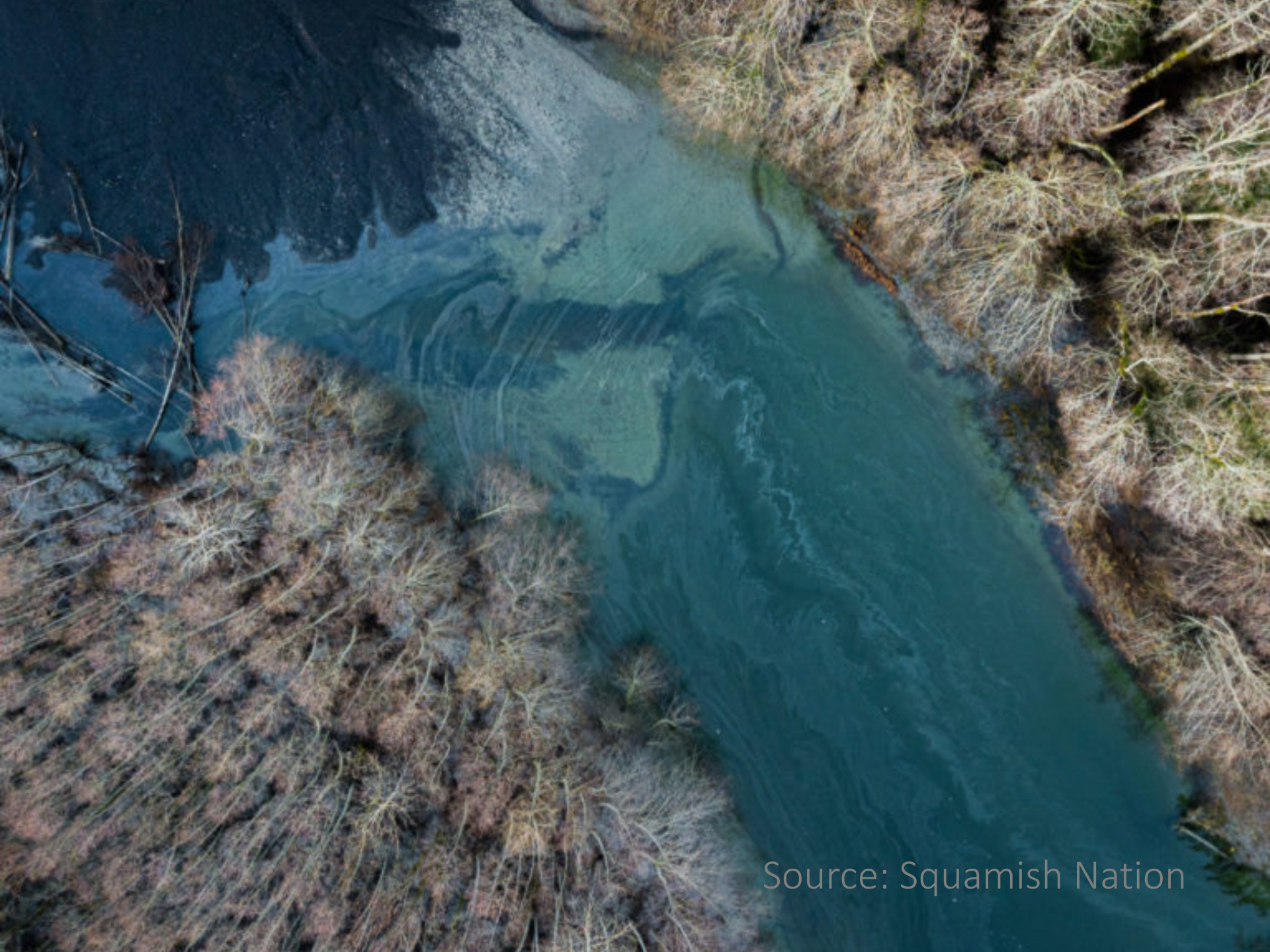


Realizing Resilient Buildings (R2B)

BOABC Conference—May 28 2024

Presented by: Cariad Garratt, Pinna Sustainability





Source: Squamish Nation

Realizing Resilient Buildings: project overview

- **Goal:** Contribute to improved safety and resilience of new and existing buildings in the face of climate change and earthquakes.
- **Project Purpose:** Identify key barriers that make it harder to increase the resilience of new and existing buildings in B.C. and identify the key enablers needed to overcome the challenges.
- **Project Deliverables:**
 - Discussion Paper: Realizing Resilient Building in B.C.
 - Toolkit for Local Governments

R2B project team

- Funded and led by:



- Consulting team:



Gary Penway Consulting



Part 1: What are resilient buildings?

Realizing Resilient Buildings in BC

Climate resilience

Canada's National Adaptation Strategy: Building Resilient Communities and a Strong Economy



“All of us living in Canada, our communities, and the natural environment are resilient in the face of a changing climate. Our collective adaptation actions enhance our well-being and safety, promote justice, equity, and reconciliation with Indigenous Peoples, and secure a thriving natural environment and economy for future generations.”



R2B context: a resilient building...

- Enables people to care for themselves, their neighbours and communities in the face of adversity
- Protects people from the elements in comfort and security now and for future generations
- Has longevity, is safer, more durable and livable, and protects public and private investments



Scope: hazards considered



Extreme heat



Flooding: Coastal and Riverine/Lake



Flooding: Pluvial



Wildland Urban Interface Fires



Wildfire smoke and air quality



Storms and power outage



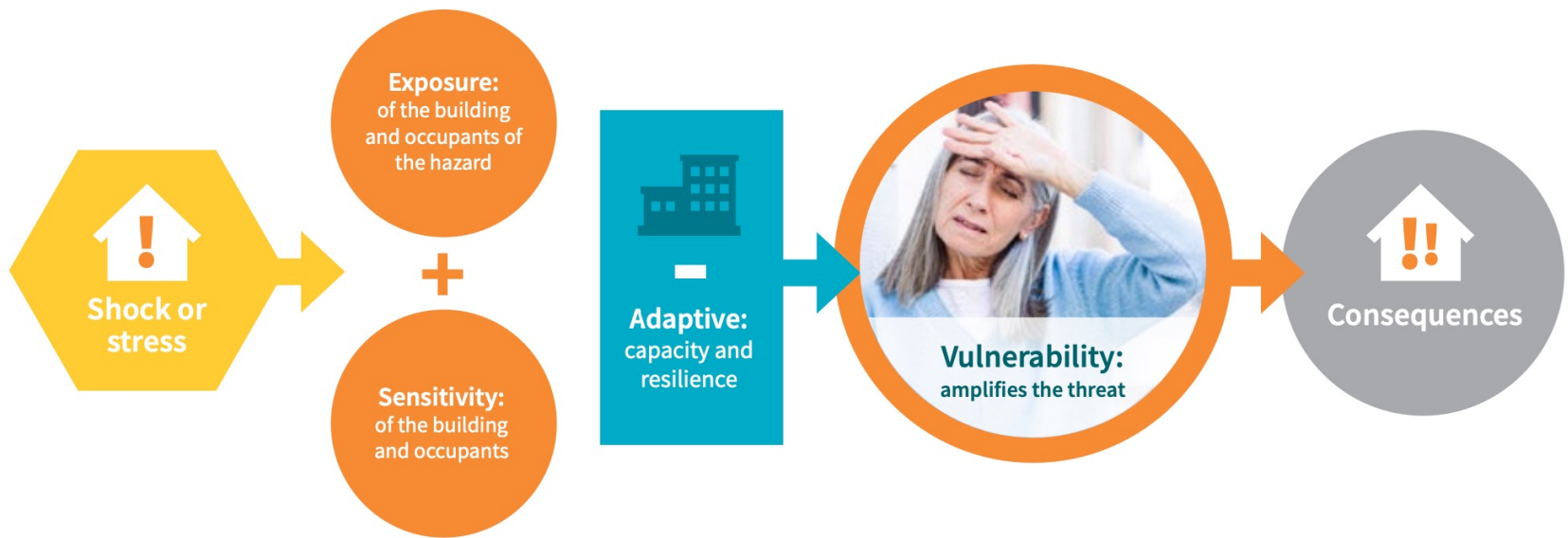
Drought and short-term water shortage



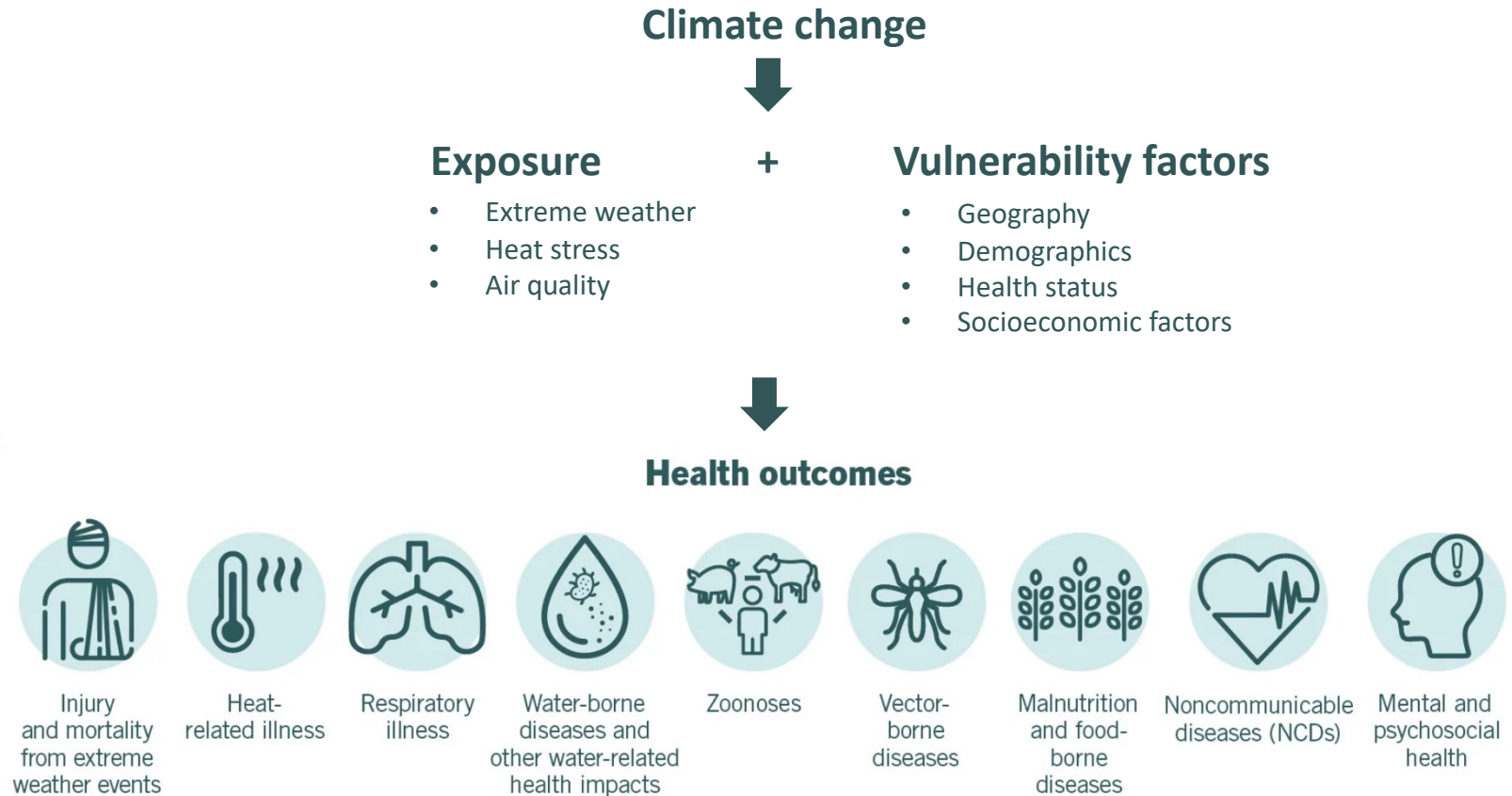
Earthquake



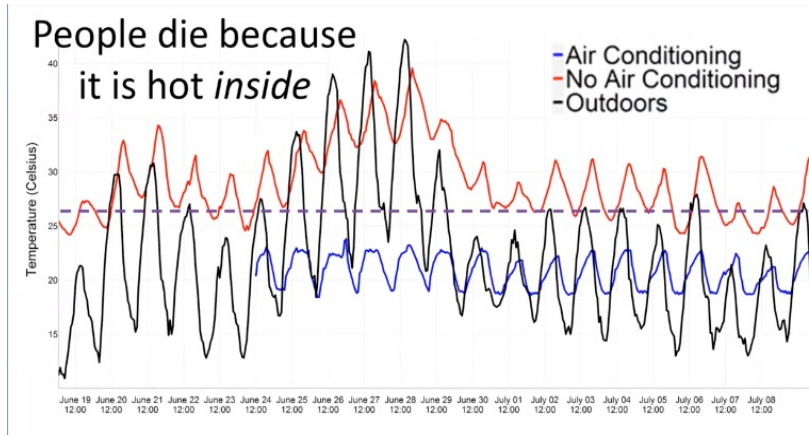
Many factors determine the impacts felt



Climate-sensitive health risks for building occupants



Resilient buildings are safer buildings



Source: BC CDC



Source: Health Canada

Resilient buildings are also zero carbon

Resilient buildings:

- are resistant to future hazards
- support social connection
- support faster recovery
- are zero carbon



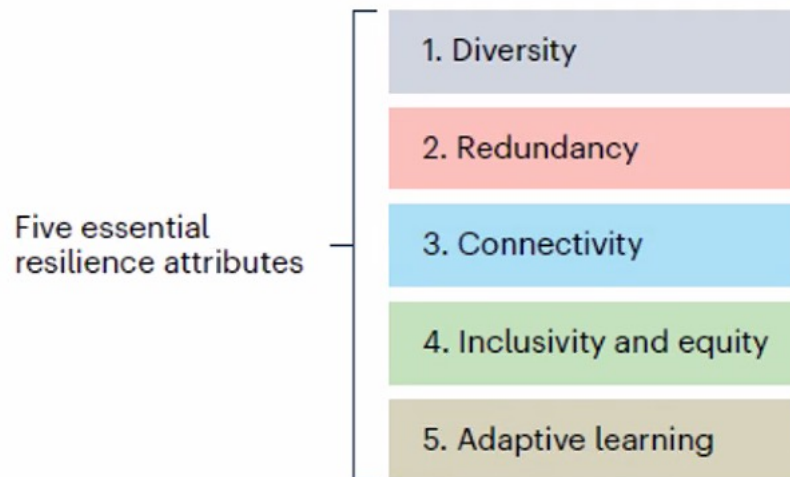
Zero carbon buildings:

- are energy efficient
- have low embodied carbon
- run on clean energy

Resilient buildings help improve equity

- *“As we build systems and solutions that are more climate resilient, we have the opportunity to address systemic inequities that make people vulnerable.”*

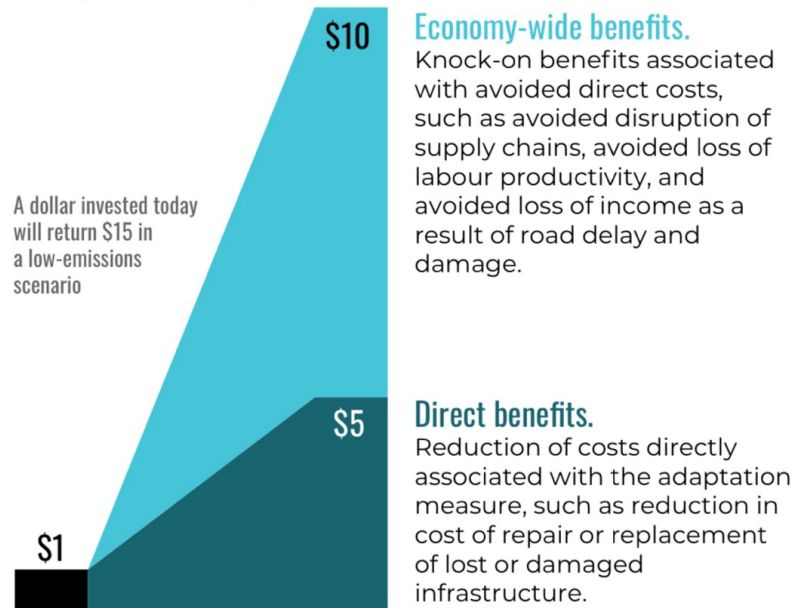
(Government of Canada. 2022. Draft National Adaptation Strategy.)



Source: Global Resilience Partnership

Resilient buildings are more **cost effective over time**

Proactive adaptation is a strong investment that generates major economic returns.



Source: Canadian Climate Institute, Damage Control: Reducing the costs of climate impacts in Canada

Multiple objectives, many co-benefits

Objectives



Co-benefits

- Healthier, safer indoor environments
- Vegetation and trees have multiple benefits including reducing stress
- Improved social connections, improved sense of belonging and wellbeing
- Areas of refuge translate across hazards
- Renewable energy sources provide redundancy

Zero-emission building features	Resilient zero-emission building features	Equitable considerations
Energy efficient building envelopes and mechanical systems	<ul style="list-style-type: none"> → Improve airtightness, and include good ventilation and air filtration effective for wildfire smoke 	<ul style="list-style-type: none"> → Prioritize older buildings with more vulnerable occupants
High-efficiency electric heating	<ul style="list-style-type: none"> → Include high-efficiency cooling systems → Add backup power 	<ul style="list-style-type: none"> → Prioritize cooling in units or in rooms on site for populations more vulnerable to heat in units (e.g., reduced mobility, elderly, certain medical conditions)
On-site renewable energy	<ul style="list-style-type: none"> → Add energy storage or backup power suitable for use during future hazard events 	<ul style="list-style-type: none"> → Consider diverse needs for backup power (e.g., refrigeration of medications, technology that supports those with disabilities)
Passive heating and cooling designs	<ul style="list-style-type: none"> → Include options for active heating and cooling in preparation for more extreme conditions → Add space for larger mechanical systems 	<ul style="list-style-type: none"> → Consider and prioritize cooling needs for populations more vulnerable to heat
Low-carbon building materials	<ul style="list-style-type: none"> → Materials are resistant to all hazards identified by local risk assessment (fire, flood, wind, snow, earthquakes, etc.) 	
Energy and water conservation	<ul style="list-style-type: none"> → Plan for backup sources for power outages or periods of drought → Increase occupant awareness of alternative options 	<ul style="list-style-type: none"> → Make all information and awareness campaigns available to diverse audiences
Site planning preserves and enhances natural carbon sinks	<ul style="list-style-type: none"> → Plan for trees and ventilation to provide cooling effects, areas of respite and social connection, water management during high precipitation or drought periods 	<ul style="list-style-type: none"> → Ensure spaces feel safe and are accessible to those with diverse needs
Redevelop sites for higher density, walkable, accessible, complete communities	<ul style="list-style-type: none"> → Redevelop sites in a manner that increases social connection 	<ul style="list-style-type: none"> → Provide continuity of community and avoid displacement from redevelopment



Resilience strategies: growing list of resources

BC HOUSING

Home / Research Centre / Research Library / Mobilizing Building Adaptation and Resilience (MBAR)

Mobilizing Building Adaptation and Resilience (MBAR)

Mobilizing Building Adaptation and Resilience (MBAR) is a multi-year, multi-stakeholder knowledge and capacity building project led by BC Housing, with participation and contribution from over 30 organizations, including national, provincial, and local agencies; and industry partners.

Video

Introduces the Mobilizing Building Adaptation and Resilience Initiative

Watch on **YouTube**

Pilot Projects

Building owners, construction experts, and design professionals are invited to join MBAR

Interested in supporting the MBAR initiative? You can apply to have your current or planned building project included in MBAR as a pilot project or offer your expertise to support MBAR pilot projects by completing the relevant Expression of Interest form below:

[Expression of Interest - Consultants](#)

[Expression of Interest - Pilot Projects](#)

Email your completed Expression of Interest form to mbar@bchousing.org

Climate Resilience Guidelines for BC Health Facility Planning & Design

December 2020 | Version 1.1

fraserhealth **Interior Health** **island health** **northern health** **Povidence** **Provincial Health Services Authority** **Vancouver Coastal Health**

CLIMATE-READY HOUSING DESIGN GUIDE

Quick User Guide

June 2022

Climate change is having significant impacts on homes and communities across British Columbia – from extreme heatwaves, more frequent flooding, and more severe wind storms. Annual average temperatures across Canada have increased by 1.7°C since pre-industrial times, which is almost twice the rate of temperature rise around the world. These trends are expected to increase as global temperatures continue to rise, particularly if the world does not take radical action to curb greenhouse gas emissions at a local and global scale.

Historic trends are the foundation for the current building codes and standards that we use to design our homes and buildings. This is the key issue. Most of the residential buildings that exist and are being built today are not designed for future extreme conditions and may face increased maintenance needs, system failure in extreme events and fail to protect the health and safety of building occupants.

There is a critical opportunity for housing providers and developers to more proactively incorporate future climate considerations when designing new housing and retrofitting existing buildings. The federal government and Province of B.C. are in the process of developing new standards and tools to support more climate-ready design in the buildings sector.

About this Guide

This Climate-ready Housing Design Guide is intended to serve as a reference tool for housing providers, developers, and other building industry professionals across B.C. on emergent best practices and recommended technical standards for more climate-ready housing design. The Guide provides an editable toolkit of resources that design teams can use to inform more climate resilient design of new or existing housing, including the following key components:

- **Guiding Objectives** – broad statements of best practices for climate resilience to guide design planning and decision-making.
- **Resilient Design Approaches & Technical Standards** – key best practices for more resilient housing planning, design and documentation with details on recommended design thresholds and features.
- **Resilient Design Strategies** – a comprehensive list of climate resilient design strategies that housing providers and designers can pick and choose from to meet their resilience objectives and emerging standards.
- **Low Carbon Resilience Potential** – High-level overview of how each resilience approach and strategy may contribute to reductions in operational and embodied carbon emissions for lower-carbon design.

The Guide is designed to be updated and refined over time to incorporate new technologies, best practices. It will evolve to align with provincial and federal design standards as they are updated to account for climate change.

This version of the Guide has a particular focus on strategies for designing new Part 3 housing (e.g. multi-family residential buildings like apartments and townhomes) to better accommodate overheating, wildfire and poor air quality events. It also includes preliminary guidance on designing for a range of other climate-related impacts affecting buildings such as flooding, seismic, power outage, windstorms, drought, moisture, and ice and snow.

It was designed by BC Housing's Mobilizing Building Adaptation and Resilience (MBAR) initiative with support from Integral Group and a panel of resilient building design experts. It was developed through an iterative workshop series to ensure content represents the most current resilient design best practices, knowledge and technology at the time.

Your thoughts

- What hazards are you seeing in your communities? How do those impact buildings and their occupants?

Part 2: Barriers and enablers



Discussion Paper: Realizing Resilient Buildings in BC

Overview: primary barriers

Technical Training and Capacity

Limited innovation in design

Little data/ understanding of site hazard exposures

Insufficient training on appropriate resilience measures

Little data on effectiveness of resilience measures

Product availability

Electrical grid capacity constraints

Labour supply limitations

Productivity Limitations

Political and Regulatory

Barriers to retrofits and those imposed by leases and stratas

Complex systems, processes cross jurisdictions

Building Code slow to change

Resilience insufficiently integrated into development regulations

Resilient design conflicts with local policies

Lack of strategic, policy or legislative direction

Training and capacity for local government

Economic and Financial

Few incentives to incorporate resilience approaches

Low consumer demand

Increased burden on operations

Insurance sector grappling with increased costs and incentivizing resilience

Banks and investors lack tools to evaluate climate-related risks

Post-event financial assistance

Funding resilience measures through development may impact affordability

Social and Informational

Range of reporting frameworks on the resilience of buildings

Lack of understanding building system operation and maintenance

Poor awareness of and preparation for local hazards






Social connectivity ignored in building design and operation, may conflict with security

Barrier example: housing typologies



Credit - Public: Architecture + Communications

Primary enablers

-  **Data and information:** Understand, identify, disclose, communicate
-  **Awareness and capacity:** Expand labour, industry, owner and government capacity on resilience
-  **Policy development:** Build market demand for resilient buildings
-  **Financial mechanisms:** Improve investment and financing opportunities
-  **Social capacity:** Integrate social resilience into building design, retrofits, programming

Recommendation highlights

Understand, Identify, Disclose and Communicate Risk

Public hazard data repository and guidance for disclosure

Expand forensic accounting of hazard events

Resilience rating system for buildings

Expand Labour, Industry, Owner and Government Capacity on Resilience

Raise awareness on benefits of integrating resilience and net-zero building actions

Enhance recruitment, retention and skill development in the construction sector

Ensure climate risk and adaptation in professional competencies and development

Build Market Demand for Resilient Buildings

Demonstrate leadership in public sector buildings

Establish guidance and resources for community retrofit programs

Support innovative material and technologies

Recommendation highlights continued...

Improve Investment and Financing Opportunities

Expand existing government financial support to include resilience

Increase building-owner access to capital for resilience enhancing investments

Develop and communicate a method for resilient cost-benefit analysis

Integrate Social Resilience Into Building Design, Retrofit and Programming

Develop and test innovation in design for social resilience

Establish social resilience indicators to inform planning

Resource program supporting social resilience in multi-unit buildings

Quicker steps Short: 1 to 5 years Medium: 6 to 10 years Long term: 11+ years

BC Ministry of Emergency Management and Climate Readiness

BC Ministry of Environment and Climate Change Strategy

BC Ministry of Housing

Other Provincial Ministries

BC Housing

Federal Government

Utilities

Local Governments

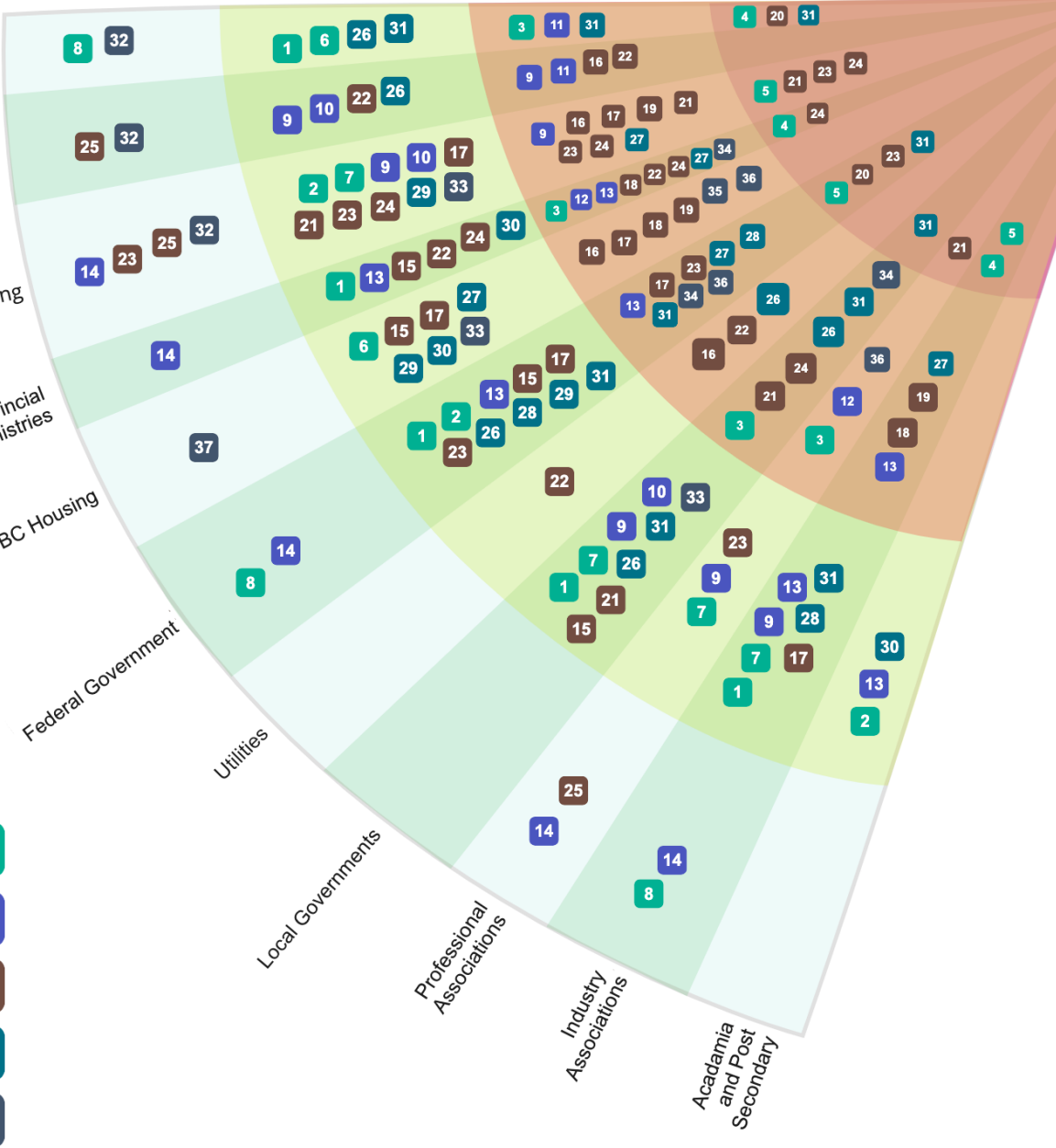
Professional Associations

Industry Associations

Academia and Post Secondary

Realizing Resilient Buildings in BC

- Understand, Identify, Disclose and Communicate Risk
- Expand Labour, Industry, Owner and Government Capacity on Resilience
- Build Market Demand for Resilient Buildings
- Improve Investment and Financing Opportunities
- Integrate Social Resilience into Building Design, Retrofit, Programming



Your thoughts

- Do these barriers and enablers resonate with your experience?
- What else would you highlight?

Part 3: Toolkit for Local Governments



Realizing Resilient Buildings in BC

A toolkit for local governments

- **Audience:** BC regional and municipal governments
- **Purpose:** Build capacity of staff and elected officials on climate resilience in the building sector
- **Focus:** Preparedness and risk mitigation at building & site scale

What is the hazard threat and how is it changing?

Design features that improve resilience

Local gov't strategies and tools for implementation

Equity Considerations

Extreme heat

This diagram shows some examples of building-scale strategies that are important to increase resilience to extreme heat.

Building orientation to increase solar gain in winter and reduce solar gain in summer

Operable windows with cross-ventilation

Shading with trees

Use methods of **natural ventilation**

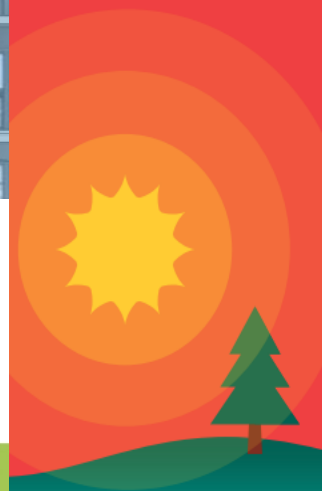
Exterior window shades

Lower wall to window ratios

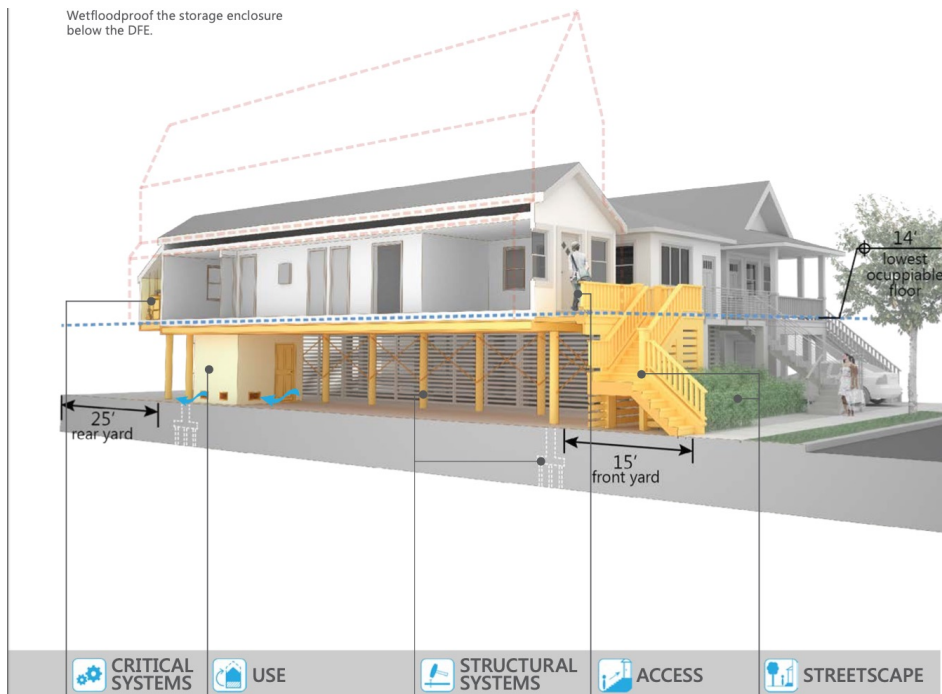
Provide a **cool room** in a common area

Design sufficient **mechanical cooling** for heat waves, considering closed windows if high pollution coincides

Heat pumps for energy efficient cooling



Flooding: coastal, river, lake

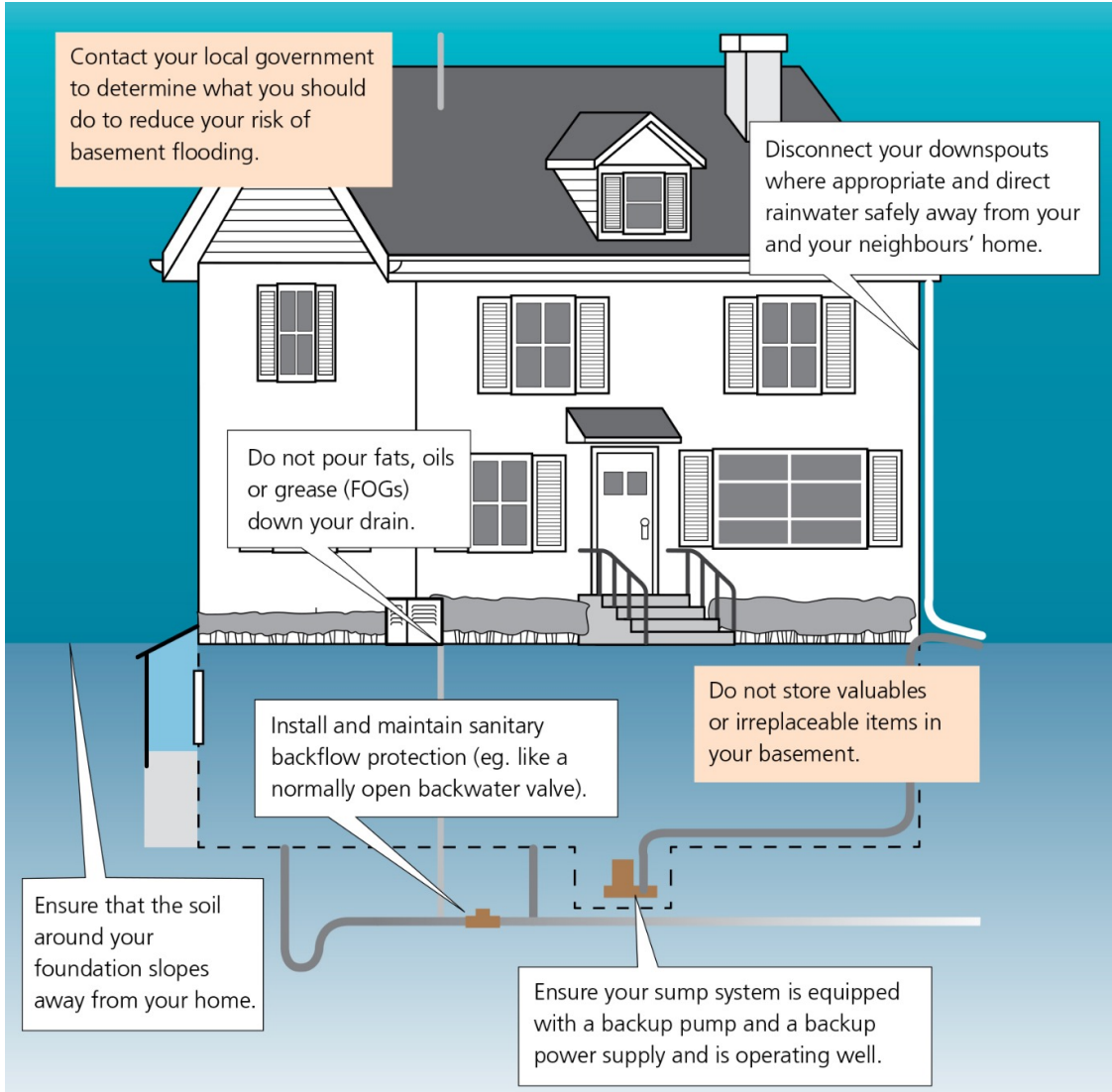


Source: NYC Design Guidelines

- Living spaces and major electrical above Flood Construction Level (FCL)
- Setbacks from natural bodies of water
- Wet and dry floodproofing (waterproof drywall, mould-resistant flooring, sealing the exterior)
- Flexible first floor uses



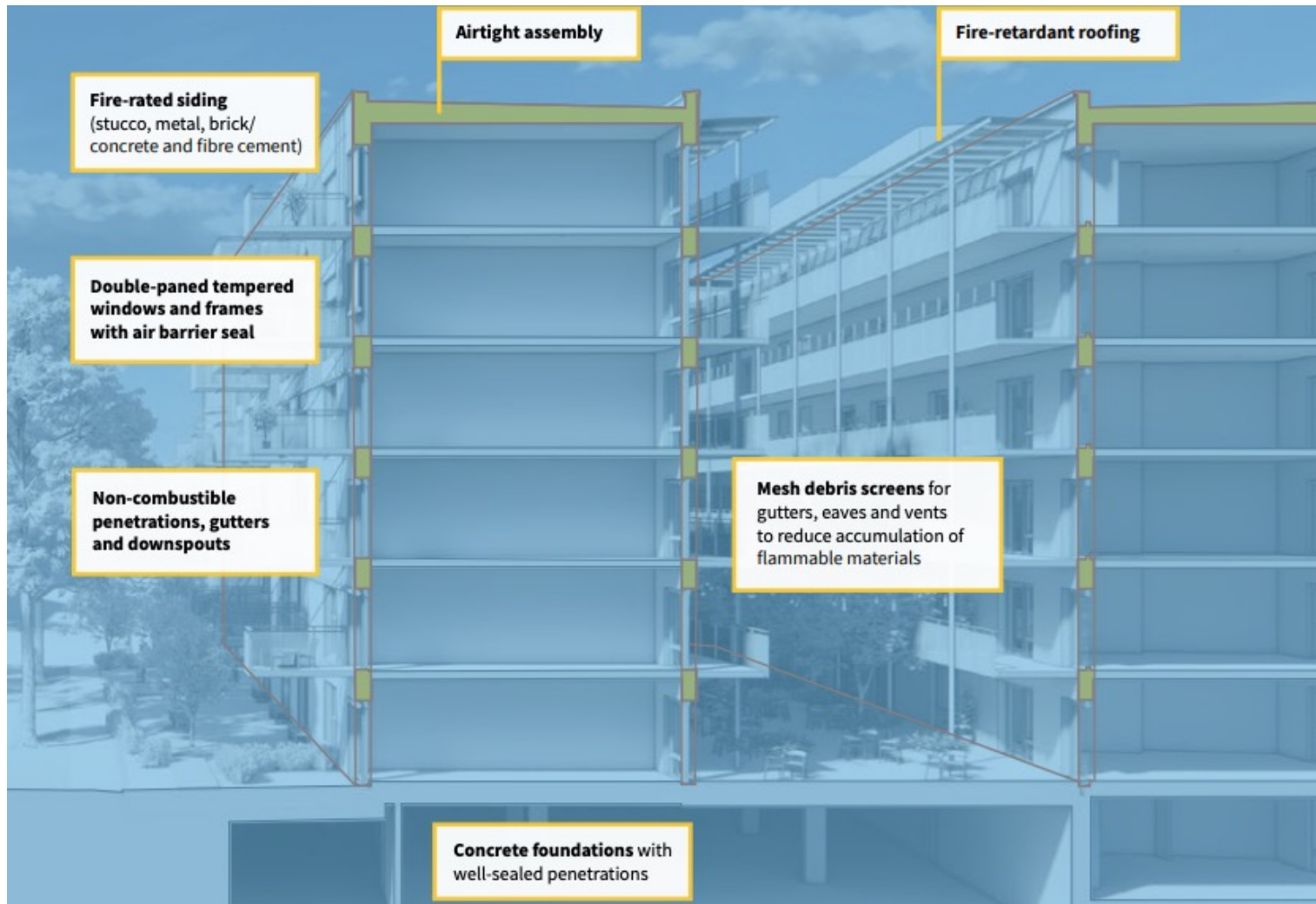
Flooding: pluvial



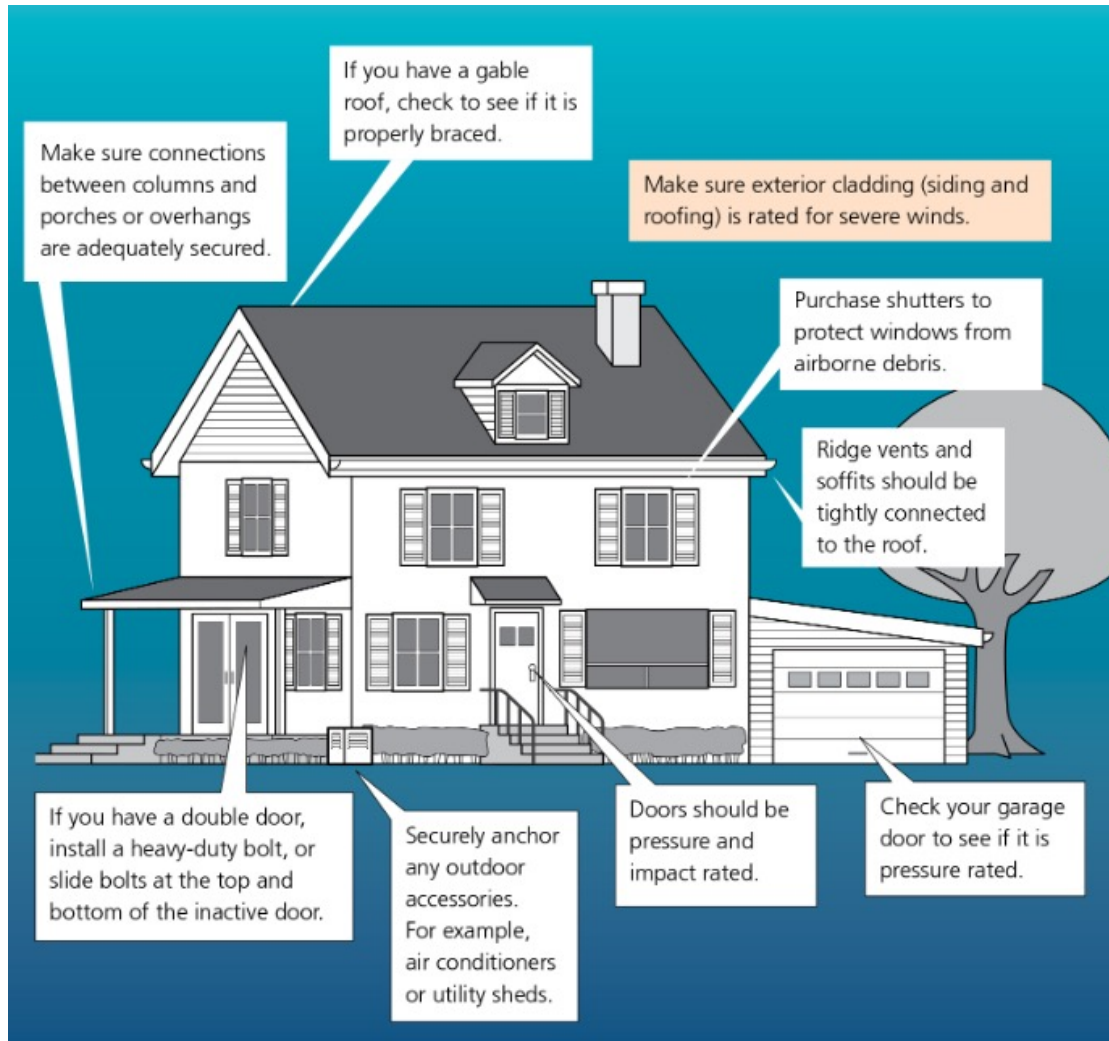
Source: Institute for Catastrophic Loss Reduction



Wildfire



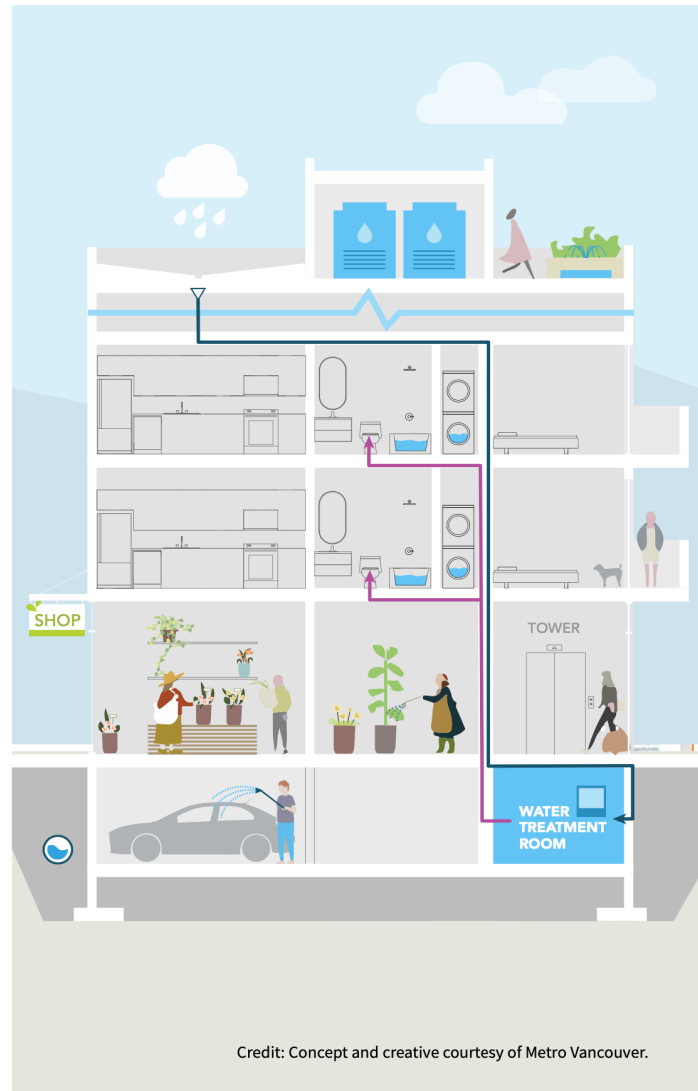
Storms and power outages



Source: ICLR, Wind



Drought and short-term water shortage



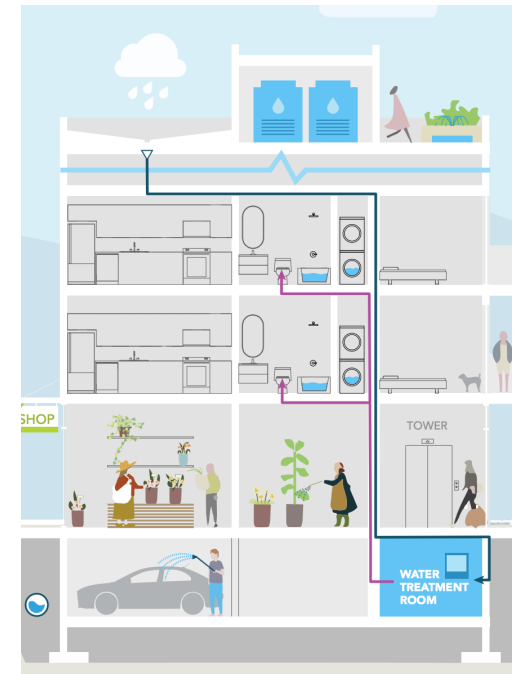
Key areas for local governments



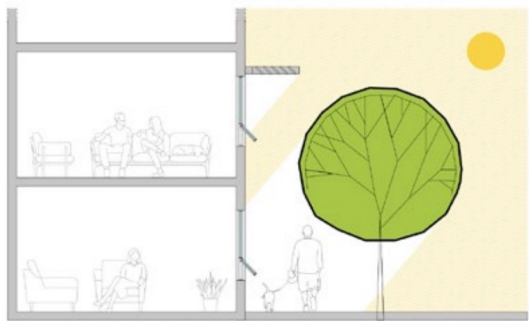
Site Coverage, Setbacks, Balconies, Noise



Building Height and Roofs



Gross Floor Area



Landscaping
Trees and
Water



Form and
Character
Guidelines



Example: building height and roofs



- Mechanical equipment and emergency back-up power may be located on the roof
- As FCLs increase, height relaxations may be needed (no habitable space below FCL)
- Roof pitch and setbacks from edge and ridge may limit effectiveness of solar panels
- Green roofs provide initial stormwater mgt.
- Include future wind and snow loads in roof design

Example: site coverage, setbacks, balconies, noise



- Allow heat pumps in setback areas, on private decks or balconies
- Allow on-site stormwater detention tanks, rain gardens and other stormwater management features
- Review noise bylaws to ensure they don't preclude heat pumps
- Consider structure configuration, density and proximity to treed areas to minimize wildfire risk

Example: landscaping, trees and water



- Use vegetation to mitigate urban heat island effect, provide shading to lower building storeys, provide outdoor respite areas
- Maintain buffers between trees and subdivisions in potential wildfire areas
- Establish policies for greywater surface discharge for irrigation to reduce impacts of drought



Your thoughts

- How do you think local governments can influence having more resilient new buildings?

Thank you!

Send me an email if you'd like to be updated when the report and guidebook are released:

Cariad Garratt, Principal
Pinna Sustainability Inc.

cgarratt@pinna.ca



Thank you!

Realizing Resilient Buildings in BC