GIANT MINE
Oversight Board

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November 12, 2017

GMOB Review: HHERA Report October 2017

Dear Ms. Plato;

The Giant Mine Oversight Board (GMOB) has reviewed the Human Health and Ecological Risk Assessment (HHERA).

Please find attached the results of our evaluation and recommendations to date.

GMOB thanks the Project Team for providing both the material and opportunity to provide comments and we look forward to your final report in this regard.

If you have any questions in this regard, please contact our office directly.

Sincerely,

Dr. Kathleen Racher

Cc: Parties to the Environmental Agreement
Bill Slater, Advisor to the GMWG
Jane Amphlett, Engineering Manager, GMRPT, INAC

HHERA REVIEW COMMENTS

Ken Froese / GMOB

INTRODUCTION

This review of the HHERA is written with two main audiences in mind: CanNorth, for clarifying and refining various technical and editorial aspects of the assessment; and both CanNorth and the Project Team, to offer points for emphasis, clarification, and broader context and communication of the HHERA, its results, and, most critically, its limitations. I leave it to CanNorth and the Project Team to decide which comments are best addressed in the HHERA final report and which to address in the Project Team's overall communication plan for the report.

GENERAL COMMENTS

The Human Health and Ecological Risk Assessment (HHERA) is an important contributor to the overall understanding of the potential adverse impacts of arsenic and other contaminants from the Giant Mine site and its surrounding area. As with any HHERA, it is not an assessment of current health concerns – it provides an evaluation of whether exposure to arsenic (As) and other mine-related contaminants are above an accepted regulatory guideline, possibly resulting in higher long-term health risks. HHERA is a formalized process to collect, organize, and evaluate data to inform risk management decision making. It is not an exact science; there are many uncertainties inherent in a risk calculation, including chemical analysis of contaminants, estimating exposures for people and other organisms, and the science and policy around deriving toxicity benchmarks. Because of these uncertainties, there is a deliberate bias toward over-estimating risks to ensure that ultimate risk management decisions protect the most susceptible receptors (e.g. toddlers; elderly). The extent of the overestimation is a challenge – we want to be conservative, however, not to a level that is unreasonable.

Human health risk estimates are based on upper reasonable exposure ranges for the different receptor scenarios. It is difficult to portray in a risk assessment report that, particularly for the incremental lifetime cancer risk estimates, people would need to be exposed to the upper range of soil, dust, country food, water, and sediment every day for 80 years. The cancer risks are not based on single meals of fish from Back Bay, or individual dust events in the springtime.

WHAT WAS DONE WELL?

From an overall perspective, the HHERA is a good example of how such an assessment should be done. Local data from many sources (literature, government agencies, previous studies, and targeted studies) were collected and carefully vetted against quality criteria prior to being included in the dataset for this assessment. All

HHERAs are limited to a greater or lesser extent by time, budget, and personnel – that's simply a given in all of these projects. While some have criticised this study for limited data collection, none of the previous risk assessments done for the Giant Mine or any other mine sites in the North have region-specific data on country foods (that consumers have provided from their own food supplies) and consumption parameters. Having this substantially reduces the uncertainty inherent in these parameters – until recently, most risk assessments have had to rely on food consumption parameters that were derived from surveys in the 1970s.

Regarding background contaminants concentrations – CanNorth developed revised background As values, updating the derivations described in a RiskLogic (2002) document. It appears to be a robust approach from both data source- and selection methods, and the statistical methods used for removing data outliers (high concentrations that are not representative of actual background).

WHAT COULD BE IMPROVED?

Communicating results. The results for arsenic for all communities fall into the low- to very low risk category as defined in the report. Some readers likely want to see quantitative numbers associated with these, rather than just the bar graphs. Perhaps a useful metric along with general terms such as a chest x-ray or dental x-ray could be the calculated ILCR of a lifetime of drinking water at the current drinking water maximum contaminant level for arsenic: at 10 µg/L, or 0.01 mg/L, the calculated ILCR is 3.8×10^{-4}, or 38 in 100,000. So, someone drinking water that meets the Canadian drinking water standard could have a higher lifetime cancer risk than the Ndilo receptor with a high country food diet (approximately 12 in 100,000).

Describing and communicating the uncertainties in the risk assessment, and what these mean for the overall results. There is a section on uncertainties for each of the HHRA and ERA components, however, I find this section is not clear enough to help understand how these really affect the risk estimates. The accompanying tables (Tables 3.12 and 4.50) leave a rather equivocal interpretation – that the assessment team isn't able to state whether the risks for arsenic are greatly overestimated, underestimated, or simply not definable. This leaves me with some discomfort with the report overall, because as a risk assessment professional, I understand the assessment process is implicitly biased toward overestimation. However, the reading audience does not readily understand this. The uncertainties in a risk assessment, as discussed briefly above, compound through the exposure calculations and risk characterisation. For the HHRA components, the ultimate overestimate is arguably in the range of 3- to 5-times greater than the "true" risk. This overestimate range would apply equally to all receptor groups, therefore the differences between the communities observed in the results of the risk assessment remain applicable. However, knowledge that the calculated risks are conservatively overestimated should provide context for addressing community concerns about arsenic in their environment. In the final communications to all parties, these distinctions need to be expressed in clear, plain language.

SPECIFIC CRITIQUES

The following specific issues arose during review of the main report, and inquiries into the Appendices to clarify questions or inconsistencies observed in the main report. In general, the technical concerns discussed here are not likely to have a major quantitative influence on the final risk estimates as reported. However, they do affect the overall uncertainty of the risk estimates and the clarity/transparency of how the risk estimates were calculated.

TECHNICAL

Moose meat / shoulder sample – a particular sample that was provided by a YKDFN community member was highlighted a number of times. The arsenic concentration was substantially higher in this sample than other moose meat samples and it was noted that it may be more representative of arsenic concentration in bone than in meat, and the sample result was not included in the country food exposure; however, there is no supporting evidence for concluding that it was representative of bone and should be excluded from the sample set. William Lines indicated during the HHERA presentation to the Working Group that there was indeed sufficient muscle meat for a good sample and no bone fragments were part of the sample submitted. The sample may be seen as an outlier; however, without sufficient statistical basis for excluding it as an outlier, the result should be included in the analysis.

Bioaccessibility – exposure point concentrations (EPCs) were calculated for the compounds of potential concern (COPC); arsenic EPCs were adjusted for bioaccessibility and presented as adjusted EPCs. While this is not incorrect from a technical approach, it does introduce an avenue for confusion when reading the HHERA and when working through sample calculations. No bioaccessibility adjustments were done for the other COPC. The exposure calculation equations from Health Canada allow for adjustment based on absorption factors and exposure frequency factors: it would be a more transparent approach to include the bioaccessibility adjustment as a parameter in the exposure calculation equation and report the arsenic EPC as the statistical value of the exposure matrix.

Bioaccessibility in dust – Is the bioaccessibility assumption the same for indoor dust as for soil? Would the dust vs. soil particle size make a difference?

Speciation in fish – it is not clear how speciation (i.e. arsenobetaine) data is used in conjunction with the bioaccessibility fraction. Presumably the bioaccessibility determination was done for total arsenic in fish, without consideration of arsenobetaine. Is it appropriate to adjust EPCs for fish by both the bioaccessibility and the speciation factors without some understanding of whether and how the speciation affects bioaccessibility? Also, similar to the concern with the bioaccessibility adjustment, any adjustments in the exposure calculation should be explicitly done as part of the exposure equation, and not embedded into the EPCs.

Average, maximum or 95th UCLM – there appears to be inconsistency in which statistical value is used, particularly for the country foods. In Appendix F, p F-40 it

indicates using the 95th UCLM if there are 10 or more samples available; if fewer samples are available, the 95th percentile or the maximum value will be used. However, in Table F 27, the 95th UCLM was used for fish; all other country foods were reported as average concentration, and adjusted for bioaccessibility for arsenic.

Sediment for Ndilo and Latham Island – sediment EPC for Ndilo is the maximum value for samples collected at Ndilo due to number of samples (not enough for 95th UCLM). There were fewer samples collected at Latham Island, therefore, the data for Ndilo and Latham Island were combined, providing sufficient samples to calculate the 95th UCLM. Why the inconsistent approach? If it is appropriate to combine Ndilo samples with Latham Island samples for the Latham Island sediment EPC, why not do the same for Ndilo?

Use of background COPC concentrations – background data is used both for screening for COPC and in the risk calculation. For screening, if the 95th UCLM of the matrix data is less than the average background concentration, the compound is dropped from the list and not considered further. For risk calculations, the 95th UCLM of the background data was used – CanNorth specifies that this is the recommendation in the FCSAP guidance on background concentrations. While this statistic is considered conservative for exposure calculations, if the background value is subtracted from the exposure point concentration, using the 95th UCLM for background results in less conservatism (i.e. you end up subtracting more background arsenic from the exposure sites) than if the average value was used. The cited FCSAP guideline suggests use of the 95th UCLM statistic for background concentration, however, it does not describe directly how this is used in the RA. It does, however, indicate that for ecological receptors, it is generally inappropriate to subtract background from site concentration. Some clarification on this is required, as understanding background concentrations and how they were used in the RA was a topic of discussion at the community/public meetings.

Background for beaver and muskrat – only one sample was obtained for beaver from outside the 25km radius of the mine site. While this sample has a higher arsenic concentration, we need to be careful in characterizing the regional and background beaver and muskrat against this sample. A single sample doesn't provide a basis for comparison or conclusions. Preference would be to indicate that a single sample was obtained from outside the area of historical Giant Mine influence, but a background characterisation can't be confirmed.

Significant figures: some tables display two significant figures, while many others display data with four or more significant figures. While this doesn't change outcomes in the RA, it perpetuates a perspective that the science (analytical chemistry; fate and transport modeling; exposure modeling) is more precise than is achievable. Given uncertainties in all of the stages from sampling to analysis and modeling, two significant figures in any of the concentration data, statistics, and calculation results are the most that can be justified.

EDITORIAL

Verify results of HHERA with Health Effects Monitoring Program – p. ix of Executive Summary. CanNorth should specify how the results of the HHERA could be verified with the Health Effects Monitoring Program. The two studies are fundamentally different, with this HHERA estimating the lifetime carcinogenic risk from arsenic exposure, and the health effects monitoring program measuring arsenic in nails and urine (measures that are not correlated with lifetime cancer risk). The only potential verification is whether or not Ndilo residents have higher measured body burden of arsenic (from nail samples) than residents in the City or in Dettah. This should be made more explicit.

Recreational future receptor – for the future case after mine site remediation, the HHERA used a hypothetical receptor who would access the former mine site on a recreational basis. It was very apparent in the YKDFN HHERA results meeting that this came as an unwelcome perspective. In the SDE engagement, the communities clearly said that they do not want the area to be used in the future, and major design features should actively dissuade people from using the site far into the future. So, while the exercise in the HHERA is meant as a hypothetical scenario, it can easily be interpreted or misconstrued as a viable future scenario. Perhaps there is a better way to characterize this future receptor?

Bioavailability and bioaccessibility – these terms appear to be used interchangeably and not consistently in text and tables, in spite of the discussion in Section 3.3.4. The literature values from Koch et al (2013), and presumably other cited references, are bioaccessibility measurements, therefore, the term bioaccessibility should be used consistently throughout the HHERA, unless there is specific differentiation to bioavailability.

Concentration terminology – water concentration; soil concentration; sediment concentration; etc. This is a chemistry word use issue. While it is quite common and the majority of readers likely understand what is meant, i.e. water concentration = the concentration of the COPC in water, the phrase is technically not correct because it's actually the COPC concentration that is being referred to. In the majority of cases, simply using "COPC concentration" or refer to the compound itself (i.e. arsenic) is sufficient, because the context of the table or discussion makes it obvious what the matrix is.