

Strategic Climate Risk Assessment Framework for British Columbia

Developed in progress toward a
Strategic Climate Risk Assessment
for British Columbia

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Ministry of
Environment and
Climate Change Strategy

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PROJECT ADVISORY COMMITTEE

Dave Aharonian, *Ministry of Forests, Lands, Natural Resource Operations and Rural Development*

Liz Anderson, *Ministry of Forests, Lands, Natural Resource Operations and Rural Development*

Emily Dicken, *Emergency Management B.C.*

Jenny Fraser, *Ministry of Environment and Climate Change Strategy*

Marten Geertsema, *Ministry of Forests, Lands, Natural Resource Operations and Rural Development*

Jennifer Grant, *Ministry of Environment and Climate Change Strategy*

Mitchell Hahn, *Ministry of Forests, Lands, Natural Resource Operations and Rural Development*

Lee Nicol, *Ministry of Municipal Affairs and Housing*

Caitlin McGuire, *Ministry of Health*

Ian McLachlan, *Ministry of Agriculture*

Tina Neale, *Ministry of Environment and Climate Change Strategy*

Dirk Nyland, *Ministry of Transportation and Infrastructure*

Todd Orchard, *Ministry of Finance*

Emily Quinn, *Ministry of Health*

Elizabeth Scambler, *Emergency Management B.C.*

Jesal Shah, *Emergency Management B.C.*

Dominique Sigg, *Ministry of Environment and Climate Change Strategy*

Anna Stemberger, *Ministry of Agriculture*

Richard Thompson, *Ministry of Environment and Climate Change Strategy*

Mark Traverso, *Ministry of Transportation and Infrastructure*

Thomas White, *Ministry of Forests, Lands, Natural Resource Operations and Rural Development*

Johanna Wolf, *Ministry of Environment and Climate Change Strategy*



ADDITIONAL EXPERTS CONSULTED

Jim Baker, Stephen Ban, Sylvia Barroso, Julia Berry, Kevin Boon, Louise Bouchard, Amanda Broad, Ashleigh Brooks, Mary Cameron, Valerie Cameron, Jonathan Carroll, Crystal Chadburn, Brian Chow, John Clague, Garry Clarke, Stewart Cohen, Sarah Cooley, Tara DeCourcy, Rob Dorling, Wiley Evans, Nathan Friesen, Victoria Gagnon, Eleni Galanis, Dieter Geesing, Nicole Goldring, Bonnie Henry, Chris Hodder, Christina Huey, Kirsten Hunter, Debbie Ianson, Gregory Kehm, Anita Koralewicz, Tom Kosatsky, Crystal Lacher, Tim Lambert, Pat Lapcevic, Suzan Lapp, Cathy LeBlanc, Cameron Lewis, Richard Linzey, Steve Litke, Carol Loski, Emily MacNair, Elise McLellan, Jennifer Miles, Kate Miller, Glenn Moore, R.D. Moore, Muhammad Morshed, Trevor Murdock, Darren Nelson, Harry Nelson, Nicholas Ogden, Kelly Osbourne, Stephanie Papik, Robin Pike, Sue Pollock, Peter Prendergast, Mark Raymond, Heather Richards, Archie Riddell, Lindsay Row, Steve Sobie, Dave Spittlehouse, Jasmine Taulu, Gail Wallin, Shannon Waters, Catriona Weidman, Mark Weston, Bruce Whyte, Haley Williams, Lindsay Wood, Xibiao Ye, Francis Zwiers

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Key Terms

The definitions provided below are specific to the usage of these terms in the context of conducting a strategic climate risk assessment for British Columbia (B.C.).

- Asset – resources, services, or systems important to the province of B.C.
- Consequence – outcome of an event affecting objectives
- Cultural resource – a human work, an object, or a place that is determined, on the basis of its heritage value, to be directly associated with an important aspect or aspects of human history and culture (Parks Canada, 2013)¹
- Disruption to daily life – the ability to carry out daily activities (e.g., traveling to work or school, operating a business, spending time with family)
- Health – a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (World Health Organization, 1948)
- Likelihood – chance of something happening
- Loss of life – number of deaths due to a specific event
- Mitigation – this document uses the term “mitigation” to refer to risk mitigation (as opposed to greenhouse gas mitigation). See *risk mitigation* definition below.
- Morbidity – having a disease or symptom of disease, or the amount of disease within a population (National Cancer Institute, n.d.)
- Natural resources – biodiversity, ecosystems, ecosystem services, protected species, protected areas, and other resources provided by the natural environment
- Risk – effect of uncertainty on objectives
- Risk cause – climate-related hazards that are anticipated in B.C. and have the potential to negatively affect objectives
 - Discrete risk cause – a risk cause related to an individual extreme event (e.g., storm) or disaster that occurs over a relatively short period of time (e.g., days or weeks)
 - Ongoing risk cause – a risk cause related to a gradual change in climate that occurs over many years (e.g., sea level rise)
- Risk event – occurrence or change of a particular set of circumstances that could occur, due at least in part to climate change, and would have a significant impact on provincial objectives
- Risk mitigation – actions taken to reduce the likelihood or impact of a risk event
- Scenario – this document refers to two types of scenarios:
 - Emission scenario – Projections of a potential future, based on a clear logic and quantified storyline of the key driving forces of greenhouse gas emissions (IPCC, 2000)

¹ This is a widely-used definition and one applied and interpreted broadly for this framework. This category could include potential impacts to Indigenous communities and perspectives, but those impacts may also transcend this category.

- Risk event scenario – For a given risk event, a plausible set of specific circumstances such as location affected, time frame, and severity of hazard, to facilitate evaluation of likelihood and consequences

1 Introduction

The B.C. Climate Action Secretariat (CAS) engaged ICF to develop a framework for a strategic assessment of climate-related risks that can be used to prioritize adaptation responses across the provincial government.

The goal of the risk assessment is to enable the provincial government to compare different provincially significant climate-related risks; compare those with other risks; develop proportional responses to priority risks; and identify potential situations where current response capacity may be exceeded. In addition, the risk assessment should be consistent with risk disclosure standards and provincial risk management policy, including the *Risk Management Guideline for the B.C. Public Sector* (Province of British Columbia Risk Management Branch and Government Security Office, 2012).

This report documents our recommended climate risk assessment framework for B.C. The risk assessment itself will follow this framework, which is consistent with the ISO 31000 process, to evaluate climate-related risks and populate those climate-related risks into the B.C. risk register template (Figure 1).

	A	G	H	I	J	O	P	Q	R	S	
1	RISK IDENTIFICATION						INITIAL RISK RATING				Objective of the
2	#	OBJECTIVE	RISK EVENT	RISK CAUSE	IMPACT/ CONSEQUENCE	EXISTING MITIGATIONS	L (1-5)	C (1-5)	SUM	RISK RATING	
3							How likely?	How severe?			
4	<i>This prompt row can be hidden to provide more page space.</i>	What planning objective does this event affect?	What is it that you are working to avoid or reduce the likelihood or impact of occurring? Risks are future events that could interfere with achievement of objectives.	What are the triggers, sources or circumstances that could act alone or together to increase the likelihood of the Risk Event occurring? There are usually multiple causes leading to a Risk Event.	If this Risk Event did occur, how would it impact objectives? What are the longer-term or cumulative consequences?	What are you doing now to reduce the likelihood or impact of the event?					
5	Sample	1.3 Timely service delivery to citizens.	Invoice delivery to clients is slow and inaccurate.	- Legacy system is incompatible with data input requirements. - Data entry practices inconsistent - Manual data checks	- Unmet client service quality performance - Increased A/R - Increased risk of loss - Increased cost of recovery	- Manual data checks - Training manual	3	4	12	HIGH	

Figure 1. B.C. risk register template.

The framework is designed to be flexible and scalable for use in applications outside of the B.C. provincial risk assessment, and allows users to assess probabilities and consequences in a consistent and defensible way. While the majority of the framework is transferable for any use, the objectives and consequence categories presented in this framework are unique to the needs of the CAS and should be customized for other users.

We developed the framework to be consistent with the eight guiding principles specified by CAS (Table 1).

Table 1. Guiding Principles for B.C. Risk Assessment Framework

Principle	Approach to Meeting Principle in Framework
Comparability	<p>A detailed methodology is provided for each step in the risk assessment process that can be applied across sectors.</p> <p>The likelihood and consequence rating scales are clearly defined and mapped to the B.C. risk management template rating scales to ensure comparability across multiple sectors and beyond climate-related risk events as well as other types of risks.</p>
Proportionality	<p>The likelihood rating scale is designed to account for both discrete risk events and ongoing risk events. Recommendations are provided for how to consistently evaluate each type of event.</p> <p>The consequence rating scale is designed to account for multiple consequence categories and clearly articulate the order of magnitude of the different consequences types, which will facilitate identification of proportional responses.</p>
Recognition of existing capabilities	<p>Existing capabilities are accounted for in the “adequacy of existing risk mitigations” step of the risk assessment.</p>
Evidence-based	<p>The likelihood and consequence rating recommendations include evidence-based approaches. Suggested data sources are also provided to ensure all decisions are well-supported, and the framework recommends a template by which all evaluations are documented.</p>
Consistent with disclosure standards	<p>The framework is consistent with the Risk Management Guideline for the Public Sector, which follows ISO31000:2009.</p>
Consistent with other provincial policy	<p>The framework is consistent with the Risk Management Guideline for the Public Sector, which follows ISO31000:2009.</p>
Accessible	<p>The framework is written for a broad audience in plain English.</p>
Repeatable	<p>A detailed methodology is provided for each step in the risk assessment process to ensure repeatability. All steps, sources, and assumptions made during the risk assessment process are also documented.</p>

2 B.C. Risk Assessment Framework

Per the guiding principles, the B.C. climate risk assessment framework is designed to be consistent with the *Risk Management Guideline for the B.C. Public Sector* and ultimately result in a populated B.C. risk register template that covers climate-related risk events. The Risk Management Guidelines follow ISO31000:2009, the steps of which are outlined in Figure 2.

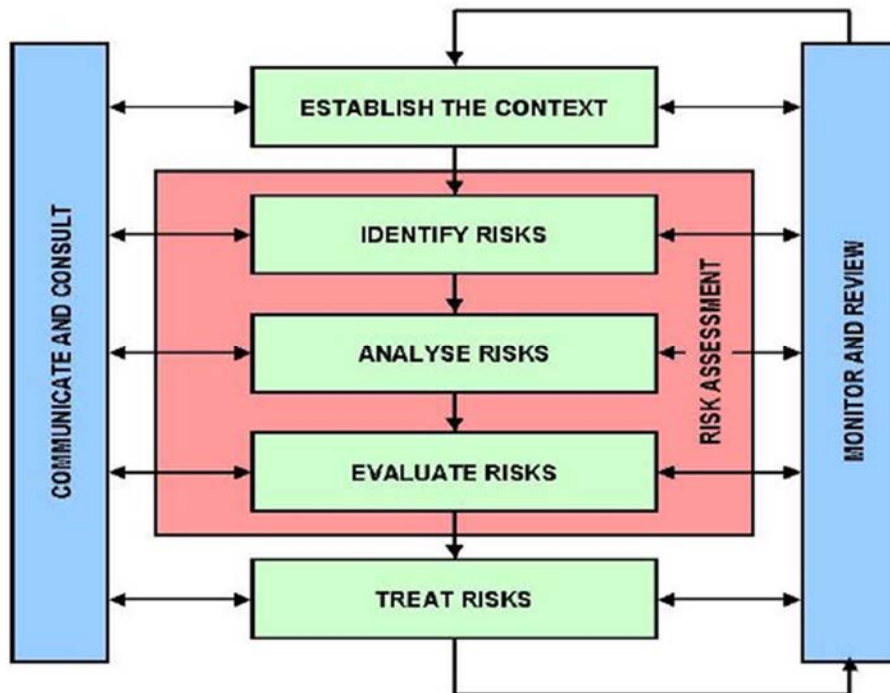


Figure 2. ISO 31000.

This document—the framework—provides guidance to the provincial government of B.C. for how these steps can be applied to assess climate-related risks.

The B.C. climate risk assessment framework includes four key steps to determine priority climate risk events in the province, shown in Figure 3.



Figure 3. B.C. climate risk assessment framework overview.

2.1 Step 1: Understand the context

For any risk assessment, the first step is to establish the context—such as goals, objectives, operating principles, and stakeholders—which will inform subsequent methodological decisions.

The context for the B.C. risk assessment is detailed in Section 3, B.C. Climate Risk Assessment.

2.2 Step 2: Identify risk events

The purpose of this step is to identify high priority “risk events” that will be evaluated in the risk assessment. Per the goals of the overall risk assessment, the risk events should be “provincially significant” (see definition below), and facilitate provincial risk mitigation decisions.

2.2.1 Determine objectives and risk causes

Risk events are the function of an “objective”—that is, something of value to B.C.—and one or more “risk causes”—something that could negatively affect the objectives. The risk events will ultimately become the line items in the B.C. risk register template. Objectives and risk causes for B.C. are shown in Table 2 and Table 3, respectively. Some risk events may be secondary to the risk causes provided in Table 3, such as wildfires or glacial loss.

Table 2. Example Objectives (additional information in Appendix A)

Objective	Description
Minimize loss of life	Preserve and enhance public health and safety and emergency/disaster response and recovery to limit rates of mortality
Minimize morbidity, injury, disease, or hospitalization	Preserve and enhance public health and safety, medical care, and emergency/disaster response and recovery to limit rates of morbidity or injury
Minimize psychological impacts	Preserve and enhance mental health and wellbeing, including safety and security
Minimize loss of social cohesion	Preserve and enhance quality of life, including access to social services (e.g., education and schools, housing and shelter, governance), community institutions, and employment
Minimize loss of cultural resources	Preserve and enhance culturally significant resources, including ancestral and historical sites, artifacts, culturally significant species, traditional foods, heritage values, and other cultural resources
Minimize loss of natural resources	Preserve and enhance the natural environment and ecosystem services, such as biodiversity, ecosystems, ecosystem services, protected species, protected areas, protected lands, parks, air quality, and water quality
Minimize loss of economic productivity	Preserve and enhance economic productivity, including agriculture (e.g., food production, processing, and distribution), energy production (e.g., natural gas, petroleum), forestry (e.g., timber), mining, quarrying, oil and gas, construction, and manufacturing

Objective	Description
Minimize loss of infrastructure services	Preserve and enhance infrastructure services, including utility services (e.g., energy transmission, energy consumption, drinking water, wastewater treatment) and the movement of goods, services and people (e.g., roads, rail, airports, ports)

Table 3. Potential B.C. Climate-related Risk Causes (additional information in Appendix A)

Risk Cause	Discrete or ongoing event
Change in average temperatures (including average air, river, and ocean temperatures)	Ongoing
Increase in extreme heat	Discrete
Change in seasonal precipitation patterns (including seasonal changes in rainfall, snowfall, and snowpack)	Ongoing
Increases in extreme precipitation	Discrete
Sea level rise	Ongoing
Coastal storms and storm surge	Discrete
Ocean acidification	Ongoing
Change in wind patterns and speed	Ongoing

2.2.2 Identify provincially significant risk events

For the purposes of this risk assessment, “provincially significant” risk events are those that would result in catastrophic or major impacts to any one of the provincial objectives, for example, an event or change that would result in:

- Loss of life
- Widespread injuries or disease outbreaks
- Widespread damage to infrastructure, personal property, or other resources
- Long-term disruption to a significant economic sector
- Significant disruption to daily life (e.g., traveling to work or school, operating a business, spending time with family and friends)
- Widespread psychological impacts
- Significant loss of natural resources (e.g., natural environment and ecosystem services)

- Significant loss of cultural resources (i.e., a human work, an object, or a place that is determined, on the basis of its heritage value, to be directly associated with an important aspect or aspects of human history and culture) (Parks Canada, 2013)²

These impacts could be experienced province-wide or concentrated in one or more regions of the province.

There are a range of ways to identify provincially significant risk events, including:

- Consultation with provincial experts and managers (e.g., through a workshop, meeting, or interviews)
- Comprehensive risk identification matrix (impacts of risk causes on objectives)
- Hybrid approach relying on both of the strategies above

Given the objectives of the B.C. risk assessment to efficiently hone in on a core set of high priority, cross-cutting risk events, we recommend and undertook a hybrid approach:

- Use an initial stakeholder workshop with experts from across government to brainstorm risk events that would have significant consequences across the province.
- Supplement these brainstorming exercises with a matrix outlining the impacts of the possible climate risk causes on each provincial objective (see Appendix A). This allows for 1) less familiar risk cause-objective impacts to not be overlooked in the brainstorming, and 2) analysts to see how cross-cutting risk events emerge from the matrix, where a single risk cause effects multiple objectives, a single objective is affected by multiple risk causes, or both.
- Populate a table like the one shown in Table 4 with each possible risk event, its risk cause(s), and whether there are provincially significant consequences to any of the objectives.

2.2.3 Select risk events for inclusion and define risk event scenarios

If necessary to reduce the number of risk events assessed to align with available resources, further screen potential risk events by likelihood using expert judgment and high-level data analysis to identify risk events most likely to occur within the target timeframe (e.g., 2050). In Table 5, select the provincially significant risk events that are most likely to occur and should, thus, be evaluated in more detail in the risk assessment process.

For each provincially significant risk event, articulate a plausible “scenario” of the event to consider in the risk assessment. The scenario serves to define a set of specific circumstances to facilitate evaluation of likelihood and consequences. In other words, the scenario details one possible permutation of the risk event, such as the location affected, time frame, comparable

² This is a widely-used definition and one applied and interpreted broadly for this framework. This category could include potential impacts to Indigenous communities, but those impacts may also transcend this category.

event (if any), or consequences. Historical analogues (past events that can inform future events) may be useful to consider.

See Section 3, B.C. Climate Risk Assessment, for the risk events selected through this process.

Table 4. Risk Event Statements

Risk Event	Type	Risk Causes	Potential Consequences						
			Health	Social functioning	Cultural resources	Natural resources	Economic vitality	Cost to provincial government	Other
<i>Loss of salmon populations in B.C.</i>	<i>Ongoing</i>	<i>Change in water temperatures, change in precipitation</i>	<i>Reduced food security in some communities</i>	<i>Psychological effects, food supply impacts</i>	<i>Loss of culturally significant item, resource, or asset</i>	<i>Loss of a natural resource</i>	<i>Loss of major export</i>		

*Note: the example risk event and consequences presented here are illustrative only, and do not reflect the result of a thorough risk event identification or assessment process.

2.3 Step 3: Analyze risks

Next, analyze risk of each risk event by determining each event's likelihood and consequence. This step will allow comparison and prioritization across risk events.

Complete this step by gathering a combination of quantitative data from models and literature, as well as qualitative expert opinion from expert consultations and workshops. Specific suggestions are provided below.

2.3.1 Rate likelihood

Rate the likelihood of each risk event for a baseline time period and the future time period to demonstrate how climate change increases risk. The likelihood of each risk event is a function of the likelihood of the climate-related risk cause and the likelihood of its impact on the objective. This section provides rating scales for evaluating likelihood of each risk event, and an explanation of the recommended evidence base to justify these ratings.

2.3.1.1 Rating scales

To account for differences in risk causes, this framework distinguishes between two types of climate-related risk events whose likelihoods are fundamentally different:

- **Discrete risk causes** – For risk events affected by discrete risk causes such as heat waves, severe storms, or nuisance flooding, likelihood is associated with the potential frequency and severity of these risk events by a future time period (in this case 2050).
- **Ongoing risk causes** – For risk events affected by ongoing risk causes such as increasing average temperatures, change in seasonal precipitation patterns, or sea level rise, likelihood is associated with the probability that some critical threshold is exceeded by a given time period (in this case 2050).

Discrete and ongoing risk causes can also have compounding effects, and therefore are both important to consider. In many cases, changes in ongoing risk causes (e.g., increase in temperatures) may affect the frequency and severity of discrete risk causes (e.g., heat waves, wildfires, floods). In addition, ongoing risk causes may reach a critical threshold at which a significant discrete impact occurs during the time period of analysis. For example, gradual changes in temperature or precipitation could eventually result in the extirpation of a species or introduction of a new disease vector (Harris, et al., 2018).

Apply the rating scale outlined in Table 5 to the risk events for both the baseline time period (2010s – 2000 to 2020) and the future time period (2050s – 2040 to 2060). For the baseline time period, assess the current frequency of each risk event. The likelihood rating scale is modified from the B.C. Risk Register to fit the climate change context, including consideration of risk events with low likelihood but high consequence (such as major floods). Appendix A includes a side-by-side comparison of the two scales.

The likelihood scale shown in Table 5 provides a different rubric for how to rate the likelihood for discrete and ongoing climate-related risks events, as their likelihoods (and the associated types of consequences) are fundamentally different. Additional information is provided below on the recommended evidence base to use to evaluate each risk event against these criteria.

Table 5. Likelihood Rating Scale for Discrete and Ongoing Climate-Related Risk Events

Likelihood	Rating	Criteria for <u>Discrete</u> Climate-Related Risk Events	Criteria for <u>Ongoing</u> Climate-Related Risk Events
Almost certain	5	Event is expected to happen about once every two years or more frequently (i.e., annual chance \geq 50%*).	Event is almost certain to cross critical threshold.
Likely	4	Event is expected to happen about once every 3-10 years (i.e., $10\% \leq$ annual chance $<$ 50%).	Event is expected to cross critical threshold. It would be surprising if this did not happen.
Possible	3	Event is expected to happen about once every 11-50 years (i.e., $2\% \leq$ annual chance $<$ 10%).	Event is just as likely to cross critical threshold as not.
Unlikely	2	Event is expected to happen about once every 51-100 years (i.e., $1\% \leq$ annual chance $<$ 2%).	Event is not anticipated to cross critical threshold.
Almost certain not to happen	1	Event is expected to happen less than about once every 100 years (i.e., annual chance $<$ 1%).	Event is almost certain not to cross critical threshold.

*Annual chance is the probability that an event will occur in a given year

2.3.1.2 Evidence base for likelihood ratings

Selection of data sources for the likelihood ratings should follow the following hierarchy:

- 1) Existing peer-reviewed or other authoritative (e.g., government-approved) studies of the topic – If such data are available exploring changes in a specific climate-related risk event, or associated risk cause, leverage this work.
- 2) Analysis of climate model data – If no existing studies have evaluated the change in the relevant risk event or risk cause(s), review and analyze existing climate model data from sources such as the Pacific Climate Impacts Consortium (PCIC) data portal. A list of potential and recommended climate data resources is provided in Appendix C. For a new climate data analysis, follow these guidelines:
 - Use the RCP 8.5 (when available) or A2 emission scenarios (which correspond to high global greenhouse gas emissions).
 - Use the full range of model results available, including a multi-model ensemble average, plus the range of values across models.

Document all sources in the risk assessment template, and denote confidence (high, medium, or low) in the final rating based on the guidelines in Table 6. These confidence rating guidelines are adapted from the UK Climate Change Risk Assessment (UK Committee on Climate Change, 2017) and indicate the strength and consistency of the knowledge base.

Table 6. Confidence Rating Guidelines

High confidence	Medium confidence	Low confidence
Multiple sources of independent evidence based on reliable analysis and methods, with widespread agreement	Several sources of high quality independent evidence, with some degree of agreement	Varying amounts and quality of evidence and/or little agreement between experts; or assessment made only using expert judgment

Additional guidelines are provided below for discrete and ongoing risk events.

2.3.1.2.1 Discrete risk event

To assign likelihood ratings for discrete risk events, gather and review historical and projected climate data from sources such as the Pacific Climate Impacts Consortium (PCIC). A list of potential and recommended climate data resources is provided in Appendix C. For each risk event, pull the relevant climate information and assess the frequency of the risk cause.

Climate models will not provide exact projections of future frequency. However, they can often provide an indication of the range of future likelihoods. In some cases, climate projections will not include precise future likelihoods, but could be combined with known current likelihood and the projected trend to determine a rating. Use the confidence rating denote confidence in the likelihood rating (see Table 6).

For example, a discrete risk event may be a massive flood in the lower Fraser River. In this case, an existing study assesses the likelihood of the event: the Lower Mainland Flood Management Strategy, Phase 1 Summary Report (Fraser Basin Council, 2016) includes projections for the frequency of the current 500-year flood by 2100.

Because the existing study does not include projections for 2050, the risk assessment process would work through the following hierarchy of options:

- Contact the report authors to determine whether they have unpublished data for 2050
- If not, analyze original climate data to determine projections for 2050
- If it is not possible to estimate 2050 projections using available data, use the existing 2100 projections and estimate a range of possible values for 2050 using a range of possible rates of change between present and 2100.

2.3.1.2.2 Ongoing risk event

Frequency of occurrence may not be an appropriate measure of likelihood for ongoing risk events. Instead, identify a critical threshold for the risk cause change at which the impact is likely to occur, and rate the likelihood of crossing that critical threshold by 2050.

For example, to assess the likelihood of “loss of salmon populations in B.C.,” identify the risk cause threshold (e.g., a critical water temperature) at which salmon populations begin to decline. This threshold may vary depending on the specific region defined in the risk event scenario.

Use a combination of desk research and expert consultation to determine the critical threshold(s) for the risk event. For instances where data regarding the critical thresholds are not

available, consult experts and practitioners for their judgment about what the critical threshold might be for a given risk event and scenario.

Then determine the expected magnitude and rate of change of the climate-related risk cause by 2050 to determine the probability for the risk event. Recommended data sources for these projections are provided in Appendix C.

The amount of overlap between the critical threshold range and the climate projection range can inform the likelihood ratings.

Figure 4 illustrates this conceptually. If an impact is known to occur with a 2-3 degree temperature change and average temperatures are expected to change 4-5 degrees, then the risk event has a higher likelihood than an impact known to occur with a 4-6 degree change.

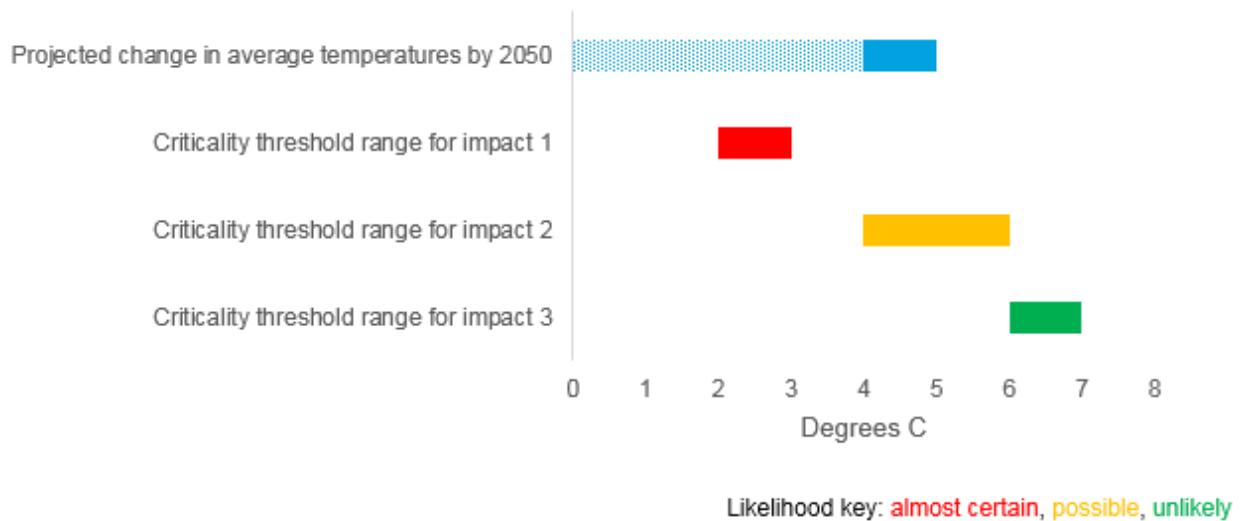


Figure 4. Conceptual diagram of evaluating likelihood of ongoing risk events, for risk events related to changing temperatures.

2.3.1.3 Documentation

For each likelihood evaluation, provide a 1-2 sentence justification for the rating given and cite sources to document the evidence base. An example evaluation is shown in Table 7.

Table 7. Example Likelihood Evaluation

Risk Event:		Loss of salmon populations in B.C.		
	Type	Rating	Justification	Confidence
Likelihood	Ongoing event	2 (Unlikely)	Climate-related risk cause: Increase in river water temperature	n/a
			2050 projections: Exact projections are unknown. Historical data indicates that the average temperature of the Fraser River warmed from about 15.9°C to about 16.5°C between 1953 and 1998, a rate equivalent to 2.2°C per century (B.C. Ministry of Environment, 2016).	Low

Risk Event:	Loss of salmon populations in B.C.		
			Average air temperatures are expected to rise 1.3-2.7°C by the 2050s (PCIC, 2012).
			Threshold range: The preferred temperature range for salmon is 12°C to 15°C, but salmon can tolerate temperatures up to 24.5°C (B.C. Ministry of Environment, 2016).
			Overall: To cross critical threshold of 24.5°C would require an increase in water temperature of 8°C, more than four times the rate of historical warming. Additional modeling is needed to determine the likelihood of crossing this threshold but based on available information it seems unlikely.
			High
			Low

2.3.2 Rate consequences

Next, rate the consequences of each risk event. Consequence refers to the severity of the risk event, including damage and value lost. While each risk event receives only one likelihood rating, measure consequence across multiple consequence categories using the metrics outlined in Table 8. These metrics are intended to facilitate consistency and comparability across risk events that vary greatly.

For each risk event, evaluate the following nine consequence types, grouped into six high-level categories. The categories are designed to capture the range of consequences from discrete and ongoing risk events:

- Health
 - Loss of life
 - Morbidity, injury, disease, or hospitalization
- Social functioning
 - Psychological impacts
 - Loss of social cohesion (e.g., degradation of trust in government, disruption to daily life, and other elements of social fabric)
- Cultural resources
 - Loss of cultural resources (i.e., a human work, an object, or a place that is determined, on the basis of its heritage value, to be directly associated with an important aspect or aspects of human history and culture) (Parks Canada, 2013)
- Natural resources
 - Loss of natural resources (e.g., natural environment and ecosystem services)
- Economic vitality
 - Loss of economic productivity (e.g., impacts to key industries or jobs)
 - Loss of infrastructure services (e.g., transportation, water, or energy services)
- Cost to provincial government – Note this is a parallel category to the others (e.g., health impacts, disruption to daily life, infrastructure impacts, and others would create a cost to

provincial government), included to highlight information on these costs for key government decision-makers³

2.3.2.1 Rating scales

For each category, rate the consequence on a scale of 1-5. Table 8 provides a detailed rating rubric that is consistent with the B.C. Risk Register consequence rating scale, but modified to fit the climate change context. Appendix A includes a side-by-side comparison of the two scales and documentation of the rubric development process. The overall consequence rating is an average of each consequence rating.

³ This is a widely-used definition and one applied and interpreted broadly for this framework. This category could include potential impacts to Indigenous communities, but those impacts may also transcend this category.

Table 8. Modified Risk Event Consequence Rating Scale

	Health		Social functioning		Cultural resources	Natural resources	Economic vitality		Cost to provincial government ^x
	Loss of life	Morbidity, injury, disease, or hospitalization	Psychological impacts	Loss of social cohesion	Loss of cultural resources	Loss of natural resources	Loss of economic productivity	Loss of infrastructure services	
Catastrophic - 5	100+ people or >25% of a single community	1,000+ people affected or >25% of a single community	Widespread and severe disturbance resulting in long-term psychological impacts (e.g., post-traumatic stress disorder (PTSD))	Months-long disruption to daily life (e.g., inability to access employment, education) Widespread, permanent loss of livelihoods or way of life Severe, widespread erosion in public confidence in government Erosion of community institutions and community cohesion	Resource can never recover; destruction is permanent and irreversible (e.g., destruction of an irreplaceable artifact or knowledge)	Resource can never recover; destruction is permanent and irreversible (e.g., extinction of a species within the province)	Potential direct and indirect economic losses of over \$1 billion* Long-term disruption or loss of an economic sector and associated job losses	Months-long disruption in infrastructure services Major impediment to day-to-day life	Added cost is far beyond Contingency Reserve Fund (i.e., > \$1.5 billion)
Major- 4	10-100 people or > 15% of a single community	100-1000 people affected or > 15% of a single community	Localized severe disturbance resulting in long-term psychological impacts (e.g., loss of home, identity, or sense of place)	Weeks-long disruption to daily life (e.g., inability to access employment, education) Localized, permanent loss of livelihoods or way of life Moderate erosion of public trust in government or community cohesion	Recovery of the resource will take decades	Recovery of the resource will take decades	Potential direct and indirect economic losses of over \$100 million* Months-long disruption to a major economic sector and associated job losses	Weeks-long disruption in infrastructure services Major impediment to day-to-day life	Significant added cost; up to 2x Contingency Reserve Fund amount (i.e., \$750 million - 1.5 billion)

Health		Social functioning		Cultural resources	Natural resources	Economic vitality		Cost to provincial government ^x	
Loss of life	Morbidity, injury, disease, or hospitalization	Psychological impacts	Loss of social cohesion	Loss of cultural resources	Loss of natural resources	Loss of economic productivity	Loss of infrastructure services		
Moderate - 3	2-10 people or > 5% of a single community	10-100 people affected or > 5% of a single community	Widespread moderate disturbance resulting in temporary psychological impacts (e.g., feelings of fear and anxiety)	Days-long disruption to daily life (e.g., inability to access employment, education) Seasonal loss of livelihoods or way of life Minor erosion of public trust in government or community cohesion	Recovery of the resource will take years	Recovery of the resource will take years	Potential direct and indirect economic losses of over \$10 million*; Weeks-long disruption to a major economic sector and employment	Days-long disruption in infrastructure services Major impediment to day-to-day life	Added costs can be covered within Contingency Reserve Fund but would detract from other priorities (e.g., >50% of Contingency Reserve Fund or > \$375 million but < \$750 million)
	Low potential for multiple loss of life	<10 people affected	Localized moderate disturbance resulting in temporary psychological impacts (e.g., feelings of fear and anxiety)	Hours-day-long disruption to daily life (e.g., inability to access employment, education) Low potential for erosion of public trust in government or community cohesion	Recovery of the resource will take months	Recovery of the resource will take months	Potential direct and indirect economic losses of over \$1 million*; Days-long disruption to a major economic sector and employment	Hours-long disruption in infrastructure services	Added costs can be easily covered within Contingency Reserve Fund (≤\$350 million)

	Health		Social functioning		Cultural resources	Natural resources	Economic vitality		Cost to provincial government ^x
	Loss of life	Morbidity, injury, disease, or hospitalization	Psychological impacts	Loss of social cohesion	Loss of cultural resources	Loss of natural resources	Loss of economic productivity	Loss of infrastructure services	
Insignificant - 1	No possibility of loss of life other than through unforeseeable misadventure	No possibility for morbidity, injury, disease, or hospitalizations other than through unforeseeable misadventure	Minimal expected reactions of fear anxiety or disruption to daily life	Minimal disruption to daily life Trust in government remains unchanged	Little impact or resource can recover within days	Little impact or resource can recover within days	Potential direct and indirect economic losses less than \$1 million*	Temporary nuisance	No expected additional costs to provincial government

*Chained 2007 dollars

*Based on an annual Contingency Reserve Fund of approximately \$750 million (B.C. Ministry of Finance, 2018).

2.3.2.2 Evidence base for consequence ratings

Use evidence-based information, gathered through literature reviews and expert and practitioner consultations to inform the consequence ratings of each risk event. Review existing literature to provide some empirical data on examples of the level of impact experienced in past events, either in the province or other parts of the world comparable to British Columbia. For example, reviewing the literature may provide information on the number of hospitalizations during an extreme heat event that is comparable to what would be projected in B.C. but has not yet been experienced.

Involve experts to provide numerical ratings, qualitative justifications, and prioritization based on their experiences, solicited, for example, through workshops or interviews. Additionally, include a wide range of external stakeholders to provide diverse perspectives on the consequences.

As with likelihood, denote the confidence in each consequence rating using the scale provided in Table 6.

2.3.2.3 Documentation

For each consequence category, provide a 1-2 sentence description of the consequence to justify the rating given. Since all of these risk events are complex and nuanced, distilling consequences into numbers does not represent the full story. The justification is an opportunity to provide qualitative context for each rating and describe more details about the level of consequence. An example consequence evaluation is shown in Table 9.

Table 9. Example Consequence Evaluation

Risk event:	Loss of salmon populations in B.C.				
	Category	Consequence	Rating*	Justification*	Confidence
Consequence	Health	Loss of life	1	No expected loss of life	High
		Morbidity, injury, disease, or hospitalization	3	Reduced food security in some communities could lead to adverse health outcomes	Low
	Social functioning	Psychological impacts	3	Could affect mental wellness, especially in fishing-dependent communities.	Low
		Loss of social cohesion	2	Would disrupt livelihoods and could increase local prices for salmon, reducing demand.	Low
	Cultural resources	Loss of cultural resources	5	Permanent or temporary loss of a key culturally-significant species represents grave damage to B.C. cultural resources.	High

Risk event:	Loss of salmon populations in B.C.				
	Natural resources	Loss of natural resources	5	Grave loss of a natural resource for B.C. as a whole. Consequential impacts to other species that depend on salmon.	High
	Economic vitality	Loss of economic productivity	1	The seafood sector contributes about \$415 million, or about 0.2% of provincial total GDP.**	High
		Loss of infrastructure services	1	No expected impact on infrastructure reliability.	High
	Cost to provincial government		2	Potential for lost revenues from seafood industry.	Low
Average Consequence Score			2.6		Medium

*Note: the example risk event and consequences presented here are illustrative only, and do not reflect the result of a thorough risk event identification or assessment process.

** (B.C. Ministry of Agriculture, 2017)

2.4 Step 4: Evaluate risks

Finally, combine the information on likelihood and consequence, consider the adequacy of existing risk mitigations, and compare and prioritize risk events.

2.4.1 Evaluate risk

2.4.1.1 Rate risk

Multiply the likelihood and average consequence score to compute a risk score and rating for each risk event, following the rubric shown in Table 10.

Table 10. Risk Rating Rubric

Risk Score	Rating
0 – 5.9	Low
6 – 11.9	Medium
12 – 19.9	High
20 – 25	Extreme

This rubric is modified slightly from the B.C. risk register rating matrix (see Figure 5) to fill gaps in the rating rubric. These gaps exist because the original B.C. risk register does not account for non-integer consequence ratings. Because in this climate risk assessment framework the

consequence score is an average of multiple consequence ratings, there are likely to be non-integer consequence scores that could result in overall risk scores that fall, for example, between 16 and 20.

Risk Rating Matrix					
5	LOW	MED	HIGH	EXT	EXT
4	LOW	MED	HIGH	HIGH	EXT
3	LOW	MED	MED	HIGH	HIGH
2	LOW	LOW	MED	MED	MED
1	LOW	LOW	LOW	LOW	LOW
LIKELIHOOD	1	2	3	4	5
	CONSEQUENCE				

L x C
 Score 0 - 5 = Low
 Score 6 - 10 = Medium
 Score 12 - 16 = High
 Score 20 - 25 = Extreme

Figure 5. B.C. risk register risk rating matrix.

2.4.1.2 Documentation

Add the likelihood and consequence evaluations into the risk rating evaluation, as shown in Table 11. Include the final risk rating and the justification, if necessary, for the final rating.

Table 11. Example Risk Rating Evaluation

Risk event: Loss of salmon populations in B.C.					
Risk Element	Type or Category	Consequence	Rating*	Justification*	Confidence
Likelihood	Ongoing event	n/a	2	Climate-related risk cause: Increase in river water temperature	n/a
				2050 projections: Exact projections are unknown. Historical data indicates that the average temperature of the Fraser River warmed from about 15.9°C to about 16.5°C between 1953 and 1998, a rate equivalent to 2.2°C per century (B.C. Ministry of Environment, 2016). Average air temperatures are expected to rise 1.3-2.7°C by the 2050s (PCIC, 2012).	Low
				Threshold range: The preferred temperature range for salmon is 12°C to 15°C, but salmon can tolerate temperatures up to 24.5°C (B.C. Ministry of Environment, 2016).	High
				Overall: To cross critical threshold of 24.5°C would require an increase in water temperature	Low

Risk event: Loss of salmon populations in B.C.						
Risk Element	Type or Category	Consequence	Rating*	Justification*	Confidence	
				of 8°C, more than four times the rate of historical warming. Additional modeling is needed to determine the likelihood of crossing this threshold but based on available information it seems unlikely.		
Consequence	Health	Loss of life	1	No expected loss of life	High	
		Morbidity, injury, disease, or hospitalization	3	Reduced food security in some communities could lead to adverse health outcomes	Low	
	Social functioning	Psychological impacts	3	Could affect mental wellness, especially in fishing-dependent communities.	Low	
		Loss of social cohesion	2	Would disrupt livelihoods and could increase local prices for salmon, reducing demand.	Low	
	Cultural resources	Loss of cultural resources	5	Permanent or temporary loss of a key species represents grave damage to B.C. cultural resources.	High	
	Natural resources	Loss of natural resources	5	Grave loss of a natural resource for B.C. as a whole. Consequential impacts to other species that depend on salmon.	High	
	Economic vitality	Loss of economic productivity	1	The seafood sector contributes about \$415 million, or about 0.2% of provincial total GDP.**	High	
		Loss of infrastructure services	1	No expected impact on infrastructure reliability.	High	
	Cost to provincial government			2	Potential for lost revenues from seafood industry.	Low
	Average Consequence			2.5		
Overall Risk (likelihood × average consequence)			Medium (5.1)		Medium	

*Note: the example risk event and consequences presented here are illustrative only, and do not reflect the result of a thorough risk event identification or assessment process.

** (B.C. Ministry of Agriculture, 2017)

In addition to the risk rating evaluation template for each risk event, summarize and compare risks using matrices (Figure 6), bar charts (Figure 7), or other methods (simplified examples shown).

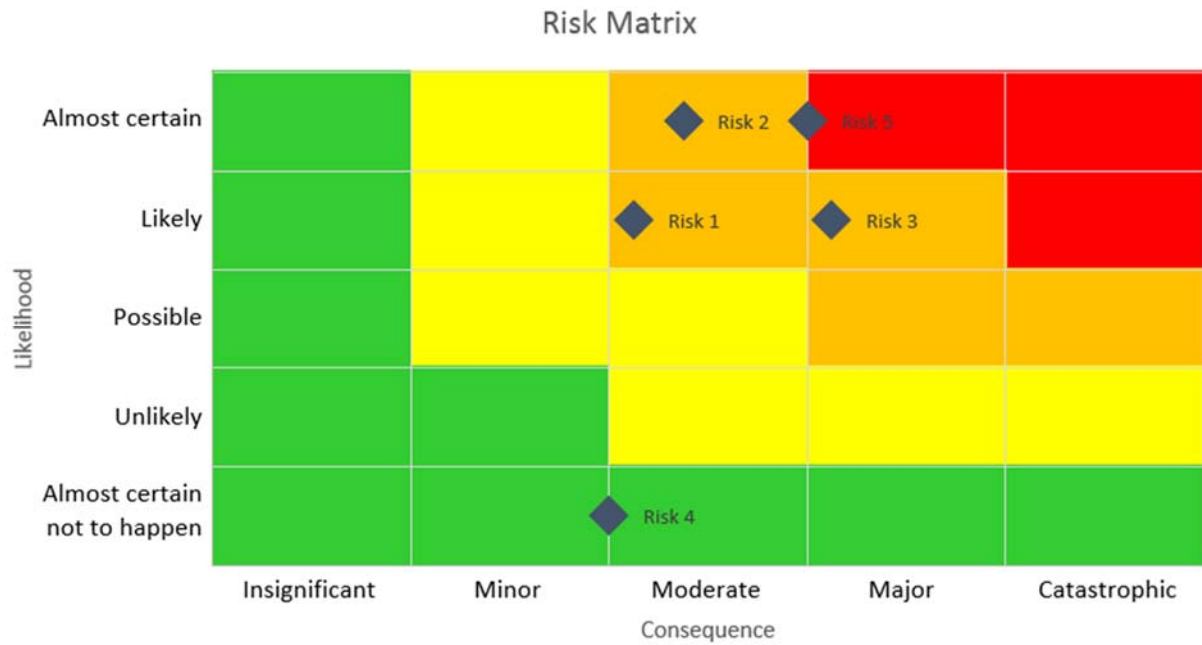


Figure 6. Example summary risk matrix.

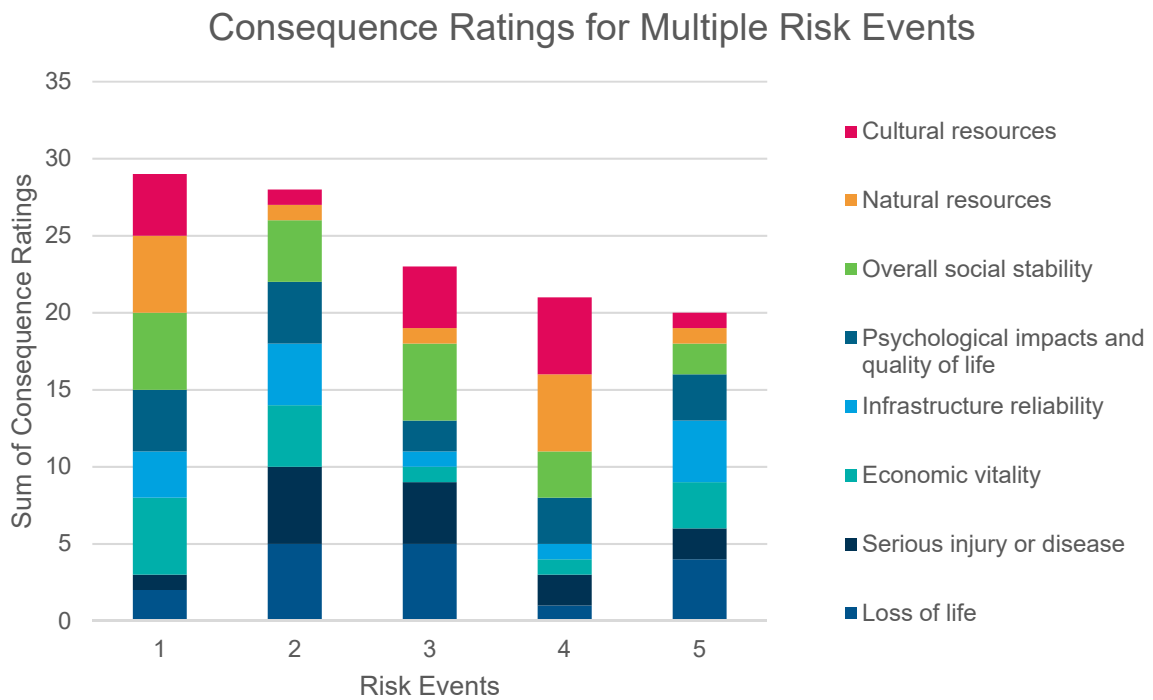


Figure 7. Example summary of consequences across risk events.

2.4.2 Evaluate adequacy of existing risk mitigations

Finally, identify existing risk mitigations that may affect the extent of the risk event impact. Ask ministry representatives what they or others are doing now to reduce the likelihood and consequences of the event and evaluate the adequacy of the existing risk mitigations to meet the climate-influenced risk levels as:

- Non-existent
- Inadequate
- Adequate
- Robust
- Excessive

This is the last step of the framework. Equipped with the information collected during the risk assessment, the next step would be to prioritize risk events and make risk management decisions.

3 B.C. Climate Risk Assessment

3.1 Context

The B.C. climate risk assessment identifies provincially significant climate risks and does not reflect the risks in a specific region or location in B.C. Local governments and other organizations will need to assess their own risks, but the provincial assessment is useful in that it provides a framework that can be scaled for use in other contexts.

3.1.1 Scope and objectives

The objective of the B.C. climate risk assessment is to assess, compare, and prioritize potential climate-related risk events with significant provincial impacts on fundamental qualities of life in the province (e.g., food production, movement of goods, services, and people, public health and safety). To align with existing provincial long-range planning horizons, the risk assessment is focused on risk events from present to 2050. Climate risk events will continue and, likely, grow beyond 2050. Focusing on risk events through 2050 aligns with current planning horizons, however, and will allow the province to inform immediate priorities and planning decisions. Further, climate model projections of conditions by 2050 are less subject to change based on actual global emissions pathways compared to later time horizons. In other words, expected conditions by 2050 provide a reasonable estimate of potential future needs and responses, and the risk assessment can be repeated in future years or extended to a longer timeframe.

B.C. Risk Assessment Scope

Geographic and sectoral scope:
Whole of province, all sectors
Temporal scope: present through
2050

The B.C. government can then use the results to evaluate and prioritize adaptation needs. The scope of the assessment, therefore, spans the range of B.C. provincial government interests and any climate-related risk causes that could affect those interests. Although this framework is designed to assess province-wide risk events, users should be aware that a low risk event on a province-wide scale may still be a high risk to a particular ministry or location. Criteria for defining provincially-significant risk events are outlined further under Section 2.2.

3.1.2 Audience

The B.C. Deputy Ministers Council (DMC) will be the primary audience for the findings of the B.C. risk assessment. They will use the results to inform high-level risk management strategies for the province and may also lead the development of more detailed adaptation responses.

3.2 Risk events identified

Table 12 provides a list of potential provincially significant risk events for inclusion in the risk assessment. This list was refined with input from stakeholders across provincial ministries from the starting point described in Section 2.2.

Table 12. Risk Events and Scenarios Selected

Risk Event	Risk Cause(s)	Example Impacts	Significant Consequences?	Plausible by 2050?
Discrete risk events				
Severe riverine flooding (Scenario: 500-year flood on Fraser River)	<ul style="list-style-type: none"> • Higher temperatures → more rapid snowmelt • Heavy precipitation 	<ul style="list-style-type: none"> • Flooding of roadways and other infrastructure • Irrigation dam failures • Safety risks • Contaminated drinking water 	<ul style="list-style-type: none"> ✓ Loss of life ✓ Injuries/disease ✓ Psychological impacts ✓ Cultural resources ✓ Natural resources (e.g., landscape change) ✓ Economic vitality (property loss) ✓ Infrastructure services ✓ Cost to provincial government 	Y
Severe wildfire season (Scenario: At least one million hectares burned that affect human settlements)	<ul style="list-style-type: none"> • Higher temperatures → higher ignition risk, drier fuels, pine beetle • Drier conditions 	<ul style="list-style-type: none"> • Wide-scale evacuations • Safety risks (residents and emergency responders) • Loss of structures 	<ul style="list-style-type: none"> ✓ Loss of life ✓ Injuries/disease ✓ Psychological impacts ✓ Social cohesion ✓ Cultural resources ✓ Economic vitality ✓ Infrastructure services ✓ Cost to provincial government 	Y
Heat wave (Scenario: Heat wave of at least three days that affects human health)	<ul style="list-style-type: none"> • Higher temperatures 	<ul style="list-style-type: none"> • Higher rates of pulmonary, heart disease • Excess deaths, especially in elderly and sick populations • Stress to crops and dairy • Strain on electric grid, possible power outages 	<ul style="list-style-type: none"> ✓ Loss of life ✓ Injuries/disease ✓ Natural resources ✓ Economic vitality ✓ Cost to provincial government 	Y
Seasonal water shortage (Scenario: Months-long summer water shortage affecting two or more regions)	<ul style="list-style-type: none"> • Change in seasonal precipitation 	<ul style="list-style-type: none"> • Decline in drinking water quantity; increases cost of water treatment • Crop stress 	<ul style="list-style-type: none"> ✓ Psychological impacts ✓ Natural resources ✓ Economic vitality ✓ Infrastructure services 	Y
Moderate riverine flooding	<ul style="list-style-type: none"> • Higher temperatures → 	<ul style="list-style-type: none"> • Wide-scale evacuations 	<ul style="list-style-type: none"> ✓ Loss of life ✓ Injuries/disease 	Y

Risk Event	Risk Cause(s)	Example Impacts	Significant Consequences?	Plausible by 2050?
(Scenario: Increase in moderate flood events in a single B.C. community)	<ul style="list-style-type: none"> more rapid snowmelt • Heavy precipitation 	<ul style="list-style-type: none"> • Isolated communities • Loss of structures • Flooding of roadways and other infrastructure 	<ul style="list-style-type: none"> ✓ Psychological impacts ✓ Social cohesion ✓ Cultural resources ✓ Economic vitality ✓ Infrastructure services ✓ Cost to provincial government 	
Severe coastal storm (Scenario: 500-year winter storm event + 0.5 m of SLR, pushing a 3.4 m storm surge during a king tide)	<ul style="list-style-type: none"> • Coastal storm+ sea level rise 	<ul style="list-style-type: none"> • Flooding of roadways and other infrastructure • Safety risks • Erosion, land loss, shoreline change 	<ul style="list-style-type: none"> ✓ Loss of life ✓ Injuries/disease ✓ Psychological impacts ✓ Cultural resources ✓ Natural resources ✓ Economic vitality ✓ Infrastructure services ✓ Cost to provincial government 	Y
Extreme precipitation and landslide (Scenario: Significant landslide in Hope triggered by extreme precipitation)	<ul style="list-style-type: none"> • Heavy precipitation 	<ul style="list-style-type: none"> • Flooding of roadways and other infrastructure • Landslides and associated damage • Safety risks 	<ul style="list-style-type: none"> ✓ Loss of life ✓ Injuries/disease ✓ Psychological impacts ✓ Economic vitality ✓ Infrastructure services ✓ Cost to provincial government 	Y
Ongoing risk events				
Increased incidence of vector-borne disease (Scenario: At least a doubling of Lyme disease cases within B.C. in three years)	<ul style="list-style-type: none"> • Multiple causes (temperature and precipitation changes) 	<ul style="list-style-type: none"> • Increase in disease rate, potential fatalities • Higher cost to manage outbreak, control vectors 	<ul style="list-style-type: none"> ✓ Loss of life ✓ Injuries/disease ✓ Cost to provincial government 	Y
Saltwater intrusion (Scenario: Episodic saltwater intrusion of the Fraser River delta and surrounding delta,	<ul style="list-style-type: none"> • Sea level rise 	<ul style="list-style-type: none"> • Reduced fresh water availability for agriculture and drinking water 	<ul style="list-style-type: none"> ✓ Natural resources ✓ Economic vitality ✓ Cost to provincial government 	Y

Risk Event	Risk Cause(s)	Example Impacts	Significant Consequences?	Plausible by 2050?
caused by 0.5 m of SLR by 2050)				
Ocean acidification (Scenario: 0.15 reduction in pH by 2050)	<ul style="list-style-type: none"> • Higher temperatures • Higher atmospheric carbon dioxide concentrations 	<ul style="list-style-type: none"> • Reduced shellfish productivity 	<ul style="list-style-type: none"> ✓ Psychological impacts ✓ Natural resources ✓ Economic vitality ✓ Cost to provincial government 	Y
Increase in invasive species (Scenario: Expansion of knotweed by 2050)	<ul style="list-style-type: none"> • Multiple causes (temperature and precipitation changes) 	<ul style="list-style-type: none"> • Ecosystem disruption • Increased control costs • Disruption to infrastructure services 	<ul style="list-style-type: none"> ✓ Natural resources ✓ Economic vitality ✓ Infrastructure services ✓ Cost to provincial government 	Y
Reduction in ecosystem connectivity (Scenario: Reduction in ecosystem connectivity in the Okanagan-Kettle region by 2050)	<ul style="list-style-type: none"> • Multiple causes including wildfires, flooding, and ecosystem shifts 	<ul style="list-style-type: none"> • Loss of natural resources, ecological integrity • Reduction in species resiliency to adapt • Loss of species altogether 	<ul style="list-style-type: none"> ✓ Natural resources ✓ Economic vitality 	Y
Loss of forest resources (Scenario: 25% decline in timber growing stock by 2050)	<ul style="list-style-type: none"> • Multiple causes (temperature and precipitation changes) 	<ul style="list-style-type: none"> • Ecosystem disruption • Economic disruption and loss of livelihoods 	<ul style="list-style-type: none"> ✓ Cultural resources ✓ Natural resources ✓ Economic vitality 	Y
Glacier mass loss (Scenario: 25% decline in glacier area by 2050)	<ul style="list-style-type: none"> • Higher temperatures 	<ul style="list-style-type: none"> • Water shortages • Changes in aquatic ecosystems and species 	<ul style="list-style-type: none"> ✓ Natural resources ✓ Economic vitality 	Y
Long-term water shortages (Scenario: Multi-year water shortage in at least one region by 2050)	<ul style="list-style-type: none"> • Change in seasonal precipitation patterns year on year (or multi-year) 	<ul style="list-style-type: none"> • Decline in drinking water quality and quantity • Crop stress • Economic shifts 	<ul style="list-style-type: none"> ✓ Psychological impacts ✓ Social cohesion ✓ Economic vitality (agriculture) ✓ Infrastructure services ✓ Cost to provincial government 	Y

Other risk events considered in the course of the analysis are noted in Table 13 for reference.

Table 13. Risk Events Considered and Not Included in the Risk Assessment

Risk Event	Risk Cause(s)	Example Impacts	Significant Consequences?	Plausible by 2050?	Final Notes
Algal bloom	<ul style="list-style-type: none"> Higher temperatures 	<ul style="list-style-type: none"> Decline in drinking water quality Damage to aquatic species 	<ul style="list-style-type: none"> ✓ Injuries/disease ✓ Natural resources ✓ Economic vitality ✓ Infrastructure services 	Y	Consider for future iteration.
Loss of species (Possible scenarios: salmon, bull trout, shellfish)	<ul style="list-style-type: none"> Multiple causes (temperature and precipitation changes, ocean acidification) 	<ul style="list-style-type: none"> Loss of economic, cultural, natural resource 	<ul style="list-style-type: none"> ✓ Psychological impacts ✓ Cultural resources ✓ Natural resources ✓ Economic vitality 	Unknown	Consider for future iteration if additional information becomes available on likelihood.
Loss of agricultural productivity	<ul style="list-style-type: none"> Higher temperatures, shifting precipitation patterns, water shortages 	<ul style="list-style-type: none"> Decline in economic output, jobs, food security 	<ul style="list-style-type: none"> ✓ Economic vitality (with lesser effects on health, cultural resources, social stability) 	Unknown	Consider for future iteration if additional information becomes available on likelihood.
Decline in drinking water quality	<ul style="list-style-type: none"> Higher temperatures, seasonal precipitation changes 	<ul style="list-style-type: none"> Higher water treatment costs 	<ul style="list-style-type: none"> ✓ Cost to provincial government 	Unknown how plausible to reach dangerous levels for humans by 2050	Consider for future iteration if additional information becomes available on likelihood.
Decline in marine productivity (Scenario: warm water “blob”)	<ul style="list-style-type: none"> Higher temperatures 	<ul style="list-style-type: none"> Varied effects on salmon and other aquatic resources 	<ul style="list-style-type: none"> ✓ Unknown 	Unknown	Consider for future iteration. Difficult to measure with available knowledge.
Influx of climate refugees	<ul style="list-style-type: none"> Multiple causes (temperature and 		Unclear – impacts could be positive and negative, but could affect:	Unsure	Consider for future iteration. Difficult to

Risk Event	Risk Cause(s)	Example Impacts	Significant Consequences?	Plausible by 2050?	Final Notes
	precipitation changes)		<ul style="list-style-type: none"> ✓ Psychological impacts ✓ Social cohesion ✓ Economic vitality ✓ Cost to provincial government 		measure with available knowledge.
Global increase in food prices	<ul style="list-style-type: none"> • Multiple causes (temperature and precipitation changes) 		<ul style="list-style-type: none"> ✓ Social cohesion ✓ Economic vitality 	Unsure	Consider for future iteration. Difficult to measure with available knowledge.
Permanent inundation of coastal communities	<ul style="list-style-type: none"> • Sea level rise 	<ul style="list-style-type: none"> • Loss of infrastructure, infrastructure services • Forced migration 	<ul style="list-style-type: none"> ✓ Psychological impacts ✓ Social cohesion ✓ Cultural resources ✓ Natural resources ✓ Economic vitality ✓ Infrastructure services ✓ Cost to provincial government 	N (some intrusion, but not permanent inundation)	N (not likely within time frame)
Inability of flights to take off from airports	<ul style="list-style-type: none"> • Higher temperatures 		No	N (not by 2050)	Unlikely within time frame
Increase in combined sewer overflows	<ul style="list-style-type: none"> • Heavy precipitation 		Unclear	Y	Unlikely to be provincially significant
Decrease in winter recreation	<ul style="list-style-type: none"> • Higher temperatures 		Unclear	Initial scan of research suggests decrease in snowfall for coastal resorts by end-of-century, and	Unlikely to be provincially significant by 2050

Risk Event	Risk Cause(s)	Example Impacts	Significant Consequences?	Plausible by 2050?	Final Notes
				no impact inland	

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Appendix A: Justification for Framework Recommendations

“Objective” Identification

The project team considered several types of economic sectors, societal values, and other assets in developing the set of potential “objectives” for consideration in the B.C. risk assessment. Ultimately, we developed a set of objectives intended to:

- Capture a range of assets and values that are important in B.C., and
- Provide a sufficient level of detail to prompt brainstorming and identification of high consequence risk events, while creating room for risk events that cut across objectives.

Candidates considered in developing this set of potential objectives included:

- Major economic sectors (agriculture, energy, mining, forestry, tourism, healthcare)
- Infrastructure sectors (transportation, energy, water, telecommunications)
- Government services (public health, health care delivery, public safety, emergency management, education, governance)
- Societal values (equity, affordability, natural resource protection, cultural resource protection)

The resultant set of potential objectives is:

- Minimize loss of life
- Minimize morbidity, injury, disease, or hospitalization
- Minimize psychological impacts
- Minimize loss of social cohesion
- Minimize loss of cultural resources
- Minimize loss of natural resources
- Minimize loss of economic productivity
- Minimize loss of infrastructure services

“Risk Cause” Identification

The Office of the Auditor General of British Columbia identified flood, wildfire, drought, invasive species, and shifting ecosystems as the major climate change impacts in B.C and concluded that the three highly significant climate-related “risk areas” were flood, wildfire, and drought (Office of the Auditor General of British Columbia, 2018).

While the project team agrees that the impacts identified in the OAG report should be included in the risk assessment, the project team recommends a systematic approach to identifying and evaluating climate-related risk causes to capture a wider range of potential hazards.

To identify potential climate-related risk causes for the climate risk assessment, the project team reviewed existing assessments and resources on climate change impacts in B.C. (see Appendix B) to compile a list of potential risk causes.

The project team recommends including all of the identified climate-related risk causes in the risk event identification stage of the risk assessment rather than selecting a certain number of risk causes for further evaluation. This will allow for a more comprehensive risk assessment.

Risk Event Articulation

To aid users in the development of risk event statements, the project team used the matrix in Table 14 to develop a list of example risk events. The purpose of the examples is to help spur thought and discussion and to provide examples of the level of detail and type of risk events that should be considered. In addition to objective-specific risk events, users should also consider cross-cutting risk events that affect multiple objectives.

Table 14. Example Impacts, by Risk Cause and Objective (to prompt ideas for risk event statements – shading indicates like impacts)

	Loss of life	Morbidity, injury, disease, or hospitalization	Psychological impacts	Loss of social cohesion	Loss of cultural resources	Loss of natural resources	Loss of economic productivity	Loss of infrastructure services	Cost to provincial government
Change in average temperatures (air and water)	Increase in heat-related deaths	Increase in cases of childhood asthma in urban areas	Changes in food availability or access	Higher energy bills	Decrease in important cultural resources (e.g., corn, salmon)	Changes in biodiversity	Higher prevalence of pests	More frequent heat-related infrastructure damage	Increased need to provide cooling spaces
Increase in extreme heat	Increase in heat-related deaths	Increase in heat-related illnesses or hospitalizations	Increased need to seek air-conditioned shelter	High heat exposure in schools and homes that lack air conditioning	More frequent and severe heat stress on corn	Higher stress on species in national parks and forests	Higher energy demands	More frequent periods of higher energy demand that exceeds supply	Increased need to provide cooling spaces
Change in seasonal precipitation	Increase in flood-related deaths	Increase in flood-related injuries or hospitalizations	Changes in food availability or access	More frequent or severe flooding of schools or homes	More frequent or severe water stress on corn	Shorter winter sports season	More frequent water restrictions	Changes in water level (high or low) in transportation routes	Increased need to provide emergency services
Increase in extreme precipitation	Increase in flood-related deaths	Increase in flood-related injuries or hospitalizations	More frequent evacuations or loss of homes	More frequent or severe widespread flooding events	More frequent or severe flooding of important cultural resources	Flooded trails and access roads at a national park	Blocked access roads (e.g. flooding or landslide)	Increase in combined sewer overflows and untreated wastewater	Increased need to provide emergency services
Sea level rise and storm surge	Increase in coastal storm-related deaths	Increase in coastal storm-related injuries or hospitalizations	More frequent evacuations or loss of homes	Greater coastal flooding, of schools and local communities	Greater coastal flooding of important cultural resources	Greater inundation and damage to coastal parks	Inundation of critical access roads	Increase in the frequency and extent of road inundation in coastal areas	Increased need to repair/rebuild critical infrastructure

	Loss of life	Morbidity, injury, disease, or hospitalization	Psychological impacts	Loss of social cohesion	Loss of cultural resources	Loss of natural resources	Loss of economic productivity	Loss of infrastructure services	Cost to provincial government
Ocean acidification	n/a	n/a	n/a	n/a	Loss of important cultural resources (e.g., salmon)	Uninhabitable environment for some aquatic species	Loss of shellfish and salmon populations in B.C.	n/a	n/a
Change in wind patterns and speed	Unknown	Change in the movement of air pollution from concentrated areas	Unknown	Unknown	Unknown	Areas of forest blowdown	Unknown	Airport flight delays or cancellations	Unknown

Likelihood Scale

The modified likelihood rating scale used in the risk assessment is consistent with the B.C. risk register likelihood rating scale, as shown in Table 15, but modified to capture salient differences with respect to climate projections (e.g., long time horizons and uncertainty in future likelihoods). For example, several climate-related risk events, such as severe storms or floods, could occur on the order of once every 50, 100 or 500 years, so it is important to differentiate across those scenarios.

Table 15. Comparison of B.C. Risk Register Likelihood Criteria and the Modified Likelihood Rating Scale for Climate-Related Risk Events

Likelihood	Rating	B.C. Risk Register Criteria (for reference)		Climate Risk Assessment Criteria	
		Criteria	Probability	Criteria for Discrete Climate-Related Risk Events	Criteria for Ongoing Climate-Related Risk Events
Almost certain	5	<i>It is expected to happen. Will certainly happen this fiscal year or during the three-year period of the Service Plan.</i>	<i>80% to 100% or once a year or more frequently</i>	Event is expected to happen about once every two years or more frequently (i.e., annual chance $\geq 50\%$).	Event is almost certain to cross critical threshold.
Likely	4	<i>We expect it to happen. It would be surprising if this did not happen.</i>	<i>61% to 79% or once every 3 years</i>	Event is expected to happen about once every 3-10 years (i.e., $10\% \leq$ annual chance $< 50\%$).	Event is expected to cross critical threshold. It would be surprising if this did not happen.
Possible	3	<i>Just as likely to happen as not. We don't expect it to happen, but there is a chance.</i>	<i>40% to 60% or once every 5 years</i>	Event is expected to happen about once every 11-50 years (i.e., $2\% \leq$ annual chance $< 10\%$).	Event is just as likely to cross critical threshold as not.
Unlikely	2	<i>Not anticipated. We won't worry about it happening.</i>	<i>11% to 39% or once every 15 years</i>	Event is expected to happen about once every 51-100 years (i.e., $1\% \leq$ annual chance $< 2\%$).	Event is not anticipated to cross critical threshold.
Almost certain not to happen	1	<i>It would be surprising if this happened. There would have to be a combination of unlikely events for it to happen.</i>	<i>0% to 10% or once every 25 years</i>	Event is expected to happen less than about once every 100 years (i.e., annual chance $< 1\%$).	Event is almost certain not to cross critical threshold.

*Annual chance is the probability that an event will occur in a given year

Consequence Categories and Scales

Categories

To develop a set of consequence categories for the B.C. risk assessment, we considered the following guiding principles:

- Consequence categories should resonate with diverse stakeholders in B.C. and capture important consequences to quality of life in the province
- Categories should be detailed enough to be meaningful, while being manageable enough to evaluate within the resources of this project

The resultant set of categories is:

- Health
 - Loss of life
 - Morbidity, injury, disease, or hospitalization
- Social functioning
 - Psychological impacts
 - Loss of social cohesion (e.g., equity, housing/food affordability, trust in government, and other elements of social fabric)
- Cultural resources
 - Loss of cultural resources (i.e., a human work, an object, or a place that is determined, on the basis of its heritage value, to be directly associated with an important aspect or aspects of human history and culture) (Parks Canada, 2013)⁴
- Natural resources
 - Loss of natural resources (e.g., natural environment and ecosystem services)
- Economic vitality
 - Loss of economic productivity (e.g., impacts to key industries or jobs)
 - Loss of infrastructure services (e.g., transportation, water, or energy services)
- Cost to provincial government

In development of these categories through desk research, a workshop, and written feedback from subject matter experts, we considered a range of options, from high-level categories of People, Economy, and Environment, to more detailed categories such as deaths, injuries or illnesses, infrastructure damage (\$), direct economic impacts, indirect economic impacts, effects on equity, effects on daily life, effects on natural resources, and effects on cultural resources.

The resultant set of categories is intended to strike a balance and provide a set that is clearly defined, but measurable within the scope of this project. The order of the categories is consistent with the EMBC hierarchy of impacts: fatality, injury, critical facilities, lifelines, property damage, environment, economic, and social (EMBC, 2004).

⁴ This is a widely-used definition and one applied and interpreted broadly for this framework. This category could include potential impacts to Indigenous communities, but those impacts may also transcend this category.

Rating Scales

Details about each rating scale are below. All scales were vetted and refined with workshop participants and the Project Committee.

- **Loss of life**
 - Scale addresses feedback from workshop to allow for consideration of relative as well as absolute thresholds.
 - Absolute thresholds are derived from the Dam Failure Consequence Classification Guideline for Dams in British Columbia, which represents an existing classification of fatality thresholds for discrete events in the province.
 - Relative thresholds are derived from professional judgment, and could be refined over the course of testing and applying the framework.
- **Morbidity, injury, disease, or hospitalization**
 - Scale derived based on professional judgment relative to be one order of magnitude higher than the loss of life rating scale. The resulting order of magnitude is similar (though more conservative than) the Emergency Management B.C. (EMBC) Hazard Risk Vulnerability Assessment (HRVA) thresholds (EMBC, 2004).⁵
- **Psychological impacts**
 - Scale reflects workshop feedback to capture severity of disturbance as well as number of people affected.
- **Social cohesion**
 - Scale reflects workshop feedback to incorporate impacts to quality of life, plus a blend of (1) the scale/severity combinations from EMBC HRVA and (2) implied thresholds from Norway risk assessment:
 - (1) EMBC “economic and social” rubric:
 - Temporary impact (e.g., power loss) < temporary and widespread (e.g., loss of lifeline) < extended and widespread (e.g., pandemic flu) < long term disruption (e.g., foot and mouth disease)
 - (2) Norway assessment key words from descriptions of “social and psychological” consequence category (Norwegian Directorate for Civil Protection, 2014):
 - Uncertainty, reactions of anxiety and fear
 - Unmet expectations of emergency/crisis management
 - Shocking and frightening
 - Sense of helplessness
 - Unrest and anxiety
- **Loss of cultural resources**

⁵ EMBC HRVA thresholds for injuries/illness: 1 = very low = 0-4 (e.g., auto accident); 2 = low = 4-50 (e.g., bus accident); 3 = high = 50-2000 (e.g., contaminated water); 4 = very high = 2000+ (e.g., pandemic flu)

- Scale started with default consequence rating scale from the B.C. Risk Register and, based on workshop feedback, updated scale to be more descriptive and explicit about temporal nature of impacts.
- **Loss of natural resources**
 - Scale started with default consequence rating scale from the B.C. Risk Register and, based on workshop feedback, updated scale to be more descriptive and explicit about temporal nature of impacts.
- **Loss of economic productivity**
 - Scale addresses feedback from workshop to include an example dollar threshold for impacts (chained to a dollar year) or a temporal threshold for economic impacts.
 - Settled on \$1B threshold for catastrophic impacts and scaled down by order of magnitude, based on assessment of the costs of past catastrophic events, including:
 - 2003 wildfire season: **\$1.3 billion** in direct fire suppression costs + indirect economic losses (Sagan, 2017)
 - 2017 wildfire season (Abbott & Chapman, 2018):
 - \$562.7 million in direct fire suppression costs
 - \$20M in aid for ranchers
 - Indirect economic losses unknown (too soon to tell, but clear long-term effects)
 - 2008 recession:
 - B.C. economy contracted by 2.3% in 2009, employment declined 1.6% (B.C. Ministry of Finance, 2010)
 - Change in GDP (2007 chained dollars): = \$4.8 billion (Government of B.C., 2018)
 - Using chained 2007 dollars since that is the standard used in current BC GDP estimates (Government of B.C., 2018).
- **Loss of infrastructure services**
 - Scale based on the EMBC HRVA consequence rating scale for infrastructure noted below (EMBC, 2004). Other data points considered:
 - Critical facilities
 - Temporary relocation < few days closure < loss of 50% of capability < long-term disruption
 - Lifelines (water, gas, power, etc.)
 - Temporary interruption < few days interruption < week-long interruption < long-term disruption
 - Property damage
 - Minimal damage < localized damage < localized and severe < widespread and severe

- “Economic and social”
 - Temporary impact (e.g., power loss) < temporary and widespread (e.g., loss of lifeline) < extended and widespread (e.g., pandemic flu) < long term disruption (e.g., foot and mouth disease)
- **Cost to provincial government**
 - Scale developed based on feedback from workshop to scale relative to the approximate size of the Contingency Reserve Fund.

The modified consequence rating scale used in the risk assessment is consistent with the B.C. risk register consequence rating scale, as shown in Table 16.

Table 16. Comparison of B.C. Risk Register Consequence Criteria and the Modified Consequence Rating Scale

Consequence	Rating	B.C. Risk Register Criteria/ Examples	Health		Social functioning		Cultural resources	Natural resources	Economic vitality		Cost to provincial government*
			Loss of life	Morbidity, injury, disease, or hospitalization	Psychological impacts	Loss of social cohesion	Loss of cultural resources	Loss of natural resources	Loss of economic productivity	Loss of infrastructure services	
Catastrophic	5	<p><i>Major problem from which there is no recovery</i></p> <p><i>Significant damage to ministry credibility or integrity</i></p> <p><i>Complete loss of ability to deliver a critical program</i></p>	100+ people or >25% of a single community	1,000+ people affected or >25% of a single community	Widespread and severe disturbance resulting in long-term psychological impacts (e.g., post-traumatic stress disorder (PTSD))	<p>Months-long disruption to daily life (e.g., inability to access employment, education)</p> <p>Widespread, permanent loss of livelihoods or way of life</p> <p>Severe, widespread erosion in public confidence in government</p> <p>Erosion of community institutions and community cohesion</p>	Resource can never recover; destruction is permanent and irreversible (e.g., destruction of an irreplaceable artifact or knowledge)	Resource can never recover; destruction is permanent and irreversible (e.g., extinction of a species within the province)	<p>Potential direct and indirect economic losses of over \$1 billion*</p> <p>Long-term disruption or loss of an economic sector and associated job losses</p>	<p>Months-long disruption in infrastructure services</p> <p>Major impediment to day-to-day life</p>	Added cost is far beyond Contingency Reserve Fund (i.e., > \$1.5 billion)

Consequence	Rating	B.C. Risk Register Criteria/ Examples	Health		Social functioning		Cultural resources	Natural resources	Economic vitality		Cost to provincial government*
			Loss of life	Morbidity, injury, disease, or hospitalization	Psychological impacts	Loss of social cohesion	Loss of cultural resources	Loss of natural resources	Loss of economic productivity	Loss of infrastructure services	
Major	4	<p><i>Event that requires a major realignment of how service is delivered</i></p> <p><i>Significant event which has a long recovery period</i></p> <p><i>Failure to deliver a major political commitment</i></p>	10-100 people or > 15% of a single community	100-1000 people affected or > 15% of a single community	Localized severe disturbance resulting in long-term psychological impacts (e.g., loss of home, identity, or sense of place)	<p>Weeks-long disruption to daily life (e.g., inability to access employment, education)</p> <p>Localized, permanent loss of livelihoods or way of life</p> <p>Moderate erosion of public trust in government or community cohesion</p>	Recovery of the resource will take decades	Recovery of the resource will take decades	<p>Potential direct and indirect economic losses of over \$100 million*</p> <p>Months-long disruption to a major economic sector and associated job losses</p>	<p>Weeks-long disruption in infrastructure services</p> <p>Major impediment to day-to-day life</p>	Significant added cost; up to 2x Contingency Reserve Fund amount (i.e., \$750 million - 1.5 billion)
Moderate	3	<p><i>Recovery from the event requires cooperation across departments</i></p> <p><i>May generate media attention</i></p>	2-10 people or > 5% of a single community	10-100 people affected or > 5% of a single community	<p>Widespread moderate disturbance resulting in temporary psychological impacts (e.g., feelings of fear and anxiety)</p>	<p>Days-long disruption to daily life (e.g., inability to access employment, education)</p> <p>Seasonal loss of livelihoods or way of life</p> <p>Minor erosion of public trust in government or</p>	Recovery of the resource will take years	Recovery of the resource will take years	<p>Potential direct and indirect economic losses of over \$10 million*;</p> <p>Weeks-long disruption to a major economic sector and employment</p>	<p>Days-long disruption in infrastructure services</p> <p>Major impediment to day-to-day life</p>	Added costs can be covered within Contingency Reserve Fund but would detract from other priorities (e.g., >50% of Contingency Reserve Fund or > \$375 million but < \$750 million)

Consequence	Rating	B.C. Risk Register Criteria/ Examples	Health		Social functioning		Cultural resources	Natural resources	Economic vitality		Cost to provincial government*
			Loss of life	Morbidity, injury, disease, or hospitalization	Psychological impacts	Loss of social cohesion	Loss of cultural resources	Loss of natural resources	Loss of economic productivity	Loss of infrastructure services	
						community cohesion					
Minor	2	<p><i>Can be dealt with at a department level but requires Executive notification</i></p> <p><i>Delay in funding or change in funding criteria</i></p> <p><i>Stakeholder or client would take note</i></p>	Low potential for multiple loss of life	<10 people affected	Localized moderate disturbance resulting in temporary psychological impacts (e.g., feelings of fear and anxiety)	<p>Hours-day-long disruption to daily life (e.g., inability to access employment, education)</p> <p>Low potential for erosion of public trust in government or community cohesion</p>	Recovery of the resource will take months	Recovery of the resource will take months	<p>Potential direct and indirect economic losses of over \$1 million*;</p> <p>Days-long disruption to a major economic sector and employment</p>	Hours-long disruption in infrastructure services	Added costs can be easily covered within Contingency Reserve Fund (≤\$350 million)
Insignificant	1	<p><i>Can be dealt with internally at the branch level</i></p> <p><i>No escalation of the issue required</i></p> <p><i>No media attention</i></p> <p><i>No or manageable stakeholder or client interest</i></p>	No possibility of loss of life other than through unforeseeable misadventure	No possibility for morbidity, injury, disease, or hospitalizations other than through unforeseeable	Minimal expected reactions of fear anxiety or disruption to daily life	<p>Minimal disruption to daily life</p> <p>Trust in government remains unchanged</p>	Little impact or resource can recover within days	Little impact or resource can recover within days	Potential direct and indirect economic losses less than \$1 million*	Temporary nuisance	No expected additional costs to provincial government

Consequence	Rating	B.C. Risk Register Criteria/ Examples	Health		Social functioning		Cultural resources	Natural resources	Economic vitality		Cost to provincial government*
			Loss of life	Morbidity, injury, disease, or hospitalization	Psychological impacts	Loss of social cohesion	Loss of cultural resources	Loss of natural resources	Loss of economic productivity	Loss of infrastructure services	
				misadventure							

*Based on an annual Contingency Reserve Fund of approximately \$750 million (B.C. Ministry of Finance, 2018).

Appendix B: Climate Resources for Identifying Objectives, Risk Causes, and Risk Events

The following resources will be helpful for identifying objectives, risk causes, and risk events.

- Provincial level climate resources
 - Indicators of Climate Change for British Columbia (B.C. Ministry of Environment, 2016)
 - Annotated Bibliography on Climate Change Impacts in British Columbia: Background and Overview Document (ESSA, 2017)
- Regional climate resources
 - Climate Summary for Cariboo Region (PCIC, 2013a)
 - Climate Summary for Kootenay/Boundary Region (PCIC, 2013b)
 - Climate Summary for Northeast Region (PCIC, 2013c)
 - Climate Summary for Omineca Region (PCIC, 2013d)
 - Climate Summary for Skeena Region (PCIC, 2013e)
 - Climate Summary for South Coast Region (PCIC, 2013f)
 - Climate Summary for Thompson/Okanagan Region (PCIC, 2013g)
 - Climate Summary for West Coast Region (PCIC, 2013h)
 - Canada's Marine Coasts in a Changing Climate (Lemmen, Warren, James, & Mercer Clarke, 2016)
- Hazard-specific resources
 - Flooding and sea level rise
 - Potential Impacts of Climate Change on B.C. Hydro's Water Resources (Jost & Weber, 2012)
 - Lower Mainland Flood Management Strategy - Analysis of Flood Risk Scenarios (Kerr Wood Leidal Consulting Engineers, 2015)
 - Lower Mainland Flood Management Strategy Project 2: Regional Assessment of Flood Vulnerability (Northwest Hydraulic Consultants, 2016)
 - Simulating the Effects of Sea Level Rise and Climate Change on Fraser River Flood Scenarios (B.C. Ministry of Forests, Lands and Natural Resource Operations, 2014)
 - Capital Regional District Coastal Sea Level Rise Risk Assessment (AECOM, 2015)
 - Wildfire
 - B.C. 2017 Wildfire Season Summary (Government of British Columbia, 2018)
 - Landslide
 - Potential Impacts of Climate Change on Landslide Occurrence in Canada (Cloutier, Locat, Geertsema, Jakob, & Schnorbus, 2016)
 - Glacier melt and permafrost

- Assessment of Glacier and Permafrost Hazards in Mountain Regions – Technical Guidance Document (GAPHAZ, 2017)
- Sector-specific resources
 - Agriculture
 - Climate Change Adaptation Programming for B.C. Agriculture: Partnering for Success (B.C. Agriculture & Food Climate Action Initiative, 2017)
 - B.C. Agriculture Climate Change Adaptation Risk and Opportunity Assessment: Provincial Report (Crawford & MacNair, 2012)
 - B.C. Agriculture and Climate Change Regional Adaptation Series (B.C. Agriculture & Food Climate Action Initiative, 2016)
 - Pilot Application: Adaptive Design & Assessment Policy Tool (ADAPTTool) – British Columbia Ministry of Agriculture Marine Fisheries and Seafood Program (B.C. Ministry of Agriculture Climate Action Team et. al, 2013)
 - Health
 - Addressing Climate and Health Risks in B.C. factsheets (B.C. Ministry of Environment and Climate Change Strategy, 2017a; B.C. Ministry of Environment and Climate Change Strategy, 2017b; B.C. Ministry of Environment and Climate Change Strategy, 2017c; B.C. Ministry of Environment and Climate Change Strategy, 2017d; B.C. Ministry of Environment and Climate Change Strategy, 2017e)
 - Health Authority Perceptions and Capacity for Action: Health Impacts of Climate Change in B.C. (Barter & Klein, 2013)
 - Oil and Gas
 - Northeastern British Columbia Climate Risk Assessment for the Oil and Gas Sector (Fraser Basin Council, 2015)
 - Transportation
 - Climate Risks and Adaptation Practices for the Canadian Transportation Sector 2016 (Nyland & Nodelman, 2017)

Appendix C: Historical and Projected Climate Data for Likelihood Ratings

The following resources in Table 17 will be helpful for gathering historical and projected climate information for each risk event.

Table 17. Climate Data Resources

Climate Hazard	Data Source
Sea level rise	Kopp et al. (2014) probabilistic projections of local sea level rise (Prince Rupert and Tofino tide gauges; 2000-2100)
Coastal flooding	University of Hawaii Sea Level Rise Center, storm tide records (Prince Rupert and Tofino tide gauges; 1909-2018)
Average sea surface temperature	World Climate Research Program global climate model output (Across British Columbia; 1950-2100)
Average air temperature	Pacific Climate Impacts Consortium, Bias Corrected Spatially Downscaled data (Across British Columbia; 1950-2100)
Maximum temperature	Pacific Climate Impacts Consortium, Bias Corrected Spatially Downscaled data (Across British Columbia; 1950-2100)
Seasonal precipitation	Pacific Climate Impacts Consortium, Bias Corrected Spatially Downscaled data (Across British Columbia; 1950-2100)
Extreme precipitation	Pacific Climate Impacts Consortium, Bias Corrected Spatially Downscaled data (Across British Columbia; 1950-2100)
Wildfire	National Resources Canada, Projected change in the length of the fire season (Across British Columbia; 1981-2100)
Ocean acidification	Intergovernmental Panel on Climate Change qualitative assessment.
Wind patterns and speed	Intergovernmental Panel on Climate Change qualitative assessment.
Soil moisture (indicator for agriculture)	Pacific Climate Impacts Consortium, VIC hydrologic model output (four basins in BC; 1950-2100)
Snow water equivalent (indicator for water supply)	Pacific Climate Impacts Consortium, VIC hydrologic model output (four basins in BC; 1950-2100)
Streamflow	Pacific Climate Impacts Consortium, Station hydrologic model output (120 sites across four basins in BC; 1950-2098)

Appendix D: Populating the B.C. Risk Register Template

After completing each step of the climate risk assessment framework, transfer the results to the B.C. risk register template.

First, Populate the “Project Context” tab of the risk register template with the results from Section 2.1 Step 1: Understand the context, as illustrated in Figure 8. This includes the goal and objectives and operating principles of the assessment.

	A	B	C	D	E	F	G	H	I	J
1	CONTEXT TEMPLATE									
2	ESTABLISH CONTEXT									
3	Purpose: establish scope, criteria, and deliverable for a particular risk assessment									
4										
5	1. State the subject of the risk analysis (e.g., strategic plan; business case; project agreement) and its scope with respect to organisations involved, intended audience and time frame.									
6	Text text text.									
7										
8	2. State goals and objectives of the program or plan in question.									
9	Text text text.									
10										
11	3. State the mission, vision, operating principles and any other value criteria.									
12	Text text text.									
13										
14	4. Identify stakeholders ; determine their influence on the process; methods of consultation and communication, as appropriate.									
15	Text text text.									
16										
17	5. Set out assumptions and constraints (deadlines, time-frames, environmental factors, executive or political directives).									
18	Text text text.									
19										
20										
21										
	1. Risk Register Template		2. L&C Matrix		3. Project Context		4. Process Help			

Figure 8. Populate the B.C. risk register template with the results from Step 1: Establish the Context.

Next, populate columns G, H, I, and J in the “Risk Register Template” tab with the results from Section 2.2 Step 2: Identify , as illustrated in Figure 9. List the top 10-15 risk events selected in Section 2.2 in column H, titled “Risk Events.” Enter the corresponding objective and risk cause for each risk event into column G “Objective” and column I “Risk Cause,” respectively. Detail the expected impacts of each risk event on the objectives in column J “Impact/Consequence.” Impacts were discussed in Section 2.2 during the development of the risk event statements.

	A	G	H	I	J
1					
2	RISK IDENTIFICATION				
3	#	OBJECTIVE	RISK EVENT	RISK CAUSE	IMPACT/ CONSEQUENCE
4	<i>This prompt row can be hidden to provide more page space.</i>	<i>What planning objective does this event affect?</i>	<i>What is it that you are working to avoid or reduce the likelihood or impact of occurring? Risks are future events that could interfere with achievement of objectives.</i>	<i>What are the triggers, sources or circumstances that could act alone or together to increase the likelihood of the Risk Event occurring? There are usually multiple causes leading to a Risk Event.</i>	<i>If this Risk Event did occur, how would it impact objectives? What are the longer-term or cumulative consequences?</i>
5	<i>Sample</i>	<i>1.3 Timely service delivery to citizens.</i>	<i>Invoice delivery to clients is slow and inaccurate.</i>	<i>- Legacy system is incompatible with data input requirements. - Data entry practices inconsistent - Manual data checks</i>	<i>- Unmet client service quality performance - Increased AIFI - Increased risk of loss - Increased cost of recovery</i>
6					
7					
8					
9					
10					

Navigation bar: 1. Risk Register Template | 2. L&C Matrix | 3. Project Context | 4. Process Help

Figure 9. Populate the B.C. risk register template with the Results from Step 2: Identify Risk Events.

Next, populate columns P, Q, R, and S in the “Risk Register Template” tab with the results from Section 2.3 Step 3: Analyze risks, as illustrated in Figure 10. Transfer the likelihood rating for each risk event from Section 2.3.1 to column P, titled “L (1-5)” and transfer the overall consequence rating for each risk event from Section 2.3.2 to column Q, titled “C (1-5).” Column R “Sum” and column S “Risk Rating” will be automatically populated based on the likelihood and consequence ratings inputted into columns P and Q. Verify that the results in columns R and S match the conclusions from Section 2.4.1.

Finally, populate columns O and T in the “Risk Register Template” tab with the results from Section 2.4 Step 4: Evaluate, also illustrated in Figure 10. For each risk event, list any existing risk mitigations identified in Section 2.4.2 in column O “Existing Mitigations” and transfer the adequacy of existing risk mitigations rating from Section 2.4.2 to column T “Adequacy of Existing Mitigations.”

	O	P	Q	R	S	T
1	<i>Objective of the risk assessment.</i>					
2	INITIAL RISK RATING				EVALUATION	
3	EXISTING MITIGATIONS	L (1-5)	C (1-5)	SUM	RISK RATING	ADEQUACY OF EXISTING MITIGATIONS
4	<i>What are you doing now to reduce the likelihood or impact of the event?</i>	<i>How likely?</i>	<i>How severe?</i>			<i>Non-existent, Inadequate, Adequate, Robust, Excessive</i>
5	- Manual data checks - Training manual	3	4	12	HIGH	<i>Inadequate</i>
6				0	UNRATED	
7				0	UNRATED	

1. Risk Register Template | 2. L&C Matrix | 3. Project Context | 4. Process Help

Figure 10. Populate the B.C. Risk Register with the Results from Step 3: Analyze Risk Events and Step 4: Evaluate Risk Events.