



Izok Corridor Project Proposal

SECTION 9

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9 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

9.1 Introduction

Human Health and Ecological Risk Assessment (HHERA) is a framework used to determine how much contact (exposure) people, animals and plants could have with specific chemicals, and estimates the likelihood of adverse effects from that exposure.

An HHERA will be conducted for the Izok Corridor Project to evaluate the potential for health effects on local people and off-work staff, and wildlife resources in the study area. The assessment will comprise two major components: 1) a human health risk assessment (HHRA) to evaluate the potential effects of suspended particulates and standard pollutants at specific receptor locations; and 2) an ecological risk assessment (ERA) to evaluate potential effects on the atmospheric and aquatic environments and key wildlife species.

9.2 Potential Project Effects

The Project has the potential to affect human health through exposure from air, soil, vegetation and aquatic pathways, including:

- Degradation of ambient air quality leading to potential inhalation-based health effects on local people and staff during off-work hours
- Deposition of contaminant-laden dust into the terrestrial environment, leading to potential uptake by humans if local plants and animals are eaten
- Discharge of mine-affected waters, effluents and accidental release of such waters through seepage and leakage into the surrounding groundwater and surface waters, leading to potential human health effects from drinking local waters

The Project has the potential to affect ecological receptors through exposure from air, soil, vegetation and water, including:

- Deposition of contaminant-laden dust leading to uptake by local vegetation and animals, potentially resulting in adverse health effects in plant and animal populations
- Discharge of mine-affected waters, effluents and accidental release of such waters through seepage and leakage into the surrounding groundwater and surface waters, leading to potential health effects on fish and fish-eating wildlife

9.3 Approach

The HHERA for the Project will follow a tiered approach, initiated as a screening-level risk assessment. Depending on the results of the screening, it may be necessary to progress to a greater level of detail and modelling rigor. The next step will focus on specific chemicals of concern and exposure pathways identified during the screening process. The HHERA will evaluate both short-term and long-term exposure scenarios and resulting potential for health effects. The assessment will be based primarily on results of the air quality, airborne deposition, and water quality modelling and associated terrestrial and



aquatic effects assessments. The HHERA assessment may also include consideration of potential contaminant-related health concerns identified during the consultation process.

The HHERA will focus on potential human health and ecological health effects at the Izok Mine site. The reasons for this approach are two-fold. The HHERA conducted for the High Lake Project DEIS concluded that there would be no significant adverse health effects to humans or ecological receptors associated with the development of the High Lake Mine. This conclusion was based on baseline studies conducted from 2005 to 2006, which involved comprehensive sampling programs for:

- water quality
- soil and sediment chemistry
- tissue metals concentrations in vegetation (i.e., rock sedge, water sedge, crowberry stems and berries, Labrador tea leaves, snow lichen)
- fish (i.e., Lake trout, Arctic char; muscle and liver samples)
- small mammals (i.e., northern redbacked vole)

Because current Project plans involve locating the processing facility at Izok, the overall footprint and air emissions from construction and operation of the High Lake Mine will be smaller than previously proposed and assessed. Results of the 2008 HHERA are therefore considered applicable and conservatively protective.

Further, the current Project design incorporates several mitigation measures to minimize the generation of fugitive dust from the handling, storage and transportation of concentrate. As discussed in section 2, haul truck containers and storage and loading facilities at Grays Bay Port will be enclosed to minimize airborne dust emissions of concentrate and potential deposition of metals along Izok Road and at the port site. Consequently, potential effects on air quality and the terrestrial/marine environments are no longer considered to be a substantial concern. Pre-construction baseline studies along the road and at the port site will be used to develop a comprehensive database for use during operational monitoring and the reclamation phase.

9.4 Field Program

In 2008, baseline studies were conducted at 25 sites proximate to the Izok Mine. These baseline studies provide valuable chemical data for water, soil, sediment, fish tissues (i.e., lake trout, round whitefish), forage and browse vegetation, and plants consumed by humans (i.e., tea leaves, berries). However, data gaps were identified in relation to baseline soil, vegetation, and small mammal data for the Izok Mine area.

To fulfill data requirements for the HHERA, a spatial grid will be established around the Izok Mine area, compatible with both the air quality and risk assessments. This will allow evaluation of risk to human and ecological receptors in a spatially explicit manner based on background soil quality conditions and expected deposition of chemicals of concern (i.e., metals) over the construction and operations phases of the mine. The spatially explicit aspect of the HHERA is important because the geographic magnitude of environmental effects is a key factor for reliably establishing the significance of adverse environmental effects.



The HHERA program will incorporate available traditional knowledge (TK) and land use information to identify human and key ecological receptor locations, develop site-specific exposure scenarios in relation to air, soil, water and foods, and obtain information on the terrestrial environment (soil, plants, invertebrates, wildlife) and aquatic environment (water and sediment quality, invertebrates, fish) in the air quality dispersion model.

The 2012 fish baseline program will provide fish tissue data for large-bodied species (i.e., muscle filets consumed by people and whole body carcasses consumed by wildlife) and small-bodied species (i.e., forage fish that are prey to piscivorous fish species). Lake trout, Arctic grayling and round whitefish will likely be the species sampled, depending on local fish distributions in Itchen Lake and at reference sites. Similarly, the 2012 soils baseline program will provide soil chemistry data for the study area. The 2012 HHERA field program will involve further sampling and analysis of surface soil chemistry to spatially characterize trace metal concentrations within the air quality sampling grid. At a subset of these new sites, co-located vegetation samples (i.e., berries, lichen, sedge, shrubs, tea leaves) and small mammal samples will be collected, as available. The field program will be undertaken in August to coincide with developed vegetative growth, berry-ripening, and higher levels of nocturnal mammal activity. These data are critical site-specific inputs to the multi-media food chain model used to estimate health risks.

9.5 HHERA Analytical Methods

The HHERA uses a generalized risk assessment framework (**Figure 9.5-1**). The assessment will identify contaminants of concern, potential human and ecological receptors and potential exposure pathways (during the problem formulation stage) and potential toxic effects.

9.5.1 Overview

A quantitative HHERA comprises:

- Problem formulation (descriptions of the contaminants of concern, potential human and ecological receptors, potential exposure pathways)
- Estimation of exposure concentrations from field samples and/or modelled concentrations
- Selection of toxicological reference values (TRVs) as per federal guidance
- Comparison of exposure estimates to TRVs and determination of potential risk
- Description and rationale for all assumptions and uncertainties

Risk management or mitigation strategies will be proposed in cases where potential health risks are predicted to occur.

In cases where contaminants of concern, receptors or potential exposure pathways do not exist, potential health effects can be assessed qualitatively. The difference between a qualitative and quantitative assessment is that qualitative assessments are generally descriptive or categorical in nature; whereas, quantitative assessments are based on predictive calculations of chemical exposure.

A quantitative HHERA is planned for the Izok Mine area. This will focus on the potential for contaminant transfer and resultant health effects due primarily to fugitive dust associated with mining activities, vehicular emissions, and effluent and seepage waters. Project design, mitigation and management plans will be incorporated into the risk assessment. Toxicity information on each chemical of concern will be combined with the results of the exposure assessment to characterize potential health risks.

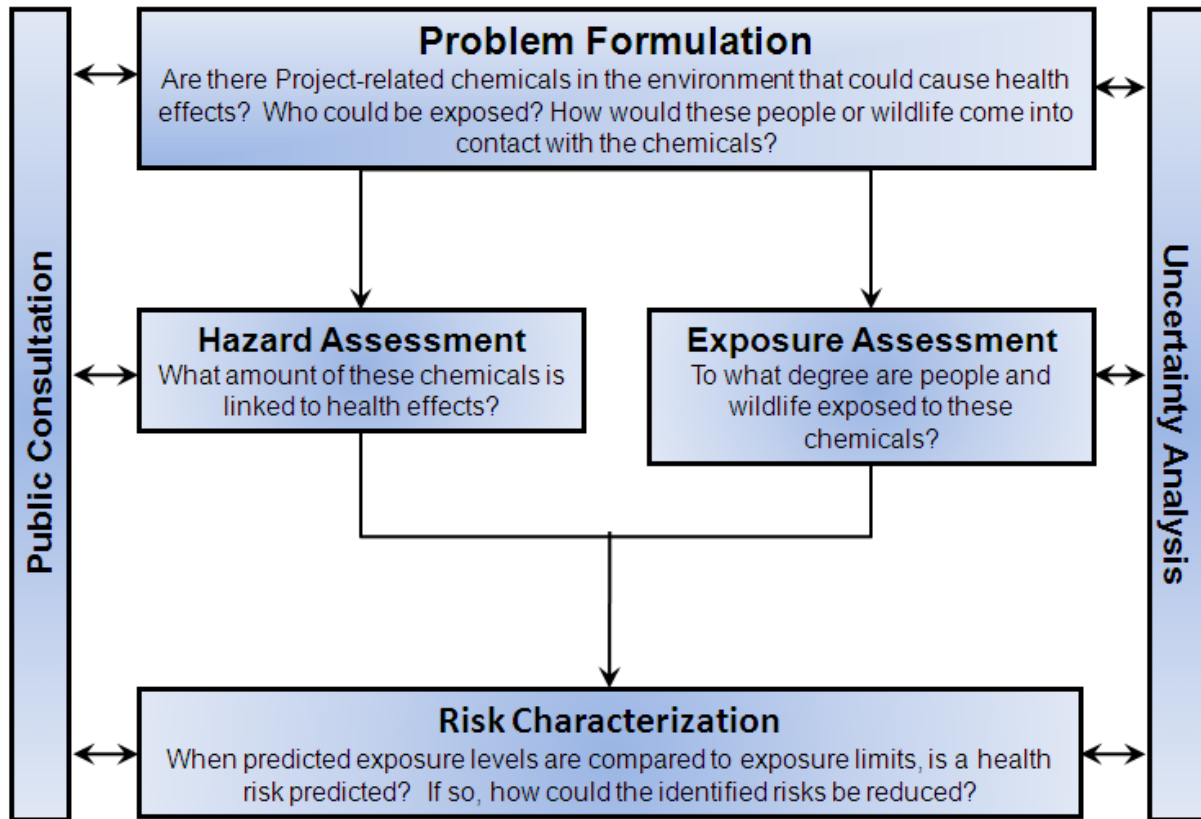


Figure 9.5-1 Risk Assessment Framework

9.5.2 Hazard and Exposure Assessments

For the HHRA, the ratio of predicted dose to tolerable dose provides the hazard quotient (HQ) to evaluate soil and food ingestion. The ratio of exposure concentration to a health-based TRV provides a concentration ratio (CR) used to evaluate air and water exposures. The HQ and CR are effects benchmarks for non-carcinogenic chemicals to identify potential health risks. For carcinogenic chemicals, the incremental lifetime cancer risk (ILCR) is calculated and evaluated based Health Canada's recommended level of acceptable cancer risk level of 1 in 100,000 individuals.

Toxicity information for the ERA will be focused on ingestion of soil, water and food. Chronic TRV indicating effects to each ecological species (or laboratory surrogate), based on environmental concentrations, will be used. Toxicological benchmarks for the HHRA and ERA will be based on government sources including Health Canada and the United States Environmental Protection Agency (Risk Assessment Information System, and Oak Ridge National Laboratory).

Historical and current baseline data will be compiled together with predicted soil and water concentrations, based on aerial deposition and water quality models. These data will be inputs to the HHRA and ERA models for evaluating health risks for each Project phase. Human health will be assessed for local Inuit and non-aboriginal people who use, or could potentially use the area, and for workers who may be exposed during off-work hours at camp. Ecological health will be evaluated for both terrestrial



and aquatic wildlife and bird populations using representative species for each major ecological niche. These will be selected based on wildlife baseline studies, and will integrate TK and communications with local residents. Fish tissue chemistry will also be used in the HHRA and ERA models based on the consumption of fish species by people or by specific wildlife receptors of interest. However, the evaluation of effects to fish species and other aquatic biota will be addressed in the aquatics effects assessment in the DEIS.

9.5.3 Risk Characterization

The risk characterization phase of the HHERA will determine whether the planned development is anticipated to have any adverse effects on human health or the health of selected ecological receptor species. Each contaminant will be assessed for the potential to cause adverse effects to each receptor of concern based on the resultant HQ or ILCR produced. A HQ or CR greater than the acceptability benchmark (sum for all pathways of 1) indicates that potential exposures may be a source of non-carcinogenic health effects, and that some form of mitigation may be required to prevent unacceptable exposures.

Similarly, an ILCR greater than 1×10^{-5} indicates that potential exposures are above the accepted threshold of carcinogenic health risk and warrant further assessment. These potential health concerns are evaluated in consideration of statistical confidence in the result, uncertainty in exposure modelling and toxicity data. It is also important to have a clear understanding of naturally elevated background levels and the relative change in baseline or background conditions that the planned operations would have and its effect on overall cancer risk.

The potential cumulative effects on human or ecological health will be assessed based on the results of the respective cumulative effects assessments (i.e., evaluating potential interactions with other projects in the area) from the air quality, soil quality, and water quality assessments.