CMD 25-H12-REF4 CNSC Staff Submission

Reference Package 4 for CMD 25-H12 CNSC Staff Submission on NexGen Energy Ltd. Licence Application to Prepare Site and Construct the Rook I Project

Classification	Unclassified
Type of CMD	References
CMD Number	CMD 25-H12.REF4
Original CMD	CMD 25-H12
Public hearing date	09-12 February 2026
SharePoint ID	QQQVZZNDK725-166150894-9663
Summary	This document contains documents referenced in the Environmental Assessment Report appended to 25-H12, to be placed on the Record for the proceeding.
Actions required	There are no actions requested of the Commission. This CMD is in support of the actions and recommendations set out in CNSC staff CMD 25-H12.

CMD 25-H12-REF4 Soumission par le personnel de la CCSN

Références liées 4 au CMD 25-H12 Soumission par le personnel de la CCSN la demande de permis de préparation de l'emplacement et de construction du projet de Rook I présentée par NexGen Energy Ltd.

Classification	NON CLASSIFIÉ
Type de CMD	Références
Numéro de CMD	CMD 25-H12.REF4
CMD Original	CMD 25-H12
Date de l'audience	09 au 12 février 2026
SharePoint ID	QQQVZZNDK725-166150894-9663
Résumé	Ce document contient les documents cités dans le rapport d'évaluation environnementale annexé à 25-H12, qui seront versés au dossier de l'instance.
Mesures requises	Aucune mesure n'est requise de la Commission. Le présent CMD appuie les mesures et les recommandations énoncées dans le CMD CMD 25-H12 du personnel de la CCSN.

CMD 25-H12-REF4

Reference Package 4 for CMD 25-H12 CNSC Staff Submission on NexGen Energy Ltd. Licence Application to Prepare Site and Construct the Rook I Project

Signed by: 2026-01-09

X DBeaton

Signed by: Beaton, Dana

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Canadian Environmental Assessment Agency
Agence canadienne d'évaluation environnementale

Technical Guidance for assessing the Current Use of Lands and Resources for Traditional Purposes under the *Canadian Environmental Assessment Act, 2012*

December 2015

Draft for public comment

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Disclaimer

This technical guidance is for information purposes only. It is not a substitute for the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) or any of its regulations. In the event of any inconsistency between this technical guidance and CEAA 2012 or its regulations, CEAA 2012 or its regulations, as the case may be, would prevail.

For the most up-to-date versions of CEAA 2012 and its regulations, please consult the Department of Justice website at: http://laws-lois.justice.gc.ca/eng/

The list of examples provided in this guidance document is not exhaustive or prescriptive but rather provides examples of the kinds of information that may be relevant and sought in an environmental assessment.

Draft Version: Public Comments Invited

Environmental assessment practitioners, the public and Aboriginal groups are invited to provide comments on this draft technical guidance document. Any feedback on this document should be submitted to the Agency at CEAA.guidance-orientation.ACEE@ceaa-acee.gc.ca by June 16th, 2016. All comments will be reviewed and considered for integration in the document for release in its finalized form. The document will be considered an 'evergreen' resource and will be subject to periodic updates as appropriate.

Updates

This document may be reviewed and updated periodically by the Canadian Environmental Assessment Agency. For the most up-to-date version, please consult the Policy and Guidance page of the Canadian Environmental Assessment Agency's website.

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Ce document a été publié en français sous le titre : *Orientations techniques pour l'évaluation de l'usage courant des terres et des ressources à des fins traditionnelles en vertu de la* Loi canadienne sur l'évaluation environnementale (2012)

Alternative formats may be requested by contacting: info@ceaa-acee.gc.ca.

Table of Contents

Context

The *Canadian Environmental Assessment Act, 2012* (CEAA 2012) aims to protect components of the environment that are within federal legislative authority from significant adverse environmental effects caused by a designated project, including cumulative environmental effects.

In addition, CEAA 2012 ensures that a designated project is considered in a careful and precautionary manner to avoid significant adverse environmental effects, when the exercise of a power or performance of a duty or function by a federal authority under any Act of Parliament is required for the designated project to be carried out.

Throughout the technical guidance document, the term "environmental effects" refers to environmental effects as described in section 5 of CEAA 2012. Under CEAA 2012, the “environmental effects” to be considered are those in areas of federal jurisdiction as described in section 5, and include:

- effects on fish and fish habitat, shellfish and their habitat, crustaceans and their habitat, marine animals and their habitat, marine plants, and migratory birds;
- effects on federal lands;
- effects that cross provincial or international boundaries;
- effects of any changes to the environment on Aboriginal peoples related to health and socio-economic conditions; physical and cultural heritage; current use of lands and resources for traditional purposes; or any structure, site or thing that is of historical, archeological, paleontological or architectural significance; and
- changes to the environment that might result from the federal decisions as well as any associated effects on health and socio-economic conditions, matters of historical, archaeological, paleontological or architectural interest, or other matters of physical or cultural heritage.

Purpose

This technical guidance document supports the implementation of CEAA 2012 provisions related to the effects of any changes to the environment on the current use of lands and resources for traditional purposes by Aboriginal peoples. It provides guidance on how to conduct the environmental assessment (EA) of a designated project when the Canadian Environmental Assessment Agency (the Agency) is the responsible authority or supports an EA conducted by a review panel.

The technical guidance informs the preparation of Agency directives and key EA documents and serves as core guidance to proponents who propose the carrying out of a designated project. It also provides direction to Agency employees throughout the EA of a designated project in their interactions with those engaged in the EA process, such as proponents, federal authorities, other jurisdictions, review panel members, Aboriginal groups and the public.

In combination with Agency directives and key EA documents, the technical guidance aims to ensure that CEAA 2012 requirements related to the current use of lands and resources for traditional purposes are met in order to achieve a high quality EA of a designated project.

Application

The technical guidance is intended for use in the EA of a designated project. This technical guidance should be used in conjunction with other Agency policy and guidance instruments. For an EA by a review panel, additional guidance and direction may be provided in the Terms of Reference and/or Joint Review Panel Agreement.

In this technical guidance, the term “designated projects” refers to projects initiated under CEAA 2012, and “EA” refers to the EA of designated projects initiated under CEAA 2012 for which the Agency is the responsible authority or for an EA conducted by a review panel.

This technical guidance is applicable to designated projects which fall under sections 1-30 of the schedule in the Regulations Designating Physical Activities. (Schedule – Physical Activities)

In this technical guidance, Aboriginal refers to First Nations, Inuit and Metis.

Agency directives and key EA documents include Project Description, Environmental Impact Statement Guidelines, Environmental Impact Statement, Information Requests, and EA Report.

Relevant Provisions of CEAA 2012

This technical guidance addresses subparagraph 5(1)(c)(iii) of CEAA 2012 “with respect to aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on the current use of lands and resources for traditional purposes”.

The technical guidance supports paragraph 4(1)(d) in promoting communication and cooperation with Aboriginal peoples with respect to EAs as one of the purposes of CEAA 2012.

Subsection 19(1) of CEAA 2012 identifies the factors that are to be taken into account in an EA, including the significance of environmental effects, mitigation measures and the requirements of a follow-up program. This subsection also indicates the environmental effects to be taken into account in the EA include cumulative environmental effects and the environmental effects of malfunctions or accidents. In examining these factors, the EA may take into account community knowledge and Aboriginal traditional knowledge, in accordance with subsection 19(3).

Under section 52 of CEAA 2012, the Minister of the Environment must decide if, taking into account the implementation of mitigation measures the Minister considers appropriate, the designated project is likely to cause significant adverse environmental effects

When the Minister of the Environment determines that the designated project is not likely to cause significant adverse environmental effects referred to in subsections 5(1) and/or 5(2) of CEAA 2012, or if the Governor in Council determines any significant adverse environmental effects identified by the Minister are justified in the circumstances, the Minister, in accordance with section 53 of CEAA 2012, will identify, in the EA decision statement, the conditions with which the proponent must meet with respect to mitigation measures and follow-up program requirements.

Aboriginal Rights Information – Interface with Paragraph 5(1)(c)

The subject areas included in paragraph 5(1)(c) and in particular the term “current use of lands and resources” by Aboriginal peoples is often expressed by Aboriginal groups as rights, namely “aboriginal rights”, “treaty rights” and “aboriginal title”. This Guidance document is not intended to create, deny, limit or define any potential legal rights of any Aboriginal groups. Rather, this guidance document is provided to assist the public, Aboriginal groups, proponents and EA practitioners to understand the kinds of information that is to be collected and considered under paragraph 5(1)(c) and when implementing CEAA 2012.

The information gathered under paragraph 5(1)(c) may also assist other kinds of assessments needed to meet other kinds of obligations that may arise in the course of implementing CEAA 2012. For example, the information collected may overlap with the information needed to assess potential adverse impacts on Aboriginal or Treaty rights which in turn may inform any consultation or treaty implementation requirements that may arise. However, this Guidance document is not directed at informing these other kinds of assessments or obligations that may arise in relation to the implementation of CEAA 2012.

Understanding subparagraph 5(1)(c)(iii)

The current use of lands and resources for traditional purposes by Aboriginal peoples is determined on a case-by-case basis over a defined area and period of time. Under subparagraph 5(1)(c)(iii), effects from a designated project on the current use of lands and resources for traditional purposes are considered through a change in the environment.

The current use of lands and resources for traditional purposes, as well as the exercise of treaty rights, is associated with an Aboriginal group's practices, traditions or customs, which are part of an Aboriginal group's distinctive culture and fundamental to their social organization and the sustainment of present and future generations. Practices, traditions and customs are generally defined as follows:

- Practice: a way of doing something that is common, habitual or expected;
- Tradition: a custom, opinion or belief handed down primarily orally or by practice; and
- Custom: a particular, established way of behaving.

Understanding "Current use"

In the context of an EA, "current use" refers to how the use of lands and resources may be affected throughout the proposed project's lifecycle (pre-construction, construction, operation, decommissioning and abandonment).

This includes uses by Aboriginal peoples that are actively being carried out at the time of the assessment and uses that are likely to occur in a reasonably foreseeable future provided that they have continuity with traditional practices, traditions or customs. Some uses may be more difficult to identify at the time of the assessment because they occur at long time intervals or with low frequency.

Furthermore, uses that may have ceased due to external factors should also be considered if they can reasonably be expected to resume once conditions change.

Examples: The recovery plan for a species may preclude its harvesting by Aboriginal peoples within a geographic area until the species population rebounds.

Land disturbance from a previous project or natural causes such as forest fires may have affected the habitat and abundance of a bird species, resulting in a reduction of traditional hunting on that land. Remediation of the land may lead to a recovery of the bird population and enable hunting by Aboriginal peoples to resume.

The availability of information on patterns of use of lands and resources across a range of time can assist in considering "current use" in relation to a specific timeframe. An expansion or contraction of that time period may be considered as new information becomes available during the course of an EA.

The following questions may assist in determining how the lands and resources are currently being used for traditional purposes by Aboriginal peoples:

- What is the frequency, duration, spatial and seasonal aspects of the use?
- Does the timing of the use correspond to the biophysical cycles of migration or growth of the resource?
- Does the timing relate to a spiritual or cultural consideration of the resource or land use?
- Are there any external factors that may have temporarily altered or halted traditional practices?
- Are Aboriginal peoples permanently or temporarily residing on the lands?

Understanding "Use"

The term "use" may refer to activities involving the harvest of resources, such as hunting, trapping, fishing, gathering of medicinal plants, berry picking, and travelling to engage in these or other kinds of activities.

In addition, use may also refer to particular connections and uses of the lands and resources related to ceremonies, customs, cultural practices, traditional governance, trade or stories. For any given Aboriginal group, use occurs over a specific geographic area; however, several groups may use portions of that same area.

The use of the lands and resources by Aboriginal peoples may have tangible values (e.g., wildlife species or traditional plants) and/or intangible values (e.g., quiet enjoyment of the landscape or sites used for teachings). Intangible values are often linked with spiritual, artistic, aesthetic and educational elements that are often associated with the identity of Aboriginal groups.

In relation to use, "occupancy" may be viewed as a distinct way of viewing an Aboriginal group's presence in an area. Occupancy may refer to a defined area that an Aboriginal group regards as its own by virtue of continuing use, habitation, naming, knowledge and control. Transmittal of legends, oral histories and ecological knowledge about places, in addition to indigenous place names and habitation sites, are often used to substantiate Aboriginal groups' claims of occupancy. The geographic boundaries of occupancy are generally smaller than those that represent use and could be shared by two or more groups.

Understanding "Lands and Resources"

The term "lands" may refer to terrestrial, riverine, lake and marine ecosystems. Land can have spiritual, economic and political significance for Aboriginal peoples. Aboriginal peoples often have a long and complex relationship with the land, which results in strongly held views about the cultural, biophysical and spiritual connectedness between the lands, waters, the peoples and their societies. Aboriginal peoples' traditional territory, both the lands occupied and those used historically, can be integral to their identity as a distinct nation.

The use of the land may be defined by the resources harvested, the activities undertaken to procure the resource and the locations where the activities have taken place. More specifically, the use of the land can be expressed in the following terms:

- subsistence practices (e.g., hunting, fishing, gathering);
- places where transmission of cultural knowledge occurs, including language, sense of self and place within the community;

- ceremonies/events (e.g., harvest feasts, solstice, annual gatherings);
- traditional routes (e.g., trails, waterways, landmarks, portages);
- sacred sites (e.g., burial grounds, cultural landscapes); and
- habitation sites.

The importance placed on the uses of the land by Aboriginal groups may vary from group to group based on the values, practices, traditions and geographic location of each group. Lands and resources may be utilized by one or more Aboriginal groups. Those groups that give prominence to certain resources (e.g., caribou) also tend to give prominence to the area where the resource is extracted (e.g., preferred harvesting area where teachings about hunting and cultural history occur).

Understanding "Traditional Purposes"

Traditional purposes typically relates to activities that are integral to a community's way of life and culture, and have continuity with historic practices, customs and traditions of the community.

Although these practices may be considered traditional and as having a strong historic link, these activities are not static. They evolve over time to reflect contemporary views, knowledge and practices. The practices, traditions and customs of Aboriginal peoples often change as a result of evolving trends occurring within society as whole (e.g., technological innovations). For example, hunting and fishing practices may have evolved from using dog sleds and canoes to snowmobiles and power boats.

For the purpose of an EA, the expressions "pre-contact or post-contact with European society or colonization" are frequently used to measure the number of years, decades, generations and centuries that an Aboriginal group's current use of lands and resources for traditional purposes can be traced. Pre-contact evidence and information such as archaeological sites are frequently presented to quantify how far back the use of specific lands and resources may extend. Practices, customs and traditions that are resumed after an interruption may still be considered in the EA, despite the interruption. Practices, traditions or customs do not have to be connected to a potential or established Aboriginal right, or to an area of historic occupancy, for them to be considered in an EA.

The concept of "within living memory" generally refers to a period of time within a person's life and may include childhood recollections. It can be recorded using a number of qualitative research methods (e.g., map biography), often derived from interviews. These initiatives can present comprehensive information regarding the use of lands and resources by one or more groups for a given period of time (e.g., years, decades or centuries).

Linkages with other provisions of section 5

A land or resource that is part of the current use of lands and resources for traditional purposes may also fit under other provisions of section 5.

Example: Fish and fish habitat, aquatic species, migratory birds and any other components of the environment set out in Schedule 2 fall within paragraph 5(1)(a). These components are very often part of an Aboriginal group's current use of the lands and resources for traditional purposes.

Furthermore, any one of these components under paragraph 5(1)(a), or other components not specifically listed in subsection 5(1) (e.g., caribou, deer) may be used by an Aboriginal group for more than one purpose.

Example: Fishing and hunting might be part of an Aboriginal group's economy and therefore may also be considered as part of their health and socio-economic conditions identified under subparagraph (5)(1)(c)(iii).

In addition to being currently used for traditional purposes, a land or resource may be valued or hold value that may link it to other provisions of section 5.

Example: Aboriginal fishing cabins, and/or the lands on which fishing activities take place, may also have heritage value and be considered as physical and cultural heritage identified under subparagraph (5)(1)(c)(ii) or any site, structure or thing of historical, archeological, paleontological or architectural significance identified under subparagraph (5)(1)(c)(iv).

Introducing the Environmental Assessment Framework

An EA examines any changes to the environment that may be caused by a designated project, and pursuant to subparagraph 5(1)(c)(iii) considers how these changes to the environment may affect the current use of lands and resources for traditional purposes with respect to Aboriginal peoples.

The approach and level of effort applied to assessing effects of any changes to the environment on the current use of lands and resources for traditional purposes in an EA are established on a case-by-case basis taking into consideration the:

- characteristics of the designated project;
- potential environmental effects;
- state (health, status or condition), nature and extent of the valued components (VCs) that may be affected by a change in the environment;
- potential for mitigation and the extent to which mitigation measures may address potential environmental effects;
- potential for cumulative environmental effects; and
- level of concern expressed by Aboriginal groups.

The EA framework should include the following five steps:

- Step 1: scoping;
- Step 2: analysis;
- Step 3: mitigation;
- Step 4: significance; and
- Step 5: follow-up.

The steps are iterative; circumstances (e.g., information or analysis) commonly arise during the course of an assessment that requires one step or several steps to be revisited. EA documentation must clearly explain and justify the methodologies used to assess the effects of any changes to the environment on the current use of lands and resources for traditional purposes.

Once the potential effects of the designated project on the current use of lands and resources for traditional purposes have been identified, mitigation measures are considered. The implementation of mitigation measures is taken into account by the Minister of the Environment when determining whether a project is likely to cause significant adverse environmental effects.

Information that is gathered from Aboriginal groups by practitioners throughout the five steps needs to be assessed and presented in a manner that reflects each group's individual concerns, issues and interests in relation to the current use of lands and resources for traditional purposes.

Note that each Aboriginal group is unique and the current use of lands and resources for traditional purposes should be discussed and collected with each Aboriginal group identified in the Environmental Impact Statement (EIS) guidelines.

Aboriginal Traditional Knowledge (ATK) should be used as sources of information during all five steps. For more information on how to integrate ATK in the assessment see *Considering Aboriginal traditional knowledge in environmental assessments conducted under the* Canadian Environmental Assessment Act, 2012

Step 1: Scoping

Scoping is an iterative process that focuses the assessment on relevant issues and concerns and establishes the spatial and temporal boundaries of the EA. Scoping should cover the following aspects:

- identifying VCs;
- listing potential effects; and
- determining spatial and temporal boundaries.

Scoping for the EA is made in relation to section 5 of CEAA 2012 and takes into account direction provided by the Agency (e.g., in the EIS Guidelines). As scoping is iterative, information gained throughout the EA, such as information on potential or confirmed current use of lands and resources for traditional purposes, may help clarify what needs to be considered and to what extent.

Identifying valued components

A VC represents an environmental element of an ecosystem that is identified as having scientific, social, cultural, economic, historical, archaeological or aesthetic importance. The value of an ecosystem component may be determined on the basis of cultural ideals or scientific concern. For the purposes of CEAA 2012, VCs are selected to assist in predicting and assessing environmental effects as described under section 5 and taking into account direction provided by the Agency or, in the case of an EA by review panel, the Minister.

Identifying VCs may involve making an inventory of the current use of lands and resources for traditional purposes that may be affected by the designated project.

Examples of questions that should be considered in identifying VCs include:

- Are there any lands and resources that are known to be currently used by Aboriginal peoples for traditional purposes?
- Are there any traditional activities, cultural and spiritual practices, intergenerational transfer of culture and knowledge, or traditional values taking place?
- Has any work been previously undertaken to identify lands and resources that are currently being used by Aboriginal peoples for traditional purposes, such as land use studies?
- What lands and resources are valued by an Aboriginal group?

The current use of lands and resources for traditional purposes generally consists of a combination of three elements: activities, resources and locations, as shown in Table 1.

Table 1: Elements associated with the current use of lands and resources for traditional purposes.

Elements	Examples
Activity	• Hunting • Fishing • Trapping • Berry picking • Plant gathering • Teaching • Gathering of people (e.g., for spiritual/ceremonial reasons, to share/teach skills, etc.) • Forestry
Resource	• Big game mammals: moose, deer, mountain goat, caribou, elk and muskox • Fur bearing mammals: marten, mink, beaver, otter, muskrat hare, lynx, wolverine, red and arctic fox, grizzly bear, polar bear and black bear • Other land mammals: squirrel, skunk and porcupine • Aquatic mammals: ringed seal, bearded seal, walrus, narwhal and beluga whale • Fish: lake whitefish, northern pike, sturgeon, arctic char and salmon • Waterfowl: eider, duck, Canada goose and swan • Seabirds: birds and eggs • Other birds: ruffed grouse and wild chicken • Plants, shrubs, and trees: berries, herbs, moss, medicinal plants, tobacco, bearberry, Canada yew, Lodgepole pine, Douglas fir, spruce, birch, silverberry, false dogbane bush, juniper and Saskatoon berries • Drinking/cooking water
Location	• Cabins/camps • Resource harvesting areas (e.g., plant gathering, fishing, hunting, trapline) • Trails • Ceremonial/sacred sites • Graves/burial sites • Cultural landscapes • Habitation sites

When identifying VCs, it may be useful to consider that in most cases all three of these elements form an integral part of any given current use of the lands and resources by Aboriginal peoples.

Example: A mine may have potential effects on an Aboriginal fishing site. Contamination or disturbance to the fishing site (location) could affect the fish (resource), which would in turn affect aboriginal fishing (activity).

During scoping, a VC may be identified at a broad level (e.g., hunting) or at a more specific level (e.g., hunting of migratory birds). The consideration of the effects of the designated project will generally involve an examination of the specific features of the VC.

Gathering data and information on VCs of interest

Identifying VCs may be achieved through a combination of researching existing sources of information, engagement with Aboriginal groups, Traditional Land Use Studies, or other methods.

Existing sources of information

Aboriginal groups, experts, stakeholders, government and non-government organizations, as well as existing literature, can be important sources of information in identifying and evaluating lands and resources currently used by Aboriginal peoples for traditional purposes.

Possible sources of information may include the following:

- Aboriginal groups (communities and organizations)
- Aboriginal consultation records from other provincial or federal activities
- Aboriginal treaties and land claims
- existing Traditional Land Use Studies
- provincial or federal EAs conducted for other projects
- court cases and decisions
- professional societies and organizations
- academic and research institutions
- cultural environmental setting report
- registered fur management areas (traplines)
- federal, provincial and municipal archives and libraries
- federal and provincial Archaeological records
- land and marine use plans
- Canadian Registry of Historic Places
- federal and provincial government departments
- federal, provincial and territorial guidance documents and legislations
- photographs and maps
- Aboriginal Treaty and Rights Information System

Professional judgment should be exercised in evaluating the credibility, applicability and validity of any sources for the purpose of an EA. The identification of VCs of interest should also be informed by engaging Aboriginal groups and conducting Traditional Land Use Studies.

Engaging Aboriginal groups

Engaging all potentially affected Aboriginal groups during the scoping phase will assist practitioners in identifying VCs that appropriately represent the current use of lands and resources for traditional purposes that may be affected by the designated project. Early engagement with Aboriginal groups and making effective use of ATK are strongly encouraged in order to achieve a more complete EA, manage risks of costs and delays later in the process, and be aware of any issues surrounding the capacity of Aboriginal groups to participate in the EA.

Information on the current use of lands and resources for traditional purposes is often conveyed through ATK. ATK is also known by other names such as Traditional Ecological Knowledge, Traditional Knowledge and Indigenous Knowledge. In general terms, ATK refers to a body of knowledge built up by a group of people through generations of living in close contact with nature. ATK is often unwritten and transmitted orally, and includes beliefs, wisdom, activities, traditions and skills derived from extended observations of the land and its creatures, weather, seasonality and other cycles, and spiritual associations. Prominent across Aboriginal beliefs is the seventh generation principle, which holds that the decisions made today should result in a sustainable world seven generations into the future.

Engagement could involve visiting communities, hosting workshops, or attending meetings to build relationships and discuss current use with Aboriginal groups. Such initiatives can increase the credibility of the EA and minimize the risk of the information being misunderstood, misinterpreted and/or taken out of context. Engaging a cross-section of the Aboriginal group, including leadership, harvesters, elders, women and youth, may help to make interactions more inclusive and the information obtained more representative of the community as a whole. Interactions with Aboriginal peoples should be in keeping with appropriate ethical standards. Confidentiality procedures can assist in avoiding any potential inadvertent disclosures (e.g., disclosure of traditional knowledge to a band member which the community restricts to its elders).

Consent forms can be used to establish agreements between practitioners and communities as to the confidentiality and intellectual property rights for information collected. These agreements provide authorization to publish relevant information in EA documents. It is important to understand the particular governance structure of each Aboriginal group so as to ensure compliance with desired protocols, and to maintain respectful working relationships.

It is important to note that all records submitted for the EA are considered part of the Canadian Environmental Assessment Registry (the Registry). The Registry consists of an *Internet site* of basic project information and *project files*, accessible to the public, which contain the records produced or obtained for the purpose of conducting an EA. When requested, copies of records in the project file must be provided to the public in a timely manner. The project file does not, however, include records that would not have been released if a request had been made under the *Access to Information Act.*

Participants submitting information or documents in the EA by review panel can make a request in writing to the panel for confidentiality prior to or concurrent with the submission of the information if disclosure would cause harm to a witness or harm to the environment.

Traditional Land Use Studies

Traditional Land Use Studies seek to determine the extent of past and present use of the land for traditional purposes important to Aboriginal peoples including, but not limited to, hunting, fishing, trapping, ceremonial pursuits and the gathering of plants including berries and herbal medicines.

These studies can assist in documenting each Aboriginal group's use and habitation of the territory at any time during the groups' existence, or within living memory. They are typically completed either by the Aboriginal communities, by practitioners, collaboratively between both parties, or by a consultant hired by either the community or practitioner. Methods to complete these studies may include historical research, interviews, community meetings, geographic information systems and other mapping exercises, and field studies. These documents should be viewed as "living" and should be updated over time to reflect the changing land and resource uses of an Aboriginal group.

Traditional Land Use Studies cover the types of practices, activities, sites, and/or areas frequented by the respective groups, including:

- important travel sites and routes (e.g., trail systems, waterways, and landmarks);
- harvesting (e.g., registered traplines, resource use and harvesting areas, special-use sites such as fish camps, berry-picking areas, and medicinal plant collection areas);
- occupied areas (e.g., residential areas, meeting areas, gathering places, cabins, and campsites); and
- spiritual sites and sacred landscapes (e.g., burial sites and cultural landscapes).

Studies conducted to document land and resource use by Aboriginal peoples may be named as land use studies, traditional use studies, and traditional land use and occupancy studies. The practitioners should work with each Aboriginal group to determine what terminology and methods are most appropriate and respectful for that community.

If, instead of conducting a new Traditional Land Use Study as part of the EA, the EA relies on previous studies, their original purpose should be transparent and they should reflect the views and knowledge of the Aboriginal group. It is best practice to seek the permission of Aboriginal groups prior to using existing studies and that these studies be validated in the current context. If significant time has elapsed since the study was completed, consideration should be given to conducting new research to update the previous study.

Considerations for identifying VCs

In determining potential current use of lands and resources for traditional purposes that may be affected by a designated project, the following considerations may be of assistance:

- Context: A particular resource or parcel of land may not appear important on its own. However, considering the historical and physical context and information content (such as cultural significance) may provide insight into its value. For example, places that are sacred to Aboriginal peoples may show no signs of physical activity, but may be associated with the creation of legends, ceremonial functions, personal vision quests, puberty rites, etc.

- Disturbances: The degree of intactness of the lands or resources is evaluated, including the level to which they have been disturbed or are preserved. Such an evaluation requires data on the previous condition of the lands or resources, which may not always be available or documented.
- Evidence: Some types of sites, such as burial sites, are not visible. It is therefore important to take the necessary steps to identify where these sites may be present in order to avoid or mitigate any adverse effects on them. Engaging Aboriginal groups may help in locating these sites.
- Access: Aboriginal groups rely on access to lands and resources to pursue traditional uses, such as access to quality hunting areas, preferred fishing sites, established trails and ceremonial sites. The environmental effects of a designated project may result in a change in access to the area and/or changes to the resources themselves. A decrease in access for Aboriginal peoples or an increase in access for non-Aboriginal peoples (e.g., increased hunting pressures) could have a negative effect on the current use of lands and resources for traditional purposes. Consideration should be given on how land tenures (e.g., crown lands) in the area may affect access to and availability of lands and resources.
- Evolution: The current use of lands and resources for traditional purposes by Aboriginal peoples is constantly evolving over time. Traditional practices may also change over specific intervals of time, for example, when they are dependent or associated with seasons or cultural/ceremonial traditions. When considering traditional uses, “traditional” should be viewed as something that, while rooted in historical practices, remains very much a part of the contemporary culture.

Listing potential effects

Under CEAA 2012, the “environmental effects” to be considered are those described in section 5, including:

- With respect to Aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on the current use of lands and resources for traditional purposes.

The following questions could be considered to help identify potential effects on the current use of lands and resources for traditional purposes:

- What are the changes to the environment that may be caused by a designated project?
- How will these changes to the environment affect Aboriginal groups’ current use of lands and resources for traditional purposes?
- What are some of the characteristics associated with the use of lands and resources, such as the location, frequency, duration or timing of the traditional practices?
- Are there cumulative effects that will affect the identified current use of lands and resources for traditional purposes?
- What are the Aboriginal groups’ concerns associated with the potential effects?

There may be a relationship between the effects on the biophysical components of the environment and the effects on the current use of lands and resources for traditional purposes. Such relationships will exist when the use is related to a particular component (e.g., fish). The assessment of a biophysical VC may inform the assessment of a current use VC. However, effects to current use cannot always be entirely captured solely on an independent assessment of biophysical components.

Example: Effects of the designated project may alter the migration patterns of a migratory bird that is hunted by an Aboriginal group. From a biophysical standpoint, this may have a minimal effect on the viability of the migratory bird population; however, this alteration may have a greater effect on the Aboriginal group's ability to hunt the migratory birds in a preferred area.

Therefore, assessing potential effects on current use VCs could involve first identifying those which are specific to current use of lands and resources for traditional purposes (e.g., fishing) and then identifying biophysical parameters which may inform the assessment (e.g., fish and fish habitat). In some cases, the biophysical parameter will also be a VC (e.g., salmon).

Determining spatial and temporal boundaries

Defining the spatial and temporal boundaries for the assessment of effects on VCs establishes a frame of reference for identifying and assessing the environmental effects associated with the designated project. These boundaries are set to provide some structure for the analysis of potential environmental effects, selection of mitigation measures and determination of significance. The spatial and temporal boundaries used in the EA may vary depending on the VC.

Spatial boundaries will be defined taking into account the appropriate scale and spatial extent of potential environmental effects, community knowledge and ATK, current land and resource use by Aboriginal groups, ecological, technical and social and cultural considerations.

Temporal boundaries should span all phases of the designated project (e.g., construction, operation, decommissioning and abandonment). Each project phase is expressed in terms of the amount of time, in years or months, needed to complete each phase. Community knowledge and ATK should factor into decisions around temporal boundaries.

For information on establishing boundaries associated with cumulative environmental effects, please refer to the *Technical Guidance for Assessing Cumulative Environmental Effects under CEAA 2012.*

Step 2: Analysis

The objective of the analysis step is to describe how the potential changes to the environment caused by a designated project may affect the current use of lands and resources for traditional purposes. The analysis of a particular VC may be applicable or used to support more than one subparagraph of section 5.

Examples: The analysis of fish assessed under 5(1)(a)(i) can provide information relevant to the analysis on the ability of Aboriginal peoples to practice fishing under 5(1)(c)(iii).

An Aboriginal practice such as trapping may be assessed both as a current use of lands and resources for traditional purposes under 5(1)(c)(iii) and as being part of socio-economic conditions under 5(1)(c)(i).

Building on the information gathered from the scoping, this step of the assessment should include:

- A description of baseline conditions for the current use of lands and resources for traditional purposes;
- An assessment of how the potential changes to the environment caused by a designated project may affect the current use of lands and resources for traditional purposes;
- An assessment of how malfunctions or accidents related to the designated project may affect the current use of lands and resources for traditional purposes; and
- The consideration of potential cumulative effects.

Establishing baseline

Baseline conditions refer to present-day conditions, prior to implementation of the designated project. These conditions may not be fully representative of the variations in natural conditions, due to natural variability, historical shifts, or effects from other human activity.

Spatial and temporal boundaries inform the establishment of baseline environmental conditions. Baseline conditions should be provided for each VC potentially affected in sufficient detail to enable the identification of how the designated project could affect the VCs and an analysis of those effects. Aboriginal groups may request to be involved in the gathering of baseline information. Practitioners should indicate how input from Aboriginal groups was used in establishing the baseline conditions.

Based on the scope of the assessment, some of the baseline information that may be described and characterized includes:

- access and travel routes for conducting traditional practices;
- location of hunting camps, cabins and traplines;
- traditional uses currently practiced or practiced in recent history;
- presence of cultural or spiritual sites;
- frequency, duration or timing of traditional practices;
- geographic areas where fish, wildlife, birds, plants or other natural resources are harvested; and
- historic context about the state of the factors above.

Data collection and/or generation are important components of an analysis of environmental effects. At times, it may be challenging to obtain or generate data to support the analysis. Potential environmental effects should be considered in the analysis even when there is little supporting data or there is predictive uncertainty so that the EIS can present the most complete picture of the potential environmental effects. In all cases, uncertainties and assumptions underpinning an analysis should be described and information sources clearly documented.

Interviews and questionnaires can be used to collect baseline data. Regardless of the methods used or the level of the Aboriginal community’s involvement in the gathering of baseline information, cultural sensitivities should be taken into account.

When dealing with confidential information, some considerations to take into account include:

- sharing only information relevant to environmental effects;
- summarizing specific information into general conclusions;
- describing specific sites (e.g., harvesting and hunting locations) in a more general way so that specific locations are not revealed (e.g., highest concentration of use is within X kilometers of designated project); and
- when mapping sensitive locations, sharing information only with necessary and appropriate parties.

As indicated in table 1, activities, resources and locations are three elements that form an integral part of the current use of lands and resources for traditional purposes. When analysing potential effects, it may be useful to consider the interaction between all three elements in selecting appropriate VCs and assessing potential effects of changes to the environment on these VCs.

Table 2 provides examples of how changes to the environment may affect the current use of lands and resources for traditional purposes, as well as examples of measures that may be used to mitigate these effects.

Table 2: Examples of how changes to the environment may affect the current use of lands and resources for traditional purposes, as well as measures to mitigate these effects.

Change in the Environment	Potential effects on the Current Use of Lands and Resources for Traditional Purposes	Mitigation measures
Introduction of herbicides or pesticides along a transmission line.	• Reluctance to pick berries and gather food plants from areas where herbicides or pesticides have been used.	• Avoiding or minimizing the use of herbicides and pesticides near locations of plants of importance to Aboriginal groups.
Influx of project workers in designated project area.	• Greater pressure on species used by Aboriginal groups.	• Instituting a hunting ban for employees to prevent additional hunting pressures. • Prohibiting workers and contractors from fishing in Aboriginal preferred fishing sites.
Road construction creates new rights of way, increasing access and traffic to previously remote area.	• Increased mortality of ungulates, which may affect hunting.	• Setting speed limits for vehicles that reduce the potential for vehicle-wildlife collisions.

Destruction of wetlands supporting moose and migratory birds.	• Reduced harvest of meat for food, and increased travel due to changes in moose and migratory bird abundance and distribution.	• Requiring selection and design of wetland compensation sites to take into account opportunities to provide for current use activities.
Loss of land due to project footprint.	• Loss of ceremonial/sacred sites for transmittal of culture through teachings and storytelling.	• Adjustment of the designated project footprint (or parts of it) to avoid sensitive areas such as those which are known to be used for ceremonial purposes by Aboriginal peoples.
Decline in water quality from leaching of tailing storage facility.	• Permanent loss of area traditionally used as a source of drinking water around trails, cabins and camps.	• Maintain water quality in a given area by capturing runoff, using mitigation measures for seepage and using collection wells.
Increased noise levels due to mine operation.	• Disturbance of waterfowl hunted by Aboriginal peoples, requiring Aboriginal peoples to change their hunting practices.	• Reducing noise (e.g., helicopter and all-terrain vehicle travel) on certain parts of the land during waterfowl hunting seasons.
Construction of a hydro-electric dam.	• Loss of access to an Aboriginal fishery.	• Developing a fish habitat compensation plan for Aboriginal fisheries that includes: fish passage restoration, enhancement of tributaries through barrier removal, riparian planting and upgrading of a hatchery.
Destruction of land.	• Loss of forage areas compromises ability to raise domesticated animals for food (livestock) and travel (horses).	• Restore the designated project site in such a way as to re-establish forage areas.
Increased marine traffic.	• Disruption of traditional navigation routes used for recreation, travel to other communities and marine harvesting.	• Adjust the timing, speed and routing of marine traffic to minimize disturbance to Aboriginal peoples.

The methodologies and methods used to predict environmental effects must be clearly described. With this information, reviewers will be able to examine the analysis and the rationale supporting the conclusions reached. Any assumptions or conclusions based on professional judgment should be clearly identified and described.

The assessment of cumulative effects on the current use of lands and resources for traditional purposes must consider how other physical activities act cumulatively to affect an Aboriginal group's ability to use the lands and resources for various purposes such as fishing, hunting and trapping, and spiritual and cultural practices.

Step 3: Mitigation

Technically and economically feasible measures that would mitigate any significant adverse environmental effects must be identified. Mitigation of environmental effects can take two forms:

- Elimination, reduction or control of a designated project's environmental effects is preferred.
- Where this is not possible, restitution for any damage to the environment caused by the environmental effects should be considered (e.g., replacement, restoration, compensation).

Consultations and ATK can help inform the appropriate and desired measures to avoid or mitigate the adverse environmental effects.

Table 2 presents examples of measures that may be used to mitigate the effects of any changes to the environment on the current use of lands and resources for traditional purposes.

The views of affected Aboriginal groups on mitigation should be considered and included in the EIS. This could assist in ensuring that the environmental effects on the current use of land and resources for traditional purposes are at an acceptable level for the community.

Engaging Aboriginal groups is particularly important when practitioners are considering alternate sites as a form of mitigation. Aboriginal peoples have strong connections to specific lands, and therefore, even if similar lands and resources are located in a nearby region, their practices may not be adaptable or readily reproduced elsewhere.

Information on past, existing and future physical activities may help identify appropriate mitigation measures for the current use of lands and resources for traditional purposes.

Step 4: Significance

An EA must consider the significance of any adverse environmental effects that are likely to result from a designated project after taking into account the implementation of any mitigation measures, including a consideration of the level of effectiveness of mitigation measures and any uncertainties associated with them.

Significance predictions in relation to the effects of any changes to the environment on the current use of lands and resources for traditional purposes should be clearly presented and rationalized against defined criteria consistent with the Agency's Operational Policy Statement *Determining Whether a Designated Project is Likely to Cause Significant Adverse*

Environmental Effects under the Canadian Environmental Assessment Act, 2012 (November 2015), or any future updates made to this document.

As shown in table 3, there are various considerations in the determination of the significance of potential adverse environmental effects on the current use of lands and resources for traditional purposes.

Table 3: Examples of considerations in determining significance for the current use of lands and resources for traditional purposes.

Criteria	Consideration
Magnitude	What is the amount of change in a measurable parameter relative to baseline conditions or to other targets? • What proportion of an Aboriginal group's harvest will be affected if a flock of Canada geese migratory pattern is altered or relocate due to designated project activities?
Geographic extent	What is the spatial area over which the environmental effect occurs? • Will water pollutants only affect Aboriginal fishing sites proximal to the designated project area or will they affect sites further downstream?
Timing, Frequency and Duration	When does the effect occur? How often will the effect occur? Will these occurrences be short or long term? • Will project-related noise disturb caribou herds so that hunting by Aboriginal peoples is affected throughout the lifecycle of the designated project? Does the noise cause caribou to move from the area consistently or persistently? Or does the noise occur rarely so that caribou hunting is only affected once in a while?
Reversibility	Will the VC recover from the effect? • Are effects temporary, such as the loss of access during construction and operation to a plant gathering site (reversible) or permanent, such as the destruction of a culturally modified tree (irreversible)?

The context within which environmental effects occur should be taken into account when considering criteria in relation to the current of lands and resources for traditional purposes, as it may help better characterize whether adverse effects are significant.

Other criteria may also be considered provided that they are described and a rationale for their use is documented. The extent to which an individual criterion will influence the determination of significance will vary depending on the VC under consideration, the nature of the project and its potential environmental effects, as well as the context.

As each Aboriginal group is unique, the circumstances which may cause a significant effect on the current use of lands and resources for traditional purposes should be examined on a case-by-case basis.

Example: A wildlife species may be a steady part of one Aboriginal group's diet, while for another Aboriginal group it is used far less frequently for ceremonial purposes.

Approaches and suggestions made by Aboriginal peoples concerning how the significance of environmental effects may be determined should be considered. In addition, early discussion about significance can assist in considering potential benchmarks for significance.

Determination of significance should consider project-specific environmental effects and cumulative environmental effects. Residual effects from past, present, and future physical activities, when assessed individually, can be seen as minimal. However, when assessed together, the incremental effects may be significant. Therefore, a determination of significance should assess how the practices and uses of the lands and resources have been and will be affected cumulatively.

Step 5: Follow-up

The objectives of a follow-up program are to verify the accuracy of the EA and determine the effectiveness of any mitigation measures that have been implemented.

The results of a follow-up program can help determine the need for adaptive management to respond to unforeseen adverse effects or to change existing measures if necessary.

The design of a follow-up program should identify the current use of lands and resources for traditional purposes of concern and specific indicators that will be used to measure whether the actual environmental effects resulting from the designated project occur as predicted in the EA and that mitigation measures are effective.

Examples: Indicators could include camp usage; wildlife presence or migration patterns, usage of hunting and navigation routes; hunting, trapping and fishing capture rates, and quantity of land and/or resources available for use for hunting, fishing or gathering.

Indicators can also be useful for planning follow-up programs for the assessment of cumulative effects.

Follow-up programs present an opportunity to make best use of the participation of Aboriginal groups on the affected territory during the implementation of the program.

To help determine the follow-up program, additional guidance is available through the Operational Policy Statement published by the Agency on *Follow-up Programs under the Canadian Environmental Assessment Act* (December 2011), or any future updates to this document.

Canadian Environmental Assessment Agency
Agence canadienne d'évaluation environnementale

Operational Policy Statement

Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under the *Canadian Environmental Assessment Act, 2012*

November 2015

Canada

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Document Information

Disclaimer

This Operational Policy Statement (OPS) is for information purposes only. It is not a substitute for the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) or its regulations. In the event of an inconsistency between this OPS and CEAA 2012 or its regulations, CEAA 2012 or its regulations would prevail.

For the most up-to-date versions of CEAA 2012 and regulations, please consult the Department of Justice website.

Updates

This document may be reviewed and updated periodically. To ensure that you have the most up-to-date version, please consult the Policy and Guidance page of the Canadian Environmental Assessment Agency's website.

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User Feedback

If you have used or consulted the *Operational Policy Statement: Determining Whether a Project is Likely to Significant Adverse Environmental Effects under the Canadian Environmental Assessment Act, 2012*, we would like to hear from you.

Please submit your comments through the User Feedback webpage.

Thank you for taking the time to contribute. Your feedback is appreciated.

Table of Contents

1.0 Purpose

This document supports the implementation of *Canadian Environmental Assessment Act, 2012* (CEAA 2012) provisions related to determining whether a designated project is likely to cause significant adverse environmental effects. Specifically, it provides guidance on how to apply the provisions when the Canadian Environmental Assessment Agency (the Agency) is the responsible authority.

The document informs the preparation of Agency documents such as the Environmental Impact Statement (EIS) Guidelines and the Environmental Assessment (EA) report. It is intended to support proponents of designated projects in the preparation of an EIS, in conjunction with other Agency policy and guidance instruments. It also provides direction to Agency employees throughout the EA of a designated project in their interactions with those engaged in federal EAs, such as proponents, review panel members, federal authorities, other jurisdictions, Aboriginal groups and the public.

2.0 Application

This document is intended for use in an EA of a designated project for which the Agency is the responsible authority, including EAs by review panel.

When the National Energy Board (NEB) is the responsible authority, direction and guidance can be found in the NEB filing manual. Applicants seeking guidance on nuclear projects should refer to the Canadian Nuclear Safety Commission’s regulatory framework.

The term “project” refers to designated projects under CEAA 2012 for which the Agency is the responsible authority, and “project EA” refers to the EA of designated projects conducted under CEAA 2012 for which the Agency is the responsible authority.

Throughout the document, the term "environmental effects" refers to environmental effects as described in section 5 of CEAA 2012.

This guidance replaces the Agency’s 1994 *Reference Guide: Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects* and is for application under CEAA 2012. The 1994 reference guide will continue to apply for project EAs initiated under the former *Canadian Environmental Assessment Act* and are being completed under the transitional provisions of CEAA 2012.

3.0 Relevant Provisions of CEAA 2012

Section 5 of CEAA 2012 describes the environmental effects that must be considered in the implementation of the legislation.

Section 19 specifies the factors to be taken into account in the EA of a designated project, including the environmental effects described in section 5 and the significance of these effects. This includes cumulative environmental effects that are likely to result from the designated project in combination with other physical activities that have been or will be carried out, as well as environmental effects of accidents and malfunctions that may occur in relation to the designated project. Section 19 also requires that the EA of a designated project take into account mitigation measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects.

For projects where the Agency is the responsible authority, subsection 52(1) requires the Minister of the Environment (the Minister) to decide if, taking into account the implementation of any mitigation measures the Minister considers appropriate, the project is likely to cause significant adverse environmental effects referred to in section 5. Should the Minister decide that a project is likely to result in significant adverse environmental effects, subsection 52(2) calls for referral to the Governor in Council for a decision on whether those effects are justified in the circumstances.

As per section 54 of CEAA 2012, the Minister must issue an EA decision statement to the proponent of a designated project. The decision statement includes the decision of whether significant adverse effects are likely to occur and any conditions, established under section 53 with which the proponent must comply.

4.0 Determination of Significance under CEAA 2012

Determining whether a project is likely to cause significant adverse environmental effects (often referred to as determination of significance) is central to the practice of project EA. The determination of significance includes considering whether the predicted environmental effects are adverse, significant and likely. A proponent, the Agency or a review panel may make a determination of significance in the course of a project EA. Such determinations of significance are separate from, but may inform, the decision made by the Minister under subsection 52(1) of CEAA 2012.

When a project is predicted to have adverse environmental effects, as defined in section 5 of CEAA 2012, the EA examines whether the project is likely to cause significant adverse environmental effects after taking into account the implementation of technically and economically feasible mitigation measures.

This OPS describes how the determination of significance is nested within the environmental assessment framework (EA framework) and explains the approach recommended by the Agency for reaching a determination on significance. Guidance is also provided on information requirements, documentation needed to support the determination of significance and on roles relative to decision-making.

Environmental Assessment Framework

Environmental effects are commonly identified by comparing the current state (health, status or condition) of a Valued Component (VC) to the predicted future state of the VC with the project in place. VCs are selected to focus the assessment of section 5 environmental effects, taking into account direction provided by the Agency, or in the case of an EA by review panel, by the Agency or the Minister.

The information collected and considered for each VC (including information from Aboriginal communities and the public) is processed through the EA framework. This iterative framework consists of the following steps: scoping, analysis, mitigation, significance, and follow-up (further described in Appendix 1).

The determination of whether a project is likely to cause significant adverse environmental effects (step 4 in the EA framework) relates to the residual adverse environmental effects. A residual adverse environmental effect is an adverse environmental effect of a project that remains, or is predicted to remain, after mitigation measures have been implemented.

Significance is determined for each residual adverse environmental effect using VCs to focus information gathering on each effect.

Proponents are expected to determine whether their project is likely to cause significant adverse environmental effects in their EIS with respect to the residual adverse environmental effects. This requirement is outlined in the EIS Guidelines issued by the Agency for each project EA.

Such determinations must be made for project-specific effects and for any cumulative environmental effects. Both of these determinations, documented in the EA report or panel report, are taken into account in the decision made by the Minister under section 52 of CEAA 2012.

The determinations must take into account uncertainties. All project EAs involve some level of uncertainty, and observed results will often deviate, to some degree, from predictions made in the EA. Uncertainty could be related to a number of factors such as: project design and components, baseline environmental conditions, VC response, effectiveness of mitigation, overall scope of effects, and natural and human causes of accidental events.

The level of effort applied to the determination of significance is established on a case-by-case basis using the same factors as the overall EA, i.e.:

- the characteristics of the project;
- the potential environmental effects;
- the state (health, status or condition) of VCs that may be impacted by the environmental effects;
- the potential for mitigation and the extent to which mitigation measures may address potential environmental effects; and,
- the level of analysis required to address issues raised by Aboriginal groups or the public.

5.0 Approach

This approach is nested within the significance step of the EA framework (see Appendix 1, step 4)

The recommended approach to determining if a designated project is likely to cause significant adverse environmental effects consists of three stages:

- Stage 1: Determining whether the residual environmental effects are **adverse**;
- Stage 2: Determining whether the residual adverse environmental effects are **significant**;
- Stage 3: Determining whether the significant adverse environmental effects are **likely**.

This approach is carried out for each potential environmental effect.

Stage 1: Adverse

Only residual environmental effects that are adverse are considered in the determination of significance under CEAA 2012. Identification of these effects is the result of the scoping, analysis and mitigation steps of the EA framework (steps 1-3 in Appendix 1). The identification of residual adverse environmental effects applies to the full life cycle of the project: construction, operation, decommissioning and abandonment of the project.

An adverse environmental effect can be described in qualitative or quantitative terms. Examples of adverse environmental effects for generic VCs that may be linked to section 5 of CEAA 2012 are listed below.

Examples:

Loss of fish or fish habitat

Migratory bird mortality

Decline in the health, status, or condition of marine plants

Reductions in species diversity or abundance of marine animals

Reduction in air quality on federal lands or in another province during project operation

Loss of, or damage to, habitats, including habitat fragmentation that would affect the current use of lands and resources for traditional purposes by Aboriginal peoples

Negative impacts on human health, such as contamination of country food relied upon by Aboriginal peoples

Loss of, or damage to, physical and cultural heritage resources of Aboriginal peoples (e.g., changes to sites of cultural importance) during project construction

Loss of, or damage to, Aboriginal historical, archaeological, paleontological, or architectural resources

Stage 2: Significant

This stage involves considering if the residual adverse environmental effects identified in stage 1 are significant for each potentially affected VC.

Key criteria (further described in Appendix 2) that should be considered in this stage include:

- Magnitude;
- Geographic extent;
- Timing;
- Frequency;
- Duration; and
- Reversibility.

Other criteria may also be considered provided that they are described and a rationale for their use is documented. In the case of a proponent seeking to ensure proper documentation of such project-specific criteria, discussion with Agency staff is recommended.

The extent to which an individual criterion will influence the determination of significance will vary depending on the VC under consideration, the nature of the project and its potential environmental effects, as well as the context.

Example: A migratory bird may interact with the construction phase of a project during a short period of time every year and within a small portion of its habitat. If the interaction occurs during its breeding period and in its breeding habitat, it may be more harmful than an interaction occurring during other times of the year or in other parts of its habitat.

The ecological and social context within which potential environmental effects may occur should be taken into account when considering the key criteria above in relation to a particular VC, as the context may help better characterize whether adverse effects are significant. For example, information on the context is useful when it reveals:

- a unique characteristic of the area (e.g., proximity to park lands, ecologically critical or fragile areas, valuable heritage resources);
- unique values or customs of a community that influence the perception of an environmental effect (including cultural factors);
- a VC that is important to the functioning of an ecosystem, ecological community or community of people; or
- a VC for which a target has been established.

Activities over the life-cycle of the project should be considered. For example planned decommissioning activities may influence the criteria. As well, it is important to note that the environmental effects may extend beyond the period of physical interaction between the project activity and VC.

Stage 3: Likely

The determination of likelihood is based on consideration of probability and uncertainty, and is considered only when it is established through stage 2 that one or more predicted residual adverse effects are significant.

The probability of an environmental effect occurring may be based on knowledge and experience with similar past environmental effects. The full life cycle of a project, including its various stages and lifespan, should also be considered in determining the probability of occurrence of an effect.

6.0 Implementation Guidance

The following guidance is provided to assist in clarifying information requirements, documentation, and how the determination of significance informs decision-making.

Information requirements

The Agency issues EIS Guidelines to proponents specifying the nature, scope and extent of the information and analysis required for the preparation of the EIS. In an EA by review panel, the Minister determines the scope of the factors to be taken into account. The Agency, Minister or review panel may also issue information requests to a proponent seeking additional clarification, the collection of information, and the undertaking of studies, if necessary.

Community knowledge and Aboriginal traditional knowledge can contribute to the determination of significance. The public and Aboriginal groups can provide information, offer a different interpretation of the facts or question the conclusions put forward during an EA process.

EA practitioners should use qualitative or quantitative information in determining the confidence level associated with a prediction that supports the determination of significance, e.g. the range within which a predicted value lies within a stated degree of probability.

Documentation

Practitioners are expected to develop clear descriptions of what would be considered a significant adverse environmental effect on a VC. The determination of significance should be presented in a rational, defensible way, and the reasons for the determination should be clearly documented, including the following:

- A residual environmental effect should take into account the predicted effectiveness of proposed mitigation measures and any uncertainties associated with these measures.
- Practitioners should submit analysis of each of the key criteria presented in Appendix 2, as well as any other criteria used in the determination of significance. A rationale must be presented if a particular criterion is deemed not relevant.
- The analysis of likelihood of the significant adverse environmental effects should provide sufficient detail, to substantiate how conclusions were reached.
- The degree of scientific uncertainty related to the data and methods used within the framework of the environmental analysis should be described.

Decision-making: Roles and Responsibilities

The proponent is responsible for providing the necessary information to assess significance and to provide conclusions on determination of significance. This is done through the EIS, as well as subsequent responses to information requirements, where applicable.

The Agency or review panel examines the proponent's information and conclusions on determination of significance, as well as other perspectives on significance received during the EA process. The Agency or review panel then outlines its rationale and conclusions on determination of significance in the EA report or the panel report. These conclusions may align with, or may differ from, those presented by the proponent.

The EA report or panel report is considered by the Minister in making the decision under subsection 52 (1) of CEAA 2012.

Appendix 1: Environmental Assessment Framework

Step 1: Scoping

Identification of the initial focus of an environmental assessment including: the identification of VCs, potential environmental effects, and spatial and temporal boundaries; and the examination of other physical activities that may contribute to cumulative environmental effects.

Step 2: Analysis

Data collection or generation through means such as surveys, literature reviews, on-site testing, community knowledge and Aboriginal traditional knowledge, and a clear description of methods used to predict environmental effects.

Step 3: Mitigation

Identification of technically and economically feasible measures to mitigate any significant adverse effects by reduction, elimination or control or, when these forms of mitigation are not possible, restitution measures such as replacement, restoration or compensation.

Step 4: Significance

Development of conclusions about whether a project is likely to result in significant adverse effects, taking into account the implementation of any mitigation measures.

Step 5: Follow-up

Development of a program to verify the accuracy of the EA of a designated project and/or the effectiveness of mitigation measures.

Appendix 2: Key Criteria for Determination of Significance

As outlined in stage 2 of the approach for determining significance, in addition to the criteria outlined below, EA practitioners should also consider the ecological and social context within which the potential residual adverse environmental effect may occur, in determining significance.

Magnitude

Magnitude refers to the amount of change in a measurable parameter relative to baseline conditions or other standards, guidelines or objectives (e.g., proportion of species habitat affected, number of lost hunting days).

The magnitude of an environmental effect should be expressed in measureable or quantifiable terms, whenever possible. There may be multiple measureable parameters relevant to a VC. When using quantitative or qualitative descriptions of magnitude, clear definitions of terms should be provided. The definition of these terms may vary according to the VC under consideration. For example, if using categories such as “low”, “moderate” or “high” each category should be clearly defined, and the rationale for identifying an environmental effect as being a low, moderate or high magnitude should be clearly documented.

Some considerations that may influence the evaluation of the magnitude of an effect include:

- natural variability, normal fluctuations, or shifts in baseline conditions;
- scale at which magnitude is considered (for example, the percentage of a population affected may represent 80% at a local level and 5% at the regional level);
- resiliency of the VC and surrounding area to change (for example, considering whether especially vulnerable segments of the VC are affected); and
- whether the VC has already been adversely affected by other physical activities or natural change.

Geographic extent

Geographic extent refers to the spatial area over which the environmental effect is predicted to occur. Typical qualitative scales for characterizing geographic extent include site specific, local, regional, provincial, national or global. Prediction of the geographic extent should be quantitative whenever possible (e.g. hectares of habitat change). The traditional territories of potentially affected Aboriginal groups should be considered where relevant.

Depending on the VC, it may be important to take into account the extent to which adverse environmental effects caused by the project may occur in areas far removed from it (e.g. the long-range transportation of atmospheric pollutants).

Timing

Timing considerations should be noted when it is important in the evaluation of the environmental effect (e.g. when the environmental effect could occur during breeding season, or during a period of species migration through the area). It may also be relevant to discuss variation in timing of project activities, such as reservoir level fluctuations, and how that may cause varying environmental effects.

For non-biophysical environmental effects, it is important to take into account seasonal aspects of land and resource use and whether timing is related to Aboriginal spiritual and cultural considerations.

Frequency

Frequency describes how often the environmental effect occurs within a given time period (e.g., alteration of aquatic habitat will occur twice per year).

Frequency should be described using quantitative terms where possible, such as daily, weekly or number of times per year. It may also be described qualitatively as rare, sporadic, intermittent, continuous, or regular. If using qualitative terms, these should be defined for each VC.

Duration

Duration refers to the length of time that an environmental effect is discernible (e.g. day, month, year, decade, permanent). This can refer to the amount of time required for the VC to return to baseline conditions, through mitigation or natural recovery (e.g. vegetation re-colonization, return of wildlife to an area where habitat was avoided due to disturbance).

The duration of the environmental effect may be longer than the duration of the activity that caused the environmental effect. For example, the discharge of a substance into a water body may occur only during operation of a project, but the environmental effect to aquatic biota may last beyond the operational lifespan of the project. In this example, if the discharge is continuous throughout operation and results in reduced fish populations, then the frequency of the environmental effect is continuous and the duration spans operation and post-operation up to the point where fish populations return to baseline.

Environmental effects may not occur immediately following the activity causing them, but these effects still need to be considered. For example when a new reservoir is created there will be a delay before increases in methyl mercury concentrations occur in fish. Similarly, the effect on the intergenerational transfer of knowledge in an Aboriginal community may not be observed for many years after a project disrupts a specific traditional use of the land.

Reversibility

A reversible environmental effect is one where the VC is expected to recover from the environmental effects caused by the project. This would correspond to a return to baseline conditions or other target (e.g., a population management objective, remediation target), through mitigation or natural recovery within a reasonable timescale.

Reversibility is influenced by the resilience of the VC to imposed stresses and the degree of existing stress on that VC.

Canadian Environmental Assessment Agency

Agence canadienne d'évaluation environnementale

Addressing "Purpose of" and "Alternative Means" under the *Canadian Environmental Assessment Act, 2012*

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For the most up-to-date versions of CEAA 2012 and regulations, please consult the Department of Justice website at: http://laws.justice.gc.ca/en/

Updates

This document may be reviewed and updated periodically by the Canadian Environmental Assessment Agency (the Agency). For the most up-to-date version, please consult the Policy and Guidance page of the Agency website at: www.ceaa.gc.ca

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User Feedback

If you have used or consulted the Operational Policy Statement: Addressing "Purpose of" and "Alternative Means" under the *Canadian Environmental Assessment Act, 2012*, we would like to hear from you.

Please submit your comments through the User Feedback webpage. Thank you for taking the time to contribute. Your feedback is appreciated

Table of Contents

Purpose

The Operational Policy Statement (OPS) aims to ensure that the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) requirements related to the purpose of a designated project and alternative means of carrying out the designated project are met in all environmental assessments (EAs) for which the Canadian Environmental Assessment Agency (the Agency) is the responsible authority.

The OPS sets out the general requirements and approach to address the purpose of a designated project and alternative means of carrying out the designated project under CEAA 2012 when the Agency is the responsible authority.

The OPS informs the preparation of directives by the Agency, such as the Environmental Impact Statement (EIS) Guidelines. The OPS serves as core guidance to project proponents. It provides direction to Agency employees in their interactions with those engaged in federal EA, such as proponents, federal authorities, other jurisdictions, Aboriginal groups and the public, throughout the EA of a designated project.

Application

In the OPS, "project EA" means the EA of a designated project under CEAA 2012. Throughout the OPS, the term "environmental effects" refers to environmental effects as described in section 5 of CEAA 2012.

The OPS should be used to inform the preparation of the EIS Guidelines and EIS for a designated project. It should be used in conjunction with other Agency policy and guidance instruments.

For application under CEAA 2012, this OPS replaces the Agency's OPS entitled, *Addressing "Need for", "Purpose of", "Alternatives to" and "Alternative Means" under the Canadian Environmental Assessment Act*, which had been updated in 2007.

The 2007 OPS will continue to apply for project EAs initiated under the *Canadian Environmental Assessment Act* that are being completed pursuant to the transitional provisions of CEAA 2012.

Relevant Provisions of CEAA 2012

CEAA 2012 aims to protect components of the environment that are within federal legislative authority from significant adverse environmental effects caused by a designated project. In addition, CEAA 2012 ensures that a designated project is considered in a careful and precautionary manner to avoid significant adverse environmental effects, when the exercise of a power or performance of a duty or function by a federal authority under any Act of Parliament is required for the designated project to be carried out.

Section 19 of CEAA 2012 identifies factors to be considered in the EA of a designated project, including:

- the "purpose of" the designated project, as per paragraph 19(1)(f); and

- "alternative means" of carrying out the designated project, as per paragraph 19(1)(g).

With respect to the latter, alternative means considered in a project EA must be technically and economically feasible. The project EA must address the environmental effects as defined under section 5 of CEAA 2012 for each of these alternative means.

Section 5 of CEAA 2012 describes the environmental effects that must be considered in the implementation of the legislation, including changes to the environment and effects of changes to the environment. Paragraph 19(1)(a) clarifies that environmental effects include cumulative environmental effects and environmental effects of accidents and malfunctions.

A project EA must address other factors laid out in section 19 of CEAA 2012. For example, factors related to determining the significance of environmental effects, selecting mitigation measures and implementing a follow-up program are also considered for the one or many alternative means brought forward for decision making. Community knowledge and Aboriginal traditional knowledge may also be taken into account in the project EA.

Considerations in Addressing the "Purpose of" the Designated Project

The purpose of the designated project is defined as the rationale or reasons for which the designated project would be carried out from the proponent's perspective. It conveys what the proponent intends to achieve by carrying out the designated project. It is often described concisely in terms of:

- the problems that the project is intended to address (for example, resolving a supply gap);
- the opportunities that the project is designed to seize (for example, achieving growth potential);
- the manner in which the project relates or contributes to broader private or public sector policies, plans or programs (for example, contribution to an energy efficiency plan); and/or,
- any other objectives of the proponent in carrying out the project (for example, increasing the productivity of a business line).

The information regarding the purpose of the designated project should be sufficient to provide context for public and technical comment periods during the project EA, and ultimately to allow the decision maker to understand the purpose of the designated project. Should a Governor in Council decision subsequently be required, it may also help inform whether significant adverse environmental effects would be justified in the circumstances.

Considerations in Addressing "Alternative Means" of the Designated Project

"Alternative means" are the various technically and economically feasible ways under consideration by the proponent that would allow a designated project to be carried out. Identified by the proponent, the alternative means include options for locations, development and/or implementation methods, routes, designs, technologies, mitigation measures, etc. Alternative means may also relate to the construction, operation, expansion, decommissioning and abandonment of a physical work.

The alternative means should be considered by the proponent as early as possible in the planning of a designated project, even before the beginning of the EA process by a responsible authority. The Agency recognizes that projects may be in the early planning stages when project descriptions are being prepared. In many cases, proponents have not made final decisions concerning the placement of project infrastructure, the technologies to be employed or other options that may exist for various project components. In these situations, project proponents are strongly encouraged to describe the various options available, and their associated environmental effects, within the project description. This will allow the Agency to set direction in the EIS Guidelines regarding which alternative means should be addressed in the EIS, where appropriate, and will avoid unnecessary delays at a later stage of the project EA. Project proponents should contact the Agency for further guidance in this area prior to the submission of the project description.

Once an EA has commenced, the approach and level of effort applied to addressing alternative means is established on a project-by-project basis, taking into consideration:

- the characteristics of the project;
- the environmental effects associated with the potential alternative means;
- the health or status of valued components (VCs) that may be impacted by the alternative means;
- the potential for mitigation and the extent to which mitigation measures may address potential environmental effects; and,
- the level of concern expressed by Aboriginal groups or the public.

EA documentation must clearly explain and justify the methodologies that have been used to address alternative means. At any step during the alternative means analysis, the proponent may consider community knowledge and Aboriginal traditional knowledge.

Considering the alternative means of carrying out the designated project should include the four steps described below:

Step 1: Identify technically and economically feasible alternative means

To identify and describe the technically and economically feasible alternative means to carry out the designated project, the proponent should:

- *Develop criteria to determine the technical and economic feasibility of the alternative means.*

  Examples of technical criteria could include use of energy, mode of operation, performance, supporting infrastructure, schedule and risks. Examples of economic criteria could consist of a comparison of cost estimation and forecasted revenues.

- *Identify and describe the alternative means from the proponent's perspective.*

The description of the alternative means must be in sufficient detail to establish how to assess them relative to the criteria developed for determining their technical and economic feasibility, as well as to support the analysis described in Steps 2 to 4.

- *Establish which of these alternative means are technically and economically feasible.*

  A qualitative approach may be used to establish how the alternative means relates to the criteria, based on evidence and professional judgment. Thresholds or other quantitative decision-making tools may also be used, when available and relevant for specific criteria.

- *Document the rationale for the alternative means retained for consideration in the project EA.*

  The rationale must provide sufficient detail for an independent reviewer to assess the criteria developed, the nature of the alternative means considered, the approach taken to assess these alternative means against the criteria, and the alternative means retained for further analysis in Step 2.

Step 2: List their potential effects on valued components

Under CEAA 2012, identification of VCs for the project EA is made in relation to section 5 of CEAA 2012 and takes into account direction provided by the responsible authority. Analysis is then undertaken iteratively to examine which of those VCs should be considered in addressing alternative means identified in Step 1 as technically and economically feasible.

For Step 2, the proponent should:

- *Identify the key VCs potentially affected by each alternative means.*

  The end result is an understanding of what VCs should be retained for analysis given the nature of the alternative means under consideration.

- *Examine briefly the potential effects on the VCs for each alternative means.*

The intent is to relate the alternative means under consideration with their potential effects on key VCs. A full assessment of environmental effects is not necessary at this stage.

The intent is to develop a sufficient understanding of potential environmental effects of the alternative means under consideration to inform the selection of an approach in Step 3 and, subsequently, to serve in scoping the assessment of environmental effects in Step 4.

Step 3: Select the approach for the analysis of alternative means

Based on information gathered in Step 1 and Step 2, proponents are encouraged to identify a preferred means of carrying out the designated project. The preferred means then becomes the focus of the project EA, and no further analysis is generally required on other alternative means considered in Step 1 or 2.

In cases where the proponent is not able to identify a preferred means, multiple alternative means can be brought forward in the project EA. For efficiency, the proponent is then encouraged to identify a scenario that will become the focus of the analysis. The other alternatives would be the object of further analysis only in terms of how they differ from the scenario relative to potential effects on VCs.

Case A: Identifying a preferred means

To identify a preferred means among the alternative means of carrying out the designated project, the proponent should:

- determine and apply criteria to examine the environmental effects (identified in Step 2) of the technically and economically feasible alternative means (identified in Step 1). Examples of criteria are distance to a watercourse or minimization of loss of wildlife habitat.
- compare the alternative means on the basis of environmental effects, as well as technical and economic feasibility. Thresholds, governmental standards and public concerns may support the criteria used in the comparative analysis; and
- identify the preferred alternative means based on the relative consideration of environmental effects, and of technical and economic feasibility.

If a preferred means is selected, the analysis and the rationale for the choice should be explained from the perspective of the proponent, and be documented in the EIS in sufficient detail to provide context for public and technical comment periods during the project EA, and ultimately to allow the decision maker to understand the choice.

Case B: Bringing forward multiple alternative means

The proponent can bring forward in the project EA multiple alternative means that are technically and economically feasible. The proponent is then encouraged to:

- identify one scenario on which the analysis will focus; and
- describe how the other alternative means retained for further analysis differ from this scenario.

The choice of a scenario should be informed by Steps 1 and 2, as well as the consideration of whether a preferred means can be identified in Step 3. There are many ways in which such scenario can be built.

The scenario can be selected based on practical criteria such as, likelihood that it will be implemented, efficiency in the comparative analysis of alternative means, or ease of presentation in an EIS. For instance, selecting a scenario that represents the worst case of potential environmental effects would provide increased confidence that the predictions in the project EA are applicable to any of the alternative means.

Step 4: Assess the environmental effects of alternative means

In the case where a preferred means is chosen by the proponent (Step 3-a), the project EA should focus the analysis on the environmental effects of the preferred means. A concise summary documenting Steps 1 to 3 in EA documents will suffice to inform reviewers and the decision maker of other alternative means considered by the proponent.

In the case where the proponent chose to put forward multiple alternative means to carry out the designated project (Step 3-b) in the project EA, the following approach is suggested:

- conduct the analysis of the environmental effects of the scenario;
- assess the environmental effects of the other alternative means on the basis of the consequences of their deviation from the scenario;
- after consideration of mitigation measures, provide a rationale for determining the significance of the environmental effects related to the scenario and to each of the other alternatives means.

For either case, the proponent must provide sufficient information to allow the decision maker to decide whether, based on the definition of environmental effects in section 5 of CEAA 2012, the designated project is likely to cause significant adverse environmental effects after implementing mitigation measures.

The final implementation of a designated project can vary somewhat from the proposal considered during the project EA. In the case where multiple alternative means are brought forward, the proponent will be expected to carry out the designated project in a way that is consistent with the analysis (e.g. the proponent will implement one of the scenarios that was brought forward or within the bounds of the worst case scenario assessed during the EA). Similarly, when a preferred means is identified for analysis, variations during implementation are acceptable provided that they remain within the bounds of the analysis conducted. In both cases, proponents must comply with conditions established in the EA decision statement.

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Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM)

Prepared by the Canadian NORM Working Group of the Federal Provincial Territorial Radiation Protection Committee

Revised 2011

Canada

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Table of Contents

List of Tables

List of Figures

Preface

The NORM Working Group, a working group of the Federal Provincial Territorial Radiation Protection Committee, represents the interests of provincial and territorial regulators and includes affected industries in the petroleum production, fertilizer manufacturing and metal recycling industry sectors. With the support and encouragement of Health Canada and the Canadian Nuclear Safety Commission, these *Guidelines* are the result of their efforts.

Comments or suggestions concerning the *Guidelines* should be sent to:

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Abbreviations Used in the *Guidelines*

ALARA	An acronym for "As Low As Reasonably Achievable", social and economic factors being taken into account. ALARA is a guiding principle in radiation protection, and encourages managers to reduce dose levels as much as possible, even if they are already meeting allowable levels.
ALI	Annual Limit on Intake
BEIR	(United States National Academy of Science Committee on the) Biological Effects of Ionizing Radiation
CNSC	Canadian Nuclear Safety Commission is the federal agency that licenses and regulates nuclear facilities and materials. The CNSC is the successor to the Atomic Energy Control Board (AECB).
DC	Dose Coefficient
DRL	Derived Release Limit
DWL	Derived Working Limit
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
NCRP	National Council on Radiation Protection and Measurements
NDR	National Dosimetry Registry
NORM	Naturally Occurring Radioactive Material
PTNSR	Packing and Transport of Nuclear Substances Regulations
SCO	Surface Contaminated Object
TDGR	Transportation of Dangerous Goods Regulations
TENORM	Technologically Enhanced Naturally Occurring Radioactive Material
UDRL	Unconditional Derived Release Limit
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation

Introduction

The Canadian Nuclear Safety Commission (CNSC), formerly the Atomic Energy Control Board (AECB), has legislative control of nuclear fuel cycle materials and man-made radionuclides. However, naturally occurring radioactive material (NORM) is exempt from CNSC jurisdiction except for the import, export and transport of the material. Therefore, jurisdiction over use and radiation exposure to NORM rests with each Canadian province and territory.

It has been the practice for companies that encounter challenges associated with NORM to seek advice on safety procedures from provincial and territorial regulatory agencies. Such advice has been given on an *ad hoc* basis, leading to inconsistencies in the interpretation and application of radiation safety standards across Canada.

The Federal Provincial Territorial Radiation Protection Committee (FPTRPC), a Canadian intergovernmental committee established to support federal, provincial and territorial radiation protection agencies in carrying out their respective mandates, recognizes that the potential radiation hazards from NORM are the same as those from radioactive materials controlled by the CNSC. The basic principle of these guidelines is that where workers or the public are exposed to additional sources or modes of radiation exposure because of activities involving NORM, the same radiation protection standards should be applied as for CNSC regulated activities. This applies to situations where NORM is in its natural state and to cases in which the concentration of NORM material has been increased by processing.

However, in practice there may also be situations where existing natural background radiation is significant quite apart from any activities involving the use of NORM. The issue of whether human intervention is required to reduce such natural radiation levels is quite separate from the issues discussed in these *Guidelines* and the reader is referred to ICRP 65 for a discussion of when such intervention might be warranted.

To that end, the Canadian NORM Working Group has, on behalf of the FPTRPC, produced the *Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM)*. The *Guidelines* are an extension of the work done by the Western Canadian Committee on Naturally Occurring Radioactive Materials (NORM) published in August 1995 as the *Guidelines for the Handling of Naturally Occurring Radioactive Materials (NORM) in Western Canada*. [(1)] The differences between the Canadian Guidelines and the Western Canadian Guidelines reflect changes in national and international radiation protection practices and consensus standards for NORM classification and management since 1995.

The *Canadian Guidelines* set out principles and procedures for the detection, classification, handling and material management of NORM in Canada, and also include guidance for compliance with federal transportation regulations. These *Guidelines* provide the framework for the development of more detailed NORM management practices and guidelines by regulatory authorities, affected industries and specific workplaces. A separate section outlines the basic science of radioactivity and explains the technical terms and concepts that are used throughout the *Guidelines*. There is also a glossary at the end of the document for quick reference and definition.

1 NORM as a Radiation Concern

1.1 Definition

NORM is an acronym for *naturally occurring radioactive materials*, which include radioactive elements found in the environment. Long-lived radioactive elements of interest include uranium, thorium and potassium, and any of their radioactive decay products, such as radium and radon. These elements have always been present in the earth's crust and within the tissues of all living beings.

Although the concentration of NORM in most natural substances is low, higher concentrations may arise as the result of human activities. For example, calcium scale precipitated from oil recovery brine may contain radium at much greater concentrations than the water source itself. The processing of raw materials by many resource-based industries may increase the concentration of radioactive substances in those materials, to levels at which special precautions are needed for handling, storing, transporting, and disposal of material, by-products, end-products or process equipment.

1.2 Purpose of the Canadian NORM Guidelines

As NORM is not part of the nuclear fuel cycle, it does not come under the control of the CNSC, which licenses and controls radioactive materials associated with the nuclear fuel cycle and artificially produced radionuclides. NORM-related activities therefore fall under the jurisdiction of the provinces and territories. This has led to inconsistent application of radiation protection standards with numerous agencies involved as materials cross jurisdictional boundaries. For example, transportation of a NORM material for disposal involves:

- Provincial/Territorial Health, Labour and Radiation Regulatory Agencies for worker and public exposure;
- Provincial Environmental Regulatory Agencies for disposal options;
- The CNSC for transport of radioactive material.

> **Note:** In its legislation, the CNSC uses the term Naturally Occurring Nuclear Substances instead of NORM.

Accordingly, the *Guidelines* were developed to:

- ensure adequate control of NORM encountered by affected industries;
- harmonize standards;
- reduce jurisdictional gaps or overlap.

The basic principle of the *Guidelines* is that persons exposed to NORM should be subject to the same radiation exposure standards that apply to persons exposed to CNSC-regulated radioactive materials. No distinction is made regarding the origin of the radiation, whether it is NORM in its natural state or NORM whose concentration of radioactive material has been increased by processing (Technologically Enhanced NORM or TENORM). However, because of the ubiquitous nature of NORM, in dealing with situations where natural radiation is significant the cost of any intervention must be taken into account.

A major principle in radiation dose control is that if doses can be reduced by reasonable actions, those actions should be taken. As even low doses of radiation exposure may produce harmful effects, reducing low doses of radiation may be beneficial. The goal is that doses should be *As Low As Reasonably Achievable*, economic and social factors being taken into consideration. This principle is usually referred to by the acronym ALARA.

1.3 Industries with NORM Radiation

There are industries where NORM may be present in amounts sufficient to cause significant radiation doses to workers that require the application of radiation protection practices to reduce radiation doses. Such industries include:

Mineral Extraction and Processing: NORM may be released or concentrated in a process stream during the processing of ore, such as in the phosphate fertilizer industry and the abrasives and refractory industries.

Oil and Gas Production: NORM may be found in the liquids and gases from hydrocarbon- bearing geological formations.

Metal Recycling: NORM-contaminated materials can be redistributed to other industries resulting in the formation of new NORM-contaminated products.

Forest Products and Thermal-Electric Production: mineral ashes left from combustion may concentrate small amounts of NORM present naturally in plant materials and in coal.

Water Treatment Facilities: fresh or waste water is treated through sorptive media or ion-exchange resins to remove minerals and other impurities from the water being treated and may release radon (geothermal sources, fish hatcheries).

Tunnelling and Underground Workings: in areas where small amounts of indigenous radioactive minerals or gases may be present, such as in underground caverns, electrical vaults, tunnels, or sewer systems.

1.4 Description and Sources of NORM

1.4.1 Background Radiation

Life on earth has always been exposed to natural radiation from the environment, also referred to as background radiation. The main sources of this radiation are cosmic radiation from the sun and outer space, and terrestrial radiation from radioactive elements in the earth's crust. A common example of terrestrial radiation source is radon gas, which comes from uranium in the soil and can accumulate in buildings.

1.4.2 Radionuclides and Ionizing Radiation

Chemical elements are characterized by the number of protons in the nucleus of their atoms. Atoms also contain other "sub-atomic particles" such as neutrons and electrons. The number of protons in the atoms of a given element is constant, but the number of neutrons can differ. Atoms of an element that have different numbers of neutrons are called isotopes of that element, though they all behave chemically the same way. Isotopes of an element are referred to by the name of the element followed by the number of the isotope's nucleons (protons + neutrons). Uranium, for example, always has 92 protons, but it has a number of isotopes identified by the number of their nucleons, such as uranium-235 and uranium-238.

Most common isotopes of chemical elements are stable; that is, the balance of protons and neutrons in the nucleus of their atoms never changes. In isotopes of some elements, however, the balance of protons and neutrons in the atom makes the atom unstable, so it ejects one or more particles and excess energy from the nucleus to become more stable. This process is called nuclear disintegration. The particles or high-energy rays are called "ionizing radiation" because they ionize, or change the physical and chemical structure of, other atoms of matter they pass through. Elements that emit ionizing radiation are called radioactive; in some cases, one or more isotopes of an element are radioactive, and are called radioisotopes, or radionuclides.

1.4.3 Half-Life and the Radioactive Decay Series

A radionuclide can be identified by the characteristics of the radiation it emits. These characteristics include the decay rate, or half-life of the radionuclide, and the type and energy of radiation emitted.

The rate at which particles are emitted is expressed by the half-life of the radionuclide. The half-life is the length of time it takes for half of a substance's atoms to 'decay' to a more stable form, or to reduce the radioactivity by half. The half-life can be as short as a fraction of a second or as long as billions of years. As a radionuclide decays, it becomes an isotope of another element. If this new isotope is also radioactive it decays further. Thus there can develop a "decay series." The two most common NORM decay series are the uranium-238 and the thorium-232 series. Figure 1.1 lists the radioisotopes associated with the uranium and thorium radioactive decay series and potassium, and also gives the chemical symbol for each element and isotope.

Table 1.1
Chemical Symbols and Important Characteristics of the U-238, Th-232 Radioactive Decay Series and K-40

Uranium 238 Series

NORM Nuclide	Symbol	Half-life	Major Emissions
Uranium 238	^{238}U	$4.5x10^{9}$ y	α
Thorium 234	^{234}Th	24.0 d	β, γ
Protactinium 234m	^{234m}Pa	1.2 m	β, γ
Uranium 234	^{234}U	$2.5x10^{5}$ y	α, γ
Thorium 230	^{230}Th	$7.7x10^{4}$ y	α, γ
Radium 226	^{226}Ra	$1.6x10^{3}$ y	α, γ
Radon 222	^{222}Rn	3.83 d	α
Polonium 218	^{218}Po	3.1 m	α
Lead 214	^{214}Pb	27 m	β, γ
Bismuth 214	^{214}Bi	20 m	β, γ
Polonium 214	^{214}Po	$1.6x10^{-4}$ s	α, γ
Lead 210	^{210}Pb	22.3 y	β, γ
Bismuth 210	^{210}Bi	5.01 d	β
Polonium 210	^{210}Po	138 d	α
Lead 206	**^{206}Pb**	**stable**	**none**

Thorium 232 Series

NORM Nuclide	Symbol	Half-Life	Major Emissions
Thorium 232	^{232}Th	$1.4x10^{10}$ y	α
Radium 228	^{228}Ra	5.7 y	β
Actinium 228	^{228}Ac	6.1 h	β, γ
Thorium 228	^{228}Th	1.9 y	α, γ
Radium 224	^{224}Ra	3.7 d	α, γ
Radon 220	^{220}Rn	55.6 s	α
Polonium 216	^{216}Po	0.15 s	α
Lead 212	^{212}Pb	10.6 h	β, γ

Bismuth 212	^{212}Bi	61 m	α, β, γ
Polonium 212 (65%)	^{212}Po	$3x10^{-7}$ s	α
Thallium 208 (35%)	^{208}Tl	3.1 m	β, γ
Lead 208	**^{208}Pb**	**stable**	**none**
		Potassium -40	
Potassium 40	^{40}K	$1.3x\ 10^9$ y	β, γ

Key:

Example: **Bismuth 212** **^{212}Bi** **61 m** **α, β, γ**

212: Mass number for Bismuth 212

Bi: Chemical symbol for Bismuth

61 m: Radioactive half-life of 61 minutes
(y = years; d = days; h = hours;
m = minutes; s = seconds)

α: Alpha decay (emission)
β: Beta decay (emission)
γ: Gamma (emission)

1.4.4 Radioactive Equilibrium

The final member of a decay series is stable. The first member (the "parent radionuclide") is almost always very long-lived - it has a long half-life. When all the members of a decay series (the parent radionuclide and its "progeny") are "in equilibrium" they all decay at the same rate - the rate at which each in turn is being produced - and every radioactive element or radioactive progeny in the series has the same amount of radioactivity. If such radioactive material is processed chemically or otherwise disturbed, the equilibrium is disrupted.

1.4.5 Types of Radiation

There are three basic types of radiation that may be emitted by NORM:

- **alpha** (α) radiation is made up of heavy, charged particles that cannot penetrate very far, even in air. They can be stopped by a piece of paper.
- **beta** (β) radiation consists of lighter charged particles than alpha particles, that travel faster and are thus more penetrating than alpha radiation. Beta radiation can be stopped by a few centimetres of plywood.

- **gamma** (γ) radiation consists of high-energy rays, and is very penetrating. It can be stopped by a metre of concrete or several metres of water.

1.5 Fundamental Radiation Protection Quantities

There are two fundamental quantities:

Becquerel (= Activity). The becquerel (Bq) measures the quantity of radioactivity present without consideration for what kind of radiation is emitted. 1 Bq = 1 nuclear transformation (disintegration) per second.

Sievert: Effective Dose (= Biological Effect). Different types of radiation have different penetrating power, and different parts of the body have different sensitivities to radiation. Dose assessment therefore requires knowledge of the type and amount of radiation and the biological sensitivity of the body part exposed. The sievert (Sv) is the unit of Effective Dose of radiation, and accounts for the total effect of different types of radiation on different parts of the body. Most occupational doses are in the millisievert range, or mSv. Regulations express the dose on a yearly basis, as millisieverts per annum or mSv/a.

An individual may receive an “internal” exposure to a radioactive substance, by inhaling radioactive gas or particles suspended in the air, or by ingesting radioactive dust. The material may remain in the body for some time after the intake, giving a dose. The life-time dose that will be received from an internal exposure is the “committed dose,” also expressed in sieverts.

1.6 Background Radiation Dose summary

Figure 1.2 is a pie chart showing the size in percent of each component of the background radiation dose received by the average Canadian.[(2)] Sources of natural radiation can be classified into three groups: the dose that comes from direct cosmic radiation that arrives at the earth’s surface from the sun and outer space; the dose from environmental radiation, which comes from the natural radioactivity at the earth’s surface; and internal radiation.

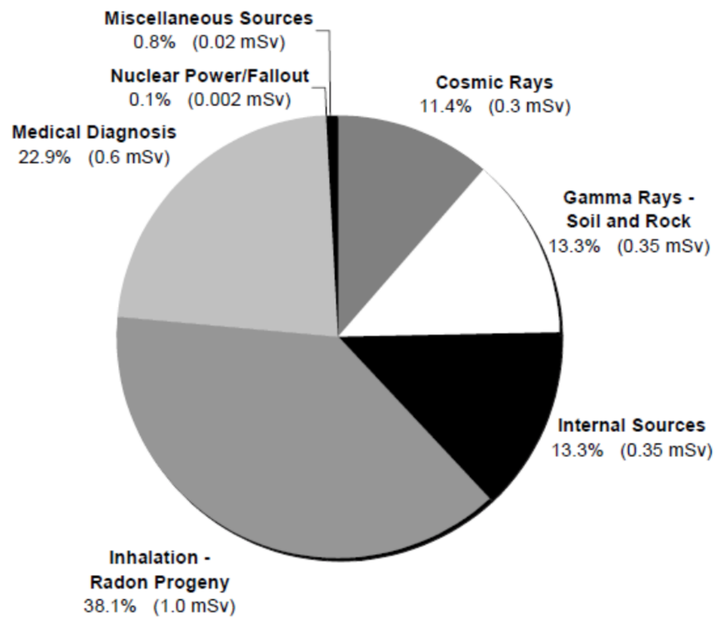
Cosmic radiation varies with elevation above sea level, but contributes about 0.3 mSv/a over most of Canada.

The range of gamma dose rates from naturally occurring radionuclides in the uranium and thorium series, and potassium-40 present in typical soil is:

0.045 - 0.09 mSv/a for the uranium-238 series;
0.09 - 0.15 mSv/a for the thorium-232 series;
0.09 - 0.15 mSv/a from potassium-40.

The typical dose rate from the two series and potassium-40 is 0.35 mSv/a.

Figure 1.1
Average Annual Radiation Dose to Canadians
(Average Total Dose of 2.62 mSv per year)



Source: Canada; Living with Radiation, AECB, 1995.

There is an average internal dose of about 1.0 mSv from the inhalation of radon progeny; but the dose varies greatly with the geological composition of the environment. For example, the average dose from radon progeny in Vancouver is 0.2 mSv/a, but in Winnipeg it is 2.2 mSv/a.

Another source of internal radiation is from a radioactive isotope of potassium: muscle tissue contains potassium, of which 0.0118 % is potassium-40, a natural gamma and beta ray emitter which contributes about 0.35 mSv per year.

In total, a Canadian may receive a range of annual doses from background radiation from 1.2 mSv/a to 3.2 mSv/a based on geographical location. The average Canadian receives a typical annual dose of approximately 2.0 mSv from background radiation.

Clearly, as radiation doses from NORM cannot be prevented, the question is: **At what incremental dose should we begin to apply radiation protection practices to NORM?** The *Guidelines* have been developed to help answer this question.

2 The NORM Standards — Basis and Criteria

2.1 Uniformity of Protection

The basic principle of these guidelines is that the same radiation exposure criteria should be applied where workers or the public are exposed to new sources or modes of radiation from activities involving NORM, as for radiation exposure from CNSC regulated activities. This applies to cases where NORM is in its natural state and to cases in which the concentration of NORM material has been increased by processing.

2.2 Guideline Basis

The *Guidelines* are based on the most recent international standards recommended by the International Commission on Radiological Protection (ICRP) and CNSC regulations. The recommendations of the ICRP represent international consensus on radiation protection standards and provide the basis for regulatory control of radioactive materials in virtually all countries of the world. As these regulations and standards are subject to periodic amendment, the *Guidelines* may also be updated to reflect amendments to accepted national and international radiation protection practices. The ICRP and International Atomic Energy Agency (IAEA) radiation protection philosophy and recommendations of significance for NORM in Canada are contained in ICRP reports 60[(3)], 65[(4)], 68[(5)], 72[(6)] and 77[(7)] and IAEA Safety Series 115[(8)].

2.3 The Acceptability of Occupational Risks in Industry

The ICRP reviews estimates of radiation risk from every available source, particularly the work of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the United States National Academy of Science Committee on the Biological Effects of Ionizing Radiation (BEIR). The reports of the ICRP go further than these sources, in that the ICRP recommends permissible exposures for workers while the other bodies merely estimate the risks associated with radiation exposure.

The ICRP believes that any exposure to ionizing radiation may be potentially harmful to health, and advocates three fundamental principles for managing radiation exposures:

- **Justification** — No activity involving ionizing radiation for any purpose can be justified unless it is possible to demonstrate that it will lead to a positive net benefit.

- **Optimization** — All exposures shall be kept as low as reasonably achievable, economic and social factors being taken into consideration (the ALARA principle).

- **Limitation** — The maximum acceptable occupational exposure of any individual must not involve a radiation risk to that individual greater than the risk that arises in working in what is generally regarded as a "safe" industry.

The ICRP recognizes that everyone is subject to a significant background radiation exposure. However, even smaller-than-background doses from occupational practices are unjustifiable if there is no associated benefit, or they can be readily avoided.

2.4 Recommended Radiation Dose Limits

It is the recommendation of the FPTRPC that the annual incremental effective dose to persons exposed to NORM as the result of a work practice be limited to the values given in Table 2.1.

These dose limits are the foundation for all other radiation protection program recommendations contained in the *Guidelines*; are harmonized with the radiation dose limits recommended by the CNSC for nuclear fuel cycle; and incorporate the recommendations of ICRP Publication 103[(17)].

2.4.1 Incremental Dose

Dose limits in this document are defined in terms of incremental dose, which is the dose resulting from the work practice in question. The natural background radiation, with the exception of radon (see section 4.2), is excluded from the dose limitations. Radiation dose arising from the application of medical procedures is also excluded from the dose limitations.

2.4.2 Effective Dose

The ICRP defines the effective dose as the sum of all tissue equivalent doses multiplied by the appropriate tissue weighting factors associated with each respective tissue. The effective dose accumulated over a given period includes:

a. the effective dose from external sources, and
b. the committed effective dose from intakes of radionuclides in that period.

Table 2.1
Radiation Dose Limits

Affected Group	**Annual Effective Dose Limit** (mSv)[(a)]	**Five Year Cumulative Dose Limit** (mSv)
Occupationally Exposed Workers[(b)]	20[(c)]	100
Incidentally Exposed Workers and Members of the Public	1	5

Notes:

(a) These limits are exclusive of natural background and medical exposures. Refer to Appendix D for guidance on dose limit calculations.

(b) For the balance of a known pregnancy, the effective dose to an occupationally exposed worker must be limited to 4 mSv as stipulated in the “Radiation Protection Regulations”, Canadian Nuclear Safety Act. This limit may differ from corresponding dose limits specified in current provincial legislation applicable for exposure to sources of x-rays.

(c) For occupationally exposed workers, a maximum dose of 50 mSv in one year is allowed, provided that the total effective dose of 100 mSv over a five-year period is maintained. This translates into an average limit of 20 mSv/a.

Occupationally Exposed Workers are employees who are exposed to NORM sources of radiation as a result of their regular duties. They are classified as NORM Workers working in an occupational exposure environment, and their average annual effective dose should not exceed 20 mSv (see Table 2.1 note c, for exception).

Incidentally Exposed Workers are employees whose regular duties do not include exposure to NORM sources of radiation. They are considered as members of the public who work in an occupational exposure environment and, as such, the annual effective dose limit for these workers is 1 mSv.

Members of the Public are persons who have no occupational exposure to NORM. The annual effective dose limit for members of the public is 1 mSv. For the control of public exposure an appropriate value for the dose constraint is 0.3 mSv in a year.

2.4.3 Dose Constraint

A dose constraint is an upper bound on the annual dose that members of the public or incidentally exposed workers should receive from the planned operation of any source. To ensure that the public and incidentally exposed workers do not exceed the annual dose limit of 1 mSv, the ICRP[(17)] and the IAEA[(8)] suggest the use of a dose constraint. The dose constraint would allow for exposures from other sources without the annual limit being exceeded. The retrospective finding that a dose constraint, as opposed to a dose limit, has been exceeded does not imply a failure to comply with the recommendations of the guidelines. Rather it should call for a reassessment of the effectiveness of the program.

ICRP[(17)] suggests that for the control of public exposure an appropriate value for the dose constraint is 0.3 mSv in a year. In keeping with this suggestion the Canadian NORM guidelines have adopted 0.3 mSv/a as its first investigation level. Tables 5.1 and 5.2 list the amounts of radioactive materials that if released to the environment without further controls will not cause doses in excess of 0.3 mSv/a.

3 Development of a NORM Management Program

3.1 The NORM Program Classifications

The NORM program classifications summarize the requirements for managing NORM. The worksite classification is set by the maximum annual dose received by both members of the public and workers at the worksite (Figure 3.1). The classification of an individual NORM source is set by the annual dose that may be received by a member of the public from exposure to the shipment or disposal practice.

Estimates should be made of the effective dose to workers and the public resulting from the following exposure pathways:

- External gamma exposure.
- Ingestion of NORM-containing materials.
- Inhalation of NORM-containing dust.
- Inhalation of radon gas and its radioactive decay products.

The highest individual dose determines the NORM Management classification. Guidance on effective dose calculations can be found in Appendix D.

It is strongly recommended that a person knowledgeable in radiation protection conduct the worksite radiological evaluation. A list of radiation protection consultants can be obtained from the appropriate provincial or territorial government contact. A list of government contacts can be found in Appendix B.

3.2 NORM Classification/Thresholds

3.2.1 Investigation Threshold

An incremental dose of 0.3 mSv/a, the dose constraint value set in section 2.4.3, is adopted as the NORM Investigation Threshold. Where doses to workers or members of the public may exceed this value, a site-specific assessment should be carried out.

3.2.2 NORM Management Threshold

An assessed incremental dose to the public or workers of greater than 0.3 mSv/a, the dose constraint value set in section 2.4.3 and the Investigation Threshold, is adopted as the NORM Management Threshold.

3.2.3 Dose Management Threshold

An assessed incremental dose of 1 mSv/a to a worker is adopted as the Dose Management Threshold.

3.2.4 Radiation Protection Management Threshold

An assessed or measured incremental worker dose of 5 mSv/a is adopted as the Radiation Protection Management Threshold.

3.3 Introduction of a NORM Program

The steps to determine the type of NORM Management program at a workplace are given below. Figure 3.1 summarizes the process in a flow-chart.

3.3.1 Initial Review

If a workplace falls in one of the NORM-prone industries noted in Section 1.3:

- stores, handles or disposes of materials containing amounts of natural radioactive substances in excess of amounts in Tables 5.1 for diffuse NORM or 5.2 for discrete NORM; or

- has suspected incremental effective dose rates in excess of 0.3 mSv/a;

the NORM Investigation Threshold may be exceeded. A dose assessment should be carried out.

3.3.2 Radiation Dose Assessment

Estimate doses to members of the public, and workers by conducting a radiation survey of the workplace/worksite. The survey should include evaluations of both gamma dose-rates and airborne radioactivity as required.

Workers with estimated doses in excess of 1 mSv/a are classified as occupationally exposed workers.

Estimate doses to members of the public from feedstock, product and waste transport, storage and disposal. Radiochemical analysis of feed stock, products and waste materials may be needed.

3.3.3 Evaluation and Program Classification

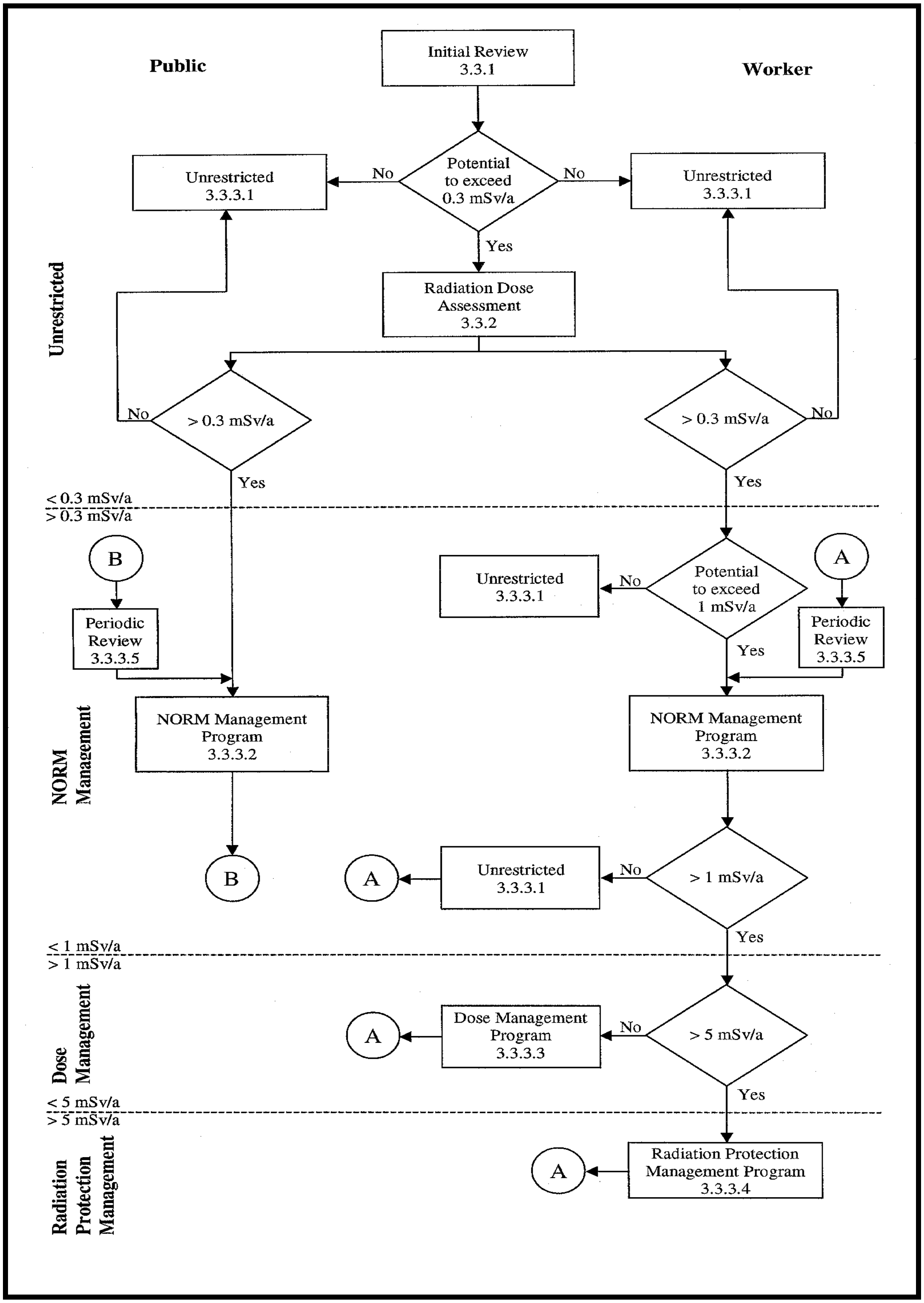
3.3.3.1 Unrestricted Classification

Where the estimated incremental annual effective dose to the public is less than 0.3 mSv/a and to the worker is less than 1.0 mSv/a, the NORM program classification is ***Unrestricted***. No further action is needed to control doses or materials.

3.3.3.2 NORM Management Classification

Where the estimated incremental annual effective dose to members of the public or incidental workers is greater than the investigation threshold of 0.3 mSv/a, the NORM classification is ***NORM Management***. Public access would need to be restricted. However, worker access would be unrestricted. Depending on the circumstances and the source of the dose, the NORM Management Program may include:

Figure 3.1
NORM Classification Flowchart



- Introduction of incidentally exposed worker access restrictions.
- Introduction of shipping and/or material management.
- Changes in work practices.

Where the work site, feed and waste materials are subject to change, the work site, feed and waste material should be reviewed periodically to verify that conditions have not changed.

3.3.3.3 Dose Management

Where the estimated incremental annual effective dose to an occupationally exposed worker is greater than the dose management threshold of 1 mSv/a, the NORM classification is ***Dose Management***.

The program should include:

- Worker notification of radiation sources.
- Consideration of work procedures and protective clothing to limit worker dose from NORM.
- Application of engineering controls where appropriate (see 4.3.3).
- Training to control and reduce worker dose.
- Introduction of a worker radiation dose estimate program. Doses may be estimated from the dose rate in each working area and the time spent in each area or by personal monitoring.
- Reporting of worker doses to the National Dose Registry (NDR) through the dosimetry service provider (see address in Appendix B).

Assess the work site periodically to measure changes in conditions and to facilitate worker dose calculations.

3.3.3.4 Radiation Protection Management

Estimated Annual Effective Dose
Where the estimated annual effective dose to an occupationally exposed worker is greater than 5 mSv/a, the NORM classification is ***Radiation Protection Management***. In addition to the requirements of the Dose Management Program, the following should be included:

- Introduce a formal radiation protection program as described in Appendix F. This program is similar to the formal program required by the CNSC for nuclear energy workers exceeding 5 mSv/a.

- Place those workers estimated to exceed 5 mSv/a in a personal radiation dosimetry program meeting the requirements of S-106 revision 1, Technical and Quality Assurance Requirements for Dosimetry Services. [9]

- Provide protective equipment, clothing and work procedures to reduce worker dose and the spread of contamination.

Measured Annual Effective Dose

Where the measured annual effective dose reported by a personal radiation dosimetry program is greater than 5 mSv/a, the NORM classification is ***Radiation Protection Management***. The program should include the following additional steps:

- Use engineering controls and provide protective equipment designed to reduce worker dose as required.

- Ensure that workers do not exceed the five-year average occupational dose limit of 20 mSv/a.

Assess the work site periodically to measure changes in conditions and to facilitate worker dose calculations.

3.3.3.5 Periodic Review

Whenever a NORM Management, Dose Management or Radiation Protection Management Program has been implemented, a periodic review is needed. The review is to determine if there have been changes to the system that may affect the radiation dose, to monitor the effectiveness of the NORM program and to determine if modifications are required. The frequency of the periodic review will depend on the ability of conditions to change and the NORM program.

3.3.4 ALARA

The goal is that doses should be ALARA, economic and societal factors being taken into account. From the time a NORM accumulation is expected to the implementation of a NORM Program, the ALARA principle should be the prime decision making criterion used to ensure minimal public and worker radiation dose.

4 Derived Working Limits (DWLs) for NORM

Derived Working Limits (DWLs) have been determined from the annual radiation dose limits to assist in dose assessment. The DWLs provide an estimate of dose from the quantities that may be directly measured in the workplace. A Radiation Assessment program may compare measurement results to DWLs.

4.1 Gamma Radiation Dose Rate

4.1.1 Investigation Threshold

The occupational dose-rate that will give an incremental gamma radiation dose of 0.3 mSv/a is 0.15 µSv/h. The DWL for the gamma Investigation Threshold is an incremental dose-rate above off-site background of 0.15 µSv/h.

4.1.2 Dose Management Threshold

The occupational dose-rate that will give an incremental gamma radiation dose of 1 mSv/a is 0.5 µSv/h. The DWL for the gamma Dose Management Threshold is an incremental dose-rate of 0.5 µSv/h.

4.1.3 Radiation Protection Threshold

There is no DWL for the gamma Radiation Protection Threshold as doses are expected to be derived by dosimetry measurement/estimation.

4.2 Radon Concentration

4.2.1 Introduction

Radon is a radioactive gas produced by the decay of radium isotopes in both the uranium and thorium radioactive decay series (see Figure 1.1). As it is a gas, radon can be carried away from its origin by air or water flows, and released into workplace air. Usually radon-222 is the only isotope present in high enough concentrations to provide a significant dose, but radon-220 (thoron) can be present where thorium is handled or stored.

Although elevated radon concentrations from natural causes are common in buildings, it is not the intention of these *Guidelines* to provide guidance on the management of radon in other than workplace settings. Information on public/residential radon exposure guidelines can be obtained from *Radon – Reduction Guide for Canadians*(10) published by Health Canada.

Radon released from soil beneath a building gives rise to an average indoor background concentration of about 45 Bq/m^3, but much higher values are possible in some areas. This concentration is variable with time; therefore long-term assessment measurements are recommended. In excavations and tunneling the industrial practice releases radon from the soil, so there can be no distinction between background radon and that introduced or released by the industrial practice (practice radon).

As a result, the recommendations for radon are modified to take practical constraints into account. As background radon generally cannot be distinguished from radon generated by a workplace the dose limits given here are based on TOTAL dose from radon exposure not the INCREMENTAL dose from the practice as used elsewhere in these *Guidelines*.

The dose from radon can be estimated either from the radon gas concentration (Bq/m^3), or from the progeny energy concentration (joules per cubic metre (J/m^3)). On grounds of cost and convenience, it is recommended that radon-222 concentration be the preferred method for screening measurements. The only approved personal dosimetry system measures progeny concentration (J/m^3), therefore dose assessment as required in a Radiation Protection Management Program must be evaluated on that basis. The dose from thoron can only be estimated from progeny concentration.

Conversion factors relating dose from exposure to radon concentration and from progeny energy concentration are given in Appendix C. The assumptions and uncertainties in these conversion factors are described in ICRP Publication 65.[(4)] Other relationships between gas and progeny measurements are also given in Appendix C (see also reference 18).

4.2.2 Investigation Derived Working Limit for Radon

As radon concentration can vary considerably it is recommended that all workplaces be assessed for potential elevated levels. The DWL for radon is 200 Bq/m^3. The Unrestricted Classification therefore applies to all circumstances where the average radon concentration is less than 200 Bq/m^3. Where the annual average concentration of radon gas is expected to be above 200 Bq/m^3, measurements should be made to estimate the average annual radon gas concentration.

4.2.3 NORM Management for Radon

Where the estimated annual average concentration of radon gas in an occupied area is more than 200 Bq/m^3 but less than 800 Bq/m^3, the NORM Classification is NORM Management. Steps to reduce this exposure should be taken and include:

- introduction of public and incidentally exposed worker access controls;
- changes in work practices; and
- reducing the radon concentration levels to below 200 Bq/m^3.

The work site should be reviewed periodically to verify that conditions have not changed.

4.2.4 Radiation Protection Management for Radon

The DWL for the radon-222 Radiation Protection Management threshold is an average annual radon concentration of 800 Bq/m^3. Where the estimated annual average concentration of radon gas is more than 800 Bq/m^3, the NORM Classification is Radiation Protection Management. A Radiation Protection Management program as described in section 3.3.3.4 should be implemented. The Radiation Protection Management Program requires the initiation of a dose monitoring program. Where possible, the program should include steps to reduce the radon concentration levels to below 200 Bq/m^3.

4.3 Annual Limit on Intake (ALI)

The Annual Limit on Intake (ALI) is the amount of radioactive material a worker can ingest or inhale each year, that will deliver an annual effective dose of 20 mSv. ALI values are derived from dose coefficient (DC) values, developed by the ICRP. They are based on a critical review of available research on the estimation of radiation dose delivered to specific organs and tissues which arise from an intake of a given quantity of the radionuclide.

Intake parameters (breathing rate, particle size etc.) are different for occupational or public exposure conditions so there are different DC values for occupational (DC_w) or public (DC_p) exposure.

4.3.1 Occupational ALIs

Two groups of workers must be considered in assigning ALIs:

- **Occupationally Exposed Workers** are employees who are exposed to NORM sources of radiation through their regular duties. They are classified as NORM Workers working in an occupational exposure environment, and their average annual effective dose must not exceed 20 mSv.

- **Incidentally Exposed Workers** are other employees whose regular duties do not include exposure to NORM sources of radiation. They are considered as members of the public who work in an occupational exposure environment and, as such, the annual effective dose limit for these workers is 1 mSv.

Table 4.1 shows DC_w and ALI values for NORM workers for significant NORM radionuclides. The DC_w values are from ICRP Publication 68[(5)], and are based on an average effective dose limit of 20 mSv per year.

Appropriate ALI values for incidentally exposed workers are 1/20 of the ALI values listed in Table 4.1.

Table 4.1
Radon and NORM Program Classifications[a]

Average Annual Concentration	NORM Program Classification
800 – 3000 Bq/m^3	Radiation Protection Management
200 – 800 Bq/m^3	NORM Management
Background – 200 Bq/m^3	Unrestricted

Notes:

(a) Control of Radon 222 and its progeny within the values given in Figure 4.1 will concurrently control Radon 220 and its progeny within applicable limits.

- 3000 Bq/m3 is based on the Occupational Dose Limit: five year average. An equilibrium factor of 0.4 for Radon-222 and its progeny and 2000 hours per year occupational exposure duration are assumed (Reference 4).
- 800 Bq/m3 is based on the Radiation Protection Management DWL. An equilibrium factor of 0.4 for Radon-222 and its progeny and 2000 hours per year occupational exposure duration are assumed (Reference 4).
- 200 Bq/m3 is based on the Investigation DWL. An equilibrium factor of 0.4 for Radon-222 and its progeny and 2000 hours per year occupational exposure duration are assumed (Reference 4).

4.3.2 Public ALIs

Instead of specifying ALI values for public dose, the *Guidelines* present DRLs which specify the maximum total NORM radioactivity (Bq) and radioactive NORM concentration values (Bq/g; Bq/L; Bq/m^3) for unconditional releases into the public domain in Tables 5.1, 5.2 and 5.3. This is a more practical method of providing NORM material management guidance and is consistent with other related environmental release standards.

These release limits are based on the dose arising from all the radiation exposure pathways arising from the release, and are based on a maximum annual dose limit of 0.3 mSv as recommended by ICRP 77[7].

4.3.3 Inhalation Control Measures

Inhalation can deliver most of the dose in some NORM work environments. Where annual intakes exceed 1/20 of the ALI, engineering control of the source of airborne radioactive material is the preferred management method. Controls include capture ventilation at the source to prevent escape into the air, and room ventilation rate increase.

If intakes exceed 25% of the ALI (equivalent to 5 mSv/a) after engineering controls are applied, a respiratory protection program and/or limiting worker access should be considered as part of the radiation protection program. Respiratory protection must follow the standards requirements specified for other hazardous dusts under the local jurisdiction.

Respirator Program

A high protection factor can only be obtained if there is an effective respirator selection, service and fitting program. (11)

Table 4.2
Annual Limits on Intake for Occupationally Exposed Workers

NORM Radionuclide	Inhalation (5 μm AMAD)[a]			Ingestion		
	Type[b]	DC_w (Sv/Bq)	ALI (Bq)[c]	f_1[d]	DC_w (Sv/Bq)	ALI (Bq)[c]
Lead-210	F	1.1e-06	18,000	0.2	6.8e-07	29,000
Polonium-210	F M	7.1e-07 2.2e-06	28,000 9,000	0.1	2.4e-07	83,000
Radium-226	M	2.2e-06[g]	9,000	0.2	2.8e-07	71,000
Radium-228	M	1.7e-06	12,000	0.2	6.7e-07	30,000
Thorium-228	M S	2.3e-05 3.2e-05	900 600	0.0005 0.0002	7.0e-08 3.5e-08	290,000 570,000
Thorium-232	M S	2.9e-05 1.2e-05	700 1,700	0.0005 0.0002	2.2e-07 9.2e-08	91,000 200,000
Uranium[e] (all progeny)	Mixed	7.1e-06	2,800	Composite	1.2e-07	170,000
Uranium (par) (U-238, U-234)[f]	F M S	5.8e-07 1.6e-06 5.7e-06	34,000 13,000 3,500	0.02 0.002	4.4e-08 7.6e-09	450,000 2,600,000

Notes:

(a) Activity Mean Aerodynamic Diameter. An average inhaled aerosol size of 5 microns (5μm).

(b) The column "Type" reflects the relative rate of absorption of deposited material from the respiratory tract into the blood stream hence the probability of uptake of the material into biological systems. Types F, M, and S materials respectively have; Fast, Moderate and Slow rates of absorption into blood from the respiratory tract.

(c) ALI values are based solely on radiological considerations where the intake of 1 ALI corresponds to an annual effective dose of 20 mSv. For incidentally exposed workers multiply the ALI values by 1/20. For some long-lived NORM radionuclides, chemical toxicity may be more restrictive. Chemical and radiological toxicity should be reviewed prior to setting workplace exposure limits.

(d) The retained fraction of the initial intake. The fraction absorbed versus total intake quantity. The rest passes through the GI Tract and is excreted.

(e) From “Interim Annual Limits on Intake for Long-lived Radioactive Dust”, Atomic Energy Control Board (CNSC), January 1995.

(f) The residual uranium nuclide remaining after the chemical or physical separation of its progeny.

(g) From “Annex B. Inhalation Dose Coefficients for Workers Exposed to Ra 226", ICRP 72, 1996.

5 NORM Material Management

5.1 Non-radioactive Hazards of NORM Materials

The *Guidelines* provide recommendations based on the radiological properties of NORM. In determining an acceptable material management option, other hazardous properties such as chemical toxicity must be considered. In many cases, the non-radiological hazardous properties of NORM materials are the critical selection criteria for the preferred NORM material management option.

5.2 NORM Derived Release Limits

To assist in NORM material management, Derived Release Limits (DRLs) have been determined from the annual radiation dose limits. The DRLs provide an estimate of public dose from measured releases of NORM. A Radiation Assessment or Material Management program may compare measurement results to DRLs.

5.2.1 Unrestricted Classification

The control of public exposure to radiation from NORM disposal is constrained to less than the public dose limit to allow for exposures from multiple sources. The *Guidelines* recommend that NORM may be released with no radiological restrictions when the associated dose is no more than 0.3 mSv in a year. The radioactive hazard associated with this dose is considered insignificant, and no further control on the material is necessary on radiological protection grounds. It may be necessary to consult and obtain approval from Provincial waste disposal regulatory agencies regarding non-radiological properties.

DRLs for the amount and concentration of NORM materials that meet this criteria have been calculated, and are presented in Tables 5.1,5.2 and 5.3 as Unconditional Derived Release Limits (UDRLs).

5.2.2 Release with Conditions

NORM quantities in excess of the UDRLs may, after a specific site review, be released without further consideration. In such instances, the basic premise is that the material, in its final disposition, will not contribute a dose to an individual that is greater than 0.3 mSv/a. Outside those situations or conditions, the material falls within a more restrictive NORM classification.

5.3 Derived Release Limits for NORM Materials

5.3.1 Diffuse NORM

Diffuse NORM is generally large in volume, with a relatively low radioactive concentration that is uniformly dispersed throughout the material. Diffuse NORM by-products from industrial activity are usually stored close to the point of generation as the cost of long distance transportation is prohibitive. Phosphogypsum, a by-product of fertilizer production, is an example of diffuse NORM.

Disposal of diffuse NORM sources requires consideration of the effects of dilution, possible re-concentration of the material in the environment, and the manner in which the material may deliver radiation doses to the public.

Table 5.1 shows the UDRLs for Diffuse NORM. Unrestricted release of NORM at the listed concentrations will deliver a maximum effective dose of 0.3 mSv/a under conservative scenarios. The calculations are given in Appendix E. Actual effective doses arising from releases of NORM at UDRLs are expected to be substantially less than the 0.3 mSv/a.

Table 5.1
Unconditional Derived Release Limits- Diffuse NORM Sources

NORM Radionuclide	Derived Release Limit[(a)]		
	Aqueous[(b)] (Bq/L)	**Solid** (Bq/kg)	**Air** (Bq/m^3)
Uranium-238 Series (all progeny)	1	300	0.003
Uranium-238 (U-238, Th-234, Pa-234m, U-234)	10	10,000	0.05
Thorium-230	5	10,000	0.01
Radium-226 (in equilibrium with its progeny)	5	300	0.05
Lead-210 (in equilibrium with bismuth-210 and polonium-210)	1	300	0.05
Thorium-232 Series (all progeny)	1	300	0.002
Thorium-232	1	10,000	0.006
Radium-228 (in equilibrium with Ac-228)	5	300	0.005
Thorium-228 (in equilibrium with all its progeny)	1	300	0.003
Potassium-40	n/a[(d)]	17,000[(c)]	n/a

Notes:

(a) Pathways Considered:
Aquatic
1. Value 10x Guideline for Canadian Drinking Water Quality.
Terrestrial
1. External groundshine from soil contaminated to infinite depth.
2. Soil-veg-ingestion/soil ingestion.
3. Inhalation of resuspended material.

Air

1. Inhalation at concentration resulting in 0.3 mSv.
2. Exposure factor of 25% assumed.

Assumptions:

- All radionuclides and compartments in equilibrium.
- Typical values for uptake and transfer factors.
- No allowance for hold-up time.
- 25% “occupancy” factor for solid source (groundshine, soil ingestion, resuspension), 25% ‘occupancy’ factor for air, and 50% of vegetable intake grown on soil.
- No correction for shielding, surface roughness.

Where more than one long-lived radionuclide is present in a sample, the appropriate sum of the ratios of the activity of each long-lived radionuclide and its corresponding Release limit, must not exceed 1, for example:

$$\frac{Concentration\ NORM\ Isotope\ A}{Derived\ Release\ Limit\ A} + \frac{Concentration\ NORM\ Isotope\ B}{Derived\ Release\ Limit\ B} + \ldots + \frac{Concentration\ NORM\ Isotope\ N}{Derived\ Release\ Limit\ N} \leq 1$$

(b) Aqueous Release limits ~10x Guidelines for Canadian Drinking Water Quality. Subsequent dilution of the release is assumed. Refer to the Provincial Drinking Water Standard where planned diffuse NORM releases must meet provincial drinking water standards. (See reference 15)

(c) Natural abundance of Potassium 40 in potassium chloride.

(d) No aqueous release limit is needed as potassium content of the body is under homeostatic control, and is not influenced by environmental levels.

5.3.2 Discrete NORM

Discrete NORM sources are small in size and exceed the concentration criteria for a diffuse source. Because of the possibility of high radiation dose-rates close to the source, the UDRLs are lower than for diffuse NORM.

Table 5.2 lists the UDRLs for discrete NORM sources. The material must also meet the applicable radioactive surface contamination values, shown in Table 5.3.

Table 5.2
Unconditional Derived Release Limits

NORM Radionuclide	Unconditional Derived Release Limit[(a)] (Bq)
Uranium Ore (in equilibrium with all progeny)	1,000
Uranium-238 (partitioned) (in equilibrium with thorium-234 and protactinium-234)	10,000
Thorium-230 (no progeny)	10,000
Radium-226 (in equilibrium with its progeny)	10,000
Lead-210 (in equilibrium with bismuth-210 and polonium-210)	10,000
Thorium-232 (in equilibrium with all progeny)	1,000
Radium-228 (in equilibrium with actinium-228)	100,000
Thorium-228 (in equilibrium with its short-lived progeny)	10,000
Potassium-40	1,000,000

Notes:

(a) UDRLs, DRLs, (Activity and Concentration) relate to the long-lived parent radionuclide in equilibrium with its progeny. The use of Uranium Ore is considered appropriate for NORM-contaminated substances where equilibrium has not been disturbed by partitioning of the Uranium decay series. Where partitioning has occurred, the activity of *each* long-lived radionuclide must be found and compared to its appropriate UDRL. Where more than one long-lived radionuclide is present in a sample, the appropriate sum of the ratios of the activity of each long-lived radionuclide and its corresponding UDRL, must not exceed 1, for example:

$$\frac{Activity\ NORM\ Isotope\ A}{Unconditional\ DRL\ A}+\frac{Activity\ NORM\ Isotope\ B}{Unconditional\ DRL\ B}+\ \ldots+\frac{Activity\ NORM\ Isotope\ N}{Unconditional\ DRL\ N}\ \leq 1$$

5.3.3 Surface Contamination

Limits for surface radioactive contamination on equipment, tools or scrap surfaces intended for unconditional release are based on the analysis of personal radiation exposure pathways to a maximum annual dose of 0.3 mSv. Discrete NORM sources with surface contamination less than the Table 5.3 Surface Contamination Unconditional Derived Release Limits can be released without further investigation.

Table 5.3
Surface Contamination Unconditional Derived Release Limits - Discrete NORM Sources

Property	Limit
Dose Rate	0.5 μSv/h at 50 cm.
Surface Contamination	1 Bq/cm^2 averaged over a 100 cm^2 area

Notes:

1. A thin window radiation detector is recommended when monitoring beta/gamma sources of surface contamination.

2. Table 5.3 release limits are only applicable to fixed surface contamination. Loose surface contamination must be completely removed or all accessible surfaces stripped to ensure complete removal.

3. In most cases, decontamination efforts which meet beta surface contamination limits will concurrently provide for the control of mixed alpha / beta / gamma sources.

6 Standards for the Transport of NORM

Shipments of NORM may fall under federal transportation regulations, the *Packaging and Transport of Nuclear Substances Regulations* (PTNSR) and the *Transportation of Dangerous Goods Regulations* (TDGR). The TDGR outlines the responsibilities of the consignor, consignee and transporter and the PTNSR, which have been harmonized with the IAEA's Safety Standard No. TS-R-1 Regulations for the Safe Transport of Radioactive Materials, 1996 (revised)[14], outline the packaging, labeling and manifesting requirements for a NORM shipment. Shipments of NORM fall under these regulations if:

- the activity concentration of the material exceeds 10 times the "activity concentration for an exempt material" values specified in Table 6.1; and

- the material is transported off site over public or privately owned land not controlled by the consignment owner.

Prior to shipment, the NORM material must be assessed to determine the activity concentration.

Tables 6.1 and 6.2 outline the IAEA Safety Standards Series No. TS-R-1 Basic Radionuclide Values for NORM as well as Parent nuclides and their progeny included in secular equilibrium. The original document should be referenced for full definitions and context of use. TS-R-1 is available for download from the IAEA website at http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1098_scr.pdf.

Table 6.1
Basic NORM Radionuclide Values, paragraph 404, IAEA Safety Standards Series No. TS-R-1

Definitions [14] of A_1 and A_2:
A_1 shall mean the activity value of *special form radioactive material* which is used to determine the activity limits. A_2 shall mean the activity value of *radioactive material*, other than *special form radioactive material*, which is used to determine the activity limits.

Radionuclide	A_1 (GBq)	A_2 (GBq)	Activity concentration for exempt material (Bq/g)	Activity limit for an exempt consignment (Bq)
U-(nat)	Unlimited	Unlimited	1**	1,000**
U-238 (all lung absorption types)	Unlimited	Unlimited	10**	10,000**
Th-234*	300	300	1000**	100,000**
U-234 (slow lung absorption)	40,000	6	10	100,000
Th-230	10,000	1	1	10,000
Ra-226*	200	3	10**	10,000**
Pb-210*	1000	50	10**	10,000**
Th(nat)	Unlimited	Unlimited	1**	1,000**
Th-232	Unlimited	Unlimited	10	10,000
Ra-228*	600	20	10	100,000**
Th-228*	500	1	1	10,000**

* A_1 and/or A_2 values include contributions from progeny with half-lives < 10 days
** See progeny included in value. They are as follows in Table 6.2.

Note: For NORM materials these values are multiplied by 10 (naturally occurring).

Table 6.2
Parent nuclides and their progeny included in secular equilibrium

Parent Radionuclide	Progeny
Bi-212	Tl-208 (0.36), Po-212 (0.64)
Pb-210	Bi-210, Po-210
Pb-212	Bi-212, Tl-208(0.36), Po-212(0.64)
Ra-226	Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228	Ac-228
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208(0.36), Po-212(0.64)
Th-nat	Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208(0.36), Po-212 (0.64)
Th-234	Pa-234m
U-230	Th-226, Ra-222, Rn-218, Po-214
U-232	Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212(0.64)
U-238	Th-234, Pa-234m
U-nat	Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210

6.1 Unrestricted NORM Shipments

Materials meeting all of the following criteria do not require any special considerations for transportation:

- **Meets** the CNSC exemption criteria under the PTNSR. NORM that is in its natural state or NORM that has been processed only for purposes other than for extraction of those radionuclides provided the activity concentration of the material does not exceed 10 times the "activity concentration for an exempt material" values specified in Table 6.1, and

- **Meets** the UDRLs of section 5.3 of these guidelines.

6.2 NORM Shipments Subject to the Canadian Guidelines

For NORM shipments having an activity concentration less than 10 times the value in Table 6.1 but greater than the UDRLs in Section 5.3, the following are recommended:

- A transport manifest is completed and contains the descriptor "*Naturally Occurring Radioactive Material – NORM*".

- The shipment is securely packaged in a manner that effectively prevents release or redistribution of any NORM contamination during transport.

- The shipment has taken into account any other potential hazardous properties of the materials.

NOTE: no radioactive placards or labels should be affixed to the transport vehicle or to the exterior surfaces of the packaging.

6.3 NORM Shipments governed by the Federal Transport Regulations

Shipments of NORM falling under federal jurisdiction are required to comply with the PTNSR, established by the CNSC.

Preparation of these shipments for transport involves several steps. As a result, lead times four to six weeks prior to shipment should be planned. Timely transportation of NORM to a secure central site is recommended. For more information concerning transportation requirements, contact the appropriate Federal, Provincial or Territorial government agency. A list of government contacts is provided in Appendix B.

6.4 NORM Surface Contamination Exclusions

A surface contaminated object (SCO) is a solid object which is not itself radioactive but which has radioactive material distributed on its surface. An object with external contamination is exempted from the PTNSR if:

(a) the non-fixed contamination when averaged over each 300 cm^2 of all surfaces is less than 0.4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters*, and is less than 0.04 Bq/cm^2 for all other alpha emitters; and

(b) the activity concentration of the material does not exceed 10 times the activity concentration for an exempt material as specified in Table 6.1.

* Low toxicity alpha emitters are: natural uranium, depleted uranium, uranium-235 or uranium-238, thorium 232, thorium -228 and thorium-230 when contained in ores or physical and chemical concentrates, or alpha emitters with a half life less than 10 days.

6.5 Additional Information

Refer to the PTNSR, the TDGR, and the IAEA Regulations for the Safety Transport of Dangerous Goods for additional information on requirements for the transport of NORM [12, 13, 14].

References

1 *Guidelines for The Handling of Naturally Occurring Radioactive Materials (NORM) In Western Canada*, Western Canadian NORM Committee, Aug. 1995.

2 *Canada: Living With Radiation*, Atomic Energy Control Board, Canada Communication Group-Publishing, 1995.

3 *1990 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 60, Annals of the ICRP, Vol. 21, No. 1-3, 1991.

4 *Protection Against Radon-222 at Home and at Work*, ICRP Publication 65, Annals of the ICRP, Vol. 23, No. 2, 1993.

5 *1994 Dose Coefficients for Intake of Radionuclides by Workers*, ICRP Publication 68, Annals of the ICRP, Vol. 24, No. 4, 1994.

6 *Age Dependent Doses to Members of the Public from Intake of Radionuclides: Part 5 - Compilation of Ingestion and Inhalation Coefficients*, ICRP Publication 72, Annals of the ICRP, Vol. 26, No. 1, 1996.

7 *Radiological Protection Policy for the Disposal of Radioactive Waste.* ICRP Publication 77, Annals of the ICRP, Vol. 27, Supplement 1997.

8 *International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources*, IAEA Safety Series No. 115, 1996.

9 *Technical and Quality Assurance Requirements for Dosimetry Services*, S-106 Revision 1, Published by the Canadian Nuclear Safety Commission, May 2006.

10 *Radon – Reduction Guide for Canadians*, Health Canada, 2013. http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radon_canadians-canadiens/index-eng.php

11 *Selection, Care and Use of Respirators*, Canadian Standards Association, Z94.4- 93, August 1994.

12 *Packaging and Transport of Nuclear Substances Regulations*, Nuclear Safety and Control Act, May 2000, available at www.nuclearsafety.gc.ca

13 *Transportation of Dangerous Goods Regulations*, Canada Gazette Part II, February 20, 2008, available for download from the Transport Canada website at http://www.tc.gc.ca/

14 *Regulations for the Safe Transport of Radioactive Material*, 1996 Edition (Revised), Safety Standards Series No. TS-R-1 (ST-1, Revised), International Atomic Energy Agency, available at www.iaea.org.

15 *Guidelines for Canadian Drinking Water Quality*, Health Canada, December 2010.

16 Revised Canadian Guidelines for Radon, Canada Gazette Part I, Vol. 141, No. 23, June 9, 2007.

17 *The 2007 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 103, Annals of the ICRP, Vol. 37, No. 2-4, 2007.

18 United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). Effects of ionizing radiation. Volume I: Annex E - Sources-to-effects assessment for radon in homes and workplaces. ISBN 978-92-1-142263-4. United Nations, New York 2006

A Appendix

Publications Address List

Canadian Nuclear Safety Commission
Office of Public Information
Canadian Nuclear Safety Commission
280 Slater Street, P.O. Box 1046
Ottawa, Ontario K1P 5S9

Health Canada
Radiation Protection Bureau, AL 6302A
775 Brookfield Road
Ottawa, Ontario, K1A 1C1

International Atomic Energy Agency (IAEA)

IAEA Regional Office in Canada
Suite 1702/Box 20
365 Bloor Street East
Toronto, ON M4W 3L4

Bernan Associates
4611-F Assembly Drive
Lantham MD. USA 20706-4391

Division of Publications
International Atomic Energy Agency
Wagramerstrasse 5, P.O. Box 100
A-1400 Vienna, Austria

International Commission on Radiological Protection (ICRP)

Pergamon Press Inc.
Maxwell House, Fairview Park
Elmsford, New York, U.S.A.

Pergamon Press plc,
Headington Hill Hall
Oxford, U.K. OX3 0BW

Guidelines for the Handling of Naturally Occurring Radioactive Materials (NORM) in Western Canada
Alberta Human Resources and Employment
Information Services
2nd Floor, 10808 - 99 Avenue

Edmonton, Alberta, Canada T5K 0G5

B Appendix

Government Contacts

Federal Government Agencies

Canadian Nuclear Safety Commission
P.O. Box 1046
Ottawa, Ontario K1P 5S9
1-800-668-5284 or (613) 992-2915

Health Canada
Radiation Protection Bureau
775 Brookfield Road,
Ottawa, Ontario K1A 1C1
(613) 954-6647

Health Canada
National Dose Registry
Radiation Protection Bureau
775 Brookfield Road,
Ottawa, Ontario K1A 1C1
ndr-fdn@hc-sc.gc.ca

Provincial Government Agencies

Alberta
Occupational Health and Safety
Alberta Human Services
8th Floor, 10808- 99 Avenue
Edmonton, Alberta T5K 0G5
(780) 427-2687

British Columbia
Environmental Assessment Office (EAO)BC Ministry of Environment
PO Box 9426 Stn Prov Govt
Victoria, British Columbia V8W 9V1
(250) 356-6448

Manitoba
Radiation Protection Section
Manitoba Cancer Treatment and Research Foundation
100 Olivia Street
Winnipeg, Manitoba R3E 0V9
(204) 787-2213

New Brunswick
Public Health Management Unit
Health and Community Services
P.O. Box 5100
Fredericton, New Brunswick E3B 5G8
(506) 453 2638

Newfoundland
Employment and Labour Relations
Fall River Plaza, P.O. Box 8700
270 Torbay Road,
St. John's, Newfoundland A1C 4J6
(709) 729-0218

Northwest Territories
Department of Health and Social Services
Government of the Northwest Territories
7th Floor, Centre Square Tower
P.O. Box 320
Yellowknife, Northwest Territories X1A 2L9
(867) 920-3293

Nova Scotia
Department of Labour and Workforce Development
P.O. Box 697
Halifax, Nova Scotia B3J 3B7
(902) 424-7115

Nunavut Territory
Department of Health and Social Services
Government of the Northwest Territories
7th Floor, Centre Square Tower
P.O. Box 320
Yellowknife, Northwest Territories X1A 2L9
(867) 920-3293

Ontario
Ontario Ministry of Labour
Radiation Protection Service
81A Resources Road
Toronto, Ontario M9P 3T1
(416) 235-5922

Prince Edward Island
Division of Environmental Health
Department of Health and Social Services
Government of Prince Edward Island
P.O. Box 2000
Charlottetown, P.E. I. C1A 7N8
(902) 894-2277

Quebec
Service de la Promotion de saines habitudes de vie et de dépistage
Ministère de la Santé et des Services sociaux
1075, chemin Ste-Foy
Québec, Québec G1S 2M1
(418) 646-2515

Saskatchewan
Radiation Safety Unit
Occupational Health and Safety Division
Saskatchewan Ministry of Labour Relations and Workplace Safety
1870 Albert Street
Regina, Saskatchewan S4P 4W1
(306) 787-4538

Yukon Territory
Workers Compensation Health & Safety
Government of the Yukon Territory
401 Strictland Street
Whitehorse, Yukon Territory Y1A 5N8
(780) 667-5450

C Appendix

Radiation Unit Conversion Factors

Table C.1 Prefixes

Prefix	Symbol	Value
Tera	T	10^{12}
Giga	G	10^{9}
Mega	M	10^{6}
kilo	k	10^{3}
milli	m	10^{-3}
micro	µ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}

Table C.2 Activity Conversions

Activity (SI Units)		Activity (Former Units)	
Becquerel (Bq)	**Disintegration per second (dps)**	**Curie with prefix (Ci)**	**Curie (Ci)**
1 Bq	1 dps	27 pCi	2.7×10^{-11} Ci
1 kBq	1×10^{3} dps	27 nCi	2.7×10^{-8} Ci
1 MBq	1×10^{6} dps	27 µCi	2.7×10^{-5} Ci
1 GBq	1×10^{9} dps	27 mCi	2.7×10^{-2} Ci
1 TBq	1×10^{12} dps	27 Ci	2.7 x 10 Ci
37 mBq	0.037 dps	1 pCi	1×10^{-12} Ci
37 Bq	37 dps	1 nCi	1×10^{-9} Ci
37 kBq	3.7×10^{4} dps	1 µCi	1×10^{-6} Ci
37 MBq	3.7×10^{7} dps	1 mCi	1×10^{-3} Ci
37 GBq	3.7×10^{10} dps	1 Ci	1 Ci

Table C.3 Absorbed Dose Conversions

SI Units	Former Units
1 Gy	100 rad
1 mGy	0.1 rad
1 µGy	0.1 mrad
10 mGy	1 rad
10 µGy	1 mrad
0.01 µGy	1 µrad

Table C.4 Dose Equivalent "Biological Dose" Conversions

SI Units	Former Units
1 Sv	100 rem
1 mSv	0.1 rem
1 µSv	0.1 mrem
10 mSv	1 rem
10 µSv	1 mrem
0.01 µSv	1 µrem

Table C.5 Radon Conversions

Radiation Exposure Domain	Radon Gas (Bq/m^3)	Radon Progeny (WLM)	Radon Progeny ($mJ\ h/m^3$)	Annual Radiation Dose (mSv/a)
Occupational (2000 hours per year)	200	0.25	0.89	1.4

D Appendix

Effective Dose Calculations

1. Effective Dose Categories

The total Effective Dose, E_T, is calculated from three categories of radiation exposure:

a. External gamma and beta dose

This dose category, personal dose equivalent from penetrating radiation, is symbolized by "**H_p(10)"** and represents the beta/gamma dose received in a dosimetry period. A one-year dosimetry period is defined as the dosimetry period commencing January 1 and having one calendar year duration. The five-year dosimetry period means the period of five calendar years beginning January 1 of the year after these guidelines are published, and every period of five calendar years thereafter.

b. Internal dose from the intake of radionuclides

This dose category is symbolized by "**I**" and represents the one-year or five-year dosimetry period estimate of NORM nuclide intake (inhalation and ingestion) other than from radon and its progeny.

c. Inhalation of radon gas and its progeny

This dose category is defined by cumulative exposure to radon progeny symbolized by "**RnP**" with units of WLM. RnP represents the one-year or five-year dosimetry period estimate of cumulative radon progeny inhalation by workers.

For dose recording purposes, each dose category can be measured and recorded separately. For compliance to these *Guidelines*, or, federal, provincial or territorial dose limit regulations, these categories must be combined to calculate one effective dose for each individual. This combined dose, the effective dose, is then compared to the radiation dose limits found in Table 2.1 of the *Guideline*.

2. Effective Dose and Dose Limit Compliance Calculations

For worker dose compliance purposes, the *Guidelines* require dose calculations over a one-year and a five-year dosimetry period. One-year dosimetry period calculations are necessary for compliance with one-year maximum effective dose limits, while five-year dosimetry period calculations demonstrate compliance with the cumulative dose limits for a five-year period. The five-year cumulative limit also implies an average annual dose limit.

For workers, the implied average annual limit over a five-year period is an annual effective dose of 20 mSv versus the 50 mSv maximum in any single one-year dosimetry period. For the public, including the incidentally exposed worker, the annual limit is 1 mSv and the five-year limit is five times the annual limit. The following dose calculation methodology is recommended for determining one-year and five-year dosimetry period results.

A. One Year Dosimetry Periods

Step 1

Calculate the annual dose received from each dose category.

External Gamma and Beta Exposures

Annual dose received from all external sources, $H_p(10)$

Radionuclide Intake (Internal Exposures)

Annual dose received from all internal sources,

$$I = \sum A_n \times DC_{wn}$$

Where, A_n is the activity intake of radionuclide n and DC_{wn} is the appropriate worker dose coefficient specified for that NORM nuclide (Refer to Table 4.1 entries). For inhalation, the DC_{wn} selected from Table 4.1 will depend on the chemical form of the radionuclide, which will determine whether it is fast (F), moderate (M) or slow (S) absorption from the lungs.

Radon-222 Inhalation

Annual dose received from radon-222 progeny inhalation,

$$Rn_d = 5(RnP)$$

Where, for workers the dose conversion from WLM to mSv is 5 for radon-222 progeny. Radon-220 progeny must be treated separately.

Step 2. One-Year Dosimetry Period Compliance

Determine the effective dose by adding the dose contributions from the three categories. To determine whether the annual total effective dose received complies with the *Guidelines* compare it to the appropriate one-year dose limit from Table 2.1.

Compliance: $E_T = H_p(10) + I + Rn_d \leq the\ appropriate\ value\ from\ Table\ 2.1$

Example 1: During the year, a worker has been exposed to external gamma radiation, has ingested radium dust and was exposed to radon-222 progeny. The workers recorded doses/intakes are presented in Table D.1.

Table D.1
Worker's Record of Doses and Intakes for Example 1

Source	Recorded Dose/Intake	Effective Dose
External Radiation $H_p(10)$	12 mSv	Hp(10) = 12 mSv
Internal Radiation (radium-226) I_n	9,000 Bq	I = 2.5 mSv
Radon RnP	0.4 WLM	Rn_d = 2 mSv

This worker's internal dose component (I) can be calculated using Table 4.1. The ingestion DC_w for ^{226}Ra is 2.8 e-7 Sv/Bq.

Therefore $I = (9{,}000\ Bq)(2.8\ e - 7\ \ Sv/Bq) = 0.0025\ Sv = 2.5\ mSv$

This worker's radon dose component (Rn_d) can be calculated by multiplying the dose in WLM by 5 to convert to mSv.

Therefore $Rn_d = (0.4\ WLM)(5\ \ mSv/WLM) = 2\ mSv$

Effective Dose:
$$\begin{aligned} E_T = \ & H_p(10) + I + \ Rn_d \\ & = 12\ mSv + 2.5\ mSv + 2\ mSv \\ & = 16.5\ mSv \end{aligned}$$

Conclusion: The worker has not exceeded the annual dose limit of 50 mSv. However the worker is getting close to the average annual dose limit implied by the five-year limit (20 mSv/a).

B. Five-year Dosimetry Period

Step 1

Calculate the dose received in the five year period, or portion thereof, from each dose category.

External Gamma and Beta Exposures

Total dose received during the five year period, or portion thereof, from all external sources = $H_p(10)$

Radionuclide Intake (Internal Exposures)

Total dose received during the five year period, or portion thereof, from all internal sources,

$$I = \sum A_n \times DC_{wn}$$

Where, A_n is the activity intake of radionuclide n and DC_{wn} is the worker dose coefficient specified for that NORM nuclide (Refer to Table 4.1 entries). For inhalation, the DC_{wn} selected from Table 4.1 will depend on the chemical form of the radionuclide, which will determine whether it is fast (F), moderate (M) or slow (S) absorption from the lungs.

Radon-222 Inhalation

Total dose received during five year period, or portion thereof, from radon-222 progeny inhalation,

$$Rn_d = 5(RnP)$$

Where, for workers the dose conversion from WLM to mSv is 5. Radon-220 progeny must be treated separately.

Step 2. Five Year Dose Limit Compliance

Determine the effective dose by adding the dose contributions from the three categories. To determine whether the effective dose received complies with the *Guidelines* compare it to the appropriate five-year dose limit from Table 2.1.

Compliance: $$E_T = H_p(10) + I + Rn_d \leq the\ appropriate\ value\ from\ Table\ 2.1$$

Example 2: During a five-year period, a worker has been exposed to external gamma radiation, has ingested radium in dust and was exposed to radon-222 progeny. The workers recorded doses/intakes are presented in Table D.2.

Table D.2
Worker's Record of Doses and Intakes for Example 2

Source	Recorded Dose/Intake	Effective Dose
External Radiation $H_p(10)$	30 mSv	Hp(10) = 30 mSv
Internal Radiation (radium-226) I_n	26,000 Bq	I = 7.3 mSv
Radon RnP	1 WLM	Rn_d = 5 mSv

This worker's internal dose component (I) can be calculated using Table 4.1. The DC_w for ^{226}Ra is 2.8 e-7 Sv/Bq.

Therefore $$I = (26{,}000\ Bq)(2.8\ e-7\ \ Sv/Bq) = 0.073\ Sv = 7.3\ mSv$$

This worker's radon dose component (Rn_d) can be calculated by multiplying the dose in WLM by 5 to convert to mSv.

Therefore $$Rn_d = (1\ WLM)(5\ \ mSv/WLM) = 5\ mSv$$

Effective Dose: $E_T = H_p(10) + I + Rn_d$
$= 30\ mSv + 7.3\ mSv + 5\ mSv$
$= 42.3\ mSv$

Conclusion: The worker has not exceeded the five-year dose limit of 100 mSv.

E Appendix

Derivation of Diffuse NORM Unconditional Derived Release Limits

The Unconditional Derived Release Limit for diffuse NORM sources (solid, air, and water) is the concentration of the parent radionuclide (Bq per unit mass or volume), in equilibrium with its progeny, that could result in a dose of 0.3 mSv per year from those pathways considered in the assessment, based on conservative exposure assumptions (conservative assumptions are those that are least likely to understate exposure). The pathways, assumptions, and other related information are supplied below for the calculation of the limits for the decay chains listed in Table 5.1.

Unconditional Derived Release Limits have been calculated for ^{40}K, and for the ^{238}U and ^{232}Th decay series. Values for the two decay series are given for the various sub-chains that can be assumed to be in equilibrium, in other words, the parent radionuclide is in equilibrium with its shorter-lived progeny. For example, within the ^{238}U series, a release limit is given for ^{210}Pb in equilibrium with its progeny, ^{210}Bi and ^{210}Po.

Exposure Pathways for Diffuse NORM Sources

Solid NORM

For diffuse solid NORM, the release limit is the concentration in soil (Bq/kg) ***at the receptor*** that would result in a dose of 0.3 mSv/a to a reference adult. Based on a modification to the screening methodology recommended by the National Commission for Radiation Protection (NCRP) for disposal of radionuclides in the ground (NCRP 1996), it is assumed that the radioactive material is uniformly distributed in soil to infinite depth, and that the reference individual resides on this soil and consumes produce grown on the soil. The following exposure pathways and assumptions were considered:

- The parent radionuclide and its progeny are in equilibrium.
- The reference adult is exposed to direct external irradiation from the soil, which is assumed to be homogeneously contaminated to infinite depth.
- The individual receives an internal dose from the inhalation of resuspended dust, contaminated to the same level as the soil.
- Half of the individual's annual supply of vegetables is grown on contaminated soil. It is assumed that the land does not support livestock, so there is no dose from the consumption of animal products.
- The individual ingests contaminated soil from unwashed produce, dirt on hands, etc.
- The reference individual is assumed to occupy the site for 25% of the year, affecting the direct irradiation, inhalation, and soil ingestion pathways.

Airborne NORM

For airborne NORM, the unconditional release limit is the concentration in air (Bq/m^3) ***at the receptor*** that would result in a dose of 0.3 mSv/a to a reference adult from inhalation. The following assumptions apply:

- Only the inhalation pathway is assumed.
- The parent radionuclide and its progeny are in equilibrium (very conservative).
- The reference individual is assumed to occupy the site for 25% of the year.

Aquatic NORM

For aquatic NORM, the Unconditional Derived Release Limit is the concentration in water (Bq/L) ***at the point of release*** that would result in a dose of less than 0.3 mSv/a to a reference adult consuming water for an entire year assuming a four to ten-fold dilution in concentration between the NORM release point and a drinking water intake point. Equilibrium between the parent and its progeny is not assumed. The release limit is therefore 10 times the maximum acceptable concentration given in the Guidelines for Canadian Drinking Water Quality, 6th edition (Health Canada 1996), which is based on a dose of 0.1 mSv/a. Regardless of the NORM guideline, in all cases, provincial drinking water standards would apply to the water as released.

Discussion of Parameters Used in the Derivation of Unconditional Release Limits

Soil to plant uptake factors, Bv_x, for the various radionuclides of interest are taken from Zach and Sheppard (1992), Table 6. These were selected by Zach and Sheppard, based on a review of available data, as being appropriate mean values for the Canadian Shield.

Annual adult consumption rates for vegetables and soil are taken from Health Canada (1993). A factor of 0.5 has been applied to the intake of produce to reflect the assumption that one-half of the annual intake is grown on contaminated soil. The adult water consumption rate is from Health Canada (1996). The inhalation rate is from ICRP Publication 71 (1995), Table 6. Soil density (for conversion of groundshine dose coefficients) is taken from CSA (1987). The soil resuspension factor is from Davis *et al* (1993). An occupancy correction factor of 0.25 has been applied to exposure to airborne NORM sources by inhalation, and to exposures to solid NORM sources by

- direct groundshine irradiation;
- ingestion of soil; and
- inhalation of resuspended dust.

Committed effective dose coefficients for internal exposure (inhalation, ingestion) are from ICRP Publication 72 (1996). External dose rate coefficients for soil contaminated to infinite depth are taken from Eckerman and Legett (1996); Eckerman and Ryman (1993). These are consistent with ICRP 60 methodologies. Parameters values used in the calculation of unconditional release limits are summarised in Table 1.

It is assumed that:

- All radionuclides in the defined parent-progeny group are in equilibrium for both solid and airborne NORM sources.
- For aquatic NORM, equilibrium is not assumed, and the unconditional release limit is based on each separate radionuclide released.
- All compartments are in equilibrium, and at steady-state.
- No allowance is made for transfer times between compartments, or hold-up time of food (for example between harvest and consumption).
- No corrections are made for reduction in external irradiation due to shielding, surface roughness, etc.

Methodology and Equations:

Solid and Airborne NORM:

For a given decay chain in equilibrium (for example, $^{238}U \rightarrow {}^{234}Th \rightarrow {}^{234m}Pa$), the doses resulting from a unit concentration of *each* radionuclide, *x*, by each relevant exposure pathway, *y*, referred to as $D_{x,y}$ (mSv y^{-1}) were calculated as follows, where $DC_{x,y}$ is the radionuclide- and pathway-specific effective dose coefficient:

For Solid NORM:

- External groundshine

$$D_{x,ext/gnd} = soil\ conc'n\ (Bq/kg)\ \times\ DC_{x,ext/gnd}(Sv\ m^3 Bq^{-1} s^{-1}) \times soil\ density\ (kg\ m^{-3})\ \times \{3.16\ \times\ 10^7\ (s\ y^{-1}) \times occupancy\ factor\ (0.25)\} \times 1000\ (mSv\ Sv^{-1})$$

- Internal, ingestion of vegetables

$$D_{x,ingest/veg} = soil\ conc'n\ (Bq/kg)\ \times\ DC_{x,ingest}(Sv\ Bq^{-1}) \times \{Plant\ uptake\ factor\ \times veg.\ consumption\ rate\ (kg\ y^{-1}) \times 0.5\}\ \times 1000\ (mSv\ Sv^{-1})$$

- Internal, ingestion of soil

$$D_{x,ingest/soil} = soil\ conc'n\ (Bq/kg)\ \times\ DC_{x,ingest}(Sv\ Bq^{-1}) \times \{soil\ ingestion\ rate\ (kg\ y^{-1}) \times occupancy\ factor\ (0.25)\}\ \times 1000\ (mSv\ Sv^{-1})$$

- Internal, inhalation of resuspended material

$$D_{x,inhal/resus} = soil\ conc'n\ (Bq/kg)\ \times\ DC_{x,inhal}(Sv\ Bq^{-1}) \times dust\ loading\ factor\ (kg\ m^{-3})\ \times \{inhalation\ rate\ (m^3\ y^{-1})\ \times\ occupancy\ factor\ (0.25)\}\ \times 1000\ (mSv\ Sv^{-1})$$

Table E.1
Parameter Values

Parameter	Element	Value	Reference
Plant/Soil Uptake, Bv_x	K	2.5E-01	(Zach and Sheppard, 1992)
(Bq/kg wet / Bq/kg dry)	Pb	1.1E-02	
	Bi	8.8E-03	
	Po	6.3E-04	
	Ra	3.3E-03	
	Ac	8.8E-04	
	Th	2.1E-04	
	Pa	6.3E-04	
	U	2.1E-03	
Soil density (kg m^{-3})		1.6E+03	(CSA 1987)
Food consumption: Veg (kg y^{-1})		2.5E+02	(Health Canada 1993)
Soil ingestion rate (kg y^{-1})		7.3E-03	(Health Canada 1993)
Dust loading - resuspension (kg m^{-3})		6.0E-08	(Davis *et al.* 1993)
Adult breathing rate (m^3 y^{-1})		8.1E+03	(ICRP 1995)
Occupancy Factor		2.5E-01	(NCRP 1996)
External dose coefficients(Sv m^3 Bq^{-1} s^{-1})		Note (a)	(Eckerman and Legett 1996)
Internal dose coefficients (Sv Bq^{-1})		Note (a)	(ICRP 1996)

(a) Dose coefficients are radionuclide dependent. Refer to listed references for specific values.

For Airborne NORM:

- Internal, inhalation of airborne material

$$D_{x,inhal/air} = conc'n\ in\ air\ \ (Bq\ m^{-3}) \times DC_{x,inhal}\ (Sv\ Bq^{-1}) \times \{inhalation\ rate\ (m^3\ y^{-1})\ \times exposure\ factor\ (0.25)\} \times 1000\ (mSv\ Sv^{-1})$$

Calculation of the Unconditional Derived Release Limit
The total dose per unit concentration (soil or airborne) is given by a double sum over each radionuclide and pathway:

$$D_{total,soil/air}\ \left(mSv\ y^{-1}\ per\ \ Bq/kg\ \ (or\ m^{-3})\right) = \sum\sum D_{x,y}\ for\ each\ radionuclide, x\ in\ each\ exposure\ pathway, y$$

The Unconditional Derived Release Limit, UDRL, for the parent radionuclide in equilibrium with its progeny is:

$$URL\ (Bq/kg\ (or\ m^{-3})) = 0.1\ mSv\ y^{-1}/D_{total,soil/air}\ (mSv\ y^{-1}\ per\ \ Bq/kg\ \ (or\ m^{-3}) for\ soil\ (or\ airborne))$$

Aquatic NORM

As discussed above, the unconditional derived release limit for aquatic NORM is 10 times the maximum acceptable concentration given in the Guidelines for Canadian Drinking Water Quality, 6th edition (Health Canada 1996) for the parent radionuclide. Equilibrium between parent and progeny is not assumed.

Unconditional Derived Release Limits
Table 5.1 of the *Guidelines* provides a summary of the Unconditional Derived Release Limits calculated for the significant NORM nuclides in the Uranium and Thorium decay series and for potassium-40.

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F Appendix

Elements of a Formal Radiation Protection Program

Radiation Protection Program

Employers that implement a radiation protection program should, as part of that program, keep the exposure to radon progeny and the effective dose received by and committed to persons as low as reasonably achievable through the implementation of:

(i) management control over work practices;

(ii) personnel qualification and training;

(iii) control of occupational and public exposure to radiation; and

(iv) planning for unusual situations.

An employer should ascertain the exposure to radon progeny and the effective dose by direct measurement as a result of monitoring; or by expert estimates.

Provision of Information

(1) The employer shall inform each occupationally exposed worker, in writing:

(a) that he or she is an occupationally exposed worker;

(b) of the risks associated with radiation to which the worker may be exposed in the course of his or her work, including the risks associated with the exposure of embryos and foetuses to radiation;

(c) of the applicable radiation dose limits for occupationally exposed workers shown in Table 2.1; and

(d) of the worker's radiation dose levels.

(2) The employer should inform each occupationally exposed female worker, in writing, of the applicable effective dose limits shown in Table 2.1.

(3) The employer should obtain from each occupationally exposed worker a written acknowledgement that the worker has received this information.

Use of Licensed Dosimetry Service

Employers should use a dosimetry service, meeting the requirements of S-106, Technical and Quality Assurance Standards for Dosimetry Services in Canada, to measure the radiation doses to occupationally exposed workers who have a reasonable probability of receiving an effective dose greater than 5 mSv in a one-year dosimetry period.

Occupationally Exposed Workers

An occupationally exposed worker should on request of the employer provide the worker's:

(a) given names, surname and any previous surname;

(b) Social Insurance Number;

(c) gender;

(d) date, province or state and country of birth; and

(e) dose record for the current one-year and five-year dosimetry periods.

Pregnant Occupationally Exposed Workers

Every occupationally exposed worker who becomes aware that she is pregnant should immediately inform the employer in writing.

On being informed by an occupationally exposed worker that she is pregnant, the employer should make accommodation to comply with Note (b), Table 2.1, that will not constitute undue hardship to the employer.

When Dose Limit Exceeded

When an employer becomes aware that a dose of radiation received by and committed to a person may have exceeded an applicable dose limit shown in Table 2.1, the employer shall:

(a) immediately notify the person and the Provincial Authorities of the dose;

(b) require the person to leave any work that is likely to add to the dose;

(c) conduct an investigation to determine the magnitude of the dose and to establish the causes of the exposure;

(d) identify and take any action required to prevent the occurrence of a similar incident; and

(e) within 21 days after becoming aware that the dose limit has been exceeded, report the results of the investigation to the appropriate government authority (reference Appendix B) or on the progress that has been made in conducting the investigation.

Return to Work

If a person has received or been committed to an equivalent dose that exceeds an equivalent dose limit given in Table 2.1, and Provincial Authorities agree that the person can return to work, the authorization may specify conditions and prorated dose limits.

For the purpose of this section a prorated effective dose limit is the product obtained by multiplying the applicable dose limit given in Table 2.1 by the ratio of the number of months remaining in the dosimetry period to the total number of months in the dosimetry period.

Labelling and Signs

Labelling of Containers and Devices

Containers that store NORM radioactive material should be labelled with:

(a) the radiation warning symbol set out in Figure G-1 and the words "RAYONNEMENT — DANGER — RADIATION"; and

(b) the name, quantity, date of measurement and form of the radioactive material in the container.

This does not apply to a container used to hold radioactive material for current or immediate use or in which the quantity of radioactive material is less than or equal to the amounts shown in Table 5.1. For transporting radioactive materials refer to Section 6, Standards for the Transport of NORM.

Posting of Signs at Boundaries and Points of Access

The employer should place a durable and legible sign that bears the radiation warning symbol shown in Figure G-1 and the words "RAYONNEMENT — DANGER — RADIATION", at the boundary, and at every point of access to the area, room or enclosure:

where,

(a) there is radioactive material present in an activity greater than 100 times the value shown in Table 5.1 in an area, room, or enclosure;

or,

(b) there is a reasonable probability that a person in the area, room or enclosure will be exposed to a radiation dose rate greater than 25 μSv/h.

Use of Radiation Warning Symbol

Whenever the radiation warning symbol is used it should be:

(i) prominently displayed;

(ii) of an appropriate size for the size of the container to which it is attached, or of the area, room, enclosure or vehicle for which it is posted;

(iii) oriented with one blade pointed downward and centred on the vertical axis;

(iv) no wording shall be superimposed on it.

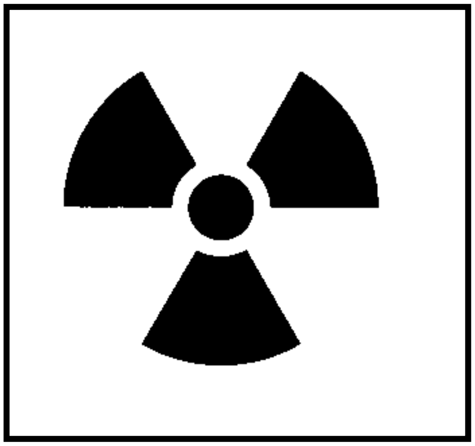
Frivolous Posting of Signs

A radiation warning sign should not be posted at a place where the radiation dose rate or radioactive material indicated on the sign is not present.

Records to Be Kept by Employer

Every employer should keep a record of the name and job category of each occupationally exposed worker.

Figure G-1
Radiation Warning Symbol



Note:

The three blades and the central disk of the symbol shall be:

(a) magenta or black; and

(b) located on a yellow background.

G Appendix

Glossary Of Radiation Terminology

Absorbed Dose: The mean energy deposited by ionizing radiation per unit mass of the body or organ or tissue of the body. Unit: gray (Gy), 1 Gy = 1 joule per kilogram.

Activity (Radioactivity): The number of nuclear transformations that occur in a quantity of material per unit of time. Unit: becquerel (Bq), 1 Bq = 1 disintegration per second.

ALARA: A principle of risk management according to which exposures are kept as low as reasonably achievable, economic and social factors being taken into consideration. A guiding principle of radiation protection.

Alpha Radiation (Alpha Decay): A high-energy positively charged particle ejected from the nucleus of an unstable (radioactive) atom, consisting of two protons and two neutrons. An alpha particle is a helium nucleus.

Annual Limit on Intake (ALI): The intake by inhalation, ingestion or through the skin of a given radionuclide in a year by a reference man which would result in a committed dose equal to the relevant dose limit. The ALI is expressed in units of activity.

Atomic Number: The number of protons contained in the nucleus of an atom. This number gives each atom its distinct chemical identity.

Atomic Mass (Mass Number): The total mass of protons and neutrons contained in the nucleus of an atom.

Background Radiation: The radiation to which an individual is exposed arising from natural radiation sources such as terrestrial radiation from radionuclides in the soil, cosmic radiation from space, and naturally occurring radionuclides deposited in the body from foods, etc.

Balance of Pregnancy: The period from the moment an employer is informed of the pregnancy to the end of the pregnancy.

Becquerel (Bq): An SI unit of radioactivity, equivalent to 1 nuclear transformation per second. Used as a measurement of the quantity of a radionuclide since the number of radioactive transformations (disintegrations) is directly proportional to the number of atoms of the radionuclide present. Replaces an earlier unit, the curie (Ci).

Beta Radiation (Beta Decay): The ejection of a high-energy negatively charged subatomic particle from the nucleus of an unstable atom. A beta particle is identical in mass and charge to an electron.

Contamination (Radioactive Contamination): Radioactive material present in excess of natural background quantities in a place it is not wanted.

Committed Dose: The total dose received from a radioactive substance in the body during the remainder of a person's life (assumed as 50 years for adults, 70 years for children) following the intake of the radionuclide.

Curie (Ci): A unit of activity equivalent to 3.7×10^{10} disintegrations per second. Replaced in international usage by the becquerel.

Decay (Radioactive Decay): A process followed by an unstable nucleus to gain stability by the release of energy in the form of particles and/or electromagnetic radiation. NORM materials decay with the release of alpha particles, beta particles and/or gamma photons.

Decay Series (Radioactive Decay Series): A succession of radionuclides, each member of which transforms by radioactive decay into the next member until a stable nuclide results. The first member is called the “parent”, the intermediate members are called “progeny” and the final stable member is called the “end product”. In the two NORM decay series; uranium-238 and thorium-232 are the “parents,” and lead-206 and lead-208 are the “end products”.

Derived Working Limit (DWL): A practical working limit derived from regulatory limits. Derived Working Limits can be compared to measured values at the work site to assess compliance with regulatory limits.

Diffuse NORM: NORM-contaminated material in which the radioactive concentration is uniformly dispersed. It is generally low in radioactive concentration, and relatively large in volume.

Discrete NORM: NORM-contaminated material in which radioactive substances are concentrated, or not uniformly dispersed throughout the material. It generally has much higher levels of radioactive concentration in a localized volume than diffuse NORM.

Dose Coefficient (DC): A factor that relates the amount of radiation dose (Sv) delivered to the body per unit of activity (becquerel) taken into the body. Unit: (Sv/Bq).

Dose Constraint: An upper bound on the annual dose that members of the public or incidentally exposed workers should receive from a planned operation or single source.

Dosimeter: A device for measuring a dose of radiation that is worn or carried by an individual.

Effective Dose: Radiation dose for primary radiation dose limits. It represents the sum of the equivalent doses received by different tissues of the human body, each multiplied by a “tissue weighting factor” (w_T). Unit: sievert (Sv).

Equilibrium (Radioactive): In a radioactive decay series, the state that prevails when the rate at which progeny are produced is equal to the rate at which they are decaying. This form of equilibrium may be attained only if the precursor is very long-lived relative to any member of the decay chain. All members of a NORM radioactive decay series in equilibrium have the same radioactivity.

Equivalent Dose: The absorbed dose multiplied by a “radiation weighting factor”, (w_R), which accounts for the different potential for adverse effects of the different types of radiation. Unit: sievert (Sv).

Five Year Dosimetry Period: The period of five calendar years beginning on January 1 of the year following the year in which the Radiation Protection Management Program is started, and every period of five calendar years thereafter.

Gamma Radiation (Gamma Rays or Gamma Photons): Electromagnetic radiation or photon energy emitted from an unstable nucleus in the process of ridding itself of excess energy. Highly penetrating, gamma rays lose energy as they pass through atoms of matter.

Gray (Gy): Radiation damage is dependent on the absorption of radiation energy and is approximately proportional to the concentration of absorbed energy in tissue. The gray is the SI unit of absorbed radiation dose corresponding to the absorption of 1 joule of radiation energy per kilogram of material. For gamma and beta radiations, the gray is numerically equal to the sievert.

Groundshine: Radiation detectable on the earth's surface from radioactive substances on or beneath the surface.

Half-life, Biological: The time required for the body to eliminate half the quantity of a substance taken into the body. A major factor in determining a radionuclide's Dose Coefficient.

Half-life, Radioactive: The time required for a radioactive material to lose half of its activity through radioactive decay.

IAEA: International Atomic Energy Agency.

ICRP: International Commission on Radiological Protection.

Incidentally Exposed Workers: Employees whose regular duties are not expected to result in exposure to NORM radiation. The public annual dose limit of 1 mSv applies to this category of workers in an occupational exposure environment - the occupational domain.

Incremental Dose: Radiation dose found in excess of the local background radiation dose.

NORM (Naturally Occurring Radioactive Materials): NORM is an acronym for naturally occurring radioactive materials comprising radioactive elements found in the environment. Long-lived radioactive elements of interest include uranium, thorium and potassium and any of their respective radioactive decay products such as radium and radon. Some of these elements have always been present in the earth's crust and within the tissues of all living beings. Although the concentration of NORM in most natural substances is low, higher concentrations may arise as the result of human activities.

One-year Dosimetry Period: The period of one calendar year beginning on January 1 of the year following the year in which the Radiation Protection Management Program is started, and every period of one calendar year thereafter.

Occupationally Exposed Workers (NORM Workers): Employees who expect to receive exposure to sources of NORM radiation as a result of their regular duties. The annual occupational dose limit of 20 mSv applies to this category of workers in an occupational exposure environment.

Personal Dosimetry Threshold: The annual effective dose above which radiation dosimetry of individual workers is required.

Phosphogypsum Stack: Phosphogypsum stack refers to the storing of phosphogypsum, a byproduct of fertilizer production, in large outdoor stockpiles.

Photons (X-ray or Gamma rays): See gamma radiation.

Rad: A historical radiation unit for measuring radiation energy absorption (dose), equivalent to 100 ergs per gram in any medium. RAD is an acronym for Radiation Absorbed Dose. Now replaced in international system of units by the “gray” (Gy).

Radiation Weighting Factor (w_R): A value recommended by the International Commission on Radiological Protection, and usually adopted by national regulatory agencies, to convert absorbed dose from various types of ionizing radiation into its dose equivalent in terms of biological harm from alpha, beta or gamma radiation. For gamma rays and beta particles, **$w_R = 1$**. For alpha particles and fast neutrons, **$w_R = 20$**.

Radiochemical Analysis: Analysis of the radioactive content of a NORM sample. Radiochemical analysis will identify and quantify the concentration of various radionuclides in the NORM sample.

Radionuclide or Radioisotope: A particular form of an element, characterized by a specific atomic mass and atomic number, whose atomic nucleus is unstable and decays or disintegrates with a statistical probability characterized by its physical half-life.

Radium-226: A radioactive element with a half life of 1600 years. It is a particularly hazardous decay product of natural uranium, and is frequently the dominant NORM nuclide. It decays into the radioactive gas Radon-222.

Radon: The only radioactive gas generated during natural radioactive decay processes. Two radioisotopes of radon are present — radon and thoron — each a decay product of radium. Radon (Rn-222) is found in the uranium decay series while thoron (Rn-220) is found in the thorium decay series.

Radon Progeny: The products of radon (radon-222) or thoron (radon-220) decay with short half-lives. Radon decay products include; Polonium-218 (RaA), Lead-214 (RaB), Bismuth-214 (RaC), and Polonium-214 (RaC'). Thoron decay products include; Polonium-216 (ThA), Lead-212 (ThB), Bismuth-212 (ThC), Polonium-212 (ThC’), and Thallium-208 (ThC”)

Rem: A historical unit of human dose equivalent. Rem is an acronym for roentgen equivalent man and was replaced in 1977 by the sievert in the international system of units.

Roentgen (R): The classical unit of radiation ionization in air, frequently misapplied as a unit of exposure in humans. Replaced in international system of units by the “coulomb per kg in air”.

Shielding: The reduction of radiation beam intensity by interposing, between the source and an object or person that might be exposed, a substance that absorbs radiation energy, either by collision, in the case of particulate radiation, or by absorption of waveform energy, in the case of gamma photons.

SI (Systeme Internationale): The “metric” system of units generally based on the metre/kilogram/second units. Special quantities for radiation include the becquerel, gray and sievert.

Sievert (Sv): The sievert is the unit of radiation equivalent dose, H, that is used for radiation protection purposes, for engineering design criteria and for legal and administrative purposes. The sievert is the SI unit of absorbed radiation dose in living organisms modified by radiation type and tissue weighting factors. The unit of dose for the terms “equivalent dose” and “effective dose”. It replaces the classical radiation unit the rem. Multiples of sieverts (Sv) used in the *Guidelines* include millisieverts (mSv) and microsieverts (μSv).

Specific Activity (Radioactive Concentration): The number of becquerels per unit of mass of a material. Units: Bq/g and kBq/kg

Tissue Weighting Factor (w_T): A weighting factor developed by the ICRP that assigns a relative share of total radiation dose detriment to specific organs and tissues. Risks from localized radiation exposures to specific organs and tissues can be quantified.

Unconditional Derived Release Limits (UDRL): Within the Unrestricted classification, the radioactive activity of NORM below which NORM can be released into the public domain without restrictions.

Working Level (WL): A unit for potential alpha energy concentration, (PAEC), resulting from the presence of radon progeny equal to the emission of 1.3×10^5 MeV of alpha energy per litre of air. In SI units the WL corresponds to 2.08×10^{-5} joules per cubic metre (J/m^3).

Working Level Month (WLM): A measure of the cumulative exposure to radon progeny in air. One Working Level Month is defined as the exposure received by an individual inhaling air containing a radon progeny concentration of one WL for a period of 170 hours, the assumed number of hours in a working month. One working level month is equivalent to 3.54 mJ h m^{-3}.

THE FEDERAL POLICY ON WETLAND CONSERVATION

Government of Canada 1991

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For more information on *The Federal Policy on Wetland Conservation* and wetlands in general, please contact:

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BACKGROUND

In 1986 and early 1987 Environment Canada developed a national statement and fact sheet on wetland issues in Canada summarizing management problems and identifying the major obstacles to wetland conservation. The Department subsequently sponsored a non-government organizations Workshop on Wetland Conservation Policy in February 1987. This workshop developed a series of recommendations directed to all governments in Canada concerning the need for wetland policy. These recommendations were sent to all Environment and Natural Resource Ministers across the country.

The Federal-Provincial Committee on Land Use (FPCLU) in 1987 identified "wetlands management" as a significant land use issue. A Wetlands Subcommittee of the FPCLU was convened in June 1987, and produced a report entitled "A Framework for Wetlands Policy in Canada". This report was endorsed by the full committee and members agreed to encourage use of this framework, as appropriate, in their own jurisdictions. Also in early 1987, the Federal Interdepartmental Committee on Land identified the need to develop a wetlands policy statement to supplement the "wise land use" provisions of the Federal Policy on Land Use. The Federal Water Policy adopted in 1987 also identified wetlands conservation as a significant water resource issue.

For over 10 years Canada has been a signator nation to the Ramsar Convention, an international treaty focusing on conservation of wetlands of international importance. A major obligation under the Convention is implementation of principles, proposed in 1987 by Canada, for the wise use of wetlands. The Convention notes the "wise use" of wetlands is defined as their "sustainable utilization for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem". Further, it calls for the establishment of wetland conservation policies in each nation to improve institutional and organizational arrangements, to address legislative needs, to increase knowledge and awareness of wetland values, to monitor the status of wetlands, to identify program priorities and to develop action plans for specific sites. Canada is a major supporter of this Convention, having hosted the Third Conference of the Contracting Parties at Regina in 1987 and, more recently, providing the Vice-Chairperson to the Convention's Standing Committee. Thirty wetlands of international importance have been designated to date in Canada out of about 450 such sites worldwide.

A commitment to wetlands conservation and the need for wetland policy have not only been recognized at the international level by Canada but also nationally. In April 1990, the Federal Government and numerous non-government and industry groups (including Ducks Unlimited Canada, Wildlife Habitat Canada, and the National Round Table on the Environment and the Economy) co-hosted a national policy conference entitled the "Sustaining Wetlands Forum". This national meeting focused on opportunities for partnerships in wetland conservation and development of responses by all economic sectors to the implementation of the North American Waterfowl Management Plan. A series of national recommendations were developed including a call for all jurisdictions in Canada to develop mutually supporting wetland conservation policies by 1991. At the Sustaining Wetlands Forum the Prime Minister of Canada was a keynote speaker. His address included statements confirming the Federal Government's intention to act on wetland policy as part of the national Green Plan.

During the summer of 1990, the Federal Government undertook national consultations on Green Plan proposals. The summary report of these consultations indicated that there is widespread public support for the conservation of Canadian wetlands, for actions to reclaim degraded sites, and for protection of important wetlands through a cooperative, national approach. Subsequently, in December 1990 the Green Plan included a specific commitment that the Federal Government would adopt *The Federal Policy on Wetland Conservation* in 1991.

Hence, for over three years a consultative process has been underway to develop clear policy by the Federal Government that promotes wetland conservation. This has arisen as a result of interdepartmental and intergovernmental interest in this area, the support and consultative advice of non-government groups, Canada's international treaty commitments, support by a national policy conference on wetlands with strong business and private sector involvement, a public commitment by the Prime Minister of Canada, and most recently, widespread public support and a clear commitment for action in this area via the Green Plan. These actions all clearly demonstrate that concerns for conservation of wetlands have been elevated to the national environmental agenda. *The Federal Policy on Wetland Conservation* has undergone extensive review by stakeholders, consultation with affected federal agencies and discussion with provincial and territorial agencies and non-government groups. The Policy represents a prudent and thoughtful federal response to wetland decline in Canada.

THE WETLAND RESOURCE

The Importance of Wetlands

Canada is the custodian of a major portion of the world's wetland resource base. With more than 127 million ha of wetlands, the country is estimated to incorporate up to one-quarter of the world's wetland area.

These wetlands are more than a peculiar landscape form. Indeed, the *World Conservation Strategy* has identified wetlands as one of the key life support systems on this planet, in concert with agricultural lands and forests. Their importance goes beyond their status as the habitat of many endangered plant and animal species. They are a vital element of national and global ecosystems and economies.

Ecological Functions

Wetlands serve many important ecological functions, including:

- **water recharge**, providing natural purification and storage of freshwater for humans and wildlife
- **natural shoreline protection** from wave action and erosion
- **natural flood reduction and control**, through water storage and retention
- **important source of oxygen**, and a vital element of the **natural evapotranspiration and climatic cycles**
- **habitats** for a wide range of waterfowl, flora, furbearers, reptiles and fish
- **refugia for rare and endangered species**
- **preservation of biodiversity and vitality of species**
- **natural storage base for carbon**

- **natural sinks for pollutants** such as sulphur from acid rain and heavy metals
- **nutrient source** for connected waters
- **soil and water conservation**

Socio-Economic Functions

With their unique properties, wetlands also serve many important socio-economic functions, including:

- **hunting, trapping and fishing** resource base (many wetland-based enterprises have special economic importance in remote areas such as for native communities that depend upon the harvest of waterfowl, ungulates, fish, and fur-bearing animals that thrive in wetland areas)
- **major attractions for tourism and recreation**
- a potential major **domestic peat energy source** available in remote areas
- an important **domestic source of peat** for horticultural and agricultural applications
- **forest products** harvesting for hardwood and pulpwood
- **agriculture** (in their natural and/or managed states, wetlands support the soil base for market garden crops and production of other specialty crops such as berries and wild rice)
- **a rich and varied landscape** serving as a valued aesthetic resource
- a focus **for scientific research**
- **natural heritage areas**

Estimated Value of Wetland Functions

In financial terms alone, Canada's wetlands are valued in the billions of dollars. This includes the financial value of annual production directly related to wetlands, including both consumptive activities such as hunting, fishing and trapping, and non-consumptive activities such as tourism and recreation. It also includes the value derived from natural functions such as flood control and water purification. Estimates in the internationally recognized book *Wetlands of Canada*, published in 1988, indicate that the economic returns derived from wetlands exceed $10 billion annually in Canada. The economic values of wetlands alone are a strong argument for their conservation.

Loss and Degradation of Wetlands in Canada

Despite the importance of wetlands to Canada's ecological and economic health and vitality, the last two centuries have witnessed their continued loss and degradation. Since 1800, an estimated 20 million ha – one seventh of Canada's total wetland base -- have been drained or lost to other functions. Millions more hectares have been seriously degraded or are at imminent risk.

The loss of wetlands has been felt in every region of the country:

- two-thirds (65%) of the **Atlantic coastal salt marshes** are gone
- 80 to 98% of wetlands immediately within or adjacent to many of Canada's **urban centres** have been lost
- more than two-thirds (68%) of the wetlands once present in **southern Ontario** no longer exist

- over half of the **potholes in the central prairies** have been lost
- the majority (70%) of the **Pacific estuary marshes** are gone or degraded

Threats to Wetlands

The greatest single threat to wetlands historically has been drainage for agricultural purposes, accounting for 85% of total known conversions. Urban growth and industrial expansion account for an additional 9%. Other factors also contribute to wetland degradation including recreational development, hydro development, lake-level management, and drainage for forestry and peat harvesting. These figures refer to outright losses or conversions of wetlands. They do not tell the whole story, since pollution, competing and incompatible uses, and other intrusions also affect the quality and character of wetlands – their ecological vitality, geographic contiguity and the surviving individual plant or animal species whose habitats or nesting grounds are in wetlands. The impacts of such major long-term forces as global climatic change, groundwater pollution and acid rain are unknown, but of great concern.

Since the settlement era in each region of the nation, wetland use and conversion have contributed significantly to socio-economic development and to the ecological vitality of Canada. However, continuing wetland degradation and loss have now reached critical levels in many areas. In order to ensure that remaining wetlands are conserved and utilized in a sustainable manner, these trends cannot be allowed to continue.

The Federal Response

Although wetland conservation is a shared federal, provincial, and territorial responsibility, the Federal Government has a particular role to play. Wetlands are critical to federal responsibilities for maintaining the quality of the environment, migratory bird populations, inland and ocean fisheries, and international or transboundary resources such as water and wildlife. The Federal Government is also responsible for managing the impacts of over 900 of its policies and programs in Canada. Many of these directly or indirectly affect wetlands. For example, the Federal Government is a major landowner in its own right, and has direct management responsibility for major tracts of wetlands across the country. Over 29% of all of Canada's wetlands are estimated to be located on federal lands or waters, largely in our northern territories. These include national parks, community pastures, ports and harbour lands, wildlife areas, and a wide range of other crown land holdings. An estimated 8% of our National Parks are covered by wetlands, and 60% of the combined area of National Wildlife Areas and Migratory Bird Sanctuaries are wetlands. The Federal Government also develops and administers a range of broader social, economic and environmental policies and programs – both domestic and international – that can have an important impact on wetland conservation and use. It has a series of international treaty obligations for wetlands as well.

The Federal Government views its role in wetland conservation as a partner with other governments and the private sector, reflecting the national interest. It intends to be a leader by example and is committed to assisting national efforts in wetland conservation through the provision of models, tools and expertise and improving knowledge on the wetland resource of Canada. It will act as a catalyst, stimulating and enabling Canadians to participate in a collective effort.

The recommendations of the (Brundtland) World Commission on Environment and

Development, the Canadian Council of Resource and Environment Ministers' (CCREM) National Task Force on Environment and Economy, the Federal-Provincial Agriculture Committee on Environmental Sustainability, the Sustaining Wetlands Forum, and public consultations on the Green Plan all have emphasized the need for wetland policy and the incorporation of environmental objectives into the mainstream of economic decision-making. *The Federal Policy on Wetland Conservation* accordingly builds wetland conservation into the daily business of the Federal Government. Working primarily through existing programs and regulatory and decision mechanisms, the Policy is designed to advance wetland conservation within the context of efficient delivery of federal services.

To carry out its responsibilities with respect to the nation's wetlands, the Federal Government has outlined a broad objective, supported by a number of specific goals. Guiding principles are presented to govern how this federal policy will be applied. Seven strategies specify the ways and means by which the Federal Government will proceed.

The Federal Policy on Wetland Conservation complements the goals and objectives of the North American Waterfowl Management Plan, the Federal Water Policy, the Fisheries and Oceans Canada Policy for the Management of Fish Habitat, the Great Lakes Water Quality Agreement, the International Ramsar Convention, the Wildlife Habitat Canada "Common Ground" Initiative, and the Wildlife Policy for Canada adopted by the Wildlife Ministers Council of Canada.

THE FEDERAL POLICY ON WETLAND CONSERVATION

Objective

The objective of the Federal Government with respect to wetland conservation is to:

> *promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future.*

Goals

In support of the above objective, the Federal Government, in cooperation with the provinces and territories and the Canadian public, will strive to achieve the following goals:

- **maintenance** of the functions and values derived from wetlands throughout Canada
- **no net loss of wetland functions** on all federal lands and waters
- **enhancement and rehabilitation** of wetlands in areas where the continuing loss or degradation of wetlands or their functions have reached critical levels
- **recognition** of wetland functions in resource planning, management and economic decision-making with regard to all federal programs, policies and activities
- **securement** of wetlands of significance to Canadians
- **recognition of sound, sustainable management practices** in sectors such as forestry and agriculture that make a positive contribution to wetland conservation while also achieving wise use of wetland resources
- **utilization** of wetlands in a manner that enhances prospects for their sustained and

productive use by future generations

Guiding Principles

In pursuing the above objectives, the Federal Government will respect the following principles. All are critical to this Policy and are not presented in any particular order of importance:

- Wetlands and their functions contribute significantly to the health and well-being of Canadians and are a desirable element of Canada's natural diversity; as such, they are a priority requirement of environmental conservation and sustainable development efforts.
- Wetland conservation is dependent on the incorporation of environmental objectives into the economic decision-making process, as recommended by the (Brundtland) World Commission on Environment and Development, the CCREM National Task Force on Environment and Economy, the Federal-Provincial Agriculture Committee on Environmental Sustainability, and the Sustaining Wetlands Forum.
- Wetlands and wetland functions are inextricably linked to their surroundings, particularly aquatic ecosystems, and therefore wetland conservation must be pursued in the context of an integrated systems approach to environmental conservation and sustainable development.
- On-going development and refinement of scientific knowledge and expertise in Canada is fundamental to the achievement of wetland conservation.
- Wetland conservation can only be achieved through a coordinated, cooperative approach involving all levels of government and the public, including landowners, non-government organizations, and the private sector.
- The Federal Government will play a major role in advocating and achieving wetland conservation, while respecting the jurisdiction of the provinces and territories and the rights of individual landowners.
- In consultation and cooperation with native institutions and representatives in Canada, the Federal Government will promote a cooperative approach to wetland conservation for lands and waters held by the Federal Government for native peoples.
- A basic change in the attitude and perceptions of Canadians regarding wetlands, through communication and education programs, is a vital prerequisite of wetland conservation.
- Canada has a special responsibility to provide leadership in international wetland conservation efforts, through the management of transboundary resources such as water and wildlife in North America, encouragement of global wetland conservation, and active participation in international treaties, conventions and forums.

Strategies

The Federal Policy on Wetland Conservation outlines seven strategies to provide for the use and management of wetlands so that they can continue to provide a broad range of functions on a sustainable basis. These strategies are aimed at working in concert with other ongoing initiatives for wetland conservation. They are aimed at providing practical direction, support, and tools to program managers. They set out direction to put the federal house in order, to manage federal wetlands, and to ensure effective wetland science and public awareness actions both nationally and internationally. All seven strategies are deemed to be critical to the success of the Policy.

1. Developing Public Awareness

The Federal Government will promote public awareness and understanding of the wetland resource in Canada and actively encourage participation of the Canadian public, including landowners, non-government organizations, aboriginal governments and institutions, and the private sector, in wetland conservation.

- Design and deliver a national public awareness program on wetlands in cooperation with other governments, non-government organizations and the private sector. This should be targeted at all levels including political.
- Inform Canadians of the health of the wetland resource on a regular basis through State of the Environment Reporting. Ensure that results of wetland research are available in formats suitable for public use and education.
- Promote the use of National Parks, National Wildlife Areas, other federal lands and waters secured for conservation purposes, and a proposed network of wetlands of significance to Canadians to communicate the values of wetlands.
- Continue to provide information and expertise concerning sustainable land use management and conservation practices, particularly as they affect soil, water and wetland conservation and management.
- Provide suitable opportunities for public review and evaluation of the Federal Government's performance relative to its wetland conservation goals.
- Promote development of targeted wetland education and outreach materials.

2. Managing Wetlands on Federal Lands and Waters and in Other Federal Programs

The Federal Government will develop exemplary practices in support of wetland conservation and sustainable wetland use to be incorporated in the design and implementation of federal programs and in the management of federal lands and waters.

- Encourage actions to enhance wetland functions on federal lands and waters through the on-going implementation of all federal programs, especially in those areas of Canada where the continuing loss or degradation of wetlands has reached critical levels, or where wetlands are important ecologically or socio-economically to a region.
- Commit all federal departments to the goal of no net loss of wetland functions (i) on federal lands and waters, (ii) in areas affected by the implementation of federal programs where the continuing loss or degradation of wetlands has reached critical levels, and (iii) where federal activities affect wetlands designated as ecologically or socio-economically important to a region. Due to local circumstances where wetland losses have been severe, in some areas no further loss of any remaining wetland area may be deemed essential.
- Develop guidelines to ensure the mitigation of the impacts of Federal Government activities affecting wetland functions and, where appropriate, develop compensatory measures.
- Promote a cooperative approach to wetland conservation initiatives for lands and waters held by the Federal Government for native peoples (such as Indian Reserves and lands and waters transferred to native peoples under comprehensive land claim settlements) in consultation and cooperation with native institutions and peoples.
- Pursue opportunities to expand or enhance federal policies, programs and regulations that have a positive effect on wetland conservation, and improve those that would otherwise result in wetland conversion or degradation in the pursuit of other objectives.

- Demonstrate and clarify links with other federal policy initiatives including the Federal Water Policy, Federal Policy on Land Use, the Fisheries and Oceans Canada Policy for the Management of Fish Habitat, the Federal Environmental Quality Policy Framework, the Arctic Marine Conservation Strategy, and the objectives of the North American Waterfowl Management Plan, that serve to advance wetland conservation interests. This may involve agreements and memoranda of understanding between federal departments or agencies to clarify respective federal roles and responsibilities with regard to wetland conservation.
- Encourage recognition of wetland functions in natural resource conservation and development strategies such as those for forests, minerals, agricultural lands, and water.
- Support protection of critical wetlands of significance to Canadians by federal or other mechanisms wherever feasible.
- Ensure that the hydrologic functions of wetlands, such as groundwater recharge, water flow regulation and water purification, are adequately reflected in federal water management activities.
- Encourage the use of watersheds as appropriate spatial units for implementation of integrated water management policy and programs.

3. Promoting Wetland Conservation in Federal Protected Areas

The Federal Government will continue to manage the use of National Parks, National Wildlife Areas, Migratory Bird Sanctuaries, National Capital Commission lands and other federal areas established for ecosystem conservation purposes so as to sustain their wetland functions and natural processes.

- Require the creation of management plans which adequately reflect the special role of the wetland resource on federal lands secured for ecosystem conservation purposes, and the periodic review and update of these plans. Management of such wetlands should only support those activities which are compatible with sustaining wetland functions.
- Commit federal land managers to the goal of no net loss of wetland functions in all federal areas secured for conservation purposes.
- Protect these wetlands from impacts resulting from land or water use and environmental quality changes, both internal and external to the federal area boundaries, by applying the Federal Environmental Assessment and Review Process, by enforcing compliance with federal regulations, by working cooperatively with other levels of government, non-government organizations and the private sector and, if required, by intervening in legal or decision-making processes.
- Encourage recreational, scientific, and educational uses of wetlands as long as these uses are not detrimental to wetland functions and do not conflict with the purposes of the area.
- Develop and amend, where necessary, new and existing federal policies and legislation so as to enhance wetland conservation within federal areas established for ecosystem conservation purposes.

4. Enhancing Cooperation

The Federal Government will continue to be a partner in cooperative activities and agreements with the provinces and territories and non-government agencies to advance wetland conservation.

- Continue to participate in joint federal, provincial and territorial wetland inventory, evaluation, and monitoring programs in support of: the identification of geographic areas within which the continuing loss or degradation of wetlands has reached critical levels; the identification of significant wetlands requiring protection; and the identification of management strategies for the sustainable use of wetland resources.

- Encourage and support provincial and territorial policies that promote wetland conservation, and promote the development of other related strategies. Encourage recognition of wetlands in the development and implementation of provincial, territorial and regional conservation strategies.
- Encourage consultation with interested provinces and territories and other parties whereby senior levels of government ensure that their wetland conservation policies and programs are supportive of each other.
- Enhance and, where necessary, develop new mechanisms for the resolution of interjurisdictional wetland problems.

5. Conserving Wetlands of Significance to Canadians

The Federal Government will participate in and promote the establishment of a systematic and coordinated national network of secured wetlands to be achieved in cooperation with provincial and territorial governments and other stakeholders. Such an approach will lead to a comprehensive network of secured sites or complexes of exemplary and strategically important wetlands of significance to Canadians, together representing the full range of wetland functions and types.

- Establish and assist in maintenance of inventories of wetlands that have been secured for conservation purposes in each of the 20 wetland regions of Canada.
- Develop national and regional criteria for identification and promote listing of wetlands of significance to Canadians in all regions using a standardized approach primarily on the basis of existing information.
- In those cases where wetlands of significance to Canadians are found to be unprotected, encourage use of all suitable mechanisms to secure these wetlands on a priority basis.
- Encourage management of all secured wetlands of significance to Canadians to promote long-term protection of their wetland functions.
- Promote use of a national network of secured wetlands as benchmark sites for environmental monitoring, scientific research, education, and public awareness.

6. Ensuring a Sound Scientific Basis for Policy

The Federal Government will support and promote the development of expertise for a sound technical and scientific basis for wetland conservation, ensuring that the information necessary for making decisions regarding wetlands is accessible to planners, managers, regulators, and other decision-makers at all levels.

- Encourage research that is directed toward advancing wetland conservation and sustainable use of wetland resources and ensure that the results of such research are effectively integrated into decision-making.
- Encourage the establishment of wetland centres of research and expertise in Canadian and foreign educational institutions.
- Support and promote a nationally standardized approach to consistent and comparable wetland inventories, monitoring, and evaluations to guide the use, management and

conservation of wetlands across Canada and to recognize the full range of wetland functions.

- Undertake, support and promote the development of guidelines and standards aimed at establishing regional target levels for the quantity and quality of wetlands required to safeguard the range of wetland functions across Canada. Such standards must refer to the level at which wetland loss or degradation threatens the health of regional ecosystems and species survival.
- Promote the use of wetland benchmark sites for long-term ecosystem monitoring, scientific research, education, and public awareness.
- Support research and demonstration projects on mitigating the impacts of inappropriate development on wetlands, and on the restoration and rehabilitation of degraded wetlands.
- Monitor wetland trends from national and regional perspectives so as to establish wetland baselines and statistics for use in targeting of conservation efforts in priority areas. Monitor wetland quality in support of the development and application of standards and guidelines for wetland conservation.
- Encourage the development of techniques for the integration of wetland functions into natural resource allocation decisions, reflecting the full range of wetland functions and values in such techniques, and demonstrate the appropriate roles of wetland conservation in solving land use problems.
- Promote research to better define the role of wetlands in the hydrologic cycle (groundwater recharge, water purification, flood control, and the maintenance of flow regimes), and the effects on wetlands of global atmospheric cycles, shoreline erosion, renewable resource production, management of exotic species such as purple loosestrife, and the provision of fish and wildlife habitat.
- Promote research on the impact of climate change on Canada's wetlands, and the implications of such change for federal policies and programs.
- Promote research on wetland restoration, minimum operating standards, and codes of ethics for peatland resource harvesting and peatland forestry industries.

7. Promoting International Actions

The Federal Government will promote conservation and sustainable use of wetlands internationally, and encourage the involvement of other nations and international organizations in wetland conservation efforts.

- Ensure that Canadian international assistance programs, such as those administered by the Canadian International Development Agency and the International Development and Research Centre, are based on sustainable development principles and promote the maintenance and enhancement of wetland functions. Promote pro-active strategies such as that emphasized in the Canadian International Development Agency's Environmental Policy.
- Provide technical and advisory assistance to wetland conservation efforts in other countries, particularly for those wetlands used by wildlife populations shared with Canada.
- Continue to support and implement Canada's commitments under international conventions and agreements that contribute to the global conservation of wetlands and their functions and encourage other nations to become signatories to such conventions and agreements.

- Strengthen Canada's role in international wetland conservation, by requiring regular review of Canadian progress on international conventions with relevance to wetlands, and by identification of gaps or weaknesses in honouring international commitments and responsibilities.
- Promote wetland conservation through continued strong commitments to the Ramsar Convention on Wetlands of International Importance, the World Heritage Convention and international agreements and treaties.
- Continue to support and implement bilateral and multilateral agreements and similar arrangements that promote conservation and sustainable use of wetlands such as the North American Waterfowl Management Plan, the Great Lakes Water Quality Agreement, the Western Hemisphere Shorebird Reserves Network, the International Biosphere Reserves Program, and new or existing agreements on marine and estuarine environmental quality, and emerging issues such as biodiversity and climate change.
- Provide leadership in global wetland conservation through development and transfer of models, tools, information and expertise to other nations.
- Ensure that Canadian representatives on international inquiries and commissions have an adequate understanding of wetland issues so as to promote wetland conservation in their consideration of the implications of transboundary management issues and opportunities for the sustainable use of wetland resources.

GLOSSARY OF TERMS IN THE POLICY

The following terms are used in the Policy. A general definition of each is presented here as a guide to readers of this document.

"Wetland"

A wetland is land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment. Wetlands include bogs, fens, marshes, swamps and shallow waters (usually 2 m deep or less) as defined in *The Canadian Wetland Classification System* published by the National Wetlands Working Group of the Canada Committee on Ecological Land Classification (1987).

"Wetland Functions"

Wetland functions include the natural processes and derivation of benefits and values associated with wetland ecosystems, including economic production (e.g. peat, agricultural crops, wild rice, peatland forest products), fish and wildlife habitat, organic carbon storage, water supply and purification (groundwater recharge, flood control, maintenance of flow regimes, shoreline erosion buffering), and soil and water conservation, as well as tourism, heritage, recreational, educational, scientific, and aesthetic opportunities.

"Wetland Regions of Canada"

As spatially defined by the National Wetlands Working Group of the Canada Committee on Ecological Land Classification, wetland regions are areas within which characteristic wetlands develop in locations that have similar topography, hydrology and nutrient regimes. Twenty wetland regions in Canada have been identified in the book *Wetlands of Canada* (1988).

"Canadian Wetland Classification System"

A national framework presenting standardized criteria and definitions, *The Canadian Wetland Classification System* contains three hierarchical levels: (1) class, (2) form, and (3) type. Five wetland classes are recognized on the basis of the overall genesis of the wetland ecosystem (i.e. bog, fen, marsh, swamp, and shallow water). Seventy wetland forms are differentiated on the basis of surface morphology and pattern, landscape setting, water type, and morphology of underlying mineral (e.g. string bog, shore marsh, stream swamp). Wetland types are classified according to vegetation physiognomy (e.g. treed, moss covered, floating).

"Wetlands of Significance to Canadians"

Wetlands of significance to Canadians are:

(a) "exemplary" or "characteristic" of the wetlands dominant or rare within each of Canada's 20 wetland regions and the full range of wetland forms and types;
(b) "strategic" or "essential" to meeting a goal or objective specific to a wetland function (e.g. a marsh essential to the maintenance of a migratory bird population).

Wetlands are considered strategically significant for a variety of factors including:

- Water Quality – the wetland enhances water quality directly, in a related groundwater system, in a watershed in general, or in a domestic or other water source.
- Toxics – the wetland acts to naturally retain toxic substances, thereby improving local or regional soil or water quality.
- Water Quantity – the wetland enhances watershed water storage capacity, thereby affecting flood peaks and seasonal water releases.
- Habitat – the wetland provides a range of valuable wildlife habitats in terms of quality, quantity and/or diversity.
- Wildlife – the population of some species of wildlife is dependent on the wetland.
- Endangered Species – the wetland is habitat for any endangered species as defined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).
- Human Use – a significant portion of the economic benefits derived from consumptive uses of the wildlife, forest products, peat, rice or other wetland natural resources is dependent on the wetland site or complex.
- Recreation – various non-consumptive and other recreational values are derived from the wetland.
- Economic – the wetland has a range of significant economic uses or potentials based on the resources and values present.
- Education and Research – the wetland is used or has potential for education, scientific monitoring, or research.
- Uniqueness – the wetland is a unique or highly representative example of an unusual ecosystem.
- Quantity – based on regional or national thresholds established for specific forms of wetlands,

the wetland is a significant component of the remaining baseline area and critical to the maintenance of local, regional or national biodiversity.

"Sustainable Use of Wetlands"

The sustainable use of wetlands requires management planned within the carrying capacity of the wetland ecosystem, or that of the regional or national resource, so as to ensure that the ecological and socio-economic functions of the wetlands are maintained for the long term in a sustainable manner.

"Secured Wetlands"

Secured wetlands are sites or complexes which are committed to conservation objectives by application of the full range of tenure and protection mechanisms (such as acquisition, legal protection, lease arrangement, or management agreement) that ensure that the wetland and/or its associated functions are sustained.

Canadian Environmental Assessment Agency | Agence canadienne d'évaluation environnementale

Public Participation in Environmental Assessment under the *Canadian Environmental Assessment Act, 2012*

Interim Reference Guide

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Version 1

Canada

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Document Information

Disclaimer

Please be advised that this draft guidance piece is an interim document. The Agency is currently reviewing the Environmental Assessment process and as a result of the review, EA practice, policies and procedures may change. This draft guidance document reflects current practice under the Canadian Environmental Assessment Act, 2012 (CEAA 2012).

This Reference Guide is for information purposes only. It is not a substitute for the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) or its regulations. In the event of an inconsistency between this Reference Guide and CEAA 2012 or its regulations, CEAA 2012 or its regulations would prevail.

For the most up-to-date versions of CEAA 2012 and regulations, please consult the Department of Justice website.

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Updates

This document may be reviewed and updated periodically. To ensure that you have the most up-to-date version, please consult the Policy and Guidance page of the Canadian Environmental Assessment Agency's website.

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Alternative formats may be requested by contacting: info@ceaa-acee.gc.ca.

This document is also available in Adobe's Portable Document Format.

TABLE OF CONTENTS

INTRODUCTION

Purpose

This Guide describes the key public participation opportunities during an environmental assessment conducted by the Canadian Environmental Assessment Agency (the Agency) or by a review panel under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012). CEAA 2012 has legislated requirements to provide opportunities for public participation, providing certainty and clarity on how your voice can be heard during the environmental assessment process.

Application

Under CEAA 2012, an environmental assessment may be required for designated projects – those projects described by the *Regulations Designating Physical Activities* or designated by the Minister of the Environment (the Minister) because of potential adverse environmental effects or related public concern (subsection 14(2)).

The term “project” refers to designated projects under CEAA 2012 for which the Agency is the responsible authority.

Throughout the document, the term "environmental effects" refers to environmental effects as described in section 5 of CEAA 2012.

Depending on the nature of the designated project, the environmental assessment is carried out by one of three responsible authorities: the Agency, the National Energy Board or the Canadian Nuclear Safety Commission. Other federal authorities may be designated as responsible authorities in the future. Projects for which the Agency is the responsible authority are described in the *Regulations Designating Physical Activities*. This Guide focusses on how the public can participate in environmental assessment processes where the Agency is the responsible authority. Information on processes by the National Energy Board or the Canadian Nuclear Safety Commission is available on their respective websites.

Predictable opportunities for public participation enable members of the public to better plan their involvement and manage resources more efficiently. After reading this Guide, you will understand how and when to participate in an environmental assessment when the Agency is the responsible authority, as well as the general roles and responsibilities of the Agency and other participants in the environmental assessment process.

CEAA 2012 allows the federal environmental assessment process to be substituted for a provincial environmental assessment process. In this case, the public needs to follow the province’s public participation process (see Annex 1).

The Environmental Assessment Process under CEAA 2012

Environmental assessment is a planning and decision-making tool used to minimize or avoid adverse environmental effects of proposed initiatives before they are carried out.

An environmental assessment identifies possible adverse environmental effects and mitigation measures to lessen those effects and assesses whether a project is likely to cause significant adverse environmental effects after mitigation measures are implemented.

Comments received from the public throughout the environmental assessment process influence the identification and assessment of adverse environmental effects, the development of mitigation measures, the determination of significance and the development of a follow-up program.

When the Agency is the responsible authority, there are two possible types of environmental assessment:

Environmental Assessment by the Agency:
The Agency reviews all of the information submitted by participants (e.g. the project proponent, the public and Indigenous groups) to prepare an environmental assessment report. This report is advisory in nature, contains the Agency's conclusions and recommendations, and is submitted to the Minister to support the Minister's decision.

Environmental Assessment by a review panel:
A panel of independent experts appointed by the Minister reviews all of the information submitted by participants (e.g. the project proponent, the public and Indigenous groups) to prepare a panel report. This report is advisory in nature, contains the review panel's conclusions and recommendations and is submitted to the Minister to support the Minister's decision.

Both approaches allow the Agency or the review panel to conduct the environmental assessment in cooperation with another jurisdiction, such as a province, when the jurisdiction also has a responsibility to conduct an environmental assessment (see Annex 1).

For more information about the environmental assessment process and timelines under CEAA 2012, please consult the Basics of Environmental Assessment.

Public Participation and Environmental Assessment

CEAA 2012 (paragraph 19(1)(*c*)) requires that comments from the public be considered in the environmental assessment of a designated project. Public participation is an important aspect of an open, balanced process and strengthens the quality and credibility of an environmental assessment. It encourages and supports project planning and decision-making by sharing information with, and gathering input from, members of the public who may have an interest in a proposed project.

By sharing your comments and concerns, you are giving the decision-maker the benefit of your views, experience and knowledge. As a participant, you can contribute to discussions on improving or adapting the project to avoid potential adverse environmental effects. Your input contributes to a fully informed decision.

Who can participate?

During an environmental assessment, anyone with an opinion, information or expertise relevant to a project and its potential environmental effects, can provide comments. Comments on specific documents must generally be received within the defined public comment periods to be considered by the Agency or a review panel.

CEAA 2012 states that a review panel must hold public hearings *in a manner that offers any interested party an opportunity to participate*. CEAA 2012 defines an interested party as any person that, in the opinion of the review panel, is directly affected by the carrying out of the designated project or has relevant information or expertise. The review panel determines who is an interested party.

Aboriginal groups may provide input through Aboriginal consultation activities and/or public participation opportunities. More information on the Crown's legal duty to consult Aboriginal groups is available in the *Updated Guidelines for Federal Officials to Fulfill the Duty to Consult* and on the Agency's Aboriginal Consultation in Federal Environmental Assessment webpage.

Support for meaningful participation

The Agency and review panels ensure that meaningful opportunities for public participation occur during an environmental assessment. This is done through notification of opportunities for public participation, reasonable timing, provision of accessible information, transparent reporting of results, financial support for participants, and coordination with other jurisdictions. Please consult Annex 1 for more information on support for participants.

Structure of the Guide

This Guide is divided into five parts to better direct you to the most relevant public participation opportunity for a particular environmental assessment.

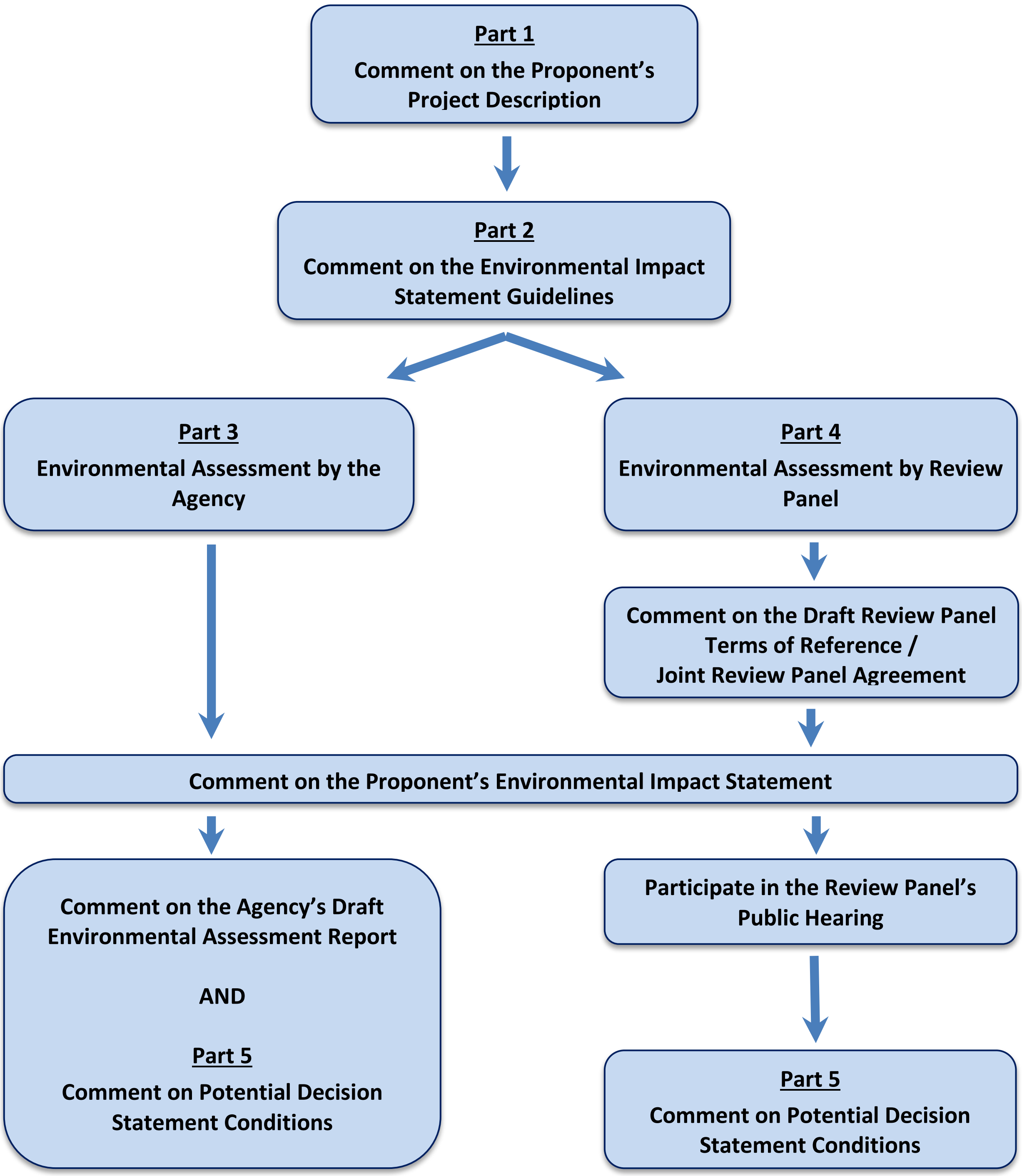
- Project Description (Part 1);
- Draft Environmental Impact Statement Guidelines (Part 2);
- Environmental Assessment by the Agency (Part 3);
- Environmental Assessment by Review Panel (Part 4); and
- Potential Decision Statement Conditions (Part 5).

Parts 1, 2 and 5 outline public participation opportunities in the environmental assessment process that are common to both an environmental assessment by the Agency and an environmental assessment by review panel. Part 3 focuses on the key public participation opportunities for an environmental assessment by the Agency. Part 4 explains the key public participation opportunities for an environmental assessment by review panel. Both environmental assessment by the Agency and environmental assessment by review panel provide public comment opportunities on important information such as the proponent's environmental impact statement.

Figure 1 illustrates the five parts of this document relative to the environmental assessment process.

Figure 1: Key Opportunities for Public Participation in an Environmental Assessment under CEAA 2012

Note: This diagram sequentially illustrates the stages presented for public participation during an environmental assessment led by the Agency or by a review panel. There are five key possibilities during and Agency-led process, and six for a Review Panel.



PART 1: OPPORTUNITIES TO COMMENT ON A PROJECT DESCRIPTION (20 DAYS)

When a proponent proposes a project that is described in the *Regulations Designating Physical Activities*, they are required to submit a project description to the Agency that complies with the *Prescribed Information for the Description of a Designated Project Regulations*. Generally a project description will include the following information:

- activities involved in carrying out the proposed project;
- timelines for the project life cycle, including construction, operation, decommissioning, and abandonment;
- description of any public or Indigenous engagement planned and/or carried out;
- information on any relevant environmental studies being carried out in the project area;
- maps showing the location of the project in relation to various landscape features (e.g. wetlands, water sources, sensitive areas, etc.), residential areas, and federal lands, including Indigenous communities and traditional territories;
- if there is any financial support from federal authorities and if any federal land would be used in carrying out the project;
- anticipated required permits or authorizations (federal and provincial);
- description of any changes that may be caused to the environment, should the project be carried out, specifically to fish and fish habitat, aquatic species, and migratory birds;
- effects that may occur on federal lands;
- effects that may cross provincial or international boundaries; and
- description of how potential changes to the environment could impact Aboriginal peoples in terms of health, socio-economic conditions, physical and cultural heritage, current use of lands and resources for traditional purposes, or on anything of historical, archaeological, paleontological or architectural significance (e.g., burial sites, ceremonial lands, teaching sites).

Once the Agency determines that the project description is complete, it is posted on the Registry Internet site, and a 20-day public comment period will begin.

What should your comments focus on?

The purpose of public participation at this stage is to provide input early in the environmental assessment process and gather information which may help determine if an environmental assessment is required and to define the scope of issues to be considered. As such, your comments should focus on the project and its potential environmental effects.

How are your comments used?

Your comments will help the Agency:

- determine whether an environmental assessment is required and, if so, whether the project should continue to be assessed by the Agency or be recommended for referral to a review panel;
- identify issues of importance to the public in relation to the project; and
- prepare the draft environmental impact statement guidelines.

Part 2: Opportunities to Comment on Draft Environmental Impact Statement Guidelines (30 Days)

Once it has been decided that an environmental assessment is required for the project (and before the Minister decides whether the project should be referred to a review panel), the Agency will prepare draft environmental impact statement guidelines and make them available on the Registry Internet site for a public comment period, generally for 30 days.

The environmental impact statement guidelines identify the information that must be included in the proponent's environmental impact statement and specify the nature, scope and extent of that information.

Within 60 days of the start of an environmental assessment, the Minister may refer the project to a review panel. Opportunities for public participation in an environmental assessment by a review panel are explained in Part 4.

If the Minister does not refer the project to a review panel, the Agency will continue to conduct the environmental assessment. Opportunities for public participation in an environmental assessment by the Agency are explained in Part 3.

What should your comments focus on?

Your comments should focus on which aspects of the environment may be affected by the project and what should be examined during the environmental assessment. If you believe that an important component of the environment is missing or may not be adequately assessed you should let the Agency know.

How are your comments used?

Your comments will be used to strengthen the draft environmental impact statement guidelines which may include the identification of additional valued components and/or studies to be undertaken in the environmental impact statement. Taking into account the comments received, the Agency will finalize the environmental impact statement guidelines, issue them to the proponent, and post them on the Registry Internet site for the public.

The public comments received at this stage may also inform whether or not the designated project is recommended for referral to environmental assessment by review panel.

PART 3: OPPORTUNITIES DURING AN ENVIRONMENTAL ASSESSMENT BY THE AGENCY

This section focuses on the key opportunities for public participation once it has been decided that the environmental assessment will be conducted by the Agency, specifically:

- Opportunities to comment on the environmental impact statement; and
- Opportunities to comment on the draft environmental assessment report.

3.1 The Environmental Impact Statement (30 Days)

The Agency is responsible for a technical review of the proponent's environmental impact statement. Both the full version and a summary of the environmental impact statement are made available on the Registry Internet site and a public comment period is held, generally for 30 days.

The environmental impact statement includes detailed information, such as:

- a list of stakeholders and summaries of engagement sessions with the public and Indigenous groups;
- information on the project's activity throughout its life cycle (construction, operation, decommissioning, and abandonment);

- a description of the current environment;
- an assessment of alternative ways to carry out the project;
- an analysis of potential environmental effects;
- proposed mitigation measures;
- a determination of the significance of the residual adverse environmental effects remaining after mitigation;
- response plans for accidents and malfunctions;
- cumulative environmental effects; and
- a follow-up program.

In some cases, the Agency may hold public meetings or open houses in areas that are likely to be affected by the project. The Agency would consider factors such as the degree of public concern, complexity of the project and coordination with a provincial environmental assessment process in making the decision to hold public meetings or open houses. These events provide the public with an opportunity to provide oral comments and are advertised through local media and in local communities, at places such as community halls or libraries.

What should your comments focus on?

Your knowledge of the project area and local environment can contribute to the evaluation of the environmental impact statement.

Your comments can assist the Agency in determining whether information provided in the environmental impact statement is sufficient and technically appropriate or whether additional information, studies, analyses or advice are required. You should provide comments on the key questions below and advise the Agency if you identify any information gaps (i.e. missing information or analysis):

- Are the methods appropriate?
- Is the environmental impact statement factually correct and is sufficient technical detail available?
- Are effects predictions correct? Should additional effects be assessed?
- Is the project likely to cause significant adverse environmental effects?
- Are the mitigation measures and follow-up program clearly stated, appropriate and likely to function as designed?

Your comments may take the form of a request for additional information. Such requests should be clear and concise, providing enough information to ensure the Agency understands exactly what part of the environmental impact statement is incomplete and what information is requested. If you have more than one request, you should number them, identify the sections of the environmental impact statement in question, and clearly reference the relevant requirements from the environmental impact statement guidelines.

How are your comments used?

Your comments can assist the Agency in determining if the environmental impact statement is sufficient and technically appropriate. They can also assist the Agency in identifying and formulating information requests to be addressed by the proponent.

3.2 The Draft Environmental Assessment Report (30 days)

After careful analysis of the environmental impact statement and all comments received, the Agency prepares a draft environmental assessment report. This document includes the Agency's conclusions and recommendations regarding the potential environmental effects of the project, the mitigation measures that were considered, the significance of any residual adverse environmental effects, and the proposed follow-up program.

The draft environmental assessment report includes a summary of the key comments received with a description of what the proponent did to address the public's concerns. This allows you to see how public comments influence the environmental assessment process.

The draft environmental assessment report is generally subject to a public comment period of 30 days. In some cases, in addition to the written comment period, the Agency may also hold targeted public meetings or open houses in the project area. These meetings provide the public with an opportunity to provide oral comments.

What should your comments focus on?

When reviewing the environmental assessment report, your comments should focus on:

- the Agency's conclusions and recommendations regarding the project's potential environmental effects;
- proposed mitigation measures;
- the significance of any remaining adverse environmental effects; and
- the follow-up program.

How are your comments used?

The Agency will consider all comments received when finalizing the environmental assessment report. This report informs the Minister's environmental assessment decision.

PART 4: OPPORTUNITIES DURING AN ENVIRONMENTAL ASSESSMENT BY REVIEW PANEL

The review panel process begins once the Minister refers the environmental assessment of a designated project to a review panel, generally following public comments on the draft environmental impact statement guidelines. The Agency notifies the public of this decision by posting a notice on the Registry Internet site.

This section focuses on the key opportunities for public participation once it has been decided that the environmental assessment will be conducted by a review panel, specifically the opportunities to:

- comment on the draft review panel terms of reference and/or joint review panel agreement;
- comment on the proponent's environmental impact statement; and
- participate in the public hearing.

Some of these opportunities are offered by the Agency prior to appointment of the review panel, and some are offered by the review panel once it is appointed. Once appointed, the review panel is responsible for the conduct of the environmental assessment process.

4.1 The Draft Review Panel Terms of Reference (Typically 30 Days)

Prior to panel appointment, the Agency will prepare, and make available on the Registry Internet site, the draft Terms of Reference for the review panel. The Terms of Reference outline the mandate of the review panel, the scope of the review and the process and timelines for the review panel to follow during the environmental assessment.

In the case of joint review panels, the Agency will also prepare a draft Joint Review Panel Agreement, in consultation with the other jurisdiction. The Joint Review Panel Agreement is an agreement between the Agency and a partner jurisdiction that outlines how the environmental assessment by review panel will proceed, taking into consideration the requirements of both jurisdictions. The Joint Review Panel Agreement typically outlines the following:

- the process and timelines of the review;
- definitions of terminology;
- responsibility for maintenance of the Registry;
- the composition of the review panel and the secretariat;
- considerations related to the decision-making process; and,
- how contributions and considerations of Indigenous groups will be addressed by the review panel.

What should your comments focus on?

Comments on the draft Terms of Reference, or Joint Review Panel Agreement if applicable, should address the mandate, the scope of the review, processes and timelines outlined in the documents. You are encouraged to provide comments with rationale and suggestions to ensure that a sound review process is followed.

How are your comments used?

Your comments can assist the Agency in providing a comprehensive and complete document for the consideration of the Minister, who will approve the final versions. Any comments received will be posted on the Registry Internet site and made public.

4.2 The Environmental Impact Statement

Once appointed, the review panel must determine if it has sufficient information to schedule the public hearing. The panel will conduct a review of the proponent's environmental impact statement to determine whether information provided is sufficient and technically appropriate or whether additional information, studies, analyses or advice are required.

The environmental impact statement includes detailed information, such as:

- a list of stakeholders and summaries of engagement sessions with the public and Indigenous groups;
- information on the project's activity throughout its life cycle (construction, operation, decommissioning, and abandonment);
- a description of the current environment;
- an assessment of alternative ways to carry out the project;
- an analysis of potential environmental effects;
- proposed mitigation measures;
- a determination of the significance of the residual adverse environmental effects remaining after mitigation;
- response plans for accidents and malfunctions;

- cumulative environmental effects; and
- a follow-up program.

The review panel typically requests public comments on the environmental impact statement and any supplemental information gathered to date, and will generally provide a minimum of 45 days for the public comment period.

There may be additional opportunities for public participation in relation to the environmental impact statement. These opportunities may include technical meetings or a site visit.

Any comments received will be posted on the Registry Internet site and made public.

What should your comments focus on?

Your knowledge of the project area and local environment can contribute to evaluation of the environmental impact statement.

Your comments can assist the review panel in assessing the technical merit and sufficiency of the information presented in the environmental impact statement and any supplementary information. You should provide comments on the key questions below and advise the review panel if you identify any information gaps (i.e., missing information or analysis):

- Are the methods appropriate?
- Is the environmental impact statement factually correct and is sufficient technical detail available?
- Are effects predictions correct? Should additional effects be assessed?

Your comments may take the form of a request for additional information. Such requests should be clear and concise, providing enough information to ensure the review panel understands exactly what part of the environmental impact statement is incomplete and what information is requested. If you have more than one request, you should number them, identify the sections of the environmental impact statement in question and clearly reference the relevant requirements from the environmental impact statement guidelines.

How are your comments used?

Your comments can assist the review panel in determining if the environmental impact statement is sufficient and technically appropriate.

4.3 The Public Hearing

The review panel conducts a public hearing to determine if the project is likely to result in significant adverse environmental effects, and to ensure that the panel has all of the information that it needs to complete its report to the Minister.

The public hearing provides opportunities for:

- the proponent to explain the designated project and respond to concerns and questions raised by participants;
- participants to provide their views and ask questions on the potential environmental effects of the designated project; and
- the review panel to receive information that would help it complete its assessment of the potential environmental effects of the designated project.

The review panel must conduct the public hearing in a manner that promotes a thorough examination of relevant issues and encourages participation and input from interested parties and other participants. The public hearing should follow a fair and orderly process, but is generally not bound by the strict rules of procedure and evidence applicable to judicial proceedings.

The review panel's Terms of Reference may specify the timeline in which the review panel must conduct its public hearing. For instance, the review panel may be directed to use its best efforts to complete the public hearing in 30 days.

The review panel will issue a Notice of Hearing, outlining the start date and location(s) of the public hearing, the deadline to register as a presenter, and the deadline for written submissions. The review panel's Terms of Reference may outline the timelines for the public hearing, but the Notice of Hearing is usually made public at least 45 days in advance to give participants time to prepare.

Following the release of the Notice of Hearing, the review panel will issue a detailed hearing schedule with the times and locations of all hearing sessions. In determining the locations for the public hearing, the review panel will consider the communities most likely to be affected by the project, locations of interested participants, local culture and customs of potentially affected Indigenous communities, and the need to complete the review in a timely and cost-efficient manner.

Although hearing sessions are open to anyone wishing to observe the proceedings, the review panel may require you to register in advance if you wish to make a presentation during the hearing sessions. Advance registration allows the public hearing to be planned and conducted in a logical and organized manner.

Public hearing procedures, issued by the review panel, will outline any requirements with respect to the public hearing, including details regarding registration.

Typically there are three types of hearing sessions that a review panel may hold:

1. Community hearing sessions: Encourage the full and open participation of people living in, or adjacent to the project area and provide a more informal setting in which community members are able to make presentations to the review panel on any matters within the scope of the review and present community knowledge or Aboriginal traditional knowledge.
2. General hearing sessions: Provide an opportunity for interested parties and the proponent to make presentations to the review panel on both the technical and non-technical subjects that are within the scope of the review. They also provide the opportunity for participants to question the information submitted during the review process.
3. Technical hearing sessions: Allow participants who possess specialized knowledge or expertise in a specific topic to present the results of their analysis of the potential environmental effects of the designated project to the review panel. They also allow for scrutiny of the designated projects by participants who have conducted a technical review of the project. This includes participants who have hired technical experts to assist them with their review.

Transcripts of the public hearing will be produced and made public through the Registry Internet site.

At the end of the public hearing, the review panel may reserve time for closing remarks by participants or interested parties. Closing remarks are not intended for the presentation of new information. Instead, you may summarize your position on the project and the types of recommendations that the review panel should make in relation to the project.

All comments and presentations from hearing sessions are considered part of the record of the review and will be posted on the Registry Internet site and made public. The record of the review is the body of information on which the review panel will rely in writing its report.

Once the review panel has all the information it requires to write its report, it will close the record of the review and post a notice on the Registry Internet site. New information cannot be accepted once the record is closed.

The review panel's report is advisory in nature and contains the review panel's conclusions and recommendations with respect to the project. The review panel submits its report to the Minister and any partnering jurisdictions (as appropriate). Typically, a review panel will issue a news release on the Registry Internet site when it has submitted its report. Under CEAA 2012, the Minister is responsible for making the report available to the public.

What should your comments focus on?

Your comments can assist the review panel in their consideration of key questions such as:

- Is the project likely to cause significant adverse environmental effects?
- Are mitigation measures and the follow-up program appropriate and likely to function as designed?

How are your comments used?

Your comments are used to inform the review panel's conclusions and recommendations with respect to the project. These conclusions and recommendations are contained in the panel report submitted to the Minister.

PART 5: OPPORTUNITIES TO COMMENT ON POTENTIAL DECISION STATEMENT CONDITIONS (TYPICALLY 30 DAYS)

After analysis of the environmental impact statement and consideration of comments received, the Agency prepares a document containing potential decision statement conditions for the project. These potential conditions relate to proposed mitigation measures and a follow-up program. The final conditions would become legally binding on the proponent if the Minister issues a decision statement indicating that the project may proceed. The potential decision statement conditions are posted on the Registry Internet site for public comment, generally for 30 days.

What should your comments focus on?

Your comments should focus on the adequacy and sufficiency of the potential decision statement conditions, suggestions for improvement and any additional measures you would like to see included.

How are your comments used?

The Agency will consider all written comments received when finalizing its recommendations to the Minister on potential conditions for inclusion in the environmental assessment decision statement. The Agency's recommendations will inform the Minister's decision-making.

ANNEX 1: SUPPORT FOR MEANINGFUL PUBLIC PARTICIPATION

The Agency and review panels ensure that meaningful opportunities for public participation occur during an environmental assessment. This is done through notification of opportunities for public participation, reasonable timing, provision of accessible information, transparent reporting of results, financial support for participants, and coordination with other jurisdictions.

Notification

The Agency or review panel will inform the public of participation opportunities, including information on any timelines, the public hearing schedule, how comments may be submitted or how to register for a hearing. This is often done through the issuance of a public notice and/or news release. You may also subscribe (by completing a short form on the Agency's website) to receive a weekly bulletin of Agency news, including updates on environmental assessments and opportunities for public participation. The Agency and review panels also maintain email distribution lists that are used to update participants on the status of an environmental assessment and opportunities for participation.

Reasonable timing

The Agency or review panel will provide the public with a fair and reasonable amount of time to engage in participation opportunities such as needed for evaluating information, providing and submitting comments on that information, planning and preparing for information sessions and public hearings.

Accessible information

The Canadian Environmental Assessment Registry (the Registry) consists of both an internet site and project files, established for the purpose of facilitating access to records related to current and potential environmental assessments of projects subject to CEAA 2012. It is operated in a manner that provides the public with convenient and timely access to information in support of public participation.

Within the Registry Internet site, there is a dedicated page specific for each project. This page includes any information regarding public comment periods, documents for public comment, and contact information specific to the environmental assessment of the project.

Transparent results

The environmental assessment report, prepared by the Agency or a review panel, documents the results of the environmental assessment and includes the rationale, conclusions and recommendations regarding:

- the potential environmental effects of the designated project;
- the mitigation measures that were taken into account;
- the significance of adverse environmental effects after mitigation measures are implemented; and
- follow-up program requirements.

For an environmental assessment by the Agency, the environmental assessment report reflects the comments received during the comment period on the environmental impact statement. Generally, the key comments received are summarized and accompanied by a description of what the proponent did to address the public's concerns. This allows you to see how public comments influenced the environmental assessment process.

For an environmental assessment by review panel, the panel's report summarizes the views of the public and Indigenous groups on key issues, as well as the views of the proponent.

The Agency also seeks public comment on any draft potential conditions with which the proponent must comply, should the Minister include these conditions in a decision statement.

Financial support

The Agency administers the Participant Funding Program that supports individuals, Indigenous groups, and non-profit organizations interested in participating in an environmental assessment, both by the Agency and review panel. Funding supports eligible expenses, such as travel costs and fees for experts.

Please visit the Participant Funding Program webpage for more information on the program, eligibility and the application process.

Coordination with other jurisdictions

For environmental assessments involving both the federal government and another jurisdiction with environmental assessment responsibilities, such as a province, opportunities to coordinate efforts are pursued to increase efficiency and reduce the potential burden on participants.

CEAA 2012 allows the federal environmental assessment process to be substituted for a provincial environmental assessment process, in the event that the province makes a request. The Agency consults the public for their views on whether substitution should occur. If a federal environmental assessment process has been substituted for a provincial environmental assessment process, the public needs to follow the province's public participation process. For more information on substitution under CEAA 2012, refer to *Substitution of the federal environmental assessment process under CEAA 2012*.

Resources

Practitioners Glossary for the Environmental Assessment of Designated Projects under the *Canadian Environmental Assessment Act, 2012*

- This document defines or explains terms that are commonly used in relation to environmental assessments under CEAA 2012. It supports Agency training and guidance materials.

Basics of Environmental Assessment

- This document provides information on the purpose and steps of environmental assessments under CEAA 2012.

Canadian Environmental Assessment Registry

Participant Funding Program Guide and Forms

Policy and Guidance Instruments for CEAA 2012

Acts and Regulations

Substitution Backgrounder

Species at Risk Act
Recovery Strategy Series

Amended Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada

Woodland Caribou, Boreal population

2020

Government of Canada Gouvernement du Canada

Canada

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Note: The Woodland Caribou, Boreal population is referred to as "boreal caribou" in this document.

For copies of the recovery strategy, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry[1].

Cover photo: © Tom Perry

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[1] www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

AMENDED RECOVERY STRATEGY FOR THE WOODLAND CARIBOU (*RANGIFER TARANDUS CARIBOU*), BOREAL POPULATION, IN CANADA (2020)

The Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada was posted on the Species at Risk Public Registry in October 2012 (Environment Canada, 2012a).

Under Section 45 of the *Species at Risk Act* (SARA), the competent Minister may amend a recovery strategy at any time. This Amended Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada (hereafter, "amended recovery strategy") is for the purposes of:

- Identifying critical habitat in northern Saskatchewan's Boreal Shield range (SK1).
- Updating population and habitat condition information, based on information previously published in the 5-Year Progress Report (Environment and Climate Change Canada, 2017).
- Other minor edits to update factual information and/or to improve internal consistency within the document.

At the time of final posting, this amended recovery strategy replaces the 2012 Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada (Environment Canada, 2012a).

PREFACE

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996)[2] agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years after the publication of the final document on the Species at Risk (SAR) Public Registry.

The Minister of Environment and Climate Change and Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Woodland Caribou, Boreal population, and has prepared both the 2012 Recovery Strategy and this amended recovery strategy, as per section 37 of SARA.

Environment and Climate Change Canada's Canadian Wildlife Service led the development of the 2012 Recovery Strategy. Seven provinces, two territories, one Indigenous government, four wildlife management boards and the Parks Canada Agency contributed information for the recovery strategy. Additional effort was made by Environment and Climate Change Canada to engage Indigenous communities that the minister considered directly affected by the recovery strategy. These efforts included two rounds of engagement, one before and the second one after the proposed recovery strategy was posted on the SAR Public Registry, to gather information on boreal caribou and to provide communities with an opportunity to comment on the proposed recovery strategy. In the first round, 271 Indigenous communities were contacted and 161 engaged, and in the second round, 265 Indigenous communities were contacted and 87 engaged. In addition, 25 formal submissions were received from Indigenous communities and organizations.

Following the posting of the proposed recovery strategy on August 26, 2011, the standard 60-day public comment period was extended by 120 days to February 22, 2012 as a result of Environment and Climate Change Canada's desire to consult Indigenous communities prior to finalizing the recovery strategy. The high level of interest in boreal caribou resulted in the submission of 19,046 comments during and subsequent to the public comment period. The majority of these were received as copies of form letters initiated by environmental group's campaigns. A total of 192 more detailed and/or technical submissions were received from governments, wildlife management boards, Indigenous communities and organizations, industry stakeholders, environmental organizations and academia.

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or an action plan, SARA requires that critical habitat then be protected. Environment and Climate Change Canada's Canadian Wildlife Service also led the development of this amended recovery strategy in order to identify critical habitat in northern Saskatchewan's Boreal Shield range (SK1). The work completed for the amended recovery strategy was done in

[2] www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2

collaboration with the Government of Saskatchewan, the Science and Technology Branch of Environment and Climate Change Change, and the Parks Canada Agency. Prior to posting the proposed amended recovery strategy on the Species at Risk Public Registry, 34 Indigenous communities and 31 Indigenous organizations/governments located within and adjacent to SK1 were invited to share information, comments and dialogue on the draft amendment to the recovery strategy. At the time of posting the proposed amendment, 11 communities and five organizations/governments participated in information sessions and/or meetings.

Landscape level planning is essential for the recovery of boreal caribou. Provinces and territories have the primary responsibility for management of lands, natural resources and wildlife within boreal caribou ranges; however, this responsibility does vary in some parts of the country. For example, in the Northwest Territories, the Tłı̨chǫ Government manages land and resources (including wildlife) within Tłı̨chǫ Lands, as described in the Tłı̨chǫ Agreement (a combined comprehensive land claims and self-government agreement). There are also wildlife management boards that have been established under land claims agreements as the primary instrument for wildlife management in some regions of the country.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that are or will be involved in implementing the directions set out in this strategy and will not be achieved by Environment and Climate Change Canada and the Parks Canada Agency, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of boreal caribou and Canadian society as a whole.

This recovery strategy is being followed by range plans or other similar documents and/or action plans that provide information on recovery measures that are being or will be taken by provinces and territories, Environment and Climate Change Canada and the Parks Canada Agency, other federal departments, wildlife management boards, Indigenous communities, stakeholders, and other organizations, to achieve the survival and recovery of boreal caribou. Environment and Climate Change Canada, for its part, released its Action Plan for boreal caribou in February 2018, which sets out the measures that the Government of Canada is taking and will take to support the recovery of boreal caribou (Environment and Climate Change Canada, 2018). In addition to this Action Plan, Parks Canada Agency site-specific Action Plans that address boreal caribou conservation and recovery efforts on lands administered by the Agency can be found on the SAR Public Registry. Implementation of this recovery strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

ACKNOWLEDGEMENTS

Environment and Climate Change Canada would like to express its gratitude to the Indigenous people who shared their knowledge about boreal caribou in support of the recovery of this species. Knowledge was shared by Indigenous Knowledge holders and Indigenous communities and organizations on boreal caribou life history, habitat use, population status, threats facing the species and conservation measures, and this information has been used in the development of this recovery strategy (see Appendices B and C). Indigenous people consistently indicated that conservation of boreal caribou is essential, as this species is integral to the culture, identity and survival of their communities. The Indigenous Knowledge that was shared may also be used to support the development of range plans and/or action plans for boreal caribou, where consent for such use is granted. Environment and Climate Change Canada appreciates that so many Indigenous people were willing to share their knowledge and experiences to help in the recovery of this species.

Gratitude is also extended to federal, provincial and territorial jurisdictions, the Tłı̨chǫ Government, and wildlife management boards with management responsibility for boreal caribou, for generously sharing information and providing expertise to develop this recovery strategy. The Boreal Caribou Working Group, comprised of Environment and Climate Change Canada staff from across Canada, contributed extensively by working with Canadians to gather information and support processes to collect Indigenous Knowledge used to inform the development of this recovery strategy, and by compiling material and drafting the recovery strategy. Appreciation is extended to Environment and Climate Change Canada's Wildlife and Landscape Science Directorate (WLSD), the boreal caribou Science Management Committee and boreal caribou science advisors, for their extensive efforts and contribution to the recovery strategy through the provision of the 2008 Scientific Review for the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada, and the Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada, 2011 Update. Thanks are also given to the National Boreal Caribou Technical Committee for providing advice and feedback on the science work that was undertaken by WLSD as part of the schedule of studies to inform the identification of critical habitat in northern Saskatchewan's Boreal Shield range (SK1). Acknowledgement and thanks are given to all other parties that provided advice and input used in the development of this recovery strategy, including the Species at Risk Advisory Committee (SARAC), Indigenous governments, communities and organizations, industry stakeholders, non-government organizations and academia.

EXECUTIVE SUMMARY

This recovery strategy is for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population herein referred to as "boreal caribou", assessed in May 2002 as threatened and re-examined and confirmed as threatened in November 2014 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). This document is an amended version of the boreal caribou recovery strategy published by Environment and Climate Change Canada under the title Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada (Environment Canada, 2012a). At the time of final posting, the final version of this amended recovery strategy will replace the 2012 Recovery Strategy.

Boreal caribou are distributed broadly throughout the boreal forest, occurring in seven provinces and two territories and extending from the northeast corner of Yukon east to Labrador and south to Lake Superior. Boreal Caribou require large areas comprised of continuous tracts of undisturbed habitat rich in mature to old-growth coniferous forest, lichens, muskegs, peat lands, and upland or hilly areas. Large areas with suitable quality habitat allow boreal caribou to disperse across the landscape when conditions are unfavorable (e.g. natural fire disturbance, anthropogenic disturbance) and to maintain low population densities to reduce their risk of predation.

The geographic area occupied by a group of boreal caribou that are subject to similar factors affecting their demography and used to satisfy their life history processes (e.g. calving, rutting, wintering) over a defined time frame is referred to as a range. There are 51 boreal caribou ranges in Canada. Information available to delineate boreal caribou ranges varies in certainty and therefore ranges are categorized into three types: conservation units, improved conservation units and local population units. In this recovery strategy, the group of boreal caribou occupying any of the three types of ranges is referred to as a "local population" of boreal caribou.

Due to the specific life history characteristics they possess, boreal caribou are limited in their potential to recover from rapid, severe population declines. Habitat alteration (i.e. habitat loss, degradation, and fragmentation) from both anthropogenic and natural sources, and increased predation as a result of habitat alteration have led to local population declines throughout their distribution. Some local populations of boreal caribou are at risk because of other factors, mainly over-harvest. Threats are closely interrelated and act cumulatively to have direct or indirect impacts on boreal caribou and their habitat. Recovery of all boreal caribou local populations across Canada is technically and biologically feasible.

The recovery goal for boreal caribou is to achieve self-sustaining local populations in all boreal caribou ranges throughout their current distribution in Canada, to the extent possible. Achieving the recovery goal would allow for local population levels sufficient to sustain traditional Indigenous harvesting activities, consistent with existing Aboriginal and treaty rights. Ranges that are highly disturbed will take decades to recover from habitat alteration, as boreal caribou occur in mature boreal forest ecosystems that have evolved over centuries. Achieving this recovery goal for all local populations will take a number of decades.

To guide recovery efforts, the population and distribution objectives for boreal caribou across their distribution in Canada are, to the extent possible, to:

- Maintain the current status of the 15 existing self-sustaining local populations; and
- Stabilize and achieve self-sustaining status for the 36 not self-sustaining local populations.

Performance indicators are identified as a means by which progress towards achieving the population and distribution objectives can be measured. The critical habitat necessary to achieve the population and distribution objectives for the recovery and survival of boreal caribou is now fully identified within this amended recovery strategy, as critical habitat is identified for all 51 boreal caribou ranges.

Critical habitat was not identified in the Boreal Shield range (SK1) in the 2012 Recovery Strategy due to a lack of data on population size and trend, and the uniqueness of the disturbance regime (i.e. high fire and very low anthropogenic disturbance). As required under the *Species at Risk Act* (SARA), a schedule of studies was developed to identify critical habitat in SK1. That schedule of studies for SK1 is now complete.

Critical habitat for boreal caribou is identified as: i) the area within the boundary of each boreal caribou range that provides an overall ecological condition that will allow for an ongoing recruitment and retirement cycle of habitat, which maintains a perpetual state of a minimum of 65% of the area as undisturbed habitat in all ranges other than SK1, and a minimum of 40% undisturbed habitat in SK1; and ii) biophysical attributes required by boreal caribou to carry out life processes.

With the exception of SK1, this recovery strategy identifies 65% undisturbed habitat in a range as the disturbance management threshold, which provides a measurable probability (60%) for a local population to be self-sustaining. This threshold is considered a minimum threshold because at 65% undisturbed habitat there remains a significant risk (40%) that local populations will not be self-sustaining.

The disturbance management threshold for SK1 is 40% undisturbed habitat in the range, which provides a measurable probability (71%) for the local population to be self-sustaining. This threshold is considered a minimum threshold because at 40% undisturbed habitat there remains a risk (29%) that the SK1 local population will not be self-sustaining. Based on the best available information, SK1 is the first local population that is currently self-sustaining below the 65% undisturbed habitat threshold (based on 3 years of data). For this reason, and because of the uniqueness of the disturbance regime in SK1, a lower undisturbed habitat threshold has been identified for this range.

Environment and Climate Change Canada (2019) demonstrated that the SK1 local population is sensitive to small increases in anthropogenic disturbance and small decreases in adult survival. The analyses also showed that anthropogenic disturbance is not equivalent to fire, with the former having a stronger negative effect on population condition. Therefore, caution is warranted with respect to additional anthropogenic disturbance in this range. For SK1 critical habitat, activities that pertain specifically to increasing the level of anthropogenic disturbance in SK1 above 5% (while maintaining a minimum of 40% undisturbed habitat in the range) has been added to the list of factors that increase the likelihood that critical habitat will be destroyed. The range plan for SK1 should outline how total anthropogenic disturbance in the range will be maintained at or below 5%. In addition, the SK1 local population should continue to be monitored to ensure that future changes in range condition (fire and anthropogenic disturbance) do not compromise the ability of the range to support a self-sustaining local population.

The recovery of boreal caribou requires actions that will vary according to both the habitat and population conditions within each boreal caribou range. This recovery strategy provides broad strategies and general approaches to achieve the population and distribution objectives, which will assist in the development of range plans and action plans. The suite of actions needed to maintain or recover the self-sustaining status of a boreal caribou local population will be determined and managed by the responsible jurisdictions in collaboration with Environment and Climate Canada, and consistent with this recovery strategy. The recovery actions most appropriate for a specific range will be governed by local opportunities and constraints, and the level of urgency for a given recovery action will be determined by both the population and habitat conditions within the range.

To guide the protection of critical habitat and the recovery of boreal caribou, range plans or other similar documents and/or action plans are being prepared by provincial and territorial jurisdictions. These plans provide detailed information on recovery measures that are being or will be implemented by provinces and territories, Environment and Climate Change Canada, other federal departments, wildlife management boards, Indigenous communities, stakeholders, and other organizations involved in the conservation, survival and recovery of boreal caribou. Success in recovering boreal caribou will depend on the commitment, collaboration and cooperation among all interested parties.

RECOVERY FEASIBILITY SUMMARY

Recovery of boreal caribou is considered to be both technically and biologically feasible across the species' distribution in Canada based on the following four criteria that Environment and Climate Change Canada uses to establish recovery feasibility.

Current evidence supports the conclusion that the recovery of all local populations is biologically and technically feasible. However, small local populations, and particularly those isolated from the core distribution of the national boreal caribou population, are at greater risk of not becoming self-sustaining. In these situations, a local population may have greater difficulty withstanding stochastic events, and may not experience enough immigration to maintain genetic diversity and therefore will be at greater risk of not persisting in the long-term. There may be other situations where recovery of a particular local population proves to be, over time and through unforeseen circumstances, not biologically or technically feasible and, as such, may affect the likelihood of achieving the population and distribution objectives.

1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.
Yes. According to current best estimates, there are approximately 34,000 (see Section 3.2.2) boreal caribou across nine provinces and territories in Canada capable of successful reproduction and available to improve local population growth rates and abundance to achieve self-sustainability (Environment Canada, 2011b).

2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.
Yes. Some boreal caribou local populations have sufficient suitable habitat within their ranges. For other boreal caribou local populations where sufficient suitable habitat is currently unavailable to support local populations at a self-sustaining level, sufficient habitat could be made available through habitat management or restoration.

3. The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.
Yes. The primary threat to most boreal caribou local populations is unnaturally high predation rates as a result of human-caused and natural habitat loss, degradation, and fragmentation. These habitat alterations support conditions that favour higher alternate prey densities (e.g. moose (*Alces alces)*, deer (*Odocoileus spp*.)), resulting in increased predator populations (e.g. wolf (*Canis lupus*), bear (*Ursus spp.*)) that in turn increase the risk of predation to boreal caribou. This threat can be mitigated through coordinated land and/or resource planning, and habitat restoration and management, in conjunction with predator and alternate prey management where local population conditions warrant such action. In some ranges, over-exploitation through hunting can also be an issue. This threat can be avoided or mitigated through regulations and stewardship.

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.
Yes. Recovery techniques (e.g. protection and management of boreal forest habitat, habitat restoration, predator and alternate prey management, hunting regulations, stewardship initiatives)

are available to achieve the population and distribution objectives for boreal caribou, although there is uncertainty with regard to the effectiveness of some of these techniques, as they have not yet undergone a sufficiently long trial period.

TABLE OF CONTENTS

1 COSEWIC SPECIES ASSESSMENT INFORMATION

Date of Assessment: November 2014

Common Name (population): Caribou (Boreal population)

Scientific Name: *Rangifer tarandus*

COSEWIC Status: Threatened

Reason for Designation: This population occurs at naturally low densities in mature boreal forest habitats from Labrador to Yukon, with small, isolated populations at the southern part of the range, including along the Lake Superior coastline and in the Charlevoix region of Québec. Over the past century, local subpopulations have been lost; range contraction has proceeded from the south by up to 50% of historical range in some areas. Despite considerable conservation efforts, range-wide declines have continued since the last assessment in 2002, particularly in Alberta, northeastern British Columbia, and Labrador. Some populations remain poorly monitored, particularly those in the northern portion of the range. For 37 of 51 subpopulations where trend data are available, 81% are in decline, as indicated by negative population growth rates. Some of the most intensively managed subpopulations may remain critically imperiled. Reasons for decline are mainly due to increased predation and habitat loss, the latter stemming from the combination of anthropogenic (natural resource extraction) and natural (fires) disturbance. The proliferation of linear landscape features such as roads and seismic lines facilitates predation by wolves, and the conversion of mature – old conifer stands to younger seral stages promotes increases in alternate prey such as Moose and White-tailed Deer. Shifts in the northern distribution of White-tailed Deer, mediated by landscape change, also bring novel parasites into parts of the range of this population. In some regions, overhunting poses a threat to long-term conservation. Threats are closely interrelated and act cumulatively to impact this population. Population increases do not appear likely in one-third of subpopulations where disturbances exceed a threshold of viability. A >30% decline in population is projected in the near term.

Canadian Occurrence: Yukon, Northwest Territories, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Newfoundland and Labrador.

COSEWIC Status History: The Boreal population was designated threatened in May 2000. Status re-examined and confirmed in May 2002 and November 2014.

* COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

In 2000, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, as threatened. The species was added to the List of Wildlife Species at Risk (Schedule 1) under SARA, at Proclamation, in 2003. In 2011, COSEWIC adopted new "Designatable Units" (DU) for caribou (*Rangifer tarandus*) in Canada using a number of variables to classify the different herds or groups of herds

(COSEWIC, 2011). These DU descriptions provided a clear and consistent scheme for identifying DUs due to the complexity of *Rangifer tarandus* in Canada. Woodland Caribou (*Rangifer tarandus caribou*), Boreal population is equivalent to COSEWIC's DU6, which is called Caribou (*Rangifer tarandus*), Boreal population. The 2014 COSEWIC assessment for the species was completed under this new DU structure/name (COSEWIC, 2014). However, until such time as Schedule 1 of SARA is amended to reflect the new common and scientific names changes, the species remains Woodland Caribou (*Rangifer tarandus caribou*), Boreal population under SARA. In this recovery strategy, the Woodland Caribou, Boreal population is referred to as simply "boreal caribou".

2 SPECIES STATUS INFORMATION

Boreal caribou are listed as threatened under Canada's *Species at Risk Act* (SARA), based on an observed, estimated, inferred or suspected reduction in population size of > 30% over three caribou generations (approximately 20 years). Boreal caribou have been provincially/territorially ranked in most jurisdictions (see Table 1). Boreal caribou have not been ranked globally by NatureServe.

Table 1. Canadian status and provincial/territorial designations for boreal caribou.

Canadian Status	Provincial/Territorial Designation
SARA – Schedule 1 (Threatened)	NT – Threatened YT – Not Listed BC – Red Listed (Threatened – Endangered) AB – Threatened SK – Not Listed MB – Threatened ON – Threatened QC – Vulnerable (Special Concern – Threatened) NL – Threatened

3 SPECIES INFORMATION

Caribou and reindeer are members of a single species, *Rangifer tarandus*. The term "caribou" is used to describe the various subspecies present in North America, whereas "reindeer" refers to the domesticated, semi-domesticated or wild subspecies found in Eurasia (Hummel and Ray 2008). Although there is considerable variation in phenotypic traits in this species (e.g., body size, pelage colour, morphology), caribou and reindeer are able to interbreed and produce fertile, viable offspring (Hummel and Ray 2008). It should be noted that reindeer occur in North America, particularly Newfoundland, as a result of human introductions.

Banfield (1974) recognized four existing subspecies of caribou in Canada, including Peary Caribou (*Rangifer tarandus pearyi*), Barren-ground Caribou (*R. t. groenlandicus*), Grant's Caribou (*R. t. granti*), and Woodland Caribou (*R. t. caribou*). A fifth subspecies, the Dawson's Caribou (*R. t. dawsoni*), which occurred in Haida Gwaii (i.e. Queen Charlotte Islands, BC) is extinct. Each subspecies displays differences in morphology, behaviour, and areas of geographic occurrence. Boreal caribou are among those caribou populations that were classified by Banfield (1974) as Woodland Caribou.

Boreal caribou are endemic to Canada, and are distributed across nine provinces and territories, including British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Newfoundland and Labrador, Northwest Territories, and Yukon (see Figure 1) (DU6; COSEWIC 2011).

3.1 Species Description

Like all Woodland Caribou, boreal caribou are a medium-sized (1.0-1.2 m shoulder height and weighing 110-210 kg) member of the deer family (*Cervidae*) (Thomas and Gray, 2002). Adults have a dark brown coat with a creamy white neck, mane, shoulder stripe, underbelly, underside of the tail, and patch above each hoof (Banfield, 1974; Boreal Caribou ATK Reports, 2010-2011). A distinctive characteristic of all caribou is large crescent-shaped hooves that provide flotation in snow and soft ground (e.g. peat lands), and assist in digging through snow to forage on lichens and other ground vegetation (Thomas and Gray, 2002). Antlers of boreal caribou are flattened, compact, and relatively dense. As a unique feature among the deer family, both male and female boreal caribou have antlers during part of the year, although some females may have only one antler or no antlers at all (Thomas and Gray, 2002; Boreal Caribou ATK Reports, 2010-2011). In comparison to Barren-ground Caribou, boreal caribou antlers are thicker and broader, and their legs and heads are longer.

3.2 Population and Distribution

Boreal caribou are forest-dwelling, sedentary caribou that occur only in Canada and are distributed broadly across the boreal forest (Thomas and Gray, 2002; Festa-Bianchet, 2011). The Canadian distribution of boreal caribou stretches from the northeast corner of Yukon east to Labrador, and extends as far south as Lake Superior (see Figure 1) (Environment Canada, 2008; Environment Canada, 2011b). Across Canada, the southern limit of boreal caribou distribution has progressively receded northward since the early 1900s (see Figure 1), a trend that continues today (Thomas and Gray, 2002; Schaefer, 2003; Festa-Bianchet et al., 2011). Indigenous Knowledge indicates that boreal caribou have moved northward as a result of habitat loss in the south (Boreal Caribou ATK Reports, 2010-2011).

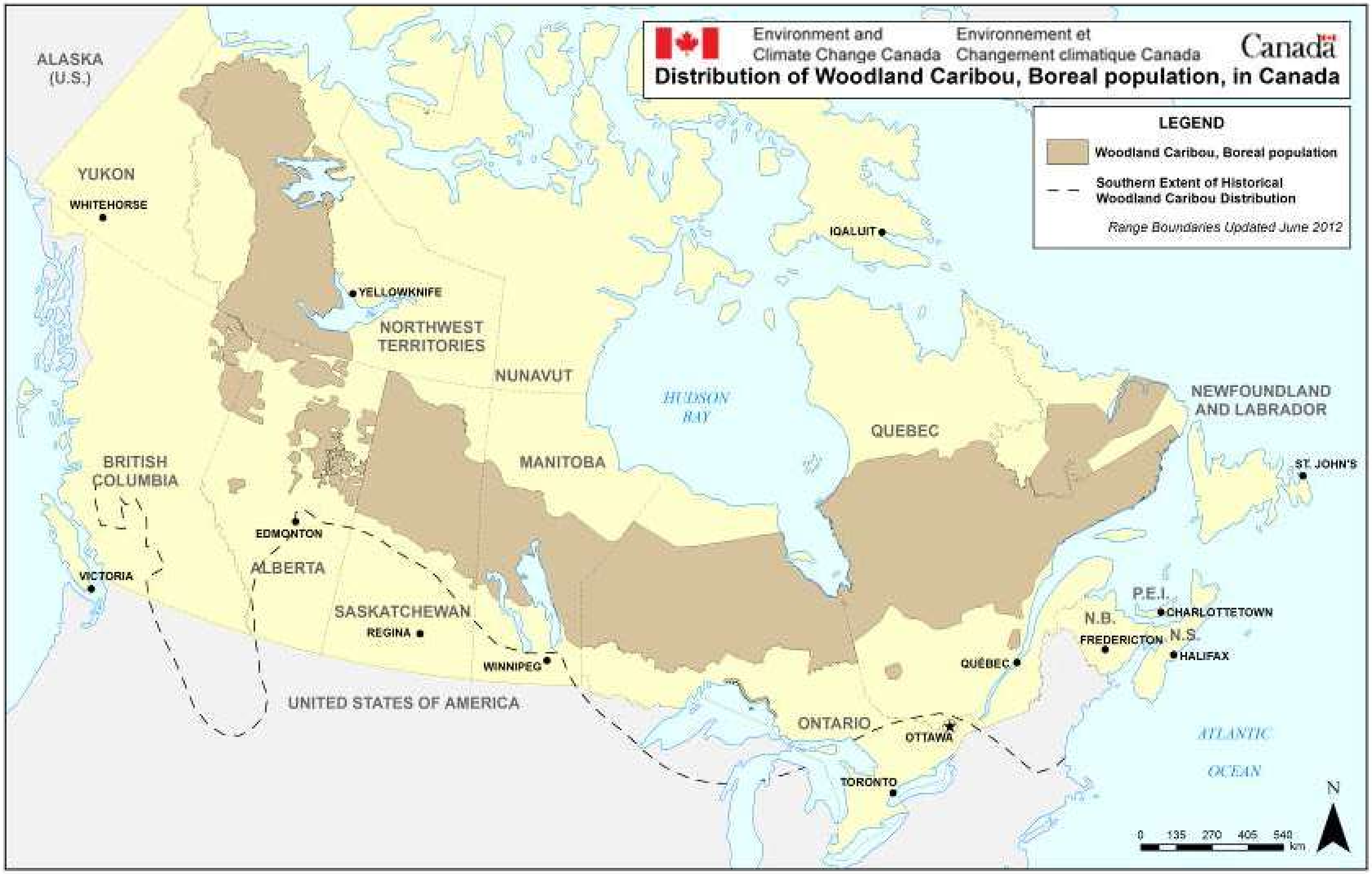

Figure 1. Distribution (i.e. extent of occurrence) of boreal caribou in Canada. The current distribution of boreal caribou is shown in brown. The estimated southern extent of historical Woodland Caribou distribution is indicated by the dashed line.

3.2.1 Boreal Caribou Ranges

The geographic area occupied by a group of boreal caribou that are subject to similar factors affecting their demography and used to satisfy their life history processes (e.g. calving, rutting, wintering) over a defined time frame is referred to as a range (Environment Canada, 2011b). Boreal caribou are distributed across 51 ranges (see Figure 2 and Table 2) based on the best available information provided by the provincial and territorial jurisdictions, including observational and telemetry data, and biophysical analyses (Environment Canada, 2011b).

Environment and Climate Change Canada (2011b) identified three types of boreal caribou ranges, categorized based on the degree of certainty in the delineated boundaries. Eight ranges have been identified as “conservation units” (low certainty), 20 ranges as “improved conservation units” (medium certainty), and 23 ranges as “local population units” (high certainty) (see Appendix F). It is anticipated there will be changes to conservation units and improved conservation units as more information becomes available. In this recovery strategy, “local population” refers to a group of boreal caribou occupying any of the three types of boreal caribou ranges (conservation unit, improved conservation unit, local population unit).

In this recovery strategy, “local population” refers to a group of boreal caribou occupying any of the three types of boreal caribou ranges (conservation unit, improved conservation unit, local population unit).

As a result of limited information on many of the ranges in Canada, only three transboundary ranges (a range that extends across a provincial or territorial boundary) have been defined: Northwest Territories range (NT1), Chinchaga range (AB1), and Lac Joseph range (NL1). As new and more refined information is continually being collected by jurisdictions, range delineation and population demographic information will be updated and may result in revisions to range boundaries and possibly more transboundary ranges.

Ranges can and do vary greatly in size; some cover very large areas (e.g. Northwest Territories range (NT1): 44,166,546 ha), whereas others are much smaller (e.g. Charlevoix range (QC2): 312,803 ha). Whether a range can support a self-sustaining local population is a function of both the amount and quality of habitat available for boreal caribou.

Of the 51 boreal caribou local populations, 15 are “self-sustaining”, 26 are “not self-sustaining” and 10 are “as likely as not self-sustaining”, based on Environment and Climate Change Canada’s (2011b) methodology and data from provincial and territorial jurisdictions (see Figure 3 and Appendix F). In the population and distribution objectives, “not self-sustaining” local populations refers to both the local populations assessed as “as likely as not self-sustaining” and those assessed as “not self-sustaining”. The assessment of the likelihood of self-sustainability may change when ranges that cross jurisdictional boundaries are combined. Range boundaries and integrated risk assessments will be updated annually based on new or more refined evidence provided by the provincial and territorial jurisdictions.

In some cases, there are discrepancies between the range boundaries as presented in Figure 2, which were based on information provided by provincial and territorial jurisdictions, and the information that was provided by Indigenous Knowledge holders. These will be addressed in range plans and/or action plans (see Sections 7.3 and 9) where provinces and territories, Indigenous communities, and other people with knowledge of a particular boreal caribou range can work together to ensure range boundaries are based on the best available information.

Boreal caribou use of a range may change over time as a result of variation in ecological conditions (e.g. vegetation change as a result of natural disturbances, predator/prey dynamics) and patterns of human disturbance (e.g. industrial development) affecting the landscape. Variation in habitat conditions, resource availability, and the amount and arrangement of disturbance on the landscape, influences patterns of boreal caribou range use that result in either: a) a discrete range, where boreal caribou occupy a clearly defined area with little exchange with other ranges (e.g. Coastal range (ON6), Charlevoix range (QC2)); or b) a continuous range where boreal caribou are dispersed over a large area and may move more freely and over greater distances within the area characterized by common biophysical attributes (e.g. Northwest Territories range (NT1)).

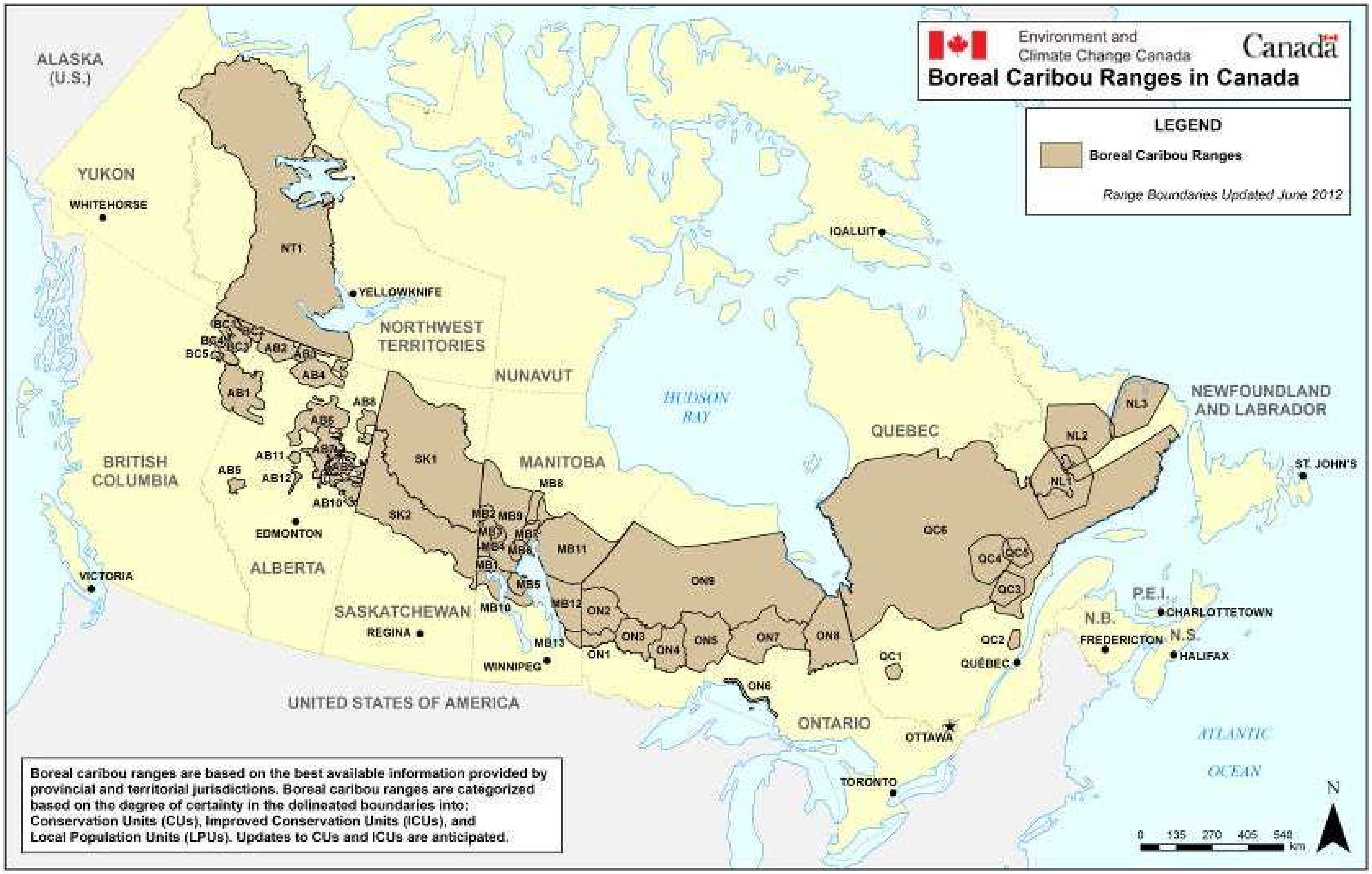

Figure 2. Geographic distribution of the 51 known ranges of boreal caribou in Canada as of June 2012.

Table 2. Range identification and range names for the 51 known ranges of boreal caribou in Canada.

Range ID	Range Name
NT1	Northwest Territories
BC1	Maxhamish
BC2	Calendar
BC3	Snake-Sahtahneh
BC4	Parker
BC5	Prophet
AB1	Chinchaga (incl. BC portion)
AB2	Bistcho
AB3	Yates
AB4	Caribou Mountains
AB5	Little Smoky
AB6	Red Earth
AB7	West Side Athabasca River
AB8	Richardson
AB9	East Side Athabasca River
AB10	Cold Lake
AB11	Nipisi

Range ID	Range Name
AB12	Slave Lake
SK1	Boreal Shield
SK2	Boreal Plain
MB1	The Bog
MB2	Kississing
MB3	Naosap
MB4	Reed
MB5	North Interlake
MB6	William Lake
MB7	Wabowden
MB8	Wapisu
MB9	Manitoba North
MB10	Manitoba South
MB11	Manitoba East
MB12	Atikaki-Berens
MB13	Owl-Flinstone
ON1	Sydney

Range ID	Range Name
ON2	Berens
ON3	Churchill
ON4	Brightsand
ON5	Nipigon
ON6	Coastal
ON7	Pagwachuan
ON8	Kesagami
ON9	Far North
QC1	Val d'Or
QC2	Charlevoix
QC3	Pipmuacan
QC4	Manouane
QC5	Manicouagan
QC6	Quebec
NL1	Lac Joseph
NL2	Red Wine Mountain
NL3	Mealy Mountain

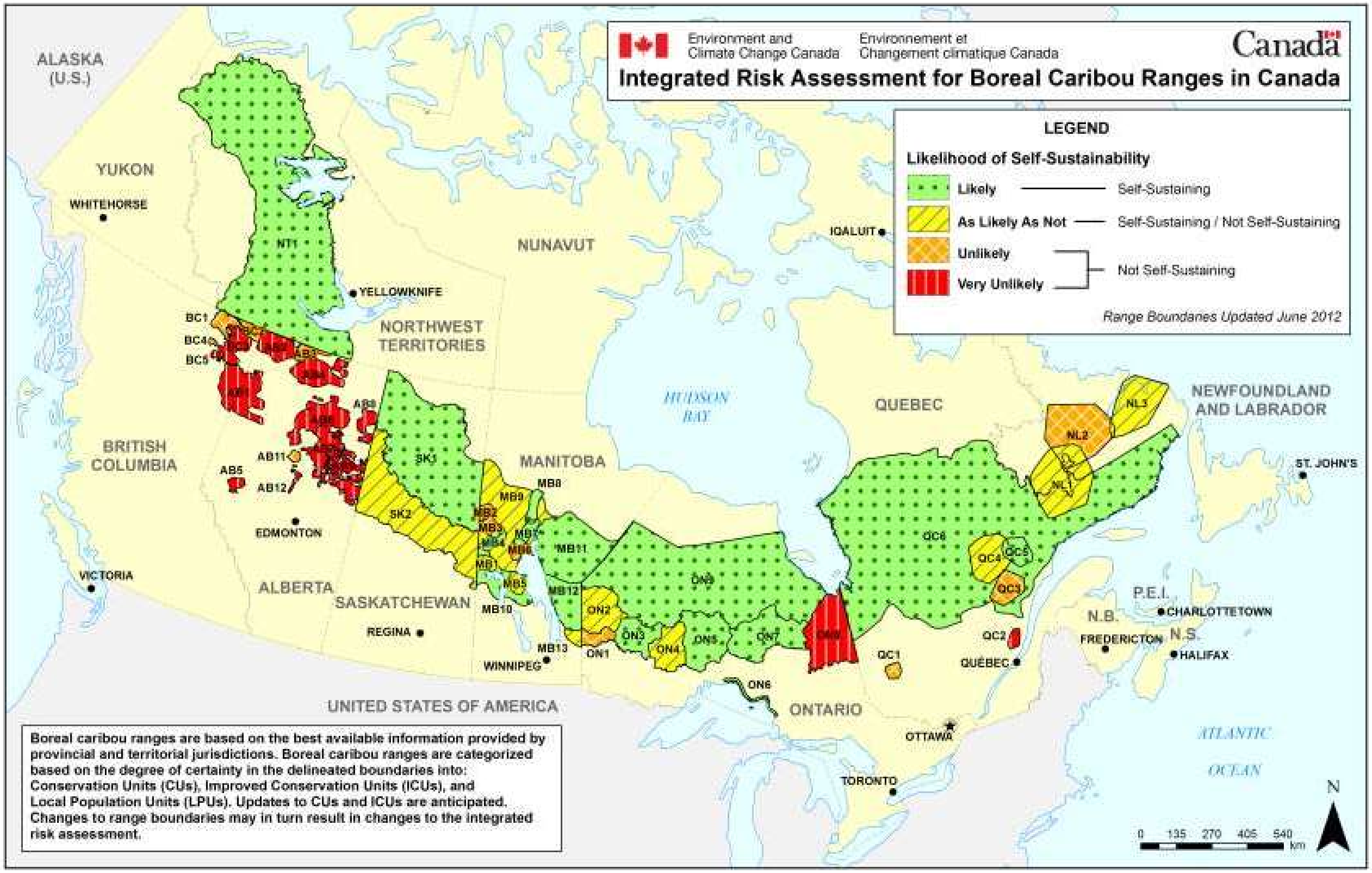

Figure 3. Integrated risk assessment for boreal caribou ranges in Canada as of June 2012, reflecting the capacity of each range to maintain a self-sustaining local population of boreal caribou. The likelihood of self-sustainability for the Boreal Shield range (SK1) has been updated from “unknown” to “likely” in this amended recovery strategy. The integrated risk assessments for the remaining ranges have not been updated.

3.2.2 Local Populations

Precise enumeration of the size of a boreal caribou local population is a challenge due to the large areas that boreal caribou occupy (often over thousands of square kilometres), the low densities at which they occur (making survey from aircraft challenging), and their relatively solitary habits (Environment Canada, 2008; Callaghan et al., 2010). Across Canada, densities average two to three animals per 100 km^2, but densities vary regionally and can be higher in areas with high quality habitat (Environment Canada, 2011b). The literature also reports that more than 300 boreal caribou are needed for self-sustaining local populations, thereby requiring ranges of at least 10,000 to 15,000 km^2 in size subject to type and quality of habitat (Environment Canada, 2011b).

Within ranges, boreal caribou are often found in small groups of fewer than 15 individuals. This will vary seasonally in accordance with life processes (e.g. calving, rutting, wintering) and based on local conditions within the range (Boreal Caribou ATK Reports, 2010-11). Boreal caribou typically form relatively mixed-sex groups; however, during calving periods females are generally solitary (Boreal Caribou ATK Reports, 2010-2011; Nagy et al., 2011).

Based on the best available information, the current overall number of boreal caribou in Canada is estimated to be approximately 33,000-34,000 individuals (Environment Canada, 2011b; COSEWIC, 2014). This number is based on mean local population size estimates as provided by the provincial and territorial jurisdictions. It is important to note that the overall national population size estimate is only a crude approximation, as population estimates over time are unavailable in most regions. Appendix F outlines the current population size and trend information for each of the 51 ranges, as provided by provincial and territorial jurisdictions (Environment and Climate Change Canada, 2017).

3.3 Needs of the Boreal Caribou

3.3.1 Habitat and Biological Needs

Boreal caribou require large range areas comprised of continuous tracts of undisturbed habitat. In general, boreal caribou prefer habitat consisting of mature to old-growth coniferous forest (e.g. jack pine (*Pinus banksiana*), black spruce (*Picea mariana*)) with abundant lichens, or muskegs and peat lands intermixed with upland or hilly areas (Stuart-Smith et al., 1997; Rettie and Messier, 2000; Courtois, 2003; Brown et al., 2007; Boreal Caribou ATK Reports, 2010-2011). Large range areas reduce the risk of predation by allowing boreal caribou to maintain low population densities throughout the range and by allowing them to avoid areas of high predation risk, such as areas with high densities of alternate prey species (e.g. moose and deer) and predators (e.g. wolf and bear) (Rettie and Messier, 2001; Brown et al., 2003; Whittington et al., 2011) (see Section 4.2). Boreal caribou use a variety of habitats to avoid predators, including muskegs and bodies of water, as well as mature and old-growth forests (Boreal Caribou ATK Reports, 2010-2011).

Boreal caribou select habitat that provides food, particularly terrestrial and arboreal lichens, during late winter and early spring, and avoid early stage, successional forests and recently disturbed areas (Schaefer and Pruitt, 1991; Stuart-Smith et al., 1997; Rettie and Messier, 2000;

Dunford et al., 2006; Boreal Caribou ATK Reports, 2010-2011), which have poor feeding options, impede movement, and attract other ungulates (Whitefeather Forest, 2006). In order to access forage during winters with deep or crusted snow, boreal caribou require habitat that has arboreal lichens and shallower snow (such as mature coniferous stands with closed canopies and upland or hilly areas exposed to wind), where it is easier to dig for ground lichens (Vandal and Barrette, 1985; Thomas and Armbruster, 1996; Courbin et al., 2009; Boreal Caribou ATK Reports, 2010-2011; Moreau et al., 2012).

Boreal caribou have specific habitat requirements during calving and post-calving periods. To calve, pregnant cows travel to isolated, relatively predator-free areas where nutritious forage is available, such as islands in lakes, peat lands or muskegs, lakeshores and forests (Boreal Caribou ATK Reports, 2010-2011). Unavailable, inadequate or degraded habitat affects the reproductive success of females as well as the survival of calves, and can result in population decline (Thomas and Gray, 2002; McCarthy et al., 2011; Pinard et al., 2012).

Boreal caribou shift their use of habitat and their distribution within the range in response to various natural processes (e.g. forest fire, food availability, weather conditions) and human activities (e.g. development, logging, recreation) (Boreal Caribou ATK Reports, 2010-2011; Environment Canada, 2011b). For example, any mature and old-growth forest stands lost to fire or tree removal practices will result in the degradation of suitable habitat in the short-term. In response to such changing environmental conditions, boreal caribou will shift within their range. Over time, a disturbed area may recover and become suitable for use by boreal caribou.

3.3.2 Connectivity

Connectivity of habitat both within a range and between ranges is essential for boreal caribou persistence on the landscape. Within a range, habitat connectivity allows for seasonal movement among habitats with the different resources needed by boreal caribou to satisfy their life history requirements (see Appendix H for examples of biophysical attributes), and for boreal caribou to use different areas as they respond to disturbance or as disturbed habitat recovers (Saher and Schmiegelow, 2005).

Connectivity between boreal caribou ranges allows for immigration and emigration between local populations, which increases gene flow, thereby helping to maintain genetic diversity and the species' subsequent resilience to environmental stressors (e.g. disease, severe weather). Studies have demonstrated that isolation of local populations as a result of disturbance to the landscape (i.e. any form of anthropogenic or natural habitat alteration), can result in a significant reduction in genetic diversity (Courtois et al., 2003; Weckworth et al., 2012). Connectivity between ranges also maintains recovery or rescue effects between boreal caribou ranges. Finally, connectivity within and between boreal caribou ranges will allow for movement in response to changing environmental conditions (e.g. climate change) (Racey and Armstrong, 2000; Courtois et al., 2003; McLoughlin et al., 2004; Pither et al., 2006; Boreal Caribou ATK Reports, 2010-2011).

3.3.3 Limiting Factors

Boreal caribou possess certain life history characteristics that limit their potential to recover from rapid, severe population declines. As a primary anti-predator survival strategy, boreal caribou spatially separate themselves from predators and alternate prey, maintaining low population densities across their range (Bergerud, 1988; Bergerud, 1996; Johnson et al., 2001; Environment Canada, 2008). Accordingly, continuous tracts of undisturbed habitat of suitable quality (i.e. with the required biophysical attributes) are needed to ensure self-sustaining local populations.

Boreal caribou have a low reproductive output relative to other ungulates and therefore are vulnerable to higher rates of mortality whether caused by predation or over-harvesting. Females typically do not produce young until three years of age and then have only one calf per year (Bergerud, 2000). In addition, while all age classes of boreal caribou are vulnerable to predation, calf mortality can be especially high, particularly within the first thirty days after birth (Bergerud and Elliot, 1986; Gustine et al., 2006). Calves disperse themselves over the landscape as an anti-predator tactic. In most cases predation is the main proximate factor limiting boreal caribou population growth, since the survival of calves to one year of age is usually low and is often insufficient to compensate for annual adult mortality in declining populations (Bergerud, 1974; Stuart-Smith et al., 1997; DeMars et al., 2011).

Small local populations with few adult females (and hence few births) and low calf survival have a low potential for population growth (Bergerud, 1980; Bergerud, 2000; McCarthy et al., 2011). In addition to being affected by reproductive and mortality rates related to their age distribution, small local populations can be disproportionately affected by stochastic events (e.g. environmental events such as winter icing or heavy snowfalls, fire, disease). Consequently, population growth is likely to be highly variable in small local populations, with an increased probability of extirpation (Caughley, 1994; Courtois et al., 2007).

4 THREATS

4.1 Threat Assessment

There are a variety of threats that directly and/or indirectly affect boreal caribou and their habitat across Canada. A summary of these threats and their national level of concern are provided below (see Table 3). The level of concern was determined using best available information, including Indigenous Knowledge and comments received through engagement with Indigenous communities. Threats and their level of concern differ between regions and local populations. For example, the level of concern for the effect of hunting on local populations is high in Labrador, while it remains medium nationally. Actions to mitigate threats are being or will be addressed in range plans and/or action plans (see Sections 7.3 and 9).

Many of the threats to boreal caribou and their habitat are related and may interact, in which case they can have cumulative impacts that may not be evident when threats are examined individually (Weclaw and Hudson, 2004; Boreal Caribou ATK Reports, 2010-2011; Badiou et al., 2011). Additionally, the impacts of threats on the size and distribution of boreal caribou local populations have a lag effect, which can take years to manifest (Vors et al., 2007).

Table 3. Threat assessment table for boreal caribou.

Threat	Level of Concern[1]	Extent	Occurrence	Frequency	Severity[2]	Causal Certainty[3]
Habitat Alteration (Disturbance)						
Habitat alteration (loss, degradation or fragmentation) as a result of human land-use activities	High	Widespread across Canada	Current	Continuous	High	High
Habitat alteration (loss, degradation or fragmentation) as a result of forest fire	Medium	Widespread across Canada	Current	Recurrent	Moderate	High
Natural Processes						
Predation	High	Widespread across Canada	Current	Continuous	High	High
Parasites and disease	Low	Localized across Canada	Anticipated	Unknown	Unknown	Low

Threat	Level of Concern[1]	Extent	Occurrence	Frequency	Severity[2]	Causal Certainty[3]
Biological Resource Use						
Hunting	Medium	Localized across Canada	Current	Seasonal	Moderate	Medium
Climate and Natural Disasters						
Climate change and severe weather	Medium	Widespread across Canada	Current	Unknown	Unknown	Low-Med
Other Threats						
Noise and light disturbance	Low-Med	Localized across Canada	Current	Recurrent	Unknown	Low
Vehicle collisions	Low	Localized across Canada	Current	Recurrent	Low	Low
Pollution	Low	Localized across Canada	Unknown	Unknown	Unknown	Low

1 Level of concern: qualifies the level of concern for managing the threat for the recovery of the species, consistent with the population and distribution objectives. This criterion considers all other criteria in the table.

2 Severity: reflects the population-level effect (i.e. high means a very large population-level effect; low means a limited population-level effect).

3 Causal certainty: reflects the degree of evidence that is known for the threat (i.e. high: available evidence strongly links the threat to stresses on population viability; medium: there is a correlation between the threat and population viability according to best available information; low: the threat is assumed or plausible).

4.2 Description of Threats

The threats to boreal caribou and their habitat identified in Table 3 are described below.

4.2.1 Habitat Alteration (Disturbance)

Habitat alteration occurs when changes are made on the landscape that adversely impact the ecosystem, either temporarily or permanently, reducing the overall function of habitat within the range for boreal caribou. Habitat loss is a change to a landscape that results in areas with no immediate or long-term future value to boreal caribou (e.g. conversion to agriculture, development of industrial facilities) whereas habitat degradation refers to a reduced but not total loss of habitat value for boreal caribou (e.g. reduction in the availability or quality of habitat following timber harvesting or seismic line development). Habitat fragmentation is the dissection of habitat by human-made linear features (e.g. roads, seismic lines, pipelines, hydroelectric corridors) and polygonal features (e.g. forestry cut blocks) that may affect how boreal caribou use habitat or may result in a negative impact on the overall condition of a local population.

Environment and Climate Change Canada mapped total disturbance levels on boreal caribou ranges across their distribution in Canada as a predictor of self-sustainability for boreal caribou local populations. The total disturbance footprint was measured as the combined effects of fire that has occurred in the past 40 years and buffered (500 m) anthropogenic disturbance defined as any human-caused disturbance to the landscape that could be visually identified from Landsat imagery at a scale of 1:50,000. Although the effect of anthropogenic disturbance varies for individual ranges (i.e. in some ranges extending up to 14 km), Environment and Climate Change Canada (2011b) demonstrated that the application of a 500 m buffer to mapped anthropogenic features best represents the combined effects of increased predation and avoidance on caribou population trends at the national scale (Environment Canada, 2011b).

Data and approaches used to measure disturbance in Environment and Climate Change Canada's meta-analysis (2011b) were consistently applied across all provinces and territories. Disturbance data have been used for the purposes of this recovery strategy. Provinces and territories may have updated information and tools (e.g. Lidar remote sensing, detailed field sampling, other inventory techniques) to measure disturbance that were not considered in the national-level integrated risk assessment. Strong evidence validated by Environment and Climate Change Canada may be used to update disturbance measures and the integrated risk assessment.

Environment and Climate Change Canada (2011b) developed a methodology for consideration of disturbance management thresholds, which is described in more detail in Appendix E. With the exception of the Boreal Shield range (SK1), this amended recovery strategy identifies 65% undisturbed habitat in a range as the disturbance management threshold, which provides a measurable probability (60%) for a local population to be self-sustaining. This threshold is considered a minimum threshold because at 65% undisturbed habitat there remains a significant risk (40%) that a local population will not be self-sustaining.

For SK1, this amended recovery strategy identifies 40% undisturbed habitat in the range as the disturbance management threshold, which provides a measurable probability (71%) for the local population to be self-sustaining. This threshold is considered a minimum threshold because at 40% undisturbed habitat there remains a risk (29%) that the SK1 local population will not be self-sustaining (see Appendices D and E).

In any given range, habitat disturbance reduces the suitability of adjacent habitat, increase rates of predation, increase access to the land for hunting opportunities, and can act as barriers to boreal caribou movement (Chubbs et al., 1993; Smith et al., 2000; Dyer et al., 2001; Lander, 2006; Boreal Caribou ATK Reports, 2010-2011; Environment Canada, 2011b). In some cases boreal caribou may use areas of inadequate or degraded habitat (e.g. remnant habitat following certain types of forest fires, buffer habitat surrounding certain types of development), particularly in highly disturbed ranges where opportunities for movement to suitable undisturbed habitat are limited or unavailable. In these situations boreal caribou are at a higher mortality risk. In addition, large-scale disturbances to the landscape (e.g. intense forest fire, widespread forest harvest) can cause boreal caribou to cease their use of portions of the range.

4.2.1.1 Habitat Alteration (Loss, Degradation or Fragmentation) as a Result of Human Land-use Activities

Indigenous Knowledge and science identify disturbance primarily associated with the following human land-use activities as having a negative effect on boreal caribou local populations across Canada: forestry; oil and gas exploration and development; mining and mineral exploration and development; hydro-electric development; and tourism. These activities affect boreal caribou through a combination of direct and functional habitat loss, decreased habitat quality (i.e. habitat degradation), and development of linear features such as roads and seismic lines (i.e. habitat fragmentation) (Thomas and Gray, 2002; Vors et al., 2007; Boreal Caribou ATK Reports, 2010-2011).

The effects of habitat alteration may reduce the viability of a boreal caribou local population through the reduction of habitat quality and quantity, possibly leading to a reduction in the size of the range, and potentially resulting in the extirpation of a local population.

4.2.1.2 Habitat Alteration (Loss, Degradation or Fragmentation) as a Result of Forest Fire

Forest fires are required for boreal forest regeneration and have historically played a significant role in the local population size and distribution of boreal caribou within their range and across their Canadian distribution (Thomas and Gray, 2002; Dzus et al., 2010). Natural processes such as forest fires can directly alter habitat, making it unsuitable for boreal caribou (e.g. loss of mature conifer stands, loss of lichens and other forage plants, barriers to movement) (Environment Canada, 2011b). Boreal caribou generally do not return to burned areas for several decades until the forest is old enough to support lichens and other food sources, although they may make limited use of burned areas to feed on new growth (Boreal Caribou ATK Reports, 2010-2011).

Historically, when a forest fire occurred, boreal caribou would shift their use of habitat from the burned areas to areas that are more suitable. However, with the increase of industrial exploration and development, in a number of ranges there are fewer available suitable areas into which boreal caribou can move. When combined with human-caused disturbance, forest fires can threaten boreal caribou recovery even though they are a natural component of the boreal forest ecosystem. In some areas, forest fires have been reported as occurring more frequently than in the past (Whitefeather Forest, 2006; Boreal Caribou ATK Reports, 2010-2011).

4.2.2 Natural Processes

4.2.2.1 Predation

Across most of the distribution of boreal caribou, human-induced habitat alterations have caused an imbalance in predator-prey relationships resulting in unnaturally high predation rates. This is the major factor affecting the viability of most boreal caribou local populations (Bergerud, 1988; Stuart-Smith et al., 1997; Rettie and Messier, 1998; Schaefer et al., 1999; James and Stuart-Smith, 2000; Wittmer et al., 2005; Chabot, 2011). Based on the weight of evidence coming from science and Indigenous Knowledge, increased wolf and/or bear predation is the main proximate cause of boreal caribou decline across Canada (Bergerud, 1988; Edmonds, 1988; Seip, 1992;

Boertje et al., 1996; Boreal Caribou ATK Reports, 2010-2011; Pinard et al., 2012). However, in some parts of Canada, cougar (*Puma concolor*), coyotes (*Canis latrans*), lynx (*Lynx canadensis*), and eagles (*Haliaeetus leucocephalus* and *Aquila chrysaetos*) have also been identified as predators of boreal caribou, particularly calves (Thomas and Gray, 2002; Boreal Caribou ATK Reports, 2010-2011; McCarthy et al., 2011).

Human-caused habitat alterations have been shown to facilitate movement of predators within the boreal forest and hence can increase the abundance, distribution and hunting efficiency of species that prey on boreal caribou (James and Stuart-Smith, 2000; Neufeld, 2006; Boreal Caribou ATK Reports, 2010-2011). Additionally, although boreal caribou may not be the target prey species, they are taken opportunistically when encountered. In boreal caribou ranges with habitat alterations that provide favorable conditions for prey species such as deer and moose, predators such as wolves can increase in number, which can significantly reduce or even eliminate boreal caribou local populations (Seip, 1991; Seip, 1992; Wittmer et al., 2005; Courtois and Ouellet, 2007; Courbin et al., 2008; Boreal Caribou ATK Reports, 2010-2011). In addition to deer and moose, elk (*Cervus canadensis*), bison (*Bison bison*), and beaver (*Castor canadensis*) are other species that predators of boreal caribou commonly hunt and that have increased in number within the distribution of boreal caribou (Boreal Caribou ATK Reports, 2010-2011).

4.2.2.2 Parasites and Diseases

Viral, parasitic, and bacterial diseases can affect individual boreal caribou and may have effects at the local population level in certain parts of the country, although it is not thought to be one of the major threats affecting boreal caribou at the national level.

Other natural processes such as forest insects and disease can leave large areas of forest defoliated, and eventually dead, and may have an effect on boreal caribou habitat. In particular the mountain pine beetle (*Dendroctonus ponderosae*), which covers large areas of northeastern British Columbia and northern Alberta and threatens to move into Saskatchewan, could indirectly affect boreal caribou (Richie, 2008; Environment Canada, 2011a).

4.2.3 Biological Resource Use

4.2.3.1 Hunting

Hunting has and continues to contribute to the decline of boreal caribou (Bergerud, 1967; Kelsall, 1968; Bergerud, 1974; Bergerud, 1978; Courtois et al., 2007; Boreal Caribou ATK Reports, 2010-2011). Both targeted hunting and incidental harvest (when boreal caribou intermingle seasonally with legally hunted migratory caribou ecotypes) of boreal caribou are of concern in several areas, and may be contributing to local population declines and/or preventing recovery (Environment Canada, 2011a).

Although the extent of hunting is poorly understood in most areas, analyses of historical population trends, data from radio-collared animals, and current demographic information suggest that hunting remains a significant component of adult female boreal caribou mortality and hence is a primary threat in some ranges (Dzus, 2001; Schmelzer et al., 2004; Courtois et al., 2007). Hunting of boreal caribou is facilitated by the construction of roads and other linear features and by the use of off-road vehicles that enable access to previously inaccessible areas (Boreal Caribou ATK Reports, 2010-2011). Moreover, Indigenous Knowledge indicates that technological advances in hunting tools (e.g. high-powered rifles and scopes) and in methods used to locate and access hunting sites (e.g. GPS, satellite tracking, aircraft, snowmobiles, trucks) have facilitated the chase of boreal caribou, resulting in a greater number of caribou being taken (Boreal Caribou ATK Reports, 2010-2011; Environment Canada, 2011a).

4.2.4 Climate and Natural Disasters

4.2.4.1 Climate Change and Severe Weather

Climate change has been identified by Indigenous Knowledge holders and scientists as a threat to boreal caribou and their habitat. Both groups indicate that there are many uncertainties surrounding the impacts of climate change and how climate change may interact with other threats. The long-term effects of climate change and the implications on boreal caribou habitat are unknown.

Greater weather variability and severe weather events, which are expected to increase with climate change, are likely to increase the frequency and severity of wildfires and cause more freeze-thaw cycles, freezing rain, deep snow, hot summer temperatures, and changes in the forest composition and food supply (Thomas and Gray, 2002; Vors and Boyce, 2009; Boreal Caribou ATK Reports, 2010-2011). In some areas, a shift in the timing and length of seasons, with earlier spring thaws and later freeze-ups, has been observed by many Indigenous Knowledge holders (Boreal Caribou ATK Reports, 2010-2011). Climate change will likely also lead to changes in habitat which, in the Northwest Territories, can increase permafrost melting.

Climate related changes in habitat favour deer and other prey species, which expand into boreal caribou range, increasing predator populations and predation of boreal caribou, and facilitating the spread of disease. Climate change may result in habitat change for boreal caribou, as it drives boreal forest composition to shift northwards, and results in other factors including the spread of forest insects that cause tree mortality (e.g. mountain pine beetle) (Johnston, 2009; Johnston, 2010).

4.2.5 Other Threats

Other threats that have a lower level of concern at the national scale (although they may be of greater concern for individual ranges) include:

Noise and Light Disturbance: Noise and light disturbance result in short-term behavioural and physiological responses of individual boreal caribou, including a startle response, elevated heart rate, and production of glucocorticoids. Sustained or repeated disturbance can result in avoidance of areas and the reduction in use of suitable habitat (Sapolsky, 1992; Creel et al., 2002).

Vehicle Collisions: In some areas, boreal caribou are vulnerable to mortality from vehicle or rail collisions (Brown and Hobson, 1998); however, on a national scale, vehicle collisions are not thought to pose a major threat to boreal caribou (Boreal Caribou ATK Reports, 2010-2011).

Pollution: The threat of pollution (e.g. from oil and gas, chemical spraying for forestry, pesticides, hydro, salt, dust and litter coming from the creation of roads) was identified as a concern through meetings held with Indigenous communities (Environment Canada, 2011a) and by Indigenous Knowledge holders (Boreal Caribou ATK Reports, 2010-2011). Very little is known about the severity of this threat to boreal caribou local populations.

5 POPULATION AND DISTRIBUTION OBJECTIVES

The national population of boreal caribou is currently made up of local populations distributed across 51 ranges in Canada (see Figure 2 and Table 2). Boreal caribou ranges are the fundamental units of conservation and management for boreal caribou recovery planning and actions (Thomas and Gray, 2002). The range is the appropriate unit of analysis for identifying critical habitat and other requirements for self-sustaining local populations of boreal caribou. The range represents the geographic area occupied by a group of individuals that are subject to similar factors affecting their demography and is used to satisfy their life history processes (e.g. calving, rutting, wintering) over a defined time frame.

5.1 Recovery of Boreal Caribou

5.1.1 Varying Ecological Conditions

Indigenous Knowledge and comments received through engagement with Indigenous communities identifies the need for continued presence of self-sustaining local populations in all boreal caribou ranges across Canada (Boreal Caribou ATK Reports, 2010-2011; Environment Canada, 2011a). This is reflected in the knowledge that all animals are connected to each other and that boreal caribou are essential to the balance of nature and for their role in the boreal ecosystem.

Boreal caribou encounter a wide variety of ecological conditions across their distribution. Taken together, all boreal caribou ranges contribute to ensuring that the full ecological gradient is represented and captures local adaptations to change. This allows for maintenance of the evolutionary potential of the species and accounts for the full spectrum of ecological interactions boreal caribou can have within the full array of ecological settings (Redford et al., 2011).

Science supports that conservation of a species such as boreal caribou is achieved by maintaining multiple local population units across a species' geographical range, in representative ecological settings, with replicate local populations in each setting that are self-sustaining, genetically robust, ecologically functional, and resilient to climate and other changes (Environment Canada, 2011b). Without connectivity, redundancy and representivity across several ecological scenarios there is an increased risk to the survival and recovery of boreal caribou.

Small local populations, particularly those isolated from the core distribution of the national population of boreal caribou, are at greater risk of not becoming self-sustaining or maintaining self-sustaining status. In these situations, a local population may have greater difficulty withstanding stochastic events, and may not experience enough immigration to maintain genetic diversity or adequate population size, and therefore will be at greater risk of not persisting in the long-term. Accordingly, different recovery actions (e.g. translocation, captive breeding) may be necessary to maintain and recover small local populations, and particularly those that are declining. There may be considerable uncertainty regarding the effectiveness of such recovery tools. It will be important to assess feasibility and conduct a risk assessment prior to undertaking any such activities.

There are several small local populations including Parker (BC4) and Prophet (BC5) in British Columbia, Nipisi (AB11) and Slave Lake (AB12) in Alberta, The Bog (MB1), Kississing (MB2), North Interlake (MB5), William Lake (MB6) and Owl-Flinstone (MB13) in Manitoba, and Red Wine Mountain (NL2) in Newfoundland and Labrador. Small isolated local populations include Little Smoky (AB5) in Alberta, Coastal (ON6) in Ontario, and Val D'Or (QC1) and Charlevoix (QC2) in Quebec (see Figure 2).

5.1.2 Connectivity Between and Within Boreal Caribou Ranges

Maintaining a long-term self-sustaining status for boreal caribou ranges depends on connectivity within and between ranges. Connectivity between ranges enables immigration and emigration between neighbouring boreal caribou local populations, which allows for the maintenance of local population size and genetic diversity. Maintaining genetic diversity is needed to maintain the resilience of a local population as described in Section 3.3.2.

Connectivity also allows wide ranging mammals like boreal caribou to adapt to changes in their natural environment (e.g. climate change, disturbance), recognizing that a contiguous population does not mean that each range must be physically connected to other ranges or that areas of habitat within a range must be physically connected to other areas. However, it does mean that the distance between ranges and between core habitat areas within a range should not be so large that no movement of boreal caribou could occur, though it may not be their preferred habitat type. Connectivity between ranges benefits gene flow and helps to maintain or increase population size. Connectivity within a range is important for seasonal movement and the use of habitat as boreal caribou respond to disturbance or as disturbed habitat recovers (Saher and Schmiegelow, 2005).

5.2 Objectives

5.2.1 Recovery Goal

The recovery goal for boreal caribou is to achieve self-sustaining local populations in all boreal caribou ranges throughout their current distribution in Canada, to the extent possible.

The recovery goal reflects the best available information, including scientific knowledge, Indigenous Knowledge and comments received through engagement with Indigenous communities. The goal is informed by the scientific principles of conservation and reflects the intent to recover all local populations. Achieving the recovery goal would allow for local population levels sufficient to sustain traditional Indigenous harvesting activities, consistent with existing Aboriginal and treaty rights. Feedback received from Indigenous communities indicated a strong support for this recovery goal.

Recovery for boreal caribou is the achievement of self-sustaining local populations, which are demographically and genetically viable connected local populations across the species' distribution. Current evidence supports the conclusion that the recovery of all local populations is biologically and technically feasible. As noted in Sections 3.3.3 and 5.1.1, small and isolated local populations are at greater risk of not becoming self-sustaining or maintaining self-sustaining status. There may be situations where recovery of a particular local population proves to be, over time and through unforeseen circumstances, not biologically or technically feasible. Each boreal caribou local population contributes to the biodiversity, ecological functionality, and resilience of the species to environmental change, reducing the risk of species' extinction (Ray, 2011).

5.2.2 Population and Distribution Objectives

To guide recovery efforts, the population and distribution objectives (see Figure 4) are, to the extent possible, to:

- Maintain the current status of the 15 existing self-sustaining local populations (green dotted ranges); and
- Stabilize and achieve self-sustaining status for the 36 not self-sustaining local populations (blue hatched ranges).

"Not self-sustaining" local populations refers to the local populations assessed as "as likely as not self-sustaining" and those assessed as "not self-sustaining". The population and distribution objective for the Boreal Shield (SK1) local population has been changed from "stabilize and achieve self-sustaining status" to "maintain self-sustaining status" in this amended recovery strategy, based on work carried out by P.D. McLoughlin (University of Saskatchewan, personal communications) and Environment and Climate Change Canada (2019) that indicates that the SK1 local population is self-sustaining.

5.3 Timelines to Recovery

Boreal caribou exist in mature boreal forest ecosystems that evolved over centuries, and in turn take decades to recover from disturbance. Reversing ecological processes detrimental to boreal caribou (e.g. habitat degradation and loss, the increase in predator and alternate prey populations), and instituting changes to management frameworks and ongoing land use arrangements, will often require time frames in excess of 50 to 100 years. Given these realities, while it is currently biologically and technically feasible to recover all local populations, under the best efforts of all parties, some local populations will not return to a self-sustaining status for a number of decades.

For several boreal caribou local populations, immediate actions to avoid extirpation are needed such that recovery can be achieved over time. Recovery will be monitored continuously and reported every five years (see Section 8).

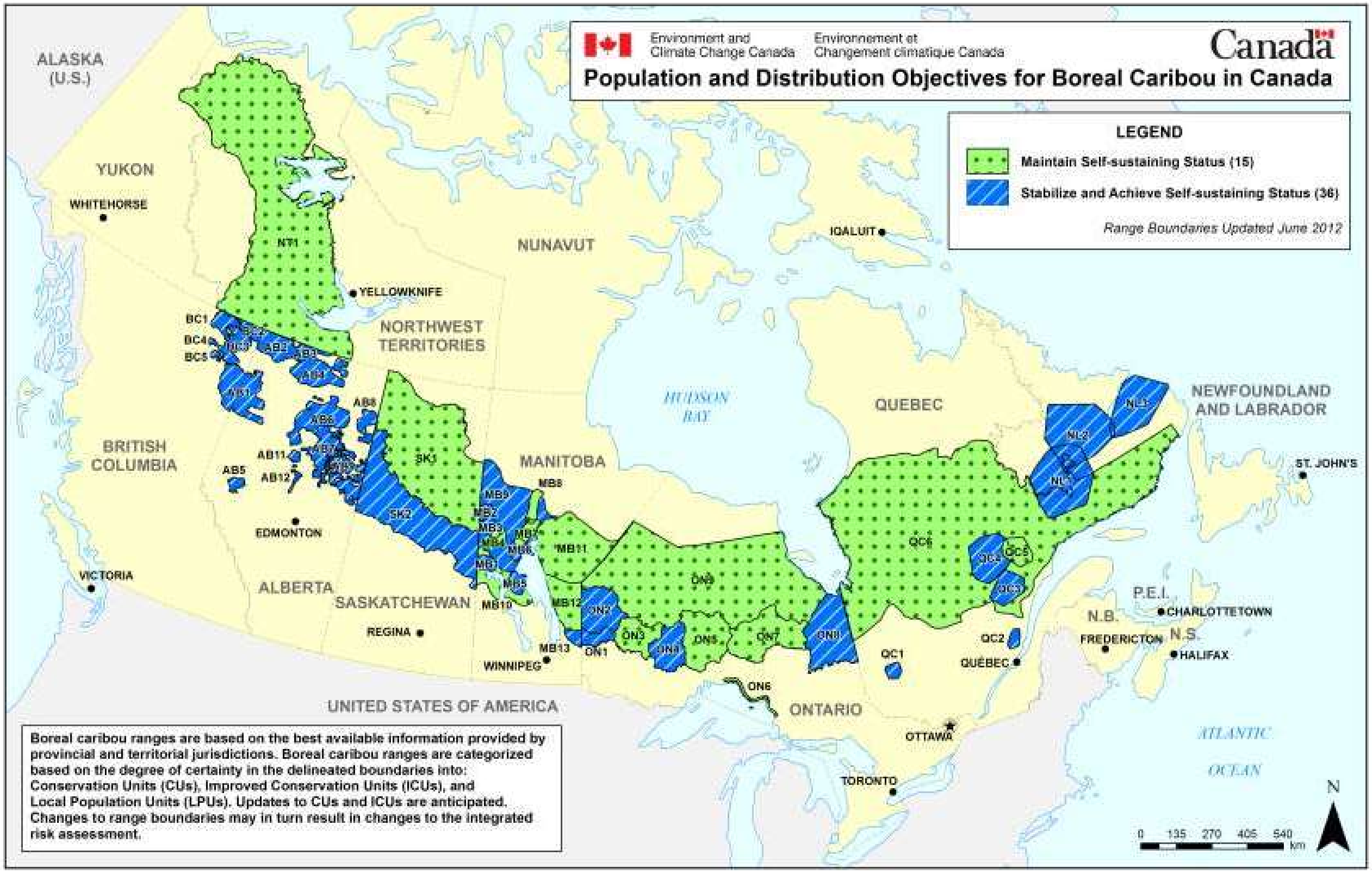

Figure 4. Population and distribution objectives for boreal caribou in Canada. The population and distribution objective for the Boreal Shield range (SK1) has been updated from “stabilize and achieve self-sustaining status” in the 2012 Recovery Strategy to “maintain self-sustaining status” in this amended recovery strategy.

5.4 Prioritizing Recovery Actions and Managing Risk

All local populations are included in the goal for the recovery of boreal caribou based on their contributions to connectivity, representivity and redundancy. Each local population also faces different challenges to maintain or achieve self-sustaining status. Successful recovery of boreal caribou will require practical considerations and implementation of recovery actions tailored for each range. Prioritization of recovery actions is being addressed at the range and/or action planning stage where the allocation of effort and the rate of risk reduction for individual ranges can best be determined.

Range and/or action planning considers a multitude of information and factors, such as regional ecological conditions, local population size and trend, boreal caribou movement between ranges, habitat condition between ranges, distribution of resources for restoration efforts, and others. In prioritizing recovery actions, consideration should be given to the current risk of extirpation of a local population, the length of time to achieve a self-sustaining status, ecological needs of connectivity, representivity and redundancy, as well as population and habitat conditions.

5.5 Achieving Recovery for Self-Sustaining Local Populations

Recovery is achieved for the 15 self-sustaining local populations by maintaining population and range conditions that support their self-sustaining status.

5.6 Achieving Recovery for Not Self-Sustaining Local Populations

Recovery is achieved for the 36 not self-sustaining local populations through a combination of coordinated habitat restoration and population management actions applied over time to return a local population to a self-sustaining status. For each not self-sustaining local population, the timeframe for achieving recovery will vary depending on whether the habitat condition and/or the population condition is/are a limiting factor.

For boreal caribou ranges where local populations are declining, stabilizing the local population by halting its decline will require immediate action. For all ranges wherein the local population size is small, achieving a stable population trend and recovering the population to a minimum of 100 animals[3] will be necessary to mitigate risk of quasi-extinction. Although certain local populations with fewer than 100 animals may be stable and persist over the short-term where adequate suitable habitat supply is available, the long-term persistence of those populations is less certain. In some instances, continued human intervention may be required to achieve the minimum population size target.

In addition to managing local population size, habitat management will also be necessary. This recovery strategy identifies 65% undisturbed habitat in all ranges except SK1, and 40% undisturbed habitat in SK1, as the disturbance management threshold. This provides a

[3] 100 animals provides a 0.7 probability of not reaching a quasi-extinction threshold of less than 10 reproductively active females under stable conditions over 50 years (Environment Canada, 2011b).

measurable probability (60% for all ranges with the exception of SK1, which has a 71% probability) for a local population to be self-sustaining (see Appendix E).

For boreal caribou ranges with undisturbed habitat below the threshold:

- Restoration of disturbed habitat to a minimum of 65% undisturbed habitat will be necessary in all ranges except SK1, where the threshold is set at 40% undisturbed habitat.

For boreal caribou ranges with undisturbed habitat equal to or above the threshold:

- Maintenance of a minimum of 65% undisturbed habitat will be necessary in all ranges except SK1, where maintenance of a minimum of 40% undisturbed habitat will be necessary.

There are 31 ranges that do not meet the disturbance management threshold of 65% undisturbed habitat (40% undisturbed habitat for SK1) (see Section 7.1). Of these ranges, local population trends are declining (16 local populations), stable (eight local populations) or unknown (seven local populations).

There are 20 ranges where the habitat condition meets or exceeds the disturbance management threshold. Of these ranges, four local populations are declining, two local populations are stable, and the trend of 14 local populations is unknown.

6 BROAD STRATEGIES AND GENERAL APPROACHES TO MEET OBJECTIVES

6.1 Actions Already Completed or Currently Underway

Federal, provincial and territorial governments, wildlife management boards, Indigenous people, non-government organizations, and affected industries across Canada have taken and continue to take a range of actions to manage and protect boreal caribou and their habitat. Environment and Climate Change Canada's 5-Year Progress Report, published in October 2017, highlights progress made by governments, Indigenous people, and other partners and stakeholders in implementing the 2012 Recovery Strategy (Environment and Climate Change Canada, 2017). Examples of actions already completed or currently underway vary across Canada, and include:

- Identification and delineation of boreal caribou ranges and habitats within ranges;
- Assessment of the population size and/or trend and/or distribution of local populations of boreal caribou across Canada;
- Consideration of boreal caribou habitat requirements when planning and implementing forest harvesting and other industrial activities;
- Development and implementation of operating guidelines for industrial development within boreal caribou ranges;
- Land-use planning to identify areas within boreal caribou ranges where boreal caribou conservation is prioritized;
- Closed, restricted, and/or managed hunting by Indigenous and non-Indigenous people, on a voluntary basis or through regulations;
- Predator and alternate prey management in some ranges where local populations of boreal caribou are rapidly declining;
- Development of cooperative stewardship agreements and activities to support the engagement of Indigenous organizations and stakeholders in the monitoring, management, and conservation of boreal caribou;
- Preparation of outreach materials on boreal caribou and dissemination to interest groups and the general public;
- Research on boreal caribou ranges, habitat, ecology and limiting factors; and
- Continue to implement the Action Plan for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada – Federal Actions, including as it relates to the development of conservation agreements (Environment and Climate Change Canada, 2018).

Collectively, these actions, and the level of commitment associated with these actions, are an encouraging foundation upon which to build. Table 4 outlines the status of provincial and territorial recovery planning for boreal caribou.

Table 4. Status of boreal caribou recovery planning, as of April 2019, in provincial and territorial jurisdictions where boreal caribou occur.

Provincial/ Territorial Jurisdiction	Recovery Document	Recovery Goal/Objective
Northwest Territories	• Recovery Strategy for the Boreal Caribou (*Rangifer tarandus caribou*) in the Northwest Territories, 2017	• Ensure a healthy and sustainable boreal caribou population across their territorial range that offers harvesting opportunities for present and future generations.
British Columbia	• Implementation Plan for the Ongoing Management of Boreal Caribou in British Columbia, 2011 • An updated recovery planning document is being collaboratively developed	• Decrease the expected rate of decline • Significantly reduce the risk of extirpation for four populations within 50 years
Alberta	• A Woodland Caribou Policy for Alberta, June 2011 • Alberta Woodland Caribou Recovery Plan, 2004/05 – 2013/14	• Achieve self-sustaining woodland caribou herds and maintain the distribution of caribou in the province • Ensure long-term habitat requirements throughout caribou ranges in the province
Saskatchewan	• Conservation Strategy for Boreal Woodland Caribou (*Rangifer tarandus caribou*) in Saskatchewan, 2013	• Sustain and enhance woodland caribou populations, and maintain the ecosystems they require, throughout their current range
Manitoba	• Manitoba's Boreal Woodland Caribou Recovery Strategy, 2015	• Self-sustaining local populations of boreal caribou across all management units • Management and protection of caribou habitat to sustain boreal caribou populations
Ontario	• Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*)(Forest-dwelling, Boreal Population) in Ontario, 2008 • Ontario's Woodland Caribou Conservation Plan, 2009	• Maintain self-sustaining, genetically-connected local populations of Woodland Caribou (forest-dwelling boreal population) where they currently exist, improve security and connections among isolated mainland local populations, and facilitate the return of caribou to strategic areas near their current extent of occurrence
Quebec	• Quebec Recovery Plan for Woodland Caribou, 2013-2023	• Maintain suitable habitat for caribou • Maintain current distribution • Achieve and maintain uniform distribution (> 11,000 caribou)
Newfoundland and Labrador	• Recovery Strategy for Three Woodland Caribou Herds (*Rangifer tarandus caribou*; Boreal population) in Labrador, 2004 • Updated Recovery Plan is being prepared	• Prevent extinction and improve status of current herds • Determine and achieve viable, self-sustaining wild populations distributed throughout their available current and historical ranges for each of the three herds

6.2 Strategic Direction for Recovery

The following table (see Table 5) and narrative describe, at a national level, the broad strategies and general approaches to be taken and the research and management activities needed to address the threats to boreal caribou and achieve the population and distribution objectives for each range. Many strategies and approaches are interrelated and details on their implementation and their level of priority will differ across the country and by local population and habitat conditions. Sequencing and timing of specific recovery actions and their level of priority will be outlined and addressed in range plans and/or action plans (see Sections 7.3 and 9).

Table 5. Recovery planning table for boreal caribou

Threat or Limitation	Priority[5]	Broad Strategy to Recovery	General Description of Research and Management Approaches
Landscape Level Planning			
Habitat alteration as a result of human land-use activities Habitat alteration as a result of natural processes	Urgent	Undertake landscape level planning that considers current and future boreal caribou habitat requirements	• Develop range plans (see Section 7.3) that outline range-specific population and habitat management activities with measurable targets to achieve recovery goal. • Undertake coordinated land and/or resource planning to ensure that development activities are planned (type, amount, and distribution) and implemented at appropriate spatial and temporal scales (e.g. consider sensitive periods/areas such as calving). • Plan to maintain habitat within and between boreal caribou ranges, to maintain connectivity where required. • Undertake coordinated planning among provincial and territorial jurisdictions that jointly manage ranges (i.e. transboundary ranges) to reach agreement on the overall strategic direction for local population recovery. • Develop range-appropriate cumulative effects assessment approaches. Very large ranges (Northwest Territories (NT1), Far North (ON9), and Quebec (QC6)) will require different approaches. • Communicate among governments, wildlife management boards, Indigenous communities and organizations, non-governmental organizations, and other organizations responsible for land and/or resource management and/or conservation within the boreal forest to ensure coordination of planning and management and, where applicable, facilitate cross-jurisdictional cooperation and implementation.
Habitat Management			
Habitat alteration as a result of human land-use activities Habitat alteration as a result of natural processes	Urgent	Manage habitat to meet current and future habitat requirements of boreal caribou	• Protect key areas for boreal caribou through appropriate habitat management and protection mechanisms (e.g. legislated protected areas, no development zones, mixed use zones, and conservation agreements). • Undertake coordinated actions to reclaim boreal caribou habitat through restoration efforts (e.g. restore industrial landscape features such as roads, old seismic lines, pipelines, cut-lines, temporary roads, cleared areas; reconnect fragmented ranges).

Threat or Limitation	Priority[5]	Broad Strategy to Recovery	General Description of Research and Management Approaches
			• Measure and monitor disturbance on the landscape (see Section 4.2.1). Update range plans to reflect changes in habitat condition. • Where ranges are highly disturbed, identify areas that will be prioritized for boreal caribou recovery and targeted for early habitat reclamation. Incorporate management guidelines and actions into permitting conditions for activities identified as affecting boreal caribou or their habitat. • For ranges that are jointly managed (i.e. transboundary), undertake collaborative habitat management among responsible provincial and territorial jurisdictions to ensure equitable efforts are underway. • Encourage stewardship of boreal caribou habitat among industries, interest groups, and Indigenous communities and organizations. • Assess the impact of natural disturbance (e.g. forest fire) on the long-term habitat management of boreal caribou ranges. Where necessary, incorporate short- and long-term boreal caribou habitat considerations, along with other considerations, into forest fire management. • Monitor habitat and use adaptive management to assess progress and adjust management activities as appropriate.
Mortality and Population Management			
Predation	High	Manage predators and alternate prey	• Where necessary, apply predator management as an interim management tool, in conjunction with other management approaches (e.g. habitat restoration and management), to achieve boreal caribou local population growth. Alternate prey management may also be applied in conjunction with predator management. • Where applicable, consider effective indirect predator management techniques as an alternative to direct predator management (e.g. limiting predator access, penning of boreal caribou). • Where mortality and/or population management are implemented, monitor boreal caribou local populations and consider monitoring the effects on other impacted species.
Hunting	Medium	Manage direct human-caused mortality of boreal caribou	• Determine the extent of current hunting, and the effects of hunting on boreal caribou local populations. • In consultation with Indigenous people, develop and implement harvest strategies, where required to achieve boreal caribou recovery. • Assess and address impacts of hunting regulations for all boreal caribou ranges that overlap with other legally hunted Woodland Caribou ecotypes. • Reduce illegal hunting through stewardship, education and enforcement.

Threat or Limitation	Priority[5]	Broad Strategy to Recovery	General Description of Research and Management Approaches
Population Monitoring			
Knowledge gaps: Population dynamics (trends, size, structure, and distribution)	High	Conduct population studies to better understand population structure, trends and distribution	• Where necessary, refine understanding of the structure and functioning of boreal caribou local populations. • Monitor population size and/or trend, as well as changes in boreal caribou distribution over time and in relation to habitat condition and disturbance. • Coordinate data collection, data-sharing, and planning between or among neighbouring provincial and territorial jurisdictions to establish transboundary ranges where appropriate. • Revise boreal caribou range delineations based on updated population information from science and Indigenous Knowledge.
Knowledge gaps: boreal caribou health and condition	Low - Medium	Monitor boreal caribou health and condition	• Gather information, monitor and manage the health and body condition of individual boreal caribou.
Knowledge gaps: boreal caribou sensory disturbance	Low - Medium	Monitor and manage sensory disturbance of boreal caribou	• Assess the extent, distribution, and possible consequences of sensory disturbance (e.g. aircraft traffic, snowmobiles, all-terrain vehicles, tourism, research, and equipment associated with oil and gas or forestry) on boreal caribou, and where required reduce its effects, particularly during sensitive periods (e.g. calving). • Minimize disturbance to boreal caribou during monitoring and research programs, and select monitoring and research techniques that are the least intrusive.

[5] Priority: reflects the level of priority of the broad strategy on a national level. This priority for each local population may differ.

6.3 Narrative to Support the Recovery Planning Table

Recovery of boreal caribou will require the commitment, collaboration and cooperation among federal, provincial and territorial jurisdictions, wildlife management boards, Indigenous people, local communities, landowners, industry and other interested parties. It will be important to monitor habitat conditions, size and/or trend, and the distribution of boreal caribou local populations so that the effectiveness of individual range management regimes can be evaluated, and adjusted as necessary. It should also be recognized that it takes time for the impact of human developments and natural disturbances on boreal caribou to become evident. Therefore, range plans and/or action plans must take into account the likelihood of a delayed boreal caribou population and distribution response to anthropogenic or natural habitat alterations.

6.3.1 Landscape Level Planning

As the range has been identified as the most relevant scale at which to plan for the conservation of boreal caribou, undertaking landscape level land and/or natural resource planning is appropriate for effective management of cumulative effects of habitat disturbance within boreal caribou ranges and for managing disturbance over time to ensure sufficient habitat is available for boreal caribou, both of which are more difficult in the context of individual project approvals. Range-level planning for boreal caribou should consider current and future human developments and determine detailed management activities that are tailored to the conditions of the range and the local population in question. Range plans and/or action plans should take into account natural disturbances and cumulative effects of development within and between boreal caribou ranges.

It will be important to undertake coordinated land and/or resource planning to ensure that development activities are planned and approved, taking into consideration the cumulative impacts of all current and future developments within a range. Assessing cumulative effects will require a different approach for large continuous ranges than for smaller discrete ranges. The impact of disturbance that may be concentrated in part of a large continuous range may be masked given the size of the range. Dividing the large areas into smaller management units may allow land managers to better understand where the disturbance is occurring and plan accordingly, in order to avoid irreversible range retraction and permanent breaks in range connectivity.

In light of the impacts that actions taken in neighbouring ranges have on boreal caribou, it will be important that provinces and territories take a collaborative approach to land and/or resource planning, particularly in ranges that are jointly managed (i.e. transboundary), to ensure an agreed upon direction to boreal caribou recovery is attained.

6.3.2 Habitat Management

Boreal caribou ranges will need to be managed to ensure their current and future ability to support self-sustaining local populations. The effectiveness of various management activities may vary between and within ranges due to differences in population condition and specific local conditions.

Management of the amount, type and distribution of human developments will be necessary. Both anthropogenic and natural disturbances will need to be monitored and measured. Methods may vary in accordance with the information and tools available to the provinces and territories. Anthropogenic disturbance (i.e. industrial and other human activities) will need to be managed in a manner consistent with land and/or resource planning that has taken into account the current and future habitat requirements of boreal caribou. Disturbed areas may need to be improved or restored to support population and distribution objectives within each boreal caribou range. Maintaining connectivity within and between habitat patches and ranges will be particularly important for boreal caribou. In certain cases, it may be necessary to identify and designate protected areas with biophysical attributes for boreal caribou. For ranges that are jointly managed by provinces and territories (i.e. transboundary), collaborative habitat management approaches will be necessary to ensure that equitable recovery efforts are underway. Though ranges may cross provincial and territorial boundaries, each jurisdiction remains accountable for activities carried out in their own range.

6.3.3 Mortality and Population Management

6.3.3.1 Manage Predators and Alternate Prey

Human-induced habitat alterations have upset the natural balance between boreal caribou and their predators, resulting in unnaturally high predation rates in some boreal caribou ranges. As a result, in some ranges, a population management approach involving management of other wildlife species (i.e. predators and alternate prey) may be required to stop boreal caribou declines and stabilize the local population in order to prevent their extirpation in the short-term. Where the condition of the local population warrants such measures, predator and in some cases alternate prey management may be applied as interim management tools, recognizing that a punctuated approach to mortality management may be necessary over a period of time while habitat conditions in the range recover. Where mortality management is applied, concurrent application of other management tools will be needed to achieve boreal caribou recovery. In particular, habitat restoration and management will be necessary to recover the range conditions to provide an adequate habitat supply system to support boreal caribou local populations. Predator and alternate prey management should be considered simultaneously. Alternate prey management applied in the absence of concurrent predator management has the potential to be harmful to boreal caribou conservation.

6.3.3.2 Manage Direct Human-Caused Mortality of Boreal Caribou

The extent of hunting and its effect on boreal caribou local populations is largely unknown across most of the distribution of boreal caribou. Therefore, it is important to first determine the level of hunting within a range in order to understand the potential impact of hunting on the viability of a local population. Attention should also be given to areas where boreal caribou ranges overlap with legally hunted caribou ecotypes, and hunting regulations for the legally hunted caribou ecotypes should be modified as appropriate. In areas where hunting is shown to have a negative effect on local population viability, harvest strategies should be developed, in consultation with Indigenous people, to achieve boreal caribou recovery.

6.3.4 Population Monitoring

6.3.4.1 Conduct Population Studies to Better Understand Boreal Caribou Population Structure, Trends and Distribution

There is considerable variation in the level of understanding of boreal caribou local population structure and trends across their distribution. While accurate population size and trend estimates are available for some local populations, for others, size and trend estimates are based primarily on professional judgement and limited data. For local populations where little is known, baseline population ecology studies such as boreal caribou collaring, aerial observations/counting, and on the ground monitoring activities are required to establish a baseline from which to plan and measure recovery progress. For all local populations, size and/or trend, and distribution should be monitored over time to test the efficacy of management actions and adapt those management actions as appropriate.

6.3.4.2 Monitor Boreal Caribou Health and Condition

Parasites and disease can affect individual boreal caribou and may have effects at the local population level in certain parts of the country. Pollution from oil and gas contaminated sites has also been shown to negatively affect the health of boreal caribou and may result in mortality if individuals consume toxins at waste sites. However, little is known about the severity of parasites, disease and pollution to individual boreal caribou or to boreal caribou local populations. Therefore, information on the health and body condition of boreal caribou should be monitored to better understand the relationship between these threats and the viability of local populations, and whether there is a need for additional recovery actions.

6.3.4.3 Monitor and Manage Sensory Disturbance of Boreal Caribou

The extent, distribution and effects of various sources of sensory disturbance (e.g. low-flying aircraft, snowmobiles, equipment associated with various industries) on individual boreal caribou and boreal caribou local populations should be assessed. Where required, management actions to reduce the effects of sensory disturbance on boreal caribou should be implemented and the effectiveness of the management actions should be monitored over time and adapted as necessary.

7 CRITICAL HABITAT

Under SARA, critical habitat is defined as “the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species’ critical habitat in the recovery strategy or in an action plan for the species”. For boreal caribou, critical habitat identification describes the habitat that is necessary to maintain or recover self-sustaining local populations throughout their distribution. In some of the areas identified as critical habitat, the quality of habitat will need to be improved for recovery to be achieved.

Boreal caribou shift in their use of range over space and time, in accordance with changes in the location of biophysical attributes within the range as areas of disturbed and undisturbed habitat cycle on the landscape. For a local population to be self-sustaining over time, this habitat supply system (i.e. critical habitat) must function perpetually.

7.1 Identification of Critical Habitat for Boreal Caribou

7.1.1 Critical Habitat for All Ranges Except the Boreal Shield Range

Based on the foregoing, critical habitat for boreal caribou is identified for all boreal caribou ranges, except for northern Saskatchewan’s Boreal Shield range (SK1), (see Figure 5) as:

- The area within the boundary of each boreal caribou range that provides an overall ecological condition that will allow for an ongoing recruitment and retirement cycle of habitat, which maintains a perpetual state of a minimum of 65% of the area as undisturbed habitat; and
- Biophysical attributes required by boreal caribou to carry out life processes (see Appendix H).

Based on methodology developed by Environment and Climate Change Canada (2011b), a disturbance management threshold of 65% has been identified, which provides a measurable probability (60%) for a local population to be self-sustaining (see Appendix E). The precise location of the 65% undisturbed habitat within the range will vary over time. The habitat within a range should exist in an appropriate spatial configuration such that boreal caribou can move throughout the range and access required habitat when needed. The key to this identification is achieving and maintaining an overall, ongoing range condition that allows for the dynamic habitat supply system, containing the biophysical attributes upon which boreal caribou depend, to operate. It is this dynamic habitat supply system within the range boundaries that is the habitat condition necessary for the recovery of boreal caribou.

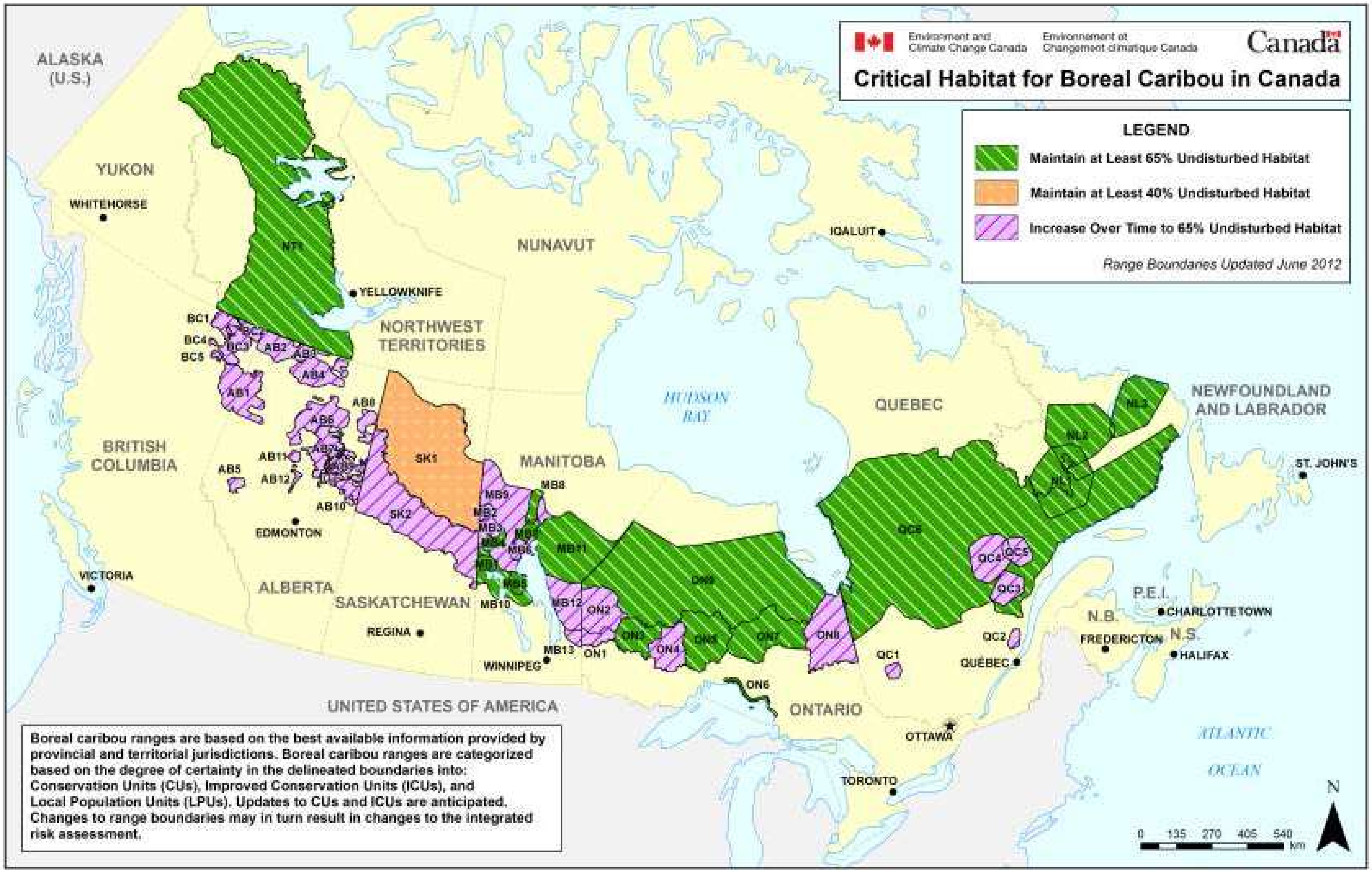

Figure 5. Critical habitat for boreal caribou in Canada as of 2019. Updated information includes the identification of critical habitat in SK1. MB6 and QC5 have also been updated from green to mauve based on habitat condition information previously published in the 5-Year Progress Report (Environment and Climate Change Canada, 2017).

7.1.2 Critical Habitat in Northern Saskatchewan's Boreal Shield Range (SK1)

Critical habitat was not identified in SK1 in the 2012 Recovery Strategy due to a lack of data on population size and trend, and the uniqueness of the disturbance regime (i.e. high fire and very low anthropogenic disturbance). As required under SARA, a schedule of studies was developed to identify critical habitat in SK1 and the schedule of studies is now complete (see Appendix D).

Critical habitat for boreal caribou in northern Saskatchewan's Boreal Shield range (SK1), (see Figure 5) is identified as:

- The area within the boundary of the SK1 boreal caribou range that provides an overall ecological condition that will allow for an ongoing recruitment and retirement cycle of habitat, which maintains a perpetual state of a minimum of 40% of the area as undisturbed habitat; and
- Biophysical attributes required by boreal caribou to carry out life processes (see Appendix H).

Based on three years of demographic data collected in SK1 between 2015 and 2017 by P.D. McLoughlin (University of Saskatchewan, personal communication), as part of the schedule of studies to identify critical habitat, additional analyses were completed by Environment and Climate Change Canada that indicate the SK1 local population is likely self-sustaining at current levels of disturbance (60% total disturbance), with a 71% probability of persistence (see Figure 3 and Appendix E). Environment and Climate Change Canada's analyses also show that the SK1 local population is sensitive to small increases in anthropogenic disturbance and sensitive to small decreases in adult survival. For these reasons, a higher probability of persistence was selected for critical habitat identification in SK1 (71%) than was selected for the other 50 ranges across Canada (60%) (Environment and Climate Change Canada, 2019).

The precise location of the 40% undisturbed habitat within the range will vary over time. The habitat within the SK1 range should exist in an appropriate spatial configuration such that boreal caribou can move throughout the range and access required habitat when needed. The key to this identification is achieving and maintaining an overall, ongoing range condition that allows for the dynamic habitat supply system, containing the biophysical attributes upon which boreal caribou depend, to operate. It is this dynamic habitat supply system within the SK1 range boundary that is the habitat condition necessary for the recovery of boreal caribou.

7.1.3 Components of Critical Habitat

The identification of critical habitat for boreal caribou is comprised of three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat. Appendix J provides critical habitat component information for each boreal caribou range.

Location

Location describes where critical habitat is found. For boreal caribou the relevant scale to identify critical habitat is the range, which delineates the area within which critical habitat is located. There are 51 ranges within the current distribution of the boreal caribou (see Figure 2 and Table 2).

Amount

Amount describes the quantity of critical habitat.

A strong relationship exists between habitat disturbance and whether a local population is stable, increasing or decreasing. As the quantity and/or severity of disturbance increases, there is increasing risk that a local population will be in decline (Environment Canada, 2011b), as further described in Appendix E.

Amount for all ranges except the Boreal Shield range: With the exception of the Boreal Shield range (SK1), this recovery strategy identifies a minimum of 65% undisturbed habitat in a range as the disturbance management threshold, which provides a measurable probability (60%) for a local population to be self-sustaining. This threshold is considered a minimum threshold because at 65% undisturbed habitat there remains a significant risk (40%) that local populations will not be self-sustaining.

Amount for the Boreal Shield range: For SK1, this recovery strategy identifies a minimum of 40% undisturbed habitat in the range as the disturbance management threshold, which provides a measurable probability (71%) for the local population to be self-sustaining. This threshold is considered a minimum threshold because at 40% undisturbed habitat there remains a risk (29%) that the local population will not be self-sustaining.

Habitat disturbance within a range needs to be managed by the responsible jurisdiction at a level that will allow for a local population to be self-sustaining. As there is variation in habitat and population conditions between boreal caribou local populations across their distribution, for some ranges it may be necessary to manage the range above the 65% undisturbed habitat threshold, while for other ranges, such as SK1, it may be possible to manage the range below the 65% undisturbed habitat threshold. However, there must be strong evidence, validated by Environment and Climate Change Canada, from population data collected over an extended period of time to support the management decision to establish a lower range-specific threshold (i.e. the lag effects of disturbance on a local population have been considered and accounted for).

In the absence of strong evidence to support lowering the undisturbed habitat threshold below 65%, the amount of critical habitat for all ranges, except SK1, is at least 65% undisturbed habitat. For management purposes, the amount of critical habitat may need to be maintained or restored, depending on the level of disturbance in a range.

- In ranges with undisturbed habitat below the threshold, initially, critical habitat is the existing habitat that over time would contribute to the attainment of 65% undisturbed habitat (40% undisturbed habitat for SK1).
- In ranges with undisturbed habitat equal to or above the threshold, critical habitat is at least 65% undisturbed habitat in a range (40% undisturbed habitat for SK1).
- The habitat that is included in the 65% undisturbed habitat (40% undisturbed habitat for SK1) will change over time given the dynamic nature of the boreal forest.

As previously reported in the 5-Year Progress Report, two ranges – the William Lake range (MB6) and the Manicouagan range (QC5) – changed from having greater than 65% undisturbed habitat to having less than 65% undisturbed habitat (Environment and Climate Change Canada, 2017). This change is reflected in both Figure 5 and Appendix J, where the amount of critical habitat for these two ranges changed from green ("maintain at least 65% undisturbed habitat") to mauve ("increase over time to 65% undisturbed habitat").

Section 4.2.1 describes the methodology used to measure disturbance for each range.

Type

Type describes the biophysical attributes of critical habitat.

Biophysical attributes are the habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery. Biophysical attributes within and adjacent to core habitat areas of boreal caribou use will be more important to a local population than those that are isolated and less accessible to boreal caribou (i.e. spatially separated by a disturbance). The biophysical attributes for boreal caribou will vary over space and time with the dynamic nature of the boreal forest. In addition, particular biophysical attributes will be of greater importance to boreal caribou at different points in time. Certain biophysical attributes are required more by a local population during different life processes, seasons or at various times over the years.

Information from Indigenous Knowledge (Boreal Caribou ATK Reports, 2010-2011), habitat selection analyses, and scientific published reports (Environment Canada, 2011b) were used to summarize the biophysical attributes necessary for boreal caribou. Results are categorized by the habitat type (e.g. calving habitat, winter habitat) and are provided by ecozone in order to capture the ecological variation across the current distribution of boreal caribou (see Appendix H). In addition to variation across ecozones, the biophysical attributes necessary for boreal caribou will vary both between and within ranges. For certain ranges, more specific information was made available to describe biophysical attributes and this has been included in Appendix H.

7.2 Activities Likely to Result in the Destruction of Critical Habitat

SARA requires that a recovery strategy identify examples of activities likely to destroy critical habitat. Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by boreal caribou. Destruction may result from a single activity, multiple activities at one point in time, or from the cumulative effects of one or more activities over time.

Activities that are likely to result in the destruction of critical habitat, include, but are not limited to, the following:

- Any activity resulting in the direct loss of boreal caribou critical habitat. Examples of such activities include: conversion of habitat to agriculture, forestry cut blocks, mines, and industrial and infrastructure development.

- Any activity resulting in the degradation of critical habitat leading to a reduced, but not total loss of both habitat quality and availability for boreal caribou. Examples of such activities include: pollution, drainage of an area, and flooding.
- Any activity resulting in the fragmentation of habitat by human-made linear features. Examples of such activities include: road development, seismic lines, pipelines, and hydroelectric corridors.

7.2.1 Likelihood of Critical Habitat Destruction for All Ranges Except the Boreal Shield Range

The likelihood that critical habitat will be destroyed is increased if any one of the above activities, or combination thereof, were to occur in such a manner, place and time, that after appropriate mitigation techniques (see Appendix I) any one of the following were to occur:

- Compromise the ability of a range to be maintained at 65% undisturbed habitat;
- Compromise the ability of a range to be restored to 65% undisturbed habitat;
- Reduce connectivity within a range;
- Increase predator and/or alternate prey access to undisturbed areas; or
- Remove or alter biophysical attributes necessary for boreal caribou.

7.2.2 Likelihood of Critical Habitat Destruction for the Boreal Shield Range

For the Boreal Shield range (SK1), the likelihood that critical habitat will be destroyed is increased if any one of the above activities, or combination thereof, were to occur in such a manner, place and time, that after appropriate mitigation techniques (see Appendix I) any one of the following were to occur:

- Compromise the ability of the range to be maintained at 40% undisturbed habitat;
- Increase total anthropogenic disturbance within the range above 5% (while maintaining a minimum of 40% undisturbed habitat);
- Reduce connectivity within the range;
- Increase predator and/or alternate prey access to undisturbed areas; or
- Remove or alter biophysical attributes necessary for boreal caribou.

Based on Environment and Climate Change Canada's 5-Year Progress Report, and as reported in Appendix F, the SK1 range currently has 40% undisturbed habitat (or 60% disturbed habitat) (Environment and Climate Change Canada, 2017). The 60% total non-overlapping disturbance is comprised of 58% fire and 3% anthropogenic disturbance[4]. Analyses conducted by Environment and Climate Change Canada, using population data provided by the University of Saskatchewan, indicates that based on the three years of available population data there is a 71% probability that

[4] When calculating total disturbance for a range, anthropogenic disturbance and fire disturbance that overlap are not counted twice in the total.

the SK1 location population is self-sustaining at the current levels of disturbance (P.D. McLoughlin, University of Saskatchewan, personal communication; Environment and Climate Change Canada, 2019). Environment and Climate Change Canada's analyses also investigated the changes in the probability of persistence with increasing levels of anthropogenic disturbance in the range. Results show that with an additional 2.5–3.0% anthropogenic disturbance, the probability of persistence of the SK1 local population drops from 71% to 60%, and to 50% when the additional anthropogenic disturbance reaches 5% (Environment and Climate Change Canada, 2019). The analyses did not consider the additional effects of fire disturbance due to the difficulties in managing wildfires.

Additional analyses by Environment and Climate Change Canada (2019) demonstrated that anthropogenic disturbance is not equivalent to fire, with the former having a stronger negative effect on population condition. This result, coupled with the analyses that showed that the local population is sensitive to small increases in anthropogenic disturbance and sensitive to small decreases in adult survival, indicates that caution is warranted with respect to additional anthropogenic disturbance in this range (see Appendix D) (Environment and Climate Change Canada, 2019). Therefore, for SK1 critical habitat, activities that pertain specifically to increasing the level of anthropogenic disturbance in SK1 has been added to the list of factors that increase the likelihood that critical habitat will be destroyed.

7.2.3 Cumulative Effects

A single project/activity may or may not result in the destruction of critical habitat; however, when considered in the context of all current and future development activities within and among ranges, the cumulative impacts may result in the destruction of critical habitat.

Mitigation of adverse effects from individual projects/activities will require a coordinated approach and management of cumulative effects within and among ranges. A cumulative effects assessment is essential to position the proposed project/activity in the context of all current and future development activities. The cumulative effects assessment will:

- Assess the impact of all disturbances (anthropogenic and natural) at the range-scale;
- Monitor habitat conditions, including the amount of current disturbed and undisturbed habitat (see Section 4.2.1), and amount of habitat being restored;
- Account for planned disturbances; and
- Assess the distribution of disturbance in large ranges for risk of range retraction in parts of the range.

For large continuous ranges, a different approach for assessing cumulative effects will be required than for smaller discrete ranges. Dividing the large areas into smaller management units will allow land managers to understand where the disturbance is occurring and avoid irreversible range retraction and a permanent break in range connectivity.

Determination of whether an activity is likely to result in the destruction of critical habitat will be facilitated by a range plan. For example, a range plan would identify activities that are likely to result in direct loss, degradation, and/or fragmentation of habitat, relevant to specific local circumstances. Any development that does not align with the range plan would be considered an activity likely to destroy critical habitat.

7.3 Range Plans

Given the dynamic nature of boreal caribou habitat requirements, the landscape scale at which those requirements operate, and the highly variable present-day land management and ecological conditions that exist among all boreal caribou ranges, range-specific approaches to protecting critical habitat, and in many cases improving the condition of critical habitat for this species, are needed.

In light of jurisdictional responsibilities for land and natural resource management, it is expected that they will develop range plans. In areas where the responsibility for land and natural resource management varies, range plans will be developed collaboratively between all responsible authorities. Range plans may be stand-alone documents, or part of other planning documents including action plans. In September 2016, Environment and Climate Change Canada published the Range Plan Guidance for Woodland Caribou, Boreal Population to assist provincial and territorial jurisdictions in their preparation of range plans (Environment and Climate Change Canada, 2016). The Range Plan Guidance provides general guidance on the development of range plans and is consistent with the guidance provided in this recovery strategy.

Range plans will outline how the given range will be managed to maintain or attain a minimum of 65% undisturbed habitat in all ranges other than SK1, and 40% undisturbed habitat in the SK1 range, over time. Specifically each range plan should reflect disturbance patterns on the landscape, as measured and updated by the provinces and territories, and outline measures and steps that will be taken to manage the interaction between human disturbance and natural disturbance.

Difference between a range plan and an action plan

Action plans, which are required under SARA, provide the public and stakeholders with details on how the recovery strategy will be implemented. Action plans include a broad spectrum of subjects, such as: measures to address threats and to achieve population and distribution objectives; an evaluation of socio-economic costs and benefits to be derived from its implementation; and an approach for monitoring and reporting, etc. An action plan is not necessarily range-specific; it could cover multiple ranges or even specific recovery measures within a range. Range plans are documents that outline how a given range will be managed to ensure that critical habitat is protected from destruction.

Purpose of a range plan

The main purpose of a range plan is to outline how range-specific land and/or resource activities will be managed over space and time to ensure that critical habitat is protected from destruction. As such, each range plan should reflect disturbance patterns on the landscape, as measured and updated by the provinces and territories, and outline the measures and steps that will be taken to manage the interaction between human disturbance, natural disturbance, and the need to maintain or establish an ongoing, dynamic state of a minimum of 65% of the range as undisturbed habitat in all ranges other than SK1, and 40% undisturbed habitat in the SK1 range, at any point in time to achieve or maintain a self-sustaining local population. While the general ecological principles and critical habitat dynamics described in the recovery strategy apply to all ranges, individual ranges also possess a unique mix of ecological and land use conditions (e.g. population condition, habitat condition and configuration, social and legal arrangements) that must be factored into decision making.

The range plans, consistent with this recovery strategy, will be one factor considered by the Minister of Environment and Climate Change in forming an opinion on whether the laws of the province or territory effectively protect critical habitat within each boreal caribou range. As such, range plans should contain the background information necessary for the Minister of Environment and Climate Change to make an informed assessment of whether critical habitat protection is in place or is being realistically pursued throughout the range. Specifically, range plans should indicate what laws of the province or territory, legislative and/or regulatory provisions, licences or other instruments issued under an Act or regulation, or contractually binding agreements the jurisdiction intends to use to protect critical habitat. In the absence of range plans, the minister will use the best available information and consult with the jurisdiction to determine whether critical habitat is effectively protected. If the minister is of the opinion that there are no provisions in or measures under SARA or another Act of Parliament that protect the critical habitat (including a section 11 agreement) and the laws of the provinces and territories do not effectively protect their critical habitat, the Minister of Environment and Climate Change is required to recommend that a protection order be made to the to the Governor in Council.

Range plans may form part of an action plan under SARA. However, in order to be adopted in whole or in part as an action plan by the Minister of Environment and Climate Change, the range plan and the process used to develop it will need to meet the requirements of section 48 (cooperation) and section 49 (content) of SARA. In addition, range plans will be used to inform reporting that is required under SARA on implementation and progress toward meeting the population and distribution objectives of this recovery strategy. Finally, range plans may be used to inform decisions related to environmental assessments, issuance of permits (either under SARA or other applicable legislation), and other similar approval processes.

Process for developing a range plan

The development of each range plan will be led by the responsible provincial or territorial jurisdiction. In areas where the management responsibility for land and natural resource management varies, range plans will likely be multi-jurisdictional led between all responsible authorities. Range plans should be developed in a collaborative manner with directly affected stakeholders and should also engage local land users. Jurisdictions are encouraged to use Indigenous Knowledge when developing range plans and should also apply the appropriate level of cooperation with Indigenous peoples as they would in any other resource management planning process that is undertaken within their province or territory. The exact process of collaboration that is used is the responsibility of each jurisdiction and may vary between jurisdictions.

Range plans may be updated by the jurisdictions over time to reflect changes in habitat and population conditions for any given range. In particular, range plans should be updated following any significant natural disturbance event (e.g. forest fires).

Timelines for the development of range plans

Given the variation in management contexts, population and habitat information, and levels of risk across the geographic distribution of boreal caribou, the 2012 Recovery Strategy called for range plans to be completed by the responsible jurisdiction(s) within 3-5 years of the posting of the 2012 Recovery Strategy. Environment and Climate Change Canada continues to seek commitments to develop jurisdictional range plans or other similar documents through the development of conservation agreements.

For the Boreal Shield range (SK1), the Government of Saskatchewan should complete the range plan by June 2021.

What should be included in a range plan?

There is no single prescriptive approach to developing a range plan, and jurisdictions may select those approaches they consider most appropriate. Range plans should include such things as:

- Demonstration of how at least 65% undisturbed habitat (40% undisturbed habitat in SK1), will be achieved and/or maintained over time;
- For SK1, demonstration of how total anthropogenic disturbance in the range will be maintained at or below 5% (while maintaining a minimum of 40% undisturbed habitat) (see section 7.2.2);
- List of the laws of the province or territory (including any corresponding regulations, permits, licenses, etc.) and conservation measures (such as agreements, programs, compliance incentives, conservation leases, etc.) that will be used to prevent activities likely to destroy critical habitat;
    - include land tenure assessment for all areas of critical habitat within each range
    - where protection measures do not exist, the range plan should indicate the steps being taken to put them in place and the expected timeline for implementation
- Information on range-specific activities likely to destroy critical habitat within each range. This will involve identifying and assessing current projects/activities as well as any foreseeable future projects/activities, and should include a cumulative effects analysis;
- An approach for measuring disturbance to the landscape and monitoring critical habitat to ensure that protection mechanisms are in place and are working to prevent the destruction of boreal caribou critical habitat;
- An approach for monitoring population trends to ensure that local populations are responding positively to management techniques;
- An approach for monitoring natural disturbances, and habitat quality and quantity; and
- Identification of information needs and plans for addressing information gaps.

8 MEASURING PROGRESS

Under SARA, the competent minister must report on the implementation of a recovery strategy and the progress towards meeting its objectives every five years. Population and habitat conditions for boreal caribou will change over time given the changes to population demographics, the dynamic nature of the boreal ecosystem and the manner in which the species shifts in its use of the landscape over time. Accordingly, the five-year time frame for reporting on implementation allows for these changes to be included in an updated recovery strategy, and for subsequent range plans and action plans to be updated under an adaptive management framework.

Monitoring of boreal caribou local populations based on performance indicators will be essential to have the information necessary to evaluate the effectiveness of management actions and to make necessary adjustments through an adaptive management process over time.

8.1 Adaptive Management

The process of adaptive management planning and implementation acknowledges and supports the adjustment of management actions in light of new or more refined knowledge. Through adaptive management, knowledge gaps and uncertainties are identified, evaluated and reported as information needs, addressed through monitoring and research, and then implemented through revised and improved management actions.

The challenge of achieving the recovery goal of self-sustaining local populations of boreal caribou will vary by boreal caribou range given the habitat and population conditions and management context associated with each range. In order to ensure adaptive management is applied to boreal caribou recovery, cooperation with federal, provincial and territorial jurisdictions, wildlife management boards, Indigenous people, and others involved in the conservation, survival and recovery of boreal caribou is required.

8.2 Performance Indicators

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives.

The ultimate performance indicator of boreal caribou recovery is self-sustaining local populations throughout the entirety of their distribution in Canada. Performance indicators for this recovery strategy are that the population and distribution objective is met for each boreal caribou range, and that boreal caribou become less at risk. Recovery of all boreal caribou local populations is technically and biologically feasible; however given the challenges of recovery for boreal caribou, some local populations that are currently not self-sustaining will likely require a number of decades to return to a recovered state.

The performance indicators described below are provided as national guidelines to gauge the successful implementation of the recovery strategy. More detailed performance indicators that reflect the specific local conditions (e.g. population condition, habitat condition, alternate prey/predator dynamics, mortality rates) of each boreal caribou range will need to be developed at the range plan and/or action plan stage.

General:

a) Complete range plans for each range within 3-5 years of the posting of the 2012 Recovery Strategy (see Section 7.3).

b) For SK1, complete the range plan by June 2021 (see Section 7.3).

Population Condition (population trend and size):

a) Maintain current distribution of boreal caribou across Canada.
b) Achieve and/or maintain a stable to increasing population trend as measured over five years (i.e. $\lambda \geq$ stable) or other empirical data that indicates population trend is stable or increasing.
c) Achieve a minimum of 100 animals[5] for boreal caribou ranges with population estimates of less than 100 animals, or show progress towards this goal every five years.

Habitat Condition (amount and type of undisturbed habitat):

a) For ranges that meet or exceed the undisturbed habitat threshold, maintain the undisturbed habitat that includes the biophysical attributes needed for boreal caribou to carry out life processes at a minimum of 65% (40% for SK1) of the total range.
b) For ranges below the 65% undisturbed habitat threshold (40% for SK1), identify in a range and/or action plan specific areas of existing undisturbed habitat, as well as those areas where future habitat is to be restored to an undisturbed condition over reasonable, gradual increments every five years.
c) Provide measurements of disturbance for each range that reflect the best available information, as provided by the provinces and territories, to update the recovery strategy accordingly every five years.

[5] 100 animals provides a 0.7 probability of not reaching a quasi-extinction threshold of less than 10 reproductively active females under stable conditions over 50 years (Environment Canada, 2011b).

9 STATEMENT ON ACTION PLANS

As required by SARA, the Minister of Environment and Climate Change published the Action Plan for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada – Federal Actions on the Species at Risk Public Registry on February 13, 2018 (Environment and Climate Change Canada, 2018). The Action Plan presents the recovery measures that the federal government is taking or plans to take to help achieve the recovery goal and population and distribution objectives for the species, as identified in the 2012 Recovery Strategy (Environment Canada, 2012a). In addition to this Action Plan, Parks Canada Agency site-specific Action Plans that address boreal caribou conservation and recovery efforts on lands administered by the Agency can be found on the SAR Public Registry.

Action plans provide information on recovery measures that should be taken by Environment and Climate Change Canada and other federal government departments and agencies including Parks Canada Agency, Crown-Indigenous Relations and Northern Affairs Canada, Department of National Defence and the Canadian Forces among others, provincial and territorial jurisdictions, wildlife management boards, Indigenous people, stakeholders and other organizations involved in the conservation, survival and recovery of boreal caribou. Action plans provide the public and stakeholders with details on how the recovery strategy will be implemented. Action plans include a broad spectrum of subjects, such as: measures to address threats and to achieve population and distribution objectives; an evaluation of socio-economic costs and benefits to be derived from its implementation; and, an approach for monitoring and reporting. An action plan is not necessarily range-specific; instead it could cover multiple ranges.

Range plans are documents that outline how the habitat condition within a given range will be managed over time and space to ensure that critical habitat for boreal caribou is protected from destruction and therein, that each local population will either continue to be self-sustaining or become self-sustaining over time. In September 2016, Environment and Climate Change Canada published the Range Plan Guidance for Woodland Caribou, Boreal Population to assist provincial and territorial jurisdictions in their preparation of range plans (Environment and Climate Change Canada, 2016).

The Minister of Environment and Climate Change may adopt or incorporate parts of a range plan, an existing provincial or territorial plan, or other relevant planning documents that meet the requirements of SARA as an action plan. Where the Minister of Environment and Climate Change proposes to adopt an existing plan or a portion of it as a SARA action plan, it will be posted on the Species at Risk Public Registry for the prescribed 60-day comment period. Within 30 days after the expiry of the comment period, and considering the comments received, the minister will publish a final action plan.

9.1 Coordinated Approach

9.1.1 Provincial and Territorial Jurisdictional Leadership

Provinces and territories have the primary responsibility for management of lands and wildlife within boreal caribou distribution, however this responsibility does vary in some parts of the country. For example, in the Northwest Territories, the Tłı̨chǫ Government manages land and resources (including wildlife) within Tłı̨chǫ Lands, as described in the Tłı̨chǫ Agreement (a combined comprehensive land claims and self-government agreement). There are also wildlife management boards that have been established under land claims agreements as the primary instrument for wildlife management in some regions of the country. In addition, Parks Canada Agency has a significant role to play where boreal caribou exist within national parks and historic sites.

Range plans and/or action plans inform broader land-use planning and decision making, and require substantial inter-agency communication and cooperation. Coordination is particularly important for range and/or action plans that address boreal caribou recovery in transboundary ranges, and for ensuring connectivity within ranges and across the species current distribution is maintained.

9.1.2 Indigenous Involvement

The Minister of Environment and Climate Change must cooperate with affected Indigenous organizations for recovery strategies and action plans. Across Canada, cooperation with Indigenous people is key to the success in developing and implementing action plans.

In acknowledgement of existing Aboriginal and treaty rights, to the extent possible, details of harvesting plans for local populations, consistent with the principles of conservation, will be addressed in range and/or action plans. When applicable, harvesting plans will follow the required process under Land Claim Agreements or provincial/territorial laws. Indigenous involvement will be required to determine population targets that ensure stable boreal caribou local populations are maintained and recovery of local populations that are not self-sustaining is achieved, while providing for traditional Indigenous harvesting practices consistent with conservation and existing Aboriginal and treaty rights. A description of Environment and Climate Change Canada's approach to engaging with Indigenous people in the development of both the 2012 Recovery Strategy and the 2020 Amended Recovery Strategy for boreal caribou is provided in Appendix B.

9.1.3 Stakeholder Engagement

Success in the recovery of this species depends on the commitment, collaboration, and cooperation of many different constituencies that are or will be involved in implementing the broad strategies and general approaches set out in this recovery strategy and will not be achieved by Environment and Climate Change Canada, or any other jurisdiction, alone. All stakeholders, including the industry sector, environmental organizations, and private landowners should be engaged where appropriate in developing and implementing action plans.

9.2 Range Specific Actions

The recovery of boreal caribou requires actions that will vary by individual boreal caribou range based on the population and habitat conditions. Each range will require a range-specific path forward for the recovery of boreal caribou. As described under Section 7.3, range plans and/or action plans are needed to guide protection and management of critical habitat, and overall recovery actions, in each boreal caribou range.

Range plans describe how critical habitat will be protected. The 2012 Recovery Strategy called for these jurisdictionally-led range plans to be produced for each range within 3-5 years of the posting of the 2012 Recovery Strategy. Environment and Climate Change Canada continues to seek commitments to develop jurisdictional range plans or other similar documents through the development of conservation agreements for the species.

For the Boreal Shield range (SK1), the Government of Saskatchewan should complete the range plan by June 2021.

In the absence of range plans, the Minister of Environment and Climate Change will use the best available information and consult with the jurisdiction to make a determination on the state of protection of critical habitat for boreal caribou.

9.2.1 Habitat and Population Management

The broad strategies and general approaches to meet the population and distribution objectives (see Section 6), as set out in this recovery strategy, will inform the development of range plans and action plans, where detailed local-level planning will occur to guide the implementation of recovery actions.

The broad strategies and general approaches are designed to guide range and action planning based on the state of each boreal caribou range. Many approaches and strategic directions are inter-related and should be implemented as described in the range plans and action plans. Generally, for self-sustaining local populations, minimal management actions may be necessary, and strategically planned development could take place without threatening boreal caribou and the status of the local population. Where local populations are not self-sustaining, specific management action is needed, in some cases for many decades, until sufficient habitat is restored and the population condition is improved. Mortality management, including predator and alternate prey management, may be needed to help prevent extirpation of a boreal caribou local population in the interim while habitat management efforts are underway to restore the ecological conditions of the range necessary to support a self-sustaining local population.

Jurisdictions are accountable for the long-term planning and management of boreal caribou ranges with the implementation of different habitat and population management tools available at their discretion, depending on the specific local conditions. The implementation of habitat management practices, such as fire suppression, and mortality management practices, such as predator control, are at the discretion of jurisdictions, and the application of these tools will vary in accordance with jurisdictional policies and procedures.

10 GLOSSARY

Note: The following terms are defined in accordance with their use in this document.

Anthropogenic: caused by human activity.

Biological feasibility: recovery is determined to be biologically feasible under the following circumstances: individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance; sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration; and primary threats to the species or its habitat can be avoided or mitigated.

Biophysical attributes: habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery (see Appendix H).

Current distribution (extent of occurrence): the area that encompasses the geographic distribution of all known boreal caribou ranges, based on provincial and territorial distribution maps developed from observation and telemetry data, local knowledge (including in some cases Indigenous Knowledge), and biophysical analyses.

Disturbance management threshold: at the scale of boreal caribou range, the habitat disturbance point below which conditions are such that the recovery goal will likely be met (i.e. acceptable level of risk), and above which the outcome is either highly uncertain or unacceptable.

Disturbed habitat: habitat showing: i) anthropogenic disturbance visible on Landsat at a scale of 1:50,000, including habitat within a 500 m buffer of the anthropogenic disturbance; and/or ii) fire disturbance in the last 40 years, as identified in data from each provincial and territorial jurisdiction (without buffer).

Existing habitat: the entire boreal caribou range area minus permanent alterations. See also *permanent alterations.*

Indigenous Knowledge (IK): IK includes, but is not limited to, the knowledge Indigenous peoples have accumulated about wildlife species and their environment. Much of this knowledge has accumulated over many generations.

Local population: a group of boreal caribou occupying a defined area distinguished spatially from areas occupied by other groups of boreal caribou. Local population dynamics are driven primarily by local factors affecting birth and death rates, rather than immigration or emigration among groups.

In this recovery strategy, “local population” refers to a group of boreal caribou occupying any of the three types of boreal caribou ranges (i.e. conservation unit, improved conservation unit, local population unit). See also *range*.

Not self-sustaining local population: in the population and distribution objectives "not self-sustaining local population" includes both the local populations assessed as "as likely as not self-sustaining" and those assessed as "not self-sustaining".

Permanent alterations: existing features found within a range, such as industrial and urban developments, permanent infrastructure, and graded or paved roads that do not currently possess or have the potential to possess the biophysical attributes of critical habitat for boreal caribou.

Quasi-extinction: a population with less than 10 reproductively active females.

Range: the geographic area occupied by a group of individuals that are subject to similar factors affecting their demography and used to satisfy their life history processes (e.g. calving, rutting, wintering) over a defined time frame. Environment and Climate Change Canada (2011b) identified three types of boreal caribou ranges categorized based on the degree of certainty in the delineated range boundaries (i.e. conservation unit, improved conservation unit, local population unit).

Range plan: a document that demonstrates how the habitat condition within a given range will be managed over time and space to ensure that critical habitat for boreal caribou is protected from destruction and therein, that each local population will either continue to be self-sustaining or become self-sustaining over time.

Self-sustaining local population: a local population of boreal caribou that on average demonstrates stable or positive population growth over the short-term (≤20 years), and is large enough to withstand stochastic events and persist over the long-term (≥50 years), without the need for ongoing active management intervention.

Technical feasibility: recovery is determined to be technically feasible when recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

To the extent possible: current evidence supports the conclusion that the recovery of all local populations is technically and biologically feasible. There may be situations where recovery of a particular local population proves to be, over time and through unforeseen circumstances, not biologically or technically feasible and as such may affect the likelihood of achieving the population and distribution objectives for some local populations.

Undisturbed habitat: habitat not showing any: i) anthropogenic disturbance visible on Landsat at a scale of 1:50,000, including habitat within a 500 m buffer of the anthropogenic disturbance; and/or ii) fire disturbance in the last 40 years, as identified in data from each provincial and territorial jurisdiction(without buffer). Disturbance within the 500 m buffer would result in a reduction of the undisturbed habitat.

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APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals.* The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making, and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the *Federal Sustainable Development Strategy's* (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that certain strategies may also inadvertently lead to environmental effects beyond the intended benefits, or have negative impacts upon other species. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below in this statement.

Boreal caribou are an umbrella species for the older-growth boreal forest at large. There are many species that share the same habitat requirements as boreal caribou and will benefit from the recovery actions outlined in this recovery strategy. This recovery strategy will benefit the environment and biodiversity as a whole by promoting the recovery of boreal caribou and by protecting and enhancing habitat.

The management measures outlined in this recovery strategy are those required to halt boreal caribou local population declines and to assist in stabilizing and recovering local populations. With respect to broader environmental impacts, certain management tools, most notably predator (e.g. wolves, bears) and alternate prey (e.g. moose, deer) management, may be required in areas with unnaturally high rates of predation on boreal caribou.

Short-term (i.e. 5–10 years) predator and alternate prey suppression has been used in wildlife management across North America over the past decades, with predator and alternate prey species generally demonstrating fairly rapid recovery once the measures have ceased.

The recovery strategy acknowledges that predator and alternate prey management may be required in some ranges to help stop boreal caribou declines and stabilize local populations that are at risk of extirpation. Where applied, predator and alternate prey management should be used as an interim management tool, in conjunction with other management tools (e.g. habitat restoration and management) to prevent extirpation and achieve population growth. Effective indirect predator management techniques (such as actions to limit the access of predators to boreal caribou) should be considered prior to undertaking direct predator and alternate prey management. When a predator or alternate prey management program is being planned, the conservation status of all affected species must be considered. Where implemented, the effects of mortality management activities on boreal caribou local populations should be monitored.

APPENDIX B: ENGAGEMENT WITH INDIGENOUS PEOPLE IN THE DEVELOPMENT OF THE RECOVERY STRATEGY FOR BOREAL CARIBOU

Once a species is listed as extirpated, endangered or threatened under SARA, a recovery strategy must be developed. Recognizing the important traditional, cultural, and spiritual role of boreal caribou in the lives of Indigenous people, Environment and Climate Change Canada sought engagement and input from Indigenous communities in the development of both the 2012 Recovery Strategy and the 2020 Amended Recovery Strategy for boreal caribou.

2012 Recovery Strategy (2009-2012)

Two rounds of engagement were undertaken, with a focus on seeking input and sharing information with Indigenous communities. In addition, Environment and Climate Change Canada supported processes to gather Indigenous Knowledge (see Appendix C). These two components were essential in the development of the 2012 Recovery Strategy. Nationally, Environment and Climate Change Canada contacted over 260 Indigenous communities located within and adjacent to the current distribution of boreal caribou during both rounds of engagement to invite them to participate in Environment and Climate Change Canada's process to develop the recovery strategy for boreal caribou.

Round 1 Meetings (2009-2011)

In the first round of engagement on the recovery strategy, Environment and Climate Change Canada contacted 271 Indigenous communities and 161 of them participated. Engagement at this early stage in the development of the recovery strategy provided Indigenous communities the opportunity to share comments, opinions, and information about boreal caribou. Environment and Climate Change Canada used this information to inform the development of the key elements of the recovery strategy, including: i) population and distribution objectives for boreal caribou; ii) threats to boreal caribou and their habitat; and iii) identification of boreal caribou critical habitat.

The information that Environment and Climate Change Canada received from Indigenous communities and from stakeholder meetings, meetings with the provinces and territories, scientific studies, and Indigenous Knowledge studies were used to draft the proposed recovery strategy (Environment Canada, 2011a).

Round 2 Meetings (2011-2012)

In the second round of engagement, Environment and Climate Change Canada contacted 265 [1] Indigenous communities and 87 of those participated; in addition, Environment and Climate Change Canada received 25 formal submissions from Indigenous communities and organizations. This round of engagement provided the opportunity for comments and dialogue

[1] During the first round of engagement, 6 Indigenous communities indicated they did not require any further follow-up throughout this process. This accounts for the discrepancy in the number of Indigenous communities contacted during round 1 and 2.

on the proposed recovery strategy that was posted on the Species at Risk Public Registry on August 26, 2011. The required 60-day public comment period was extended by an additional 120 days until February 22, 2012 to allow time for Indigenous communities to better participate in the engagement process and provide comments on the proposed recovery strategy prior to finalization.

Environment and Climate Change Canada considered all feedback received from Indigenous communities, along with the over 19,000 comments received from government, industry, environmental organizations, and the public when finalizing the 2012 Recovery Strategy (Environment Canada, 2012b). Changes made to the proposed recovery strategy were a direct result of the feedback received during the public comment period, including the input received from Indigenous communities and organizations.

2020 Amended Recovery Strategy (2018 – 2019)

Environment and Climate Change Canada contacted 34 Indigenous communities and 31 Indigenous organizations/governments located within and adjacent to northern Saskatchewan's Boreal Shield range (SK1) to invite them to participate in the process to develop an amendment to the 2012 Recovery Strategy for boreal caribou to identify critical habitat in SK1. At the time of posting the proposed amendment to the recovery strategy on the Species at Risk Public Registry, 11 communities and five organizations/governments participated in information sessions and/or meetings. This engagement provided the opportunity for participating groups to share information, comments, and dialogue on the draft amendment to the recovery strategy.

APPENDIX C: INDIGENOUS KNOWLEDGE SUMMARY REPORTS ON BOREAL CARIBOU

SARA specifies that "... the traditional knowledge of the Aboriginal peoples of Canada should be considered (...) in developing and implementing recovery measures." In the summer of 2009, Environment and Climate Change Canada made a commitment to ensure that Indigenous Knowledge from across the range of boreal caribou would inform the development of the recovery strategy. This commitment came from the recognition that Indigenous people possess significant and unique knowledge about boreal caribou biology, population trends, distribution, and threats facing the species, which could support recovery planning.

Environment and Climate Change Canada staff in each province/territory within the boreal caribou range began the process to have Indigenous Knowledge inform the recovery strategy by contacting Indigenous provincial and territorial organizations, Tribal Councils, and Indigenous consultants/facilitators to determine their interest in helping to gather Indigenous Knowledge. Additionally, each Indigenous community within and adjacent to the range of boreal caribou was contacted and followed up with, inviting them to participate in the process of developing the recovery strategy. As a result of these efforts, one of three basic processes was followed in the participating communities:

1. Local or regional Indigenous organizations interviewed knowledge holders;
2. Regional or local workshops coordinated by Indigenous facilitators were held; or
3. Indigenous Knowledge sharing was done in partnership with other initiatives (e.g. projects funded by Aboriginal Funds for Species at Risk).

All Indigenous contractors/communities/organizations that participated prepared summary reports based on interviews with knowledge holders. Environment and Climate Change Canada's Boreal Caribou Working Group received all summary reports and reviewed these in detail to highlight information that could inform the recovery strategy. Knowledge provided that would be more applicable at the action planning stage was also identified and flagged by Environment and Climate Change Canada's Boreal Caribou Working Group. The purpose of this step was to identify where and how the Indigenous Knowledge could support the recovery strategy and the subsequent range and/or action plans.

Each Indigenous Knowledge summary report received contains unique and geographically specific information that is representative of the knowledge and experiences shared by knowledge holders (Boreal Caribou ATK Reports, 2010-2011). Indigenous Knowledge with respect to boreal caribou life history, habitat use, population status, threats facing the species, and conservation measures was used to inform the recovery strategy. In addition, Indigenous Knowledge holders shared considerable detailed local knowledge about boreal caribou, which may be used to support range and/or action plans, if and where consent for such use is granted. In all cases, Environment and Climate Change Canada reconfirmed the intention of the use of Indigenous Knowledge in this document with knowledge holders.

APPENDIX D: SCIENTIFIC ASSESSMENTS OF CRITICAL HABITAT FOR BOREAL CARIBOU

2008 Scientific Review

In 2007, Environment and Climate Change Canada launched a science-based review with the mandate to identify boreal caribou critical habitat to the extent possible, using the best available information, and/or prepare a schedule of studies to complete this task. The results were summarized in a report entitled *Scientific Review for the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada* (hereinafter referred to as the 2008 Scientific Review).

Identifying critical habitat for boreal caribou was framed as an exercise in decision analysis and adaptive management. Establishment of a systematic, transparent and repeatable process was central to the approach. The resultant Critical Habitat Framework was anchored by synthesis and analysis of available quantitative data and published scientific information on boreal caribou population and habitat ecology.

The 2008 Scientific Review established boreal caribou ranges as the appropriate scale at which to identify critical habitat, and applied a probabilistic approach to assessing the adequacy of the current range conditions to support a self-sustaining local population based on three lines of evidence: percent total disturbance, local population growth and local population size. Of the 57 local populations or units of analysis delineated at the time, 30 were assessed as 'Not Self-Sustaining' (integrated probability of less than 0.5), 17 as 'Self-Sustaining' (integrated probability of greater than 0.5), and 10 as "as likely as not self-sustaining" (integrated probability equal to 0.5).

Additional Scientific Activities

The 2008 Scientific Review established a foundation for the assessment of critical habitat; however, Environment and Climate Change Canada identified key areas for further exploration to improve the science foundation to inform the identification of critical habitat:

1. Implications to critical habitat identification of variation in approaches applied by provincial and territorial jurisdictions to delineate ranges.
2. Relative impacts of different disturbances and habitat types, and their configurations, on the ability of ranges to support self-sustaining local populations, and resultant critical habitat identification.
3. Identification of disturbance management thresholds for self-sustaining local populations.
4. Influence of future range conditions on disturbance management thresholds given the dynamic nature of disturbance in a given range.

The purpose of addressing these knowledge gaps was to further inform the identification of critical habitat for boreal caribou, using the best available information. To this end, Environment and Climate Change Canada undertook the work presented in the Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou *(Rangifer tarandus caribou),* Boreal Population, in Canada: 2011 Update (herein referred to as the 2011 Scientific Assessment).

2011 Scientific Assessment: Concepts and Methodology

Similar to the 2008 Scientific Review, the 2011 Scientific Assessment was designed to provide a probabilistic evaluation of critical habitat relative to the set of conditions (demographic and environmental) for each range. The framework and components developed in the 2008 Scientific Review were expanded and enhanced through a suite of scientific activities including: enhanced disturbance mapping; habitat selection analysis; buffer analysis; meta-analysis of boreal caribou local population and habitat conditions; assessment of current conditions to support self-sustaining boreal caribou local populations using indicators of two ecological components of sustainability (stable or positive population growth and long-term persistence); representation of future conditions through application of a simple habitat dynamics model; and development of a methodology for establishing risk-based, range-specific disturbance management thresholds based on best available information.

Information to Support the Identification of Critical Habitat

The information to inform the identification of boreal caribou critical habitat provided in the 2011 Scientific Assessment for each range consists of the following four components:

1. The delineation and location of the range, and certainty in range delineation.
2. An integrated risk assessment based on multiple lines of evidence from three indicators, and application of hierarchical decision rules to evaluate the probability that current conditions on a range will support a self-sustaining local population. The result is expressed as a likelihood statement relative to achieving the population and distribution objectives.
3. Information to support the identification of disturbance management thresholds. Specifically, a consistent methodology for deriving such thresholds is provided, along with examples of their potential application, and discussion of their interpretation relative to the criteria and indicators evaluated.
4. A description of the biophysical attributes, defined as the habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery. The results from the habitat selection analyses and other published reports were used to summarize biophysical attributes by ecozone.

The related goals of assessing the ability of ranges to support self-sustaining local populations, and establishment of disturbance management thresholds, must acknowledge uncertainties arising from the availability and reliability of information about current local population condition, as well as how local populations might respond to additional and often interacting stressors. The probabilistic approach applied in the 2011 Scientific Assessment explicitly incorporated the effects of uncertainties and data quality in the assessment process. This approach is consistent with the concept of adaptive management, which expresses probable outcomes as hypotheses. Monitoring and evaluation of realized outcomes informs adaptations of management strategies over time.

Key Findings

The information and analyses presented in the 2011 Scientific Assessment addresses limitations identified with implementation of the work presented in the 2008 Scientific Review. However, neither the approach nor the results of the 2011 assessment represent a fundamental shift from the 2008 Scientific Review's conclusion that range is the appropriate geographic delineation for critical habitat description. Further, the amount of total disturbance within a range remains the primary criteria for identifying critical habitat to meet a goal of self-sustaining local populations of boreal caribou.

Highlights of the application of the conceptual framework and associated analyses supporting the 2011 assessment include:

1. Nearly 70% of the variation in boreal caribou recruitment across 24 study areas spanning the full range of boreal caribou distribution and range condition in Canada was explained by a single composite measure of total disturbance (fire + buffered anthropogenic), most of which could be attributed to the negative effects of anthropogenic disturbance.
2. Of the 57 identified boreal caribou ranges in Canada at the time, 17 (30%) were assessed in the 'self-sustaining' category, 7 (12%) in the "as likely as not self-sustaining category", and 33 (58%) in the 'not self-sustaining' category.
3. Range-specific disturbance management thresholds can be derived from a generalized disturbance-population growth function in conjunction with range-specific information. A methodology was developed to extend the critical habitat description for consideration of disturbance management thresholds when acceptable risks are defined by managers.

In addition to these highlights, several important observations related to the availability of information emerged, and recommendations related to these are advanced:

1. Most boreal caribou ranges in Canada have not been fully described owing to a lack of standardized animal location data and poor understanding of movement within and between ranges. While a total of 57 ranges were still recognized at the time by provincial and territorial jurisdictions in Canada, changes to the delineation of boreal caribou ranges have been made since the 2008 Scientific Review, by various jurisdictions, based on different criteria. The issue of appropriate delineation of transboundary ranges remains unresolved.
2. Demographic data are lacking for many boreal caribou ranges in Canada. Monitoring and assessment programs to provide data on local population size, local population trend, recruitment and adult mortality are required to improve understanding of factors affecting boreal caribou survival and recovery, to increase certainty in assessment results, and to monitor response of local populations to recovery actions and to assess progress towards meeting the population and distribution objectives for boreal caribou across Canada.

In conclusion, significant advances were made to the conceptual and methodological design in the 2011 Scientific Assessment to address some key uncertainties or limitations identified in the 2008 Scientific Review. These advances improved the robustness of the results with respect to providing a scientific basis to inform the identification of critical habitat for boreal caribou across Canada.

Scientific Research to Inform Critical Habitat in Saskatchewan's Boreal Shield Range

The 2012 Recovery Strategy used the scientific foundation of the 2008 Scientific Review and 2011 Scientific Assessment as the basis for critical habitat identification for all boreal caribou ranges in Canada, except for northern Saskatchewan's Boreal Shield range (SK1) (Environment Canada, 2008; Environment Canada, 2011b; Environment Canada, 2012a). Critical habitat for SK1 was not identified in 2012 because population size and trend were unknown, and the high fire (55%) and low anthropogenic (3%) disturbance represented conditions not well represented in the data used to identify 65% undisturbed habitat in each range as the disturbance management threshold. The 2012 Recovery Strategy identified this knowledge gap in the schedule of studies.

Since the 2012 Recovery Strategy, three years of demographic data have been collected for SK1 and a number of other jurisdictions have also acquired additional recruitment and adult survival data, with better representation of the spectrum of combinations between anthropogenic disturbance and fire. Environment and Climate Change Canada also updated the disturbance mapping, based on 2015 imagery, facilitating temporal correspondence with the new demographic data. This new and larger dataset facilitated additional scientific analysis including (Environment and Climate Change Canada, 2019):

1. An evaluation of a subset of the 2011 recruitment models to distinguish the effects of buffered anthropogenic disturbance from the effects of fire.
2. An evaluation of the newly collected demographic data from SK1 in the context of the national models that predict recruitment as a function of disturbance.
3. An evaluation of the subset of 2011 models to investigate the potential influence of anthropogenic disturbance and fire on adult female survival.
4. A scenario analysis exploring the potential impacts of additional levels of buffered anthropogenic disturbance using updated information.

Key Findings (Environment and Climate Change Canada, 2019)

1. The model separating the effects of anthropogenic disturbance (buffered by 500m) from fire received the highest level of support explaining 39% of the variation in recruitment. Both anthropogenic disturbance and fire had significant negative effects; however, anthropogenic disturbance had a larger effect.
2. Both the total disturbance model (top model in 2011) and the model separating anthropogenic disturbance from fire adequately predict recruitment for SK1 (average observed recruitment falls within 95% confidence intervals).
3. In the evaluation of adult female survival, the top model included anthropogenic disturbance (buffered by 500m) only, explaining about 12% of the variation. Additional analysis are required to understand other potential factors that may be influencing adult female survival. Currently, SK1 has one of the highest rates of boreal caribou adult female survival reported in Canada. Additional analyses indicate that the probability of maintaining a self-sustaining population in SK1 is sensitive to decreases in adult female

survival. For example, the probability that SK1 is self-sustaining would drop to less than 20% if adult female survival fell from 0.91 to 0.87 (assuming no change in recruitment).

4. At current disturbance levels, the probability that SK1 is self-sustaining is 71%; the probability is based on the three years of recruitment and adult survival collected for SK1. The scenario analyses suggest that SK1 would fall to 60% chance of maintaining a self-sustaining population with an additional 2.5-3.0% anthropogenic disturbance. Continued population monitoring will be important in order to reduce uncertainty in population condition over the longer term and to monitor population response to future landscape change.

APPENDIX E: IDENTIFYING DISTURBANCE MANAGEMENT THRESHOLDS

This Appendix is derived from Environment and Climate Change Canada's Scientific Assessment (2011b), and has been adapted for the purposes of this recovery strategy. A methodology was developed for consideration of disturbance management thresholds (Environment Canada, 2011b) and is herein described. Establishing disturbance management thresholds requires a recovery goal and an acceptable level of risk from a management perspective.

The recovery goal for boreal caribou is to achieve self-sustaining local populations in all boreal caribou ranges throughout their current distribution in Canada, to the extent possible. Environment and Climate Change Canada (2011b) expressed this recovery goal as the likelihood of observing a mean lambda (population growth) over a 20-year period of a stable or increasing population and the likelihood of the population size remaining above a quasi-extinction threshold of 10 reproductively active females over a 50 year period. The likelihood of the population remaining stable or increasing over 20 years was based on two indicators: population trend and disturbance level within a boreal caribou range. In order to assess the influence of disturbance level on the population trend, a study was completed to develop a relationship that expresses the probability of a population being stable or increasing at varying levels of total range disturbance (see Figure E-1). This relationship was derived by combining information on the negative effects of disturbance on boreal caribou recruitment with a national mean annual adult survival rate for mature females. This relationship was used to inform the range condition required to meet the recovery goal which is a core element of the identification of critical habitat in this recovery strategy.

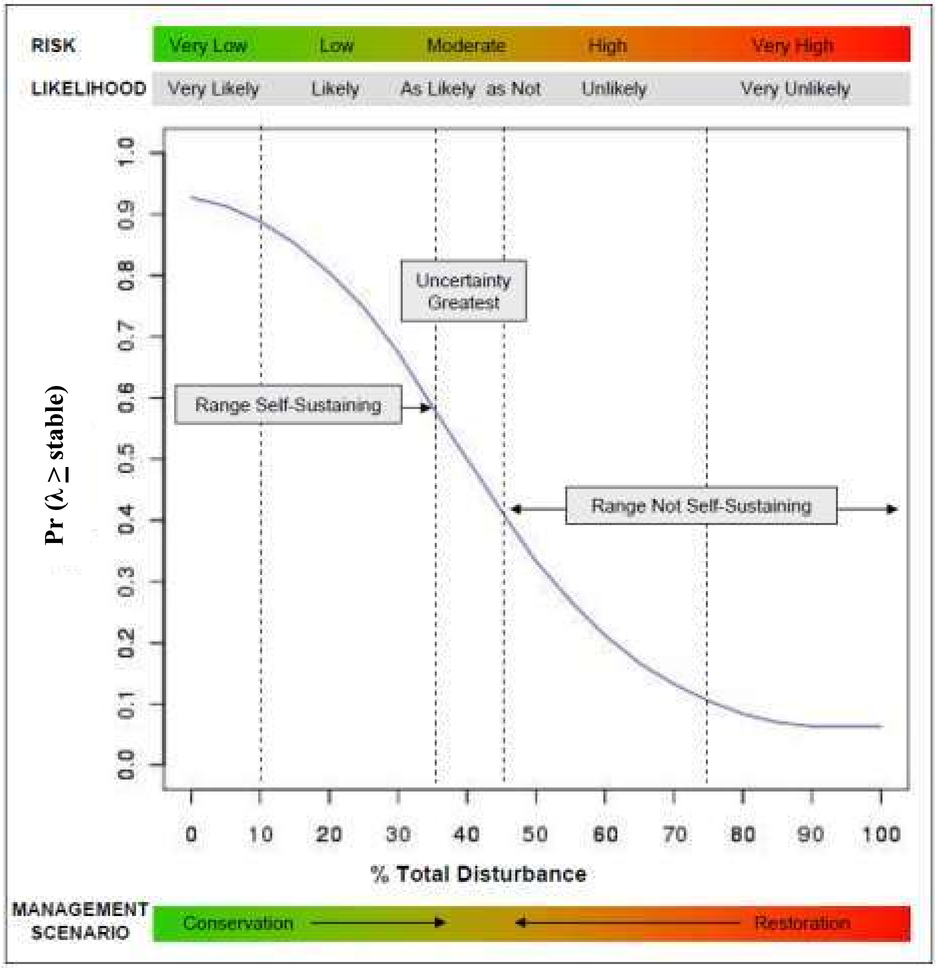

Figure E-1. Disturbance management thresholds: The probability of observing stable or positive growth ($\lambda \geq$ stable) of boreal caribou local populations over a 20-year period at varying levels of total range disturbance (fires ≤ 40 years + anthropogenic disturbances buffered by 500 m). Certainty of outcome, ecological risk, and management scenarios are illustrated along a continuum of conditions.

The disturbance values associated with the likelihood of achieving a self-sustaining local population can be used to express the relative risk of not achieving a self-sustaining local population (see Table E-1). At this point, a given management objective or target must be specified in order to determine what is an acceptable level of risk from a management perspective.

Table E-1. Intervals of total range disturbance associated with varying levels of certainty in outcome and assigned risk relative to achieving stable or positive population growth.

Probability of Sustained Stable or Positive Growth[1]	Likelihood of Desired Outcome	Disturbance Interval	Level of Risk
≥ 90%	Very Likely	≤ 10%	Very Low
< 90 to ≥ 60%	Likely	> 10 to 35%	Low
< 60 to ≥ 40%	As Likely as Not	> 35 to 45%	Moderate
< 40 to ≥ %10	Unlikely	> 45 to 75%	High
< 10%	Very Unlikely	>75%	Very High

[1] *Intervals adapted from the International Panel on Climate Change 2005; time frame for assessing mean growth rate is 20 years.*

A disturbance management threshold marks the point below which (i.e. at lower levels of disturbance) range conditions are likely to meet the recovery goal with an acceptable level of risk, and above which the outcome is either highly uncertain or unacceptable. In this recovery strategy a 0.6 or 60% probability of self-sustainability (i.e. population growth is stable/increasing) is applied resulting in a maximum disturbance management threshold of 35% total disturbance (or 65% undisturbed habitat as referenced throughout the recovery strategy) (see Figure E-1). A probability of 1.0 or 100 % is ideal, however, unrealistic since 0% total disturbance is virtually impossible even without anthropogenic disturbances. The maximum disturbance management threshold of 35% at 0.6 or 60% probability of self-sustainability is a reasonable starting point providing a likely certainty of recovery, given the available information on boreal caribou at this time. It is important to emphasize that this is a maximum disturbance management threshold because there is still a risk (0.4 or 40%) that local populations will not be self-sustaining. Local populations that have greater than 35% total disturbance (or less than 65% undisturbed habitat) will first be recovered to the 35% disturbance management threshold (i.e. to achieve 65% undisturbed habitat). The disturbance management threshold may be altered in the future as more information becomes available on the associated level of risk for boreal caribou local populations to meet the recovery goal outlined in this strategy.

For SK1, a minimum of 40% undisturbed habitat in the range is identified as the disturbance management threshold, which provides a measurable probability of 71% for the local population to be self-sustaining. Given that the analyses conducted by Environment and Climate Change Canada indicate that the population is sensitive to small increases in anthropogenic disturbance and sensitive to small decreases in adult survival, a higher probability of persistence was selected for critical habitat identification in SK1 (71%) than was selected for the other 50 ranges across Canada (60%) (Environment and Climate Change Canada, 2019). Continued population monitoring will be needed to reduce uncertainty in population condition over the longer term, particularly in light of future changes in range condition (e.g. increased fires associated with climate change).

APPENDIX F: SUMMARY OF BOREAL CARIBOU LOCAL POPULATION CONDITION AND HABITAT CONDITION

Table F-1 provides a summary of boreal caribou local population condition and habitat condition for each of the 51 boreal caribou ranges. Boreal caribou distribution (see Figure 2) and population and habitat condition information is based on the best available information including observational and telemetry data, and biophysical analyses, provided by provincial and territorial jurisdictions (Environment and Climate Change Canada, 2017). As a result of limited information on many of the ranges in Canada, only three transboundary ranges (a range that extends across a provincial or territorial boundary) have been defined: Northwest Territories range (NT1), Chinchaga range (AB1), and Lac Joseph range (NL1). As more refined information is being continually collected by jurisdictions, range delineation and population demographic information will be updated and may result in revisions to range boundaries and possibly more transboundary ranges. The assessment of self-sustainability may change when ranges that cross jurisdictional boundaries are combined. Range boundaries and integrated risk assessments will be updated annually based on new or more refined evidence provided by the provincial and territorial jurisdictions. In some cases, local population size estimates and trend data are based primarily on professional judgment and limited data, and not on rigorously collected field data.

The Range Type lists the different classification of local populations based on June 2012 range boundaries for boreal caribou provided by jurisdictions, which were subsequently classified into three types reflecting the level of certainty in range boundaries: Conservation Units (CU - low certainty), Improved Conservation Units (ICU- medium certainty), and Local Population (LP - high certainty).

Risk assessment is the status of self-sustainability of the local populations where SS=self-sustaining; NSS = not self-sustaining; NSS/SS = as likely as not self-sustaining.

Further explanation on disturbance is provided in Section 4.2.1.

Table F-1. Boreal caribou local population condition and habitat condition information. The population condition and habitat condition have been updated in this amended recovery strategy based on information previously published in the 5-Year Progress Report (Environment and Climate Change Canada, 2017).

Range Identification	Range Name	Range Type	Population Estimate relative to 100[1] (≥ 100, or < 100)	Population Trend	Disturbed Habitat (%)			Risk Assessment[5]
					Fire[2]	Anthropogenic[3]	Total[4]	
Northwest Territories								
NT1	Northwest Territories	ICU	≥ 100[6]	not available[7]	28	9	35	SS
British Columbia								
BC1	Maxhamish	LP	≥ 100	stable[8]	2	67	68	NSS
BC2	Calendar	LP	≥ 100	stable[8]	16	53	61	NSS

Range Identification	Range Name	Range Type	Population Estimate relative to 100[1] (≥ 100, or < 100)	Population Trend	Disturbed Habitat (%)			Risk Assessment[5]
					Fire[2]	Anthropogenic[3]	Total[4]	
BC3	Snake-Sahtahneh	LP	≥ 100	stable[8]	5	77	79	NSS
BC4	Parker	LP	< 100	declining[8]	3	57	57	NSS
BC5	Prophet	LP	< 100	declining[8]	10	78	78	NSS
Alberta								
AB1	Chinchaga (incl. BC portion)	LP	≥ 100	declining	9	79	80	NSS
AB2	Bistcho	LP	≥ 100	declining	40	58	75	NSS
AB3	Yates	LP	≥ 100	stable	42	20	55	NSS
AB4	Caribou Mountains	LP	≥ 100	declining	46	27	62	NSS
AB5	Little Smoky	LP	≥ 100	stable[9]	0.4	96	96	NSS
AB6	Red Earth	LP	≥ 100	declining	40	48	72	NSS
AB7	West Side Athabasca River	LP	≥ 100	declining	5	70	72	NSS
AB8	Richardson	LP	≥ 100	stable	74	23	88	NSS
AB9	East Side Athabasca River	LP	≥ 100	declining	28	78	84	NSS
AB10	Cold Lake	LP	≥ 100	declining	33	76	87	NSS
AB11	Nipisi	LP	< 100	not available[10]	9	75	77	NSS
AB12	Slave Lake	LP	< 100	not available[10]	39	74	87	NSS
Saskatchewan								
SK1	Boreal Shield	CU	≥ 100[11]	stable	58	3	60	SS
SK2	Boreal Plain	CU	≥ 100	not available[12]	30	20	45	NSS/SS
Manitoba								
MB1	The Bog	ICU	≥ 100[13]	not available[14]	6	14	19	NSS/SS
MB2	Kississing	ICU	≥ 100[13]	not available[14]	39	15	54	NSS
MB3	Naosap	ICU	not available[15]	not available[15]	28	28	52	NSS
MB4	Reed	ICU	not available[15]	not available[15]	7	20	26	SS

Range Identification	Range Name	Range Type	Population Estimate relative to 100[1] (≥ 100, or < 100)	Population Trend	Disturbed Habitat (%)			Risk Assessment[5]
					Fire[2]	Anthropogenic[3]	Total[4]	
MB5	North Interlake	ICU	< 100	not available[14]	4	14	18	NSS/SS
MB6	William Lake	ICU	< 100	not available[14]	25	17	36	NSS
MB7	Wabowden	ICU	≥ 100	not available[14]	10	20	28	SS
MB8	Wapisu	ICU	not available[15]	not available[15]	11	13	24	SS
MB9	Manitoba North	CU	not available[15]	not available[15]	23	11	33	NSS/SS
MB10	Manitoba South	CU	not available[15]	not available[15]	4	12	16	SS
MB11	Manitoba East	CU	not available[15]	not available[15]	26	3	29	SS
MB12	Atikaki-Berens	ICU	not available[15]	not available[15]	29	6	34	SS
MB13	Owl-Flinstone	LP	< 100	not available[14]	25	18	39	NSS/SS
Ontario								
ON1	Sydney	ICU	< 100	declining	27	25	49	NSS
ON2	Berens	ICU	≥ 100	declining	31	6	37	NSS/SS
ON3	Churchill	ICU	≥ 100	declining	8	28	34	SS
ON4	Brightsand	ICU	≥ 100	declining	19	26	41	NSS/SS
ON5	Nipigon	ICU	≥ 100	declining	7	25	30	SS
ON6	Coastal	CU	≥ 100	declining	0	15	15	SS
ON7	Pagwachuan	ICU	≥ 100	stable	0.7	27	27	SS
ON8	Kesagami	ICU	≥ 100	declining	3	37	40	NSS
ON9	Far North	CU	≥ 100[16]	declining[16]	15	1	16	SS
Quebec								
QC1	Val d'Or	LP	< 100	declining	0.2	65	65	NSS
QC2	Charlevoix	LP	< 100	declining	4	80	82	NSS
QC3	Pipmuacan	ICU	≥ 100	declining	11	60	68	NSS

Range Identification	Range Name	Range Type	Population Estimate relative to 100[1] (≥ 100, or < 100)	Population Trend	Disturbed Habitat (%)			Risk Assessment[5]
					Fire[2]	Anthropogenic[3]	Total[4]	
QC4	Manouane	ICU	≥ 100	stable	18	26	41	NSS/SS
QC5	Manicouagan	ICU	≥ 100[17]	stable[17]	3	36	37	SS
QC6	Quebec	CU	≥ 100[17]	not available[18]	20	13	32	SS
Newfoundland and Labrador[19]								
NL1	Lac Joseph	LP	≥ 100	not available[20]	12	2	14	NSS/SS
NL2	Red Wine Mountain	LP	≥ 100[21]	not available[22]	7	3	9	NSS
NL3	Mealy Mountain	LP	≥ 100	not available[23]	1	1	2	NSS/SS

[1] A minimum of 100 animals was used in the 2011 Scientific Assessment to evaluate when local populations might be vulnerable to extinction from stochastic events due to small size (Environment Canada, 2011b).
[2] Fire disturbance is any area where a fire has occurred in the past 40 years (without buffer).
[3] For anthropogenic disturbance, a 500 meter buffer is applied to all linear and polygonal disturbances.
[4] For total disturbance, both anthropogenic and fire disturbances that overlap are not counted twice in the total.
[5] With the exception of the Boreal Shield range (SK1), the integrated risk assessments have not been updated in this amended recovery strategy.
[6] The population size estimate for NT1 is 6000 to 7000 individuals.
[7] Sub-regional collar-based monitoring programs, and traditional and community knowledge, suggests that boreal caribou population trends differ in various part of NT1. Generally speaking, population trends seem to be increasing or stable in northern NT1, and stable or decreasing in southern NT1. More information is available in the Northwest Territories' Recovery Strategy published in 2017(http://www.nwtspeciesatrisk.ca/sites/default/files/nwt_boreal_caribou_recovery_strategy_2017_final_0.pdf).
[8] In 2013-2014 there was a bacterial pathogen outbreak which caused local population declines in BC. Parker and Prophet ranges have not recovered from the outbreak. The other local populations have been recovering, but the current trend information may not reflect equilibrium conditions for these populations.
[9] AB5 is stable in response to delivery of an annual wolf population reduction program.
[10] Population trend is not available for AB11 and AB12 due to low collared female sample size, resulting in unreliable estimates of annual adult female survival.
[11] The population size estimate for SK1 is >5000 individuals.
[12] Monitoring data are insufficient in SK2 to establish a population trend.
[13] The increase to ≥ 100 reflects an increased survey effort and does not necessarily indicate an improvement in overall status.
[14] Population trend data for Manitoba ranges are under review by the province of Manitoba and were not available to be included in this amended recovery strategy.
[15] The province of Manitoba delineated new range boundaries in 2015 (https://www.gov.mb.ca/sd/wildlife/sar/pdf/cariboustrategy_octfall2015.pdf). As a result, there are no updated population data available for these ranges. Population data for Manitoba's new provincial ranges are presented in the 5-Year Progress Report (Environment and Climate Change Canada, 2017).
[16] ON9 was delineated into 6 new ranges by the province of Ontario in 2013 (https://www.ontario.ca/document/range-management-policy-support-woodland-caribou-conservation-and-recovery). Population data for these new provincial ranges are presented in the 5-Year Progress Report (Environment and Climate Change Canada, 2017).

[17] The province of Quebec is in the process of updating range and population condition metrics for QC5 and QC6. Preliminary data are available in the 5-Year Progress Report for areas defined by Fortin et al. (2017) (Environment and Climate Change Canada, 2017).
[18] It is not possible to estimate population trend for QC6 as a whole because of insufficient survey data across the range. Preliminary population trends are available in the 5-Year Progress Report for areas defined by Fortin et al. (2017) that fall within the QC6 range (Environment and Climate Change Canada, 2017).
[19] The province of Newfoundland and Labrador is in the process of updating population condition metrics as part of an updated provincial recovery plan. The future reporting of survey results will be dependent on ongoing exercises to delineate subpopulations in Labrador.
[20] A recent survey was conducted in the NL1 range, but the data could not be analyzed in time for this amended recovery strategy.
[21] The understanding of population structure for NL2 has changed since the 2012 Recovery Strategy. The increase to ≥ 100 animals is due to a shift from minimum population counts (associated with collar deployment and other field activities) to systematic surveys in portions of the range.
[22] Preliminary data and expert opinion suggests that population trends in NL2 are generally increasing in the southern part of the range and declining in the northern part of the range.
[23] The understanding of population structure for NL3 has changed since the 2012 Recovery Strategy. A survey of NL3 is tentatively being planned during the next five years with Parks Canada Agency.

APPENDIX G: DETAILS ON THE IDENTIFICATION OF CRITICAL HABITAT FOR BOREAL CARIBOU

Table G-1 provides a summary of boreal caribou habitat condition for each of the 51 boreal caribou ranges. Boreal caribou distribution (see Figure 2) and habitat condition information is based on the best available information including observational and telemetry data, and biophysical analyses, provided by provincial and territorial jurisdictions (Environment Canada, 2011b). As a result of limited information on many of the ranges in Canada, only three transboundary ranges (a range that extends across a provincial or territorial boundary) have been defined: Northwest Territories range (NT1), Chinchaga range (AB1), and Lac Joseph range (NL1). As more refined information is being continually collected by jurisdictions, range delineation and population demographic information will be updated and may result in revisions to range boundaries and possibly more transboundary ranges. The assessment of self-sustainability may change when ranges that cross jurisdictional boundaries are combined. Range boundaries and integrated risk assessments will be updated annually based on new or more refined evidence provided by the provincial and territorial jurisdictions.

As described in Section 7.1, the identification of critical habitat for boreal caribou is comprised of three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

Table G-1. Boreal caribou critical habitat information. The habitat condition has been updated in this amended recovery strategy based on information previously published in the 5-Year Progress Report (Environment and Climate Change Canada, 2017).

Range Identification	Location	Amount					Type
	Range Name	Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Biophysical Attributes (see corresponding ecozone table in Appendix H)
			Fire[1]	Anthropogenic[2]	Total[3]		
Northwest Territories							
NT1	Northwest Territories	44,166,546	28	9	35	65	Taiga Plain Boreal Plain Southern Arctic Taiga Cordillera
British Columbia							
BC1	Maxhamish	710,105	2	67	68	32	Taiga Plain
BC2	Calendar	496,393	16	53	61	39	Taiga Plain
BC3	Snake-Sahtahneh	1,198,752	5	77	79	21	Taiga Plain
BC4	Parker	75,222	3	57	57	43	Taiga Plain
BC5	Prophet	119,396	10	78	78	22	Taiga Plain
Alberta							
AB1	Chinchaga (incl. BC portion)	3,162,612	9	79	80	20	Taiga Plain Boreal Plain

Range Identification	Location	Amount					Type
	Range Name	Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Biophysical Attributes (see corresponding ecozone table in Appendix H)
			Fire[1]	Anthropogenic[2]	Total[3]		
AB2	Bistcho	1,436,555	40	58	75	25	Taiga Plain
AB3	Yates	523,094	42	20	55	45	Taiga Plain
AB4	Caribou Mountains	2,069,000	46	27	62	38	Taiga Plain Boreal Plain
AB5	Little Smoky	308,606	0.4	96	96	4	Montane Cordillera Boreal Plain
AB6	Red Earth	2,473,729	40	48	72	28	Boreal Plain
AB7	West Side Athabasca River	1,572,652	5	70	72	28	Boreal Plain
AB8	Richardson	707,350	74	23	88	12	Boreal Shield (West) Boreal Plain
AB9	East Side Athabasca River	1,315,980	28	78	84	16	Boreal Plain
AB10	Cold Lake	672,422	33	76	87	13	Boreal Plain
AB11	Nipisi	210,771	9	75	77	23	Boreal Plain
AB12	Slave Lake	151,904	39	74	87	13	Boreal Plain
Saskatchewan							
SK1	Boreal Shield	18,034,870	58	3	60	40	Taiga Shield Boreal Shield (West)
SK2	Boreal Plain	10,592,463	30	20	45	55	Boreal Plain
Manitoba							
MB1	The Bog	446,383	6	14	19	81	Boreal Plain
MB2	Kississing	317,029	39	15	54	46	Boreal Shield (West)
MB3	Naosap	456,977	28	28	52	48	Boreal Shield (West) Boreal Plain
MB4	Reed	357, 425	7	20	26	74	Boreal Shield (West) Boreal Plain
MB5	North Interlake	489,680	4	14	18	82	Boreal Plain
MB6	William Lake	488,219	25	17	36	64	Boreal Plain
MB7	Wabowden	628,938	10	20	28	72	Boreal Shield (West) Boreal Plain
MB8	Wapisu	565,044	11	13	24	76	Boreal Shield (West)

Range Identification	Location	Amount					Type
	Range Name	Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Biophysical Attributes (see corresponding ecozone table in Appendix H)
			Fire[1]	Anthropogenic[2]	Total[3]		
MB9	Manitoba North	6,205,520	23	11	33	67	Boreal Shield (West) Boreal Plain
MB10	Manitoba South	1,867,255	4	12	16	84	Boreal Plain
MB11	Manitoba East	6,612,782	26	3	29	71	Boreal Shield (West and West Central)
MB12	Atikaki-Berens	2,387,665	29	6	34	66	Boreal Shield (West Central)
MB13	Owl-Flinstone	363,570	25	18	39	61	Boreal Shield (West Central)
Ontario							
ON1	Sydney	753,001	27	25	49	51	Boreal Shield (West Central)
ON2	Berens	2,794,835	31	6	37	63	Boreal Shield (West Central)
ON3	Churchill	2,150,490	8	28	34	66	Boreal Shield (West Central)
ON4	Brightsand	2,220,921	19	26	41	59	Boreal Shield (West Central)
ON5	Nipigon	3,885,026	7	25	30	70	Boreal Shield (West and West Central)
ON6	Coastal	376,598	0	15	15	85	Boreal Shield (West Central and Central)
ON7	Pagwachuan	4,542,918	0.7	27	27	73	Hudson Plain Boreal Shield (West, West Central and Central)
ON8	Kesagami	4,766,463	3	37	40	60	Hudson Plain Boreal Shield (Central)
ON9	Far North	28,265,143	15	1	16	84	Hudson Plain Boreal Shield (West and West Central)
Quebec							
QC1	Val d'Or	346,861	0.2	65	65	35	Boreal Shield (Central)
QC2	Charlevoix	312,803	4	80	82	18	Boreal Shield (Southeast)

Range Identification	Location	Amount					Type
	Range Name	Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Biophysical Attributes (see corresponding ecozone table in Appendix H)
			Fire[1]	Anthropogenic[2]	Total[3]		
QC3	Pipmuacan	1,376,899	11	60	68	32	Boreal Shield (East)
QC4	Manouane	2,716,449	18	26	41	59	Boreal Shield (East)
QC5	Manicouagan	1,134,129	3	36	37	63	Boreal Shield (East)
QC6	Quebec	62,156,186	20	13	32	68	Boreal Shield (Central, East and Southeast) Taiga Shield Hudson Plain
Newfoundland and Labrador							
NL1	Lac Joseph	5,802,491	12	2	14	86	Taiga Shield Boreal Shield (East)
NL2	Red Wine Mountain	5,838,594	7	3	9	91	Taiga Shield Boreal Shield (East)
NL3	Mealy Mountain	3,948,463	1	1	2	98	Taiga Shield Boreal Shield (East)

[1] Fire disturbance is any area where a fire has occurred in the past 40 years (without buffer).
[2] For anthropogenic disturbance, a 500 meter buffer is applied to all linear and polygonal disturbances.
[3] For total disturbance, both anthropogenic and fire disturbances that overlap are not counted twice in the total.

APPENDIX H: BIOPHYSICAL ATTRIBUTES FOR BOREAL CARIBOU CRITICAL HABITAT

Biophysical Attributes

Indigenous Knowledge (Boreal Caribou ATK Reports, 2010-2011), habitat selection analyses, and scientific published reports (Environment Canada, 2011b) were used to summarize biophysical attributes required by boreal caribou to carry out life processes necessary for survival and recovery. Results are provided by ecozone and ecoregion in order to capture the ecological variation across the distribution of boreal caribou.

Boreal Caribou Ranges by Ecozone and Ecoregion

Boreal caribou are distributed in the boreal forest across eight ecozones in Canada including: Taiga Plain, Montane Cordillera, Taiga Shield, Boreal Plain, Boreal Shield, Hudson Plain, Southern Arctic, and Taiga Cordillera. The largest ecozone, Boreal Shield, is further divided into five ecoregions: Boreal Shield West, Boreal Shield West Central, Boreal Shield Central, Boreal Shield East, and Boreal Shield South East (see Figure H-1).

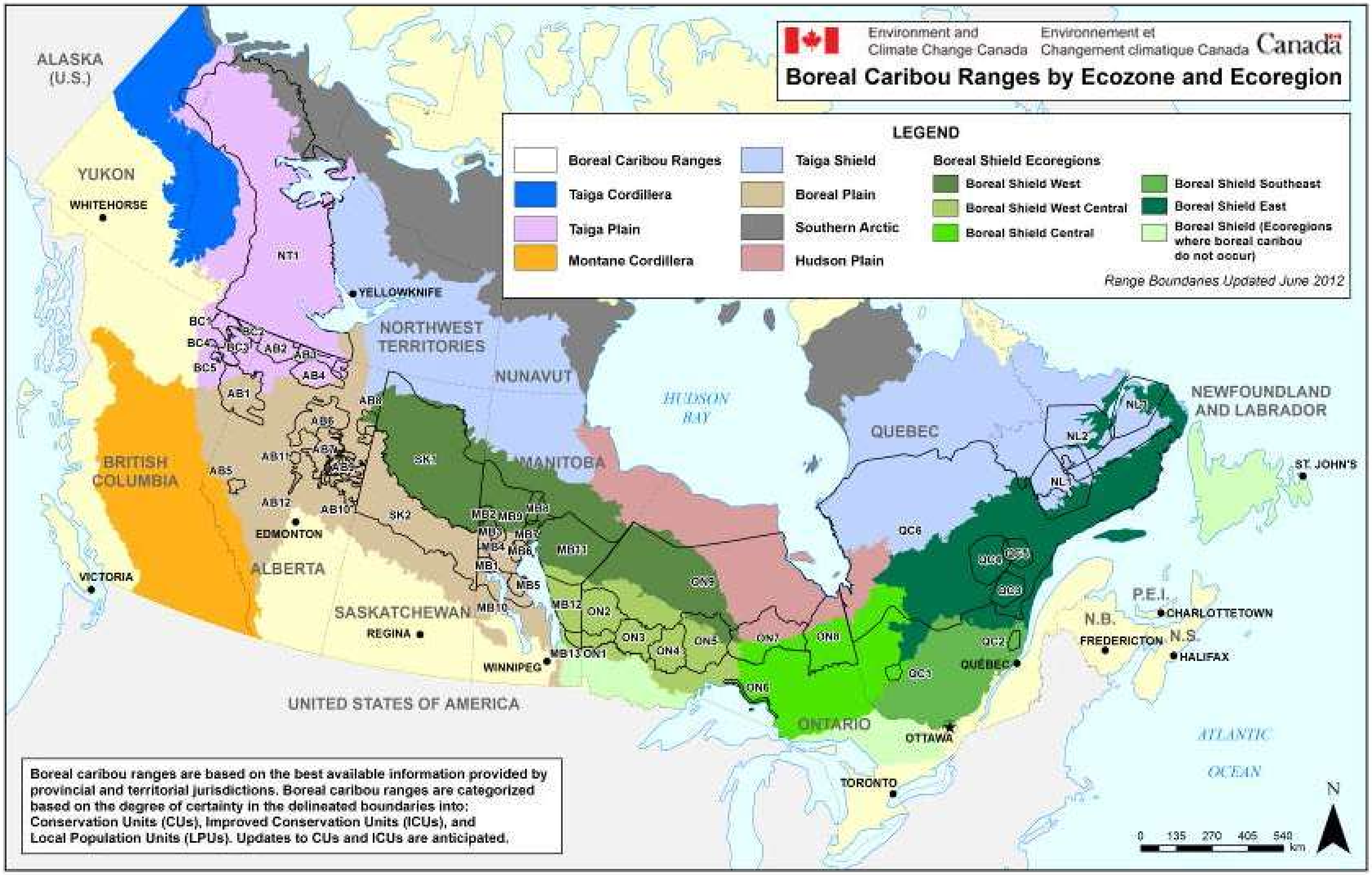

Figure H-1. Boreal caribou distribution across ecozones and ecoregions in Canada.

Biophysical Attribute Descriptions

The biophysical attributes for boreal caribou critical habitat are categorized by the types of habitat used by boreal caribou in accordance with seasonal and life-stage activity which include broad scale, calving, post-calving, rutting, wintering, and travel. This information is provided in the following tables by ecozone and ecoregion.

Biophysical attributes will vary both between and within boreal caribou ranges. As the biophysical attributes presented in this recovery strategy were developed at a national scale by ecozone and ecoregion, and not by local population, it is anticipated that each provincial and territorial jurisdiction may have or will develop over time, a more refined description of the biophysical attributes required for each range. Biophysical attributes specific to boreal caribou ranges in Labrador have been provided by the jurisdiction and are included in Table H-6 below.

Table H-1. Biophysical attributes for boreal caribou critical habitat in the Taiga Plain ecozone.

Type of habitat	Description
Broad scale	Mature forests (jack pine, spruce, and tamarack) of 100 years or older, and open coniferous habitat. Large areas of spruce peat land and muskeg with preference for bogs over fens and upland and lowland black spruce forests with abundant lichens, and sedge and moss availability. Flatter areas with smaller trees and willows, hills and higher ground.
Calving	Open coniferous forests, tussock tundra, low shrub, riparian, recent burned areas, south and west aspects and hills and higher locations. Muskegs, marshes, staying close to water sources. Caribou observed on small islands of mature black spruce or mixed forests within peat lands, in old burns at the edge of wetlands, in alder thickets with abundant standing water and on lake shores.
Post-calving	Muskegs or areas with access to muskegs, open meadows on higher ground, close to water (lakes and rivers) and mixed bush areas. Open coniferous forests with abundant lichens, low shrub, riparian, tussock tundra, sparsely vegetative habitat, recent burns and west aspects. Old burns and neighbouring remnant unburned forests selected in late spring and early summer.
Rutting	Open coniferous and mixed wood forests, low shrub, riparian, tussock tundra, recent burns and west aspect. Still use muskegs that harbor ground lichen and sedges, mixed bush areas, areas of higher ground. Regenerating burns and sparsely vegetated habitat.
Winter	Open coniferous forests (black spruce and pine) that provide adequate cover with abundant lichens, riparian areas. Caribou observed in muskeg areas in early winter. Spruce-lichen forests, fire regenerated, sparsely vegetated habitat, herbaceous and tall shrub habitat and sphagnum moss with scattered spruce. As snow depth increases, they remain more often in areas of dense pine or thickly wooded black spruce, with hanging lichen and remains access to open, mixed vegetation for ground forage.
Travel	Females show high fidelity to calving sites among years (i.e. within 14.5 km). Many caribou shift the pattern of use based on seasonal preferences, in large multi-habitat areas. Rates of movement increase during the rut and are greatest in winter.

Table H-2. Biophysical attributes for boreal caribou critical habitat in the Montane Cordillera ecozone.

Type of habitat	Description
Broad scale	Upland lodge pole pine, mixed conifer lodgepole pine/black spruce and treed muskeg areas with abundant lichens. Open, pine dominated stands of 80 years or more.
Calving	Areas closer to cut-blocks with a high proportion of larch are selected during calving. Lower mountain peaks.
Post-calving	Homogeneous areas of conifer dominated stands.
Rutting	No information on rutting habitat currently available.
Winter	Caribou use areas with a high proportion of larch and pine forests during winter.

Table H-3. Biophysical attributes for boreal caribou critical habitat in the Taiga Shield ecozone (see Table H-6 for biophysical attributes more specific to Labrador ranges).

Type of habitat	Description
Broad scale	Upland tundra dominated by ericaceous shrubs (*Ericaceae* spp.), lichen, grasses and sedges. Lowland tundra composed of peat land complexes (muskeg and string bogs), wetlands (swamps, marshes), lakes, rivers and riparian valleys. Dense mature jack pine and black spruce stands with balsam fir and tamarack present and open conifer forests with abundant lichens.
Calving	String bogs, treed bogs, small open wetlands (< 1 km^2), large muskeg, marshes along water bodies. Barren grounds. Calving on peninsulas and islands increases with amount of open water.
Post-calving	Forested wetlands. Hilly areas, coastal sites, along shorelines of water bodies (rivers, lakes, creeks), marshes with lichen availability.
Rutting	Open wetlands, swamps. Mature forests, mountainous terrain with forests of black spruce, tamarack and pine trees with abundant lichen.
Winter	Forested areas are used in years of low snow accumulation; otherwise winter habitat selection reflects general avoidance of deep snow, including use of tundra habitat at higher elevations in mountainous regions and bogs along lakes or oceans. Forested wetlands. Tundra uplands and sand flats in proximity to water. Barren grounds. Bog edges, glacial erratics and bedrock erratics with lichen and lakes. Some use of mature white spruce and fir stands as alternative to habitat with arboreal lichens. Mix of mature forest stands, mountainous terrain with forests of black spruce, tamarack and jack pine with abundant lichen.
Travel	Connectivity between selected habitat types important given reported patterns of movement among caribou. Some animals have been reported to travel up to distances of approximately 200 km, although the majority of animals appear to move shorter distances. Females show fidelity to post-calving sites returning to within 6.7 km of a given location in consecutive years.

Table H-4. Biophysical attributes for boreal caribou critical habitat in the Boreal Plain ecozone.

Type of habitat	Description
Broad scale	Late seral-stage (> 50 years old) conifer forest (jack pine, black spruce, tamarack), treed peat lands, muskegs or bogs, use dry islands in the middle of muskegs, with abundant lichens. Hilly or higher ground and small lakes. Restricted primarily to peat land complexes. Higher elevations (~1135 m). Selected old (>40 years) burns.
Calving	Bogs and mature forests selected for calving as well as islands and small lakes. Peat lands and stands dominated by black spruce and lowland black spruce stands within muskeg are used for calving.
Post-calving	Forest stands older than 50 yrs. Upland black spruce/jack pine forests, lowland black spruce, young jack pine and open and treed peat lands and muskeg are also selected during summer. Use lichen and low muskeg vegetation. In some areas, sites with abundant arboreal lichen are selected during summer.
Rutting	Mature forests. Upland black spruce/jack pine forests, lowland black spruce, young jack pine and open and treed peat lands and muskeg during summer.
Winter	Treed peat lands, treed bog and treed fen and open fen complexes with > 50% peat land coverage with high abundance of lichens. Use of small lakes, rock outcrops on lakes for lichen access. Mature forest > 50 years old. Upland black spruce/jack pine forests, lowland black spruce, young jack pine and open and treed peat lands.

Table H-4a. Biophysical attributes for boreal caribou critical habitat in the Boreal Shield West ecoregion.

Type of habitat	Description
Broad scale	Conifer/tamarack-dominated peat land complexes, muskegs or bogs, use dry islands in the middle of muskegs and upland moderate to dense mature conifer forests (jack pine, black spruce, tamarack) with abundant lichens. Hilly or higher ground, lots of smaller lakes in area.
Calving	Peat lands, stands dominated by black spruce, mature forest stands and treed muskeg all used for calving. Caribou will use islands, small lakes, lakeshores during calving.
Post-calving	Wooded lakeshores, islands, sparsely treed rock, upland conifer-spruce and treed muskeg are used in summer. Sites with a high abundance of arboreal lichen are important for foraging in some areas. Dense conifer and mixed forest are also used.
Rutting	Dense and sparse conifer and mixed forests. Open riparian habitats are also used during the rut.
Winter	Mature upland spruce, pine stands and treed muskeg. Jack pine dominated forests. Caribou select sparse and dense conifer, mixed forests and treed bogs. In some areas caribou will select habitat with greater visibility and further away from forest edges.
Travel	Some males move > 100 km during the rutting season. Traditional travel routes between summer and winter ranges occur in large peat land complexes. Caribou migrate in a north to south pattern.

Table H-4b. Biophysical attributes of boreal caribou habitat in the Boreal Shield West Central ecoregion.

Type of habitat	Description
Broad scale	Mature conifer uplands and conifer/tamarack dominated lowlands. Conifer/tamarack-dominated peat lands, muskegs with abundant arboreal lichens, upland mature conifer forests stands with abundant terrestrial lichen and rocky areas with sparse trees. Elevations of 300 m. Intermediate values of Normalized Difference Vegetation Index[1]. Selection for old (>40 years) burns.
Calving	Forested wetlands/treed bog, old burns, sparse conifer and dense spruce. Need lichen availability. Peat lands, raised hillrocks with large muskeg areas, forested islands and shorelines of large lakes selected during calving. Jack pine or jack pine/black spruce forests also used for calving.
Post-calving	Peat land with forested islands, islands, and shorelines selected during summer. Mature, dense forest stands.
Rutting	Semi-open and open bogs and mature conifer uplands selected during rutting. Terrestrial lichens and arboreal lichens, sedges and bog ericoids (*Andromeda glaucophylla, Chamaedaphne calyculata, Kalmia polifolia,* and *Ledum groenlandicum*) are important sources of forage.
Winter	Mature coniferous stands. Areas with a high proportion of lakes (> 5-100 ha) with convoluted shorelines. Caribou forage in areas with high lichen abundance and fewer shrubs in jack pine and black spruce stands with low tree densities, low basal areas and short heights. Caribou select open bogs, intermediate to mature jack pine rock ridges, jack pine habitats with lichens and lakes, but move to jack pine ridges in mature conifer stands with lichen when winter conditions prevent foraging in bogs. Arboreal lichens, terrestrial lichens, sedges and ericaceous species are an important source of forage.
Travel	Travel mainly in conifer forests, avoiding open habitats (e.g. lakes, disturbed areas, etc.) when migrating from summer to winter habitat. Use frozen lakes for travel during winter/spring, in some instances to reach islands for calving. Spring migration is not restricted to specific travel routes. Some move at a range of 100 km during the rutting season. Caribou moved 8-60 km away after logging operations were begun.

Table H-4c. Biophysical attributes for boreal caribou critical habitat in the Boreal Shield Central ecoregion.

Type of habitat	Description
Broad scale	Late seral-stage black spruce-dominated lowlands and jack pine dominated uplands. Open black spruce lowlands. Low-density late seral-stage jack pine or black spruce forests and black spruce/tamarack-dominated peat lands with abundant terrestrial and moderate arboreal lichens. Caribou also use areas with dry to moist sandy to loamy soils and shallow soils over bedrock. Elevations of 300 m. Intermediate values of Normalized Difference Vegetation Index[1]. Selection for old (>40 years) burns.
Calving	Open canopies of mature black spruce and mesic peat land with ericaceous species for calving are selected for calving in the Claybelt region. Females with calves selected areas with more abundant ericaceous shrubs and terrestrial lichens during the summer compared to females without calves.
Winter	Large areas of contiguous forests dominated by black spruce. Open conifer forests or forests with lower tree densities where terrestrial and arboreal lichen are abundant and there is significant less snow (e.g. shorelines) are also selected.

Table H-4d. Biophysical attributes for boreal caribou critical habitat in the Boreal Shield East ecoregion (see Table H-6 for biophysical attributes more specific to Labrador ranges).

Type of habitat	Description
Broad scale	Conifer-feather moss forests on poorly-drained sites and mature conifer uplands with abundant terrestrial lichen. Black spruce, jack pine and balsam fir stands present with abundant lichen. Water bodies and wetlands (swamps, marshy areas with tamarack). Mountains or rolling hills. Elevations of 300 m. Intermediate values of Normalized Difference Vegetation Index[1]. Selection for old (>40 years) burns.
Calving	Open wetlands, peninsulas and islands. Sedges, ericaceous species, bryophytes, alder and larch selected in spring. Balsam fir, dense black spruce stands, spruce-fir forests older than 40 years, and dry bare land with high lichen densities. Mature conifer stands, as well as wetlands (marshes, peat moss areas). Higher altitudes used for calving in this area rather than lake or water bodies.
Post-calving	Open and forested wetlands (marshes, swamps), and continued use of peninsulas and islands. Hilly areas, coastal sites, shorelines (rivers, lakes, creeks). Aquatic plants, dwarf birch (*Betula glandulosa*), deciduous shrubs, ericaceous species and moss.
Rutting	Open wetlands selected, swamps. Terrestrial and arboreal lichens, forbs, sedges, mosses and coniferous and deciduous shrubs. Balsam fir stands, dense spruce stands, mature and regenerating conifer stands, other forest stands (tamarack, pine) with abundant lichens, wetlands (swamps) and dry bare lands.
Winter	Forested wetlands. Some use of upland-tundra for loafing. Mountainous terrain. Dry bare land, wetlands, mature conifer forests with lichen, balsam fir stands, dense spruce stands, and mixed spruce-fir forests older than 40 years selected in southern areas. Observed along frozen bodies of water. Use of mature forests protected from harvesting increases probability of encounters with wolves that select the same habitats in winter. Shallow snow depths selected in late winter.
Travel	Caribou move greater distances during the rutting season.

Table H-4e. Biophysical attributes for boreal caribou critical habitat in the Boreal Shield Southeast ecoregion.

Type of habitat	Description
Broad scale	Late seral-stage black spruce-dominated lowlands and jack pine-dominated uplands, Balsam fir stands, marshlands and abundant lichen.
Calving	Open, medium-closed conifer forests. Elevations of 300 m. Intermediate values of Normalized Difference Vegetation Index[1]. Selection for old (>40 years) burns.
Rutting	Dense and open mature conifer forests of spruce, tamarack, jack pine and young conifer forests between 30 – 50 years old.
Winter	Open stands of balsam fir, balsam fir-black spruce, black spruce, black-spruce-tamarack and jack pine stands older than 70 yrs. Dry bare lands, 30-50 year old stands of balsam fir or fir-black spruce, as well as 50 year old jack pine stands, and arboreal and terrestrial lichens.

Table H-5. Biophysical attributes for boreal caribou critical habitat in the Hudson Plain ecozone.

Type of habitat	Description
Broad scale	Habitats selected generally to reduce predation risk. Shrub rich treed muskeg and mature conifer forests abundant in lichens. Shorelines of deep lakes and rivers (birch trees). Poorly drained areas dominated by sedges, mosses and lichens, as well as open black spruce and tamarack forests. Elevations of 150m. Intermediate levels of ruggedness[1] and Normalized Difference Vegetation Index[2].
Calving	Mature conifer stand with and without lichens and muskegs. Preference for higher altitudes compared to habitat use during other periods.
Post-calving	Fens, bogs and lakes.
Rutting	Wetlands and conifer stands with lichen. Mature and regenerating conifer stands are also used, albeit to a lesser degree. Caribou use hills in the lowlands, treed islands in muskegs with several different tree species.
Winter	Dense and mature conifer forests with lichens and wetlands. Peat lands dominated by open bogs and terrestrial lichens. Large patches of intermediate and mature black spruce, shrub-rich treed muskeg and mixed conifer stands all used in late winter.
Travel	Movements greatest in fall/winter when caribou transition from calving to winter habitat. Long range movements are greater in areas with high moose densities, presumably to reduce predation risk.

[1] Vector ruggedness is a metric used to capture variability in slope and aspect.
[2] Normalized Difference Vegetation Index (NDVI) is an index that provides a standardized method of comparing vegetation greenness between satellite images.

NOTE: A small portion of boreal caribou critical habitat in the northern portion of the Northwest Territories range falls within the Southern Arctic ecozone and the Taiga Cordillera ecozone. Currently, there is no information available on boreal caribou habitat use or biophysical attributes in either of these ecozones. Biophysical attributes in the Taiga Plain ecozone are used to describe the type of habitat needed for the identification of critical habitat for boreal caribou in the Southern Arctic and Taiga Cordillera ecozones.

Biophysical attributes specific to Labrador ranges, containing detailed information as made available by the jurisdiction.

Table H-6. Biophysical attributes of boreal caribou critical habitat in the Taiga Shield ecozone and Boreal Shield East ecoregion, specific to Labrador ranges.

Type of habitat	Description
Broad scale	Subarctic and boreal forests. Tundra and low shrubs at high elevations. Numerous lakes, peatlands (string, plateau and basin bogs, ribbed and ladder fens) and peatland complexes of several wetland types adjacent and contiguous to each other, broad river valleys. Lichen woodlands, new and regenerating burns. Intermediate values of Normalized Difference Vegetation Index[1]. Lac Joseph (NL1) Mid and low subarctic forests characterized by open coniferous forests, eskers and upland plateaus. Black spruce dominant; jackpine and trembling aspen occur sporadically. Poorly-drained sites characterized by extensive ribbed fen-string bog complexes bordered by black-spruce sphagnum stands. Well drained sites and river uplands often containing open lichen woodlands. Lakes comprising approximately 15%of range, including Lac Joseph, Lake Ashuanipi and Atikonak Lakes. Red Wine Mountain (NL2) High boreal forest and alpine areas in addition to low subarctic forest. Boreal forest portions contain productive, close-canopied boreal forests, with deep river valleys. Black spruce predominant, while some balsam fir, white birch, and trembling aspen also occur. Dominant topographical feature are the Red Wine Mountains (600m- 900m asl), and an extensive upland boreal plateau consisting of a mosaic of extensive string bogs and open conifer forest (400 m asl). Alpine areas with tundra vegetation; larch and black spruce on lower valley slopes. Mealy Mountain (NL3) Extensive tree-less coastal barrens and offshore islands with tundra-like vegetation, and extensive string bogs and open pools of water, with hummocks dominated by scrub spruce and Labrador tea on the Eagle River Plateau. Mid-boreal forest characterized by closed-canopied black spruce and balsam fir forests. Eskers which occasionally support ribbons of lichen woodland. Dominant topographical feature is the Mealy Mountain range (1000m asl), containing alpine areas with tundra vegetation.
Calving	Muskegs, lakes and islands, peninsulas of large lakes, or combinations of these features. Mature, dense conifer stands (>90 years) with a sphagnum, forb or shrub understory, particularly when in proximity to wetlands or lakes.
Post-calving and summer	Immediately post calving: wetlands and areas with open water, and adjacent areas of mature, dense coniferous forest. Summer (July through September) and early fall: broader array of vegetation communities in the vicinity of their calving areas, including mature coniferous forests with a shrub or moss/forb understory, treed bogs and some open-canopied woodlands with an extensive shrub understory. Open and forested wetlands (muskeg, treed bogs) and continued use of peninsulas and islands, shorelines (rivers, lakes, creeks). Riparian plants, dwarf birch (*Betula glandulosa*), willow, ericaceous shrubs, forbs grasses and sedges for forage.

Type of habitat	Description
Rutting	Wetlands and areas with open water, and adjacent areas of mature, dense coniferous forest. Mature coniferous forests with a shrub or moss/forb understory, treed bogs and some open-canopied woodlands with an extensive shrub understory. Open and forested wetlands (muskeg, treed bogs) and continued use of peninsulas and islands, shorelines (rivers, lakes, creeks). Riparian plants, dwarf birch (*Betula glandulosa*), willow, ericaceous shrubs, forbs and sedges for forage.
Winter	Early winter (November through January): lichen woodlands and lichen-shrub woodlands. Occasional use of wetlands. Late winter: lichen woodlands, ice-covered water bodies (for rest and as a refuge), and regenerating burns (with shrub and Cladina mitis understory) in some cases. Extensive use of coastal barrens in Mealy Mountain range. Some use of Alpine areas in Red Wine Mountain and Mealy Mountain range.
Travel	During spring and fall migration, select open habitats that are easy to travel through. In particular, during spring migration select for (frozen) wetlands and burns, and during fall migration added open lichen woodlands to the latter cover classes. Most females travel up to 20 km from winter areas to calving sites, but can move by as much as 120 km.

[1] Normalized Difference Vegetation Index (NDVI) is an index that provides a standardized method of comparing vegetation greenness between satellite images.

APPENDIX I: MITIGATION TECHNIQUES TO AVOID DESTRUCTION OF CRITICAL HABITAT

Mitigation of the adverse effects that may result from a proposed project on boreal caribou could include different techniques. These techniques include avoiding destruction of undisturbed habitat or biophysical attributes necessary for the species to carry out life processes, reducing noise or pollution, or minimizing disturbance by adapting its shape or adjusting the timing of the disturbance. Table I-1 provides examples of considerations and possible mitigation techniques when planning development within a boreal caribou range.

Table I-1. Examples of considerations when planning development within a boreal caribou range and possible mitigation techniques.

Considerations when planning development	Examples of possible mitigation techniques
Threshold of disturbance in the short- and long-term	Minimize the footprint of development, consider locations where habitat is already disturbed; restore habitat to provide continual availability of undisturbed habitat over time.
Ecological factors	Avoid destruction of biophysical attributes (see Appendix H).
Spatial configuration	Minimize disturbance by adapting its shape (small polygon vs. linear).
Sensory disturbances	Mitigation of noise, light, smells, vibrations to prevent harassment of boreal caribou.
Pollution	Mitigate pollution through scrubbers or other techniques. Some types of pollution may be especially of concern (e.g. air pollution that increases acidity may affect lichens on which boreal caribou depend for food).
Timing of disturbance	Certain types of disturbance could occur only in seasons when boreal caribou are not using the area or do not respond negatively to the activity.
Induced effects	New access roads in previously undisturbed areas may induce further disturbance by opening territory to more development, recreational users, etc. This could be prevented by an access management plan that could include limiting access, decommissioning roads, etc.
Corridors that support predator movement	Impact may be reduced by using techniques that prevent use of corridor by predators (no compaction of snow, immediate replanting of trees, etc.).
Increases in predator and/or alternate prey populations	Mortality management techniques may be considered where the killing of predators would be a final, necessary option implemented temporarily, along with habitat restoration.

APPENDIX J: CRITICAL HABITAT FACTSHEETS

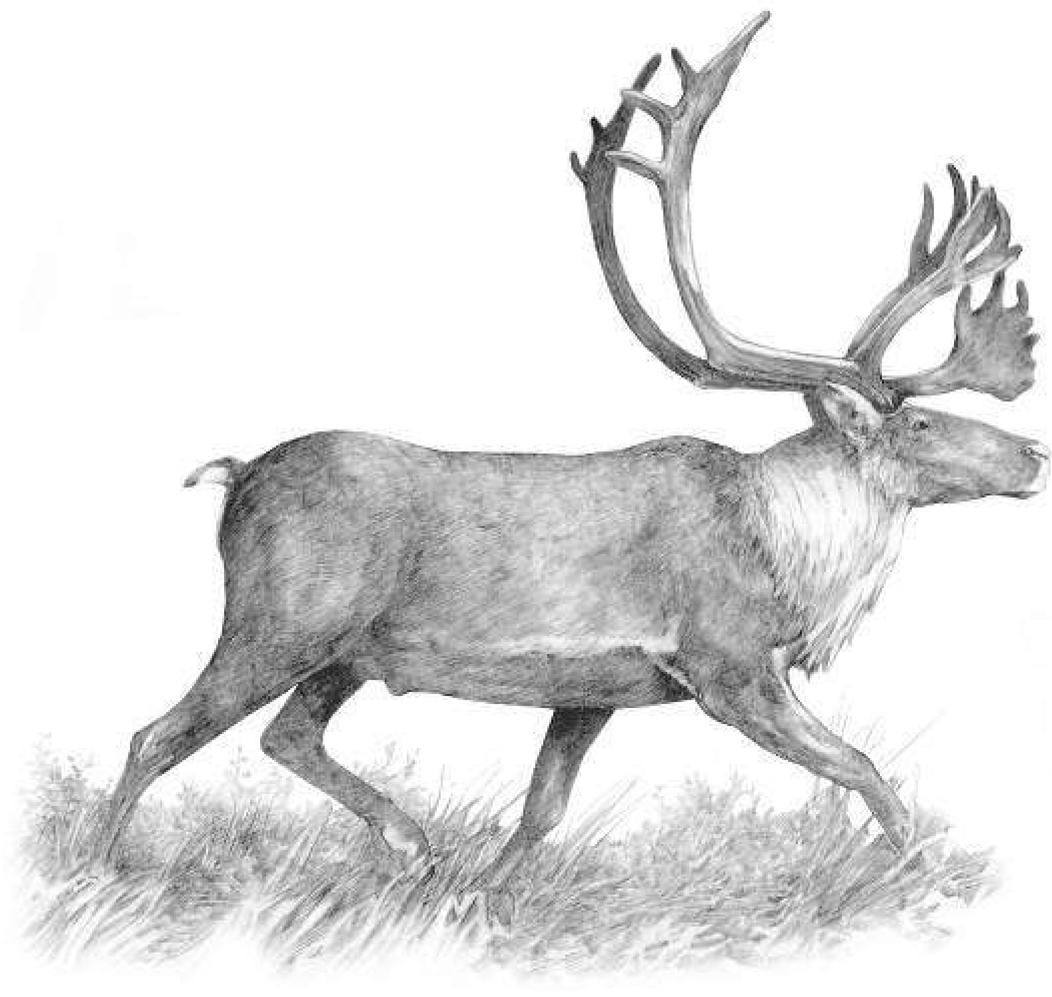

Illustration © Judie Shore

CRITICAL HABITAT FACTSHEETS: NORTHWEST TERRITORIES

Critical Habitat Identification: Northwest Territories Range (NT1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-1. Key map of the general location of the range.

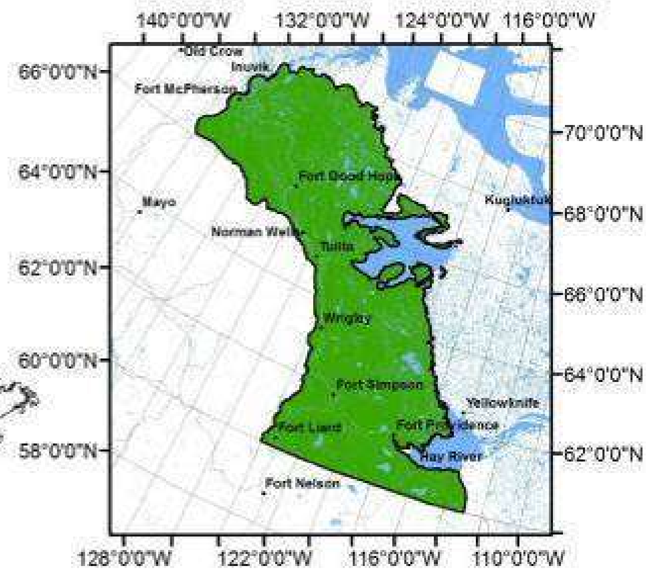

Figure J-2. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
44,166,546	28	9	35	65	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain
	Boreal Plain
	Southern Arctic
	Taiga Cordillera

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: BRITISH COLUMBIA

Critical Habitat Identification: Maxhamish Range (BC1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-3. Key map of the general location of the range.

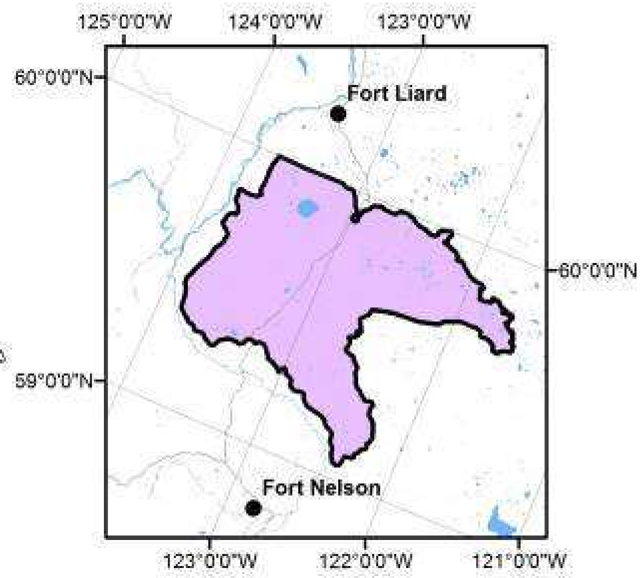

Figure J-4. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
710,105	2	67	68	32	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Calendar Range (BC2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-5. Key map of the general location of the range.

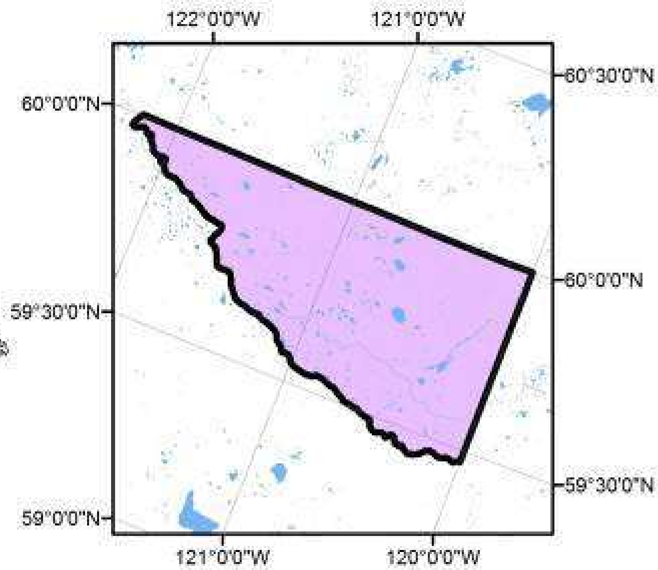

Figure J-6. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
496,393	16	53	61	39	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Snake-Sahtahneh Range (BC3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

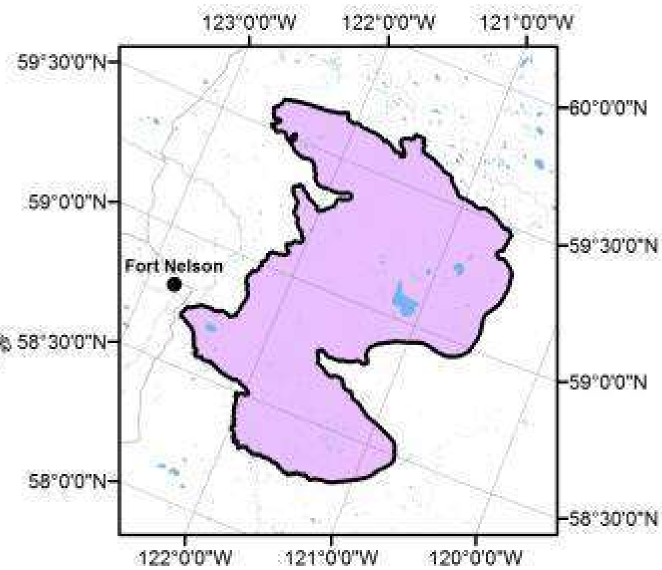

Figure J-7. Key map of the general location of the range.

Figure J-8. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,198,752	5	77	79	21	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Parker Range (BC4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-9. Key map of the general location of the range.

Figure J-10. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
75,222	3	57	57	43	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Prophet Range (BC5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-11. Key map of the general location of the range.

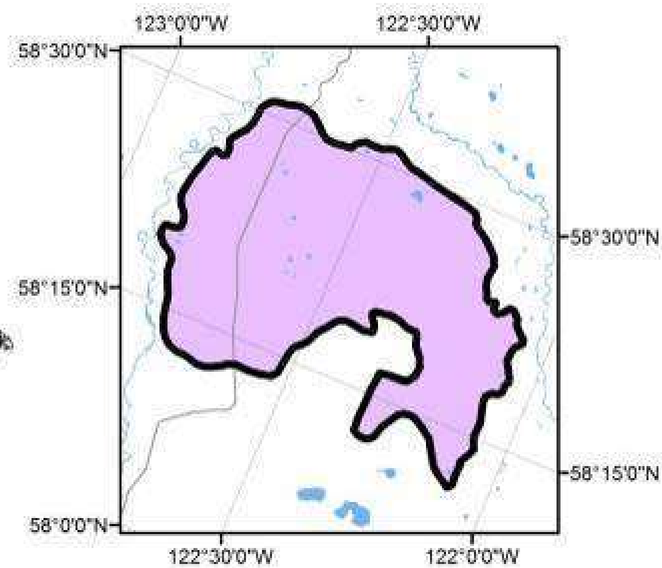

Figure J-12. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
119,396	10	78	78	22	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: ALBERTA

Critical Habitat Identification: Chinchaga Range (incl. BC portion) (AB1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-13. Key map of the general location of the range.

Figure J-14. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
3,162,612	9	79	80	20	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain
	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Bistcho Range (AB2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-15. Key map of the general location of the range.

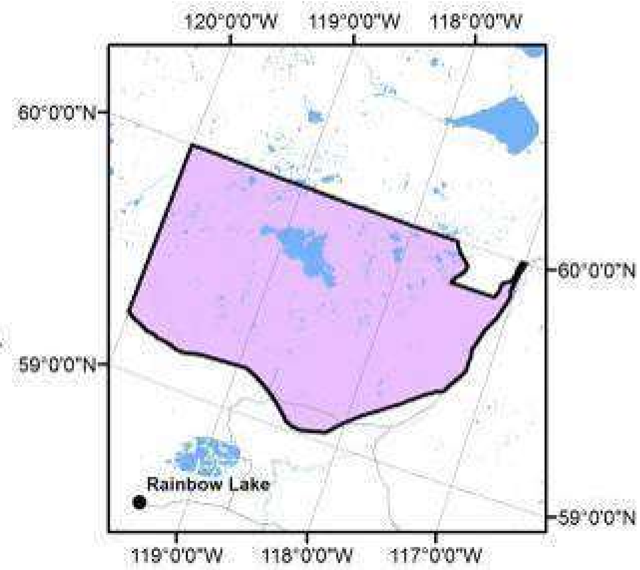

Figure J-16. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,436,555	40	58	75	25	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

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iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Yates Range (AB3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-17. Key map of the general location of the range.

Figure J-18. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
523,094	42	20	55	45	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Caribou Mountains Range (AB4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-19. Key map of the general location of the range.

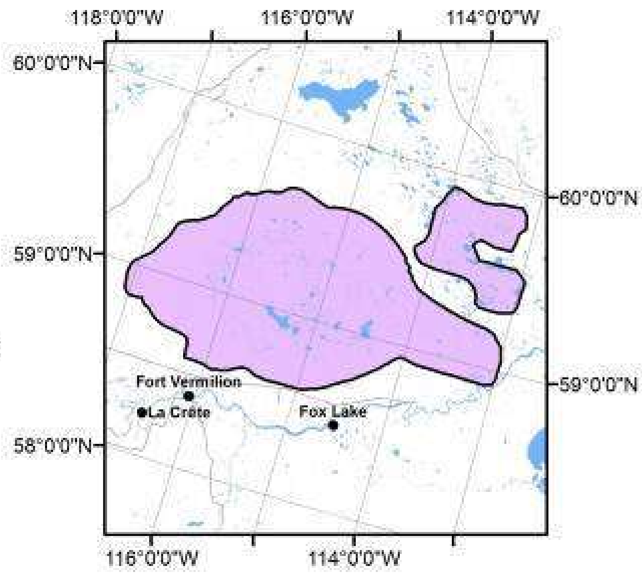

Figure J-20. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,069,000	46	27	62	38	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain
	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Little Smoky Range (AB5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-21. Key map of the general location of the range.

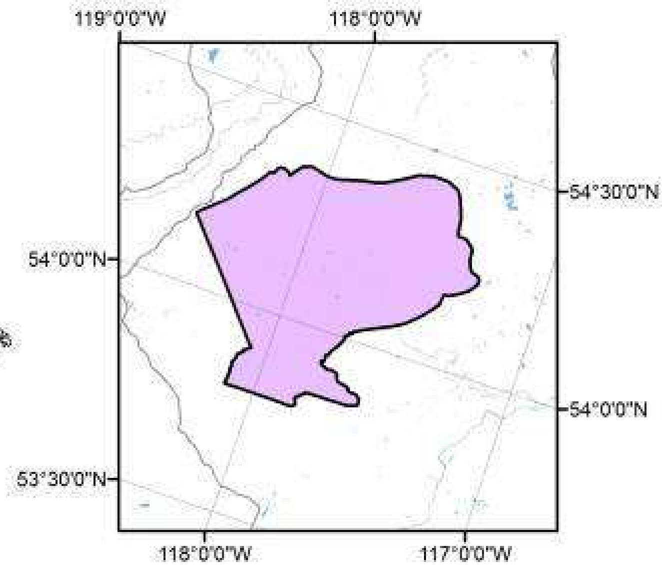

Figure J-22. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
308,606	0.4	96	96	4	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Montane Cordillera
	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Red Earth Range (AB6)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-23. Key map of the general location of the range.

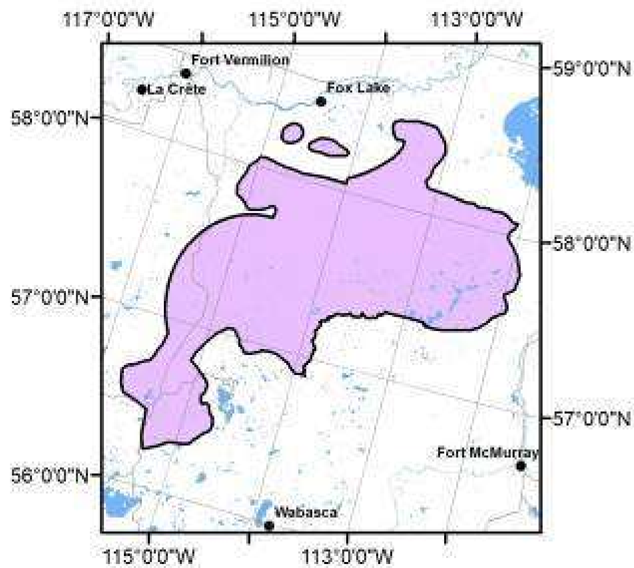

Figure J-24. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,473,729	40	48	72	28	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

---

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: West Side Athabasca River Range (AB7)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-25. Key map of the general location of the range.

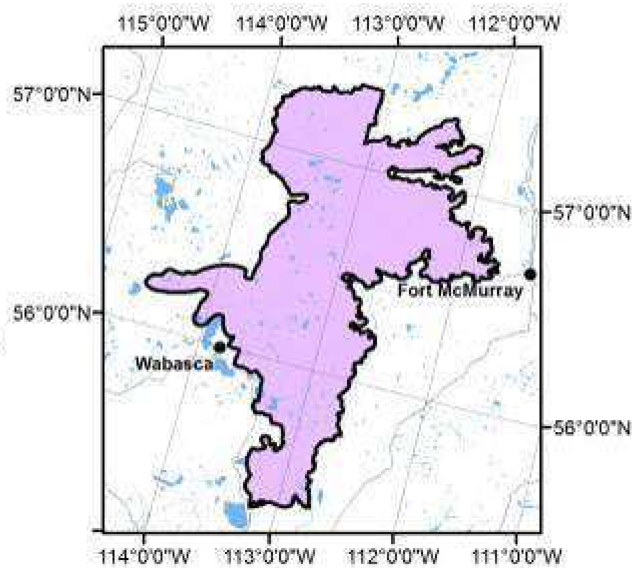

Figure J-26. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,572,652	5	70	72	28	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] See Appendix H

Critical Habitat Identification: Richardson Range (AB8)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-27. Key map of the general location of the range.

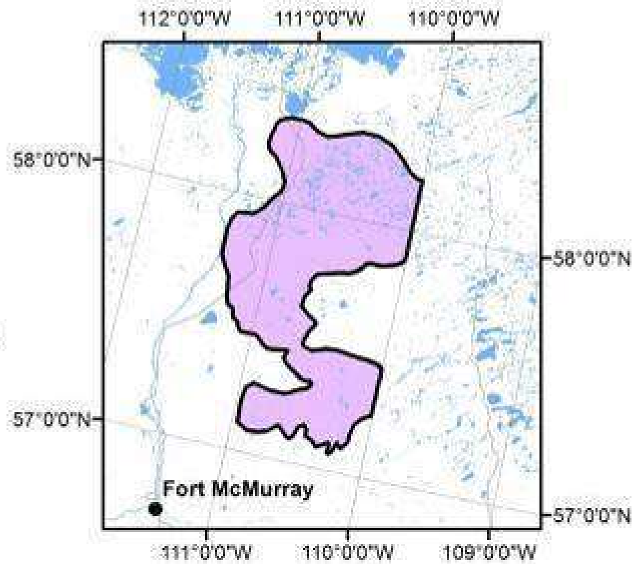

Figure J-28. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
707,350	74	23	88	12	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: East Side Athabasca River Range (AB9)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-29. Key map of the general location of the range.

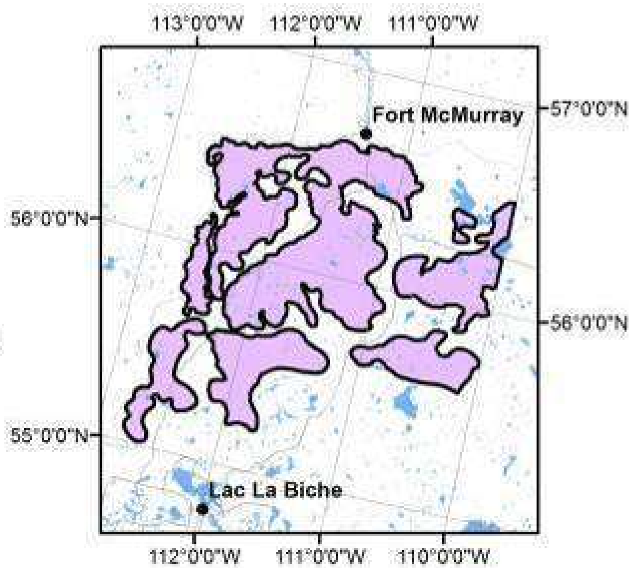

Figure J-30. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,315,980	28	78	84	16	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Cold Lake Range (AB10)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-31. Key map of the general location of the range.

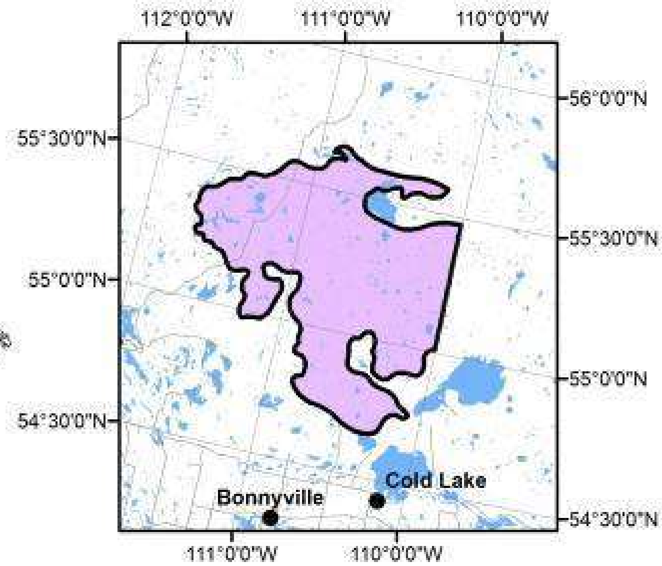

Figure J-32. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
672,422	33	76	87	13	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Nipisi Range (AB11)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-33. Key map of the general location of the range.

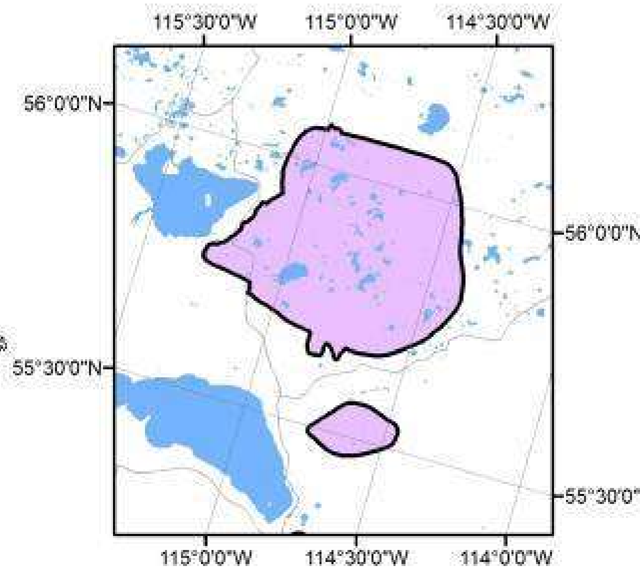

Figure J-34. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
210,771	9	75	77	23	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Slave Lake Range (AB12)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

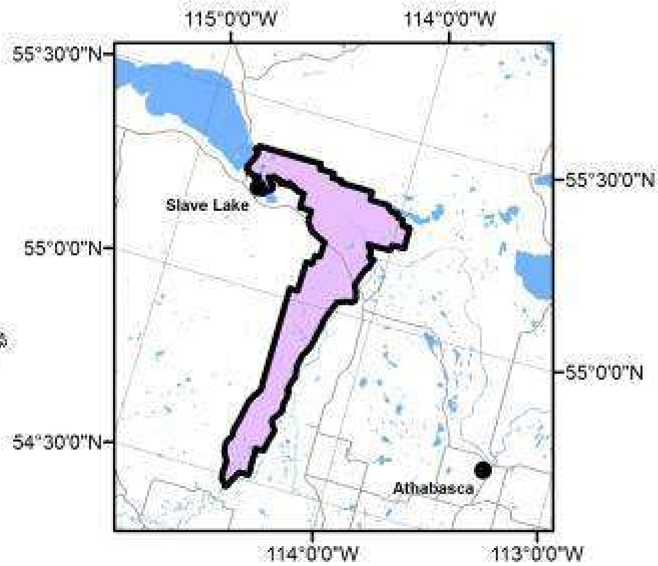

Figure J-35. Key map of the general location of the range.

Figure J-36. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
151,904	39	74	87	13	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: SASKATCHEWAN

Critical Habitat Identification: Boreal Shield Range (SK1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

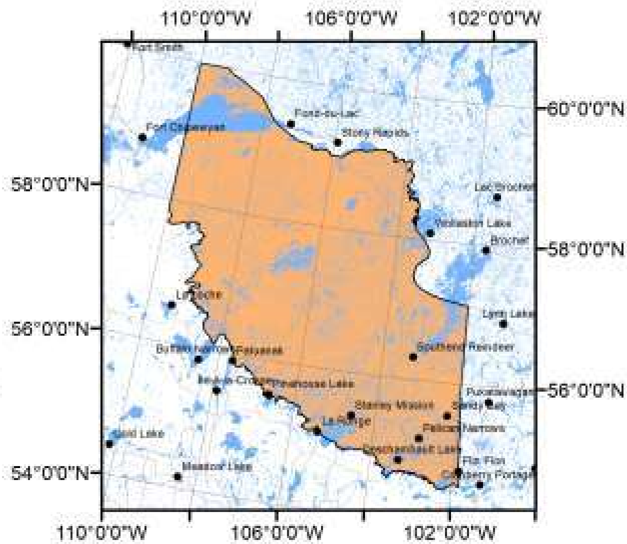

Figure J-37. Key map of the general location of the range.

Figure J-38. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
18,034,870	58	3	60	40	At least 40% undisturbed habitat

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iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Shield
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Boreal Plain Range (SK2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-39. Key map of the general location of the range.

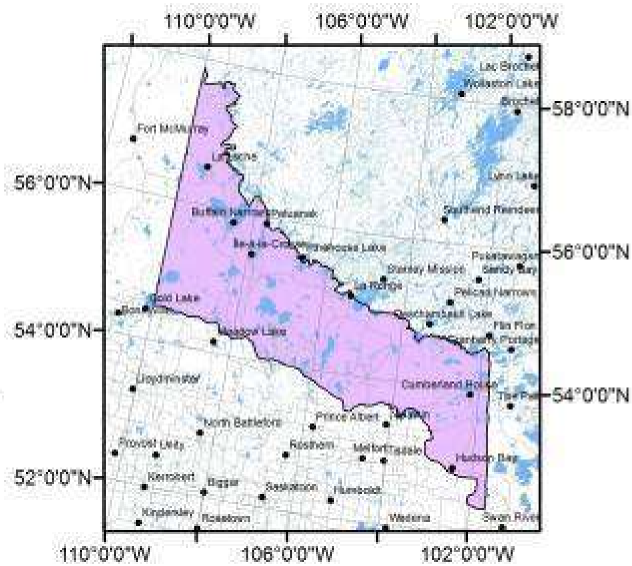

Figure J-40. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
10,592,463	30	20	45	55	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

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iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: MANITOBA

Critical Habitat Identification: The Bog Range (MB1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-41. Key map of the general location of the range.

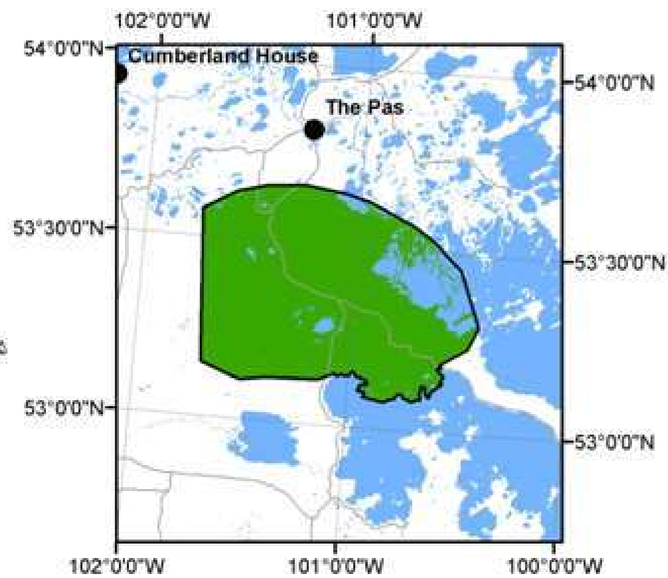

Figure J-42. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
446,383	6	14	19	81	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Kississing Range (MB2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-43. Key map of the general location of the range.

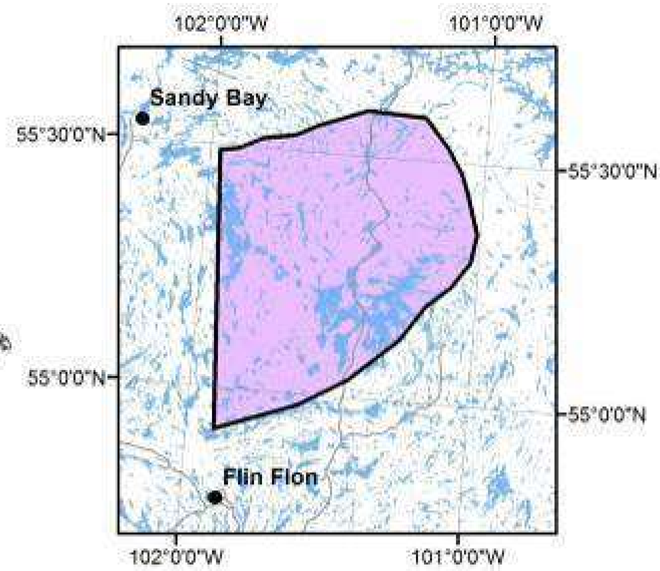

Figure J-44. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
317,029	39	15	54	46	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Naosap Range (MB3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-45. Key map of the general location of the range.

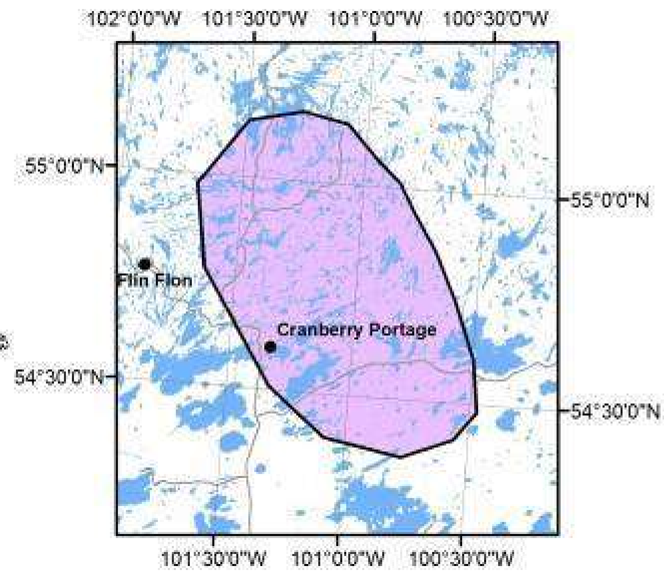

Figure J-46. The geographic boundary within which critical habitat is located

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
456,977	28	28	52	48	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Reed Range (MB4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-47. Key map of the general location of the range.

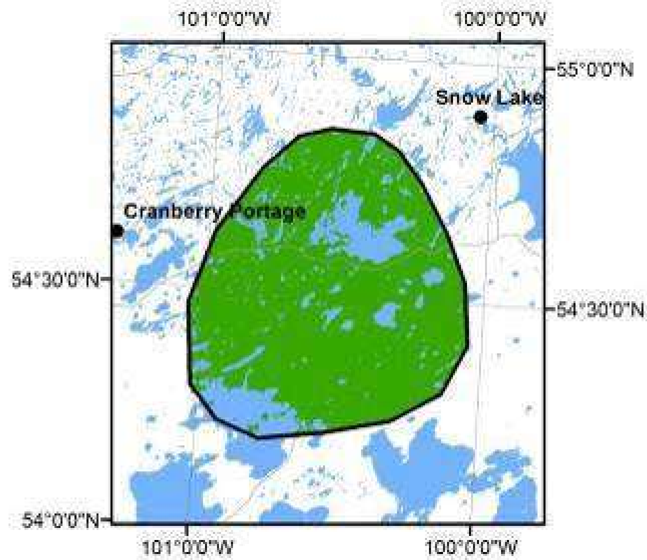

Figure J-48. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
357, 425	7	20	26	74	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: North Interlake Range (MB5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-49. Key map of the general location of the range.

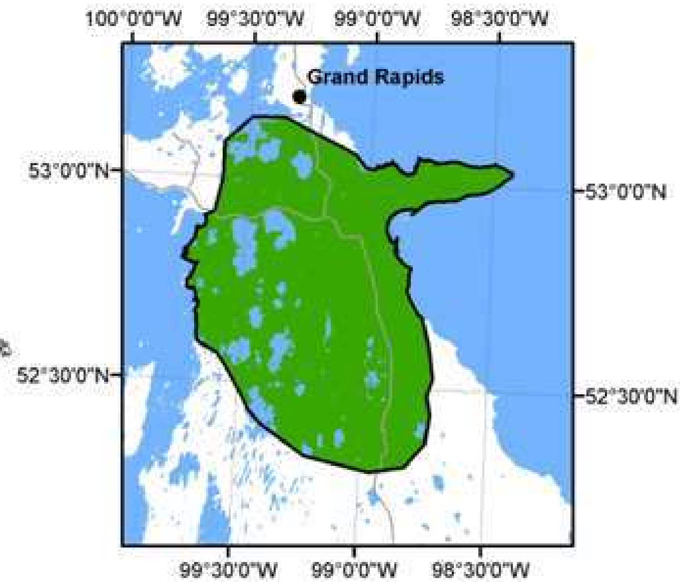

Figure J-50. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Critical Habitat Undisturbed
	Fire	Anthropogenic	Total		
489,680	4	14	18	82	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: William Lake Range (MB6)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-51. Key map of the general location of the range.

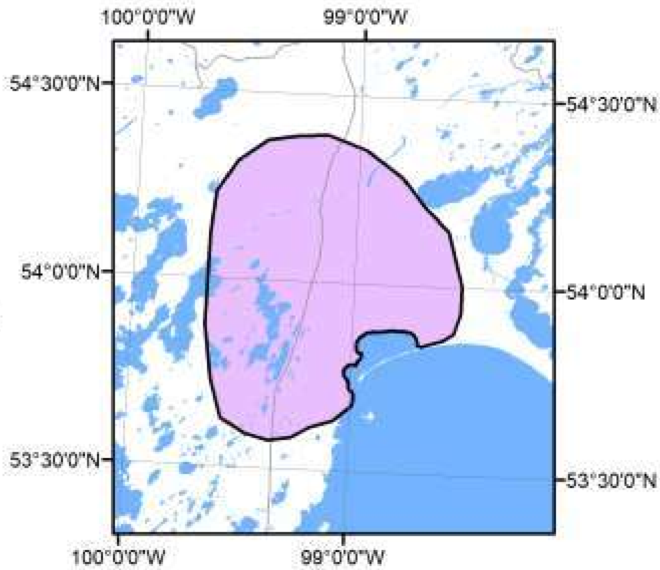

Figure J-52. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
488,219	25	17	36	64	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Wabowden Range (MB7)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-53. Key map of the general location of the range.

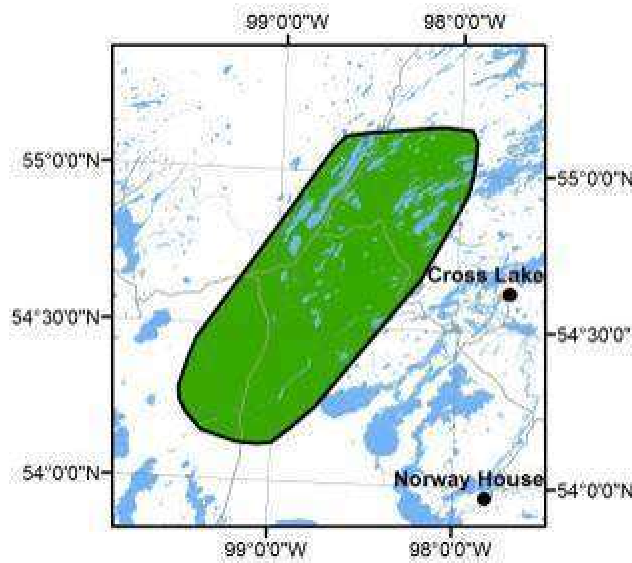

Figure J-54. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
628,938	10	20	28	72	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozones(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Wapisu Range (MB8)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-55. Key map of the general location of the range.

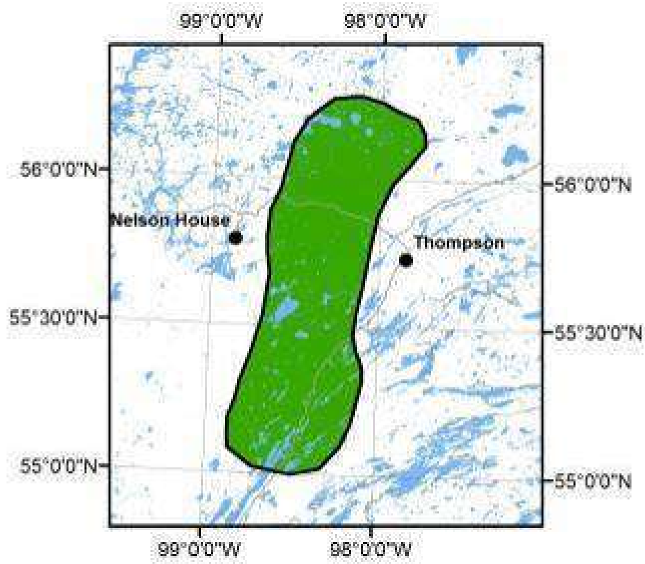

Figure J-56. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
565,044	11	13	24	76	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Manitoba North Range (MB9)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-57. Key map of the general location of the range.

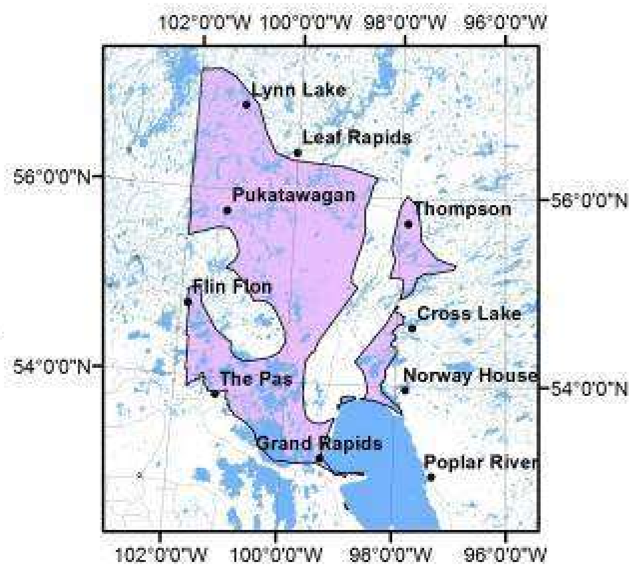

Figure J-58. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
6,205,520	23	11	33	67	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Manitoba South Range (MB10)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-59. Key map of the general location of the range.

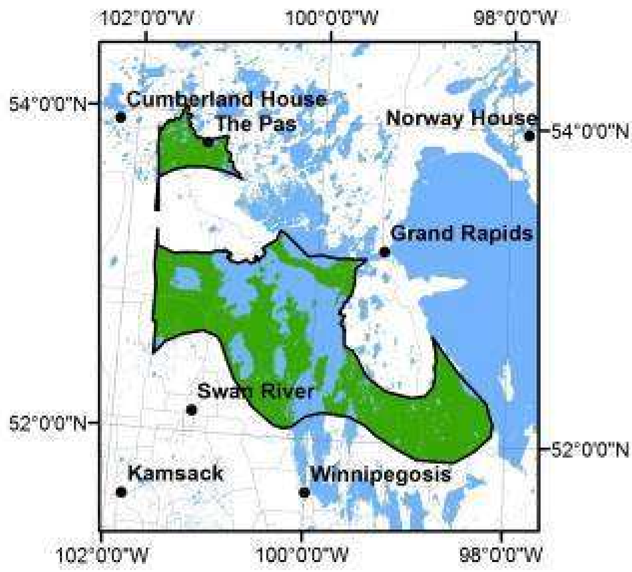

Figure J-60. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,867,255	4	12	16	84	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Manitoba East Range (MB11)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-61. Key map of the general location of the range.

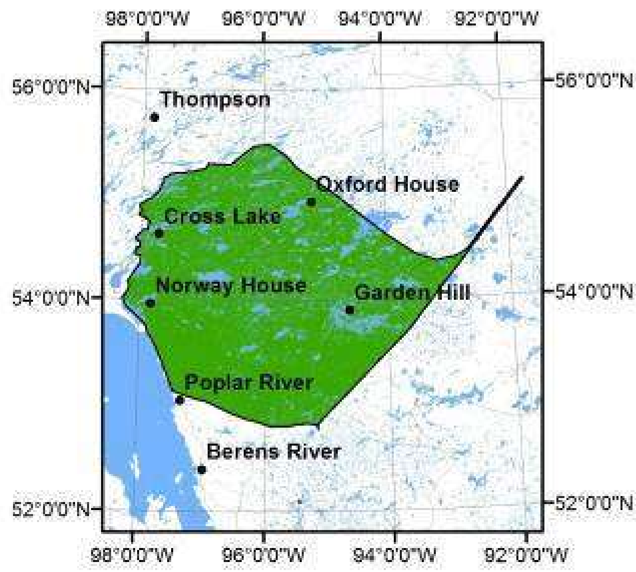

Figure J-62. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
6,612,782	26	3	29	71	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)
	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Atikaki-Berens Range (MB12)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-63. Key map of the general location of the range.

Figure J-64. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,387,665	29	6	34	66	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Owl-Flinstone Range (MB13)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-65. Key map of the general location of the range.

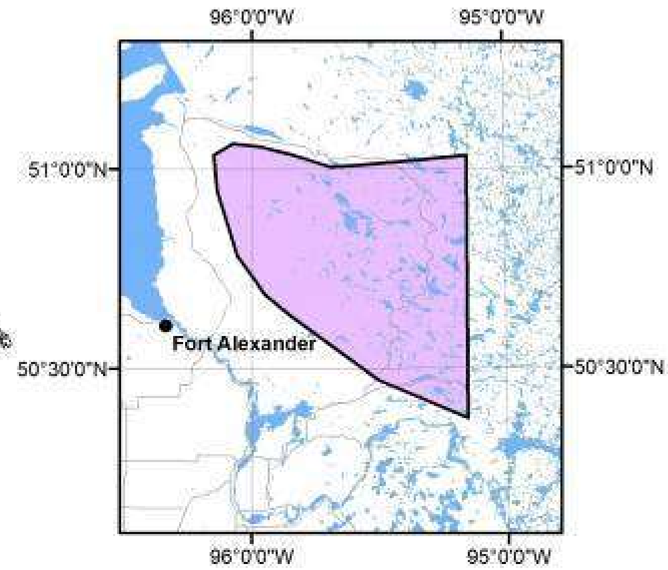

Figure J-66. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
363,570	25	18	39	61	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: ONTARIO

Critical Habitat Identification: Sydney Range (ON1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-67. Key map of the general location of the range.

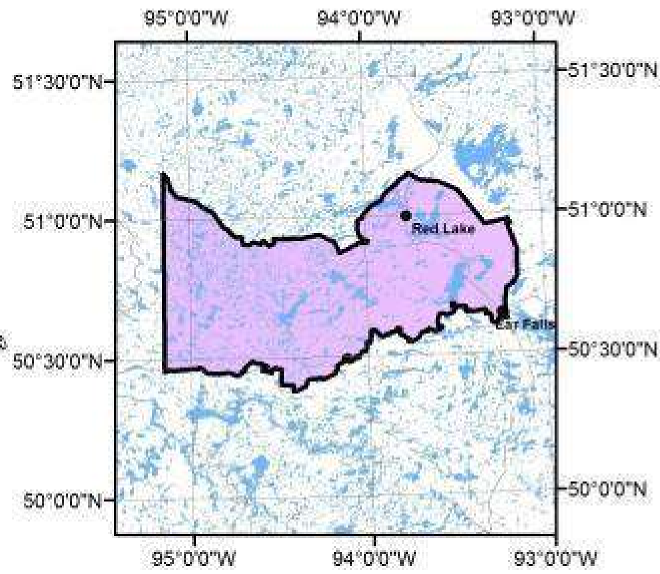

Figure J-68. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
753,001	27	25	49	51	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Berens Range (ON2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-69. Key map of the general location of the range.

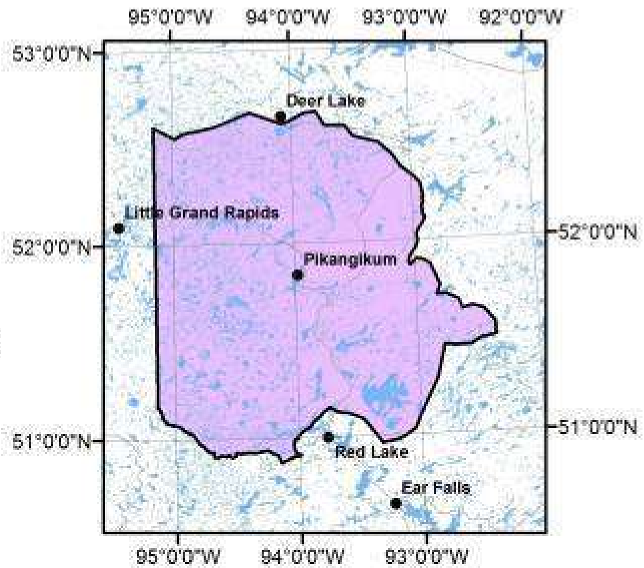

Figure J-70. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,794,835	31	6	37	63	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Churchill Range (ON3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-71. Key map of the general location of the range.

Figure J-72. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,150,490	8	28	34	66	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Brightsand Range (ON4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-73. Key map of the general location of the range.

Figure J-74. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,220,921	19	26	41	59	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Nipigon Range (ON5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-75. Key map of the general location of the range.

Figure J-76. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
3,885,026	7	25	30	70	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)
	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Coastal Range (ON6)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-77. Key map of the general location of the range.

Figure J-78. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
376,598	0	15	15	85	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)
	Boreal Shield (Central)

[1] *See Appendix H*

Critical Habitat Identification: Pagwachuan Range (ON7)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-79. Key map of the general location of the range.

Figure J-80. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
4,542,918	0.7	27	27	73	At least 65% undisturbed habitat

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iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Hudson Plain
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)
	Boreal Shield (West Central)
	Boreal Shield (Central)

[1] *See Appendix H*

Critical Habitat Identification: Kesagami Range (ON8)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-81. Key map of the general location of the range.

Figure J-82. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
4,766,463	3	37	40	60	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Hudson Plain
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (Central)

[1] *See Appendix H*

Critical Habitat Identification: Far North Range (ON9)[1]

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-83. Key map of the general location of the range.

Figure J-84. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
28,265,143	15	1	16	84	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[2]:	Hudson Plain
	Boreal Shield
Ecoregion(s)[2]:	Boreal Shield (West)
	Boreal Shield (West Central)

[1] The ON9 range was delineated into six new ranges by the province of Ontario in 2013 (https://www.ontario.ca/document/range-management-policy-support-woodland-caribou-conservation-and-recovery).

[2] See Appendix H

CRITICAL HABITAT FACTSHEETS: QUEBEC

Critical Habitat Identification: Val d'Or Range (QC1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-85. Key map of the general location of the range.

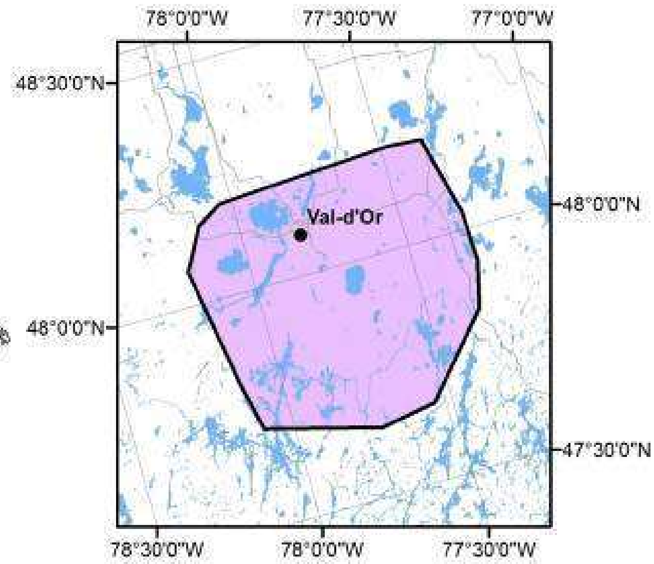

Figure J-86. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
346,861	0.2	65	65	35	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (Central)

[1] *See Appendix H*

Critical Habitat Identification: Charlevoix Range (QC2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-87. Key map of the general location of the range.

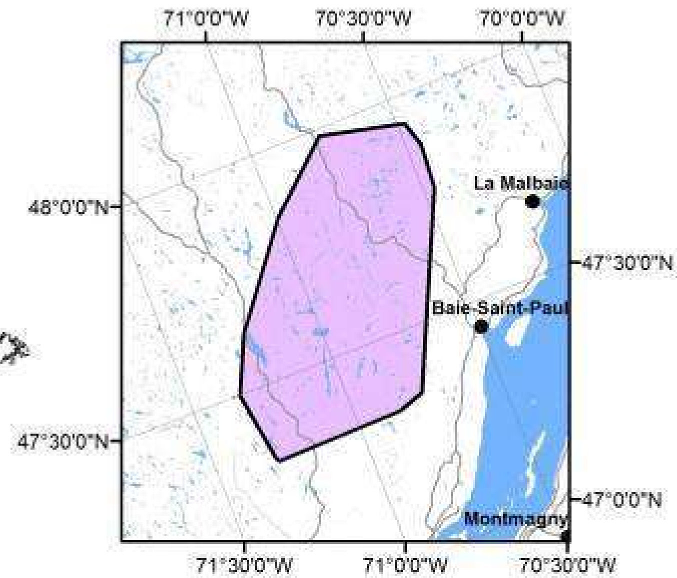

Figure J-88. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
312,803	4	80	82	18	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (Southeast)

[1] *See Appendix H*

Critical Habitat Identification: Pipmuacan Range (QC3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-89. Key map of the general location of the range.

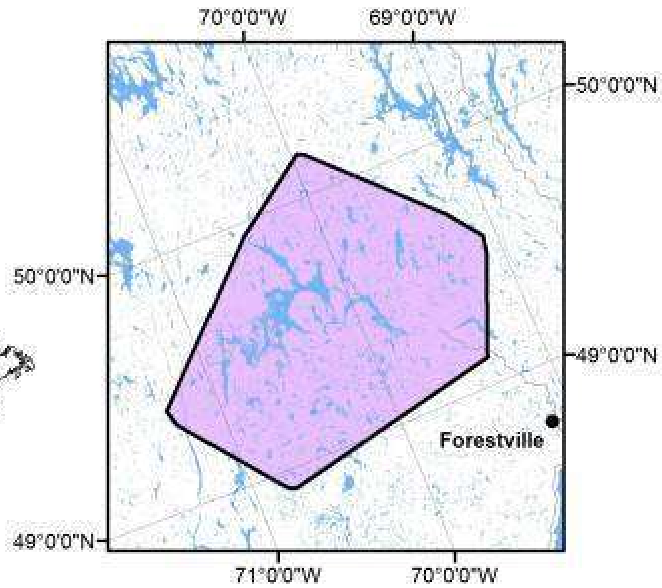

Figure J-90. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,376,899	11	60	68	32	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Manouane Range (QC4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-91. Key map of the general location of the range.

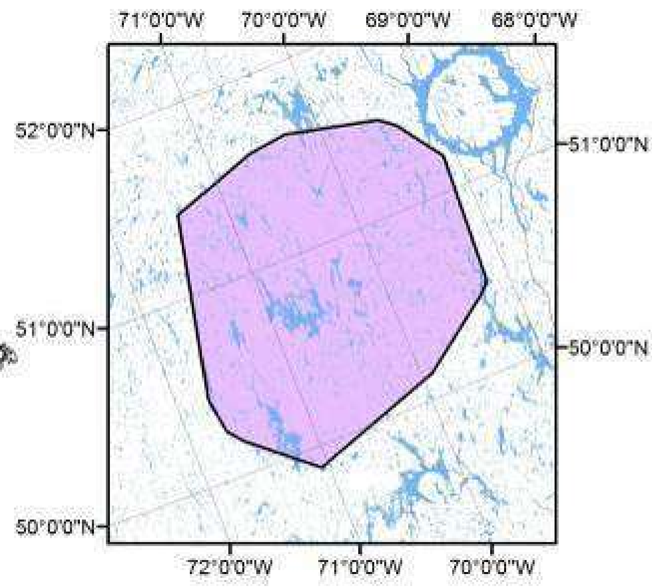

Figure J-92. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,716,449	18	26	41	59	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Manicouagan Range (QC5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-93. Key map of the general location of the range.

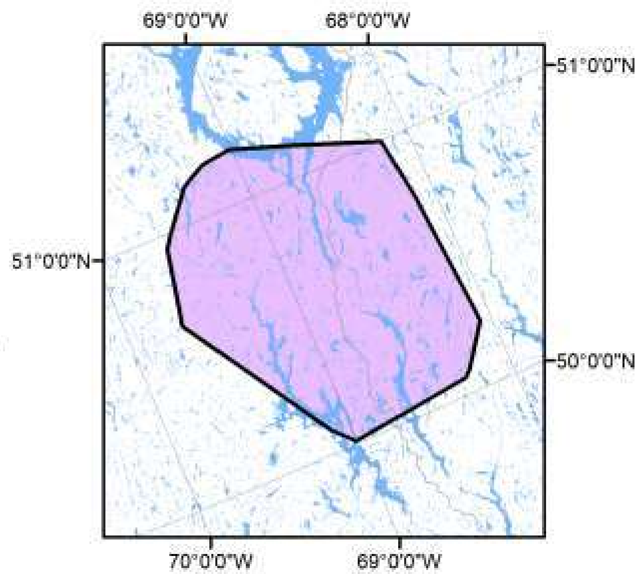

Figure J-94. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,134,129	3	36	37	63	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Quebec Range (QC6)[1]

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-95. Key map of the general location of the range.

Figure J-96. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
62,156,186	20	13	32	68	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[2]:	Boreal Shield
	Taiga Shield
	Hudson Plain
Ecoregion(s)[2]:	Boreal Shield (Central)
	Boreal Shield (East)
	Boreal Shield (Southeast)

[1] The range is likely made up of several populations for which the self-sustainability status may vary. New data are currently being collected by the provincial jurisdiction for this range. This may result in an update to the range delineation and/or the identification of new ranges, as well as a revision of their self-sustainability status following integrated risk assessment of new ranges or new range boundaries.

[2] See Appendix H

CRITICAL HABITAT FACTSHEETS: NEWFOUNDLAND AND LABRADOR

Critical Habitat Identification: Lac Joseph Range (NL1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-97. Key map of the general location of the range.

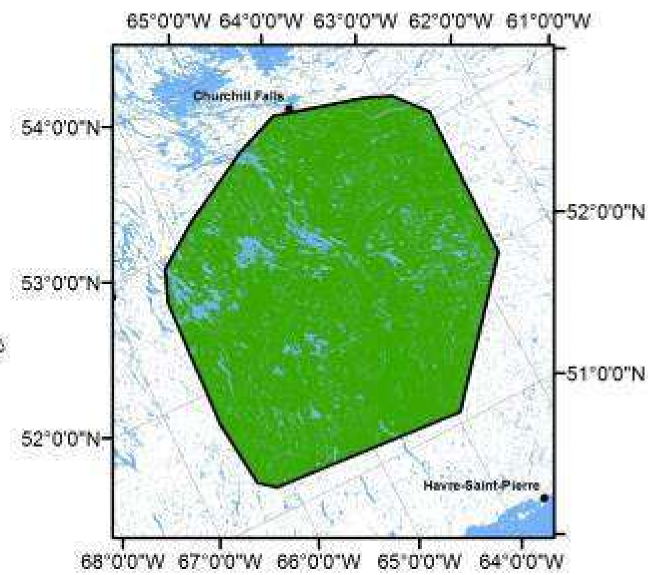

Figure J-98. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
5,802,491	12	2	14	86	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Shield
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Red Wine Mountain Range (NL2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-99. Key map of the general location of the range.

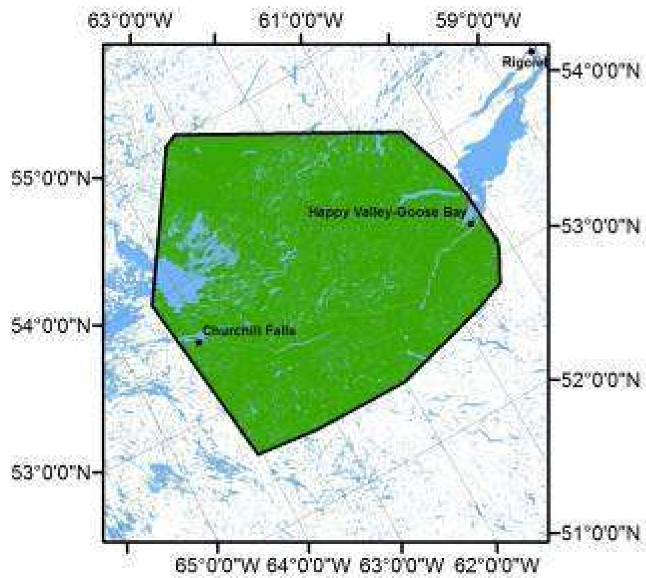

Figure J-100. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
5,838,594	7	3	9	91	At least 65% undisturbed habitat

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iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Shield
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Mealy Mountain Range (NL3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-101. Key map of the general location of the range.

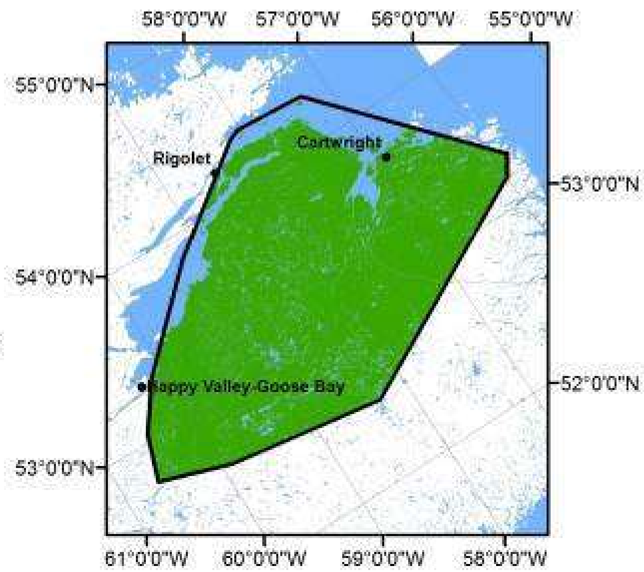

Figure J-102. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
3,948,463	1	1	2	98	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Shield
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*