off (Kopp 2021). Roofs are typically most vulnerable (Kopp 2021) where the nails connect the roof trusses to the top of the wall (known as toe nails). Damage to the windows, walls, and roof can allow any rainfall that is also part of the storm to enter the house.

Water: Flooding, Snow, Ice and Hail

This section examines various forms of water hazards to houses from multiple types of flooding, snow and ice, and hail.

Several types of flooding are described below:

- Fluvial flooding results from rivers, creeks, and streams overflowing water into the surrounding land (Institute for Catastrophic Loss Reduction a).
- Extreme storms and rainfall flooding, sometimes called pluvial flooding, results from heavy rains in one area in a short period of time (Institute for Catastrophic Loss Reduction a). This can be exacerbated by frozen ground in springtime or by saturated ground (Canada 2022d).
- Overland flooding results from water flowing over the land and finding its way into buildings (Canada 2022e).
- Sanitary sewer backup results from rain overwhelming the sewer systems (Blakelock 2019).
- Urban flooding results from a combination of extreme storms and rainfall flooding, overland flooding, infrastructure flooding, and sewer back up, which leads to an overload of the drainage systems in developed areas (Institute for Catastrophic Loss Reduction a). This is exacerbated by the large areas of impervious surfaces in urban areas, reducing the amount of rainfall captured by nature (Blakelock 2019).
- Groundwater flooding results from large rainfalls saturating the ground, exacerbated by high water tables and soil conditions (Institute for Catastrophic Loss Reduction a).
- Snowmelt runoff results from melting snow and ice in late winter or spring, and is dependent on how frozen the ground is, the depth of snow, outdoor temperatures, and the presence of rainfall (Institute for Catastrophic Loss Reduction a).

- Ice jams result when floating ice blocks river flows, often where rivers narrow or bend, or where infrastructure, such as a bridge, spans a river (Institute for Catastrophic Loss Reduction a). They often occur in early winter or spring and can cause flooding upstream during the blockage and downstream when the ice dam fails (Institute for Catastrophic Loss Reduction a).
- Coastal flooding results from high winds and wave action, tides, storm surges, and changes in sea level, and can happen along the ocean coast and lake shorelines (Institute for Catastrophic Loss Reduction a). Sea levels are projected to rise, changing the frequency and intensity of storm surges during high wind events and storms, leading potentially to additional flooding and coastal erosion. While these processes are natural and important to ecosystems, they can increase hazard to homes (J. L. Eyquem 2021). Disappearing sea ice in the North can impact wave action, extreme water levels, flooding, and coastal erosion (Wallace 2019) (J. L. Eyquem 2021). More than 7 million people who live in coastal communities in Canada could be affected (Canada 2023a).

Climate change will increase the severity and frequency of these events, with one estimate projecting 100-year rainfalls occurring every six years in some areas including Toronto, Edmonton, and Calgary (Ness, Clark, et al. 2021).

Determining the exact cause of a flood in a home can be difficult. Often several types of events will occur simultaneously and contribute to damages (Institute for Catastrophic Loss Reduction a). The specific cause of a flood may matter to insurers and governments, but homeowners see a ‘flood’ as any experience of unexpected or unwanted water (Institute for Catastrophic Loss Reduction a). From a homeowner perspective, similar adaptation measures can mitigate the impacts of different flood types (described in Section 1.3 and Appendix B).

Flooding can damage interior finishes and personal possessions, and, when from sewer backup, can introduce pathogens into a house as unsanitary water travels back through pipes. It can erode living conditions (White-Crummey 2023) (Sandink 2016). A commonly cited estimate in the reviewed sources from the US National Flood Insurance Program is that a 15 centimetre (6 inch) flood in a 185 square metre (2,000 square foot) home can cause \$40,000 in flood damage (Feltmate, Evans and Moudrak 2017) (Re/Max 2022). A 2024 estimate put the cost at \$54,000 (Feltmate and Bonada 2024).

In a 2018 survey of residents in the City of Windsor, of whom 81% had experienced flooding in the previous 8 years, the most common impacts of flooding included:

- being unable to use the washer, dryer, furnace, or hot water heater, meaning that homeowners were unable to do laundry, wash dishes, bathe, or clean,
- missing work to either clean up after the flood or to deal with contractors, insurance adjusters, or city workers, and
- being unable to access the basement (St. Amour-Gomes, Heldsinger and Peddle 2018).

In the same survey, 69% of those who provided details said that repairing the damage cost over \$10,000, while 17% said damage repair costs were more than \$50,000. The respondents talked about their emotional states, saying they were “worried”, “panicked”, or that they spent time “hoping and praying” (St. Amour-Gomes, Heldsinger and Peddle 2018). When asked how damage was paid for:

- 41% paid for damages with personal savings,
- 45% with insurance,
- some could not pay to repair the damages, and

- others took out second mortgages, applied for lines of credit, used credit cards, or borrowed money from friends and family (St. Amour-Gomes, Heldsinger and Peddle 2018).

Following a large snowfall, freezing rain, or a series of snow and ice events, a major concern is roof collapse where ice and snow can build up, particularly for roofs with lower slopes, chimneys, skylights, and dormers, (Institute for Catastrophic Loss Reduction 2012). Another concern is ice damming, or a build-up of ice at the edge of a roof that prevents melting snow and water from dripping off of a roof. Ice damming can result in water penetration into the walls, ceiling, and attic of a home (Institute for Catastrophic Loss Reduction 2012). Ice dams can result from a number of factors including roof design, localized snow melt on a roof, and insufficient attic ventilation (Institute for Catastrophic Loss Reduction 2012).

While every province and territory can experience significant hail events, the majority occur in BC, Alberta, the Prairies, and southern Ontario (Institute for Catastrophic Loss Reduction 2018). Hail can damage roofs and siding, vents, soffits, fascia, and can break windows and skylights, which can lead to other problems including water damage from infiltrating rain (Institute for Catastrophic Loss Reduction 2018).

Wildfires

Wildfires are a natural occurrence for forests, with an average of 2.5 million hectares burning every year in Canada (Canada 2020a). Climate change will increase the severity and frequency of these events. This can have catastrophic and long-lasting consequences for communities in forested areas (Climate Atlas of Canada a). Wildfires can completely or partially destroy homes, disrupt communities, and cause death (Evans, Bonada and Feltmate 2023).

Communities in forested areas are surrounded by a flammable landscape (McKinley 2023), and are referred to as being in the wildland-urban interface, where approximately 12.3% of the Canadian population lives (Erni, et al. 2021).

Canada had a particularly bad year for wildfires in 2023, with fires in nearly every province and territory (Shakil 2023). As of October 2023, more than 18.4 million hectares had burned within that calendar year (Canadian Interagency Forest Fire Centre Inc. n.d.), forcing 200,000 Canadians to evacuate their homes (Evans, Bonada and Feltmate 2023). A community can need years to rebuild after a wildfire. Two years after the catastrophic 2016 Fort McMurray wildfire, 20% of damaged buildings had been repaired; it took six years to repair 86% of them (Evans, Bonada and Feltmate 2023).

Wildfires can spread to homes in three ways:

1. Embers and sparks, which can travel up to 2 kilometres ahead of wildfires and ignite the home or materials near the home (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019).
2. Radiant heat from wildfire flames within 30 metres of the home, which can melt vinyl siding, ignite the home, or break windows (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019).
3. Direct flame (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019).

In addition to the destructive capabilities of wildfires, they have additional health and environmental consequences, such as when melted vinyl siding and plastic contaminate the soil surrounding a house (Cecco 2023). The smoke is harmful to breathe due to the toxins and fine particles it contains (J. L. Eyquem 2022). Wildfire smoke can travel for thousands of kilometres on the wind (Evans, Bonada and Feltmate 2023). This reduced air quality leads to illness and death, with Health Canada estimating 240 deaths per year attributed to short-term

exposure to the particles in wildfire smoke, and 2,500 deaths per year attributed to long-term exposure (between 2013 and 2018) (Canada 2023d).

Extreme Temperature

While this section addresses both extreme cold and extremely hot temperatures, the recent, prominent concern in Canada has been extreme heat. Extreme heat is where temperatures are at or above 30 degrees Celsius or the humidex is at or above 40 degrees Celsius, and can lead to dehydration, rashes, fainting, fatigue, heat stroke, heat exhaustion, heat cramps, hospitalization, and death (J. L. Eyquem 2022) (First Street Foundation 2022) (Rutgers 2023) (Action Canada 2023). Extreme heat is the leading cause of death in Canada for climate-related events, with a recent tragedy occurring in the summer of 2021 where more than 600 people died as a result of extreme heat in British Columbia, nearly all of the deaths occurring indoors without access to indoor cooling (Sawyer, et al. 2020) (J. L. Eyquem 2022) (Rutgers 2023). The hazard of extreme heat is exacerbated in urban centres (urban heat islands), where more than 70% of Canadians live, as man-made structures absorb heat and create higher surface and ambient temperatures. (J. L. Eyquem 2022) (Action Canada 2023). If an extended heat wave occurred during prolonged power outages, devastating consequences could result (J. L. Eyquem 2022). While places throughout Canada have legislation for minimum indoor temperatures to protect occupants from exposure to extreme cold, no equivalent law proscribing maximum indoor temperatures currently exists (Rutgers 2023) (Wong 2023) (Hogan 2023).

For extremely cold temperatures, beyond the risk of occupant exposure, the major risks to the home includes frozen pipes (which can lead to water damage when pipes rupture) (Institute for Catastrophic Loss Reduction 2012), and potentially frost heave affecting foundations. Cold weather in Alberta in January

of 2024 resulted in so many broken furnaces and frozen pipes, that wait times for plumbers and heating technicians for repairs were reportedly longer than usual (Dupuis 2024).

Permafrost Thaw

The hazard of permafrost thaw facing the North is unlike the other hazards highlighted in this report, because once the permafrost is gone, it is gone forever with no option to simply rebuild like after a flood or wildfire (Canada 2016). Much of the housing in Canada's north was constructed atop permafrost with the assumption that the ground would remain permanently frozen (Phillips n.d.). Many houses were built on piles that reach to a depth below the active layer of permafrost, which experiences a freeze-thaw cycle, to the permanently frozen ground (Wallace 2019). However, the active layer is increasing in depth due to warming temperatures, causing the piles to shift (Wallace 2019) (The Firelight Group 2022). This leads to the shifting of houses, where floors can buckle, walls can crack, the frames of doors and windows can warp, cold air can infiltrate the house, infrastructure such as sewage pipes can break, and the entire house can collapse (Wallace 2019) (Climenhaga 2022) (Clark 2022). It was noted that a house could be repaired after being damaged from permafrost thaw, only to be significantly damaged the next year (The Firelight Group 2022).

Housing in the North is expensive to build and maintain; repeated, costly repairs from permafrost thaw, which may not be covered by insurance, can lead to dangerous situations and worsening housing shortages, and can increase inequities experienced in affected communities (Sawyer, et al. 2020) (Canada 2023a) (The Firelight Group 2022) (Clark 2022). When damage to a house from permafrost thaw starts to show, it has been said to be almost impossible to insure it or sell it (Schreiber 2018). The sources reviewed indicated limited data

was available about permafrost thaw, and that the thawing can be influenced by not only temperature but also moisture and precipitation (Phillips n.d.) (The Firelight Group 2022). Permafrost thaw can lead, also, to other hazards such as slumping, sinkholes, landslides, and changes to bodies of water (Wallace 2019) (Phillips n.d.). The impacts will vary throughout the North, however Nunavut and the Northwest Territories have the most homes built on permafrost (Clark 2022). The Canadian Climate Institute's report *Due North: Facing the costs of climate change for Northern infrastructure* included the following statement in regard to this hazard:

We acknowledge that our listening efforts have only scratched the surface, however, and that there are many more stories that need to be heard. We believe it is essential that all orders of government engage directly with Indigenous governments to understand the infrastructure challenges communities are experiencing and collaboratively develop the needed solutions. (Clark 2022)

Appendix B

Catalogue of Potential Adaptation Actions and Information

The following is a collection of potential adaptation measures for homeowners, as collected from a variety of the reviewed sources. It does not include a detailed background analysis of the science behind the recommendations, or the effectiveness of the adaptation measures themselves. This is meant to be a catalogue of potential actions a homeowner could take to protect their house against climate change hazards. The applicability of the adaptation measures for each house would need to be determined based on the location, risks, type of construction, age, and upkeep, for example. The adaptation measures range in cost and level of difficulty. This catalogue does not represent a ‘how-to’ guide or recommendations for homeowners. It does not replace advice from professionals. It provides general information only. Homeowners should contact professionally licensed and insured experts and their local municipal government about their circumstances, with any questions, to find out what is and is not allowed in their jurisdiction, and to obtain building permits and inspections as applicable. There is no implied guarantee that implementing these measures will prevent damages (Insurance Bureau of Canada 2019).

Additional resources, including those directed specifically to homeowners, can be found in Appendix C.

Many of the adaptation measures may have co-benefits, including improving comfort, well-being and mental health, lowering energy bills, and enhancing property values (J. L. Eyquem 2022).

General Preparedness

This section includes general things homeowners could do to prepare for climate events. These include:

- home maintenance,
- home assessments,
- understanding home insurance coverage,
- preparing an emergency kit, and
- preparing for a home purchase.

Homeowners should ensure that their homes:

- are appropriately maintained, as this can greatly help in protecting a home from climate events (Berkow 2021),
- have the home address clearly marked to ensure first responders can easily find the home (Institute for Catastrophic Loss Reduction 2019) (FireSmart Canada c), and
- have smoke and carbon monoxide alarms installed in all the recommended locations for the home and test them regularly to ensure they work properly (Insurance Bureau of Canada b).

Homeowners need to assess their level of risk for climate hazards, consider their neighbourhood and the age and construction of their home, and seek assistance to understand their level of risk (Financial Consumer Agency of Canada 2023). Homeowners should consider adaptation measures when they are performing regular maintenance, or upgrading or replacing aspects of their homes (Council of Canadian Academies 2019). The assessment should consider

the benefits of adopting adaptation measures even if the house is not considered high risk since much of the risk is unknown, risk levels will change, and all homes have some risk of certain hazards, for example severe wind and flooding (Oakley 2018). It could be more cost effective to implement low- and no-cost adaptation measures proactively rather than pay for damages (Oakley 2018).

Many sources stressed the importance that homeowners review their home insurance policy or speak to their insurance representative to understand their coverage (Khan 2023), to ensure that they have enough and sufficient coverage before a climate event occurs, and to ensure that they understand what risks they are responsible for covering (Canada 2022a). The Financial Consumer Agency of Canada has provided sample questions, below, that homeowners can ask their insurance companies. Additional questions relating to flood insurance can be found in the Intact Centre on Climate Adaptation's document *Questions to Ask Your Insurance Provider About Water Damage Coverage* (Intact Centre on Climate Adaptation b).

- *Which types of unexpected events and disasters are covered or not covered by your home insurance policy?*
- *Is additional coverage available for unexpected events and disasters that aren't covered by your policy (for example, floods, sewer backup, landslides or earthquakes)?*
- *What is your home's level of risk for different types of unexpected events and disasters? Your insurance agent or broker may have access to information that can help you assess your risk level*
- *What is your home's replacement value?*
- *Does your policy include a guaranteed cost to rebuild or does it only provide coverage up to a certain limit?*

- *Are there any limits or exclusions for add-on coverage for unexpected events or disasters?*
- *What is the limit for additional living expenses?*
- *How does your insurance company calculate your premium?*
- *How is your deductible determined?*
- *If the deductible is a percentage of the coverage limit for your home, what does that equal in dollars?*
- *What steps should you take before you make a claim? For example, creating an inventory of the contents of your home can make it easier to make a claim*
- *What are the steps to make a claim after an unexpected event or disaster?*
- *How long can you expect to wait to receive money after you submit a claim?*

(Financial Consumer Agency of Canada 2023)

It is recommended that households have a 72-hour emergency kit, which may include:

- Water (2 litres per person per day),
- Non-perishable foods, including infant formula and supplies if applicable,
- Utensils, plates, and cups,
- Manual can opener,
- Whistle,
- A battery powered radio,
- Flashlight,
- Candles and matches or lighter (place in sturdy containers and do not burn unattended)
- First aid kit,
- Shoes for each family member,
- Change of clothes for each family member,

- Sleeping bag or warm blanket for each family member,
- Toiletries and personal hygiene items,
- Hand sanitizer, toilet paper, garbage bags,
- Identification and important documents such as insurance and bank records,
- Cash,
- Extra keys to house and car,
- Prepaid phone card, mobile phone charger,
- Pet food and supplies,
- Activities for children if applicable,
- Basic tools (hammer, pliers, wrench, screwdrivers, work gloves, pocketknife)
- Duct tape,
- Other special needs items such as medications and medical equipment.

(Insurance Bureau of Canada c) (Canada 2022f)

A key recommendation for homeowners is to set up an emergency fund that they can draw upon in case of disasters (Financial Consumer Agency of Canada 2023).

It is recommended that home buyers ask neighbours and real estate agents about past climate events in a community before purchasing a home, ask the seller about previous flood or fire damage and any adaptation measures already installed, request a home insurance estimate, and ask a home inspector to scan for evidence of previous flood or fire damage (Lerner 2022).

Wind

The following is a collection of potential adaptation measures that homeowners could choose to adopt to protect their houses and properties from wind damage. They are listed in no particular order.

- Weather seal around windows, doors, and siding to help limit wind-driven rain from entering the home. (Beckett 2021)
- Limit flying debris by anchoring heavy items, such as garbage cans, patio furniture, BBQs, and sports equipment. (Insurance Bureau of Canada c) (Ontario Society of Professional Engineers 2019) (TD Insurance a) (RBC Insurance n.d.) (Institute for Catastrophic Loss Reduction c) (Canadian Red Cross n.d.)
- Install heavy-duty bolts for the front door at both the top and bottom of the frame. (TD Insurance a) (RBC Insurance n.d.) (Institute for Catastrophic Loss Reduction c)
- Install a stronger garage door or garage door braces. (Financial Consumer Agency of Canada 2023) (TD Insurance a) (RBC Insurance n.d.) (Institute for Catastrophic Loss Reduction c)
- Conduct regular maintenance to fix loose fence boards and roof shingles. (Ontario Society of Professional Engineers 2019)
- Safely trim dead branches from trees and shrubs and remove dead trees, checking local bylaws and for proximity to hydro lines beforehand. (Ontario Society of Professional Engineers 2019) (TD Insurance a) (RBC Insurance n.d.) (Canadian Red Cross n.d.)
- Stay on top of repairs for roofs, windows, doors, and garages and replace when they are at end-of-life. Consider replacing with products that are designed and rated for high winds. (Ontario Society of Professional Engineers 2019) (TD Insurance a) (Institute for Catastrophic Loss Reduction c)
- For a high level of protection, doors should be pressure- and impact-rated; window shutters can be installed; and anti-shatter weather protection film

can be applied to the inside surface of your windows. (TD Insurance a)
(Institute for Catastrophic Loss Reduction c)

- Move valuables away from windows and glass doors. (Canadian Red Cross n.d.)
- Check that gable roofs are properly braced. (Institute for Catastrophic Loss Reduction c)
- Ensure adequate securing of the connections between columns and porches or overhangs. (Institute for Catastrophic Loss Reduction c)

Additional considerations are available at the time of home construction or renovation to protect houses against damage from high winds:

- Use better building materials for siding, shingles, and roofs. (Beckett 2021)
- Install hurricane straps to the roof. (Financial Consumer Agency of Canada 2023)

Water: Flooding, Snow, Ice, and Hail

The following is a collection of potential adaptation measures that homeowners could choose to adopt to protect their houses and properties from water.

Some of the flood adaptation information sources for homeowners claim that much of the adaptation work can be done by the homeowner in one day for less than \$250 (Canada 2022g). This list, which is in no particular order, includes adaptation measures for different types of floods. If homeowners are wanting to reduce their risk for a specific type of flood, the adaptation actions they take should align with the type of flood (Institute for Catastrophic Loss Reduction b).

- Regularly clean the eavestroughs and ensure they drain properly. (TD Insurance a) (Canada 2023e) (Insurance Bureau of Canada d) (Intact Centre on Climate Adaptation c) (Sandink 2009)
- Extend the downspouts to at least 2 metres away from the house and ensure they drain away from the house and neighbouring properties. Clear downspouts of debris. (Blakelock 2019) (Canada 2023e) (Insurance Bureau of Canada d) (Intact Centre on Climate Adaptation c) (Canada 2022h) (Ontario 2023) (Insurance Bureau of Canada 2023b)
- Install window wells, and help to keep water out of window wells using window well covers. (Insurance Bureau of Canada d) (Intact Centre on Climate Adaptation c) (Sandink 2009)
- Unblock and clear basement drains. (Intact Centre on Climate Adaptation c) (Insurance Bureau of Canada 2023b) (Canada 2023f)
- Install a sewer backwater valve following the requirements of the municipality. Regularly clean it out. (Blakelock 2019) (Financial Consumer Agency of Canada 2023) (Canada 2023e) (Insurance Bureau of Canada d) (Intact Centre on Climate Adaptation c) (Sandink 2009) (Insurance Bureau of Canada 2023b)
- Raise valuable items off the basement floor, or do not keep them in the basement. Place personal belongings in sealed bins. (Blakelock 2019) (Financial Consumer Agency of Canada 2023) (Insurance Bureau of Canada d) (Intact Centre on Climate Adaptation c) (Sandink 2009) (Ontario 2023) (Insurance Bureau of Canada 2023b)
- Weather seal windows and doors to prevent water from infiltrating. Also ensure proper sealing around other above-grade openings, for example for utilities, wires, and pipes. (Sandink 2016) (Canada 2023e) (Sandink 2009) (Canada 2022h) (Ontario 2023) (Canada 2023f)

- Disconnect downspouts from the sewer system, weeping tiles, and french drains. Cap foundation drains. (Blakelock 2019) (Financial Consumer Agency of Canada 2023) (Insurance Bureau of Canada d) (Intact Centre on Climate Adaptation c) (Sandink 2009)
- Ensure the land slopes away from the house so water drains away at least 2 metres. Check sidewalks, patios, decks, and driveways to ensure they are not draining towards the house. (Blakelock 2019) (Financial Consumer Agency of Canada 2023) (Canada 2023e) (Insurance Bureau of Canada d) (Intact Centre on Climate Adaptation c) (Sandink 2009)
- Raise large appliances, furnaces, hot water heaters, and electrical panels off of the basement floor to above the potential floodwater level. This should be done by professionals. (Canada 2023e) (Insurance Bureau of Canada d) (Insurance Bureau of Canada 2023b) (Canada 2023f)
- Safely check for ice dams. (Canada 2022h)
- Set up a rain barrel (with overflow provisions) to catch runoff from the roof. (Canada 2023e) (Canada 2022h)
- Install flood barriers or flood shields to basement windows and doors. The tops of the shields should extend above ground level. (Canada 2023e) (Insurance Bureau of Canada d) (Canada 2022h) (Canada 2023f)
- Install a sump pump if applicable. Regularly check that the sump pump is working properly and has a backup battery. (Blakelock 2019) (Canada 2023e) (Insurance Bureau of Canada d) (Intact Centre on Climate Adaptation c) (Sandink 2009) (Ontario 2023) (Insurance Bureau of Canada 2023b) (Canada 2023f)
- Seal cracks in basement floor and walls. (Sandink 2009)
- Regularly maintain water drainage systems, including weeping tiles, culverts, and ditches (Ontario 2023)

- Prevent fuel tanks from tipping and leaking by anchoring them to the floor and ensure vents and fill-line openings are above flood levels. First check with the fuel company before making any changes, especially for propane. (Canada 2023e) (Intact Centre on Climate Adaptation c)
- Clear snow away from the foundation. (Canada 2023e) (Insurance Bureau of Canada d)
- Secure outdoor furniture and other items, remove debris. (Ontario 2023)
- Do not pour fats, oils, and grease down the drains. (Blakelock 2019) (Insurance Bureau of Canada d) (Sandink 2009)
- Clear debris away from city storm drains. (Insurance Bureau of Canada d) (Intact Centre on Climate Adaptation c) (Sandink 2009)
- Install and maintain a flood alarm. (Intact Centre on Climate Adaptation c)
- Visit the municipal government's website or contact the public works, utilities, or building department to find out about basement flooding in your community. (Moudrak 2020) (Sandink 2009)
- Hire a plumber to conduct a plumbing investigation. (Sandink 2016)

Homeowners should also:

- Research available incentive programs that may be available through local governments or utilities. (Moudrak 2020)
- During a renovation, use water-resistant building materials in the basement. (Canada 2023e) (Insurance Bureau of Canada d)
- Consider planting a rain garden to use landscaping to catch and disperse water in the soil around the house. Use plants that resist soil erosion. (Canada 2023e) (Insurance Bureau of Canada d)

Homeowners can take action ahead of time to reduce the risk of roof collapse from snow and ice build-up by installing electric heating cables, which may require a contractor to install (Institute for Catastrophic Loss Reduction 2012).

Snow build-up can be carefully removed, although a snow removal contractor may be needed (Institute for Catastrophic Loss Reduction 2012). Snow should also be removed from around gas meters, gas appliance vents, exhaust vents, and basement windows (Insurance Bureau of Canada b).

Homeowners can also take action ahead of time to reduce the risk posed by ice dams:

- Seal attic penetrations such as attic doors, plumbing stacks, electrical service penetrations, and chimneys,
- Ensure entire heated ceiling is insulated, including over light fixtures,
- Seal any penetrations between the house and unheated attic,
- When installing a new roof, homeowners can ask for ice and water membrane to be installed,
- Increase the insulation above the ceiling particularly above the wall top plates,
- Regularly maintain and clean the eavestrough, scuppers, and downspouts.

(Institute for Catastrophic Loss Reduction 2012)

To protect from hail damage, homeowners can consider installing shingles that are designed to better withstand hailstorms, or install alternative roofing systems (Institute for Catastrophic Loss Reduction 2018). Installing roof underlayment and sealing the roof decking at the time of getting a new roof can help to protect against infiltrating water if the roof does get damaged (Institute for Catastrophic Loss Reduction 2018). Homeowners can consider installing cement board siding instead of aluminum or vinyl siding, as cement board is more resilient against hail damage (Institute for Catastrophic Loss Reduction 2018). Homeowners can also install window safety films to minimize damage from broken windows (Institute for Catastrophic Loss Reduction 2018).

Wildfires

The following is an inventory collected from multiple sources of potential adaptation measures that homeowners could choose to adopt to protect their houses and properties from wildfires. The lists below are in no particular order. Homes that undertake these measures are not fireproof and are not intended to provide safe shelter during a wildfire (Evans, Bonada and Feltmate 2023).

Adaptation measures for wildfires are usually divided into three zones based on distance from the home. The main strategy is to reduce the likelihood that the home and the area around the home could catch fire from embers or small flames (Wildfire Risk to Communities 2023).

Actions for the Immediate Wildfire Zone (the home and 1.5 metres surrounding it):

- Replace unrated or old roofing materials with fire-rated roofing materials that meet or exceed local requirements. Consider installing a Class A fire-rated roof assembly. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (FireSmart Canada d) (Insurance Bureau of Canada e)
- Install non-combustible material for all vents, and have non-combustible 3 mm screens (except for dryer vents) or ASTM fire rated vents. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (FireSmart Canada d)
- Where combustible siding is installed, such as wood or vinyl, consider replacing it with a non-combustible or ignition resistant siding such as stucco, metal siding, brick/concrete, and fibre cement siding that is non-combustible or is ignition resistant. Ensure there is at least a 15-centimetre (6 inch) ground-to-siding non-combustible clearance. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (FireSmart Canada d) (Insurance Bureau of Canada e)

- Install tempered, thermal, multi-pane windows. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (FireSmart Canada d)
- Install fire-rated doors and ensure they are well sealed, including the garage doors. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (FireSmart Canada d)
- Install a non-combustible drip edge or soffit or flashing between the upper extent of the gutters and the roof covering. (FireSmart Canada d)
- Ensure soffits and fascia are properly fitted. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019)
- Replace decks and porches with non-combustible or fire-rated materials. Cap deck joints with flashing or foil tape. (FireSmart Canada d)
- Avoid storing combustible materials on or under decks. Remove debris or leaves from decks. Enclose spaces under decks. Sheath in the base of decks, balconies, and houses with fire resistant materials. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (Wildfire Risk to Communities 2023) (FireSmart Canada d) (Insurance Bureau of Canada e)
- Remove vegetation, flammable materials, mulch, branches, leaves, and debris within 1.5 metres around the house. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (Wildfire Risk to Communities 2023) (FireSmart Canada d) (Canada 2023g) (Insurance Bureau of Canada 2023c)
- Clean gutters and roofs of debris, particularly inside corners and places where debris can collect. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (Wildfire Risk to Communities 2023) (FireSmart Canada d)
- Install a spark arrestor on the chimney. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (Insurance Bureau of Canada e)

- Screen the gutters with metal mesh to reduce debris build up. (Institute for Catastrophic Loss Reduction 2019) (FireSmart Canada d)
- Do not store firewood against the house, move the piles to at least 10 metres from the house. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (FireSmart Canada d) (Insurance Bureau of Canada 2023c)
- Do not store flammable materials such as gasoline and solvents and other materials that may ignite within 10 metres of the home. (Insurance Bureau of Canada 2023c)
- Burn barrels should be placed as far from the house and other structures as possible, and a 3-metre area around the barrel should be free of combustible materials. Ensure the barrel has proper ventilation and is screened with at least a 6mm wire mesh. Also check with the local municipality about other specific requirements and restrictions. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019)
- Have shovels, rakes, axes, garden hoses, sprinklers, and ladders readily available to help suppress wildfires. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019)
- Have a working sprinkler in an accessible location. (Canada 2023g)
- If sheds are within 10m of the house, consider all of the above for the shed as well. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (FireSmart Canada d)

Actions for the Intermediate Wildfire Zone (1.5-10 metres surrounding the home):

- Reduce fuels and materials that could easily ignite in the surrounding landscape, such as removing overhanging branches. (Institute for Catastrophic Loss Reduction 2019) (Wildfire Risk to Communities 2023)

- Replace wood fences with non-combustible metal fencing, or separate wood fences and the house by at least 1.5 metres, for example with a metal gate. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (Wildfire Risk to Communities 2023) (FireSmart Canada d)
- Maintain short grass less than 10 centimetres (4 inch). (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (FireSmart Canada d) (Insurance Bureau of Canada e)
- Plant a low density of fire resistant plants and shrubs. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (FireSmart Canada d)
- Remove evergreen/coniferous trees within 10 metres of the home. (Institute for Catastrophic Loss Reduction 2019)
- Clean up dry leaves, twigs, and branches. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019)
- Hire an arborist to assess the conditions of mature trees. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019)
- Remove combustible shrubs from the drip line of trees. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019)

Actions for the Extended Wildfire Zone (10-30 metres surrounding the home)

- Space trees at least 3 metres apart, measured between the outermost branches, within 30 metres of the home. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (Wildfire Risk to Communities 2023) (Insurance Bureau of Canada e)
- Prune trees within 2 metres of the ground within 30 metres of the home. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (Wildfire Risk to Communities 2023) (FireSmart Canada d)

- Clean up dry branches, dry grass, and needles. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019)

Other actions for areas 30-100 metres surrounding the home, and more generally

- Space trees at least 3 metres apart. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (Wildfire Risk to Communities 2023)
- Prune trees within 2 metres of the ground. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019) (Wildfire Risk to Communities 2023) (FireSmart Canada d)
- Create a fire break by creating space between trees and other flammable vegetation. (Institute for Catastrophic Loss Reduction 2019)
- Remove smaller evergreen trees. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019)
- Clean woody debris and combustible shrubs. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019)
- Additional consideration for vegetation and tree maintenance is required if the property has a slope as fire travels faster uphill. (FireSmart Canada c) (Institute for Catastrophic Loss Reduction 2019)
- Install an air filtration system of MERV 13+ for mechanical ventilation and portable filtration systems (Lepage 2021).
- In the event of a nearby fire, keep windows and doors closed, limit the use of kitchen and bathroom fans, use the home's HVAC system on recirculation mode, and use a HEPA rated portable air purifier (The Weather Network 2024).

Extreme Temperature

The following is a collection of potential adaptation measures that homeowners could choose to adopt to protect their houses and properties and themselves from extreme heat and extreme cold. They are listed in no particular order.

Extreme Heat

- Install an air conditioner, either for a specific room or as a central system, or a heat pump when replacing a furnace. However, air conditioners can release a lot of heat waste, contributing to urban heat islands. They also increase demand on the electrical grid, which may be unsustainable and lead to brownouts and blackouts. (Beckett 2021) (J. L. Eyquem 2022) (Rutgers 2023) (Edmonton 2022) (Hogan 2022) (Climate Atlas of Canada b) (Intact Centre on Climate Adaptation d)
- Learn how to naturally ventilate the home, particularly at nighttime. (J. L. Eyquem 2022) (Intact Centre on Climate Adaptation d)
- Plant leafy, shading trees and other plants near the south, east, and west facing windows, following FireSmart recommendations for wildfire risks. For condos, add potted, hanging, and climbing plants. (J. L. Eyquem 2022) (Edmonton 2022) (Hogan 2022) (Intact Centre on Climate Adaptation d) (Institute for Catastrophic Loss Reduction 2020) (Ho 2022) (Intact Centre on Climate Adaptation e)
- When replacing windows, select products with a low U-value and a low Solar Heat Gain Coefficient. Lightly tinted windows are also available to help reduce the incoming heat. Choose operable windows to allow for natural ventilation. (J. L. Eyquem 2022) (Intact Centre on Climate Adaptation d) (Institute for Catastrophic Loss Reduction 2020) (Ho 2022)

- Shade windows and glass doors with window shading devices, porches, brise-soleils, vertical or horizontal louvres, insulated exterior roll shutters, exterior window screens, roll out awnings, or heat control window films. Relying solely on interior blinds will allow the heat to enter the home through the window. (J. L. Eyquem 2022) (Hogan 2022) (Intact Centre on Climate Adaptation d) (Institute for Catastrophic Loss Reduction 2020) (Ho 2022) (Owen 2022)
- Install weather stripping around doors and windows. (J. L. Eyquem 2022) (Intact Centre on Climate Adaptation d) (Ho 2022)
- Install light-coloured blinds, heat resistant curtains, or films on windows. (Ho 2022) (Intact Centre on Climate Adaptation d)
- Install energy efficient light bulbs such as LEDs, and energy efficient appliances. Do not use lights or appliances if possible during extreme heat. (J. L. Eyquem 2022) (Intact Centre on Climate Adaptation d) (Institute for Catastrophic Loss Reduction 2020) (Ho 2022)
- Paint the interior walls with lighter colours. (Institute for Catastrophic Loss Reduction 2020) (Intact Centre on Climate Adaptation e)
- When replacing the roof, consider a cool roof, that can include highly reflective types of paint, sheet covering, or highly reflective or lighter coloured tiles or shingles. (J. L. Eyquem 2022) (Edmonton 2022) (Intact Centre on Climate Adaptation d) (Institute for Catastrophic Loss Reduction 2020) (Ho 2022)
- Install a ceiling fan or purchase portable fans. Although they can be problematic during high temperatures. Regardless of humidity levels, the maximum temperature for the safe use of fans is 39°C for healthy adults 18 to 40 years old; 38°C for healthy adults under 65; and 37°C for older adults

who take certain medications. (J. L. Eyquem 2022) (Intact Centre on Climate Adaptation d) (Ho 2022)

- Consider installing an energy recovery ventilator. (Ho 2022)
- Consider increasing insulation levels. (J. L. Eyquem 2022) (Edmonton 2022) (Climate Atlas of Canada b) (Ho 2022)
- Consider converting paved areas such as driveways to vegetation to absorb less heat. (Intact Centre on Climate Adaptation d)

Other Considerations

- During the design and construction of new homes, utilize passive cooling strategies such as thick masonry walls, small exterior windows, cross ventilation, window overhangs, window placement, higher insulation values, and reflective building exteriors. (Beckett 2021) (Institute for Catastrophic Loss Reduction 2020)

Extreme Cold

- Insulate exposed pipes. (Institute for Catastrophic Loss Reduction 2012) (Insurance Bureau of Canada b) (TD Insurance b)
- Seal any place that cold air can infiltrate the home, for example attic penetrations. Inspect the attic and crawlspaces for frost accumulation and moisture build-up. (Institute for Catastrophic Loss Reduction 2012) (Insurance Bureau of Canada b) (TD Insurance b)
- Disconnect garden hoses and turn off the indoor valve for the hose, and drain the pipe between the valve and faucet. (Institute for Catastrophic Loss Reduction 2012) (Insurance Bureau of Canada b)
- Maintain a consistent indoor temperature. (Institute for Catastrophic Loss Reduction 2012)
- Ensure the garage door is kept closed. (Institute for Catastrophic Loss Reduction 2012)

- Install weather stripping on doors and windows. (British Columbia d)
- Consider increasing insulation levels. (British Columbia d)
- Regularly have the heating sources inspected, replace any filters, and make sure they are working properly. (Insurance Bureau of Canada b) (TD Insurance b)
- Regularly run water through all fixtures to reduce the chances of freezing. (Insurance Bureau of Canada b) (TD Insurance b)
- Know where the plumbing shut-off valves are located. Test all plumbing shut off valves to ensure they are working properly. (Insurance Bureau of Canada b) (TD Insurance b)

Permafrost Thaw

At the moment, there may be limited actions that homeowners can take to adapt their homes to thawing permafrost. Many houses in the North are constructed on stilts, pilings, and screwjacks, that raise them above the permafrost ground, and, where possible, those will need to be adjusted up or down as the ground shifts (Schreiber 2018) (The Canadian Press 2010). A strategy known as thermosyphons may be able to keep heat away from permafrost by passively pulling the heat from the ground and ventilating it up into the air, thereby maintaining the permafrost under buildings and infrastructure (Sawyer, et al. 2020) (Clark 2022) (Schreiber 2018). One source indicated that thermosyphons are straightforward to install and are relatively inexpensive (Schreiber 2018). However, analysis is needed whether this is an effective strategy knowing that permafrost thaw is inevitable, and it may be more cost effective to replace certain infrastructure than protect it (Sawyer, et al. 2020). The North urgently needs additional research on permafrost thaw and related geological processes, and better understanding of the benefits and limitations of

adaptation strategies, and these must be developed collaboratively with Indigenous communities (Sawyer, et al. 2020) (GRID-Arendal 2020). As the Council of Canadian Academies' 2019 report *Canada's Top Climate Change Risks* states,

Understanding the climate change risks facing Indigenous Peoples in Canada requires a deeper exploration of these risks and associated adaptation potential, consistent with the spirit of reconciliation. Indigenous ways of life is a unique area of risk, one that merits further assessment through an inclusive and reflective process together with Indigenous Peoples. The Assembly of First Nations, Inuit Tapiriit Kanatami, and Métis National Council have documented their expectations for what constitutes acceptable engagement. Future climate risk assessments would benefit from a comprehensive process, potentially co-designed by and co-executed with Indigenous participants. Collaboration and coordination efforts would ideally be grounded in a rights-based approach, consistent with the spirit of reconciliation. (Council of Canadian Academies 2019)

Appendix C

Additional Resources on Adaptation Measures

Some additional resources regarding potential adaptation measures for houses, including ones directed specifically to homeowners, are listed below.

General Preparedness

<https://firesmartcanada.ca/wp-content/uploads/2023/07/Begins-at-Home-Guide-With-Self-Assessment-WEB.pdf>

<https://publications.saskatchewan.ca/#/products/30484>

<https://swnbclimate.ca/wp-content/uploads/2020/05/climate-pamphlet.pdf>

<https://www.canada.ca/en/financial-consumer-agency/services/insurance/unexpected-events-disasters.html>

<https://www.canada.ca/en/financial-consumer-agency/services/savings-investments/setting-up-emergency-funds.html>

<https://www.climate resilienthome.ca/>

<https://www.edmonton.ca/sites/default/files/public-files/ClimateResilientHomeGuide-web.pdf>

<https://www.getprepared.gc.ca/cnt/kts/bsc-kt-en.aspx>

<https://www.ibc.ca/stay-protected/seasonal-safety/winter>

<https://www.ibc.ca/stay-protected/severe-weather-safety/wind-and-tornado>

https://www.iclr.org/wp-content/uploads/2019/07/ICLR_Emergency-generators_2019v2.pdf

https://www.iclr.org/wp-content/uploads/2019/09/ICLR_Wildfire_2019.pdf

https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2019/03/Final-Copy-Questions-to-Ask-Your-Insurance-Provider_March-14-2019.pdf

<https://www.princeedwardisland.ca/en/publication/your-emergency-preparedness-guide>

<https://www.princeedwardisland.ca/en/topic/emergency-preparedness>

<https://www.princeedwardisland.ca/sites/default/files/publications/ops-preguide.pdf>

<https://www.quebec.ca/en/public-safety-emergencies>
<https://www.quebec.ca/en/public-safety-emergencies/emergency-situations-disasters-and-natural-hazards/how-prepare-at-home>
https://www.redcross.ca/crc/documents/How-We-Help/Emergencies-and-Disasters-in-Canada/Flood-Risk-brochure_Digital.pdf
<https://www.saskpublicsafety.ca/at-home/emergency-preparedness-at-home>
<https://www2.gov.bc.ca/gov/content/safety/emergency-management/preparedbc>
<https://www2.gov.bc.ca/gov/content/safety/emergency-management/preparedbc/know-your-hazards/power-outages>

Wind

https://ospe.on.ca/membership/protect-your-home-from-wind-damage/?gclid=CjwKCAjwLJimBhAsEiwA1hrp5oy-bzZXpxetYCYGdZHN16S9dEzzPM8289lmyzx48ST2T82QNazcxoCDUMQAvD_BwE
<https://www.canada.ca/en/financial-consumer-agency/services/insurance/unexpected-events-disasters.html>
<https://www.edmonton.ca/sites/default/files/public-files/ClimateResilientHomeGuide-web.pdf>
<https://www.abc.ca/stay-protected/severe-weather-safety/wind-and-tornado>
https://www.iclr.org/wp-content/uploads/2023/07/ICLR_Wind-Infographic.pdf
https://www.iclr.org/wp-content/uploads/PDFS/ICLR_Severe-wind_2018.pdf
<https://www.rbcinsurance.com/home-insurance/prevent-minimize-property-damage.html>
<https://www.redcross.ca/how-we-help/emergencies-and-disasters-in-canada/types-of-emergencies/hurricanes>
<https://www.tdinsurance.com/products-services/home-insurance/tips-advice/hurricanes-preparedness>

Water

<http://floodsmartcanada.ca/flood-prevention-and-preparedness-communication-materials/>
<https://climatecheck.com/risks/flood>
<https://climatecheck.com/risks/flood/mitigation-guide-for-homeowners>
<https://raincommunitiesolutions.ca/en/for-property-owners/>
<https://www.canada.ca/en/campaign/flood-ready/know-the-risks/cost-floods.html>
<https://www.canada.ca/en/campaign/flood-ready/prepare-home/basement-protection.html>
<https://www.canada.ca/en/campaign/flood-ready/prepare-home/property-protection.html>

<https://www.canada.ca/en/campaign/flood-ready/prepare-home/window-protection.html>
<https://www.citywindsor.ca/residents/environment/climate-change-adaptation/climate-resilient-home/Pages/Backwater-Valve.aspx>
<https://www.citywindsor.ca/residents/environment/climate-change-adaptation/climate-resilient-home/Pages/Downspout-Disconnection-and-Rain-Barrels.aspx>
<https://www.citywindsor.ca/residents/environment/climate-change-adaptation/climate-resilient-home/Pages/Infiltration-Trench.aspx>
<https://www.citywindsor.ca/residents/environment/climate-change-adaptation/climate-resilient-home/Pages/Land-Regrading.aspx>
<https://www.citywindsor.ca/residents/environment/climate-change-adaptation/climate-resilient-home/Pages/Rain-Gardens.aspx>
<https://www.citywindsor.ca/residents/environment/climate-change-adaptation/climate-resilient-home/Pages/Sump-Pump-with-Overflow.aspx>
<https://www.edmonton.ca/sites/default/files/public-files/ClimateResilientHomeGuide-web.pdf>
https://www.gov.nl.ca/ecc/files/I-Live-in-a-Floodplain_resident.pdf
https://www.gov.nl.ca/ecc/files/Our-town-has-floodplain-mapping_town.pdf
<https://www.gov.nl.ca/ecc/files/waterres-flooding-floodproofing-protect-your-home-against-flooding-.pdf>
<https://www.ibc.ca/stay-protected/seasonal-safety/winter>
<https://www.ibc.ca/stay-protected/severe-weather-safety/flood-and-water>
https://www.iclr.org/wp-content/uploads/2018/05/ICLR_Snow-and-ice-Infographic.pdf
https://www.iclr.org/wp-content/uploads/2021/04/ICLR_Hail-2020_E_2021.pdf
https://www.iclr.org/wp-content/uploads/2021/04/ICLR_Hail-2020_E_2021.pdf
https://www.iclr.org/wp-content/uploads/2023/07/ICLR_Basement-flooding-Infographic.pdf
https://www.iclr.org/wp-content/uploads/2023/07/ICLR_Hail-Infographic.pdf
<https://www.iclr.org/wp-content/uploads/PDFS/focus-on-backwater-valves.pdf>
<https://www.iclr.org/wp-content/uploads/PDFS/handbook-for-reducing-basement-flooding.pdf>
https://www.iclr.org/wp-content/uploads/PDFS/ICLR_Snow-and-ice-storms_2018.pdf
<https://www.iclr.org/wp-content/uploads/PDFS/protect-your-home-from-basement-flooding.pdf>
https://www.iclr.org/wp-content/uploads/PDFS/Sump_pump_booklet.pdf
https://www.intactcentreclimateadaptation.ca/programs/home_flood_protect/resources/
<https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2016/08/Updated-Home-Flood-Prevention-Tune-Up.docx.pdf>

<https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2019/03/Basement-Flood-Protection-Checklist-2019.02.25.pdf>

https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2019/03/Cost-Range-for-Flood-Risk-Reduction-Projects_final_March-14-2019.pdf

https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2019/03/Final-Copy-Questions-to-Ask-Your-Insurance-Provider_March-14-2019.pdf

https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2019/03/Home-Flood-Protection-Program-Best-Practice-Summary_2019.03.21.pdf

<https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2019/03/Self-Help-Resource-List-for-Homeowners-March-14-2019.pdf>

https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2019/03/TopActions_infographic_r1_feb2019_nocrop_broker-version-for-translation.pdf

https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2019/03/Understanding-Water-Damage-Insurance_Final.pdf

https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2019/03/Water-Resistant-Building-Materials-Resource-for-Homeowners_FINAL_March-14-2019.pdf

https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2019/05/EN_Insurance-Flood-Risks-Infographic-2019.04.23.pdf

<https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2019/09/Flood-Insurance-Discounts.pdf>

https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2019/12/Seasonal-Flood-Protection-Maintenance-Record-2018_Final-002_update-Dec-18-2018.pdf

<https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2020/01/Canadian-Municipal-Subsidy-Program-Formal-1.pdf>

<https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2020/04/Sources-of-Home-Water-Damage-and-Opportunities-to-Reduce-Risk.pdf>

<https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2023/05/IntactCentre-3-steps-home-flood-pretction-QR.pdf>

<https://www.newswire.ca/news-releases/insurance-bureau-of-canada-encourages-ontarians-to-prepare-for-2023-flood-season-819094721.html>

<https://www.ontario.ca/page/floods>

<https://www.quebec.ca/en/public-safety-emergencies/emergency-situations-disasters-and-natural-hazards/what-to-do-before-during-after-emergency-disaster/flooding/what-to-do-before>

<https://www.redcross.ca/how-we-help/emergencies-and-disasters-in-canada/types-of-emergencies/floods>

<https://www.tdinsurance.com/products-services/home-insurance/tips-advice/hurricanes-preparedness>

<https://www.youtube.com/watch?v=gO2kuwzpEXk>

<https://www.youtube.com/watch?v=iQNM01WJFrQ>

<https://www.youtube.com/watch?v=LEe0u-Adu-E>

<https://www.youtube.com/watch?v=lkzU2ITkdg8>

<https://www.youtube.com/watch?v=llUxk3Fm8WQ>

<https://www.youtube.com/watch?v=IMZjQaBaC4U>

<https://www.youtube.com/watch?v=M9Kn8h6gBNs>

<https://www.youtube.com/watch?v=rDjD56ygwus>

<https://www.youtube.com/watch?v=uszMX59zA2l>

<https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/preparedbc/preparedbc-guides/>

[preparedbc_flood_preparedness_guide_fillable.pdf](#)

<https://www2.gov.bc.ca/gov/content/safety/emergency-management/preparedbc/know-your-hazards/floods/before-flood>

<https://yukon.ca/en/emergencies-and-safety/floods/keeping-yourself-and-your-home-safe-during-flood>

<https://yukon.ca/en/emergencies-and-safety/floods/preparing-flood>

<https://yukon.ca/floods>

Wildfire

<https://begins-at-home-guide.firesmartbc.ca/>

<https://firesmartbc.ca/landscaping-hub/>

<https://firesmartbc.ca/resource/cri-firesmart-home-assessment-score-card/>

<https://firesmartbc.ca/resource/tips-to-firesmart-your-home/>

<https://firesmartbc.ca/wp-content/uploads/2019/04/Emergency-Wildfire-Preparedness-Checklist.pdf>

https://firesmartbc.ca/wp-content/uploads/2020/04/05.30.23_BeginsatHomeGuide_Web.pdf

<https://firesmartbc.ca/wp-content/uploads/>

[2020/12/05.08.21_FiresmartBC_TipsToFireSmartYourHome_Poster-compressed.pdf](#)

<https://firesmartbc.ca/wp-content/uploads/2021/04/FSC-CRI-Home-Ignition-Zone-Assessment-Score-Card-Fillable.pdf>

<https://firesmartcanada.ca/homeowners/home-construction/>

<https://firesmartcanada.ca/homeowners/homeowner-resources/>

<https://firesmartcanada.ca/homeowners/protect-your-home/>
<https://firesmartcanada.ca/homeowners/yard-and-landscaping/>
<https://firesmartcanada.ca/programs/firesmart-101/>
<https://firesmartcanada.ca/wp-content/uploads/2023/07/Begins-at-Home-Guide-With-Self-Assessment-WEB.pdf>
<https://wildfirerisk.org/reduce-risk/ignition-resistant-homes/>
<https://www.edmonton.ca/sites/default/files/public-files/ClimateResilientHomeGuide-web.pdf>
<https://www.getprepared.gc.ca/cnt/hzd/wldfrs-prp-en.aspx#s1>
<https://www.ibr.ca/news-insights/news/high-risk-of-wildfires-in-ontario-insurance-experts-share-tips-to-stay-safe-and-protect-your-property>
<https://www.ibr.ca/stay-protected/severe-weather-safety/fire-and-wildfire>
https://www.iclr.org/wp-content/uploads/2018/05/ICLR_Wildfire-Infographic.pdf
https://www.iclr.org/wp-content/uploads/2019/09/ICLR_Wildfire_2019.pdf
<https://www.iclr.org/wp-content/uploads/PDFS/protect-your-home-from-wildfire.pdf>
https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2023/05/IntactCentre_3-steps-to-a-cost-effective-FireSmart-Home-QR.pdf
<https://www.redcross.ca/how-we-help/emergencies-and-disasters-in-canada/types-of-emergencies/wildfires>
https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/preparedbc/preparedbc-guides/wildfire_preparedness_guide.pdf
<https://www2.gov.bc.ca/gov/content/safety/emergency-management/preparedbc/know-your-hazards/wildfires/before-wildfire>

Extreme Temperature

<https://climateatlas.ca/health-impacts-extreme-heat>
<https://www.ctvnews.ca/climate-and-environment/how-to-cool-your-house-during-a-heatwave-1.5995607>
<https://www.edmonton.ca/sites/default/files/public-files/ClimateResilientHomeGuide-web.pdf>
<https://www.ibr.ca/stay-protected/seasonal-safety/winter>
https://www.iclr.org/wp-content/uploads/2020/07/ICLR_Extreme-heat_2020.pdf
https://www.iclr.org/wp-content/uploads/2020/10/ICLR_Extreme-heat-Infographic.pdf
https://www.iclr.org/wp-content/uploads/PDFS/ICLR_Snow-and-ice-storms_2018.pdf

https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2023/05/IntactCentre-Three_steps-Apartment_Heat_Protection.pdf

https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2023/05/IntactCentre-Three_steps-Home_Heat_Protection.pdf

<https://www.tdinsurance.com/products-services/home-insurance/tips-advice/winterize-your-home>

https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/preparedbc/preparedbc-guides/preparedbc_extreme_heat_guide.pdf

<https://www2.gov.bc.ca/gov/content/safety/emergency-management/preparedbc/know-your-hazards/severe-weather/extreme-heat>

<https://www2.gov.bc.ca/gov/content/safety/emergency-management/preparedbc/know-your-hazards/severe-weather/storms>

Appendix D

Recently Developed Climate-Smart Documents

The National Research Council launched the *Climate-Resilient Buildings and Core Public Infrastructure (CRBCPI) Initiative* in 2016 (funded by Infrastructure Canada), and in the last few years, a number of climate-smart documents have been developed:

- CSA Z800, Guideline on basement flood protection and risk reduction, 2018,
- Practical Guidance for Private-side Drainage Systems to Reduce Basement Flood Risk: Addressing Critical Information Gaps, 2021,
- Guidelines for improving flood-resistance for existing buildings, 2021,
- Guide for design of flood-resistant buildings, 2021,
- Climate Resilience Buildings: Guideline for Management of Overheating Risk in Residential Buildings, 2021,
- National Guide for Wildland-Urban Interface (WUI) Fires, 2021,
- CSA Plus 4011 Infrastructure in Permafrost: A Guideline for Climate Change Adaptation, 2019,
- CSA S520 High Wind Safety for Low-rise Residential and Small Buildings, 2022,
- CSA W210 Prioritization of Flood Risk in Existing Communities, 2021,
- CSA S478 Standard on durability in buildings, 2019,

- Updated suite of Canadian Fenestration Standards (CAN/CSA A440) (CSA A440.2, CSA A440.4, CSA A440S1),
- Future climate data that considers climate change for use in the design of buildings and bridges,
- A total of six new standards as well as a new guide on addressing climate hazards faced by northern communities, including best practices to address permafrost.

(Canada 2022a) (Climate Data b) (Canada 2023c) (Canada 2022c) (Canada 2023h)

Appendix E

Key Informant Interview Questions

Consumers Council of Canada (CCC) is exploring homeowners' attitudes and understanding of potential climate change related risks to their homes created by weather extremes. The project will catalogue weather-related home damage and document measures homeowners can adopt to increase the resiliency of their homes and manage their risks. The project seeks to identify and describe the marketplace context and identify challenges specific to desired homeowner behaviours. The project, which will include a literature review, key informant interviews, a homeowner survey, and homeowner focus groups, is scheduled to be completed by March 2025. buildABILITY is conducting the research on behalf of CCC.

1. Tell us about your and your organization's specific area of expertise.
2. Awareness: How effective have measures taken to date been in making homeowners aware of climate change risks? Are there gaps in the information being provided to consumers, and, if so, what are they? What new approaches would you recommend to improve homeowner awareness of climate change adaptation measures needed to improve their homes? What's preventing homeowners from being better aware of their needs and choices to adapt their homes to make them more resilient to the impacts of climate change?

3. Interest: How interested are homeowners in adapting to climate change? How is this known? What will increase their interest? What inhibits homeowners' interest?
4. Action: How effective have efforts been so far to get homeowners to improve or purchase homes better adapted to the conditions being created by climate change. How is this known? What's stopping homeowners from acting? What would help them to act?
5. Examples: Are you aware of any strategies pursued in other jurisdictions that have been used to increase the adoption of property level climate change adaptation? If so, do you think they might be appropriate for Canada and why or why not?
6. Support: What can be done by stakeholders (private sector, public sector, not-for-profits) to get homeowners to become aware, interested, and to act? Is supportive communication a barrier to action?
7. Tell us about any insights that you might have from your work related to specific climate-change-related risks. Are there are seminal pieces of literature that you think we should review?

Appendix F

Survey Results

Extreme Weather in Canada

Homeowner Survey Report



May 2024

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Methodology & Logistics

Overview

The following represents the results of a May 2024 telephone survey of N=1000 Canadian homeowners. The survey was conducted by Oraclepoll Research Ltd for buildABILITY. The survey covered issues related to knowledge and awareness of extreme weather events, actions taken to mitigate their effects and the likelihood of taking actions in the future.

Study Sample & Error Rates

Respondents were screened to ensure that they were Canadians, 18 years of age or older, homeowners and one of the decision makers at their residence.

The sample was stratified to ensure a representative breakdown by region. The table below provides a breakdown of the total sample by area or region.

	Frequency	Percent
Atlantic	70	7%
Ontario	390	39%
Quebec	240	24%
Manitoba / Sask	70	7%
Alberta	100	10%
BC	130	13%
Total	N=1000	100%

A randomized dual sample frame database was used that was inclusive of cellular and land line telephone numbers.

Survey Method

The poll was conducted by telephone with live person-to-person operators at the Oraclepoll call centre facility using computer-assisted techniques of telephone interviewing (CATI) and random number selection (RDD). A total of

20% of all interviews were monitored and the management of Oraclepoll Research supervised 100%.

Initial calls were made between the hours of 6:00 p.m. and 9:00 p.m. within each respective time zone. Subsequent call-backs of no-answers and busy numbers were made on a (staggered) daily rotating basis up to 5 times (from 10:00 a.m. to 9:00 p.m.) until contact was made. In addition, telephone interview appointments were attempted with those respondents unable to complete the survey at the time of contact. If no contact was made at a number after the fifth attempt, the number was discarded, and a new one supplanted it.

Logistics

Data was collected between the days of May 1st and May 20th, 2024.

Error Rates

The margin of error for the N=1000 sample is $\pm 3.1\% \frac{19}{20}$ times.

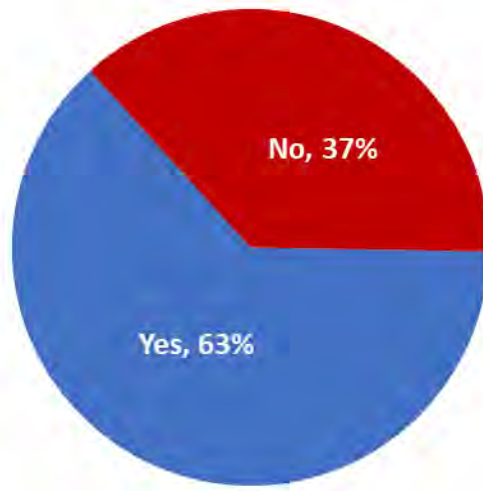
Error rates vary and are larger for geographic and demographic sub-samples of the survey population.

Extreme Weather Events, Protection & Changes

Respondents were first read the following short statement after which they were asked if they have ever considered how their home might be affected by extreme weather events and how they might protect it.

“We will be asking a series of questions on your home and extreme weather events. These events include flooding and water entering your home, wildfires, very strong winds, very high temperatures, and very low temperatures. We will be calling all of these “extreme weather events.”

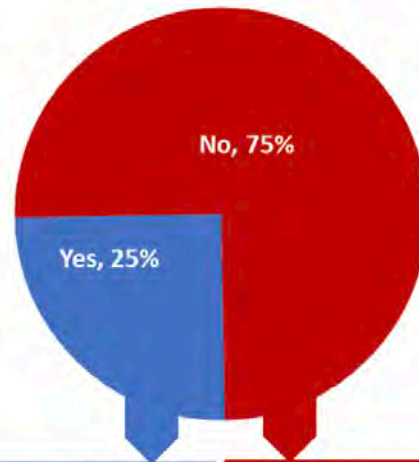
Q1. Have you ever considered how your home might be affected by extreme weather events and how you might protect it?



More than six in ten answered that they have taken extreme weather into consideration. Those living in Atlantic Canada (71%), Quebec (74%) and BC (68%) were more likely to say yes, as were 35-54 (74%) and 18-34-year-olds (64%), university graduates (66%) and the highest earners in the \$90,000+ cohort (79%).

All respondents were next asked if they have ever made changes to a home that they have owned to protect it from extreme weather events. Those that answered yes were asked in Q3A about the reasons for making changes, while those saying no were questioned in Q3B about why changes were not made. Multiple responses were accepted for each of the follow-up probes and the results illustrated are the percentage of cases or each time an area was mentioned.

Q2. Have you ever made changes to a home that you owned to protect it from potential damage from extreme weather events?



One-quarter claimed to have made changes to a home. Results were highest among Atlantic Canadians (43%), 18–34-year-olds (31%), and those earning \$90,000 a year or more (43%).

Q3A. What were your top three reasons for making changes to protect your home?

I want to protect my possessions	49%
Don't want home to be damaged / want to protect	48%
Had extreme weather damage / prevent future	30%
I want to maintain the value of my home	11%
Regular maintenance / owning / my responsibility	10%
Insurance won't cover the cost to repair damages	7%
For the health and safety of me and my family	3%
Family, friends, neighbours recommended it	2%
I want to reduce time away from school or work	1%
I love my home	1%

Q3B. Why have you not made changes to protect your home?

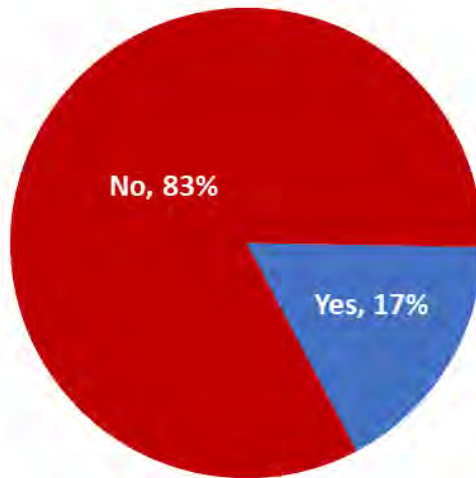
don't know what to do or what's effective	31%
never thought about it before	22%
no problem with extreme weather events	15%
home won't be affected / I have low risk	15%
low priority / not important to me	10%
don't have time to do it / I'm too busy	8%
not my responsibility, insurance / gov't responsible	7%
my house is well constructed	6%
I'll take my chances	3%
I don't know anyone else who is acting	2%
it's too stressful or scary	1%
don't like / want contractors in house	1%
it would lower the value / ability to sell my home	<1%
difficult to find a contractor	<1%

Reasons for making changes included wanting to protect possessions, not wanting their home damaged and that because of experiencing damage before they want to prevent it from happening again. On the other hand, those that have not made changes cited a lack of awareness of what to do, not considering it, not having experienced events and a low likelihood of being at risk.

Past Damages & Future Concerns

In the next probe, all respondents were asked if they have ever experienced home damage from an extreme weather event.

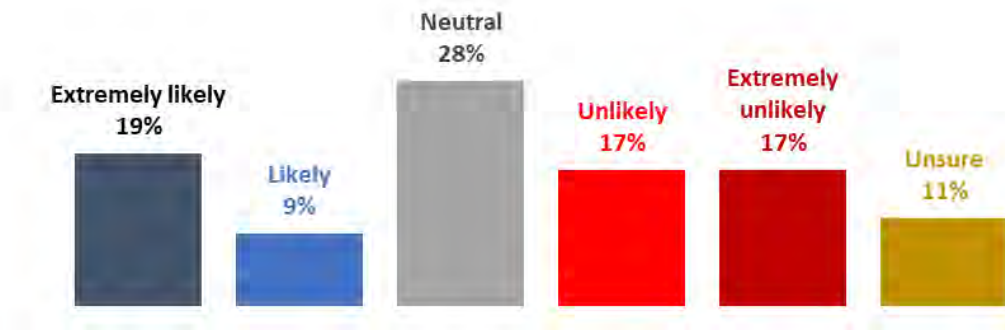
Q4. Have you ever experienced damage from an extreme weather event at a home that you owned?



Seventeen percent claimed that they have at one time experienced damage to their home as a result of an extreme weather event. Atlantic Canadians were most likely to have experienced damage at 57%, next followed by a far lesser number of those living in BC (20%), Alberta (17%), Manitoba/Saskatchewan (16%), Quebec (14%) and then Ontario (10%),

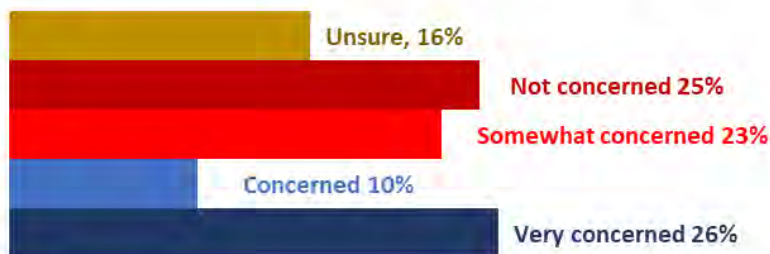
All respondents were asked about their perceived likelihood of an extreme weather event negatively impacting their home and then about their concern over an extreme weather event damaging their home in the next year.

Q5. In your opinion, how likely is it that an extreme weather event will negatively impact your home?



Twenty-eight percent answered that it is likely or extremely likely that an extreme weather event will negatively impact their home. Atlantic residents were most likely to say likely or extremely likely (69%), as were university graduates (34%) those earning \$90,000+ (39%) and 35–54-year-olds (32%).

Q6. How would you rank your concern of an extreme weather event damaging your home in the next year?



In total, 36% percent said that they are concerned or very concerned over an extreme weather event damaging their home over the next 12 months. Residents of Atlantic Canada (87%) and BC (45%) were most concerned or very concerned.

Motivators & Challenges

In a question allowing for multiple responses, all those surveyed were read a list of issues and were asked if they would motivate them to start taking steps to protect their home from extreme weather events. Displayed below are the percentage of cases or each time an issue was mentioned.

Q7. What could prompt you the most to start taking steps to protect your home from extreme weather events?

Having more information	36%
Experiencing an event or damage from an event	29%
Being told by a trusted source or news story that steps to be taken	25%
An increase in extreme weather events (frequency, intensity)	23%
Having more time or money	15%
I wouldn't take action to protect my home	14%
Family / friends taking steps to protect their homes	1%

Having more information was most identified, next by having experienced an event, being told by a reputable source and witnessing an increase in extreme weather events.

In an open-ended probe allowing for multiple responses, all respondents were next asked to identify the challenges they may face when making changes to their home. Displayed below are the percentage of cases or each time an issue was mentioned.

Q8. What challenges do you think you might encounter or have encountered when making changes to your home to protect it from extreme weather events?

I don't have time to do it / I'm too busy	26%

Cost	24%
I don't know how to do it / don't have the skills to do it	12%
Not applicable / I wouldn't take steps to protect my home	12%
I don't know what to do	11%
Low priority / not important to me / I have other things to deal with	10%
I don't trust the information that is available	7%
It is difficult to find a contractor	5%
Don't want contractors in house / don't want to deal with contractors	1%
Concern that it would lower the value of home / ability to sell my home	1%
It's too stressful or scary	<1%
Other members of my household might not agree	<1%
Might not like how my house or yard looks afterwards	<1%

Most referenced was a lack of time, cost and not knowing what to do or how to do it.

In the final open probe in this section allowing for multiple responses, all respondents were asked to name what could or would help them overcome challenges to protecting their home. Displayed below are the percentage of cases or each time an issue was mentioned.

Q9. What could or would have helped you to overcome those challenges to protecting your home from extreme weather events?

Help understanding what to do	23%
Availability of financial support (grants, subsidies, rebates, loans)	22%
Talking to trained professionals / contractors / hardware store	17%
More information on the costs	13%
I wouldn't take steps to protect my home	12%
Help understanding how to do it	11%
Nothing / don't need any help	10%
More money	7%
List of qualified contractors	7%
More time	5%

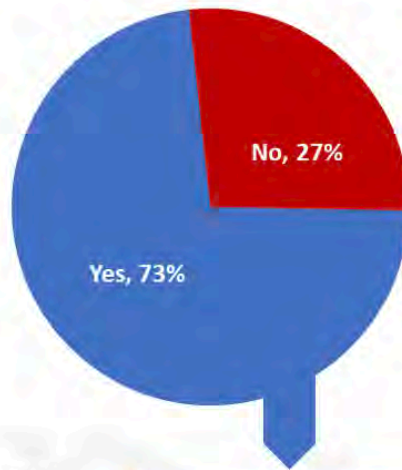
Talking to friends, family, and neighbours	<1%

Knowing what to do, including being advised by professionals, having financial supports as well as more information on prices were most recalled.

Information

All respondents were first asked if they would want a trusted source to tell them about the specific vulnerability of their home to an extreme weather event and how to protect it. The 73% or n=734 that answered yes were then asked in Q10B to name those trusted sources. Q10B allowed for multiple responses and the results displayed are the percentage of cases or each time an area was named.

Q10A. Would you want a trusted source to tell you about the specific vulnerability of your home and how to protect it from an extreme weather event?



Nearly three-quarters or 73% said they would want a trusted source to provide them with information.

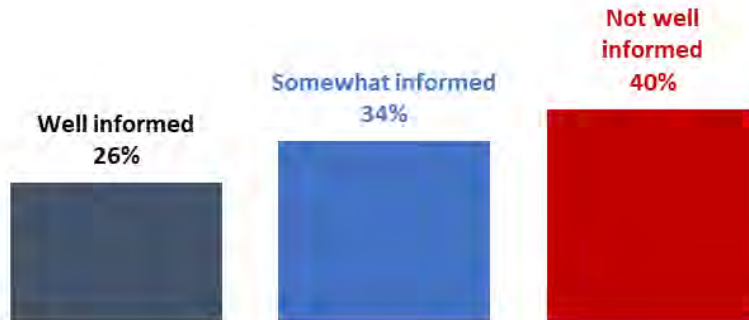
When asked to name the sources, certified professionals was most mentioned, next by governments.

Q10B. Who would those trusted sources be?

Certified professionals giving assessment / realtors	43%
Government (federal, provincial, or municipal)	27%
Online resources, brochures, social media, TV, news	16%
Insurance or mortgage company or bank	14%
Independent consumer organizations	11%
Hardware store, contractors, and tradespeople	10%
Family, friends, neighbours, local community groups	2%

In the following questions, all respondents were asked about how well informed they are about extreme weather events, their impacts and what actions need to be taken.

Q11. How well informed are you about extreme weather events, the potential impacts on your home, and the actions you could take to protect your home?

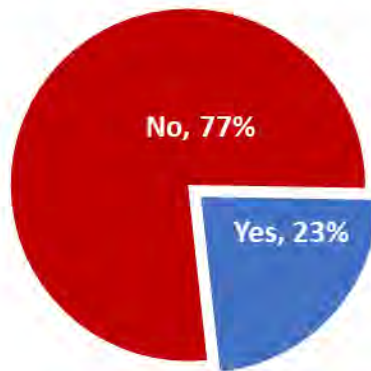


Slightly more than a quarter or 26% said they are well informed, compared to four in ten not well informed, while 34% answered somewhat informed. Those most likely to say well informed were from the Atlantic (47%), BC (40%) and Quebec (35%), younger 18-34 (34%), university educated (30%) and higher earners in the \$90,000 cohort (43%).

Extreme Weather Vulnerability & Climate Change

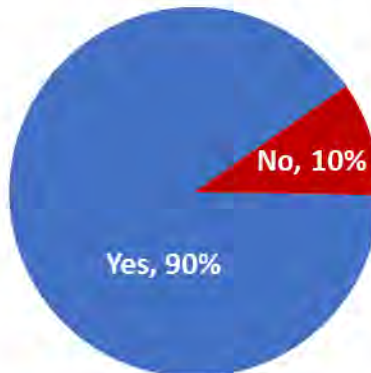
In the final two survey questions, all respondents were asked if they live in an area vulnerable to extreme weather events and if they think that extreme weather events are increasing as a result of climate change.

Q12. Do you live in an area that is vulnerable to extreme weather events, such as a coastal area, a flood plain, or a wooded area?



Twenty-three percent claim they live in an area vulnerable to extreme weather events, with results highest in the Atlantic region (70%), then followed by BC (29%), Manitoba / Saskatchewan (24%) and Quebec (23%).

Q13. Do you think that extreme weather events like flooding or wildfires are increasing because of climate change?



Most or nine in ten surveyed are of the opinion that extreme weather events are increasing as a result of climate change.

Appendix G

Focus Group Outline

Intro

Greetings and introductions.

We have asked you all here today because you own a home in a location that may be vulnerable to flooding, wildfires, or high winds. We are going to be asking you questions about what it's like to own a home in these locations, and your experiences with these events, home maintenance, insurance, and information resources.

Experience

1. Tell us about any experiences that you've had with flooding, wildfires, or high winds at a home that you owned, or any experiences that you've seen firsthand.
 - *The damage: if any, and how you repaired the damage*
 - *Tell us about your experience accessing home insurance or government disaster relief, and if the experience was efficient (not costly, bureaucratic, or slow)*
 - *Would you do something different next time?*
2. How do you know if your home is at risk?
 - *How do you assess the risk to your home from flooding, wildfire, or high winds and its resiliency to these events?*

3. If you recognize that you live in a high-risk area for flooding, wildfire, or high winds, what preventative actions would you consider doing, if any at all?
 - *What do you consider to be most important?*
 - *How did you / would you assess that the selected preventative actions were worthwhile?*

Information and Resources

4. Who have you turned to in the past to learn about the actions you can take to address this risk?
 - *Did they have the necessary knowledge and experience?*
5. Where and how are you currently getting information about this topic?
6. Are you interested in becoming more informed on floods, wildfires, and high winds, the vulnerability of your home, and the actions you could take to protect your home?
 - *Why or why not?*
 - *What kind of information would you want and how would you want to receive it? (website, maps, brochures, videos, text messages, newspapers, news broadcasts, live events webinars, public library seminars, learning sessions by the municipality)*
7. Who would you most trust to provide you with reliable information?
8. Would you value getting information from not-for-profits, like a consumer advocacy organization?
 - *Do you think the information would be more trustworthy?*

Home Maintenance

9. Can you name some actions a homeowner could do to protect their home from floods, wildfires, and high winds before they happen?

10. Look over this list of potential actions that homeowners could do to protect their home from floods, wildfires, and high winds before they happen. *Display list, provide a bit of time for them to read list.*
 - *Raise your hand if you would be interested in undertaking any of these actions?*
 - *Why are the actions that you have picked of interest to you?*
11. Have you undertaken any of these and if so, What was the process like?
 - *Why might you or homeowners in general NOT take these actions? (what are the barriers to adoption?)*
 - *What could help encourage you or homeowners in general to take these actions? (how to overcome the barriers?)*
12. Would you be interested in having a risk assessment done of your home by a certified professional to provide you with recommendations on actions to protect your home from potential damage? Why or why not?
 - *Who would you trust to certify the assessor?*
 - *How important is the certification to you?*
13. If you adopt resiliency measures, do you think that potential buyers of your home would pay more for your house as a consequence of the changes that you made?

Purchase

14. Did you discuss flooding, wildfire, and high wind risks with your realtor, lawyer, home inspector, or insurer before you purchased a home that you have owned? Who?
 - *What did you do as a consequence of that discussion?*

Insurance

15. What is your overall experience with insurance coverage and its cost?

16. Did you ever have any problems securing affordable insurance?
17. Has your insurer reached out to you personally about protecting your house, and how?
 - *What kind of communication is best to catch your attention?*

Conclusion

18. We are at the final question, and I would like you to think of all the potential barriers to taking action. What are the (three) biggest barriers that are stopping you from taking action to protect your home from flooding, wildfires, or high winds and why?

Appendix H

Focus Group Results

Extreme Weather & Homeowners

Focus Group Report

October 2024



Overview

Oraclepoll Research Ltd. was commissioned by buildABILITY to conduct two focus groups among Canadians on issues related to extreme weather and the vulnerability of homes to events such as flooding, wildfires, or high winds. Issues

discussed related to a home in vulnerable locations, and experiences with these events, home maintenance, insurance, and information resources.

They were screened to ensure that they were 18 years of age or older, a freehold homeowner, aware of extreme weather events causing damage to homes. In each group there were participants that were victims of events causing damage and willing to take preventative actions or have done so in the past.

Each of the two groups contained a mix of participants that were from BC, Alberta, Ontario, Quebec and Atlantic Canada.

Study Sample

In total N=17 participated in each of two groups held on Monday October 7th, 2024.

The first group held at 5 pm contained three Ontarians, three British Columbians, one Albertan and one Atlantic Canadian.

The second group (7 pm) was comprised of two Quebecers, two British Columbians, two Albertans, two Ontarians and one Atlantic Canadian.

Sessions & Report Format

The sessions for each cohort were conducted using the same survey script and the approximate average length of each group was one hour. Each participant was paid an honorarium of \$100 to attend.

This report provides an overview of the findings from both sessions by topic and theme as they were discussed in the meetings.

Session Results – Experience

Q1. Tell us about any experiences that you've had with flooding, wildfires, or high winds at a home that you owned, or any experiences that you've seen firsthand.

- The damage: if any, and how you repaired the damage
- Tell us about your experience accessing home insurance or government disaster relief, and if the experience was efficient (not costly, bureaucratic, or slow)
- Would you do something different next time?

While all participants in the sessions had experienced extreme weather events, roughly half said they had damage to their properties or residences with damages being varied. Events included downed trees, wildfires, wind damage to roofs or siding, flooding and water damage. While most of those experiencing events did not go through their insurance company rather doing most of the work themselves, for the most part those putting in claims had a positive experience with their provider or those doing the work. There were two participants that said their insurance did not cover all of the repair work, and of those that did results were mixed. Hefty deductibles, not all work being covered, and shoddy craftsmanship were cited.

With respect to doing things differently, there was a consensus that more could be done to prepare their yards by cutting brush, trimming trees and removing dead trees and other objects that would be blown by high winds.

Q2. How do you know if your home is at risk?

- How do you assess the risk to your home from flooding, wildfire, or high winds and its resiliency to these events?
- Identify the damage: if any, and how you repaired the damage

There was a consensus that it is difficult to determine if homes are at risk. What participants did say is that previous storms that caused damage made them self aware – for instance checking that pumps are working and cleaning yards, securing loose objects. It was also mentioned by some that despite not knowing when a storm will hit or what will be damaged, they checked weather sites and channels. In short you need to be aware and prepared.

Most, aside from major roof repair and had water damage and flooding, only had minor damage or none at all.

Q3. How do you assess the risk to your home from flooding, wildfire, or high winds and its resiliency to these events?

Few in the sessions claimed to be handy or knew much about renovations with the exception of two. Most said they wanted to learn more. There were some that hired a home inspector, cut trees and brush as well as checking their sump/lift pumps.

Q4. If you recognize that you live in a high-risk area for flooding, wildfire, or high winds, what preventative actions would you consider doing, if any at all?

Responses varied and included checking to see if pumps work, that yards are cleared / clean, trees trimmed and do routine checkups of gutters, down spouts as well as sealing windows and doors.

Information and Resources

Q5. Who have you turned to in the past to learn about the actions you can take to address this risk? Did they have the necessary knowledge and experience?

Few have called an expert. Mentions included social media, web searches, weather channels and an insurance company that send flyers and word of mouth from others. One person referenced a hardware store.

Q6. Where and how are you currently getting information about this topic? Are you interested in becoming more informed on floods, wildfires, and high winds, the vulnerability of your home, and the actions you could take to protect your home?

While all participants expressed interest in becoming more informed, their sources varied. Some preferred electronic methods such as email and websites and opposed having mailings which they said they would never read. There were also those that answered mailouts with a link to a website – but the information needs to be concise.

Q7. What kind of information would you want and how would you want to receive it? (website, maps, brochures, videos, text messages, newspapers, news broadcasts, live events webinars, public library seminars, learning sessions by the municipality). Who would you most trust to provide you with reliable information?

Insurance companies were most referenced followed by government websites, while other mentions included restoration firms, the Weather Network and experts at hardware stores. Some favoured paper mailings or bill inserts.

Q8. Would you value getting information from not-for-profits, like a consumer advocacy organization?

Value was seen for having not for profits or community groups providing them with information. They were seen as being neutral and not profit oriented, but they would need to be legitimate and reputable experts. When asked if they felt this information would be trustworthy, most concurred if they are experts.

Home Maintenance

Q9. Can you name some actions a homeowner could do to protect their home from floods, wildfires, and high winds before they happen?

Comments reflected the need to control; their environment by trimming trees, removing dead branches and tying down objects.

Q10. Look over this list of potential actions that homeowners could do to protect their home from floods, wildfires, and high winds before they happen. Display list, provide a bit of time for them to read list.

- Raise your hand if you would be interested in undertaking any of these actions? Why are the actions that you have picked of interest to you?

List of Possible Actions

- a) Clean eavestroughs and gutters
- b) Extend downspouts at least 2m away from the house
- c) Stack firewood away from the house
- d) Install and maintain a sump pump
- e) Install and maintain a backflow valve
- f) Install fire resistance roof and siding
- g) Remove plants near the house
- h) Store valuables in waterproof containers or remove them from the basement
- i) Install window well covers
- j) Seal windows, doors, siding, and other exterior openings
- k) Seal cracks in basement floor and walls
- l) Anchor heavy items in your yard
- m) Regularly maintain fence boards and shingles
- n) Trim dead branches from trees and shrubs
- o) Repair roofs
- p) Clear basement drains
- q) Slope the land away from your house
- r) Don't pour fats, oils, and grease down your drain
- s) Remove plants and mulch from around the house
- t) Replace wood fencing with metal fencing
- u) Cut the grass around your house

Most reacted favourably to the list of actions that were displayed, and some were pleased to have a checklist. It was seen as preventative maintenance, that is, they could prevent higher costs if their home needed repairs from a damaging event. They most liked the lower hanging fruit items which cost less such as cleaning gutters and their yard and actions, stacking firewood at a distance, anchoring items and storing valuables in waterproof containers.

When asked about barriers, cost was a dominant theme, followed by lack of knowledge and a lack of time. It was suggested that loans be made available or having the actions being more affordable.

Q11. Have you undertaken any of these and if so, what was the process like?

- Why might you or homeowners in general NOT take these actions? (what are the barriers to adoption?)
- What could help encourage you or homeowners in general to take these actions? (how to overcome the barriers?)

Most have done yard work, roof repairs (out of necessity) and have taken other low-cost items and most said the experience was okay. Once again, cost was named as the major reason for not undertaking larger action, followed by a lack of time and a lack of knowledge.

Q12. Would you be interested in having a risk assessment done of your home by a certified professional to provide you with recommendations on actions to protect your home from potential damage? Why or why not? Who would you trust to certify the assessor? How important is the certification to you?

Participants were not opposed to having an assessment but there would have to be certain conditions. The assessor would have to be reputable and accredited, and some wanted to know if it would help reduce insurance costs. Cost was also mentioned, so if not free it would need to be reasonable, or a

government subsidy would be needed.

Q13. If you adopt resiliency measures, do you think that potential buyers of your home would pay more for your house because of the changes that you made?

Participants were split on this issue.

Purchase

Q14. Did you discuss flooding, wildfire, and high wind risks with your realtor, lawyer, home inspector, or insurer before you purchased a home that you have owned? Who? What did you do as a consequence of that discussion?

One person asked a realtor, and another had a home inspection.

Insurance

Q15. What is your overall experience with insurance coverage and its cost?

Q16. Did you ever have any problems securing affordable insurance?

Q17. Has your insurer reached out to you personally about protecting your house, and how? What kind of communication is best to catch your attention?

Some had issues with their company not paying full cost or having delayed substandard work completed, while some others had no issues. Others who have not had a claim referenced the high and rising cost of insurance and not being aware of their deductible. There were issues securing affordable insurance by younger and older participants.

Only one person said their insurance company reached out to them. As mentioned earlier there was a divide on the issue of how they want to be communicated with. This included social media, emails, and an app by some, while other older persons still prefer paper.

Conclusion

Q18. We are at the final question, and I would like you to think of all the potential barriers to acting. What are the (three) biggest barriers that are stopping you from taking action to protect your home from flooding, wildfires, or high winds and why?

Cost, time and lack of knowledge or awareness were once again referenced.

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