Guide

Consideration of Climate Change in Environmental Assessment in Ontario

Legislative Authority:

Environmental Assessment Act, RSO 1990, chapter E.18

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Climate Change Action Plan

Ontario

Readers should check with the Environmental Approvals Access and Service Integration Branch of the Ministry of the Environment and Climate Change to find out if there have been any revisions.

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Under section 31(1)(e) of the Environmental Assessment Act, the Minister of the Environment and Climate Change may gather, publish and disseminate information with respect to the environment or environmental assessments for the purposes of administrating and enforcing the Environmental Assessment Act and regulations made thereunder. Therefore, the ministry expects that this Guide will be considered by proponents.

Ce document est aussi disponible en français.

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Introduction

Environmental assessment is a planning and decision-making process used to promote environmentally responsible decision-making. In Ontario, this process is governed by the Environmental Assessment Act. The purpose of this Act is the betterment of the people of the whole or any part of Ontario by providing for the protection, conservation and wise management in Ontario of the environment.

To achieve this purpose, the Environmental Assessment Act promotes responsible environmental decision-making and ensures that interested persons have an opportunity to comment on undertakings that may affect them. In the Environmental Assessment Act, "environment" is broadly defined to include the natural, social, economic, cultural and built environments.

The Ministry of the Environment and Climate Change (ministry) has developed Codes of Practice (Codes) to provide guidance on key aspects of the environmental assessment process. The Codes include:

- Preparing and Reviewing Terms of Reference for Environmental Assessments in Ontario;
- Consultation in Ontario's Environmental Assessment Process; and,
- Using Mediation in Ontario's Environmental Assessment Process.

Together, the Codes of Practice:

- Provide guidance on key aspects of the environmental assessment process;
- Set out the ministry's expectations for the content of a variety of environmental assessment documents and provide guidance on the roles and responsibilities of all participants in an environmental assessment process;
- Provide clear direction to proponents, environmental assessment practitioners, and other stakeholders involved in the environmental assessment process on terms of reference, consultation, and mediation; and,
- Promote the transparency of government involvement and the decision-making process when projects must meet the requirements of provincial environmental assessment legislation.

This Guide is a companion to the environmental assessment program's Codes of Practice and guidance and sets out ministry expectations for considering climate change in the preparation, execution and documentation of environmental assessment studies and processes (see also Table 1).

This Guide also supports the province's Climate Change Action Plan by outlining how environmental assessment processes and studies can incorporate climate effects considerations.

This Guide covers the consideration of:

- the effects of a project on climate change;
- the effects of climate change on a project; and
- various means of identifying and minimizing negative effects during project design.

The outcome of a climate consideration is an undertaking or project:

- that has taken into account alternative methods to reduce its greenhouse gas emissions and negative effects on carbon sinks;
- that is more resilient to future changes in climate and helps maintain the ecological integrity of the local environment through an assessment of present and future environmental effects in the face of a changing climate.

Considering how a project may contribute to climate change, through its greenhouse gas emissions or its effects on the natural landscape, is important to the planning process as it allows proponents to consider climate mitigation measures to avoid, minimize, or offset such effects.

Considering how climate change may affect a project, such as through increased flooding or drought, is also critical to the planning process through enabling proponents to make informed decisions around how to design a project to withstand such environmental conditions. Finally, considering how projects affect the ability of ecosystems and species to adapt to climate change, such as changes to habitat or altering natural processes, is critical to reducing impacts on the adaptive capacity and resilience of natural systems.

Environmental Assessment process	Refer to this Guide	Climate Mitigation Consideration	Climate Adaptation Consideration
Environmental Assessment (i.e., "individual")	Yes	Yes	Yes
Class Environmental Assessment projects	Consult Guide if approved class environmental assessment has no climate consideration method or method does not meet ministry expectations	Consideration scaled to the significance of the project's potential environmental effects. Screening criteria, class environmental assessment methodology may support consideration.	Consideration scaled to the significance of the project's potential environmental effects Screening criteria, class environmental assessment methodology may support consideration.

Renewal / Major Amendment of Approved Class Environmental Assessments	Yes	Methods in this Guide to be considered for mitigation and use in approved class environmental assessment processes	Method in Guide to be considered for adaptation and use in approved class environmental assessment processes
Environmental Assessment projects under Waste, Transit, Electricity regulations	Yes	Consideration scaled to the significance of the project's potential environmental effects	Consideration scaled to the significance of the project's potential environmental effects

Table 1: Use of Guide in relation to environmental assessment processes

Policy Related to Climate Effects in Ontario

Climate Effects in Provincial Policy Statement

Some class environmental assessment projects and environmental assessment undertakings also have Planning Act requirements that must be met. The 2014 Provincial Policy Statement issued under the Planning Act advises planning authorities of the need to consider development that reduces greenhouse gas emissions and reduces the potential risk of climate change related events like droughts or intense precipitation. A partial listing of applicable policies in the 2014 Provincial Policy Statement include:

- Policies 1.6.2, 1.6.6.7 - Encourage green infrastructure (e.g., permeable surfaces) and strengthen stormwater management requirements
- Policy 1.8 - Require the consideration of energy conservation and efficiency, reduced greenhouse gas emissions and climate change adaptation (e.g., tree cover for shade and for carbon sequestration)
- Policy 3.1.3 - Requires consideration of the potential effects of climate change that may increase the risk associated with natural hazards (e.g., flooding due to severe weather)

For a complete description of the statements above, please refer to the 2014 Provincial Policy Statement issued under section 3 of the Planning Act.

Using This Guide

A proponent should consult this Guide when preparing a terms of reference for an environmental assessment, when preparing an environmental assessment study, or when planning projects carried out as part of a class environmental assessment or other streamlined environmental assessment process.

Proponents should seek to determine as early as possible in the environmental assessment process, whether there are likely to be relevant climate change

considerations associated with the project that should be addressed in more detail. In the case of some projects being planned under streamlined environmental assessment processes, a proponent might conclude that an undertaking is sufficiently minor in scale and short in lifespan that a climate consideration cannot be practically carried out or is not applicable. In this instance, the proponent should provide a rationale where possible in the environmental assessment documentation as to why the consideration of climate change could not be completed or is not applicable.

Ontario environmental assessment processes where proponents are expected to give consideration to climate change are briefly described below.

Environmental Assessments

An environmental assessment (i.e., "individual" environmental assessment) is a term that describes both a study that is conducted to assess the potential environmental effects of a proposed undertaking, and the resulting report that includes documentation of that analysis. The environmental assessment report documents the results of the study and includes both positive and negative potential environmental effects. Key components of an environmental assessment process and of the resulting report include consultation with government agencies, Aboriginal communities and the public; consideration and evaluation of alternatives; and the management of potential environmental effects. Conducting an environmental assessment promotes good environmental planning before decisions are made about proceeding with a proposal.

The first step in the application for approval to proceed with an undertaking under the Environmental Assessment Act is the approval of a terms of reference by the Minister of the Environment and Climate Change. The terms of reference allows the proponent to produce an environmental assessment that is more direct and easier for interested persons to review. It allows the focus of the environmental assessment to be the identification and management of potential environmental effects.

The proponent can start preparing the environmental assessment when the terms of reference is approved. The planning process for an environmental assessment must be documented in its entirety in the environmental assessment report. The environmental assessment must provide a plan that sets out how and when all commitments, including impact management measures, made in the document will be fulfilled and how the proponent will report to the ministry about compliance. The environmental assessment must be submitted by the proponent to the ministry for review and approval. For greater detail on the environmental assessment process, see the ministry's *Code of Practice: Preparing and Reviewing Environmental Assessments in Ontario*.

Streamlined Environmental Assessments

Streamlined self-assessment processes are available for certain classes of projects that are carried out routinely and have predictable environmental effects that can be readily managed. Streamlined environmental assessment processes in Ontario include those established by regulation (for electricity projects, transit projects and waste management projects) and those approved as part of a class environmental assessment.

A class environmental assessment is a planning document prepared by a proponent that must be approved under the Environmental Assessment Act. Once approved, the class environmental assessment serves as the process guiding document and can therefore be used to plan projects subject to the class, as defined in the document.

These streamlined processes provide an efficient, timely and environmentally responsible approach to the planning of these projects. As with environmental assessments, public notification/consultation with interested persons, government agencies and Aboriginal peoples and communities is integral to these processes.

Some class environmental assessment processes may already include climate change considerations in the process of determining the potential environmental effects for any given project.

Content of This Guide

The content of this Guide is generic in nature and not dedicated to any specific type of project. The Guide provides ideas on how to incorporate climate change considerations into the environmental assessment process and documentation. This Guide also provides examples of approaches to considering greenhouse gas emission reductions and project resilience in relation to a changing climate. Example outcomes of considering climate in project planning are also included. The Guide provides environmental assessment proponents and practitioners with:

- Several means of considering climate change in project planning;
- A concise and select overview of tools and methodologies from the field of climate change adaptation and project resiliency research; and
- Examples of how climate effects have been incorporated into project planning and how climate vulnerability has been assessed for existing built components and ecological components of the environment.

This Guide does not limit a proponent in terms of the choices of methodologies, approaches and modelling information used in a climate change consideration. This Guide will be updated and amended from time to time to reflect the future

development of policy or methods in the consideration of climate change in environmental assessment.

Climate Change and Climate Effects

Climate Change

The potential contribution of carbon emissions from human activities to the atmosphere's naturally-occurring greenhouse effect was first identified in the late nineteenth century. Systematic, annual monitoring of the carbon dioxide concentration in the atmosphere has been undertaken by climate researchers at the Mauna Loa Observatory in Hawaii beginning in the late 1950s. This monitoring identified that the atmospheric concentration of carbon dioxide was increasing at a gradual, incremental rate on a year-after-year basis.

Carbon dioxide is one of approximately two dozen greenhouse gases in significant concentration in the Earth's atmosphere; others include methane, nitrous oxide and certain halogenated carbon compounds. Greenhouse gases can exhibit heat-trapping properties in the earth's atmosphere and can be rated according to their global warming potential over different atmospheric time frames.

The concern that rising concentrations of greenhouse gases in the atmosphere could be contributing to a rise in global mean surface temperature began to mount in the 1980s. Climate and geologic records indicate that a rapid increase in global mean surface temperature has been associated with disturbances in global climate and hydrological patterns, often with significantly varying effects on regional climate and hydrology. Some of the phenomena associated with this form of climate disturbance include changes in the frequency, intensity and duration of precipitation events, changes in soil moisture and permafrost, changes in sea levels and polar ice cover and shifts in plant growth and growing season, and in the geographic extent of species range, habitat and forest cover.

Climate change and related extreme weather events are of concern to many segments of society and sectors of the economy. Two approaches for considering and addressing climate change in project planning are through:

- reducing a project's effect on climate change (climate change mitigation) and
- increasing the project's and local ecosystem's resilience to climate change (climate change adaptation).

Before knowing what mitigation or adaptation is appropriate for a project, it is important to consider and understand the potential effects that a project may have on climate change, the potential effects that climate change may have on a project, and the effect of the project on the local environment's resilience to climate change.

A Project's Effects on Climate Change

In the last several decades, the relationship between society's greenhouse gas emissions and rising greenhouse gas concentrations in the atmosphere has become more clearly understood. Most recently, the global scientific community has provided evidence that the rise of greenhouse gas emissions is influencing climate patterns, hydrology, ecosystems and ocean chemistry. Any contribution of greenhouse gases from a project or landscape change which affects the removal of carbon dioxide from the atmosphere or the storage of carbon on the landscape has the potential of having an effect on climate change.

The ministry considers focussing efforts on reducing greenhouse gas emissions and avoiding increases in the levels of these gases in the atmosphere to be in keeping with the principle of pollution prevention and the precautionary approach.

Effects of Climate Change on a Project

In addition to the concern about the effects of climate change on ecosystems, climate change and extreme weather events are of concern to many segments of society and sectors of the economy. Effects of climate change range from property specific concerns such as flooding and sewer overflow or ice storm damage, to regional-level changes in agricultural productivity and ecosystem resilience, to system-wide effects on water demand and electricity consumption. Any weather event related to climate change that exerts an influence on a project can be considered an effect of climate change on a project.

Many jurisdictions worldwide are implementing programs and policies that increase the adaptive capacity and resilience of human-built structures and land use activities. Planning processes for long-term projects are beginning to consider greater variation in future climate scenarios, resulting in projects that are more adaptable, more resilient and less likely to cause negative environmental effects. The ministry considers this to be a prudent and diligent approach to project planning.

Considering the Project's Effect on Climate

A principle of environmental assessment in Ontario is that the proponent consider all aspects of the environment (as defined in the Environmental Assessment Act) in project planning.

Many types of projects planned through environmental assessment processes will have an effect on the atmosphere through the emission of greenhouse gases or through changes to the landscape which affect the removal of carbon dioxide from the atmosphere (e.g., changes to site and vicinity plant cover). These effects on the atmosphere and the landscape have the potential to contribute to climate change. Landscape changes are often described in terms of carbon stocks, sinks and sources; proponents of natural resource related projects should consult Appendix B for treatment of carbon stocks as sinks versus sources.

This section provides proponents with an overview of how a proposed project's effects on climate may be considered in environmental assessment processes. This section is partly modelled on existing climate change guidance from the Nova Scotia Department of the Environment and the Canadian Environmental Assessment Agency (see references in Appendix D).

A proponent considering a project's potential effects on climate change could begin by assessing the project's direct greenhouse gas emissions and whether the project will positively or negatively affect the storage of carbon or removal of carbon dioxide from the atmosphere. The proponent could undertake this consideration by addressing questions such as the following:

1. How might a project generate greenhouse gas emissions or affect carbon storage or the removal of carbon dioxide from the atmosphere?
2. To what extent have the project's effects on the atmosphere already been taken into account in project planning?
3. Are there alternative methods to implement the project that would better take into account any adverse contributions to a changing climate?
4. How might a project give rise to climate effects, positive or negative, on Aboriginal people and/or communities?

Approaches to addressing these questions include:

1. How might a project generate greenhouse gas emissions or affect carbon storage or the removal of carbon dioxide from the atmosphere?

   A proponent may need to consider all direct and indirect greenhouse gas emissions that would be generated by the project, or indirectly stimulated

by its implementation. A proponent may need to consider changes in local hydrology and vegetation that could result in changes to the carbon sequestration and storage capacity of a local landscape feature.

2. To what extent have the project's effects on the atmosphere already been taken into account in project planning?

   A proponent may need to review existing features of the project and detail those features which may reduce greenhouse gas emissions, like energy and water efficiency measures. A proponent may need to identify impact management measures intended to limit the project's interference with the local landscape, plant cover and other natural features. A proponent may wish to describe contributions to or investments in natural spaces projects that offset or mitigate the project's climate effects.

3. Are there alternative methods to implement the project that would better take into account any adverse contributions to a changing climate?

   A proponent should consider alternative methods to project implementation in order to reduce the project's greenhouse gas emissions or any negative effects on carbon storage or the removal of carbon dioxide from the atmosphere. This may entail aspects of the proposed project's scheduling, footprint, operation or function. For example, a proponent could consider the scheduling and roll-out of construction activities in a way and at a time of year that would limit the negative effects on the vegetation of the site and vicinity. A proponent may need to consult industry standards, best practices and best available technology in identifying alternative methods.

4. How might a project give rise to climate effects, positive or negative, on Aboriginal people and/or communities?

   A proponent can lessen the project's climate effects on Aboriginal people by working with Aboriginal communities to identify potential climate change concerns or opportunities related to the project. A community may decide to share Traditional Knowledge with the proponent to document knowledge regarding particular areas and relay concerns of community members. A proponent could then involve the community in creating and implementing impact mitigation measures to address those concerns or provide for enhanced protection of the environment.

This generic approach to climate consideration could potentially inform a variety of environmental assessment studies and processes, or be adapted to a variety of activities, proposals and plans including those involving components of the built and natural environment.

Approaches to Considering Effects on Climate

Many projects that are planned in accordance with the Environmental Assessment Act will result in the generation of greenhouse gas emissions in the construction, operation and decommissioning of the project. For example, greenhouse gas emissions like carbon dioxide could be emitted from heavy vehicles during the construction of a wastewater collection system, treatment plant, municipal road or dam. Effects on atmospheric levels of greenhouse gases could also occur through landscape changes that alter its ability to store carbon or remove carbon dioxide from the atmosphere. Emissions of methane may be generated from a waste management project involving the landfilling of organic waste.

If a project involves a new building or structure that requires heating, cooling and lighting and electrical needs then there may be an opportunity to reduce carbon emissions associated with these needs. Climate mitigation measures such as using alternative energy, energy efficiency, insulation, and even changes in the design and layout of the structure can reduce the life-time generation of carbon emissions arising from the energy needs of the building or structure.

Business-as-Usual vs. Climate-Focussed Approaches

For any project, a proponent could consider how the project would perform where greenhouse gas management measures were not a significant priority (business-as-usual) and compare it to an approach in which greenhouse gas management measures are prominently factored into the design of the project (climate-focussed approach). This comparative consideration could be done on a qualitative or quantitative basis.

Qualitative Consideration of Effects on Climate

A qualitative consideration of the potential effects on climate change from a project and the climate mitigation measures to lessen its negative effects or to enhance its positive effects can be carried out by the steps shown in Table 2: Steps in a qualitative consideration of a project's effects on climate. To conduct a qualitative consideration of a project, a proponent would begin by describing the project in a manner in which no particular regard was given to climate mitigation measures (business-as-usual approach). In step two, the proponent would describe the project in a manner that includes all proposed climate mitigation measures to be incorporated (climate-focussed approach). Climate mitigation measures could include the use of different technologies, building materials, hours of operation and other factors. In step three, the proponent would describe the potential avoided greenhouse gas emissions and/or enhancements to carbon storage by implementing the project with climate mitigation measures.

Proponents should attempt to summarize the avoided greenhouse gas emissions avoided or improvements to carbon storage by implementing the project using a climate-focussed approach.

1. Describe the project in a manner in which no particular regard was given to climate mitigation measures (business-as-usual approach).
2. Describe the project in a manner that includes all proposed climate mitigation measures to be incorporated (climate-focussed approach).
3. Describe the potential avoided greenhouse gas emissions and/or enhancements to carbon storage by implementing the project with climate mitigation measures.

Table 2: Steps in a qualitative consideration of a project's effects on climate

Quantitative Consideration of Effects on Climate

A quantitative consideration of the potential effects on climate change from a project and the climate mitigation measures to lessen its negative effects or enhance its positive effects can be carried out using the same method in Table 2: Steps in a qualitative consideration of a project's effects on climate but with the added feature of quantifying greenhouse gas emission reductions by adopting the climate-focussed approach in step 2. Quantifying greenhouse gas emission reductions would require some understanding of emission calculations, emission estimation factors and the global warming potential of various greenhouse gases.

A quantitative consideration of a project would begin by describing and quantifying its greenhouse gas emissions as if the project were to be implemented with no particular regard for climate mitigation measures (business-as-usual approach). The next step would be to describe and quantify the greenhouse gas emissions of the project where it includes all proposed climate mitigation measures to be incorporated (climate-focussed approach). The final step is to describe and quantify the potential avoided greenhouse gas emissions and improvements to carbon storage by implementing the project with climate mitigation measures (see Figure 1 below).

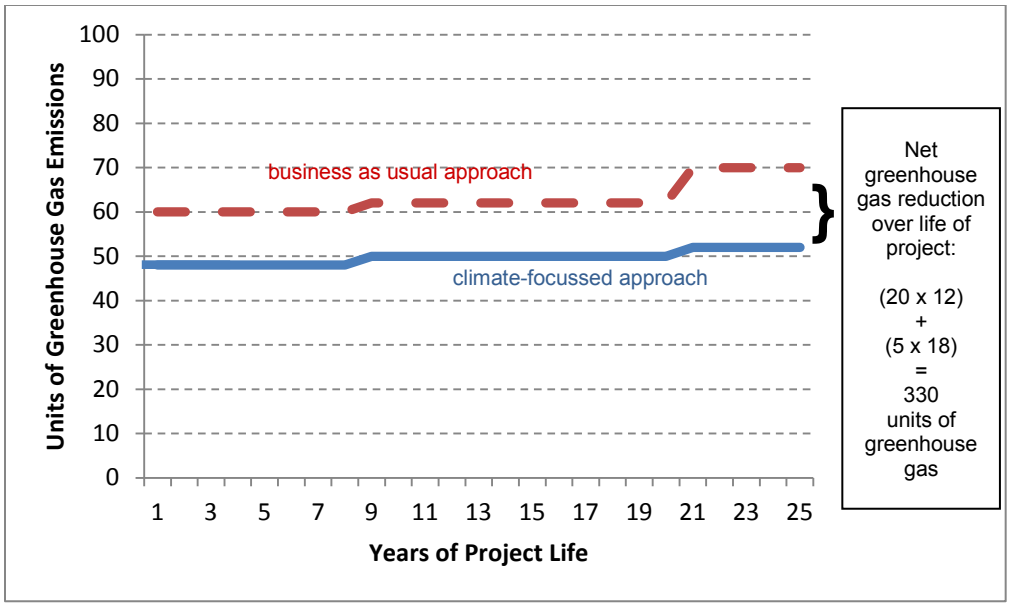

Figure 1: Quantifying Greenhouse Gas Emission Reduction

Considering the Effects of Climate on a Project

A number of environmental assessment principles are key to successful planning and approval under the Environmental Assessment Act. These principles form the foundation for the overall guidance of an environmental assessment process and provide direction when challenges present themselves.

One principle is that an environmental assessment consider all aspects of the environment including the interrelationships between various components of the environment. Environmental assessments typically evaluate a proposed project in terms of the effect that the project could have on the environment. Climate change requires that environmental assessments also consider the effects that the environment could have on the project. The purpose of the latter consideration from an environmental perspective is to identify any environmental effects which could be exacerbated by climate change leading to greater risk to the surrounding environment.

In applying this principle, a proponent should attempt to demonstrate how the effects of climate on a project can be incorporated into its environmental assessment, as the proposed project could be affected by changing climatic conditions.

Broad Consideration of Effects of Climate on a Project

Proponents could consider the potential effects of climate change on a proposed project by addressing the following questions:

1. How potentially vulnerable is the project to a changing climate?
2. Does the project as proposed contribute to the vulnerability or resilience of surrounding ecosystems to climate change?
3. Are there potential effects that climate change may exert on the project that may pose a risk to the environment?
4. Are there alternative methods of carrying out the project that could lessen the negative effects of climate change on the project thereby reducing the risk to the local environment?
5. Could the project, with the effects of future climate change factored in, result in disruption to lands or waters associated with Aboriginal cultural resources?

Approaches to addressing these questions include:

1. How potentially vulnerable is the project to a changing climate?

   A proponent may need to consult existing project plans and documentation, historical and present climate data, and projections of future climate. To further assess project vulnerability an environmental assessment could examine the effects of variation in climate parameters such as temperature, precipitation, wind gust or others, on the proposed project and its alternatives over time. If any of the climate changes aggravate any of the environmental effects of the project, this should be identified in the environmental assessment study and measures considered to ensure these effects are managed.

2. Does the proposed project contribute to or diminish the resilience of surrounding ecosystems to climate change?

   A proponent may need to consult historical and present climate data and projections of future climate in the area of the undertaking or project. The inventory of environmental features carried out as part of the environmental assessment study assists in understanding and describing the surrounding environment. These steps will help to assess how the project may affect the surrounding environment's ability to be resilient and maintain its adaptive capacity to climate change.

   Specifically, a proponent may need to examine the effects of projected changes in temperature, precipitation, or other features of the local environment when the project is implemented compared to if the project was not implemented. For example, could the project's alteration of local drainage patterns exacerbate impacts to water resources projected to occur with climate change? How might this affect the health and resiliency of the surrounding forest and wetlands?

3. Are there potential effects that climate change may exert on the project that may pose a risk to the environment?

   A proponent may need to review existing features of the project and detail those features which may reduce climate risk. A proponent may need to consult existing project plans and documentation, present and future climate data to carry out such a consideration.

   In considering the effects of climate change on a project, a proponent should be aware that the environmental effects of a project may be greater when coupled with the projected climate changes. For example, a project's demand on a local water supply may need to factor in a projected decline in water supply due to climate changes such as warmer temperatures and increased evaporation.

4. Are there alternative methods of carrying out the project that could lessen the negative effects of climate change on the project thereby reducing the risk to the local environment?

   A proponent may need to consult industry standards, best practices and best available technology in relation to existing project plans and documentation, future climate projections, and the potential environmental effects under current and changing climate conditions.

   A proponent should be aware of future climate change risks in the area of a project that may necessitate consideration of alternative methods. For example, a proponent of a storage yard with extensive paved surfaces in a location where climate change projections include more frequent and severe rain events, may need to consider alternative methods in order to reduce impervious surfaces and limit runoff to nearby water bodies.

   In order to reduce future climate-related risks to the local environment, a proponent could consider climate adaptation measures that increase resilience of any aspect of the proposed project's design, operation and function which could be susceptible to climate variability.

5. Could the project, with the effects of future climate change factored in, result in disruption to lands or waters associated with Aboriginal cultural resources.

   A proponent may need to consider whether the project coupled with climate change could exacerbate the project's anticipated environmental effects and pose additional challenges facing Aboriginal communities in a particular area. Existing challenges reported by Aboriginal communities include decreased availability of traditional foods and need of reliable infrastructure and transportation corridors.

This generic approach to climate consideration could potentially inform a variety of environmental assessment studies and processes, or be adapted to a variety of activities, proposals and plans including those involving components of the built and natural environment.

Detailed Consideration of Effects of Climate on a Project

Table 3: Conceptual Approach to Considering Effects of Climate on a Project provides an approach to begin a detailed consideration of the effects of climate on a project in the planning stage. The project components in this example could be altered to better suit projects involving wildlife habitat, ecosystem protection or other components of the natural environment.

The generic examples in Table 3: Conceptual Approach to Considering Effects of Climate on a Project demonstrate that consideration of climate effects in project planning could involve many points of analysis, or interactions, for example:

- What effect, if any, would a projected change in maximum wind gust have on project-related communications installations?
- What effect could a short-term disruption of utility services due to an extreme climate event have on project operations?
- What effect would a projected increase in certain precipitation events, fog or snow conditions have for staff mobility, waterway navigation, access to natural resource operations, or access to equipment vital to project operation? Could any variation in a climate phenomenon be significant enough to warrant additional project consideration?

Not all points of analysis or interactions between climate and project need to be considered to the equivalent degree. For example, in a roadway project, increased precipitation could be a significant concern, whereas a change in drought conditions less so. Drought, low precipitation, or low soil moisture conditions could be of greater concern to projects involving public water supplies or components of the natural environment, like forests, protected areas or

COLUMN 1 **Climate Variable**		**COLUMN 2** **Generic Project Component**
Temperature extremes • High • Low • Warmest / coldest period Precipitation (Rain) • Freezing rain • Intensity • Flooding return period • Wettest / driest period • Total annual Precipitation (Snow) • Snow load • Snow water equivalent Wind Speed • Extreme gusts • Gale, hurricane force winds, tornados • Fog, hail, lightning	***If the frequency, severity or duration of any of the variables in Column 1 changes, what will be the effect on any component in Column 2?*** [1,2]	Utilities • Air intake • Water intake • Drainage / wastewater • Electrical and gas • Fire and Safety • Communications • Transport (road, rail) Operations • Maintenance • Continuity • Reliability Administration • Personnel • Occupational Safety • Insurance / liability Buildings • Structural integrity • Fatigue / stress / failure

Table 3: Conceptual Approach to Considering Effects of Climate on a Project

[1] Approach is adapted from that formulated by the Public Infrastructure Engineering Vulnerability Committee, see Appendix A. or www.pievc.ca.

[2] Neither the list of climate variables nor generic project components is meant to be exhaustive. Examples are provided for illustrative purposes.

natural resource operations. Nevertheless all climate parameters with potential to interact with a project should be defined and considered at a screening level to fully understand which interactions pose higher risk.

The projected magnitude of future climate variation would assist in determining which, if any, project components require greater consideration for vulnerability to climate variation. Most importantly, proponents need to be aware of the potential of future variability of climate phenomena, and what effects, positive or negative, this variability could have on the environmental effects of a proposed project.

The determination of the most appropriate point in an environmental assessment to introduce the consideration of climate effects is important. The ministry advises that the consideration begin as early as possible in an environmental assessment process. Documentation of this decision should be included as part of the environmental assessment.

Where the potential effects from climate change on the project are uncertain, proponents should explain this in environmental assessment documentation. For example, a proponent may not be able to precisely predict an effect because of time frame, complexity or other factors. In this case, the proponent could discuss why the effect may vary, identify the expected range of effects, and the level of certainty of these predictions.

Potential Outcomes of Climate Effects Consideration

This section provides examples of how proponents can prepare and incorporate climate effects considerations into terms of reference and environmental assessments for the environmental assessment process. Climate effects consideration can also be incorporated into streamlined environmental assessment processes.

Environmental Assessments

Considering climate change in a terms of reference for an environmental assessment could result in the proponent committing to consider climate effects in its studies that are part of the environmental assessment process and prepared in support of the environmental assessment report.

Considering climate change in an environmental assessment could result in the proponent refining and documenting measures for dealing with climate effects as the undertaking moves toward implementation stages.

Processes that Establish or Renew Class Environmental Assessments

Considering climate change in the development or review of class environmental assessments could result in a description of how the proponent would consider climate effects in environmental assessments for that class of projects.

Streamlined Environmental Assessment Processes

Considering climate change in streamlined environmental assessment processes and studies could result in the inclusion of a commitment on how the proponent will implement climate change adaptation and mitigation measures during the detailed design phase of any given project.

The consideration of climate effects in environmental assessments enables a proponent to demonstrate due diligence in relation to reducing the effects of, and from climate change, in relation to the project proposal.

Documenting Climate Effects in Environmental Assessment

Environmental assessments are able to consider and document relationships between climate and project, i.e.,

- the project's potential effects on climate; and
- the potential effect of climate on the project.

These climate considerations can be carried out by reviewing the potential for a project to generate greenhouse gas emissions and affect carbon sinks, by assessing the vulnerability of the project to changing climatic conditions, and by examining the impact of a project on the environment's adaptive capacity.

The following guidance applies primarily to the preparation of individual environmental assessments but may also be considered relevant to proponents of class environmental assessment processes. Ministry reviews of proponents' documentation will be evaluating the extent to which climate change effects were considered during the planning and environmental assessment processes. The documentation of a climate change consideration may vary, depending on the undertaking. An undertaking subject to an environmental assessment may have extensive documentation, whereas a routine class environmental assessment project may not require a separate analysis of the climate consideration. A class environmental assessment proponent may include the outcome of its project screening in its documentation and note where criteria were used in its approved class environmental assessment to demonstrate how climate effects were considered in the environmental study.

Documenting Climate Considerations in Environmental Assessment

An environmental assessment can track and document climate considerations like other environmental components such as air, water and natural features. Climate considerations could be added to the following chapters of the environmental assessment:

- Existing Environment
- Environmental Effects
- Cumulative Effects (where applicable)

The climate consideration section would be enhanced by the inclusion of historical climate data for the study area (where available) and representation of data through charts, graphs and tables. This will facilitate the ability of the

reviewers to identify trends. Proponents could include any of the following information for the study area in the "Existing Environment" section:

- A graph showing annual and/or monthly high and low temperatures and precipitation amounts along with projected changes based on best available climate modeling results.
- A discussion of the freeze/thaw cycles in the local area and nearby waterways and potential effect to or from the undertaking.
- A map showing the contours, location, extent of the local floodplain based on historical flood information.

The consideration of climate in an environmental assessment could result in a proponent including:

- An analysis of alternatives with respect to their potential contributions to climate change as well as their potential vulnerability from the effects of climate change.
- A consideration of climate mitigation measures with respect to avoiding, minimizing or offsetting effects of the undertaking on climate change.
- A consideration of climate change effects in any alternative screening process.

Additional Considerations

The following guidance may be relevant to proponents of either individual or class environmental assessment processes.

Existing Climate Strategies

Proponents may wish to draw upon or make reference to their own, or other existing climate change strategies or policies in carrying out an environmental assessment. Proponents should consider whether making reference to existing climate change strategies or policies alone is sufficient as a consideration of climate, or whether a more detailed consideration of climate should be carried out when conducting project-specific environmental assessment studies. Documentation of the results of this consideration should be included as part of project reporting.

Regional Government Plans and Master Plans

Many regional municipalities in Ontario have developed master plans for water, sewer, transportation and other services, and some have included reference to future climate effects in these plans and/or their Official Plans. Proponents are encouraged to consider master plan documents in relation to relevant project specific environmental assessment studies and processes. Proponents are encouraged to consider whether climate effects should be considered at a project level, i.e., beyond a consideration made within master plan documents.

Emergency Management Plans

Ontario municipalities are required to have an emergency management program under the Emergency Management and Civil Protection Act (EMPCPA). The EMCPA, administered by the Ministry of Community Safety and Correctional Services (MCSCS), also requires municipalities to adopt emergency response plans to describe the method by which the municipality and its agencies will respond to an emergency. MCSCS also has guidance available to assist municipalities interested in preparing an emergency plan related to a flood emergency. A municipal proponent may be able to draw upon its emergency management program or plans in documenting the consideration of climate effects on a project as proposed as part of an environmental assessment process.

Operation of Project, Service

In certain instances, the temporary loss of project service or function due to climate related extremes might be an acceptable project design or adaptation approach. For example, in rural areas, some roads and rights-of-way are operational on a weather-permitting or seasonal basis. A road may become impassable due to flooding or drifting snow for several weeks per year and is temporarily closed. The risk of brief closures could be acceptable for the community that uses the road. If so, this consideration could form part of the conception of the project from the outset. Before conditions like this are applied in project planning, design and operation, the proponent should consult with the affected community, reach a shared understanding of this risk, and document this understanding.

Conversely, if a road or right-of-way is vitally needed by a community as the principal or only route to medical care or other vital services, then the community may have little tolerance for service disruption. This would be the case whether or not the source of disruption was a weather-related event. In this instance the community's tolerance to risk of closure is low, and the road should be planned, designed, built and operated to a very high standard.

Projects in Ontario's North

It is anticipated that some Aboriginal communities, especially in Northern Ontario, have already experienced significant impacts of climate change as a result of the natural environment changing, such as impacts on reliability of winter ice-roads, water quality and community flooding and it is anticipated that communities will continue to experience significant impacts of climate change.

The consideration of climate in project planning is particularly important in regions where climate change is projected to occur at a greater pace or extent. This includes much of northern and western Ontario, where projected surface temperature change is among the most significant of all regions of the province.

Ministry staff carrying out reviews of environmental assessment documentation will need to address matters such as: has the proponent taken into account, in its project, the risks posed by climate change?

Factors that the ministry has considered or specified to be included in the terms of reference for environmental assessment projects in Ontario's north include:

- An assessment of how the proponent's construction practices, operational procedures and the design of the undertaking will respond to storms, flooding, drought, fires or other severe weather events resulting from climate change.
- Assessment of how the site will be decommissioned to ensure resilience to climate change impacts.
- Discussion and assessment of whether climate change scenarios could alter the anticipated effects on the environment, and impact the adaptive capacity of the ecosystem.
- Discussion and assessment of impacts of all phases and components of the project on air quality and climate including assessment of emission rates of greenhouse gases.
- Discussion and assessment of project's contribution to climate change related to the disturbance of the peatlands and release of carbon and other greenhouse gases.
- Description of proposed mitigation measures to avoid, offset or minimize the contribution of the project to climate change.

This Guide is intended to provide proponents and other interested persons with an understanding of how climate effects could be considered as part of environmental assessment. The ministry regards climate effects consideration to be a demonstration of responsible planning and due diligence. Questions about a specific project or environmental assessment should be referred to the ministry staff assigned to the project or environmental assessment.

Those interested in information about Ontario's environmental assessment process should consult the ministry's website or contact the ministry at the address below to obtain process, consultation and mediation guidance.

Ministry of the Environment and Climate Change
Environmental Approvals Access and Service Integration Branch
135 St. Clair Avenue West
Toronto, Ontario M4V 1P5 Canada

Telephone: 416-314-8001
Toll Free: 1-800-461-6290
Fax: 416-314-8452
E-mail: EAASIBgen@ontario.ca
Website: www.ontario.ca/environmentalassessments

In addition, the ministry has developed guidance materials for the following key elements of the environmental assessment process:

- Class environmental assessments
- Consultation
- Coordinating federal and provincial environmental assessment requirements
- Electricity projects
- Environmental assessments
- Glossary
- How to make a Part II Order request
- Making a hearing request
- Mediation
- Terms of reference
- Transit projects
- Waste management projects

Appendix A

Examples of Considering Climate Effects in Project Planning

Overview of the Work of the Public Infrastructure Engineering Vulnerability Committee (see www.pievc.ca)

Engineers Canada, Natural Resources Canada and partner organizations established the Public Infrastructure Engineering Vulnerability Committee (the committee) in 2005 to assess the challenge to the built environment posed by climate change. The committee includes representation from all three levels of government in Canada as well as many non-governmental organizations.

Since 2008 the committee has carried out a series of studies and the development of a protocol for assessing the vulnerability of a range of infrastructure to changing climatic conditions. The committee's approach has involved a broad and systematic review of infrastructure vulnerability to climate change.

The committee originally studied four categories of public infrastructure: buildings; roads and associated structures; storm water and wastewater systems; and water resources. Initial "scoping" studies examined the current state of each infrastructure, availability of climate data and indicators of adaptive capacity.

The initial studies formed the basis for Engineers Canada to develop an engineering protocol, known as the PIEVC Engineering Protocol or "the Protocol". To date, it has been used to assess the vulnerability and climate risk of over 40 various types and sizes of infrastructure systems across Canada. For example, the Protocol was used to assess the vulnerability of water resources infrastructure as described in two of the case studies in Appendix A, those for the Toronto and Region Conservation Authority and the Union Water Supply System in southwestern Ontario.

One of the key challenges identified through the committee was the traditional reliance on historical data to design long-lasting, safe and reliable infrastructure. New practices will require the accommodation of increased uncertainties because modelling results which characterize future climate are never as accurate as historical data. This creates a challenge to existing infrastructure design approaches and practices. As a first step to dealing with this challenge, the committee structured a two-part approach:

- Evaluate the vulnerability of Canada's infrastructure to the effects of climate change from an engineering perspective; and,

- Derive key findings of the vulnerability assessment to inform the review of design, operation and maintenance codes, standards and practices.

Based on the committee's approach, the engineering profession is developing new design and operational practices to withstand changing climate conditions – both extremes and gradual changes.

Toronto and Region Conservation Authority: Flood Control Dam Water Resources Infrastructure Assessment

Key Points of Analysis: The risks of various climate events increasing in occurrence between approximately the 1970s and 2050s, and the vulnerabilities these pose to flood control dams.

The climate analysis and projections portion of this study included the establishment of a set of climate parameters describing climatic and meteorological phenomena relevant to the geographic areas of the Claireville and G. Ross Lord flood control dams. The analysis resulted in the determination of general probability scores reflective of the occurrence of each phenomenon, both historically and in the future.

Climate parameters were selected on the basis of relevance to the region (southern Ontario) given the region's known seasonal variability. Parameter selection was also based on those with the potential to present vulnerability to the infrastructure and its components as a result of either extreme or persistent occurrences. In this evaluation, parameter usefulness was based on three factors:

- usefulness of the climate parameter in determining vulnerability;
- availability of information;
- ability to relate this information to a probability.

In total, more than twenty parameters were selected including five-day total rainfall, heavy rain, ice storm, heat wave and hurricane/tropical storm occurrence, cold wave, freeze thaw, and snow accumulation.

The following parameters were predicted to have a greater probability of occurrence between the historical (1970s to 2000s) and future (2040s to 2070s) time periods: heat wave, heavy rain, five-day total rainfall, ice storm, and hurricane/tropical storm. The parameters: cold wave, freeze thaw, and snow accumulation were predicted to have a lower probability of occurrence, with reference to the two time periods.

Follow-up actions from the evaluation, for consideration, included:

- review of emergency operational plans to ensure they are adequate for all types of extreme climate events – rain, snow, ice and high winds;
- review of backup systems by simulating various catastrophic events e.g. a loss of electrical power plus a loss of cellphone network;
- maintaining dam-side operator's residences to minimize the travel time of operators during severe weather events;
- develop emergency response plans for a number of climate events that have low risk of occurrence but would result in extremely severe impacts. These events are heavy long-term rainfall, ice storms, lightning, hurricane/tropical storms and tornados.

Intensity Duration Frequency Curves – Road, Highway, Urban Drainage Design

Key Points of Analysis: Design implications for storm sewer, road and highway drainage infrastructure from rain events of various frequencies, intensities and durations.

When designing drainage infrastructure such as culverts, bridges, sewer systems and roadside ditches, good estimates of peak rainfall intensity are essential. Quality rainfall data enable designers to make calculations that meet drainage capacity design standards and avoid the over- or under-design of drainage elements. Design flow rates for a particular area are typically estimated using rainfall Intensity Duration Frequency curves. The curves summarize extreme rainfall patterns for a particular location, by representing the statistical relationship of rainfall intensity corresponding to storm duration and frequency, by graph or table.

The ministry has obtained climate model results which allow the generation of Intensity Duration Frequency curves over an extensive time frame for locations throughout Ontario (see Drainage in Appendix C). Curves created using projected (future) climate conditions can be compared to curve information from the present or past to assess the significance of changes to climate on a localized basis.

Research through the University of Western Ontario has assessed the variation in Intensity Duration Frequency curves used by the City of London to account for changing climatic conditions, as the design of municipal wastewater management infrastructure (sewers, storm water management ponds or detention basins, street curbs and gutters, catchbasins, swales) is typically based on these curves.

Ontario's Ministry of Transportation has funded the development of a web-based tool that provides Intensity Duration Frequency curves for provincial highway design at any location across Ontario using up-to-date data from Environment Canada. Updating Intensity Duration Frequency curves as additional data and

new techniques become available is essential so that if or when a change in key climate variables occurs, this occurrence is reflected in a timely fashion.

Highway 407 East Extension – Effect of the Environment on the Project

Key Points of Analysis: Effect of eight climatic variables on the construction and operation of a major highway development.

As part of a Comprehensive Study Report pursuant to the former Canadian Environmental Assessment Act (CEAA), the Ontario Ministry of Transportation conducted an evaluation of the potential effect of the environment on the preferred route selection for the Highway 407 East Extension. CEAA requirements included the identification of likely effects, mitigation measures, and residual effects after mitigation is applied. The proponent carried out a high-level evaluation of the potential effects of the environment on the project. The evaluation was conducted in consultation with experts on climate effects. Some of the climate phenomena and effects which were identified and evaluated included:

Lightning

- A potential increase in lightning strikes on light standards and other tall structures associated with highway development. Mitigation measures include back-up systems for critical electrical systems.

Hail

- Increased frequency of hail storms on the operation of the proposed highway. Mitigation measures include restrictions to operations in accordance with standard Ministry of Transportation practices.

Heavy Rain/Flooding

- Design standards for major watercourse crossing structures based on the Regional Storm event (Hurricane Hazel) to prevent potential flooding effects.

Fog

- Mitigation measures include installation of reflective markers on the roadway surface.

Drought

- Where long term effects to groundwater cannot be avoided at major fills or deep cuts, long-term engineering / foundation design measures will be undertaken as appropriate. Specific outfall control measures will be implemented for all storm water management facilities to prevent erosion of the receiving streams, with specific attention to outfalls to the deeper valleys

and at many of the high sensitivity watercourses in the eastern portion of the study area.

The proponent concluded at the outcome of the evaluation that after taking into consideration the likelihood of extreme weather and incorporating mitigation measures (some of which are described above) no residual adverse effects of the environment on the project were anticipated. After the evaluation, the proponent concluded that the probability of weather events of such extremity to cause damage or major disruption in the area of the 407 East Transportation Corridor was low.

Climate Risk Assessment and Vulnerability Analysis of a Municipal Water Treatment System in Southwestern Ontario

Key Points of Analysis:	To assess the potential effects of climate change on public infrastructure and to advance planning and prioritization of adaptation strategies. A case study of a municipal drinking water treatment system.

The Union Water Supply System (UWSS) is a municipal water supply system jointly owned by the Ontario municipalities of Leamington, Kingsville, Essex and Lakeshore. Treated water from UWSS is supplied to the four owner municipalities for local distribution to residents, businesses and the agricultural sector.

In 2012, the Ministry of Environment and Climate Change procured the services of Engineers Canada to assess the vulnerability of the UWSS infrastructure to the potential effects of future climate and provide recommendation for operational modifications to address potential effects.

The primary objective of the study was to identify the areas within the current design, construction, operation, and management of the UWSS that are at an increased or decreased risk of failure and/or damage due to potential changes in climatic conditions. The study was carried out using Engineers Canada's Public Infrastructure Engineering Vulnerability Committee Protocol (version 10) and delivered recommendations for remedial action and/or further study.

The climate analysis and projections portion of the study included the establishment of a set of climate parameters describing climatic and meteorological phenomena relevant to the geographic areas of the UWSS service area. This included: high temperature, low temperature, heat wave, cold wave, extreme diurnal temperature variability, freeze-thaw, heavy rain, sustained high temperature in winter with snow on ground, heavy 5-day total rainfall, winter rain, freezing rain, ice storm, heavy snow, snow accumulation, blowing snow/blizzard, lightning, hailstorm, hurricane/tropical storm, high wind, tornado, drought/dry period, and heavy fog. Climate parameter selection for the study was based on a parameter's potential to present vulnerability to the

infrastructure and its components as a result of either an extreme or persistent occurrence.

Future climate projections were analyzed using climate model outputs from Environment Canada's Canadian Climate Change Scenario Network Plots, the Intergovernmental Panel on Climate Change 4th Assessment Report Regional Climate Projections chapter (and others, where applicable), and scientific journal articles presenting regional and local projections and predictions.

The following interactions were assessed as having the highest risk scores for both existing and future climate conditions:

- Lightning's effect on communications, transformers, transmission lines and data acquisition systems
- The effect of blowing snow or a blizzard on chemical storage
- The effect of lake water level on the emergency water intake

Some of the recommendations arising from the study include:

- Review the emergency response policies and procedures for various components of the UWSS
- Review the potential need for the existing emergency water intake (and potential modifications to it) be investigated to ensure it remains functional during lower lake levels
- Accelerate modifications to older storage tanks to ensure adequate circulation of water in storage
- Investigate the condition of electrical transformers
- Continue to monitor the risks identified through the assessment, particularly as components continue to age.

Appendix B

Considering Climate Effects in Natural Resource Project Planning

Some projects involving natural resources, particularly forests, soils and wetlands, may result in aspects of climate mitigation and adaptation being undertaken in the same measure. For example reforesting lands will result in removing carbon from the atmosphere (mitigation). The same initiative may result in a landscape better adapted to reducing the effects of climate extremes – tree cover can provide shade and cooling for soils and buildings and the delay the rate of overland drainage from intense precipitation events (adaptation). For reasons such as this, climate effects considerations for natural resource projects may vary somewhat from other project types. Specific variations include:

Carbon stock

Carbon stock is the quantity of carbon in a carbon pool. Carbon pool refers to a physical component or components of the climate system where carbon is stored. Examples of carbon pools are forest biomass, wood products, soils and the atmosphere. The carbon stock in a pool can change due to the difference between additions of carbon and losses of carbon. When the losses are larger than the additions, the carbon stock becomes smaller, and thus the pool acts as a source to the atmosphere; when the losses are smaller than the additions, the pools acts as a sink to the atmosphere.

Climate Effects Consideration

The outcome of a climate effects consideration for natural resource projects may include an assessment of ecological integrity and resilience as part of, or in addition to mitigation and adaptation:

The outcome of a climate consideration is an undertaking or project that has taken into account the means to reduce its direct greenhouse gas emissions and effects on carbon sinks/sources, that is more resilient to projected changes in climate, and helps to maintain the ecological integrity of the local environment through an assessment of present and future environmental effects in the face of a changing climate.

Case Study – Climate Considerations in MNRF's Class Environmental Assessment Processes

The Ministry of Natural Resources and Forestry (MNRF) has identified a way in which climate considerations may be accounted for in their class environmental processes.

Class Environmental Assessment for Parks Protected Areas and Conservation Reserves (Class EA-PPCR)

There are several ways that consideration of climate change is inherently built into the Class EA-PPCR process.

The screening criteria in Table 3.1 of MNRF's Class EA-PPCR is used to rate the potential net effect of a proposed project against criteria in the categories of:

- natural environmental considerations;
- land use, resource management considerations;
- social, cultural and economic considerations; and, aboriginal considerations.

These criteria incorporate potential effects related to climate change. For example, the screening table includes evaluation of several criteria related to assessing effects of projects on ecosystem resilience and adaptive capacity, as well as effects to air and water quality, land subject to natural or human-made hazards, drainage or flooding and permafrost.

The Class EA-PPCR provides guidance for assessing the significance of environmental effects, including elements related to consideration of climate change, such as geographic extent, duration and frequency of effects, direct and indirect effects and cumulative effects.

As part of the Class EA-PPCR process, mitigation must be identified to reduce effects on environmental components, including measures that would reduce effects from or on climate change. MNRF is proposing to add descriptions of typical mitigation measures to include examples of mitigation measures specific to climate change.

Additionally, the Class EA-PPCR process outlines the need for project monitoring, which allows for assessment of predicted effects with respect to acceptable outcomes, which may include effects as a result of a changing climate and the potential to identify remedial actions.

Consideration of Climate Change in the Class Environmental Assessment for Resource Stewardship and Facilities Development (Class EA-RSFD)

The screening criteria in Table 3.1 of the Class EA-RSFD are used to rate the potential net effect of a proposed project against criteria in the categories of:

- natural environmental considerations;
- land use, resource management considerations;
- social, cultural and economic considerations; and,
- aboriginal considerations.

The criteria allow for consideration of potential effects related to climate change (e.g. air and water quality, water quantity (flows and levels, drought response), and land subject to natural or human-made hazards).

MNRF is proposing to add direction specific to climate effects consideration in the application of the screening criteria, e.g.,

> *"The effects of climate change are pervasive, alter the composition and function of Ontario's ecosystems, and include more frequent extreme weather events (e.g., flooding, drought, and wind storms) that compromise or destroy infrastructure with significant implications to the future health and well-being of people and their communities.*
>
> *Consideration should be given to the known and anticipated effects of climate change on a proposed project and whether the project description includes adequate mitigation and adaptation options."*

MNRF is also proposing generic examples of typical mitigation measures for use by environmental assessment project staff. The examples provide more detail in responding to Section 14 (2) (5) of the Environmental Assessment Act (description of mitigation measures for undertakings subject to the class environmental assessment). The examples of mitigation measures will include those which mitigate the impacts of climate change.

Appendix C

Availability and Use of Climate Model Results

Sources of climate model results that focus on Ontario and other evaluation tools are available for climate effects consideration.

Ontario Climate Change Scenarios

Climate model results have been generated for Ontario and can be used in the evaluation of future climate effects. Data can be downloaded from various websites to construct climate scenarios, as well as data used as input variables for further downscaling.

Climate data are provided as long-term (usually 3 decades) averages or time-series at daily, monthly, seasonal or annual scales. Long-term average climate information is available for the baseline period (1961–1990 or 1981-2010) and three future periods (2011–2040, 2041–2070, and 2071–2100), while time series are available continuously from 1960 to 2100. In addition to the typical climate variables (temperature and precipitation), extreme climate indices (i.e. heat waves, IDF curves and droughts) are also available as well. While climate data is available at many sources, Ontario-specific high resolution regional climate data can be found at:

http://www.ontarioccdp.ca/

and

http://occp.lamps.yorku.ca/

These are the two major data portals with the most up-to-date climate information when this document was written, developed by partner academic institutions with funding from MOECC.

The Scientific Literature

Proponents are encouraged to consult the peer reviewed scientific literature as a matter good practice and due diligence. The following papers are two examples.

Gula, J. and Peltier, W.R. 2012. Dynamical downscaling over the Great Lakes Basin of North America using the WRF Regional Climate Model: The impact of the Great Lakes System on regional greenhouse warming, Jnl. of Climate, 25, (Nov.), 7723-7742, doi: 10.1175/JCLI-D-11-00388.1

Mckenney, D. W., Hutchinson, M. F., Papadopol, P., Lawrence, K., Pedlar, J. H., Campbell, K., Owen, T. (2011). Customized Spatial Climate Models for North

America. *American Meteorological Society*, 1611–1622. doi:10.1175/BAMS-D-10-3132.1

Drainage Information

Information about, and tools for generating Intensity Duration Frequency curves are available through:

Ministry of the Environment and Climate Change

AR4:A1B. Dynamically-downscaled climate projections with the PRECIS model under A1B emissions scenario, projected rainfall intensity-duration-frequency (IDF) curves and daily and hourly time series data for climate change impact assessment.
http://www.ontarioccdp.ca/

Ministry of Transportation

The IDF Curve Lookup is a web-based application provided by the Ontario Ministry of Transportation (MTO) for the purpose of retrieving Intensity-Duration-Frequency (IDF) curves.
www.mto.gov.on.ca/english/engineering/drainage/

Appendix D

Additional Resources

Published Sources of Climate Consideration in Project Planning, Environmental Assessment

For additional reference, approaches and methods for incorporating climate change considerations in project planning and environmental assessment, see:

- Alberta Environment. February 2011. Guide to Preparing Environmental Impact Assessment Reports in Alberta.
- Canadian Environmental Assessment Agency. November 2003. Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners.
- Engineers Canada, Public Infrastructure Engineering Vulnerability Committee (PIEVC). November 2007. City of Portage la Prairie: Water Resources Infrastructure Assessment Phase II – Pilot Study.
- Engineers Canada, Public Infrastructure Engineering Vulnerability Committee (PIEVC). April 2008. Adapting to Climate Change: Canada's First National Engineering Vulnerability Assessment of Public Infrastructure.
- Intergovernmental Panel on Climate Change (IPCC). 2014: Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.
- Ministry of Natural Resources and Ontario Centre for Climate Impacts and Adaptation Resources. 2011. A Practitioner's Guide to Climate Change Adaptation in Ontario's Ecosystems.
- Ministry of Transportation. 2012. Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects.
- Nova Scotia Environment. February 2011. Guide to Considering Climate Change in Project Development in Nova Scotia.
- Toronto and Region Conservation Authority. June 2010. National Engineering Vulnerability Assessment of Public Infrastructure to Climate Change: Toronto and Region Conservation Authority Flood Control Dam Water Resources Infrastructure Assessment.

Glossary

The definitions in this glossary are intended to assist the reader in understanding the terms used in this Guide. The definitions for some of these terms were derived from the Fourth and Fifth Assessment Reports (AR4, AR5) of the Intergovernmental Panel on Climate Change (2007, 2013) and the Report of the Expert Panel on Climate Change Adaptation (2009). For terms that are also contained in the Environmental Assessment Act, the wording and meaning contained in the Environmental Assessment Act shall prevail.

adaptation

The process of adjustment in the built and natural environments in response to actual or expected climate change and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.

In natural resources management, adaptation seeks to address the vulnerability of species or natural systems and processes by reducing threats, enhancing resilience, engaging people, and improving knowledge.

adaptive capacity

The ability or potential of a species or ecological system to respond successfully to climate variability and change.

alternative methods

Alternative methods of carrying out the proposed undertaking are different ways of doing the same activity. Alternative methods could include consideration of one or more of the following: alternative technologies, alternative methods of applying specific technologies, alternative sites for a proposed undertaking, alternative design methods, and alternative methods of operating facilities associated with a proposed undertaking.

carbon sink

A carbon sink is any process, activity or mechanism that removes carbon dioxide from the atmosphere. Examples of carbon sinks include but are not limited to oceans, forests, soils, peatlands and wetlands.

carbon source

A carbon source is any process, activity, or mechanism that releases carbon dioxide into the atmosphere. Carbon sources may be anthropogenic, as in the combustion of fossil fuels, or natural in origin as when plants release carbon dioxide into the atmosphere through respiration.

carbon stock

Carbon stock is the quantity of carbon in a carbon pool. Carbon pool refers to a physical component of the climate system where carbon is stored. Examples of carbon pools are forest biomass, wood products, soils and the atmosphere.

climate change

Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer.

effects of climate change

The consequences of climate change on natural and human systems, such as projects and their environmental effects. (Also referred to "effects of climate" for brevity.)

effects on climate change

A project's greenhouse gas emissions and any changes to carbon sinks (e.g., changes to the landscape that alters its carbon dioxide removal capability). These effects of the project are likely to lead to increased levels of atmospheric greenhouse gases. (Also referred to "effects on climate" for brevity.)

environment*

The Environmental Assessment Act defines environment to mean:

(a) air, land or water,
(b) plant and animal life, including human life,
(c) the social, economic and cultural conditions that influence the life of humans or a community,
(d) any building, structure, machine or other device or thing made by humans,
(e) any solid, liquid, gas, odour, heat, sound, vibration or radiation resulting directly or indirectly from human activities, or
(f) any part or combination of the foregoing and the interrelationships between any two or more of them,
in or of Ontario;

impact management measures

Measures which can lessen potential negative environmental effects or enhance positive environmental effects. These measures could include mitigation, compensation, or community involvement.

* An asterisk (*) beside a defined term indicates that the term is defined in the Environmental Assessment Act.

mitigation (climate)
The use of measures or actions to avoid or reduce greenhouse gas emissions, to avoid or reduce effects on carbon sinks, or to protect, enhance, or create carbon sinks.

proponent*
"proponent" means a person who,
(a) carries out or proposes to carry out an undertaking, or
(b) is the owner or person having charge, management or control of an undertaking; ("promoteur")

resilience
The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change.

terms of reference
An approved terms of reference sets out the framework for the planning and decision-making process to be followed by the proponent during the preparation of an environmental assessment. In other words, it is the proponent's work plan for what is going to be studied. The environmental assessment must be prepared in accordance with the approved terms of reference.

undertaking*
"undertaking" means,
(a) an enterprise or activity or a proposal, plan or program in respect of an enterprise or activity by or on behalf of Her Majesty in right of Ontario, by a public body or public bodies or by a municipality or municipalities,
(b) a major commercial or business enterprise or activity or a proposal, plan or program in respect of a major commercial or business enterprise or activity of a person or persons other than a person or persons referred to in clause (a) that is designated by the regulations, or
(c) an enterprise or activity or a proposal, plan or program in respect of an enterprise or activity of a person or persons, other than a person or persons referred to in clause (a), if an agreement is entered into under section 3.0.1 in respect of the enterprise, activity, proposal, plan or program;
(Undertaking is also referred to as "project" in this Guide for brevity).

vulnerability
The degree to which components of the natural and built environment are susceptible to, and unable to withstand adverse effects of climate change. Vulnerability is a function of the character, magnitude, and rate of climate change combined with the system's sensitivity and adaptive capacity.