Version 1.0

Integrated Building Adaptation and Mitigation Assessment (IBAMA) Framework

Applicable to the Design of Multi-Unit Residential Buildings

REFERENCE GUIDE

November 2020

New Jubilee House (Image courtesy of GBL Architects Inc., by permission. Photographer: Derek Lepper)

PICS
PACIFIC INSTITUTE FOR CLIMATE SOLUTIONS

THE UNIVERSITY OF BRITISH COLUMBIA
Institute for Resources, Environment and Sustainability
Faculty of Science

BC HOUSING

IBAMA was developed as part of BC Housing's Mobilizing Building Adaptation and Resilience (MBAR) initiative.

The project was led by Ilana Judah, architect and MSc Student at The Institute for Resources, Environment and Sustainability at The University of British Columbia, under the supervision of Dr. Stephanie Chang.

Funding and project management support were provided by the Pacific Institute for Climate Solutions (PICS).

IBAMA Version 1.0 will be piloted on a BC Housing case study/ies in order to produce a baseline assessment, optimize the tools and incorporate additional references.

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Introduction to IBAMA

The Integrated Building Adaptation and Mitigation Assessment (IBAMA) framework is a tool to assist BC Housing project teams as well as other building industry stakeholders in BC, Canada, and beyond; to help increase their project's resilience to climate hazards (adaptation) while optimizing GHG reduction (mitigation) and sustainability goals.

Why IBAMA?

There are many policies and systems that focus on climate mitigation/sustainability in buildings, and a growing number of guidelines and frameworks that address climate adaptation/resilience. However, most don't adequately integrate mitigation/sustainability with adaptation/resilience approaches. This lack of integration can result in unintended consequences such as increased greenhouse gas (GHG) emissions, augmented risks, negative health outcomes, maladaptation, and added costs. By using IBAMA, project teams can investigate interactions between adaptation and mitigation strategies to maximize synergies, minimize conflicts, identify trade-offs, and achieve more holistic solutions.

What is IBAMA?

IBAMA is a roadmap and flexible decision-making tool rather than a checklist or set of prescriptive requirements. This will enable project teams to respond to the unique context, vulnerabilities and circumstances of their project such as the location and neighbourhood, potential climate hazards, occupant demographics, budgets, and management structures.

How is IBAMA implemented?

This document serves as a reference guide for implementing IBAMA. It is accompanied by an IBAMA Excel tool where information and decisions can be documented, and evaluations carried out. A separate abbreviated primer that introduces the framework process to project teams is also available and can be used at a project's inception to generate initial thoughts and establish a general direction on adaptation, mitigation and sustainability goals and strategies.

When is IBAMA used?

It is critical to use the IBAMA framework at the early stages of a project: financing, pre-design and schematic design. However, there are milestones and deliverables at later stages of the design, construction and operations process to ensure that goals are being met and strategies carried out. Most importantly, final goals and strategies implemented should be clearly documented for reference by the management and operations team throughout the project's lifespan.

Where should IBAMA be employed?

While IBAMA is conceived to be used on new construction projects, the process can be adapted for retrofits and renovations. In this case, additional parameters pertaining to existing conditions and logistics planning should be added.

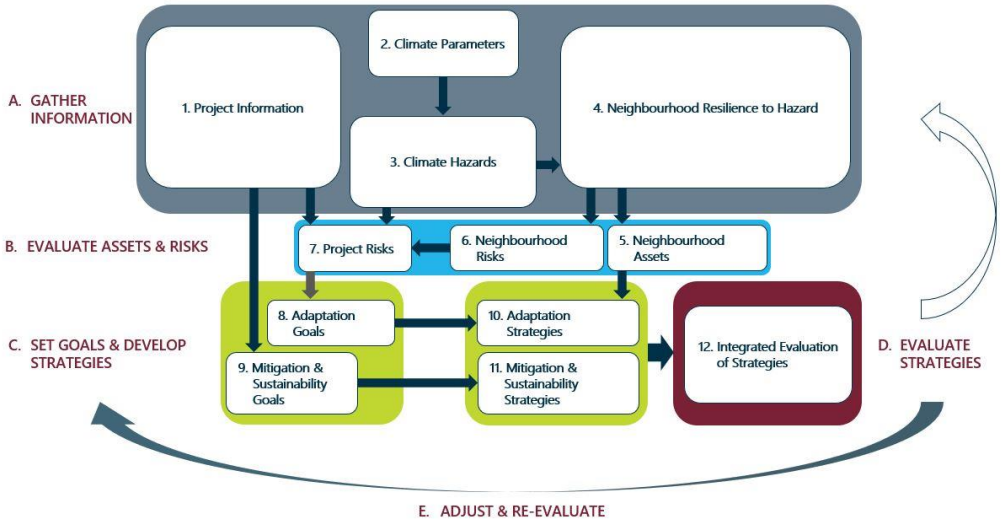


Figure 1. Integrated Building Adaptation and Mitigation Assessment (IBAMA) Process

Reference Guide Instructions

The IBAMA Reference Guide is intended to be used (with the associated Excel tool) as a living document that evolves through the project planning, design, construction and operations phases. Each section of the guide provides step-by-step instructions about the information required for the evaluation, the parameters to assess; and the stakeholders needed to complete an evaluation, develop goals, or determine appropriate strategies. The guide also includes suggestions for when to carry out integrated project meetings and/or workshops, and what deliverables should be provided at each stage of the process.

Document Structure

Following the introduction and instructions, the Reference Guide is organized into twelve sequential sections that are grouped according to the first four phases of the IBAMA process (Figure 1). A fifth phase, *Adjust and Re-evaluate*, allows for an iterative process whereby strategies that don't sufficiently meet adaptation, mitigation and sustainability goals would be eliminated, revised, or re-evaluated. While not in the current scope of IBAMA, understanding impacts of proposed strategies on the neighbourhood is also encouraged.

A. Information Gathering
B. Evaluation of Assets and Risks
C. Goal Setting and Strategy Development
D. Strategy Evaluation

Each framework section is organized as follows:

Section Description – Overview of the purpose, intent and objectives of the chapter.

Parameters – Information inputs, assessments or evaluations required. Instructions are provided on how to complete fields, as well as suggestions for which party/ies are responsible for their completion. This information should be input in the IBAMA Excel tool and updated as the project evolves.

Reference Standards – Official documents and standards that were used either to help develop the parameters and/or can serve as references when completing the parameter fields.

Additional Resources – Additional reference materials that may be helpful for completing inputs or making decisions regarding goals or strategies. Some of these resources are valuable technical resources for developing specific strategies.

Case Study Example – Where applicable, examples of how parameters can be completed/developed using a BC Housing project or other BC case study. *Note: The examples and associated inputs are for illustrative purposes only, and do not represent actual project designs, evaluations or decisions by the project team.*

Recommended Documentation and Deliverables – Suggested deliverables at each project milestone, including parties responsible for documentation.

IBAMA Excel Tool

The IBAMA Excel tool is to be used as a master document to track project, climate, and neighbourhood information; document neighbourhood and project assets and risks; establish adaptation, mitigation and sustainability goals; develop potential strategies; and evaluate solutions. The tool should be updated regularly as the project evolves.

The tool is divided into tabs that follow the framework's sections. Section 12 scores the proposed strategies according to a series of weighted evaluation criteria, with greater weight placed on meeting adaptation, mitigation and sustainability goals. Once the strategies have been evaluated, the tool will generate a series of graphs to help teams compare options.

Integrated Project Team

An integrated design, construction, and operations process is essential for effective implementation of climate mitigation and sustainability goals. With adaptation and resilience goals, ensuring team integration is even more critical.

Whereas project teams addressing mitigation and sustainability goals are generally bounded by the limits of the project site and program, incorporating adaptation and resilience requires broader expertise related to climate science, municipal and infrastructure systems, neighbourhood amenities, as well as health and social services.

Given that some of the expertise required is beyond the scope of traditional design and construction teams, the project owner and/or developer should review the IBAMA parameters to determine how to obtain necessary information and guidance. This may mean allocating additional fees for an expanded project team, greater collaboration with the municipality, or leveraging knowledge from other nearby projects. If the owner is not able to acquire all the necessary information related to the adaptation and resilience parameters, it is recommended that the project team take a precautionary approach when determining adaptation and resilience strategies.

Ideally, an integrated IBAMA project team would include many of the following members at various phases of the project, depending upon the project's scope. Depending upon the project others may also be included, such as health or equity consultants. Those in **bold** represent participants that are not typical to a conventional design and construction process:

> Architect, **Adaptation Consultant**, **Climate Scientist,** Commissioning Agent, Contractor/Construction Manager, Cost Estimator, **Emergency Management Representative, Facilities Manager, Health Authority Representative,** Landscape Architect, MEP Engineer, **Municipal Resiliency Officer, Neighbourhood Representative,** Owner/Developer, Peer Reviewer, **Planner/ Urban Designer**, Resident Representative, Site/Civil Engineer, **Social Services Representative,** Structural Engineer, Sub-Contractors (as required), Sustainability Consultant, **Utilities' Representatives.**

List of project team members with abbreviations

Team Member	Abbr.	Team Member	Abbr.
Architect	AR	***Owner/Developer***	OD
Adaptation Consultant	AC	***Peer Reviewer*** *(On large projects, consultant outside project team hired to review the design)*	PR
Climate Scientist	CS	***Planner/Urban Designer***	PL
Commissioning Agent	CX	***Resident Representative***	RR
Contractor/Construction Manager	CM	***Site/Civil Engineer***	SC
Cost Estimator	CE	***Social Services Representative***	SS
Emergency Management Representative	EM	***Structural Engineer***	ST
Facilities Manager	FM	***Sub-contractors***	SB
Health Authority Representative	HA	***Sustainability Consultant***	SU
Landscape Architect	LA	***Utilities Representative - Electricity***	UT-E
MEP Engineer	ME	***Utilities Representative - Gas***	UT-G
Municipal Resiliency Officer	MU	***Utilities Representative - IT***	UT-I
Neighbourhood Representative *(Community Board member or Neighbourhood Planning Committee member)*	NR	***Utilities Representative - Other***	UT-O

Summary of IBAMA Parameters

The table below summarizes IBAMA categories and sub-categories. Individual parameters are listed in each section of the IBAMA Reference Guide and in the Excel tool.

Summary of Parameter Categories

	Parameter Category	Sub-Category
1	***Project Information***	General Information
		Project Program & Requirements
		Location, Site & Building Features
		Anticipated Project Demographics
2	***Climate Information***	Climate Change Scenarios
		Project & Systems Lifespans
		Building Systems Linkages to Climate Change Scenarios
3	***Hazards***	Hazard Scoring
		Description of Top Climate Hazards & Compounding Hazards
4	***Neighbourhood Resilience to Hazards***	Infrastructure
		Built Environment
		Natural Environment
		Transportation
		Community Governance, Services & Health
		Neighbourhood Demographics
		Economy
5	***Neighbourhood Assets***	Neighbourhood Assets for Top Hazards
6	***Neighbourhood Vulnerabilities & Risks***	Neighbourhood Vulnerabilities & Risks for Top Hazards
7	***Project Vulnerabilities & Risks***	Project Vulnerabilities & Risks for Top Hazards
8	***Climate Adaptation Goals***	Adaptation Goals for Top Hazards
9	***Climate Mitigation & Sustainability Goals***	Climate Mitigation Goals
		Sustainability Goals
10	***Adaptation Strategies***	Adaptation Strategies for Top Hazards
		Follow-up on Selected Adaptation Strategies
11	***Climate Mitigation & Sustainability Strategies***	Climate Mitigation Strategies & Follow-up on Selected Strategies
		Sustainability Strategies & Follow-up on Selected Strategies
12	***Evaluation of Strategies***	Adaptation, Mitigation & Sustainability Strategy Evaluation Criteria
		Evaluation of Adaptation Strategies
		Scoring of Adaptation Strategies
		Summary of Adaptation Strategies for Development
		Evaluation of Mitigation & Sustainability Strategies
		Scoring of Mitigation & Sustainability Strategies
		Summary of Mitigation & Sustainability Strategies for Development

Scoring and Performance Metrics

Project teams score potential adaptation, mitigation and sustainability strategies according to a series of evaluation criteria that can be weighted according to the owner's priorities. A minimum weight is given to both meeting adaptation goals and meeting mitigation & sustainability goals. Twenty-one evaluation criteria are grouped into six categories:

- Climate Adaptation Goals
- Climate Mitigation & Sustainability Goals
- Technical Requirements
- Project Requirements
- Direct Costs
- Indirect Costs & Benefits

If desired, additional criteria can be added by the project team. Once strategies have been evaluated, total scores, scores by category, and comparative charts are generated in the Excel tool (Figures 2 & 3).

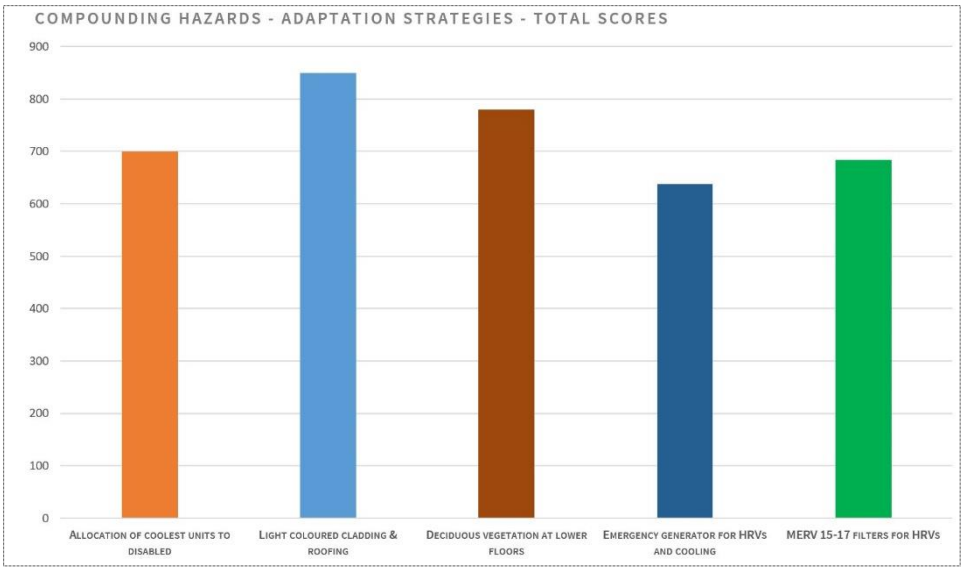


Figure 2. Bar chart comparing adaptation strategies for a compounding hazards scenario.

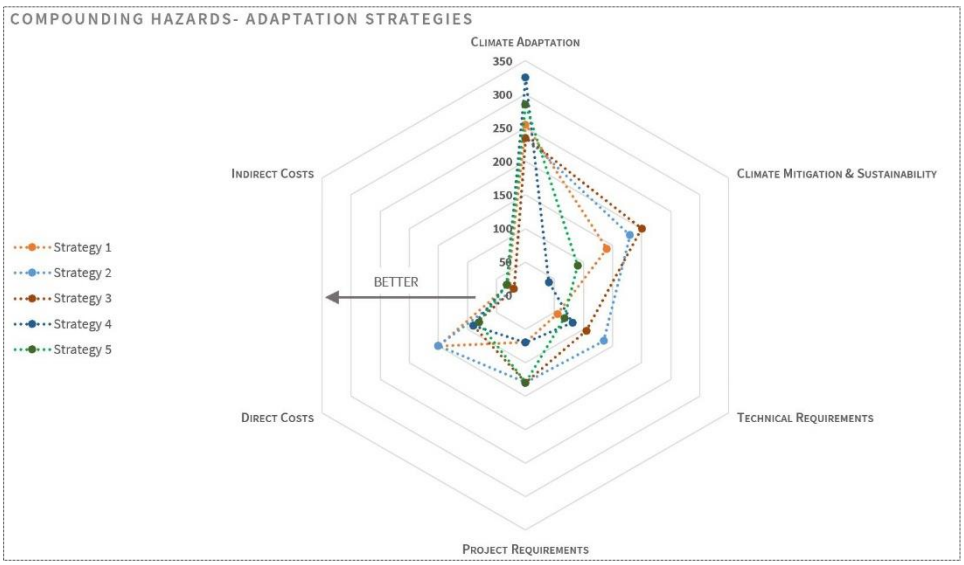


Figure 3. Radar chart comparing adaptation strategies for a compounding hazards scenario.

Integrated Process Meetings & Site

The table below summarizes the minimum recommended integrated team meetings and actions at each phase, with suggested participants. These can be adjusted according to the project's level of complexity, budget, and schedule.

Project Phase	Minimum Meetings & Site Visits	Suggested Participants
Feasibility & Financing	▪ Owners meeting to determine initial budget & consultant scope/fees for additional adaptation, mitigation & sustainability measures. ▪ Meeting to develop project purpose and principles. ▪ Meetings to develop project program. ▪ Meetings to develop Owner's Project Requirements (OPR).	OD, CE OD, RR OD, RR, FM, (AR) OD, RR, FM
Pre-Design	▪ Meeting with Neighbourhood and Municipal representatives to review/complete Section 4. ▪ Meeting(s) with Utility representatives to review/complete neighbourhood infrastructure evaluation in Section 4. ▪ Integrated Team workshop to complete Sections 1-9 of the IBAMA framework tool and discuss initial adaptive mitigation approach.	OD, MU, NR, PL, HA, EM, AC, (AR) OD, MU, NR, UTs, SC, AC, AR, ME, LA, AC OD, RR, FM, AR, SC, ST, ME, LA, SU, AC, CM, CE, CS
Schematic Design	▪ Integrated Team workshop to review updated Sections 1-9 of the IBAMA framework tool, complete Sections 10-12 (proposed adaptation, mitigation, and sustainability strategies), and select strategies for further evaluation or development. ▪ Meeting w/ municipal and neighbourhood representatives to discuss feasibility and next steps for any proposed neighbourhood-related strategies.	OD, RR, FM, AR, SC, ST, ME, LA, SU, AC, CM, CE, CS, PL OD, AR, MU, NR, EM, AD
Design Development	▪ Minimum of two team meetings to review development of adaptation, mitigation, & sustainability strategies, costs, potential adjustments, and peer review comments. ▪ Follow up meeting(s) related to neighbourhood strategies. ▪ Onboarding meeting for new project team members.	OD, RR, FM, AR, SC, ST, ME, LA, SU, AC, CM, CE, (SBs) OD, AR, NR, EM, AD New team members
Construction Documents	▪ Minimum bi-monthly team meeting to review development of adaptation, mitigation, & sustainability strategies, costs and potential adjustments. ▪ Onboarding meeting for new project team members.	OD, FM, AR, SC, ST, ME, LA, SU, AC, CM, CE, CX, (SBs). New team members
Project Construction	▪ Onboarding meeting for new construction team members. ▪ Dedicated IBAMA time slot at regular construction meetings.	New team members CM, SBs, OD, AR, SC, ST, ME, LA, CX, others if needed.
As-built/ Occupancy	▪ Integrated team project walkthrough to review as-built adaptation, mitigation and sustainability strategies. ▪ Integrated team meeting with management and resident representatives to review as-built strategies and associated operating requirements.	OD, FM, RR, CX, AR, SC, ST, ME, LA, SU, AC, CM
Post-Occupancy	▪ Integrated team meeting to review one-year post-occupancy adaptive mitigation "Commissioning" report.	OD, FM, RR, CX, AR, SC, ST, ME, LA, SU, AC, CM

Key Deliverables per Project Phase

The table below summarizes the main recommended deliverables at each phase. These can be adjusted according to the project's level of complexity, budget, and schedule. However, a first iteration of Sections 1-9 should be completed by the Pre-Design phase. Additional deliverables and details are listed subsequent sections of the IBAMA Reference Guide.

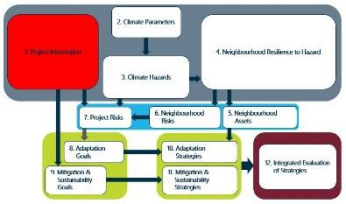
Project Phase	Deliverable
Feasibility & Financing	▪ Preliminary high-level climate hazard assessment. ▪ Budget with allocation for additional consultant fees. ▪ Initial budget that accounts for potential climate mitigation & adaptation measures, including potential value creation assessment.
Pre-Design	▪ List of integrated team members and auxiliary contacts. ▪ Completed sections 1-9 of the IBAMA framework tool. ▪ Summary report of key climate hazards, risks & assets, adaptation goals, and mitigation/sustainability goals.
Schematic Design	▪ Updated sections 1-9 of the IBAMA framework tool. ▪ Completed sections 10-13 of the IBAMA framework tool. ▪ Strategy evaluation report describing adaptation, mitigation and sustainability strategy alternatives with associated scores, and selected strategies. ▪ Preliminary cost estimate of selected strategies. ▪ Updated report of key climate hazards, risks & assets, adaptation, mitigation and sustainability goals.
Design Development	▪ Updated IBAMA framework tool with modifications noted. ▪ Development of technical strategies in drawings and specifications. ▪ Peer-review report of strategies to confirm alignment with initial adaptation and mitigation/sustainability goals, as well as recommended adjustments. ▪ Updated report of key climate hazards, risks & assets, adaptation, mitigation and sustainability goals; selected strategies and scores, explaining synergies and conflicts. ▪ Updated cost estimate of selected strategies.
Construction Documents	▪ Further development of technical strategies in drawings and specifications. ▪ Updated cost estimate of selected strategies. ▪ Updated report of key climate hazards, risks & assets, adaptation, mitigation and sustainability goals; selected strategies and scores, explaining synergies and conflicts.
Project Construction	▪ Contact list of design & construction leads responsible for IBAMA strategies. ▪ Ongoing construction meeting agenda item for IBAMA strategies in meeting minutes. ▪ Monthly IBAMA-related construction report by general contractor. ▪ Schedule of IBAMA-related site visits with IBAMA design & construction leads. ▪ IBAMA site visit reports by IBAMA design & construction leads.
As-built/ Occupancy	▪ Summary of adaptation, mitigation and sustainability goals, as well as strategies. ▪ Manual and/or training video for building managers and operators focusing on proposed strategies and related hazards. ▪ Contact list of project team, municipality, utility & other representatives.
Post-Occupancy	▪ Resident education video for hazard preparedness, mitigation and sustainability best practices. ▪ Schedule of hazard preparedness drills coordinated with municipality. ▪ Schedule for testing and inspections of adaptation, mitigation and sustainability-related systems. ▪ Adaptive mitigation commissioning report following first year of occupancy.

Glossary of Terms

Avoided Costs or Losses	Hazard-related economic costs losses that were avoided due to specific adaptation or resilience measures.
Cascading Impacts	The secondary impacts or hazards following an initial natural or climate hazard event. Examples include power outages due to wildfires, heavy rain causing landslides, reduced road and transportation access after flooding, or supply chain interruptions following an earthquake.
Climate Adaptation	A gradual process of maintaining points of resilience to climate change that ultimately results in a future state of being.
Climate Analog	Climate-analog mapping involves matching the expected future climate at a location with the current climate of another, potentially familiar, location - thereby providing a more relatable, place-based assessment of climate change.
Climate Hazard	Agent of disaster for human settlements or to the environment. Includes wildfires, tropical cyclones, thunderstorms, tornadoes, drought, flooding, rain, hail, snow, lightning, fog, wind, temperature extremes, air pollution, and climatic change.
Climate Mitigation	Reducing of net greenhouse gas (GHG) emissions to decrease global warming.
Climate Resilience	The capacity of a building or community to absorb external climate stresses; retain function; reduce risk; and enable people, organizations, and systems to persist.
Co-benefit	Benefit(s) of a mitigation and/or adaptation strategy that contributes to additional project or community goals.
Compounding Hazards *(Synonyms: compounding processes, compounding events)*	The effects of multiple natural or climate hazard events occurring concurrently or at around the same time. Examples include wildfires occurring during periods of extreme heat and drought, with ensuing poor air quality. A compounding hazard can also include the same hazard occurring multiple times within a short period, such as multiple heavy rainfalls over consecutive days.
Conflict	Adaptation action that has negative consequences for mitigation, or vice-versa.
Effectiveness	The degree to which a strategy is effective at reducing risk or GHG emissions. For example, an extensive green roof may have low effectiveness at reducing stormwater runoff while an intensive green roof may have moderate effectiveness.
Embodied GHG Emissions *(or Embodied Carbon)*	The total impact of all the greenhouse gases emitted by the materials and construction of a building. This includes the impacts of sourcing raw materials, manufacturing, transportation, wastage, maintenance, repairs, and disposal or recovery.
Equity	A concept concerned with the fair and equitable provision, implementation, and impact of services, programs, and policies for all community members.

Hazard *(See Climate Hazard)*	The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources. In this document, the term hazard typically refers to climate-related physical events, or trends, or their physical impacts. (Intergovernmental Panel on Climate Change, 2014. Annex II Glossary, in *Climate Change 2014: Impacts, Adaptation, and Vulnerability).*
Hazard Mitigation	Measures that aim to lessen physical damage to natural and built environments during and after hazard events, and also reduce impacts on the social and economic networks of a community.
Independence from external systems/services	The degree to which a strategy is reliant on the functioning of an externally provided system or service such as an electric utility, municipal transportation service, or community centre.
Indirect Costs or Benefits	Hazard-related costs or benefits that are not borne by or directed to the project owner or developer, but by or to entities external to the project such as municipalities or health services.
Maladaptation	Reducing short-term risk at the expense of long-term vulnerability, or increasing the vulnerability of other systems, sectors or social groups over any time horizon.
Multi-hazard *(or Multi-hazard Approach)*	An approach that considers more than one hazard in a given place and the interrelations between these hazards, including their simultaneous or cumulative occurrence and their potential interactions.
Net-Zero Building *(or Zero Carbon)*	A highly energy efficient building that produces onsite, or procures, carbon-free renewable energy or high-quality carbon offsets to offset the annual carbon emissions associated with building operations, and sometimes materials.
Opportunity Costs	The economic benefits that are missed when selecting one strategy over another.
Reliability/Functionality	The degree to which a strategy can reliably function in order to achieve the desired goal. For example, having residents opening windows for natural ventilation to reduce artificial cooling is not a highly reliable strategy, whereas automated shutoff of cooling systems below a specific temperature may be a more reliable strategy.
Representative Concentration Pathways (RCPs)	Greenhouse concentration (not emissions) trajectories adopted by the Intergovernmental Panel on Climate Change (IPCC). Four pathways were used for climate modeling and research for the IPCC fifth Assessment Report (AR5) in 2014. The pathways describe different climate futures, all of which are considered possible depending on the volume of greenhouse gases (GHG) emitted in the years to come. The original RCP scenarios are RCP2.6, RCP4.5, RCP6, and RCP8.5. Additional RCP scenarios have been developed since AR5.
Resilience Dividend	The difference in the outcomes between a scenario with a resilience approach and one with a non-resilient business-as-usual approach. It quantifies both the direct returns to the immediate resilience goal, as well as the societal and financial co-benefits. (Rodin, J., 2017, *Valuing the Resilience Dividend*). These can include value-added to the project and regenerative potential.
Risk	The possibility of injury, loss, damage or negative environmental impact created by a hazard. Risk is a function of the probability and severity of a hazard event, exposure to the hazard, and the vulnerability of the people or physical assets exposed.

Sustainability	• Meeting present needs without compromising ability of future generations to meet their needs. • Increasing quality of life with respect to environmental, social and economic considerations, both in present and future generations.
Synergy	Interaction between adaptation and mitigation strategies when the combined effect of the strategies is equally or more beneficial than the effects of the individual strategies.
Trade-off	Action that balances mitigation and adaptation when it is not possible to fully carry out both objectives.
Vulnerability	The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.



Section 1 - Project Information

Description

This section outlines what general project information is required for the IBAMA analysis. This information forms the basis for making informed decisions throughout the project regarding potential mitigation and adaptation strategies.

Parameters

1a. General Information

Parameter	Notes	Completed by
List the name, title or information for each of the parameters below. i. Name ii. Address iii. Owner iv. Operator v. Funder vi. Neighbourhood - *align with municipal/census information* vii. Municipality viii. Region ix. Indigenous Territory & Stakeholders x. Local Ecological Knowledge (LEK)	Some data may not be available at the neighborhood scale, only at the municipal level. Wherever possible, reference municipal level information.	OD
List the names of all relevant utility providers, contact person if available, and any specific details pertaining to utility service. xi. Utility Providers • Electricity • Water • Sewer • Phone • Internet/Cable • Gas • Other *(specify)*		OD
Describe the project typology in sufficient detail (e.g. low income assisted living, transitional housing for single mothers, market rate condos, etc.) xii. Typology		OD
List anticipated project budget & schedule. Includes all hard (construction) and soft (permits, design fees, land) costs related to design and construction. xiii. Project budget – total xiv. Project schedule & milestones	Include all anticipated project costs related to design & construction. Include all schedule milestones.	OD, CE
Describe the overall project's purpose and guiding principles. xv. Project's purpose and guiding principles	Similar to a mission statement.	OD, RR

1b. Project Program and Requirements

Parameter	Notes	Completed by
Reference or append existing documents or provide a breakdown of the program and project requirements per the list below. i. Project program • List of unit types and counts • List of amenity areas • List of service areas • Retail areas if applicable • Parking requirements • List of site/outdoor areas • Area breakdown of all spaces *(m^2 or ft^2)* • Space efficiency requirements • Other program requirements ii. Owner's project requirements (OPR) • Mechanical, electrical, plumbing, security, and other technical requirements • Building performance requirements • Operations & Maintenance criteria • Occupant comfort requirements • Other requirements	See *Additional Resources – Project Program and Requirements* for guidance on project programs and Owner's project requirements.	OD, RR, AR OD, RR, FM
List estimated costs and budgets. iii. Soft project costs *(consultant fees, permits, land costs, etc.)* iv. Construction budget (project budget minus soft costs) v. Annual operations budget *(staff, energy costs, etc.)* vi. Estimated costs associated with IBAMA process vii. Anticipated value to be added from adaptation, mitigation & sustainability measures.		OD, CE, CM, FM
List all applicable codes and regulations, including reference year. viii. Applicable building codes & regulations • Building code • Energy code • Fire code • Plumbing Code • Building by-laws • Zoning regulations • Official Community Plan (OCP) • Neighbourhood regulations • Other regulations	Note any codes and regulations that may potentially impact mitigation and/or adaptation strategies	AR, SC, ST, ME, LA, PL

1c. Location, Site and Building Features

Parameter	Notes	Completed by
Describe all relevant site and infrastructure features. Append a site analysis drawing that includes information listed. i. Site Features • Soil & topographical conditions • Water bodies and watershed • Landscape features • Adjacencies *(Neighbouring buildings, features)* • On-site food cultivation opportunities • Contamination and remediation needs • Air and noise quality ii. Infrastructure • Location of utilities serving the site • Roads, sidewalks and access • Transportation *(bus, rail, bicycle, etc.)*	Cross reference information compiled in this section to findings from Section 4 - Neighbourhood Resilience.	AR, SC, LA
Describe desired building features. iii. Building Design Features • Materials • Structural systems • Mechanical systems • Landscape features • Other *(social, age-related, services, amenities)*	If unknown at early project stages, update as the project evolves.	OR, RR, AR, ST, ME, LA

1d. Anticipated Project Demographics

Parameter	Notes	Completed by
Describe the primary resident type in each category. If multiple types, list 'variable' or note all types. i. Primary age group *(adults, families, seniors, etc.)* ii. Dominant family type *(singles, couples, families, variable)* iii. Income *(low, middle, high income)* iv. Other demographics *(e.g. LGBTQ+, domestic violence, etc.)*	Estimate initial information as best as possible, and update as the project evolves. See *Additional Resources – Project Demographics*	RR, FM
List estimated percentages of project residents. v. Indigenous and ethno-racial vi. Official language speakers vii. Disability *(indicate percentages and types of disabilities)*		RR, FM
Identify anticipated general level of health of residents. viii. Health *(poor, moderate, good, excellent)*	Consult local health authority and see *Additional Resources – Project Demographics*	RR, FM, HA
Rank as High, Medium or Low. ix. Ratio of management and operations staff to residents x. Capacity level of management and operations staff	Capacity: knowledge and ability to manage more complex systems.	OD, FM

Reference Standards

British Columbia, BC Building Code
http://free.bcpublications.ca/civix/content/public/bcbc2018/?xsl=/templates/browse.xsl

British Columbia, BC Energy Step Code - https://energystepcode.ca/

British Columbia, BC Fire Code - http://free.bcpublications.ca/civix/content/public/bcfc2018/?xsl=/templates/browse.xsl

British Columbia, BC Plumbing Code
http://free.bcpublications.ca/civix/content/public/bcpc2018/?xsl=/templates/browse.xsl

BC Housing, Design Guidelines & Construction Standards
https://www.bchousing.org/publications/BCH-Design-Guidelines-Construction-Standards.pdf

City of Vancouver, Vancouver Building By-Law 2019
http://free.bcpublications.ca/civix/content/public/vbbl2019/?xsl=/templates/browse.xsl

Additional Resources

General Information

US Green Building Council, LEED v4.1 Building Design and Construction, IP Prerequisite: Integrative Project Planning and Design, - https://www.usgbc.org/leed/v41#bdc

Project Program and Requirements

ASHRAE, ASHRAE Headquarters Draft Owner's Project Requirements*
https://www.ashrae.org/File%20Library/About/New%20HQ/ASHRAE-OPR-attachment-to-Design-Services-RFP-signed.pdf

Building Green, Owner's Project Requirements: What It Is, What It Could Be*
https://www.buildinggreen.com/primer/owner-s-project-requirements-what-it-what-it-could-be

U.S. General Services Administration, Define Owner's Project Requirements with the Customer Agency*
https://www.gsa.gov/real-estate/design-construction/commissioning/commissioning-program/building-commissioning-process/planning-stage/define-owners-project-requirements-with-the-customer-agency

Whole Building Design Guide, Architectural Programming*
https://www.wbdg.org/design-disciplines/architectural-programming

Location, Site and Building Features

US Green Building Council, LEED v4.1 Building Design and Construction, SS Credit: Site Assessment*
https://www.usgbc.org/leed/v41#bdc

Project Demographics

BC Centre for Disease Control, BC Community Health Data
http://communityhealth.phsa.ca/HealthProfiles#panel-nha2019

Government of Ontario, Health Equity Impact Assessment (HEIA) - http://www.health.gov.on.ca/en/pro/programs/heia/

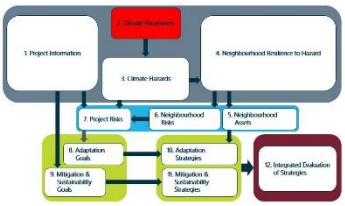
Statistics Canada, Census Profile, 2016 Census
https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E

* US or International Reference

Recommended Documentation and Deliverables

Note that some of the deliverables listed overlap with and/or are repeated in other sections.

Project Phase	Deliverable	Completed by
Feasibility & Financing	▪ Allocation for additional consultants/consultant fees, and quantify potential cost-benefits if possible	OD
	▪ General % budget allocation for adaptation, mitigation, & sustainability measures beyond standard requirements	OD, CE
	▪ List of municipal, neighbourhood, and utility representative contacts	OD
	▪ Develop Owner's Project Requirements (OPR)	OD, RR, FM
Pre-Design	▪ List of integrated team members and auxiliary contacts	OD
	▪ Develop project program	OD, RR, AR
	▪ Completed Section 1 of IBAMA framework	See 1a-1d
Schematic Design	▪ Updated Section 1 of IBAMA framework & updates to IBAMA summary report	See 1a-1d
	▪ Update to project budget based on preliminary cost estimate of selected strategies	CE
	▪ Code and regulatory review report of selected strategies	AR, SC, ST, ME, LA, PL
Design Development	▪ Updated Section 1 of IBAMA framework & updates to IBAMA summary report	See 1a-1d
	▪ Update to project budget based on updated cost estimate of revised strategies	CE
	▪ Updates to code and regulatory review of revised strategies	AR, SC, ST, ME, LA, PL
Construction Documents	▪ Updated Section 1 of IBAMA framework & updates to IBAMA summary report	See 1a-1d
	▪ Update to project budget based on updated cost estimates	CE
	▪ Updates to code and regulatory review of revised strategies	AR, SC, ST, ME, LA, PL
Project Construction	▪ Contact list of design & construction leads responsible for IBAMA strategies	CM
	▪ Monthly updates to Section 1 of IBAMA framework based on construction changes	CM, AR, SC, ST, ME, LA
As-built/ Occupancy	▪ Updated project program and OPR based on as-built conditions	OD, AR, SC, ST, ME, LA
	▪ Updated operations budget	FM, RR
	▪ Updated demographic information with additional details for building management	RR, FM
	▪ Contact list of project team, municipal, health authority and utility representatives	OD, FM
Post-Occupancy	▪ One-year post-occupancy adaptive mitigation "Commissioning" report	AR, SC, ST, ME, LA, SU, AC
	▪ Ongoing updates of demographic information	FM, RR
	▪ Regular updates of contact list	FM
	▪ Regular updates of operations budget	FM, RR



Section 2 - Climate Information

Description

This section pertains to climate data that will inform climate hazards potentially impacting the project. Selecting a future climate scenario(s) based on climate change projections will help project teams design for future conditions. The goals in Section 2 are to target an official climate change scenario developed by the Intergovernmental Panel on Climate Change (IPCC), identify sources that translate the IPCC scenarios into locally applicable data, and link the anticipated lifespans of specific building systems to the appropriate reference year of the IPCC climate scenarios. Engaging a climate adaptation consultant or climate scientist to assist the design team is important. Considering current and past weather data along with multiple climate scenarios is also important, to ensure that systems are designed for peak hazard conditions.

The reasoning for linking system lifespans to IPCC scenario reference years is to reduce overdesign, embodied carbon and costs for systems that will be replaced before the end of a building's lifespan. When developing solutions, design teams still must be careful to consider the lifespan of related systems. For example, a chiller may have a 20-year lifespan while its support structure has a 100-year lifespan and should be engineered to accommodate a future larger chiller.

Parameters

2a. Climate Change Scenarios

Parameter	Notes	Completed by
Identify the IPCC Climate Scenarios and historical climate data to be used for the project. Reference official scenarios and climate data adopted by the municipality. If not available, reference official provincial or territorial information. i. IPCC climate scenarios *(RCP 8.5, 6.0, 4.5, or 2.6)* ii. Other climate data *(historical and/or current)* iii. Climate analog location *(see Glossary of Terms)*	Sufficiently granular data may be difficult to locate if the region or municipality has not created it. If not, consider hiring a climate scientist to help determine scenarios.	AC, CS

2b. Project and Systems Lifespans

Parameter	Notes	Completed by
Indicate anticipated lifespan (in five-year increments) prior to significant repair or replacement of the component or system. i. Building, Structure and Foundations ii. Enclosure – Exterior Walls iii. Enclosure – Roof iv. Enclosure – Windows v. Systems – HVAC vi. Systems – Electrical vii. Systems – Lighting viii. Systems – IT & Communications ix. Systems – Plumbing Distribution x. Systems – Plumbing Fixtures xi. Systems – Fire Protection xii. Systems – Vertical Transportation xiii. Site – Stormwater xiv. Site – Landscape and Paving xv. Other	Reference product literature, testing standards, specifications, depreciation reports of similar building types, and manufacturer warrantees. See *Additional Resources – Building System Lifespans*	Building & Structure: O, ST, SC Enclosure: AR Systems: ME, Elevator Consultant Site: SC, LA

The Architect, Engineers, Landscape Architect and Adaptation Consultant should to complete the table below in the IBAMA Excel tool. Use multiple copies of the table as needed. The top climate hazards identified in Section 3 should be used for the potential system lifespan interactions assessment in 2c. Hypothetical example inputs are indicated in grey.

1) *Link the anticipated system lifespan in 2b to the appropriate reference year for the selected IPCC Scenario in 2a.*
2) *Rank feasibility of retrofitting the system at end of its lifespan using a later climate scenario (Low, Medium, High). In other words, if the climate changes, how easily can the system be retrofitted to adapt to the new climate?*
3) *Using the hazards identified in Section 3, list potential system interactions and strategies to accommodate future climate retrofits. For example, an HVAC system with a 15-year lifespan would only need to be designed to a 2035 climate. However, sufficient space for equipment and distribution would be required to ensure future cooling requirements for 2050 and 2080.*
4) *Rank potential cost impacts of designing to the selected climate scenario, as well as preparing the current construction to be retrofit for later climate scenarios (Low, Medium, High).*

2c. Building Systems Linkages to Climate Change Scenarios *(see Appendix B for additional worksheets)*

Building Component/ System	System Lifespan	Related climate scenario and year	Retrofit feasibility for later climate	Potential system lifespan interactions *(In reference to each top hazard in Section 3)*	Potential cost impacts of designing to future climate
Building Structure and Foundations	100 yrs.	RCP 8.5 (2100)	N/A	Flood level/waterproofing for 2100	Medium
Enclosure – Exterior Walls	60 yrs.	RCP 8.5 (2080)	Medium	Design structural connections for exterior wall w/ 2100 projections.	Low
Enclosure – Roof	25 yrs.	RCP 8.5 (2050)	Medium	Design structure to consider 2100 loads, but roof membrane for 2050.	Medium
Enclosure - Windows	30 yrs.	RCP 8.5 (2050)	High	Framing around window to support future shading or additional panes.	Low
Systems – HVAC - Cooling	15 yrs.	RCP 8.5 (2050)	Medium	Ensure adequate space/ distribution to upgrade for future climate.	High
Systems – HVAC - Heating					
Systems – HVAC - Ventilation					
Systems – Electrical					
Systems – Lighting					
Systems – IT & Communications					
Systems – Plumbing Distribution					
Systems – Plumbing Fixtures					
Systems – Fire Protection					
Systems – Vertical Transportation					
Site – Stormwater					
Site – Landscape and Paving					
Other (describe)					
Other (describe)					

Reference Standards

BC Ministry of Environment, Indicators of Climate Change for British Columbia - 2016 Update
https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/reporting/envreportbc/archived-reports/climate-change/climatechangeindicators-13sept2016_final.pdf

Capital Region District, Climate Projections for the Capital Region - https://www.crd.bc.ca/docs/default-source/climate-action-pdf/reports/2017-07-17_climateprojectionsforthecapitalregion_final.pdf

Environment and Climate Change Canada, Computer Research Institute of Montréal, Ouranos, Pacific Climate Impacts Consortium, Prairie Climate Centre, HabitatSeven; Climatedata.ca - https://climatedata.ca/

Fraser Basin Council, Climate Projections for the BC Northeast Region
https://www.fraserbasin.bc.ca/_Library/CCAQ/fbc_ne_climatereport_web.pdf

Metro Vancouver, Climate Projections for Metro Vancouver - http://www.metrovancouver.org/services/air-quality/AirQualityPublications/ClimateProjectionsForMetroVancouver.pdf

Metro Vancouver, Study of the Impacts of Climate Change on Precipitation and Stormwater Management
http://www.metrovancouver.org/services/liquid-waste/LiquidWastePublications/TMs-GHD-StudyImpacts-ClimateChangePrecipitationStormwater-2018.pdf

Pacific Climate Impacts Consortium (PCIC), Climate Explorer
https://www.pacificclimate.org/analysis-tools/pcic-climate-explorer

Pacific Climate Impacts Consortium (PCIC), Future Shifted Weather Files
https://www.pacificclimate.org/data/weather-files

Additional Resources

Climate Change Scenarios

Government of Canada, Canadian Weather Year for Energy Calculation (CWEC)
https://climate.weather.gc.ca/prods_servs/engineering_e.html

Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5)*
https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf

Building and Systems Lifespans

ASHRAE, Equipment Life Expectancy chart*
https://www.naturalhandyman.com/iip/infhvac/ASHRAE_Chart_HVAC_Life_Expectancy.pdf

Building Owner's and Managers Association (BOMA), Preventive Maintenance Guidebook*
https://icap.sustainability.illinois.edu/files/projectupdate/2289/Project%20Lifespan%20Estimates.pdf

Carbon Leadership Forum, Recommended guidelines for building component lifespans in whole building life cycle assessment* - http://www.carbonleadershipforum.org/wp-content/uploads/2018/07/CLF_Recommendations_BuildingComponentLifespans_07-06-2018.pdf

New York City Mayor's Office of Recovery and Resiliency, NYC Climate Resiliency Design Guidelines, Version 4.0*
https://www1.nyc.gov/assets/orr/pdf/NYC_Climate_Resiliency_Design_Guidelines_v4-0.pdf

* US or International Reference

Case Study Example

Below is a hypothetical example of a building component assessment with respect to a future climate scenario in Vancouver.

Note: This hypothetical assessment is for illustrative purposes only. It is not representative of actual conditions and should not be substituted for an actual building component assessment completed by the appropriate experts.

Building Component/ System

Green Roof Assembly

Figure 4. Vancouver Olympic Village Green Roof (©Vitaroofs International Inc., Joy Schmidt, by permission)

Sub-System Lifespan, Related IPCC Scenario & Year

Sub-System	Lifespan	IPCC Scenario & Year	References
Roof Structure	80 years	RCP 8.5 (2100)	BOMA Preventative Maintenance Guidebook
Insulation and waterproof membrane	20 years	RCP 8.5 (2040)	Hydrotech Membrane Corp.
Roof Pavers	50 years	RCP 8.5 (2080)	Hanover Architectural Products
Growing Medium & Plants	10 years	RCP 8.5 (2030)	Hydrotech Membrane Corp.
Irrigation System	20 years	RCP 8.5 (2040)	Netafim Irrigation Inc.

Top Climate Hazards (see Section 3)

Source: Climate Projections for Metro Vancouver, 2016

Climate Hazard	RCP 8.5 (2050)*	RCP 8.5 (2080)*	References
Increasing summer temperatures and heat waves	Summer Days >25C= 55 days	Summer Days >25C= 79 days	Climate Projections for Metro Vancouver
Summer droughts	Dry spell duration = 26 days	Dry spell duration = 29 days	Climate Projections for Metro Vancouver
Fall precipitation increases	5-day maximum precipitation = 178 mm	5-day maximum precipitation = 199 mm	Climate Projections for Metro Vancouver

**Data for the available RCP scenario year may not align with the system's estimated end-of-life. In this case, the project team should either interpolate data between RCP scenario years or choose the more stringent scenario.*

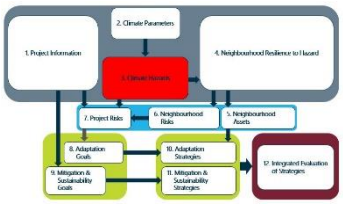
Sub-System Retrofit Feasibility, System Lifespan Interactions, Cost Impacts of Design for Future Climate

Sub-System	Retrofit feasibility for later climate	Potential system lifespan interactions	Potential cost impacts of designing to future climate
Roof Structure	N/A	Design for peak loads and green roof saturation thresholds using historical and RCP 8.5 2100 precipitation data.	Low
Insulation and waterproof membrane	High	Ensure parapet design/height can accommodate future slope adjustments for drainage and insulation thickness.	Low
Roof Pavers	High	Paver height to consider potential changes to plantings.	None to Low
Growing Medium & Plants	High	Coordinate to ensure replacement can occur independent of irrigation system.	N/A
Irrigation System	High	Design system considering climate up to 2040/2050. Ensure water delivery piping designed up to 2080 climate conditions.	Medium

Recommended Documentation and Deliverables

Note that some of the deliverables listed overlap with and/or are repeated in other sections.

Project Phase	Deliverable	Completed by
Feasibility & Financing	▪ Fee allocation for climate scientist or adaptation consultant ▪ Identify climate scenarios and other climate data to include in preliminary climate risk assessment ▪ Include expected project and main systems lifespans in Owner's Project Requirements	OD CS OD
Pre-Design	▪ Completed Section 2 of IBAMA framework	See 2a-2c
Schematic Design	▪ Updated Section 2 of IBAMA framework & updates to IBAMA summary report ▪ Update to system lifespan interaction comments in Section 2c based on selected strategies	See 2a-2c See 2c
Design Development	▪ Updated Section 2 of IBAMA framework & updates to IBAMA summary report ▪ Expanded system lifespan interaction report based on revised strategies This should include all components connected to the strategies proposed	See 2a-2c See 2c team
Construction Documents	▪ Updated Section 2 of IBAMA framework & updates to IBAMA summary report ▪ System lifespan interaction peer review. This should include all components connected to strategies proposed	See 2a-2c Peer Reviewer
Project Construction	▪ Site visit reports confirming systems built per interactions outlined in Section 2c	See 2c team
As-built/ Occupancy	▪ Final project report confirming systems built per interactions outlined in Section 2c ▪ Include climate thresholds and lifespan targets in systems manuals with explanation for facility managers	See 2c team
Post-Occupancy	▪ Draft deferred maintenance plan indicating climate thresholds and lifespan targets.	See 2c team



Section 3 – Climate Hazards

Description

This section assists project teams in identifying the top climate hazards using the scenarios that they have selected in Section 2. Using the IBAMA Excel document, teams will identify up to ten climate hazards, and due to potential cost limitations, expand upon a minimum of the top three of concern. In addition, at least one compounding hazard should be investigated. These are the hazards that require immediate action. The remaining six hazards should be reviewed to determine when and how they should be taken into consideration over the lifespan of the project. While not explicitly part of the IBAMA framework, teams may include hazards that are not climate-based such as earthquakes or tsunamis.

Parameters

3a. Hazard Scoring

Parameter	Notes	Completed by
Based on the climate scenarios selected in Section 2a, identify up to ten hazards that would likely occur during the lifespan of the project. Include at least one compounding hazard. For each hazard, use the worst-case scenario based on past, present and projected data. *Using the Excel tool, assess each hazard for the following factors:* *i.* IPCC Scenario & target year from Section 2 *(for climate hazards)* ii. Frequency of occurrence *(Ongoing, Multiple times/year, Annually, Every two years, Less often than every two years)* iii. Intensity/Severity *(Catastrophic, Major, Moderate, Minor, Insignificant)* iv. Anticipated duration of event and recovery to 90% function *(Years, Months, Weeks, Days, Hours or less)* v. Exposure of residents/asset to hazard *(High, Medium, Low)* vi. Affected Area *(Greater than regional, Regional Municipality, Neighbourhood, Project Site)* vii. Variability of hazard projections *(High, Medium, Low)* *Scores will be generated in the Excel tool for each hazard assessed.*	Use existing municipal, provincial or other official documentation to determine and evaluate key hazards. Use both projected and historical data. If this information is not available, defer to guidance provided by climate scientists and adaptation consultant. Hazards may vary locally or on a site-by-site basis as compared to municipal or regional information. See Glossary of Terms in Section 1 for definition of compounding hazards.	Led by AC & CS w/input from AR, MU, NR, UTs & others as needed

3b-e. Top Hazards *(see Appendix B for worksheets to assess additional hazards)*

Parameter	Notes	Completed by
Identify and describe the hazard with the highest score from Section 3a. i. Description of Hazard A	See Glossary of Terms in Section 1 for definition of cascading impacts.	Led by AC & CS w/input from AR, MU, NR, UT & others as needed
List the top three potential cascading impacts associated with Hazard A ii. Potential Cascading Impact iii. Potential Cascading Impact iv. Potential Cascading Impact		

Reference Standards

BC Ministry of Environment & Climate Change Strategy, Preliminary Strategic Risk Assessment for British Columbia https://www2.gov.bc.ca/assets/gov/environment/climate-change/adaptation/prelim-strat-climate-risk-assessment.pdf

FEMA, Threat and Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR) Guide, p.11* - https://www.fema.gov/media-library-data/1527613746699-fa31d9ade55988da1293192f1b18f4e3/CPG201Final20180525_508c.pdf

Public Infrastructure Engineering Vulnerability Committee (PIEVC) Engineering Protocol - https://pievc.ca/protocol

US Department of Heath and Human Services, Threat/Hazard Assessment Module (THAM)* https://www.phe.gov/Preparedness/planning/RISC/Documents/risc-tham-narrative.pdf

Additional Resources

Capital Region District, Climate Projections for the Capital Region - https://www.crd.bc.ca/docs/default-source/climate-action-pdf/reports/2017-07-17_climateprojectionsforthecapitalregion_final.pdf

City of Vancouver, Climate Change Adaptation Strategy, 2018 Update and Action Plan https://vancouver.ca/files/cov/climate-change-adaptation-strategy.pdf

City of Vancouver, Resilient Vancouver Strategy, p.38 - https://vancouver.ca/files/cov/resilient-vancouver-strategy.pdf

Di Napoli, C. et al., (2018), Assessing heat-related health risk in Europe via the Universal Thermal Climate Index (UTCI). *Int J Biometeorol* 62, 1155–1165* - https://doi.org/10.1007/s00484-018-1518-2

Emergency Management BC, Hazard Reference Guide for Local Authorities and First Nations https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/local-government/hrva/guides/hrva_hazard_reference_guide.pdf

U.S. Green Building Council, Assessment and Planning for Resilience* https://www.usgbc.org/credits/assessmentresilience?return=/pilotcredits/new-construction/v4

* US or International Reference

Case Study Example

Below is a hypothetical example of a climate hazard assessment for a new low-income residential building in a suburb of Victoria, BC. Residents are a combination of singles, families and seniors. The focus is primary on hazards that may directly impact the project, but local and regional hazards should be evaluated for potential secondary impacts to the project. Data used to determine hazard assumptions should be documented with appropriate references or citations.

Note: This hypothetical assessment is for illustrative purposes only. It is not necessarily representative of actual conditions or hazards and should not be substituted for an actual hazard assessment completed by the appropriate experts.

Climate & Hazard Data Sources

Climate Projections for the Capital Region, 2017
Preliminary Strategic Risk Assessment for British Columbia, 2019
Capital Regional District, Coastal Sea Level Rise Risk Assessment, 2015
BC Hydro Storm Report, 2019
BC Ministry of Energy & Mines, Relative Earthquake Hazard Map of Greater Victoria, 2000

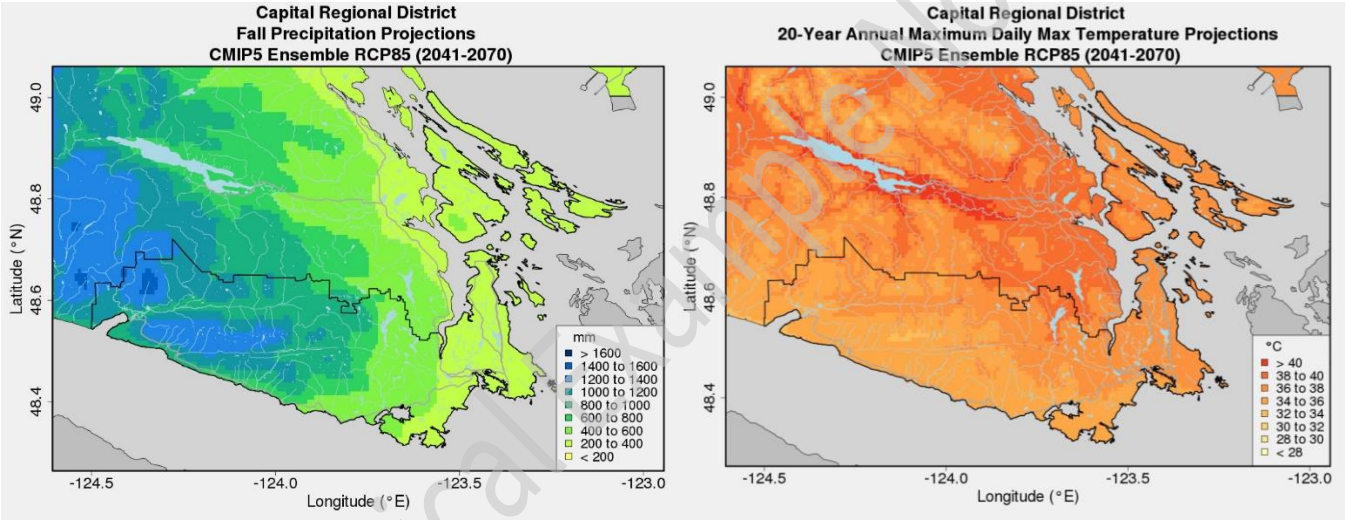


Figure 5. CRD - Fall Precipitation 2050s (RCP 8.5)

Figure 6. CRD – 1-in-20 Hottest Day 2050s (RCP 8.5)

(Images from © Capital Regional District. (2017). *Climate Projections for the Capital Region*. Retrieved from https://www.crd.bc.ca/about/data/climate-change. By permission from author.)

Figure 7. CRD – 2018 Windstorm Damage (©Robert Fraser via Victoria Buzz, by permission)

3a. Hazard Scoring

	Hazard 1	Hazard 2	Hazard 3	Hazard 4	Hazard 5	Compounding Hazards	Compounding Hazards
Hazard Name & Description	Category 7 or Higher Earthquake*	Severe Windstorm	Heatwave	Increasing Autumn Precipitation	Tsunami*	Summer drought + high water demand from heat waves	Heat waves+ drought+ wildfires= Poor Air Quality
IPCC Scenario & target year	n/a	RCP 8.5 2080	RCP 8.5 2080	RCP 8.5 2080	n/a	RCP 8.5 2080	RCP 8.5 2080
Frequency of occurrence	Less often than every two years	Less often than every two years	Multiple times/yr.	Every two years	Less often than every two years	Every two years	Every two years
Intensity/ Severity	Catastrophic	Major	Major	Moderate	Catastrophic	Moderate	Major
Anticipated Duration of Event & Recovery to 90% function	Years	Months	Days	Weeks	Years	Months	Weeks
Exposure of residents/asset to hazard	High	Medium	High	Medium	Low	Medium	High
Affected Area	Regional	Regional	Regional	Municipality	Regional	Greater than regional	Greater than regional
Variability of hazard projections	Low	Medium	Low	Medium	Low	Medium	Medium
Total Hazard Score	**22**	**19**	**20**	**17**	**17**	**20**	**22**

3b. Top Hazard A

Parameter	Additional Notes	Completed by
Identify and describe the hazard with the highest score from Section 3a. i. Category 7 earthquake* or higher – Score 22	Other cascading impacts. Consult with municipal resilience officer for further information.	
List the top three potential cascading impacts associated with Hazard A. ii. Power outages iii. Supply chain interruptions iv. Transportation disruption		

**While IBAMA is conceived for climate hazards, project teams may choose to use it for geophysical hazards for preliminary analysis.*

3b. Top Hazard B

Parameter	Additional Notes	Completed by
Identify and describe the hazard with the second highest score from Section 3a. i. Heatwave – Score 20	# of days >25C and temperatures will increase over time. Important to also consider how humidity and the urban health island effect could exacerbate the impact of heatwaves beyond dry bulb temperatures.	
List the top three potential cascading impacts associated with Hazard B. ii. Increase in mortality & morbidity will stress health services capacities. iii. Power interruptions if high electricity demand for cooling or stress to power infrastructure. iv. Potential stress on water supply due to increased demand.		

3c. Top Hazard C (Compounding Hazards)

Parameter	Additional Notes	Completed by
Identify and describe the hazard with the third highest score from Section 3a. i. Summer drought + high water demand – Score 20	Increasing in severity between the present and 2050.	
List the top three potential cascading impacts associated with Hazard C. ii. Increase in mortality & morbidity will stress health services capacities. iii. Reduction in local food availability/ Price increases. iv. Biodiversity loss.		

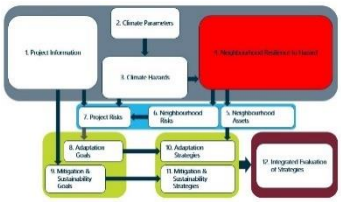
3d. Compounding Hazards

Parameter	Additional Notes	Completed by
Identify and describe the compounding hazards scenario with the highest score from Section 3a. Increasing summer temperatures + Seasonal drought + Major wildfire = Poor Air Quality - Score 22	Based on a combination of climate projections and historical data. Wind direction and rain are key variables.	
List the top three potential cascading impacts associated with the compounding hazards scenario. i. Increase in mortality & morbidity will stress health services capacities. ii. Power outages. iii. Impacts to water treatment & distribution services.		

Recommended Documentation and Deliverables

Note that some of the deliverables listed overlap with and/or are repeated in other sections.

Project Phase	Deliverable	Completed by
Feasibility & Financing	▪ Preliminary high-level climate hazard assessment – see Section 3a	CS
Pre-Design	▪ Completed Section 3 of IBAMA framework ▪ Include key climate hazards in IBAMA summary report	See 3a-3e
Schematic Design	▪ Updated Section 3 of IBAMA framework & updates to IBAMA summary report	See 3a-3e
Design Development	▪ Updated Section 3 of IBAMA framework & updates to IBAMA summary report ▪ Peer-review evaluation report to include cross-verification of hazard assessment with respect to proposed adaptation strategies, including initial list developed in Section 3a	See 3a-3e PR
Construction Documents	▪ Updated Section 3 of IBAMA framework & updates to IBAMA summary report	See 3a-3e
Project Construction	▪ Any updates to Section 3 of IBAMA framework based on evolving hazard information, events or government reports ▪ Inclusion of any relevant changes to hazard information in IBAMA-related construction reports	See 3a-3e AC, CM
As-built/ Occupancy	▪ Summary of hazards targeted, specifics goals and strategies employed to target hazards, and potential hazards or adaptation goals not addressed	AC, AR, SC, ST, ME, LA, FM
Post-Occupancy	▪ Include hazard information in resident education video	FM, AC



Section 4 - Neighbourhood Resilience to Hazards

Description

This section helps project teams identify the resilience of a project's immediate neighbourhood to the climate hazards identified in Section 3. Adaptation and resilience issues are multi-scalar and cannot be resolved exclusively at the building scale. Understanding the degree of neighbourhood resilience can help inform solutions, facilitating more cost-effective strategies and better allocation of resources. In addition, increasing the lines of communication between the project team and neighbourhood stakeholders will help foster long-term community resilience.

Obtaining the necessary information to effectively evaluate neighbourhood resilience may be challenging. It will require input from the municipality's adaptation planners and emergency managers, utility providers, local health authorities and social services. This may exceed the capacity of the project team or even the municipality. As such, teams are encouraged to complete the evaluation to the best of their abilities, taking a precautionary approach where information is lacking. To simplify the exercise, teams can choose to assess only the most essential neighbourhood parameters pertaining to the specific hazard being investigated.

Once an initial evaluation is done for the neighbourhood, the project team and municipality should consider sharing the information for use on other projects.

Parameters

Evaluation of neighbourhood resilience parameters can be subjective. In order to control for this, it would be best for the municipality to lead this process to ensure consistency across projects. If this is not possible, more than one stakeholder with the relevant expertise should evaluate each parameter to expose differences in perspectives.

4a. Infrastructure

Parameter	Notes	Completed by
For each infrastructure type, list key dependencies (i.e. water infrastructure requires power; public transit infrastructure requires fuel supply, etc.) *Estimate the resilience of each neighbourhood infrastructure type with respect to the top hazards identified in Section 3, taking into consideration key dependencies (i.e. water infrastructure resilience score is affected by the power infrastructure resilience score). If the degree of resilience is highly uncertain, indicate with a '?' and follow up with team members to determine next steps.* i. Stormwater infrastructure ii. Sanitation infrastructure iii. Road infrastructure iv. Public transportation infrastructure v. Other transportation infrastructure *(walking, cycling, etc.)* vi. Power infrastructure vii. Water infrastructure viii. Communications infrastructure	Resilience Scoring (1-5): 1 = Low resilience, 3 =Average resilience, 5 = High Resilience, ? = Uncertain, N/A = Not Applicable When determining resilience scores, consider factors such as: age, current physical condition, estimated original design criteria, service capacity, redundant design systems, maintenance schedules and budgets, past system events, system capacity with respect to future climate projections.	MU, NR, UT (all applicable), others as required

4b. Built Environment

Parameter	Notes	Completed by
Evaluate the resilience of each built environment parameter listed below with respect to the top hazards identified in Section 3. Scores may vary depending on type of hazard. For example, building density might be desirable for power outages, but less desirable for heat waves. If the degree of resilience is highly uncertain, indicate with a '?' and follow up with team members to determine next steps. i. Building density ii. % Project-adjacent buildings resilient to hazard iii. % Neighbourhood buildings resilient to hazard iv. Hotel rooms/capita v. Resilience & reliability of hotel rooms to hazard vi. Resilience & reliability of resilience hubs/shelters to hazard vii. Resilience of community facility buildings (e.g. schools, libraries, churches) to hazard	Resilience Scoring (1-5): 1 = Low resilience, 3 =Average resilience, 5 = High Resilience, ? = Unknown, N/A = Not Applicable When determining resilience scores, consider factors such as: age, physical condition, service capacity, systems redundancy, performance in past hazard events.	MU
Evaluate the proximity of the project with respect to each built environment neighbourhood parameter listed below. Consider each parameter with respect to the top hazards identified in Section 3. In some instances, proximity might not be desirable, in which case scores should inverted. viii. Proximity of project to neighborhood resilience hubs/shelters ix. Proximity of project to healthy & affordable food x. Proximity to hospitals/clinics xi. Proximity of project to banking services xii. Proximity of project to shopping centers xiii. Proximity of project to schools xiv. Proximity of project to libraries xv. Proximity of project to religious facilities xvi. Proximity of project to other community facilities	Scoring*(1-5): 1 = Very distant, 3 = Within 20 min. walk/1.5km, 5 = Very close/adjacent, N/A = Not Applicable **Invert scores if proximity is not a desirable trait to increase resilience to hazard*	PL or AR

4c. Natural Environment

Parameter	Notes	Completed by
Estimate the resilience of each natural environment parameter listed below with respect to the top hazards identified in Section 3. Scores may vary depending on type of hazard. For example, more green space could be a detriment in an area with high wildfire risk. If the degree of resilience is highly uncertain, indicate with a '?' and follow up with team members to determine next steps. i. Outdoor air quality ii. Water quality iii. % Open public space iv. % Green space v. % Land area at risk/exposure to hazard	Resilience Scoring (1-5): 1 = Low resilience, 3 =Average resilience, 5 = High Resilience, ? = Unknown, N/A = Not Applicable When determining resilience scores for air and water quality, consider existing government indicators and historical data from past events.	MU

4d. Transportation

Parameter	Notes	Completed by
Estimate the resilience of each transportation parameter listed below with respect to the top hazards identified in Section 3. Scores may vary depending on type of hazard (i.e. flooding is likely to result in low public transportation resilience, whereas heat waves may minimally impact service). If the degree of resilience is highly uncertain, indicate with a '?' and follow up with team members to determine next steps. i. Frequency of bus service ii. Frequency of subway/train service iii. Bicycle network iv. Walkability v. Points of access/entry to neighborhood	Resilience Scoring (1-5): 1 = Low resilience, 3 =Average resilience, 5 = High Resilience, ? = Unknown, N/A = Not Applicable When determining resilience scores for transportation, consider resources such as LEED v4.1 LT Credit: Access to Quality Transit, LEED v4 ND NPD Credit: Connected and Open Community, Walk Score®, and Bike Score®.	MU or PL

4e. Community Governance, Services, and Health

Parameter	Notes	Completed by
Evaluate the resilience of each community governance, services and health parameter listed below with respect to the top hazards identified in Section 3. Scores may vary depending on type of hazard. If the degree of resilience is highly uncertain, indicate with a '?' and follow up with team members to determine next steps. i. Community resilience & emergency plan ii. Level of emergency preparedness to hazard iii. Resilience & hazard-related staff capacity iv. Emergency management & resilience staff training v. City budget for resilience & emergency management vi. Emergency management communications to residents vii. Map of hazard-related community assets	Resilience Scoring (1-5): 1 = Low resilience, 3 =Average resilience, 5 = High Resilience, ? = Unknown, N/A = Not Applicable When determining resilience scores for governance, meet with municipal resilience officers and emergency managers, and consult resources such as ICLEI Canada to assist with comparative references.	MU
viii. Number of voluntary and religious organizations ix. Hazard-related human resources within the community (e.g. firefighters, first aid responders, tradesperson, etc.) x. Density of police/fire stations xi. Density of fuel & charging stations xii. Quantity of commercial business & retail services xiii. Diversity of businesses & services	When determining resilience scores for services, higher quantities typically correlate (though not always) with higher levels resilience.	MU, NR
xiv. Available social services xv. Community health – available health practitioners/100,000 residents xvi. Community health - % of people with at least four people to confide in xvii. Community health - % of people with a somewhat strong or very strong perception of community belonging xviii. Community health – incidence rate of chronic & communicable disease/ 100,000 residents	Compare with provincial and federal averages to determine resilience scores.	HA

4f. Neighbourhood Demographics

Parameter	Notes	Completed by
Indicate the percentages of the following vulnerable populations. i. % under 14 ii. % over 65 iii. % who don't speak an official language iv. % Indigenous v. % ethno-racial vi. % immigrants vii. % single parent households viii. % single occupant residences ix. % with disability x. % without post-secondary certificate, diploma or degree xi. % homeless xii. % other demographics (gender, sexual orientation, etc.)	Reference municipal data, census data, or data from the local health authority.	MU, HA

4g. Economy

Parameter	Notes	Completed by
Indicate dollar amounts for the following economic parameter. i. Median annual household income	Reference municipal data or census data.	MU
Indicate percentages of the following economic parameters. ii. % households > 30% income on housing iii. % unemployed iv. % not in labour force v. % home ownership vi. % commute by vehicle		

Reference Standards

Public Infrastructure Engineering Vulnerability Committee (PIEVC) Engineering Protocol - https://pievc.ca/protocol

Additional Resources

City of Vancouver, Resilient Neighbourhoods Toolkit
https://vancouver.ca/people-programs/resilient-neighbourhoods-program.aspx

BC Centre for Disease Control, BC Community Health Data - http://communityhealth.phsa.ca/

British Columbia Environmental Protection & Sustainability, Air, Land & Water
https://www2.gov.bc.ca/gov/content/environment/air-land-water

ICLEI Canada, Adaptation Resources for Communities
https://icleicanada.org/resources/

Metro Vancouver, Health Impact Assessment of Transportation and Land Use Planning Activities
http://www.metrovancouver.org/services/regional-planning/PlanningPublications/HIA-Guidebook.pdf

NIST, Community Resilience Planning Guide for Buildings and Infrastructure Systems*
https://www.nist.gov/topics/community-resilience/planning-guide

Statistics Canada, 2016 Census - https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E

US Green Building Council, LEED v4.1 Building Design and Construction*
https://www.usgbc.org/leed/v41#bdc

US Green Building Council, LEED v4 for Neighborhood Development*
https://www.usgbc.org/resources/leed-v4-neighborhood-development-current-version

Vancouver Coastal Health, Community Health Profiles
http://www.vch.ca/public-health/healthy-communities-population-health/community-health-profiles

Vancouver Coastal Health, Social Connection and Health
http://www.vch.ca/Documents/MHMC-SocialConnections-Report.pdf

Walk Score, Walk Score®* - https://www.walkscore.com/

Walk Score, Bike Score®* - https://www.walkscore.com/bike-score-methodology.shtml

* US or International Reference

Case Study Example

Below is a hypothetical example of a neighbourhood resilience assessment for a new independent living facility for senior citizens in West Vancouver, BC. The resilience assessment is in reference to hypothetical heavy precipitation/ flash flooding. As noted in this example, data and assumptions used to determine the neighbourhood resilience scores should be documented with the appropriate references or citations, as well as noting the person completing each part of the assessment. Parameters highlighted in green are those that would be most essential to assess for a heavy precipitation/ flash flooding scenario and cascading impacts.

Note: This hypothetical assessment is for illustrative purposes only. It is not representative of actual conditions and should not be substituted for an actual neighbourhood resilience assessment completed by the appropriate experts.

Climate Scenario & Target Year

IPCC RCP 8.5 2050

Project Address & Neighbourhood

Confidential, West Vancouver

Hazard Referenced

Heavy precipitation/ flash flooding

Potential Cascading Impacts

Limited transportation access & access to essential goods and services; sewage backup; power outages/shutdowns; risk of electric shocks; natural gas shutdowns; communications shutdowns.

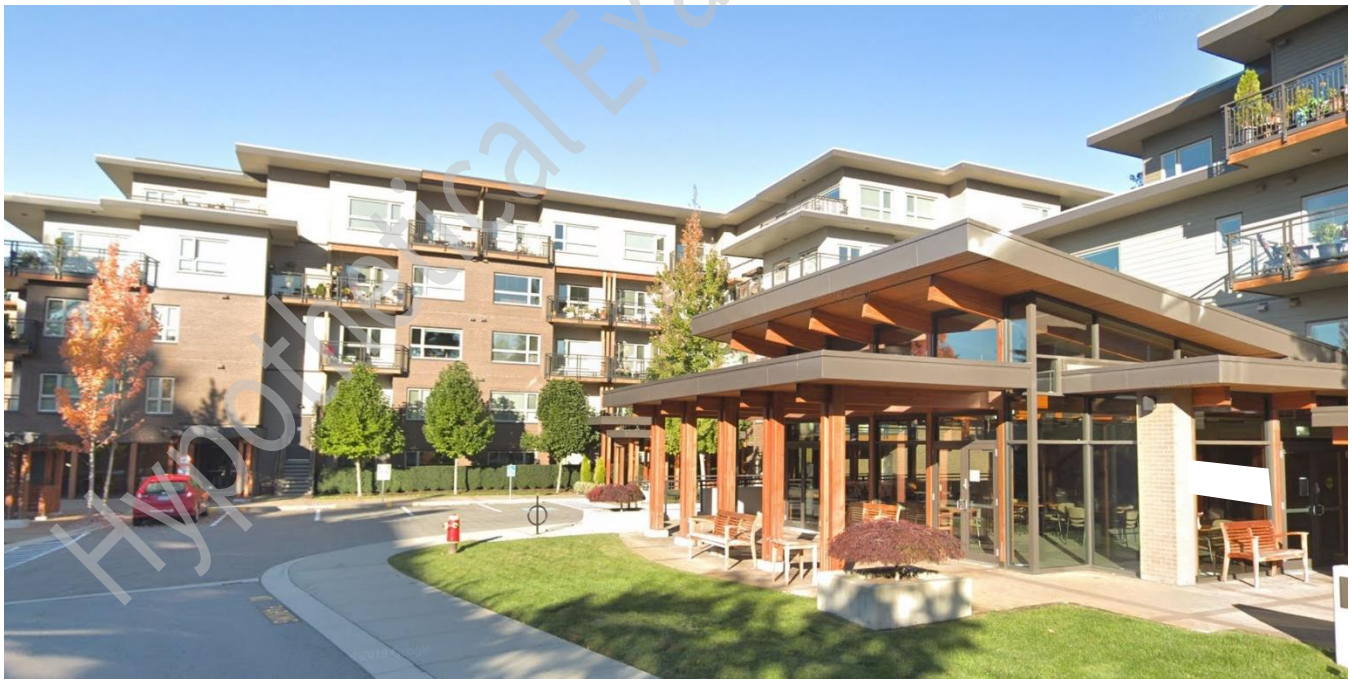


Figure 8. West Vancouver Assisted Living Facility Image Capture: Oct 2018 ©2019 Google

4a. Heavy Precipitation/Flash Flooding - Infrastructure

Parameter	Resilience Score	References/Citations	Notes	Completed by
Stormwater infrastructure	2	West Vancouver Stormwater Infrastructure Asset Management Plan	Increasing need for replacement and upgrades of storm mains and culverts between 2030-2050.	
Sanitation infrastructure	3	City of West Vancouver	Bi-weekly garbage collection; weekly collection of other materials. May be interrupted due to road conditions.	
Road infrastructure	2	City of West Vancouver	Several roads, especially E-W, likely unnavigable due to flooding.	
Public transportation infrastructure	2	Coast Mountain Bus Operations Team	Some routes likely impeded or interrupted due to flooding.	
Other transportation infrastructure	3	City of West Vancouver, Metro Vancouver	Boats and water vehicles may be able to assist with evacuation or transport of goods if main roads impeded.	
Power infrastructure	2	BC Hydro/ FortisBC	Power supply and/or gas may need to be shut off in some areas in a flood.	
Water infrastructure	4	West Vancouver Water Asset Management Plan	Water supply main upgrades in progress.	
Communications infrastructure	4	Telus/Bell/Shaw	Communications infrastructure has independent backup power.	

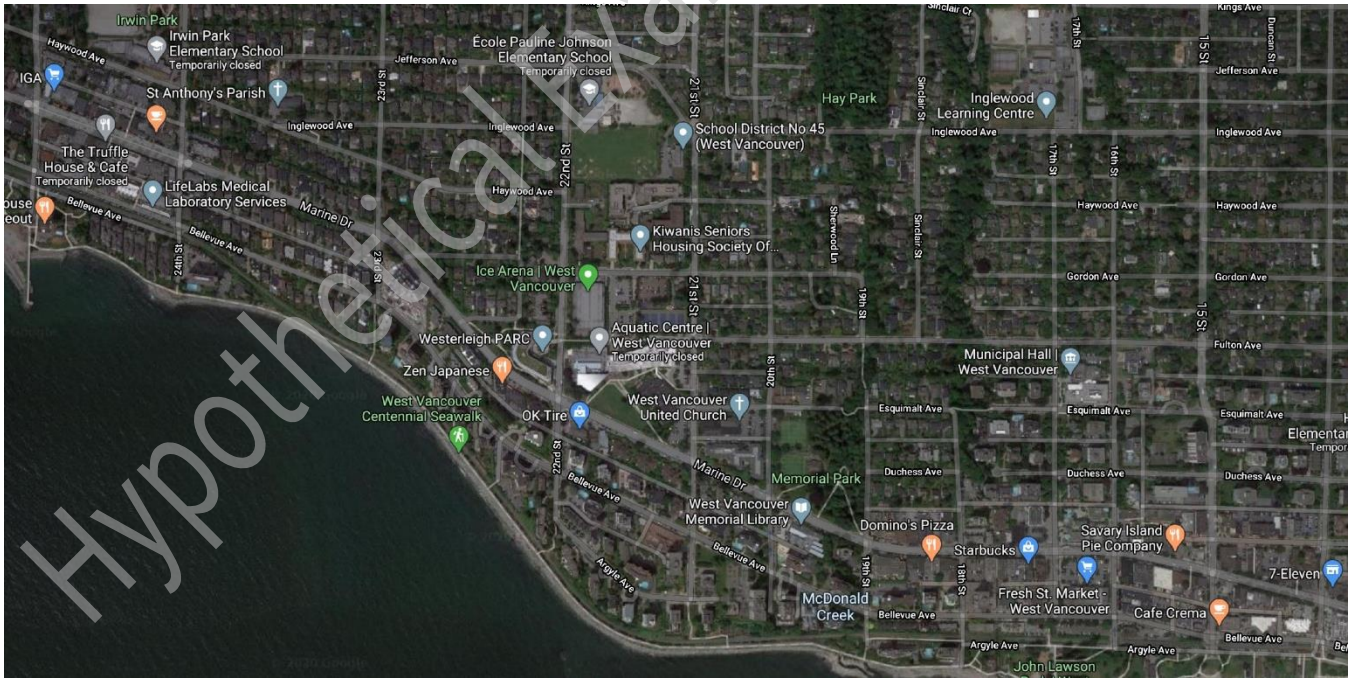


Figure 9. West Vancouver Neighbourhood Map

Imagery ©2019 Google, Imagery ©2019 CNES/Airbus, IMTCAN, Maxar Technologies, Map data ©2019

4b. Heavy Precipitation/Flash Flooding - Built Environment

Parameter	Resilience Score	References/ Citations	Notes	Completed by
Building density	4	https://westvancouver.ca/home-building-property/planning	Low-mid density and compactness facilitates relocation and evacuation.	
% Project-adjacent buildings resilient to hazard	2	City of West Vancouver	Many homes vulnerable to basement floods, some to ground floor flooding.	
% Neighbourhood buildings resilient to hazard	2		Many homes vulnerable to basement floods, some to ground floor flooding. Some public facilities better prepared.	
Hotel rooms/capita	1		Closest hotels in North Vancouver. A few B&Bs in West Vancouver.	
Resilience & Reliability of hotel rooms to hazard	1		Motel-style lodging in North Vancouver doesn't appear to be flood resilient.	
Resilience & reliability of resilience hubs/shelters to hazard	n/a		No neighbourhood resilience hub identified.	
Resilience of community facility buildings to hazard	2	City of West Vancouver	Most buildings not designed to address flooding though some are moving critical equipment from basements.	
Proximity to neighborhood resilience hubs/shelters	1	City of West Vancouver	No neighbourhood resilience hub currently identified by City of West Vancouver.	
Proximity to healthy & affordable food	3		Access to IGA, Loblaws and Whole Foods. 15-30+ min walk. Prices vary.	
Proximity to hospitals/clinics	3	https://medimap.ca/	No hospitals. Community Health Centre and clinics within 5-20 min walk.	
Proximity to banking services	4		15 min walk to multiple full-service bank branches.	
Proximity to shopping centres	3	https://www.shopparkroyal.com/	Park Royal Shopping Centre. Outdoor mall so temporary sheltering not viable.	
Proximity to schools	5	https://westvancouverschools.ca/ecole-pauline-johnson-elementary/	Pauline Johnson Elementary School. Elevated ground floor may provide some flood protection.	
Proximity to libraries	5	https://westvanlibrary.ca/	West Vancouver Memorial Library. Not flood resistant but upper level spaces available for temporary shelter.	
Proximity to religious facilities	5	https://www.ststephenschurch.ca/	St. Stephen's Anglican Church. Building not flood resistant but congregation provides community services.	
Proximity to other community facilities	5		Community centre, ice arena, aquatic centre, and seniors' activity centre are all adjacent to project.	

4c. Heavy Precipitation/Flash Flooding - Natural Environment

Parameter	Resilience Score	References/Citations	Notes	Completed by
Outdoor air quality	n/a			
Water quality	4	City of West Vancouver water quality reports.	Potential for stormwater overflow into buildings. Civil Engineer to verify potential impacts/risks for project.	
% Open public space	5		Large green open space areas near the project.	
% green space	4		Majority of dwellings have <50% site coverage, with much of the remaining site having green space for stormwater absorption.	
% Land area at risk/exposure to hazard	2		Higher grounds to the North increases neighbourhood vulnerability.	

4d. Heavy Precipitation/Flash Flooding - Transportation

Parameter	Resilience Score	References/Citations	Notes	Completed by
Frequency of bus service	?	https://westvancouver.ca/transportation-roads	Will depend on degree of flooding.	
Frequency of subway/train service	n/a		No train service in the area.	
Bicycle network	1		Will depend on the degree of flooding. Most seniors may not have capacity to cycle.	
Walkability	1	https://www.walkscore.com/score/187-28th-street-west-vancouver-central	Normally very walkable. Will depend on degree of flooding.	
Points of access/entry to neighborhood	3		Marine Drive & Highway 99 main thoroughfares for emergencies.	

4e. Heavy Precipitation/Flash Flooding - Community Governance, Services, and Health

Parameter	Resilience Score	References/Citations	Notes	Completed by
Community resilience & emergency plan	2	City of West Vancouver, North Shore Emergency Management	New plan in early stages of development.	
Level of emergency preparedness to hazard	3	North Shore Emergency Management		
Resilience & hazard-related staff capacity	4	City of West Vancouver, North Shore Emergency Management		
Emergency management & resilience staff training	3	City of West Vancouver, North Shore Emergency Management	Coastal Marine Management Plan working group as resource.	
City budget for resilience & emergency management	2	City of West Vancouver		
Emergency management communications to residents	3	City of West Vancouver	Monthly emails & updates to website. Working on phone data notifications.	
Map of hazard-related community assets	1		No map currently available.	
Community hazard-related human resources	?		Need to determine count of local tradespeople.	
Number of voluntary and religious organizations	3	City of West Vancouver	High number of organizations but need to be mobilized for hazard.	
Density of police/fire stations	3	https://westvancouver.ca/home-building-property/emergency-preparedness		
Density of fuel & charging stations	?		May become flooded	
Quantity of commercial business & retail services	4	West Vancouver Chamber of Commerce	Specific focus on essential services	
Diversity of businesses & services	4	West Vancouver Chamber of Commerce	Specific focus on essential services	
Social & community services	5	City of West Vancouver, Senior Manager of Community Services		
Available health practitioners	3	BC Community Health Profile – West Vancouver	Equal to BC Average.	
People to confide in	4	Vancouver Coastal Health, Social Connection and Health	8% higher than Metro Vancouver.	
Community belonging	5		18% higher than Metro Vancouver.	
Rate of chronic & communicable diseases	4	BC Community Health Profile – West Vancouver	25% lower than BC average.	

4f. Heavy Precipitation/Flash Flooding - Neighbourhood Demographics

Parameter	%	References/Citations	Notes	Completed by
% under 14	14%	Census Canada – 2016 Profile		
% over 65	28%		Significantly higher elderly population compared to Greater Vancouver Region.	
% who don't speak an official language	15%			
% Indigenous	0.6%			
% ethno-racial	36%			
% immigrants	45%			
% single parent households	14%			
% single occupant residences	27%			
% with disability	?		Need to connect with health & social services to identify disabled residents in the community.	
% without post-secondary certificate, diploma or degree	31.8%			
% homeless	See notes	2020 Homeless Count in Metro Vancouver – BC Non-Profit Housing Association	121 homeless people on North Shore.	

4g. Heavy Precipitation/Flash Flooding - Economy

Parameter	$ or %	References/Citations	Notes	Completed by
Median household income	$89,808	Census Canada – 2016 Profile	Higher income than Greater Vancouver Region.	
% households > 30% income on housing	31%			
% unemployed	5.5%			
% not in labour force	48%			
% home ownership	75%			
% commute by vehicle	80%			

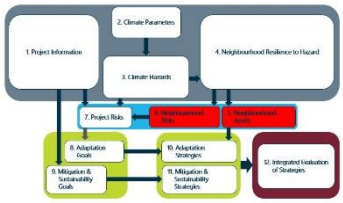
Key Assessment Conclusions

- Stormwater infrastructure is currently not sized to meet anticipated 2050 overland flooding levels.
- Further assessment of flood risk to road transportation infrastructure is required, as is flood risk to key essential services and businesses in the region. This will inform viable adaptation goals and strategies.
- Opportunity to investigate retrofits/upgrades to community facilities for use as temporary shelter or storage of essential supplies. Currently most facilities are not flood resilient.
- High percentage of elderly population can potentially overtax emergency, evacuation and medical services.

Recommended Documentation and Deliverables

Note that some of the deliverables listed overlap with and/or are repeated in other sections.

Project Phase	Deliverable	Completed by
Feasibility & Financing	▪ List of municipal, neighbourhood, health authority, infrastructure and utility representatives	OD
Pre-Design	▪ Completed Section 4 of IBAMA framework	See 4a-4g
Schematic Design	▪ Updated Section 4 of IBAMA framework ▪ Assessment report of any proposed neighbourhood-related strategies using Section 4 assessment	See 4a-4g PL, MU, NR, others as needed
Design Development	▪ Updated Section 4 of IBAMA framework ▪ Report on development of any proposed neighbourhood-related strategies	See 4a-4g PL, MU, NR, others as needed
Construction Documents	▪ Updated Section 4 of IBAMA framework ▪ Updated report on any proposed neighbourhood-related strategies	See 4a-4g PL, MU, NR, others as needed
Project Construction	▪ Updated contact list of municipal, neighbourhood, health authority, infrastructure and utility representatives ▪ Updated report on any proposed neighbourhood-related strategies	OD PL, MU, NR, others as needed
As-built/ Occupancy	▪ Final report on neighbourhood-related strategies for facility manager including updated and abbreviated Section 4 assessment	PL, MU, NR, others as needed
Post-Occupancy	▪ Regular updates to contact list of municipal, neighbourhood, health authority, infrastructure and utility representatives ▪ Annual check-in & report with municipal & neighbourhood representatives to review original neighbourhood assessment, strategies and adjustments	FM, RR OD, FM, RR



Sections 5 & 6 - Neighbourhood Assets and Risks

Description

Drawing from the information in Section 4, this section helps project teams identify potential neighbourhood assets and risks with respect to the top climate hazards identified in Section 3. These assets and risks will help inform adaptation and resilience strategies for the project. For example, if limited food access during a flood is a significant risk, then the project may allocate more space for non-perishable food storage. Conversely, if community facilities have the capacity to shelter vulnerable residents during a heat wave, the project may decide to forgo cooling within individual units.

Due to differences in risk perceptions, it is advisable to have multiple stakeholders involved in the assessment. If possible, this exercise should be done as part of an integrated team meeting with the local municipality. Once key neighbourhood assets have been defined, the project team and municipality should carry out any additional analysis required to confirm adequate resilience of the assets to the hazards identified. If there are neighbourhood resilience projects in process, municipal representatives should outline goals and anticipated timeframes. Similarly, the municipality should confirm the project team's assessment of neighbourhood risks and identify any additional risks.

Parameters

5. Neighbourhood Assets

Outline as many neighbourhood assets as relevant that may improve project resilience to each of the top hazards identified in Section 3. Use sufficient nuance and detail to enable project teams to consider the viability of neighbourhood assets as potential adaptation strategies for the project. When determining viability for the project, take into consideration that the asset will likely be needed for the larger community during and after the hazard.

Given that some assets may not be available throughout the full life expectancy of the project, clarify the duration that the asset may be available, or if the duration is uncertain. In addition, specify space, time and other limitations associated with the asset (e.g. community facility can accommodate 300 people as cooling centre during the daytime only). For neighbourhood resilience initiatives currently in process, specify goals and anticipated project completion.

5a. Neighbourhood assets for Hazard A

(see Appendix B for worksheets to outline assets for additional hazards)

Asset	Description of neighbourhood asset	Duration *(short, medium, long, ?)*	Space & time limitations	Completed by
Asset 1				OD, RR, AR, FM, AC, PL, MU, NR, others if needed (SC, ST, ME, LA, CS)
Asset 2				
Asset 3				

Asset	Description of neighbourhood asset	Duration *(short, medium, long, ?)*	Space & time limitations	Completed by
Asset 4				OD, RR, AR, FM, AC, PL, MU, NR, others if needed (SC, ST, ME, LA, CS)
Asset 5				
Asset 6				
Asset 7				
Asset 8				
Asset 9				
Asset 10				

6. Neighbourhood Vulnerabilities & Risks

Based on the neighbourhood resilience assessment in Section 4, identify neighbourhood risks that may impact the project with respect to each of the top hazards identified in Section 3. Neighbourhood risks are determined as a function of the hazard (probability, frequency, severity, exposure, etc.) and neighbourhood vulnerabilities. In describing the risks, use sufficient nuance and detail to enable project teams to develop effective project adaptation strategies. Take into consideration the lifespan of the project in the assessment.

Step 1. Based on the lowest resiliency scores in Section 4 (score of 3 or less), list at least ten neighbourhood vulnerabilities to each of the top hazards. In identifying vulnerabilities, reference only the Section 4 parameters relevant to the hazards. Rank the vulnerabilities from highest to lowest with respect to how they may directly or indirectly impact the project during and following the hazard event. When ranking vulnerabilities, identify first those that have the greatest impact on the health and safety of project occupants, followed by impacts to the building/ property, and lastly by other impacts, such as those on the community. Several vulnerabilities can be ranked equally (i.e. using the same number) if there is uncertainty.

Step 2. Based on the product of the vulnerability ranking and the individual hazard score from Section 3, identify a minimum of the five highest neighbourhood risks (highest scores) for each hazard, noting the estimated risk time frame. More risks can be included as deemed appropriate by the project team.

6a. Neighbourhood vulnerabilities & risks to Hazard A

(see Appendix B for worksheets to identify vulnerabilities and risks for additional hazards)

Neighbourhood Vulnerability to Hazard A	Vulnerability ranking *(from H=10 to L=1)*	Hazard A score *(Score from Section 3 divided by 10)*	Risk score & ranking *(Vulnerability x hazard score)*	Risk time frame *(immediate, medium or long-term)*	Completed by
1.					
2.					
3.					
4.					
5.					OD, RR, AR, FM, AC, PL, MU, NR, others if needed (SC, ST, ME, LA, CS)
6.					
7.					
8.					
9.					
10.					

Reference Standards

FEMA, Threat and Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR) Guide*
https://www.fema.gov/media-library-data/1527613746699-fa31d9ade55988da1293192f1b18f4e3/CPG201Final20180525_508c.pdf

Public Infrastructure Engineering Vulnerability Committee (PIEVC) Engineering Protocol - https://pievc.ca/protocol

US Department of Heath and Human Services, Threat/Hazard Assessment Module (THAM)*
https://www.phe.gov/Preparedness/planning/RISC/Documents/risc-tham-narrative.pdf

Additional Resources

Assistant Secretary for Preparedness and Response, Healthcare and Public Health Risk Assessment Toolkit*
https://www.phe.gov/Preparedness/planning/RISC/Pages/default.aspx

City of Vancouver, Climate Change Adaptation Strategy, 2018 Update and Action Plan
https://vancouver.ca/files/cov/climate-change-adaptation-strategy.pdf

City of Vancouver, Resilient Vancouver Strategy - https://vancouver.ca/files/cov/resilient-vancouver-strategy.pdf

Emergency Management BC, Hazard Reference Guide for Local Authorities and First Nations
https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/local-government/hrva/guides/hrva_hazard_reference_guide.pdf

ICLEI Canada, Changing Climate, Changing Communities - https://icleicanada.org/project/changing-climate-changing-communities-guide-and-workbook-for-municipal-climate-adaptation/

NIST, Community Resilience Planning Guide for Buildings and Infrastructure Systems*
https://www.nist.gov/topics/community-resilience/planning-guide

Preliminary Strategic Risk Assessment for British Columbia - https://www2.gov.bc.ca/assets/gov/environment/climate-change/adaptation/prelim-strat-climate-risk-assessment.pdf

Public Safety Canada, All Hazards Risk Assessment Methodology Guidelines
https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/ll-hzrds-ssssmnt/ll-hzrds-ssssmnt-eng.pdf

* US or International Reference

Case Study Example

Below is a hypothetical example of a neighbourhood assets and risks assessment for a new independent living facility for senior citizens in West Vancouver, BC. The assets and risk assessed are in reference to how a heavy precipitation/ flash flooding hazard may impact the neighbourhood and are based on hazard information and cascading impacts established in Section 3 and neighbourhood resilience assessment from Section 4.

Note: This hypothetical assessment is for illustrative purposes only. It is not representative of actual conditions, assets or risks, and should not be substituted for actual neighbourhood assets and risks assessment completed by the appropriate experts.

Climate Scenario & Target Year
IPCC RCP 8.5 2050

Project Address & Neighbourhood
Confidential, West Vancouver

Hazard Referenced
Heavy precipitation/ flash flooding

Potential Cascading Impacts
Limited access to transportation & essential goods and services; sewage backup; power outages/shutdowns, risk of electric shocks; natural gas shutdowns; communications shutdowns.

5a. Neighbourhood assets for Hazard A – Heavy Precipitation/ Flash Flooding

Asset	Description of neighbourhood asset	Duration	Space, time & other limitations	Completed by
Asset 1	High degree and frequency of emergency management communications with the community, including key seniors' organizations.	Unknown	Capacity of municipal emergency management and social services may vary over the life of the project depending upon financial and human resources and municipal priorities.	
Asset 2	Fairly high degree of municipal capacity to manage emergencies.	Unknown		
Asset 3	Robust social services for seniors.	Unknown		
Asset 4	Large green open space areas near the project. Potential to retrofit them to manage and divert increased stormwater.	Medium to Long	Cost and permitting associated with retrofitting spaces and infrastructure to manage additional stormwater.	
Asset 5	Nearby residential lots have >50% green space for stormwater absorption.	Medium	More detailed analysis required to determine potential absorption capacity.	
Asset 6	Project adjacent to multiple community organizations such as local school, library, community centre, church, aquatic centre, etc.	Medium to Long.	Most community buildings are not flood resilient and would require some retrofitting for use.	

6a. Neighbourhood vulnerabilities & risks to Hazard A – Heavy Precipitation/ Flash Flooding

Neighbourhood Vulnerability to Heavy Precipitation/Flash Flooding	Vulnerability ranking	Hazard score	Risk score & ranking	Risk time frame	Completed by
Aging stormwater infrastructure cannot accommodate near-term or projected peak precipitation levels.	11	2.0	**22**	Immediate to medium term	
Road transportation network vulnerable to flooding.	10		**20**	Medium to long term	
Aging power and gas infrastructure may require shutdown during event.	4		8	Immediate	
Higher elevation land to the north increases the neighbourhood's vulnerability to overland flooding.	12		**24**	Immediate	
The majority of buildings in the neighbourhood are not flood resilient to projected precipitation levels.	7		**14**	Medium-term	
Lack of shelter facilities within the community.	9		**18**	Medium-term	
No publicly designated community resilience hub to mobilize for flood event.	5		10	Immediate	
Most community facilities are not flood resilient to projected precipitation levels.	8		**16**	Medium-term	
A high percentage of elderly people within the community.	6		**12**	Immediate to medium term	
~15% of population does not speak English create emergency management communication challenges.	2		4	Immediate	
No updated municipal emergency management plan.	1		2	Immediate	
Very limited budget for municipal emergency management.	3		6	Immediate	

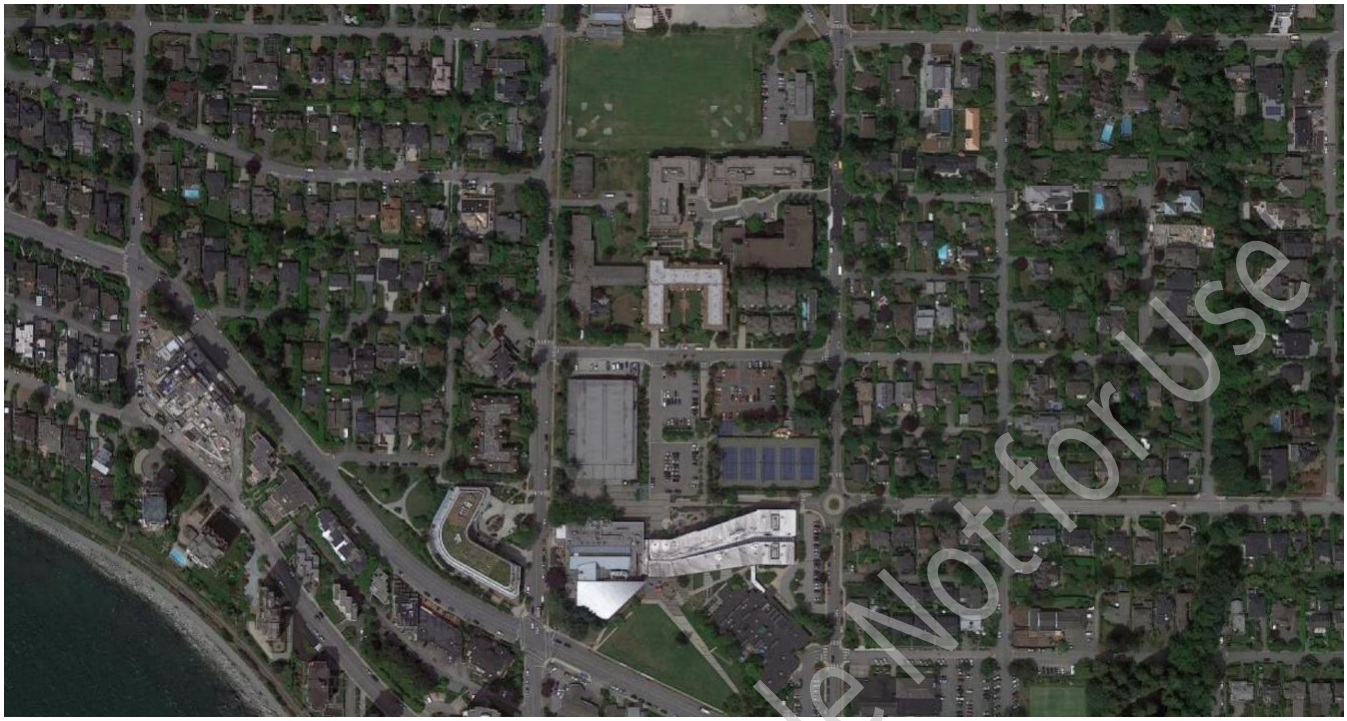


Figure 10. West Vancouver Immediate Neighbourhood Map
Imagery ©2019 Google, Imagery ©2019 CNES/Airbus, IMTCAN, Maxar Technologies, Map data ©2019

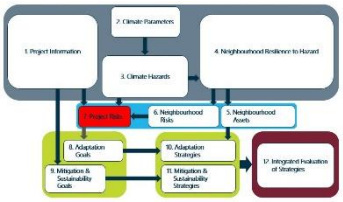
Assessment Notes & Follow-up

Risk	Description of neighbourhood risk	Comments & follow-up	Completed by
Risk 1	Higher elevation land to the north	Verify if additional water runoff modeling can be done to determine risk to project.	
Risk 2	Aging Stormwater Infrastructure	Currently planned upgrades anticipated to take five years. Need to confirm if designed for future peak precipitation projections.	
Risk 3	Vulnerable road infrastructure	Evacuation and delivery of goods and services to the facility may be challenging. Investigate evacuation scenario options.	
Risk 4	Lack of emergency shelter facilities within the community	Review long-term planning options with municipality.	
Risk 5	Most community facilities not flood resilient	Municipality to follow up with community facility managers to discuss potential cost-effective flood resilience strategies.	
Risk 6	Neighbourhood buildings not flood resilient	Increases overall community risk and will potentially overburden the capacity of municipal emergency services.	
Risk 7	High percentage of elderly within the community	Will make evacuation strategies more challenging.	

Recommended Documentation and Deliverables

Note that some of the deliverables listed overlap with and/or are repeated in other sections.

Project Phase	Deliverable	Completed by
Feasibility & Financing	▪ See Section 4	OD
Pre-Design	▪ Completed Sections 5 & 6 of IBAMA framework	See 5a-d/6a-d
Schematic Design	▪ Updated Sections 5 & 6 of IBAMA framework ▪ Assessment report of any proposed neighbourhood-related strategies using Section 5 & 6 assessments	See 5a-d/6a-d PL, MU, NR, others as needed
Design Development	▪ Updated Sections 5 & 6 of IBAMA framework ▪ Report on development of any proposed neighbourhood-related strategies using Section 5 & 6 assessments	See 5a-5/6a-d PL, MU, NR, others as needed
Construction Documents	▪ Updated Sections 5 & 6 of IBAMA framework ▪ Updated report on development of any proposed neighbourhood-related strategies	See 5a-5/6a-d PL, MU, NR, others as needed
Project Construction	▪ See Section 4 ▪ Updated report on development of any proposed neighbourhood-related strategies	OD PL, MU, NR, others as needed
As-built/ Occupancy	▪ Final report on neighbourhood-related strategies for facility manager including updated and abbreviated Section 5 & 6 assessments	PL, MU, NR, others as needed
Post-Occupancy	▪ Regular updates to contact list of municipal, neighbourhood, health authority, infrastructure and utility representatives ▪ Annual check-in & report with municipal & neighbourhood representatives to review original neighbourhood risk & assets assessment, and make adjustments as required	FM, RR OD, FM, RR



Section 7 - Project Risks

Description

Drawing from the neighbourhood assets and risks identified in Sections 5 & 6 and the general project information identified in Section 1, this section helps project teams identify vulnerabilities and potential risks to the project with respect to each of the climate hazards identified in Section 3. This will help inform adaptation and resilience strategies for the project. For example, if limited mobility increases residents' risks to heat waves, project teams may elect to provide an in-unit cooling solution instead of solely providing common area cooling.

Due to differences in risk perceptions, it is advisable to have multiple stakeholders involved in the assessment, including those who may not be part of the core project team, such as an equity consultant or an Indigenous Knowledge Holder. If possible, this exercise should be done as part of an integrated project team meeting. After an initial evaluation, project risks should be revisited and re-confirmed once adaptation goals are established in Section 8.

Parameters

7. Project Vulnerabilities & Risks

Considering each of the top hazards identified in Section 3, review the project information in Section 1 to identify project vulnerabilities. Project risks are determined as a function of the hazard (probability, frequency, severity, exposure, etc.) and project vulnerabilities. In addition, review the neighbourhood risks identified in Section 6 and consider if any should be included as critical project risks for the hazard in question. Take into consideration the lifespan of the project in the assessment.

Step 1. Using the information in Section 1, list at least ten project vulnerabilities to the hazard. Describe the vulnerabilities in sufficient detail to inform potential adaptation goals and strategies. Consider physical, social, operational and economic vulnerabilities over the project's lifespan.

Step 2. Rank the vulnerabilities from highest to lowest with respect to how they may directly or indirectly impact the project during and following the hazard event. When ranking vulnerabilities, identify those that would have the greatest impact on the health and safety of project occupants, followed by impacts to the building and property, and lastly by other types of impacts. If needed, several vulnerabilities can be ranked equally (i.e. using the same number).

Step 3. Based on the product of the vulnerability ranking and the individual hazard score from Section 3, identify at minimum, the five highest project risks (highest scores). Include any key neighbourhood risks of relevance. Given the use of future climate projections, note the estimated risk time frame.

Examples of risks:

- *An elderly population with low mobility would pose a high risk during a heat wave.*
- *A sloped site would increase the risk of structural destabilization from frequent overland flooding.*
- *Few community facilities with backup power could increase project risks during a long winter power outage.*

7a. Project vulnerabilities & risks to Hazard A

(see Appendix B for worksheets to outline vulnerabilities and risks for additional hazards)

Project Vulnerability to Hazard A *(list key neighbourhood risks if applicable)*	**Vulnerability ranking** *(from H=10 to L=1)*	**Hazard A score** *(Score from Section 3 divided by 10)*	**Risk score & ranking** *(Vulnerability x hazard score)*	**Risk time frame** *(immediate, medium or long-term)*	**Completed by**
1.					
2.					
3.					
4.					
5.					
6.					OD, RR, FM, AD, AR, others if needed
7.					
8.					
9.					
10.					
Neighbourhood risks (if applicable)					

Reference Standards

FEMA, Threat and Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR) Guide*
https://www.fema.gov/media-library-data/1527613746699-fa31d9ade55988da1293192f1b18f4e3/CPG201Final20180525_508c.pdf

Institute for Sustainable Infrastructure, Envision* – https://sustainableinfrastructure.org/envision/use-envision/

Public Infrastructure Engineering Vulnerability Committee (PIEVC) Engineering Protocol - https://pievc.ca/protocol

U.S. Green Building Council, Assessment and Planning for Resilience*
https://www.usgbc.org/credits/assessmentresilience?return=/pilotcredits/new-construction/v4

Additional Resources

Assistant Secretary for Preparedness and Response, Healthcare and Public Health Risk Assessment Toolkit*
https://www.phe.gov/Preparedness/planning/RISC/Pages/default.aspx

BC Housing, Mobilizing Building Adaptation and Resilience (MBAR) Design Discussion Primers
https://www.bchousing.org/research-centre/library/residential-design-construction/MBAR&sortType=sortByDate

Public Safety Canada, All Hazards Risk Assessment Methodology Guidelines
https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/ll-hzrds-ssssmnt/ll-hzrds-ssssmnt-eng.pdf

* US or International Reference

Case Study Example

Below is a hypothetical example of a project vulnerability and risk assessment for a new low-income residential building in a suburb of Victoria, BC. Residents are a combination of singles, families and seniors, including some with disabilities. The project risk assessment is in reference to a compounding hazards scenario of increasing summer temperatures combined with seasonal drought, and a nearby major wildfire that results in poor air quality.

Note: This hypothetical assessment is for illustrative purposes only. It is not representative of actual conditions or risks and should not be substituted for an actual project risk assessment completed by the appropriate experts.

Climate Scenario & Target Year

IPCC RCP 8.5 2050

Project Address & Neighbourhood

Confidential Address, Colwood

Hazard Referenced

Compounding Hazards: Increasing summer temperatures + seasonal drought+ major wildfire resulting in poor air quality.

Cascading Impacts

Power outages; impacts to water treatment and distribution; stress on health service capacities; supply chain stresses.

Figure 11. Low-Income Rental Residential Building, Colwood (Image courtesy of Cascadia Architects Inc., by permission.)

7d. Project vulnerabilities & risks to Compounding Hazards – Increasing summer temperatures + Seasonal drought + Major wildfire = Poor Air Quality

Project Vulnerability to Compounding Hazards	Vulnerability ranking	Compounding Hazards score	Risk score & ranking	Risk time frame	Completed by
15-20 % of residents have limited mobility and can't easily displace.	8	**2.4**	**19**	Immediate	
Low income residents w/ limited ability to pay for cooling.	5		**12**	Immediate	
Low number of building staff per resident limits management abilities.	3		7	Immediate	
Limited shading and trees on project site increases exposure to high heat.	2		5	Medium-term	
Small operating budget limits ability to pay high electricity bills.	6		**14**	Immediate	
Requirements for large asphalt parking, increasing heat exposure.	1		2	Medium-term	
Construction budget currently doesn't account for cooling systems.	7		**17**	Medium-term	
Neighbourhood Risk - Low walkability & public transit reduces ability to displace to temporary facilities.				Immediate	
Neighbourhood Risk – Few existing community facilities with adequate cooling & air filtration systems.				Immediate	

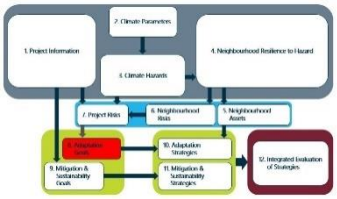
Assessment Notes & Follow-up

Risk	Description of project risk	Comments & follow-up	Completed by
Risk 1	Disabled residents at high risk to hazard.	May not be able to easily displace to community cooling centre w/ air filtration during hazard event.	
Risk 2	Construction budget doesn't account for cooling systems.	Using IBAMA process, determine if other solutions are possible, if and when cooling is necessary, and potential additional costs.	
Risk 3	Low operating budget – limits funds for common area cooling/filtration.	Assess potential common area electricity costs based on hazard frequency, duration and severity.	
Risk 4	Low income residents may limit cooling & filtration use.	Assess potential unit electricity costs based on hazard frequency, duration and severity.	
Risk 5	Few existing community facilities with adequate cooling & air filtration.	Identify existing community facilities with adequate systems and establish potential agreement to shelter high risk residents during a hazard event.	

Recommended Documentation and Deliverables

Note that some of the deliverables listed overlap with and/or are repeated in other sections.

Project Phase	Deliverable	Completed by
Feasibility & Financing	▪ Include a short list of potential project vulnerabilities when developing the Owner's project requirements	OD
Pre-Design	▪ Completed Section 7 of IBAMA framework	See 7a-d
Schematic Design	▪ Updated Section 7 of IBAMA framework ▪ Assessment report of any proposed adaptation strategies using Section 7 assessment	See 7a-d AR, AC, others as needed
Design Development	▪ Updated Section 7 of IBAMA framework ▪ Report on development of any proposed adaptation strategies ▪ Risk assessment review included in DD peer-review report	See 7a-d AR, AC, others as needed PR
Construction Documents	▪ Updated Section 7 of IBAMA framework ▪ Report on development of any proposed adaptation strategies	See 7a-d AR, AC, others as needed
Project Construction	▪ Report on development of any proposed adaptation strategies	AR, AC, others as needed
As-built/ Occupancy	▪ Include abbreviated project risk assessment in final report to facility manager.	AR, AC, others as needed
Post-Occupancy	▪ Annual check-in & report to review original project risks assessment and make adjustments as required	OD, FM, RR



Section 8 – Climate Adaptation Goals

Description

This section provides the opportunity for the project team to outline their climate adaptation goals based on the project information in Section 1 and the assets and risks identified in Sections 5, 6, & 7. Adaptation goals should be developed in concert with mitigation and sustainability goals to ensure as much alignment as possible. These goals will inform the adaptation, mitigation and sustainability strategies developed in Sections 10 & 11. The project team should review Section 8 & 9 goals as the project evolves and revise them if required.

Parameters

8. Climate Adaptation Goals

Selection of the appropriate adaptation goals should be as aspirational or as realistic as deemed appropriate by the owner, taking into account the project and neighbourhood information from Sections 1 and 4, and the assets and risks identified in Sections 5-7. Adaptation goals should be considered with respect to the project's overall purpose and principles, as outlined in Section 1.

Adaptation goals for residential buildings can be grouped into three main categories, which are often interrelated:

A. *Goals pertaining to occupants and building staff*
B. *Goals pertaining to protection of the asset/ property*
C. *Other goals (e.g. economic, neighbourhood/community, infrastructure)*

In order to make goals specific, measurable and possible to implement, goals should generally be structured as follows:

<u>Occupants/ Building Staff</u>

1. *Identify hazard(s) and associated risks for the target IPCC climate scenario and year.*
2. *Establish the criteria for the occupants' essential needs relevant to the risks. Essential needs include:*
   - *Thermal comfort criteria (temperature and humidity)*
   - *Air quality standards*
   - *Minimum power & communications*
   - *Minimum potable water & hot water*
   - *Basic food and nutritional requirements*
   - *Sanitary requirements (toilets, sinks, trash & recycling)*
   - *Access to medicine & medical devices*
   - *Safety & security requirements*
   - *Minimum physical & mental health requirements (accessibility, daylight, outdoor access, etc.)*
   - *Other health-related standards*
3. *Identify occupant-related goal during and following the hazard event. Examples of goals:*
   - *Shelter in unit*
   - *Shelter in building common room*
   - *Shelter in immediate neighbourhood*
   - *Evacuate safely and shelter in a safe region*
   - *Evacuate safely, shelter in safe region, and return to functional building*
4. *Determine the minimum timeframe/duration/recovery period that the goals are required for.*

Asset/ Property

1. *Identify hazard(s) and associated risks for the target IPCC climate scenario and year.*
2. *Identify asset/property-related goal during and following the hazard event. Examples of goals:*
    - *No damage*
    - *Minor damage that still enables occupants to shelter-in-place*
    - *No damage to components or systems with >20-year lifespan*
    - *No damage to structural or enclosure components*
    - *Total damage not to exceed $X million or X% of building value*
3. *Determine the minimum timeframe/duration/recovery period that the goals are required for.*

Community & Other Goals

1. *Identify hazard(s) and associated risks for the target IPCC climate scenario and year.*
2. *Identify other goals during and following the hazard event. Examples of goals:*
    - *Support food distribution for X additional community members/day*
    - *Ensure residents can have adequate on-site childcare if community daycares are impacted*
    - *Amass an emergency fund of $X to support recovery efforts*
3. *Determine the minimum timeframe/duration/recovery period that the goals are required for.*

Adaptation goals should be outlined by considering at minimum the top three project risks identified in Section 7 for each of the top hazards. Additional risks should be included if possible. Neighbourhood assets and risks identified in Sections 5 and 6 should be considered when establishing goals that rely on or contribute to the surrounding community. Goals should be developed with a balance of aspiration and realism considering other priorities (program, site, budget, added value, etc.). Describe the goals in sufficient detail to inform potential strategies to be developed in Section 10.

8a. Adaptation Goals for Hazard A

(see Appendix B for additional worksheets to list adaptation goals for the other key hazards)

Recap of Top Risks and Minimum Occupant Essential Needs	Notes	Completed by
Minimum top three risks from Section 7a):		OD, RR, FM, AR, AC, others as needed per hazard & risks.
Relevant minimum occupant essential needs:		

8a. Adaptation Goals for Hazard A *(continued)*

(see Appendix B for additional worksheets to list adaptation goals for the other key hazards)

Adaptation Goals	Goal Type *(occupant, asset, other)*	Timeframe/ Duration/ Recovery	Notes	Completed by
				OD, RR, FM, AR, AC, others as needed per hazard & risks.

Reference Standards

ASHRAE, ASHRAE Standard 55 – Thermal Environmental Conditions for Human Occupancy* - https://www.ashrae.org/technical-resources/bookstore/standard-55-thermal-environmental-conditions-for-human-occupancy

Arup, REDi Rating System (Non-climate earthquake hazards)* https://www.arup.com/perspectives/publications/research/section/redi-rating-system

Institute for Sustainable Infrastructure, Envision* – https://sustainableinfrastructure.org/envision/use-envision/

U.S. Green Building Council, Passive Survivability and Back-up Power During Disruptions* https://www.usgbc.org/credits/passivesurvivability?return=/pilotcredits/new-construction/v4

WELL Building Institute, WELL Building Standard, v.2* - https://v2.wellcertified.com/v/en/concepts

Additional Resources

Adaptation & Resilience Goals

NIST, Community Resilience Planning Guide for Buildings and Infrastructure Systems, Volume I, Section 4* https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1190v1.pdf

US Department of Homeland Security, Ready.gov, Evacuation* - https://www.ready.gov/evacuation

US Department of Homeland Security, Ready.gov, Shelter* - https://www.ready.gov/shelter

Essential Needs

ASHRAE, 2017 ASHRAE Handbook, Chapter 10, Indoor Environmental Health* - https://www.ashrae.org/file%20library/technical%20resources/covid-19/i-p_f17_ch10indoorenvironmentalhealth.pdf

Centre for the Built Environment, 2019 Thermal Comfort Tool* - https://comfort.cbe.berkeley.edu/

City of Vancouver, Energy Modelling Guidelines v. 2.0 - https://vancouver.ca/files/cov/guidelines-energy-modelling.pdf

Di Napoli, C. et al., (2018), Assessing heat-related health risk in Europe via the Universal Thermal Climate Index (UTCI). *Int J Biometeorol* 62, 1155–1165* - https://doi.org/10.1007/s00484-018-1518-2

Government of Canada, Residential Indoor Air Quality Guidelines - https://www.canada.ca/en/health-canada/services/air-quality/residential-indoor-air-quality-guidelines.html

New York City Housing Authority, Sheltering Seniors from Extreme Heat* https://www1.nyc.gov/assets/nycha/downloads/pdf/n20-sheltering-seniors-from-extreme-heat.pdf

Sphere Association, The Sphere Handbook, Humanitarian Charter and Minimum Standards in Humanitarian Response* https://spherestandards.org/handbook-2018/

US Environmental Protection Agency, Indoor Air Quality (IAQ)* - https://www.epa.gov/indoor-air-quality-iaq

US Environmental Protection Agency, Wildfires and Indoor Air Quality (IAQ)* - https://www.epa.gov/indoor-air-quality-iaq/wildfires-and-indoor-air-quality-iaq

World Food Programme, Supply Assessment of Goods and Services for Essential Needs* https://docs.wfp.org/api/documents/WFP-0000074196/download/?_ga=2.16383411.443759423.1587002039-1899257735.1587002039

* US or International Reference

Case Study Example

Below is a hypothetical example of adaptation goals established for a new low-income residential building in a suburb of Victoria, BC. Residents are a combination of singles, families and seniors. This includes a population with disabilities. The adaptation goals are in reference to the project risk assessment example from Section 7 for a compounding hazards scenario of increasing summer temperatures combined with seasonal drought, and a nearby major wildfire that results in poor air quality. Goals also consider Sections 4, 5 & 6 as required.

Note: This hypothetical example is for illustrative purposes only. It is not representative of actual conditions or goals and should not be substituted for actual adaptation goal setting completed by the appropriate experts.

Climate Scenario & Target Year

IPCC RCP 8.5 2050

Project Address & Neighbourhood

Confidential Address, Colwood

Hazard Referenced

Compounding Hazards: Increasing summer temperatures + seasonal drought+ major wildfire resulting in poor air quality.

Cascading Impacts

Power outages; impacts to water treatment and distribution; stress on health service capacities; supply chain stresses.

Figure 12. Greater Victoria - Wildfire & Drought Period, August 2018 (©Adrian Lam, Time Colonist, by permission)

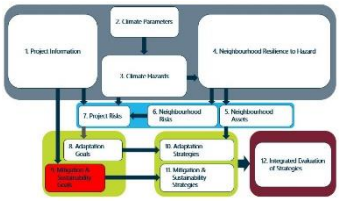
8d. Adaptation Goals for Compounding Hazards – Increasing summer temperatures + Seasonal drought + Major wildfire = Poor Air Quality

Description of Adaptation Goals			Notes	Completed by
Minimum top three risks from Section 7d): 1. Disabled residents at higher risk to hazard. Due to their low mobility, they cannot be easily displaced to other parts of the building or evacuated. 2. Construction budget doesn't account for cooling systems. 3. Low operating budget – the organization may have limited funds to pay for additional common area cooling/ air filtration.			All risks listed are immediate and increase over time through the project's lifespan.	
Relevant minimum occupant essential needs: 1. Indoor temperatures should not exceed 26C @ 50% RH. 2. WELL Building Standard - Air Precondition 01 for minimum indoor air quality requirements. 3. Sufficient emergency power to ensure cooling and air quality needs for duration of event.			Though water shortages are a longer-term risk, essential water needs should be considered in the project design: 50 l/ person/day for 72-hour event.	
Adaptation Goal	**Goal Type**	**Timeframe/ Duration/ Recovery**		
Shelter low mobility/disabled residents in their units during hazard.	Occupant	Near-term, for entirety of event	About 20% of residents anticipated to be low mobility or otherwise disabled.	
Ensure that other occupants can be sheltered in some part of the facility or community during hazard.	Occupant	Near & long-term, for entirety of event	Review Section 4 assessment for options. Note Section 7 risks of low walkability & transit and limited facilities with cooling and filtration.	
Minimize operating costs of cooling and indoor air quality strategies.	Other	Near & long-term/Annual costs	Project electricity cost increases over project lifespan.	
Maximize passive cooling solutions to avoid the need for mechanical cooling.	Occupant	Near & long-term, for entirety of event	Consider current and future climate data for passive solutions.	

Recommended Documentation and Deliverables

Note that some of the deliverables listed overlap with and/or are repeated in other sections.

Project Phase	Deliverable	Completed by
Feasibility & Financing	▪ N/A	
Pre-Design	▪ Completed Section 8 of IBAMA framework	See 8a-d
Schematic Design	▪ Updated Section 8 of IBAMA framework ▪ Assessment report of any proposed strategies using adaptation goals established in Section 8	See 8a-d AR, AC, others as needed
Design Development	▪ Updated Section 8 of IBAMA framework, including potential goal revisions ▪ Report on development of proposed strategies with respect to adaptation goals	See 8a-d AR, AC, others as needed
Construction Documents	▪ Updated Section 8 of IBAMA framework, including potential goal revisions ▪ Updated report on development of proposed strategies with respect to adaptation goals	See 8a-d AR, AC, others as needed
Project Construction	▪ Updated report on development of proposed strategies with respect to adaptation goals	AR, AC, others as needed
As-built/ Occupancy	▪ Include list of adaptation goals in final report to facility manager.	AR, AC, others as needed
Post-Occupancy	▪ Annual check-in & report to review original adaptation goals and make adjustments as required ▪ If feasible, integrate finalized adaptation goals into land title and property disclosure information.	OD, FM, RR OD



Section 9 - Climate Mitigation & Sustainability Goals

Description

This section provides the opportunity for the project team to outline their climate mitigation and sustainability goals. These should be developed in concert with adaptation goals to ensure as much alignment as possible. Mitigation and sustainability goals may be mandated by government requirements, based on an institution's standards, or determined by the project team. These goals will inform the adaptation, mitigation and sustainability strategies developed in Sections 10 & 11. The project team should review Section 8 & 9 goals as the project evolves and revise them if needed.

Parameters

9. Climate Mitigation & Sustainability Goals

Climate mitigation goals can be grouped into four main categories, all of which share the greater objective of reducing global greenhouse gas (GHG) emissions:

A. *Operational GHG Emissions – GHG emissions associated with the operation of a building. This includes emissions from non-renewable energy consumption, and from refrigerant and fire suppression gas leakage.*
B. *Embodied GHG Emissions – GHG emissions associated with extraction, production, transportation and disposal of construction materials in a building, as well as the construction, renovation and repair of the building.*
C. *Renewable Energy Production – Production of on-site energy from renewable resources such as solar and wind.*
D. *GHG Sequestration – Capture and storage of GHGs, typically through landscape-based solutions.*

Examples of climate mitigation goals:

- *Operational GHG Emissions – Meeting BC Energy Step Code 4 targets.*
- *Embodied GHG Emissions – 25% reduction in embodied GHG emissions as compared to a similar building.*
- *Renewable Energy Production – 10% of the project's electricity demand met by on-site renewables energy.*
- *GHG Sequestration – Planting 100 hardwood trees to absorb ~100 metric tons of $C0_2$ over the next 40 years.*

Sustainability goals not captured under climate mitigation would likely fall under the categories below, in alignment with LEED, WELL and similar green building rating systems:

A. *Location & Site – Goals pertaining to the project location and neighbourhood, as well as the project site.*
B. *Water – Water use reduction and water quality goals. Stormwater management falls under adaptation goals.*
C. *Materials (goals not covered by embodied GHG emissions) – Goals pertaining to lifecycle impacts of materials, hazardous chemicals or elements used in building materials, responsible manufacturing and procurement, etc.*
D. *Health & Indoor Environment – Goals pertaining to thermal comfort, air quality, daylight, acoustics, active design, social connectivity, food, etc.*
E. *Community, Equity & Environmental Justice – Goals pertaining to accessible design, community access and engagement, affordable housing, health equity, etc.*

Examples of sustainability goals:

- *Location & Site – All landscaping must promote biodiversity of local species.*
- *Water - 50% potable water use reduction.*
- *Materials – Natural materials should be certified to be responsibly sourced.*
- *Health & Indoor Environment – Meet WELL Building Standard Light Precondition 01.*
- *Community, Equity & Environmental Justice – Minimum 25% of units accessible to those with disabilities.*

Climate mitigation and sustainability goals should be considered with respect to the project's overall purpose and principles, as outlined in Section 1.

List all applicable mitigation and sustainability goals in Sections 9a) and 9b) below. When setting goals, take into account future climate projections based the project's lifespan.

9a. Climate Mitigation Goals *(see Appendix B for additional worksheet)*

Description of Mitigation Goals			
Mitigation Goal	**Goal Type** *(operational GHGs, embodied GHGs, renewable energy, GHG sequestration)*	**Notes**	**Completed by**
			OD, AR, SU, SC, ST, ME, FM, CM, others as needed.

9b. Sustainability Goals *(see Appendix B for additional worksheet)*

Description of Sustainability Goals			
Sustainability Goal	**Goal Type** *(location & site, water, materials, health, other, etc.)*	**Notes**	**Completed by**
			OD, AR, SU, SC, ST, ME, LA, FM, CM, others as needed.

Reference Standards

ASHRAE, ASHRAE Standard 90.1* https://www.ashrae.org/technical-resources/90-1-portal

BC Housing, Design Guidelines & Construction Standards
https://www.bchousing.org/publications/BCH-Design-Guidelines-Construction-Standards.pdf

Canada Building Council, LEED Rating System v.4
https://www.cagbc.org/CAGBC/Programs/LEED/LEEDv4/LEED_v4_Resources.aspx

City of Vancouver, Climate Emergency Response - https://council.vancouver.ca/20190424/documents/cfsc1.pdf

Enterprise Community Partners, 2020 Enterprise Green Communities Criteria*
https://www.greencommunitiesonline.org/

Government of British Columbia, BC Energy Step Code - https://energystepcode.ca/

Institute for Sustainable Infrastructure, Envision* – https://sustainableinfrastructure.org/envision/use-envision/

International Living Future Institute, Living Building Challenge v.4.0*
https://www2.living-future.org/LBC4.0?RD_Scheduler=LBC4

International WELL Building Institute, WELL Building Standard v.2 Pilot* – https://v2.wellcertified.com/v/en/overview

National Research Council of Canada, 2017 National Energy Code of Canada for Buildings
https://nrc.canada.ca/en/certifications-evaluations-standards/codes-canada/codes-canada-publications/national-energy-code-canada-buildings-2017

Passive House Institute, Criteria for the Passive House, EnerPHit and PHI Low Energy Building Standard*
https://www.passivehousecanada.com/wp-content/uploads/2017/02/Passive-House-and-EnerPHit_building_criteria.pdf

Additional Resources

American Institute of Architects, New York City Chapter, Embodied Energy: A Primer for Architects*
https://www.aiany.org/membership/oculus-magazine/article/fall-2019/embodied-energy-a-primer-for-architects/

City for All Women Initiative (CAWI), Advancing Equity and Inclusion: A Guide for Municipalities
https://www.cawi-ivtf.org/sites/default/files/publications/advancing-equity-inclusion-web_0.pdf

City of Toronto, Zero Emissions Building Framework – https://www.toronto.ca/wp-content/uploads/2017/11/9875-Zero-Emissions-Buildings-Framework-Report.pdf

City of Vancouver, Greenest City 2020 Action Plan - https://vancouver.ca/files/cov/Greenest-city-action-plan.pdf

City of Vancouver, Renewable City Strategy (2015-2050) - https://vancouver.ca/files/cov/renewable-city-strategy-booklet-2015.pdf

City of Vancouver, Zero Emissions Buildings Plan - https://vancouver.ca/green-vancouver/zero-emissions-buildings.aspx#zero-emissions-building-plan

World Green Building Council, Bringing Embodied Carbon Upfront* - https://www.worldgbc.org/news-media/bringing-embodied-carbon-upfront

* US or International Reference

Case Study Example

Below is a hypothetical example of mitigation and sustainability goals established for a supportive housing building in central Vancouver, BC. Residents are homeless or at risk of homelessness, aboriginal peoples, women with children fleeing abusive relationships, people with mental and physical disabilities, and people with addictions. The largest proportion of residents are youths. Mitigation goals are in reference to a combination of municipal requirements and institutional standards.

Note: This hypothetical example is for illustrative purposes only. It is not representative of actual conditions or goals and should not be substituted for actual mitigation and sustainability goal setting completed by the appropriate experts.

Climate Scenario & Target Year

IPCC RCP 8.5 2080

Project Address & Neighbourhood

Confidential Address, Vancouver

Figure 13. Supportive Housing Project, Vancouver (Image courtesy of NSDA Architects, by permission. Photographer: Derek Lepper)

9a. Climate Mitigation Goals

Description of Mitigation Goals			
Mitigation Goal	**Goal Type**	**Notes**	**Completed by**
Meet Passive House criteria for maximum space heating demand (or load), cooling demand (or load), air leakage, and total primary energy renewable (PER).	Operational GHGs	See City of Vancouver's Green Buildings Policy for Rezonings, Near Zero Emissions Buildings Path.	
40% reduction in embodied GHG emissions as compared to a 2018 baseline	Embodied GHGs	See City of Vancouver's Climate Emergency Response.	
1% of annual project electricity consumption comes from on-site renewable energy, excluding heating electricity.	Renewable Energy	See City of Vancouver's Renewable City Action Plan.	

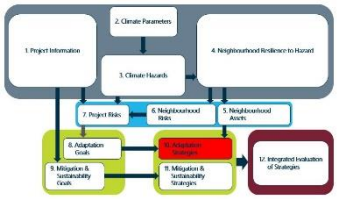
9b. Sustainability Goals

Description of Sustainability Goals			
Sustainability Goal	**Goal Type**	**Notes**	**Completed by**
Manage 80% percentile rainfall event per LEED SS Rainwater Management credit	Location & Site	See LEED v4.1 – SS: Rainwater Management	
Meet City of Vancouver's water efficiency requirements + showerhead flow reduction of additional 20%.	Water	See City of Vancouver's Water Safety and Efficiency Requirements	
Meet 2018 BC Building Code + LEED EQ Minimum Indoor Air Quality Prerequisite	Health – Air Quality	See LEED v4.1 – EQ: Minimum Indoor Air Quality Performance	
Eliminate Red-list materials where there is significant direct exposure to occupants (finishes, hardware, furniture, etc.)	Materials	See Living Building Challenge Imperative 13 – Red List	
Include at least five active design measures to promote the physical activity of building occupants.	Health	See Center for Active Design's Active Design Guidelines	

Recommended Documentation and Deliverables

Note that some of the deliverables listed overlap with and/or are repeated in other sections.

Project Phase	Deliverable	Completed by
Feasibility & Financing	▪ N/A	
Pre-Design	▪ Completed Section 9 of IBAMA framework	See 9a-b
Schematic Design	▪ Updated Section 9 of IBAMA framework ▪ Assessment report of any proposed strategies for mitigation and sustainability goals established in Section 9	See 9a-b AR, SU, LA, Engineers
Design Development	▪ Updated Section 8 of IBAMA framework, including potential goal revisions ▪ Report on development of proposed strategies for mitigation and sustainability goals	See 9a-b AR, SU, LA, Engineers
Construction Documents	▪ Updated Section 9 of IBAMA framework, including potential goal revisions ▪ Updated report on development of proposed strategies for mitigation and sustainability goals	See 9a-b AR, SU, LA, Engineers
Project Construction	▪ Updated report on development of proposed strategies for mitigation and sustainability goals	AR, SU, LA, Engineers, CM
As-built/ Occupancy	▪ Include list of mitigation and sustainability goals in final report to facility manager.	AR, SU, others as needed
Post-Occupancy	▪ Annual check-in & report to review original sustainability goals and make adjustments as required	OD, FM, RR



Section 10 - Adaptation Strategies

Description

This section provides a roadmap for project teams to develop viable adaptation strategies based on the project risks outlined in Section 7, the climate adaptation goals outlined in Section 8, and within the context of the project's overall purpose and principles outlined in Section 1.

Development of adaptation strategies will be iterative. Initial strategies proposed for each hazard should be evaluated to determine feasibility with respect to the project requirements in Section 1, and adaptation goals for the other top hazards identified in Section 3. Strategies that are deemed to have significant conflicts should be revised. As the design and construction process advances, strategies and goals will be further developed and potentially revised.

Parameters

10. Adaptation Strategies

As part of an integrated team workshop, develop an initial list of adaptation strategies for each of the top hazards based on the adaptation goals outlined in Section 8. The workshop should ideally include the owner, members of the design and construction team, adaptation and sustainability consultants, and building management. Various team members can then follow up to determine viability of the proposed strategies.

Consider strategies that pertain to design and construction, management and operations, and/or neighbourhood assets. Some strategies may not be effective or permanently in place throughout the full life expectancy of the project. As such, clarify the anticipated timeframes or time limitations of each strategy. Reference the project and system lifespan information in Section 2 to note where adjustments to the strategy would be required over the lifespan of the project (e.g. allocate additional roof structure, space and duct size for cooling system retrofit in 15 years).

10a. Adaptation Strategies for Hazard A

(see Appendix B for additional worksheets to outline adaptation strategies for the other key hazards)

Step 1 – List adaptation goals and occupant essential needs (if applicable) from Section 8

Adaptation Goals	Occupant Essential Needs	Completed by
1.	1.	AD
2.	2.	
3.	3.	

Step 2 – Develop initial adaptation strategies noting time limitations and lifespan considerations

Proposed Adaptation Strategies	Time Limitations *(see Section 8)*	Lifespan Considerations *(see Section 2)*	Completed by
1.			OD, AR, AD, ME, SC, LA, ST, CM, Others as applicable
2.			
3.			
4.			
5.			

Step 3 – Determine if the proposed adaptation strategies meet main project requirements from Section 1

Proposed Adaptation Strategies	Meets Code & Zoning Requirements*	Meets Program & OPR	Completed by
1.	Y/N/TBD	Y/N/Partial/TBD	OD, AR, AD, ME, SC, LA, ST, CM, SU, Others as applicable
2.	Y/N/TBD	Y/N/Partial/TBD	
3.	Y/N/TBD	Y/N/Partial/TBD	
4.	Y/N/TBD	Y/N/Partial/TBD	
5.	Y/N/TBD	Y/N/Partial/TBD	

**If regulatory requirements are not met, identify opportunities to address conflicts with government agencies.*

Step 4 – Determine that the proposed adaptation strategies do not conflict with adaptation goals for the other top hazards.

Proposed Adaptation Strategies	Avoids Conflicts w/Hazard B	Avoids Conflicts w/Hazard C	Avoids Conflicts w/ Compounding Hazards	Completed by
1.	Y/N/TBD	Y/N/TBD	Y/N/TBD	OD, AR, AD, ME, SC, LA, ST, CM, SU, Others as applicable
2.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
3.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
4.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
5.	Y/N/TBD	Y/N/TBD	Y/N/TBD	

If a strategy conflicts significantly with adaptation goals for the other top hazards, it should be revised or eliminated.

10e. Follow-up on Selected Adaptation Strategies for all key hazards

List selected strategies for all key hazards, and follow-up tasks required (e.g. cost estimates, technical analysis, etc.)

Selected Adaptation Strategies	Follow up Required	Date Required	Action by
1.			Varies depending upon strategy proposed
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			

Reference Standards

FEMA, Flood Resistant Provisions of the International Codes (2015)*
https://www.fema.gov/media-library/assets/documents/100537

Insurance Institute for Business and Home Safety, Fortified Construction Standards*
https://ibhs.org/guidance/fortified-construction-standards/

International Association of Plumbing and Mechanical Officers (IAPMO), Flood Resistant Provisions of the 2015 Uniform Codes* - https://www.fema.gov/media-library/assets/documents/111741

International Code Council, CodeMaster - Flood Resistant Design (2018 IBC, 2018 IRC, ASCE 7-16, ASCE 24-14)*
https://shop.iccsafe.org/codemaster-flood-resistant-design-2015-ibc-2015-irc-and-asce-7-10-24-14-1.html

International Code Council, International Wildland-Urban Interface Code*
https://codes.iccsafe.org/content/IWUIC2018/effective-use-of-the-international-wildland-urban-interface-code

U.S. Green Building Council, LEED Resilient Design Pilot Credits*
https://www.usgbc.org/articles/revised-leed-resilient-design-pilot-credits-now-available

U.S. Green Building Council, RELi 2.0 Rating Guidelines for Resilient Design & Construction*
https://www.usgbc.org/resources/reli-20-rating-guidelines-resilient-design-and-construction

Additional Resources

Strategies for Multiple Hazards

BC Housing, BC Energy Step Code, Design Guide Supplement S3 on Overheating and Air Quality
https://www.bchousing.org/research-centre/library/residential-design-construction/bc-energy-step-code-design-guide&sortType=sortByDate

Enterprise Community Partners, Ready to Respond: Strategies for Multifamily Building Resilience*
https://www.enterprisecommunity.org/resources/ready-respond-strategies-multifamily-building-resilience-13356

New York State Energy Research and Development Authority, Climate Resilience Strategies for Buildings in New York State* - https://ap.buffalo.edu/content/dam/ap/PDFs/NYSERDA/Climate-Resilience-Strategies-for-Buildings.pdf

University of Minnesota, Resilient Adaptation of Sustainable Buildings*
https://www.pca.state.mn.us/sites/default/files/p-gen4-17.pdf

Urban Green Council, Building Resiliency Task Force Report*
https://www.urbangreencouncil.org/sites/default/files/2013_brtf_summaryreport_0.pdf

Strategies for Extreme Heat

BC Housing, Mobilizing Building Adaptation and Resilience (MBAR) Design Discussion Primers – Heat Waves
https://www.bchousing.org/research-centre/library/residential-design-construction/MBAR&sortType=sortByDate

City of Vancouver, Extreme Heat, Cool Buildings - https://sustain.ubc.ca/sites/default/files/2014-16_Extreme%20Heat%20Cool%20Buildings_Tesche.pdf

New York City Housing Authority - Sheltering Seniors from Extreme Heat*
https://www1.nyc.gov/assets/nycha/downloads/pdf/n20-sheltering-seniors-from-extreme-heat.pdf

RDH Building Science, UBC - Designing Climate Resilient Multifamily Buildings
https://planning.ubc.ca/sites/default/files/2020-05/REPORT_UBC_Climate%20Resilient%20Multifamily%20Buildings.pdf

Strategies for Floods

BC Housing, Mobilizing Building Adaptation and Resilience (MBAR) Design Discussion Primers – Flood Events
https://www.bchousing.org/research-centre/library/residential-design-construction/MBAR&sortType=sortByDate

FEMA, Floodproofing Non-Residential Buildings* – https://www.fema.gov/media-library/assets/documents/34270

FEMA, Protecting Building Utility Systems from Flood Damage* - https://www.fema.gov/media-library/assets/documents/3729

Strategies for Poor Air Quality

BC Centre for Disease Control, Evidence Review: Filtration in institutional settings during wildfire smoke events
http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Health-Environment/WFSG_EvidenceReview_FiltrationinInstitutions_FINAL_v3_edstrs.pdf

BC Housing, Mobilizing Building Adaptation and Resilience (MBAR) Design Discussion Primers – Air Quality
https://www.bchousing.org/research-centre/library/residential-design-construction/MBAR&sortType=sortByDate

Strategies for Power Outages

BC Housing, Mobilizing Building Adaptation and Resilience (MBAR) Design Discussion Primers – Power Outages and Emergencies - https://www.bchousing.org/research-centre/library/residential-design-construction/MBAR&sortType=sortByDate

City of Toronto, Minimum Backup Power Guidelines for MURB's - https://www.toronto.ca/wp-content/uploads/2017/11/91ca-Minimum-Backup-Power-Guideline-for-MURBs-October-2016.pdf

FEMA, Emergency Power Systems for Critical Facilities* - https://www.fema.gov/media-library/assets/documents/101996

Strategies for Precipitation & High Wind Events

BC Housing, Mobilizing Building Adaptation and Resilience (MBAR) Design Discussion Primers – Severe Storms
https://www.bchousing.org/research-centre/library/residential-design-construction/MBAR&sortType=sortByDate

FEMA, Safe Rooms for Tornadoes and Hurricanes* - https://www.fema.gov/media-library/assets/documents/3140

Strategies for Snow, Frost & Freeze-Thaw Events

BC Housing, Mobilizing Building Adaptation and Resilience (MBAR) Design Discussion Primers – Chronic Stressors
https://www.bchousing.org/research-centre/library/residential-design-construction/MBAR&sortType=sortByDate

FEMA, Snow Load Safety Guide* - https://www.fema.gov/media-library-data/7d8c55d1c4f815edf3d7e7d1c120383f/FEMA957_Snowload_508.pdf

Strategies for Wildfires

BC Housing, Mobilizing Building Adaptation and Resilience (MBAR) Design Discussion Primers – Fire
https://www.bchousing.org/research-centre/library/residential-design-construction/MBAR&sortType=sortByDate

FEMA, Wildfire Hazard Mitigation Handbook for Public Facilities* – https://www.fema.gov/media-library/assets/documents/16568

The co-operators, FireSmart Canada Home Development Guide - https://firesmartcanada.ca/wp-content/uploads/2019/10/FireSmart_Canada_Home_Development_Guide.pdf

* US or International Reference

Case Study Example

Below is a hypothetical example of adaptation strategies proposed for a new low-income residential building in a suburb of Victoria, BC. Residents are a combination of singles, families and seniors. This includes a population with disabilities. The adaptation strategies are based on the goals established in Section 8 in reference to a compounding hazards scenario of increasing summer temperatures combined with seasonal drought, and a nearby major wildfire that results in poor air quality. Potential strategies also consider the neighbourhood assessments from Sections 4, 5 & 6.

Note: This hypothetical example is for illustrative purposes only. It is not representative of actual conditions or strategies and should not be substituted for actual adaptation strategy development by the appropriate experts.

Climate Scenario & Target Year
IPCC RCP 8.5 2050

Project Address & Neighbourhood
Confidential Address, Colwood

Hazard Referenced
Compounding Hazards: Increasing summer temperatures + seasonal drought+ major wildfire resulting in poor air quality.

Cascading Impacts
Power outages; impacts to water treatment and distribution; stress on health service capacities; supply chain stresses.

Other Top Hazards Assessed
Major Earthquake, Increasing precipitation & flash flooding, Summer drought

Figure 14. Low-Income Rental Residential Building, Colwood (Image courtesy of Cascadia Architects Inc., by permission.)

10d. Adaptation Strategies for Compounding Hazards
Increasing summer temperatures + Seasonal drought + Major wildfire = Poor Air Quality

Step 1 – List adaptation goals and occupant essential needs from Section 8

Adaptation Goals	Occupant Essential Needs	Completed by
1. Shelter low mobility/disabled residents in their units during hazard (20% of population). 2. Ensure that other occupants can be sheltered in some part of the facility or community during hazard. 3. Minimize operating costs of cooling and indoor air quality strategies. 4. Maximize passive cooling solutions to avoid the need for mechanical cooling.	1. Indoor temperatures should not exceed 26C @ 50% RH. 2. WELL Building Standard Air Precondition 01 for minimum indoor air quality requirements. 3. Sufficient power to ensure cooling and air quality needs.	OD, FM, RR, ME

Step 2 – Develop initial adaptation strategies noting time limitations and lifespan considerations

Proposed Adaptation Strategies	Time Limitations *(see Section 8)*	Lifespan Considerations *(see Section 2)*	Completed by
1. Following thermal comfort modeling for present and future climates, allocate the most thermally comfortable units to low mobility/disabled residents.	Low mobility occupants may exceed available comfortable units at various times.	Based on modeling units may require future cooling. Verify for future overheating.	AR, ME, FM, RR
2. Light coloured cladding and roofing to reduce solar heat gain.		Roof replacement in 20 years.	AR, ME
3. Provide deciduous vegetation that amply shades first two floors and common area.	Trees will not reach full height for 10-15 years.		LA, ME
4. Provide cooling in common room. Consider expanding size of common room to increase capacity.		Cooling unit lifespan of 15 years. Ensure space for future climate.	AR, ME
5. Create ventilated backup common room in below ground parking. Locate below landscaped area and consider skylight.			AR, ME
6. Shuttle to Juan de Fuca recreation centre for daytime sheltering.	Operating hours of recreation centre.	Uncertain – based on rec centre's systems.	AD, FM
7. Minimum MERV 15 filters on rooftop HRVs units during wildfire events, ideally MERV 17.	Relies on storage of filters & replacement.	HRV unit lifespan of 15-20 years.	ME
8. Purchase or lease supply of portable air cleaners and store in parking storage area.	Units may get lost or damaged. May have insufficient qty.	Air cleaners have 5-10 year lifespan.	ME, AD
9. Emergency standby natural gas generator to run HRV system and common room cooling.		Generator lifespan of 3,0000 hours.	ME

Step 3 – Determine if the proposed adaptation strategies meet main project requirements from Section 1

Proposed Adaptation Strategies	Meets Code & Zoning Requirements	Meets Program & OPR	Completed by
1. Allocation of coolest units to disabled.	Y	Partial	OD, FM, ME
2. Light coloured cladding and roofing.	Y	Y	AR
3. Provide deciduous vegetation that amply shades first two floors and common area.	Y	TBD	LA
4. Common room cooling & enlarged area.	TBD	Partial	AR, ME
5. Second common room in parking area.	TBD	Y	AR, ME
6. Shuttle to Juan de Fuca recreation centre.	Y	TBD	AD, FM
7. MERV 15-17 filters on rooftop HRVs units.	Y	TBD	ME
8. Purchase portable air cleaners.	Y	N	ME, FM
9. Emergency generator for HRV and cooling.	TBD	Y	ME, AR

Step 4 – Determine if the proposed adaptation strategies conflict with adaptation goals for the other top hazards.

Proposed Adaptation Strategies	Avoids Conflicts w/Earthquake	Avoids Conflicts w/Flooding	Avoids Conflicts w/Drought	Completed by
1. Allocation of coolest units to disabled.	Y	TBD	Y	OD, FM, ME
2. Light coloured cladding and roofing.	Y	Y	Y	AR
3. Deciduous vegetation that amply shades first two floors and common area.	TBD	TBD	TBD	LA
4. Common room cooling & enlarged area.	Y	TBD	Y	AR, ME
~~5. Second common room in parking area.~~	Y	N	Y	AR, ME
6. Shuttle to Juan de Fuca recreation centre.	Y	Y	Y	AD, FM
7. MERV 15-17 filters on rooftop HRVs units.	Y	Y	Y	ME
~~8. Purchase portable air cleaners.~~	Y	N	Y	ME, FM
9. Emergency natural gas generator for HRVs and cooling.	N	TBD	Y	ME, AR

10e. Follow up on Selected Adaptation Strategies

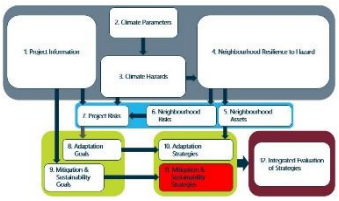
List selected strategies and follow-up tasks required (e.g. code compliance, cost & technical analysis, etc.)

Selected Adaptation Strategies	Follow up Required	Date Required	Action by
1. Allocation of coolest units to disabled.	Thermal comfort model to determine if feasible; Meet with RR & FM to determine viability.		ME, RR, FM
2. Light coloured cladding and roofing.	Confirm design choices with OD and municipality.		AR
3. Provide deciduous vegetation that amply shades first two floors and common area.	Select drought resilient species; design drainage for flooding; verify earthquake impacts.		LA, SC, ST
4. Common room cooling & enlarged area.	Verify if common room vulnerable to future flooding. Verify electricity costs to ensure ops budget is sufficient.		AR, SC
6. Shuttle to Juan de Fuca recreation centre.	Meet w/municipality to discuss.		AD, FM
7. MERV 15-17 filters on rooftop HRVs units.	Review filter storage & replacement. Verify air pressure thresholds for HRV's.		ME, FM
9. Emergency natural gas generator for HRVs and cooling.	Verify sizing, loads, regulations, costs. Review propane option.		ME, AR

Recommended Documentation and Deliverables

Note that some of the deliverables listed overlap with and/or are repeated in other sections.

Project Phase	Deliverable	Completed by
Feasibility & Financing	▪ General % budget allocation for adaptation measures beyond standard requirements, and quantify potential cost-benefits if possible	OD
Pre-Design	▪ N/A	
Schematic Design	▪ Completed Section 10 of the IBAMA framework ▪ Assessment report of proposed adaptation/resilience strategies including strategy evaluation scores ▪ Preliminary cost estimate of selected strategies	See 10a-e AR, AD, LA, Engineers CE, CM
Design Development	▪ Updated Section 10 of IBAMA framework ▪ Updated assessment report of proposed adaptation/resilience strategies ▪ Updated cost estimate of selected strategies ▪ Peer-review evaluation report of strategies to confirm alignment with initial adaptation and resilience goals, as well as proposed adjustments	See 10a-e AR, AD, LA, Engineers CE, CM Peer Reviewer
Construction Documents	▪ Updated Section 10 of IBAMA framework ▪ Report on development of proposed adaptation and resilience strategies ▪ Further development of technical strategies in drawings and specifications ▪ Updated cost estimate of selected strategies	See 10a-e AR, SU, LA, Engineers CE, CM
Project Construction	▪ Ongoing construction meeting agenda item for IBAMA strategies with notes included in meeting minutes ▪ Monthly IBAMA-related construction report ▪ Schedule of IBAMA-related site visits to review implementation of strategies ▪ IBAMA site visit reports by IBAMA design & construction leads	CM CM CM AR, AD, LA, Engineers
As-built/ Occupancy	▪ Summary of adaptation and resilience goals and strategies ▪ Manual and/or training video for building managers and operators related to proposed adaptation/resilience strategies and associated hazards	AR, AD, others as needed
Post-Occupancy	▪ Testing and inspections schedule for adaptation/ resilience-related systems ▪ Annual commissioning of building systems ▪ Resident education video including for hazard preparedness best practices ▪ Schedule of hazard preparedness drills, including liaising with municipal and utility representatives	FM, ME, CX Agent OD, RR FM, RR



Section 11 - Climate Mitigation & Sustainability Strategies

Description

This section is dedicated to developing viable mitigation and sustainability strategies based on the climate mitigation and sustainability goals outlined in Section 9 and within the context of the project's overall purpose and principles outlined in Section 1. Strategies should take into account the changing climate throughout the building's lifespan.

Development of mitigation strategies will be iterative. Initial strategies proposed should be evaluated to determine viability with respect to the project requirements in Section 1 and ensure no major conflicts with the other mitigation and sustainability goals. Strategies that are deemed to have significant conflicts should be revised. Strategies that are deemed to have significant conflicts should be revised.

Parameters

11. Climate Mitigation & Sustainability Strategies

As part of an integrated team workshop, develop an initial list of mitigation and sustainability strategies based on the goals outlined in Section 9. The workshop should ideally include the owner, members of the design and construction team, sustainability and adaptation consultants, and building management. Various team members can then follow up to determine viability of the proposed strategies.

Initial selection of mitigation strategies should be as aspirational or pragmatic as deemed appropriate by the owner, taking into account project information from Section 1 and neighbourhood information from Section 4. For each of the goals, consider strategies that relate to design and construction-related as well as management and operations.

11a. Climate Mitigation Strategies

(see Appendix B for additional worksheets to outline supplemental mitigation and sustainability strategies)

Step 1 – List mitigation goals from Section 9 and develop an initial list of mitigation strategies.

Mitigation Goals	Proposed Mitigation Strategies	Completed by
	1.	OD, AR, SU, ME, ST, CM, LA, AD, Others as applicable
	2.	
	3.	
	4.	
	5.	
	6.	
	7.	
	8.	

Step 2 – Determine if the proposed mitigation strategies meet the main project requirements from Section 1 and do not conflict with other mitigation or sustainability goals listed in Section 9.

Proposed Mitigation Strategies	Meets Codes & Zoning*	Meets Program & OPR	Aligns w/ Other Goals	Completed by
1.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	OD, AR, SU, ME, ST, CM, LA, AD, Others as applicable
2.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
3.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
4.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
5.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
6.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
7.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
8.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	

**If regulatory requirements are not met, identify opportunities to address conflicts with government agencies.*

Step 3. List selected strategies and follow-up tasks (e.g. verification for code compliance, cost & technical analysis, etc.)

Selected Mitigation Strategies	Follow up Required	Date Required	Action by
1.			Varies depending upon strategy proposed
2.			
3.			
4.			
5.			
6.			
7.			
8.			

If a strategy does not comply with project requirements or conflicts significantly with other mitigation or sustainability goals, it should be further investigated, revised or eliminated.

11b. Sustainability Strategies

Step 1 – List sustainability goals from Section 9 and develop an initial list of sustainability strategies.

Sustainability Goals	Proposed Sustainability Strategies	Completed by
	1.	OD, AR, SU, ME, ST, CM, LA, AC, Others as applicable
	2.	
	3.	
	4.	
	5.	
	6.	
	7.	
	8.	

Step 2 – Determine if the proposed sustainability strategies meet the main project requirements from Section 1 and do not conflict with other mitigation or sustainability goals listed in Section 9.

Proposed Sustainability Strategies	Meets Codes & Zoning*	Meets Program & OPR	Aligns w/ Other Goals	Completed by
1.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	Varies depending upon strategy proposed
2.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
3.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
4.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
5.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
6.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
7.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
8.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	

**If regulatory requirements are not met, identify opportunities to address conflicts with government agencies.*

Step 3. List selected strategies and follow-up tasks (e.g. verification for code compliance, cost & technical analysis, etc.)

Selected Sustainability Strategies	Follow up Required	Date Required	Action by
1.			Varies depending upon strategy proposed
2.			
3.			
4.			
5.			
6.			
7.			
8.			

If a strategy does not comply with project requirements or conflicts significantly with other mitigation or sustainability goals, it should be further investigated, revised or eliminated.

Reference Standards

International Code Council, 2018 International Green Construction Code*
https://www.ashrae.org/technical-resources/bookstore/standard-189-1

BC Housing, BC Energy Step Code - Design Guide – https://www.bchousing.org/research-centre/library/residential-design-construction/bc-energy-step-code-design-guide&sortType=sortByDate

Canada Building Council, LEED Rating System v.4
https://www.cagbc.org/CAGBC/Programs/LEED/LEEDv4/LEED_v4_Resources.aspx

Enterprise Community Partners, 2020 Enterprise Green Communities Criteria*
https://www.greencommunitiesonline.org/

International WELL Building Institute, WELL Building Standard v.2 Pilot* – https://v2.wellcertified.com/v/en/overview

Passive House Institute, Criteria for the Passive House, EnerPHit and PHI Low Energy Building Standard*
https://www.passivehousecanada.com/wp-content/uploads/2017/02/Passive-House-and-EnerPHit_building_criteria.pdf

Additional Resources

American Institute of Architects, Ten Steps to Reducing Embodied Carbon*
https://www.aia.org/articles/70446-ten-steps-to-reducing-embodied-carbon

ASHRAE, ASHRAE Green Guide* https://www.ashrae.org/technical-resources/bookstore/ashrae-greenguide-the-design-construction-and-operation-of-sustainable-buildings

Architecture 2030, 2030 Palette* - http://2030palette.org/

BC Housing, Building Envelope Thermal Bridging Guide, https://www.bchousing.org/research-centre/library/residential-design-construction/building-envelope-thermal-bridging-guide&sortType=sortByDate

BC Housing, Heat Recovery Ventilation Guide for Multi-Unit Residential Buildings - https://www.bchousing.org/research-centre/library/residential-design-construction/heat-recovery-ventilation-guide-murbs&sortType=sortByDate

BC Housing, Illustrated Guide - Achieving Airtight Buildings - https://www.bchousing.org/research-centre/library/residential-design-construction/achieving-airtight-buildings&sortType=sortByDate

BC Housing, Low Thermal Energy Demand for Large Buildings, https://www.bchousing.org/research-centre/library/residential-design-construction/guide-low-energy-demand-large-buildings&sortType=sortByDate

BuildingGreen* - https://www.buildinggreen.com/

Building Transparency, The Embodied Carbon Construction Calculator* - https://www.buildingtransparency.org/en/

International Living Future Institute, Living Building Challenge Resources* - https://living-future.org/lbc-3_1/resources/

KT Innovations, Tally® Life Cycle Assessment App* - https://www.choosetally.com/

Ted Kesik & Liam O'Brien, MURB Design Guide - https://www.daniels.utoronto.ca/faculty/kesik_t/MURB-Design-Guide/MURB-Design-Guide-v1.0-Jan2017.pdf

Whole Building Design Guide, Resource Pages* - https://www.wbdg.org/resources

* US or International Reference

Case Study Example

Below is an example of mitigation and sustainability strategies established for a supportive housing building in central Vancouver, BC. Residents are homeless or at risk of homelessness, aboriginal peoples, women with children fleeing abusive relationships people with mental and physical disabilities, those with addictions. The largest proportion of residents are youths. Strategies are based on the goals established in Section 9.

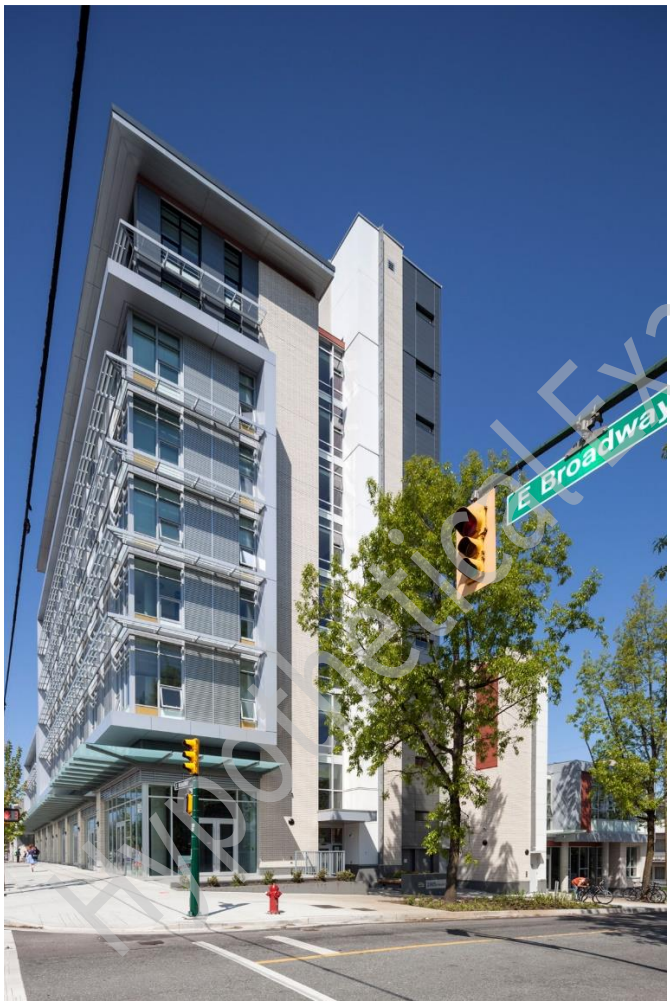
Note: This example is hypothetical and for illustrative purposes only. It is not representative of actual conditions or strategies and should not be substituted for actual mitigation and sustainability strategy development by the appropriate experts.

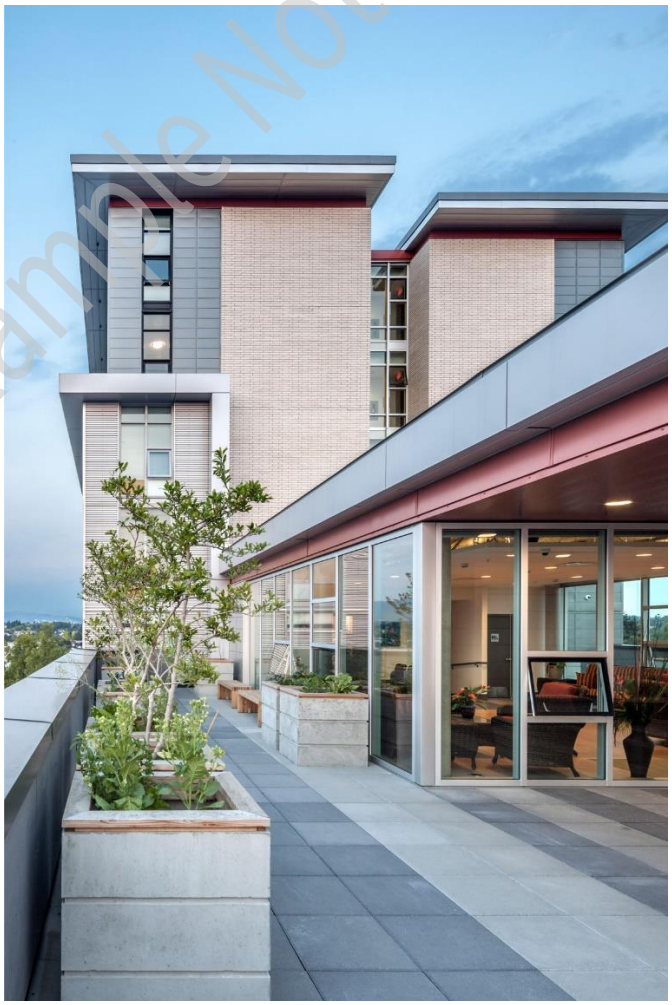
Climate Scenario & Target Year

IPCC RCP 8.5 2080

Project Address & Neighbourhood

Confidential Address, Vancouver





Figures 15 &16. Supportive Housing Project, Vancouver
(Images courtesy of NSDA Architects, by permission. Photographer: Derek Lepper)

11a. Climate Mitigation Strategies

Step 1 – List mitigation goals from Section 9 and develop an initial list of mitigation strategies.

Mitigation Goals	Proposed Mitigation Strategies	Completed by
Meet Passive House criteria for maximum space heating demand (or load), cooling demand (or load), air leakage, and total primary energy renewable (PER).	1. Passive House Certified windows	OD, AR, ME, ST, SU, CM
	2. Optimized insulation to meet Passive House	
	3. Spray foam insulation for air leakage	
	4. All LED lighting	
	5. Reduced window size w/operable panel for air circulation	
	6. High efficiency (>75%) centralized rooftop HRV's & electric baseboards if needed	
	7. Thermal break detailing for shading	
40% reduction in embodied GHG emissions as compared to a 2018 baseline	8. Mass timber or hybrid mass timber structure	OD, AR, CM, ST
	9. High recycled content windows & window wall systems and exterior shades	

Step 2 – Determine if the proposed mitigation strategies meet the main project requirements from Section 1 and do not conflict with other mitigation or sustainability goals listed in Section 9.

Proposed Mitigation Strategies	Meets Codes & Zoning	Meets Program & OPR	Aligns w/ Other Goals	Completed by
1. Passive House Certified windows	Y	Partial	N	AR, SU
2. Optimized insulation to meet Passive House	Y	TBD	Y	AR, SU
3. Spray foam insulation for air leakage	Y	N	N	AR, SU
4. All LED lighting	Y	Y	Y	ME
5. Reduced window size w/operable panel for air circulation	TBD	TBD	Y	AR, SU
6. High efficiency (>75%) centralized rooftop HRV's & electric baseboards if needed	Y	TBD	Y	ME
7. Thermal break detailing for shading	TBD	TBD	Y	ST
8. Mass timber or hybrid mass timber structure	TBD	Y	Y	AR, ST
9. High recycled content windows & window wall systems and exterior shades	TBD	Y	TBD	AR, CM

Step 3. List selected strategies and follow-up tasks

Selected Mitigation Strategies	Follow up Required	Date Required	Action by
1. Passive House Certified windows	Cost estimate and embodied GHG analysis.		AR, CE, SU
2. Optimized insulation to meet Passive House	Energy model (present and future climate) to determine thickness & impact on interiors.		SU, AR
~~3. Spray foam insulation for air leakage~~	Investigate alternatives w/lower embodied GHGs/ VOCs		SU, CM, AR
4. All LED lighting	Energy model & cost estimate.		ME, CE
5. Reduced window size w/operable panel for air circulation	Verify w/ City re: façade; Cost estimate; daylight analysis.		SU, CE, AR
6. High efficiency (>75%) centralized rooftop HRV's & electric baseboards if needed	Discuss maintenance & operations with OD & FM.		ME, OD, FM
7. Thermal break detailing for shading	Verify viable code-compliant options; Cost estimate.		ST, CE
8. Mass timber or hybrid mass timber structure	Precedent research. Integrated workshop to determine viability.		OD, AR, ST, CM, CE, ME, SC
9. High recycled content windows & window wall systems and exterior shades	Verify for manufacturers that provide high recycled content and can meet CSA/ Passive House standards.		CM, AR, SU

11b. Sustainability Strategies

Step 1 – List sustainability goals from Section 9 and develop an initial list of sustainability strategies.

Sustainability Goals	Proposed Sustainability Strategies	Completed by
Manage 80% percentile rainfall event per LEED SS Rainwater Management credit	1. Semi-Intensive or intensive green roof	OD, AR, SU, ME, ST, SC, LA, CM Others as applicable
	2. Stormwater tank in P1, with treatment for non-potable reuse in toilet flushing	
Meet Vancouver's water efficiency requirements + showerhead flow reduction of additional 20%.	3. 1.5 GPM showerheads	
Meet 2018 BC Building Code + LEED EQ Minimum Indoor Air Quality Prerequisite	4. Ensure HRVs specified meet minimum ventilation requirements, and ensure minimum MERV 11 filters	
Eliminate Red-list materials where there is significant direct exposure to occupants (finishes, hardware, furniture, etc.)	5. Red-list free linoleum (verify adhesives)	
	6. Red-list free kitchen & bathroom cabinetry substrates	

Step 2 – Determine if the proposed sustainability strategies meet the main project requirements from Section 1 and do not conflict with other mitigation or sustainability goals listed in Section 9.

Proposed Sustainability Strategies	Meets Codes & Zoning	Meets Program & OPR	Aligns w/ Other Goals	Completed by
1. Semi-Intensive or intensive green roof	TBD	TBD	Y	LA, ST, AR, SC
2. Stormwater tank in P1, with treatment for non-potable reuse in toilet flushing	TBD	TBD	Y	SC, ME, AR
3. 1.5 GPM showerheads	Y	TBD	Y	ME
4. Ensure HRVs specified meet minimum ventilation requirements, and ensure minimum MERV 11 filters	Y	Y	TBD	ME
5. Red-list free linoleum (verify adhesives)	Y	TBD	TBD	AR, SU
6. Red-list free kitchen & bathroom cabinetry substrates	Y	Y	TBD	AR, SU

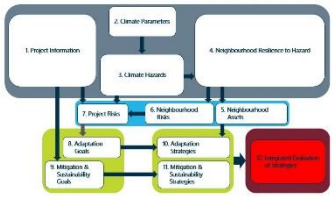
Step 3. List selected strategies and follow-up tasks (e.g. verification for code compliance, cost & technical analysis, etc.)

Selected Sustainability Strategies	Follow up Required	Date Required	Action by
1. Semi-Intensive or intensive green roof	Meet with City officials to determine possible variances; Meet w/ FM re: maintenance; Cost estimate.		LA, SC, FM, CE
2. Stormwater tank in P1, with treatment for non-potable reuse in toilet flushing	Meet with City officials to discuss treatment & reuse; Meet w/ FM re: maintenance; Concept design for cost estimate.		SC, ME, AR, CE
3. 1.5 GPM showerheads	Research and test models for viability.		ME, OD, FM, AR
4. Ensure HRVs specified meet minimum ventilation requirements, and ensure minimum MERV 11 filters	Verify alignment with Passive House requirements.		ME, SU
5. Red-list free linoleum (verify adhesives)	Research available products, costs, maintenance and embodied GHG.		SU, AR
6. Red-list free kitchen & bathroom cabinetry substrates	Research available products, costs, maintenance and embodied GHG.		SU, AR

Recommended Documentation and Deliverables

Note that some of the deliverables listed overlap with and/or are repeated in other sections.

Project Phase	Deliverable	Completed by
Feasibility & Financing	▪ General % budget allocation for climate mitigation and sustainability measures, and quantify potential cost-benefits if possible	OD
Pre-Design	▪ N/A	
Schematic Design	▪ Completed Section 11 of the IBAMA framework ▪ Assessment report of proposed mitigation and sustainability strategies including strategy evaluation scores ▪ Preliminary cost estimate of selected strategies	See 11a-b AR, SU, LA, Engineers CE, CM
Design Development	▪ Updated Section 11 of IBAMA framework ▪ Report on development of proposed mitigation and sustainability strategies ▪ Updated cost estimate of selected strategies ▪ Peer-review evaluation report of strategies to confirm alignment with initial mitigation/sustainability goals, as well as proposed adjustments	See 11a-b AR, SU, LA, Engineers CE, CM Peer Reviewer
Construction Documents	▪ Updated Section 11 of IBAMA framework ▪ Report on development of proposed mitigation and sustainability strategies ▪ Further development of technical strategies in drawings and specifications ▪ Updated cost estimate of selected strategies	See 11a-b AR, SU, LA, Engineers CE, CM
Project Construction	▪ Ongoing construction meeting agenda item for IBAMA strategies in meeting minutes ▪ Monthly IBAMA-related construction report ▪ Schedule of IBAMA-related site visits to review implementation of strategies ▪ IBAMA site visit reports by IBAMA design & construction leads	CM CM CM AR, SU, LA, Engineers
As-built/ Occupancy	▪ Summary of mitigation and sustainability goals and strategies ▪ Manual and/or training video for building managers and operators focusing on proposed strategies	AR, SU, others as needed
Post-Occupancy	▪ Testing and inspections schedule for mitigation and sustainability systems ▪ Annual commissioning of building systems ▪ Resident education video including energy efficiency and sustainability best practices	FM, ME, CX Agent OD, RR



Section 12 - Evaluation of Strategies

Description

Section 12 enables the project team to carry out a high-level assessment of proposed adaptation, mitigation and sustainability strategies according to consistent evaluation criteria. This will help decision-makers prioritize which strategies to pursue. Interactions between adaptation and mitigation/sustainability strategies are the foremost priority of IBAMA and are weighted accordingly in the strategy assessment scoring. However, other factors typically associated with design and construction are also included, such as technical feasibility, project requirements and costs. Should the project team determine that a proposed strategy does not have an adequate score in any or all of the evaluation categories, they may elect to revise goals and/or strategies.

Evaluation Criteria Definitions

Avoided Costs or Losses	Hazard-related economics costs or losses that were avoided due to specific adaptation or resilience measures.
Effectiveness	The degree to which a strategy is effective at reducing risk or GHG emissions. For example, an extensive green roof may have low effectiveness at reducing stormwater runoff while an intensive green roof may have moderately effectiveness.
Equity	A concept concerned with the fair and equitable provision, implementation, and impact of services, programs, and policies.
Independence from external systems/services	The degree to which a strategy is reliant on the functioning of an externally provided system or service such as an electric utility or municipal transportation service.
Indirect Costs or Benefits	Hazard-related costs or benefits that are not borne by or directed to the project owner or developer, but by or to entities external to the project.
Opportunity Costs	The economic benefits that are missed when selecting one strategy over another.
Reliability/Functionality	The degree to which a strategy can reliably function in order to achieve the desired goal. For example, having residents opening windows for natural ventilation to reduce artificial cooling is not a highly reliable strategy, whereas automated shutoff of cooling systems below a specific temperature is a more reliable strategy.
Resilience Dividend	The difference in the outcomes between a scenario with a resilience approach and one with a non-resilient business-as-usual approach. It quantifies both the direct returns to the immediate resilience goal, as well as the societal and financial co-benefits. These can include value-added to the project and regenerative potential.

Parameters

12. Evaluation of Strategies

12a. Strategy Evaluation Criteria – Ownership Priorities

Before evaluating the various adaptation, mitigation, and sustainability strategies, the ownership team should determine their overall priorities for the project. This is done by distributing 200 points across the 21 evaluation criteria, with the most points allocated to criteria that have the highest priority. For example, if there will be limited staff to maintain the building, more points might be allocated to criteria T2 - Simplicity of management/operations. This will result in a weighted scoring of the proposed strategies from Sections 10 and 11, with ownership priorities more heavily weighted. Point allocation should be carried out in Section 12a of the Excel tool.

Given the focus on climate adaptation and mitigation, a minimum of 25 points should be allocated to criteria A1 - Meeting/Leveraging climate adaptation goals , and M1 - Meeting/Leveraging climate mitigation/sustainability goals.

Evaluation Criteria			Points
Distribute 200 points amongst the following criteria, allocating more points to criteria with higher priorities, 0 points if not applicable. A minimum 25 points each must be allocated to criteria A1 & M1.			
Climate Adaptation	A1.	Meeting/Leveraging climate adaptation goals	Min. 25
	A2.	Effectiveness to reduce hazard risk	
	A3.	Reliability to be able to function during hazard	
Climate Mitigation & Sustainability	M1.	Meeting/Leveraging climate mitigation and sustainability goals	Min. 25
	M2.	Effectiveness in reducing GHGs	
	M3.	Reliability/ Functionality in reducing emissions	
Technical Requirements	T1.	Simplicity of implementation	
	T2.	Simplicity of management/operations	
	T3.	Durability/ Longevity/ Duration of strategy	
	T4.	Independence from external systems/services	
Project Requirements	P1.	Alignment with other project goals/ requirements	
	P2.	Contributes to occupant health, comfort and well-being	
	P3.	Redresses current inequities or improves equity	
Direct Costs	C1.	Minimizes additional design costs	
	C2.	Minimizes additional construction costs	
	C3.	Minimizes total project costs	
	C4.	Minimizes operations & maintenance costs	
Indirect Costs & Benefits	I1.	Low opportunity costs	
	I2.	Avoids hazard-related costs (avoided costs or losses)	
	I3.	Low indirect costs (displacement, emergency management, health costs)	
	I4.	High resilience dividends & value-added	
Other	O1.	Other criteria (defined by team)	
	O2.	Other criteria (defined by team)	
	O3.	Other criteria (defined by team)	
		Total	**200**

12b. Evaluation of Adaptation Strategies *(see Appendix B for additional worksheets)*

Using the evaluation criteria listed in Section 12a, the project team should evaluate the adaptation strategies proposed in Section 10 for each of the top hazards identified. Strategies can be assessed as High, Medium or Low in how well they perform with respect to the evaluation criteria. Evaluation of strategies should be carried out in the Excel tool.

	Hazard *(describe)*	**Strategy 1** *(describe)*	**Strategy 2** *(describe)*	**Strategy 3** *(describe)*	**Strategy 4** *(describe)*	**Completed by**
	Evaluation Criteria	**H/M/L**	**H/M/L**	**H/M/L**	**H/M/L**	
Climate Adaptation	Meeting/Leveraging climate adaptation goals					AC
	Effectiveness to reduce hazard risk					
	Reliability to be able to function during hazard					
Climate Mitigation & Sustainability	Meeting/Leveraging climate mitigation and sustainability goals					SU
	Effectiveness in reducing GHGs					
	Reliability/ Functionality in reducing emissions					
Technical Requirements	Simplicity of implementation					Varies
	Simplicity of management/operations					
	Durability/ Longevity/ Duration of strategy					
	Independence from external systems/services					
Project Requirements	Alignment with other project goals/ requirements					Varies
	Contributes to occupant health, comfort and well-being					
	Redresses current inequities or improves equity					
Direct Costs	Minimizes additional design costs					CE, Others as required
	Minimizes additional construction costs					
	Minimizes total project costs					
	Minimizes operations & maintenance costs					
Indirect Costs & Benefits	Low opportunity costs					CE, AC, Others as required
	Avoided costs or losses					
	Low indirect costs					
	High resilience dividends & value-added					
Other	Other criteria (defined by team)					Varies
	Other criteria (defined by team)					

When evaluating proposed strategies with respect to Climate Adaptation or Climate Mitigation & Sustainability criteria, refer to the goals established in Sections 8 and 9. For adaptation strategies, determine how the strategy may impact mitigation goals (operational GHGs, embodied GHGs, renewable energy) or sustainability goals . With respect to embodied GHG goals, consider factors such as the need for additional space, additional equipment, additional materials, or different types of materials, all of which may increase embodied GHGs.

If required, copy the Excel spreadsheet to analyse strategies with respect to each distinct mitigation and sustainability goal.

12c. Scoring of Adaptation Strategies

Based on the points allocated to the criteria in Section 12a and the evaluations in Section 12b, a weighted score is calculated in the Excel tool for each adaptation strategy. The maximum possible score is 1000, representing a strategy with the highest favourability. The minimum possible score is 200. A score between 600-750 is considered acceptable with certain limitations, while a score below 600 would be considered unacceptable and trigger the team to propose alternatives. The strategy must also achieve a minimum score of 100 in both the Climate Adaptation and the Climate Mitigation & Sustainability categories, with strategies scoring above 150 in both categories deemed as synergistic.

A summary of the scores of the strategies proposed for each of the top hazards will be generated in the Excel tool:

Adaptation Strategy Scoring Summary					
Hazard *(describe)*	**Strategy 1**	**Strategy 2**	**Strategy 3**	**Strategy 4**	**Strategy 5**
Climate Adaptation					
Climate Mitigation & Sustainability					
Technical Requirements					
Project Requirements					
Direct Costs					
Indirect Costs & Benefits					
TOTAL SCORE					

If any of the strategies has a score below 600, or a score of below 100 in the Climate Adaptation or Climate Mitigation & Sustainability categories, the project team should revise the original adaptation strategies in Section 10 to develop alternate approaches.

The Excel tool will generate a bar chart for each hazard, comparing total scores of the proposed adaptation strategies (Figure 17).

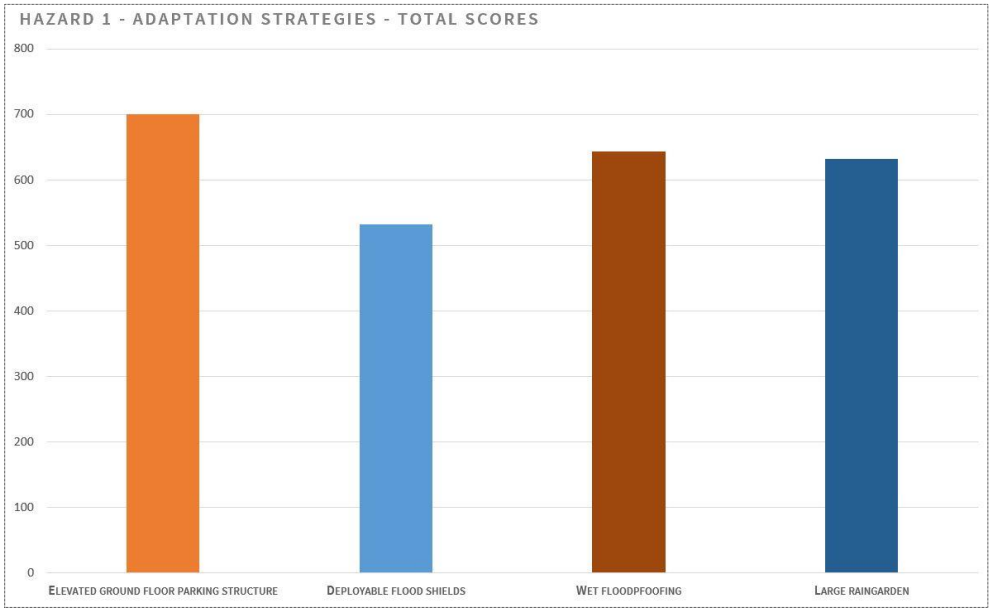


Figure 17. Example Bar Chart Comparing Adaptation Strategy Scores

For each group of strategies analyzed, the Excel tool will generate a radar chart indicating relative scoring of each adaptation strategy in each of the evaluation criteria categories (Figure 18). This will enable project teams to carry out more nuanced decision-making to determine which strategies are selected.

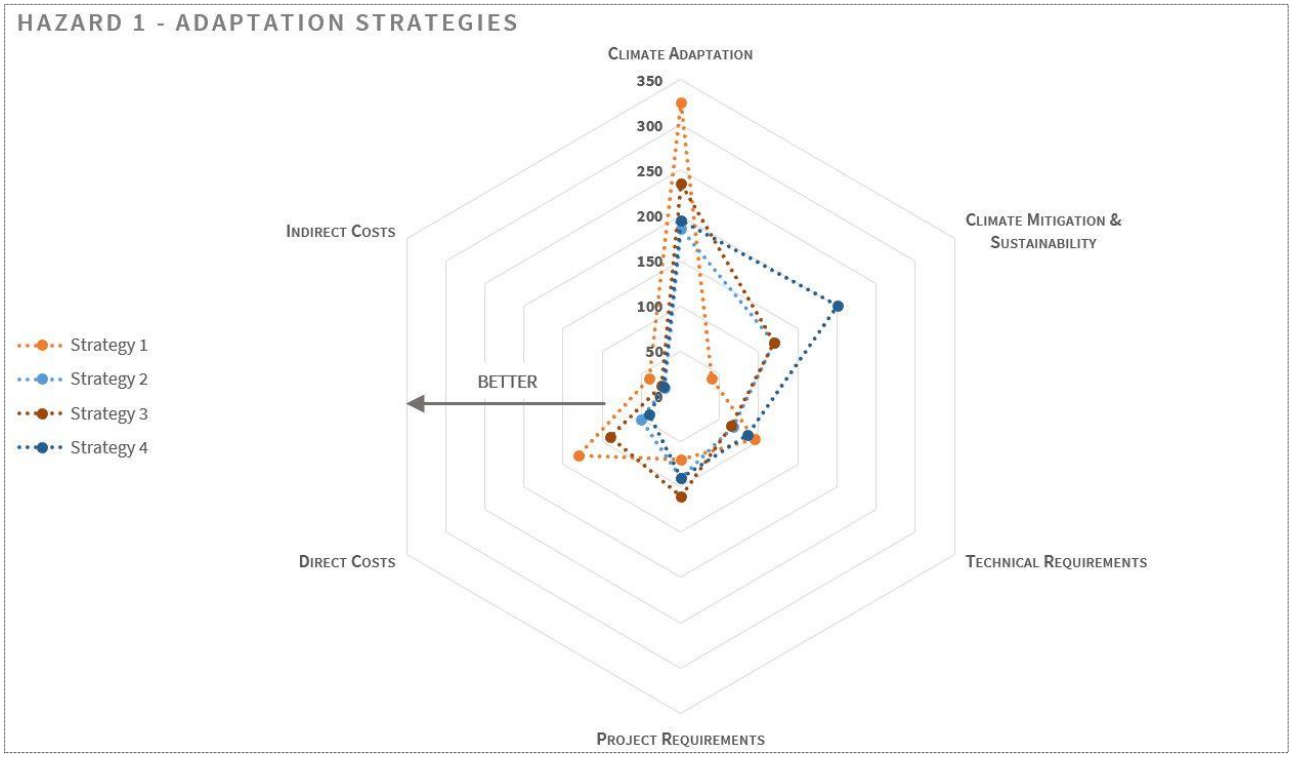


Figure 18. Example Radar Chart Comparing Adaptation Strategy Scores by Evaluation Category

For strategies scoring between 600 and 750, review the scores of the categories and/or individual evaluation criteria to determine if the strategy should be developed further. Some questions that can be asked to determine this are:

- *In which categories/criteria are the lowest scores? How high of a priority are they? Can priorities be adjusted?*
- *Are there ways that a strategy can be altered to improve it's score in a high priority category? For example, if simplicity of operations and maintenance is a high priority and a proposed in-unit air filtration system requires frequent filter replacement, would a centralized filtration system with fewer filters to replace be feasible?*
- *What trade-offs might a team be willing to accept for the benefits that the strategy provides? For example, giving up some resident parking spaces for a raingarden to manage perimeter stormwater would trade-off some minor occupant convenience for significant stormwater management and flood reduction benefits.*

12d. Summary of Adaptation Strategies for Development

Provide a brief description of the adaptation strategies to be further developed and incorporated into the project.

Hazard	Description of Adaptation Strategy & Follow-Up	Completed by	Action by
Hazard A		AC	
Hazard A			
Hazard A			
Hazard B			
Hazard B			
Hazard B			
Hazard C			
Hazard C			
Hazard C			
Hazard C			
Compounding Hazards			
Compounding Hazards			
Compounding Hazards			

12e. Evaluation of Mitigation and Sustainability Strategies *(see Appendix B for additional worksheets)*

Using the evaluation criteria listed in Section 12a, the project team should evaluate the climate mitigation and sustainability strategies proposed in Section 11. Strategies can be assessed as High, Medium or Low in response to the evaluation criteria. Evaluation of strategies should be carried out in the Excel tool.

	Mitigation or Sustainability Goal *(describe)*	Strategy 1 *(describe)*	Strategy 2 *(describe)*	Strategy 3 *(describe)*	Strategy 4 *(describe)*	Completed by
	Evaluation Criteria	**H/M/L**	**H/M/L**	**H/M/L**	**H/M/L**	
Climate Adaptation	Meeting/Leveraging climate adaptation goals					AC
	Effectiveness to reduce hazard risk					
	Reliability to be able to function during hazard					
Climate Mitigation & Sustainability	Meeting/Leveraging climate mitigation and sustainability goals					SU
	Effectiveness in reducing GHGs					
	Reliability/ Functionality in reducing emissions					
Technical Requirements	Simplicity of implementation					Varies
	Simplicity of management/operations					
	Durability/ Longevity/ Duration of strategy					
	Independence from external systems/services					
Project Requirements	Alignment with other project goals/ requirements					Varies
	Contributes to occupant health, comfort and well-being					
	Redresses current inequities or improves equity					
Direct Costs	Minimizes additional design costs					CE, Others as required
	Minimizes additional construction costs					
	Minimizes total project costs					
	Minimizes operations & maintenance costs					
Indirect Costs & Benefits	Low opportunity costs					CE, AC, Others as required
	Avoided costs or losses					
	Low indirect costs					
	High resilience dividends & value-added					
Other	Other criteria (defined by team)					Varies
	Other criteria (defined by team)					

When evaluating proposed strategies with respect to Climate Adaptation or Climate Mitigation & Sustainability criteria, refer to the goals established in Sections 8 and 9. For mitigation and sustainability strategies, determine how the strategy might affect adaptation goals for each of the top four hazards. If needed, copy the Excel spreadsheet to address distinctions between the adaptation goals for each of the hazards.

12f. Scoring of Mitigation and Sustainability Strategies

Based on the points allocated to the criteria in Section 12a and the evaluations in Section 12e, a weighted score is calculated in the Excel tool for each mitigation/sustainability strategy. The maximum possible score is 1000, representing a strategy with the highest favourability. The minimum possible score is 200. A score between 600-750 is considered acceptable with certain limitations, while a score below 600 would be considered unacceptable and trigger the team to propose alternatives. The strategy must also achieve a minimum score of 100 in both the Climate Adaptation and the Climate Mitigation & Sustainability categories, with strategies scoring above 150 in both categories deemed synergistic.

A summary table of the scores of the mitigation and sustainability strategies proposed will be generated in the Excel tool:

Mitigation and Sustainability Strategy Scoring Summary					
Mitigation or Sustainability Goal *(describe)*	**Strategy 1**	**Strategy 2**	**Strategy 3**	**Strategy 4**	**Strategy 5**
Climate Adaptation					
Climate Mitigation & Sustainability					
Technical Requirements					
Project Requirements					
Direct Costs					
Indirect Costs & Benefits					
TOTAL SCORE					

If any of the strategies has a score below 600, or a score of below 100 in the Climate Adaptation or Climate Mitigation & Sustainability categories, the project team should return to the mitigation and sustainability strategies in Section 11 to develop alternate approaches.

For each mitigation or sustainability goal, the Excel tool will generate a bar chart comparing the total scores of proposed mitigation strategies (Figure 19).

Figure 19. Example Bar Chart Comparing Sustainability Strategy Scores

The Excel tool will generate a radar chart indicating relative scoring of each mitigation or sustainability strategy in each of the evaluation criteria categories (Figure 20). This will enable project teams to carry out more nuanced decision-making to determine which strategies are selected.

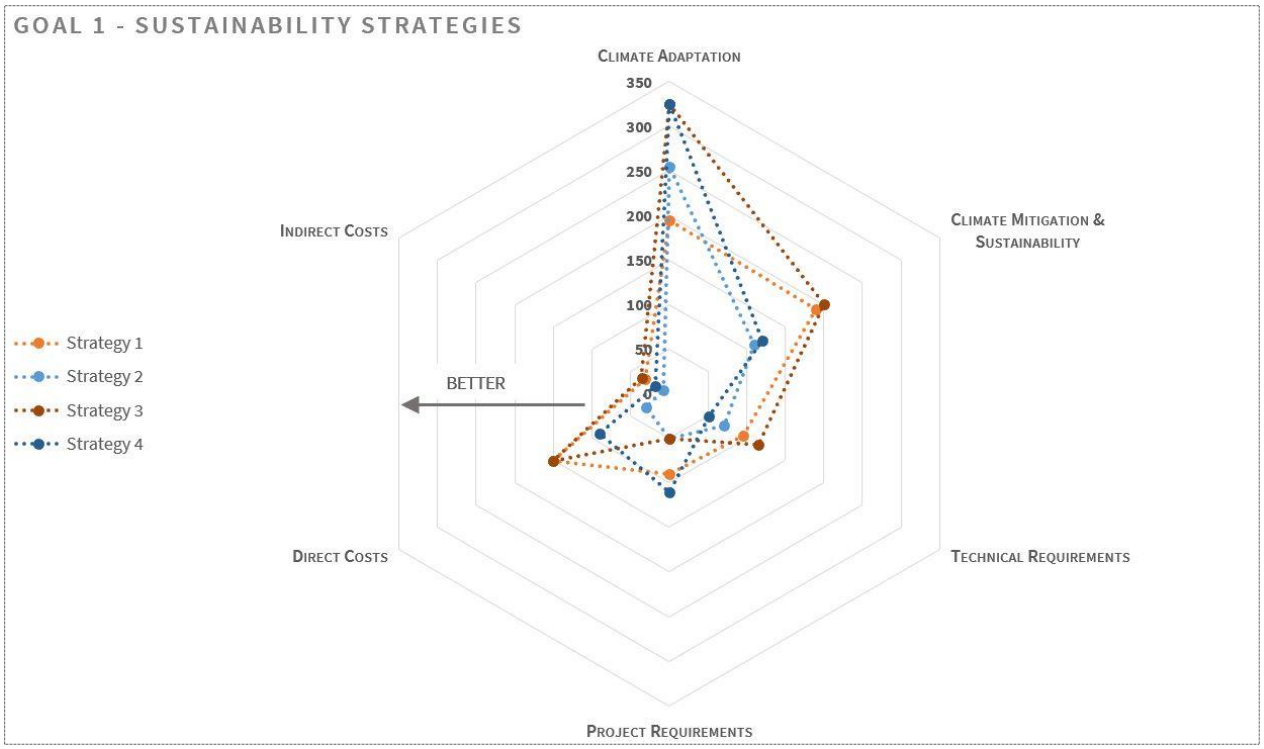


Figure 20. Example Radar Chart Comparing Sustainability Strategy Scores by Evaluation Category

For strategies scoring between 600 and 750, review the scores of the categories and/or individual evaluation criteria to determine if the strategy should be developed further. Some questions that can be asked to determine this are:

- *In which categories/criteria are the lowest scores? How high of a priority are they? Can priorities be adjusted?*
- *Are there ways that a strategy could be altered to improve it's score in a high priority category? For example, if simplicity of operations and maintenance is a priority and a proposed intensive green roof system would require monthly maintenance, could the plantings be modified to lower maintenance types?*
- *What trade-offs might a team be willing to accept for the benefits that the strategy provides? For example, a small reduction in occupant comfort by using 1.5 GPM showerheads is a trade-off for water conservation and water heating energy reduction benefits.*

12g. Summary of Mitigation and Sustainability Strategies for Development

Briefly describe the mitigation/ sustainability strategies to be further developed and incorporated into the project.

Mitigation or Sustainability Goal	Description of Mitigation or Sustainability Strategy & Follow-Up	Completed by	Action by
Goal 1		SU	
Goal 1			
Goal 1			
Goal 2			
Goal 2			
Goal 2			
Goal 3			
Goal 3			
Goal 3			
Goal 4			
Goal 4			
Goal 4			

Case Study Example

Below is an example of evaluation of adaptation strategies proposed for a new low-income residential building in a suburb of Victoria, BC. Residents are a combination of singles, families and seniors. This includes a population with disabilities. The adaptation strategies proposed are in reference to a compounding hazards scenario of increasing summer temperatures combined with seasonal drought, and a nearby major wildfire that results in poor air quality.

Note: This example is for illustrative purposes only. It is not representative of actual conditions or strategies and should not be substituted for an actual evaluation of strategies by the appropriate experts.

Climate Scenario & Target Year

IPCC RCP 8.5 2050

Project Address & Neighbourhood

Confidential Address, Colwood

Hazard Referenced

Compounding Hazards: Increasing summer temperatures + seasonal drought+ major wildfire resulting in poor air quality.

Cascading Impacts

Power outages; impacts to water treatment and distribution; stress on health service capacities; supply chain stresses.

12a. Adaptation, Mitigation and Sustainability Strategy Evaluation Criteria

Evaluation Criteria			Points
Distribute 200 points amongst the following criteria, allocating more points to criteria with higher priorities, and 0 points if criteria are not applicable. A minimum 25 points each must be allocated to criteria A1 & M1.			
Climate Adaptation	A1.	Meeting/Leveraging climate adaptation goals	30
	A2.	Effectiveness to reduce hazard risk	15
	A3.	Reliability to be able to function during hazard	20
Climate Mitigation & Sustainability	M1.	Meeting/Leveraging climate mitigation and sustainability goals	25
	M2.	Effectiveness in reducing GHGs	10
	M3.	Reliability/ Functionality in reducing emissions	5
Technical Requirements	T1.	Simplicity of implementation	10
	T2.	Simplicity of management/operations	5
	T3.	Durability/ Longevity/ Duration of strategy	10
	T4.	Independence from external systems/services	2
Project Requirements	P1.	Alignment with other project goals/ requirements	10
	P2.	Contributes to occupant health, comfort and well-being	10
	P3.	Redresses current inequities or improves equity	10

Evaluation Criteria			Points
Direct Costs	C1.	Minimizes additional design costs	0
	C2.	Minimizes additional construction costs	10
	C3.	Minimizes total project costs	15
	C4.	Minimizes operations & maintenance costs	5
Indirect Costs & Benefits	I1.	Low opportunity costs	0
	I2.	Avoids hazard-related costs (Avoided costs or losses)	5
	I3.	Low indirect costs (displacement, emergency management, health costs)	2
	I4.	High resilience dividends & value-added	1
Other	O1.	Other criteria (defined by team)	0
	O2.	Other criteria (defined by team)	0
	O3.	Other criteria (defined by team)	0
		Total	**200**

12b. Evaluation of Adaptation Strategies

	Hazard	Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5
	Increasing summer temperatures + Seasonal drought + Major wildfire = Poor Air Quality	*Allocation of coolest units to disabled*	*Light coloured cladding & roofing*	*Deciduous vegetation at lower floors*	*Emergency generator for HRVs and cooling*	*MERV 15-17 filters for HRVs*
	Completed By	ME, FM, RR	AR, ME	LA, SC, ME	ME, AR	ME
	Evaluation Criteria	**H/M/L**	**H/M/L**	**H/M/L**	**H/M/L**	**H/M/L**
Climate Adaptation	Meeting/Leveraging climate adaptation goals	H	M	M	H	H
	Effectiveness to reduce hazard risk	M	M	M	H	H
	Reliability to be able to function during hazard	M	H	H	H	M
Climate Mitigation & Sustainability	Meeting/Leveraging climate mitigation and sustainability goals	M	H	H	L	M
	Effectiveness in reducing GHGs	H	M	H	L	L
	Reliability/ Functionality in reducing emissions	M	H	H	L	L
Technical Requirements	Simplicity of implementation	M	H	M	M	M
	Simplicity of management/operations	L	H	M	M	L
	Durability/ Longevity/ Duration of strategy	L	H	H	M	M
	Independence from external systems/services	H	H	H	M	L

	Hazard	Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5
	Increasing summer temperatures + Seasonal drought + Major wildfire = Poor Air Quality	*Allocation of coolest units to disabled*	*Light coloured cladding & roofing*	*Deciduous vegetation at lower floors*	*Emergency generator for HRVs and cooling*	*MERV 15-17 filters for HRVs*
Project Requirements	Alignment with other project goals/ requirements	L	H	H	L	H
	Contributes to occupant health, comfort and well-being	M	M	M	H	H
	Redresses current inequities or improves equity	M	H	H	L	M
Direct Costs	Minimizes additional design costs	M	H	M	M	L
	Minimizes additional construction costs	L	L	M	M	M
	Minimizes total project costs	H	H	M	M	M
	Minimizes operations & maintenance costs	H	H	M	M	L
Indirect Costs & Benefits	Low opportunity costs	M	H	H	L	L
	Avoided costs or losses	H	M	M	H	H
	Low indirect costs	H	M	M	L	L
	High resilience dividends & value-added	M	M	M	H	H

12c. Scoring of Adaptation Strategies

Adaptation Strategy Scoring Summary					
Compounding Hazards	**Strategy 1**	**Strategy 2**	**Strategy 3**	**Strategy 4**	**Strategy 5**
Climate Adaptation	255	235	235	325	285
Climate Mitigation & Sustainability	140	180	200	40	90
Technical Requirements	55	135	105	81	67
Project Requirements	70	130	130	70	130
Direct Costs	150	150	90	90	80
Indirect Costs & Benefits	30	20	20	32	32
TOTAL SCORE	**700**	**850**	**780**	**638**	**684**

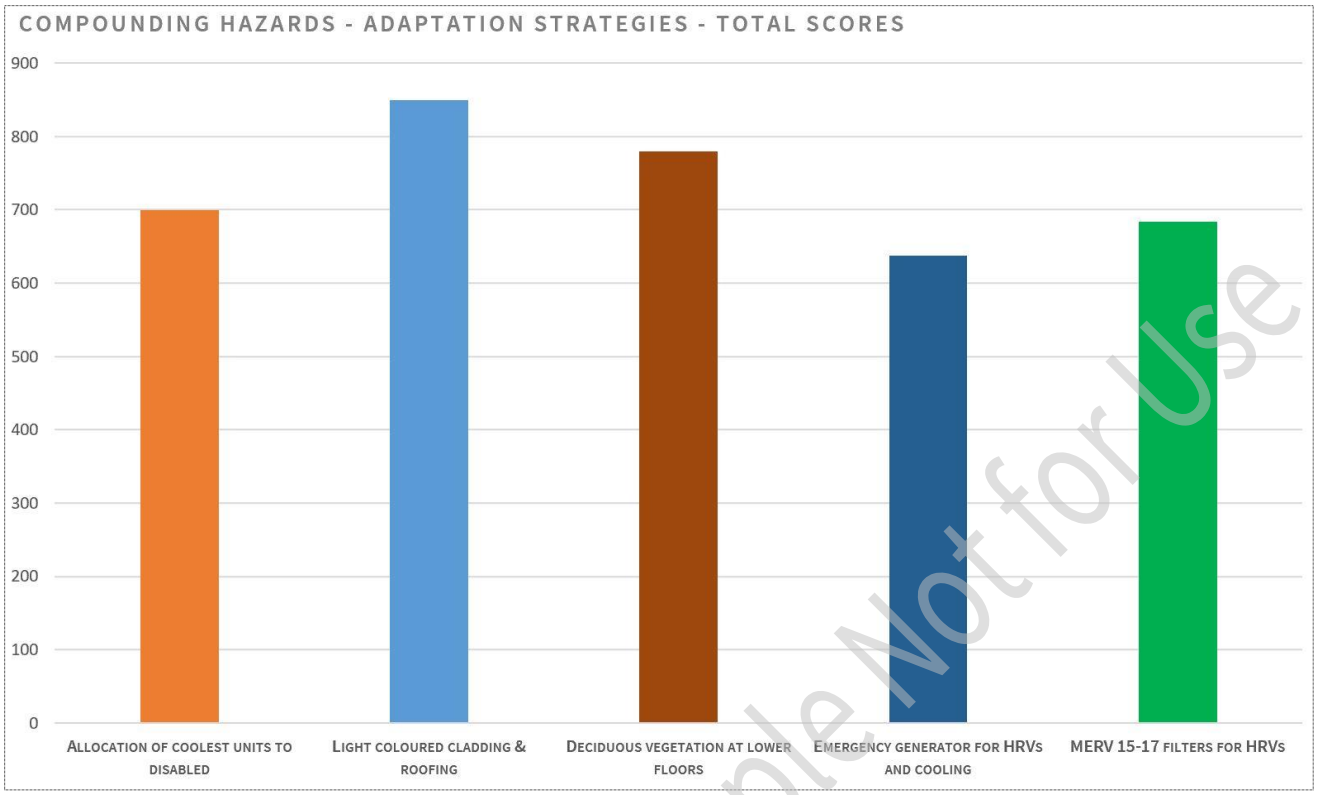


Figure 21. Bar chart comparing total scores of adaptation strategies analyzed for compounding hazards

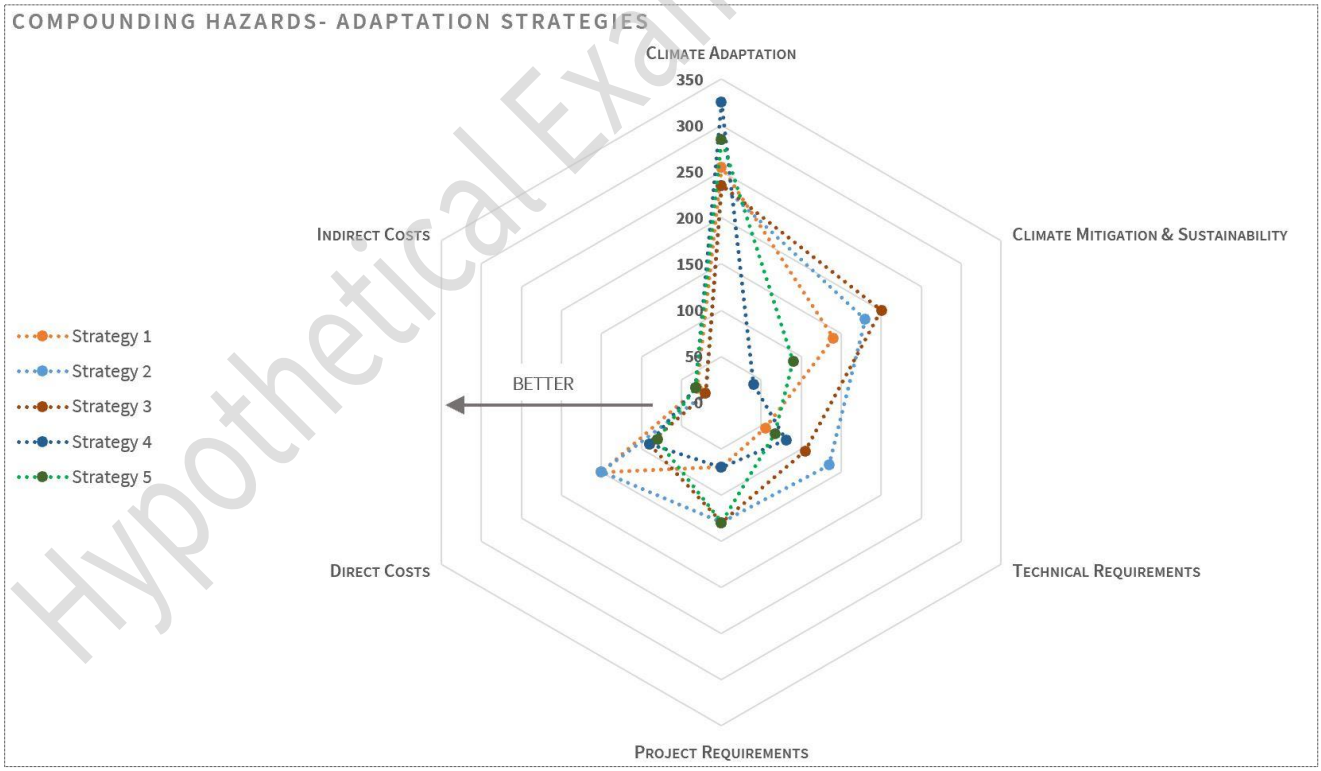


Figure 22. Radar chart comparing category scores of adaptation strategies analyzed for compounding hazards

12d. Summary of Adaptation Strategies for Development

Based on the assessment, the following strategies are recommended for the compounding hazards of increasing summer temperatures with seasonal drought leading to major wildfires that result in poor air quality. Strategies are complementary to each other and therefore should be carried out as an ensemble.

Hazard	Description of Adaptation Strategy & Follow-Up	Completed by	Action by
Compounding Hazards - Increasing summer temperatures + Seasonal drought + Major wildfire = Poor Air Quality	<u>Strategy 1 – Allocation of coolest units to disabled</u> Strategy scored only a medium on both effectiveness and reliability to reduce the hazard risk. Following thermal comfort modeling for present and future climates, confirm that units will be sufficiently cool. If so, allocate the most thermally comfortable units to low mobility/disabled residents. Lower floor & north facing units favoured. If not, determine at which point in the future that supplementary cooling would be required, and for which units. Ensure that the project is 'cooling ready' with the necessary infrastructure.	OD, AR, ME, FM, AC, SU	ME, AC
	<u>Strategy 2 – Light coloured cladding and roofing</u> Low to no cost modification. Adjust thermal comfort model to account for change in solar reflectance index of the exterior walls and roof to determine indoor temperature changes. If changes are insufficient, refer to recommendations in Strategy 1.		ME, AR
	<u>Strategy 3 – Deciduous vegetation at lower floors</u> Light coloured cladding and roofing to reduce solar heat gain. Confirm material options with owner.		AR
	<u>Strategy 5 - MERV 15-17 filters on rooftop HRVs units</u> Design HRV system to accommodate MERV 15-17 filters during a wildfire event, while using the standard MERV 13 filters during non-wildfire periods. Though this strategy does not meet the minimum mitigation & sustainability score of 100 due to increased energy use and no reduction in GHG emissions, the anticipated increase in energy consumption will only occur when the system is using finer filters during wildfire periods, with negligible GHGs due to hydroelectric power. However, electricity cost and system maintenance should be investigated more carefully due to limited operations & maintenance budgets and human resources. Energy consumption of the system should be modeled for wildfire periods to assess increases in use and cost.		ME, SU

Recommended Documentation and Deliverables

Note that some of the deliverables listed overlap with and/or are repeated in other sections.

Project Phase	Deliverable	Completed by
Feasibility & Financing	▪ General % budget allocation for climate mitigation and sustainability measures, and quantify potential cost-benefits if possible	OD
Pre-Design	▪ N/A	
Schematic Design	▪ Completed Section 12 of the IBAMA framework ▪ Strategy evaluation report describing adaptation, mitigation and sustainability strategy alternatives with associated scores, and selected strategies ▪ Preliminary cost estimate of selected strategies	See 12a-g AR, SU, LA, Engineers CE, CM
Design Development	▪ Updated Section 12 of IBAMA framework ▪ Report on development of proposed strategies including evaluation scores ▪ Updated cost estimate of selected strategies ▪ Peer-review evaluation report of strategies to confirm alignment with initial goals, as well as proposed adjustments	See 12a-g AR, SU, LA, Engineers CE, CM Peer Reviewer
Construction Documents	▪ Updated Section 12 of IBAMA framework ▪ Updated report on development of proposed strategies including evaluation scores ▪ Further development of technical strategies in drawings and specifications ▪ Updated cost estimate of selected strategies	See 12a-g AR, SU, LA, Engineers CE, CM
Project Construction	▪ Ongoing construction meeting agenda item for IBAMA strategies in meeting minutes ▪ Monthly IBAMA-related construction report ▪ Schedule of IBAMA-related site visits to review implementation of strategies ▪ IBAMA site visit reports by IBAMA design & construction leads	CM CM CM AR, SU, LA, Engineers
As-built/ Occupancy	▪ Summary of adaptation, mitigation and sustainability goals and strategies ▪ Manual and/or training video for building managers and operators focusing on proposed strategies	AR, SU, others as needed
Post-Occupancy	▪ Schedule for testing and inspections of mitigation, sustainability and adaptation-related systems ▪ Resident education video for hazard preparedness, energy efficiency, and sustainability best practices	FM, ME, CX Agent OD, RR

Appendix A – IBAMA Summary for Project Team

Description

This form summarizes the key information related to climate adaptation, mitigation and sustainability goals targeted for the project, as well as the specific strategies being employed to meet these goals. This summary can also be completed in the IBAMA Excel tool and should be updated at a minimum of once per project phase, or as goals and strategies evolve. It should be distributed to all project team members, including subcontractors and building operations staff.

General Information

Project Name	
Project Address	
Neighbourhood	
Municipality	
Owner	
Manager/Operator	
Anticipated Lifespan	
Climate Scenario & Primary Target Year	
Project Demographics	
Typology	
Unit Mix	
Project Purpose & Principles Statement	

Top Hazards, Project Risks, Adaptation Goals & Selected Strategies

Hazard A

Hazard Description -

Project Risks to Hazard	Adaptation Goals	Strategies to Meet Adaptation Goals	Completed by

Hazard B

Hazard Description -

Project Risks to Hazard	Adaptation Goals	Strategies to Meet Adaptation Goals	Completed by

Hazard C

Hazard Description -			
Project Risks to Hazard	**Adaptation Goals**	**Strategies to Meet Adaptation Goals**	**Completed by**

Compounding Hazards

Hazard Description -

Project Risks to Hazard	Adaptation Goals	Strategies to Meet Adaptation Goals	Completed by

Climate Mitigation Goals, Sustainability Goals & Selected Strategies

Climate Mitigation

Mitigation Goals	Strategies to Meet Mitigation Goals	Completed by

Sustainability

Sustainability Goals	Strategies to Meet Sustainability Goals	Completed by

Key Contacts for Additional Information on Goals & Strategies

Name	Area of Expertise	Contact Details

Appendix B – Additional Worksheets

Section 2 – Climate Information

2c. Building Systems Linkages to Climate Change Scenarios

Building Component/ System	System Lifespan	Related climate scenario and year	Retrofit feasibility for later climate	Potential system lifespan interactions *(In reference to each top hazard in Section 3)*	Potential cost impacts of designing to future climate
Building Structure and Foundations					
Enclosure – Exterior Walls					
Enclosure – Roof					
Enclosure - Windows					
Systems – HVAC - Cooling					
Systems – HVAC - Heating					
Systems – HVAC - Ventilation					
Systems – Electrical					

Building Component/ System	System Lifespan	Related climate scenario and year	Retrofit feasibility for later climate	Potential system lifespan interactions *(In reference to each top hazard in Section 3)*	Potential cost impacts of designing to future climate
Systems – Lighting					
Systems – IT & Communications					
Systems – Plumbing Distribution					
Systems – Plumbing Fixtures					
Systems – Fire Protection					
Systems – Vertical Transportation					
Site – Stormwater					
Site – Landscape and Paving					
Other (describe)					

Section 3 – Climate Hazards

3c. Top Hazard B

Parameter	Notes	Completed by
Identify and describe the hazard with the second highest score from Section 3a. i. Description of Hazard B		
List the top three potential cascading impacts associated with Hazard B ii. Potential Cascading Impact iii. Potential Cascading Impact iv. Potential Cascading Impact	See Glossary of Terms in Section 1 for definition of cascading impacts.	

3d. Top Hazard C

Parameter	Notes	Completed by
Identify and describe the hazard with the third highest score from Section 3a. i. Description of Hazard C		
List the top three potential cascading impacts associated with Hazard C ii. Potential Cascading Impact iii. Potential Cascading Impact iv. Potential Cascading Impact	See Glossary of Terms in Section 1 for definition of cascading impacts.	

3e. Compounding Hazards

Parameter	Notes	Completed by
Identify and describe the compounding hazards scenario with the highest score from Section 3a. i. Description of Compounding Hazards		
List the top three potential cascading impacts associated with the compounding hazards scenario i. Potential Cascading Impact ii. Potential Cascading Impact iii. Potential Cascading Impact	See Glossary of Terms in Section 1 for definition of cascading impacts.	

3f. Additional Hazards

Parameter	Notes	Completed by
Identify any additional hazards for consideration from Section 3a. i. Description of Additional Hazard(s)		
List the top three potential cascading impacts associated with the additional hazard(s) iv. Potential Cascading Impact v. Potential Cascading Impact vi. Potential Cascading Impact	See Glossary of Terms in Section 1 for definition of cascading impacts.	

Sections 5 & 6 – Neighbourhood Assets & Risks

5b. Neighbourhood assets for Hazard B

Asset	Description of neighbourhood asset	Duration *(short, medium, long, ?)*	Space & time limitations	Completed by
Asset 1				
Asset 2				
Asset 3				
Asset 4				
Asset 5				
Asset 6				
Asset 7				
Asset 8				
Asset 9				
Asset 10				

5c. Neighbourhood assets for Hazard C

Asset	Description of neighbourhood asset	Duration *(short, medium, long, ?)*	Space & time limitations	Completed by
Asset 1				
Asset 2				
Asset 3				
Asset 4				
Asset 5				
Asset 6				
Asset 7				
Asset 8				
Asset 9				
Asset 10				

5d. Neighbourhood assets for Compounding Hazards

Asset	Description of neighbourhood asset	Duration *(short, medium, long, ?)*	Space & time limitations	Completed by
Asset 1				
Asset 2				
Asset 3				
Asset 4				
Asset 5				
Asset 6				
Asset 7				
Asset 8				
Asset 9				
Asset 10				

6b. Neighbourhood vulnerabilities & risks to Hazard B

Neighbourhood Vulnerability to Hazard B	Vulnerability ranking *(from H=10 to L=1)*	Hazard B score *(Score from Section 3 divided by 10)*	Risk score & ranking *(Vulnerability x Hazard)*	Risk time frame *(immediate, medium or long-term)*	Completed by
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

6c. Neighbourhood vulnerabilities & risks to Hazard C

Neighbourhood Vulnerability to Hazard C	Vulnerability ranking *(from H=10 to L=1)*	Hazard C score *(Score from Section 3 divided by 10)*	Risk score & ranking *(Vulnerability x Hazard)*	Risk time frame *(immediate, medium or long-term)*	Completed by
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

6d. Neighbourhood vulnerabilities & risks to Compounding Hazards

Neighbourhood Vulnerability to Compounding Hazards	Vulnerability ranking *(from H=10 to L=1)*	Compounding Hazard score *(Score from Section 3 divided by 10)*	Risk score & ranking *(Vulnerability x Hazard)*	Risk time frame *(immediate, medium or long-term)*	Completed by
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Section 7 – Project Risks

7b. Project vulnerabilities & risks to Hazard B

Project Vulnerability to Hazard B *(list key neighbourhood risks if applicable)*	**Vulnerability ranking** *(from H=10 to L=1)*	**Hazard B score** *(Score from Section 3 divided by 10)*	**Risk score & ranking** *(Vulnerability x Hazard)*	**Risk time frame** *(immediate, medium or long-term)*	**Completed by**
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
Neighbourhood risk (if applicable)					

7c. Project vulnerabilities & risks to Hazard C

Project Vulnerability to Hazard C	Vulnerability ranking *(from H=10 to L=1)*	Hazard C score *(Score from Section 3 divided by 10)*	Risk score & ranking *(Vulnerability x Hazard)*	Risk time frame *(immediate, medium or long-term)*	Completed by
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
Neighbourhood risk (if applicable)					

7d. Project vulnerabilities & risks to Compounding Hazards

Project Vulnerability to Compounding Hazards	Vulnerability ranking *(from H=10 to L=1)*	Compounding Hazards score *(Score from Section 3 divided by 10)*	Risk score & ranking *(Vulnerability x Hazard)*	Risk time frame *(immediate, medium or long-term)*	Completed by
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
Neighbourhood risk (if applicable)					

Section 8 – Adaptation Goals

8b. Adaptation Goals for Hazard B

Recap of Top Risks and Minimum Occupant Essential Needs			Notes	Completed by
Minimum top three risks from Section 7b):				
Relevant minimum occupant essential needs:				
Adaptation Goals	**Goal Type** *(occupant, asset, other)*	**Timeframe/ Duration/ Recovery**		

8c. Adaptation Goals for Hazard C

Recap of Top Risks and Minimum Occupant Essential Needs			Notes	Completed by
Minimum top three risks from Section 7c):				
Relevant minimum occupant essential needs:				
Adaptation Goals	**Goal Type** *(occupant, asset, other)*	**Timeframe/ Duration/ Recovery**		

8d. Adaptation Goals for Compounding Hazards

Recap of Top Risks and Minimum Occupant Essential Needs			Notes	Completed by
Minimum top three risks from Section 7d):				
Relevant minimum occupant essential needs:				
Adaptation Goals	**Goal Type** *(occupant, asset, other)*	**Timeframe/ Duration/ Recovery**		

Section 9 – Climate Mitigation & Sustainability Goals

9a. Climate Mitigation Goals

Description of Mitigation Goals			
Mitigation Goal	**Goal Type** *(operational GHGs, embodied GHGs, renewable energy, GHG sequestration)*	**Notes**	**Completed by**

9b. Sustainability Goals

Description of Sustainability Goals			
Sustainability Goal	**Goal Type** *(location & site, water, materials, health, other, etc.)*	**Notes**	**Completed by**

Section 10 – Adaptation Strategies

10b. Adaptation Strategies for Hazard B

Step 1 – List adaptation goals and occupant essential needs (if applicable) from Section 8

Adaptation Goals	Occupant Essential Needs	Completed by
1.	1.	
2.	2.	
3.	3.	

Step 2 – Develop initial adaptation strategies noting time limitations and lifespan considerations

Proposed Adaptation Strategies	Time Limitations *(see Section 8)*	Lifespan Considerations *(see Section 2)*	Completed by
1.			
2.			
3.			
4.			
5.			

Step 3 – Determine if the proposed adaptation strategies meet main project requirements from Section 1

Proposed Adaptation Strategies	Meets Code & Zoning Requirements	Meets Program & OPR	Completed by
1.	Y/N/TBD	Y/N/Partial/TBD	
2.	Y/N/TBD	Y/N/Partial/TBD	
3.	Y/N/TBD	Y/N/Partial/TBD	
4.	Y/N/TBD	Y/N/Partial/TBD	
5.	Y/N/TBD	Y/N/Partial/TBD	

If a strategy does not comply with project requirements, it should be further investigated, revised or eliminated.

Step 4 – Determine that proposed adaptation strategies do not conflict with adaptation goals for the other top hazards.

Proposed Adaptation Strategies	Avoids Conflicts w/Hazard B	Avoids Conflicts w/Hazard C	Avoids Conflicts w/ Compounding Hazards	Completed by
1.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
2.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
3.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
4.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
5.	Y/N/TBD	Y/N/TBD	Y/N/TBD	

If a strategy conflicts significantly with adaptation goals for the other top hazards, it should be revised or eliminated.

10c. Adaptation Strategies for Hazard C

Step 1 – List adaptation goals and occupant essential needs (if applicable) from Section 8

Adaptation Goals	Occupant Essential Needs	Completed by
1.	1.	
2.	2.	
3.	3.	

Step 2 – Develop initial adaptation strategies noting time limitations and lifespan considerations

Proposed Adaptation Strategies	Time Limitations *(see Section 8)*	Lifespan Considerations *(see Section 2)*	Completed by
1.			
2.			
3.			
4.			
5.			

Step 3 – Determine if the proposed adaptation strategies meet main project requirements from Section 1

Proposed Adaptation Strategies	Meets Code & Zoning Requirements	Meets Program & OPR	Completed by
1.	Y/N/TBD	Y/N/Partial/TBD	
2.	Y/N/TBD	Y/N/Partial/TBD	
3.	Y/N/TBD	Y/N/Partial/TBD	
4.	Y/N/TBD	Y/N/Partial/TBD	
5.	Y/N/TBD	Y/N/Partial/TBD	

If a strategy does not comply with project requirements, it should be further investigated, revised or eliminated.

Step 4 – Determine that proposed adaptation strategies do not conflict with adaptation goals for the other top hazards.

Proposed Adaptation Strategies	Avoids Conflicts w/Hazard B	Avoids Conflicts w/Hazard C	Avoids Conflicts w/ Compounding Hazards	Completed by
1.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
2.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
3.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
4.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
5.	Y/N/TBD	Y/N/TBD	Y/N/TBD	

If a strategy conflicts significantly with adaptation goals for the other top hazards, it should be revised or eliminated.

10d. Adaptation Strategies for Compounding Hazards

Step 1 – List adaptation goals and occupant essential needs (if applicable) from Section 8

Adaptation Goals	Occupant Essential Needs	Completed by
1.	1.	
2.	2.	
3.	3.	

Step 2 – Develop initial adaptation strategies noting time limitations and lifespan considerations

Proposed Adaptation Strategies	Time Limitations *(see Section 8)*	Lifespan Considerations *(see Section 2)*	Completed by
1.			
2.			
3.			
4.			
5.			

Step 3 – Determine if the proposed adaptation strategies meet main project requirements from Section 1

Proposed Adaptation Strategies	Meets Code & Zoning Requirements*	Meets Program & OPR	Completed by
1.	Y/N/TBD	Y/N/Partial/TBD	
2.	Y/N/TBD	Y/N/Partial/TBD	
3.	Y/N/TBD	Y/N/Partial/TBD	
4.	Y/N/TBD	Y/N/Partial/TBD	
5.	Y/N/TBD	Y/N/Partial/TBD	

**If regulatory requirements are not met, identify opportunities to address conflicts with government agencies.*

Step 4 – Determine that proposed adaptation strategies do not conflict with adaptation goals for the other top hazards.

Proposed Adaptation Strategies	Avoids Conflicts w/Hazard B	Avoids Conflicts w/Hazard C	Avoids Conflicts w/ Compounding Hazards	Completed by
1.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
2.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
3.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
4.	Y/N/TBD	Y/N/TBD	Y/N/TBD	
5.	Y/N/TBD	Y/N/TBD	Y/N/TBD	

If a strategy conflicts significantly with adaptation goals for the other top hazards, it should be revised or eliminated.

Section 11 – Climate Mitigation & Sustainability Strategies

11a. Climate Mitigation Strategies

Step 1 – List mitigation goals from Section 9 and develop an initial list of mitigation strategies.

Mitigation Goals	Proposed Mitigation Strategies	Completed by
	1.	OD, AR, SU, ME, ST, CM, LA, AD, Others as applicable
	2.	
	3.	
	4.	
	5.	
	6.	
	7.	
	8.	

Step 2 – Determine if the proposed mitigation strategies meet the main project requirements from Section 1 and do not conflict with other mitigation or sustainability goals listed in Section 9.

Proposed Mitigation Strategies	Meets Codes & Zoning*	Meets Program & OPR	Aligns w/ Other Goals	Completed by
1.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	OD, AR, SU, ME, ST, CM, LA, AD, Others as applicable
2.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
3.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
4.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
5.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
6.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
7.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
8.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	

**If regulatory requirements are not met, identify opportunities to address conflicts with government agencies.*

Step 3. List selected strategies and follow-up tasks (e.g. verification for code compliance, cost & technical analysis, etc.)

Selected Mitigation Strategies	Follow up Required	Date Required	Action by
1.			Varies depending upon strategy proposed
2.			
3.			
4.			
5.			
6.			
7.			
8.			

If a strategy does not comply with project requirements or conflicts significantly with other mitigation or sustainability goals, it should be further investigated, revised or eliminated.

11b. Sustainability Strategies

Step 1 – List sustainability goals from Section 9 and develop an initial list of sustainability strategies.

Sustainability Goals	Proposed Sustainability Strategies	Completed by
	1.	OD, AR, SU, ME, ST, CM, LA, AC, Others as applicable
	2.	
	3.	
	4.	
	5.	
	6.	
	7.	
	8.	

Step 2 – Determine if the proposed sustainability strategies meet the main project requirements from Section 1 and do not conflict with other mitigation or sustainability goals listed in Section 9.

Proposed Sustainability Strategies	Meets Codes & Zoning*	Meets Program & OPR	Aligns w/ Other Goals	Completed by
1.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	Varies depending upon strategy proposed
2.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
3.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
4.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
5.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
6.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
7.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	
8.	Y/N/TBD	Y/N/Partial/TBD	Y/N/TBD	

**If regulatory requirements are not met, identify opportunities to address conflicts with government agencies.*

Step 3. List selected strategies and follow-up tasks (e.g. verification for code compliance, cost & technical analysis, etc.)

Selected Sustainability Strategies	Follow up Required	Date Required	Action by
1.			Varies depending upon strategy proposed
2.			
3.			
4.			
5.			
6.			
7.			
8.			

If a strategy does not comply with project requirements or conflicts significantly with other mitigation or sustainability goals, it should be further investigated, revised or eliminated.

Section 12 – Evaluation of Strategies

12b. Evaluation of Adaptation Strategies

	Hazard *(describe)*	Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5
	Evaluation Criteria	**H/M/L**	**H/M/L**	**H/M/L**	**H/M/L**	**H/M/L**
Climate Adaptation	Meeting/Leveraging climate adaptation goals					
	Effectiveness to reduce hazard risk					
	Reliability to be able to function during hazard					
Climate Mitigation & Sustainability	Meeting/Leveraging climate mitigation and sustainability goals					
	Effectiveness in reducing GHGs					
	Reliability/ Functionality in reducing emissions					
Technical Requirements	Simplicity of implementation					
	Simplicity of management/operations					
	Durability/ Longevity/ Duration of strategy					
	Independence from external systems/services					
Project Requirements	Alignment with other project goals/ requirements					
	Contributes to occupant health, comfort and well-being					
	Redresses current inequities or improves equity					
Direct Costs	Minimizes additional design costs					
	Minimizes additional construction costs					
	Minimizes total project costs					
	Minimizes operations & maintenance costs					
Indirect Costs & Benefits	Low opportunity costs					
	Avoided costs or losses					
	Low indirect costs					
	High resilience dividends & value-added					
Other	Other criteria (defined by team)					
	Other criteria (defined by team)					

12b. Evaluation of Adaptation Strategies (continued)

	Hazard *(describe)*	Strategy 6	Strategy 7	Strategy 8	Strategy 9	Completed by
	Evaluation Criteria	**H/M/L**	**H/M/L**	**H/M/L**	**H/M/L**	
Climate Adaptation	Meeting/Leveraging climate adaptation goals					AC
	Effectiveness to reduce hazard risk					
	Reliability to be able to function during hazard					
Climate Mitigation & Sustainability	Meeting/Leveraging climate mitigation and sustainability goals					SU
	Effectiveness in reducing GHGs					
	Reliability/ Functionality in reducing emissions					
Technical Requirements	Simplicity of implementation					Varies
	Simplicity of management/operations					
	Durability/ Longevity/ Duration of strategy					
	Independence from external systems/services					
Project Requirements	Alignment with other project goals/ requirements					Varies
	Contributes to occupant health, comfort and well-being					
	Redresses current inequities or improves equity					
Direct Costs	Minimizes additional design costs					CE, Others as required
	Minimizes additional construction costs					
	Minimizes total project costs					
	Minimizes operations & maintenance costs					
Indirect Costs & Benefits	Low opportunity costs					CE, AC, Others as required
	Avoided costs or losses					
	Low indirect costs					
	High resilience dividends & value-added					
Other	Other criteria (defined by team)					Varies
	Other criteria (defined by team)					

12e. Evaluation of Mitigation & Sustainability Strategies

	Mitigation or Sustainability Goal *(describe)*	Strategy 1	Strategy 2	Strategy 3	Strategy 4	Strategy 5
	Evaluation Criteria	**H/M/L**	**H/M/L**	**H/M/L**	**H/M/L**	**H/M/L**
Climate Adaptation	Meeting/Leveraging climate adaptation goals					
	Effectiveness to reduce hazard risk					
	Reliability to be able to function during hazard					
Climate Mitigation & Sustainability	Meeting/Leveraging climate mitigation and sustainability goals					
	Effectiveness in reducing GHGs					
	Reliability/ Functionality in reducing emissions					
Technical Requirements	Simplicity of implementation					
	Simplicity of management/operations					
	Durability/ Longevity/ Duration of strategy					
	Independence from external systems/services					
Project Requirements	Alignment with other project goals/ requirements					
	Contributes to occupant health, comfort and well-being					
	Redresses current inequities or improves equity					
Direct Costs	Minimizes additional design costs					
	Minimizes additional construction costs					
	Minimizes total project costs					
	Minimizes operations & maintenance costs					
Indirect Costs & Benefits	Low opportunity costs					
	Avoided costs or losses					
	Low indirect costs					
	High resilience dividends & value-added					
Other	Other criteria (defined by team)					
	Other criteria (defined by team)					

12e. Evaluation of Mitigation & Sustainability Strategies (continued)

	Mitigation or Sustainability Goal *(describe)*	Strategy 6	Strategy 7	Strategy 8	Strategy 9	Completed by
	Evaluation Criteria	**H/M/L**	**H/M/L**	**H/M/L**	**H/M/L**	
Climate Adaptation	Meeting/Leveraging climate adaptation goals					AC
	Effectiveness to reduce hazard risk					
	Reliability to be able to function during hazard					
Climate Mitigation & Sustainability	Meeting/Leveraging climate mitigation and sustainability goals					SU
	Effectiveness in reducing GHGs					
	Reliability/ Functionality in reducing emissions					
Technical Requirements	Simplicity of implementation					Varies
	Simplicity of management/operations					
	Durability/ Longevity/ Duration of strategy					
	Independence from external systems/services					
Project Requirements	Alignment with other project goals/ requirements					Varies
	Contributes to occupant health, comfort and well-being					
	Redresses current inequities or improves equity					
Direct Costs	Minimizes additional design costs					CE, Others as required
	Minimizes additional construction costs					
	Minimizes total project costs					
	Minimizes operations & maintenance costs					
Indirect Costs & Benefits	Low opportunity costs					CE, AC, Others as required
	Avoided costs or losses					
	Low indirect costs					
	High resilience dividends & value-added					
Other	Other criteria (defined by team)					Varies
	Other criteria (defined by team)					