Kiggavik Project
Final Environmental Impact Statement

Tier 2 Volume 4:
Atmospheric Environment

Part 1 – Air Quality and Climate Change

September 2014

History of Revisions

Revision Number	Date	Details of Revisions
01	December 2011	Initial release Draft Environmental Impact Statement (DEIS)
02	September 2014	FINAL Environmental Impact Statement

Foreword

The enclosed document forms part of the Kiggavik Project Final Environmental Impact Statement (FEIS) submission, presenting potential environmental and social impacts to determine if the Project should proceed and if so, under what terms and conditions. The submission has been prepared for the Nunavut Impact Review Board by AREVA Resources Canada Inc. to fulfill the requirements of the "Guidelines for the Preparation of an Environmental Impact Statement for AREVA Resources Canada Inc.'s Kiggavik Project (NIRB File No. 09MN003)", to include new material or clarity provided during the review of the Draft Environmental Impact Statement, and to address company commitments and direction from the Nunavut Impact Review Board as outlined in the "Preliminary Hearing Conference Decision Concerning the Kiggavik Project (NIRB File No. 09MN003)".

The FEIS submission consists of a number of documents, as shown in the attached road map. These documents have been categorized into tiers, as follows:

- **Tier 1** document (Volume 1) provides a plain language summary of the Final Environmental Impact Statement.

- **Tier 2** documents (Volumes 2 to 10) contain technical information and provide the details of the assessments of potential Project environmental effects for each environmental compartment. Tier 2 Volume 11 contains executive, popular, and volume summaries in Inuktitut.

- The Tier 2 documents each have a number of technical appendices, which comprise the **Tier 3** supporting documents. These include the environmental baseline reports, design reports, modelling reports and details of other studies undertaken to support the assessments of environmental effects. Management plans are provided as Tier 3 documents.

Volume 1 Main Document

Volume 2 Project Description and Assessment Basis

- Governance and Regulatory Oversight
- Project Description
- Assessment Basis

2A Alternatives Assessment
2B Drilling and Blasting Design
2C Explosives Management Plan
2D Design of Ore and Mine Rock Pads and Ponds
2E Water Diversion and Collection Design
2F Design of Andrew Lake Dewatering Structure
2G Kiggavik-Sissons Road Report
2H Ore Storage Management Plan
2I Water Management Plan
2J Marine Transportation
2K Winter Road Report
2L All-Season Road Report
2M Roads Management Plan
2N Borrow Pits and Quarry Management Plan
2O Mine Site Airstrip Report
2P Occupational Health and Safety Plan
2Q Radiation Protection Plan
2R Preliminary Decommissioning Plan
2S Waste Management Plan
2T Environmental Management Plan
2U Hazardous Materials Management Plan
2V Mine Geotechnical Reports

Volume 3 Public Engagement and Inuit Qaujimajatuqangit

Part 1
- Public Engagement

Part 2
- Inuit Qaujimajatuqangit

3A Public Engagement Documentation
3B Inuit Qaujimajatuqngit Documentation
3C Community Involvement Plan

Volume 4 Atmospheric Environment

Part 1
- Air Quality and Climate Change

Part 2
- Noise and Vibration

4A Climate Baseline
4B Air Dispersion Assessment
4C Air Quality Monitoring Plan
4D Baker Lake Long-Term Climate Scenario
4E Noise and Vibration Assessment
4F Noise Abatement Plan

Volume 5 Aquatic Environment

- Surface Hydrology
- Hydrogeology
- Water and Sediment Quality
- Aquatic Organisms
- Fish and Fish Habitat

5A Hydrology Baseline
5B Geology and Hydrogeology Baseline
5C Aquatics Baseline
5D Groundwater Flow Model
5E Prediction of Water Inflows to Kiggavik Project Mines
5F Mine Rock Characterization and Management
5G Thermal and Water Transport Modelling for the Waste Rock Piles and Tailings Management Facilities
5H Waste Rock Water Balance
5I Hydrology of Waste Rock Piles in Cold Climates
5J Tailings Characterization and Management
5K Historical and Climate Change Water Balance
5L Kiggavik Conceptual Fisheries Offsetting Plan
5M Aquatics Effects Monitoring Plan
5N Hydrology Assessments
5O Sediment and Erosion Control Plan
5P Technical Assessments of Water Withdrawal Locations and Baker Lake Dock Site

Volume 6 Terrestrial Environment

- Terrain
- Soils
- Vegetation
- Terrestrial Wildlife

6A Surficial Geology and Terrain Baseline
6B Vegetation and Soils Baseline
6C Wildlife Baseline
6D Wildlife Mitigation and Monitoring Plan

Volume 7 Marine Environment

- Marine Water and Sediment Quality
- Marine Mammals
- Marine Fish

7A Marine Environment Baseline
7B Underwater Acoustic Modelling

Volume 8 Human Health

- Occupational Dose Assessments
- Human Health Risk Assessment

8A Ecological and Human Health Risk Assessment
8B Radiation Protection Supporting Document

Volume 9 Socio-Economic Environment and Community

Part 1
- Socio-Economic Environment

Part 2
- Heritage Resources

9A Socio-Economic Baseline
9B Archaeology Baseline
9C Human Resources Development Plan
9D Archaeological Resource Management Plan

Volume 10 Accidents, Malfunctions and Effects of the Environment on the Project

- Risk Assessments
- Effects of the Environment on the Project

10A Transportation Risk Assessment
10B Spill Contingency and Landfarm Management Plan
10C Emergency Response Plan

Volume 11 Executive, Popular and Volume Summaries Translated into Inuktitut

KEY:

Tier 1 Document	Tier 2 Document	Tier 3 Document
Main Documents	Environmental Effects Assessment Report	Technical Appendices, Baseline Reports, Technical Development and Management Plans

Executive Summary – Air Quality and Climate Change

As per the guidelines issued by the Nunavut Impact Review Board (NIRB 2011), AREVA has prepared an Environmental Impact Statement (EIS), which includes the assessment of the potential effects to the atmospheric environment including effects air quality and climate change associated with the Kiggavik Project (Project).

The primary Project components considered in the air quality and climate change assessments include all land-based construction, operation, final closure and post closure activities. Two access road options were considered in the assessment; a Winter Road and an All-Season Road. Two siting options for the Baker Lake dock and storage facility were also included in the assessment.Scope of the Assessment

The NIRB developed the scope of the air quality and climate change assessments for the Project based on input from Inuit, government, and other interested stakeholders. Inuit stakeholders have played a fundamental role in raising awareness of potential Project interactions with the atmospheric environment.

Through Inuit Qaujimajatuqangit (IQ) interviews and engagement activities, AREVA has learned about the importance of the atmospheric environment to Kivalliq community members. This includes concerns and questions about emissions and dispersion of dust and radioactive components of dust (EN–AR OH Nov 2010[1], EN–BL OH Nov 2010[2], EN-CH OH Nov 2010[3], EN-CI OH Nov 2010[4], EN–RB NIRB April 2010[5], EN–BL OH Oct 2012[6], EN-BL OH Nov 2013[7], EN-CI OH Nov 2013[8]), as well as the potential contamination of the plants and animals (EN-RB KIA Apr 2007[9], IQ–ARHT 2009[10], EN–BL EL Oct 2012[11]). It also includes the importance of protecting wildlife and human health

[1] EN – AR OH Nov 2010: *How far will dust travel from the mine? Will there be uranium dust produced during mining?*

[2] EN – BL OH Nov 2010: *Concerned with dust from blowing storms.*

[3] EN - CH OH Nov 2010: *Radioactive dusts will travel downwind to Rankin Inlet.*

[4] EN - CI OH Nov 2010: *What will happen to dust from mining?*

[5] EN – RB NIRB April 2010: *Need to consider that uranium mining is different from other types of mines. The byproducts are different. Need to consider the pollutants that can travel by air onto land.*

[6] EN – BL OH Oct 2012: *Uranium goes into the air, and it is dangerous for the community.*

[7] EN - BL OH Nov 2013: *How long will uranium be in the atmosphere?*

[8] EN – CI OH Nov 2013: *What about dust? Lots of wind can carry dust. The dust will be an issue because there is constant wind that will lift the dust and keep it suspended.*

[9] EN - RB KIA Apr 2007. *Believe that there is waste in air from dust. Know for fact that the tree line, the ashes and dust end up in Nunavut and everywhere. Is there a boundary set up so that no tailings go everywhere to wildlife? Sometimes dead caribou are eaten by other animals, so contaminants travel in food chain.*

[10] ARHT 2009: *Hunters and elders expressed concerns about the potential for airborne contamination settling on vegetation and being consumed by caribou.*

[11] EN – BL EL Oct 2012: *I am pretty sure there will be dust that will spread everywhere. There will be lots of dust and animals like rabbits and wolves that will be affected.*

against the effects of aiborne contaminants (EN–RI KWB Oct 2009[12], IQ–BLE 2009[13], IQ-RIE 2009[14], EN–RB NIRB April 2010[15], EN-CH OH Nov 2010[16]). The value of the terrestrial environment and the scope of this assessment exemplify the IQ guiding principle of Avatimik Kamattiarni (the concept of environmental stewardship).

Ambient air quality and climate change were selected as valued environmental components (VECs) for the atmospheric assessment because they have the potential to be affected by Project activities and are of considered to be important to health in the Kivalliq region.

Inidcators of ambient air quality include measurable concentrations of Constituents of Potential Concern (COPCs). COPCs included in the air quality assessment are:

- Total Suspended Particulate Matter (TSP)
- Particulate matter less than 10 microns (µm) in diameter (PM_{10})
- Particulate matter less than 2.5 microns (µm) in diameter ($PM_{2.5}$)
- Radioactive and non-radioactive constituents in TSP, including:
  - Uranium-238 (U)
  - Arsenic (As)
  - Cadmium (Cd)
  - Chromium (Cr)
  - Cobalt (Co)
  - Copper (Cu)
  - Molybdenum (Mo)
  - Lead (Pb)
  - Nickel (Ni)
  - Selenium (Se)
  - Zinc (Zn)
  - Nitrogen Oxides (specifically, NO2)
  - Sulphur Dioxide (SO2)
  - Radionuclides, including:
  - Radon (Rn-222)
  - Lead-210 (Pb-210)
  - Polonium-210 (Po-210)

[12] EN – RI KWB Oct 2009: *How is contaminant dust controlled? Will there be control on the road? How does dust affect the environment?*

[13] IQ – BLE 2009: *Elders are concerned that uranium may escape and contaminate the grounds; especially the land along the Thelon River, or on the south side of Bake Lake.*

[14] IQ - RIE 2009: *Elders expressed concern about the potential effects of uranium dust travelling and affecting many people.*

[15] EN – RB NIRB April 2010: *Concerned with air pollutants travelling by way of dust particles. Dangers associated with the dust to human health and wildlife.*

[16] EN - CH OH Nov 2010: *Radioactive dusts will travel downwind to Rankin Inlet.*

Increased emissions of greenhouse gases (GHGS) are known to contribute to the greenhouse effect, therefore, any changes to GHG levels resulting from Project-related activities have the potential to lead to changes in the regional climate in the long term. Because of the possible linkage to climate change, managing Project GHG emissions were used as indicator for climate change. Regulatory considerations pertaining to air quality include regulatory standards and guidelines for maximum permissible air concentrations of COPCs under the Nunavut *Environmental Protection Act*, the *Canadian Environmental Protection Act* (CEPA 1999) as well as other provincial and territorial Acts and Regulations.

The air quality assessment is spatially bound by three assessment areas: the Project footprint, the local assessment area (LAA), and the regional assessment area (RAA). The Project footprint is the area of direct physical disturbance by the Project, including the access road options, and the Baker Lake dock and storage facility. The LAA is the maximum area within which Project effects can be predicted or measured with reasonable accuracy and confidence. The LAA is defined by an area that is approximately a 25 km by 25 km centered over the mining area and a 5 km by 5 km area centered over the Baker Lake dock and storage facility. The RAA is a broader area within which cumulative effects may potentially occur. The air quality RAA extends beyond the LAA to encompass a 117 km by 65 km area from Samarook Lake to just east of Whitehills Lake, and includes the mining areas, the Kiggavik-Sissons haul road, the Baker Lake-Kiggavik access road options, as well as the community of Baker Lake.

The temporal boundaries for the assessment were defined based on the timing and duration of potential effects from activities associated with the Project. The assessment covers the period of all major Project phases including construction, operation, final closure and post-closure. Since the level of activity from each of the Project phases differs, the extent of any related potential effects will also differ. The total life span of the Project is expected to be 25 years, with post-closure extending beyond the final closure phase. However, for the purpose of assessing air quality, the total duration of Project operations was considered to be 15 years. By assuming operational activities are condensed into a shorter time period, emissions will be greater than if they were calculated over a longer period of time.

With respect to assessing the potential effects to climate change from the Project, the operational year with the highest anticipated greenhouse gas emissions was selected.

A residual environmental effect caused by the Project is considered significant if it adversely affects the long-term viability of the VEC. The significance of a residual environmental effect was determined based on thresholds or standards identified for each VEC. For example, the significance of a residual effect to air quality was assessed using territorial or federal ambient air quality criteria. In the absence of known thresholds or standards, professional judgment was used to determine significance. A residual effect is considered to be not significant if the effect causes a change in the

VEC that is within the range of natural variability, or does not affect the integrity of the VEC in a measurable or meaningful way.

Existing Environment

Air quality monitoring programs were carried out at the proposed Project site during summer field seasons to measure air concentrations of particulate matter, metals and radionuclides. The average 24-hour total Suspended Particulate (TSP) concentration was about 7 $\mu g/m^3$, which is comparable to background levels reported in Environmental Impact Statements for other projects located in Nunavut. The findings also suggest that measured baseline concentrations of particulate, metals, and radionuclides are generally low compared to more developed or urbanised areas in Canada, particularly in the southern regions. Background concentrations were added to model predicted concentrations of COPCs when assessing the effects to ambient air qulity.

The baseline level of GHG emissions in Nunavut were considered to be 210 kt of CO_2-equivalent based on Environment Canada's 2012 National Inventory Report (Environment Canada, 2014), and includes an additional 203 kt of CO_2-equivalent representing emissions from the Meadowbank Gold Mine not captured by the 2012 inventory report. This mine is currently and may be in operation when the Project is commissioned and was therefore included as part of the baseline.

Air Quality Effects Assessment

Effects of Project-Related Activities on Air Concentrations of COPCs

During each Project phase (construction, operation, final closure and post-closure), activities will occur which have the potential to increase ambient air concentrations of COPCs within the local and regional environments, including dust (i.e., particulate matter), metals, gaseous compounds and radionuclides. A summary of Project activities which may result in effects to air quality is as follows:

Construction Activities:

- Land clearing, excavating (i.e., earth moving), vehicle travel, quarrying, material handling and fuel combustion.

Operation Activities:

- Drilling and blasting, ore and mine rock handling, stockpile and road maintenance, wind erosion of stockpiles, vehicle travel, fuel combustion and milling operations.

Final Closure Activities:

- Backfilling mine rock into the Tailings Management Facilities (TMFs), closure of TMFs and fuel combustion.

Post-Closure Activities:

- Passive radon emissions from permanent mine rock stockpiles and closed TMFs.

Mitigation and Project Design

Mitigation by Design and Mitigation by Management measures have been incorporated into the current Project plans to minimize Project-associated COPC emissions and/or the potential effect of emissions to air quality. Design-based mitigation includes several focused air dispersion modelling studies that were conducted to examine the potential effect(s) of alternate locations of various Project facilities such as the acid plant, power plant, storage piles and accommodation complex. These locations were utilized in the final dispersion modelling assessment.

Mitigation by Management will include measures such as employing standard operating procedures for equipment/machinery and ensuring that regular maintenance is performed in accordance with good engineering practices or as recommended by suppliers, such that the equipment is kept in good operating condition. As well, the Project proponent will adhere to conditions outlined in all permits, authorizations and/or approvals. Procedures will also be developed to address community complaints.

Other activity-specific mitigation measures by Management will include the use of appropriate exhaust emissions controls such as catalytic converters and diesel particulate filters to mitigate fuel combustion emissions from heavy equipment, vehicles and marine vessels. Emissions of sulphur dioxide will also be minimized by using fuels with low sulphur content. Additionally, the number of equipment/vehicle movements and travel distances will be optimized to minimize dust. Lowering vehicle speeds on unpaved roads (including pit ramps), applying water or other dust suppressants to unpaved roads as well as implementing good road maintenance practices will minimize the potential for road dust emissions.

Lastly, emissions from processing sources will be minimized through installing appropriate air pollution controls on exhaust stacks of the mill complex and acid plant (e.g., wet scrubbers, dust collectors). Tailings will be chemically treated and released to the TMFs sub-aqueously to minimize the release of dust and radon. Permanent mine rock stockpiles will be covered with a layer of compacted clean rock and overburden to encourage growth of vegetation and suppress the release of dust emissions over the long term.

Details of all planned mitigation are provided in Appendix 4C – Draft Air Quality Monitoring and Mitigation Plan.

Residual Project Effects to Air Quality

Air concentrations of COPCs were predicted for various scenarios using the CALPUFF/CALMET air dispersion modelling package to capture potential effects of the Project over its lifetime. Emission inventories and subsequent modelling was completed for construction (quarrying), operations, final closure and post-closure phases. Four operational phases were used to assess long-term effects (i.e., annual) and a maximum operations (i.e., worst-case bounding) scenario was used to assess short-term effects (i.e., 1- and 24-hour). Predicted concentrations and deposition of acidifying COPCs from the phased operation scenarios were also assessed through an exposure pathways analysis (see Volume 6 – Terrestrial Environment and Volume 8 – Human Health). The maximum operation scenario was also used to conservatively assess dust deposition (i.e., dustfall) even though dust deposition is considered to have long-term (i.e., monthly or annual) effects. The potential effect of the predicted deposition rates on aquatic resources is assessed in Volume 5 – Aquatic Environment. A summary of the model predicted results is provided below. For the purpose of the air quality assessment, a residual effect is defined as any predicted COPC concentration that is in excess of a chosen ambient air quality criterion, also known as the Indicator Threshold (or Threshold).

Construction (Quarrying)

- The overall maximum TSP concentration predicted from quarrying activities at a distance of 500 m from a quarry is 14.6 µg/m³. Measureable changes in concentration were found to be limited to a distance of less than 2 km from a quarry.

Operations

Dust (TSP, PM_{10} and $PM_{2.5}$)

- Model predicted maximum 24-hour concentrations for all three size fractions of dust (TSP, PM_{10}, $PM_{2.5}$) exceed their respective Indicator Thresholds extending into a limited area of the LAA at both the Kiggavik and Sissons mine sites. Exceedances can be attributed to emissions of dust from open pit mining activities, in particular unpaved road dust generated on the in-pit ramps.
    - o There are predicted to be no more than 30 days of exceedances per year beyond the Project Footprint for TSP and PM_{10} and 4 days for $PM_{2.5}$. Predicted effects occur within 3 to 4 km of the Project Footprint.
- During phased operations, the predicted annual average TSP concentrations are below the Indicator Threshold at receptor locations within the LAA and RAA.

- Total annual dust deposition rates are below their respective Indicator Thresholds at all receptor locations beyond the Project Footprint.
- Dust deposition rates in the vicinity of the Kiggavik-Sissons haul road are predicted to be around 15 g/m^2/year (150 kg/ha/year) which drops to 5 g/m^2/year within 200 m of the road. At about 12 km from the Project Footprint, total annual deposition begins to approach background levels.
  - The predicted pattern of dust deposition from Kiggavik is similar to the findings described in the EKATI Diamond Mine dispersion modelling assessment (Rescan 2006a), which predicted high deposition rates near unpaved roads that quickly dropped off with increasing distance. Measurable dust deposition (i.e., above baseline) was also predicted to occur within a zone of 14 km which is not unlike the Kiggavik assessment. A detailed comparison between the Kiggavik and EKATI mining assessments is provided in Technical Appendix 4B, Attachment E.

Uranium and Metals

- The maximum predicted 24-hour uranium concentrations are above the Indicator Threshold beyond the Project Footprint, into the LAA. However, the number of exceedances predicted is limited to a single day within approximately 1,100 m of the Kiggavik mine site and within 500 m of the Sissons mine site.
- The maximum predicted 24-hour concentrations of all other metals are below the Indicator Thresholds within the Project Footprint and at all LAA and RAA receptor locations.
- There are no exceedances of the annual average Indicator Thresholds for either uranium or any of the other metals within the LAA and RAA.

Gaseous COPCs

- The maximum predicted 1-hour and 24-hour concentrations of SO2 are well within the limits of the Indicator Thresholds at all receptor locations in the LAA and RAA.
- The maximum predicted 1- and 24-hour NO2 concentrations exceed their Indicator Thresholds both within the Project Footprint, extending into the LAA. Exceedances can be attributed to large emissions of NOx from open pit mining activities including diesel-powered mining equipment and blasting.
  - There are no more than 11 days of exceedances of the 24-hour NO_2 Threshold (or 3%) and no more than 140 hours (1.6%) when the 1-hour NO_2 Threshold was exceeded. In addition, exceedances of the 24-hour threshold are limited to the area within 500 m from Sissons mine site and 900 m from the Kiggavik mine site. Similarly, exceedances of the 1-hour threshold extend no more than 1.4 kmfrom Kiggavik mine site and 1.5 km from the Sissons mine site.

- The highest predicted annual NO_2 and SO_2 concentrations are below their applicable Indicator Thresholds for all off-site locations in the LAA, RAA as well as at the Accommodation Complex.
- PAI values did not exceed either the 0.5 keq/ha/yr or 1.0 keq/ha/year levels in the LAA or RAA. However there were exceedances of the Indicator Threshold at the Kiggavik site; these are limited to within approximately 1 km of the Project Footprint.

Radionuclides

- The highest predicted annual radionuclide concentrations are well below their respective Indicator Thresholds at all off-site receptor locations in the LAA, RAA and at the Accommodation Complex.

Baker Lake – Kiggavik Access Road Options

- The overall maximum predicted concentrations of TSP, PM_{10}, $PM_{2.5}$, NO_2 and SO_2 along the Winter Road option and the All-Season Road opion are predicted to be well below their applicable Indicator Thresholds.
- Predicted concentrations of TSP, PM_{10} and $PM_{2.5}$ are higher for the All-Season Road compared to the Winter Road since it will be constructed completely out of granular fill. In contrast, concentrations of NO_2 and SO_2 were predicted to be higher along the Winter Road as a result of higher traffic counts compared to the All-Season Road.

Baker Lake Dock and Storage Facility

- Incremental concentrations for all contaminants but NO_2 were predicted to be well below all applicable Indicator Thresholds.
- Maximum predicted 1- and 24-hour concentrations of NO_2 exceeded applicable Thresholds, extending to a distance of about 1 km southwest of the dock.

Final Closure

- During the Final Closure phase, all COPCs were predicted to be well below applicable Indicator Thresholds.

Post-Closure

- Predicted incremental radon concentrations are well below the annual Indicator Threshold of 60 Bq/m^3 within the LAA and RAA.

Overall, all predicted residual effects resulting from the Project are predicted not to be significant since the effects are expected not to extend more than 4 km beyond the Project Footprint and only occur a few times per year.

Residual Cumulative Effects

A list of Future projects that may overlap with the proposed Project was screened for potential cumulative effects with the identified residual Project effects. None of the Future projects on the list are located within close enough proximity to interact spatially with the effects from the Kiggavik Project site (i.e., no overlap in the zone of influence for emissions from the Kiggavik mine site with the zone of influence for emissions from other projects or activities). The only cumulative effect that was assessed includes the potential increase in ambient NO_2 concentrations resulting from dock and storage facility operations serving the Project and the Meadowbank Gold Mine; both projects will produce NO_2 emissions and the zone of influence for each overlap spatially and temporally.

The preferred dock option and storage area for the Project will be located approximately 1 km southeast of the Meadowbank Gold Project's dock and storage facilities. The facilities will both receive fuel and other supplies via barge or tug-barge during the ice-free shipping season from mid-July to early October. As a result, barge (or tug-barge) traffic will likely be present in each dock area at the same time, releasing NO_x emissions simultaneously from the idling engines. In addition, other sources of NO_x, including heavy-duty equipment such as cranes, may also operate simultaneously.

Identical operations and emissions were assumed to be occurring simultaneously at both the Project dock and the Meadowbank dock location and were simulated using the CALPUFF dispersion model. The maximum predicted incremental 1- and 24-hour NO_2 concentrations at the receptor site representing the Community of Baker Lake were below applicable Indicator Thresholds, but exceed them in the area immediately surrounding both facilities. However, exceedances were limited to within 2 km from the Project Footprint, and occurred infrequently. As a result, with proposed mitigation and environmental protection measures (e.g., emission controls, equipment optimization, trip optimization; see next section), the cumulative residual effect of increased ambient NO_2 concentrations from the Project and the Meadowbank dock operations is not significant.

Mitigation Measures

AREVA will employ a suite of mitigation measures to reduce potential cumulative environmental effects to ambient $NO_{2.}$ These measures include use of appropriate exhaust emissions controls, optimization of the number of heavy equipment movements, and overall minimization of travel distances, the number of barge shipments and offloading activities, and the extent and duration of barge or tug-barge engine idling at each dock (i.e., limit idling to a single tug-barge at each dock, if possible.

Air Quality Monitoring and Follow-Up

A Draft air quality monitoring program is presented in Appendix 4C for all phases of the project for verification and compliance purposes, and includes monitoring of TSP (and metals in TSP), PM_{10}, $PM_{2.5}$, NO_2, SO_2, dustfall (and metals in dustfall) and radionuclides. In addition, short-term local monitoring is proposed at Baker Lake for NO_2 during one shipping season to confirm the model predictions. A complaints/community concerns response procedure will also be implemented.

Climate Change Effects Assessment

Effects of Project-Related Activities on Emissions of Greenhouse Gases

During the construction, operation and final closure phases of the Project, activities will occur which will generate greenhouse gas emissions (GHGs) and therefore have the potential to contribute to climate change. Activities that could result in increased concentrations of GHGs include fuel combustion sources such as heavy-duty equipment operation at the mine site and at the Baker Lake dock and storage facility and well as vehicle travel, power generation, and marine vessels.

Mitigation and Project Design

Mitigation by Design and mitigation by Management measures have been incorporated into the current Project plans which will minimize Project-associated GHG emissions. These include incorporating energy efficient and emissions minimization features into the building design as well as in the operation of any equipment and ancillary facilities. In general, the use of standard operating procedures for equipment and machinery and ensuring that regular maintenance is performed to help keep equipment in good operating condition will also minimize GHG emissions. In addition, the number of equipment/vehicle movements and travel distances will also be optimized to reduce fuel consumption, and consequently GHG emissions.

Residual Project Effects to Climate Change

Because of the possible linkage between increased emissions of GHGs and Global Warming, there is a potential for the Project to contribute to changes in climate in the long term, although, the nature and magnitude of these changes is highly speculative. In particular, the Canadian Environmental Assessment Agency's guide to Incorporating Climate Change Considerations in Environmental Assessment (CEA Agency 2003) notes that climate change is a complex, global phenomenon and unlike most project-related environmental effects, the contribution of an individual project to climate change cannot be measured. As a result, the potential effects of the Project to climate change were assessed quantitatively through comparison of Project-related emissions of GHGs to total federal and territorial GHG emission levels. The estimated maximum annual GHG emissions based on the peak level of fuel consumption is 181 kilotonnes of CO_2-equivalent. This represents a 44% increase in the baseline GHG emissions for Nunavut,a 0.03% increase in the baseline GHG emissions for Canadaand a 0.0006 % increase in global GHG emissions. However, it is expected that other proposed projects will become operational after Kiggavik Project operations commence, therefore, the contribution to Nunavut GHG emissions will likely be a smaller fraction relative to the total emissions than predicted here.

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ᖃᓄᐃᓂᕆᔭᖓ ᐊᒻᒪ ᓯᓚᐅᑉ ᐊᓯᐊᙵᕐᓂᖓ

ᒪᓕᒃᑕᐅᔭᕆᐊᓕᒃᑎᒍᑦ ᓴᖅᑭᑕᐅᔪᑦ ᓄᓇᕗᒻᒥ ᐊᒃᑐᖅᓯᓂᕐᒧᑦ ᕿᒥᕐᕈᔨᓄᑦ (NIRB 2011), ᐊᕉᕙᒃᑯᑦ ᐋᕿᒃᓱᐃᓚᐅᖅᑐᑦ ᐊᕙᑎᒥᒃ ᐊᒃᑐᖅᓯᓂᕐᒧᑦ ᑎᑎᖅᑲᒥᑦ (EIS), ᐃᓚᐅᐸᓪᓗᓂ ᖃᐅᔨᓴᐃᓂᖅ ᐊᒃᑐᖅᓯᓂᐅᔪᓐᓇᖅᑐᖅ ᓯᓚᐅᑉ ᐊᕙᑎᖓᓂᒃ ᐃᓚᐅᐸᓪᓗᓂ ᖃᓄᐃᙵᓕᕐᓂᐅᔪᑦ ᐊᓂᖅᓵᖅᑐᖅᑕᐸᑕ ᖃᓄᐃᓂᕆᔭᖓ ᐊᒻᒪ ᓯᓚᐅᑉ ᐊᓯᐊᙵᕐᓂᖓ ᐊᒃᑐᐊᓂᕐᑲᖅᑐᑦ ᑭᖑᕚᒃ ᐱᓕᕆᐊᒧᑦ (ᐱᓕᕆᐊᖅ).

ᐱᓕᕆᐊᒧᑦ ᐃᓚᒋᔭᐅᖃᑕᐅᓗᐊᖅᑐᑦ ᐱᓕᕆᐊᙳᔪᑦ ᐊᓂᖅᓵᖅᑐᖅᑕᐸᑕ ᖃᓄᐃᓂᓐᓂᕆᔭᙱᓄᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᐃᓚᐅᔪᑦ ᑕᒪᐃᓂᒃ ᓄᓇᒦᑐᑦ ᓴᓇᔭᐅᔪᕐ, ᐊᐅᓛᕐᓂᖅ, ᑭᙳᓪᓕᖅᐸ̇ᒃᑯᑦ ᐅᒃᑯᐊᕐᓂᖅ ᐊᒻᒪ ᐅᒃᑯᐊᖅᓯᒪᓕᖅᑎᓪᓗᒍᒥᑦ ᐊᑐᖅᑕᐅᔪᑦ ᐊᒻᒪ ᖃᓄᐃᓕᐅᕐᓂᕐᔪᑦ. ᒪᕿᒃ ᐊᕙᑯᑏᓐᓄᑦ ᖃᓄᐃᓕᐅᕆᓂᕐᒧᑦ ᐃᓱᒪᒋᔭᐅᓚᐅᖅᑐᖅ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ; ᐅᑭᐅᑯᑦ ᐊᕙᑯᑎ ᐊᒻᒪ ᐅᑭᐅᓗᒃᑖᕐᒥᑦ ᐊᕙᑯᑎ ᐊᑐᖅᑕᐅᔪᓐᓇᖅᑐᖅ. ᒪᕿᓐᓄᑦ ᐃᓱᒪᒋᔭᐅᔪᑦ ᖃᒪᓂᑦᑐᐊᕐᒥᑦ ᐃᒃᓴᕙᖕᒧᑦ ᑐᖅᑯᖅᓯᓯᒪᕚᖕᒧᓪᓗ ᐃᓚᐅᖅᑕᐅᓚᐅᕐᒥᔪᑦ ᖃᐅᔨᓴᐃᓂᐅᔪᒥᕐ. ᑕᐅᑦᓱᒪ ᖃᐅᔨᓴᐃᓂᖅ.

NIRB-ᑯᑦ ᓴᖅᑭᑎᓚᐅᖅᑐᑦ ᓇᓃᓐᓂᕆᔭᖓᓂᒃ ᐊᓂᖅᓵᖅᑐᖅᑕᐸᑕ ᖃᓄᐃᓂᕆᔭᖓᓄᑦ ᓯᓚᐅᑉ ᐊᓯᐊᙵᕐᓂᖓᓄᑦ ᖃᐅᔨᓴᐃᓂᖅ ᐱᓕᕆᐊᒧᑦ ᐊᑐᖅᓱᕆᑦ ᐅᖃᐅᓯᐅᔪᑦ ᐃᓄᖕᓄᑦ, ᒐᕙᒪᒃᑯᓐᓄᑦ ᐊᒻᒪ ᐊᓯᙱᓐᓄᑦ ᐱᖃᖅᑕᐅᔪᓄᑦ. ᐃᓄᐃᑦ ᐱᖃᖅᑕᐅᔪᑦ ᐅᔾᔨᕈᓯᓕᕐᓂᖃᑎᐊᓚᐅᖅᑐᑦ ᐱᓕᕆᐊᒧᑦ ᐊᒃᑑᑎᖃᑦᑕᕐᓂᐅᔪᓐᓇᖅᑐᓂᒃ ᓯᓚᐅᑉ ᐊᕙᑎᖓᓂᑦ.

ᐃᓄᐃᑦ ᖃᐅᔨᒪᔾᔪᖃᖕᒋᑎᒍᑦ (IQ) ᐊᐱᖅᓱᐃᓂᖅ ᐃᓚᐅᖃᑕᐅᓂᒃᑯᓪᓗ, ᐊᕉᕙᒃᑯᑦ ᐃᓕᑎᓚᐅᖅᑐᑦ ᐱᒻᒪᕆᔭᐅᓂᖒᓐᓄᑦ ᓯᓚᐅᑉ ᐊᕙᑎᖓᓂᑦ ᑭᕙᓪᓕᕐᒥᐅᓄᑦ. ᐃᓚᐅᔪᑦ ᐃᓱᒫᓘᑕᐅᔪᑦ ᐊᐱᖅᑯᑕᐅᔪᓪᓗ ᐳᔪᕐᓗᐃᑦ ᐊᓂᐊᔪᑦ ᒥᒃᓵᓄᑦ ᐳᔪᖅᑖᓄᓪᓗ ᐅᓗᕆᐊᓇᖅᑐᓪᓗ ᐳᔪᖅᑖᓂᑦ (EN–AR OH ᓄᕙᐱᕆ 2010[17], EN–BL OH ᓄᕙᐱᕆ 2010[18], EN-CH OH ᓄᕙᐱᕆ 2010[19], EN-CI OH ᓄᕙᐱᕆ 2010[20], EN–RB NIRB ᐄᐳᕆ 2010[21], EN–BL OH ᐅᒃᑑᐱᕆ 2012[22], EN-BL OH ᓄᕙᐱᕆ 2013[23], EN-CI OH ᓄᕙᐱᕆ 2013[24]), ᐊᒻᒪ ᐱᕈᖅᓯᐊᑦ

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[17] EN-AR OH ᓄᕙᐱᕆ 2010: ᖃᓄᖅ ᐅᖓᓯᒃᑎᕆᔪᒧᑦ ᐳᔪᖅᑖᖅ ᐃᖏᕐᕋᓂᐊᖅᐸ? ᓄᖑᓱᐃᑐᖅ ᐳᔪᖅᑖᖅᑖᖅᑎᑦᑎᓂᐊᖅᐸ ᐅᔭᕋᖕᓂᐊᕐᓂᖅᑕᖅᑲᖅᑎᓪᓗᒍ?

[18] EN-BL OH ᓄᕙᐱᕆ 2010: ᐃᓱᒫᓗᑎᖅᑲᖅᑐᖅ ᐳᔪᖅᑖᒥᑦ ᐊᓄᕆᑐᑎᓪᓗᒍ.

[19] EN-CH OH ᓄᕙᐱᕆ 2010: Radioactive ᐳᔪᖅᑖᑦ ᐃᖏᕐᕋᓂᐊᖅᑐᑦ ᑲᖏᖅᖠᓂᐅᐸ ᒥᒃᓯᖓᓄᑦ.

[20] EN-CI OH ᓄᕙᐱᕆ 2010: ᓱᓂᐊᖅᐸ ᐳᔪᖅᑖᖅ ᐅᔭᕋᖕᓂᐊᕐᓂᕐᒥᑦ ᐱᔪᖅ?

[21] EN – RB NIRB ᐄᐳᕆ 2010: ᐃᓱᒪᕆᔭᐅᔭᕆᐊᖃᖅᑐᖅ ᓄᖑᓱᐃᑐᒥᒃ ᐅᔭᕋᖕᓂᐊᖅᑐᓕᕆᓂᖅ ᐊᔾᔨᒌᙱᒻᒪᒍ ᐊᓯᙱᓐᓄᑦ ᐅᔭᕋᖕᓂᐊᖅᑐᓕᕆᓂᐅᔪᑦ. ᓴᓇᔭᐅᔪᑦ ᐊᔾᔨᒌᙱᑦᑎᙱᑦ. ᐃᓱᒪᕆᔭᐅᔭᕆᐊᖃᖅᑐᖅ ᐅᓗᕆᐊᓇᖅᑐᑦ ᐃᖏᕐᕋᔪᓐᓇᖅᑐᑦ ᓯᓚᒃᑯᑦ ᓄᓇᒧᑦ.

[22] EN – BL OH ᐅᒃᑑᐱᕆ 2012: ᓄᖑᓱᐃᑐᖅ ᓯᓚᒧᐊᖃᑦᑕᖅᑐᖅ ᐊᓂᖅᓵᖅᑐᖅᑕᐸᑎᖕᓄᑦ, ᐊᒻᒪ ᐅᓗᕆᐊᓇᖅᓱᓂ ᓄᓇᓕᖕᒧᑦ.

[23] EN - BL OH ᓄᕙᐱᕆ 2013: ᖃᓄᖅ ᐊᑯᓂᐅᑎᕆᔪᖅ ᓄᖑᓱᐃᑐᖅ ᓯᓚᒦᓐᓂᐊᖅᐸ?

[24] EN – CI OH ᓄᕙᐱᕆ 2013: ᐳᔪᖅᑖᓪᓚ? ᐊᓄᕆᑐᔫᑉᐸᑦ ᐳᔪᖅᑖᖕᒥᑦ ᐱᓯᒪᔪᓐᓇᖅᑐᖅ. ᐳᔪᖅᑖᖅ ᐃᓱᒫᓘᑕᐅᓂᐊᖅᑐᖅ ᐊᓄᕆᑕᖃᐃᓐᓇᖅᑲᑦᑕᕐᒪᑦ ᐳᔪᖅᑖᖕᒥᑦ ᓇᒃᓴᕐᓗᓂᓗ.

ᓂᕐᔪᑏᑦᑐ ((EN-RB KIA ᐋᐳᓇ 2007[25], IQ–ARHT 2009[26], EN–BL EL ᐅᒃᑑᐱᓇ 2012[27]). ᐊᒪᓗ ᐃᓚᐅᔪᑦ ᐱᒻᒪᓇᐅᓂᖅ ᒥᐊᓂᖅᓯᓂᕐᒧᑦ ᐃᓄᐃᑦ ᐋᓐᓂᐊᕐᖃᖅᑕᐃᓕᒪᓂᖏᓐᓂᒃ ᐊᒃᑐᖅᓯᓂᐅᔪᓂᒃ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑎᖕᓄᐊᖅᑐᓂᒃ (EN–RI KWB ᐅᒃᑑᐱᓇ 2009[28], IQ–BLE 2009[29], IQ-RIE 2009[30], EN–RB NIRB ᐋᐳᓇ 2010[31], EN-CH OH ᓄᕕᐱᓇ 2010[32]). ᐱᒻᒪᓇᐅᓂᖏᑦ ᓄᓇᒥᐅᑕᐃᑦ ᐊᒪᓗ ᑕᐅᑐᑲᐅᔪᖅ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᑕᑯᒃᓴᐅᑎᑦᑎᒃᑲᓐᓂᖅᑐᖅ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᖅᑐᖅᑲᖏᑦᑕ ᒪᓕᒃᑕᐅᔫᒃᓴᖏᓐᓄᑦ ᒪᓕᒐᖕᒐᓂᒃ 'ᐊᕙᑎᒥᒃ ᑲᒪᑦᑎᐊᕐᓂᖅ' (ᑕᐅᑐᒃᑕᐅᓂᖓᓄᑦ ᐊᕙᑎᒥᒃ ᒥᐊᓂᖅᓯᓂᖅ).

ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓ ᐊᒪᓗ ᓯᓚᐅᑉ ᐊᓯᐊᖑᕐᓂᖓ ᓂᕈᐊᖅᑕᐅᓚᐅᖅᑐᑦ ᐱᒻᒪᓇᐅᑉᑐᑎᒃ ᐃᓚᒋᔭᐅᓂᖏᓐᓄᑦ (VECs) ᓯᓚᒧᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᐊᒃᑐᖅᓯᓂᕐᑲᑐᐃᓐᓇᓇᐊᕐᑲᕐᓂᖏᓐᓄᑦ ᐱᓕᓇᐊᒥᒃ ᖃᓄᐃᓕᐅᕐᓂᐅᔪᓄᑦ ᐊᒪᓗ ᐱᖅᑯᓯᒃᑯᑦ ᐆᒻᒪᓂᒃᑯᑦᑐ ᐱᒻᒪᓇᐅᕆᔭᐅᖕᒪᑕ ᑭᕙᓪᓕᕐᒥᑦ.

ᓇᓗᓇᐃᖅᓯ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓᓄᑦ ᐃᓚᐅᔪᑦ ᐆᒃᑐᕋᖅᑕᐅᔪᓐᓇᖅᑐᑦ ᑲᑎᓯᒪᔪᑦ ᐃᓗᓕᖏᑦ ᐱᓗᐊᖅᑐᑦ (COPCs). COPC-ᓂᒃ ᐃᓚᐅᔪᑦ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓᓄᑦ ᖃᐅᔨᓴᐃᓂᕐᒥᑦ ᐅᑯᐊᖑᔪᑦ:

- ᑲᑎᖢᒋᑦ ᑕᒫᓂᖅᓯᔪᑦ ᒥᑭᑦᑑᔪᑦ (TSP)
- ᒥᑭᑦᑑᔪᑦ ᒥᑭᓂᖅᓴᐅᔪᑦ 10 microns (μm) ᐊᖕᒪᓗᖅᑐᒥᑦ (PM10)
- ᒥᑭᑦᑑᔪᑦ ᒥᑭᓂᖅᓴᐅᔪᑦ 2.5 microns (μm) ᐊᖕᒪᓗᖅᑐᒥᑦ (PM2.5)
- ᐅᓗᓇᐊᓇᖅᑐᓄᑦ ᐊᒪᓗ ᐅᓗᓇᐊᓇᖅᑐᖅᑲᖏᑦᑐᑦ ᐃᓗᓕᖏᑦ TSP-ᒥᑦ ᐃᓚᐅᔪᑦ:
  - Uranium-238 (U)
  - Arsenic (As)
  - Cadmium (Cd)
  - Chromium (Cr)
  - Cobalt (Co)
  - Copper (Cu)
  - Molybdenum (Mo)
  - Lead (Pb)

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25 EN - RB KIA ᐋᐳᓇ 2007. ᐱᐅᖏᑦᑐᓂᒃ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑎᖕᓅᑐᖅᑲᕐᓂᖕᒐᓂᒃ ᐅᒃᐱᕈᓯᒃᑐᖓ ᐳᔪᖅᑖᒥᑦ. ᖃᐅᔨᒪᔪᖓ ᓇᐹᖅᑐᖅᑕᓕᐅᑉ ᐱᕆᐊᕐᓂᖓᓂᑦ, ᐊᕐᔭᐃᑦ ᐊᒪᓗ ᐳᔪᖅᑖᑦ ᑕᐅᕙᙵᑦ ᓄᓇᕗᒻᒧᐊᖅᑲᑦᑕᖅᑐᑦ ᓇᒧᒃᑖᕐᓗ. ᑭᓪᓕᓕᐅᖅᓯᒪᔪᖅᑲᖅᐸ ᕿᒪᒃᑎᑦᑐᑦ ᓇᒧᐃᓐᓈᕐᑯᙱᒧᑦ ᓂᕐᔪᑎᓄᑦ? ᐃᑖᓂ ᑐᕐᑯᖓᔪᑦ ᑐᒃᑐᐃᑦ ᓂᕆᔭᐅᖅᑲᑦᑕᕐᒪᑕ ᐊᓯᖏᓐᓄᑦ ᓂᕐᔪᑎᓄᑦ, ᐱᐅᖏᑦᑐᑦ ᑕᐃᒪᓐᓇ ᐊᓯᖏᓐᓄᐊᖅᑲᑦᑕᖅᑐᑦ ᓂᕆᔭᐅᔪᑎᒍᑦ.

26 ARHT 2009: ᒪᖃᐃᓃᑦ ᐃᓐᓇᓇᔭᐅᔪᑦᑐ ᐃᓱᒫᓘᑎᖏᓐᓂᒃ ᐅᖃᓚᐅᖅᑐᑦ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑎᖕᓄᐊᖅᑐᖅᑲᕈᖕᓇᕐᓂᖕᒐᓄᑦ ᐳᔪᕐᓗᖕᓂᒃ ᐱᕈᖅᑐᓄᐊᕐᓗᑎᓪᓗ ᓂᕆᔭᐅᓗᑎᒃ ᑐᒃᑐᓄᑦ.

27 EN – BL EL ᐅᒃᑑᐱᓇ 2012: ᓇᓗᙱᑦᑐᖓ ᐳᔪᖅᑖᑦ ᓇᒧᐃᓐᓇᖅ ᓯᐊᒪᖕᓂᐊᖅᑐᑦ. ᐳᔪᖅᑖᓕᒻᒪᓇᐅᓂᐊᖅᑐᖅ ᐊᒪᓗ ᓂᕐᔪᑏᑦ ᓲᕐᓗ ᐅᑲᓕᐊᕐᔪᐃᑦ ᐊᒪᖅᑯᐃᑦᑐ ᐊᒃᑐᖅᑕᐅᓂᖅᑲᕐᓂᐊᖅᑐᑦ.

28 EN – RI KWB ᐅᒃᑑᐱᓇ 2009: ᖃᓄᖅ ᐅᓗᓇᐊᓇᖅᑐᖅᑲᖅᑐᖅ ᐳᔪᖅᑖᖅ ᐊᐅᓚᑕᐅᖅᑲᑦᑕᖅᐸ? ᖃᓄᖅ ᐳᔪᖅᑖᖅ ᐊᒃᑐᖅᓯᖅᑲᑦᑕᖅᐸ ᓯᓚᒥᑦ?

29 IQ – BLE 2009: ᐃᓐᓇᓇᔭᐅᔪᑦ ᐃᓱᒫᓘᑎᖃᖅᑐᑦ ᓄᖑᓯᐃᑐᖅ ᓯᐊᒪᑐᐃᓐᓇᓇᐊᕐᑲᕐᓂᖕᒐᓄᑦ ᐊᒪᓗ ᓱᕈᐃᓗᓂ ᒪᓂᕋᕐᒥᑦ; ᓄᓇᒥᓗᐊᖅ Thelon ᑰᑉ ᖃᓂᑕᖕᒐᓂᑦ, ᐅᕙᓘᓃᑦ ᖃᒪᓂᑦᑐᐊᑉ ᓂᕆᖅᐸᓯᐊᓂᑦ.

30 IQ - RIE 2009: ᐃᓐᓇᓇᔭᐅᔪᑦ ᐅᖃᖅᑐᑦ ᐃᓱᒫᓘᑎᖃᕐᓂᖏᓐᓄᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᐅᔪᖕᓇᖅᑐᒥᒃ ᓄᖑᓯᐃᑐᖅ ᐳᔪᖅᑖᒧᐊᕐᓗᓂ ᐃᖏᕐᕋᖅᐸᑦ ᐊᒃᑐᖅᓯᓂᖅᑲᕐᓗᓂᓗ ᐊᒥᓯᓂᒃ ᐃᓄᖕᓂᑦ.

31 EN – RB NIRB ᐋᐳᓇ 2010: ᐃᓱᒫᓘᑏᑦ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑎᖕᓄᐊᖅᑐᑦ ᐳᔪᖅᑖᑎᒍᑦ ᐅᓗᓇᐊᓇᖅᑐᑦ. ᐅᓗᓇᐊᓇᖅᑐᑦ ᐳᔪᖅᑖᒥᑦ ᐱᔪᑦ ᐃᓄᐃᑦ ᓂᕐᔪᑏᑦᑐ ᐋᓐᓂᐊᕐᖃᖅᑕᐃᓕᒪᓂᖏᓐᓄᑦ.

32 EN - CH OH ᓄᕕᐱᓇ 2010: Radioactive ᐳᔪᖅᑖᑦ ᐃᖏᕐᕋᓂᐊᖅᑐᑦ ᑕᐅᓄᖓ ᐊᓄᓇᑎᒍᑦ ᑲᖏᖅᖢᓂᕐᒧᑦ.

- Nickel (Ni)
- Selenium (Se)
- Zinc (Zn)
- Nitrogen Oxides (specifically, NO2)
- Sulphur Dioxide (SO2)
- Radionuclides, including:
- Radon (Rn-222)
- Lead-210 (Pb-210)
- Polonium-210 (Po-210)

ᐊᖏᒡᓕᓯᒪᔪᑦ ᐳᔪᕐᓗᐃᑦ ᐊᓂᐊᔪᑦ GHGS-ᓂᑦ ᖃᐅᔨᒪᔭᐅᔪᑦ ᐃᑲᔪᐃᖃᑦᑕᕐᓂᖏᓐᓂᒃ ᓯᓚᒥᒃ ᐊᒃᑐᖅᓯᓂᐅᔪᒥᒃ, ᑕᐃᒪᓐᓇᒧᑦ, ᐊᓯᐊᙳᕐᓂᐅᔪᑦ GHG-ᓄᑦ ᓇᓃᓐᓂᕆᔭᖏᓐᓄᑦ ᐱᓕᕆᒥᐅᖓᔪᓂᒃ ᐊᓯᐊᙳᖅᓯᑎᑦᑎᑐᐃᓐᓇᕆᐊᖃᖅᑐᑦ ᑕᒫᓂ ᓯᓚᒧᑦ ᐊᑯᓂᐅᔪᒥᑦ. ᐊᒃᑐᐊᓂᖃᑐᐃᓇᕆᐊᖃᕐᓂᖓ ᓯᓚᐅᑉ ᐊᓯᐊᙳᕐᓂᖓ, ᐊᐅᓚᓐᓂᖅ ᐱᓕᕆᐊᒥᑦ GHG ᐳᔪᕐᓗᐃᑦ ᐊᓂᐊᔪᓄᑦ ᐊᑐᖅᑕᐅᓚᐅᖅᑐᖅ ᓇᓗᓇᐃᑯᑕᐅᑉᓗᓂ ᓯᓚᐅᑉ ᐊᓯᐊᙳᕐᓂᖓᓂᒃ. ᒪᓕᒐᐃᑦ ᐃᓱᒪᒋᔭᐅᓚᐅᖅᑐᑦ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓐᓂᕆᔭᖓᓄᑦ ᐃᓚᐅᔪᑦ ᒪᓕᒐᐅᔪᑦ ᐊᑐᖅᑕᐅᔪᑦ ᐊᒻᒪ ᒪᓕᒃᑕᐅᔪᒃᓴᐃᑦ ᐊᖏᓛᒃᑰᖓᔪᑦ ᐱᔪᖕᓇᖅᑎᑕᐅᔪᑦ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑎᖕᓂᑦ ᑲᑎᓯᒪᔪᑦ COPC-ᓂᑦ ᒪᓕᒃᓱᒋᑦ *ᓄᓇᕗᑦ ᐊᕙᑎᒥᒃ ᒥᐊᓂᖅᓯᓂᕐᒧᑦ ᐱᖁᔭᖏᑦ*; *ᑲᓇᑕᒥᑦ ᐊᕙᑎᒥᒃ ᒥᐊᓂᖅᓯᓂᕐᒧᑦ ᐱᖁᔭᖏᑦ* (CEPA 1999) ᐊᒻᒪ ᐊᓯᖏᑦ ᐊᕕᒃᑐᖅᓯᒪᔪᓂᑦ ᐅᑭᐅᖅᑕᖅᑐᒥᓪᓗ ᐱᖁᔭᐃᑦ ᒪᓕᒐᐃᓗ.

ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓ ᖃᐅᔨᓴᐃᓂᖅ ᑭᓪᓕᓕᐅᖅᓯᒪᔪᖅ ᐱᖓᓲᔪᓂᑦ ᖃᐅᔨᓴᐃᓂᖅᕐᕕᐅᔪᓄᑦ: ᐱᓕᕆᐊᑉ ᐃᓂᖓᓂᑦ, ᖃᓂᑦᑐᒥᒃ ᖃᐅᔨᓴᐃᓂᖅ (LAA), ᐊᒻᒪ ᐅᖓᓯᖕᓂᖅᓯᒪᒥᒃ ᖃᐅᔨᓴᐃᓂᖅ (RAA). ᐱᓕᕆᐊᑉ ᐃᓂᖓ ᐱᓕᕆᐊᑉ ᐱᓕᕆᕝᕕᒋᔭᖓᐅᔪᖅ, ᐃᓚᐅᑉᓗᓂ ᐊᑉᖁᑏᑦ, ᐊᒻᒪ ᖃᒪᓂᑦᑐᐊᕐᒥᑦ ᐃᒃᓴᕐᕕᖕᒧᑦ ᑐᖅᑯᓯᓯᒪᕝᕕᖕᒧᓪᓗ. LAA ᐊᖏᓛᒃᑰᖓᔪᖅ ᐱᓕᕆᐊᒥᑦ ᐊᒃᑐᖅᑕᐅᓂᖃᕐᓂᕐᓄᑦ ᓇᓚᐅᑖᖅᑕᐅᔭᖕᓇᖅᑐᑦ ᐆᒃᑯᖅᑕᐅᓗᓂᓘᓃᑦ ᓈᒻᒪᓈᕈᕐᓗᑎᒃ ᓇᓗᙱᑦᑎᐊᕐᓗᑎᒃᓘᓃᑦ. LAA ᓇᓗᓇᐃᖅᑕᐅᓯᒪᔪᖅ ᐃᓂᐃᔪᒥᑦ 25 ᑭᓛᒥᑕᒥᑦ 25 ᑭᓛᒥᑕᒧᑦ ᕿᑎᖓᓃᓗᓂ ᐅᔭᕋᖕᓂᐊᕐᕕᐅᑉ ᐃᓂᖓᓂᑦ ᐊᒻᒪ 5 ᑭᓛᒥᑕᒥᑦ 5 ᑭᓛᒥᑕᒧᑦ ᕿᑎᖓᓃᓗᓂ ᖃᒪᓂᑦᑐᐊᕐᒥᑦ ᐃᒃᓴᕐᕕᒃ ᐊᒻᒪ ᑐᖅᑯᓯᓯᒪᕝᕕᖕᒥᑦ. RAA ᐃᓂᖓ ᐊᖏᓂᖅᓴᐅᔪᖅ ᑲᑎᑉᐸᓪᓕᐊᔪᓂᒃ ᖃᓄᐃᖓᓂᖅᑕᖅᑐᐃᓐᓇᕆᐊᖃᖅᑐᒥᑦ. ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓ RAA-ᒥᑦ ᑎᑭᐅᑎᔪᖅ LAA ᐅᖓᑖᓄᑦ ᐊᕙᓗᓯᐸᓗ 117 ᑭᓛᒥᑕᒥᑦ 65 ᑭᓛᒥᑕᒧᑦ Samarook ᑕᓯᕐᒥᑦ ᑲᓇᖕᓇᖓᓄᑦ Whitehills ᑕᓯᕐᒧᑦ, ᐊᒻᒪ ᐃᓚᐅᑉᓗᓂ ᐅᔭᕋᖕᓂᐊᕐᕕᐅᑉ ᐃᓂᖓ, ᑭᒡᒐᕕᒃ-Sissons ᐅᓯᑲᑦᑕᖕᓂᕐᒧᑦ ᐊᑉᖁᑎ, ᖃᒪᓂᑦᑐᐊᖅ-ᑭᒡᒐᕕᒃ ᐊᑉᖁᑎ, ᐊᒻᒪ ᓄᓇᓕᒃ ᖃᒪᓂᑦᑐᐊᖅ.

ᑭᓪᓕᐅᔪᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᓇᓗᓇᐃᖅᑕᐅᓚᐅᖅᑐᑦ ᐊᑐᖅᓱᑎᒃ ᖃᖓᒃᑯᑦ ᐊᒻᒪ ᖃᓄᑎᒋᐅᓂᕐᒧᑦ ᐊᒃᑐᖅᓯᓂᐅᔪᖕᓇᖅᑐᓄᑦ ᖃᓄᐃᓕᐅᕐᓂᖓᓄᑦ ᐱᓕᕆᐊᒥᑦ. ᖃᐅᔨᓴᐃᓂᐅᔪᖅ ᐱᓕᕆᐊᑉ ᓇᐅᑰᕐᓂᓗᒃᑖᖓᓘᔪᖅ ᐃᓚᐅᑉᓗᓂ ᓴᓇᕙᓪᓕᐊᓂᖅ, ᐊᐅᓛᕐᓂᖅ, ᑭᖑᓪᓕᖅᐹᒃᑯᑦ ᐅᒃᑯᐊᖅᑎᓪᓗᒍ ᐊᒻᒪ ᐅᒃᑯᐊᖅᓯᒪᓕᖅᑎᓪᓗᒍ. ᓇᓃᓐᓂᕆᔭᖓ ᐊᑐᓂ ᐱᓕᕆᐊᑉ ᖃᓄᐃᓕᐅᕐᓂᕆᔭᖏᑦ ᐊᔾᔨᒌᖏᒻᒪᑕ, ᖃᓄᑎᒋᐅᓂᖓ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔭᖕᓇᖅᑐᑦ ᐊᔾᔨᒌᔾᔨᖏᒻᒥᔪᑦ. ᑲᑎᓗᒃᑖᓗᒋᑦ ᐊᐅᓛᕐᓂᓗᒃᑖᕆᓂᐊᖅᑕᖓ ᐱᓕᕆᐊᑉ ᓂᕆᐅᒋᔭᐅᔪᖅ 25-ᓄᑦ ᐅᑭᐅᓅᓂᐊᕐᓂᖓᓄᑦ, ᐅᒃᑯᐊᖅᐸᓪᓕᐊᓂᖓ ᑎᑭᐅᑎᓗᓂ ᑭᖑᓪᓕᖅᐹᒃᑯᑦ ᐅᒃᑯᐊᖅᓯᒪᓕᖅᐸᐅᑉ ᐅᖓᑖᓄᑦ. ᑭᓯᐊᓂ, ᐱᔾᔪᑎᐊ ᖃᐃᔨᓴᐃᓂᐅᑉ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓᓄᑦ, ᑲᑎᓗᒃᑖᖅᓗᒋᑦ ᐱᓕᕆᐊᑉ ᐊᐅᓛᕐᓂᕆᓂᐊᖅᑕᖓ ᐃᓱᒪᒋᔭᐅᔪᖅ 15-ᓄᑦ ᐅᑭᐅᓅᓂᐊᕐᓂᖓᓄᑦ. ᐃᓱᒪᒋᓗᒍ

ᐊᐅᓛᕐᓂᕐᒨᖓᔪᑦ ᑲᑎᓯᒪᓗᒋᑦ ᓇᐃᓂᖅᓴᐅᓗᒍ, ᐳᔪᕐᓗᐃᑦ ᓯᓚᒧᐊᖅᑐᑦ ᐊᖏᓂᖅᓴᐅᓂᐊᖅᑐᑦ ᓈᓴᖅᑕᐅᓚᐅᖅᐸᑕᒧᑦ ᐊᑯᓂᐅᓂᖅᓴᒧᑦ.

ᐱᔾᔪᑎᒋᐸᓗᒍ ᖃᐅᔨᓴᐃᓂᖅ ᐊᒃᑐᖅᓯᓂᐅᑐᐃᓐᓇᓇᐊᓕᖕᓄᑦ ᓯᓚᐅᑉ ᐊᓯᐊᖑᕐᓂᖓᓄᑦ ᐱᓕᕆᐊᒥᑦ, ᐊᐅᓛᕐᓂᐅᔪᖅ ᖁᑦᑎᓛᒃᑯᑦ ᓂᕈᐅᖏᔭᐅᔪᑦ ᐳᔪᕐᓗᐃᑦ ᓯᓚᒧᐊᖅᑐᑦ ᓂᕈᐊᖅᑕᐅᓂᐊᖅᑐᑦ.

ᕿᒪᒃᑎᑦᑐᓄᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᖅ ᐱᓕᕆᐊᒥᑦ ᐃᓱᒪᒋᔭᐅᔪᖅ ᐊᖏᔫᓂᖓᓂᒃ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐊᖅᐸᑦ ᐊᑯᓂᐅᔪᒥᒃ ᐊᔪᖏᓐᓂᕆᔭᖓᑕ VEC. ᐊᖏᓂᐅᔪᖅ ᕿᒪᒃᑎᑦᑐᓄᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᕐᒧᑦ ᖃᐅᔾᔭᐅᓚᐅᖅᑐᖅ ᐊᑐᖅᐸᑎᒃ ᓈᓴᐅᑎᓂᒃ ᐅᕙᓃᓐᓂᑦ ᐊᑐᖅᑕᐅᔪᓂᒃ ᐃᓕᑕᕆᔭᐅᔪᑦ ᐊᑐᓂ VEC-ᓄᑦ. ᐆᒃᑑᑎᒋᓗᒍ, ᐊᖏᓂᖓ ᕿᒪᒃᑎᑦᑎᓄᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᑉ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓᓄᑦ ᐊᑐᖅᐸᓂ ᓄᓇᕗᒻᒥᑦ ᑲᓇᑕᐅᑉᓘᓃᑦ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓᓄᑦ ᐊᑐᖅᑕᐅᔪᕐᒥᑦ. ᐱᑦᖃᖕᒋᑎᓪᓗᒋᑦ ᓈᓴᐅᑏᑦ ᐅᕙᓃᓐᓂᑦ ᐊᑐᖅᑕᐅᔪᑦ, ᖃᐅᔨᒪᔪᐃᑦ ᐃᓱᒪᒋᔭᖏᑦ ᐊᑐᖅᑕᐅᓚᐅᖅᑐᑦ ᖃᐅᔨᓂᕐᒧᑦ ᐊᖏᓂᐅᔪᒥᒃ. ᕿᒪᒃᑎᑦᑐᓄᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᖅ ᐃᓱᒪᒋᔭᐅᔪᖅ ᐊᖏᔫᔾᔭᖏᓐᓂᖓᓂᒃ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔪᖅ ᐊᓯᐊᖑᖅᓯᒃᐸᑦ VEC-ᒥᒃ ᑕᐃᑲᓃᓗᓂ ᐊᔾᔩᖏᑦᑐᓂᑦ, ᐅᕙᓃᓐᓂᑦ ᐊᒃᑐᖅᓯᓂᖅᖃᖏᐸᑦ ᐃᓗᐃᑑᓂᖏᓐᓂᒃ VEC ᐆᒃᑐᕋᖅᑕᐅᔪᖕᓇᖅᑐᑎᑦ ᑐᑭᓕᒃᑯᓪᓗᓃᑦ.

ᒫᓐᓇᐅᔪᖅ ᐊᕙᑎ

ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓᓄᑦ ᖃᐅᔨᒋᐊᖅᖃᑦᑕᕐᓂᕐᒧᑦ ᑐᕌᖓᔪᑦ ᐱᓕᕆᐊᖑᓚᐅᖅᑐᑦ ᐱᓕᕆᐊᑉ ᐃᓂᒃᓴᖓᓂᑦ ᐊᐅᔭᒃᑯᑦ ᐆᒃᑰᐃᔪᒪᒧᑦ ᐊᓐᓂᖅᓵᖅᑐᖅᑕᑉᑎᖕᓅᑐᓂᒃ, ᓴᕕᖕᓂᑦ, ᐊᒻᒪ radionuclides. 24 ᐃᑲᖁᓂᑦ TSP-ᓂᑦ ᑲᑎᓯᒪᖃᑦᑕᖅᑐᑦ 7 μg/m³, -ᓗᐊᑦ, ᖃᓄᐃᓂᖅᓴᐅᓂᖏᓐᓅᕈᑕᐅᔪᖕᓇᖅᑐᑦ ᓇᓐᓂᐅᔪᓂᒃ ᑎᑎᕋᐅᓯᐅᓯᒪᔪᑦ ᐊᕙᑎᒥᒃ ᐊᒃᑐᖅᓯᓂᕐᒧᑦ ᑎᑎᖅᖃᓂᑦ ᐊᓯᖏᓐᓄᑦ ᐱᓕᕆᐊᓄᑦ ᓄᓇᕗᒻᒦᑦᑐᓂᒃ. ᓇᓂᔭᐅᔪᑦ ᐅᖃᖅᓯᒪᖕᒥᔪᑦ ᐆᒃᑐᕋᖅᑕᐅᓯᒪᔪᑦ ᕿᓪᓕᐅᔪᑦ ᑲᑎᓯᒪᔪᓂᑦ, ᓴᕕᖕᓂᑦ, ᐊᒻᒪ radionuclides-ᓂᑦ ᐊᑦᑎᑰᓚᔫᒃᑐᑦ ᑕᐅᑐᖕᒫᖅᓱᒋᑦ ᐊᖏᓂᖅᓴᐅᔪᑦ ᓄᓇᐃᑦ ᑲᓇᑕᒥᑦ, ᐱᓗᐊᖅᑐᒥᑦ ᖃᐸᓗᓈᑦ ᓄᓇᖏᓐᓂᑦ. ᑲᑎᓯᒪᔪᑦ ᐃᓚᔭᐅᓚᐅᖅᑐᑦ ᐊᑐᖅᑕᐅᔪᒧᑦ ᓇᓚᐅᑖᖅᑕᐅᔪᓄᑦ ᑲᑎᓯᒪᔪᓂᒃ COPC-ᓂᑦ ᖃᐅᔨᓴᐃᑎᓪᓗᒋᑦ ᐊᒃᑐᖅᓯᓂᐅᔪᓂᒃ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓᓂᒃ.

ᑭᓪᓕᒋᔭᖓᑕ ᓇᓃᓐᓂᖓᓄᑦ GHG ᐊᓂᐊᔪᑦ ᓄᓇᕗᒻᒥᑦ ᐃᓱᒪᒋᔭᐅᓚᐅᖅᑐᑦ 210 kt-ᖑᓂᖏᓐᓂᒃ CO_2-ᐊᔾᔨᐸᓗᖏᓐᓄᑦ ᐊᑐᖅᓱᒍ ᐊᕙᑎᓕᕆᔨᒃᑯᑦ ᑲᓇᑕᒥᑦ ᖃᑉᓯᐅᓂᕐᓄᑦ ᓈᓴᖅᑕᖏᓐᓄᑦ ᐅᓂᑉᑳᖓᓐᓂᒃ 2012 (ᐊᕙᑎᓕᕆᔨᒃᑯᑦ ᑲᓇᑕᒥᑦ, 2014), ᐊᒻᒪ ᐃᓚᐅᐸᓗᓂ 203 kt-ᖑᒃᑲᓐᓂᖅᑐᑦ CO_2-ᐊᔾᔨᐸᓗᖏᓐᓄᑦ ᑕᑯᒃᓴᐅᑎᑦᑎᔪᑦ ᐊᓂᐊᔪᓂᒃ ᐊᐳᖅᑎᓈᖅᑐᒥᑦ ᐅᔭᕋᖕᓂᐊᕐᕕᖕᒥᑦ ᐱᔭᐅᖏᑦᑐᑦ 2012-ᒥᑦ ᓈᓴᖅᑕᐅᔪᓄᑦ ᐅᓂᑉᑳᒥᑦ. ᐅᔭᕋᖕᓂᐊᕐᕕᒃ ᒫᓐᓇᐅᔪᖅ ᐊᒻᒪ ᐊᐅᓛᕐᓂᐊᖅᑐᒃᓴᐅᐸᓗᓂ ᓱᓕ ᐱᓕᕆᐊᖅ ᐱᒋᐊᕈᖓᖅᑎᑕᐅᒃᐸᑦ ᑕᐃᒪᓐᓇᒧᓪᓗ ᐃᓚᐅᑎᑕᐅᓚᐅᖅᑐᖅ ᐃᓚᒋᔭᐅᐸᓗᓂ ᑭᓪᓕᐅᔪᓄᑦ.

ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓ

ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓃᑦ ᐱᓕᕆᐊᒨᖓᔪᓂᒃ ᖃᓄᐃᓕᐅᕐᓂᐅᔪᓂᒃ ᓯᓚᒧᐊᖅᑐᑦ ᑲᑎᓯᒪᔪᑦ COPC-ᓂᑦ

ᐱᓕᕆᐊᖅ ᐱᓕᕆᐊᖑᕙᓪᓕᐊᓂᖓᓂᑦ (ᓴᓇᕙᓪᓕᐊᓂᖅ, ᐊᐅᓛᕐᓂᖅ, ᑭᖑᓪᓕᖅᐹᒃᑯᑦ ᐅᒃᑯᐊᖅᑎᓪᓗᒍ ᐊᒻᒪ ᐅᒃᑯᐊᖅᓯᒪᓕᖅᑎᓪᓗᒍ), ᖃᓄᐃᓕᐅᕐᓂᖅᑕᖃᕐᓂᐊᖅᑐᖅ ᐊᖏᓪᓕᒋᐊᖅᑎᑦᑎᔪᖕᓇᖅᑐᖅ ᓯᓚᒧᐊᖅᑐᑦ ᑲᑎᓯᒪᔪᑦ

COPC-ᓂᑦ ᖃᓂᑦᑐᒥᑦ ᐅᖓᓯᖕᓂᖅᓴᒥᑦᑐ ᐊᕙᑎᐅᔪᓂᑦ, ᐃᓚᐅᑉᑐᑎᒃ ᐳᔪᖃᑖᖅ (ᓲᕐᖁ, ᒥᑭᑦᑐᑦ), ᓴᕖᑦ ᐅᖅᓱᖅᑕᓖᑦ ᐊᒻᒪᓗ radionuclides. ᓇᐃᓈᖅᓯᒪᔪᑦ ᐱᓕᕆᐊᒥᑦ ᖃᓄᐃᓕᐅᕐᓃᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᔪᓐᓇᖅᑐᑦ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓᓂᒃ ᐅᑯᐊᖑᔪᑦ:

ᓴᓇᕙᓪᓕᐊᓂᖅ:

- ᓄᓇᒥᒃ ᐲᔭᐃᓂᖅ, ᓄᓇᒥᒃ ᐃᓗᑦᑐᖅᑎᕆᓂᖅ (ᓲᕐᖁ, ᓄᓇᒥᒃ ᓅᑎᕆᓂᖅ), ᓄᓇᒃᑰᕈᐱᑦ ᐃᖏᕐᖁᔭᒃᑐᑦ, ᐃᓗᑐᔪᕐᒦᑐᓕᕆᓂᖅ, ᐱᕐᑯᑎᓕᕆᓂᖅ ᐊᒻᒪᓗ ᐅᖅᓱᐊᓗᓕᕆᓂᖅ.

ᐊᐅᓛᕐᓂᕐᒨᖓᔪᑦ:

- ᐃᑰᑕᐃᓂᖅ ᖄᖅᑎᕆᓂᕐᓗ, ᐅᔭᕋᐃᑦ ᐅᔭᖕᓂᐊᕐᕕᖕᒥᑦᑐ ᐅᔭᕋᓕᕆᓂᖅ, ᓯᐅᕋᓂᒃ ᑲᑎᖅᓱᐃᓂᖅ ᐊᒻᒪᓗ ᐊᑉᕐᑯᓯᕆᓂᖅ, ᐊᓗᓇᒥᑦ ᓲᑯᒃᐸᓪᓕᐊᔪᑦ ᑲᑎᓯᒪᔪᑦ, ᐃᖏᕐᖁᔭᒃᑐᑦ, ᐅᖅᓱᐊᓗᓕᕆᓂᖅ ᐊᒻᒪᓗ ᓯᕐᑲᓪᓕᑎᕆᓂᕐᒧᑦ ᐊᐅᓚᑦᑎᓐᓂᑦ.

ᑭᖑᓪᓕᖅᐹᑯᑦ ᐅᑯᐊᖅᐸᓪᓕᐊᓕᕆᓂᖅ:

- ᐅᔭᖕᓂᐊᕐᕕᖕᒥᑦ ᐅᔭᖅᑲᐃᑦ TMF-ᓄᐊᖅᑎᕆᓂᖅ, ᐅᒃᑯᐊᕐᓂᖅ TMF-ᓄᑦ ᐊᒻᒪᓗ ᐅᖅᓱᐊᓗᓕᕆᓂᖅ.

ᐅᒃᑯᐊᖅᓯᒪᓕᖅᑎᓪᓗᒍ:

- radon ᐊᓂᐊᔪᑦ ᐅᔭᖕᓂᐊᕐᕕᖕᒥᑦ ᐅᔭᖅᑲᐃᑦ ᑲᑎᑕᐅᔪᓂᑦ ᐅᒃᑯᐊᖅᓯᒪᔪᓂᓪᓗ TMF-ᓂᑦ

ᐊᖏᓗᐊᖏᑭᐊᖅᑎᑦᑎᓂᖅ ᐊᒻᒪᓗ ᐱᓕᕆᐊᑉ ᖃᓄᐃᑑᓂᖓ

ᐊᖏᓗᐊᖏᑭᐊᖅᑎᑦᑎᓂᖅ ᖃᓄᐃᑑᓂᖓᒍᑦ ᐊᒻᒪᓗ ᐊᖏᓗᐊᖏᑭᐊᖅᑎᑦᑎᓂᖅ ᐊᐅᓚᑦᑎᓂᒃᑰᖓᔪᑎᒍᑦ ᐃᓚᓕᐅᑎᔭᐅᓚᐅᖅᑐᑦ ᒫᓐᓇᐅᔪᖅ ᐱᓕᕆᐊᒧᑦ ᐸᕐᓇᐅᑎᓂᒃ ᒥᑭᓪᓕᑭᐊᖅᑎᑦᑎᓂᐊᖅᑐᖅ ᐱᓕᕆᐊᒨᖓᔪᓂᒃ COPC-ᓂᒃ ᐊᓂᐊᔪᓄᑦ ᐊᒻᒪᓗ/ᐅᕙᓘᓃᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔪᓐᓇᖅᑐᑦ ᐊᓂᐊᔪᓂᒃ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓᓄᑦ. ᖃᓄᐃᖓᓂᐊᖅᑑᓂᖓᓂᑦ ᐊᖏᓗᐊᖏᑭᐊᖅᑎᑦᑎᓂᕐᒥᑦ ᐃᓚᐅᔪᑦ ᐊᒥᓱᐊᕐᔪᐃᑦ ᓯᓚᒧᐊᖅᐸᓪᓕᐊᔪᓂᒃ ᐊᑐᖅᑕᐅᔪᓄᑦ ᖃᐅᔨᓴᐃᓐᓂᑦ ᐱᓕᕆᐊᖑᓚᐅᖅᑐᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐊᒃᑐᖅᓯᓂᐅᔪᓐᓇᖅᑐᓂᒃ ᐊᓯᖏᓐᓂᒃ ᐃᓂᐅᔪᓂᒃ ᐊᔾᔩᖏᑦᑐᓄᑦ ᐱᓕᕆᐊᑉ ᐱᕐᑯᑎᖏᓐᓄᑦ ᓲᕐᖁ (acid) ᐋᓯᑦᑎᕆᕝᕕᖕᒧᑦ, ᐆᒻᒪᖅᑯᑎᓕᕆᕝᕕᒃ, ᑐᖅᑯᖅᓯᒪᔪᓂᑦ ᐊᒻᒪᓗ ᓯᓂᒃᑕᕐᕕᑭᔭᐅᔪᒥᑦ. ᑕᒪᒃᑯᐊ ᐊᑐᖅᑕᐅᓚᐅᖅᑐᑦ ᑭᖑᓪᓕᖅᐹᒃᑯᑦ ᓯᐊᒻᒥᑎᕆᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᔪᒥᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ.

ᐊᖏᓗᐊᖏᑭᐊᖅᑎᑦᑎᓂᖅ ᐊᐅᓚᑦᑎᔾᔪᑦ ᐃᓚᐅᓂᐊᖅᑐᑦ ᐊᑐᖅᑕᐅᑎᓐᓂᖅ ᐊᐅᓛᖅᑎᑦᑎᓂᕐᒧᑦ ᒪᓕᒃᑕᐅᔭᕆᐊᓖᑦ ᐃᑯᒪᖃᖅᑐᓄᑦ ᐊᒻᒪᓗ ᐱᓕᕆᐊᖑᐃᓐᓇᖃᑦᑕᕐᓗᑎᒃ ᒪᓕᒡᓗᒥᑦ ᐃᑯᒪᓕᕆᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᖃᑦᑕᖅᑐᑦ ᐅᕙᓘᓃᑦ ᐱᕐᑯᔭᐅᓂᖏᑦᑎᒍᑦ ᐱᕐᑯᑎᑖᕐᕕᐅᖃᑦᑕᖅᑐᓄᑦ, ᑕᒪᒃᑯᐊ ᐃᑯᒪᖃᖅᑐᑦ ᐊᐅᓛᑦᑎᐊᖏᓐᓇᖅᑑᕐᑯᐸᓗᒥᑦ. ᐊᒻᒪᓗ, ᐱᓕᕆᐊᒨᖓᔪᖅ ᒪᓕᖅᑲᑦᑕᕐᓂᐊᖅᑐᖅ ᖃᓄᐃᓕᐅᕆᐊᖅᑲᕐᑯᔭᐅᓂᐅᔪᓂᒃ

ᐱᔪᓐᓇᖅᑎᑕᐅᓂᕐᒧᑦ (permits) ᐳᒥᑦᓃᑐᓗᒃᑖᓂᕐ, ᐱᒋᐊᕈᓐᓇᖅᑎᑕᐅᓃᑦ ᐊᒻᒪ/ᐅᕙᓘᓃᑦ ᓈᒻᒪᒋᔭᐅᓂᒃᑯᑦ. ᒪᓕᒃᑕᐅᔭᕆᐊᖃᖅᑐᓂᒃ ᓴᖅᑭᑦᑎᓂᐊᕐᒥᔪᑦ ᐱᓕᕆᐊᕆᓂᐊᕐᓗᒋᑦ ᓄᓇᓕᖕᒥᑦ ᐅᕐᑲᐅᓯᐅᔪᑦ.

ᐊᓯᖏᑦ ᖃᓄᐃᓕᐅᕐᓂᕐᔫᖓᔪᑦ ᐊᖏᓗᐊᖏᒋᐊᖅᑎᑦᑎᓃᑦ ᐊᐅᓚᑦᑎᔾᔭᓄᑦ ᐃᓚᐅᓂᐊᖅᑐᑦ ᐊᑐᖅᑕᐅᓂᖏᑦ ᐃᓯᐊᕿᔪᓂᑦ ᐊᓂᐊᔪᓄᑦ ᐊᐅᓚᑦᑎᔾᔪᑏᑦ ᓱᕐᓗ ᐱᒋᐊᖅᑎᑦᑎᔪᓂᒃ ᐊᓯᐊᖑᖅᑎᑦᑎᔾᔪᑏᑦ ᐊᒻᒪ ᐅᖅᓱᐊᓗᐃᑦ ᐃᓚᖏᓐᓄᑦ ᓴᓗᒪᐃᑐᓂᒃ ᐊᓂᐊᑎᑦᑎᑦᑕᐃᓕᒪᔪᑏᑦ ᐊᖏᓗᐊᖏᒋᐊᖅᑎᑦᑎᓂᕐᒧᑦ ᐅᖅᓱᐊᓗᖕᒥᑦ ᐊᓂᐊᔪᓂᒃ ᓄᓇᒃᑰᕈᑎᕐᔪᐊᓂᕐ, ᓄᓇᒃᑰᕈᑎᓂᒃ ᐊᒻᒪ ᐅᒥᐊᕐᔪᐊᓂᕐ. ᐳᔪᕐᓗᐃᑦ ᐊᓂᐊᔪᑦ sulpher dioxide-ᒥᑦ ᒥᑭᒡᓕᒋᐊᖅᑕᐅᓂᐊᕐᒥᔪᑦ ᐊᑐᕐᓗᑎᒃ ᐅᖅᓯᓂᒃ ᐊᑦᑎᒃᑐᒥᒃ sulphur-ᕐᑲᖅᑐᓂᒃ. ᐊᒻᒪ, ᖃᑉᓯᐅᓂᖏᑦ ᓄᓇᒃᑰᕈᑏᑦ ᐊᐅᓚᓂᖏᑦ ᐅᖓᓯᖕᓂᖏᓪᓗ ᐃᖏᕋᓂᖏᑦ ᐱᐅᓯᒋᐊᖅᑕᐅᓂᐊᕐᒥᔪᑦ ᒥᑭᒡᓕᒋᐊᖅᑎᑦᑎᓂᕐᒧᑦ ᐳᔪᖅᑖᓂᒃ. ᓄᓇᒃᑰᕈᑎᓂᒃ ᓇᑭᓴᒃᑲᓂᖅᑎᑦᑎᓂᖅ ᕿᑯᒃᑯ ᐊᑉᕐᑯᑎᒃᑰᖅᑎᓪᓗᒋᑦ (ᐃᓚᐅᑉᓗᑎᒃ ᐊᑦᑎᒃᑐᒧᙱᐅᔪᑦ), ᐃᒻᒥᖅᑐᕐᓗᒋᑦ ᐅᕙᓘᓃᑦ ᐊᓯᖏᓐᓂᒃ ᐊᑐᕐᓗᓂ ᐳᔪᖅᑕᕐᑲᓗᐊᖅᑎᑦᑎᑦᑕᐃᓕᒪᓂᕐᒧᑦ ᕿᑯᒃᑰᖅᑎᓪᓗᒋᑦ ᐊᒻᒪ ᐊᑉᕐᑯᓯᓕᓇᖅᑕᕐᓂᖅ ᒥᑭᒡᓕᒋᐊᖅᑎᑦᑎᓂᐊᖅᑐᖅ ᐳᔪᖅᑖᓂᒃ.

ᑭᖑᓪᓕᖅᐹᑯᑦ, ᐳᔪᕐᓗᐃᑦ ᐊᓂᐊᔪᑦ ᐱᕙᓪᓕᐊᖁᖕᓂᑦ ᒥᑭᒡᓕᒋᐊᖅᑕᐅᓂᐊᖅᑐᑦ ᐃᓕᓯᓗᑎᒃ ᐊᓂᐊᔪᓂᒃ ᐊᐅᓚᑦᑎᔾᔪᑎᓂᒃ ᐃᓯᐊᕿᔪᓂᑦ ᓯᕐᑲᓪᓕᑎᓇᖁᖕᒥᑦ ᐊᒻᒪ acid ᐋᓯᑦᓕᓇᖁᖕᒥᑦ (ᓱᕐᓗ, ᖃᐅᓯᖅᓘᑎᒃ ᓴᓗᒻᒪᖅᓴᐃᔾᔪᑏᑦ, ᐳᔪᖅᑖᓂᒃ ᑲᑎᖅᓱᐃᔾᔪᑏᑦ). ᕿᒪᒃᑎᑦᑐᑦ ᐱᓕᕆᐊᖑᖅᑲᑦᑕᕐᓂᐊᖅᑐᑦ ᓴᑉᑯᑕᐅᓗᑎᒡᓗ TMF-ᒧᑦ ᒥᑭᒡᓕᒋᐊᖅᑎᓐᓂᕐᒧᑦ ᓴᑉᑯᑕᐅᔪᑦ ᐳᔪᖅᑖᑦ ᐊᒻᒪ radon. ᐅᔭᕋᖕᓂᐊᕐᕕᖕᒥᑦ ᐅᔭᖅᑲᐃᑦ ᑲᑎᓯᒪᔪᑦ ᖃᓕᖅᑕᐅᓂᐊᖅᑐᑦ ᓴᓗᒪᔪᓂᒃ ᐅᔭᖅᑲᓂᒃ ᐱᒋᐊᖅᑎᑦᑎᓂᕐᒧᑦ ᐱᕈᖅᑐᓂᒃ ᐊᒻᒪ ᓄᖅᑲᖅᑎᑦᑎᓂᕐᒧᑦ ᐳᔪᖅᑖᓂᒃ ᐊᑯᓂᐅᔪᒧᑦ.

ᓇᓗᓇᐃᔭᖅᓯᒪᔪᑦ ᑕᒪᐃᓂᒃ ᐸᕐᓇᐅᑏᑦ ᐊᖏᓗᐊᖏᒋᐊᖅᑎᑦᑎᓂᕐᒧᑦ ᑎᑎᖅᑲᖅ 4C-ᒦᑐᑦ – ᐆᒃᑑᑎ ᐊᓂᖅᕵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖕᒐᓂᒃ ᖃᐅᔨᒋᐊᖃᑦᑕᕐᓂᖅ ᐊᒻᒪ ᐊᖏᓗᐊᖏᒋᐊᖅᑎᑦᑎᓂᕐᒧᑦ ᐸᕐᓇᐅᑎ.

ᕿᒪᒃᑎᑦᑐᑦ ᐱᓕᕆᐊᒥᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓃᑦ ᐊᓂᖅᕵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖕᒐᓄᑦ

ᓯᓚᒥᑦ ᑲᑎᓯᒪᔪᑦ COPC-ᓂᑦ ᓇᓚᐅᑖᖅᑕᐅᓚᐅᖅᑐᑦ ᐊᔾᔨᒌᖏᑦᑐᓂᒃ ᐊᑐᖅᓗᑎᒃ CALPUFF/CALMET-ᒥᑦ ᓯᓚᒧᑦ ᓯᐊᒪᒃᑐᓄᑦ ᐊᑐᖅᑕᐅᔪᑦ ᖃᐅᔨᔪᒪᓂᕐᒧᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᐅᔪᖕᓇᖅᑐᓂᒃ ᐱᓕᕆᐊᑉ ᐊᐅᓛᕐᓂᓗᒃᑖᖕᒐᓂᐅᑎᓪᓗᒍ. ᐳᔪᕐᓗᐃᑦ ᐊᓂᐊᔪᓂᑦ ᓈᓴᖅᑕᐅᔪᑦ ᐊᒻᒪ ᐊᑐᖅᑕᐅᓂᐊᖅᑐᖅ ᐱᐊᓂᒃᑕᐅᓚᐅᖅᑐᖅ ᓴᓇᔭᐅᓂᕐᒧᑦ (ᐃᓗᑦᑐᖅᓯᒪᔪᖅ), ᐊᐅᓛᕐᓂᕐᒧᑦ, ᑭᖑᓪᓕᖅᐹᒃᑯᑦ ᐅᒃᑯᐊᖅᑎᓪᓗᒍ, ᐊᒻᒪ ᐅᒃᑯᐊᖅᓯᒪᓕᖅᐸᒧᑦ. ᓯᑕᒪᐅᓕᖕᒐᔪᑦ ᐊᐅᓛᖅᑎᑦᑎᓂᕐᔫᖕᒐᔪᑦ ᐊᑐᖅᑕᐅᓚᐅᖅᑐᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐊᑯᓂ-ᑕᕿᓂᖕᒐᓄᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᐅᔪᓄᑦ. (ᓱᕐᓗ, ᐊᕐᕌᒍᑕᒫᑦ) ᐊᒻᒪ ᐊᖏᓛᒃᑯᑦ ᐊᐅᓛᖅᑎᑦᑎᓃᑦ (ᓱᕐᓗ, ᐱᐅᖏᓛᒃᑯᖅᑐᓂᒃ) ᐊᖅᑐᑕᐅᓚᐅᖅᑐᖅ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᓇᐃᑐᒥᒃ-ᑕᕿᓂᖕᒐᓄᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᐅᔪᓄᑦ (ᓱᕐᓗ, 1 ᐊᒻᒪ 24-ᓄᑦ ᐃᑲᕐᕋᓄᑦ). ᓇᓚᐅᑖᖅᑕᐅᔪᑦ ᑲᑎᓯᒪᔪᓂᑦ ᐊᒻᒪ ᐊᓂᐊᔪᑦ acid ᐋᓯᑦᖑᖅᐸᓪᓕᐊᔪᑦ COPC-ᑦ ᐊᐅᓛᕐᓂᐅᓇᔭᖅᑐᓂᑦ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᕐᒥᔪᑦ ᐊᒃᑐᐊᓂᕐᑲᖅᑐᒃᑰᖓᔪᒃᑯᑦ ᖃᐅᔨᓴᐃᓂᒃᑯᑦ (ᑕᑯᓗᒍ ᑎᑎᕐᑲᖅ 6 – ᓄᓇᐅᑉ ᐊᕙᑎᖓ ᐊᒻᒪ ᑎᑎᖅᑲᖅ 8 – ᐃᓅᑉ ᐋᓐᓂᐊᕐᑲᖅᑕᐃᓕᒪᓂᖓ). ᐊᖏᓛᒃᑯᑦ ᐊᐅᓛᖅᑎᑦᑎᓂᕐᔫᖕᒐᔪᑦ ᐊᑐᖅᑕᐅᓚᐅᕐᒥᔪᖅ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐳᔪᖅᑖᓂᒃ ᐊᓂᐊᔪᓂᒃ (ᓱᕐᓗ, ᐳᔪᖅᑖᑦ ᑐᓐᓂᖏᑦ) ᐳᔪᖅᑖᑦ ᐊᓂᐊᔪᑦ ᐃᓯᒪᒋᔭᐅᕙᓗᐊᖅᑎᓪᓗᒋᑦ ᑕᕿᔫᓂᖕᒐᓄᑦ-ᐊᑯᓂᐅᑎᒋᓂᖕᒐ (ᓱᕐᓗ, ᑕᖅᑭᑕᒫᑦ ᐅᕙᓘᓃᑦ ᐅᑭᐅᓗᒃᑖᑕᒫᑦ) ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᐅᔪᑦ. ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᐅᔪᖕᓇᖅᑐᖅ ᓇᓚᐅᑖᖅᑕᐅᔪᑦ ᐊᓂᐊᔪᓄᑦ ᓈᓴᐅᑏᑦ ᐃᒪᕐᓄᑦ ᖃᐅᔨᓴᖅᑕᐅᔪᖅ ᑎᑎᖅᑲᖅ 5-ᒥᑦ ᐃᒪᕐᒥᐅᑕᐃᑦ ᐊᕙᑎᖓ. ᓇᐃᓈᖅᓯᒪᔪᖅ ᐊᑐᖅᑕᐅᔪᒧᑦ ᓇᓚᐅᑖᖅᑕᐅᔪᓄᑦ ᖃᓄᐃᖕᒋᓂᐅᔪᑦ ᐊᑖᓂ ᑕᑯᒃᓴᐅᔪᑦ. ᐱᔾᔪᑎᒋᐸᓗᒍ ᐊᓂᖅᕵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖕᒐᓄᑦ ᖃᐅᔨᓴᐃᓂᖅ, ᕿᒪᒃᑎᑐᓄᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᖅ ᑐᑭᓕᐅᖅᑕᐅᔪᖅ ᓇᓚᐅᑖᖅᑕᐅᔪᑐᑦ COPC-ᓂᒃ ᑲᑎᓯᒪᔪᓂᒃ

ᐅᖓᑕᐅᑎᓯᒪᔪᑦ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓐᓂᕆᔭᖓᓄᑦ ᐊᑐᖅᑐᒧᑦ, ᐊᒻᒪ ᖃᐅᔨᒪᔭᐅᓪᓗᓂ ᓇᓗᓇᐃᖁᑕᖅ ᓈᓴᐅᑎ (ᐅᕙᓘᓃᑦ ᓈᓴᐅᑎ).

ᓴᓇᔭᐅᓂᖅ (ᐃᓗᑦᑐᖅᓯᒪᔪᖅ)

- ᑕᒪᐃᓅᖓᔪᖅ ᐊᖏᕌᒃᑯᑦ TSP ᑲᑎᓯᒪᔪᑦ ᓇᓚᐅᑖᖅᑕᐅᔪᖅ ᐃᓗᑦᑐᖅᓯᒪᔪᓕᕆᓂᕐᓂᑦ ᐅᖓᓯᓐᓂᖅᑲᖅᑐᒥᑦ 500m-ᓂᒃ ᐃᓗᑦᑐᖅᓯᒪᔪᒥᑦ 14.6 µg/m³-ᖑᔪᖅ. ᐆᒃᑐᕋᒃᓴᐅᔪᑦ ᐊᓯᐊᖑᕐᓃᑦ ᑲᑎᓯᒪᔪᓂᑦ ᑭᒡᓕᖅᑲᖅᑐᒦᑐᑦ 2 ᑭᓛᒥᑕ ᑐᖕᓕᓂᑦ ᐃᓗᑦᑐᖅᓯᒪᔪᒥᑦ.

ᐊᐅᓛᖅᑎᑦᑎᓃᑦ

ᐳᔪᖅᑖᖅ (TSP, PM₁₀ ᐊᒻᒪ PM₂.₅)

- ᐊᑐᖅᑕᐅᔪᖅ ᓇᓚᐅᑖᕆᓂᕐᒧᑦ ᐊᖏᕌᒃᑯᑦ 24-ᓂᒃ ᐃᑲᕐᕋᓄᑦ ᐃᓚᖏᓐᓄᑦ ᐳᔪᖅᑖᒧᑦ (TSP, PM₁₀, PM₂.₅) ᐅᖓᑕᐅᑎᔪᖅ ᓇᓗᓇᐃᖁᑕᖏᓐᓄᑦ ᓈᓴᐅᑎᖏᓐᓂᑦ ᑎᑭᐅᑎᑉᐳᓂ ᑭᒡᓕᖅᑲᖅᕕᐅᔪᒧᑦ LAA-ᒥᑦ ᑕᒪᐃᓄᑦ ᑭᒡᒐᕕᖕᒥᑦ ᐊᒻᒪ Sissons ᐅᔭᕋᖕᓂᐊᕐᕕᖏᓐᓂᑦ. ᐅᖓᑕᐅᑎᔪᑦ ᐱᔾᔪᑎᖃᕈᓐᓇᖅᑐᑦ ᐳᔪᖅᑐᖕᓂᑦ ᐊᓂᐊᔪᓄᑦ ᐳᔪᖅᑖᒥᒃ ᐅᒃᑯᐃᖓᔪᓂᑦ ᐅᔭᕋᖕᓂᐊᕐᕕᓕᕆᓂᐅᔪᓂᑦ, ᐱᓗᐊᖅᑐᒥᑦ ᕿᓅᖏᑦᑐᓂᑦ ᐊᑉᖁᑎᓂᒃ ᐳᔪᖅᑖᖑᖅᑐᑦ ᐅᒃᑯᐃᖓᔪᓂᒃ ᐊᑉᖁᑎᓂᑦ.
  ᓇᓚᐅᑖᖅᑕᐅᔪᑦ 30 ᐅᓪᓗᐃᑦ ᐅᖓᑖᓄᐊᓵᖏᑦᑐᑦ ᐅᖓᑕᐅᑦᑎᔪᓂᒃ ᐅᑭᐅᑕᒫᑦ ᐱᓕᕆᐊᑉ ᐃᓂᖓᑕ ᐅᖓᑖᓄᑦ TSP-ᒧᑦ ᐊᒻᒪ PM₁₀-ᒧᑦ ᐊᒻᒪ ᓯᑕᒪᓄᑦ ᐅᓪᓗᓂᒃ PM₂.₅-ᒧᑦ. ᓇᓚᐅᑖᖅᑕᐅᔪᑦ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔪᑦ ᑕᐃᒪᐅᓂᐊᖅᑐᑦ 3-ᒥᑦ 4-ᒧᑦ ᑭᓛᒥᑕᒥᒃ ᐱᓕᕆᐊᑉ ᐃᓂᖓᓂᑦ.
- ᐊᐅᓛᕐᓂᐅᑎᓪᓗᒍ, ᓇᓚᐅᑖᖅᑕᐅᔪᑦ ᐊᕐᕌᒍᑕᒫᑦ TSP ᑲᑎᓯᒪᔪᑦ ᐊᑦᑎᖕᓂᖅᓴᐅᔪᑦ ᓇᓗᓇᐃᖁᑕᒧᑦ ᓈᓴᐅᑎᒥᒃ ᐱᔪᓂᒃ ᐃᓂᐅᔪᓄᑦ LAA-ᒥᑦ ᐊᒻᒪ RAA-ᒥᑦ.
- ᐊᕐᕌᒍᑕᒫᑦ ᐳᔪᖅᑖᓄᑦ ᓈᓴᐅᑏᑦ ᐊᑦᑎᖕᓂᖅᓴᐅᔪᑦ ᓇᓗᓇᐃᖁᑕᒧᑦ ᓈᓴᐅᑎᒥᒃ ᐱᔪᓂᒃ ᐃᓂᐅᔪᓄᑦ ᐱᓕᕆᐊᑉ ᐃᓂᖓᑕ ᐅᖓᑖᓄᑦ.
- ᐳᔪᖅᑖᓄᑦ ᓈᓴᐅᑏᑦ ᑭᒡᒐᕝ-Sissons-ᒥᑦ ᐅᓯᒃᑕᖕᓂᖅᒧᑦ ᐊᑉᖁᑎᒥᑦ ᓇᓚᐅᑖᖅᑕᐅᔪᑦ 15 g/m²/ᐅᑭᐅᑕᒫᑦ (150 kg/ha/ᐅᑭᐅᖅ) 5 g/m²/ᐅᑭᐅᖅ-ᒧᐊᖅᑐᖅ 200 m-ᒥᒃ ᐊᑉᖁᑎᒥᑦ. 12 ᑭᓛᒥᑕ ᐱᓕᕆᐊᑉ ᐃᓂᖓᓂᑦ, ᑲᑎᖪᒋᑦ ᐊᕐᕌᒍᑕᒫᑦ ᐳᔪᖅᑖᑦ ᑎᑭᐅᑎᕆᐊᖅᑲᑦᑕᖅᑐᑦ ᓇᓐᓂᓂᐅᔪᓄᑦ. ᓇᓚᐅᑖᖅᑕᐅᔪᖅ ᖃᓄᐃᓕᐅᕐᓂᕆᔭᖓᑕ ᐳᔪᖅᑖᑉ ᑭᒡᒐᕕᖕᒥᑦ ᐊᔾᔨᐸᓗᖓ ᓇᓂᔭᐅᔪᓂᒃ EKATI Diamond Mine-ᒥᑦ ᐊᑐᖅᑕᐅᔪᑦ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ (Rescan 2006a), ᓇᓚᐅᑖᖅᑐᑦ ᖁᑦᑎᒃᑐᓂᒃ ᐳᔪᖅᑖᓄᑦ ᓈᓴᐅᑎᓂᒃ ᕿᑯᖅᑳᕆᑦᑐᑦ ᐊᑉᖁᑏᑦ ᖃᓂᑕᖕᒋᓐᓂᑦ ᑲᑕᒃᐅᑎᕆᔾᑦ ᐅᖓᓯᒃᓯᕙᓪᓕᐊᓂᖅ ᒪᓕᒃᑲᓗᒍ. ᐆᒃᑐᖅᑕᐅᔪᖕᓇᖅᑐᑦ ᐳᔪᖅᑖᑦ (ᓲᕐᓗ ᑭᒡᓕᐅᔾᔫᑉ ᖁᑦᑎᓂ) ᓇᓚᐅᑖᖅᑕᐅᓚᐅᕐᒥᔪᖅ ᑕᐃᒪᐅᓂᐊᕐᓂᖓᓄᑦ 14 ᑭᓛᒥᑕ ᐃᓗᐊᓂᑦ ᐊᔾᔨᒋᙱᑦᑕᖓᓕ ᑭᒡᒐᕕᖕᒥᑦ ᖃᐅᔨᓴᐃᓂᐅᔪᒧᑦ. ᓇᓗᓇᐃᔭᑦᑎᐊᖅᓯᒪᔪᑦ ᖃᓄᐃᓂᖅᓴᐅᓂᕐᓄᑦ ᑭᒡᒐᒃ ᐊᒻᒪ EKATI-ᒧᑦ ᖃᐅᔨᓴᐃᓂᐅᔪᓂᑦ ᑕᐃᒪᐅᔪᖅ ᑎᑎᖅᑲᒥᑦ 4B, ᐃᓚᓕᐅᑎᓯᒪᔪᖅ E.

ᓄᖑᓯᐃᑐᖅ ᐊᒻᒪ ᓴᕕᑦ

- ᓇᓚᐅᑖᕆᓂᕐᒧᑦ ᐊᖏᕌᒃᑯᑦ 24-ᓂᒃ ᐃᑲᕐᕋᓄᑦ ᓄᖑᓯᐃᑐᑦ ᑲᑎᓯᒪᔪᑦ ᖁᓛᓃᑐᑦ ᓇᓗᓇᐃᖁᑕᐅᑉ ᓈᓴᐅᑎᐅᑉ ᐱᓕᕆᐊᑉ ᐃᓂᖓᑕ ᐅᖓᑖᓄᑦ, ᑕᐃᒃᑯᖓ LAA-ᒧᑦ. ᑭᓯᐊᓂ, ᓈᓴᐅᑎᖓ ᐅᖓᑕᐅᑎᓂᖅᒧᑦ

ᓇᓚᐅᑖᖅᑕᐅᔪᖅ ᐅᑉᐳᕐᒧᑦ ᐊᑕᐅᓯᕐᒨᖓᔪᖅ 1100m-ᒥᒃ ᑭᒡᒐᕕᒃ ᐅᔭᕋᖕᓂᐊᕐᕕᐅᑉ ᐃᓂᖓᓂᑦ ᐊᒻᒪ 500m-ᒥᒃ Sissons ᐅᔭᕋᖕᓂᐊᕐᕕᐅᑉ ᐃᓂᖓᓂᑦ.

- ᓇᓚᐅᑖᕆᓂᕐᒧᑦ ᐊᖏᓛᒃᑯᑦ 24-ᓂᒃ ᐃᑲᕐᕋᓄᑦ ᑲᑎᓯᒪᔪᑦ ᑕᒪᐃᓂᒃ ᓴᕕᖕᓄᑦ ᐊᑖᓃᑦ ᓇᐅᓇᐃᑯᑕᐅᑉ ᓈᓴᐅᑎᐅᑉ ᐱᓕᕆᐊᑉ ᐃᓂᖓᓂᑦ ᐊᒻᒪ ᑕᒪᐃᓂᒃ LAA ᐊᒻᒪ RAA ᐱᔪᓄᑦ ᐃᓂᐃᔪᓄᑦ.
- ᐅᖓᑕᐅᑎᓂᖅᑕᕐᑲᙳᑦᑐᖅ ᐊᕐᕌᒍᑕᒫᑦ ᓇᐅᓇᐃᑯᑕᐅᑉ ᓈᓴᐅᑎᐅᑉ ᓇᓕᐊᖕᓂᑐᐃᓐᓇᖅ ᓄᖑᓯᐃᑐᓄᑦ ᐅᕙᓗᓃᑦ ᐊᓯᖏᓐᓄᑦ ᓴᕕᖕᓄᑦ LAA-ᒥᑦ RAA-ᒥᓪᓗ.

ᐅᖅᓲᓂᐅᔪᑦ COPC-ᓪ

- ᓇᓚᐅᑖᕆᓂᕐᒧᑦ ᐊᖏᓛᒃᑯᑦ ᐊᑕᐅᓯᕐᒧᑦ ᐃᑲᕐᕋᒧᑦ ᐊᒻᒪ 24-ᓂᒃ ᐃᑲᕐᕋᓄᑦ ᑲᑎᓯᒪᔪᑦ SO_2 ᑭᒡᓕᐅᔫᑐᑦ ᓇᓗᓇᐃᑯᑕᐅᑉ ᓈᓴᐅᑎᐅᑉ ᑕᒪᐃᓄᑦ ᐱᔪᓄᑦ ᐃᓂᐅᔪᓄᑦ LAA-ᒥᑦ RAA-ᒥᓪᓗ.
- ᓇᓚᐅᑖᕆᓂᕐᒧᑦ ᐊᖏᓛᒃᑯᑦ ᐊᑕᐅᓯᕐᒧᑦ ᐃᑲᕐᕋᒧᑦ ᐊᒻᒪ 24-ᓂᒃ ᐃᑲᕐᕋᓄᑦ NO_2 ᑲᑎᓯᒪᔪᑦ ᐅᖓᑕᐅᑎᔪᑦ ᓇᓗᓇᐃᑯᑕᐅᑉ ᓈᓴᐅᑎᐅᑉ ᐱᓕᕆᐊᑉ ᐃᓂᒋᔭᖓᓂᑦ, ᑎᑭᐅᑎᑉᐳᓂ LAA-ᑦ. ᐅᖓᑕᐅᑎᓃᑦ ᐱᔾᔪᑎᕐᑲᕈᖕᓇᖅᑐᑦ ᐊᖏᔪᓄᑦ ᐳᔪᕐᓗᖕᓂᒃ ᐊᓂᐊᔪᓄᑦ NO_x ᓂᒃ ᐅᒃᑯᐃᖓᔪᓂᒃ ᒪᓂᕋᒥᑦ ᐅᔭᕋᖕᓂᐊᕐᕕᓕᕆᓂᐅᔪᓂᒃ ᐃᓚᐅᑉᐳᑎᒃ ᐅᖅᓱᐊᓗᕐᒥᑦ ᐊᑐᖅᐳᑎᒃ ᐊᐅᓛᕈᑕᐅᔪᑦ ᐱᕐᑯᑏᑦ ᐊᒻᒪ ᖄᖅᑎᕆᓂᖅ.

  11 ᐅᑉᐳᓂᒃ ᐅᖓᑕᐅᑎᓂᖅᑕᕐᑲᕈᖕᓃᖅᑐᖅ 24-ᓂᒃ ᐃᑲᕐᕋᓄᑦ NO_2-ᒧᑦ ᓈᓴᐅᑎᒥᒃ (ᐅᕝᕙᓘᓃᑦ 3%) ᐊᒻᒪ 140 ᐃᑲᕐᕋᐃᑦ (1.6%) ᐅᖓᑖᓅᖏᑦᑐᖅ NO_2-ᒧᑦ ᓈᓴᐅᑏᑦ ᐅᖓᑕᐅᑎᓚᐅᖅᑐᖅ. ᐊᒻᒪ, ᐅᖓᑕᐅᑎᓃᑦ 24-ᓂᒃ ᐃᑲᕐᕋᓄᑦ ᓈᓴᐅᑏᑦ 500 m-ᒥᑦ Sissons ᐅᔭᕋᖕᓂᐊᕐᕕᐅᑉ ᐃᓂᖓᓂᑦ ᐊᒻᒪ 900 m-ᒥᑦ ᑭᒡᒐᕕᒃ ᐅᔭᕋᖕᓂᐊᕐᕕᐅᑉ ᐃᓂᖓᓂᑦ. ᐊᔾᔨᐸᓗᖓ, ᐅᖓᑕᐅᑎᓂᖅ ᐊᑕᐅᓯᕐᒧᑦ ᐃᑲᕐᕋᒧᑦ ᓈᓴᐅᑎ ᑎᑭᐅᑎᔪᖅ 1.4 ᑭᓛᒥᑕ ᐅᖓᑖᓅᖏᑦᑐᖅ ᑭᒡᒐᕕᒃ ᐅᔭᕋᖕᓂᐊᕐᕕᐅᑉ ᐃᓂᖓᓂᑦ ᐊᒻᒪ 1.5 ᑭᓛᒥᑕ Sissons ᐅᔭᕋᖕᓂᐊᕐᕕᐅᑉ ᐃᓂᖓᓂᑦ.
- ᕿᑦᑎᓛᖅ ᓇᓚᐅᑖᖅᑕᐅᔪᖅ ᐊᕐᕌᒍᑕᒫᑦ NO_2-ᒧᑦ ᐊᒻᒪ SO_2-ᒧᑦ ᑲᑎᓯᒪᔪᑦ ᐊᑖᓃᑦ ᓇᓗᓇᐃᑯᑕᐅᑉ ᓈᓴᐅᑏᑦ ᑕᒪᐃᓄᑦ ᐃᓂᒦᖏᑦᑐᓂᑦ ᐃᓂᐅᔪᓂᑦ LAA-ᒥᑦ ᐊᒻᒪ RAA-ᒥᑦ ᐊᒻᒪ ᓯᓂᒃᑕᕐᕕᐅᔪᒥᑦ.
- PAI-ᒧᑦ ᓈᓴᐅᑏᑦ ᐅᖓᑕᐅᑎᓚᐅᖏᑦᑐᑦ ᓇᓕᑐᐃᓐᓇᖏᓐᓂᒃ 0.5 keq/ha/ᐅᑭᐅᖅ ᐅᕝᕙᓘᓃᑦ 1.0 keq/ha/ᐅᑭᐅᖅ ᓇᓅᓐᓂᐅᔪᓂᒃ LAA-ᒥᑦ ᐊᒻᒪ RAA-ᒥᑦ. ᑭᓯᐊᓂ ᐅᖓᑕᐅᑎᓂᖅᑕᕐᑲᓚᐅᖅᑐᖅᓇᓗᓇᐃᑯᑕᐅᑉ ᓈᓴᐅᑎᐊᓂᒃ ᑭᒡᒐᕕᒃ ᐅᔭᕋᖕᓂᐊᕐᕕᐅᑉ ᐃᓂᖓᓂᑦ; ᑕᒪᒃᑯᐊ ᑭᒡᓕᖅᑲᖅᑐᑦ 1 ᑭᓛᒥᑕᒥᒃ ᐱᓕᕆᐊᑉ ᐃᓂᖓᓂᑦ.

Radionuclides

- ᕿᑦᑎᓛᖅ ᓇᓚᐅᑖᖅᑕᐅᔪᖅ ᐊᕐᕌᒍᑕᒫᑦ radionuclide ᑲᑎᓯᒪᔪᑦ ᐊᑖᓃᑐᑲᓪᓚᐃᑦ ᓇᓗᓇᐃᑯᑕᐅᑉ ᓈᓴᐅᑏᑦ ᑕᒪᐃᓄᑦ ᐃᓂᒦᖏᑦᑐᓂᑦ ᐱᔪᓂᑦ ᐃᓂᐅᔪᓂᑦ LAA-ᒥᑦ ᐊᒻᒪ RAA-ᒥᑦ ᐊᒻᒪ ᓯᓂᒃᑕᕐᕕᐅᔪᒥᑦ.

ᖃᒪᓂᑦᑐᐊᖅ – ᑭᒡᒐᕕᒃ ᐊᑉᕿᑎᒧᑦ

- ᐊᖏᓛᑯᑦ ᓇᓚᐅᑖᖅᑕᐅᔪᑦ ᑲᑎᓯᒪᔪᑦ The TSP, PM_{10}, $PM_{2.5}$, NO_2 ᐊᒻᒪ -ᓂᒃ SO_2 -ᓂᒃ ᐅᑭᐅᑯᑦ ᐊᑉᕿᑎᒃᓴᐅᑉ ᖃᓂᖓᓂ ᐊᒻᒪ ᐅᑭᐅᓗᒃᑖᒥᑦ ᐊᑉᕿᑎᒃᓴᐅᑉ ᐃᓚᖓᓂᑦ ᓇᓚᐅᑖᖅᑕᐅᔪᑦ ᐊᑖᓃᑐᑲᓪᓚᐃᑦ ᓇᓗᓇᐃᑯᑕᐅᑉ ᓈᓴᐅᑏᑦ.

- ᓇᓚᐅᑖᖅᑕᐅᔪᑦ ᑲᑎᓯᒪᔪᑦ The TSP, PM_{10}, $PM_{2.5}$, ᖁᑦᑎᖕᓂᖅᓴᐅᔪᑦ ᐅᑭᐅᓗᒃᑖᒥᑦ ᐊᐸᖁᑎᒃᓴᐅᑉ ᑕᐅᑐᖕᒑᖅᑯᒧ ᐅᑭᐅᖁᑦ ᐊᐸᖁᑎᒃᓴᖅ ᓴᓇᔭᐅᓂᐊᕐᒪᑦ ᓯᐅᕋᐅᓗᒧ. ᐱᕐᑳᒍᑦ, ᑲᑎᓯᒪᔪ NO_2 ᐊᒻᒪ SO_2 wereᓇᓚᐅᑖᖅᑕᐅᓚᖅᑐᑦ ᐅᑭᐅᖁᑦ ᐊᐸᖁᑎᒃᓴᐅᑉ ᖃᓂᑕᖕᒐᓂᑦ ᐃᖏᕐᕋᔭᒡᕙᐅᒐᔪᖕᓂᖕᒐᓄᑦ ᑕᐅᑐᖕᒑᖅᑯᒧ ᐅᑭᐅᓗᒃᑖᒥᑦ ᐊᐸᖁᑎᒃᓴ.

ᖃᒪᓂᑦᑐᐊᕐᒥᑦ ᐃᒃᓴᕿᕕᖕᒍᑦ ᑐᖅᑯᖅᓯᓯᒪᕝᕕᖕᒍᑦᑐ

- ᐊᖏᓪᓕᒐᓪᓕᐊᔪᑦ ᑲᑎᓯᒪᔪᑦ ᑕᒪᐃᓂᓄᑦ ᐅᑐᓇᐊᓇᖅᑐᓄᑦ ᑭᓯᐊᓂ -ᖅᑲᖏᑦᑐᑦ ᓇᓚᐅᑖᖅᑕᐅᓚᐅᖅᑐᑦ ᐊᑖᓃᑐᑲᓪᓚᐅᓂᐊᕐᓂᖏᓐᓄᑦ ᓇᑐᓇᐃᑯᑕᐅᑉ ᓈᓴᐅᑎᖏᓐᓂᑦ.
- ᓇᓚᐅᑖᓇᓂᕐᒧᑦ ᐊᖏᓛᒃᑯᑦ ᐊᑕᐅᓯᕐᒧᑦ ᐃᑲᕐᕋᒧᑦ ᐊᒻᒪ 24-ᓂᒃ ᐃᑲᕐᕋᓄᑦ ᑲᑎᓯᒪᔪᑦ NO_2 ᐅᖓᑕᐅᑎᓚᐅᖅᑐᑦ ᓈᓴᐅᑎᓂᒃ, ᑎᑭᐅᑎᑉᐳᓂ ᐅᖓᓯᖕᓂᖅᑲᖅᑐᒧᑦ 1 ᑮᓛᒥᑕᒥᒃ ᓂᖏᖅᐸᓯᐊᓂᑦ ᐱᖓᖕᓇᖅᐸᓯᐊᓂᑦ ᐃᒃᓴᕿᕕᐅᑉ.

ᑭᖑᓪᓕᖅᐹᒃᑯᑦ ᐅᒃᑯᐊᕐᓂᖅ

- ᑭᖑᓪᓕᖅᐹᒃᑯᑦ ᐅᒃᑯᐊᕐᓂᖅᑲᖅᑎᓪᓗᒍ, ᑕᒪᐃᓂᒃ COPC-ᑦ ᓇᓚᐅᑖᖅᑕᐅᓚᐅᖅᑐᑦ ᐊᑖᓃᑐᑲᓪᓚᐅᓂᐊᕐᓂᖏᓐᓄᑦ ᓇᑐᓇᐃᑯᑕᐅᑉ ᓈᓴᐅᑎᖏᓐᓂᑦ.

ᐅᒃᑯᐊᖅᓯᒪᓕᖅᑎᓪᓗᒍ

- ᓇᓚᐅᑖᖅᑕᐅᔪᑦ ᐊᖏᓪᓕᒐᓪᓕᐊᔪᑦ radon ᑲᑎᓯᒪᔪᑦ ᐊᑖᓃᑐᑲᓪᓚᐅᓂᐊᕐᓂᖏᓐᓄᑦ ᓇᑐᓇᐃᑯᑕᐅᑉ ᓈᓴᐅᑎᖏᓐᓂᑦ 60 Bq/m^3-ᖑᔪᒥᑦ LAA-ᒥᑦ ᐊᒻᒪ RAA-ᒥᑦ.

ᑕᐅᑐᓗᒃᑖᖅᑯᒧ, ᑕᒪᐃᓂᒃ ᓇᓚᐅᑖᖅᑕᐅᔪᑦ ᕿᒪᒃᑎᑦᑐᓄᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᐅᔪᑦ ᐱᓕᕆᐊᒥᑦ ᓇᓚᐅᑖᖅᑕᐅᔪᑦ ᐊᖏᔫᔾᔭᖏᓐᓂᖏᓐᓄᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᐅᔪᑦ ᓂᕆᐅᒋᔭᐅᖕᒪᑕ ᑎᑭᐅᑎᔾᔭᖏᓐᓂᖏᓐᓄᑦ 4 ᑮᓛᒥᑕᒥᒃ ᐱᓕᕆᐊᑉ ᐃᓂᒋᔭᖕᒐᑕ ᐅᖓᑖᓄᑦ ᐊᒻᒪ ᑕᐃᒪᐅᖅᑲᑦᑕᕐᓂᐊᖅᑯᓂ ᖃᑉᔫᖅᑖᕐᔪᑐᐃᓐᓇᕐᑐᓂ ᐅᑭᐅᒥᑦ.

ᕿᒪᒃᑎᑦᑐᑦ ᑲᑎᑉᐸᓪᓕᐊᓂᕐᒧᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓃᑦ

ᑎᑎᕋᖅᓯᒪᔪᑦ ᓯᕗᓂᕐᒥᑦ ᐱᓕᕆᐊᓄᑦ ᐊᒃᑐᐊᓂᖅᑲᕈᖕᓇᖅᑐᑦ ᐱᓕᕆᐊᙳᖅᑎᑕᐅᔪᒪᔪᒧᑦ ᕿᒥᕐᕈᔭᐅᓚᐅᖅᑐᖅ ᑲᑎᑉᐸᓪᓕᐊᓂᐅᔪᖕᓇᖅᑐᓄᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᐅᔪᓄᑦ ᐃᓕᑕᕆᔭᐅᔪᓄᑦ ᕿᒪᒃᑎᑦᑐᓄᑦ ᐱᓕᕆᐊᒥᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᐅᔪᓄᑦ. ᓯᕗᓂᕐᒥᑦ ᐱᓕᕆᐊᒃᓴᐅᔪᑦ ᑎᑎᕋᖅᓯᒪᔪᑦ ᐱᑕᖅᑲᙱᑦᑐᑦ ᖃᓂᑦᑐᒥᑦ ᑎᑭᐅᑎᖅᑲᑦᑕᕐᓂᐊᕐᓂᖏᓐᓄᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᐅᔪᓄᑦ ᑭᒡᒐᕝᕕᒃ ᐱᓕᕆᐊᑉ ᐃᓂᖕᒐᓂᑦ (ᓱᕐᓗ, ᐃᓂᐅᔪᒥᑦ ᑎᑭᐅᑎᖅᑲᑦᑕᕐᓂᖅᑳᖏᓪᓗᓂ ᐳᔪᕐᓗᖕᓂᑦ ᐊᓂᐊᔪᓄᑦ ᑭᒡᒐᕝᕕᒃ ᐅᔭᕋᖕᓂᐊᕐᕕᐅᑉ ᐃᓂᖕᒐᓂᑦ ᐳᔪᕐᓗᖕᓄᑦ ᐊᓂᐊᔪᓂᑦ ᐊᓯᖏᓐᓂᑦ ᐱᓕᕆᐊᓂᑦ ᖃᓄᐃᓕᐅᕐᓂᐅᔪᓂᒡᓘᓃᑦ). ᑲᑎᑉᐸᓪᓕᐊᓂᕐᒧᑦ ᖃᓄᐃᖕᒐᓕᖅᑎᑦᑎᓂᑐᐊᖅ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᑐᖅ ᐃᓚᐅᔪᖅ ᐊᖏᓪᓕᑐᐃᓐᓇᓂᐊᖅᑲᕐᓂᖓ NO_2 ᑲᑎᓯᒪᔪᑦ ᐃᒃᓴᕿᕕᖕᒥᑦ ᑐᖅᑯᖅᓯᓯᒪᕝᕕᖕᒥᒃᑐ ᐊᐅᓚᕐᓂᓴᖏᓐᓂᑦ ᐱᓕᕆᐊᒧᑦ ᐊᒻᒪ ᐊᐳᖅᑎᓈᖅᑐᖅ ᒨᑐᒧᑦ ᐅᔭᕋᖕᓂᐊᕐᕕᖕᒧᑦ; ᑕᒪᕐᒥᒃ ᐱᓕᕆᐊᑦ NO_2-ᓂᒃ ᐳᔪᕐᓗᖕᓂᒃ ᐊᓂᐊᑎᑦᑎᓂᐊᖅᑐᑦ ᐊᒻᒪ ᐃᓂᐃᔪᖅ ᐱᑎᑦᑎᔪᖅ ᐊᑐᓂ ᑎᑭᐅᑎᔪᓄᑦ ᐃᓂᐅᔪᓄᑦ ᓄᓇᒥᑦ ᐊᒻᒪ ᓯᓚᒥᑦ.

ᐃᑲᔅᕕᒃ ᐊᑐᖅᑕᐅᖔᕈᒪᔪᖅ ᑐᖅᑯᖅᓯᒪᕗᕕᒡᓗ ᐱᓕᕆᐊᒧᑦ 1 ᑭᒥᒥᑕᒥᒃ ᐅᖓᓯᒃᑎᒋᓂᐊᖅᑐᖅ ᓂᒋᖅᐸᓯᐊᓂᑦ ᐱᖓᓐᓇᖅᐸᓯᐊᓂᑦ ᐊᐳᖅᑎᓐᓈᖅᑑᐸ ᒨᓗᒧᑦ ᐱᓕᕆᐊᐸ ᐃᑲᔅᕕᖓᓂᑦ ᑐᖅᑯᖅᓯᒪᕗᕕᖕᓂᓪᓗ. ᑖᐸᑯᐊᒃ ᐅᖅᓱᕐᒥᒃ ᐱᖃᑦᑕᕐᓂᐊᖅᑐᑦ ᐊᓯᖏᓐᓂᓪᓗ ᐱᕐᑯᑎᓂᒃ ᓯᑲᐅᑯᑦ ᐅᒥᐊᕐᔪᐊᑯᓪᓘᓅᑦ ᐊᐅᔭᒃᑯᑦ ᔪᓚᐃ ᕿᑎᐊᓂᑦ ᐅᒃᑑᐱᓇ ᐱᒋᐊᕌᕐᓂᖓᓂᑦ. ᑕᐃᒪᓐᓇᒧᑦ, ᓯᑲᐅᑦ ᐃᖏᕐᕋᔪᑦ ᑕᐃᒪᐅᕐᑲᑦᑕᕐᓂᐊᖅᑐᑦ ᐃᑲᔅᕕᖕᓂᑦ ᐊᑕᐅᑎᒃᑯᑦ, NO_x-ᒥᒃ ᐳᔪᕐᓗᖕᓂᒃ ᐊᓂᐊᑎᑦᑎᓗᑎᒃ ᐃᑯᒪᖏᓐᓂᒃ ᓄᖅᑲᖕᖑᖅᑎᓪᓗᒋᑦ. ᐊᒻᒪ, ᐊᓯᖏᑦ ᐱᕝᕕᐅᔪᑦ NO_x-ᒥᒃ, ᐃᓚᐅᑉᓗᑎᒃ ᓄᓇᒃᑰᕈᑎᕐᔪᐊᑦ ᓱᕐᓗ ᐊᒧᓯᓲᑦ, ᐊᑕᐅᑎᒃᑯᑦ ᐊᐅᓛᕐᓂᕐᑲᕐᑲᑦᑕᕐᓂᐊᖅᑐᒃᓴᐅᔪᑦ.

ᐊᔾᔨᖏᑦ ᐊᐅᓛᕐᓅᑦ ᐳᔪᕐᓗᐃᓗ ᐊᓂᐊᔪᑦ ᐃᓱᒪᒋᔭᐅᓚᐅᖅᑐᑦ ᐊᑕᐅᑎᒃᑰᕐᓗᑎᒃ ᑕᐃᒪᐅᖅᑲᑦᑕᕐᓂᐊᕐᓂᖏᓐᓄᑦ ᐃᑲᔅᕕᖓᓂᑦ ᐊᐳᖅᑎᓐᓈᖅᑐᒥᑦ ᐊᒻᒪ ᐊᔾᔨᓕᐅᖅᑕᐅᑉᓗᑎᒃ ᐊᑐᖅᓗᑎᒃ CALPUFF-ᒥᑦ ᐊᓂᐊᑎᑦᑎᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᔪᖅ. ᓇᓚᐅᑖᖅᑎᓂᕐᒧᑦ ᐊᖏᓛᒃᑯᑦ ᑲᑎᑉᐸᓪᓕᐊᔪᑦ ᐃᑲᕐᕋᒧᑦ ᐊᒻᒪ 24-ᓂᒃ ᐃᑲᕐᕋᓄᑦ NO_2 ᑲᑎᓯᒪᔪᑦ ᐱᔪᓂᑦ ᐃᓂᐃᔪᑦ ᖃᒪᓂᑦᑐᐊᕐᒥᑦ ᐊᑦᑎᖕᓂᖅᓴᐅᓚᐅᖅᑐᑦ ᓇᓗᓇᐃᖅᓯᓂᕐᒧᑦ ᓈᓴᐅᑎᒥᑦ, ᑭᓯᐊᓂ ᐅᖓᑕᐅᑎᐸᓗᑎᒃ ᑕᒪᐃᓂᒃ ᐱᕐᑯᑎᓂᑦ. ᑭᓯᐊᓂ, ᐅᖓᑕᐅᑎᓅᑦ ᑭᒡᓕᖅᑲᖅᑐᑦ 2 ᑭᒥᒥᑕᒥᒃ ᐅᖓᓯᒃᑎᕆᔪᒥᑦ ᐱᓕᕆᐊᐸ ᐃᓂᖓᓂᑦ, ᐊᒻᒪ ᑕᐃᒪᐅᓚᔾᔪᒃᓗᑎᒃ. ᑕᐃᒪᓐᓇᒧᑦ, ᐊᖏᓗᐊᖏᕆᐊᖅᑎᑦᑎᓂᐅᔪᒪᔪᖅ ᐊᒻᒪ ᐊᕙᑎᒥᒃ ᒥᐊᓂᖅᓯᓂᕐᔫᖓᔪᑦ (ᓲᕐᓗ, ᐊᓂᐊᔪᓂᒃ ᐊᐅᓚᑦᑎᔾᔪᑏᑦ; ᑕᑯᓗᒍ ᑐᓪᓚᐅᓂᐊᖅᑐᖅ), ᑲᑎᑉᐸᓪᓕᐊᔪᑦ ᕿᒪᒃᑎᑦᑐᓄᑦ ᖃᓄᐃᖓᑎᑦᑎᓂᖅ ᐊᖏᓪᓕᕆᐊᖅᑐᓂᒃ NO_2-ᓂᒃ ᑲᑎᓯᒪᔪᓂᒃ ᐱᓕᕆᐊᒥᑦ ᐊᒻᒪ ᐊᐳᖅᑎᓐᓈᖅᑐᒥᑦ ᐃᑲᔅᕕᖕᒥᑦ ᐊᐅᓚᑦᑎᓅᑦ ᐊᖏᔫᖏᑦᑐᖅ.

ᐊᖏᓗᐊᖏᕆᐊᖅᑎᑦᑎᓂᕐᔫᖓᔪᑦ

ᐊᓅᕙᒃᑯᑦ ᐱᓕᕆᐊᖅᑲᕐᓂᐊᖅᑐᑦ ᖃᐸᓯᐊᕐᔪᖕᓂᒃ ᐊᖏᓗᐊᖏᕆᐊᖅᑎᑦᑎᓂᕐᔫᖓᔪᓂᒃ ᒥᒃᓵᕆᐊᖅᑎᑦᑎᓂᕐᒧᑦ ᑲᑎᑉᐸᓪᓕᐊᓂᐅᔪᖕᓇᑐᓂᒃ ᐊᕙᑎᒥᒃ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔪᓂᒃ NO_2-ᒧᑦ. ᑕᒪᒃᑯᓇᓂ ᐃᓚᐅᔪᑦ ᐊᑐᕐᓗᓂ ᐃᓱᐊᕿᔪᓄᑦ ᐊᐅᓚᑦᑎᔾᔪᑎᓂᒃ, ᐋᕿᒋᐊᕐᓗᒋᑦ ᖃᐸᓯᐅᓂᖕᒋᑦ ᓄᓇᒃᑰᕈᑎᕐᔪᐊᑦ ᐊᐅᓚᓪᓗᑦ, ᐊᒻᒪ ᓇᐃᓪᓕᒋᐊᕐᓗᒋᑦ ᐅᖓᓯᒃᑐᒧᑦ ᐃᖏᕐᕋᔭᖕᓂᐅᔪᑦ, ᖃᐸᓯᐅᓂᖕᒋᑦ ᓯᑲᐅᑯᒃ ᐊᐅᓚᖅᑎᓂᐅᔪᑦ ᐅᓲᔭᐃᓃᓪᓗ, ᐊᒻᒪ ᓯᑲᐅᓪᓗ ᐅᒥᐊᕐᔪᐊᓪᓗ ᐃᑯᒪᖏᑦ ᐊᐅᓛᕐᓂᖏᑦ ᓄᖅᑲᖓᑎᓪᓗᒋᑦ ᐃᑲᔅᕕᖕᒥᑦ (ᓲᕐᓗ, ᑭᒡᓕᖅᑲᖅᑎᓪᓗᒋᑦ ᓄᖅᑲᖓᓗᑎᒃ ᐃᑯᒪᖏᑦ ᐊᐅᓛᕐᓂᖏᑦ ᐊᑕᐅᓯᕐᒧᑦ ᓯᑲᐅᒧᑦ ᐃᑲᔅᕕᖕᒥᑦ, ᐊᔪᕐᓇᙱᑦᑕᕐᐸᑦ).

ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓᓂᒃ ᖃᐅᔨᒋᐊᖃᑦᑕᕐᓂᖅ

ᐆᒃᑑᑎ ᐊᓂᖅᓵᖅᑐᖅᑕᑉᑕ ᖃᓄᐃᓂᕆᔭᖓᓂᒃ ᖃᐅᔨᒋᐊᖃᑦᑕᕐᓂᕐᒧᑦ ᑐᕌᖓᔪᖅ ᑎᑎᖅᑲᖅ 4C-ᒦᑐᖅ ᑕᒪᐃᓄᑦ ᓇᓃᓐᓂᓗᒃᑖᕆᔭᖓᓄᑦ ᐱᓕᕆᐊᐸ ᓇᓗᓇᐃᖅᓯᓂᕐᒧᑦ ᐊᒻᒪ ᒪᓕᖕᓂᕐᒧᑦ ᐱᔾᔪᑎᓄᑦ, ᐊᒻᒪ ᐃᓚᐅᔪᑦ TSP (ᓴᕝᕚᓪᓗ TSP-ᒥᑦ), PM_{10}, $PM_{2.5}$, NO_2, SO_2, ᐳᔪᖅᑳᖅ (ᐊᒻᒪ ᓴᕝᕚᑦ ᐳᔪᖅᑳᒥᑦ) ᐊᒻᒪ radionuclides. ᐊᒻᒪ, ᓇᐃᑐᒥᒃ-ᖃᓄᑎᒋᐅᓂᖓ ᖃᓂᑦᑐᒥᒃ ᖃᐅᔨᒋᐊᖃᑦᑕᕐᓂᖅᑕᖃᕈᒪᔪᖅ ᖃᒪᓂᑦᑐᐊᕐᒥᑦ NO_2-ᒧᑦ ᐊᐅᓚᖅᑎᑦᑎᖃᑦᑕᕐᓂᐅᑎᓪᓗᒍ ᓇᓗᓇᐃᖅᓯᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᔪᓄᑦ ᓇᓚᐅᑖᖅᑎᓐᓂᑦ. ᐅᖃᐅᓯᐅᔪᑦ/ᓄᓇᓕᖕᒥᑦ ᐃᓱᒫᓘᑎᓄᑦ ᑭᐅᔾᔪᑕᐅᔪᓄᑦ ᒪᓕᒃᑕᐅᔪᒃᓴᐃᑦ ᐊᑐᓕᖅᑎᑕᐅᓂᐊᕐᒥᔪᑦ.

ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᕐᓄᑦ ᖃᐅᔨᓴᐃᓂᖅ ᓯᓚᐅᑉ ᐊᓯᐊᖑᕐᓂᖓᓄᑦ

ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓃᑦ ᐱᓕᕆᐊᒥᑦ ᖃᓄᐃᓕᐅᕐᓂᐅᔪᓂᑦ ᐳᔪᕐᓗᖕᓂᒃ ᐊᓂᐊᔪᓂᑦ

ᓴᓇᔭᐅᑎᑦᓱᒍ, ᐊᐅᓛᖅᑎᑦᓱᒍ ᐊᒪᓗ ᑭᖑᓪᓕᖅᐹᒃᑯᑦ ᐅᒃᑯᐊᖅᑎᑦᓱᒍ ᐱᓕᕆᐊᖅ, ᖃᓄᐃᓕᐅᕐᓂᐅᔪᑦ ᑕᐃᒪᐅᖅᑲᑦᑕᕐᓂᐊᖅᑐᑦ ᐳᔪᕐᓗᖕᓂᒃ ᐱᑕᖅᑲᖅᑎᑦᑎᓗᑎᒃ (GHG)-ᓂᒃ ᐊᒪᓗ ᑕᐃᒪᓐᓇᒎᑦ ᐃᑲᔪᐃᓂᖅᑲᕆᐊᓐᓇᖅᓗᓂ ᓯᓚᐅᑉ ᐊᓯᐊᖑᕐᓂᖓᓄᑦ. ᖃᓄᐃᓕᐅᕐᓂᐅᔪᑦ ᐊᖏᓪᓕᒋᐊᖅᑎᑦᑎᔪᓐᓇᖅᑐᑦ ᑲᑎᓯᒪᔪᓂᒃ GHG-ᓂᒃ ᐃᓚᐅᔪᑦ ᐅᖅᓱᖅᑐᕐᓂᖏᑦ ᓅᕐᑐ ᓄᓇᒃᑰᕈᑎᕐᔪᐊᑦ ᐅᔭᕋᖕᓂᐊᕐᕕᖕᒥᑦ ᐊᒪᓗ ᖃᒪᓂᑦᑐᐊᕐᒥᑦ ᐃᒃᓴᕐᕕᖕᒥᑦ ᑐᖅᑯᖅᓯᓯᒪᕝᕕᖕᒥᑦᑐ ᐊᒪᓗ ᓄᓇᒃᑰᕈᑏᑦ ᐃᖏᕐᕋᑎᑦᓱᒋᑦ, ᐃᑯᒪᖅᑯᑎᑐᕐᓂᖅ, ᐊᒪᓗ ᐅᒥᐊᕐᔪᐊᓂᑦ.

ᐊᖏᓗᐊᖏᒋᐊᖅᑎᑦᑎᓂᖅ ᐊᒪᓗ ᐱᓕᕆᐊᑉ ᖃᓄᐃᑑᓂᖓ

ᐊᖏᓗᐊᖏᒋᐊᖅᑎᑦᑎᓂᖅ ᖃᓄᐃᑑᓂᖓᒍᑦ ᐊᒪᓗ ᐊᖏᓗᐊᖏᒋᐊᖅᑎᑦᑎᓂᖅ ᐊᐅᓚᑦᑎᓂᒃᑰᖓᔪᑎᒍᑦ ᐃᓚᓕᐅᑎᔭᐅᓚᐅᖅᑐᑦ ᒫᓐᓇᐅᔪᖅ ᐱᓕᕆᐊᒍᑦ ᐸᕐᓇᐅᑎᓂᒃ ᒥᑭᓪᓕᒋᐊᖅᑎᑦᑎᓂᐊᖅᑐᖅ ᐱᓕᕆᐊᒨᖓᔪᓂᒃ GHG-ᓂᒃ ᐊᓂᐊᔪᓄᑦ. ᑕᒃᑯᓇᓂ ᐃᓚᐅᔪᑦ ᐃᓚᓕᐅᑎᔭᐅᔪᑦ ᐆᒻᒪᖅᑯᑎᒃᑯᑦ ᐃᓗᐊᖅᓯᓯᒪᔪᑦ ᐊᒪᓗ ᐳᔪᕐᓗᖕᓂᒃ ᐊᓂᐊᔪᓂᒃ ᒪᑭᓪᓕᒋᐊᖅᑎᑦᑎᓂᕐᒨᖓᔪᓂᒃ ᐃᓪᓗᕐᔪᐊᑉ ᖃᓄᐃᑑᓂᐊᕐᓂᓇᔭᖓᓄᑦ ᐊᒪᓗ ᐊᐅᓛᖅᑎᑦᑎᓂᕐᒥᑦ. ᐊᑐᖅᑕᐅᓂᖏᑦ ᐊᑐᖅᑕᐅᕙᒃᑐᑦ ᐊᐅᓛᖅᑎᑦᑎᓂᕐᒧᑦ ᒪᓕᒃᑕᐅᔪᒃᓴᐃᑦ ᐃᑯᒪᓅᖅᑐᓄᑦ ᐱᓕᕆᐊᖑᖅᑲᑦᑕᐅᔭᕐᓂᐊᖅᑐᑦ ᐊᑐᖅᑕᐅᔪᑦ ᐊᐅᓛᑦᑎᐊᕈᓐᓇᖃᑐᐊᕐᓂᖏᓐᓄᑦ ᑕᐃᒪᓐᓇ ᒥᑭᓪᓕᒋᐊᖅᑎᑦᑎᓂᐊᖅᑐᑦ ᐳᔪᕐᓗᖕᓂᒃ ᐊᓂᐊᔪᓂᒃ. ᐊᒪᓗ, ᓄᓇᒃᑰᕈᑏᑦ ᐊᐅᓚᑦᑐᑦ ᐃᖏᕐᕋᓃᑦᑐ ᐅᖓᓯᖕᓂᖏᑦ ᐱᐅᓯᕆᐊᖅᑕᐅᓂᐊᖅᑐᑦ ᐅᖅᓱᖅᑐᓗᐊᖏᓐᓂᕐᒧᑦ, ᑕᐃᒪᓐᓇᓗ ᒥᑭᓪᓕᒋᐊᖅᑎᑦᑐᑎᒃ ᐳᔪᕐᓗᖕᓂᒃ ᐊᓂᐅᔪᓂᒃ.

ᕿᒪᒃᑎᑦᑐᓄᑦ ᐱᓕᕆᐊᒥᒃ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓃᑦ ᓯᓚᐅᑉ ᐊᓯᐊᖑᕐᓂᖓᓄᑦ

ᐊᒃᑐᐊᓂᖅᑲᕆᐊᓐᓇᖅᓂᖏᓐᓄᑦ ᐊᖏᓪᓕᒋᐊᖅᓃᑦ ᐊᓂᐊᔪᑦ GHG ᐊᒪᓗ ᓄᓇᕐᔪᐊᖅ ᐆᓇᖅᓯᕚᓪᓕᐊᓂᖓ, ᐱᓕᕆᐊᖅ ᐃᑲᔪᐃᓂᖅᑲᑐᐃᓐᓇᕆᐊᖅᑲᖅᑐᖅ ᓯᓚᐅᑉ ᐊᓯᐊᖑᕐᓂᖓ ᑕᑭᔪᒥᒃ-ᐊᑯᓂᐅᑎᒋᓂᖓᓄᑦ, ᖃᓄᐃᑦᑐᓂᕆᔭᖓ ᐊᖏᓂᕆᔭᖓᑐ ᐊᓯᐊᖑᕐᓂᐅᔪᑦ ᐅᓯᒪᒋᔭᐅᑐᐃᓐᓇᖅᑑᕙᑐᐊᖅᑎᑦᓱᒋᑦ. ᐱᑐᐊᖅᑐᒥᑦ, ᑲᓇᑕᒥᑦ ᐊᕙᑎᒥᒃ ᖃᐅᔨᓴᐃᔪᓕᕆᔨᒃᑯᑦ ᒪᓕᒃᑕᐅᔪᒃᓴᖓᑦ ᐃᓚᐅᑎᑦᑎᓂᖏᑦ ᓯᓚᐅᑉ ᐊᓯᐊᖑᕐᓂᖓᓄᑦ ᐃᓱᒪᒃᓴᖅᓯᐅᕈᑏᑦ ᐊᕙᑎᒥᒃ ᖃᐅᔨᓴᐃᓂᖏᓐᒥᑦ (CEA Agency 2003) ᐅᖃᖅᑐᑦ ᓯᓚᐅᑉ ᐊᓯᐊᖑᕐᓂᖓ ᓇᓗᓇᖅᑑᖓᑕᑦ, ᓄᓇᕐᔪᐊᕐᒨᓕᖓᕙᑉᑐᓂ ᐊᒪᓗ ᐊᓯᖏᑦᑎᑑᖏᑦᑐᖅ ᐱᓕᕆᐊᒨᖓᔪᑦ ᐊᕙᑎᒥᒃ ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔪᑦ, ᐃᑲᔪᐃᓂᖓ ᐊᑕᐅᓯᐅᑉ ᐱᓕᕆᐊᑉ ᓯᓚᐅᑉ ᐊᓯᐊᖑᕐᓂᖓᓄᑦ ᐆᒃᑐᕋᖅᑕᐅᓂᖅ ᐊᔪᖅᑐᖅ. ᑕᐃᒪᓐᓇᒎᑦ, ᖃᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔪᖕᓇᖅᑐᑦ ᐱᓕᕆᐊᒥᑦ ᓯᓚᐅᑉ ᐊᓯᐊᖑᕐᓂᖓᓄᑦ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᑐᑦ ᖃᑉᓯᐅᓂᕐᒨᖓᕙᑉᑐᒍ ᖃᓄᐃᓂᖅᓴᐅᓂᒃᑯᑦ ᐱᓕᕆᐊᒨᖓᔪᑦ ᐳᔪᕐᓗᐃᑦ ᐊᓂᐊᔪᑦ GHG-ᑦ ᑕᒪᐃᓄᑦ ᑲᓇᑕᒥᑦ ᐅᑭᐅᖅᑕᖅᑐᒥᑦᑐ ᐊᕕᒃᑐᖅᓯᒪᔪᖏᓐᓂᑦ GHG ᐊᓂᐊᔪᑦ ᓇᓃᓂᖏᑦ. ᓇᓚᐅᑖᖅᑕᐅᔪᑦ ᐊᖏᓛᒃᑯᑦ ᐊᕐᕌᒍᑕᒫᑦ GHG ᐊᓂᐊᔪᑦ ᐊᑐᖅᓗᓂ ᑎᑭᐅᑎᓂᖅ ᓇᓐᓂᐅᔪᒧᑦ ᐅᖅᓱᖅᑐᕐᓂᖅ 181 kilotonnes-ᖑᔪᖅ CO_2-ᐊᔾᔨᖓ. ᑕᑯᔅᓴᐅᑎᑦᑎᔪᖅ 44%-ᒥᒃ ᐊᖏᓪᓕᒋᐊᕐᓂᖓ ᑭᓪᓕᐅᔪᓂᒃ GHG ᐊᓂᐊᔪᑦ ᓄᓇᕗᒻᒧᑦ, 0.03%-ᒥᒃ ᐊᖏᓪᓕᒋᐊᖅᑐᖅ ᑭᓪᓕᐅᔪᒥᑦ GHG ᐊᓂᐊᔪᓄᑦ ᑲᓇᑕᒧᑦ ᐊᒪᓗ 0.0006%-ᒥᒃ ᐊᖏᓪᓕᒋᐊᖅᓗᓂ ᓄᓇᕐᔪᐊᒥᑦ GHG ᐊᓂᐊᔪᓄᑦ. ᑭᓯᐊᓂ, ᓂᕆᐅᒋᔭᐅᔪᖅ ᐊᓯᖏᑦ ᐱᓕᕆᐊᖑᖅᑎᑕᐅᔪᒪᔪᑦ ᐊᐅᓛᓕᕈᓐᓇᕐᓂᐊᕐᒪᑕ ᑭᓪᓚᕕᖕᒥᑦ ᐱᓕᕆᐊᖅ ᐊᐅᓚᓕᖅᑳᖅᑎᑦᓱᒍ, ᑕᐃᒪᓐᓇᒎᑦ, ᐃᑲᔪᐃᓂᖅ ᓄᓇᕗᑦ GHG ᐊᓂᐅᔪᓄᑦ ᒥᑭᓂᖅᓴᐅᓂᐊᖅᑐᖅᓴᐅᔪᖅ ᑲᑎᓗᒃᑖᕐᓗᑎᑦ ᐊᓂᐊᔪᑦ ᓂᕆᐅᒋᔭᐅᔪᓂᐅᓚᓂᑦ ᑕᒃᕙᓂ.

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Attachments

Attachment A Glossary and Terms

1 Introduction – Air Quality and Climate Change

1.1 Background

The Kiggavik Project (Project) is a proposed uranium ore mining and milling operation located in the Kivalliq region of Nunavut approximately 80 km west of the community of Baker Lake (Figure 1.1-1). The Project is operated by AREVA Resources Canada Inc. (AREVA), in joint venture partnership with JCU (Canada) Exploration Co., Ltd. and Daewoo International Corp.

Within the Kiggavik Project there are two general site areas referred to herein as the Kiggavik site and the Sissons site. The two sites are located approximately 17 km apart. Three uranium ore deposits will be mined at the Kiggavik site: East Zone, Centre Zone and Main Zone. A uranium mill, related facilities, main accommodations, and landing strip will also be located at the Kiggavik site. The Sissons site has two uranium ore deposits to be mined: Andrew Lake and End Grid. Open pit mining will be used to extract the ore from the three Kiggavik deposits as well as the Andrew Lake deposit. Mining of End Grid ore will require underground methods.

All ore extracted from the mine sites will be processed through the Kiggavik mill. Mined out pits at the Kiggavik site will sequentially be used as tailings management facilities (TMFs) with East Zone being the initial TMF. The uranium product will be packaged and transported via aircraft to southern transportation networks. Initially, mill reagents, fuel and other supplies will be transported by barge to Baker Lake and then by truck to the mine site over a winter access road. An all-season road between Baker Lake and the Kiggavik Site is carried as a secondary option proposed as a contingency in case the winter road cannot adequately support the Project over its life-span.

Decommissioning of the Project will include demolition of site facilities, clean up and reclamation of any disturbed areas, closure of the TMFs and reclamation of mine rock piles to promote vegetative growth and to provide wildlife access.

Projection: NAD 1983 UTM Zone 14N
Creator: CDC
Date: 8/21/2014 Scale: 1:16,000,000
File:
Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, Geological Survey of Canada, AREVA Resources Canada Inc.*

FIGURE 1.1-1
GENERAL LOCATION OF PROPOSED KIGGAVIK PROJECT IN CANADA

ENVIRONMENTAL IMPACT STATEMENT VOLUME 4

Kiggavik Project

AREVA

AREVA Resources Canada Inc - P.O. Box 9204 - 817 - 45th Street West - Saskatoon, SK - S7K 3X5

The Kiggavik Project is subject to the environmental review and related licensing and permitting processes established by the Nunavut Land Claims Agreement (NLCA) (NIRB [Nunavut Impact Review Board] 2011), and to the licensing requirements of the Canadian Nuclear Safety Commission (CNSC). The Minister of Indian and Northern Affairs Canada (now Aboriginal Affairs and Northern Development Canada; AANDC) referred the Kiggavik Project to the NIRB for a Review under Part 5 of Article 12 of the NLCA in March of 2010.

The final NIRB “Guidelines for the Preparation of an Environmental Impact Statement for AREVA Resources Canada Inc.’s Kiggavik Project (NIRB File No. 09MN003)” (NIRB 2011) were issued in May of 2011. AREVA submitted the Draft Environmental Impact Statement in December 2011 and again in April 2012 with the NIRB determining that the submission successfully conformed to the EIS guidelines in May 2012. Two review periods followed with the Information Request stage completed in January 2013 and the Technical Review stage completed in May 2013. An in-person technical meeting was hosted in Rankin Inlet, Nunavut by the NIRB in May 2013 with a Community Roundtable and a Pre-Hearing Conference (PHC) hosted in Baker Lake, Nunavut shortly after in June 2013. Following the Pre-Hearing Conference the NIRB issued the “Preliminary Hearing Conference Decision Concerning the Kiggavik Project (NIRB File No. 09MN003)” in July 2013.

1.2 Nunavut Impact Review Board Guidelines for the Environmental Impact Statement and Prelimary Conference Decision

The DEIS, including this volume, was determined by the NIRB on May 4, 2012 to have adequately addressed relevant sections of the NIRB “Guidelines for the Preparation of an Environmental Impact Statement for AREVA Resources Canada Inc.’s Kiggavik Project (NIRB File No. 09MN003)” (NIRB 2011).

Greater clarity, consistency and, in some cases, additional design or assessment were provided within AREVA’s responses to information requests in January 2013 and technical comments in May 2013. AREVA commitments for the preparation of the FEIS and regulatory review requirements are listed in the NIRB PHC Decision dated July 2013. Changes from the draft to final EIS including the location of information related to information requests, technical comments, and PHC requirements is noted in the Final Environmental Impact Statement (FEIS) conformity table (Tier 1, Volume 1, Technical Appendix 1A).

This volume is intended to address Section 8.1.1 and 8.1.2 of the NIRB “Guidelines for the Preparation of an Environmental Impact Statement for AREVA Resources Canada Inc.’s Kiggavik Project (NIRB File No. 09MN003)” (NIRB 2011) whereby the following requirements are outlined:

Air Quality Baseline Information requirements:

- Background air quality data and data related to atmospheric conditions collected in the LAA and RAA including where relevant radon-222, airborne dust (total suspended particulates (TSP), PM_{10} and $PM_{2.5}$, radioactive constituents, and/or metals), GHG emissions, hydrochloric acid (HCl), and standard air constituents such as sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), hydrocarbons, ozone (O_3), etc.;
- Current sources of potential activities which may contribute acidic precipitation; and
- Current sources of emissions and seasonal variations or climatic conditions associated with variations in air quality.

Air Quality Impact Assessment requirements:

- Discussion of the standards, guidelines and regulations that the Proponent will incorporate to minimize and mitigate effects to air quality;
- Predictions of principle pollution emission sources and emission rates of both radiological and non-radiological emissions from the Project at various stages, including:
  - o Gaseous emissions from the fuel consumption of mobile equipment such as vehicles, marine vessels, aircrafts, and stationary equipment such as diesel generators and other combustion sources;
  - o Fugitive dust and gaseous (i.e., radon) emissions from extraction and ore processing, handling, tailings, waste rock and ore stockpiling, quarries and other Project components and works; and
  - o Fugitive dust emissions from ground transportation and wind erosion at various Project components including the all-weather road, access roads and mine hauling roads.
- Assessment of dispersion of Project emissions using a LAA and RAA, using appropriate modelling, and discussion of related impacts and mitigation strategies;
- Discussion of Project components and activities which may contribute to the potential for acidic precipitation, and an evaluation of associated effects;
- Assessment of effects on air quality from Project emissions during various Project stages; including radon-222, airborne dust [total suspended particulates (TSP), PM_{10} and $PM_{2.5}$, radioactive constituents, and/or metals], GHG emissions, HCl, and standard air constituents such as SO_2, NO_x, CO, hydrocarbons, O_3, etc.;
- Assessment of the Project's GHG contributions to both Nunavut and Canada; and
- A discussion of the potential effects of changes in air quality on human health (see Volume 8 – Human Health).

Climate (including climate change) and Meteorology Baseline Information requirements:

- A description of the baseline meteorological and climatic conditions at the LAA and RAA, including methods of determination including a discussion of how data from outside the project area may have been utilized and uncertainties encountered;
- Meteorological data including but not limited to: air temperature, precipitation, evaporation and sublimation rates, wind directions and velocity, and prevailing wind directions at areas of project components and along proposed shipping route(s);
- Annual, seasonal, monthly and daily average/mean values of above noted meteorological parameters; seasonal and yearly fluctuations and variability; and extreme climate events over the same period of time in which the data, including site-specific data are collected in the RSA of the Project; and
- Prevalent trends related to VECs in the Project area and any resulting implications to the Project.

Climate (including climate change) and Meteorology Impact Assessment requirements:

- Discussion of the relationship between climate change and GHG emissions from the Project; and
- Discussion on the climate parameters that may change due to emissions (GHG, HCl, and standard air constituents such as SO_2, NO_x, CO, hydrocarbons, O_3, etc.) from the Project.

1.3 Purpose and Scope

The purpose of this document is to describe the Project components and activities that have the potential to interact with the atmospheric environment and result in a potential environmental effect to air quality and climate change. The overall objective of the Air Quality and Climate Change Environmental Effects Assessment is to identify the potential residual environmental effects to air quality and climate change resulting from the Project and to determine the significance of such effects.

The FEIS has been prepared to fulfil the intent of the NIRB Guidelines and PHC Decision, ultimately providing the information required to confidently proceed with an environmental assessment determination. The assessment has been influenced and reflects input provided from Inuit, Land Claim, Government, community, and other interested stakeholders.

1.4 Report Content

In addition to this introduction (Section 1), this volume consists of the following sections:

- Section 2: An Overview of the Project and associated assessment basis
- Section 3: A description of the environmental assessment approach and methodology used to assess potential effects of the Project
- Section 4: A description of the scope of assessment and the methodology used for the Air Quality and Climate Change Environmental Effects Assessment
- Section 5: A summary of the existing environment
- Section 6: An assessment of Project effects and cumulative effects to air quality
- Section 7: An assessment of Project effects and cumulative effects to climate change

Tier 3 documents are appended to this Volume to provide further details and supporting information. The Technical Appendices pertaining to this volume are as follows:

- Technical Appendix 4A: Climate Baseline
- Technical Appendix 4B: Air Dispersion Assessment
- Technical Appendix 4C: Atmospheric Monitoring and Mitigation Plan
- Technical Appendix 4D: Baker Lake Long-term Climate Scenario
- Technical Appendix 4E: Noise and Vibration Assessment
- Technical Appendix 4F: Noise Abatement Plan

2 Project Overview – Air Quality and Climate Change

2.1 Project Fact Sheet

Location	• Kivalliq Region of Nunavut, approximately 80 km west of Baker Lake. • The Project includes two sites: Kiggavik and Sissons (collectively called the Kiggavik Project). • The Kiggavik site is located at approximately 64°26'36.14"N and 97°38'16.27"W. • The Sissons site is located approximately 17 km southwest of Kiggavik at 64°20'17.61"N and 97°53'14.03"W. • The Kiggavik and Sissons sites are composed of 37 mineral leases, covering 45,639 acres.
Resources	• The total quantity of resources is currently estimated at approximately 51,000 tonnes uranium (133 million lbs U3O8) at an average grade of 0.46% uranium.
Life of Mine	• Approximately 12 years of production, based on studies to date. It is anticipated that pre-operational construction will require three years while remaining post-operational decommissioning activities will require five years. • Date of Project construction will be influenced by favorable market conditions, completion of detailed engineering, and successful completion of licensing and other Project approvals.
Mining	• There are five individual mines proposed for the Project: East Zone, Center Zone and Main Zone at the Kiggavik site; End Grid and Andrew Lake at the Sissons site. • The three Kiggavik deposits and the Andrew Lake deposit will be mined by truck-shovel open pit, while End Grid will be an underground mine.
Mine Rock	• Mine rock will be segregated into material suitable for use in construction (Type 1), non-acid generating (Type 2), and potentially problematic material (Type 3). • Type 1, Type 2 and Type 3 rock will be managed in surface stockpiles during operation. • Upon completion of mining, Type 3 mine rock will be backfilled into mined-out pits.
Mill	• The ore will be processed in a mill at the Kiggavik site to produce 3,200 to 3,800 tonnes uranium (8.3 to 9.9 million lbs U3O8) per year as a uranium concentrate, commonly referred to as yellowcake.
Tailings	• The mill tailings will be managed at in-pit tailings management facilities constructed using the mined-out East Zone, Centre Zone and Main Zone open pits at the Kiggavik site. • Administrative and action levels will be used to control and optimize tailings preparation performance for key parameters.
Water Management	• A purpose-built-pit will be constructed at the Kiggavik site to optimize water management, storage, and recycling. • All mill effluent, tailings reclaim, and site drainage will be treated prior to discharge to meet the Metals Mining Effluent Regulations and site-specific derived effluent release targets. • Administrative and action levels will be used to control and optimize water treatment plant performance for key elements.
Site Infrastructure	• Power will be supplied by on-site diesel generators. • The operation will be fly-in/fly-out on a 7 to 14 day schedule with on-site employees housed in a permanent accommodations complex.

Access	• Access to the site will be provided by a winter road between Baker Lake and Kiggavik. An all-season road is assessed as an option should the winter road be unable to adequately support the Project. Supplies will be shipped to a dock facility at Baker Lake during the summer barge season and trucked to Kiggavik via the road. • An airstrip will be constructed and operated at site for transportation of personnel and yellowcake.
Environment	• Site-specific environmental studies have been on-going since 2007 • Public engagement and collection of Inuit Qaujimajatuqangit has been on-going since 2006; this information is integrated into the environmental effects assessment reports • AREVA's approach has been to integrate environmental assessment and decommissioning requirements into the Project design cycle to enhance mitigation of effects by design and to support the development of management, mitigation, and contingency plans to protect the environment
Benefits	• AREVA is negotiating an Inuit Impact Benefit Agreement with the Kivalliq Inuit Association • The total taxes and royalties to be paid on the Kiggavik project would be approximately $1 billion, payable to Nunavut Tunngavik Inc., Government of Nunavut, and Government of Canada. • The Project is expected to employ up to 750 people during construction and 400 to 600 people during operation.

The economic feasibility of the Kiggavik Project depends on 1) the production cost for the uranium concentrate including construction, operation and decommissioning costs and 2) the market value of the final product. The latest feasibility study completed for the Kiggavik Project was in November 2011. The study assessed the technical and economic viability of developing and operating a uranium mine and mill site in the Kiggavik area and estimated the capital cost of the Project at $2.1 billion and the operating cost at $240 million per year. This initial feasibility study will be updated and refined prior to a development decision. The market price for uranium concentrate over the last years has been within the range needed for a reasonable return on investment to its owners, however at the time of FEIS preparation was below the threshold needed for Project advancement. AREVA believes future opportunities are strong enough to encourage Project advancement with the intent of development that will coincide with viable future markets.

2.2 Assessment Basis

To ensure that the potential environmental and socioeconomic effects of the Kiggavik Project are adequately considered in this environmental assessment, it was determined that it would be advantageous to develop a clear "assessment basis" for the Project. The purpose of the assessment basis is to clearly and consistently define how the design parameters detailed in Tier 2 Volume 2 Project Description encompass the more conservative values for various design features and options. It is consistent with the precautionary principle to assess potential environmental effects conservatively to improve confidence that the Project can be realized within the predicted effects and approved environmental assessment.

The assessment basis is summarized in Table 2.2-1 and presented with greater detail in Tier 2 Volume 2 Section 20. For biophysical and some socio-economic effects, the range value with the greatest potential to result in an adverse effect is used. In the case of socio-economic benefits, the range value resulting in the lowest benefit is used.

Table 2.2-1 Project Assessment Basis

Project Activities/Physical Works	Parameter	Units	Parameter / Assumption Values	
			Base Case (PD)	Assessment Case
Overall	Production Rate	Tonnes U per year	3,200 – 3,800	3,200 - 4,000
	Mill Feed Rate	Kilotonnes per year	71 - 977	1,000
	Project Operating Life	Years	2 years pre-production 12 years production	25
	Project Footprint	Hectares (ha)	938	1,102
	Access Road Route	Not Applicable	Winter Road	Winter Road All-Season Road
	Dock Site Location	Not Applicable	Site 1	Sites 1,2, Agnico Eagle's Meadowbank Dock Site
Milling	Flowsheet	Not Applicable	Resin in Pulp (RIP)	Resin in Pulp (RIP), possibly solvent extraction (SX) and / or calciner
	Final Product	Not Applicable	Non-calcined uranium concentrate	Non-calcined or calcined uranium concentrate
Tailings Management	Containment volume	Million cubic metres (Mm^3)	28.4	30.0
	Total tailings volume (un-consolidated)	Million cubic metres (Mm^3)	21	30.0
	Design		Natural surround, no drain	Various design contingencies
Water Management	Freshwater requirements – no permeate or site drainage recycle	Cubic metres per day (m^3/day)	7,910	8,000
	Freshwater requirements – permeate and site drainage recycle	Cubic metres per day (m^3/day)	2,000	8,000
	Freshwater requirements - Sissons	Cubic metres per day (m^3/day)	60	60
	Treated effluent discharge at base quality – Kiggavik	Cubic metres per day (m^3/day)	2,707	3,000
	Treated effluent discharge – Sissons	Cubic metres per day (m^3/day)	1,700	1,700
Power Generation	Kiggavik peak load	megaWatt (MW)	13.0	13.0 – 16.8
	Sissons peak load	megaWatt (MW)	3.8	0 – 3.8
Logistics & Transportation	Number of barge trips – 5000t & 250 containers	Barge trips / year	9 - 31	31
	Number of barge trips – 7500t & 370 containers	Barge trips / year	7 - 22	22
	Number of truck trips – 56,000L & 48t	Truck trips / year	328 – 3,233	3,300
	Number of truck trips – 70,000L & 60t	Truck trips / year	243 – 2,405	2,500
	Number of yellowcake flights	Flights / year	310 - 350	355
Decommissioning	Period	Years	10	10

3 Assessment Methodology – Air Quality and Climate Change

3.1 Introduction

This section describes the methods used in the assessment of environmental and socio-economic effects associated with the Kiggavik Project. The methods meet the applicable regulatory requirements while focusing the assessment on the matters of greatest environmental, social, cultural, economic and scientific importance. The methodological approach also recognizes the iterative nature of project-level environmental assessment, considering the integration of engineering design and mitigation and monitoring programs into comprehensive environmental management planning for the life of the Project.

The environmental effects assessment method is based on a structured approach that:

- considers the factors that are required under Nunavut Land Claim Agreement;
- focuses on issues of greatest concern;
- affords consideration of all territorial and federal regulatory requirements for the assessment of environmental effects;
- considers issues raised by the Inuit, regulators, government agencies and public stakeholders; and
- integrates Project design and programs for mitigation and monitoring into a comprehensive environmental planning.

The environmental assessment focuses on specific environmental components called Valued Environmental Components (VECs) or Valued Socio-economic Components (VSECs) that are of particular value or interest to Inuit, regulators, government agencies and stakeholders. The term Valued Components (VCs) refers collectively to VECs and VSECs. Valued Components are selected based on regulatory issues and guidelines, consultation with Inuit, regulators, government agencies and stakeholders, field studies, and professional judgment of the study team. Where a VC has various sub-components that may interact in different manners with the Project, the environmental assessment may consider the environmental effects on individual Key Indicators (KIs).

The term “environmental effect” is used throughout the Application and broadly refers to the response of the biophysical or human system or a component of these systems to a disturbance from a Project action or activity or other regional actions (i.e., projects and activities).

The environmental assessment methods address Project-related and cumulative environmental effects. Project-related environmental effects are changes to the biophysical or socio-economic environment that are caused by the Project or activity arising solely because of the proposed principal works and activities, as defined by the Scope of the Project. This includes consideration of the environmental effects of malfunctions or accidents that may occur in connection with the Project. Cumulative environmental effects are changes to the biophysical or socio-economic environment that are caused by an action of the Project in combination with other past, present and future projects and activities.

In this assessment, Project-related environmental effects and cumulative environmental effects are assessed sequentially. The mechanisms through which a Project-specific environmental effect may occur are discussed first, taking into account Project design measures and mitigation that help to reduce or avoid environmental effects. The residual environmental effect is then characterized taking into account planned mitigation. At a minimum, all Project environmental effects are characterized using specific criteria (e.g., magnitude, geographic extent, duration) that are defined for each VC.

A cumulative environmental effects screening is then conducted to determine if there is potential for the Project residual environmental effect to act in a cumulative manner with similar environmental effects from other projects and activities. If there is potential for the Kiggavik Project to contribute to cumulative environmental effects, the environmental effect is assessed to determine if it has the potential to shift a component of the natural or socio-economic environment to an unacceptable state.

The environmental effects assessment approach used in this assessment involves the following steps:

- ***Scoping***: Scoping of the overall assessment, which includes: issues identification; selection of VCs (and KIs, if required); description of measurable parameters; description of temporal, spatial, administrative and technical boundaries; definition of the parameters that will be used to characterize the Project-related environmental effects and cumulative environmental effects; and identification of the standards or thresholds that will be used to determine the significance of environmental effects.
- ***Assessment of Project-related environmental effects***: The assessment of Project-related environmental effects, which includes: description of the mechanism(s) by which an environmental effect will occur; mitigation and environmental protection measures to reduce or eliminate the environmental effect; and evaluation and characterization of the residual environmental effects (i.e., environmental effects remaining after application of mitigation measures) of the Project on the biophysical and socio-economic environment for each development phase.

- ***Evaluation of cumulative environmental effects:*** The evaluation of cumulative environmental effects, which involves two tasks: screening for potential cumulative environmental effects and, if there is potential for cumulative environmental effects, assessment of cumulative environmental effects. Where an assessment of potential cumulative environmental effects is required, the residual cumulative environmental effects of the Project are evaluated in combination with other past, present and future projects and activities.
- ***Determination of significance***: The significance of Project-related and cumulative residual environmental effects is determined using standards or thresholds that are defined for each VC.
- ***Monitoring***: Several different types of monitoring may be required to confirm compliance with mitigation measures or Project design features, address uncertainties or verify environmental effects predictions and/or assess the effectiveness of mitigation measures.
- ***Summary***: The last step of the assessment of environmental effects on a VC is the development of summaries on Project and cumulative environmental effects (including combined Project environmental effects and combined cumulative environmental effects), mitigation measures and Project design features, and monitoring.

3.2 Scope of the Assessment

3.2.1 Valued Components, Indicators and Measurable Parameters

Valued Components are defined as broad components of the biophysical and socio-economic environments, which if altered by the Project, would be of concern to regulators, Inuit, resource managers, scientists, and public stakeholders.

VECs for the biophysical environment typically represent major components or aspects of the physical and biological environment that might be altered by the Project, and are widely recognized as important for ecological reasons.

Criteria for selection of VCs include:

- Do they represent a broad environmental, ecological or human environment component that may be altered by the Project?
- Are they vulnerable to the environmental effects of the Project and other activities in the region?
- Have they been identified as important issues of concerns of Inuit or stakeholders, or in other assessments in the region?
- Were they identified by the Nunavut Impact Review Board (NIRB), Inuit organizations or departments within the territorial or federal government?

Key indicators (KIs) are species, species groups, resources or ecosystem functions that represent components of the broader VCs. They are selected using the same criteria as described above for VCs. For practical reasons, KIs are often selected where sufficient information is available to assess the potential Project residual environmental effects and cumulative environmental effects.

For each VC or KI, one or more measurable parameters are selected to quantitatively or qualitatively measure the Project environmental effects and cumulative environmental effects. Measurable parameters provide the means of determining the level or amount of change to a VC or KI. The degree of change in the measurable parameter is used to characterize project-related and cumulative environmental effects, and evaluate the significance of these effects. Thresholds or standards are identified for each measurable parameter, where possible, to assist in determining significance of the residual environmental effect.

3.2.2 Key Issues

Issues identification focuses the assessment on matters of greatest importance related to the Project, and assists in determining which factors and the scope of those factors that will be considered in the assessment.

Issues and concern about the possible biophysical or socio-economic effects of the Project have been identified from a variety of sources, including:

- the regulatory requirements applicable to the Project;
- discussions with technical experts from various territorial and federal government agencies;
- input from Inuit and public stakeholders during engagement activities in relation to the Project;
- existing regional information and documentation regarding environmental components found near the Project;
- baseline and assessment studies conducted in the area of the Project; and
- the professional judgment of the assessment team, based on experience with similar projects elsewhere and other mining project and activities in Nunavut.

Key Project-related issues are summarized in the scoping section for each discipline considered in the assessment.

3.2.3 Project – Environment Interactions and Environmental Effects

Key Project-related activities that are likely to result in environmental effects are considered for each VC. A matrix of Project activities and environmental components is provided in the scoping section for each discipline to identify where interactions are likely to occur based on the spatial and temporal overlap between Project activities and the VC. Each interaction is ranked according to the potential for an activity to cause an environmental effect. The interactions are ranked according to the following:

- If there is no interaction or no potential for substantive interaction between a Project activity and the VC to cause a potential environmental effect, an assessment of that environmental effect is not required. These interactions are categorized as 0, and are not considered further in the EA. The environmental effects of these activities are thus, by definition, rated not significant.
- If there is likely to be a potential interaction between a Project activity and a VC but not likely to be substantive in light of planned mitigation, the interaction is categorized as 1. Such interactions are well understood and are subject to prescribed mitigation or codified practices. These interactions are subject to a less detailed environmental effects assessment and are rated as not significant. Justification is provided and the mitigation is described for such categorizations. Such interactions can be mitigated with a high degree of certainty with proven technology and practices.
- If a potential interaction between a Project activity and a VC could result in more substantive environmental effects despite the planned mitigation, if there is less certainty regarding the effectiveness of mitigation, or if there is high concern from regulatory agencies, Inuit or stakeholders, the interaction is categorized as 2. These potential interactions are subject to a more detailed analysis and consideration in the environmental assessment in order to predict, mitigate and evaluate the potential environmental effects.

The ranking takes a precautionary approach, whereby interactions with a meaningful degree of uncertainty are assigned a rank of 2 to ensure that a detailed analysis of the potential environmental effect is undertaken.

Justification for ranking the Project-environmental interactions considered for each VC is provided in the scoping section for each discipline.

3.2.4 Assessment Boundaries

Boundaries of the assessment are defined for each VC to allow for a meaningful analysis of the significance of environmental effects. The assessment boundaries are described in terms of temporal, spatial and administrative and technical boundaries.

3.2.4.1 Spatial Boundaries

Spatial boundaries are established for assessing the potential Project-related environmental effects and cumulative environmental effects on each VC. The primary consideration in establishing these boundaries is the probable geographical extent of the environmental effects (i.e., the zone of influence) on the VC.

Spatial boundaries represent the geographic extent of the VC, as they pertain to potential Project-environment interactions. Spatial boundaries are selected for each VC to reflect the geographic extent over which Project activities will or are likely to occur, and as such, they may be different from one VC to another depending on the characteristics of the VC. For this assessment, the spatial boundaries are referred to as 'assessment areas' to differentiate the areas from the local and regional study areas referred to in many baseline studies.

Three assessment areas are defined for each VC.

The ***Project Footprint*** is the most immediate area of the Project. The Project Footprint includes the area of direct physical disturbance associated with the construction or operation of the Project.

The ***Local Assessment Area*** (LAA) is the maximum area within which Project-related environmental effects can be predicted or measured with a reasonable degree of accuracy and confidence. The LAA includes the Project Footprint and any adjacent areas where Project-related environmental effects may be reasonably expected to occur.

The **Regional Assessment Area** (RAA) is a broader area within which cumulative environmental effects on the VC may potentially occur. This will depend on physical and biological conditions (e.g., air sheds, watersheds, seasonal range of movements, population unit), and the type and location of other past, present or reasonably foreseeable projects or activities. For the socio-economic environment, the RAA may be much broader (planning areas, regions, territories etc.) based on the potential geographic extent over which socio-economic effects are likely to occur. It is also the area where, depending on conditions (e.g., seasonal conditions, habitat use, more intermittent and dispersed Project activities), Project environmental effects may be more wide reaching.

3.2.4.2 Temporal Boundaries

The temporal boundaries for the assessment are defined based on the timing and duration of Project activities and the nature of the interactions with each VC. Temporal boundaries encompass those periods during which the VCs and KIs are likely to be affected by Project activities.

For the Kiggavik Project, temporal boundaries include the following Project phases.

- construction;
- operations;
- final closure; and
- post closure.

The operations phase includes consideration of maintenance, planned exploration and temporary closure (care & maintenance) of the Project. The final closure phase considers decommissioning and reclamation, and post-closure phase includes management of restored sites.

In some cases, temporal boundaries are refined to a specific period of time beyond simply limiting them to a specific phase of the Project. This is carried out as necessary within each environmental effects analysis section. Temporal boundaries for the assessment may reflect seasonal variations or life cycle requirements of biological VCs, long-term population cycles for some biological VECs, or forecasted trends for socio-economic VSECs.

3.2.4.3 Administrative and Technical Boundaries

Administrative and technical boundaries are identified and justified for each VC or KI, as appropriate. Administrative boundaries include specific aspects of provincial, territorial and federal regulatory requirements, standards, objectives, or guidelines, as well as regional planning initiatives that are relevant to the assessment of the Project's environmental effects on the VC. Administrative boundaries may be selected to establish spatial boundaries.

Technical boundaries reflect technical limitations in evaluating potential environmental effects of the Project, and may include limitations in scientific and social information, data analyses, and data interpretation.

3.2.5 Environmental Effects Criteria

Where possible, the following characteristics are described quantitatively for each VC to assist in the assessment of residual environmental effects. Where these residual environmental effects cannot be defined quantitatively, they are described using qualitative terms. If qualitative descriptions are used, definitions are provided for each VC or KI, as appropriate, in the scoping section of the environmental assessment for that VC or KI.

- ***Direction:*** the ultimate long-term trend of the environmental effect (e.g., positive, neutral or adverse)

- ***Magnitude:*** the amount of change in a measurable parameter or variable relative to the baseline case (i.e., low, moderate, high)
- ***Geographical Extent:*** the geographic area within which an environmental effect of a defined magnitude occurs (site-specific, local, regional, territorial, national, international)
- ***Frequency:*** the number of times during the Project or a specific Project phase that an environmental effect may occur (i.e., once, sporadically, regular, continuous)
- ***Duration:*** this is typically defined in terms of the period of time that is required until the VC returns to its baseline condition or the environmental effect can no longer be measured or otherwise perceived (i.e., short term, medium term, long term, permanent)
- ***Reversibility:*** the likelihood that a measurable parameter for the VC will recover from an environmental effect (i.e., reversible, irreversible)
- ***Ecological or socio-economic context:*** the general characteristics of the area in which the Kiggavik Project is located (i.e., undisturbed, disturbed, urban setting)

3.2.6 Standards or Thresholds for Determining Significance

Where possible, threshold criteria or standards for determining the significance of environmental effects are defined for each VC or KI to represent that limit beyond which a residual environmental effect would be considered significant. In some cases, standards or thresholds are also defined for specific environmental effects on a VC or KI.

Standards are recognized federal and territorial regulatory requirements or industry objectives that are applicable to the VC, and that reflect the limits of an acceptable state for that component. Where standards, guidelines or regulatory requirements do not specifically exist, thresholds are defined for the measurable parameters for an environmental effect on a VC based on resource management objectives, community standards, scientific literature, or ecological processes (e.g., desired states for fish or wildlife habitats or populations).

Potential changes in a measurable parameter or VC resulting from residual Project or cumulative environmental effects are evaluated against these standards or thresholds. Environmental effects are rated as either *significant* or *not significant*.

3.2.7 Influence of Engagement on the Assessment

Engagement undertaken to date with regulators, Inuit and public stakeholders in relation to the Project is described in Volume 3. Issues raised during these engagement activities and Inuit Qaujimajatuqangit (IQ) sessions were documented, and were reviewed for consideration in each discipline-specific assessment, including scoping of baseline data collection, selection of VC and KIs, use of TEK and IQ in the environmental effects assessment, mitigation and monitoring.

3.3 Assessment of Project Environmental Effects

3.3.1 Existing Conditions

The existing conditions for each VC are described according to the status and characteristics of the VC within its defined spatial and temporal assessment boundaries. This is based on a variety of sources, including:

- information from past research conducted in the region;
- Inuit Qaujimajatuqangit (IQ); and
- knowledge gained from the collection of baseline data through literature review, qualitative and quantitative analyses and field programs carried out as part of the environmental assessment.

In general, the description of existing conditions is limited to information directly relevant to the potential VC interactions with the Project to support the environmental effects analysis.

3.3.2 Project Effect Linkages

The mechanisms or linkages through which the Project components and activities could result in an environmental effect on a VC, and the spatial and temporal extent of this interaction is described based on the existing conditions of the VC. Because the assessment focuses on residual environmental effects, effects prior to mitigation are not characterized or quantified and the significance of the effect is not determined.

3.3.3 Mitigation Measures and Project Design

Where Project activities are likely to cause an environmental effect on a VC, mitigation measures are identified to minimize or avoid environmental effects of the Project. This includes measures or strategies that are technically and economically feasible and that would reduce the extent, duration or magnitude of the environmental effect.

Mitigation includes Project design features to change the spatial or temporal aspect of the Project, specialized mitigation, environmental protection measures and protocols..

Where mitigation is identified, a brief discussion of how the measure(s) will help to minimize the residual environmental effect on the VC is provided. Where possible, this includes a description of how effective the measure is expected to be in minimizing the change in the measurable parameters for the environmental effect.

3.3.4 Residual Project Effects Assessment

Taking into account the mitigation and expected effectiveness of the measure(s), the residual environmental effects of the Project are described according to their probable magnitude, geographic scope, duration, frequency, reversibility and ecological context, where appropriate. The residual effect is characterized in the context of the existing condition for the measureable parameter(s) and how it is likely to change as a result of the Project environmental effect. For some residual environmental effects, the change in the measurable parameter is described relative to each Project phase.

Where possible, the magnitude, geographic extent and duration of the residual environmental effect are quantified. If a residual effect cannot be quantified, qualitative terms are used to describe the attributes of the effect.

3.3.5 Significance of Residual Project Environmental Effects

Significance of a residual Project environmental effect is determined based on standards or thresholds that are specific to the VEC, KI and/or the measurable parameters used to assess the environmental effect. Determination of whether a residual environmental effect is considered to be significant or not significant is based on a comparison of the predicted change in the VC or measurable parameter to the defined threshold or standard. This includes an indication of the likelihood that a residual environmental effect on a VC will occur based on probability of occurrence (i.e., based on past experience) and level of scientific uncertainty.

Determination of significance also includes a discussion of the confidence of the prediction with respect to:

- the characterization of environmental effects, and
- the success of Project design features, mitigation measures, and environmental protection measures in effectively reducing the environmental effect.

Prediction confidence for the environmental effect and the success of mitigation measures is ranked as low, moderate or high.

3.3.6 Monitoring of Residual Project Environmental Effects

Based on analysis of the residual Project environmental effect, it may be necessary to conduct a monitoring program. Monitoring is recommended in cases where there is a need to address Project-related issues of public concern, test the accuracy of the assessment predictions, verify the success of the mitigation measures, or gain additional scientific knowledge related to prediction of the Project environmental effect.

Two types of monitoring are considered: compliance and follow-up environmental monitoring.

Compliance monitoring is undertaken to confirm that Project design features, mitigation measures, environmental protection measures, or benefit agreements are being effectively implemented.

Biophysical and socio-economic monitoring programs are used to:

- verify predictions of environmental effects;
- determine the effectiveness of mitigation measures, environmental protection measures or benefits agreements in order to modify or implement new measures where required;
- support the implementation of adaptive management measures to address previously unanticipated adverse environmental effects; and
- support environmental management systems used to manage the environmental effects of projects.

Where a monitoring program for a specific VC or KI is identified, the following aspects of the program are defined:

- parameters to be measured;
- methods and equipment to be used;
- location and timing of surveys; and
- how the results of the monitoring will be applied, including consideration of an adaptive management approach.

3.4 Assessment of Cumulative Environmental Effects

3.4.1 Screening for Potential Cumulative Effects

Cumulative environmental effects are only assessed if the following criteria are met for the residual Project effect under consideration:

- The Project will result in a measurable, demonstrable or reasonably-expected residual environmental effect on a component of the biophysical or socio-economic environment;
- The Project-specific residual environmental effect on the component will likely act in a cumulative fashion with the environmental effects of other past or future projects or activities that are likely to occur (i.e., Is there overlap of environmental effects?); and

- There is a reasonable expectation that the Project's contribution to cumulative environmental effects will be substantive, measurable or discernible such as that it will affect the viability or sustainability of the resource.

If, based on these criteria, there is potential for cumulative environmental effects, the effect is assessed further to determine if it is likely to shift the component to an unacceptable state. Where there is no potential for the environmental effect of the Project to spatially or temporally overlap with similar effects of other project and activities, justification for not carrying these environmental effects forward to the assessment of cumulative environmental effects is provided.

3.4.2 Project Inclusion List

The project inclusion list includes all past, present and reasonable foreseeable projects, activities and actions in the region of the Kiggavik Project. Only projects and activities that overlap with the Project residual environmental effects both spatially and temporally are considered in the assessment of potential cumulative environmental effects.

The specific projects, activities and action considered for each environmental effect are described in the assessment for the VC or KI.

3.4.3 Description of Cumulative Environmental Effects

The first step in the assessment of cumulative environmental effects involves describing the environmental effect, the mechanisms by which the Project environmental effect may interact cumulatively with other projects and activities in the RAA (from the Project Inclusion List), and the geographic and temporal scope of the cumulative environmental effect.

For this assessment, cumulative environmental effects are described for four cases. A more detailed description of the assessment cases is provided within the Project Inclusion List (Volume 1, Appendix 2).

- ***Base Case***: the current status of the measurable parameters for the environmental effects at baseline (i.e., prior to the Project). Baseline includes all past and present projects and activities in the RAA that may result in similar environmental effects to the Project environmental effect, including ongoing mineral exploration. Existing projects include projects that have received environmental approval and are in some form of planning, construction and/or commissioning.
- ***Project Case:*** the status of the measurable parameters for the environmental effect with the Project in place, over and above the Base Case. This is usually assessed using the peak environmental effect of the Project or maximum active footprint for the Project.

- ***Future Case:*** the status of the measurable parameters for the environmental effect because of the Project Case, in combination with all reasonable foreseeable projects, activities and actions. Reasonably foreseeable projects are defined as future projects, activities and actions that will occur with certainty, including projects that are in some form of regulatory approval or have made a public announcement to seek regulatory approval.

For this assessment, future projects include proposed mines that are currently under NIRB review:

- Meadowbank;
- Doris North 1;
- Doris North 2;
- Meliadine;
- Mary River;
- Hackett River;
- Back River;
- Hackett River; and
- High Lake.

The combination of the Project Case with the Future Case allows determination of the Project's contribution to cumulative effects of all past, present and reasonably-foreseeable projects and activities.

- ***Far Future Case:*** the status of the measurable parameters for the environmental effect because of the Future Case, in combination with possible far future developments in the Kiggavik region.

It is recognized that exploration activities will continue in the vicinity of the Kiggavik Project, and that there is the potential for additional resources to be discovered during the life of the Project. To address such a possibility, a potential far future development scenario was developed. This scenario assumes additional deposits within a 200 km radius of the Kiggavik site, and the development of a non-uranium operation located within the Kiggavik RSA. The Meadowbank gold operation is used as the model for this. It assumes additional resources are found in the Meadowbank area, and that operation of Meadowbank continues. The following projects and activities are included in the development scenario.

Component	Locations
Uranium mines	3 mines within 200 km of Kiggavik
Uranium mills	Kiggavik mill
Gold mines	1 mine within Kiggavik RSA Meadowbank region
Gold mills	Meadowbank region Additional mill within Kiggavik RSA
Access Roads	Meadowbank region Additional mill within Kiggavik RSA
Exploration	Induced exploration near the access road(s) and in the Kiggavik area

Due to the lack of information regarding the specific details of potential future developments (i.e., footprint of projects and activities), the assessment of cumulative environmental effects under this Case is by definition qualitative and is limited to a description of how these projects, activities and actions could affect the magnitude, duration and extent of cumulative environmental effects.

3.4.4 Mitigation of Cumulative Environmental Effects

Mitigation measures that would reduce the Project's environmental effects are described for cumulative environmental effects, with emphasis on measures that should limit the interaction of environmental effects of the Project with similar environmental effects from other projects. Three types of mitigation measures are considered, where appropriate:

- Measures that can be implemented solely by AREVA;
- Measures that can be implemented by AREVA, in cooperation with other project proponents, government, Aboriginal organizations and/or public stakeholders; and
- Measures that can be implemented independently by other project proponents, government, Aboriginal Organizations and/or public stakeholders.

For the latter two types of mitigation, the degree to which AREVA can or cannot influence the implementation of these measures is noted.

Mitigation measures that could assist in reducing potential cumulative environmental effects are identified for each environmental effect, including a discussion of how these measures may potentially modify the characteristics of an environmental effect.

3.4.5 Residual Cumulative Environmental Effects Assessment

Residual cumulative environmental effects are described, taking into account how the mitigation will change the environmental effect. Where possible, cumulative environmental effects are characterized quantitatively or qualitatively in terms of the direction, magnitude, duration, geographic extent, frequency and reversibility. This includes characterization of:

- the total residual cumulative environmental effects based on the Future Case (i.e., the environmental effects of all past, present and reasonably foreseeable project and activities), in combination with the environmental effects of the Project, and
- the contribution of the Project to the total residual cumulative effects (i.e., how much of the total residual cumulative effects can be attributed to the Project).

3.4.6 Significance of Residual Cumulative Environmental Effects

The significance of cumulative environmental effects is determined using standards or thresholds that are specific to the VC, KI and/or measurable parameters used to assess the Project environmental effect. Determinations of significance are made for:

- the significance of the total residual cumulative environmental effect; and
- the significance of the contribution of the Project to the total residual cumulative environmental effect.

The determination of residual cumulative environmental effects includes a discussion of the confidence of the prediction based on scientific certainty relative to:

- quantifying or estimating the environmental effect (i.e., quality and/or quantity of data, understanding of the effects mechanisms), and
- the effectiveness of the proposed mitigation measures.

As for residual Project environmental effects, prediction confidence for the cumulative environmental effect and the success of mitigation measures is ranked as low, moderate or high.

3.4.7 Monitoring of Cumulative Environmental Effects

Based on the evaluation of residual cumulative environmental effects, it may be necessary to conduct monitoring programs. Monitoring programs are designed to:

- confirm the effectiveness of a broad range of approved mitigation techniques;

- determine whether different or an increased level of mitigation is required to achieve the mitigation or reclamation goals; and
- identify and address any cumulative effects that occur but were not predicted.

Two types of monitoring are considered:

- **Compliance Monitoring:** to confirm that Project design features, mitigation measures, environmental protection measures, or benefit agreements are being effectively implemented.
- **Biophysical or Socio-economic Monitoring:** to confirm the environmental effect prediction and/or effectiveness of a Project design feature, mitigation measure, environmental protection measure, or benefit agreement.

3.5 Summary of Residual Environmental Effects

Residual Project and cumulative environmental effects are briefly summarized for each VC. This includes a discussion of the overall combined environmental effect of the Project on the VC and its significance, as well as a discussion of the overall combined effect of all cumulative effects on the VC and its significance. For biophysical VECs, this relates to the sustainability of the resource or populations being considered. For socio-economic VSECs, this relates to the ability of the community, the Kivalliq region and/or Nunavut to adapt to or manage the environmental effect. A discussion of the Project's contribution to the combined cumulative effect is also provided.

In addition, this summary section presents an assessment of the effects of climate change on residual Project and cumulative effects. Where possible, the effects are described quantitatively, and include a description of how likely climate changes in the region will likely influence Project and cumulative residual effects.

3.6 Assessment of Transboundary Effects

As required by the NIRB EIS Guidelines, the assessment includes consideration of transboundary effects, where residual environmental effects are likely to extend beyond the Nunavut into federal waters and/or other provincial or territorial jurisdictions. As this is based largely on the cumulative effects assessment, the transboundary effects are characterized qualitatively or semi-quantitatively.

3.8 Summary of Mitigation

A detailed description of the mitigation measures proposed to minimize or avoid project-related and cumulative effects on VCs is provided based on the scoping and effects analyses. This includes:

- relevant Project design features to reduce environmental effects;
- project policies (e.g., Inuit hiring policy);
- specialized mitigation measures to minimize environmental effects on VECs;
- social or community programs to minimize environmental effects on VSECs;
- environmental Protection plans;
- broader agreements (e.g., benefits agreements); and
- compensation.

3.9 Summary of Monitoring

Monitoring programs to address uncertainties associated with the environmental effects predictions and environmental design features and mitigation proposed for residual Project effects and cumulative effects are described in detail. This includes all compliance monitoring and environmental monitoring that may be applied during the life of the Project, and that will form the:

- Compliance Monitoring Program Framework;
- Environmental Monitoring Program Framework;
- Socio-Economic Monitoring Program Framework;
- Post-Project Analysis Program Framework; and
- Follow-up Monitoring Programs.

4 Scope of the Assessment – Air Quality and Climate Change

This section describes the scope of the assessment for potential effects to air quality and climate change. Resource exploration, extraction, processing and transportation activities associated with the Kiggavik Project have the potential to affect ambient air quality and generate emissions of greenhouse gases (GHGs). Increased emissions of GHGs have the potential to affect climate.

The various Project phases, including construction, operation, final closure and post-closure will result in atmospheric emissions of Constituents of Potential Concern (COPCs) and GHGs and as a result, the discussions presented herein focus on the potential effects of the Project as they relate to changes in ambient air COPC concentrations or changes in GHG emissions. Other disciplines evaluate the potential effects of air quality on the terrestrial and aquatic environments, as well as the potential effects of changes in air quality to human health. Refer to Volume 5: Aquatic Environment, Volume 6: Terrestrial Environment, and Volume 8: Human Health, for these assessments.

4.1 Issues and Concerns Identified During Inuit Qaujimajatuqangit Interviews and Inuit, Government and Stakeholder Engagement

The Nunavut Impact Review Board (NIRB) "Guidelines for the Preparation of an Environmental Impact Statement for AREVA Resources Canada Inc.'s Kiggavik Project (NIRB File No. 09MN003)" (NIRB 2011), incorporated advice from the public and interested parties on the proposed scope of assessment for the atmospheric environment, including identification of Valued Environmental Components (VECs) and issues that should be considered in the Environmental Impact Statement (EIS). Specifically, the guidelines require an analysis of the environmental effects of the following activities:

- open-pit and underground mining and their associated activities, including drilling, blasting, transportation, and stockpiling activities;
- mill operations, including crushing, screening, yellowcake processing, and power generation;
- dock and storage facility operations; and
- ground transportation, including mine traffic along the Kiggavik-Sissons haul road and the Baker Lake-Kiggavik access road options.

These effects, as identified by NIRB, were analyzed in the assessment of environmental effects to air quality and climate change.

Project-specific issues and concerns identified during IQ interviews and stakeholder engagement broadly include:

- concerns over emissions and dispersion (travel) of dust from the Project[33][34][35];
- concerns over airborne uranium and radionuclides from the Project[36][37][38][39][17];
- concerns about specific sources of dust, uranium and radionuclides including mine roads[40], blasting[41], and milling[42];
- how dust will be controlled from the mine, particularly from unpaved roads[43][44][45];
- potential effects that airborne contaminants may have on wildlife like caribou and fish[46][47][48];
- concerns about the potential human health effects from dust travelling through the environment and neighboring communities[49][50][51]{20]];
- concerns over the potential effects to wildlife and human health in general[52][53];
- how will climate change affect the Project[54]; and

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[33] EN - CI OH Nov 2010: *What will happen to dust from mining?*

[34] EN – CI OH Nov 2013: *What about dust? Lots of wind can carry dust. The dust will be an issue because there is constant wind that will lift the dust and keep it suspended.*

[35] EN – BL OH Nov 2010: *Concerned with dust from blowing storms.*

[36] EN - BL OH Nov 2013: *How long will uranium be in the atmosphere?*

[37] EN – BL OH Oct 2012: *Uranium goes into the air, and it is dangerous for the community.*

[38] EN – RB NIRB April 2010: *Need to consider that uranium mining is different from other types of mines. The byproducts are different. Need to consider the pollutants that can travel by air onto land.*

[39] EN – AR OH Nov 2010: *How far will dust travel from the mine? Will there be uranium dust produced during mining?*

[40] IQ – BLHT 2011: *Be aware that the road to Meadowbank produces a lot of dust in the summertime. Caribou feed on grass close to the road; this grass is full of dust. If you are going to build a road, try to minimize dust.*

[41] EN – BL NIRB April 2010: *Concerns over blasting and the dust from blasting (dust travels far over the land). What will be done for the uranium dust when blasting is occurring?*

[42] EN – RB OH Nov 2012: *When milling, is dust safe for people?*

43 EN – AR AC Nov 2010: *When doing open pit mining, how do you control dust (blasting)?*

[44] EN – RI KWB Oct 2009: *How is contaminant dust controlled? Will there be control on the road? How does dust affect the environment?*

[45] EN – BL OH Nov 2013: *Dust from road. What will AREVA do to suppress dust? Agnico Eagle said it would stop transport when the caribou herd is nearby, but they don't. Will AREVA do the same?*

[46] EN – BL EL Oct 2012: *I am pretty sure there will be dust that will spread everywhere. There will be lots of dust and animals like rabbits and wolves that will be affected.*

[47] EN - RB KIA Apr 2007: *Believe that there is waste in air from dust. Know for fact that the tree line, the ashes and dust end up in Nunavut and everywhere. Is there a boundary set up so that no tailings go everywhere to wildlife? Sometimes dead caribou are eaten by other animals, so contaminants travel in food chain.*

[48] IQ – ARHT 2009: *Hunters and elders expressed concerns about the potential for airborne contamination settling on vegetation and being consumed by caribou.*

[49] EN - CH OH Nov 2010: *Radioactive dusts will travel downwind to Rankin Inlet.*

[50] IQ - RIE 2009: *Elders expressed concern about the potential effects of uranium dust travelling and affecting many people.*

[51] IQ – BLE 2009: *Elders are concerned that uranium may escape and contaminate the grounds; especially the land along the Thelon River, or on the south side of Bake Lake.*

[52] EN – RB NIRB April 2010: *Concerned with air pollutants travelling by way of dust particles. Dangers associated with the dust to human health and wildlife.*

[53] EN – RI KWB Oct 2009: *How does dust affect people?*

- how the Project will affect greenhouse gas emissions and climate change[55][56].

As part of AREVA's efforts to gather input and feedback from Kivalliq community members on the Project, a number of public engagement events (Tier 2, Volume 3, Part 1 Public Engagement) and IQ interviews (Tier 2, Volume 3, Part 2 Inuit Qaujimajatuqangit) were conducted. AREVA efforts to engage various groups (e.g. Elders, youth, hunters, women) within communities demonstrates the commitment to IQ guiding principles (GN 2009) of Tunnganarniq (fostering good spirit by being open, welcoming, and inclusive), Aajiiqatigiingniq (consensus decision-making) and Inuuqatigiitsiarniq (respecting others, relationships, and caring for people) and as all groups are recognized as valued contributors. The term Inuit Qaujimajatuqangit is used to describe Inuit epistemology or the Indigenous knowledge of the Inuit (Tagalik 2012). Inuit Qaujimajatuqangit translates into English as "that which Inuit have always known to be true." Throughout the assessment, Inuit Qaujimajatuqangit and engagement comments are differentiated by prefix of either 'IQ' for Inuit Qaujimajatuqangit or 'EN' for engagement.

Many of the issues and concerns raised about the potential effects of the Project on the atmospheric environment highlight the understanding that *the health of Inuit, of wildlife and of the environment are interconnected* (IQ-Nunavut Tunngavik Inc. 2005) and the IQ guiding principle of Avatimik Kamattiarniq, the concept of environmental stewardship (GN 2009).

The issues and concerns identified during the stakeholder engagement sessions and IQ interviews were incorporated into the air quality assessment and informed the associated mitigation and monitoring plans. Refer to Section 4.10 for a discussion of the influence of Inuit Qaujimajatuqangit and stakeholder engagement on the assessment.

4.2 Regulatory Setting for the Atmospheric Environment

The design, construction and operational phases of the Project are subject to regulatory approvals by different jurisdictions having regulatory authority relating to air quality. The regulatory approvals applicable to the Project are discussed in the following sections.

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[54] EN - BL NIRB April 2010: *How will climate change affect the Project?*

[55] EN - AR OH Nov 2012: *How much energy will be produced, and how much greenhouse gases will be offset?*

[56] EN - RB OH Nov 2010: *How does AREVA deal with Global Warming?*

4.2.1 Nunavut Environmental Protection Act

The *Nunavut Environmental Protection Act* (Government of Nunavut 1988) is a piece of territorial legislation established to regulate contaminant discharges into the environment, including emissions to air. The Nunavut Department of Environment (Environmental Protection Service) regulates activities that have the potential to affect air quality (via the *Act*), and has set guidelines related to ambient air concentrations for a limited number COPCs that were included in the assessment.

Since air quality is a territorial jurisdiction, air quality objectives, guidelines, standards or criteria enacted under the Nunavut Environmental Protection Act will be given precedence over federal objectives, guidelines, standards or criteria. However, federal objectives and standards are discussed below for completeness.

4.2.2 Canadian Environmental Protection Act

Regulatory jurisdiction for air quality (i.e., the act of setting and enforcing standards) generally rests with the provincial and territorial governments in Canada. However, Environment Canada has also set National Ambient Air Quality Objectives (NAAQOs) to use as a benchmark to assess the effect of anthropogenic activities on air quality in Canada. These air quality objectives are set by the federal government based on recommendations from a National Advisory Committee and Working Group on Air Quality Objectives and Guidelines under the authority of the *Canadian Environmental Protection Act* (CEPA) (Government of Canada 1999), and are based on recognized scientific principles that include risk assessment and risk management. The NAAQOs are based on a two-tiered approach which identifies the different ranges of air concentrations having specific levels of effects to air quality: maximum desirable and maximum acceptable levels. Provincial and territorial governments have the option of adopting these levels either as objectives or as enforceable standards according to their legislation.

In addition, the Canadian Council of Ministers of the Environment (CCME) has also established Canada-Wide Standards (CWS) for fine particulate matter ($PM_{2.5}$) and ozone (O_3) with the objective to protect human health (CCME 2000). Many jurisdictions, including the Government of Nunavut (2011), have adopted the CWS for fine particulate matter. However, the CCME published revised Canadian Ambient Air Quality Standards (CAAQS) in October 2012, which were enacted under CEPA on May 25, 2013. CAAQS were developed under the CCME Air Quality Management System framework for managing air zones (i.e., airsheds) within provinces and territories. CAAQS are more stringent than the previous CWS. CAAQS have introduced lower short-term limits and long-term exposure limits for fine particulate matter. Like NAAQOs, provincial and territorial governments are encouraged to undertake actions to meet the new CAAQS.

4.2.3 Other Provincial Regulations

Other Canadian provinces also have acts and regulations that govern allowable emissions to air and/or set standards for predicted COPC concentrations. For example, Ontario Regulation 419/05: Air Pollution – Local Air Quality (Government of Ontario 2005) uses a mixture of regulatory standards and guidelines to govern allowable off-property concentrations for a large number of COPCs. Similarly, regulations in Newfoundland, Alberta and British Columbia have regulatory standards for a number of COPCs. These will be used as Project-specific guidelines for COPCs in the absence of applicable Nunavut regulatory standards or federal objectives and standards.

In the event that no other objectives, guidelines, standards or criteria exist, World Health Organization (WHO) guidelines will be used.

4.3 Project – Environment Interactions and Effects: Air Quality and Climate Change

Project activities and physical works have the potential to interact with and affect the surrounding environment. This section identifies such interactions and the potential environmental effects to air quality and climate change. Interactions are expected to occur between the atmospheric environment and Project-related activities during construction, operation and final closure phases. These are ranked according to the potential for an activity to interact with one or more components of the atmospheric environment. Ranking of each interaction was assigned as described in Section 3.2.3 of this report.

Table 4.3-1 through Table 4.3-3 present the rankings of interactions between the Project and the atmospheric environment (i.e., air quality and climate) for the construction, operations and final closure phases of the Project as well as the rationale for each of the chosen rankings. Interactions are ranked according to the potential for a Project activity to interact with the atmospheric environment to cause an environmental effect to air quality and/or climate.

4.3.1 Construction

The primary sources of air emissions during the construction phase are fugitive dust emissions resulting from earthworks, material movement and vehicle travel, in addition to exhaust emissions from heavy equipment operation. All Project-environmental effects interactions for construction are outlined in Table 4.3-1.

As shown in Table 4.3-1, all in-water construction activities have been ranked as one (1). Emissions of COPCs due to in-water construction activities are minor in relation to emissions from on-land activities since majority of the work is done in wet conditions that will naturally suppress dust.

Similarly, equipment installation and commissioning have also been ranked as one (1) since emissions of COPCs from these activities are negligible compared to other construction activities like earthworks activities and building infrastructure.

For on-land construction of the mine sites, the following types of activities have been ranked as two (2), and therefore included in the assessment: topsoil removal and site clearing; pad construction; and construction of foundations and buildings. Supporting activities such the operation of heavy equipment and the transport of fuel and supplies to the mine site were also ranked as two (2). This means that emissions from transport along the Winter Road and from operations at the Baker Lake Dock and Storage Facility were considered when assessing construction of the mine sites.

Similarly, on-land construction of the Baker Lake Dock and Storage Facility was considered in the assessment and the following activities were ranked as two (2): topsoil removal and site clearing; pad construction, construction of foundations and buildings; and emissions from heavy equipment.

Most of the emissions associated with construction of the access roads will be from quarrying. As a result, quarry development was also ranked as two (2) and included in the assessment. All other activities associated with constructing the access roads were ranked as one (1).

Finally, emissions of greenhouse gases from construction activities will result from fuel combustion in heavy equipment. However, the construction phase is short in comparison to the operations phase, and has a lower overall fuel consumption. As a result, all construction activities have been ranked as one (1) for climate change, and therefore not carried forward in the assessment.

Table 4.3-1 Identification of Project-Environmental Effects Interaction – Construction

	Activities	Study Area	Component	Air Quality	Climate Change
Economic Activities	Construction Workforce Management (hiring and training) Contracts and Taxes Advance Training of Operations Workforce			0	0
In-Water Construction	Construct freshwater diversions and site drainage containment systems (dykes, berms, collection ponds)	Site Access	Freshwater diversions	1	1
		Mine Site	Freshwater diversions Site containment dykes and berms Andrew Lake dyke Site runoff ponds Purpose built pit	1	1
	Construct in-water / shoreline structures	Site Access	Wharf construction Thelon bridge Ferry crossing Water crossings (culverts and clear span bridges)	1	1
		Mine Site	Water crossings (culverts and clear span bridges) Intake pipelines Effluent pipelines and diffusers	1	1
	Water transfers and discharge	Site Access	Domestic wastewater	1	1
		Mine Site	Andrew Lake dewatering Minor ponds/standing water dewatering Domestic wastewater	1	1
	Freshwater withdrawal	Site Access	Ice flooding winter road	1	1
		Mine Site	Kiggavik site freshwater Sissons site freshwater Ice flooding temporary airstrip	1	1
On-Land Construction	Site clearing and pad construction (blasting, earth-moving, loading, hauling, dumping, crushing)	Site Access	Baker Lake Dock and Storage Facility	2	1
			Winter road	1	1
			All weather road	1	1
			Quarry development	2	1
		Mine Site	Kiggavik, including pit stripping	2	1
			Sissons, including pit stripping	2	1

Table 4.3-1 Identification of Project-Environmental Effects Interaction – Construction

Activities		Study Area	Component	Air Quality	Climate Change
	Site clearing and pad construction (blasting, earth-moving, loading, hauling, dumping, crushing)		Airstrip		
			Quarry development	2	1
			Haul road and site roads	2	1
	Construct foundations	Site Access	Baker Lake fuel tank farm	2	1
		Mine Site	Mill and powerhouse, tank farms Accommodation complex	2	1
	Construct buildings	Site Access	Emergency shelters Warehouse	1	1
		Mine Site	Mill, powerhouse, mine shops, water treatment plants Accommodation complex and temporary camps Backfill Plant Airstrip shelter	2	1
	Install equipment	Site Access	Generators Dock and Storage Facility Port crane and fuel off-loading	1	1
		Mine Site	Temporary generators Mill, backfill and water treatment equipment Powerhouse Utility distribution Maintenance Incinerator Communications systems	1	1
	Install and commission fuel tanks	Site Access	Baker Lake tank farm	1	1
		Mine Site	Kiggavik site tank farm Sissons fuel tanks Airstrip jet fuel tanks	1	1
	Mill dry commissioning (water only)	Mine Site		1	1
Supporting Activities	Transport fuel and construction materials	Site Access	Transfers, barging, trucking	2	1
		Mine Site	Transfers	1	1
	Air transport of personnel and supplies	Mine Site		1	1
	Hazardous materials storage and use	Site Access	Baker Lake Dock and Storage Facility	1	1

Table 4.3-1 Identification of Project-Environmental Effects Interaction – Construction

Activities		Study Area	Component	Air Quality	Climate Change
		Mine Site	Kiggavik and Sissons	1	1
	Explosives storage and use	Site Access		1	1
		Mine Site		1	1
	Waste incineration and disposal	Site Access		1	1
		Mine Site		1	1
	Industrial machinery operation	Site Access		1	1
		Mine Site		2	1
	Power generation	Site Access	Baker Lake Dock and Storage Facility	2	1
		Mine Site	Temporary generators	2	1

4.3.2 Operations

Activities associated with the operation of the Project and its related facilities (i.e., the mill complex and ancillary works such as the accommodation complex) have the potential to affect air quality. The primary sources of air emissions during this phase are point source emissions from power generation, milling and acid production, in addition to fugitive dust emissions resulting from mining activities (drilling, blasting, excavating) and vehicle travel and exhaust emissions from heavy equipment. All Project environmental effects interactions for operations are outlined in Table 4.3-2.

Activities related to mine dewatering, freshwater withdrawal and placement or consolidation of tailings slurry are all wet activities and are not expected to generate emissions of COPCs. Therefore, these have been assigned a rating of zero.

Fugitive and tailpipe emissions of COPCs from waste management activities, including disposal and/or management of industrial, domestic, hazardous waste and sewage sludge are minor in comparison to the emissions from the mining and milling operations. As such, these sources have been ranked as a one (1) and not assessed further in this Volume. It should be noted however that incineration of food/organic wastes was rated as two (2) and was included in the assessment.

General site operations and maintenance services, such as the operation of the accommodation complex, etc., are expected to have minimal releases of COPCs relative to mining and milling operations. In addition, maintenance services are often short-lived and only occur on an as needed basis. As such, these activities are rated as one (1) and not carried forward.

Air transportation of personnel and yellowcake, as well as general air transportation support are considered to be minor, short-lived sources of COPCs in relation to the other sources on site since emissions will typically last over a 5 to 10 minute period during take-off, landing or taxiing of aircraft for a maximum of 4 to 5 times per day. Similarly, ground transportation of site personnel or controlled public traffic on the access roads were also considered to be intermittent sources which are minor in nature compared to the mining truck traffic. These sources have therefore all been rated as one (1) and were not carried forward in the assessment.

During the operational phase of the Project, greenhouse gases are expected to be emitted as a result of the combustion of fossil fuels. The primary sources of fossil fuel combustion are power generation and the operation of heavy equipment (loaders, excavators, haul trucks, etc.). While there are other sources of fossil fuel combustion (e.g., air transportation of yellowcake or personnel and miscellaneous industrial equipment [e.g., pumps]), these are minor in comparison to the primary emissions sources and occur over a short-term or intermittent basis. Also, all equipment that operates on electrical power has been rated as zero (e.g., process equipment in the mill) since the greenhouse gas emissions have been accounted for in the assessment of power generation.

Finally, ongoing exploration activities are also expected to be transient in nature and will only occur for limited periods. As such these activities are rated as one (1) and are not carried forward.

Table 4.3-2 Identification of Project-Environmental Effects Interaction – Operations

Activities		Study Area	Component	Air Quality	Climate Change
Economic Activities	Workforce Management (hiring and training)			0	0
	Employment				
	Contracts and Taxes				
Mining	Mining ore (blasting, loading, hauling)	Mine Site	East Zone, Centre Zone, Main Zone, Andrew Lake open pits	2	2
			End Grid Underground		
			Haul Road		
	Ore stockpiling	Mine Site	Kiggavik ore stockpile	2	2
			Sissons ore stockpile		
	Mining special waste (blasting, loading, hauling)	Mine Site	East Zone, Centre Zone, Main Zone, Andrew Lake open pits	2	2
			End Grid Underground		
	Special waste stockpiling	Mine Site	Kiggavik special waste stockpile	2	2
			Sissons special waste stockpile		
	Mining clean waste (blasting, loading, hauling)	Mine Site	East Zone, Centre Zone, Main Zone, Andrew Lake open pits	2	2
			End Grid Underground		
	Clean rock stockpiling	Mine Site	Kiggavik clean rock stockpile	2	2
			Sissons clean rock stockpile		
	Mine dewatering	Mine Site	East Zone, Centre Zone, Main Zone, Andrew Lake open pits	0	0
			End Grid Underground		
	Underground ventilation	Mine Site	End Grid Underground	2	2
	Backfill production and underground placement	Mine Site	End Grid Underground	2	2
Milling	Transfer ore to mill	Mine Site		2	2
	Crushing and grinding	Mine Site		2	0
	Leaching and U Recovery	Mine Site		2	0
	U Purification	Mine Site		2	0
	Yellowcake drying and packaging	Mine Site		2	0
	Tailings neutralization	Mine Site		2	0
	Reagents Preparation and Use	Mine Site		2	0

Table 4.3-2 Identification of Project-Environmental Effects Interaction – Operations

Activities		Study Area	Component	Air Quality	Climate Change
Tailings Management	Pumping and placement of tailings slurry	Mine Site	East Zone, Centre Zone, Main Zone TMFs; pipelines	0	0
	Consolidation of tailings	Mine Site	East Zone, Centre Zone, Main Zone TMFs	0	0
	Pumping of TMF supernatant	Mine Site	East Zone, Centre Zone, Main Zone TMFs; pipelines	0	0
	Create and maintain water levels	Mine Site	East Zone, Centre Zone, Main Zone TMFs	0	0
Water Management	Freshwater withdrawal	Site Access	Ice flooding winter road	0	0
		Mine Site	Kiggavik site, potable and industrial use		
			Sissons site, potable and industrial use		
	Potable water treatment	Mine Site	Kiggavik	0	
			Sissons		
	Collection of site and stockpile drainage	Mine Site	Site runoff ditches and ponds	0	0
			Purpose built pit		
			Snow fencing and clearing		
			Stockpile drainage collection		
	Water and sewage treatment	Mine Site	Kiggavik water treatment plant	0	0
			Sissons water treatment plant		
	Discharge of treated effluents (including grey water)	Site Access	Domestic wastewater	0	0
		Mine Site	Kiggavik treated effluent		
			Sissons treated effluent		
			Clean waste stockpile excess runoff		
Waste Management	Disposal industrial waste	Mine Site	Kiggavik and Sissons	1	1
	Management of hazardous waste	Mine Site	Kiggavik and Sissons	1	1
	Management of radiologically contaminated waste	Mine Site	Kiggavik and Sissons	1	1
	Disposal of domestic waste	Mine Site	Kiggavik and Sissons	1	1
	Incineration and handling of burnables	Mine Site	Kiggavik incinerator	2	1
	Disposal of sewage sludge	Mine Site	Kiggavik and Sissons	1	1
General Services	Generation of power	Site Access	Baker Lake Dock and Storage Facility generator	2	2
		Mine Site	Kiggavik powerhouse		
			Sissons powerhouse		
			Power transmission lines	0	0
	Operate accommodations complex	Mine Site	Cafeteria, recreation areas, quarters	1	1
	Recreational activities (e.g., fishing)	Mine Site		0	0

Table 4.3-2 Identification of Project-Environmental Effects Interaction – Operations

Activities		Study Area	Component	Air Quality	Climate Change
	Maintain vehicles and equipment	Mine Site	Shops and wash bays	1	1
	Maintain infrastructure	Site Access	Roads, bridges, culverts, cable ferry, Dock and Storage Facility	1	1
		Mine Site	Site pads, roads, bridges, culverts, airstrip, buildings		
	Operate airstrip	Mine Site	Arrivals, departures, transfer materials, planes + helicopters	1	1
	Hazardous materials storage and handling (reagents, fuel and hydrocarbons)	Site Access	Baker Lake storage	1	1
		Mine Site	Kiggavik and Sissons		
	Explosives storage and handling	Site Access	Baker Lake storage	0	0
		Mine Site	Kiggavik and Sissons		
Transportation	Marine transportation	Site Access	Loading barges, barging, off-loading; fuel, reagents and supplies; Baker Lake and Churchill); back-haul	2	2
	Truck transportation	Site Access	Fuel, reagents and supplies; winter road and/or all-weather road; cable ferry operation	2	2
	General traffic (Project-related)	Site Access		1	1
		Mine Site		2	2
	Controlled public traffic	Site Access		1	1
	Air transportation of personnel, goods and supplies	Mine Site		1	1
	Air transportation of yellowcake	Mine Site	Handling and transport of yellowcake to Points North	1	1
	General air transportation support	Mine Site	Airplanes + helicopters; medivac, inspections, exploration, monitoring	1	1
On-going Exploration	Aerial surveys	Mine Site		1	1
	Ground surveys	Mine Site		1	1
	Drilling	Mine Site		1	1

4.3.3 Final Closure

Activities associated with the closure and decommissioning of the Project and all related facilities (mill complex, access roads and accommodation complex, etc.) have the potential to affect air quality. The primary sources of air emissions during this phase are fugitive emissions resulting from earthworks, material movement and vehicle travel, in addition to exhaust emissions from heavy equipment. All Project-environmental effects interactions for final-closure are outlined in Table 4.3-3.

Emissions of COPCs from all remaining on-land decommissioning activities such as the removal of foundations, buildings, equipment, fuel tanks, etc., are minor in comparison to the primary fugitive dust sources and thus have not been assessed further.

Emissions of COPCs from in-water closure and decommissioning activities including the removal of freshwater diversions, surface drainage containment, shoreline structures, etc., are minor in relation to the emissions from other decommissioning operations, as a majority of the work is done in wet conditions which will naturally suppress dust. Therefore, these activities have been rated as one (1), and are not carried forward in the assessment.

Emissions of greenhouse gases from final closure and decommissioning activities will result from fuel combustion in heavy equipment. However, this phase has a lower overall fuel consumption and thus lower emissions in comparison to the operations phase. As a result, all closure and decommissioning activities have been ranked as one (1) for climate change and therefore, not carried forward in the assessment.

4.3.4 Post-Closure

Once all of the final closure and decommissioning activities have been completed there will be one remaining Project-related interaction with the atmospheric environment. Although the clean rock (Type II) stockpiles will have been contoured and re-vegetated, they will be a continuous source of passive radon emissions. The potential effect of this interaction has been ranked as a two (2), and was assessed in more detail.

Table 4.3-3 Identification of Project-Environmental Effects Interaction – Final Closure

	Activities	Study Area	Component	Air Quality	Climate Change
General	Decommissioning Workforce Management (hiring and training)			0	0
	Contracts and Taxes				
	Hazardous materials storage	Site Access	Storage at Baker Lake port	1	1
		Mine Site			
	Industrial machinery operation	Site Access		2	2
		Mine Site			
In-Water Decommissioning	Remove freshwater diversions; re-establish natural drainage	Mine Site	Headwater stream channel	1	1
			Centre Zone		
			Andrew Lake berm		
	Remove surface drainage containment	Site Access	Site runoff pond Baker Lake port	1	1
		Mine Site	Site containment dykes and berms		
			Monitoring ponds		
			Site runoff pond, Kiggavik, Sissons		
	Remove in-water/shoreline structures	Site Access	Wharf removal	1	1
			Thelon bridge		
			Cable ferry		
			Water crossings (culverts		
			Clear span bridges		
		Mine Site	Freshwater pipelines		
			Effluent pipeline		
			Intakes		
			Diffusers		
	Water transfers and discharge	Site Access	Domestic wastewater	1	1
		Mine Site	Andrew Lake flooding		
			PBP flooding		
			Domestic wastewater		

Table 4.3-3 Identification of Project-Environmental Effects Interaction – Final Closure

Activities		Study Area	Component	Air Quality	Climate Change
	Construct fish habitat	Mine Site	In-pit	1	1
On-Land Decommissioning	Remove site pads (blasting, earth-moving, loading, hauling, dumping)	Site Access	Baker Lake port	1	1
			Winter road		
			Site roads		
			AWR		
		Mine Site	Kiggavik, including pits and stockpiles	2	1
			Sissons, including mines and stockpiles		
			Airstrip		
			Quarry development		
			Haul road		
	Backfilling	Mine Site	Special waste into TMFs and pits	2	1
			Underground mine stabilization		
	Contouring	Site Access	Quarries	1	1
		Mine Site	Clean mine rock piles	2	1
	Covering	Mine Site	TMFs	2	1
			Landfills		
	Revegetation	Site Access	Baker Lake port	1	1
			Thelon crossing		
			Quarries		
		Mine Site	Kiggavik site pad		
			Sissons site pad		
			Clean mine rock piles		
			TMFs		
			Airstrip		
	Remove foundations	Site Access	Baker Lake fuel tank farm	1	1
		Mine Site	Mill and powerhouse buildings, Kiggavik fuel tanks		

Table 4.3-3 Identification of Project-Environmental Effects Interaction – Final Closure

Activities		Study Area	Component	Air Quality	Climate Change
			Sissons fuel tanks and WTP		
			Accommodation complex		
	Remove buildings	Site Access	Emergency shelters	1	1
			Warehouse		
		Mine Site	Backfill Plant		
			Kiggavik structures		
			Sissons structures		
			Airstrip shelter		
			Accommodation complex and potable WTP		
	Remove equipment	Site Access	Temporary generators - Baker Lake	1	1
			Port crane and fuel off-loading		
		Mine Site	Mill equipment		
			Power house equipment		
			Utility distribution		
			Incinerator		
	Remove fuel tanks	Site Access	Baker Lake tank farm	1	1
		Mine Site	Kiggavik site tank farm		
			Sissons fuel tanks		
			Airstrip jet fuel tanks		

4.4 Valued Components, Indicators and Measurable Parameters

The Nunavut Impact Review Board selected the Valued Environmental Components (VECs) for the assessment of the Project, based on the following criteria:

- Do they represent a broad human environment component that may be affected by the Project?
- Are they vulnerable to the environmental effects of the Project and other activities in the region?
- Have they been identified as important issues or concerns during Inuit, government and stakeholder engagement or in other effects assessments in the region?

Two VECs were selected for the atmospheric assessment:

- VEC 1 – Ambient Air Quality
- VEC 2 – Climate Change

In order to learn more about important values and concerns to help identify valued environmental and socioeconomic components for the Kiggavik Project, AREVA conducted a community open house tour at several communities in the Kivalliq region during 2009. During this exercise, an interactive display was set up for participants to identify broad ecological areas they valued highly and/or had concerns about in relation to the Kiggavik Project. Each participant was given four stickers that they used to select areas components. This exercise was used to confirm high-level components of concern and provide opportunities for participants to share more specific concerns with an AREVA representative. A total of 7% of respondents identified air quality as one of the components of concern.

In addition, AREVA organized a series of open houses in 2010 to gather additional information from the community. The results of surveys and feedback from these public open houses indicate that air quality is an important VEC to residents in the Kivalliq region. Community responses have primarily categorized air quality as “peaceful”, important for “health”, as well as something that commands “respect”. See Tier 3, Appendix 3A for a full discussion of the open house results.

As outlined in Section 4.1, issues and concerns related to climate change were also raised at these meetings.

4.4.1 VEC 1 - Ambient Air Quality

Ambient air quality is described by measurable concentrations of Constituents of Potential Concern (COPCs). COPCs included in the assessment were selected based on community and stakeholder engagement, regulatory requirements as well as their potential to affect ecological and human health. For the Project, the following compounds have been identified as COPCs:

- Total Suspended Particulate Matter (TSP)
- Particulate matter less than 10 microns (μm) in diameter (PM_{10})
- Particulate matter less than 2.5 microns (μm) in diameter ($PM_{2.5}$)
- Radioactive and non-radioactive constituents in TSP, including:
  - Uranium-238 (U)
  - Arsenic (As)
  - Cadmium (Cd)
  - Chromium (Cr)
  - Cobalt (Co)
  - Copper (Cu)
  - Molybdenum (Mo)
  - Lead (Pb)
  - Nickel (Ni)
  - Selenium (Se)
  - Zinc (Zn)
  - Nitrogen Oxides (specifically, NO2)
  - Sulphur Dioxide (SO2)
  - Radionuclides, including:
    - Radon (Rn-222)
    - Lead-210 (Pb-210)
    - Polonium-210 (Po-210)

Hydrogen chloride (HCl) was also identified in the NIRB Guidelines as a potential COPC for the Project. However, the only source of HCl is the incineration of food and other organic wastes. Therefore, emissions were considered negligible since the type of waste to be incinerated (i.e., organics) will not contain chlorinated compounds. Furthermore, the incinerator at the Kiggavik and potentially the Sissons site will operate on an intermittent basis, as necessary, and will be a very minor contributor to overall COPC emissions. As a result, HCl was not carried forward as a COPC in the assessment.

Additionally, Volume 2, Section 14.2.1, and Technical Appendix 2S outline that the incinerator units will be designed to meet the CWS for mercury and dioxins and furans. In particular, operation of the incinerators will follow the Environment Canada (EC) Technical Document for Batch Waste Incineration to meet the CWS and will comply with EC operating requirements (e.g., secondary combustion temperature). As a result, emissions of mercury and dioxins and furans were also considered as negligible and not carried forward as COPCs in the assessment. To demonstrate that CWS will be met, emissions testing will be conducted periodically (see Technical Appendix 4C).

Ozone (O_3) was also identified as a potential COPC in the NIRB Guidelines. Since none of the Project sources emit ozone directly, only ground level ozone formation could be included in the assessment. Ozone is formed in the atmosphere because of chemical reactions between nitrogen oxides (NO_x) and reactive organic gases (ROGs) and/or volatile organic compounds (VOCs) in the presence of sunlight. While the Project emits nitrogen oxides and ROG/VOCs, optimal conditions for ground level ozone formation include strong solar radiation, high ambient temperatures and low wind speeds. However, these conditions rarely occur within the RAA as the mean and maximum summertime temperatures are 11.4°C and 16.7°C, respectively (Environment Canada 2011a). This limits the potential for ground level ozone formation to occur. As a result, significant ground level ozone formation is not expected to occur, and O_3 was not carried forward as a COPC in the assessment.

In addition to the COPCs identified above, particulate-based compounds and gaseous compounds such as nitrogen oxides and sulphur dioxide can deposit on surfaces at far distances from the original source. Deposited particles also have the potential to become a nuisance (i.e., dusting of surfaces) or a cause a potential environmental effect to the terrestrial or aquatic environments, depending on the dust composition. Additionally, NO_x and SO_2 have the potential to acidify the environment. However, the incremental change in the deposition rates of these compounds are not considered to be a measure of the potential effect of the Project on air quality or climate change. Instead, changes in deposition rates of dust and acidifying COPCs were assessed as measures of the potential Project effects to the aquatic and the terrestrial environments, which are assessed in Volumes 5 and 6, respectively. Nonetheless, the results used by these other volumes are presented in this report for completeness.

Table 4.4-1 presents the measurable parameters studied to assess the Project effects on ambient air quality.

Table 4.4-1 Measureable Parameters for Ambient Air Quality

Environmental Effect	Measurable Parameter(s)	Rationale for Selection
Change in ambient air quality	Change in ambient air concentrations of COPCs	• potential to affect ecological and human health • community, government, stakeholder engagement • regulatory drivers

4.4.2 VEC 2 - Climate Change

Project-related activities that require the combustion of fossil fuels (e.g., diesel) will result in emissions of greenhouse gases (GHGs), including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Increased emissions of GHGs are known to contribute to the greenhouse effect, therefore, any changes to GHG levels resulting from Project-related activities have the potential to lead to changes in the regional climate in the long term. Because of the possible linkage to climate change, managing Project GHG emissions is an important issue for regulators and stakeholders. Table 4.4-2 presents the measurable parameters studied to assess the project effects on climate change.

Table 4.4-2 Measureable Parameters for Climate Change

Environmental Effect	Measurable Parameter(s)	Rationale for Selection
Potential to affect climate change	Change in emissions of carbon dioxide equivalent (CO_2-eq)	• community, government, stakeholder engagement • regulatory drivers

4.5 Spatial Boundaries

The assessment of potential effects of the Project focus largely on an area referred to as the Local Assessment Area (LAA). The cumulative effects assessment uses a broader spatial boundary referred to as the Regional Assessment Area (RAA).

4.5.1 Project Footprint

The Project Footprint consists of three components: the Kiggavik and Sissons mine sites and interconnecting Kiggavik-Sissons haul road (collectively referred to as the Mine Development Area), the Baker Lake Dock and Storage Facility, and the access road between Baker Lake and the Mine Development Area (Baker Lake-Kiggavik access road). For the purpose of this assessment, the preferred alternative for the Baker Lake-Kiggavik access road is the Winter Road. However, the All-Season Road option has also been considered in the assessment.

The Kiggavik mine site, located approximately 80 kilometres (km) west of the community of Baker Lake, includes three open pit mines (East Zone Pit, Center Zone Pit and Main Zone Pit), mine rock and ore stockpiles, and ore processing and auxiliary facilities. The Sissons mine site, located approximately 17 km southwest of the Kiggavik mine site, includes one open pit mine (Andrew Lake Pit), one underground mine (End Grid Ore Zone), mine rock and ore stockpiles, and auxiliary facilities. The Kiggavik and Sissons mine sites are connected by a 20 km Kiggavik-Sissons haul road used to transport ore from the Sissons mine site to the Kiggavik mine site for ore processing or to transport personnel to and from the Sissons Mine Site.

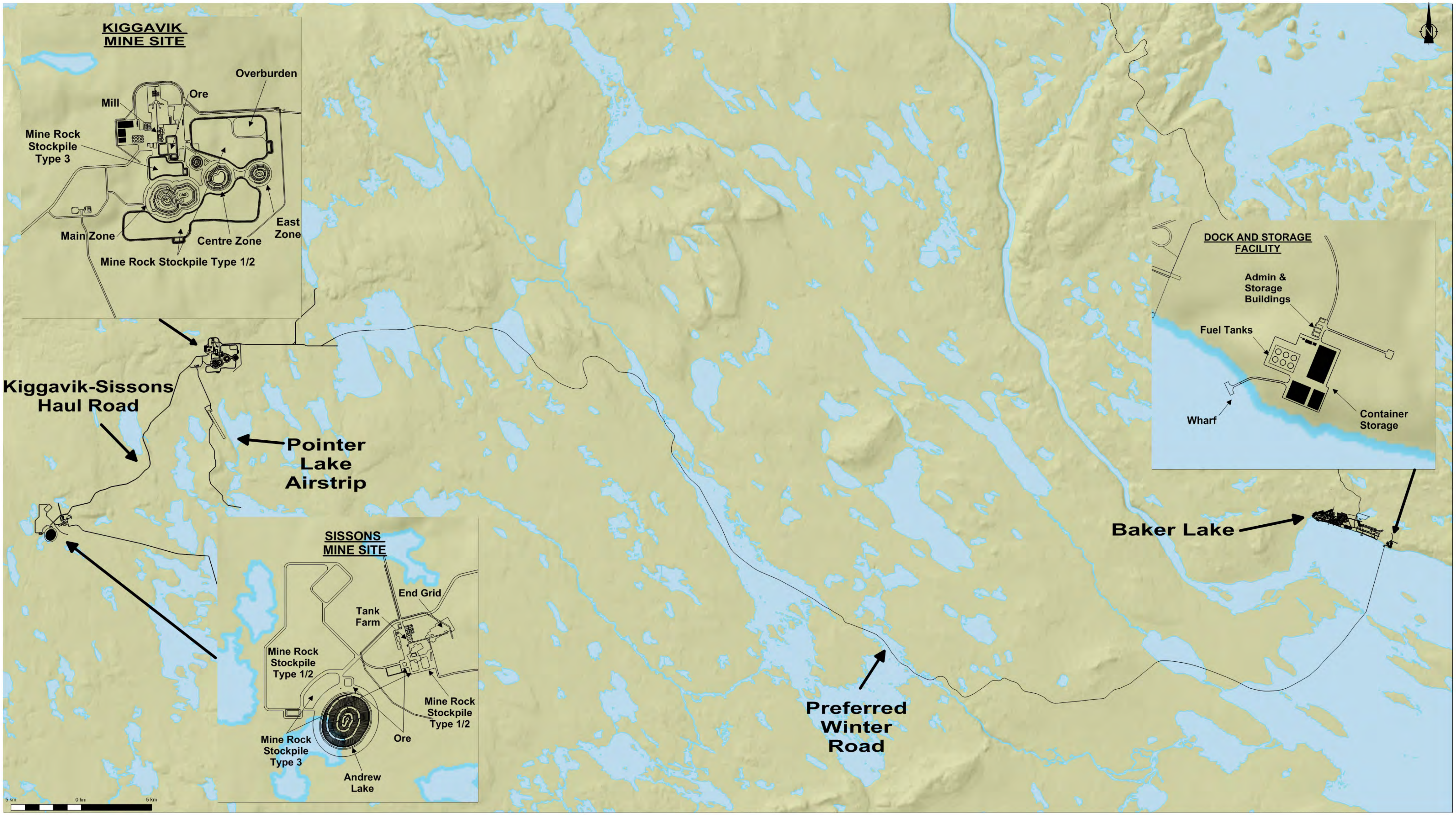
The Baker Lake Dock and Storage Facility, located approximately 2.5 km southeast of the community of Baker Lake, will act as a transfer station between the marine and road transportation routes. The preferred option for the transportation route between the Mine Development Area and Dock and Storage Facility is the 100 km Winter Road. The Project Footprint is illustrated in Figure 4.5-1.

4.5.2 Local Assessment Area

For the purpose of this assessment, the Local Assessment Area (LAA) is defined by an area which is represented by approximately a 25 km by 25 km area centered over the Mine Development Area and a 5 km by 5 km area centered over the Baker Lake Dock and Storage Facility where measureable effects from Project specific activities are most likely to occur. The LAA is illustrated in Figure 4.5-2.

4.5.3 Regional Assessment Area

For the purpose of this assessment, the Regional Assessment Area (RAA) is defined by an area that extends beyond the LAA to encompass a 117 km by 65 km area from Samarook Lake to just east of Whitehills Lake, and includes the Mine Development Area, the Kiggavik-Sissons haul road, the Baker Lake-Kiggavik access road options, as well as the community of Baker Lake. The RAA captures the full extent of potential emissions from the entire Project Footprint through all development phases (i.e., beyond the RAA, Project emissions would not be detectable). The RAA is illustrated in Figure 4.5-2.



Projection: NAD 1983 UTM Zone 14N

Compiled: SENES Consultant

Date: 05/05/2014

Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, AREVA Resources Canada Inc.

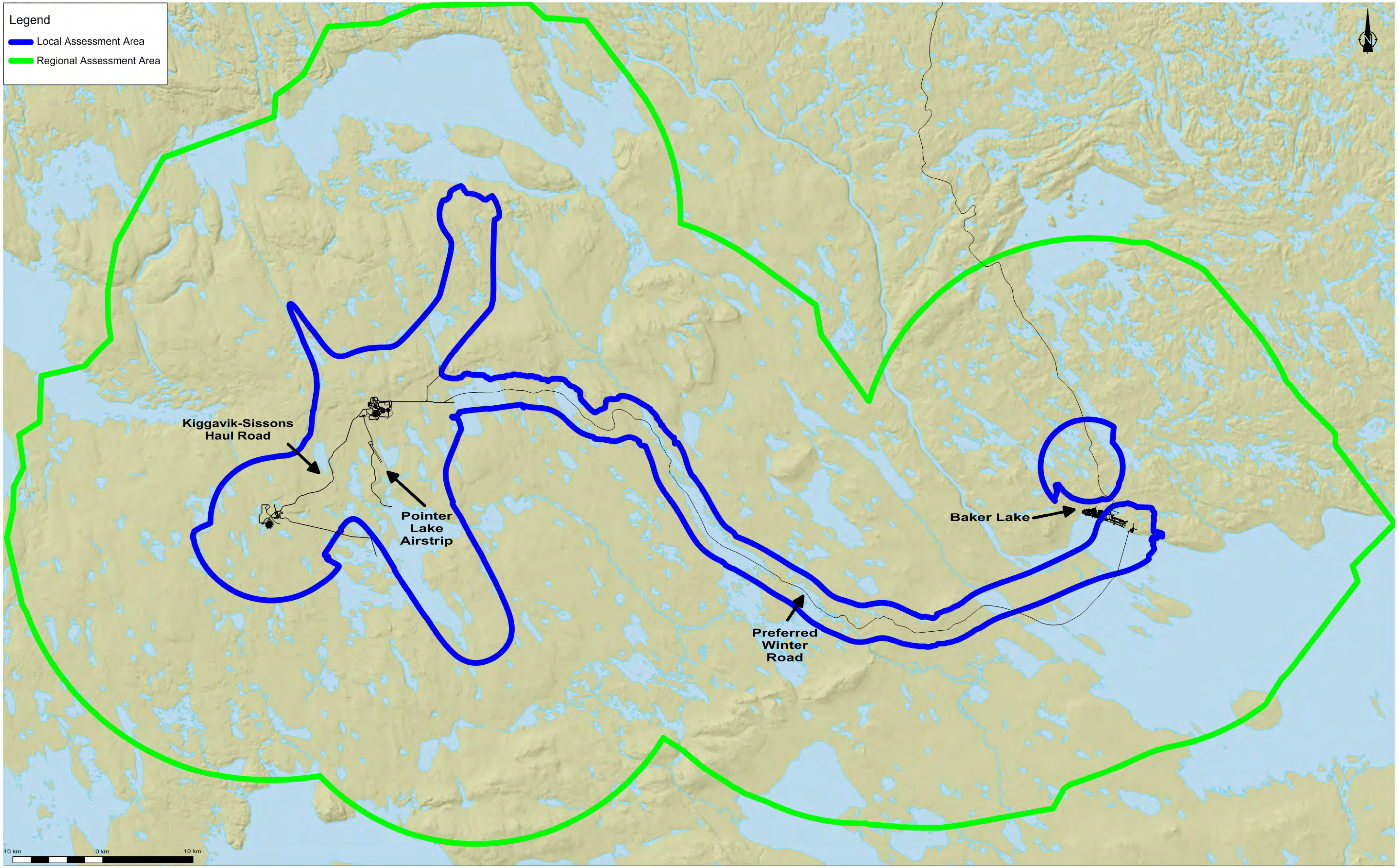
FIGURE 4.5-1
PROJECT FOOTPRINT

ENVIRONMENTAL IMPACT STATEMENT
VOLUME 4: ATMOSPHERIC ENVIRONMENT

KIGGAVIK PROJECT

AREVA

AREVA Resources Canada Inc - P.O. Box 9204 - 817 - 45th Street West - Saskatoon, SK - S7K 3X5



Projection: NAD 1983 UTM Zone 14N

Compiled: SENES Consultant

Date: 05/05/2014

Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, AREVA Resources Canada Inc.*

FIGURE 4.5-2

LOCAL AND REGIONAL ASSESSMENT AREAS

ENVIRONMENTAL IMPACT STATEMENT
VOLUME 4: ATMOSPHERIC ENVIRONMENT

KIGGAVIK PROJECT

AREVA

AREVA Resources Canada Inc - P.O. Box 9204 - 817 - 45th Street West - Saskatoon, SK - S7K 3XS

4.6 Temporal Boundaries

The temporal boundaries for the assessment were defined based on the timing and duration of potential effects from activities associated with the Project. The assessment covers the period of all major Project phases including construction, operation, final closure and post-closure. Since the level of activity from each of the Project phases differs, the extent of any related potential effects will also differ. For this reason, the assessment of potential effects of the Project on air quality and climate change has been considered as follows:

- **Maximum Construction** – The construction scenario considered land preparation and construction of the Kiggavik mine site, Sissons mine site and Baker Lake port infrastructure, as well as quarry operations for the construction of the All-Season road. Activities for these scenarios include, but are not limited to, land clearing, site grading, excavation, concrete production and pouring, rock crushing and screening, power generation and building construction. It should be noted that the simultaneous construction of both the Kiggavik and Sissons mine sites is not likely; however, it was considered as the most conservative bounding assumption possible for this scenario. The construction of the mine sites also considered emissions from fuel and supply transport (i.e., use of the Winter Road and operations at the Baker Lake Dock and Storage Facility). In addition, the quarrying assessment was based on the assumption that activities (and emissions of COPCs) will be the same for each quarry, regardless of the location. Therefore, any differences in the potential effects to air quality will occur as a result of localized effects of meteorology and terrain. As a result, three separate quarry locations were chosen for assessment to demonstrate possible localized effects of terrain and meteorology. The expected duration of the construction phase is approximately 4 years; however, it was conservatively assumed that construction will occur over a 2 year period. By assuming construction activities are condensed into a shorter time period, emissions will be greater than if they were calculated over a longer period of time.

- **Maximum Operation** – Project-related effects were also considered for a maximum emissions bounding scenario, which is an artificial scenario that represents the maximum operational period assuming that each Project activity occurs simultaneously. This is unlikely to occur in reality, but this scenario was simulated to assess the maximum envelope of operations. This assessment provides an upper bound estimate of mining activity air emissions and the predicted atmospheric concentrations are used to assess the largest potential short-term (i.e., 1- or 24-hour) effects of site activities on ambient air quality. This scenario was also used to conservatively assess dust deposition (i.e., dustfall) even though dust deposition is considered to have long-term (i.e., monthly or annual) effects. Should the current production schedule change, this assessment will provide the necessary flexibility such that a new mining schedule will be within the bounds of this maximum emissions scenario. The potential effect of the predicted deposition rates on aquatic resources are also assessed in Volume 5 – Aquatic Environment.

- **Phased Operation** – Project-related effects are considered for operational scenarios that are representative of planned mining and milling activities over the lifetime of the Project. In air dispersion modelling, it is generally not practical to model every year of scheduled production due to the excessive amount of computational time involved in carrying out the model runs and in processing the output data. Hence, it is common practice to select certain years for modelling purposes that are considered to be representative of activities at the site over consecutive periods spanning the operating life of the Project. The years chosen for modelling are generally selected on the basis that they are expected to yield the highest amount of emissions during each of the chosen periods. Long-term (i.e., monthly, annual) potential effects to air quality were assessed for four (4) phased operation scenarios associated with the scheduled activities of the Project over its lifetime. Predicted concentrations and deposition of acidifying COPCs were also assessed through an exposure pathways analysis (see Volume 6 – Terrestrial Environment and Volume 8 – Human Health). The scenarios assessed include:
  - Scenario 1 - Year 0 and 1, includes the following activities:
    - construction of the Purpose Built Pit;
    - open pit mining of East Zone Pit and Centre Zone Pit mine rock and ore;
    - open pit mining of mine rock from Main Zone East Pit; and,
    - stockpiling East Zone and Centre Zone Pit ores.
  - Scenario 2 - Year 2 to 5, includes the following activities:
    - simultaneous open pit mining of ore and mine rock from Main Zone West Pit;
    - open pit mining of mine rock from Andrew Lake Pit;
    - extraction of mine rock from End Grid Underground Mine
    - milling of ores from East Zone, Centre Zone and Main Zone pits;
    - mine rock management; and,
    - tailings management.
  - Scenario 3 – Years 6 to 13, includes the following activities:
    - open pit mining of ore and mine rock from Andrew Lake Pit;
    - extraction of ore from End Grid Underground Mine
    - milling of ores from Andrew Lake Pit and End Grid Underground mine;
    - mine rock management; and,
    - tailings management.
  - Scenario 4 – Year 14
    - milling of any remaining ore; and,
    - tailings management.

With respect to GHG emissions, the year with the highest anticipated fuel consumption was selected for the assessment of potential effects to climate change from the Project.

For the purpose of this assessment, the total duration of Project operations was considered to be 15 years (Year 0 up to and including 14). However, based on the capacity of the TMFs, the operational life of the Project may be extended to 25 years. Since the potential Project-related effects to air quality have already been captured in the outlined operational scenarios, no additional assessments were required to evaluate an extended operational life.

- **Final Closure** – For this assessment it was assumed that beginning in Year 15, closure activities will begin to restore the Mine Development Area back to a near undisturbed state. The first phase of closure will take approximately 2 years to complete and will involve the progressive rehabilitation of the mine sites. Activities will include backfilling Type III mine rock (special waste) at Kiggavik and Sissons mine sites into Main Zone pit and Andrew Lake pit, respectively and charging (or covering) Centre Zone TMF with a layer of Type II mine rock (clean waste) from the north Type II mine rock stockpile.
- **Post-Closure** – At this stage of the Project, all final closure operations are assumed to have been completed, and only passive emissions of radon from the permanent Type II mine rock stockpiles and fully charged and covered TMFs (East Zone, Centre Zone and Main Zone TMFs) are expected to occur.

4.7 Administrative and Technical Boundaries

The air quality and climate change assessments are subject to some technical limitations due to a lack of scientific information with which to form effects predictions or mitigations. These technical limitations have been considered in the assessment and pertain to the following:

- Many of the emissions estimates of COPCs from mining operations are based on U.S. EPA AP-42 emission factors (US EPA 1995) (e.g., drilling, blasting, material handling, and unpaved road dust) and site-specific mineral/metal assay data. Most of these emission factors require further site-specific or activity-specific data that was not available. For example, parameters such as roadway silt content, material moisture content, daily vehicle counts, daily material quantities handled, among others parameters, were not available. In these cases, professional judgment and information available from similar mining assessments was used in place of the site specific data.
- Site specific information pertaining to emissions of COPCs from milling equipment, including the acid plant was unavailable. As a result, estimates of COPC emissions from milling operations and acid production were based on stack testing data available from AREVA`s McClean Lake operation which has similar mill processing to what has been planned for the Project.
- Specific emissions data for each piece of equipment that would be operating, including heavy equipment, were not available. COPC emissions for heavy equipment were derived from calculations using the power rating of the equipment in combination with the US EPA emission factors published in "Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling – Compression-Ignition" (US EPA 2010). For some types of equipment, the make and model was available, and manufacturers' brochures were consulted to determine the power rating of the equipment. Where equipment make and model were not available, equipment information available from similar mining assessments was used.

These technical limitations were overcome by using conservative estimation techniques and professional judgment in a manner that likely results in an overestimate of potential effects to air quality and climate change. Technical Appendix 4B (Air Dispersion Assessment) provides further details on all assumptions that have been used in the assessment.

4.8 Environmental Effects Criteria

Project environmental effects to air quality are typically assessed in quantitative terms through comparison of atmospheric concentrations to ambient air quality criteria, objectives, standards or guidelines. Conversely, As noted in the Canadian Environmental Assessment (CEA) Agency's guide to Incorporating Climate Change Considerations in Environmental Assessment (CEA Agency 2003) the contribution of an individual project to climate change cannot be measured. Instead, as recommended by CEA Agency guidance (CEA 2003), potential effects on climate change are typically assessed quantitatively through comparison of Project-related emissions of greenhouse gases to total federal and provincial/territorial GHG emission levels.

Project effects criteria for air quality are defined by the regulatory/guidance criteria presented in Table 4.8-1. Predicted concentrations from air dispersion modelling are added to baseline values and compared to the criteria shown in Table 4.8-1 in order to determine the potential for a residual effect to occur due to changes in ambient air concentrations of COPCs. These criteria have been used as Indicator Thresholds to identify potential residual effects. In general, no residual effects to the atmospheric environment are considered to occur if the predicted concentrations of COPCs are below the applicable Indicator Threshold.

Furthermore, the Indicator Thresholds outlined below are not generally applicable to on-site locations within the Project Footprint, as different criteria or standards are generally applied to assess potential effects to workers. As a result, on-site exceedances of the selected Indicator Thresholds are not considered to be residual effects. It should also be noted that potential effects to other VECs (i.e., the aquatic environment, the terrestrial environment, and human health) resulting from changes in air quality typically use different effects criteria than those presented here. The potential effects on these VECs due to changes in ambient air COPC concentrations have been assessed in Volumes 5, Volume 6 and Volume 8.

Although changes in dust deposition levels and Potential Acid Input (PAI) are not used to assess Project effects to air quality or climate change, selected criteria are used to provide context for the air dispersion modelling results presented later in this report. The applicable criteria for dust deposition and PAI are presented in Table 4.8-2 and Table 4.8-3, respectively.

Table 4.8-1 Summary of Ambient Air Quality Effects Criteria and Selected Indicator Thresholds

COPC	Averaging Period	NWT Standards (µg/m^3)	Nunavut Standards (µg/m^3)	Canadian Ambient Air Quality Standards 2012 (µg/m^3)	Canadian Ambient Air Quality Standards 2020 (µg/m^3)	National Air Quality Objectives Maximum Desirable Level (µg/m^3)	National Air Quality Objectives Maximum Acceptable Level (µg/m^3)	Other Relevant Criteria (µg/m^3)	Indicator Threshold (µg/m^3)
TSP	Annual	60	60			60 (1)	70 (1)		60
	24-hour	120	120				120		120
PM_{10}	Annual							50 (3)(4)	50
	24-hour								
$PM_{2.5}$	Annual			10 (5)	8.8 (5)				8.8
	24-hour	30	30	28 (6)	27 (6)				27
SO_2	Annual		30			30 (2)	60 (2)		30
	24 hour		150			150	300		150
	1 hour		450			450	900		450
NO_2	Annual		60			60 (2)	100 (2)		60
	24 hour		200					200 (4)	200
	1 hour		400				400	400 (4)	400
Uranium	24 hour							0.03 (7)	0.03
	Annual							0.3 (7)	0.3
Arsenic	24 hour							0.3 (7)	0.3
	Annual							0.06 (8)	0.06
Cadmium	24 hour							0.025 (7)	0.025
	Annual							0.005 (7)	0.005
Chromium	24 hour							0.5 (7)	0.5
	Annual							0.1 (8)	0.1
Cobalt	24 hour							0.1 (7)	0.1
	Annual							0.02 (8)	0.02
Copper	24 hour							50 (7)	50
	Annual							9.6 (8)	9.6
Lead	24 hour							0.5 (7)	0.5
	Annual							0.1 (8)	0.1
Molybdenum	24 hour							120 (7)	120
	Annual							23 (8)	23

Table 4.8-1 Summary of Ambient Air Quality Effects Criteria and Selected Indicator Thresholds

COPC	Averaging Period	NWT Standards (µg/m³)	Nunavut Standards (µg/m³)	Canadian Ambient Air Quality Standards		National Air Quality Objectives		Other Relevant Criteria (µg/m³)	Indicator Threshold (µg/m³)
				2012 (µg/m³)	2020 (µg/m³)	Maximum Desirable Level (µg/m³)	Maximum Acceptable Level (µg/m³)		
Nickel	24 hour							0.2 (7)	0.2
	Annual							0.04 (7)	0.04
Selenium	24 hour							10 (7)	10
	Annual							1.9 (8)	1.9
Zinc	24 hour							120 (7)	120
	Annual							23 (8)	23
Radon	Annual							60 (Bq/m³) (9)	60 (Bq/m³)
Lead-210	Annual							0.0021 (Bq/m³) (10)	0.0021 (Bq/m³)
Polonium-210	Annual							0.0028 (Bq/m³) (10)	0.0028 (Bq/m³)

NOTES:
(1) Calculated as geometric mean (CCME 1999)
(2) Calculated as arithmetic mean (CCME 1999)
(3) Ontario Interim guideline (MOE 2012)
(4) Guideline in Ontario (MOE 2012) Newfoundland (Government of Newfoundland and Labrador 2004) and British Columbia (BC MOE 2009)
(5) Based on a 3-year average (CCME 2012)
(6) Based on 98th percentile value averaged over 3 years (CCME 2012)
(7) 24-hour criteria from Ontario's Ambient Air Quality Criteria, Ontario Ministry of Environment Standards and Development Branch, 2012. (MOE 2012)
(8) Annual values were derived for use in the current assessment from 24-hour values based on the following equation: Clong/Cshort = (tlong/tshort) 0.28 (MOE 2009)
(9) Radiation Protection Regulations of the Canadian Nuclear Safety Commission (CNSC 2000)
(10) See Appendix 4B – Air Dispersion Assessment.

Table 4.8-2 identifies dust deposition criteria for Alberta and Ontario. These criteria are nuisance based. For the purpose of this assessment, the Ontario Ambient Air Quality Criteria were selected as the applicable Indicator Thresholds to give context to the dispersion modelling results.

Table 4.8-2 Dust Deposition Criteria and Selected Indicator Thresholds

Averaging Time	Alberta Residential and Recreational Areas	Alberta Commercial and Industrial Areas	Ontario Ambient Air Quality Criteria	Indicator Threshold
Monthly	5.3 g/m²/30 days	15.8 g/m²/30 days	7 g/m²/30 days	7 g/m²/30 days
Annual Average	-	-	4.6 g/m²/30 days	4.6 g/m²/30 days
Annual Loading	-	-	55 g/m²/year (1)	55 g/m²/year
SOURCES: Alberta Environment (2011) and Ontario Ministry of Environment (MOE 2012) NOTES: (1) Calculated (4.6 g/m²/month x 12 months per year = 55 g/m²/year)				

Table 4.8-3 presents the suggested loading thresholds for Potential Acid Input (PAI) based on the sensitivity of the receiving environment. For the purpose of this assessment, the critical loading level for sensitive environments was selected as the Indicator Threshold to give context to the dispersion modelling results.

Table 4.8-3 Thresholds for Potential Acid Input

Sensitivity of Environment	Deposition Load	Parameter	Indicator Threshold
Sensitive	Monitoring	0.17 keq/ha/yr	0.25 keq/ha/yr
	Target	0.22 keq/ha/yr	
	Critical	0.25 keq/ha/yr	
Moderately Sensitive	Critical	0.50 keq/ha/yr	
Low Sensitivity	Critical	1.00 keq/ha/yr	
SOURCE: CASA and Alberta Environment (1999)			

4.8.1 Descriptors for Residual Effects of the Project on Ambient Air Quality

Residual effects are those that remain when all mitigation options have been incorporated into the Project design and operation. The criteria identified earlier in Table 4.8-1 were used to determine whether a residual effect is expected to occur as a result of the Project. Table 4.8-4 presents the descriptors used for describing the residual effects of the Project on air quality. Professional judgment was used to develop these descriptors based on the consideration of the magnitude of the effect in relation to the effects criteria, in addition to the geographic extent, duration, and frequency of the effect. As noted previously, there are no effects criteria for climate change.

Table 4.8-4 Definitions of Criteria Used in the Description of Residual Effects to Air Quality

Direction	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Likelihood	Context Socio-Economic
P Positive: an improvement in air quality due to a reduction in concentrations of COPCs in air A Adverse: a deterioration in air quality due to an increase in concentrations of air COPCs N Neutral: No notable change in concentrations of air COPCs	L Low: The predicted COPC concentrations are less than 25% greater than the Indicator Threshold (>1.25 times the Threshold) M Moderate: The predicted COPC concentrations are less than 100% greater than the Indicator Threshold (>1.25 times, but < 2 times the Threshold) H High: The predicted COPC concentrations are more than 100% greater than the Indicator Threshold (>2 times the Threshold)	F Footprint: Effect confined to the project footprint F* Footprint: Effect confined to 2km from the project footprint L Local: Effect confined to the LAA R Regional: Effect extends beyond the LAA but within the RAA	ST Short term: Less than one year (growing season) MT Medium term: More than one year, but not beyond the end of project decommissioning LT Long term: Beyond the life of the project P Permanent	R Reversible: the VEC will recover from an environmental effect I Irreversible: the VEC will not recover from an environmental effect	Infrequent – Less than 1% of the time (i.e., the effect occurs no more than four days per year or 88 hours per year)) Sporadic – Less than 3.5% of the time (i.e., the effect occurs no more than 12 days per year or 305 hours per year) Regular - Less than15% of the time (i.e., the effect occurs no more than 55 days per year or approximately 1300 hours per year) Continuous – The effect occurs more than 15% of the time	L Low probability of occurrence M Medium probability of occurrence H High probability of occurrence	Negligible: No implications to human health, well-being or quality of life Level I: No implications to human health, well-being or quality of life but some changes in annoyance / disturbance levels; potential effects on individuals within populations Level II: Implications to human health, well-being or quality of life; potential population level effects

4.9 Assessment of Significance

Under the NIRB "Guidelines for the Preparation of an Environmental Impact Statement for AREVA Resources Canada Inc.'s Kiggavik Project (NIRB File No. 09MN003)" (NIRB 2011), the environmental assessment must include a determination of the significance of environmental effects. Significance criteria were developed for the Air Quality VEC based on the measurable parameters (i.e., COPC concentrations) beyond which a residual environmental effect would be considered significant.

The potential effect to climate change was assessed through changes to emissions of greenhouse gases and the relative contribution of the Project to overall greenhouse gas emissions in Nunavut and Canada. The direct effect to climate change that could occur as a result of changes in GHGs is unknown at present (CEA 2003). As a result, it is not possible to assess the significance of changes to greenhouse gas emissions. However, Project-related greenhouse gas emissions will be put into context by comparison to greenhouse gas emissions from other existing and proposed projects in Nunavut and total GHG emissions in Canada.

4.9.1 Ambient Air Quality

Exceedances of the Indicator Thresholds indicate the presence of a residual effect. However, a predicted COPC concentration in air that is greater than the relevant Threshold is not necessarily considered to be a significant environmental effect since infrequent, low magnitude exceedances of criteria typically do not represent degradation to overall air quality. Also, there is generally an inherent amount of conservatism built into the emission estimates and model results.

Significance criteria for residual effects to air quality have been developed using professional judgement, based on the combined magnitude, frequency and geographic extent of the residual effects. As an example, residual effects to air quality are considered to be not significant if they occur infrequently and are localized to within 2 km of the Project Footprint boundary, regardless of the magnitude of the effect.

Table 4.9-1 presents the combinations of magnitude, geographic extent and frequency of residual effects, and the associated significance ratings. See Table 4.8-4 for the definitions of the effects criteria descriptors.

Table 4.9-1 Significance Criteria for Residual Effects to Air Quality

Magnitude	Geographic Extent	Frequency	Significant?
Negligible	Any	Any	NS
Low (<25%)	F*	Any	NS
	LAA	I, S, R	NS
		C	S
	RAA	I,S	NS
		R, C	S
Moderate (<100%)	F*	I, S, R	NS
		C	S
	LAA	I, S	NS
		R, C	S
	RAA	I	NS
		S, R, C	S
High (>100%)	F*	I, S	NS
		R, C	S
	LAA	I	NS
		S, R, C	S
	RAA	Any	S

The determination of significance of potential Project-related effects on biophysical VECs due to changes in air quality focuses on the specific environmental endpoints selected for analysis of each VEC. Environmental receptors for this Project include:

- soils and terrain;
- vegetation;
- wildlife;
- aquatic resources; and
- human health.

Individual disciplines (e.g., aquatic resources [Volume 5 – Aquatic Environment], vegetation, wildlife, terrain and soils [Volume 6 – Terrestrial Environment] and human health [Volume 8] consider the results developed for this volume, where relevant, to assess the potential effects of the Project on specific VECs due to changes in predicted COPC concentrations.

4.10 Influence of Inuit Qaujimajatuqangit and Stakeholder Engagement on the Assessment

As part of the consultation process for the Kiggavik Project, AREVA has conducted a community tour and held public open houses in order identify Project-specific issues and concerns and to gain a better understanding of the value associated with specific VECs. Project-specific issues and concerns identified during Inuit, government and stakeholder engagement were identified in Section 4.1. Where appropriate, these concerns were considered in the air quality and climate change assessments, or by other disciplines which assess the potential effects of changes in air quality to the environment and human health. Below, the issues and concerns have been summarized in Table 4.10-1 together with an identification of the document and where the issue is specifically addressed.

Table 4.10-1 Stakeholder Concerns Relating to Air Quality and Climate Change

Issue	Document
Concerns over emissions and dispersion (travel) of dust from the Project	Volume 4 Appendix 4B
Concerns over airborne uranium and radionuclides from the Project	Volume 4 Appendix 4B Volume 8
Concerns about specific sources of dust, uranium and radionuclides including mine roads, blasting and milling	Volume 4 Appendix 4B
How dust will be controlled from the mine, particularly from unpaved roads	Volume 4 Appendix 4C
Potential effects that airborne contaminants may have on wildlife like caribou and fish	Volume 6 Volume 8
Concern about the potential human health effects from dust travelling through the environment and neighboring communities	Volume 8
Concern over the potential effects to wildlife and human health in general	Volume 6 Volume 8
How will climate change affect the Project	Volume 4
How the Project will affect greenhouse gas emissions and climate change	Volume 4 Appendix 4B

The issues and concerns identified during the stakeholder engagement sessions and IQ interviews (Section 4.1) were incorporated into the air quality assessment and informed the associated mitigation and monitoring plans. The mitigation, monitoring, and management plan (Tier 3, Technical Appendix 4C) associated with the air quality assessments incorporate IQ guiding principles (GN 2009), including Qanuqtuurnunnarniq (being resourceful to solve problems), Avatimik Kamattiarniq (environmental stewardship), Pilimmaksarniq (skills and knowledge acquisition) and Piliriqatigiingniq (collaborative relationships or working together for a common purpose). The importance of environmental monitoring was highlighted through IQ interviews and engagement feedback (e.g. EN-BL OH Nov 2013[57]).

Results of the air quality assessment and air quality monitoring and mitigation plan (Tier 3, Technical Appendix 4C) will be communicated to local stakeholders through implementation of the Community Involvement Plan (Tier 3, Technical Appendix 3C). AREVA's commitment to engagement and community involvement is throughout the life of the Project and continues throughout construction, operations, decommissioning and reclamation. Knowledge and understanding of IQ and Inuit culture influences the way in which AREVA conducts business in Nunavut. Many IQ principles are evident in AREVA's efforts to:

- Engage various groups (e.g. Elders, youth, hunters, local businesses and others) within communities as all groups are recognized as valued contributors.
    - Tunnganarniq, Aajiiqatigiingniq, Inuuqatigiitsiarniq

- Remove language barriers through use of translated material and availability of translators at meetings
    - Pilimmaksarniq, Tunnganarniq

- Prioritize face-to-face meetings to create relationships and use of various other communication mediums to provide information and obtain feedback
    - Inuuqatigiitsiarniq, Tunnganarniq, Piliriqatigiingniq.

AREVA's experience in uranium mining in northern Saskatchewan has been used as a benchmark for Project design and planning. Kivalliq residents expressed uncertainty as to whether or not the comparison to northern Saskatchewan is relevant, since there are some important differences between the boreal and tundra environments. People have expressed the need for assurance that AREVA is designing specifically for the unique environmental conditions at Kiggavik (EN-KV OH 09[58]). Inputs into and calibration of the CALMET model (Tier 3, Technical Appendix 4B, Attachment C) included consideration of Nunavut-specific conditions, such as meterological data and terrain.

[57] EN-BL OH Nov 2013: *What about the environment? How do you know what is in the air and water and lichen that caribou eat?*

[58] EN-KIV OH 2009*: No trees up here but the trees stop the wind blowing the ore in Saskatchewan. What will be used to manage dust?*

The results of the air quality assessment were included in other sections of the environmental assessment to address public issues and concerns. For instance, the aquatic environment assessment considered the influence of dust deposition and acid deposition on water quality (Tier 2, Volume 5, Section 8). The effects of dust on soil quality and vegetation quality are addressed in Tier 2, Volume 6, Sections 8 and 9, respectively. Concerns about COPCs entering the food web through dust (IQ-ARHT 2009[59]) were addressed in the pathways of exposure in the Ecological and Human Health Risk Assessment (Tier 3, Technical Appendix 8A). Modelling the uptake of radionuclides and metals by terrestrial biota and humans can be quite involved and requires consideration of several interactions. For example, direct deposition from air to soil and terrestrial vegetation, direct uptake from soil to terrestrial vegetation, and ingestion of diet components by terrestrial animals, birds and humans are considered in the modelling.

[59] IQ-ARHT 2009: *Hunters and elders expressed concerns about the potential for airborne contamination settling on vegetation and being consumed by caribou.*

5 Summary of Existing Environment – Air Quality and Climate Change

Air quality in the vicinity of the Kiggavik site and within the Kivalliq Region in general, can be characterized as typical of the rural north in that the air is relatively pristine, with very low baseline concentrations of the COPCs of interest. However, baseline air concentrations of some COPCs can be expected to be slightly higher in and adjacent to hamlets such as Baker Lake due to increased emissions from human activities such as fuel consumption for heating and transportation.

Baseline concentrations should capture emissions from existing operations or emissions sources located within the vicinity of Project. As a result, emissions from nearby operations such as the Agnico-Eagle dock servicing the Meadowbank Gold Mine should be included as part of baseline COPC concentrations. However, monitoring data in the Baker Lake area was not available. In addition, emissions data from this source was also not available. As a result, the Agnico-Eagle dock was instead included as part of the cumulative effects assessment provided in Section 6.2 in order to capture the potential effects of this nearby source.

Baseline concentrations used in this assessment were obtained through a combination of on-site measurements and existing data and from literature reviews of EIS documents from other projects in Nunavut and are summarized below following a discussion of existing sources of COPCs.

5.1.1 Current Emission Sources of COPCs

Current sources of COPCs, including GHGs, within the local and regional assessment areas defined in Section 4.5 primarily include anthropogenic emissions from inhabited areas such as the hamlet of Baker Lake or the Agnico-Eagle dock. Specific emission sources include fuel combustion for the purpose of heating or transportation (ground, air and marine). Drilling and exploration activities would also be existing sources of COPCs; however, emissions would be short-lived.

Emissions within the study areas would tend to be higher during the winter months due to increased heating requirements, for example. Lack of daylight during the winter would also affect the formation of secondary COPCs that only react in the presence of daylight. Furthermore, concentrations of COPCs, particularly gaseous COPCs, are typically higher during the colder months because of a decrease in the depth of the mixing height. A lower mixing height means that COPCs are confined to a shallower layer of the atmosphere and cannot disperse as easily, which leads to higher concentrations near the surface.

5.1.1 Local Air Quality

A series of high volume air samplers (Hi-Vols) were used to collect on-site measurements of TSP, metals and radionuclides during the 2010, 2011, 2012 and 2013 summer field seasons (i.e., June to August) near the exploration camp near the Kiggavik mine site. Details of each sampling campaign are shown in Table 5.1-1. The Hi-Vols typically ran continuously for 20 to 30 days in order to collect a sufficient amount of sample for detailed metal and radionuclide analysis. Two Hi-Vol samples were collected in 2010 and in 2011, one sample in 2012, and three samples were collected in 2013.

Table 5.1-1 Hi-Vol Sampling Summary, 2010-2013

Hi-Vol Sample ID	Sampling Year	Sampling Month	Sampling Length (days)
CM-RAD-29JUN10	2010	June	20
CM-RAD-20JUL10	2010	July	28
CM-RAD-07JUL11	2011	July	20
CM-RAD-28JUL11	2011	July	11
2012-01	2012	August	21
2013-01	2013	June	22
2013-02	2013	July	22
2013-03	2013	August	29

Table 5.1-2 provides the average measured concentrations of TSP, metals and radionuclides over the 2010 to 2013 period. Since Hi-Vol filters were exposed for 20+ days, measured concentrations were converted to a 24-hour averaging period using the methodology outlined in the Air Dispersion Modelling Guideline of Ontario (ADMGO 2009). In addition, it was conservatively assumed that PM_{10} is 50% of the measured TSP concentration and that $PM_{2.5}$ is 25% of the measured TSP concentration. According to Brook et al. (1997), PM_{10} is on average close to 50% of TSP and $PM_{2.5}$ is on average 50% of PM_{10}. These ratios are based on data collected by the National Air Pollution Surveillance (NAPS) Network in the southern parts of Canada where anthropogenic emissions sources of fine particulate (e.g., vehicles) are generally more abundant. Therefore, the ratios are likely much lower in a northern rural environment like Nunavut, and applying them to measured TSP concentrations is considered conservative.

As shown in Table 5.1-2, the average measured TSP concentration was 2.9 $\mu g/m^3$ (or 6.9 $\mu g/m^3$ on a 24-hour basis). Most of the metal concentrations were at or below the laboratory detection limit and ranged from a low of 9.9E-06 $\mu g/m^3$ (uranium) to a high of 2.3E-02 $\mu g/m^3$ (boron). With regard to radionuclides, lead-210 had the highest overall concentration at 1.3E-04 $\mu g/m^3$ and radium-226 had the lowest concentration at 9.2E-07 Bq/m³. Overall, the concentrations of metals and radionuclides are very low considering the extended sampling period used in each sampling campaign. This is not unexpected and is considered typical of a northern rural environment.

Table 5.1-2 Average Measured Particulate, Metals and Radionuclides at Kiggavik, 2010-2013

Constituent	Average Length of Exposure (days)	Average Measured Concentration (µg/m³)(1)	24-hour Average Concentration (µg/m³)(2)
Total Particulate*	20.9	2.9	6.8
PM_{10}	20.9	1.5	3.4
$PM_{2.5}$	20.9	0.7	1.7
Aluminum (Al)	21.7	2.0E-02	4.6E-02
Antimony (Sb)	21.7	6.8E-04	1.6E-03
Arsenic (As)	21.7	1.2E-04	2.8E-04
Barium (Ba)	21.7	7.0E-04	1.6E-03
Beryllium (Be)	21.7	2.1E-05	4.9E-05
Boron (B)	21.7	2.3E-02	5.4E-02
Cadmium (Cd)	21.7	6.0E-05	1.4E-04
Chromium (Cr)	21.7	2.2E-04	5.1E-04
Cobalt (Co)	21.7	4.0E-05	9.1E-05
Copper (Cu)	21.7	1.5E-02	3.5E-02
Iron (Fe)	21.7	2.2E-02	5.0E-02
Lead (Pb)	21.7	1.1E-03	2.6E-03
Manganese (Mn)	21.7	9.3E-04	2.1E-03
Molybdenum (Mo)	21.7	2.4E-04	5.8E-04
Nickel (Ni)	21.7	1.5E-04	3.4E-04
Selenium (Se)**	24.0	3.5E-05	8.4E-05
Silver (Ag)	21.7	6.9E-05	1.6E-04
Strontium (Sr)	21.7	3.2E-04	7.3E-04
Thallium (Tl)	21.7	1.9E-04	4.3E-04
Tin (Sn)	21.7	5.8E-04	1.3E-03
Titanium (Ti)	21.7	5.2E-04	1.2E-03
Vanadium (V)	19.7	4.9E-05	1.1E-04
Zinc (Zn)	21.7	4.5E-03	1.1E-02
Uranium (U)***	23.8	9.9E-06	2.4E-05
Lead-210	21.7	1.3E-04 Bq/m³	--
Polonium-210	21.7	5.4E-05 Bq/m³	--
Radium-226	21.7	9.2E-07 Bq/m³	--
Thorium-230	21.7	1.5E-06 Bq/m³	--
Thorium-232	21.8	1.3E-06 Bq/m³	--

Table 5.1-2 Average Measured Particulate, Metals and Radionuclides at Kiggavik, 2010-2013

Constituent	Average Length of Exposure (days)	Average Measured Concentration ($\mu g/m^3$)$^{(1)}$	24-hour Average Concentration ($\mu g/m^3$)$^{(2)}$
Thorium-234	21.2	2.5E-05 Bq/m³	--

NOTES:

Concentrations in units of μg/m³ unless otherwise noted.

PM10 and PM2.5 calculated assuming PM_{10}= 50% of TSP and $PM_{2.5}$= 50% of PM10

(1) The average 2010-2013 concentration was calculated assuming any measurements less than the laboratory method detection limit (MDL) was equal to the MDL.

(2) Concentrations were converted to a 24-hour averaging period using the conversion method C1/C2 = (T2/T1)0.28, where C = concentration and T = averaging period (ADMGO 2009)

* TSP average based on 2011-2013 data

** Selenium data from 2011-2013 was excluded due to anomalously high laboratory detection limit compared to 2010 year

*** Uranium data from 2011 was excluded due to anomalously high laboratory detection compared to other years

Another ambient air quality sampling campaign was carried out near the proposed mine site using low volume air samplers (PQ-100s) to collect samples of TSP, PM_{10} and $PM_{2.5}$ about every three days throughout July 2009 and July 2010. However, a number of unforeseen challenges were experienced with the equipment (e.g., unreliable power supply) which compromised the reliability of the data that was collected. Therefore, the results for 2009 and 2010 are not presented.

Additional PQ-100 monitoring was undertaken again in the summer of 2011. However, upon examining the data, a laboratory error was detected in the gravimetric analysis. Since the filters were digested for the analyses of metals and radionuclides, the filters could not be re-analyzed. Therefore, the results for 2011 were also not included in the baseline assessment.

Sampling was also carried out to measure baseline levels of radon during the summer months of 2008, 2009 and 2010. Three dosimeters (located in Baker Lake, at the Kiggavik site and at the Sissons site), were used to measure alpha emissions of short life daughter products of radon-222 (Rn-222). Measured potential alpha energies (nJ/m³) of Rn-222 were converted to an activity or concentration (Bq/m³) of radon gas. The results of this sampling program are summarized in Table 5.1-3. As can be seen in the table, average radon concentrations are in the range of 1.4 to 2.4 Bq/m³. Overall, the baseline concentration of radon is considered to be low.

Table 5.1-3 Measured Potential Alpha Energies of Radon-222 and Resulting Activity (Bq/m³)

Parameter	Location	Jun 2008	Jul 2008	Sept 2008	Jun 2009	Jul 2009	Aug 2009	Jul 2010	Aug 2010	Average
Rn-222 PAE (nJ/m³)	Baker Lake	3	5	5	3	5	6	bdl	NA	4.5
	Kiggavik	bdl	8	bdl	5	8	6	9	8	7.3
	Sissons	bdl	7	bdl	5	7	7	13	10	8.2
Rn-222 Activity (Bq/m³)	Baker Lake	0.90	1.50	1.50	0.90	1.50	1.80	bdl	NA	1.3
	Kiggavik	bdl	2.40	bdl	1.50	2.40	1.80	2.70	2.40	2.2
	Sissons	bdl	2.10	bdl	1.50	2.10	2.10	3.90	3.00	2.4

NOTES:

PAE = potential alpha energy

bdl = below detection limit

NA = not available

5.1.2 Regional Air Quality

There were no regional monitoring sites located in close proximity to the Project site that would allow for the characterization of regional air quality. As a result, data from air quality studies submitted to NIRB as part of other EIS documents were used to assist in the characterization.

5.1.2.1 Literature Review

A review of EIS documents previously submitted to the Nunavut Impact Review Board for other regional projects was completed to identify ambient levels of target COPCs in similar environments. The following projects were identified:

Project	Proponent	Year Submitted
Meadowbank Gold	Cumberland Resources Ltd	2005
Doris North	Miramar Hope Bay Ltd	2005
Mary River	Baffinland Iron Mines Corporation	2010

Air quality monitoring data in the Meadowbank Gold Project Air Quality Impact Assessment (Cumberland Resources Ltd. 2005) noted that existing PM_{10} concentrations reported by the Environment Protection Service of the Government of NWT were less than 10 μg/m^3 for a 24-hour period for undisturbed areas of the Northwest Territories. Concentrations of SO_2, NO_x, and CO, were expected to be very low.

The Doris North Lake Atmospheric Environment Technical Report (Golder Associates 2005) indicated that a baseline particulate (TSP) monitoring program was conducted at the site using a high volume air sampler. However, a very limited dataset was collected (3 samples). The measured TSP values ranged from 3.9 μg/m³ to 5.5 μg/m³ for a 24-hour period. Concentrations in this range are consistent with those expected in an undisturbed remote environment, and are consistent with those measured at the Kiggavik site.

An ambient air monitoring program was also conducted as part of the Baffinland Mary River project, where measurements of TSP and PM_{10} were completed over 24-hour periods. SO_2, NO_2 and dust deposition (including metal constituents) were also completed (Knight Piésold Consulting 2010). The average 24-hour concentration of TSP and PM_{10} were 7.0 and 3.8 μg/m^3, respectively (Table 5.1-4). This data is also consistent with that from the measurements at the Kiggavik site. Table 5.1-4 also shows that over a 30-day period, the SO_2 and NO_2 concentrations were 0.26 and 0.19 μg/m^3, respectively which is considered very low, particularly relative to the SO_2 and NO_2 ambient air quality criteria.. The total dustfall measured was 0.40 mg/100cm^2/30-day (Table 5.1-5). The measured 30-day metal deposition rates ranged from a low of 0.3 to a high 30.6 (mg/100cm^2/30-day). Similar to the findings of the previous studies, the measured baseline concentrations and metal deposition rates are generally low compared to those from more urbanized and disturbed areas in southern regions.

Table 5.1-4 Measured Baseline Concentrations at Mary River

Constituent	Averaging Period	Concentration (μg/m^3)
TSP	24-hour	7.0
PM_{10}	24-hour	3.8
SO_2	30-day	0.26
NO_2	30-day	0.19
SOURCE: Knight Piésold Consulting (2010)		

Table 5.1-5 Baseline Dustfall and Metals Deposition Rates at Mary River

Constituent	Concentration (mg/100 cm^2/30-day)
Total Dustfall	0.40
Al	25.9
Co	0.5
Cr	0.3
Fe	30.6
Mg	23.9
Mn	1.7
SOURCE: Knight Piésold Consulting (2010)	

5.1.3 Selected Baseline COPC Concentrations

Overall, very little long-term information is available on the ambient air concentrations of COPCs in the LAA and RAA. Available short-term measured data suggests that concentrations of COPC are very low. Measurements at such low levels could be considered to be at the lower sensitivity range of the sampling equipment. This is not unexpected given the remote nature of the Project site and the relatively pristine environment of the area.

Nevertheless, the concentrations of particulate matter, metals and radionuclides outlined in Table 5.1-2 and total dustfall outlined in Table 5.1-5 were added to model predicted COPC concentrations and used to assess the potential effects to air quality in Section 6. Note that measured Hi-Vol concentrations in Table 5.1-2 were conservatively assumed to be representative of annual concentrations even though samples were only exposed for 20 to 30 days.

Since the criterion for radon is based on the increment above baseline, a background concentration was not added to the model predicted radon concentrations to assess potential effects to air quality. Also, as indicated by the measurements at Mary River, baseline NO_2 and SO_2 concentrations are expected to be low enough in the vicinity of the Project site that they would have minimal contribution relative to the predicted concentrations from the Project. As a result, baseline levels of NO_2 and SO_2 were not added to the model predicted concentrations to assess potential effects to air quality.

5.2 Potential Acid Input (PAI)

Background levels of Potential Acid Input in the RAA were calculated based on data from the National Atmospheric Chemistry Precipitation Database (NAtChem) (Environment Canada 2008). Current sources of acidic precipitation would include sources which emit precursors to acidic precipitation; primarily NO_x and SO_2. Such sources would include fuel combustion which was previously discussed in Section 5.1.1. The annual average background PAI was calculated to be 0.093 keq/ha/yr. As per the PAI calculation methodology, this background component was added to the Project related contribution to PAI. Additional details are provided in Technical Appendix 4B – Air Dispersion Assessment.

5.3 Greenhouse Gases

Canadian facilities that emit more than 50,000 tonnes of CO_2-equivalent must report their emissions to Environment Canada's Greenhouse Gas (GHG) Inventory. According to the GHG Inventory, the total amount of facility-reported GHG emissions in Canada in 2012 (the most recent year in which data is available) was 256,883 kilotonnes (kt) of CO_2-equivalent. In 2012, facility-reported GHG emissions in Nunavut totalled 203 kt of CO_2-equivalent. Reported 2012 GHG emissions were only from one facility in Nunavut (NU) – Meadowbank Gold Mine.

Environment Canada also generates a National Inventory Report (NIR) which is submitted to the United Nations Framework Convention on Climate Change (Environment Canada 2014). This report provides a summary of both national and provincial/territorial estimates of GHG emissions and includes sources or facilities that did not necessarily meet the reporting threshold for the GHG Inventory described above. According to the latest NIR submission, Canada-wide GHG emissions were 699,000 kt of CO_2-equivalent in 2012. For the same year, GHG emissions in Nunavut were estimated to be 210 kt of CO_2-equivalent. Therefore, according to the National Inventory Report, GHG emissions in Nunavut were approximately 0.03% of the 2012 total for Canada.

The Meadowbank Gold Mine is currently, and may continue to be in operation when the Kiggavik Project is commissioned and as a result, GHG emissions from this project should be included as part of the baseline GHG levels in Nunavut. The Nunavut level as reported by in the NIR does not appear to include emissions from this facility. As a result, the GHG emissions estimate of 203 kt of CO_2-equivalent as reported by the Meadowbank Gold Mine to the Environment Canada GHG Inventory was added to the reported Nunavut total in the NIR. Therefore, the baseline level of GHG emissions in Nunavut was considered to be 413 kt of CO_2-equivalent. This value was used as a measure of comparison for Project-related emissions of CO_2-equivalent.

5.4 Climate

A description of the existing climate within the LAA and RAA is outlined in the Baseline Climate report provided in Technical Appendix 4A.

6 Effects Assessment for Air Quality

The effect of the Project on air quality is measured by increased ambient levels of COPCs in the atmosphere that could result in exceedances of the Indicator Thresholds presented earlier in Table 4.8-1. Effects on air quality that could result in changes in human and/or environmental/ecological health have been assessed separately in Volume 5 (Aquatic Environment), Volume 6 (Terrestrial Environment) and Volume 8 (Human Health).

6.1 Assessment of Changes in Ambient Air Quality

6.1.1 Analytical Methods

Air quality assessments require the use of a variety of different analytical methods (e.g., computer models, manual calculations, professional judgement). The specific methods employed in this assessment are briefly described below. Further details about the methods used are provided in Technical Appendix 4B – Air Dispersion Assessment.

Emissions inventories for 17 COPCs were developed for several Project phases, namely: construction; operations (phased and maximum operations); final closure; and post-closure. These were developed primarily using US EPA AP-42 emission factors (US EPA 1995). Specifically, AP-42 emission factors were used to estimate emissions for the following activities:

- drilling, bulldozing, grading, ore and mine rock handling, vehicle movement and general construction activities.

Where AP-42 emission factors were not available, alternative emission factors were used. For example, blasting emissions were estimated using an emission factor developed by the Colorado Department of Health (CDOH) (Tistinic 1981). In addition, data from AREVA's McClean Lake operation was also utilized to estimate emissions from sources such as the mill and the acid plant.

Emissions of radionuclides were estimated assuming that radon generated through decay of uranium in ore or mine rock is at equilibrium within the void spaces of the rock.

The CALPUFF/CALMET modelling package was used to predict Project-related incremental ambient air concentrations of 17 COPCs at a network of receptor locations within the local and regional assessment areas. The CALPUFF model was also used to assess atmospheric deposition of selected COPCs (e.g., particulate matter, NO_2, SO_2) in addition to the potential acidifying effect of NO_2 and SO_2 deposition, also known as Potential Acid Input (PAI).

CALMET was used to simulate meteorological conditions in the local and regional assessment areas for a one year period (August 15, 2009 to August 14, 2010). In order to assess whether there were any potential effects from the Project, model predicted COPC concentrations were added to baseline levels where applicable, and compared to the Indicator Thresholds presented in Table 4.8-1. Where residual effects were predicted, the significance criteria outlined in Table 4.9-1 were used to assess whether the effect was significant or not.

The Indicator Thresholds presented inTable 4.8-1 for the assessment effects to air quality were also applied at three sensitive points of reception (POR) within the LAA and RAA.A total of three receptors were identified as being representative of the most sensitive POR in the vicinity of the Project and are outlined in Table 6.1-1. These receptors were of particular interest to the Human Health assessment completed as part of Volume 8.

Table 6.1-1 Summary of Sensitive Points of Reception

Receptor ID	Description	Location (Coordinates)	
		UTM-Easting (m)	UTM-Northing (m)
R1	Kiggavik Accommodation Complex	564900	7148433
R2	Community of Baker Lake	644179	7135840
R3	Judge Sissons Lake Cabin (Residence)	566550	7137729

6.1.2 Effects Mechanisms and Linkages

The Project-environment interactions and effects described above in Section 4.3 and ranked as a “2” in Tables 4.3-1 through 4.3-3 for the construction, operation and final closure Project phases, form the basis for the air quality assessment effects mechanisms and linkages. Air quality effects resulting from the Project relate to emissions of COPCs from construction activities, mining and milling activities, general supporting activities, as well as vehicle transportation. Such emissions may lead to potential exceedances of selected Indicator Thresholds within the Project Footprint, the LAA, and to a more limited extent, the RAA and the Community of Baker Lake.

The activities outlined below for each of the Project phases have the potential to release emissions of COPCs to air, including dust (and its radioactive and non-radioactive constituents), gaseous compounds and radionuclides. The effects on air quality associated with any specific activity depend on the type of activity, the type of equipment being used, the production rate, the length or duration of the activity, the material being handled (ore vs. mine rock), the distance between the activity and sensitive receptors, and any controls used to mitigate or reduce the amount of emissions that are generated by the activity (e.g., watering roads).

Complete details about the emission sources of COPCs and all assumptions used in the air quality assessment are provided in Technical Appendix 4B – Air Dispersion Assessment.

6.1.2.1 Construction

The potential environmental effects associated with on-land construction and supporting activities that could result in increased concentrations of ambient COPCs include:

- Dust emissions produced by the site preparation of the Kiggavik and Sissons sites and Baker Lake Dock and Storage Facility. Dust generating activities can include land clearing (bulldozing, grading), excavating (i.e., earth moving), material handling and the construction of infrastructure such as the mill, the accommodation complex, the power plant, etc.
- Dust emissions produced by the development of the access roads which includes quarrying to supply road bed materials.
- Gaseous emissions generated by heavy-duty diesel-powered construction equipment used for site preparation, construction of infrastructure and quarrying.

6.1.2.2 Operations

The potential environmental effects associated with open pit and underground mining, milling operations, waste management, general/supporting services, and transportation that could result in increased concentrations of ambient COPCs include:

- Dust emissions (and its radioactive and non-radioactive constituents) and/or radionuclides (i.e., radon) generated by open pit and underground mining activities, including:
- Drilling;
- Blasting;
- Ore and mine rock handling;
- Stockpile and road maintenance (i.e., dozing and grading);
- Wind erosion of stockpiles;
- Vehicle movement; and,
- Supporting activities such as the underground mine backfill plant.
- Emissions of fuel combustion products (i.e., NO_x, SO_2 and fine particulate matter) from the power plant and from the operation of diesel-powered equipment and vehicles both at the Mine Development Area and at the Dock and Storage Facility, including heavy-duty mining equipment, trucks and marine vessels.
- Emissions of dust and gaseous COPCs generated by truck traffic along the Baker Lake-Kiggavik access road options.
- Emissions of COPCs (primarily radionuclides) from milling, including ore handling, ore crushing and grinding, in-process agitated storage, yellowcake drying and packing as well as SO_2 generated by the production of acid.

- Emissions of radon from tailings management facilities (TMFs).

6.1.2.3 Final Closure

During final closure, activities will take place to restore the Kiggavik Project site back to a near undisturbed state. The first closure phase will take approximately two years to complete. The potential environmental effects associated with closure activities that could result in increased concentrations of ambient COPCs include:

- Dust (and its radioactive and nonradioactive constituents) and radionuclide emissions generated by backfilling Type III mine rock at Kiggavik and Sissons into Main Zone TMF and Andrew Lake pit, respectively and charging (covering) Centre Zone TMF with a layer of Type II mine rock (i.e., material handling).
- Emissions of radon from tailings management facilities (TMFs).
- Emissions of fuel combustion products (i.e., NO_x, SO_2 and fine particulate matter) from diesel powered equipment and vehicles.

6.1.2.4 Post-Closure

The potential environmental effects associated with the post-closure phase of the Project that could result in increased concentrations of ambient COPCs include:

- Continuous radon emissions from the remaining permanent clean mine rock stockpiles and covered TMFs.

6.1.2.5 Emission Source Summary for the Kiggavik and Sissons Mine Sites

Table 6.1-2 provides a summary of the active emission sources at the Kiggavik and Sissons mine sites during the operation, final closure and post-closure phases of the Project. As discussed in Section 4.6, mine operations (i.e., operations at the Kiggavik and Sissons mine sites) have been assessed using two different approaches. The first approach is an assessment of phased operations which is representative of planned mining activities over the lifetime of the Project (specific scenarios and the operational time periods assessed were presented in Section 4.6). The second approach assesses an artificial maximum emission scenario, whereby the highest potential emission rates from all mine site activities have been assessed. It conservatively assumes that all mining operations occur concurrently; however, it is unlikely that all of the activities will occur together at the rate that was assessed. Such a scenario was assessed to permit flexibility and allow modifications to the proposed mining schedule in the event that such changes result in higher emissions than those assessed in each of the operational phases.

Table 6.1-2 Source Activity Summary at the Kiggavik and Sissons Mine Sites by Project Phase

Source Location	Source Description	Mine Site Operations					Mine Site Closure	Mine Site Post-Closure
		Maximum	Scenario 1	Scenario 2	Scenario 3	Scenario 4		
Kiggavik Mine Site	Main Zone East Pit/TMF	A	A	A*	A*	A	A	A
	Main Zone West Pit/TMF	A	I	A	A*	A	A	A
	Centre Zone Pit/TMF	A*	A	A*	A*	A	A	A
	East Zone Pit/TMF	A*	A	A*	A*	A	A*	A
	Purpose Built Pit	I	A	I	I	I	I	A
	Kiggavik Type III Mine Rock Stockpile	A	A	A	A	A*	A	I
	Kiggavik Type II Mine Rock Stockpile – North	A	I	A	A*	A*	A	A
	Kiggavik Type II Mine Rock Stockpile – South	A	A	A	A	A*	A*	A
	Kiggavik Overburden Stockpile	A	A	A	A*	A*	I	I
	Kiggavik Ore Stockpile	A	A	A	A	A	I	I
	Mill Complex	A	A	A	A	A	I	I
	Power Plant	A	A	A	A	A	A	I
	Acid Plant	A	A	A	A	A	I	I
	Backfill Plant	A	I	A	A	I	I	I
	Incinerator	A	A	A	A	A	A	I
	Haulage routes between pits and mill and/or stockpiles	A	A	A	A	A	A	I
Sissons Mine Site	Andrew Lake Pit	A	I	A	A	A*	A	I
	End Grid Underground Mine Exhaust	A	I	A	A	I	I	I
	Andrew Lake Type III Mine Rock Stockpile	A	I	I	A	A	A	I
	Andrew Lake Type II Mine Rock Stockpile	A	I	A	A	A	A*	A
	Andrew Lake Overburden Pile	A	I	A	A	A*	I	I
	Andrew Lake Ore Pile	A	I	I	A	I	I	I
	End Grid Type III Mine Rock Stockpile	A	I	A	A	I	I	I
	End Grid Type II Mine Rock Stockpile	A	I	A	A	I	I	I
	End Grid Special Ore Stockpile	A	I	I	A	I	I	I
	Power Plant	A	I	A	A	I	I	I
	Incinerator	A	I	A	A	I	I	I

Table 6.1-2 Source Activity Summary at the Kiggavik and Sissons Mine Sites by Project Phase

Source Location	Source Description	Mine Site Operations					Mine Site Closure	Mine Site Post-Closure
	Haulage routes between pits and mill or stockpiles	A	A	A	A	A	A	I
Haul Roads	Haul road between Kiggavik and Sissons	A	I	A	A	I	I	I
	Access Road to Baker Lake (1 km segment modelled)	A	A	A	A	A	I	I
	Road to Airstrip	A	A	A	A	A	I	I

NOTES:

A = Active emission source

A* = Active emission source; radon only

I = Inactive emission source

6.1.3 Mitigation Measures and Project Design for Changes in Air COPCs

Design aspects, operational measures and other mitigation measures have been incorporated into the current Project plans which will minimize Project-associated emissions and/or the potential effect of Project-related emissions (i.e., increased ambient concentrations of COPCs). Mitigation measures that will be applied to reduce changes to ambient air quality are divided into two categories: Mitigation by Designand Mitigation by Management. Mitigation by Management is further detailed in terms of Activity-Specific Mitigation by Management. Each category is outlined below.

Mitigation by Design

- Several focused air dispersion modelling studies were conducted during the Project design phase to examine the potential effects related to air concentrations of COPCs resulting from alternate locations of several of the facilities located within the Project Footprint. These are as follows:
- Acid Plant
- Kiggavik Power Plant
- Waste Rock Stockpiles
- Accommodation Complex
- The locations of the above facilities utilized in this assessment reflect the results of these individual studies in order to minimize the potential effects to the atmospheric, terrestrial, aquatic and human environments.

Mitigation by Management

- Employ the use of standard operating procedures for use of equipment and machinery to ensure that they are operated appropriately to minimize their exhaust emissions.
- Perform regular maintenance of equipment and machinery in accordance with good engineering practices or as recommended by equipment suppliers such that the equipment is kept in good operating condition (in order to promote efficient fuel combustion).
- Develop community complaint/response procedure(s) (see Tier 3, Volume 3, Community Involvement Plan, Appendix 3C) to effectively address issues as they occur.
- Adhere to all permits, authorizations and/or approvals.

Activity-Specific Mitigation by Management

- Heavy Equipment and Machinery Operation, Vehicles and Marine Vessels.

- Where available, use diesel-powered heavy equipment equipped with appropriate exhaust emissions controls including catalytic converters to reduce NO_x emissions and use diesel particulate filters to reduce fine particulate matter and other COPCs associated with particulate emissions.
- Optimize the number of heavy equipment movements and minimize travel distances, where possible.
- Minimize the number of barge shipments and container off-loading activities
- Use diesel fuel that meets the Canada-wide Diesel Sulphur Content standard of 15 ppm for off-road engines. Marine vessels will meet the Canada-Wide sulphur fuel content of 1000 ppm. This will reduce SO_2 and particulate matter emissions.
- Unpaved Road Transportation.
- Minimize or reduce vehicle speeds on unpaved mine site roads (including pit ramps) and the Kiggavik-Sissons haul road and enforce speed limits, where possible.
- Apply water or another approved dust suppressant, such as non-toxic, resin-base binder products to the surfaces of unpaved mine site roads (including pit ramps) and to the Kiggavik-Sissons haul road, when possible.
- Maintain all unpaved road surfaces via grading or other maintenance practices to minimize the amount of silt (i.e., fine particles) present in the roadbed material.
- Blasting
- Minimize the number of charges per day to reduce NO_x and particulate matter emissions.
- Optimize/minimize the use of ANFO to reduce emissions of NO_x
- Milling and Tailings Management
- Air pollution controls that will be installed on the exhaust stacks of the mill complex and acid plant as described in Tier 2, Volume 2 include the following:
- A scrubber will be installed in the crushing and grinding circuit of the mill complex to control dust emissions.
- A scrubber and HEPA filter will be installed in the yellowcake drying circuit of the mill complex to control dust emissions.
- A scrubber will be installed on the Acid Plant to remove acid mist and excess SO_2.
- Tailings will be released to the Tailings Management Facilities (TMFs) as slurry below a water surface. This will eliminate radionuclide and non-radionuclide dust emissions from the tailings.
- Tailings will be treated to minimize the release of radon and other radionuclides.
- Closed TMFs will be covered by a layer of clean waste rock and overburden/topsoil to minimize the release of radon.
- Post-closure
- During closure/post-closure the permanent Type 1 and 2 mine rock stockpiles will be revegetated to suppress emissions of dust. Type 3 mine rock material will be removed from the surface and backfilled into open pits to eliminate emissions of dust and minimize emissions of radon.

- Waste Management:
- As outlined in the Waste Management Plan (Appendix 2S), the waste incinerator(s) will comply with the emission limits set out in the Canada-Wide Standards for mercury and dioxin and furans.
    - o Through proper waste segregation, materials containing chlorinated compounds will not be placed in the incinerator (Appendix 2S). Therefore, emissions of hydrogen chloride (HCl) will be prevented.
- Details regarding the level of dust control used in the air emissions inventory are provided in Technical Appendix 4B; however, a summary is also provided here in Table 6.1-3. It should be noted that the control efficiency assumed for natural mitigation of unpaved road dust during winter is considered conservative. A recent study to determined natural winter mitigation of road dust from mining operations in northern Canada (Golder Associates 2012) suggests that natural mitigation on mine roads during the winter months is greater than 90%. It should also be noted that for wind erosion emissions, no correction for precipitation or snow cover was included in the calculation and no other dust suppression (e.g., watering) was assumed. This will result in a conservative estimate of wind erosion emissions from stockpiles.

Table 6.1-3 Summary of Dust Mitigation included in the Emissions Inventory

Emission Source	% Control Assumed	Comments
Drilling	0%	Emission factor already assumes wet drilling
Material Handling	0%	Assumed no control for dumping of excavated material
Blasting – Underground Mining	50%	Assumed that 50% of dust will be retained in the mine due to impaction/deposition on mine walls
Unpaved roads	44%	Control efficiency for on-site vehicles travelling less than 40 kph
	75%	Control efficiency for watering (or equivalent control method) during summer
	50%	Control efficiency for natural mitigation in winter from snow and ice
Wind Erosion	0%	A 10% active area was assumed all year round.
Grading and dozing	0%	
Ore crushing and grinding	n/a	Assumed a similar design to McClean and use source testing information to scale emissions based on production

6.1.4 Residual Effects Assessment for Change in Ambient Air Quality – Preferred Options

The analytical methods described in Section 6.1.1 above were applied to the construction, operation, final closure and post-closure phases of the Project to quantify how the Project, with mitigation, might result in changes to ambient air quality.

The following sections outline the potential effects of the Project for the preferred options for each project phase. Where applicable, the results from the CALPUFF air dispersion modelling have been presented in both graphical format showing the results in the LAA and RAA, and tabular format at specific receptor locations. Complete results are provided in Technical Appendix 4B – Air Dispersion Assessment.

Note that the predicted concentrations of COPCs presented and discussed include baseline (i.e., background) air quality concentrations. However, for reasons discussed previously in Section 5.1.3, NO_2, SO_2 and radon concentrations are presented as incremental values above and beyond existing baseline air quality conditions.

6.1.4.1 Construction

Construction of the Mine Development Area

The potential effects from construction of the Mine Development Area (i.e., the Kiggavik and Sissons mine sites) were evaluated through an emissions burden analysis, which is an accounting of the total emissions of key COPCs. Since construction emissions are generated within the same footprint as site operation emissions (i.e., the Mine Development Area), the emission rates for construction can be compared to the emissions from the Mine Development Area for the maximum operation assessment to determine the potential effect of construction relative to maximum operations. If the emissions from construction are less than or equal to the maximum operation emissions, it can be inferred that the potential change in ambient air concentrations will also be the same or less.

Table 6.1-4 presents a summary of the estimated emission rates for the mine construction scenario and the maximum operations assessment scenario. As described in Appendix 4B, construction of the Mine Development Area also includes emissions from the operation of one borrow quarry. As can be seen in the table, emissions from construction of the Mine Development Area are less than those calculated for the maximum operation assessment.

During the construction phase of the mine, the Baker Lake Dock and Storage Facility and the Winter Road will also be utilized for receiving and shipping fuel and construction supplies to the Mine Development Area. The number of anticipated loads during construction will be

2,100 loads per year which is less than the anticipated number of loads (3,920 per year) assessed during peak mine operations. Since emissions correspond to the number of loads, emissions from vehicle travel along the Winter Road as well as from operations at the Dock and Storage Facility will be less during construction of the mine than during operation of the mine. This is further illustrated in Table 4-6.

In all, the comparison in Table 6.1-4 shows that the potential effects during construction (both on- and off-site) will likely be less than during maximum operations. As a result, the mine construction scenario was not carried forward to the dispersion modelling assessment. The effects of the maximum operation assessment, including the operation of the Winter Road and Baker Lake Dock and Storage Facility are discussed in Section 6.1.4.2.

Table 6.1-4 Emissions Burden Analysis Results for Mine Construction

Assessment	Location	Emission Rate (g/s)				
		TSP	PM_{10}	$PM_{2.5}$	NO_x	SO_2
Mine Development Area: Construction	Mine Sites: General Construction	20.4	7.5	7.5(1)	28.8	0.2
	Borrow quarry (one)	2.9	1.2	0.9	2.6	0.03
	Total	23.3	8.7	8.4	31.4	0.2
Mine Development Area: Maximum Operation Scenario	Kiggavik Mine Site	102.9	30.3	6.2	81.5	1.3
	Sissons Mine Site	127.6	27.2	6.3	43.4	1.1
	Total	230.5	67.5	12.5	124.8	2.4
Off-site Activities: Construction	Winter Road	17.2	4.2	0.4	0.2	0.01
	Baker Lake Dock and Storage Facility	0.1	0.1	0.1	1.9	0.1
	Total	17.3	4.3	0.5	2.1	0.1
Off-site Activities: Operations	Winter Road	31	7.6	0.8	0.4	0.02
	Baker Lake Dock and Storage Facility	0.2	0.2	0.1	3.5	0.2
	Total	31.2	7.8	0.9	3.9	0.2

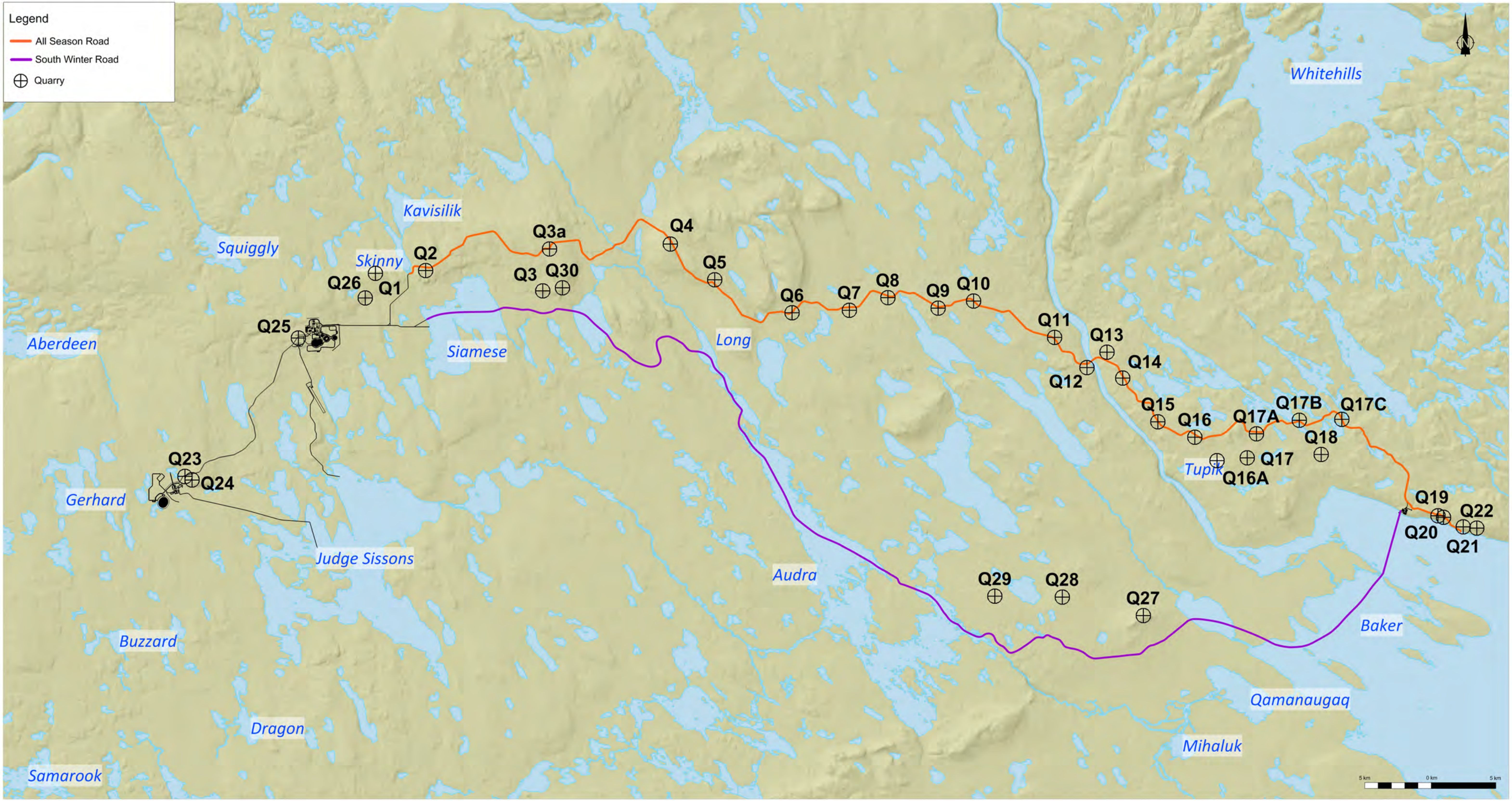
NOTES:

(1) Conservatively assumes all $PM_{2.5}$ is equal to PM_{10}.

Quarrying

Quarries will be used to supply aggregate for the construction of the mine sites and access roads. The potential effects to air quality from quarrying were quantified using separate air dispersion model runs for three possible (3) quarry locations. The quarries assessed were Q2, Q10 and Q18 whose locations are shown in Figure 6.1-1. Since the same activities are expected to occur at each quarry site, COPC emission rates were assumed to be the same from each quarry. Therefore, differences observed in the model predicted concentrations arise from the effects of terrain and air dispersion meteorology. Note that only short-term maximum effects were assessed since the lifespan of each quarry operation will be limited by the proximity of the construction activities to each quarry and by the amount of material available.

Table 6.1-5 presents the overall maximum predicted concentration for each of the COPCs assessed. The results from the three selected quarries reflect the potential maximum local effects of any of the individual quarry sites. As can be seen in the table, all COPCs are well below their respective Indicator Thresholds. Figure 6.1-2 presents the maximum predicted 24-hour TSP concentrations in the vicinity of each of the quarries included in the dispersion modelling assessment. The figure shows that the TSP concentrations drop rapidly with distance away from each quarry, with measurable changes in concentration (i.e., above baseline levels) limited to less than 2 km from the edge of each quarry.



Projection: NAD 1983 UTM Zone 14N

Compiled: SENES Consultants

Date: 05/05/2014

Data Sources: Natural Resources Canada, Geobase®, Nation Topographic Database, AREVA Resources Canada Inc.

FIGURE 6.1-1

Quarry Locations

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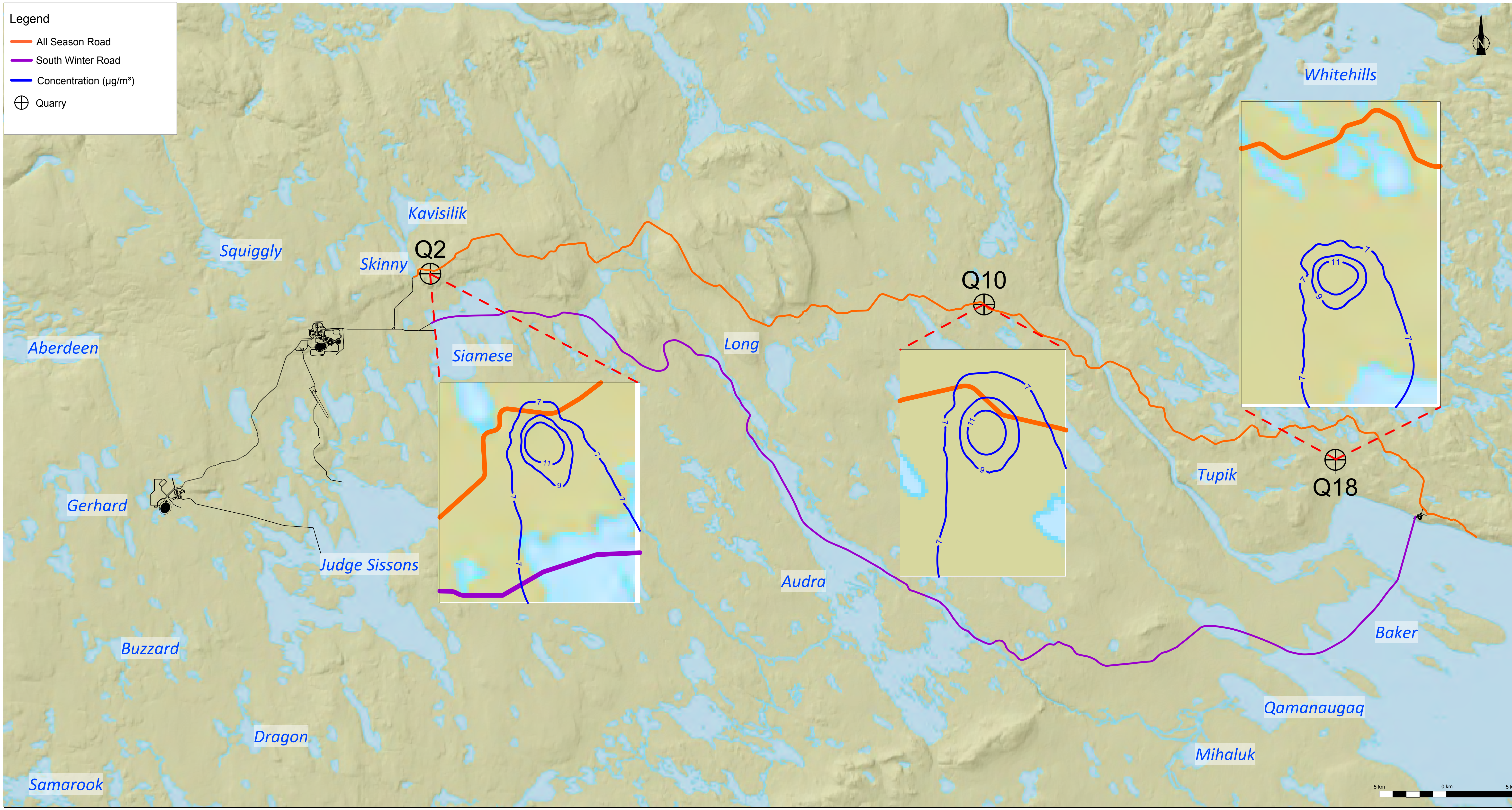

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Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, AREVA Resources Canada Inc.*

FIGURE 6.1-2

Quarry Assessment
Maximum 24-hour TSP Concentration (µg/m³)

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Table 6.1-5 Maximum Predicted COPC Concentrations at 500 m Distance from Selected Quarries

Quarry	UTM Coordinates (m)		Maximum Concentration (µg/m³) at a distance of 500 m from the Quarry						
			TSP	PM_{10}	$PM_{2.5}$	NO_2		SO_2	
	Easting	Northing	24-hour Maximum	24-hour Maximum	24-hour Maximum	1-hour Maximum	24-hour Maximum	1-hour Maximum	24-hour Maximum
Q2	573460	7152497	21.4	11.3	7.7	38.6	10.6	0.8	0.2
Q10	615476	7150167	16.3	9.0	6.0	37.2	7.5	0.7	0.1
Q18	642133	7138389	16.7	8.8	5.8	34.1	7.2	0.7	0.1
Background Concentration (µg/m³)			6.8	3.4	1.7	-	-	-	-
Indicator Threshold (µg/m³)			**120**	**50**	**27**	**400**	**200**	**450**	**150**

NOTES:

Concentrations of TSP, PM_{10} and $PM_{2.5}$ include background concentrations.

Construction of the Baker Lake Dock and Storage Facility

The potential effects from the construction of the Baker Lake Dock and Storage Facility were also evaluated through an emissions burden analysis. Since construction emissions are generated within the same footprint as operations at the Dock and Storage Facility, the emission rates for construction can be compared to the emissions for the operation assessment to determine the potential effect of construction relative to maximum operations. If the emissions from construction are less than or equal to the Baker Lake Dock and Storage Facility operation emissions, it can be inferred that the potential change in ambient air concentrations from construction will be the same or less.

Table 6.1-6 presents a summary of the estimated emission rates for the construction and maximum operations assessment scenarios for the Baker Lake Dock and Storage Facility. As can be seen in the table, emissions from construction are less than those calculated for the maximum operation assessment. Thus, the potential effects during construction will likely be less than during maximum operations. As a result, the mine construction scenario was not carried forward to the dispersion modelling assessment. The effects of the operation assessment of the Baker Lake Dock and Storage Facility are discussed in Section 6.1.4.2.

Table 6.1-6 Emissions Burden Analysis Results for Construction of the Baker Lake Dock and Storage Facility

Assessment	Location	Emission Rate (g/s)				
		TSP	PM_{10}	$PM_{2.5}$	NO_x	SO_2
Construction	Baker Lake Dock and Storage Facility	0.16	0.04	0.02	0.87	0.02
Maximum Operation Scenario	Baker Lake Dock and Storage Facility	0.16	0.16	0.14	3.47	0.22

6.1.4.2 Operation

Mine Development Area

As described in Section 4.6, various operational phases were assessed for the Project in addition to a maximum emissions bounding scenario. Various operational phases (all but the maximum assessment) were assessed for the purpose of generating inputs for pathways exposure analysis, so it was important to capture these potential effects over longer averaging periods (i.e., annual averages). In contrast, the maximum emissions bounding scenario was designed to capture the highest potential short-term effects (i.e., 1-hour and 24-hour averages). As a result, model-predicted ambient COPC concentrations from the phased operations assessments were used to evaluate long-term effects, whereas the maximum bounding assessment was used to evaluate short-term effects.

Table 6.1-6 and Table 6.1-7 provide the maximum predicted 1- and 24-hour concentrations of the COPCs including particulate matter, uranium, NO_2, SO_2, and metals resulting from the maximum emissions bounding scenario at three sensitive POR locations. Table 6.1-9 and Table 6.1-10 provide model predicted annual average concentrations for operations phases 1 to 4 (see Section 4.6) at the same POR. Contour plots are also provided to illustrate these concentrations graphically throughout the LAA and RAA. It should be noted that these figures do not represent a snapshot in time since the maximum concentrations at each receptor typically occur during different meteorological conditions (i.e., different hours and/or days) and thus do not occur simultaneously. These plots represent the highest predicted COPC concentrations at each location in the area. Complete model results from all assessment scenarios can be found in Technical Appendix 4B – Air Dispersion Assessment.

The predicted changes in ambient air concentrations due to operations for each of the COPCs or COPC groups assessed are discussed in more detail below.

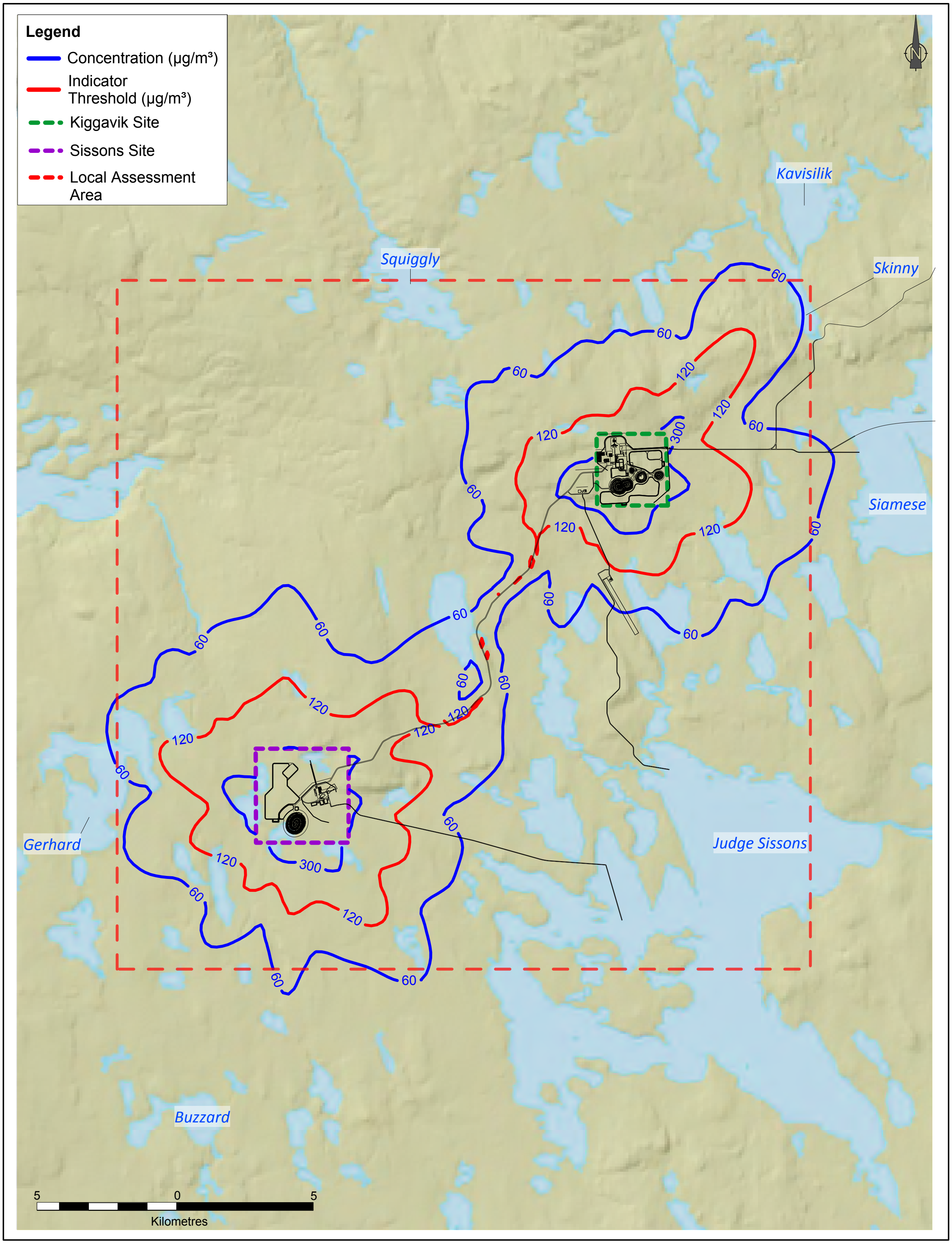
Dust (TSP, PM_{10} and $PM_{2.5}$)

The maximum 24-hour average concentrations of TSP, PM_{10} and $PM_{2.5}$ predicted for the maximum emissions bounding scenario are presented as graphically in Figure 6.1-3, Figure 6.1-4 and 6.1-5, respectively. As seen in the figures, the concentrations of TSP, PM_{10} and $PM_{2.5}$ exceed their respective Indicator Thresholds beyond the Project Footprint into a limited area of the LAA and are considered to be a residual effect. These exceedances can largely be attributed to emissions of particulate matter from open pit mining activities, in particular unpaved road dust generated on the in-pit ramps and mine site roads.

The frequency of exceedances beyond the Project Footprint were determined and are presented in Figures 6.1-6, 6.1-7 and 6.1-8 for TSP, PM_{10} and $PM_{2.5}$, respectively. As the figures demonstrate, there are few exceedances of the criteria for TSP, PM_{10} and $PM_{2.5}$ beyond the Project Footprint. In particular, there are no more than 30 days of exceedances per year off-site for TSP and PM_{10} and only 4 days for $PM_{2.5}$. The figures also show that exceedances of the Indicator Thresholds occur up to about 3 to 4 km beyond the Project Footprint in the LAA for TSP and PM_{10} and about 800 to 900 m for $PM_{2.5}$.

In addition, Table 6.1-7 shows that the maximum predicted 24-hour concentrations of TSP and PM_{10} are above the Indicator Thresholds at the Accommodation Complex. The frequency of these exceedances is also shown in the table. In contrast, the $PM_{2.5}$ Indicator Threshold is not exceeded at the Accommodation Complex. As discussed earlier in Section 4.8, even though there are on-site exceedances of the Indicator Thresholds, this is not considered to be a residual effect.

Figures 6.1-9 through 6.1-12 present the annual average TSP concentrations for operations phases 1 to 4. Annual plots for PM_{10} and $PM_{2.5}$ are provided in Technical Appendix 4B – Air Dispersion Assessment. On an annual basis, the predicted average TSP concentrations are below the Indicator Threshold of 60 $\mu g/m^3$ at receptor locations within the LAA and RAA as well as at sensitive POR as indicated in Table 6.1-9.



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Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, AREVA Resources Canada Inc.*

FIGURE 6.1-3
Maximum Operations Assessment
24-hour TSP Concentration (µg/m³)

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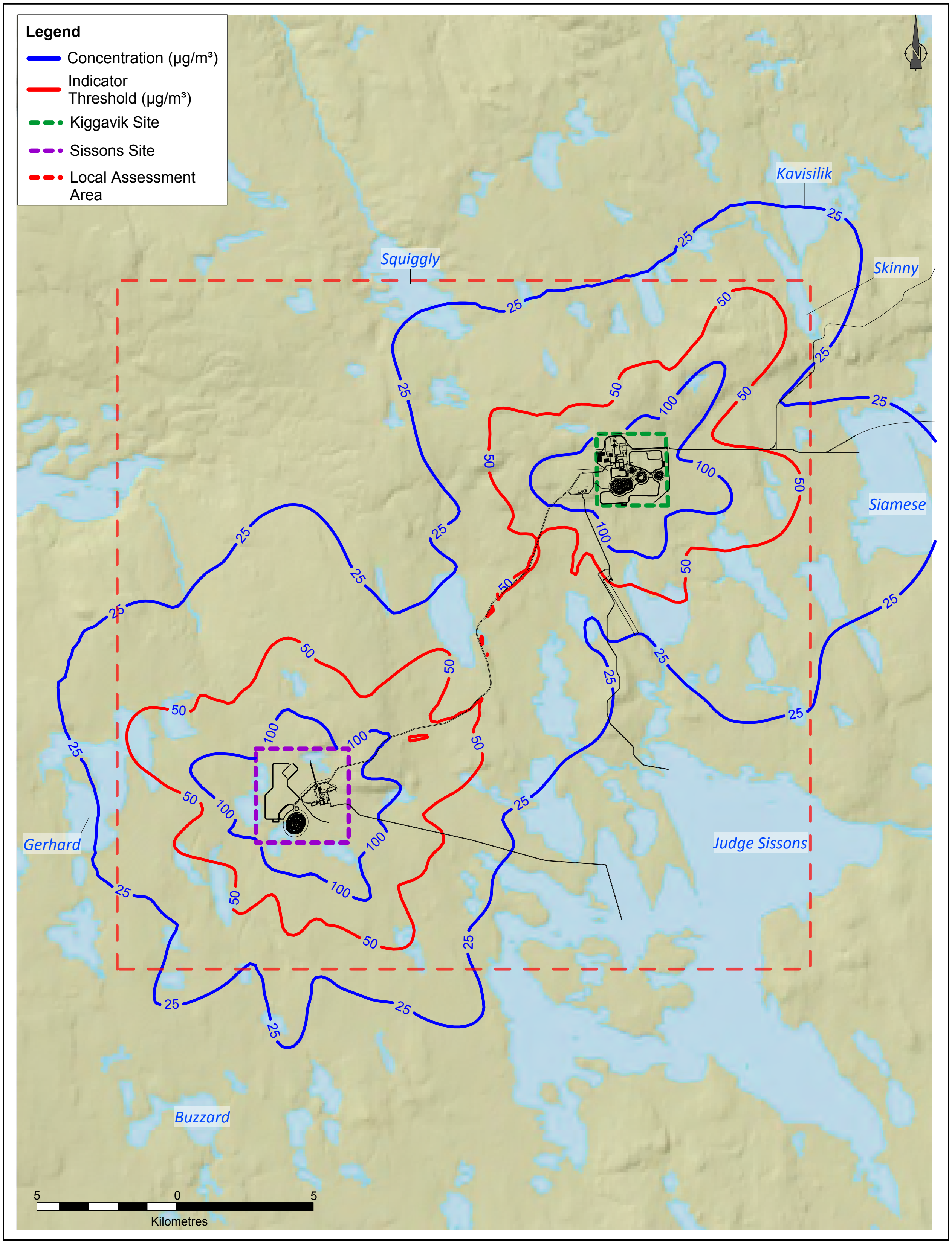

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FIGURE 6.1-4
Maximum Operations Assessment
24-hour PM_{10} Concentration (µg/m³)

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