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DMTS Fugitive Dust Risk Assessment Volume I—Report

Draft

The first set of pages, including the Table of Contents and the Executive Summary, have been separated by ADEC in this file from Exponent's original document for ease of downloading via the Internet.

Prepared for

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Draft

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Acronyms and Abbreviations

AIDEA	Alaska Industrial Development and Export Authority
ANOVA	analysis of variance
AWQC	ambient water quality criteria
CCC	criteria continuous concentration
CDC	Centers for Disease Control and Prevention
CMC	criteria maximum concentration
CoPC	chemical of potential concern
CPDB	Community Profile Database
CSB	concentrate storage building
CSM	conceptual site model
DEC	Alaska Department of Environmental Conservation
DFG	Alaska Department of Fish and Game
DHSS	Alaska Department of Health and Social Services
DMTS	DeLong Mountain Regional Transportation System
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
EPT	Ephemeroptera, Plecoptera, and Trichoptera
ERA	ecological risk assessment
ERL	effects range-low
ERM	effects range-medium
ESA	Endangered Species Act
ESOD	erythrocyte superoxide dismutase
FWS	U.S. Fish and Wildlife Service
GSD	geometric standard deviation
HHRA	human health risk assessment
IEUBK	integrated exposure uptake/biokinetic
LOAEL	lowest-observed-adverse-effect level
MVUE	minimum-variance unbiased estimate
NAAQS	National Ambient Air Quality Standards
NANA	NANA Regional Corporation
NEC	no-effect concentration
NHANES	National Health and Nutrition Examination Survey
NOAEL	no-observed-adverse-effect level
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NTP	National Toxicology Program
ORNL	Oak Ridge National Laboratory
PEC	probable effect concentration
PRG	preliminary remediation goal
RBC	risk-based concentration
RDA	recommended daily allowance
RfD	reference dose
RME	reasonable maximum exposure

SQS	sediment quality standards
TEC	threshold effect concentration
Teck Cominco	Teck Cominco Alaska Incorporated
THQ	target hazard quotient
TRV	toxicity reference value
UCL	upper confidence limit
USGS	U.S. Geological Survey
WDOE	Washington State Department of Ecology

Executive Summary

Purpose of the Risk Assessment

Elevated metals concentrations have been identified in tundra in areas surrounding the DeLong Mountain Regional Transportation System (DMTS), primarily as a result of deposition of fugitive dust originating from the DMTS corridor that is used to transport zinc and lead ore concentrates from the Red Dog Mine, which is operated by Teck Cominco Alaska Incorporated. The purpose of the DMTS fugitive dust risk assessment is to estimate possible risks to human and ecological receptors posed by current and future exposure to metals in soil, water, sediments, and biota in areas surrounding the DMTS, and in areas surrounding the Red Dog Mine ambient air/solid waste permit boundary. The risk assessment is part of the overall process in which the areas of fugitive dust deposition surrounding the DMTS are being evaluated (see the main text for a review of regulatory context). The results of the risk assessment will help risk managers to determine what additional actions may be necessary to reduce those risks.

What This Document Includes

This document is a draft of the risk assessment for the DMTS and the area outside of the Red Dog Mine ambient air boundary. The risk assessment document expands upon the risk assessment work plan previously submitted to the Alaska Department of Environmental Conservation (DEC) in February 2004 (Exponent 2004b), using the framework established in that document. The February 2004 work plan was a revised draft of the work plan previously produced in January 2003 (Exponent 2003b). The February 2004 work plan incorporated revisions based on comments (DEC 2003b) from individuals (e.g., village residents), non-governmental organizations (e.g., Trustees for Alaska, NANA Regional Corporation), and government agencies (e.g., DEC, Alaska Industrial Development and Export Authority, National Park Service) on the January 2003 work plan. DEC provided comments on the February 2004 work plan in April 2004 (DEC 2004a), and the work plan was approved with response to comments in October 2004 (Exponent 2004c; DEC 2004b). Revisions agreed to in the response to comments are incorporated into this document.

The major parts of the risk assessment document include the preliminary human health and ecological conceptual site models, which are presented and then refined based on the results of screening and selection of chemicals of potential concern (CoPCs). Human health and ecological risk calculations are presented, and the risk assessment results are summarized. Appendices to the document describe the Phase I and Phase II field programs conducted to provide data for the risk assessment, and present data used in the assessment.

Risk Assessment Results

The following subsections summarize the findings of the human health and ecological risk assessments.

Human Health Risk Assessment

In the human health risk assessment (Section 5), a site-specific risk assessment was conducted. The risk assessment evaluated exposure to DMTS-related metals through incidental soil ingestion, water ingestion, and subsistence food consumption under three scenarios: 1) Child subsistence use, 2) Adult subsistence use, and 3) Combined worker/subsistence use. The results from each of the scenarios are summarized below. Risks are necessarily expressed separately for lead and for the other (non-lead) metals because a different methodology is used to estimate lead exposure and risks, as described in Section 5.2.2.1.

Child Subsistence Use

- Using EPA's integrated exposure uptake/biokinetic (IEUBK) child lead model (U.S. EPA 1996c), with the model default soil lead bioavailability of 30 percent, the model predicted a geometric mean blood lead level of 1.2 μg/dL, with a less than 0.0005 percent chance of exceeding the target blood lead level of 10 μg/dL.
- Using the site-specific soil lead bioavailability of 9.7 percent, the model predicted a geometric mean blood lead level of 1.1 μg/dL, with a less than 0.0005 percent chance of exceeding the target blood lead level of 10 μg/dL.
- The cumulative hazard index from non-lead CoPCs was 0.3, well below the target hazard index of 1.0.
- Assuming a fractional intake from the site as high as 33 percent, cumulative risk from non-lead CoPCs would not exceed the target hazard index of 1.0.
- Assuming 100-percent intake from the site (fractional intake=1.0), no single CoPC would have a risk exceeding the target hazard index of 1.0.

Adult Subsistence Use

- For subsistence use, lead risks were evaluated only for children, but this would also be protective of adult exposure (see results for lead summarized above for child subsistence use).
- The cumulative hazard index from non-lead CoPCs was 0.1, well below the target hazard index of 1.0.
- Assuming a fractional intake from the site as high as 90 percent, cumulative risk from non-lead CoPCs would not exceed the target hazard index of 1.0.

- Assuming 100-percent intake from the site (fractional intake=1.0), no single CoPC would have a risk exceeding the target hazard index of 1.0.

Worker/Subsistence Use

- Using the adult lead model default soil lead bioavailability of 12 percent, the model predicted a geometric mean blood lead level in the fetuses of pregnant women of 1.7 μg/dL, with a 0.9 percent chance of exceeding the target blood lead level of 10 μg/dL.
- Using the site-specific soil lead bioavailability of 3.9 percent, the model predicted a geometric mean blood lead level in the fetuses of pregnant women of 1.6 μg/dL, with a 0.7 percent chance of exceeding the target blood lead level of 10 μg/dL.
- The cumulative hazard index from non-lead CoPCs was 0.07, well below the target hazard index of 1.0.
- Assuming 100-percent intake from the site (fractional intake=1.0), cumulative risk from non-lead CoPCs would not exceed the target hazard index of 1.0.

Overall, risks were well within acceptable limits. The results of the risk assessment, along with the results from the subsistence foods evaluations (Appendix H), support continued harvesting of subsistence foods without limitations. Although harvesting remains off-limits within the DMTS restricted areas, it should be noted that human health risks are not elevated even when data from the restricted areas are included in risk estimates.

Ecological Risk Assessment

In the ecological risk assessment (Section 6), a site-specific assessment was conducted to evaluate risk to ecological receptors inhabiting terrestrial, freshwater stream and pond, and coastal lagoon habitats. The risk conclusions for each habitat are summarized below.

Terrestrial Habitats

- Changes in vegetation community structure are observable within 100 m of the DMTS road and port facilities. These community shifts appear to be due, in part, to physical and chemical influences of the road and their effect on hydrology, soil chemistry, and plant vitality. Physical and chemical stresses are commonly found associated with gravel roads in tundra environments. The importance of CoPCs in fugitive dusts relative to physical stresses caused by the DMTS road in producing these changes cannot be determined based on the data available at this time.
- Differences between reference plant communities and plant communities beyond 100 m from the DMTS road, specifically the 2- to 4.5-fold decrease

in lichen cover, may be a result of fugitive dust deposition; however, road effects or natural variability in plant communities may also be contributing factors for this observed difference.

- In port facility areas, particularly in the area immediately downwind of Concentrate Storage Building 1 (CSB1), the presence of stressed and dead vegetation appears to be primarily related to fugitive concentrate dust deposition, but physical disturbance associated with construction of CSB1 may also have been a contributing factor.

- Herbivorous and insectivorous small mammals (e.g., voles and shrews) inhabiting tundra within 10-100 m of the DMTS road, near the port facilities, or near the mine's ambient air/solid waste boundary showed incremental risk from exposure to aluminum and barium. However, exposures decreased to no-effects levels or were comparable to reference exposures beyond 100 m from the road and 1,000 m from the mine's ambient air/solid waste boundary. These localized effects on individuals' survival and reproductive performance are unlikely to translate into population-level effects (e.g., changes in abundance or distribution), given the limited spatial scale of the effects, and given uncertainties associated with toxicity reference value (TRV) derivation.

- Population-level effects to herbivorous birds (e.g., ptarmigan) are unlikely. The lowest observed adverse effects level (LOAEL) based hazard quotient for barium exposure near the mine was 1.1, but at all other locations barium exposure is below the level at which adverse effects are first expected, thus the likelihood of site-wide effects on herbivorous bird populations is very low.

- For caribou, no adverse effects are predicted for the vast majority of caribou that only pass through the site during migration. There is a low likelihood that individual caribou over-wintering in the mine area may experience adverse effects (reduced growth) from exposure to aluminum, as LOAEL-based hazard quotients ranged from 2.2 to 2.5 across the site, and were about 3-fold higher than comparable reference area hazard quotients. However, the aluminum TRV probably over-estimates toxicity of the relatively low solubility, low bioavailability forms of aluminum found in the assessment area. In addition, it is very unlikely that any individual-level growth effects, if occurring, would lead to population-level effects because of the very small proportion of the total herd that could possibly over-winter near the mine site.

- The likelihood of adverse population-level effects to other terrestrial wildlife, including large-bodied mammalian herbivores (e.g., moose), avian invertivores (e.g., Lapland longspur and snipe), and avian and mammalian carnivores (e.g., snowy owl and Arctic fox), is considered to be negligible.

Freshwater Streams

- Benthic macroinvertebrate drift assemblages indicated that the overall characteristics of the communities found in the site streams crossing the road were similar to reference streams.
- Fish monitoring studies have found no consistent evidence of a road-related effect on metals concentrations in fish upstream and downstream of the DMTS. Adverse effects to fish populations are not predicted.
- Metals concentrations in plants were generally within the range of reference concentrations and/or literature phytotoxicity thresholds.
- The likelihood of adverse population-level effects to wildlife foraging in streams, including avian and mammalian herbivores (e.g., green-winged teal, muskrat, and moose) and avian invertivores (e.g., common snipe), is considered negligible.

Freshwater Ponds

- Adverse effects are not predicted in tundra ponds along the DMTS road, or at distances greater than 100 m from facilities. For these ponds, CoPC concentrations in sediment are not expected to be toxic to benthic macrofauna based on toxicity test data for coastal lagoons, metals concentrations in plants were generally within the range of reference concentrations and/or below phytotoxicity thresholds, and food-web models indicate a very low likelihood of adverse population-level effects to herbivorous wildlife (e.g., green-winged teal and muskrat).
- Adverse effects may exist for invertebrates and plants in ephemeral ponds located within 100 m of the concentrate conveyor and other port facilities.

Coastal Lagoons

- Sediment toxicity tests indicated no effects to benthic invertebrates in lagoons, even when exposed to elevated CoPC concentrations in sediments from locations nearest to port facilities.
- Plant community structure was similar at site and reference lagoons. Natural variability among and within lagoon plant communities likely accounts for the few differences that were observed.
- The likelihood of adverse population-level effects to wildlife foraging in coastal lagoons, including herbivorous and invertivorous birds (e.g., brant and black-bellied plover), is considered negligible.

Where We Are in the Process, and What Comes Next

Upon submittal of this draft risk assessment to DEC, DEC will provide a public comment period. After comments are provided, a comment response and resolution process will be completed, and then the risk assessment will be finalized. During this time frame and following completion of the risk assessment, Teck Cominco will develop a proposed risk management plan, in consultation with DEC and other stakeholders. The risk management plan will identify actions needed to address risks identified by the risk assessment, and will define a long-term program to monitor changes in conditions.

The risk management plan will be developed in parallel with the completion of the risk assessment, through the remainder of 2005. The plan will evaluate risk management options within the general categories of institutional controls, engineering controls, monitoring, and remediation/restoration. The plan will identify the most appropriate combination of actions for management of risk in the short-term, and over the long-term life of the mine.

Action levels were not calculated at this time because risks are not significantly elevated. However, action levels could be one component of a risk management strategy (e.g., as a tool for risk management associated with monitoring and/or with Teck Cominco's voluntary cleanup program). The potential need for and use of action levels will be further evaluated in the process of developing the risk management plan. If numerical action levels are determined to be needed, they will be calculated and included in the plan.

Development of the plan will be a collaborative process involving DEC and other stakeholders throughout the process of identifying and evaluating options, and determining an agreed upon course of action.