

CANADIAN CLIMATE CHANGE RISK ASSESSMENT GUIDE

A Strategic Overview of Climate Risks and Their Impact on Organizations

Interim Version

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Executive Summary

Adapting to climate change may be one of the greatest challenges to communities, governments and corporations during the next century. This Guide has been written to assist organizations, particularly small and medium sized ones, understand the risks and opportunities of climate impacts and how to manage them. The process outlined in this Guide is intended to help users through a high-level, strategic assessment of climate risks to their organization: it is simple and easy to use and requires minimal organizational and financial resources. A variety of processes are available for subsequent, more detailed and technical risk assessment for those risks that are indicated to be of extreme or high concern by this process.

The Planning Context

Most organizations produce an annual business plan and an enterprise risk management plan (such as a hazard identification and risk assessment). Many will also have a longer-term strategic plan, a business continuity plan and, possibly, an environmental management plan. It is likely that none of these address the long-term risks and opportunities that might arise from climate change impacts over the next 20 to 40 years but the results of this process will provide useful inputs to all of these plans.

Climate Change Data

The climate is changing in all parts of Canada. It is shown in Annex 1 that the trends observed for the past 40 years, since greenhouse gas forcing became a primary factor affecting climate, in temperature, precipitation and other closely related factors are reasonably good indicators of the trends to be expected for the next four decades out to 2050/2060. The extension of these trends also agrees well with Atmosphere-Ocean Global Climate Model (GCM) projections to 2050, using the A2 scenario of emissions from the Intergovernmental Panel on Climate Change (IPCC) and are consistent with energy use projections by the International Energy Agency (IEA).

As noted in Annex 1 climate projection tables for all regions of Canada, in sufficient detail for use in this process risk assessment, are available on the Institute for Catastrophic Loss Reduction (ICLR) website:

<http://www.iclr.org/climateextremesbruce.html>

These tables are generally consistent with those used in *From Impacts to Adaptation: Canada in a Changing Climate*, Govt. of Canada, NRCan, 2008.

This kind of straight-forward presentation of climate data past, and futures estimates, has been found to be readily understood and useful to many communities organizations across Canada, in considering their needs for adaptation. For those wishing to pursue further the climate and adaptation sciences an extensive bibliography is provided in Annex 1.

Risk Management Process

Risk management is a process for selecting the best course of action in uncertain situations involving risk. It does this by helping to identify, understand, analyze and treat risks and to communicate to others about them. This Guide follows the framework for risk management described in the International Organization for Standardization's document *ISO 31000 Risk management – Principles and guidelines*, First edition, November 15, 2009.

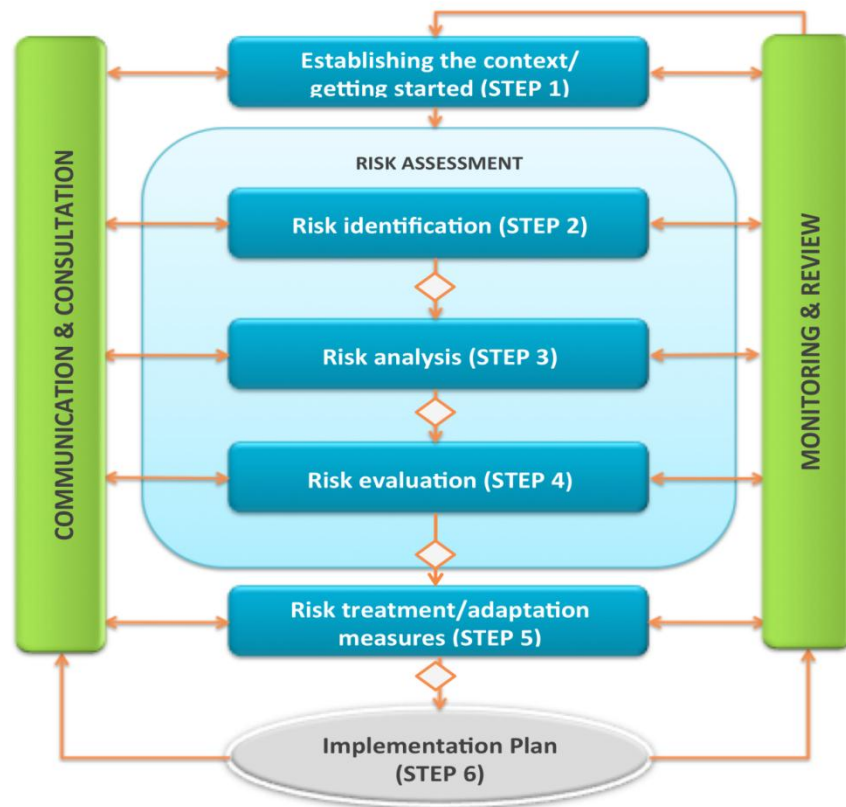
The process described in ISO 31000 is shown in the figure on the following page. For ease of reference the individual steps have been numbered and a sixth step, the implementation plan, added.

This Guide is designed to address high level or strategic issues and opportunities over a broad range of climate impacts during a 40 - 50 year timeframe. However, the same process outlined here can also be used in a more detailed technical analysis of a specific issue or event or in shorter timeframe reviews.¹

¹ The method used in this Guide has been made as simple as possible to allow non-technical users particularly in small and medium size organizations to undertake a study of expected climate impacts on their community or organization and the potential risk events arising from those without having to hire consultants or other technical assistance. For organizations that wish to explore other techniques or subject the high risks determined by this process to a more detailed examination, ISO 31010 describes other risk assessment processes.

For example, Engineers Canada are developing more technical approaches as described at info@pievc.ca and ICLEI Canada has developed the BARC process specifically for municipalities as explained at <http://www.icleicanada.org/programs/adaptation/barc>.

THE ISO31000 RISK MANAGEMENT PROCESS



General

The ISO process for analyzing risks presented by a changing climate follows a series of steps each ending in a decision point to:

1. End the process if no significant risk issue is found, or
2. Repeat the step if additional information is found or needed or a consensus on the findings is not reached by the participants in the process, or
3. Move on to the next step in the process.

This Guide includes suggested tables and templates to record the data developed during the risk assessment and management process to save users the distraction of developing their own data recording methods. These table can be modified as required by the users.

Establishing the Context and Getting Started: Step 1

If the process is to be undertaken by a group or team, the membership and responsibilities will be decided at this point in the process, along with the terms of reference and the resources needed to do the work. Also, a work plan will be drafted and the important stakeholders identified.

Risk Assessment: Steps 2, 3 and 4

Risk Identification: Step 2: Climate change impacts are analyzed using the summarized climate projects (Annex 1) and risk events and opportunities created by these impacts are identified. A preliminary estimation of likelihood and consequence is made for each risk event giving an initial estimation of the level of risk. Some lower level risk events will be discarded at this stage and not considered further.

Risk Analysis: Step 3: A more detailed estimate is made of the likelihood and consequences of the risk events and opportunities brought forward from Step 2. The analysis will also consider a perceptions of those people or groups affected by this process.

Risk Evaluation: Step 4: The risk levels estimated for the events at Step 3 are compared and considered as to the acceptability of the risks from the team's and from stakeholders' perspectives. Low level risks are again discarded and the remaining risks are ranked and preliminary consideration is given to potential risk controls or adaptation measures.

Risk Treatment or Adaptation Measures: Step 5

For those risks assessed as unacceptable in Step 4:

- Adaptation measures or risk control strategies are identified to reduce risks to acceptable levels.
- The effectiveness of the adaptation measures are evaluated including their costs, and benefits.
- Optimal adaptation measures are selected and the acceptability of residual risks is considered.

For the opportunities that have been brought forward during the process consideration is given how these could be optimized or improved.

Implementation Plan: Step 6

While strictly not part of the ISO31000 process consideration is given to how the adaptation measures could be implemented and how the opportunities could be exploited and these should be monitored. Again the affect on stakeholders and their perceptions about the implementation plan should be considered.

Step five leads naturally to conclusions about what needs to be done in the long-term to reduce the organization's exposure to climate impacts and the timeframe in which those actions need to be taken. The end objective may not be a full implementation plan but an intermediate step such as a briefing for executives of the organization. Also, consideration could be given as to which risk reduction or adaptation measures would be coordinated with other organizations or programs.

Other Considerations

General: This Guide suggests using readily available qualitative data for assessing the likelihood and consequences of risks and a small risk management or project team for the strategic assessment of risks. This will help the team explore the issues and possible outcomes rapidly and inexpensively.

Documentation: It is important to carefully document and archive, in readily retrievable form, the key information used, minutes of meetings and discussions, and decisions that were taken during the process. The results of the process, supported by good documentation, can be used to make a business case for taking further action. The documentation archived during the process can also be used as a starting point for a more

comprehensive risk management study if one is needed.

Communication and Consultations: A timely dialogue with participants and stakeholders is important throughout the whole risk management process. This is particularly important when other organizations may be affected or involved with the risk events or opportunities being considered.

Monitoring and Review: Risk management is an iterative process. The strategic overview process should be reviewed periodically, certainly when significant new information becomes available on climate change impacts, risk events or adaptation measures or opportunities.

The review and monitoring process should also consider the residual risks that were accepted in the initial planning process and whether that residual risk has changed.

Adaptation measures and opportunity exploitation plans should also be monitored to ensure that the anticipated risk reductions or benefits will be achieved and whether plans should be modified or revisited.

Tables and Templates

As noted above, the Guide contains the tables and templates that will assist in recording information and presenting the results in a clear and lucid manner.

The templates and tables and their headings are suggested formats only and users should replace any formats or headings with those they feel are more appropriate.

Glossary of Terms and Definitions

The risk management process as defined by ISO31000 was developed from related processes used by the financial community, various professions such as engineering, medicine and geology among others, and numerous scientific disciplines. Some terms and phrases used here are unique to the risk management process and have different meanings or inferences in other contexts.

To avoid lengthy discussions about terminology a glossary of terms is included in this Guide that is derived from terms and definitions contained in ISO31000 and, where appropriate, some of that standard's national precursors. It is strongly recommended that users of this Guide employ the terms that are found in the glossary.

1. Introduction

1.0. A sense of urgency

Global climate change is widely recognized as one of the world's greatest environmental, social and economic threats. In Canada, climate changes over the past 40 years are in part responsible for the exponential rise in economic losses from extreme weather events, premature weathering of infrastructure, stresses on water supplies, worsening air quality and related health and economic effects. Extreme events and rising temperatures are becoming more damaging as recent severe rainfalls, thawing permafrost and melting sea ice have demonstrated. At the same time, particularly for northern countries like Canada a warming climate presents certain opportunities and benefits.

Canada is more vulnerable than ever to the impacts of climate variability and change because of increasing urbanisation, a growing population and aging infrastructure. These changes put more people, property and ecosystems at risk. Efforts to manage and adapt to climate-related risks and opportunities have not kept pace with the challenges and it is virtually certain that the climate will continue to warm and become increasingly variable over the coming decades.

Most organizations have primary responsibility for or can significantly influence many of the factors that determine their vulnerabilities to climate-related risks and some are beginning to develop adaptive strategies.

But many are not and it is suggested that it is a matter of some urgency that organizations get started now to:

- Better understand climate change impacts and their vulnerability to them,
- Identify the risks and opportunities that are presented to their infrastructure, residents and employees,
- Analyze and prioritize the risks and determine the risk treatments and adaptation measures that should be applied to the most serious risks,
- Develop long-term adaptation plans and strategies for taking advantage of

opportunities that can be integrated into their on-going planning, risk management and development processes, and

- Work with other organizations where synergisms are possible to make best use of the time available before some of the more serious climate impacts are manifest.

This Guide has been developed to demonstrate that a proven process to undertake a risk assessment process and identify the best risk treatments and adaptation measures is simple and easy to do and requires few resources.

1.1 About the Guide

The Guide describes a simple and easy risk-based approach that can be used to assist organizations to adapt to climate change through long-term planning and short-and mid-term responses.

The Guide focuses on a strategic overview of climate impacts on an organization. It explains how to use the risk management process described in the recently published International Organization for Standardization's ISO 31000, *Risk management – Principles and guidelines*, first edition, November 15, 2009. The Guide suggests a straight-forward approach that will get organizations started thinking and acting about adapting to our changing climate. A time-consuming, expensive or highly technical analysis is not needed to reach strategic decisions about climate adaptation, but may be needed in more detailed follow-up analyses of particular risk issues or events. Also see note 1 on page iii for further information about other approaches.

Chapter 2 provides insights into what could be expected in the future climate in the various regions of Canada. Links to climate projection summaries that provide all the climate information users will require to undertake preliminary or high-level risk assessments and strategic adaptation planning for a timeframe 40 or 50 years into the future are at Annex 1. As indicated earlier, these analyses will provide important inputs into the organization's business and Enterprise Risk Management plans.

Chapter 3 explains the risk management process used in the Guide. It is based on ISO 31000 and some of the consistent practical implementation suggestions of the Canadian National Standard, *“Risk Management: Guidelines for Decision-makers”* (CAN/CSA-Q850-01). These standards also provide a glossary of definitions of risk management terms that are often confusing for users.

Chapter 3 also explains each step in the risk management process and includes:

- A description of the purpose of each step,
- An explanation of what to do and how to do it,
- A description of the expected output,
- A description of the decision to be made at the end of each step,
- A checklist to ensure that all the important aspects of each step have been completed before moving on to the next step in the process, and
- All the tables and templates needed by users to record the data and information generated by the risk assessment and management process.

The annexes of the Guide contain links to climate projections and a glossary of risk management terms.

1.2 Why risk management?

The impacts of a changing and more variable climate involve almost every aspect of society and create risks to the social, economic, cultural and environmental fabric of communities and corporations. They can also present opportunities.

Projections of future climate and other important variables are somewhat uncertain, and there may be numerous adaptation options from which

the optimal are to be selected. Adaptation decisions are generally evaluated as better or worse, not right or wrong.

Adaptation to climate change is characterized by uncertainty, complexity and risk. It can involve multiple decision-makers and other stakeholders with conflicting values and competing interests.

For every climate impact there is a range of possible responses in time, complexity and cost. For example, to deal with increasingly frequent and severe extreme weather events, short term responses might range from better warnings to increased maintenance of water management infrastructure or reduction of storage levels in reservoirs. Longer-term responses might include upgrading water management systems and better communications equipment. Multi-jurisdictional responses could involve the re-routing of major transportation arteries and changes to building codes among others. The risk management process will help identify the best solutions and a range of possible responses.

Risk management offers a practical and credible approach in the face of uncertainties for prioritizing complex risk issues and for selecting optimal risk reduction strategies in order to achieve acceptable levels of remaining societal risk. It also provides a means for balancing a range of considerations, for using predictive information and for dealing with uncertainties.

The process outlined here is a simple way of developing a strategic overview of risks and opportunities, of determining who is likely to be affected or be involved and adaptive measures that can reduce risks to acceptable levels. The process can be also be used to provide a more technical approach to a detailed or complex risk issue.

2. Climate Trends and Projections

1. Factors Affecting Change:

Over the centuries, several natural external forcing factors have resulted in global and regional warming and cooling. These have included changes in the sun's energy reaching earth, and in earth's reflectivity, changes in the number and intensity of volcanic emissions from which suspended particles cause cooling periods. However, about 1850 man's activities in burning fossil fuels and reducing forest cover began to increase the concentrations of the naturally occurring greenhouse gases in the atmosphere. These are gases which permit the sun's energy to reach earth, but inhibit transfer to space of some of the energy from the earth. The net effect is to warm the lower layer of the atmosphere.

The Intergovernmental Panel on Climate Change (IPCC) in 2007 reviewed the scientific literature on the relative magnitude of these natural forcing factors and that due to the increasing concentrations of greenhouse gases. In Fig. 1 from IPCC, the blue bar shows the temperature changes that would be expected from natural factors, the red bar shows the range of temperature changes expected from the increasing greenhouse effect. The black line shows the observed global and North American temperatures. It can be seen that before about 1970, natural forcing was most predominant, but after that, the temperature rise has been driven almost exclusively by the greenhouse gases from human activities. These will also be the major driver of climate warming this century.

2. Estimating Future Conditions:

This suggests that the trends in temperature and closely related factors such as precipitation intensities, observed from 1970 to 2010, are a useful foreshadowing of trends for the next four decades. So, one way of considering changes to 2050 is to extrapolate observed trends to that time.

Another way of estimating future climatic conditions is to obtain projections from atmosphere-ocean Global Climate Models (GCM), which simulate mathematically, the natural climate system of atmosphere-ocean-land. These mathematical computer

models are then run with increasing concentrations of greenhouse gases in the global atmosphere. The rate of greenhouse gas increases used in these simulations is based on emission scenarios developed by IPCC, and by agencies, such as the International Energy Agency (IEA). These scenarios try to account for population and economic increases, changes in energy use, deforestation rates and other factors to produce projections of future emissions and concentrations in the global atmosphere.

Intense precipitation event trends are closely related to temperature trends, since a warmer atmosphere holds more water. This means that when precipitation producing atmospheric conditions are ready to act, they more often produce intense precipitation events. Recent research shows conclusively that more intense precipitation events, widely observed, are related to increased greenhouse forcing.²

For annual and seasonal precipitation estimates, less confidence can be placed in either extension of the trends or the GCM's, although both can provide indicative information. However, influence of changes in ice cover and temperatures of oceans and lakes and other factors need to be taken into account. This has been done somewhat subjectively, with knowledge of these important interactions.

3. Acceleration of Change:

The model results from the highest emission scenarios were used, since the high emission scenarios are the closest to observed trends. Recent information on GHG concentrations, emissions and impacts lead to the view that climate change is advancing more rapidly than estimated earlier. Global atmospheric CO₂ concentration increases averaged 1.6 ppm/year from 1970 to 2007, but 1.9 ppm/year from 2000 to 2007 (Levinson, 2008). From 1990 to 2000, the atmosphere's CO₂ increased at a rate of 3.1 gigatonnes of carbon per year but from 2000 to 2008 the rate was 4.1gt C/year.³

² Min, S-K, X. Zhang, F.W. Zwiers and Hegerl, 2011. Human contributions to more intense precipitation extremes, Nature 470:378-381, 17 Feb. 2011

At the same time the International Energy Agency in late 2007 reported that global energy use and greenhouse gas emissions have been rising very rapidly. It projects a 55% increase in world energy needs between 2005 and 2030 and a 57% increase in greenhouse gas emissions. This could be tempered by aggressive global efforts to reduce emissions, not evident to date. Of course, the recent economic downturn had a short term effect on this rate of change. It is estimated that in 2009 a reduction of about 1% in global emissions occurred, but 2010 emissions are again on a path to record highs. At the same time, thawing of permafrost and drying of wetlands in the Arctic and sub-Arctic has released more methane, the second most important greenhouse gas, into the global atmosphere, since 2007, (WMO, 2010).

A 57% increase to 2030 is a more rapid increase than the greatest increase in SRES emission scenarios of IPCC, which have been used in previous climate projections. The evidence in the climate system of the acceleration of greenhouse gas emissions and concentrations can be seen in several manifestations. The decline in ice cover in the Arctic has been more rapid than in any of the IPCC scenario modeled results. Ice melt in Greenland, and effects in Antarctica have recently exceeded the rates of change projected by IPCC.

Annex 1 contains links to climate projections for all regions of Canada out to about 2050 that can be used for climate impact risk assessments with confidence.

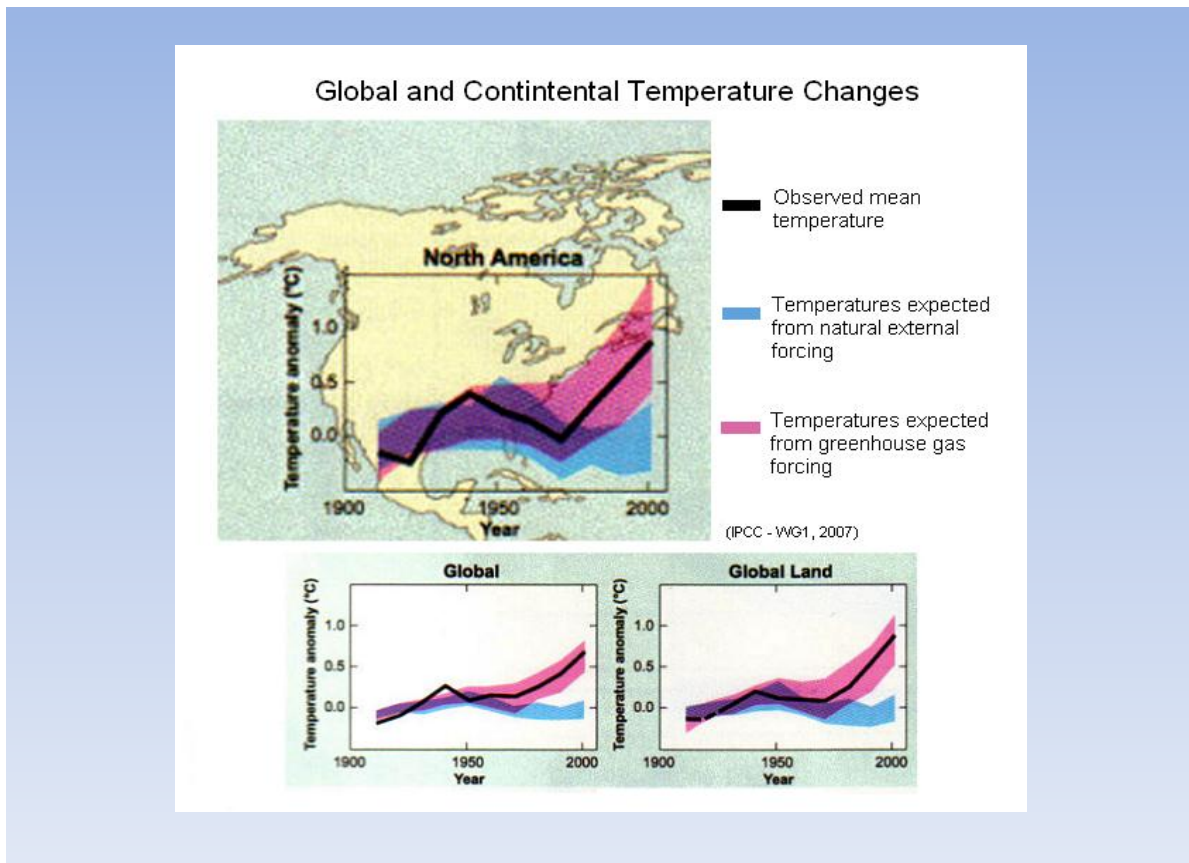


Figure From IPCC 2007

3. LeQuere, C., 2009. Closing the global budget for CO₂, Global Change 74:28-31, Intl. Geosphere Biosphere Program (IGBP).

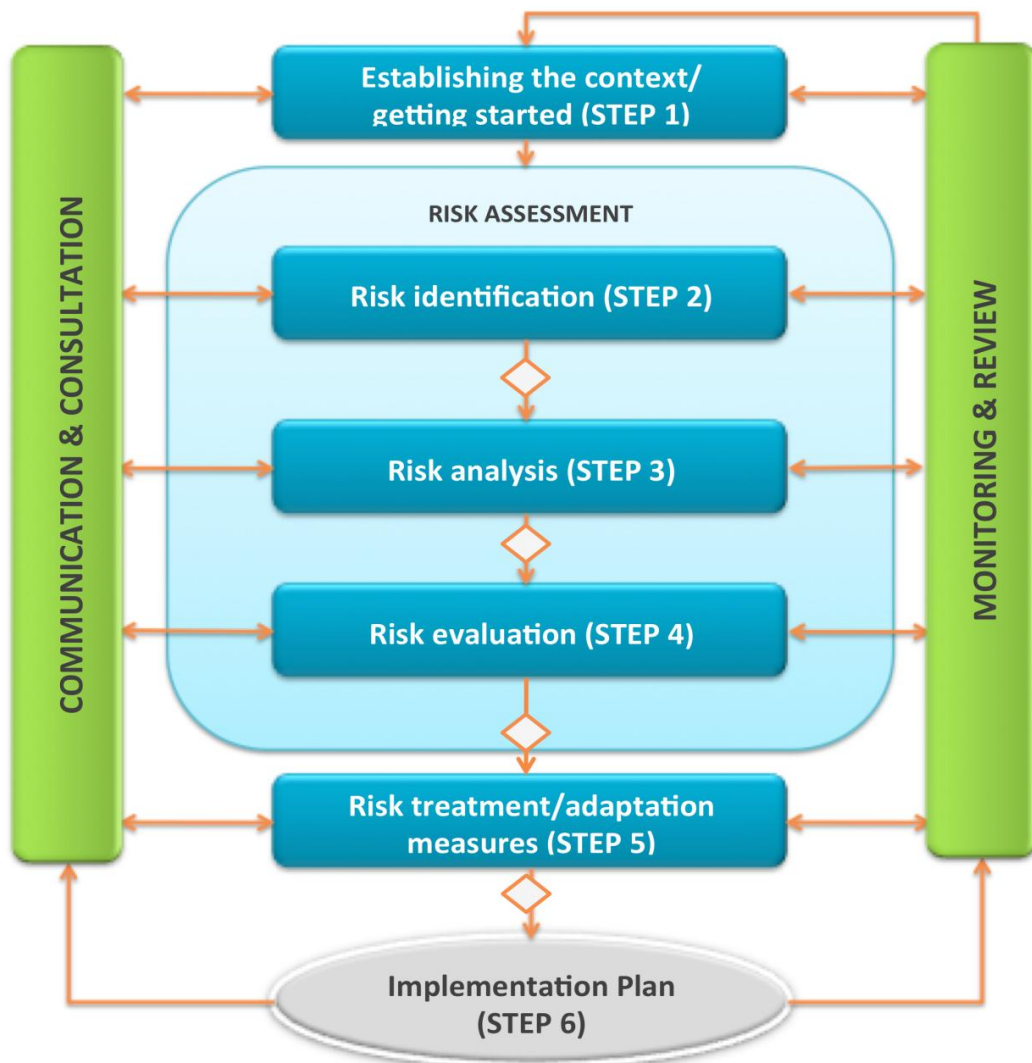
3. The Risk Management Assessment and Risk Treatment Process

3.0 Overview of the risk management process

Risk management is a systematic process for selecting the best course of action in uncertain situations. It provides a framework for developing strategies to respond to potential climate changes that create or increase risk.

The framework in this Guide is based on the International Organization for Standardization’s ISO 31000, *Risk management – Principles and guidelines*, first edition, November 15, 2009-and includes some practical process features from the Canadian national standard “*Risk Management: Guidelines for Decision-makers*” (CAN/CSA-Q850). The process, shown below in Figure 1, consists of five steps and a sixth step, the development of an implementation plan.

Figure 1: THE ISO31000 RISK MANAGEMENT PROCESS



to

This illustrates the sequence of the key activities of identifying, estimating, evaluating and ranking risks and opportunities then determining options

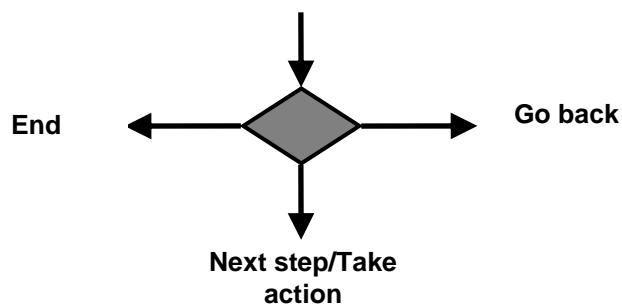
lower risks to acceptable levels or exploit opportunities. The details of what is done in each step is outlined in the following sections; a

checklist helps users confirm their actions and examples in Workbook illustrate the process.

A very important part of the process is a continuous dialogue with those involved and affected by the issue. Risk situations can be interpreted differently by various groups of people, resulting in quite different perceptions of risk, therefore the risk management process emphasizes the importance of how events might affect or be perceived by different groups.

In the risk management process, each step leads logically to the next, unless the risk issue is resolved, in which case the process is ended. Each step can be repeated to include new information or new analyses as these become available. At the completion of each step there is a decision to be made as shown in the “Decision Diamond” in Figure 2.

Figure 2: Decision diamond – decision options at completion of each step



This Guide focuses on using readily available data and a relatively small risk management group or project team. This will help the team explore the issues and possible outcomes rapidly using qualitative³ data for the most part. The results, supported by good documentation can be used to make a strong business case for taking action.

The process outlined in this guide is an overview or simplified examination of the risk or risks that face the organization and will help define the issues and provide some readily useable results.

The outcomes of the initial process may point to the need to do a more comprehensive analysis of all or some of the issues identified, using more detailed quantitative data or more in-depth expertise with which this guide can also assist.

³ Also see ISO 31010 for other methods of assessing likelihood and consequences. The matrix method used here is among the simplest for the purposes used in this Guide

Guiding principles.

The risk management process is built upon several important principles:

- **Identifying and engaging important affected or involved groups**
These groups and individuals should be identified and involved during the entire process. The project team may be modified to include members of these groups if it will help deal with the particular issue being addressed.
- **Communication**
The project team should develop an open and trustful dialogue that continues throughout the process, with groups and individuals who may be affected or involved with the risk.
- **Documentation**
Records should be thoroughly and carefully taken of important meetings, information sources, and all activities stored in a “risk information library” so that it can easily be retrieved in the future. This will help to:
 - Review how risk rankings and risk control options were derived,
 - Provide baseline information for future iterations of the process,
 - Promote accountability and transparency
- **Use of existing tools, human and technical resources**
The project team should make maximum use of existing resources, such as data, local knowledge and technical expertise, and previously documented experiences.
- **Education and Awareness**
Organizations should have a good knowledge level and awareness about climate change impacts and adaptation measures. When adaptation measures or opportunities are implemented, there may be a need to provide some education and awareness for employees and stakeholders to get their support.

3.1 Step1 - Establishing the context/getting started:

Purpose

The climate change risk assessment and management process starts with this step and includes the following preparatory activities;

- Understanding the climate change projections for the areas of interest and the associated vulnerabilities.
- Ensuring clarity about the objectives, timeframe and resources available for the risk and opportunity assessment.
- Identification of who will be members of the project team and principal people or groups that may be affected or involved;
- Assignment of responsibilities to the various members of the project team and determination of the time and resources needed to complete the study; and
- Development of a work plan.

The team leader is usually a planner or another senior staff member.

The time required by the team to complete the process depends on the scope of the risk assessment, i.e. a study of a specific climate impact or a larger strategic study of all impacts. However, it is recommended that a relatively simple overview of the problem using readily available data, as explained in Steps 2 and 3, would be very useful in developing a better understanding of the issues and scope of the problem. To do this, the team would require only a day or several days to complete a strategic overview.

What to do and how to do it?

- (1) Ensure the project team has access to and has read the latest versions of the principal literature that is applicable to organization.⁴
- (2) Establish the project team and its terms of reference, and for a larger study, develop the work plan and the key milestones:
 - Select team members with the necessary expertise to deal with the risk issues being considered.
 - Ensure that there are representatives from the main organizations that will be affected or responsible for implementing the adaptation

⁴ The best place to start is the Natural Resources Canada website at: adaptation.nrcan.gc.ca/pub_e.php. Two important references are: *From Impacts to Adaptation: Canada in a Changing Climate 2007*, and *Adapting to Climate Change : An Introduction for Canadian Municipalities, 2010*.

measures. For a larger, more detailed study, some support staff may be needed to handle the administrative and documentation matters. Others, such as legal, technical or financial advisors may be involved at times or review or advise on certain aspects of the work.

- The team leader should ensure that members of the team have sufficient time committed to complete the project and are familiar with the risk management process.
- (3) Ensure that the team is clear about the climate change issues to be investigated and any restrictions on the scope of the study.
 - (4) Assign project team responsibilities, allocate resources and set schedules.
 - (5) Identify and list the main organizational groups, outside organizations, people or groups that may be affected or involved in the study or the adaptation measures and begin an estimate which would:
 - Identify any organizations, individuals or groups that can affect or may be affected by decisions or actions resulting from the risk management process. This group could be quite large.
 - Consider their probable interests, concerns, rights and likely issues. Begin to think about how members might perceive various risk issues and how this might affect the decision process and communications with them.
 - Recognize that this group may evolve throughout the process.
 - (6) Start the record keeping system that the group will use for the project:
 - Records should be retained of all the information collected throughout the project, including information on the risks, data that are used to analyse the risks, a record of decisions taken, views of the people or groups that may be affected or involved, records of meetings and any other information that may be obtained during the risk management process.
 - These careful records will provide the means to trace the logic behind any decisions made. Also it will make it easy for the project team to review the process, should any additional information become available.

Expected results and outputs

- Project objectives, timelines and resources are agreed.
- Project team established.
- Terms of reference and budget for project team developed and approved.
- Principal people or groups that may be affected or involved have been identified and preliminary analysis of their needs, concerns and probable issues completed.
- Communications or dialogue with groups that may be affected has been considered.
- Collection of records and documentation begun.

Decision

There are three decision options (see the decision diamond in Figure 2 on page 5 End, Go back or Next step/Take action.

- **End** the process if the climate change impacts and risks are considered by the project team to be completely acceptable (very unlikely at this stage).
- **Repeat** the step if the project parameter are not clear, if the project team is not adequately established or if other important internal or external parameters are not settled.
- **Go to Step 2** If the situation continues to be a concern.

Checklist

Step 1: Establishing Context: Getting Started	
<i>Have you:</i>	
1	Ensured that the climate risk assessment project objectives, are clear and manageable, time frames and resources are appropriate?
2	Established a project team, project workplan and team members' responsibilities?
3	Identified the resources required to undertake the project, and any existing capacity that is available to the project team?
4	Identified the principal people or groups that may be affected or involved and begun to define their probable issues, needs and concerns?
5	Ensured a good understanding among team members of climate change predictions and vulnerabilities?
6	Started the records keeping system?

3.2 Step 2 - Risk identification:

Purpose

This is the beginning of the risk assessment part of the process. The sequence of risk events leading from the climate change impacts and vulnerabilities are carefully developed and given a preliminary examination. The project team does this by:

- Identifying of the specific climate change impacts and the associated potential risk events to people, property or the environment and the possible opportunities.
- Conducting a preliminary analysis of these risk events to determine in a very general sense their likelihood and possible consequences.
- Considering which events present a minimal level of risk and can be discarded from further consideration.

What to do and how to do it?

- (1) Do a careful analysis of the climate impacts to identify the risk events and potential opportunities that may result over the time frame being considered⁵.
- (2) Based on the knowledge of the project team and other readily available information⁶, make a rough estimate of the likelihood that a particular risk event will occur and the level of severity of the possible consequences on a three level scale. Table 2 below is a suggested format for tabulating the preliminary level of risk from the sequence of risk events. Use the same logic for any opportunities the project team has identified.
- (3) The risk events will form the basis for more detailed risk estimations and evaluations in the next step.

⁵ For example, a climate impact might be "intense rainfall" and in consequence "increase storm water/peak flows". The latter is the "risk event" that the organization has to consider and eventually develop an adaptation measure that will reduce or better manage storm water peak flows. Similarly, climate change may present some opportunities. These should be noted in list form and the project team may wish to consider means to facilitate them in the future. Because the main focus of this Guide is to analyze the risks, no specific tables or forms are being suggested for opportunities.

⁶ For example for a start from local municipal records, the weather records for the region, emergency measures organizations, fire records, Public Safety Canada.

Table 2: Step 2 - Preliminary Climate Change Impact/Event Assessment

Note: Make rough estimates of likelihood and consequence (these will be expanded in Step 3 to include a

Impact Event	Comment	Likelihood			Consequences			Risk Treatment/Adaptation Measures (existing or potential)
		L	M	H	L	M	H	

consideration of specific societal, economic and environmental consequences).

Likelihood:

- L Rarely occurs
- M Moderately frequent occurrence
- H Almost certain to occur

Consequences:

- L Low
- M Moderate
- H High

- (4) This preliminary estimation will act as a screening tool to reduce the number of risk events which will be carried forward to the next step and also be a test for the usefulness of available data and information needed to estimate likelihood and consequences. Discard from further consideration any risk events that appear to be negligible, very low or low level of risk. Keep track of potential opportunities in a similar fashion.
- (5) Estimates of risk levels are made against the risk baselines (i.e. current risk levels). Use whatever data are available to establish risk level baselines (for example, flood plain maps for 20 year flood risk levels) including the opinion of recognized experts or experts from governments or other organizations:
 - Review the existing information on current vulnerability and climate-related risks, based on previous studies and experiences and expert opinion.
 - Identify and describe the risk controls currently in place to manage the specific climate-related impact being considered. Describe their effectiveness and any gaps. Examples of risk controls for a flood situation would be a warning system an evacuation plan, stockpiled sandbags etc.
- (6) Continue the analysis of those other organizations, people or groups that could be affected by the risk events and update the list begun in Step 1:
 - Now that there is more information on the potential risks, identify any additional stakeholders that should be involved.
 - Refine the analysis of their needs, interests and concerns, especially other organizations or provincial or federal governments that should be or might be involved.
 - Consider how these people or organizations could be engaged or informed.
 - Create a database of these people or groups that includes their contact information and the results of your stakeholder analysis. Update the database throughout the process.
- (7) If your project team thinks that you may need a risk communication plan for stakeholder engagement, start to outline what this would consist of and begin to implement a dialogue with key people and groups.
- (8) Update the data and records storage system that you are using:
 - Organize all the information collected in this step and keep it in a safe, dedicated space. This is where all the information, assumptions, concerns, decisions and changes made throughout the process are kept.

- For example the information storage system at this step in the process could include:
 - Baseline data and information on the climate impacts or trends,
 - Complete descriptions of the climate impacts, risk events and opportunities, including the information used to make preliminary estimates of the risk levels or benefits ,
 - Information about the risk events that are not going to be considered further,
 - All stakeholder information, including minutes of meetings with them or other records of stakeholder communications,
 - A record of all decisions and assumptions,
 - Record the source of the information and the date it was collected, and any weaknesses or inaccuracies in the data.

Expected results and outputs

- Risk events and potential opportunities are developed and a preliminary analysis is completed for each, event showing initial estimates of potential consequences or benefits and likelihood.
- Existing control measures are identified as are preliminary thoughts about additional adaptation or control measures.
- Baseline information has been collected, or plans have been made to collect additional baseline information.
- Additional analysis of other organizations, governments, people or other groups who might be affected by the risks has been completed.
- An outline of a communications plan for these people or groups has been developed if it is needed.
- The data storage system is started and Important reference material is documented and stored.

Decision

There are three decision options (see the decision diamond in Figure 2 on page 5. End, Go back or Next step/Take action.

- **End** the process if the climate impacts and risk events are considered by stakeholders and the project team to be acceptable.
- **Go back** to Step 1 or the beginning of Step 2 if the project team considers that it is necessary to improve on any aspect of the information developed in those steps or to make any changes, if appropriate. Given the nature of the climate change issue, it is not unusual to have to improve data collection and revisit assumptions in order to

enhance the credibility of the entire risk management process.

- If the risk situation continues to be a concern, proceed to the **Next Step**.

Checklist

Step 2: Risk Identification	
Have you:	
1	Developed climate impacts, risk events and opportunities and completed a preliminary analysis of their probabilities and consequences or benefits?
2	Discarded risk events that are negligible, low or very low risk levels?
3	Established a baseline of data for each of the risk scenarios?
4	Developed a stakeholder database?
5	Refined your stakeholder analysis?
6	Updated the data storage system?

3.3 Step 3 - Risk analysis:

Purpose

In this step a more detailed consideration is given to the likelihood and consequences of the climate change risk events and opportunities that were selected in the Step 2. One of the final things that was done in the previous step was to discard from further consideration risk events that were assessed as being negligible, very low or low risk levels.

What to do and how to do it?

- (1) Consider what methods the project team should use for estimating likelihood and consequences. Some options are:
 - Historical records, including organizational, municipal, provincial, federal or community records and newspapers, to determine likelihood or consequences,
 - Technical data and climate projections from climate projections in Annex 1 (ICLR website links). Information about climate impacts from IPCC reports⁷ NRCan publications (see note 4 on page 7) or from other provincial, territorial, or federal government sources.
 - Local experts or knowledgeable opinions, for example from university or college sources or local special interest groups.

⁷http://www.ipcc.ch/publications_and_data/publications_and_data.shtml

(2) Estimate the likelihood of possible outcomes. A simple table such as Table 3.1 (shown below) helps to record estimates and assists in putting significant single events or on-going or cumulative occurrences in the same likelihood context.

- For the simple analysis suggested in this guide, an easy four or five tier comparative rating system (such as a scale from “likely to occur once or more annually” to “not likely to occur in period”) is useful for assessing the relative likelihood of risk events.
- Climate change assessments should be estimated to a future date 40 or 50 years or in some situations such as long-term infrastructure, as far as 100 years.
- For familiar events such as floods, fires or diseases, estimates can typically be derived from readily available historical data such as research reports, insurance company records or from similar risk situations in other regions or countries.
- If the project team has the technical experience, the use of sensitivity-type analyses, technical projections, expert judgment or other practicable and credible methods can put useful boundaries on estimates of uncertainty.

(3) Estimate the overall consequences of possible outcomes. Table 3.2 (on the next page) is a suggested way to record consequence levels for a variety of consequences from a single risk event.

- As with likelihood estimates, a simple comparative impact rating system (such as a four or five tier scale from “very minor effects” to “extremely serious effects”) may be useful for making relative estimates of various consequences from a particular risk event. If

extensive loss and other impact data are available, explicit values could be used in a tabular form so that the comparative severity can be compared. At this stage, definitive measures are not necessary as this is a ranking process to determine which risks are the most severe (see note 3 on page 6 for further information).

- Estimate the magnitude of each of the various risk events, should it actually occur. Use measurable, verifiable data wherever possible. Again, look for data and information in research reports, insurance company records or information from similar risk situations in other regions or countries.
- It may be helpful to consider the expected consequences under several sub-categories, for example, social, economic and environmental aspects. This may make comparing the losses or consequences easier and provide a baseline for later evaluation of risk control measures. Table 3-2 shows one way of displaying these. The headings in this table are generic and the project team should give some consideration to what factors are important to them.
- After each aspect of the risk consequences are considered, the project team should consider what the overall consequence is. This will be carried forward to Step 4

(4) Assess the perceptions of risk by those people or groups who might be affected. These perceptions of the importance or risk levels, are very important and may have a large influence on the ranking of risks.

Table 3.1: Step 3 - Estimates of Likelihood of Risks

Probability Range	Very Low	Low	Moderate	High	Very High
Type of Event					
Significant Single Event; or	Not likely to occur in period	Likely to occur once between 30 and 50 years	Likely to occur once between 10 and 30 years	Likely to occur at least once a decade	Likely to occur once or more annually
On-going / Cumulative Occurrence	Not likely to become critical/beneficial in period	Likely to become critical/beneficial in 30-50 years	Likely to become critical/beneficial in 10-30 years	Likely to become critical/beneficial in a decade	Will become critical/beneficial within several years

Note: Use as many rows as needed to included the selected risk events.

**Table 3.2: Step 3 - Estimates of Consequences of Risks
(Use one table for each risk event)**

Factor	People				Economic			Environment			
	Health & Safety	Displacement	Loss of Livelihood	Reputation	Infrastructure Damage	Financial Impact on Organization	Financial Impact on Stakeholders	Air	Water	Land	Ecosystems
Very Low											
Low											
Moderate											
High											
Very High											

Note: The project team should modify the columns to include the consequences that they consider important for example some may wish to include legal liability or differentiate between capital and operating costs .

Note: In both tables 3.1 and 3.2 the measurements are expressed in qualitative terms (“not likely to occur” to “likely to occur” and “very low” to “very high”). It is also possible to express these in numerical values so that adding or multiplying them gives a quantified relative likelihood or impact consequence. The problem with using numerical values is that the reader may think that it implies more accuracy than actually exists. The project team should consider the method to be used to compare relative likelihood and consequence values and agree on the most appropriate way of assigning relative values. (see also note 3 on page 5)

(6) Continue to update the stakeholder lists from Steps 1 and 2. The project team may wish to consult with some key people in the organization, other organizations or groups that might be affected or concerned.

- If the project team considered it important in Step 2 to engage some of the stakeholders in a meaningful dialogue this should begin to be implemented now. Discussions could be held about the risk estimates and their issues and concerns. In a simple study this may be through conversations with a few representatives of the most important stakeholders
- Some people may not agree with the likelihood or consequence estimates. Record their different views. Later in the process, return to this step, if necessary, to test and discuss the sensitivities of the proposed adaptation measures to these

different views of likelihood or consequences.

- Stakeholders’ issues and concerns will probably change as they become more familiar with the risk scenarios and the risk management process. Document these changes on an ongoing basis.
- At this stage when stakeholder concerns may become more important, consider using a chart such as the one shown in Table 3.3 below to list the stakeholders and their attitudes about various risks.

TABLE 3.3 Step 3 - Suggested display for stakeholders and risk perception.

Risk Events	Stakeholders	Perception of Risk
	Use a many rows as needed	

(7) Update the archived information with all data from this step. Carefully document all sources used.

Expected results and outputs

- Estimates of likelihood and consequences of risk events and opportunities.
- Presentation of likelihood and consequence estimates in a format that is easy-to-understand by non-experts.
- Estimates of the acceptance by stakeholders of risk, or a record of reasons for non-acceptance, based on a dialogue with the stakeholders and a careful documentation of their perception of the risks.

Decision

There are three decision options (see the decision diamond in Figure 2 on page 5. End, Go back or Next step/Take action.

- **End** the process if the estimated level of risks are much lower than initially estimated in the preliminary analysis, and stakeholders agree that there is no longer a significant concern.
- **Go back** if:
 - The project team is unable to reach a consensus about the level of risk events,
 - There is new information that needs to be considered
 - Additional risk scenarios need to be considered,
 - There are doubts about data quality or analytical methods, or
 - Not all important stakeholders are comfortable with the level of uncertainty associated with the analysis.
- Proceed to the **next step** if the project team is comfortable with the data, assumptions and outcomes of the risk estimation process.

Checklist

Step 3: Risk analysis	
1	Are you satisfied with the quality of your data?
2	Have you analyzed and assigned appropriate levels of likelihood to each risk event and opportunity?
3	Have you considered the expected loss, other consequences or benefits from each risk event and opportunity?
4	Have you reached a consensus about the overall consequence for each risk event?
5	Are you comfortable that stakeholders' perceptions have been assessed for each of the risk scenarios
6	Has the process been carefully documented and the data storage system updated with all relevant information?

3.4 Step 4 - Risk evaluation:

Purpose

In this step, the project team develops a process for comparing or ranking each risk event and opportunity. This is done by:

- Confirming the overall likelihood and consequence rating that was done after Tables 3.1 and 3.2 were completed in Step 3 including costs, benefits and acceptability. The overall rating should also consider the needs, issues and concerns of the principal stakeholders in the organization, other organizations or outside groups that may be affected or involved.
- Identifying unacceptable risks and ranking them for risk reduction or control measures.
- Opportunities have also been rated in Step 3 in a more general way by their likelihood and potential benefits. These should be confirmed in Step 4 and the opportunities ranked in some order of importance for exploitation.

What to do and how to do it?

To this point in the process, only the impacts, risk events, and opportunities have been analyzed. Now the risks will be compared in terms of the values that were used in Step 3. Other factors may also be brought into consideration such as the costs and benefits of that might accrue.

- (1) Compare the risks considering the likelihood and consequence analyses from Step 3. The team will have arrived at an overall consequence rating from the more detailed assessment of social, economic and environmental consequences. It is suggested that the team use a simple and convenient consequence scale ranging from very low to very high along with the likelihood estimates.
 - Consider using a highly visual display such as the “risk evaluation matrix” shown in Figure 4 on the next page to assist in comparing or prioritizing the various risks. Combine the likelihood and consequence ratings for each risk as determined in Step 3 into a single value to be entered into the matrix. Establish acceptability values against which the various risks can be compared. This chart uses qualitative measures such as “very low”, “low”, “moderate”, “high” and “very high”. Other comparators such as numerical values may be used so long as they do not imply an unrealistic accuracy.

- Because experts and non-experts generally view risks differently, it is important to maintain an open and interactive dialogue with the principal people or groups that may be affected or involved in order to accurately gauge their level of acceptance of risks.
- (2) It is helpful at this stage to also consider the costs and benefits of each risk event and any potential opportunities that the climate impacts may present including not only the direct costs and benefits but also the important indirect ones. For example, a shorter freezing period may create problems for winter operational activities but it may also bring benefits such as less snow removal costs.
 - (3) Assess how the principal people or groups that may be affected or involved view the acceptability of risks in your risk matrix.
 - (4) During the dialogue with stakeholders about their perceptions and the acceptability of the risks, begin to identify risk control options or adaptation measures to help reduce unacceptable risks to acceptable levels. These will be considered in the next step.
 - (5) Update the data storage system.

Figure 4: Step 4 - Risk Evaluation Matrix

Consequences	Very High					
	High					
	Moderate					
	Low					
	Very Low					
		Very Low	Low	Moderate	High	Very High
	Likelihood					
		Extreme Risk: Immediate controls required				
		High Risk: High priority control measures required				
		Moderate Risk: Some controls required to reduce risks to lower levels				
		Low Risk: Controls likely not required				
		Negligible Risk: Risk events do not require further consideration				

Expected results and outputs

- Risks evaluated in terms of likelihood, consequence, with some sense of costs and benefits.
- Risks ranked or prioritized.
- Unacceptable risks identified.
- Meaningful dialogue has occurred with stakeholders about acceptability of risks.
- Possible risk controls or adaptation measures have been recorded for consideration in Step 5.
- Risk data storage system updated.

Decision

There are three decision options (see the decision diamond in Figure 2 on page 5. End, Go back or Next step/Take action.

- **End** the process if:
 - Stakeholders agree that all the risks are acceptable; or
 - The risks are completely unacceptable, cannot be reasonably dealt with, and all stakeholders agree that the process should be ended.
- **Go back** if:
 - There is insufficient data or information to make a decision;
 - The principal people or groups that may be affected or involved were not adequately consulted; or not all key stakeholders agree with the conclusions; or
 - There is new information that might materially change the likelihood or consequence estimates.
- Proceed to the **Next Step** if the project team and key stakeholders agree that the risks are unacceptable and that risk control measures will have to be implemented.

Checklist

Step 4: Risk evaluation	
1	Are the evaluations and rankings completed for all risk events and opportunities?
2	Are all of the major considerations accounted for?
3	Have you consulted with key stakeholders on the acceptability of risks?
4	Have you given preliminary consideration to risk controls or adaptation measures for unacceptable risks?
5	Is the risk storage system updated?

3.5 Step 5 - Risk treatment and adaptation measures:

Purpose

In Step 4 the climate change impacts and the possible risk events or opportunities they could create were evaluated and ranked. Consideration

was given to how acceptable the risks were to the organization and principal people or groups that may be affected or involved. For unacceptable risks, some consideration was given to potential adaptation measures or risk controls. Also opportunities were identified and examined for how they could be exploited.

In this step:

- Adaptation measures or risk control strategies will be identified for reducing unacceptable risks to acceptable levels and examined for feasibility.
- Potential opportunities will be considered further for exploitation.
- The effectiveness of the adaptation measures or risk control strategies will be evaluated including the costs (both operating and capital), benefits and associated implementation risks.
- Optimal adaptation or risk control strategies and opportunity exploitation measures will be selected and consideration will be given to the acceptability of residual risks.

What to do and how to do it?

- (1) Working with the highest level risk events, identify feasible adaptation or risk control options:
 - Identify all potential adaptation actions that could reduce the likelihood or the consequences of the risks.
 - Typically, an adaptation or risk reduction strategy will consist of a portfolio of measures, for example some shorter-term actions to deal with immediate concerns and some more comprehensive longer-term actions. Together, these measures should offer a cost-effective means for reducing unacceptable risks to acceptable levels.
 - Some examples of risk control measures for climate change issues could include: inspection, monitoring, research, planning, relocation, improved or new infrastructure, changed standards or guidelines, mapping, updating emergency plans, developing capacity and resilience, etc.
- (2) Evaluate the adaptation or risk treatment options in terms of effectiveness, cost (operating and capital), residual risks and stakeholder acceptance.

- Estimate the effectiveness of the proposed options using historical data and the professional judgement of the project team.
- Identify and assess residual risks caused by the control option.
- Consider how the organization, other key organizations, other people or groups that may be affected or involved will view the risk treatments or adaptation options and their perceptions of residual risks.
- Evaluate the adaptation or risk treatment options in terms of:
 - Effectiveness in reducing losses or impacts or changing probabilities.
 - Implementation and maintenance costs.
 - Needs, issues and concerns of affected stakeholders.
 - Table 5.1 shown below is a suggested format for displaying this information is.

Table 5.1: Risk Treatment and Adaptation Measures

Risk Event	Adaptation Measure or Risk Treatment (Use as many rows as needed for each event)	Time Frame	Cost	Effectiveness	Acceptability	Comment / Evaluation

Time Frame	Cost	Effectiveness	Acceptability
Short – can be implemented within 10 years	\$ - can be completed within existing or planned budget allocation	Low – will have minor effect on risk event	Low – significant public/corporate/stakeholder resistance
Medium – can be implemented within 10-20 years	\$\$ - will require additional funding	Moderate – will have moderate effect on risk event	Moderate – moderate public/corporate/stakeholder resistance
Long – can be implemented within 20 – 50 years	\$\$\$ - will require major additional funding/major capital program	High – will virtually overcome risk event	High – little or no public/corporate/stakeholder resistance

The costs and benefits of adaptation measures can be difficult to assess, so it is important that the project team has access to the relevant expertise if they need it. An example would be the impact of reduced use of a water treatment facility because of expected higher water levels. To build a new facility would be very costly. In the short term the organization might have to forgo other developments. In the longer term, better facilities might strengthen the organization's treatment capacity without additional infrastructure costs. Also organizations are very sensitive to whether costs affect their operating or their capital budgets. Any of these outcomes has associated economic, social and cultural costs and benefits that could affect the analysis.

One means the project team could use to assess residual risk is to revisit the consequence rating at Step 3 and consider the change resulting from the proposed adaptation measure(s). This will provide a sense for the effectiveness of the adaptation measure(s) and the remaining risk levels.

- (3) Sometimes it may be possible to develop incentives to encourage adaptations to further reduce residual risks. For example, organizations can encourage employees to use more efficient transportation means.
- (4) Also consider how the identified opportunities could be developed using a similar approach as is used for risk treatments.
- (5) Develop a plan to discuss adaptation measures or risk treatments with key people and other stakeholders or groups as appropriate.
- (6) Update the data storage system.

Expected results and outputs

- Feasible adaptation measures risk treatment options are identified
- An adaptation plan is outlined for the implementation of adaptation measures.
- The potential opportunities and how they can be exploited has been considered.
- The views of the principal people in the organization, other key stakeholders or groups that may be affected or involved and their perception about residual risks have been considered.
- Updated data storage system.

adaptation measures, risk treatments or potential opportunities.

- Key stakeholders have not been consulted.
- Assumptions and uncertainties associated with estimates are not acceptable to stakeholders, or
- New risks will be introduced if the proposed control options are implemented.
- Proceed to the **Next Step** if:
 - Feasible adaptation or risk treatment options are defined and can be implemented.
 - Proposed actions are feasible from a cost and effectiveness perspective and are acceptable to stakeholders, and
 - Residual risks are acceptable to stakeholders.

Checklist

Step 5: Risk treatment and adaptation measures	
<i>Have you:</i>	
1.	Identified and evaluated feasible adaptation or risk treatment options, in terms of costs, effectiveness, stakeholder acceptance and other criteria?
2.	Selected the optimal suite of adaptation or risk treatment options reduce risks to acceptable levels?
3.	Determined the costs and benefits of the adaptation measures?
4.	Considered how to exploit the opportunities and benefits?
5.	Developed a plan for obtaining the views of key stakeholders about the proposed adaptation or risk treatment measures and residual risks?
6.	Ensured that data storage system is updated?

Decision

There are three decision options (see the decision diamond in Figure 2 on page 5. End, Go back or Next step/Take action.

- **End** if there are no feasible adaptation options.
- **Go back** if:
 - Adequate data are not available for evaluating the cost-effectiveness of potential

3.6 Step 6 - Implementation plan and monitoring:

Some Preliminary Considerations

The implementation and monitoring component should be considered even in the preliminary overview that is the primary focus of this Guide.

It could be done only in cursory form until the risk management study has been reviewed and approved by senior management. Or the output from the initial risk assessment and risk treatment study could be a series of recommendations for early low-cost actions to start the adaptation process followed by further studies to dig more deeply into the mid- and long-term consideration.

This is also the stage at which to consider synergisms with other plans and programs such as retrofitting infrastructure, rebuilding roads or other programs.

Some of what is discussed below would be required only in a larger study or if the present study is approved to move ahead to a more detailed planning stage.

Purpose

- To develop an action plan or summary implementation and results monitoring plan to ensure that the adaptation measures and opportunity exploitation means are effective and within the expected costs envelope.
- To decide to continue or terminate the risk management process.

What to do and how to do it?

As noted above, the actions to be taken in this step depend upon the objectives of the study. The final output could be an adaptation and monitoring plan, a series of recommendations for senior management to consider or a scoping study to recommend next steps in a climate change adaptation program. Whatever the outputs, some of the following considerations will be appropriate:

- (1) Develop the outline of how the adaptation measures and opportunity exploitation means could be implemented with the following considerations:
 - Consider priorities for action,
 - Consider the short, medium and long-term financial implications,
 - Link the implementation plan to other organizational programs where possible,
 - Decide the timing for the implementation of adaptation or risk treatment measures (some risk events may not surface for years, or it may not be feasible to address them immediately),
 - Consider what actions are being taken in other organizations and governments and whether these would have any impact on this plan or create opportunities for collaboration, and
 - Identify special expertise or external assistance that may be required.
- (2) Develop the results measuring or monitoring process:
 - Establish a date to review or repeat the risk assessment and record it in the data storage system (a five year repetition is strongly recommended for an organizational climate change adaptation study).
 - Consider performance indicators that will monitor the adaptation measures or risk treatments. There may be some guidance from other organizational programs that could be applied. Some other suggestions might be environmental measuring, stakeholder reactions, financial costs and benefits. In addition some monitoring considerations may have been suggested during Steps 2, 3 or 4, or during the various stakeholder communications.
- (3) Submit the implementation plan for approval.
- (4) Continue to communicate with the key stakeholders within the organization and with other organizations, groups or individuals.

- (5) Record all communications in data storage system.

Expected results

- (1) Outline implementation plans or recommendations that include:
 - Adaptation measures, risk treatments and opportunity exploitation plans that will reduce climate change risks to acceptable levels and achieve optimal benefits.
 - An overview of costs and milestones.
 - Linkages with other organizations, governments and community groups that would benefit the implementation including an information exchange.
 - A database of ongoing activities that could facilitate the implementation of the plans.
 - A list of key stakeholders that were identified and possibly consulted.
 - A list of experts and expertise that was revealed during the risk management process that can contribute to the adaptation measure and risk treatments.
 - Mechanisms for training and capacity building in the risk management process and on climate change impacts.
 - An evaluation and monitoring process plan including mechanisms for reporting on progress and evaluating results.
- (2) Implementation plan ready for submission for consideration by senior management.
- (3) Data storage system updated

Checklist

STEP 6: Implementation plan and monitoring	
<i>Have you</i>	
1.	Developed a feasible outline implementation plan or series of recommendations as required by the study objectives?
2.	Identified links with ongoing activities in the community and beyond (e.g. local, regional provincial or national initiatives)?
3.	Identified resources to implement the plan?
4.	Established an effective monitoring and review program?
5.	Submitted the implementation plan for approval?
6.	Developed a communication strategy to support implementation?
7.	Ensured that the risk information library is updated?

4. Conclusions

The process outlined in this Guide is aimed primarily at a strategic overview of the climate risks facing an organization and high-level adaptation options that could respond to those risks. It is a tool to help organizations including municipalities, regional governments and other organizations make sensible and practicable decisions to adapt to a changing and more variable climate and to consider taking advantages of any opportunities that are presented.

The process is based on an international risk management standard (ISO 31000) that is accepted by governments, senior managers, scientists and the financial and insurance community across Canada and in most countries of the world. It also uses some of the very practicable and tested processes of the Canadian national standard on risk management (CAN/CSA Q850). The Guide is written to emphasize the simplicity and practicality of the process and employs a widely recognized likelihood/consequence matrix protocol. It also recognizes that larger or more technical studies of climate risks and adaptation responses may be desired or necessary and the process is equally applicable to these situations. Also see note 1 on page iii for further information about other approaches.

It is not easy to get started; organizations have many pressing issues that demand attention and their staffs are torn between conflicting priorities. In spite of mounting evidence that gives credibility to climate change and increasing variability some organizations have not fully accepted the need to start now to examine their situations and what the future may hold.

It is also apparent that the costs of climate change are already a burden in every aspect of life; damages from severe weather events, additional construction costs for unstable soils,

upgraded water and waste water systems among others. The sooner that adaptation measures can be implemented the sooner that measures can be developed to control costs related to climate change.

This Guide suggests that some preliminary analyses could be undertaken at little cost that would provide a convincing case for adaptive actions. Management could use these analyses to promote a higher priority for, and early consideration of, climate risk.

Even though it is evident that climate change is already occurring there is still time to take effective adaptation actions. Climate change predictions indicate that there are major challenges and opportunities facing all organizations. The Guide includes a summary of the most important current documentation and a list of references if further research or information is desired.

The risk assessment and treatment process does not end with the first iteration. It requires that the adaptation or risk control measures be monitored and periodically validated and it is recommended that the climate change risk assessment be repeated every five years or whenever significant new information or new technologies that would alter the risk estimations becomes available.

It is important to recognize that different people and organizations perceive the same risks very differently. Also, differing risk terminology has been and is still being used by various professional bodies and sciences. A glossary of risk terminology taken from the standards is included and will provide some relief for users of this guide from the inevitable arguments about terminology.

Annex 1: Climate Change Projections and References:

INTRODUCTION:

The summaries of observed and expected climate change in Canada are drawn from an extensive literature. Questions of impacts of the changes and adaptation options are not discussed here since they are extensively covered in the publication of Natural Resources Canada, *"From Impacts to Adaptation: Canada in a Changing Climate 2007"*. <http://adaptation2007.nrcan.gc.ca>

Climate projections for all regions of Canada were developed by extrapolation from historical data and correlated with projections from climate models. **Add more text explaining projections tables and ICLR website.** These are available at:

<http://www.iclr.org/climateextremesbruce.html>

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Annex 2: Glossary of Terms and Definitions

The following definitions apply to the terms used in this Guidebook. The definitions are drawn from the international standard “Risk management – Principles and guidelines” (ISO 31000) unless otherwise specified.

Adaptation – Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climate or its effects, which moderates harm or exploits beneficial opportunities. (Climate Change 2001: Impacts, Adaptation and Vulnerability. IPCC, TAR, 2001)

Adaptation benefits – the avoided damage costs or the benefits following the adoption and implementation of adaptation measures. (IPCC TAR, 2001)

Adaptation costs – costs of planning, preparing for, facilitating, and implementing adaptation measures. (IPCC TAR, 2001)

Adaptive capacity – the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or cope with the consequences. (IPCC TAR, 2001)

Adverse effects – one or more of:

- Reduction of the quality of the natural environment for any use that can be made of it;
- Injury or damage to property or plant or animal life;
- Harm or material discomfort to any person;
- An adverse effect on the health of any person;
- Impairment of the safety of any person;
- Making any property or plant or animal life unfit for human use;
- Loss of enjoyment of normal use of property; and
- Interference with normal conduct of business.

Climate change – a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. (UNFCCC)

Climate impact – *projection of future climatic conditions*

Climate variability – climate variability refers to fluctuations in climate over a shorter term - the departures from long-term averages or trends, over seasons or a few years, such as those caused by the El Niño Southern Oscillation phenomenon. (UNFCCC)

Communication and consultation - *continual and iterative processes that an organization conducts to provide, share or obtain information and to engage in dialogue with stakeholders regarding the management of risk (ISO 31000)*

Consequences – *outcome of an event affecting objectives (ISO 31000)*

Control - *measure that is modifying risk (31000)*

Dialogue – a process for two-way communication that fosters shared understanding. It is supported by information.

Establishing the context - *defining the external and internal parameters to be taken into account when managing risk, and setting the scope and risk criteria for the risk management policy (ISO 31000)*

External context - *external environment in which the organization seeks to achieve its objectives (ISO 31000)*

Event - *occurrence or change of a particular set of circumstances (ISO 31000)*

Hazard – a source of potential harm, or a situation with a potential for causing harm, in terms of human injury; damage to health, property, the environment, and other things of value; or some combination of these. This term is NOT used in ISO 31000 terminology but is in common use and should probably be replaced by “impact”

Internal context - *internal environment in which the organization seeks to achieve its objectives (ISO 31000)*

IPCC – Intergovernmental Panel on Climate Change. A large (several thousand) group of qualified experts which reviews and assesses periodically, all climate change research published in many countries.

Impact – Something that logically or naturally follows from an action or condition related to climate change or climate variability.

Kyoto Protocol – an agreement (1997) under the UNFCCC by most countries of the world, by which most developed countries will begin to limit their greenhouse gas emissions by 2008 to 2012.

Likelihood - *chance of something happening (ISO 31000)*

NOTE 1 In risk management terminology, the word “likelihood” is used to refer to the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically (such as a probability or a frequency over a given time period).

NOTE 2 The English term “likelihood” does not have a direct equivalent in some languages; instead, the equivalent of the term “probability” is often used. However, in English, “probability” is often narrowly interpreted as a mathematical term. Therefore, in risk management terminology, “likelihood” is used with the intent that it should have the same broad interpretation as the term “probability” has in many languages other than English.

NOTE 3 Likelihood generally replaces previous terminology to express the probability of an event occurring; such terms as frequency, probability.

Loss – an injury or damage to health, property, the environment, or something else of value.

Mitigation – used in 2 ways in connection with climate change. It is often used to mean reduction of greenhouse gas emissions in order to slow climate change. It is also used to indicate a measure implemented to reduce impacts (Authors).

Monitoring - *continual checking, supervising, critically observing or determining the status in order to identify change from the performance level required or expected (ISO 31000)*

Organization – a company, corporation, firm, enterprise, or institution, or part thereof, whether incorporated or not, public or private, that has its own functions and administration.

Residual risk – *risk remaining after risk treatment (ISO 31000)*

Review - *activity undertaken to determine the suitability, adequacy and effectiveness of the subject matter to achieve established objectives (ISO 31000)*

Risk – *effect of uncertainty on objectives (ISO 31000).*

Risk analysis – *process to comprehend the nature of risk and to determine the level of risk (ISO 31000)*

Risk assessment – *overall process of risk identification, risk analysis and risk evaluation (ISO 31000).*

Risk attitude - *organization's approach to assess and eventually pursue, retain, take or turn away from risk (ISO 31000)*

Risk communication – any two-way communication between stakeholders about the existence, nature, form, severity, or acceptability of risks.

Risk control option – an action intended to reduce the probability and/or severity of injury or loss, including a decision not to pursue the activity.

Risk control strategy – a program that may include the application of several risk control options.

Risk criteria - *terms of reference against which the significance of a risk is evaluated (ISO 31000)*

Risk evaluation – *process of comparing the results of risk analysis with risk criteria to determine whether the risk and/or its magnitude is acceptable or tolerable (ISO 31000)*

Risk identification - *process of finding, recognizing and describing risks (ISO 31000)*

Risk information library – a collection of all information developed through the risk management process. This includes information on the risks, decisions, stakeholder views, meetings and other information that may be of value.

Risk management – *coordinated activities to direct and control an organization with regard to risk (ISO 31000).*

Risk management framework - *set of components that provide the foundations and organizational arrangements for designing, implementing, monitoring, reviewing and continually improving risk management throughout the organization (ISO 31000)*

Risk management policy - *statement of the overall intentions and direction of an organization related to risk management (ISO 31000)*

Risk management plan - *scheme within the risk management framework) specifying the approach, the management components and resources to be*

applied to the management of risk (ISO 31000)

Risk management process - systematic application of management policies, procedures and practices to the activities of communicating, consulting, establishing the context, and identifying, analyzing, evaluating, treating, monitoring and reviewing risk (ISO 31000)

Risk owner - person or entity with the accountability and authority to manage a risk (ISO 31000)

Risk perception – the significance assigned to risks by stakeholders. This perception is derived from the stakeholders' expressed needs, issues, and concerns.

Risk profile - description of any set of risks (ISO 31000)

Risk source - element which alone or in combination has the intrinsic potential to give rise to risk (ISO 31000)

Risk treatment - process to modify risk (ISO

31000)

Stakeholder – person or organization that can affect, be affected by, or perceive themselves to be affected by a decision or activity (ISO 31000)

Stakeholder analysis – Identification of individuals or groups who are likely to have an interest in the risk management issue including a consideration of what their needs issues and concerns would be and how the stakeholder should be included in the process.

TAR – Third Assessment Report of the IPCC

UNFCCC – United Nations Framework Convention on Climate Change (1992)

Vulnerability – the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is the function of the character, size, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. (Climate Change 2001: Impacts, Adaptation and Vulnerability. IPCC TAR, 2001)

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