Addendum to the August 12, 2008 Trail Phase 4 Human Health Risk Assessment

Response to Comments from Dr. Glyn Fox, Senior Science Advisor, B.C. Ministry of Environment

Prepared for:
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Contents

List of Attachments

1 Introduction

This addendum addresses technical review comments provided by the British Columbia Ministry of Environment (BCMoE) on the report, "Human Health Risk Assessment (HHRA) for Offsite Impacts from Trail, B.C., Smelter. Phase 4 – Additional Data Collection and Probabilistic Risk Calculations." The subject report (hereafter, "the HHRA"), dated August 12, 2008, was prepared by Integral Consulting Inc. (Integral) on behalf of Teck Metals Ltd. (Teck). Dr. Rosalind Schoof and Ms. Dina Johnson, formerly with Integral and now with ENVIRON International Corporation (ENVIRON), are the risk assessment professionals responsible for the HHRA.

As requested by Teck, ENVIRON has prepared this addendum to address the BCMoE comments. Attachment 1 to this addendum provides a copy of the original BCMoE comments, as authored by Dr. Glyn Fox, Senior Science Advisor with BCMoE. Dr. Fox's comments were very helpful in identifying some necessary corrections and clarifications of information presented in the HHRA, none of which substantively change the results of the HHRA. A summary of each of these corrections and clarifications is provided in section 2 of this addendum. Dr. Fox also requested addition of a report author attribution and a CD containing all original data compiled for use in the HHRA. The report author attribution is provided in section 3 of this addendum and the requested CD is provided as Attachment 2.

Collectively, the information provided by this addendum represents errata to the HHRA. For completeness, this addendum should be transmitted along with the August 12, 2008 HHRA to all future recipients of the HHRA.

2 Summary of Corrections and Clarifications

BCMoE's comments on the HHRA are comprised primarily of corrections of typographical errors and suggested revisions of report text to improve the clarity of interpretations provided. Errata pertaining to these comments are summarized below. Suggestions from BCMoE of alternate strategies that might have been employed or might be considered in the future, as well as notes regarding updated reference values published since completion of the HHRA are not specifically addressed.

1. Table 2-3 of the HHRA should have listed the 1999 Canadian Council of Ministers of the Environment (CCME) thallium soil quality guideline value for commercial land, 1 milligram per kilogram (mg/kg), instead of "n/a". Footnote "a" of Table 2-3 should correctly read: "All soil guidelines are B.C. commercial standards except the standard for thallium, which is a Canadian National Standard."

   The significance of this correction to the overall findings of the HHRA is expected to be low. Had this value been identified at the time of the HHRA, thallium would have been carried forward for further evaluation of commercial properties in East Trail along with antimony and cadmium. For thallium, East Trail commercial soil concentrations ranged from 0.5 to 3.6 mg/kg with an average of 2.1 mg/kg (calculated based on original data). For any given soil concentration input, noncancer hazard risks modeled in the HHRA for residential scenarios will always be higher than those for commercial scenarios due to slightly more conservative exposure assumptions used for the residential scenarios. Therefore, East Trail commercial soil concentrations for thallium were compared to residential soil thallium concentrations that yielded the highest noncancer risk. As shown in Table 5-3 of the HHRA, the highest 95th percentile noncancer risk for thallium in residential soil (hazard quotient of 0.236) corresponds to the child scenario in Tadanac. For this scenario, thallium soil concentrations ranged from 0.5 to 12.5 mg/kg with an average of 2.11 mg/kg (Table 3-5 of the HHRA). Therefore, one can reasonably expect that noncancer risks predicted for thallium in commercial soil in East Trail would be lower corresponding risks for residential soils in Tadanac (i.e., noncancer risks for thallium in commercial soil are expected to be well below 1.0).

2. Table 2-3 of the HHRA incorrectly lists a soil standard for zinc of 40,000 mg/kg. The correct value is 30,000 mg/kg. This correction does not change the results of the soil screening presented in the HHRA as all soil concentrations were below the corrected value.

3. Section 2.3.1 of the HHRA at page 2-8, second paragraph – For improved clarity, reviewers of the HHRA should note that further discussion of the "newly predicted antimony and zinc concentrations for prior phases" is provided in section 2.3.4 of the HHRA.

4. Table 2-12 incorrectly lists "NA" as the B.C. Drinking Water Quality Guideline for molybdenum. The correct value is 0.25 milligrams per liter (mg/L). This correction does

not change the results of the groundwater screening presented in the HHRA as all groundwater concentrations were below the corrected value.

5. Table 2-13 includes typographical errors in the concentration units reported in the table header. Units reported as "µ/L" should be "µg/L". These corrections do not change the results of the HHRA.

6. Footnote 34 pertaining to section 3.1.2.1 at page 3-4 contains a typographical error. The footnote should read as follows: "For example, if for a specific model run, the exposure duration was equal to the mean of the distribution, 12.6 years, then the exposure duration for that model run would be assigned as follows: 4.5 years for the child and 8.1 years for the adult (i.e., 12.6 minus 4.5 years)." This correction does not change the results of the HHRA.

7. Exhibit 3-3 in section 3.4.4 at page 3-17 omits the "Source/Comment" for the agricultural scenario parameter value "ET_{ADULT}". The correct source is "Phases 2 and 3 HHRA". This correction does not change the results of the HHRA.

8. Table 4-1 includes typographical errors that do not change the results of the HHRA. Corrections are as follows:

    a. The oral RfD for cadmium of $5.00x10^{-4}$ is for water, not food. The correct value was used in the HHRA calculations.

    b. The oral RfD for cadmium of $1.00x10^{-3}$ is for food, not water. The correct value was used in the HHRA calculations.

    c. Footnote b should be revised to the following: "All values except for antimony were obtained from the Updated Health Canada TRVs (Source: Federal Contaminated Site Risk Assessment in Canada. Part II: Health Canada Toxicological Reference Values (TRVs). September 2004. Environmental Health Assessment Services. Safe Environments Programme). Values are health-based tolerable daily intakes/concentrations and tumorigenic doses/concentrations. The antimony value was obtained from Health Canada's (1997) Guidelines for Canadian Drinking Water Quality: Supporting Documentation."

9. Section 4.2.2.3 of the HHRA at page 4-7, second paragraph incorrectly references "Health Canada 2004b." The correct reference, which does not change the results of the HHRA, is as follows:

    Health Canada. 1997. Guidelines for Canadian drinking water quality: supporting documentation. Antimony. http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/water-eau/antimony-antimoine/antimony-antimoine-eng.pdf Accessed on Novemer 11, 2010. Health Canada, Ottawa, Ontario.

10. Section 4.9.3.1 of the HHRA at page 4-34 incorrectly references "selenium" instead of "thallium." This correction does not change the results of the HHRA.

11. Section 4.10.2.1 of the HHRA at page 4-35, second sentence contains a typographical error. The tributyltin oxide oral reference dose value should be "3 x 10^{-4}" not "3 x 10^{-5}." The correct value was used in the HHRA calculations.

12. Section 5.1.1.1 of the HHRA at page 5-3, discussion of site wide risks incorrectly reports a hazard index of 0.787 for arsenic. The correct value is 0.671, as reflected in Table 5-2 of the HHRA. This correction does not change the interpretation of the HHRA.

13. Section 5.1.1.1 of the HHRA at page 5-3, last sentence – For improved clarity, this sentence should be revised to read: "Child 95th percentile noncancer risks equal or exceed 1.0 for thallium in East Trail, Rivervale, Tadanac, West Trail and site wide."

14. Section 5.2.1 of the HHRA at pages 5-6, 5-7, and 5-8 employ incorrect terminology regarding BCMoE's default acceptable (carcinogenic) risk standard of less than or equal to 1 in 100,000. Reference to this default acceptable risk standard should replace existing references in the HHRA to "BCMoE's target risk" or "BCMoE's target risk level." These corrections do not change the results of the HHRA.

15. Section 5.2.1.1 of the HHRA at page 5-7, last complete paragraph – For improved clarity, the last two sentences of this paragraph should be revised to read: "The highest total risk (1 in 10,000) was found in East Trail, where air contributed 54 percent, soil, indoor dust, and outdoor dust 29 percent, and produce 17 percent of the total risk (Table 5-15 and Appendix B). This maximum risk equaled but did not exceed a risk level of 1 in 10,000."

16. Section 5.2.1.1 of the HHRA at page 5-7 and 5-8, last sentence – For improved clarity, this sentence should be revised to read: "Combining the highest inhalation risk estimated for these stations (i.e., 5 in 100,000 for Butler Park, Table 5-11) with the highest total non-air risk estimated at Tadanac (i.e., 6 in 100,000, Table 5-14) results in a total combined risk of 11 in 100,000, which would be expected to closely approximate the highest site wide risk that includes air exposures."

17. Figure 5-5 of the HHRA includes an incorrect scale for the x-axis. A replacement page for that figure is attached to this addendum (Attachment 3). The results of the HHRA are not changed by this correction.

18. Section 5.2.4 of the HHRA at pages 5-9 through 5-11 – This section provides a discussion of background sources and *estimated background intakes* for two of the main risk drivers for the site: arsenic and cadmium. The intent was to provide information regarding the quantification of background intakes underlying background risk estimates presented in Appendix B.

    As referenced in this section, Appendix B of the HHRA included a probabilistic assessment of background cancer risk for arsenic and cadmium. For arsenic, background cancer risk estimates were presented for ingestion and inhalation pathways. For cadmium, background cancer risks were presented for inhalation only because there

is little evidence of an association between oral exposure to cadmium and increased cancer rates in humans (see Section 4.4.3 of the HHRA for further discussion of the carcinogenic effects of cadmium).

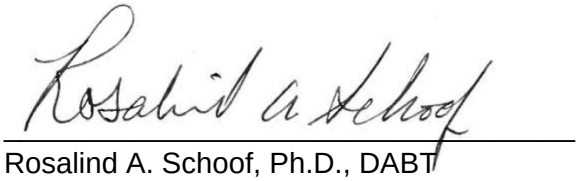
The results provided in Appendix B were presented alongside the site-related cancer risks estimated in the HHRA to provide additional context for interpreting site-related risks. However, due to differences in the sources of arsenic exposures related to the site versus background, it is acknowledged that the original presentation of this analysis in Appendix B could be improved. Therefore, data tables and pie charts presented in Appendix B for comparison of site-related and background cancer risks have been reconfigured to better illustrate the intended comparison. The revised summaries are provided as Attachment 4 to this addendum. Of note, for arsenic, inhalation risks and ingestion risks are now presented separately given that these routes have different endpoints. In addition, total cancer risks for ingestion pathways are estimated on the basis of site-related produce and soil-dust intakes combined with background drinking water and background food intakes. Pie charts depict the relative contributions of each ingestion source to the total arsenic ingestion risk for a Trail resident impacted by both site-related and background exposures to arsenic.

Cancer risks, both site-related and background, for inhalation of cadmium (by non-smokers) are also detailed in the revised summaries (Attachment 4).

19. Section 5.5 of the HHRA at pages 5-14 and 5-15 – Clarification regarding risk levels referenced in the HHRA. The HHRA interprets calculated risks for the Trail site in comparison to both the BCMoE's default acceptable risk level (1 in 100,000) and a higher risk level (1 in 10,000), which has been proposed by Hilts (2007) for consideration as a possible alternate acceptable risk level for the Trail site, at least in the shorter term. Comparisons to the Hilts (2007) risk level throughout the HHRA are intended to be speculative in nature. The BCMoE's default acceptable risk level remains the regulatory standard for the HHRA. Reviewers of the HHRA are cautioned to interpret results of the HHRA accordingly.

3 Signature Page

I certify that I am responsible for preparation of the August 12, 2008 report, "Human Health Risk Assessment (HHRA) for Offsite Impacts from Trail, B.C., Smelter. Phase 4 – Additional Data Collection and Probabilistic Risk Calculations." I further certify that I am responsible for preparation of this addendum.



Rosalind A. Schoof, Ph.D., DABT
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Attachment 1

BCMoE's Review Comments (Fox 2009)

Telephone: (250) 356-8374
Facsimile: (250) 387-9935

Date: August 14, 2009 File: 26250-20/3250 Trail WAS

To: Peggy Evans

From: Glyn Fox

Re: Human Health Risk Assessment (HHRA) for Offsite Impacts from Trail, B.C. Smelter: Phase 4 – Additional Data Collection and Probabilistic Risk Calculations. Integral Consulting Inc. August 12, 2008

As requested, I have now reviewed the above mentioned Phase 4 probabilistic HHRA for the Trail Wide Area Site.

The phase 4 probabilistic human health risk assessment represents the final risk assessment conducted for human health concerns related to heavy metal contamination, other than lead, associated with the Trail smelter. This final risk assessment completes the following prior phases of HHRA conducted for the site:

Phase 1: Environmental data evaluation and recommendations related to collection of additional data; creation of a conceptual exposure model for the site and screening pathway analysis. Determination of an initial priority PCOC list for Trail HHRA which included: antimony, arsenic, cadmium, mercury, selenium, thallium, tin and zinc.

Phase 2: In vitro bioaccessibility analysis of Trail soil to determine relative bioavailability of cadmium and arsenic. Screened newly acquired environmental data and refined PCOC list to include: arsenic, cadmium and antimony. Conducted deterministic screening HHRA for residential and commercial scenarios for ingestion of soil and dust, and inhalation of ambient air. Evaluated exposure via soil ingestion and dust and inhalation of particulates for agricultural scenario.

Phase 3: Incorporated measured produce and house dust data in a refined deterministic screening HHRA for scenarios examined in Phase 2.

General Comments

The Phase 4 risk assessment for Trail has addressed the ministry's previous comments and has incorporated the ministry's prior recommendations related to the Phase 4 workplan. The phase 4 risk assessment has been completed to Integral Consulting Inc.'s usual high quality standard and provides an authoritative and comprehensive human health risk assessment for Trail smelter related metals other than lead.

The ministry accepts and is in general agreement with the conclusions of the Phase 4 risk assessment in Trail and notes that this most recent and final HHRA for the site serves to confirm and further delineate the conclusion of elevated human health risk

related to environmental exposure to metals in Trail, reached in previous risk assessments for the site.

Report organization/objectives

The objectives of the Phase 4 risk assessment included:

General objectives:

- *Refine and augment site-specific estimates generated in prior phases (Phases 1 through 3),*
- *Incorporate additional or new data to address data gaps identified by the B.C. Ministry of Environment in Phases 1 through 3, and*
- *Employ probabilistic assessment techniques to better quantify risks reported for site neighbourhoods evaluated in Phase 3 (i.e. East Trail, Riverdale, Tadanac, Waneta and West Trail).*

Specific objectives:

- *"Synthesize recent data on environmental media concentrations of PCOCs,*
- *Address data and information gaps identified in Ministry review of Phases 1- 3 (Fox, 2004) and the Phase 4 Work Plan (Fox, 2007; pers. Comm.),*
- *Identify and address any other data gaps that may exist due to new knowledge or changes in standards or toxicity reference values (TRVs) since Phase 3 was completed,*
- *Perform probabilistic risk calculations for key pathways, to better quantify potential risks at the site,*
- *Review and summarize results of the urinary thallium survey conducted in Trail in 2002,*
- *Develop recommendations regarding the potential utility of arsenic and/or cadmium biomonitoring in characterizing local exposures to these PCOCs,*
- *Develop recommendations regarding possible methods for determining "hot spot" criteria, which would be used for deciding where contaminated soil cannot be safely managed in place, and*
- *Address risks on a site wide basis."*

With the exception of the last specific objective listed above, the specific objectives provided for the Phase 4 HHRA are identical to the specific objectives previously provided and reviewed by the ministry in the April 2007 Phase 4 HHRA workplan.

Previous Trail risk assessment phases (Phases 1 – 3) focused on screening level risk assessment and had as primary objectives: identification of appropriate contaminants of concern, critical human receptors and operative pathways of exposure at the site. These previous phases have also provided deterministic screening risk and hazard estimates related to contaminants, receptors and pathways.

The Phase 4 HHRA goes beyond simple screening risk analyses into detailed probabilistic risk assessment/risk characterization for the Trail wide area site. It is my understanding that the results of the Phase 4 analysis will comprise the final Trail human health risk assessment for metals other than lead and the August 2008 report

reviewed herein has been submitted to the ministry for regulatory review and approval.

Data availability and adequacy

Our previous reviews of Trail screening risk assessment activities (Phases 1 – 3) have consistently identified concerns related to the amount and nature of various environmental data collected for the site and used in screening risk assessment. In particular, the ministry has cautioned that the amount of soil data collected may be inadequate to support detailed quantitative risk characterization on a comparative neighbourhood by neighbourhood, substance by substance basis.

To an appropriate extent, these data concerns have been addressed in the Phase 4 report. The phase 4 report has incorporated new data for Phase 1 media and includes new data collected since Phase 3 including data for: air, fish, surface water, groundwater, outdoor dust, beach sand/sediment, home-grown produce and soil. This new data has been used to augment data available in previous phases, with the result that data availability is now considered adequate for the purposes of HHRA in Trail.

Using the new and augmented data, PCOC selection and screening for the site as a whole and for the 5 neighbourhoods studied in the Phase 3 assessment, was repeated as a component of the Phase 4 assessment. Phase 4 retained PCOCs include:

- for soil, outdoor dust and indoor dust: antimony, arsenic, cadmium, selenium, silver, thallium, tin and zinc,
- for garden produce: antimony, arsenic, cadmium and thallium,
- for air: arsenic and cadmium, and
- for fish: arsenic, mercury, vanadium, selenium, thallium and chromium.

Exposure Scenarios

Probabilistic assessment was used to re-assess the exposure scenarios of the Phase 3 HHRA. In addition, Phase 4 included new deterministic assessment for fish ingestion and ATV/Dirt bike exposure scenarios.

Probabilistic Methodology

The probabilistic assessment performed in Phase 4 followed ministry generally recognized methods (i.e. mixed PDF and point estimates, central tendency estimation (CTE) – as average or median risk distributions, reasonable maximally exposed (RME) – as 90^{th} and 95^{th} percentiles of risk distributions, Monte Carlo modelling using Crystal Ball, and quantitative sensitivity analysis). In addition, typical US EPA Superfund/Health Canada Preliminary Quantitative Risk Assessment equivalent deterministic assessment was used to characterize risks associated with Phase 4 fish ingestion and ATV/dirt bike related exposures.

Conventional contaminant intake equations were used throughout the risk assessment and the Phase 4 assessment used either typical exposure factors used previously in phase 1-3 Trail risk assessments or novel/modified exposure factors

drawn from BC MoE approved regulatory sources (primarily US EPA or Health Canada).

PCOC concentration distributions were derived in accordance with generally recognized risk assessment practise or policy (e.g. ½ the concentration of detection assumed for non-detect samples, use of PCOC PDF distributional fit tests for environmental media, use of maximal or UCLM point estimates as representative of PCOC concentrations in deterministic assessment, etc.).

Integral used arsenic:antimony regression-predicted concentrations to assess antimony risk/hazard. The ministry retains general reservations on the use of such associative based predictive procedures in risk assessment and in particular in regard to their use related to antimony in the Phase 4 HHRA. Consequently, the ministry cautions that the antimony risk characterization performed in the Phase 4 risk assessment should only be viewed as being indicative as opposed to definitive in respect to the true risk posed by antimony in Trail. However, for reasons provided in the Specific Comments section below on this issue, the ministry is prepared to accept the conclusions related to Trail antimony risk presented in the Phase 4 report.

Risk Characterization

The Phase 4 HHRA characterizes calculated risks for Trail as a whole (i.e. Trail wide site) and also characterizes risks for the 5 Trail neighbourhoods of concern based on proximity to the Trail smelter, previously identified in the Phase 3 assessment (i.e. East Trail, Riverdale, Tadanac, Waneta and West Trail). Summary risks arising from ingestion of contaminated soil, indoor/outdoor dust and garden produce were calculated site wide for Trail and for the 5 neighbourhoods. Risks for inhalation of contaminated air were calculated and added to the ingestion risk estimates only if an air monitoring station was present in a particular neighbourhood (i.e. for only East Trail, Waneta and West Trail). Risks associated with ingestion of fish and recreational ATV/dirt bike exposures were calculated separately from all other exposures.

Phase 4 Report - Major Conclusions

The phase 4 HHRA presents a large number of detailed hazard and risk conclusions related to heavy metal exposure within the residential, agricultural and commercial context. Additional hazard and risk findings are also reported for exposures related to fish consumption and recreational off-road vehicular use. Generally the findings of the Phase 4 assessment support and confirm similar findings contained in previous Phase 1 – 3 assessments for the site, that heavy metal contamination in Trail presents some degree of unacceptable human health related hazard and risk (i.e. exceed the CSR risk based standards, HI $\leq$ 1.0 and ILCR $\leq 10^{-5}$.

Phase 4 Report – Summary Conclusions

Phase 4 summary conclusions for the Trail residential, agricultural and commercial exposure scenarios and for the fish consumption and recreational off-road vehicular use assessments follow.

Residential Scenario

Residential Non-carcinogenic Hazard - ingestion

For Trail site wide: Hazard acceptable (HI < 1.0).

For the 5 neighbourhoods (East Trail, Riverdale, Tadanac, Waneta and West Trail): Hazard unacceptable (HI slightly > 1.0 for thallium). Tadanac also shows HI slightly > 1.0 for arsenic.

Residential Carcinogenic risk (95th percentile estimates – ingestion and inhalation)

For Trail site wide: Ingestion risk unacceptable (ILCR > 10^{-5} but < 10^{-4} all pathways). Total Trail site wide risk from ingestion for arsenic is 3 x 10^{-5} (2 x 10^{-5} from ingestion of soil and indoor/outdoor dust + 1.0 x 10^{-5} from ingestion of garden produce).

For all 5 neighbourhoods: Inhalation risk for arsenic unacceptable (ILCR > 2 x 10^{-5} to 7 x 10^{-5}).

Residential Carcinogenic risk (95th %tile – combined ingestion and inhalation)

For combined residential Trail site wide: Combined ingestion and inhalation risk unacceptable (1 x 10^{-4}).

Agricultural and Commercial Scenarios

Agricultural and Commercial Non-carcinogenic Hazard – ingestion and inhalation

For Trail site wide: Hazard acceptable (HI < 1.0) for antimony and cadmium ingestion - soil, indoor/outdoor dust commercial and agricultural scenarios. Agricultural scenario included above ingestion scenario (soil/dust) and antimony inhaled particulate.

Agricultural and Commercial Carcinogenic risk (95th percentile estimates – inhalation)

For Trail site wide: Risk unacceptable (ILCR > 10^{-5} but < 10^{-4}).

Inhalation risks for 3 neighbourhoods (East trail, Waneta and West trail) with ambient air monitoring stations: Risks unacceptable.

Fish Consumption

Non-carcinogenic Hazard (95th percentile HQ – fish consumption)

For Trail area consumers of native fish: Hazard unacceptable (HI > 1.0 for mercury in walleye and rainbow trout).[1]

Carcinogenic risk – fish consumption

Central tendency estimate (average) for fish consumption: Risk acceptable (CTE of ILCR > 10^{-5} arsenic). Report presents RME unacceptable risk estimates (95^{th} percentile) for arsenic related Walleye, Mountain White and Rainbow Trout fish consumption (range of ILCR = 2×10^{-5} for Mountain Whitefish to 7×10^{-5} for rainbow trout.[2]

Recreational Off-road Vehicular Use

Non-carcinogenic hazard and carcinogenic risk

Trial recreational off-road vehicular use: Hazard acceptable (HI < 1.0). As no carcinogenic PCOCs were screened in for the ATV/dirt bike area, carcinogenic risk associated with Trail recreational off-road vehicular use is also deemed to be acceptable.

Phase 4 Report Recommendations

The report makes a number of recommendations related to further interpretation of the Phase 4 HHRA findings. Notable among these recommendations are those associated with use of bio-monitoring studies for arsenic, cadmium and thallium.

Provided the Medical Health Officer for Trail supports the use of such bio-monitoring studies in interpreting the Phase 4 HHRA results, the ministry has no objection to ancillary bio-metric based studies being used in the further interpretation of human health risks in Trail.

The report also provides some novel approaches related to possible remediation of "hot spot" areas in Trail (e.g. the calculation of median, mean 5^{th} (i.e. 95^{th} percentile

[1] Note I have discounted the HQ > 1.0 reported for chromium as being based on a single unrepresentative sample.

[2] Note: As these RME estimates are based on "*applying the full consumption rate to each species of fish of local, freshwater fish evaluated*." This is equivalent to assuming an individual's entire fish consumption is for fish obtained solely from the Trail watershed and that an individual's entire fish consumption is solely restricted to only mountain whitefish or rainbow trout. These conditions are overly conservative in my opinion, and therefore I have discounted the RME estimates in favour of the CTE estimate as being more representative of actual Trail fish consumption risk.

In the case of thallium, the report indicates that the results of a bio-monitoring study performed in 2002 by the Trail Health and Environment Committee on 50 adult Trail residents would tend to support the Phase 4 finding that thallium exposures in Trail are only slightly above acceptable hazard levels for non-cancer health effects. The report suggests that this data be considered in interpreting the phase 4 thallium results. The report also recommends conducting a Trail bio-monitoring study for arsenic to similarly assist in the interpretation of the Phase 4 results for arsenic.

risk) and 1st (i.e. 99th percentile risk) percentile "preliminary remediation goals" for all Trail PCOCs based on HI = 1.0 and incremental ILCR of 10^{-6} through 10^{-4}. These ideas are certainly interesting and represent at least one possible strategy to guide remedial efforts at the site. However, as these concepts more properly relate to possible future risk management considerations for Trail, discussion of the relative merit of these ideas lies outside of risk assessment *per se*, and I will not offer comment in this review.

Specific comments

Section 2 Problem Formulation
2.2.2 Data Adequacy
Page 2-3

Integral notes that while the availability of data is sufficient to support a site wide risk assessment, for some media small sample size for certain neighbourhoods introduce greater uncertainty in risk estimates calculated for those neighbourhoods.

This is an important caveat and is pertinent to the overall conclusions of the phase 4 risk assessment.

2.3 Phase 4 Contaminant data and screening process
Page 2-4

The following thallium soil standards and criteria were used for contaminant screening purposes: Agricultural – 2 ug/g (CSR Sch 4 soil standard),
Residential – 1 ppm (1999 CCME soil criterion),
Commercial – no standard or criterion.

The 1999 CCME thallium criteria list a soil criterion of 1 ppm for commercial landuse. If this commercial criterion had been used for screening purposes, presumably the maximum value of 3.6 mg/kg seen for East Trail would have resulted in thallium being screened in as a PCOC for commercial properties in Table 2-3.

Integral should provide a rationale for not using the CCME commercial landuse criterion for thallium PCOC screening in Trail.

Also note that the CSR commercial soil standard for zinc is erroneously listed as 40,000 mg/kg in Table 2-3.

The correct value of the standard is **30,000** mg/kg.

2.3.1 Soil Data
Pages 2-5 through 2-10 and Appendix A1

The bulk of the soil data available from previous phases of Trail HHRA was obtained using the TLP (Trail Lead Program) as opposed to the SALM (Strong Acid Leachable Metals in soil) analytical method. In phase 4, matched soil samples were analyzed by

both the TLP and the SALM methods. In section 2.3.1. Integral goes to some length to statistically analyze the 2 method's datasets to determine the extent of comparability of soil data from prior phases with that collected in Phase 4.

The analysis examined the degree of comparable frequency of detection and agreement between measures of central tendency and range between the data provided for the matched soil samples analyzed by TLP and SALM methods both on a Trail site wide and neighbourhood specific basis. In regard to the conclusions reached, I would agree that generally the two methods show a comparable frequency of detection (i.e. equivalent analytical detectability) for the majority of metals assayed. In addition, the conclusion of comparable statistical equivalence of results for the two methods, site wide for: Be, Cd, Pb and Tl is well supported. However, site-wide comparable results for As, Ba, Cr, Cu, Ni, Se, Sb, Sn, Va and Zn are considerably less convincing.

The issue is even more complicated and unclear for the extent of comparability between the two methods' results for the broad suite of metals other than Be and Cd, when comparing the various Trail neighbourhoods. Complicating factors include differences in metal detection limits between the two methods and apparent temporal variation in results within a method (e.g. June versus August 2006 SALM results).

Integral's arguments to support a conclusion of acceptable data comparability between TLP and SALM method results for: As, Ba, Cr, Cu, Va and Zn (including steps taken to ensure correction of slight underestimation by TLP versus SALM for Cr, Cu and Zn) are persuasive and the ministry would agree that combining previous TLP and SALM data for those elements for subsequent risk assessment seems warranted.

Integral acknowledges that the two methods return disparate results for: Ag, Co, Ni, Se, Sb and Sn in regards to frequency of detection and measures of correlation related to central tendency. However, Integral also notes that for Ag, Co, Ni, Se and Sn the metals exhibit sufficient similarity in respect to metal specific average and range of results by either method to justify a conclusion of essential comparability. The ministry would agree with this conclusion and supports for the above mentioned metals, the pooling of previous TLP and more recent SALM data for the purposes of risk estimation in Phase 4.

The notable exception in regard to TLP and SALM comparability is antimony where TLP would seem to significantly and consistently underestimate SALM determined soil concentration. Previous risk assessment phases performed for Trail, have shown good correlation between As and Sb soil concentrations, In Phase 4, integral has attempted to exploit this association for contaminant screening purposes by using arsenic concentrations to predict corresponding antimony concentration through the use of a regression based formula. Unfortunately, the corresponding correlation coefficient (i.e. $r^2 = 0.684$) does not provide a high degree confidence for the true predictive capacity of the As:Sb association.

As previously communicated in the review of the Phase 4 workplan, the ministry would not normally support the use of such a correlative approach to predict antimony concentration based on measured arsenic concentration in soil. Nor would the ministry normally endorse screening out antimony as a PCOC based on predicted as

opposed to analytically measured antimony soil concentrations. Rather, when faced with difficulties related to the interpretation of results based on analytical methods other than the officially recognized SALM method, the ministry would typically simply require re-sampling and re-analyses of the soil at a site using the SALM methodology.

However, in view of the extensive site characterization completed to date at Trail using the TLP method, and considering the expense associated with duplicating that extent of characterization using the SALM method, it would be patently unreasonable for the ministry to require re-sampling and re-analyses based solely on an inability to demonstrate a definitive, as opposed to an indicative, statistical correlation for antimony between the TLP and SALM methods' analytical results.

The ministry's decision to allow use of arsenic predicted antimony soil concentrations in the Trail Phase 4 risk assessment was also positively influenced by the findings of the quantitative sensitivity analyses performed to test the effect of the use of the arsenic regression data in estimating corresponding antimony concentrations described in sub-section 5.4.2 of the Phase 4 report. In that sensitivity analysis, it was found that re-running the probabilistic model using only SALM antimony data returned risk estimates only marginally different from those obtained using arsenic predicted antimony data.

In regard to the ministry not endorsing the use of arsenic predicted antimony concentrations to screen antimony as a PCOC in soil at Trail, the ministry acknowledges that the objection is effectively rendered moot, since the use of the arsenic:antimony predictive approach in the Phase 4 risk assessment resulted in antimony being screened-in, as opposed to being screened-out, as a PCOC for subsequent risk characterization.

Page 2-8
3rd paragraph 1st sentence

"For screening ... including newly predicted antimony and zinc concentrations for prior phases."

It would be useful if Integral would add a footnote flagging the discussion related to the cadmium predicted zinc soil concentrations in section 2.3.4 page 2-11 to this sentence. Without such a link, the reader may be left wondering why the sentence refers to "predicted antimony and zinc concentrations" when all previous discussion in the section had been solely concerned with the arsenic:antimony prediction.

Page 2-9 : Table 2-2
Neighbourhood specific soil standard exceedances

Note to consultant

For Phase 4, fluoride was excluded as a PCOC based on Phase 3 background soil fluoride concentrations in the Trail area. On page 2-9 it is also correctly noted that selenium was present in excess of soil standards in residential areas, (i.e. according

to Table 2-2 both site wide and in the neighbourhoods of East Trail, Riverdale and Tadanac).

However, it is also interesting to note that the maximal values found in Riverdale (3.14 mg/kg) and Tadanac (3.05 mg/kg) do not actually exceed the Kootenay regional background soil quality estimate for selenium of 4 ug/g provided in CSR Protocol 4 Determining Background Soil Quality. Based on the regional background estimate, it could be argued that a neighbourhood maximal soil value for selenium in soil less than 4 mg/kg should not result in the element being retained as a PCOC.

Section 2.3.4 Soil, Outdoor Dust and Indoor Dust PCOCs
Page 2-11

Integral has taken the conservative position of retaining zinc as a PCOC in soil for the Phase 4 HHRA, despite the fact that both site wide and for the 5 neighbourhoods in which zinc was assayed, maximal values did not exceed the agricultural, residential or commercial soil standards.

In addition, the ministry also notes that a considerably better correlation (i.e. r^2 = 0.8884) exists between cadmium and zinc than that seen between arsenic and antimony. Consequently, the ministry has no difficulty in accepting Integral's use of cadmium predicted zinc concentrations in soil for the purposes of Phase 4 risk characterization.

Section 2.3.9 Groundwater Chemistry Data
Page 2-17

Note to consultant

Some of the BC guidelines/standards for drinking water provided in table 2-12, have changed since completion of the phase 4 risk assessment. For example, the CSR Schedule 6 drinking water standard for arsenic has changed from 25 ug/L (0.025 mg/L) to 10 ug/L (0.010 mg/L). The current BC Water Quality guideline for beryllium is now 4 ug/L (0.004 mg/L) versus the Table 2-12 cited value of 5 mg/L (5000 ug/L) and the drinking water guideline for nickel of 0.25 mg/l (250 ug/L) has been repealed. Additionally, note that CSR Schedule 6 provides a molybdenum drinking water standard of 250 ug/L (0.25 mg/L) rather than the notation of N/A in Table 2-12.

However, none of these changes would affect the groundwater screening results which concluded that all table 2-12 metals were in compliance with regulatory guidelines/standards and that therefore no PCOCs for groundwater (i.e. drinking water) need be retained for phase 4 risk characterizations in Trail.

Section 2.3.10 Surface Water Chemistry Data
Page 2-18

Table 2-13 provides surface water sampling results, for use in screening recreational waters for inorganic substances. As noted above for groundwater data, the current CSR Schedule 6 drinking water standard for arsenic is 10 ug/L not 25 ug/L and the current BC Water Quality Guideline for beryllium in raw drinking water is 4 ug/L not

4000 ug/L as stated in Table 2-13. However, again these recent changes would not change the conclusion that the surface water (recreational water) exposure pathway in Trail can be entirely screened out based on compliance with UN WHO recommended surrogate recreational water guidelines (i.e. 10x drinking water standard/guideline values) for the metals considered in table 2-13.

Section 3.1.1 Derivation of PCOC Concentration distributions
Page 3-3

Tables 3-1 through 3-6 provide summary statistics for the data sets related to: air, fish, indoor dust, outdoor dust, soil and produce. To ensure complete records, the ministry usually requires all original data compiled for use in risk assessment to be submitted as a component of a risk assessment report. For the purposes of this review, the original data related to the above section was requested from Integral.

This data was provided in electronic format (CD) from Ms. Dina Johnson of Integral on Feb. 20, 2009. This data CD entitled "Trail Phase 4 HHRA Data, Modeling and Risk Files" should be included as Appendix F., in any revised Phase 4 report or addendum to the existing Phase 4 report that Integral may submit in the future to address the various issues detailed in this review.

Section 3.1.2.1 Probabilistic Assessment
Page 3-4

Footnote 34 on page 3-4 indicates the exposure duration assigned to the adult in a mixed child-adult duration to be "... 4.5 years for the child and 12.6, 4.5, or 8.1 years for the adult."

More correctly, the footnote should read "... 4.5 years for the child and (**12.6 – 4.5**), or 8.1 years for the adult".

3.4.4 Exposure Time
Page 3-17

In exhibit 3-3, a point estimate of 8 hrs/day was used for Exposure Time (adult). No rationale or source is given on page 3-17 for this particular point estimate. As the modelled agricultural exposure relates to an agricultural worker, why was not the same Exposure Time (adult) assumed under commercial exposure (i.e. 10 hrs/day) used?
3.7.2 Exposure Frequency
Page 3-24

Note to consultant

The ministry is prepared to accept the ATV/dirt bike CTE and RME exposure frequency estimates (30 days/yr and 80 days/yr, respectively) but notes that these estimates appear to be largely anecdotal in origin. It would be useful, should the opportunity arise in the future, to confirm the relative accuracy of these estimates through public survey of Trail residents.

3.8.3 Exposure Times
Page 3-26

Note to consultant

The ministry is prepared to accept the ATV/dirt bike CTE and RME exposure time estimates (2 hrs/day and 4 hrs/day, respectively) but notes that these estimates appear to be largely anecdotal in origin. It would be useful, should the opportunity arise in the future, to confirm the relative accuracy of these estimates through public survey of Trail residents.

Section 4 Toxicity Assessment
4.1 Toxicity values
Table 4-1

Please note that the US EPA RfD values for cadmium in food and water have been transposed in Table 4-1.

The correct RfD values are:

1×10^{-3} (**food**) and
5×10^{-4} (**water**)

Section 4.2 Antimony Toxicity Summary
4.2.2.3 Toxicity Values for Non-cancer Effects – Oral
Page 4-7

The reference attributed to Health Canada 2004b, relating to the derivation of the oral TDI of 2×10^{-4} for antimony in the second paragraph of page 4-7 (and as cited in Table 4-1) is incorrect.

Original details related to the derivation of Health Canada's TDI for antimony can be found on page 7 in, Health Canada. !997. Guidelines for Canadian Drinking Water Quality: Supporting Documentation – Antimony, available at: http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/water-eau/antimony-antimoine/antimony-antimoine-eng.pdf

Section 4.3 Arsenic Toxicity Summary
4.3.2.4 Toxicity Values for Non-cancer Effects – Inhalation
Page 4-13

Note to consultant

While Integral is correct in noting that neither Health Canada nor US EPA have established inhalation toxicity reference values (i.e., TC or RfC, respectively) for arsenic, we note that in 2000, RIVM (Netherlands - National Institute of Public Health and the Environment) established a TCA (i.e., Tolerable Concentration in Air) for arsenic of 1×10^{-3} mg/m^3 see http://www.rivm.nl/bibliotheek/rapporten/711701025.pdf

The inhalation pathway for arsenic in air was screened out for the Phase 4 risk assessment, however for future reference, had this exposure pathway for arsenic been operable, in the absence of either US EPA or Health Canada inhalation toxicity reference values, use of the RIVM TCA would be acceptable.

Section 4.4 Cadmium Toxicity Summary
4.4.2.4 Toxicity Values for Non-cancer Effects – Inhalation
Page 4-24

Note to consultant

Integral is correct in noting that neither Health Canada nor US EPA have established inhalation toxicity reference values (i.e., TC or RfC, respectively) for cadmium. However, we note that recently, (i.e., Sept. 2008) ATSDR released a draft toxicological profile for cadmium which includes a chronic inhalation minimal risk level (MRL) of 0.01 ug Cd/m^3, see http://www.atsdr.cdc.gov/toxprofiles/tp5.html

While unlikely to significantly alter the conclusions related to the risk/hazard posed by cadmium in air at Trail as determined in the Phase 4 risk assessment, the ministry notes that this new ATSDR inhalation MRL could be used in the future to calculate non-carcinogenic related hazard associated with exposure to cadmium via the inhalation route of exposure.

Section 4.9 Thallium Toxicity Summary
4.9.3.1 Oral Toxicity Values for Cancer Effects
Page 4-34

The sentence comprising this sub-section contains an incorrect reference to selenium. Sentence should read: “No oral slope factors, tumorigenic concentrations, or unit risks have been established for ***thallium*** by Health Canada (2004b) or USEPA (2007b).”

Section 4.10 Tin Toxicity Summary
4.10.2.1 Oral Toxicity Values for Non-cancer Health Effects
Page 4-35

Note to consultant

The ministry accepts Integral’s decision to use of the more conservative 1997 US EPA oral RfD for tributyltin oxide as opposed to the 2005 ATSDR intermediate-duration MRL for inorganic tin (i.e., stannous chloride).

However, the ministry also notes that a legitimate argument might be presented to support the use of the less conservative, but more chemically appropriate ATSDR MRL for tin, in risk assessment.

Section 4.10 Tin Toxicity Summary
4.10.2.1 Oral Toxicity Values for Non-cancer Health Effects
Page 4-35

The 1997 US EPA oral RfD cited for tributyltin oxide in the 2nd sentence of this sub-section is incorrect.

Sentence should read: "As a surrogate, we conservatively used EPA's oral RfD of ***3 x 10^{-4}*** mg/k-day for tributyltin oxide." See : http://www.epa.gov/iris/subst/0349.htm

We note that the above mentioned correct RfD value is provided for tin in Table 4-1.

Section 5 Risk Characterization
5.1 Non-cancer Risks
Page 5-1

Note to consultant

In the 2nd paragraph of sub-section 5.1 Integral states "If the calculated value of the hazard quotient is greater than 1.0, then further risk evaluation is needed." This statement is correct from a risk assessment/risk evaluation point of view.

However, from the regulatory perspective of the Contaminated Sites Regulation, a hazard quotient greater than 1.0 implies the need for remediation at the site, not simply a need for further evaluation.

CSR (17) (30 Despite subsections (1) and (2), a director must consider a contaminated site to have been satisfactorily remediated without review and recommendation by the local medical health officer if
(a) for each non-threshold carcinogenic substance, the calculated human lifetime cancer risk due to exposure to that substance at the site is less than or equal to one in 100,000, and
(b) for each substance for which a hazard index is calculated, the hazard index due to exposure of a human to that substance at the site is less than or equal to one.

Section 5 Risk Characterization
5.1.1.1 Non-cancer Risks for Residential Scenarios
Page 5-3

Relative to hazard indices reported in table 5-2, there would appear to be a reporting error in the 2nd sentence of the 2nd paragraph of this sub-section. A HI value of 0.787 is reported for soil/dust + produce for arsenic (adult plus child). However the corresponding HI value provided in Table 5-2 for arsenic (adult plus child) is 0.671.

Integral is requested to clarify which HI is in fact correct.

Section 5 Risk Characterization
5.1.1.1 Non-cancer Risks for residential Scenarios
Page 5-3

Note to consultant

In the last paragraph of the sub-section Integral notes "Additionally, 95th percentile arsenic hazard indices equal or exceed 1.0 for the adult plus child receptor for East Trail and Tadanac." Presumably this conclusion relating to East Trail adult plus child arsenic, results from considering the 95th percentile hazard index of 0.994 reported in Table 5-5 as being equivalent to 1.0

The ministry notes that if the above rationale is correct then to be consistent in interpretation, the hazard index of 0.959 reported in Table 5-5 for site wide thallium for the child receptor should also be considered to equal 1.0

Such a consistent interpretation would result in the 2nd sentence of the last paragraph on page 5-3 being re-worded to read "Child 95th percentile non-cancer risks ***equal or exceed 1.0 for thallium in East Trail, Riverdale, Tadanac, West Trail and Site Wide.***

Section 5.2 Cancer Risks
Page 5-5

There would appear to be a typographical error in the 1st sentence of the 1st paragraph of this section. The sentence appears to erroneously make reference to "off-site" exposure scenarios rather than "on-site" exposure scenarios.

Sentence should read "The cancer risk estimates derived ... resulting from the specific ***on-site*** exposure scenarios that are evaluated".

Section 5.2 Cancer Risks
Page 5-5

Note to consultant

Integral should be cautious in relation to the discussion of a possible 1 in 10,000 alternate acceptable risk level for Trail. While such an alternate acceptable risk level may eventually be approved for regulatory use in Trail, such an approval would require the prior completion of the process detailed under section 18 of the CSR. For the purposes of the Phase 4 risk assessment, consideration of alternate acceptable risk levels for use at the Trail site remain speculative at best.

Section 5.2 Cancer Risks
5.2.1.1. Cancer Risks for Residential Scenarios – Site Wide
Page 5-7

Note to consultant

In regard to Trail site wide risks, the 3rd paragraph on page 5-7 notes that if the maximum 95th percentile inhalation risk seen in air for Birchbank is added to the total site wide ingestion risks (soil, indoor/outdoor dust and produce) the combined risks equal 1×10^{-4}.

While this worst case maximum site wide risk estimate clearly exceeds the default regulatory acceptable risk standard, it is also noteworthy that the total risk estimates (i.e., for air, soil, dust and produce) at Waneta and West Trail (5×10^{-5} and 8×10^{-5}, respectively) also exceed the default acceptable risk standard.

Section 5.2 Cancer Risks
5.2.1.1. Cancer Risks for Residential Scenarios – Neighbourhoods Assessed in Phase 3
Page 5-7

Note to consultant

Reference is made to "BCMoE's target risk" in the 1st sentence of the 5th paragraph on page 5-7.

The ministry does not have a "target" risk level. The ministry does have a default acceptable (carcinogenic) risk standard of $\leq 1 \times 10^{-5}$.

Section 5.2 Cancer Risks
5.2.1.1. Cancer Risks for Residential Scenarios – Neighbourhoods Assessed in Phase 3
Page 5-7

For the sake of reporting clarity, the penultimate and last sentences of paragraph 7 on page 5-7 should be re-worded to read "The highest total risk ***(1×10^{-4})*** was found in East Trail, where air contributed ... of the total risk (Table 5-15 and Appendix B). This maximum risk ***exceeded the default acceptable risk standard (1×10^{-5}) and equalled, but did not exceed. a risk level of 1×10^{-4}.***

Section 5.2 Cancer Risks
5.2.1.1. Cancer Risks for Residential Scenarios – Neighbourhoods Assessed in Phase 3
Page 5-7

The last sentence on page 5-7 of this sub-section should be re-worded to read "Combining the highest inhalation risk estimated for these stations (i.e., ***7×10^{-5}*** for Butler Park, Table 5-11) with the highest total non-air risk estimated at Tadanac (i.e., ***6×10^{-5}***, Table 5-14) results in a total combined risk of ***1.3×10^{-4}***, which ***would be expected to closely approximate*** the highest site wide risk that includes air exposures."

Section 5.2 Cancer Risks
5.2.1.3. Cancer Risks for Agricultural Scenarios
Page 5-8

Note to consultant

Reference is made to "BCMoE's target risk" in the 1st sentence of this sub-section. The ministry does not have a "target" risk level. The ministry does have a default acceptable (carcinogenic) risk standard of $\leq 1x\ 10^{-5}$.

Section 5.2 Cancer Risks
5.2.3. Comparison with Phase 3 Results
Figure 5-5

Note to consultant

The scale of the x-axis (risk estimate), in Figure 5-5 seems needlessly extended. As a result, the figure rather poorly exhibits the relative change in total risks calculated for the two phases.

Section 5.2 Cancer Risks
5.2.4. Consideration of Background Exposures
Page 5-9 through 5-11

The background comparisons provided in this section seem not very helpful in placing Trail smelter related arsenic and cadmium risks in context with non-smelter related Trail background risks.

Comparing total arsenic risk related to Trail smelter emission sources (i.e., air, soil/dust, and produce) to a total arsenic Trail background risk calculated for non-smelter emission sources (i.e., air, soil, drinking water, food and cigarettes) and concluding the two risks are similar seems more an exercise in obfuscation than lucidity.

More representative comparisons, if one's goal is to communicate the extent of incremental risk over background related to arsenic smelter related risks, would be to simply compare the smelter source versus background risks for the same media/source. For example the data in Appendix B for arsenic risk associated with air in Trail versus that believed representative of Trail background (i.e. non smelter impacted) air shows the following:

For 95th percentile air (inhalation) risks – arsenic and cadmium

	East Trail risk	Trail background risk	Comparison
As	5E-05	3E-06	risk 16.6x background
Cd	1E-05	1E-06	risk 10x background

	Waneta risk	Trail background risk	Comparison
As	3E-05	3E-06	risk 10x background
Cd	9E-06	1E-06	risk 9x background
	West Trail risk	**Trail background risk**	**Comparison**
As	3E-05	3E-06	risk 10x background
Cd	1E-05	1E-06	risk 10x background

For 95th percentile soil (ingestion) risks – arsenic

	East Trail risk	Trail background risk	Comparison
As	3E-05	3E-06	risk 10x background
	Waneta risks	**Trail background risk**	**Comparison**
As	1E-05	3E-06	risk 3.3x background
	West Trail risks	**Trail background risk**	**Comparison**
As	3E-05	3E-06	risk 10x background

If total site-related arsenic cancer risk (8E-05) must be compared to total background risk from arsenic (8E-05) then the last paragraph of sub-section 5.2.4.2 on page 5-10 should be re-worded along the lines of

Estimated 95th percentile background risk from **non-smelter related** arsenic exposure is 8 in 100,000, with the majority of **that** risk coming from exposure to arsenic in food. **Smelter**-related ***arsenic*** cancer risks ***range from 5 in 100,000 to 10 in 100,000 which when added to background arsenic risk in Trail would represent a total level of risk 1.6 to 2.25 times that attributable to background alone.***

Additionally, a conclusion related to incremental risk over background of smelter-related cadmium in air risks should be added to page 5-10 to close sub-section 5.2.4.2

Section 5.5 Conclusions
Page 5-15

Note to consultant

Integral is again cautioned about making reference to possible alternate acceptable risk levels for use in Trail. The ministry's preference would be to simply state conclusions based on the CSR default acceptable risk level of 1×10^{-5}. If the issue of

a possible alternate acceptable risk level for use in Trail must be included in the conclusions section of the report, the ministry suggest that such discussion might best be accomplished through the use of footnotes.

Comments Related to Regulatory Process

1. Need for report author attribution

Risk assessments submitted for CSR regulatory purposes take the meaning of a professional statement under section 63 of the regulation.

Professional statements

CSR (63) A director need not consider an application for
(a) an approval in principle,
(b) a certificate of compliance, or
(c) Repealed. [B.C. Regs. 322/2004 and 324/2004, s. 65.]
(d) an approval of a preliminary or detailed site investigation
until the applicant or the applicant's agent provides a written signed statement that
(e) any documentation in support of an application referred to in paragraphs (a) to (d) has been prepared in accordance with all requirements in the Act and the regulations, and
(f) certifies that the person signing the statement has demonstrable experience in remediation of the type of contamination at the site for which the statement applies and is familiar with the remediation carried out on the site.

To satisfy CSR 63 (e) and (f), risk assessment reports must be formally “signed-off” by the person with demonstrable experience, (i.e., typically the risk assessment professional who prepared the report).

Since it is likely that the Phase 4 HHRA will at least form a component of supporting documentation related to a Certificate of Compliance which may eventually be issued for the Trail site, it would be desirable that professional attribution be included in any revised Phase 4 report or addendum to the existing Phase 4 report, that Integral may submit in the future to address the various issues detailed in this review.

Typically risk assessments are signed-off either on the title page or on a separate signature page of the report. To assist Integral in regard to professional statement formatting, I have attached below, as examples, a copy of a signed title page and a signature page from other risk assessment reports recently submitted to the ministry.

2. Need for Summary of Site Condition report

Effective January 1, 2009 contaminated sites service requests for sites using the Contaminated Site Approved Professional (CSAP) process must include a completed Summary of Site Condition form, available at
http://www.env.gov.bc.ca/epd/remediation/forms/word/summary-site-condition.doc

While the Phase 4 HHRA has not been submitted under the CSAP process, and therefore a Summary of Site Condition is not required for the Trail site. Integral may still wish to consider the possible benefit of completing a Summary of Site Condition for Trail. Completion of the form would provide summary information for the Trail site in a ministry standardized format and would facilitate record keeping for the Trail site in the Site registry.

END

professional attribution title...

Professional attribution signa...

Attachment 2

Data, Modeling and Risk Files for the HHRA (on CD)

Attachment 3

Replacement Page for Figure 5-5 of the HHRA

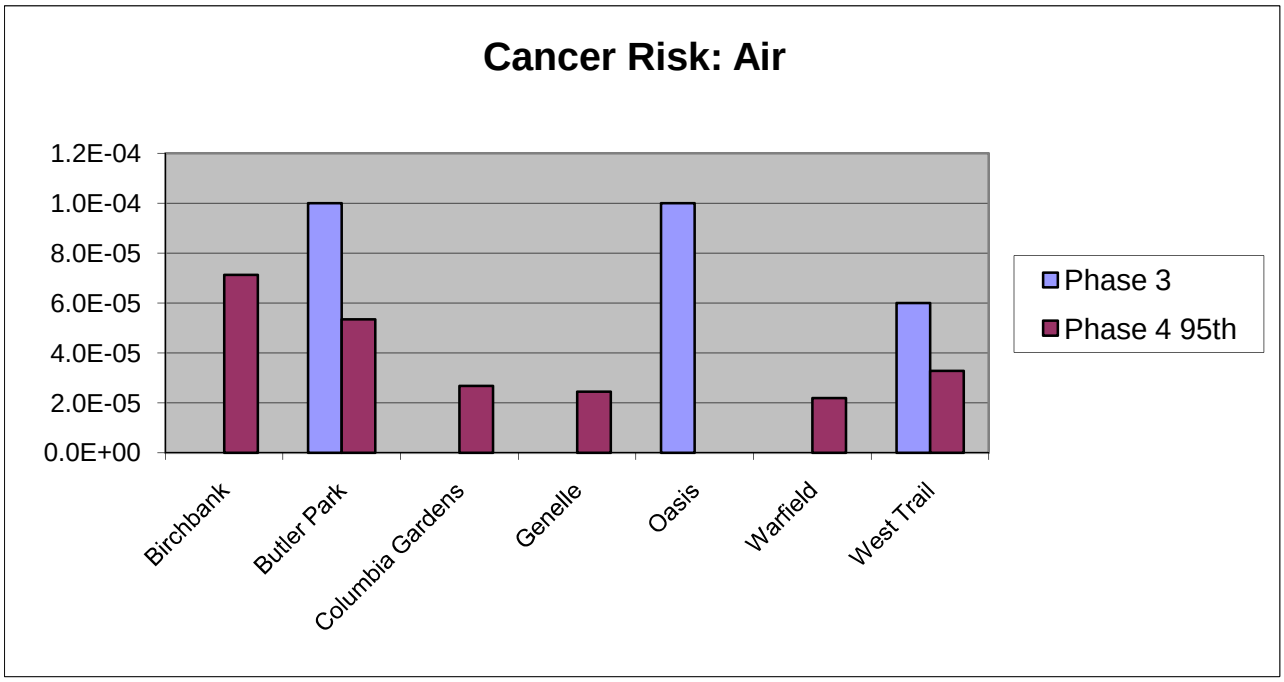


Figure 5-4. Comparison of Inhalation Cancer Risk Estimates between Phase 3 and Phase 4

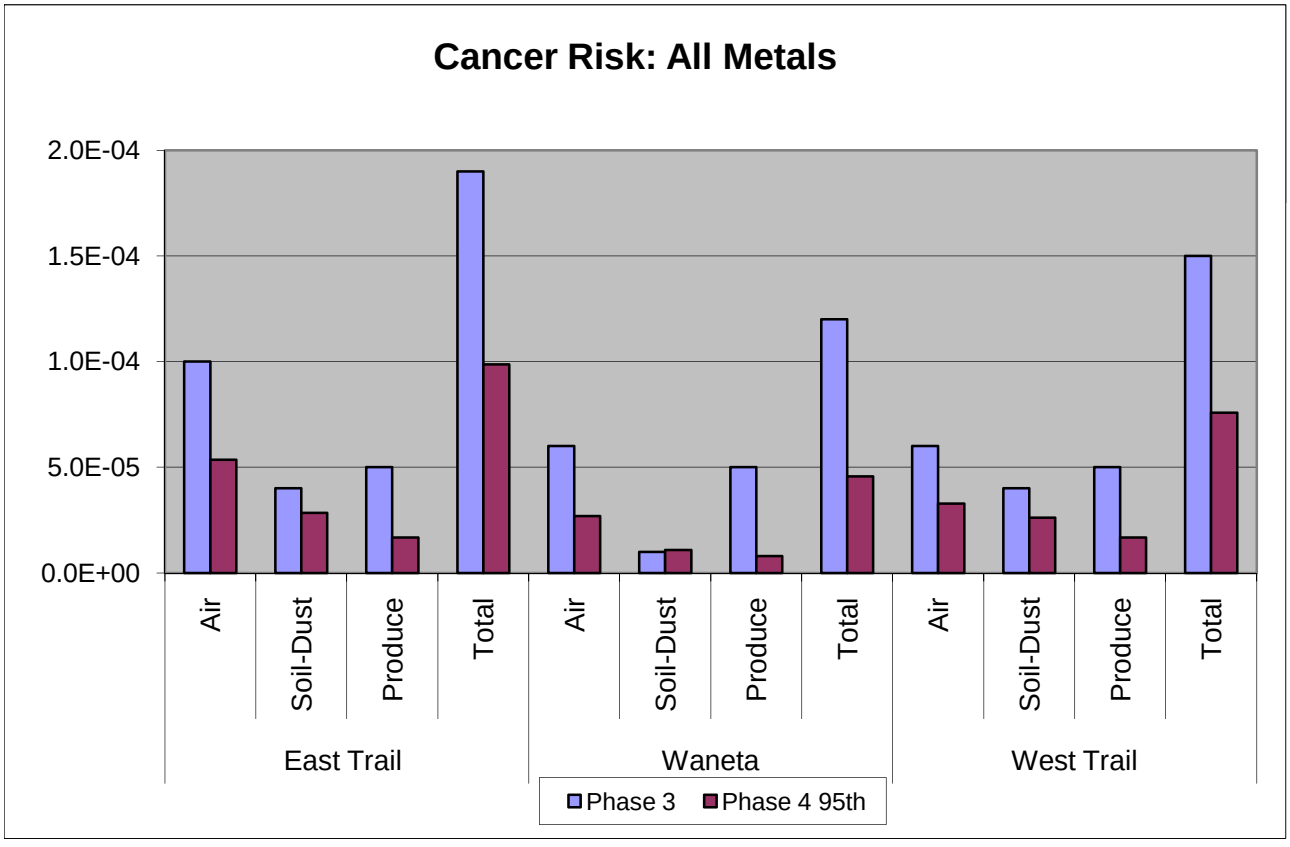
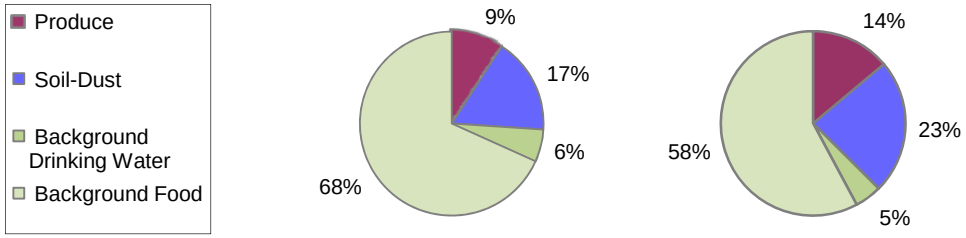


Figure 5-5. Comparison of Total Cancer Risk Estimates between Phase 3 and Phase 4

Attachment 4

Replacement Pages for Background Risk Comparisons in Appendix B to the HHRA

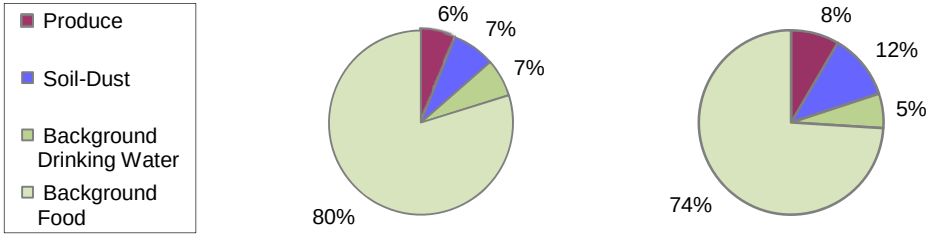
Cancer Risk: East Trail (Butler Park) versus Background



	Mean East Trail	95th East Trail	Mean Background	95th Background
Ingestion Risks: Arsenic				
Produce	4E-06	2E-05	--	--
Soil-Dust	8E-06	3E-05	1E-06	5E-06
Background Drinking Water	3E-06	6E-06	3E-06	6E-06
Background Food	3E-05	7E-05	3E-05	7E-05
Total Ingestion	5E-05	1E-04	3E-05	8E-05
Inhalation Risks: Arsenic and Cadmium				
Air - Arsenic	1E-05	5E-05	1E-06	3E-06
Air - Cadmium	4E-06	1E-05	5E-07	1E-06

Note: Background cadmium risks assume non-smokers and would be higher for smokers.

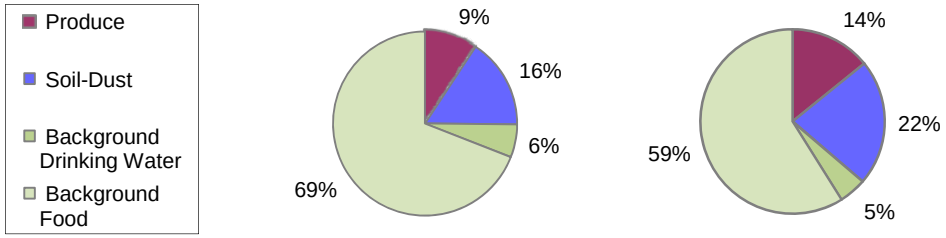
Cancer Risk: Waneta (Columbia Gardens) versus Background



	Mean Waneta	95th Waneta	Mean Background	95th Background
Ingestion Risks: Arsenic				
Produce	2E-06	8E-06	--	--
Soil-Dust	3E-06	1E-05	1E-06	5E-06
Background Drinking Water	3E-06	6E-06	3E-06	6E-06
Background Food	3E-05	7E-05	3E-05	7E-05
Total Ingestion	4E-05	9E-05	3E-05	8E-05
Inhalation Risks: Arsenic and Cadmium				
Air - Arsenic	7E-06	3E-05	1E-06	3E-06
Air - Cadmium	2E-06	9E-06	5E-07	1E-06

Note: Background cadmium risks assume non-smokers and would be higher for smokers.

Cancer Risk: West Trail (West Trail) versus Background



	Mean West Trail	95th West Trail	Mean Background	95th Background
Ingestion Risks: Arsenic				
Produce	4E-06	2E-05	--	--
Soil-Dust	7E-06	3E-05	1E-06	5E-06
Background Drinking Water	3E-06	6E-06	3E-06	6E-06
Background Food	3E-05	7E-05	3E-05	7E-05
Total Ingestion	4E-05	1E-04	3E-05	8E-05
Inhalation Risks: Arsenic and Cadmium				
Air - Arsenic	9E-06	3E-05	1E-06	3E-06
Air - Cadmium	3E-06	1E-05	5E-07	1E-06

Note: Background cadmium risks assume non-smokers and would be higher for smokers.