



Natural Resources
Canada

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Canada

March 28, 2025

CIAR: [80468](#)

Stewart Lindale
Director, Regional and Strategic Assessments
Impact Assessment Agency

Submitted by email: regionalrof-cdfregionale@iaac-aeic.gc.ca

**Subject: Natural Resources Canada FAAR update for Ring of Fire Area
Regional Assessment**

Dear Stewart,

On March 10, 2025, the Impact Assessment Agency of Canada (the Agency) requested that Natural Resources Canada (NRCan) update the Federal Authority Advice Record (FAAR) to support work planning during the conduct phase of the Ring of Fire Area Regional Assessment. The assessment is a co-led process between the Agency, and Indigenous groups who have traditional territory in the region.

NRCan is submitting this response pursuant to section 100 of the *Impact Assessment Act*. Details of NRCan's response can be found in Appendix A: Regional Assessment in the Ring of Fire Area, Federal Authority Advice Record, and Appendix B: Ring of Fire – NRCan Studies of Interest.

NRCan looks forward to ongoing collaboration throughout the assessment process. If you have any questions, comments, or concerns, please contact Colter.kelly@nrcan-nrcan.gc.ca

Sincerely,

Colter Kelly
Impact Assessment Division
Office of the Chief Scientist

CC: Jessica Coulson; Christina Clarke Sonja Kosuta

Appendix A

Regional Assessment in the Ring of Fire Area Federal Authority Advice Record
Response due to IAAC.RegionalRoF-CdFRRegionale.AEIC@Canada.ca by March 28,
2025

Department/ Agency	Natural Resources Canada
Lead RA Contact(s)	Colter Kelly
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PART 1 – In providing your responses to the items below, please include any relevant information on associated Indigenous, public or other consultation or engagement activities and identify any partners or collaborations.

1) MANDATE AND AREA(S) OF EXPERTISE

Clearly outline the mandate of your department or agency and detail your area(s) of responsibility or expertise that may be related to the regional assessment

Natural Resources Canada (NRCan) works to improve the quality of life of Canadians by ensuring that natural resources are developed sustainably, providing a source of jobs, prosperity and opportunity, while preserving our environment and respecting our communities and Indigenous peoples.

NRCan is an established leader in the fields of:

- Natural hazards, including wildland fires, earthquakes, landslides and flooding
- Land based geology
- Groundwater and hydrogeology
- Geochemistry, acid rock drainage and metal leaching
- Greenhouse gases (GHG) emissions reduction, BAT/BEP, and energy policy
- Extraction, processing and environmental management of mineral resources
- Mining economics
- Forest data, hydrology, ecology, climate change assessments and carbon modelling, biodiversity, pests, and management
- Open science and data
- Earth observation
- Science-based decision-making tools for regional cumulative effects assessment

2) REGULATORY AUTHORITIES

List and summarize the nature of the regulatory authorities of your department or agency in relation to physical works or activities in the Ring of Fire area.

Natural Resources Canada administers the *Explosives Act* and the *Explosives Regulations*, 2013 and may exercise a power, duty or function related to the manufacturing and/or storage of explosives associated with Ring of Fire development.

Under section 6 of the *Explosives Act*, it is prohibited to make or manufacture any explosive, either wholly or in part, except in a licensed factory or to store any explosive in a magazine that is not a licensed magazine. Under subsection 7(1)(a), however, the Minister of Natural Resources may issue licences for factories and magazines. Mine developments, for instance, typically include a bulk explosives plant which operates under a Division 1 factory licence.

3) EXPERT INFORMATION OR KNOWLEDGE

List and summarize the specialists or expert information or knowledge that your department or agency has that may be relevant to the regional assessment. Include all research, reports and data sets in this response inventory.

Natural Resources Canada has specialists or expert information or knowledge relevant to the regional assessment in the domains listed below. It should also be noted that expertise and knowledge relevant to natural resources may be held by other federal and provincial partners, reflecting the shared jurisdiction for natural resources within Canada. Detailed study descriptions and references to datasets can be found in Appendix B.

- **Forest and Forestry**

- **Hydrology of forest areas:** Description of potential impacts of projects on the hydrology of surrounding watersheds (surface waters) and description of mitigation measures.
- **Biodiversity and species at risk habitat (including woodland caribou):** Description of potential impacts of projects on forest vegetation, biodiversity, and habitat for key species, including caribou; loss of habitat area and quality; changes in predator movements due to habitat modification, and identification of mitigation measures.
- **Forest soil and vegetation:** Description of potential changes in soil quality, loss, compaction, erosion, carbon, etc. that could lead to a reduction in soil productivity, including methods used to clear trees and shrubs as well as potential impacts on forest vegetation, biodiversity and species of cultural value.
- **Change of use and recovery of forested land:** Description of how projects may alter land use, potential impacts (e.g., capacity for carbon storage), identification of mitigation measures and remediation.
- **Cumulative effects in forest landscapes:** Assessment of natural and anthropogenic disturbances under climate change in forest landscapes, including predictive modelling and balancing economic, environmental and social objectives.
- **Forest data:** National forest data and mapping products are available for many forest attributes including tree species, forest fragmentation, disturbance and recovery, for different temporal and spatial scales.
- **Climate change mitigation and adaptation strategies:** Assessing forest resilience and vulnerability to climate change impacts including mitigation and adaptation forest management options
- **Wildland fire management:** Provides wildland fire intelligence and predictive services. Conducts research that develops and evaluates wildland fire risk reduction approaches to strengthen wildland fire and forest resilience
- **Peatlands:** Mapping, carbon emission and removal modelling and impacts of forest disturbance, including within the Hudson Bay and James Bay lowlands.

- **Geology, Hydrogeology and Geochemistry**

- **Geology:** Description of the nature of the superficial formations and their depth, the nature of the bedrock
 - **Land processes:** Description of the nature of the geohazards, permafrost occurrence, processes and stability.
 - **Aquifer characterization:** Description of surface water/groundwater interactions and groundwater flow using hydrogeological modelling.
 - **Environmental geochemistry:** Description of geochemical content such as chromium in natural environmental archives (lake sediments, tree rings, and peat) and other types of samples (surface water, groundwater, soil and rock).
- **Explosives Manufacturing and Storage:**
 - Assessment and licensing for the storage and manufacture of explosives.
- **Minerals and Mining**
 - **Acid drainage and metal leaching:** Our expertise encompasses assessing acid rock drainage and metal leaching in various mining materials, such as ore, mine waste rock, construction materials, tailings, and open-pit walls. This extends to understanding potential issues related to acidic mine drainage and metal leaching in mining waste, involving geochemical analysis and prevention/control technology development.
 - **Mine wastes:** Assessment of acid rock drainage and metal leaching (ARD/ML), including new emerging risks from metals such as platinum, palladium, etc., and use of this ARD/ML assessment to evaluate the alternatives to the management, treatment and disposal of mine wastes including mine water, processing effluent, waste rock, tailings and sludge.
- **Mining Economics**
 - **Baseline economic conditions:** Contribution of the mining industry to baseline economic activity, including direct and indirect gross domestic product (GDP) and employment.
 - **Mineral markets:** Mineral market analyses and potential impacts of a project on commodity markets and supply chains (local and global).
 - **Economic and fiscal impacts:** Potential direct, indirect and induced impacts of a project on GDP and employment; potential impacts of a project on government revenues from taxes and royalties and public expenditures.
 - **Local and regional economic impacts:** Description of potential positive (including new economic opportunities) and negative/positive impacts of a project on local and regional economies and populations.
- **GHG Emissions Reduction Technology**
 - Offers specialized knowledge in **greenhouse gas (GHG)** emissions reduction, encompassing Best Available Techniques (BAT) and Best Environmental Practices (BEP), as well as expertise in energy policy. This includes a focus on GHG emissions mitigation, including BAT and BEP, within the context of evaluating mining projects.
- **Earth Observation and Monitoring**
 - **Baseline data:** development of baseline data describing the status and trends of ecosystem parameters (biosphere, hydrosphere and cryosphere) across the Canadian landmass.
- **Open Science and Data**

- NRCan in collaboration with ECCC leads the [Government of Canada's Open Science and Data Platform](#), a public facing tool providing single window access to federal, provincial and territorial data, science and regulatory information to support the understanding of cumulative effects and inform impact assessment processes.
- **Science-based tools for regional cumulative effects assessment**
 - **Decision-making tools:** Development of decision-making tools through multidisciplinary science and collaborative partnerships to help land managers and decision-makers prepare and respond to cumulative effects and regional challenges in Canada, including the Ring of Fire area.

4) POLICIES, PROGRAMS OR INITIATIVES

List and summarize the past, current and planned policies, programs or initiatives of your department or agency that may be relevant to the regional assessment. Include an outline of related funding initiatives in this response and provide information on geographic locations, next steps and timing for the program/initiative.

A list of past, current and planned policies, programs and initiatives that may be relevant to the regional assessment is provided below, detailed descriptions can be found in Appendix B:

Regional Energy and Resource Table Initiative

- The Regional Energy and Resource Table (RERT) Initiative was launched in June 2022, with the aim of enabling every region in Canada to seize the economic opportunities enabled by the energy transition and the advancement of a net-zero economy.
- They are a collaborative initiative between individual provinces and territories, and the federal government, in collaboration with Indigenous partners and with the participation of regional labour and industry groups to advance and accelerate economic growth and energy transformation opportunities.
- The process aims to identify and prioritize a focused set of priorities and action areas with a view of developing economic transformation strategies across the country.
- For Ontario, this means engaging Indigenous partners, including those within the catchment of the Ring of Fire Regional Assessment, to develop economic transformation strategies, and create partnerships around specific opportunity areas.
- This work will be undertaken in partnership with the Government of Ontario.

CanmetMINING

- At CanmetMINING, the Chromite Research and Development program within the Green Mining Innovation division undertakes research to investigate the potential environmental impact of chromite (Cr) mining in the Ring of Fire area. To date, research has been done on the potential Cr-leaching and oxidation potential of model mine tailings associated with chromite mining, a life-cycle assessment on potential mining and smelting operations for Ring of Fire chromite, including GHG emission estimates from planned mining operations, as well as a literature review on the interaction of Cr-bearing dusts with peatlands. Research into the potential for Cr(VI) generation during mine blasting is planned.

Geological Survey of Canada

- At the Geological Survey of Canada (GSC), under the Environmental and Groundwater Geoscience Program (2019-2024), a project has established geo-environmental characteristics of regions with high potential of natural resources

development such as the Ring of Fire. Outcomes will be produced through the new Environmental Geoscience Program (2024-2029).

- The GSC has also developed several areas of expertise over time. These broad areas of expertise range from knowledge of the regional geology and metallogeny, volcano-stratigraphic framework, ore deposit models, and critical mineral assessment of the region. This knowledge has been acquired since 2010 through various bedrock mapping and drill core logging field campaigns in the area in collaboration with the Ontario Geological Survey, mining exploration companies and academia. This work is being conducted as part of the various phases of the Targeted Geoscience Initiative program. Here are three selected references related to this work:

1. Metsaranta, R.T. and Houlé, M.G. 2017. Geochronology, mineral deposit, drill-core relogging and drill-core compilation data from the Winiskisis Channel, McFaulds Lake and Highbank Lake areas, “Ring of Fire” region, northern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 343.
2. Metsaranta, R.T. and Houlé, M.G. 2020. Precambrian geology of the McFaulds Lake “Ring of Fire” region, northern Ontario; Ontario Geological Survey, Open File Report 6359, 260p.
3. Houlé, M.G., Leshner, C.M., Metsaranta, R.T., Sappin, A.-A., Carson, H.J.E., Schetselaar, E.M., McNicoll, V., and Laudadio, A., 2020. Magmatic architecture of the Esker intrusive complex in the Ring of Fire intrusive suite, McFaulds Lake greenstone belt, Superior Province, Ontario: Implications for the genesis of Cr and Ni-Cu-(PGE) mineralization in an inflationary dyke-chonolith-sill complex; in Targeted Geoscience Initiative 5: Advances in the understanding of Canadian Ni-Cu-PGE and Cr ore systems – Examples from the Midcontinent Rift, the Circum-Superior Belt, the Archean Superior Province, and Cordilleran Alaskan-type intrusions, (ed.) W. Bleeker and M.G. Houlé; Geological Survey of Canada, Open File 8722, p. 141–163. <https://doi.org/10.4095/326892>

Office of the Chief Scientist

- Through the Office of the Chief Scientist (OCS), NRCan is collaborating with numerous Federal, Provincial and Territorial government contributors to provide access to data, scientific publications and information about development and regulatory activities through the [Open Science and Data Platform](#) (OSDP). The platform provides single-window access to a broad suite of content to support impact, regional and cumulative effects assessments to inform evidence-based decision-making.
 - Among over 174,000 content records, the OSDP includes a curated content collection entitled [Resources to Understand Cumulative Effects in Northern Ontario](#) which was developed in collaboration with the Impact Assessment Agency of Canada and was published in November 2022. The content in this collection has been selected to support the understanding of cumulative effects in the Ring of Fire area in Northern Ontario. This collection features data and scientific publications within the area delineated by several large secondary watersheds in Northern Ontario, namely: Attawapiskat, Ekwan, Lower Albany, Upper Albany, and Winisk watersheds. Through open access to science and data, the OSDP is a tool available to participants in the Ring of Fire Regional Assessment, and through data integration, can support modelling, risk analysis, and decision making. To support the conduct phase of the Regional Assessment, the content collection will be updated to include data and science products published since the collection was originally created, including NRCan studies summarized in Appendix B to ensure information is current and aligns with the themes reflected in the Terms of

Reference.

Canada Centre for Mapping and Earth Observation

- The Canada Centre for Mapping and Earth Observation (CCMEO) is leading activities to develop foundational Earth Observation baseline data and methods describing the status and trends of ecosystem parameters (biosphere, hydrosphere, and cryosphere) across the Canadian landmass and supporting the integration of these data and techniques into project and regional assessments.

Canadian Forest Service

- The Canadian Forest Service (CFS) provides a national perspective and expertise on forest issues and undertakes long-term, large-scale research and data collection focusing on complex challenges that require multilayered responses. This includes more targeted research in the areas of climate change, natural and human disturbances, ecological responses and forest management practices. CFS is committed to providing science and technical analysis, including collecting data, collating and harmonizing existing national forest data sets that have already been collected by other organizations and provincial and territorial (P/T) partners, identify relevant gaps in the existing baselines and monitoring, and fund and coordinate P/T field data collation to fill these gaps. Canada's National Forestry Inventory assesses and monitors the extent, state, and sustainable development of Canada's forests and includes traditional forest inventory attributes and a framework for collecting additional data relevant to sustainable development, forest health, biodiversity and forest productivity. CFS has many projects that have potential, transferrable and direct research expertise to contribute to Regional Assessments (see Appendix B and OSDP), including:
 - Sustainability assessment of mine-affected Indigenous communities - holistic model to impact assessment under the Canadian Impact Assessment Act, including Risk Assessment Framework and Software for Cumulative Effects assessment, focusing on the Ring of Fire;
 - Analyzing cumulative ecological and socioeconomic effects of forest management, natural disturbance, and climate change in Ontario's managed forests;
 - Targeting forest reclamation practices and developing indicators designed to protect and restore water resources and maximize carbon capture in a cumulative effects landscape;
 - Developing a flexible tool for predicting cumulative effects on forest water resources;
 - Assessing cumulative effects of natural and anthropogenic disturbances under climate change including the trade-offs among long-term conservation of priority species and places, carbon sequestration, and land management decisions;
 - Analyzing the footprint of mining activities on diversity and terrestrial ecosystem processes throughout the mine's life cycle, including protocols and indicators of mine disturbances on northern ecosystems that are relevant for the Ring of Fire area; and
 - Carbon modelling within forest and peatland ecosystems.

Past, current and planned funding programs

Critical Minerals Infrastructure Fund – Ongoing

[Critical Minerals Infrastructure Fund \(CMIF\) Contributions and Indigenous Grants](#)

Clean Energy for Rural and Remote Communities – Ongoing

[Clean Energy for Rural and Remote Communities Program - Natural Resources Canada](#)

The Clean Energy for Rural and Remote Communities (CERRC) program provides funding for renewable energy and capacity building projects to reduce the reliance on fossil fuels for heating and electricity in Indigenous, rural and remote communities across Canada.

In support of the clean energy transition, the program's objective is to reduce greenhouse gas emissions and fossil fuel use by increasing the use of local renewable energy sources and related energy efficiency measures. This creates environmental, social and economic benefits to support healthier and more sustainable communities.

Funded projects: [Clean Energy for Rural and Remote Communities funded projects - Natural Resources Canada](#)

Indigenous Forestry Initiative – Funding opportunity closed

[Indigenous Forestry Initiative - Natural Resources Canada](#)

The objective of the Indigenous Forestry Initiative (IFI) was to advance reconciliation in the forest sector by supporting Indigenous-identified priorities to accelerate Indigenous awareness, influence, inclusion, and leadership.

The IFI provided financial support to inclusive, Indigenous-led activities in the forest sector, such as:

- gathering, developing, using, and protecting Indigenous knowledge and science
- Indigenous leadership and participation in forest stewardship
- the identification, consideration, and pursuit of economic development opportunities

Funded projects: [IFI - funded projects - Natural Resources Canada](#)

Outline any additional responsibilities, information or knowledge and any partners or collaborations that have not been specified, above.

NRCan scientists have established relationships with scientists working at the Ontario government and with different Universities such as Lakehead University, University of Guelph and University of Waterloo.

Appendix B: Ring of Fire – NRCAN Studies of Interest

NRCAN has numerous studies with potential use or application in the Regional Assessment in the Ring of Fire Area.

In addition to conducting science, NRCAN plays an important role in making science and knowledge generated open and accessible to the public via the [Open Science and Data Platform](#), including the development of curated content collections as described above.

Specific studies of interest are summarized below:

Canada Centre for Mapping and Earth Observation (CCMEO)

- **Land Surface Characterization. F. Mohammadimanesh and R. Latifovic NCR 2018 - present**

Land Use/Land Cover change datasets for Canada for 2010, 2015 and 2020 from Landsat sensor observations specific to user requirements. The datasets assist studies of land-surface processes that characterize environmental, social and economic aspects of sustainability.

[Land Surface Characterization. R Latifovic NCR - 2015 Land Cover of Canada](#)

[Land Surface Characterization. R Latifovic NCR - 2020 Land Cover of Canada](#)

[Land Surface Characterization. R Latifovic NCR - Moderate Resolution Time Series Data Management and Analysis](#)

[Land Surface Characterization. R Latifovic NCR - Circa 2010 Land Cover of Canada](#)

[Local Optimization Methodology and Product Development](#)

- **National Scale Vegetation Status and Trends Monitoring System. R Fernandes NCR 2019 - present**

Maps of vegetation biophysical parameters from satellite imagery that provide national coverage with multi-decadal temporal coverage for historical and future use at a spatial resolution suitable for environmental assessments.

[Monthly Leaf Area Index of Canada from Medium Resolution Satellite Imagery - GEO.CA Viewer](#)

[Monthly Fraction of Vegetation Cover of Canada from Medium Resolution Satellite Imagery - GEO.CA Viewer](#)

[Monthly fraction of absorbed photosynthetically active radiation absorbed of Canada from Medium Resolution Satellite Imagery - GEO.CA Viewer](#)

[Site specific satellite data record from LEAF-Toolbox to support afforestation assessment in Ontario.](#)

[Monthly Vegetation Essential Climate Variable Maps for the Hudson Bay Lowland using the LEAF-Toolbox Implementation of the SL2P Algorithm](#)

- **Surface Water (J. Li and I. Olthof NCR):**

- **Surface water maps of Canada at different scales.**

A long-term (1984–2023) time series of monthly surface water maps for Canada, at a 30-meter resolution, has been generated using archived Landsat data. Based on these monthly surface water extent datasets, a surface water frequency map was also created. To meet the needs of various applications, monthly surface water fraction maps at different resolutions (e.g., 250m, 500m, 1km, 5km, and 10km) were

produced for Canada's entire landmass. These datasets will be made available to the public.

- **Dynamic Surface Water Maps of Canada.**

Historical surface water maps have been created from moderate resolution radar and optical satellite data archives to create time-series showing changes in surface water extents. From these time-series, the percent frequency of every location's inundation was calculated and depicted spatially on a map.

[Dynamic Surface Water Maps of Canada 1984-2019 2022. | Olthof NCR 2018](#)
[Dynamic Surface Water Maps of Canada from 1984-2021 2023. | Olthof NCR 2018](#)
[Mapping surface water dynamics \(1985–2021\) in the Hudson Bay Lowlands, Canada using sub-pixel Landsat analysis Olthof and Fraser, 2024.](#)

- **Canadian Wetland Inventory Map Version 3A (CWIM3A). K Murnaghan and B Brisco, NCR 2022**

Earth observation data used for national scale wetland mapping and monitoring applications.

[Canadian Wetland Inventory Map Version 3A \(CWIM3A\) - GEO.CA Viewer](#)
[RADARSAT Constellation Mission's Operational Polarimetric Modes: User-Driven Radar Architecture](#)

- **Longterm Satellite Data Records (LTSDR) of High-temporal resolution over the Ring of Fire Region. A. Trichtchenko NCR 2018 - present**

This project is focused on advancing and applying remote sensing science and technology for generating and analyzing high temporal frequency Earth observation baseline data. Data records include:

- Surface reflectance and albedo maps derived since 2000 up to now at 10-day temporal resolution and 250-m spatial resolution. These products will be made available on the Federal Geospatial Platform (FGP).
- [Weekly products of the Normalized Difference Vegetation Index \(NDVI\) during the vegetation season \(April-October\) since 2023 at 250-m spatial resolution](#)
- [Daily NDVI and Snow Mask Composite Products](#)
- Inland Water Bodies Map of Canada and Neighbouring Regions at 250-m Spatial Resolution <https://open.canada.ca/data/en/dataset/236680e0-0014-4edc-904b-2e1b9f4061ff>

- **Terrestrial Water Status and Trends. S. Wang NCR 2018 - present**

This activity aims at developing innovative Earth observation methods for advancing terrestrial water research and producing new water data for better-informed water resource management and policy development at various scales. The activity focuses on mapping, modelling, and assessing the dynamics of terrestrial water storage (TWS) and its interactions with the climate system. Major water variables include land surface evapotranspiration, water surface evaporation, aquifer recharge and discharge, and terrestrial water storage including groundwater, surface water, ice (glaciers and ice sheets), and snow. The activity uses a wide range of satellite observations and the EALCO (Ecological Assimilation of Land and Climate Observations) land surface model.

Data Product Links:

- [Land Surface Evapotranspiration for Canada's Landmass - Open Government Portal](#)
- [Water Surface Evaporation over Canada's Landmass - Open Government Portal](#)
- [Surface Water Frequency - Open Government Portal](#)

- **Pilot national scale maps of active ground deformation processes in Canada (National Mosaic). S. Samsonov NCR 2017 - 2024**

The maps show a multiyear line-of-sight ground deformation rate caused by small-scale deformation processes in Canada, measured in meters per year. The maps were calculated from Sentinel-1 Synthetic Aperture Radar data collected from 2017 to 2024 during the snow-free season. Interferometric analysis of Sentinel-1 data was performed and the long-term deformation rate was computed with the [Multidimensional Small Baseline Subset \(MSBAS\) Software Version 10](#) at the Canada Centre for Mapping and Earth Observation, Natural Resources Canada. Long-wavelength signals caused by postglacial rebound and tectonic motion were filtered to enhance the visibility of small-scale deformation processes, such as those originating from landslides and mining. Field studies have confirmed only a few of these processes to date. The maps are expected to contain processing artifacts that will be corrected in future work.

Note that this dataset is currently available to Federal Departments through the link below. Other institutions who wish to access the data should contact the dataset owner, Dr. Sergey V. Samsonov (sergey.samsonov@nrcan-rncan.gc.ca).

[National mosaics, internal STAC browser](#)

National mosaics, internal STAC API collection endpoint:

int.datacube.services.geo.ca/stac/api/collections/land-deformation-mosaic

FGP record: [FGP / PGF - FGP / PGF](#)

- **SAR Toolbox lake ice breakup method. J. van der Sanden NCR.**

This method is used to determine the extent of ice cover and water on lakes during the breakup period. It utilizes RCM Compact Polarization products and automatically retrieves lake boundary information from National Hydro Network data. The method computes various variables, such as backscatter intensities in different polarizations and polarimetric discriminators, based on the incidence angle and ice cover conditions. Additionally, historical data on precipitation, air temperature, and wind speed from the nearest ECCC weather station are accessed to establish a confidence level for the resulting ice cover conditions classification. A method to use RCM CP products for the observation of lake ice freeze-up is in development

[RCM CEOS ARD \(STAC\)](#)

[SAR Toolbox documentation](#)

- **Regional Applications for Wildlife Habitat. W. Chen NCR 2018 – present.**

This project aims to support regional assessments under the *Impact Assessment Act*. Among various valued components typically considered in impact assessment, caribou stands out as one of the top priorities because of their importance to Indigenous peoples' economy, culture, and way of life. The project maps lichen availability for caribou ranges in the Ring of Fire region and other areas and assess the cumulative effects of human and natural disturbances on lichen availability.

[A storymap "Finding Lichen for Caribou Part 1: Drone and Plot Surveys, co-production by](#)

[CCRS, NRCAN and Four Rivers Environmental Services, Matawa First Nations Management in English, French, and Cree.](#)

- **Mapping long-term dynamics of beaver-induced disturbance. R Fraser NCR 2024**

In collaboration with Environment Canada and Climate Change (ECCC) a remote sensing method was developed to track variability in beaver ponding since 1985 and provide an indicator of beaver engineering activity and populations. The method has been demonstrated over a 5127 km² area of the Hudson Bay Lowlands <https://osdp-psdo.canada.ca/dp/en/search/metadata/ECCC-CURATED-1-5D250751-08BB-4819-9DDB-4E07B6755190> and is currently being used to assess the role of wildfire disturbance and regeneration in promoting long-term beaver modifications to streams. The next phase of this work, to be completed by the end of 2026, is modifying and applying the method to document spatio-temporal changes in beaver ponding since 1985 across the Ring of Fire Assessment Area and Hudson Bay Lowlands.
- **Mapping long-term degradation of permafrost palsas in Polar Bear Provincial Park. G Gosselin and R Fraser NCR 2025**

This study with the support of the Ontario Ministry of Natural Resources and Forestry (OMNRF) used a combination of historical aerial photographs and high-resolution commercial satellite data to map thawing of ice-rich palsa landforms and their conversion to thermokarst fens. Changes were mapped from 1955-2024 within a 750 km² area of Polar Bear Provincial Park. A report and manuscript are in preparation.
- **Snow dynamics maps for Canada. M. Bonney and Y. Zhang NCR**

Maps of snow dynamics (e.g., snow melt dates) have been created from moderate (30 m) resolution optical satellite data to quantify landscape-scale snow patterns not visible in previous low-resolution snow datasets. Annual and interannual products covering winters 2018-2019 to 2023-2024 have been created for the Hudson Bay Lowlands and regions of the Canadian Arctic. Our workflow supports national-scale processing, with Canada-wide products planned.
- **Monitoring Peatland Transformations to Support Regional Assessment. R. Touzi and P. Wilson, NCR 2022**

Wetlands with at least 30–40 cm of peat accumulated on the surface represent an important class of wetlands named peatlands. Although peatlands globally only cover 3% of the land surface, they store 30% of the terrestrial carbon. The James Bay Lowland (JBL) in Ontario, Canada, is a vast area known for its extensive peatlands. This project is using advanced radar technology - L-band polarimetric Synthetic Aperture Radar (SAR) - to enhance wetland classification, improve the characterization of peatlands and monitoring their transformation, and assess the impact of mining on peatlands, with a goal towards large-scale wetland status and trends monitoring. Two study sites are being investigated – peatlands to the east of the Victor Diamond Mine site, and within the Polar Bear Provincial Park.

Publication: R. Touzi, K. Omari, B. Sleep, and X. Jiao, “Scattered and received wave polarization optimization for enhanced peatland classification and fire damage assessment using polarimetric PALSAR”, *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, Vol. 11, No. 11, pp 4452-4477, Nov. 2018

Canadian Forestry Service

- **SCANFI: the Spatialized Canadian National Forest Inventory. L Guindon, P Villemaire, D L P Correia, F Manka, S Lacarte, B Smiley 2023**

This data publication contains a set of 30m resolution raster files representing 2020 Canadian wall-to-wall maps of broad land cover type, forest canopy height, degree of

crown closure and aboveground tree biomass, along with species composition of several major tree species. SCANFI is the first coherent 30m Canadian wall-to-wall map of tree structure and species composition and opens novel opportunities for a plethora of studies in a number of areas, such as forest economics, fire science and ecology.

[SCANFI: the Spatialized Canadian National Forest Inventory data product](#)

- **CASFRI: the Common Attribute Schema for Forest Resource Inventories 2024**
The Common Attribute Schema for Forest Resource Inventories (CASFRI) is a Canadian forest resource inventory data repository. Data collected by different agencies (e.g., provincial, territorial and federal government) are harmonized to provide current and historical map-based forest resource inventory datasets spanning multiple jurisdictions.
[CASFRI: the Common Attribute Schema for Forest Resource Inventories](#)
- **MAGPlot database: the Multi-Agency Ground Plot database v1.0**
Multi-Agency Ground Plot (MAGPlot) database is a Canadian forest ground-plot data repository. Different agencies, including National Forest Inventory (NFI) and 12 Canadian jurisdictions (AB, BC, MB, NB, NL, NS, NT, ON, PE, QC, SK, and YT), contributed forest ground plot datasets in their original format into MAGPlot. The datasets delivered to us were quality controlled, standardized, and harmonized, and integrated into a single, centralized, and analysis-ready format database.
[MAGPlot database: the Multi-Agency Ground Plot database v1.0](#)
- **A Flexible Tool for Predicting Cumulative Effects on Forest Water Resources. J Leach 2019 - 2024**
Forests supply high quality water and help moderate flood and drought risks for downstream stakeholders and users. Being able to model and predict how changes in forest cover and recovery, because of mining, forestry, climate change, wildfire, and insect outbreaks, will impact downstream water resources is critical for informing effective management approaches. A modelling tool (Raven and Robin) has been developed to predict cumulative effects on forest cover and their impacts on water resources.
[A flexible tool for predicting cumulative effects on water resources.](#)
- **Sustainability Assessment of Indigenous Communities Affected by Mining, including Ring of Fire, and Cumulative Effects Risk Assessment Framework and Software. E Antwi 2019 - present**
This project develops and tests frameworks, tools, and concepts to improve the cumulative effects assessment of multiple disturbances on livelihoods and ecosystems in Canada's North. The framework integrates biophysical and socioeconomic indicators and draws on knowledge and perspectives from Indigenous communities, industry, scientists, and government stakeholders. The project works with experts and First Nation communities to co-design tools and approaches to support local capacity, create future scenarios that respond to cumulative effects' risks and impacts, and guide management decision support practices. Using the Ring of Fire as a case example, the following was developed:
 - [Risk Assessment Framework for Cumulative Effects \(RAFCE\)](#) - a risk and impacts-based cumulative effects assessment framework for scoping regional cumulative effects issues to guide present and future project and regional assessments. It provides a standardized approach to impact identification, prioritization, and mitigation during Regional Assessment.
 - [Risk Assessment Software for Cumulative Effects \(RASCE\)](#) - a Web-

based collaborative tool for Regional Risk Assessment and Prioritization. The software performs analysis and modeling using artificial intelligence and large language models to produce assessment reports and a prioritization diagram. This innovative approach provides a unique platform for systematically evaluating the cumulative effects of resource exploration by multiple stakeholders, significantly reduces the time required for the RA process, enhancing its reliability and efficiency.

Publications:

[Sustainability assessment of Indigenous communities affected by mining - holistic model to impact assessment under the Canadian Impact Assessment Act \(2019\).](#)
[A modelling approach to inform regional cumulative effects assessment in northern Ontario \(2023\)](#)

[Report on the Risk Assessment Framework for Cumulative Effects \(2023\)](#)

- **Cumulative Ecological and Socioeconomic Effects of Forest Management, Natural Disturbance and Climate Change in Ontario's managed forests. L Venier GLFC 2019 - present**

This project is designed to measure and ultimately project the cumulative effects of multiple anthropogenic and natural disturbances on a suite of ecological and socioeconomic components of concern for Ontario's area of the undertaking. The components of concern to be considered are elements of biodiversity including caribou, birds, and aquatic communities, as well as mercury contamination in fish, and socioeconomic consequences including effects on Indigenous communities and timber supply. This project is part of a larger cumulative effects project that will develop a comprehensive framework for measuring and projecting cumulative effects using ensemble modelling to address uncertainty. The proposed project is scalable such that additional research can be added once the underlying data, infrastructure, and tools are compiled and developed.

Publication:

[Cumulative ecological and socioeconomic effects of forest management, natural disturbance and climate change in ON managed forests.](#)

- **National bio-economic analyses of timber supplies, forest management, caribou and cumulative effects - trade-offs, cost effectiveness, risks and opportunities. D McKenney; J Pedlar, L Venier GLFC 2019 - present**
This is a national scaled project that examines economic and ecological trade-offs through time. Specifically, the work examines how large-scale disturbances, such as forest fire, timber harvesting, and other land uses (e.g., existing or planned mining operations) impact habitat for caribou and other selected taxa (e.g., migratory birds) in a cumulative effects context. A modeling framework to simulate these large-scale disturbances within the forested regions of Canada under current and future climate.

Publications:

[National bio-economic analysis of timber supplies, forest management, caribou and cumulative effects trade-offs, cost effectiveness risks and opportunities.](#)

[Size requirements of intact forest landscapes for effective biodiversity conservation under regional fire regimes and climate change \(2022\)](#)

- **Cumulative effects of natural and anthropogenic disturbances under climate change in Western Canada: Assessing trade-offs. E McIntire 2019 – present**
Through the development of an integrated open-platform system for management, the project team evaluates cumulative effects on indicators and examines trade-offs

among land management options in the western boreal forest, including long-term conservation of priority species and places, carbon sequestration and different land management approaches. This system can be applied to other regions and objectives. The end-goal of the project is to improve the environmental performance of forestry, mining and oil and gas sectors by creating and mobilizing the knowledge, tools and techniques needed to address cumulative effects. This will minimize any unintentional negative environmental impacts and enable science-based decision making.

Publication:

[Climate-informed forecasts reveal dramatic local habitat shifts and population uncertainty for northern boreal caribou \(2022\)](#)

- **Footprint of mining activities on diversity and terrestrial ecosystem processes throughout the mine's life cycle. C Martineau 2019-present**

This project aims at determining the footprint of mines, beyond the immediate developed area and throughout the mine lifecycle, on diversity and ecosystem processes in boreal ecosystems using various properties of the soil, water, and vegetation as indicators. The study is located in the boreal vegetation zone in the Abitibi-Témiscamingue and Nord-du-Québec regions and focuses on six mines at different stages of the mine lifecycle (i.e. from establishment to restoration).

Publications:

[Out of site, out of mind: Changes in feather moss phyllosphere microbiota in mine offsite boreal landscapes \(2023\)](#)

[How big is the footprint? Quantifying offsite effects of mines on boreal plant communities \(2023\)](#)

- **Delivery of peatland carbon modelling in the Hudson Bay Lowland Ecozone. K Webster 2023-2026**

This project will provide estimates of carbon fluxes in the Hudson Bay Lowlands Ecozone (HBLE) using the Canadian Model for Peatlands (CaMP). This work contributes to Parks Canada's Hudson Bay-James Bay Biodiversity Conservation and Carbon Sequestration Initiative, as well as work on-going under the Can-Peat program, an initiative supported by Environment and Climate Change Canada. The project is developing a permafrost module and dissolved organic carbon module within the CaMP, calibrating and validating the dynamic water table model with field measurements collected research partners, developing HBLE-specific yield curves for key tree species within forested peatlands (black spruce and larch) and modelling greenhouse gas (GHG) emissions and removals with refined peatland cover maps to understand current and future carbon sink capacity of peatlands across the HBLE, including the impacts of natural disturbances (wildfire and permafrost thaw).

Geological Survey of Canada – Lands and Minerals Sector (LMS)

- **Ring of Fire: Reconstructing Long-term Environmental Records to Support Regional Assessment Webequie to Atawapiskat Coverage. J Jautzy 2020 - present**

While five years of baseline monitoring data have been acquired by the Ontario provincial government (Ontario Ministry of the Environment Parks and Conservation), further knowledge is required to understand how these baseline conditions will respond to ongoing climate change and new anthropogenic stresses associated with

future mining activities and related infrastructure development (e.g., roads, large mining camps, traffic) in the Ring of Fire (RoF). While airborne dust, effluent, waste rock and mine tailings from mining activities are the most likely vectors for metal(loid) contamination in the environment. Changes in lake sediment redox transition zone (i.e., either seasonally or anthropogenically driven) and forest fires can potentially enhance the remobilization of metal(loid)s over time. This increases the possibility of the interplay of different sources and the evolution of their relative contributions over time due to climate forcing and transformation of surface and subsurface environments. The research activities focus on targeted sampling of natural environmental archives, including lake sediments, tree rings, and peat, as well as surface water, groundwater, soil, and rock material at two analog sites to the RoF. One site represents a pre-chromium mining environment, while the other is an abandoned site that has experienced chromium mining. The exploration will develop new environmental indicators tailored to monitoring the RoF environment, such as fire intensity molecular indicators and biocarbonate as a sentinel for metal loading.

[Ring of Fire: Reconstructing long-term environmental records to support regional assessment 2021](#)

[Ring of Fire: Reconstructing long-term environmental records to support regional assessment 2021a](#)

- **Ring of Fire: Reconstructing long-term Environmental Dynamics to Support Regional Assessment. N Benoit 2020 - present**

The project explores the chromium mobility on two former mines in the Thetford Mines area as a cumulative effect in an environmental system. The study will provide Canadians with a methodology for chromium isotope sampling and analysis as well as a geochemical approach to metal characterization in a chromite deposit context similar to the Ring of Fire. The project outcome is to inform decision-making in natural resource management in the Ring of Fire that includes an effective approach to sampling and analysis of Chromium species (Cr (III) and Cr (VI)) in water.

Publication:

[Ring of Fire: Reconstructing long-term environmental dynamics to support regional assessment](#)

- **Mineralized mafic-ultramafic intrusion systems of the Ring of Fire rock formations. M. Houli 2010 – present**

As part of the Targeted Geoscience Initiative (TGI) program, NRCAN will study numerous mafic-ultramafic intrusions of the Ring of Fire intrusive suite to advance the geoscience knowledge of these intrusions and to determine the possible relationships between various critical mineralization within this large mafic-ultramafic event in the Superior Province. As part of this study, NRCAN will also undertake a detailed study of the magmatic architecture of the Esker Intrusive Complex, including the Black Thor, Double Eagle and Eagle's Nest intrusions. More specifically, the proposed research will establish the dynamic conditions occurring within magmatic conduits/pathways that lead to the formation of magmatic sulfides-oxides mineralization and subsequent depositions within footwall embayment within or proximal to the conduits. The complete architecture (intrusive-subvolcanic-extrusive) of the mineralized mafic-ultramafic systems from the magma conduits to the deposition sites (traps) will be investigated.