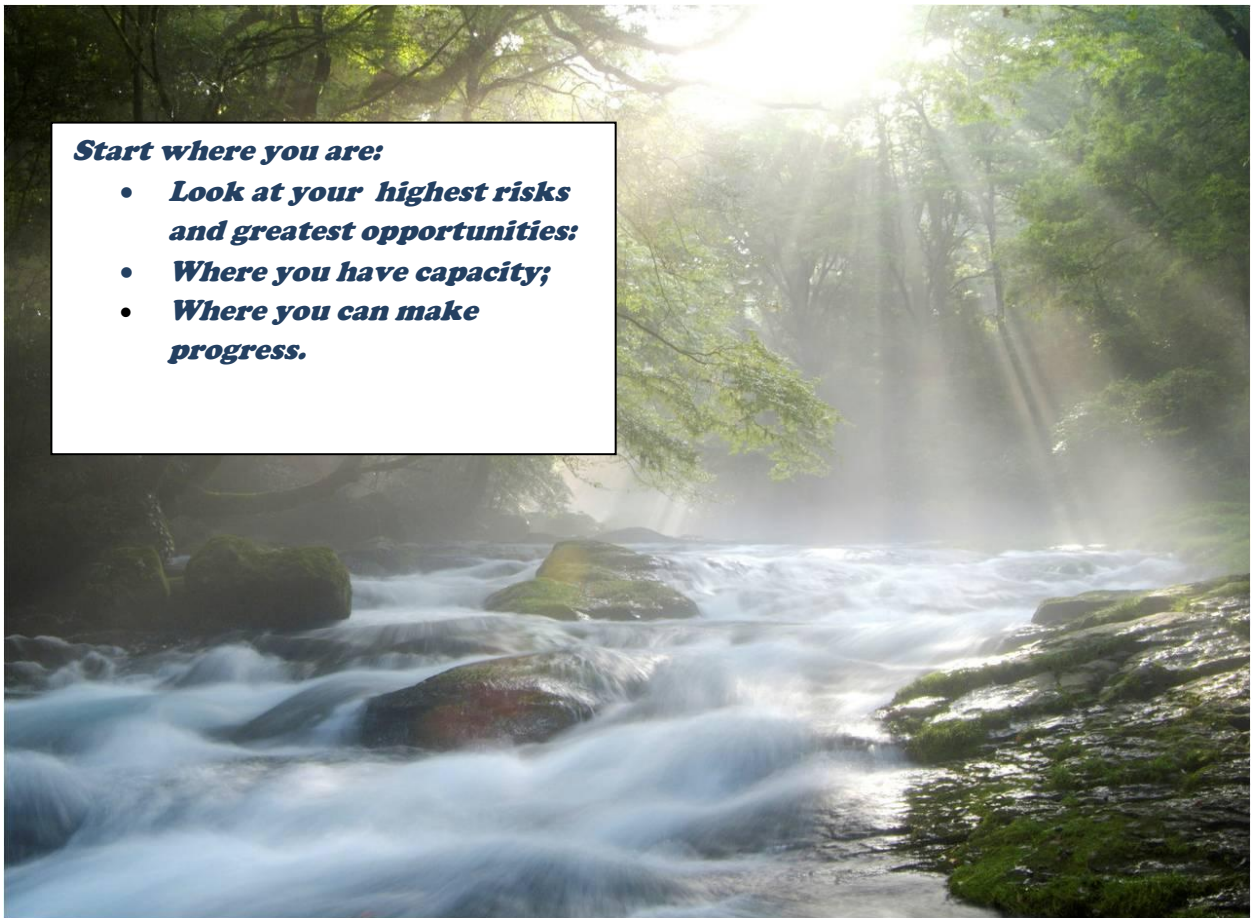


British Columbia Ministry of
Forests, Lands, and Natural Resource Operations

Climate Change Assessment Guide

Start where you are:

- ***Look at your highest risks and greatest opportunities;***
- ***Where you have capacity;***
- ***Where you can make progress.***



First Approximation: December 13: 2013
Vulnerability Assessments

BC Ministry of Forests Lands and Natural Resource Operations
Climate Change Assessment Guide
Overview and Vulnerability Assessments

December 13, 2013

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Introduction

This Guide is a tool to help natural and heritage resource managers in British Columbia (BC) develop action plans to embed climate change in the way we do business. It provides an overview of what a vulnerability assessment is, and briefly describes other types of climate change assessments.

Context: BC's resource values and communities are at increasing risk from extreme weather events and the impacts of climate change. BC's existing natural and heritage resource management and decision support systems may be inadequate to cope. Climate change assessments can assist in identifying risks and opportunities, and enable Ministry decision-makers to make more robust decisions.

Why is this Important? When making decisions affecting land, resources and infrastructure, BC resource managers will achieve better results by taking climate change into account.

Purpose

BC Ministry of Forests, Lands and Natural Resource Operations' [*Climate Action Roadmap*](#), says:

"Assessment is essential at the outset of the planning phase in order to identify risks and opportunities as well as to determine priorities for the implementation phase and again at the end of project or program delivery to determine results and achievements."

Assessment results are also useful for updating action plans as time passes and conditions change. A well crafted Climate Change Assessment produces a snapshot of high risk values, areas, processes, and practices in natural resource management. Knowing what these risks are, how and where they are spatially located, and how to reduce them can assist resource managers in prioritizing climate change adaptation and/or mitigation actions.

This Guide could also be used as a starting point to add an important climate change dimension to the work on advancing a *Natural Resource Sector Monitoring and Assessment Framework* ([Forest and Range Evaluation Program](#), [Change Monitoring Inventory](#), [Cumulative Effects Assessment](#), etc.).

Target Audience

The Guide is intended as an overview of climate change assessments for staff in the BC Ministry of Forests, Lands and Natural Resource Operations, particularly:

- resource professionals supporting Statutory Decision Makers;
- stewardship staff;
- resource managers in charge of assets (e.g. natural capital, financial capital);¹ and,
- those involved in emergency preparedness.

It may also be useful for others in the natural and heritage resource sectors, both within and outside government.

Climate Change Assessments

There are a number of different types of Climate Change Assessments, all of which can be helpful in embedding climate change into Ministry business (see Appendix 1). While there is no one particular assessment that must be completed within a Climate Action Plan, collectively they aid in both action planning and understanding how Ministry objectives may be affected by climate change and variability. Some assessments may take significant resources and time to complete, while others could be quick with low resource requirements. Assessments should be purpose-driven, and the type of assessment selected will depend upon the objectives of the business unit and the values at risk. The important thing to remember is: it doesn't really matter what level you come in at: the most important thing is to start where you are: look at what seems to be at highest risk, where you have the capacity, and where you can make progress.

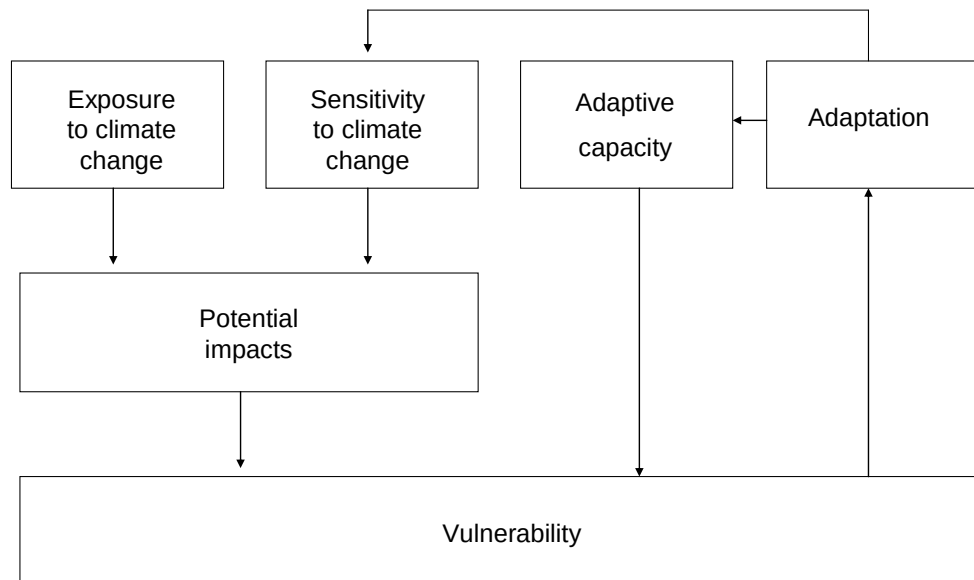
Vulnerability Assessments

A vulnerability assessment is any review of the potential vulnerabilities to climate change of an organization, an organism, a system, or just about anything. A well-crafted assessment produces a snapshot of high risk values, areas, processes, and resource management practices. Knowing what these risks are, how and where they are spatially located, and how they function can assist resource managers in prioritizing climate change adaptation and/or mitigation actions.

Fussel and Klein, in their seminal article on [*Climate change vulnerability assessments: an evolution of conceptual thinking*](#), describe various types of climate change assessments. They point to the 'adaptation policy assessment' as a broad and sophisticated approach that takes assessment forward to adaptation action. Within this framework, an assessment of vulnerability integrates several other assessment methodologies.

¹ (Asset managers are encouraged to refer to asset categories in [Nadina FFESC livelihood assessment](#) (p. 3)).

Figure 1². A simplified version of the “Adaptation Policy Assessment Approach.”



Steps in the Vulnerability Assessment Process

There are a number of components to a vulnerability assessment. The following six process steps are recommended. They can be simplified or expanded based upon circumstances.

1. Get ready;
2. Understand how current climate affects vulnerabilities and opportunities;
3. Understand how trends in future climate apply locally;
4. Assess how changes in climate may affect values of interest;
5. Describe and assess potential adaptation options; and,
6. Plan and implement management responses.

These steps, further detailed below, can be taken to assess climate change vulnerability and identify adaptation options.³

² Adapted from Fussel and Klein 2006, as per draft CCFM Vulnerability Assessment Framework (Feb 2011)

³ Adapted from:

- Canadian Council of Forest Ministers Draft CCTF Guidebook v4 Feb 2013, and
- BC Vulnerability Assessment Case Study Methods (Don Morgan, 2013)

Steps in the Vulnerability Assessment Process³

1: Get ready

- ☐ Identify the area of interest, and use expert opinion to ‘guess-timate’ which of your objectives may be compromised by climate change and extremes
- ☐ Recruit and gather together the assessment team
- ☐ Get group clarity on the reasons, benefits and intended outcomes for doing a climate change assessment:
 - Develop a clear purpose statement and expected outcome statement
- ☐ Develop a team charter and work plan outlining responsibilities and timelines for individuals and organizations participating in the assessment:
 - Describe the scope, geographic extent and characteristics of the area or value of interest
 - Consider the scale of the assessments, and how multiple scales may interact
 - Describe the decision making scope and actors within the system of interest
 - Align scope to match the purpose and expected outcomes with available resources.
- ☐ Develop a communications plan to ensure decision makers and stakeholders are kept informed of the purpose and progress of the assessment.

2. Understand how current climate affects vulnerabilities and opportunities

- ☐ Investigate current climate and its effect upon the value(s) or area of interest:
 - Gather information and data on climate and conditions and trends for the resource/value of interest
 - Examine how climate has shaped current resource values and management practices
 - Identify any recent changes or trends in climate and effects these changes have had on management practices.

3. Understand how trends in future climate apply locally

- ☐ Select and describe several alternate future climate scenarios:
 - Use [Plan2Adapt](#) or [ClimateBC](#) to project changes in climate variables (e.g., temperature, precipitation) and in “climate envelopes” for the study area, for different climate scenarios.
 - Consider a ‘book-ends’ approach, (e.g. using both B1 and A2 emissions trajectory in the [PCIC Regional Analysis Tool](#)) and be sure to include a scenario closely resembling the current emissions trajectory (e.g. [A2](#), [A1FI](#), or [RCP8.5](#)).

4: Assess how changes in climate may affect values of interest

- ☐ Create impact scenarios and an overall impact ranking for each scenario
- ☐ Estimate possible changes in character and function of the value or system:
 - E.g. for a geographic area, divide the study area into sub-units based on the potential of the chosen value(s) to respond similarly to climate change or extremes
 - Develop hypotheses and rationales (e.g., a conceptual model or narratives) to support projections of possible change, considering climate change, impacts upon values, results of management, etc.
 - Use expert workshops (with local specialists, academics and practitioners), and/or expert advice and/or literature.
- ☐ List the uncertainties and knowledge gaps about future scenarios

Steps in the Vulnerability Assessment Process³

- ☐ Document information sources
- ☐ Assess the effects of current and potential future impacts on the ability to achieve objectives
- ☐ Estimate consequences to values and to the effectiveness of management strategies (management vulnerability), resulting from changes to climate and resource values (following similar methods as above).
- ☐ Estimate adaptive capacity (including assessment of resources needed, and management's willingness to either invest or risk the consequences on non-investment (see Appendix 1).
- ☐ Assess current and future vulnerability based on impacts and adaptive capacity
- ☐ Update the list of uncertainties and knowledge gaps
- ☐ Document all of your information sources.

5. Describe and assess potential management responses (adaptation options)

- ☐ Describe potential management responses that reduce vulnerability (adaptation strategies), based on literature, expert advice and workshops.
- ☐ Develop a list of possible adaptation options for the system of interest:
 - or a list of modified adaptation options if re-assessing adaptation options.
- ☐ Assess the importance of adaptation options for achieving management objectives under the range of climate change scenarios that you have defined.
- ☐ Identify synergies
- ☐ Identify barriers to adaptation
 - Evaluate likely management responses by assessing the likelihood that managers will be willing and able to implement potential responses (current "management adaptive capacity")
 - Identify dependencies (e.g. you may want to plant different species – can you get the seedlings?)
 - Identify resources needed
- ☐ Rate the projected vulnerability of the resource value for each management response. Do this in each subunit for different levels of adaptation:
 - Baseline vulnerability: potential impacts⁴ without any management response (i.e., include inherent ability of the value or system to adapt)
 - Best case: potential impacts with full potential management response
 - Likely case: potential impacts with likely management response (considering barriers).

6: Plan and implement management responses

- ☐ Identify adaptation options to mainstream into policy, planning, practices, or infrastructure:
 - Recommend management, research, planning and policy actions to address vulnerability and barriers to adaptation.
 - Develop an implementation plan and/or strategy to mainstream adaptation into plans, policies, practices, or legal and administrative frameworks.

⁴ Impacts should consider both positive and negative changes.

Steps in the Vulnerability Assessment Process³

- ☐ Implement adaptation (management responses)
- ☐ Prepare to evaluate adaptation performance on a continuing basis:
 - Prepare a monitoring plan, or modified and existing monitoring plan to incorporate adaptations
 - Modify adaptations, expectations, and/or objectives as necessary.

Dealing with Risk and Uncertainty

“Climate change will lead to changes in geophysical, biological and socio-economic systems. An impact describes a specific change in a system caused by its exposure to climate change. Impacts may be judged to be harmful or beneficial. Vulnerability to climate change is the degree to which these systems are susceptible to, and unable to cope with, adverse impacts. The concept of risk, which combines the magnitude of the impact with the probability of its occurrence, captures uncertainty in the underlying processes of climate change, exposure, impacts and adaptation.”⁵

Risk is a function of likelihood of an undesirable event happening, coupled with the consequences of that event. Management efforts to reduce risk make most sense where the consequences are significant, the likelihood of negative consequences are high, and management interventions are available to reduce the risk. The chart below⁶ helps to focus management efforts on areas where consequences are significant and events are likely to occur.

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Severe
Almost certain	M	H	H	E	E
Likely	M	M	H	H	E
Possible	L	M	M	H	E
Unlikely	L	M	M	M	H
Rare	L	L	M	M	H

⁵ Climate Change 2007. Impacts, Adaptation and Vulnerability. IPCC WG2.

http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch19s19-es.html

⁶ http://andrewmedia.dyndns.org/Dartnell/images/risk_matrix.gif

Uncertainty: When undertaking a climate change vulnerability assessment, a number of uncertainties will come to light. *Uncertainty describes the **quality of our knowledge** concerning risk. Uncertainty may affect both the probability and consequence of the risk.*⁷ We deal with uncertainty almost constantly in our lives. For example, our day-to-day responses to the uncertainties in our lives include:

- being prepared for a range of conditions (it might rain);
- leaving a buffer (traffic might be bad);
- thinking twice before making highly consequential irreversible decisions (test paint on a small area before buying gallons);
- leaving options open (delay a decision until more information is available);
- having insurance (pool risks among many people);
- being adaptable (be ready to choose an alternative when your first choice isn't available);
- doing research or monitoring to fill in knowledge gaps (what technology could ensure your basement doesn't flood? Is water seeping in yet?); and,
- revisit decisions regularly (to ensure the research and monitoring information are used).

To deal with something as far-reaching and profound as climate change, it's helpful to bring more awareness, structure, and rigour to our responses, and ensure that our organizations and policies support rather than hinder those responses. A big part of responding to uncertainty is acknowledging its reality while not being paralyzed. There will always be uncertainty due in part to the complexity of the climate system and the inability to predict future human behaviour. Yet, one or more of the types of responses listed above could be used, depending on the specific circumstances.

Strategies to Address Uncertainty in Natural Resource Management

When assessing vulnerability in natural resource management, several methods can be useful to address the uncertainties that will undoubtedly arise. These include, for example, scenario analysis, expert elicitation, and Monte Carlo runs.⁸ Researchers in the US Forest Service

⁷ Climate adaptation: Risk, uncertainty and decision-making UKCIP Technical Report May 2003

<http://www.ukcip.org.uk/wordpress/wp-content/PDFs/Risk.pdf>

⁸ *Addressing uncertainty in vulnerability assessments*. US Fish and Wildlife Service:

http://training.fws.gov/CSP/Resources/climate_change/pdfs/addressing.pdf

developed a useful conceptual framework showing various approaches to manage resources sensitive to climate change⁹. Approaches include:

- **Resist change** when critically important values could be affected. This is a short-term solution, but may be warranted in some cases;
- **Promote resilience**, meaning the ability to return to an original condition or functionality after disturbance;
- **Facilitate response** to change by enabling or promoting establishment of a new system (forest, infrastructure, etc.) adapted to evolving climate conditions; or,
- **Revisit objectives**, since climate change may mean that old objectives and management approaches are no longer appropriate.

In selecting any approach, it's useful to:

- (1) be clear about the objectives;
- (2) define management options;
- (3) develop hypotheses about their potential effects;
- (4) test or monitor for their actual effects;
- (5) more broadly implement good approaches; and,
- (6) revisit and revise objectives and approaches with new information.

Adaptability helps to address uncertainty, for example, by:

- undertaking small scale experiments making it safe to fail;¹⁰
- using management actions as opportunities for learning, which entails:
 - developing and maintaining monitoring systems;
 - to the extent possible structuring management actions as experiments with explicit expectations about the effects of management actions;
- being open to “failures” since they can provide useful information – and learning from them (as long as they’re part of an action that doesn’t have a highly consequential irreversible impact!); and,
- regularly revisiting objectives given new knowledge and experience.

Link between Cumulative Effects & Climate Change Assessments

Climate change can be integrated into Cumulative Effects Assessments (CEA) as another lens for understanding pressures on different values. These two types of assessments complement each other: by adding a climate change lens to a CEA process, managers are better positioned to reduce risks to values over the long term. And by assessing cumulative effects in an area where

⁹ http://www.fs.fed.us/pnw/pubs/pnw_gtr855.pdf (See also <http://www.fs.fed.us/psw/cirmount/policy/pdf/millar.pdf>)

¹⁰ <http://cognitive-edge.com/library/methods/safe-to-fail-probes/>

climate change effects are being assessed, the combined effects of management and environmental change will give a more robust picture of opportunities and risks. To support Climate Action Plans, look for opportunities to integrate climate-related assessments into existing or planned Cumulative Effects Assessments. When partnered with CEA, they can help to identify and prioritize climate change risks, management interactions, and risk reduction strategies.

Climate change assessments and cumulative effects assessments dovetail, overlap, and rely upon a lot of the same information. They draw upon the same skillset, and use the same people where pilots are underway. Ideally, within CEA, every values assessment should have a climate lens for long term trends (e.g. for fish habitat, consider changes in water temperatures, low flow, peak flow with attendant changes to sediment transfer, etc.) Undertaking CEA and Climate Change Assessment together also supports integrated decision making. For more information, refer to Don Morgan's presentation on [Tying together CEA and Climate Change Assessment](#), or visit MOE's internal [Cumulative Effects Framework](#) SharePoint site.

Summary

Climate change assessments are a valuable instrument in incorporating climate change into the ministry's business. In the preparation of climate action plans, assessments can help focus efforts on those areas at highest risk, those where opportunities are greatest, areas the organization has capacity to address, and where progress can be made. By applying a climate lens to our normal business priorities, the Ministry can demonstrate due diligence in its role as steward of BC's public resources.

While vulnerability assessments tend to be among the most comprehensive of assessments, other types of assessments may be used where warranted.

For further information:

- on assessments, contact [Kathy Hopkins](#), Technical Advisor, Climate Change;
- on the Climate Action Roadmap, contact [Katharine McCallion](#), Policy Analyst;
- on the action planning process, contact [Paul Knowles](#), Director, Competitiveness and Innovation Branch.

Appendix 1 Types of Climate Change Assessments

Types of climate change assessment include:

1. Assessment of how climate is changing in your area

Refer to the [Plan2Adapt](#) website, and scroll down to the box called 'Regions.' Scroll down the pull-down box until you see 'Forestry Regions' and select the one most appropriate for your area of interest. Choose a time period, and a season of interest. Review the summary table, then use the tabs at the left to focus in on impacts. Hover your cursor over the affected sectors to see if your sector is impacted. If it's not designated as an impacted sector, consider whether it could be affected through connections such as road access changes due to extreme events.

Annual, seasonal and monthly climate variables are available through [ClimateBC](#) and [ClimateBCMap](#). Also consider local effects attributable to things like elevation, aspect, etc.

2. Risk Assessment

Risk is a function of likelihood of an undesirable event happening, coupled with the consequences of that event. For example, see the [Risk Management Framework](#) for Fisheries and Oceans Canada (DFO Habitat Management Staff).

For an example of how to complete a risk assessment, see, for example, The University of Washington Centre for Science in the Earth System's [Chapter 9 on Conducting a Climate Change Risk Assessment](#). A risk assessment from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) speaks to [Climate Change Impacts, Risk and the Benefits of Mitigation](#).¹¹

3. Impact assessment

For forest management applications, [ClimateBC](#) and [ClimateBCMap](#) can be used to identify potential changes to BEC zones, species ranges, or seed planning units. For ClimateBCMap, use the quick tutorial to get your bearings. At the top (above the map), choose whether you want to see the climate map, BEC zones, species ranges, or seed planning units. Select your location on the map, and the elevation of interest. Look at a historical normal period (30-years of averaged data), and when choosing the climate change scenarios, make sure to include one or more runs for an A2 scenario (resembling our current climate change trajectory). Compare the annual, seasonal or monthly variables with the historical period. Consider the effects of changes in those averages to your value of interest. Then consider the effect of changes in extremes or periodicity.

Consider also the effects of elevation, aspect, and proximity to features such as glaciers, unstable terrain, floodplains, or wetlands for your resource value.

¹¹ Jones, R.N. and Preston, B.L. December, 2006A report for the Energy Futures Forum

4. Policy assessment

Policy, including legislation, regulations, and administrative processes, can aid or hinder action to protect resource values from the effects of climate change. In addition, reporting mechanisms, decision support platforms, and tools may create gaps or opportunities. A policy assessment can look at the extent to which current policy requires effective action to reduce the impacts of climate change, or whether there are unintended consequences, barriers and gaps.

5. Organizational Readiness Assessment

To determine how ready your region or program is to respond to the challenges of climate change and other cumulative effects, one could look at organizational readiness to adapt. The Canadian Council of Forest Ministers has completed a series of [climate change reports](#) to assist jurisdictions and forest managers adapt to climate change. These include a report on *Adapting sustainable forest management to climate change: a systematic approach for exploring organizational readiness*. This report includes ten things to think about. [\(Abstract\)](#) [\(Full Report\)](#). What's more important is to start where you are, look at your highest priorities and values at risk, and take action.

6. Adaptive Capacity Assessment

Any region or program can be assessed relative to the assets and factors that contribute to adaptive capacity. These include, for example an assessment of:

Human and social capital

- Direction and support provided by leaders, and presence and availability of champions;
- Personal knowledge of forest managers re: climate change, education, awareness;
- Awareness, attitudes, and perceptions of risk;
- Access to and capability for undertaking climate change research, modelling and impact assessment, etc;
- Mechanisms for education, knowledge exchange, and awareness;
- Partnerships, networks, relationships, and trust.

Financial capital

- Technical capacity to mitigate and adapt, as well as the costs of failing to adapt. (e.g. technology and human systems;
- Investments in e.g. climate-relevant data, tools and geospatial temporal information management and decision support systems).

Natural capital

- Natural and heritage resource extent, condition, and trend;
- Current and foreseeable pressures on those resources.

7. Adaptation progress assessment

When developing an action plan, consideration should be given to how you'll measure and report upon progress to targets. One example of a progress assessment is British Columbia Ministry of Environment's 2012 report on [Making Progress on BC's Climate Action Plan](#). BC Ministry of Forests Lands and Natural Resource Operations regions and programs should be guided by information provided by the MFLNRO Climate Change Steering Committee. For more information, contact [Paul Knowles](#).

8. Effectiveness evaluation of adaptation actions

An assessment of the effectiveness of climate change adaptation and mitigation actions is a deeper and perhaps more meaningful measure than 'progress to targets.' Monitoring systems should be put in place to revisit, record, and report upon the success of actions. Learning from what didn't work can be equally valuable, particularly when results are shared. One goal should be an increasing tolerance for 'failure,' particularly when the experimentation necessary for successful adaptation can be managed well through defensible planning and execution, and the results are communicated effectively for organizational learning.

9. Cumulative Effects Assessment

While traditional cumulative effects assessments may take a current snapshot of the effects of management on a system, increasingly these assessments are recognized as an opportunity to factor in climate change considerations. Indeed, changing climate has already had extensive visible impact on BC landscapes affected by fire and mountain pine beetle. When management responses such as accelerated beetle harvest and salvage are factored in, cumulative effects of both climate change impacts to date and management actions can have significant effects on communities and economies. Considering both current climate (which has changed over the last century) and projected future climate along with management effects can yield many benefits, particularly when coupled with actions to reduce impacts to values.

BC's Bulkley Valley Research Center explored a [Cumulative effects assessment framework in BC](#), and work is underway on a series of pilots with a view to incorporating a climate change lens on a periodic basis. FLNR has a [Cumulative Effects Framework](#) to address the needs of decision makers in assessing the cumulative effects of resource development and natural processes.

To date, the Ministry has completed, sponsored, or participated in a number of Climate Change Assessments, including:

- Three regional (or Timber Supply Area (TSA) level) vulnerability assessments: ([Kamloops](#) (see also Kamloops [guidance document\(s\)](#)); [Nadina](#); and [West Kootenays](#));
- A [provincial vulnerability assessment](#); which draws learnings from the three regional assessments;
- A [risk assessment for the Merritt](#) and Kamloops TSAs;

- A policy assessment of BC's *Forest and Range Practices Act* (FRPA), related to climate change;¹² and,
- An [*impact assessment for forest resources*](#).

The first two vulnerability assessments above looked at parts of the Ministry of Forests, Lands and Natural Resource Operations mandate, including hydrology and aquatic ecosystems, forest ecosystems, wildlife, natural disturbance, and soils. Other assessments could be done for the full range of Ministry business. This includes for example: assessments of infrastructure; heritage buildings; biodiversity; recreation; permitting; stewardship; legislation; etc.

¹² contact [Kathy Hopkins](#) for more information

Appendix 2: Glossary¹³

Adaptation

Adaptation is the ability of an organization, infrastructure and/ or biological system to respond to the impacts from climate change. An adaptation action is what we do to reduce risks or take advantage of opportunities presented by a changing climate.

Adaptive Capacity

Adaptive capacity is the ability or potential of a system to respond successfully to climate variability and change, and includes adjustments in both behaviour and in resources and technologies. The presence of adaptive capacity has been shown to be a necessary condition for the design and implementation of effective adaptation strategies so as to reduce the likelihood and the magnitude of harmful outcomes resulting from climate change (Brooks and Adger, 2005). Adaptive capacity also enables sectors and institutions to take advantage of opportunities or benefits from climate change, such as a longer growing season or increased potential for tourism.¹⁴

Evaluation

Evaluation seeks to measure “what is” (Scriven, 1980) Chelimsky and Patton identify three purposes of evaluation:

- for accountability (*e.g. the measurement of results or efficiency*)
- for development (*e.g., the provision of evaluative help to strengthen institutions*)
- for knowledge (*e.g., the acquisition of a more profound understanding in some specific area or field*)¹⁵

Climate Change Impacts

Climate change impacts are “*The effects of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts.*” **Potential impacts** are “*all impacts that may occur given a projected change in climate, without considering adaptation.*” **Residual impacts** are “*the impacts of climate change that would occur after adaptation*” (Parry et al. 2007). In vulnerability assessment, impacts are the result of exposure to climate change and the sensitivity of the sustainable forest management system to a particular level of exposure.

Mitigation

“*Technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to climate change, mitigation means implementing policies to reduce GHG emissions and enhance sinks.*”¹³

¹³ For more, see IPCC Glossary at <http://www.ipcc.ch/pdf/glossary/ar4-wg3.pdf>

¹⁴ IPCC AR4 WG2. Impacts, Adaptation and Vulnerability.

http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch17s17-3.html

¹⁵ Chelimsky, Eleanor & William Shadish. Evaluation for the 21st Century: A Handbook, Sage Publications, 1997. p. 10 as cited in [Canadian Evaluation Society Literature Review](#).

Projection

*A projection is a potential future evolution of a quantity or set of quantities, often computed with the aid of a model. Projections are distinguished from predictions in order to emphasize that projections involve assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realised, and are therefore subject to substantial uncertainty.*¹⁶

Risk

“The probability of something happening multiplied by the resulting cost or benefit if it does.”
(Wikipedia)

Scenario

A scenario is “A plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios may be derived from projections, but are often based on additional information from other sources, sometimes combined within a ‘narrative storyline.’” (Parry et al. 2007). Scenarios are not predictions, and they typically do not include prediction errors or likelihoods.

Vulnerability

“The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity” (Parry et al. 2007).

Vulnerability assessment

A vulnerability assessment is any review of the potential vulnerabilities to climate change of an organization, an organism, a system, or just about anything.

What is the difference between vulnerability and risk?

Vulnerability takes into account both the exposure of an asset to climate change and the sensitivity of that value (which together determine potential impacts), and the ability of the system to adapt. *Risk* is rated based on the likelihood of an undesirable outcome, coupled with the consequences of that outcome.

¹⁶ IPCC AR4 WG1 Annex 1 Glossary

http://www.ipcc.ch/publications_and_data/ar4/wg1/en/annex1sglossary-p-z.html