Exponent™

Human Health Risk Assessment for Trail, British Columbia

Phase 3: Revised Screening-Level Deterministic Risk Calculation

Prepared for

Trail Lead Program
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Executive Summary

This Phase 3 assessment provides a risk evaluation for exposures to antimony, arsenic, and cadmium in Trail, British Columbia. This evaluation focused on risks associated with exposures in the Trail neighbourhoods where soil data indicated that metals concentrations exceed regulatory screening criteria. These neighbourhoods were selected on the basis of Phase 1 risk assessment efforts for Trail, and of analyses conducted during the Phase 2 effort.

The risk assessment presented in this document follows the conventional four-step risk assessment methodology recommended by regulatory agencies: data evaluation (and identification of chemicals of potential concern), exposure assessment, toxicity assessment, and combining information from the exposure assessment and toxicity assessment to characterize potential risks. Both an assessment of potential carcinogenic risks and a characterization of potential risks from exposure to noncarcinogenic compounds are included in this assessment, using standard toxicity values recommended by the British Columbia Ministry of the Environment (BCE) or the U.S. Environmental Protection Agency (U.S. EPA). Along with the standard characterization of risk, an additional evaluation of cadmium is provided, wherein exposures are estimated based on an absorbed dose (rather than on the more conventional administered dose). This approach was used to allow for a more rigorous evaluation of cadmium, as well as to assess integrated ingestion and inhalation exposures to this metal.

Data Evaluation

The goal of the Phase 3 assessment was to update the Phase 2 assessment with new data. The new data available for Phase 3 of the assessment process included more recent air concentration data from Trail; air concentration data from a background location that is believed to not be influenced by operations at the Cominco facility; data on indoor dust concentrations of arsenic, cadmium, and antimony from 57 properties; and data on the concentrations of arsenic and cadmium in produce from home gardens and retail outlets in the area. This analysis incorporated all available data of good technical quality that were applicable to the exposure scenarios evaluated. Specifically:

- Soil data collected from the period 1989 to 1997, and available air data from the period subsequent to the initiation of the new smelter at the Cominco facility were included.
- The data on arsenic, cadmium, and antimony concentrations in indoor house dust, collected in August and September of 1998, were combined with the data from 20 properties that were collected in April of 1998. These dust data were used directly to estimate mean

concentrations to use in assessing exposure to indoor dust in the different neighborhoods.

- Because a new smelter was brought on line at the Cominco facility in March 1997, and the old smelter closed down in May 1997, it was determined that the air data collected prior to July 1997 would not be representative of current or future exposures around Trail. To the extent possible, air data from the most recent monitoring dates (July 1998–June 1999) were used in assessing health risks. Older air data (July 1997–July 1998) were used only when needed to fill data gaps (e.g., for antimony). The addition of data from a background monitoring station allowed a determination to be made as to whether Trail-area air is affected by smelter operations. Comparison of mean air concentrations for arsenic and cadmium indicates that the concentrations of these metals in neighbourhoods around Trail are at least 10-fold higher than the corresponding concentrations in the background area.

- Produce concentration data were available from samples collected in August/September 1998, January 1999, and July/August 1999. This data set included samples collected from 13 neighborhoods and 14 local retailers. Data from homegrown produce were separated by crop type (leafy vs. nonleafy), and by location (near the Cominco facility vs. distant from the facility), and all data were used in determining exposure-point concentrations.

Exposure Assessment

Exponent defined the human populations believed to have potential for exposure to metals in Trail soils during the Phase 1 assessment efforts. These were determined to include residential populations in the neighborhoods, workers employed in commercial areas of East or West Trail, and farm workers in the outlying agricultural areas around Trail. These potentially exposed populations were included in the risk evaluation. Potential ingestion of soil, dust, and homegrown produce, and inhalation of airborne particulates, were evaluated.

Exposures to metals from environmental media were calculated using standard exposure and risk assessment approaches. Exposure parameters were selected based on site-specific information, guidance from BCE, guidance from U.S. EPA, or professional judgment. The selection of exposure values focused on generating final estimates of reasonable maximum exposures for each exposure pathway.

Toxicity Assessment

The objective of a toxicity assessment is to identify the adverse health effects that a chemical causes, and how the appearance of these adverse effects depends on dose. Toxicity values (i.e., cancer slope factors, reference doses, and reference concentrations) were obtained mostly from BCE, and an inhalation toxicity criterion for antimony from the U.S. EPA was incorporated. In addition, risk from exposure to cadmium was also assessed using an alternative cadmium toxicity value.

Risk Characterization

Characterizing risk for Trail involved taking all the information regarding exposure to site-related compounds, and combining estimates of exposure with information regarding toxicity, to yield estimates of risk. For non-cancer health effects, risk estimates are expressed as Hazard Indices (HIs). If an HI value is below unity (i.e., HI <1), then it can be reasonably assumed that the exposure will not be associated with toxicity. For cancer, risk estimates are calculated by multiplying the average lifetime daily dose by the cancer slope factor, expressed in $mg/kg\text{-}d^{-1}$. This yields a unitless estimate of risk, which should be interpreted as the probability of increased incidence of cancer in a lifetime.

The risk characterization results are summarized in Tables ES1, ES2, and ES3. Table ES4 summarizes the sources of uncertainty in the calculations. As can be seen in these tables, calculated HI values are uniformly below the value of 1 for all three metals evaluated, under every exposure scenario. This indicates that there is little likelihood of adverse noncancer health effects from exposure to these metals in Trail. In addition, HIs for exposure to cadmium are less than one, even after taking into account anticipated background exposure to cadmium (i.e., HI values based on the absorbed-dose reference dose for cadmium).

Estimated total increased lifetime risk of cancer associated with arsenic and cadmium exposures in the neighbourhoods included in this evaluation range from 1 in 10,000 to 2 in 10,000. This increased risk can be compared to a background lifetime cancer risk of 1 in 3 or 4 (i.e., one in every three or four people will get cancer in their lifetime). Calculated cancer risks are generally highest for inhalation exposures to arsenic; overall however, cancer risks are distributed fairly evenly across the exposure pathways (i.e., there is little difference between risks calculated for inhalation, ingestion of soil and dust, and ingestion of homegrown produce). For the commercial areas of East and West Trail, where there is no associated produce ingestion, total cancer risks are either equally distributed between ingestion of soil and dust and inhalation exposures (West Trail), or higher (3-fold) for inhalation exposures. For field activities by farm families in Waneta, the calculated risk from soil ingestion exceeds the risk from inhalation.

Cancer risk estimates associated with exposure to arsenic are uniformly at least an order of magnitude higher than the cancer risk estimates for cadmium. In commercial areas of East Trail, the risk estimate for arsenic is 8-fold higher than the estimate for exposure to cadmium.

Generally, the calculations in this assessment suggest that all exposure pathways evaluated contribute nearly evenly to total risk.

Conclusions

Although the risk for inhalation exposures in areas other than Waneta is generally higher, cancer risk estimates associated with ingestion of soil, dust, and produce fall within a factor of 2 or 3 of the risk estimates for inhalation. This suggests that all exposure pathways included in this assessment contribute nearly evenly to total risk. In interpreting these calculated risks, however, it is important to keep in mind the uncertainties associated with the input variables, as discussed above and summarized in Table ES4. Based solely on the assumed residence time of 75 years, the estimates of cancer risk exceed the more standard estimates of reasonable maximum exposure by more than a factor of two. Uncertainties associated with other exposure considerations (e.g., soil ingestion rates, inhalation rates, produce concentrations of arsenic and cadmium) suggest that risks areoverestimated, possibly by another factor of two. Additional considerations in interpreting the findings of the risk assessment are described below.

Risk from Ingested Arsenic

There is considerable uncertainty in the cancer slope factor used in assessing risk from oral exposure to arsenic, and there are reasons to suspect that this slope factor may overestimate risk by several orders of magnitude.

Inorganic arsenic is present naturally in soil, food, water, and air. Consequently, all people are exposed naturally to some level of arsenic each day. Adult nonsmokers are thought to have an average absorbed daily dose of almost 9 μg/day. For populations that do not have elevated arsenic concentrations in their drinking water, ingestion of arsenic in food is the primary source of exposure. Air is a negligible contributor to background exposures.

Consequently, it is appropriate to compare estimates of the amount of arsenic ingested in Trail with these background exposures. For the cancer risk estimates, the highest estimated daily intakes of arsenic from soil and dust were for Rivervale, where the chronic daily intake of arsenic from soil and dust ingestion totaled 0.053 μg/kg-day (including the relative bioavailability adjustment for absorption from soil and dust of 55 percent). For a 70-kg person, this yields an intake of 3.7 μg/day. If 80 percent of ingested arsenic is absorbed, this equals an absorbed dose of 3 μg/day, which is approximately one-third of the expected background exposure of almost 9 μg/day. This comparison provides the perspective that, on average, incremental exposures to soil and dust in Trail will increase total arsenic exposures by about 30 percent. Risk from arsenic associated with ingestion of homegrown produce is close to that posed by soil and dust ingestion. Therefore, taken together, soil, dust, and homegrown produce may increase total arsenic exposures to about 60 percent more than background exposures alone.

Additionally, although the analyses of homegrown produce from Trail indicate that arsenic concentrations are higher in these products relative to produce retailed in Trail, this must be interpreted within the context of relative consumption rates. It is estimated that retail produce accounts for 93% of all produce ingested, and only 7% of total produce consumed is homegrown. Therefore, although concentrations of arsenic in the homegrown produce may be as much as an order of magnitude higher than concentrations in the retail produce, the overall exposures to arsenic that occur from consumption of produce are likely to be higher for retail produce than for homegrown produce.

In addition to the point that exposures to arsenic from soil in Trail are less than background exposures, the cancer slope factor for arsenic likely overestimates risk from oral exposure to arsenic. This likely overestimate of risk suggests that, although calculated risks for ingestion exposures to arsenic from soil or produce approach the 10^{-4} range (i.e., the highest calculated cancer risk from soil/dust ingestion was 9×10^{-5}, and calculated cancer risks associated with consumption of produce in neighbourhoods "near" the facility are 4×10^{-5}), actual risks are likely to be much lower.

If, in fact, the current cancer slope factor overestimates the cancer risk associated with the ingestion of arsenic, then allocating resources to limit soil/dust ingestion exposures or the consumption of homegrown produce will be ineffective in changing actual risk (as opposed to addressing inhalation exposures).

Impact of Air Emissions

It appears that inhalation exposures are the result of a single source, because exposure-point concentrations for arsenic, cadmium, and antimony in air show much less variability among neighbourhoods than do exposure-point concentrations for soil (e.g., a two-fold variability for concentrations of arsenic in air, versus a six-fold variability in soil arsenic concentrations). A source evaluation for lead in air (TLP 1995) supported the position that a single source was responsible for concentrations of metals in air. In this analysis, the Trail Lead Program established that smelter emissions far outweighed re-entrainment of outdoor soils or dust as the source of lead in the air. This conclusion was based on analyses of seasonality (e.g., air lead concentrations related to precipitation or snow cover), wind direction versus air concentrations, and measured fallout of lead from air. This is likely to be true even with the introduction of the new smelter since the source evaluation analysis was conducted.

The results of the risk analysis can be used to guide future remediation actions in Trail. It is likely that air emissions of arsenic and cadmium contribute to the elevated concentrations of these metals in all media evaluated, and that decreasing air emissions will affect exposure and associated risk from both the inhalation and ingestion pathways. Fallout of arsenic and cadmium from air onto soils and outdoor surfaces, and entrainment in interior house dust, correlates directly with the concentrations of these metals in air. Given ongoing smelter emissions, remediation of soil may do little to reduce actual exposure, because "soil exposure" is more likely to reflect contact with dusty surfaces (e.g., picnic tables, floors) than direct contact with soil.

For produce grown in the area, plant-tissue concentrations of arsenic and cadmium will reflect the indirect effect of metals deposited onto soils, but may also reflect direct deposition onto foliar surfaces. The analyses of washed, homegrown produce collected from the Trail area indicate that the leafy portion of the produce contains the highest concentrations of arsenic and cadmium. The available data do not allow us to identify the source of the arsenic and cadmium in the leafy produce; however, it is reasonable to assume that their presence reflects foliar uptake following deposition, as well as uptake from soils.

At this writing, the new Cominco smelter has been on line for more than two years, and the air data used in this assessment were collected since the new smelter was activated. Comparison of calculated cancer risks from Phases 2 and 3 indicates that for all neighbourhoods except East Trail, risks from inhalation have decreased markedly during the past two years. Cominco staff have indicated that they continue to implement operational changes that will further reduce air emissions from the Trail facility (Sentis 1999, pers. comm.).

Given the contribution of these emissions to exposure (both inhalation and ingestion routes of exposure, as explained above), it would be reasonable to expect that exposures to arsenic and cadmium will decrease as emissions from the facility are further controlled. Monitoring of human exposure levels associated with the decreases in emissions would be the ideal mechanism for measuring the effects of smelter improvements. The long history of monitoring Trail residents' blood lead levels will support future monitoring to determine trends in blood lead levels. The correlation between blood lead levels and smelter operations can provide an important indication of the decreases in human exposure to all metals in smelter-related emissions. The assessment of exposure to lead, expressed as blood lead levels, is likely an adequate surrogate for exposure to other smelter-related metals. At present, the only established relation between smelter emissions and blood lead levels in Trail is for young children. However, children are likely the most sensitive receptors because of both behavior and physiological characteristics, and will provide an indication of changes in exposure levels across all age groups.

Taken together, the findings of this evaluation indicate that there is no imminent threat to human health in Trail from metals other than lead. Further, the potential for adverse health effects from long-term residence in Trail is very limited. The main focus of ongoing study should be to continue air monitoring for arsenic, cadmium, and lead. Specifically, the PM_{10} fraction should be measured, and detection limits should be low enough to ensure health protection, and to support any future risk evaluations. A trend in decreasing air concentrations of all these metals, combined with ongoing blood lead monitoring to assess whether there is an associated decline in human exposure to air emissions (assuming that lead is an adequate surrogate for the other site-related metals, as discussed above), should provide assurances that the level of health risk continues to decline.

Introduction

This document presents the findings of the third phase of risk assessment for non-lead constituents in Trail. Exponent conducted this three-phase assessment under the direction of the Trail Lead Program. Phase 1 risk assessment efforts consisted of screening existing data from the site against established health-based screening levels to determine whether there was any potential for human health effects associated with non-lead metals in soils at the site. The Phase 1 effort included evaluation of existing data, development of a sampling and analysis plan for soil sampling to determine chemicals of potential concern (CoPCs) for the site, mapping of chemical concentrations in soils, development of conceptual models that identified exposure pathways of concern, and finally, limited the number of CoPCs for the site to eight metals. The Phase 1 effort culminated in the report, *Human Health Risk Assessment for Trail, British Columbia, Phase 1: Problem Formulation* (PTI 1997).

The Phase 2 evaluation was undertaken to provide screening-level risk calculations associated with ingestion or inhalation of CoPCs in site soil, dust, or airborne particulates. As part of the Phase 2 effort, the following issues identified during Phase 1 were evaluated further:

- An alternative toxicity criterion was developed for cadmium based on absorbed doses. This effort was undertaken to provide a toxicity criterion for cadmium that incorporates background exposures to cadmium from the diet and other sources, so that an appropriate assessment of the potential health impacts from exposure to this metal in soils or from air can be made

- Background exposures to arsenic were summarized to provide a basis of comparison for evaluating the magnitude of arsenic exposures from soil relative to other sources.

- The potential for produce consumption to result in significant exposures to site CoPCs relative to soil was examined based on information available in the literature. This effort was undertaken to determine whether consumption of homegrown produce might contribute significantly to total exposures, and to help in the determination of whether site-specific produce data should be collected.

- Bioavailability adjustments for arsenic and cadmium from Trail soils were developed based on *in vitro* extraction procedures. Such bioavailability adjustments evaluate the solubility of metals from soils relative to the more soluble forms that are used in toxicity testing, and allow for more accurate estimation of exposures to metals from soil and dust.

- New soil data were evaluated to determine whether there were extensive areas of impact, or whether there were some metals that were limited in their distribution. This information was used to refine CoPCs for the site.

- Existing air data were compared to screening criteria to determine whether air concentrations of metals exceeded health-based benchmarks.

As a result of the analyses performed in the Phase 2 effort, some key areas of uncertainty emerged that could result in potential underestimation of risk from the site. Therefore, this Phase 3 effort was undertaken in an attempt to fill some of the information gaps identified in Phase 2. The goal of this Phase 3 effort is to update the Phase 2 risk calculations with newer and/or additional data (i.e., for media not included in the Phase 2 assessment). To this end, the majority of this Phase 3 report reproduces the *Screening-Level Deterministic Risk Calculation* document developed at the end of the Phase 2 risk assessment effort. This approach will better provide the reader with context for new calculations, whereas an addendum to the pre-existing document would require the reader to refer back to that document to make the new information meaningful.

The analyses that formed the technical basis for much of the Phase 2 risk assessment are summarized below, preceding a description of the scope of the risk assessment.

Determining an Absorbed-Dose Reference Dose (RfD) for Cadmium

The standard toxicity benchmark value for cadmium (i.e., the dose below which toxic effects are not anticipated) is based on kidney concentrations that accumulate from a lifetime of exposure. These concentrations reflect lifetime exposure to cadmium from all sources, including background exposures (which are often ignored in risk assessments). However, because cadmium intake from food and cigarette smoke can be significant relative to soil exposure pathways, determination of a cadmium concentration that can exist in soil without producing adverse effects on human populations must account for these other common exposure pathways. Therefore, background exposure to cadmium was assessed to derive an adjusted RfD for use in risk evaluations for Trail. This approach accounted for background exposures from food, drinking water, air, and smoking. Estimates of background cadmium intake ranged from 0.005 μg/kg-d for nonsmokers[1] and 0.015 μg/kg-d for 1-pack-per-day smokers. The estimated 3-fold

[1] The cadmium intake for nonsmokers excludes potential intake from environmental tobacco smoke (ETS). Nonsmokers exposed to ETS may have cadmium intakes greater than nonsmokers not affected by ETS, but probably less than smokers (i.e., within the range of cadmium intakes estimated for nonsmokers and smokers above).

difference in cadmium intake between smokers and nonsmokers is consistent with observed differences between these two groups in cadmium concentrations in the kidney and in blood (U.S. EPA 1999; ATSDR 1993). This evaluation yielded an adjusted RfD for cadmium in Trail soils of 0.02 μg/kg-d for nonsmokers, and 0.01 μg/kg-d for smokers. It is important to note that these values are expressed as *absorbed* doses of cadmium (i.e., the amount of cadmium that is absorbed into systemic circulation). This is in contrast to other RfD values for cadmium (e.g., from the British Columbia Ministry of the Environment [BCE], the World Health Organization [WHO], or the U.S. Environmental Protection Agency [U.S. EPA]), which are expressed as an *administered* dose (i.e., the amount of cadmium ingested from soil, food, water, or air). Because the cadmium RfD is based on the cumulative effects of a lifetime of exposure, it should not be used to assess childhood exposures directly. Instead, child and adult exposures should be combined, and a lifetime average dose should be used to assess risk. In the Phase 2 and 3 risk assessments, risk associated with cadmium exposure was evaluated using both the administered dose RfD and the absorbed dose RfD that was modified to account for background exposures.

Evaluating Background Exposure to Arsenic

Because arsenic occurs naturally in the environment and is present in most foods, arsenic exposure is a typical part of everyday life. Therefore, information from the literature and BCE databases was used to develop a summary of background arsenic intake from various sources for people living in southeastern British Columbia. This information provides a basis of comparison for evaluating the magnitude of arsenic exposures from soil relative to other sources. This investigation indicated that mean background exposures to inorganic arsenic for the community of Trail are an estimated 4.0–4.6 μg/day for young children, 8.7–8.9 μg/day for adult nonsmokers, and 10.5–10.7 μg/day for adult smokers. These values represent estimated average daily doses of inorganic arsenic that are absorbed into the body from air, food, drinking water, background soil, and cigarette smoke.[2] These values were used to provide better perspective on estimates of predicted risk from exposures to arsenic ingested from soil.

Screening Plant Concentrations of Arsenic and Cadmium

Because arsenic and cadmium in soil can be taken up into plants, human consumption of homegrown produce grown in soils containing these metals may constitute a potentially significant exposure pathway; however, reliable site-specific data on metal concentrations in Trail produce were not available. In this task, screening calculations were performed to determine whether potential exposures to these metals from homegrown produce were

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[2] Although the diet is by far the largest contributor to background arsenic exposure, little information is available regarding the expected range of intakes. However, there is general agreement regarding the typical amounts of arsenic intake from the diet. See PTI (1997) for a more detailed discussion of background exposure to arsenic.

significant relative to exposures from soil ingestion, which is typically considered to be the primary pathway of exposure to chemicals in soil. The calculations conducted in this assessment indicated that, for arsenic, potential exposures via ingestion of homegrown produce range from 4- to 17-fold below potential exposures via soil ingestion. The opposite was the case for cadmium, for which calculations indicated that exposure to cadmium from ingestion of homegrown produce might exceed exposures from soil ingestion by a factor of greater than three.

Although these findings indicated that consumption of homegrown produce could not be ruled out as a significant contributor to metals exposure, there was a high degree of uncertainty regarding the specific application of these findings to Trail. Therefore, these results supported the decision to collect site-specific data on cadmium concentrations in homegrown and store-bought produce.

Over the course of the last year, produce samples were collected, and the concentrations of arsenic, cadmium, and zinc in these samples were determined. This data set now includes results from two separate efforts in sampling homegrown and retail produce. In the second sampling effort, samples were split and analyzed by two different labs to ensure reproducibility of the data. The data from these efforts were used in this Phase 3 risk assessment. A more complete discussion of the available data and associated risk is presented below.

Determining the Relative Bioavailability of Arsenic and Cadmium in Trail Soils

Soil samples from Trail were tested to determine the oral bioavailability of arsenic and cadmium as they occur in the soil, relative to the bioavailability of more soluble forms of these elements. This study assessed the oral bioavailability of arsenic and cadmium in Trail soils using data from a physiologically based extraction test (*in vitro* test) that simulates the processes controlling dissolution of chemicals in the human gastrointestinal tract. The *in vitro* testing indicated that, on average, arsenic in the Trail soil samples had a relative bioavailability of 50 percent. This value is similar to the *in vitro* estimate of 49 percent relative arsenic bioavailability for soil from Anaconda, Montana. When tested in monkeys, the Anaconda soil yielded a relative bioavailability estimate of 20 percent, suggesting that the *in vitro* estimate is very conservative.

For cadmium, the relative bioaccessibility estimates averaged 61 percent for residential areas, with a value of 41 percent for the sample from the Cominco property boundary. These values are somewhat lower than the *in vitro* estimates of 70–73 percent relative bioavailability for soils from Bartlesville, Oklahoma. When tested in rats, the Bartlesville, Oklahoma sample yielded a relative cadmium bioavailability estimate of 33 percent.

Overall, the conclusion from this evaluation was that appropriate estimates of relative bioavailability for arsenic and cadmium that are both reasonable (i.e., not too high) and adequately health protective (i.e., not too low) for these metals in Trail soils are 55 percent and 33 percent, respectively.

Refining the CoPC List Based on New Data from Tadanac

In the Phase 1 risk assessment, the available data were used to determine chemicals of potential concern (CoPCs) for the site. Comparison of the metals concentrations from the available data with soil screening criteria indicated that the concentrations of antimony, arsenic, cadmium, mercury, selenium, thallium, tin, and zinc exceed the screening criteria at some locations. However, mapping of the concentration data demonstrated that the only area where concentrations of these metals exceeded soil screening criteria was along the boundary of the Cominco Metals site. Therefore, Exponent recommended that new soil samples be collected from transects in Tadanac to establish whether the elevated concentrations of these metals are widespread, or are constrained to the property boundary.

To answer this question, the TLP collected soil samples in transects near the boundary of the Cominco Metals facility, and from East and West Trail. Exponent evaluated data from the new soil samples to determine which metals should be considered CoPCs for the site. The new data indicated that soil concentrations of mercury, selenium, thallium, and tin exceeded soil-screening levels only in the area along the Cominco property boundary, and that the concentrations of these metals elsewhere in Tadanac or other Trail neighbourhoods did not exceed the soil screening criteria. Therefore, it was concluded that (non-lead) CoPCs for the site could be limited to arsenic, cadmium, and antimony. The metals considered as possible CoPCs for the site under the different phases of risk assessment work are presented in Table 1.

Screening Available Air Data Against Health-Based Criteria

Prior efforts by Exponent, based on evaluation of metals concentrations in Trail soils, had identified arsenic, antimony, and cadmium as the CoPCs for the non-lead risk assessment. However, before other metals could be eliminated conclusively from consideration as CoPCs for Trail, all potential exposure pathways of concern needed to be evaluated. Therefore, Exponent compiled air data from quarterly monitoring reports for Trail, and compared the concentrations of metals in these samples to health-based screening criteria, to determine whether the concentrations of metals in air around Trail present a potential health risk.

Using air data from the period during which the new smelter has been operational at the Cominco facility, this screening indicated that concentrations of arsenic, cadmium, and lead exceeded the screening criteria, and therefore merit further evaluation for potential impacts on the health of area residents. No additional metals were added to the list of CoPCs based on the evaluation of air data for Trail.

Evaluating Paired Soil and House-Dust Data

In the Phase 1 assessment, Exponent recommended collection of paired soil and house-dust samples from 60 homes around Trail, to determine the relation between concentrations of arsenic, cadmium, and antimony in soil and in house dust. Paired samples from a subset of 20 of these homes were collected by the TLP in the spring of 1998. As part of the Phase 2 risk assessment effort, Exponent evaluated these data to determine whether any clear relation could be discerned between indoor and outdoor concentrations of these metals. No consistent relation could be determined for indoor and outdoor concentrations of any of the metals measured, likely because too few data were available, or because of uncharacterized indoor sources of metals or outdoor sources other than soil (e.g., direct contribution from outside air to interior dust).

During the fall of 1998, indoor dust samples were collected from 57 properties. The results from these sampling efforts were not available for incorporation into the Phase 2 risk calculations. As described below, all of the available data were combined in this Phase 3 effort to determine appropriate exposure-point concentrations for CoPCs in indoor dust.

Risk Assessment Scope

The Phase 1 evaluation concluded that the screening of soil metals concentrations against conservative, health-based screening criteria indicated that three neighbourhoods in the Trail vicinity (Casino, Miral Heights, and Montrose) had no exceedances of any health-based criteria. Five neighbourhoods (Glenmerry, Oasis, Shavers Bench, Sunningdale, and Upper Warfield) exceeded only agricultural criteria, and there are no identified areas of agricultural land use in those neighbourhoods. For Lower Warfield, exceedances (of criteria for antimony in soils) were noted at only two locations. These exceedances occurred on industrial land along the boundary of Cominco's fertilizer plant, and therefore are not representative of residential soils in the neighbourhood. Therefore, all but five neighbourhoods were screened out from further analysis in subsequent Phases of the risk assessment. The neighbourhoods included in the Phase 2 and 3 evaluations are East Trail, Rivervale, Tadanac, Waneta, and West Trail. These are the neighbourhoods that are closer to the Cominco facility, except for Waneta, which though remote from the facility, exceeded agricultural screening criteria for antimony and cadmium, and residential screening criteria for antimony.

The risk assessment presented in this document follows the conventional four-step risk assessment methodology recommended by regulatory agencies: data evaluation (and identification of CoPCs), exposure assessment, toxicity assessment, and combining information from the exposure assessment and toxicity assessment to characterize potential risk. Using this methodology, risk is estimated for a "reasonable maximum exposure (RME)" level, which represents a maximum exposure level that is reasonably expected to occur at the site. Both an assessment of potential carcinogenic risk and a characterization of potential risk from exposure to noncarcinogenic compounds are included in this assessment, using standard toxicity values recommended by BCE or the

U.S. EPA. In addition to the standard characterization of risk, an additional evaluation of cadmium is provided, wherein exposure is estimated based on an absorbed dose (versus an administered dose, as is done more conventionally). This was done to allow for a more rigorous evaluation of cadmium, as well as to assess integrated ingestion and inhalation exposures to this CoPC. More details of this analysis are provided below.

The sections that follow present all components of the risk evaluation. First, the data available for conducting the evaluation are discussed, along with the methods that were used to select the CoPCs. This section discusses data by medium (i.e., separately for soil, house dust, and air), and also describes limitations associated with the data sets and the derivation of the concentrations used for estimating exposures. The section on data is followed by information regarding the exposure evaluation, including selection of potentially exposed populations, exposure calculations, and information regarding the specific values that were use in the exposure calculations. Then a discussion of the toxicity information for the metals of concern in Trail is presented. This section presents the specific values used, the source of each value, and some technical issues associated with the toxicity values. The exposure and toxicity information is then combined into a risk characterization. This section provides an estimate of the predicted carcinogenic and noncarcinogenic risks, separated by neighbourhood and by medium. To provide some perspective on the results of the risk characterization, and an understanding of the generally conservative nature of the calculations performed in the Phase 3 assessment, the uncertainties associated with the risk characterization are also described. Finally, conclusions are presented regarding the findings of this evaluation.

Qualitative Pathways and Conceptual Site Model

As part of the Phase I risk assessment effort, Exponent constructed conceptual site models for the CoPCs in the Trail area (Figures 1, 2, and 3) (PTI 1997). The conceptual site models outline sources of contaminants, present transport and exposure pathways, and rank the potential for exposure to the CoPCs. For the CoPCs included in the risk assessment (i.e., arsenic, antimony, and cadmium), several sources were determined to be complete but minor pathways of exposure. These include dermal or ingestion exposures via groundwater, surface water, or sediments; ingestion of fish and livestock; and dermal exposures to soil and dust. Because they are minor sources of exposure, no quantitative assessment of risks is necessary for these pathways. The text below describes the basis for the ranking of these pathways as minor sources of exposure.

Residential domestic-use exposures to both surface water and groundwater (i.e., ingestion of drinking water, dermal exposure during showering/bathing) are ranked as minor pathways of exposure based on data indicating that site-related chemicals are absent (i.e., below analytical detection limits), or are present at levels below human health concern (Hilts 1997a, pers. comm.). Data for residential water supplies in the Trail area (i.e., groundwater wells, and the Columbia River upstream of Cominco) are presented in Appendix B of PTI (1997), and indicate that site-related CoPCs do not occur at levels of human health concern. Therefore, residential exposures to both surface water and groundwater (ingestion, dermal contact) are minor, relative to total exposure, for the

CoPCs. Similarly, the ingestion of surface water or groundwater during occupational activities (agricultural and commercial/industrial workers) is likely to be a minor pathway of exposure for site-related CoPCs.

Site information suggests that individuals do not routinely swim, kayak, or inner-tube in parts of the Columbia River that are affected by smelter discharges (i.e., downstream of Cominco) (Hilts 1997b, pers. comm.). However, because individuals may occasionally contact surface water during recreational activities, surface water is determined to be a complete but minor pathway of incidental exposure (ingestion, dermal contact). Similarly, because residents may contact river sediments during water-related activities or during periods of low flow, the sediment pathway is potentially complete. However, because these exposures are likely to occur only infrequently, and because some data suggest that CoPCs are not present in sediment at levels of human health concern (Appendix A[3], PTI 1997), sediment is determined to be a minor pathway for site-related chemical exposure (ingestion, dermal contact). Also, dermal contact with arsenic, antimony, and cadmium in soil and indoor dust is a minor route of exposure, because these inorganic chemicals are not readily transferred through the skin (U.S. EPA 1995).

The livestock pathway was determined to be complete, because dairy and beef cattle are raised in the area on locally grown feeds, and their products are sold locally (i.e., dairy foods and meat) (Hilts 1997a, pers. comm.). However, the ingestion of meat and dairy products is considered to be a minor pathway of exposure for CoPCs, because the chemicals do not accumulate in muscle tissue or milk at levels of human health concern for the general population (ATSDR 1990, 1993, 1998; Dabeka et al. 1993). Although metals do accumulate in the liver and kidney, the ingestion rates of these organ meats are so low that we would not anticipate significant exposures to result. According the U.S. EPA (1997), per capita consumption rates of liver and kidney are 1.3 percent and 0.03 percent of the consumption rates for all beef, respectively. Similarly, while fishing does occur on the Columbia River near the site (Hilts 1997a, pers. comm.), ingestion of arsenic, antimony, and cadmium in fish is likely a minor pathway of exposure for area residents, because these CoPCs are not likely to accumulate in edible fish tissue in chemical forms that are at levels of human health concern (ATSDR 1990, 1993, 1998). In addition, fish caught near the site is likely to constitute only a small portion of a Trail area resident's diet.

Under the commercial scenario, the inhalation of CoPCs in indoor dust was denoted as a minor pathway of exposure on the conceptual site models. Nonetheless, the pathway is quantitatively evaluated in the risk assessment because site air data were available. Risks are calculated using the assumption that the concentrations of metals in indoor air are equivalent to their outdoor air concentrations. As discussed in the exposure assessment,

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[3] Arsenic and cadmium were measured in downstream sediments in concentrations less than the BCE residential soil standards. Downstream sediment concentrations of antimony slightly exceeded the BCE commercial/industrial soil standard (mean of 56 ppm vs. the standard of 40 ppm). However, this is a very health-protective comparison, because contact with sediment is likely to be much less frequent than contact with commercial/industrial (or residential) soils.

there are data from Trail that suggest that indoor air concentrations of lead are lower than those found in corresponding outdoor samples. Similarly, other research in communities affected by smelter emissions (Polissar et. al, 1987, 1990) indicates that indoor air concentrations of arsenic tend to be lower than corresponding concentrations in outdoor air.

Trail-area individuals may have exposures to CoPCs through complete but minor pathways that would generate additional risks not quantified in the risk assessment. However, based on the reasons presented above, these additional risks are likely to be small relative to the total exposure, and relative to the major exposure pathways quantified in the risk assessment.

Based on this analysis, the following exposure scenarios and exposure pathways were retained in the Phase 2 and 3 risk assessments:

- Residential
  - Soil/dust ingestion
  - Produce ingestion
  - Inhalation
- Commercial
  - Soil/dust ingestion
  - Inhalation
- Agricultural
  - Soil/dust ingestion
  - Inhalation.

Contaminants of Potential Concern

As part of the Phase 1 assessment, the Trail Lead Program provided Exponent with data for 33 metals in soils that had been collected from the Trail vicinity and from background locations. This data set was screened for data quality, and then compared to health-based soil screening criteria. Because the data indicated that soil metals concentrations exceeded screening criteria in some neighbourhoods, the Phase 1 evaluation identified eight metals (in addition to lead) as potentially requiring further evaluation in the Phase 2 risk assessment (Table 1). These metals were antimony, arsenic, cadmium, mercury, selenium, thallium, tin, and zinc. As described in the Introduction, screening of soil data collected as part of the Phase 2 efforts indicates that the elevated soil concentrations of mercury, selenium, thallium, tin, and zinc detected in Tadanac are limited to locations immediately along the property boundary of the Cominco Metals facility, and do not represent widespread concentrations above screening criteria. Therefore, soil data indicate that CoPCs for the site are antimony, arsenic, and cadmium.

In addition, screening of air concentration data from several monitoring stations around Trail against health-based screening criteria indicated that—with the possible exceptions of arsenic, cadmium, and lead—air concentrations of metals are below concentrations that might be anticipated to result in any adverse health effects (Technical Memorandum 2.2). Based on the Phase 2 evaluations of new soil data from Tadanac, East Trail, and West Trail, and the screening of air monitoring data, CoPCs included in the risk calculations performed during the Phase 2 and Phase 3 risk evaluations have been limited to antimony, arsenic, and cadmium.

Data Evaluation

This section presents a discussion of the available data, organized by environmental medium. The available data and the methods used to compile the data for use in the HHRA are described, along with the limitations of the available data, and the calculation of the exposure-point concentration. All data used in this risk evaluation were provided to Exponent by Steve Hilts of the TLP.

Soil

For the three remaining CoPCs (i.e., antimony, arsenic, and cadmium), soil concentration data were available from samples collected in 1989, 1991, 1996, 1997, and 1998. Sampling locations covered a broad range of areas, including neighbourhoods in proximity to the Cominco Metals facility, as well as areas upstream and downstream from the facility. A full description of the available soil data is presented in the Phase 1 Technical Memorandum, included as Appendix E of the final Phase 1 report (PTI 1997), and in Technical Memorandum 2.2 (Exponent 1998).

All data of good quality were used for this evaluation. All non-detect results were provided to Exponent as one-half the detection limit, and no distinction was made between detect and non-detect results, thereby precluding exclusion of some CoPCs based on frequency of detection. It should be noted that use of one-half the detection limit for non-detect data is consistent with U.S. regulatory policy (U.S. EPA 1989). However, it is not consistent with the approach used by BCE in prior evaluations of Trail (BCE 1995), where non-detects (for dust data) were omitted from the data set.

Before any other calculations were performed, results were averaged over time at each sampling location, defined by a unique set of x-y coordinates. These pre-averaged results are presented in Table A-1 (Appendix A). Data from sample locations identified as "background" were not used, because they were not collected from the neighbourhoods being characterized in this assessment. In addition, the four samples taken along the Cominco fence line in November 1997 also were not used, because Phase 2 analyses (presented in Technical Memorandum 2.2) indicated that these concentrations are confined to the area near the Cominco property boundary, and are not representative of soil concentrations in residential neighbourhoods. Any sample locations that were identified by the name of a park were grouped with the neighbourhood in which the park was located (e.g., samples from Andy Bileski Park were grouped with Glenmerry).

For the purposes of this risk evaluation, the soils data were first aggregated by neighbourhood, then by land use. The sample locations labeled as "Parks/Rec" were grouped into the "residential" land use category; those labeled "institutional" were grouped into the "commercial" category. As part of the Phase 1 effort, maps depicting these land uses were provided to the TLP. Areas categorized as "industrial" were not evaluated in this risk assessment, because they were limited to areas within the Cominco Metals facility. Evaluation of that property is outside the scope of this assessment. Summary statistics were calculated for each area, and are presented in Table 2.

Estimation of Antimony Concentrations

Because fewer soil samples were analyzed for antimony than for arsenic and cadmium, there were two areas for which no antimony data were available—the residential area in Rivervale, and the commercial area within West Trail. To evaluate the potential risks associated with exposure to antimony in soil for these two areas, the relation between arsenic and antimony concentrations was analyzed statistically, and it was determined that antimony concentrations could be predicted using arsenic concentrations. For 20 soil sampling locations, both antimony and arsenic concentration data were available, and a regression relation was established between them. Because the concentration data were distributed lognormally, the data were log transformed for this evaluation. Using all 20 soil samples, the regression correlation coefficient (R^2 value) was 0.89. However, this evaluation indicated that one data pair qualified as an outlier. Therefore, the outlier was eliminated and the regression re-run. Without the outlier, the adjusted R^2 value increased to 0.93. This regression indicated that the maximum-likelihood estimate for antimony concentrations is predicted by the equation:

$$Sb = 0.509 \times As^{1.075} \times 1.041$$

For areas where empirical antimony concentration data for soil were available, these empirical data were used in determining potential human exposures to antimony. However, for the two areas for which no antimony data were available, antimony concentrations were predicted using the equation above. Although uncertainty is introduced by using such a predictive approach, indications are that for this relation (i.e., using arsenic concentrations to predict antimony concentrations), and the range of concentrations in which most of the observations fall (i.e., arsenic concentrations below 100 ppm), the predictive ability is fairly good, with an associated error in the range of under 15 percent. This means that the predicted antimony concentration is probably within 15 percent, plus or minus, of the laboratory-measured concentration in that location. The statistical analysis used in this determination is provided in Appendix B of the Phase 2 report (Exponent 1998).

Soil Exposure-Point Concentration

As discussed in the Introduction, this assessment focuses on characterizing risks for a Reasonable Maximum Exposure (RME). Under an RME approach, the exposure-point concentration (EPC) should represent an upper bound of the average exposure that will occur over time at a given exposure location. The 95 percent upper confidence limit on the mean (UCLM) is recommended by the EPA as the most appropriate statistic (U.S. EPA 1992) and has been used in risk assessments by BCE (BCE 1995).

The first step in calculating a UCLM is to determine whether the data set is distributed normally or lognormally, and at this site, the soil data were determined to be distributed lognormally. In some instances—for example, small data sets or sites with extreme variability in chemical concentrations—the calculated UCLM for a data set exceeds the maximum detected concentration. Additionally, if the data set has fewer than three values, it is not possible to calculate a UCLM. In such instances, it is recommended that the maximum concentration be used as the exposure-point concentration (U.S. EPA 1992). The calculated UCLMs for each area are presented in Table 2, and the value chosen for the exposure-point concentration (i.e., the UCLM or the maximum detected concentration) is highlighted.

Dust Data

In the risk calculations performed in Phase 2, information about house-dust concentrations, or the relation between house dust and soil concentrations, was not adequate to determine a separate exposure-point concentration for house dust. Calculations in the Phase 2 evaluation assumed that house-dust concentrations are equal to surrounding soil concentrations, an assumption that was considered to overestimate actual exposures (i.e., indoor concentrations of metals from environmental sources would be expected to be lower than outdoor concentrations, based on analyses of other sites (EPA 1995).

For this Phase 3 effort, dust concentration data were available from samples collected in April 1998 and August/September 1998. In April 1998, samples were collected from 20 properties in East Trail, Tadanac, and West Trail. In August and September 1998, samples were collected from 57 properties in 13 neighbourhoods, including re-sampling 16 of the 20 properties sampled in April. Sampling locations covered a broad range of areas, including neighbourhoods in proximity to the Cominco Metals facility, as well as areas upstream and downstream from the facility. The quality of the data was assessed by the Trail Lead Program and determined to be adequate for use in risk assessment prior to their incorporation in this assessment (Appendix B). Dust data were used directly in calculating exposure-point concentrations, rather than estimating indoor dust concentrations on the basis of soil data. Before any other calculations were performed, duplicate results were averaged; then results were averaged over time at each sampling location, defined by a unique property ID. The results were then grouped by neighbourhood. The complete set of data is presented in Table A-2.

Dust Exposure-Point Concentration

Exposure-point concentrations for CoPCs in dust were determined by calculating the UCLM concentration for each neighbourhood. The UCLMs were calculated and used as described above in the soil section. The calculated UCLMs for each area are presented in Table 3, and the value chosen for use as the exposure-point concentration (i.e., the UCLM or maximum detected value) is highlighted. Because two neighbourhoods had a small number of dust samples (less than seven), the maximum observed value had to be used as the exposure-point concentration. For Rivervale, there was only one dust sample, which contained concentrations of 40, 26, and 21 mg/kg for antimony, arsenic, and cadmium, respectively. The corresponding exposure-point concentrations based on soil from Rivervale are 140, 169, and 14 mg/kg, respectively. The dust concentrations measured in the Rivervale sample fell within the range of soil concentrations for each analyte. Because of the limited number of dust samples, it was determined that use of the soil exposure-point concentration for Rivervale (based on 15 values) would represent a better approximator of dust concentrations over the entire neighborhood than that provided by the single dust sample.[4]

Produce Data

Produce concentration data were available from samples collected in August/September 1998, January 1999, and July/August 1999. In August and September 1998, 87 samples of homegrown produce were collected from 13 neighbourhoods. Additionally, 14 produce samples were collected from local retailers—13 of these samples had been grown in the region (BC, Okanagan, Burnaby), and one sample was grown in California. Twenty-nine different kinds of produce were sampled, including leafy vegetables such as lettuce and spinach, and nonleafy vegetables such as corn, cucumbers, and beans. In January 1999, 12 additional retail samples were collected, all of which were grown outside the region. Initial screening of these data in the spring of 1999 suggested that the concentrations of CoPCs measured in both homegrown and retail produce exceeded the concentrations reported in the literature (Dabeka et al. 1993; DePieri et al. 1997). Some of the literature values (DePieri et al. 1997) presented data for produce grown in the same region that the retail produce represented. Based on this preliminary evaluation, Exponent was concerned about the quality of the available data, and recommended that the TLP undertake an additional sampling effort, having the samples analyzed by two analytical laboratories to ensure reproducibility of the data. In July and August 1999, 19 samples of homegrown produce were collected from seven neighbourhoods, and three produce samples were collected from local retailers. The 1999 samples were sent to two laboratories, ASL and Cantest, for analysis. The results for different types of produce from each sampling effort and the two labs are provided in Table 4.

[4] Comparison of the EPCs for soil and dust concentrations of antimony, arsenic, and cadmium in the various neighbourhoods evaluated in this assessment suggests that the single dust sample from Rivervale is low for concentrations of antimony and arsenic, relative to the measured soil concentrations, and using the soil EPC as a surrogate for dust provides a concentration value that is more consistent with what is seen in the other neighborhoods. Specifically, for Rivervale, the concentrations of antimony and arsenic in the single dust sample are at least 5-fold below the EPC for soil, whereas data from the other neighborhoods indicate EPCs for antimony and arsenic in dust that are equal to or above the corresponding soil concentrations. However, using the soil EPC to approximate the dust concentration of cadmium may result in an underestimate of indoor dust concentrations for this metal in Rivervale. Data from the other neighbourhoods indicate that the dust EPC ranges from 1.6- to 5-fold higher than the corresponding EPC for soil.

Comparison of the 1998 data to the 1999 data indicates that, except for leafy produce from residential gardens, the 1998 data appear to show higher concentrations for both arsenic and cadmium. Comparison of the maximum detected concentrations in the 1998 and 1999 data suggests that the difference between the data for the two years is more extreme for arsenic than for cadmium, ranging to over an order of magnitude (Table 4). A full statistical analysis to determine whether the 1998 samples should be excluded from the risk assessment is beyond the scope of the current effort, so all data were used in determining exposure-point concentrations. Because of the potential bias of the early data, this approach may tend to overestimate calculated exposures and associated risks; however, the large sample size provided by including the 1998 data results in final EPCs for CoPCs in produce that are consistent with the newer data.[5]

In determining exposure-point concentrations for produce, before any calculations were done, the results from the two labs for the 1999 samples were averaged. Because the detection limit achieved by Cantest was significantly higher than that of ASL, a method of averaging was selected that gave preference to detected results over non-detects:

- If both results were detected, the values were averaged normally.
- If both results were non-detects, the lowest of the two detection limits was selected.
- If one result was a detected concentration and one result was a non-detect, and the detected value was lower than the non-detect, the detected value was selected.
- The case did not occur where one result was detected and the other was a non-detect, with the detected value being higher than the non-detect.

The quality of all data was evaluated by the Trail Lead Program (Appendix B), and the data were determined to be of good quality and acceptable for use in this assessment. The complete set of data is presented in Table A-3. Table 5 presents a comparison of Trail produce concentrations to published produce concentrations. This comparison indicates that the homegrown produce collected from Trail consistently contained higher concentrations of arsenic and cadmium than reported in the literature. The average concentration from homegrown produce in Trail ranged as high as 39- to 58-fold higher than the average from the literature for cadmium and arsenic, respectively. For both metals, the highest incremental difference was found in lettuce.

[5] A comparison of the risk estimates generated by using the UCLM of all (i.e., 1998 and 1999) data versus the maximum value from the 1999 data as the EPC indicates that excluding the 1998 data could reduce final risk estimates by a factor of two.

Produce Exposure-Point Concentration

Figure 4 presents a flow diagram representing the calculation of exposure-point concentrations for produce. This process included:

- All produce data were combined into one data set, and the residential homegrown samples were then selected for this assessment.
- As discussed in Technical Memorandum 2.1 (Exponent 1998), the toxicity of arsenic varies with the form of arsenic present. In produce, not all of the arsenic present is in the more toxic inorganic form. Therefore, data on total arsenic in the produce were converted into inorganic arsenic, using the ratios of inorganic arsenic to total arsenic as listed in Table 6. The values for the ratio of inorganic arsenic to total arsenic in different produce types were selected from Schoof et al. (1999).
- The produce was categorized as leafy or nonleafy, with the nonleafy category including root vegetables such as potatoes.
- Samples of fruit and herbs were excluded. Herbs were excluded because of the low ingestion rate associated with these items. Fruits were excluded because it was assumed that the concentrations of CoPCs in these products would not reflect concentrations of the metals in surface soils because of the deeper root structures associated with most fruits.
- Because there were not enough samples to calculate individual UCLMs for each neighbourhood, it was determined in conversations with the TLP (Hilts 1999, pers. comm.) that the neighbourhoods should be grouped into two categories: those near the Cominco facility (East Trail, Glenmerry, Lower Warfield, Miral Heights, Shaver's Bench, Sunningdale, Tadanac, Upper Warfield, and West Trail), and those that are far from the Cominco facility (Casino, Oasis, Rivervale, and Waneta).
- A histogram of the data for each grouping was plotted, and the data were visually determined to be most closely represented by a lognormal distribution, rather than a normal distribution.
- A UCLM was then calculated for the four groupings (i.e., leafy or non-leafy for "near" and "far" locations), using one-half the detection limit for all non-detect values, as discussed in the soil section.

A summary of the residential produce data is presented in Table 7, and the value chosen for use as the exposure-point concentration (i.e., the UCLM or maximum detected value) is highlighted.

Air Data

All available air data from the Trail vicinity were compiled and evaluated for use in site risk evaluations. Because a new smelter came on line in March 1997, and the old smelter closed down in May 1997, it was determined that only air data collected after that time would be appropriate for use in evaluating potential health risks. Therefore, only the data from July 1, 1997 to the present were used. Additionally, if data were available from the more recent monitoring dates (July 1998 through June 1999), these data were incorporated into the risk assessment. This was done because it was assumed that the most recent air data best approximate exposures into the future, with the new smelter technology. Because PM_{10} values represent the respirable fraction of materials to which a person would be exposed, PM_{10} data were used if available. In the absence of PM_{10} data, information on total suspended particulates was incorporated into the assessment with no adjustment.

Data from the air monitoring station closest to the neighbourhood of interest were used, unless the closest station measured only TSP. In that case, data from the next closest station were used. Older data (July 1997 through July 1998) or TSP data were used when necessary to fill in data gaps for antimony. The data sets used for each neighbourhood and chemical are presented in Table 8.

The older data used in this evaluation (July 1997 through July 1998) were from samples collected on a nearly daily basis. The newer data (July 1998 through June 1999) were collected in various ways. At the Columbia Gardens station, samples were collected by a high-volume sampler operating once every six days. For the Butler station, samples were collected two to three times per month, and each sample represents a duration of approximately 24 hours. For the Oasis and West Trail stations, samples were collected every six days; however, there are two gaps in this schedule, of up to 36 days each.

The complete set of air data used for this assessment is presented in Tables A-4 through A-8.

Air Exposure-Point Concentrations

Exposure-point concentrations for CoPCs in air were determined by calculating the UCLM concentration for each area. The UCLMs were calculated and used as described above in the soil section, using one-half the detection limit for non-detects. The calculated UCLMs for each area are presented in Table 9, and the value chosen for use as the exposure-point concentration (i.e., the UCLM or maximum detected value) is highlighted.

To assess the impact of using TSP data for locations where PM_{10} data were not available, data for locations where paired PM_{10} and TSP concentration data were available were evaluated to determine whether a clear relation between PM_{10} and TSP could be established and used to "correct" TSP data to be more representative of PM_{10}

concentrations. This evaluation indicated that no clear relation could be determined, that concentrations of CoPCs in PM_{10} and TSP fractions appeared to be similar, and that, in some instances, PM_{10} concentrations exceeded TSP concentrations. Therefore, TSP data were assumed to provide the best available estimate of the respirable fraction of site CoPCs, and no corrections were made to the TSP data.

For the purposes of these calculations, concentrations of CoPCs in indoor air were set equal to outdoor concentrations, which may produce an overestimate of actual risk. Paired data for bedroom air and outdoor air concentrations of lead in Trail indicate that indoor concentrations of lead in air range from 13 to 66 percent of the outdoor concentrations, with indoor concentrations being less than 60 percent of outdoor air concentrations for all but one data pair. Because indoor sources of lead are significant, it is likely that the indoor concentrations of the non-lead CoPCs at the site are, at most, 60 percent of the outdoor values. Assuming that individuals spend approximately 80 percent of their time indoors, the assumption that indoor air concentrations are equal to outdoor air concentrations may overestimate the risk from inhalation exposure by a factor of approximately 1.5.

Exposure-point concentrations for all media are summarized in Table 10.

Exposure Evaluation

The human populations believed to have potential for exposure to metals in Trail soils were identified during the Phase 1 risk assessment efforts. These exposures were determined to include those by residential populations in the neighbourhoods, by workers employed in commercial areas of East or West Trail (or by workers' children in these areas), and by agricultural workers and their families in the outlying agricultural areas around Trail. These potentially exposed populations are included in this risk evaluation. The specific exposure scenarios and exposure pathways considered in the Phase 2 and 3 assessments include:

- Residential
  - Soil/dust ingestion
  - Produce ingestion
  - Inhalation
- Commercial
  - Soil/dust ingestion
  - Inhalation
- Agricultural
  - Soil/dust ingestion
  - Inhalation.

Calculations of exposure to metals from environmental media were conducted using standard exposure and risk assessment approaches. The generic equation for calculating chemical intake is:

$$I = C \times \frac{CR \; x \; EFD}{BW} \times \frac{1}{AT}$$

where:

I	= intake (mg/kg-d)
C	= chemical concentration in the environmental media
CR	= human contact rate with the environmental media
EFD	= exposure frequency and duration
BW	= the average body weight over the exposure period
AT	= averaging time.

Specific equations designed to evaluate exposures for the populations and pathways determined to be appropriate for this assessment are presented in Tables 11–17, along with the assumptions regarding exposure parameters. These site-specific calculations are somewhat more complicated than the generic calculation presented above, because they take additional considerations into account, including apportioning exposure to soil or dust, evaluating childhood exposures separately from adult exposures, and incorporating information regarding relative bioavailability.

Tables 11–17 provide the exposure assumptions that have been compiled for use in the risk evaluation for Trail. Tables 18 and 19 present calculated estimates of exposure for each pathway and scenario, for noncancer and cancer endpoints of toxicity, respectively. Table 20 presents the calculated estimates of exposure for the total lifetime absorbed dose of cadmium. These tables provide exposure assumptions for residential, commercial, and agricultural exposure scenarios. The hierarchy used in selecting specific values was 1) site-specific information, 2) guidance from BCE, 3) guidance from U.S. EPA, and 4) professional judgment. The selection of exposure values focused on generating final estimates of Reasonable Maximum Exposures (RMEs) for each exposure pathway. Under this RME approach, the goal is to characterize an upper-bound exposure case that is still within the range of exposures reasonably expected to occur at a site (as opposed to an estimate of the upper bound of exposure). To determine an RME, some intake variables are not set at their individual maximum values, but when combined with the other variables, they result in an estimate of the maximum exposure that is reasonably expected to occur at the site (U.S. EPA 1989). In quantifying the RME, it is specifically recommended that the UCLM be used as the estimate of exposure concentration (U.S. EPA 1989).

Where possible, assumptions regarding exposure rates were based on site-specific information from Trail. For example, site-specific considerations were incorporated into assumptions regarding chemical concentrations and relative bioavailability (discussed further below). If site-specific information was not available, then guidance from BCE or the Canadian Council of Ministries of the Environment (CCME) was incorporated. In the absence of guidance from Canadian regulatory agencies, recommendations from U.S. EPA were followed. If no guidance was available, then professional judgment was used in determining the appropriate input value for the calculations. Tables 11–17 contain information regarding the source or derivation of each value incorporated into the exposure calculations. Below is a discussion of some parameters that affect all the exposure scenarios, followed by a description of some parameters for specific exposure scenarios.

Exposure Assumptions Applied to All Scenarios

Oral Bioavailability

Chemicals can occur in soils as different physical or mineralogic species, with varying solubilities. Toxicity studies for metals typically are performed using soluble compounds. For most chemicals, the toxicity values used by regulatory agencies are not adjusted to absorbed dose (i.e., the dose response evaluation is based on the administered dose). This approach can lead to overestimates of risk from exposure to a particular chemical in a medium other than the one used in the toxicity or epidemiology studies on which the toxicity values are based.

Because of this issue, Exponent conducted an assessment of Trail soils to determine an appropriate adjustment factor that would address the differences between the amounts of metals absorbed during toxicity studies and the amounts likely to be absorbed following exposure to these metals in soils from Trail. A full description of the theory, methods used, and findings of the bioavailability assessment is presented as Task 4 of Technical Memorandum 2.1 (Exponent 1998). Based on this study, Exponent conservatively estimated that Trail soil samples contain arsenic with a relative bioavailability of 55 percent, and cadmium with a relative bioavailability of 33 percent. These values were incorporated into the calculation of exposure to arsenic and cadmium via the ingestion route for all exposure scenarios evaluated. These values, and particularly the value for arsenic, are high compared to relative bioavailability values observed at other sites affected by smelter emissions. Studies conducted using monkeys have indicated that the relative bioavailability of arsenic from smelter-affected soils is approximately 20 percent of that from soluble arsenic. This specific research was conducted using soil samples from Anaconda, Montana, but the results have been applied to, and accepted by, regulatory agencies at other sites (e.g., Bartlesville, Oklahoma). It could be argued that the *in vivo* results from another smelter-affected site are more appropriate to use in deriving bioavailability adjustment values for Trail than the results from *in vitro* extraction tests. If the *in vivo* data were incorporated into the exposure calculations, estimated exposures to arsenic from soil (and the associated risks) would be almost 3-fold lower than those calculated in this assessment.

For antimony, no site-specific evaluation of Trail soils has been conducted. However, there is adequate information from the literature to support an adjustment for oral absorption of antimony from Trail soils. The toxicity value (RfD) for antimony is based on a study of potassium antimony tartrate administered in water. No discussion is provided in the documentation of this value regarding absorption, or applicability to other forms of antimony or antimony in mixed media. A draft toxicological profile for antimony from the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) does discuss absorption. This document indicates that gastrointestinal absorption of antimony salts in humans is less than 10 percent. It also specifically cites the recommendation of 10 percent for antimony tartrate and 1 percent for all other forms of antimony as values for gastrointestinal absorption of different forms of antimony in humans.

The RfD for antimony that was incorporated into this risk evaluation was based on administration of antimony tartrate, and we would not expect the antimony in Trail soils to occur in this form. This information suggests that it would be appropriate to adjust the calculated exposure of antimony from soils downward by a factor of 10. This adjustment should be adequately conservative (i.e., health protective), because it doesn't address the additional impacts that would be expected based on the difference between absorption from water (as in the toxicity testing) and absorption from soil.

Averaging Time

Averaging time is determined in several different ways in the exposure assessment, to accommodate the needs of the risk characterization. First, for assessing carcinogenic risks, the appropriate averaging time is an individual's full lifetime (i.e., 75 years). Expressed in days, this is 27,375 days. To evaluate noncarcinogenic risks, however, the exposure duration is the appropriate averaging time to incorporate into exposure and risk calculations. To ensure that the higher childhood exposures are not resulting in unacceptable risk, the risk from noncarcinogenic chemicals is assessed separately for the childhood and adult exposure periods. Therefore, specific childhood and adult averaging times are presented in the tables of exposure assumptions. Finally, as described in the introduction, noncancer risk from exposure to cadmium (i.e., exposure via ingestion) is appropriately evaluated based on lifetime exposure to cadmium (i.e., from 6 months of age when soil ingestion exposures begin, until death), so the appropriate averaging period for assessing risk from long-term exposure to cadmium is 74.5 years (27,193 days). Because of all of these considerations, four separate averaging times appear in the exposure assumption tables.

Residential Exposures

The residential exposure scenario evaluates incidental soil and dust ingestion, and inhalation exposures, for an individual who resides in Trail for their entire lifetime (75 years), and separates childhood exposures from age 6 months to 5 years (children under 6 months are assumed to have negligible exposure). The exposure calculations assume that an individual is at home for all but 2 weeks each year, and that direct exposures to soil are avoided during the 3 months of each year that snow is assumed to cover the ground. The 75-year lifetime exposure duration is longer than the 30-year duration that would normally be incorporated into exposure calculations and risk evaluations, but an earlier risk assessment conducted by BCE documents that it is foreseeable that an individual would reside in Trail for a whole lifetime (BCE 1995). Hence, the calculations incorporate a 75-year exposure duration, which is inconsistent with the goal of estimating RME exposures, as opposed to maximum exposures. This assumption of a 75-year exposure duration affects the final estimates of risk for exposure to carcinogens, and for the absorbed dose of cadmium, because the estimates of risk for these endpoints of toxicity are based on the total lifetime dose of these compounds. It will not affect the estimated risks for non-cancer endpoints of toxicity (e.g., for exposure to antimony and ingestion of cadmium using the standard RfD), because toxicity for these endpoints is assessed only for the duration of exposure, not averaged over a lifetime.

The soil ingestion rate used in this assessment is 80 mg/day for children. This value is based on information provided by BCE (1996). Guidance from the CCME provides a soil ingestion rate for children of 50 mg/day, suggesting that the exposure calculations may overestimate exposures via this exposure pathway by a factor of approximately 1.6.

For ingestion of soil and dust, it is assumed that 30 percent of the daily soil ingestion rate is contributed from soil, and 70 percent of the daily ingestion rate is contributed from dust (i.e., FI_s equals 0.3 and FI_d equals 0.7). These values are derived from information provided by BCE (1995). Specifically, this BCE document states that Canadians spend about 80 percent of each 24-hour day inside. Assuming that eight of those inside hours are spent sleeping, the time spent inside while awake (i.e., the period during which dust ingestion might occur) is 11.2 hours per day, and the remaining 4.8 waking hours are spent outside (i.e., the period during which soil ingestion might occur). Thus, the fraction of waking hours spent indoors is 70 percent, and the fraction of waking hours spent outdoors is 30 percent. This information could also affect exposures to indoor and outdoor air. However, as discussed above, no reliable indoor air concentration data are available, and therefore, indoor air concentrations were assumed to be equal to the measured outdoor concentrations, and no time-activity information was incorporated into the exposure calculations.

Technical Memorandum 2.1 presented the exposure assumptions developed in the Phase 2 effort for ingestion of homegrown produce. Several kinds of information were used to derive exposure estimates for this exposure pathway. First, a total vegetable ingestion rate of 250 g/day (wet weight), reported by Health Canada (1994) for Canadians 20 years old or older, was used in the calculations[6][7]. The Health Canada rate is based on the Nutrition Canada Survey, which is the most appropriate available value for the target population. This 250-g/day ingestion rate from the Canadian survey did not provide adequate information to apportion intake among leafy and non-leafy vegetables. This distinction can be important because the transport of chemicals from soil to plants differs for vegetative growth (leaves and stems) and non-vegetative growth (fruits, seeds, and tubers). Although non-leafy vegetables represent the majority of produce consumed by humans, leafy vegetables still constitute a portion of the human diet, and cadmium and arsenic are both known to be taken up into leafy vegetables. Therefore, U.S. data were used for this purpose. Of the total vegetables ingested, 7 percent was assumed to be leafy, and 93 percent non-leafy, based on data (dry weight) from U.S. EPA (1996). This information was combined, and the ingestion rates for non-leafy and leafy produce were estimated to be 42.6 g/d and 3.2 g/d (dry weight basis), respectively.

Another key assumption for the produce consumption exposure pathway is the fraction of produce that is assumed to be homegrown vs. commercially purchased. Based on information available from CCME (CCME 1993), approximately 7 percent of the Canadian diet is composed of homegrown produce; therefore, a fractional intake value of 0.07 was assumed in our calculations. Table 13 presents the assumptions and equations used in the calculation of exposure from consumption of homegrown produce.

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[6] Versus the U.S. EPA default value for vegetable consumption of 200 g/d.

[7] This is equal to approximately 45.8 g/day dry weight.

Inhalation rates incorporated into the exposure assessment are based on values from BCE (1996) for long-term average exposures. Specifically, the 24-hour inhalation rate for adults was assumed to be 23 m^3/day, and the 24-hour inhalation rate for children was assumed to be 5 m^3/day. These values were selected to ensure that the exposures (and accompanying risks) calculated for residents of Trail are comparable to risks calculated at other sites (i.e., using recommended values), and because direction from BCE indicates that Canadian regulatory values should be given precedence in determining exposure assumptions for this evaluation. It should be noted, however, that a recent re-evaluation of available studies of inhalation rates suggested a long-term average daily inhalation rate of 11.3 m^3/day for women, 15.2 m^3/day for men, 4.5 m^3/day for infants (<1 year old), and 7.7 m^3/day for children (0.5–10 years old, average for males and females) (U.S. EPA 1997). Therefore, inhalation exposures in this risk assessment may be overestimated for adults, and possibly underestimated for children.

Exposure assumptions associated with incidental ingestion exposures to soil and dust under the residential exposure scenario are presented in Table 11. Assumptions associated with inhalation exposures under the residential exposure scenario are presented in Table 12.

Commercial Exposures

The exposure assumptions associated with the commercial scenario are intended to characterize potential exposures by adults and children in commercial areas of Trail. The adult scenario is intended to characterize exposures during a 10-hour work shift, 5 days per week, 48 weeks per year (i.e., excluding 10 holidays and 10 vacation days). For children, it is assumed that they might accompany a parent to a commercial area for up to 8 hours, 5 days per week, 48 weeks per year. The only available BCE guidance (*Overview of CSST Procedures for the Derivation of Soil Quality Matrix Standards for Contaminated Sites*, BCE 1996) specifically addresses exposures in commercial areas and indicates exposure by children and adults for 12 hours per day, 5 days per week, 48 weeks per year. It was determined that some of these values were unrealistically high for Trail and were not consistent with other Canadian guidance (CCME 1996); therefore, the values were amended to be more appropriate to site-specific conditions.

The relative proportions of soil and dust ingested under the residential exposure scenario were incorporated for commercial exposures (i.e., 70 percent from dust, and 30 percent from soil). Similarly, the relative bioavailability of metals in soil and dust was assumed to be the same as under the residential exposure scenario (i.e., 55 percent for arsenic, 33 percent for cadmium, and 10 percent for antimony).

For assessing inhalation exposures, inhalation rates under the commercial exposure scenario were expressed as hourly rates, rather than the daily averages used in assessing residential exposures. For adults, the inhalation rate was based on the average rate for light and moderate activity levels during short-term exposure periods, as presented by U.S. EPA (1997). The inhalation rate for children was based on an average of inhalation rates for sedentary (napping) and light activity levels during short-term exposure periods, as presented by U.S. EPA (1997). This approach is similar to the approach used by BCE in their evaluation of the site (BCE 1995) (i.e., they used an average of these activity levels based on inhalation rate information from U.S. EPA); however, updated information from EPA was incorporated into the estimate.

This methodology, however, results in a logical incompatibility with the assumptions for residential inhalation exposures, presented above. Specifically, if a child is exposed under the commercial scenario for 8 hours per day, at an inhalation rate of 0.7 m^3/hour, then the 8-hour inhalation volume is calculated to be 5.6 m^3. This value contrasts with the assumed 24-hour average inhalation rate under the residential exposure scenario of 5 m^3. This difference results from inhalation rates that are based on different sets of scientific data (i.e., long-term versus short-term inhalation studies), as well as from trying to incorporate regulatory recommendations, where possible, with information from the literature or other available sources. The discrepancies between these values for inhalation rates will not significantly affect the final estimates of exposure or risk. Exponent estimates that, at worst, exposure estimates based on these assumptions may be off by a factor of 1.5 (biased low under residential exposures) for children, and 2 (biased high under residential exposures) for adults. The impacts of this uncertainty will be discussed again in the Risk Characterization section of this report.

Exposure assumptions associated with incidental ingestion exposures to soil and dust under the commercial exposure scenario are presented in Table 14. Assumptions associated with inhalation exposures under the commercial exposure scenario are presented in Table 15.

Agricultural Exposure Scenario

The exposure assumptions associated with the agricultural scenario were intended to characterize the potential exposures that might be incurred by a family who lives on and farms agricultural land around Trail. These exposures were the same (except for the concentrations of CoPCs) as those experienced under the residential exposure scenario, except that they also incorporated exposures that would be associated with periods of intense farm work, such as plowing or tilling. The exposures associated with "residential" exposures on farms were calculated separately from the exposures associated with the intense farm work and are presented as residential exposures.[8] Issues associated with the assumptions regarding the "residential" component of the agricultural exposures are discussed above under the Residential Exposure Scenario. Exposure assumptions that are unique to the agricultural scenario (i.e., those associated with plowing or tilling) include the assumed soil ingestion rate, inhalation rates, the exposure frequency, and the exposure duration.

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[8] That is, the "residential" aspect of farming-associated risk is presented along with other residential risks, differing only in that the concentration data used in the calculations are representative of agricultural sampling locations (i.e., Waneta).

Inhalation rates incorporated into the exposure assessment are based on values from BCE (1996) for long-term average exposures. Specifically, the 24-hour inhalation rate for adults was assumed to be 23 m^3/day, and the 24-hour inhalation rate for children was assumed to be 5 m^3/day. These values were selected to ensure that the exposures (and accompanying risks) calculated for residents of Trail are comparable to risks calculated at other sites (i.e., using recommended values), and because direction from BCE indicates that Canadian regulatory values should be given precedence in determining exposure assumptions for this evaluation. It should be noted, however, that a recent re-evaluation of available studies of inhalation rates suggested a long-term average daily inhalation rate of 11.3 m^3/day for women, 15.2 m^3/day for men, 4.5 m^3/day for infants (<1 year old), and 7.7 m^3/day for children (0.5–10 years old, average for males and females) (U.S. EPA 1997). Therefore, inhalation exposures in this risk assessment may be overestimated for adults, and possibly underestimated for children.

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[8] That is, the "residential" aspect of farming-associated risk is presented along with other residential risks, differing only in that the concentration data used in the calculations are representative of agricultural sampling locations (i.e., Waneta).

Little information is available regarding the specific exposures of farmers around Trail. Therefore, the assumptions of exposure incorporated into this assessment were based largely on professional judgment and precedent established by their use in other risk assessments of farming and ranching communities.

The exposure assumptions for soil ingestion rate and exposure frequency (480 mg/day, and 14 days/year, respectively) were based on values presented in a report titled *Baseline Risk Assessment for the Anaconda Smelter NPL Site, Anaconda, Montana* (CDM 1996). In that assessment, the goal was to evaluate the possible high-level exposures associated with plowing or other high-contact-rate activities that might occur occasionally during agricultural work. Because of the similarities between the target populations being evaluated in Anaconda and Trail, and the similarities in the regional location (i.e., western North America, with similar climates), these values were determined to be applicable in Trail.

It was assumed that agricultural tilling operations require the expenditure of energy associated with a moderate level of activity. Therefore, an inhalation rate of 1.6 m^3/hour was used to characterize agricultural exposures, based on the inhalation rate presented in U.S. EPA (1997) for a moderate activity level. Note that Fox (1990) presents a different inhalation rate for moderate levels of activity, and references U.S. EPA (1989) as the basis for that value. Because U.S. EPA (1997) provides updated information for exposure values, the updated inhalation rate was used in this assessment, rather than that from U.S. EPA 1989 (or from Fox 1990).

The exposure duration of 55 years was intended to include the period when a teenager might be learning the farming trade, through retirement (i.e., ages 15–70), and is based on professional judgment and conversations with staff at BCE (Fox 1998, pers. comm.).

Assumptions used in estimating exposures incurred under the agricultural exposure scenario are summarized and presented in Tables 16 and 17.

Toxicity Assessment

The basic objective of a toxicity assessment is to identify the adverse health effects that a chemical causes, and to determine the extent to which the appearance of these adverse effects depends on dose. In addition, the toxic effects of a chemical may depend on the route of exposure (oral or inhalation in this evaluation) and the duration of exposure (subchronic, chronic, or lifetime). Thus, a full description of the toxic effects of a chemical includes a listing of what adverse health effects the chemical may cause, and how the occurrence of these effects depends on dose, route, and duration of exposure.

Most chemicals can cause adverse health effects at a high enough dose. However, when the dose is sufficiently low, no adverse effect is observed. Therefore, in characterizing the non-cancer effects of a chemical, the key issue is the threshold dose at which an adverse effect first becomes evident. Doses below the threshold are considered to be without effect, while doses above the threshold may cause an effect. To be adequately health protective, non-cancer risk evaluations are not based directly on the threshold exposure level, but on a toxicity value that incorporates uncertainty factors to ensure that the threshold will not be exceeded. The toxicity value for oral exposures is referred to as the Reference Dose (RfD). For inhalation exposures, the value is the Reference Concentration (RfC). The RfD or RfC is an estimated lifetime daily exposure that is likely to be without an appreciable risk of deleterious effects.

For the chemicals evaluated in this assessment that are believed to cause cancer following exposure, it is assumed that the dose-response curve for cancer has no threshold, and that any exposure has an associated risk of causing cancer. Therefore, the carcinogenic slope factor, or CSF, is the slope of the dose-response line for carcinogenic effects from exposure.[9] The CSF is used to estimate the incremental lifetime risk of developing cancer, corresponding to the estimated exposure levels calculated in the exposure assessment.

Toxicity values (i.e., the CSFs, RfDs, and RfCs) were obtained mostly from BCE, and are listed in Tables 21 and 22. As indicated in these tables, BCE recommends the use of toxicity values from Health Canada when they are available, and then defaults to values from U.S. EPA's Integrated Risk Information System (IRIS), when none are available from Health Canada.

[9] In fact, the cancer slope factor is often an upper 95th percentile confidence limit on the slope of the dose-response line, and is therefore an upper-bound estimate of risk.

Because BCE allows the use of toxicity factors from other sources,[10] when appropriate, additional toxicity values were considered for use in this assessment. Examples of these alternative toxicity values include the following.

Antimony — No toxicity value was provided by BCE for assessing risks from inhalation exposures to antimony. Because it was a goal of this risk evaluation to characterize risks for all routes of exposure, a U.S. EPA inhalation toxicity criterion for antimony was incorporated to the extent possible. Specifically, the RfC for antimony trioxide was used to assess inhalation exposures to antimony. Although the EPA documentation for this value indicates that this toxicity criterion is specific to antimony trioxide, and should not be applied to other forms of antimony, antimony trioxide is the expected form of antimony in air following thermal reactions such as those related to smelting.

Cadmium — In addition to using the standard RfD, risks from exposure to cadmium were also assessed using an alternative cadmium toxicity value. As described in Technical Memorandum 2.1, and in the Introduction to this document, there are significant background sources of exposure to cadmium. Therefore, we derived an estimate of tolerable daily cadmium intake that accounts for background exposures in determining risks associated with incremental cadmium exposures above background in Trail. This approach considered background exposures from food, drinking water, air, and smoking. Separate estimates of acceptable cadmium exposure levels have been developed for nonsmokers and smokers. These toxicity values, referred to as "absorbed-dose RfDs" represent the benchmark absorbed dose for cadmium. This is in contrast to the RfD value provided by BCE, which is presented as an *administered dose*. Risk estimates for noncancer endpoints of toxicity from cadmium were evaluated using both the toxicity value provided by BCE and the absorbed-dose RfD values for smokers and non-smokers. Because of the difference between the toxicity values for cadmium with regard to being expressed as administered or absorbed doses, the exposure estimate used to evaluate risks with each of these RfDs was also different. This is discussed further below.

Generally, it is not appropriate to evaluate risks from one route of exposure (e.g., inhalation) based on a toxicity value derived from a different route of exposure (e.g., ingestion) (U.S. EPA 1989). However, because the absorbed dose RfD for cadmium is expressed as an absorbed, rather than administered, dose, and because the target organ of toxicity is remote from the point of exposure (i.e., toxicity is related to accumulation of cadmium in the kidney following systemic absorption and distribution), the absorbed dose RfD has the additional benefit of allowing the assessment of integrated inhalation and ingestion exposures. Therefore, this is how it was used in this risk evaluation.

The derivation of the absorbed-dose RfD incorporates the premise that cadmium toxicity is associated with the accumulation of cadmium in the kidney over a lifetime of exposure

[10] Examples include U.S. EPA's health effects assessment tables (HEAST), U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry (ATSDR), the World Health Organization (WHO), the open scientific literature, and special-purpose derivations (Fox 1995).

(this is described fully in Technical Memorandum 2.1). A new report from U.S. EPA's National Center for Environmental Assessment (NCEA) provides specific confirmation of the long averaging time in deriving the cadmium RfD (U.S. EPA 1999). This report actually proposes the adoption of a range of RfDs for cadmium: 0.0005 to 0.0007 mg/kg-day, in contrast to the existing single value of 0.0005 mg/kg-day. U.S. EPA indicates that these proposed RfDs are explicitly inclusive of dietary exposure, and the range is intended to accommodate receptor populations with different levels of background dietary intake of cadmium.[11] Smoking-related intake of cadmium was not considered in deriving this RfD range, but U.S. EPA acknowledged that cadmium intake from smoke "would lesson the period of time in which the critical urinary excretion rate would be attained to less than 70 years." The RfD for cadmium recommended by BCE and incorporated into this risk assessment is 0.00081 mg/kg-day, slightly above (and therefore less health protective than) the range recommended by NCEA.

Important to the discussion provided in the NCEA document is the fact that U.S. EPA explicitly states that these RfDs are based on lifetime daily oral intake in a general population, which included sensitive populations. This confirms that it is appropriate to use a long-term averaging time in conjunction with the RfD for cadmium, because the critical concentration of cadmium in the kidney is based on an average daily intake over a lifetime of exposure.

A final consideration in assessing the potential for toxicity from cadmium is the potential for interactions of zinc and cadmium. A number of studies have demonstrated an antagonistic effect by zinc on cadmium toxicity (i.e., zinc reduces cadmium toxicity). A summary of these issues was provided to the TLP as an appendix to the Phase 1 Recommendations for Subsequent Risk Assessment for Non-Lead Constituents at Trail, British Columbia (PTI 1997). In addition to the potential decreases in toxicity from cadmium discussed in that document, additional research indicates that co-exposure of plants to soil containing both cadmium and zinc can result in complexes of cadmium in the plant tissue (McKenna and Chaney 1991, 1995; McKenna et al. 1992, 1993). These complexes may affect the bioavailability of cadmium following ingestion (McKenna and Chaney 1991; McKenna et al. 1992). The literature on this subject is not adequate to allow a quantitative adjustment to the exposure or toxicity assessment in the HHRA, but suggests that actual exposures (and associated risks) may be significantly lower than estimated herein.

Arsenic — Standard toxicity values (i.e., RfDs and CSFs from Health Canada or U.S. EPA's IRIS database) were used in assessing risks associated with ingestion or inhalation of arsenic in Trail. In interpreting the cancer risk estimates yielded from this effort, it is important to recognize that use of the arsenic CSF is likely to result in significant overestimates of cancer risks. The arsenic CSF is based on a skin cancer study in Taiwan of individuals who were exposed to elevated levels of arsenic in drinking water (Tseng et

[11] For EPA's assessment, dietary intake of cadmium was assumed to range from 0.14 μg/kg-d for persons with typical diets to 0.3 μg/kg-d for persons consuming foods high in cadmium, such as shellfish (U.S. EPA 1999).

al. 1968). Subsequent analyses indicate that this study is not appropriate to use for a dose-response assessment of arsenic (Brown et al. 1997; Chappell et al. 1997; Guo et al. 1998). Each village in the Tseng study was grouped based on the average arsenic concentration reported for the wells tested in that village ("low," 0–300 μg/L; "medium," 300–600 μg/L; "high," >600 μg/L), but the actual concentrations of arsenic in the wells were highly variable. For example, the concentrations measured in the "low" villages ranged as high as 770 μg/L, making estimation of representative exposure concentrations for each village highly uncertain. It is likely that individuals in the "low" exposure group actually could have had exposures well above the 170-μg/L level used to represent that group. The result of this misclassification is likely an overestimation of risk at low exposure levels, which affects extrapolation of the results to North American populations. In addition to the limitations in the exposure characterization for the Tseng study, there are uncertainties regarding the impact of nutritional differences between Taiwan and North America. The Taiwanese diet is low in protein, and both human and animal studies (Mazumder et al. 1997; Hseuh et al. 1995; Zakharyan and Aposhian 1999) indicate that protein deficiencies could affect the ability to detoxify high levels of arsenic exposure, leading to an enhancement of arsenic carcinogenicity. In particular, the amino acid methionine may supply the substrate used to detoxify arsenic from the more toxic inorganic forms to the less toxic organic forms. Such inadequate levels of nutrition are unlikely to occur in North America. As a result, application of the CSF based on Taiwanese populations to North American populations may result in an overestimate of risks.

Recently, two meta-analyses of arsenic drinking water studies have been published that provide evidence that the arsenic CSF overestimates cancer risk. The first, published by Guo and Valberg (1997), evaluated skin cancer incidence in 29 populations from Taiwan, the U.S., India, Mexico, and Japan, exposed to levels of arsenic in drinking water ranging from 117 to 270 μg/L. Significantly more skin cancers were predicted using the EPA cancer slope factor than were observed, providing evidence across a range of populations that the arsenic CSF is an overestimate. Similarly, a meta-analysis of U.S. populations exposed to arsenic in drinking water concluded that it was twice as likely that there was no skin cancer due to arsenic exposures than that there was skin cancer due to arsenic exposures (Valberg et al. 1998). Furthermore, no skin cancer has ever been observed to be associated with arsenic in drinking water in several studies of U.S. populations (Valberg et al. 1998; Valentine 1994). The results of these studies provide further evidence that the arsenic CSF is likely an overestimate, particularly for North American populations.

Finally, the current arsenic CSF is modeled assuming low-dose linearity; that is, that even a very small dose of arsenic confers some excess cancer risk. In fact, based on mechanistic information, the dose-response relation is likely non-linear. From a toxicological perspective, low doses of arsenic are likely to be relatively less effective than high doses, and in fact, might be associated with zero risk. Unlike many other carcinogens, arsenic does not interact directly with DNA to cause point mutations. Based on an extensive literature review, arsenic shows primarily a non-linear dose response relation for other types of genetic alterations, such as chromosomal alterations (Rudel et al. 1996). Arsenic may act through a variety of different mechanisms, including chromosomal alterations, changes in methylation status of DNA, and alterations in gene transcription (for example, Zhao et al. 1997; Shimizu et al. 1998; Snow et al. 1998; and Germolec et al. 1997), all of which are consistent with a non-linear dose-response relation. An expert panel convened by the U.S. EPA similarly concluded that the shape of the arsenic dose-response relation is likely non-linear (ERG 1997); however, U.S. EPA determined that the available evidence was not adequate to support a revision of the oral arsenic CSF at this time. Because the current CSF for arsenic is modeled assuming low-dose linearity, it is likely to overestimate risks associated with the lower levels of exposure present in and around Trail.

All toxicity values, as well as their endpoints of toxicity and sources, are presented in Tables 21 and 22.

required to effect a reduction in risk. However, if the CSF for ingested arsenic is high by several orders of magnitude (as discussed in the Toxicity section), then this conclusion would be inappropriate.

Conclusions

The Phase 3 assessment of risks from exposure to non-lead CoPCs in Trail incorporates all of the most recent data available from the site into deterministic estimates of cancer and noncancer risks associated with exposures under residential, commercial, and agricultural exposure scenarios. The new data available for this phase of the assessment process included updated air concentration data from Trail, air concentration data from a background location that is not believed to be influenced by operations at the Cominco facility, data on indoor dust concentrations of CoPCs from 57 properties, and data on the concentrations of CoPCs in produce from home gardens and retail outlets in the area.

Air

The addition of data from a background monitoring station allowed a determination to be made as to whether Trail-area air is affected by smelter operations. Comparison of mean air concentrations of the PM_{10} fraction for arsenic and cadmium indicates that the concentrations of these CoPCs in neighbourhoods around Trail are at least 10-fold higher than the corresponding concentrations from the background area. This indicates that there is a local impact on ambient air conditions. However, a comparison of the exposure-point concentrations for CoPCs in air that were used in Phases 2 and 3 of the risk assessment process indicates marked improvement in air concentrations since the new smelter began operating (Table 37). The possible implications of this apparent trend are discussed further below.

Dust

The data on CoPC concentrations in indoor house-dust samples that were collected in August and September of 1998 were combined with the data from 20 properties that were sampled in April of 1998. A statistical analysis was undertaken to determine whether a consistent regression relation could be established between indoor dust and exterior soil concentration data from the same residential property. The data did not provide an adequate indication of a relation, and dust data were used directly to calculate UCLM concentrations to use in assessing exposures to indoor dust in the different neighborhoods. In the Phase 2 assessment, exposures were calculated assuming that the concentrations of CoPCs were equal in soil and dust. As indicated in Table 38, using the indoor house dust directly provides exposure-point concentrations that are somewhat different than those used in the Phase 2 assessment. For antimony and cadmium, the exposure-point concentrations for indoor dust generally increased in the Phase 3 assessment. This increase is small (approximately a 2-fold difference), except for Waneta, where there is a 5-fold increase in the Phase 3 exposure point concentration for cadmium. For arsenic, the Phase 3 exposure-point concentrations using indoor dust data are slightly lower than the Phase 2 values derived from soil data. In West Trail, this relation is the inverse, with the Phase 3 concentration slightly elevated from the value used in Phase 2.

The availability of specific indoor dust data strengthens the risk assessment by providing a mechanism for directly estimating exposure to this medium instead of having to rely on the assumption that house-dust concentrations of CoPCs reflect outdoor soil concentrations. The impact on the final estimate of risk will be relatively small, given that the differences in exposure-point concentrations from the Phase 2 and 3 analyses are generally within a factor of 2.

Produce

A screening-level evaluation included in the Phase 2 assessment indicated a possibility that the exposures to CoPCs associated with the consumption of locally grown produce may approach the exposure levels associated with inadvertent ingestion of soil and dust. Specifically, the Phase 2 assessment predicted that exposures to arsenic in homegrown produce would be approximately 4- to17-fold below potential exposures via soil ingestion, and that exposures to cadmium from homegrown produce may exceed exposures from soil ingestion by a factor of greater than three (Exponent 1998). The produce that was collected and analyzed as part of the Phase 3 assessment provided the empirical data to directly evaluate the magnitude of exposures associated with the ingestion of homegrown produce. The produce data indicated that the concentrations of arsenic and cadmium (antimony was not an analyte for produce) in homegrown crops were elevated relative to commercially available products. The concentration of cadmium in homegrown produce was elevated over that in the retail produce, frequently by as much as an order of magnitude. Arsenic concentrations were also elevated relative to the retail produce, but generally to a lower extent than cadmium. Estimates of risk associated with the soil/dust and produce ingestion exposure pathways indicate that the estimated exposure to arsenic and cadmium from ingestion of produce exceeded the exposures associated with ingestion of soil and dust for adults (exposures from produce consumption were not evaluated for children). This can be deduced from Table 33 by comparing the risks from produce ingestion, relative to the risks associated with adult ingestion of soil/dust. These calculations indicate that exposure to cadmium from produce may be more than 10-fold higher than from ingestion of soil/dust. For arsenic, exposures from homegrown produce are estimated to be higher than from soil/dust, but by a factor of 5 or less.

Estimates of Risk

The results of this Phase 3 evaluation indicate that the risks for noncancer endpoints of toxicity are low, as demonstrated by the fact that all calculated hazard index values, for all CoPCs, and under all exposure scenarios, are less than one. In addition, HIs for exposure to cadmium are less than one, even after taking into account anticipated background exposures to cadmium (i.e., HI values based on the absorbed-dose RfD for cadmium).

Calculated cancer risks associated with the neighbourhoods included in this evaluation range from 1×10^{-4} to 2×10^{-4}, across all chemicals and exposure routes evaluated in this assessment. In general, the calculated cancer risks are generally highest for risks associated with inhalation exposures to arsenic; overall however, cancer risks estimated for exposure to all CoPCs are distributed relatively evenly across the exposure pathways (i.e., there is little difference between risks calculated for inhalation, ingestion of soil and dust, or ingestion of homegrown produce). For the commercial areas of East and West Trail, where there is no associated produce ingestion, total cancer risks are either equally distributed between ingestion of soil and dust and inhalation exposures (West Trail), or higher (3 fold) for inhalation exposures. For field activities by farm families in Waneta, calculated risks from soil ingestion exceed risks from inhalation.

As far as determining which of the CoPCs is the largest contributor to risk, the calculations indicate that for all scenarios, cancer risk estimates associated with exposure to arsenic are uniformly at least an order of magnitude higher than the cancer risk estimates for cadmium. The only exception is for exposures in commercial areas of East Trail, where the risk estimate for arsenic is 8-fold higher than the estimate for exposures to cadmium.

The impact of these findings on consideration of different remediation approaches is discussed further below.

Interpretation

Although the risks for inhalation exposures in areas other than Waneta are generally higher, cancer risk estimates associated with ingestion of soil, dust, and produce fall within a factor of 2 or 3 of the risk estimates for inhalation. This suggests that all exposure pathways included in this assessment contribute nearly evenly to total risks. In interpreting these calculated risks, however, it is important to keep in mind the uncertainties associated with the input variables, as discussed above and summarized in Table 36. Based solely on the assumed residence time of 75 years, the estimates of cancer risk exceed the more standard estimates of reasonable maximum exposure by more than a factor of two. Uncertainties associated with other exposure considerations (e.g., soil ingestion rates, inhalation rates, produce concentrations of CoPCs) suggest that risk estimates are inflated, possibly by another factor of two. Additional considerations in interpreting the findings of the risk assessment are described below.

Risks from Ingested Arsenic

As discussed in the Toxicity and Uncertainty sections, there is considerable uncertainty in the carcinogenic slope factor (CSF, with which risk estimates are derived from calculated exposure) used in assessing risks from oral exposures to arsenic, and there are reasons to suspect that this CSF may overestimate risks by several orders of magnitude.

As described above in the Introduction and in Technical Memorandum 2.1 (Exponent 1998), inorganic arsenic is present naturally in soil, food, water, and air. Consequently, all people are exposed naturally to some level of arsenic each day. Adult nonsmokers are thought to have an average absorbed daily dose of almost 9 μg/day. For populations that do not have elevated arsenic concentrations in their drinking water, ingestion of arsenic in food is the primary source of exposure. Air is a negligible contributor to background exposures.

Consequently, it is appropriate to compare estimates of the amount of arsenic ingested in Trail with these background exposures. For the cancer risk estimates, the highest estimated daily intakes of arsenic from soil and dust were for Rivervale, where the chronic daily intake of arsenic from soil and dust ingestion totaled 0.053 μg/kg-day (including the relative bioavailability adjustment for absorption from soil and dust of 55 percent). For a 70-kg person, this yields an intake of 3.7 μg/day. If 80 percent of ingested arsenic is absorbed, this equals an absorbed dose of 3 μg/day, which is approximately one-third of the expected background exposure of almost 9 μg/day. This comparison provides the perspective that, on average, incremental exposures to arsenic from soil and dust in Trail will increase total exposures to about 30 percent more than background exposures alone. Risks from arsenic associated with ingestion of homegrown produce are close to those contributed from soil and dust ingestion. Therefore, taken together, soil, dust, and homegrown produce may increase total arsenic exposures to about 60 percent more than background exposures alone.

Additionally, although the analyses of homegrown produce from Trail indicate that arsenic concentrations are higher in these products relative to produce retailed in Trail, this must be interpreted within the context of relative consumption rates. It is estimated that retail produce accounts for 93 percent of all produce ingested, and only 7 percent of total produce consumption comes from homegrown food. Therefore, although concentrations of arsenic in the homegrown produce may be as much as an order of magnitude higher than concentrations in the retail produce, the overall exposures to arsenic that occur from consumption of produce are likely to be higher for retail produce than for homegrown produce.

In addition to the point that exposures to arsenic from soil in Trail are less than background exposures, the CSF for arsenic likely overestimates risks from oral exposures to arsenic. These issues are described more fully in the Recommendations document that was prepared as part of the Phase 1 effort for Trail (PTI 1997), and in the Toxicity and Uncertainty sections, above. This likely overestimate of risk suggests that, although calculated risks for ingestion exposures to arsenic from soil or produce approach the 10^{-4} range (i.e., the highest calculated cancer risk from soil/dust ingestion was 9×10^{-5}, and calculated cancer risks associated with consumption of produce in neighbourhoods "near" the facility are 4×10^{-5}), actual risks are likely to be much lower.

Because the appropriateness of the CSF used to generate risk estimates for ingestion exposures to arsenic has recently been called into question, this value is currently under review by the U.S. EPA. If the U.S. EPA determines that the latest information indicates a need to change the CSF, it is likely that BCE would similarly consider a re-evaluation of this toxicity criterion. It would be appropriate to re-evaluate the calculated ingestion risks for Trail if a new CSF becomes available.

If, in fact, the current CSF does overestimate the cancer risk associated with the ingestion of arsenic, then allocating resources to limit soil/dust ingestion exposures or the consumption of homegrown produce will be ineffective in changing the actual level of risk (as opposed to addressing inhalation exposures).

Impact of Air Emissions

It appears that inhalation exposures are the result of a single source, because exposure-point concentrations for CoPCs in air show much less variability among neighbourhoods than do exposure-point concentrations for soil (e.g., a two-fold variability for concentrations of arsenic in air, versus a six-fold variability in soil arsenic concentrations) (Table 9). A source evaluation for lead in air (TLP 1995) supported the position that a single source was responsible for concentrations of CoPCs in air. In this analysis, the TLP established that smelter emissions far outweighed re-entrainment of outdoor soils or dust as the source of lead in the air. This conclusion was based on analyses of seasonality (e.g., air lead concentrations related to precipitation or snow cover), wind direction versus air concentrations, and measured fallout of lead from air. This is likely to be true even with the introduction of the new smelter since the source evaluation analysis was conducted.

Because inhalation exposures appear to be tied to a single source, and the ingestion exposures evaluated in this assessment are tied more closely to exposures to CoPCs in soil, the results of the risk analysis can be used to guide future remediation actions in Trail. It is likely that air emissions of CoPCs contribute to the elevated concentrations of these metals in all media evaluated, and that decreasing air emissions will affect exposures and associated risks from both inhalation and ingestion pathways of exposure. Fallout of CoPCs from air onto soils and outdoor surfaces, and into interior house dust correlates directly with the concentrations of these metals in air. Given an ongoing source of CoPC emissions to air, remediation of soil may do little to reduce exposures. This may be partly true because "soil exposures" are actually likely to reflect exposures that result from contact with outside surfaces (e.g., pavement) rather than direct contact with soils. For produce grown in the area, tissue concentrations of CoPCs will reflect the indirect effect of metals deposited onto soils, but may also reflect direct deposition onto foliar surfaces. The analyses of homegrown produce collected from the Trail area indicate that the leafy portion of the produce contains the highest concentrations of CoPCs. The available data do not allow us to identify the source of the CoPCs in the leafy produce; however, it is reasonable to assume that their presence reflects uptake or adherence following deposition, as well as uptake from soils.

At this writing, the new Cominco smelter has been on line for more than two years, and the air data used in this assessment were collected since the new smelter was activated. Comparison of calculated cancer risks from Phases 2 and 3 (Table 39 and Figure 5) indicates that for all neighbourhoods except East Trail, risks from inhalation have decreased markedly during the past two years. Cominco staff have indicated that they continue to implement operational changes that will further reduce air emissions from the Trail facility (Sentis 1999, pers. comm.).

Given the contribution of these emissions to exposure (both inhalation and ingestion routes of exposure, as explained above), it would be reasonable to expect that exposures to COPCs will decrease as emissions from the facility are further controlled. Monitoring of human exposure levels associated with the decreases in emissions would be the ideal mechanism for determining the benefits from the smelter improvements. The long history of monitoring Trail residents' blood lead levels will support future monitoring to determine trends in blood lead levels. The correlation between blood lead levels and smelter operations can provide an important indication of the decreases in human exposure to all metals in smelter-related emissions. The assessment of exposure to lead, expressed as blood lead levels, is likely an adequate surrogate for exposure to other smelter-related metals such as the CoPCs considered in this assessment. At present, the only established relation between smelter emissions and blood lead levels in Trail is for young children. However, children are likely the most sensitive receptors because of both behavior and physiological characteristics, and will provide an indication of changes in exposure levels across all age groups.

Taken together, the findings of this evaluation indicate that there is no imminent threat to human health in Trail from metals other than lead. Further, the potential for adverse health effects from long-term residence in Trail is very limited. The main focus of ongoing study should be to continue air monitoring for arsenic, cadmium, and lead. Specifically, the PM_{10} fraction should be measured, and detection limits should be low enough to ensure health protection, and to support any future risk evaluations. A trend in decreasing air concentrations of all these metals, combined with ongoing blood lead monitoring to assess whether there is an associated decline in human exposures to air emissions (assumes that lead is an adequate surrogate for the other site CoPCs, as discussed above), should provide assurances regarding the risks to which area residents are exposed.

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Figures

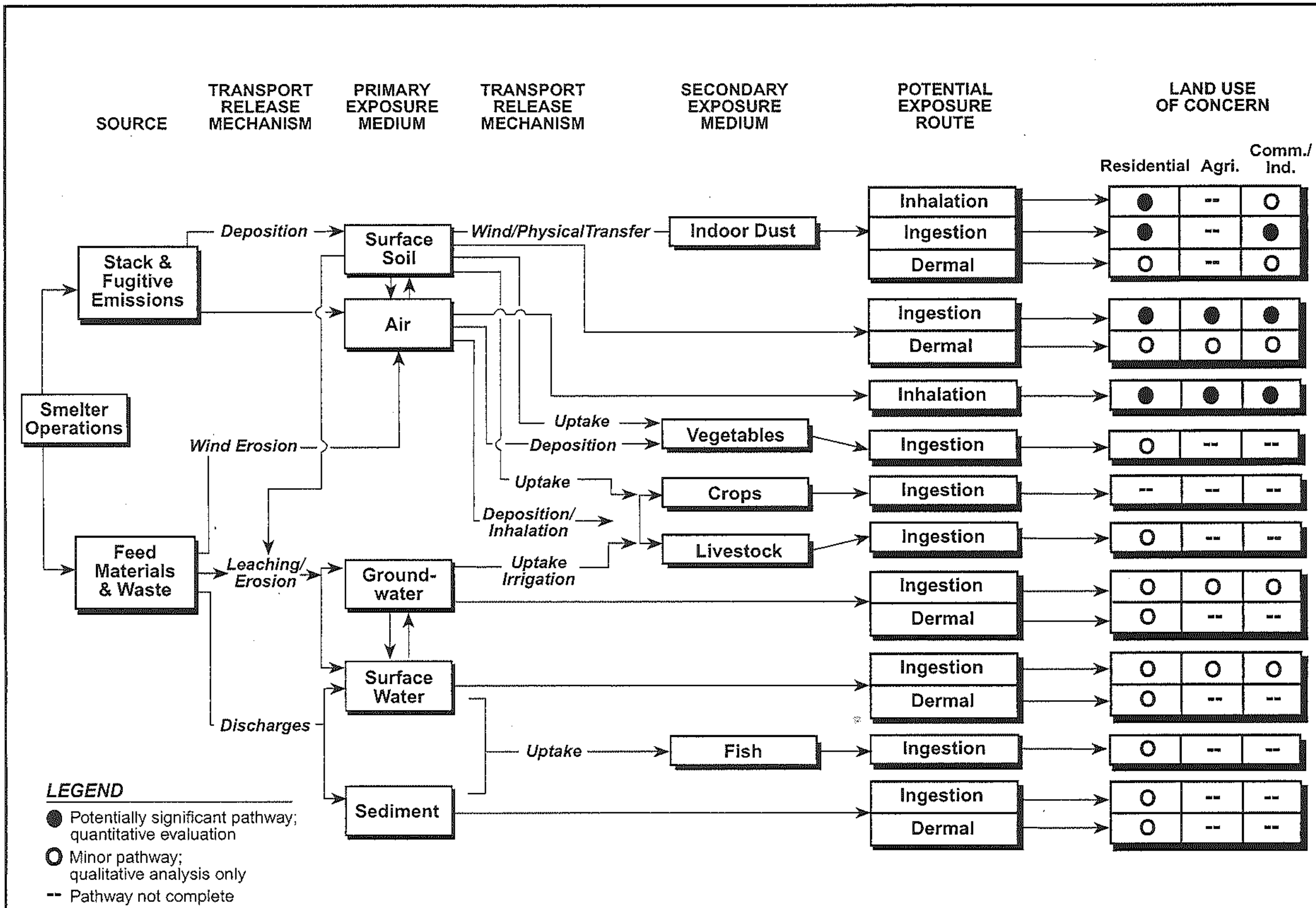

Figure 1. Antimony: conceptual site model for Trail, British Columbia.

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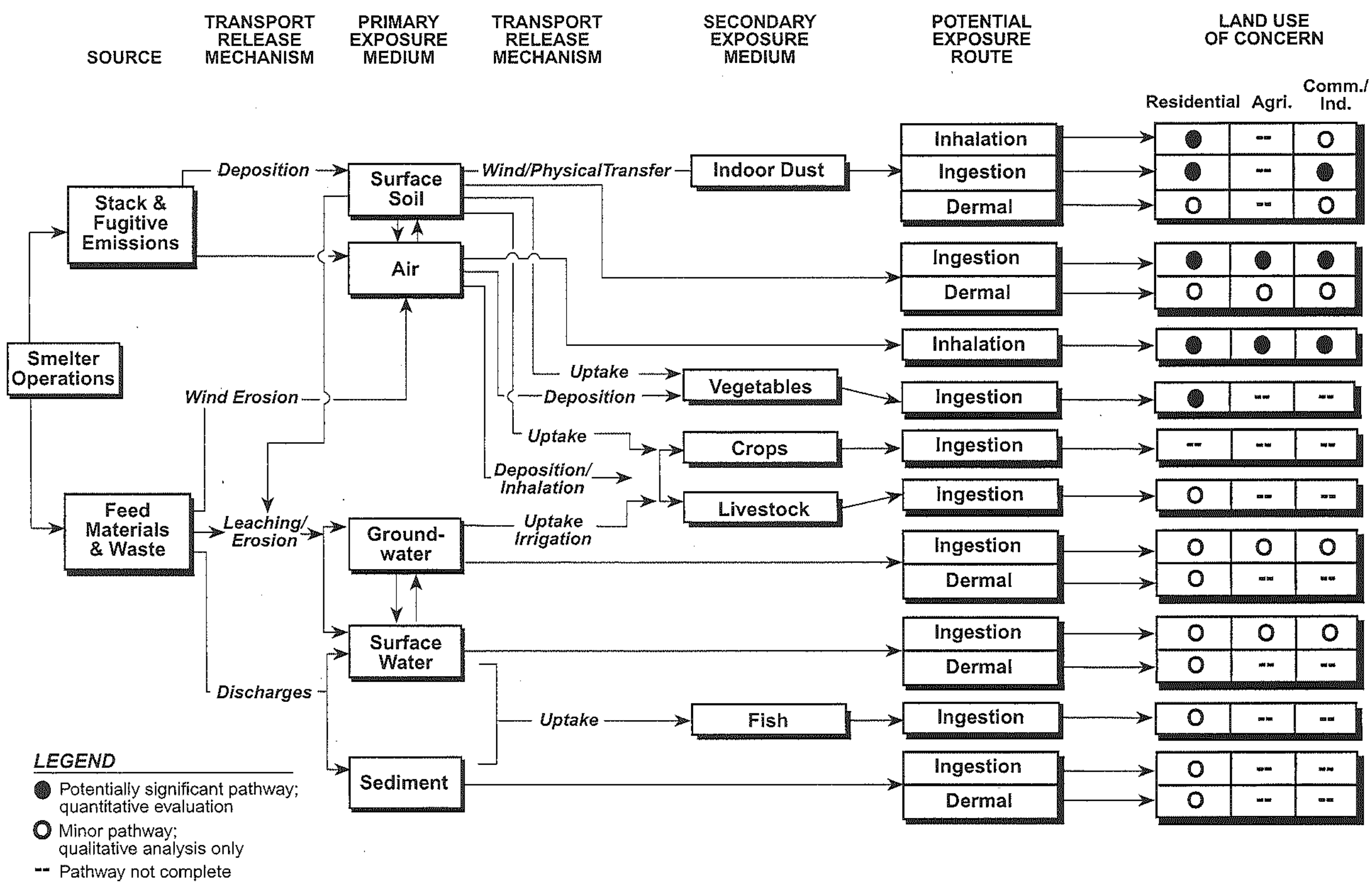

Figure 2. Arsenic: conceptual site model for Trail, British Columbia.

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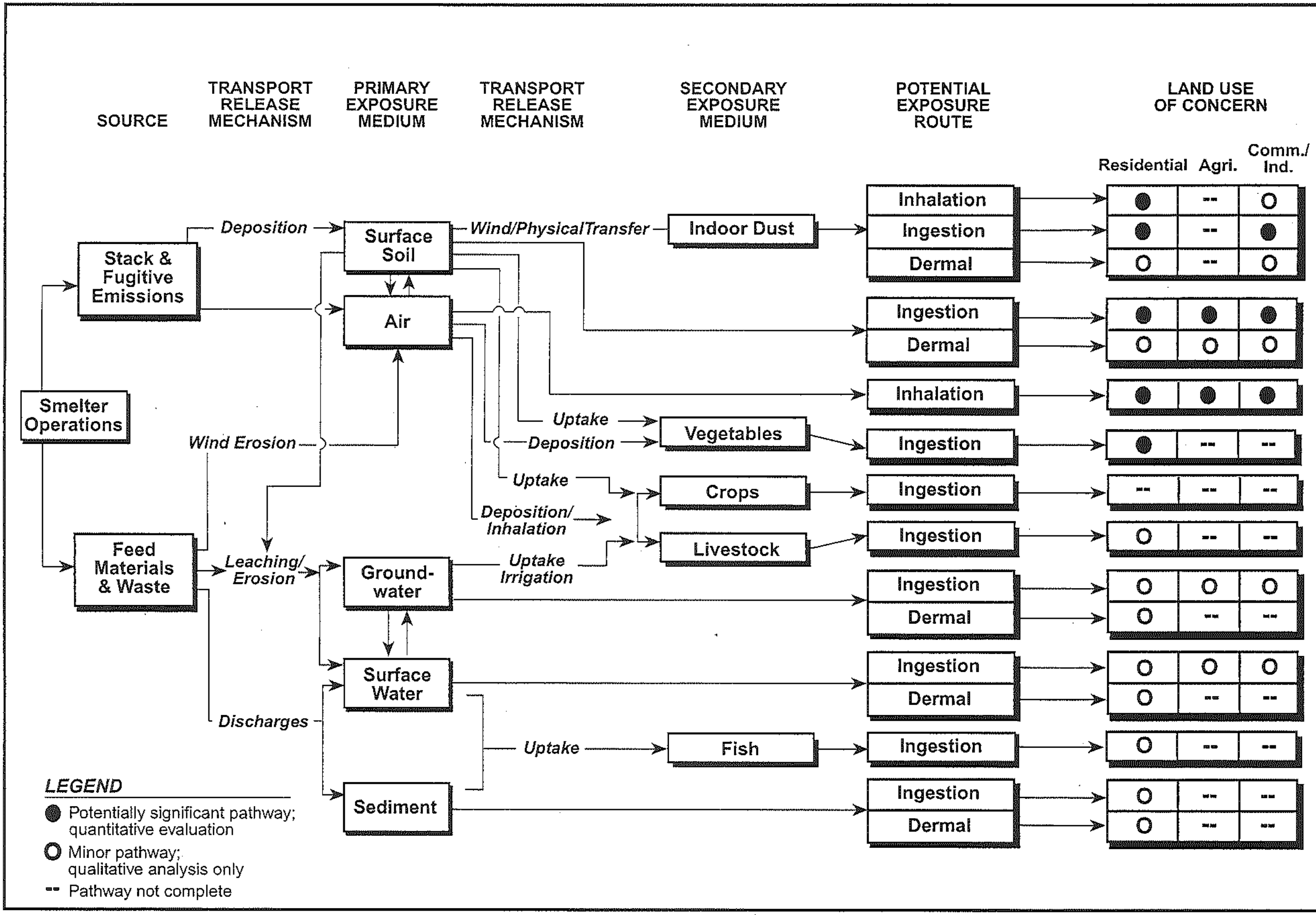

Figure 3. Cadmium: conceptual site model for Trail, British Columbia.

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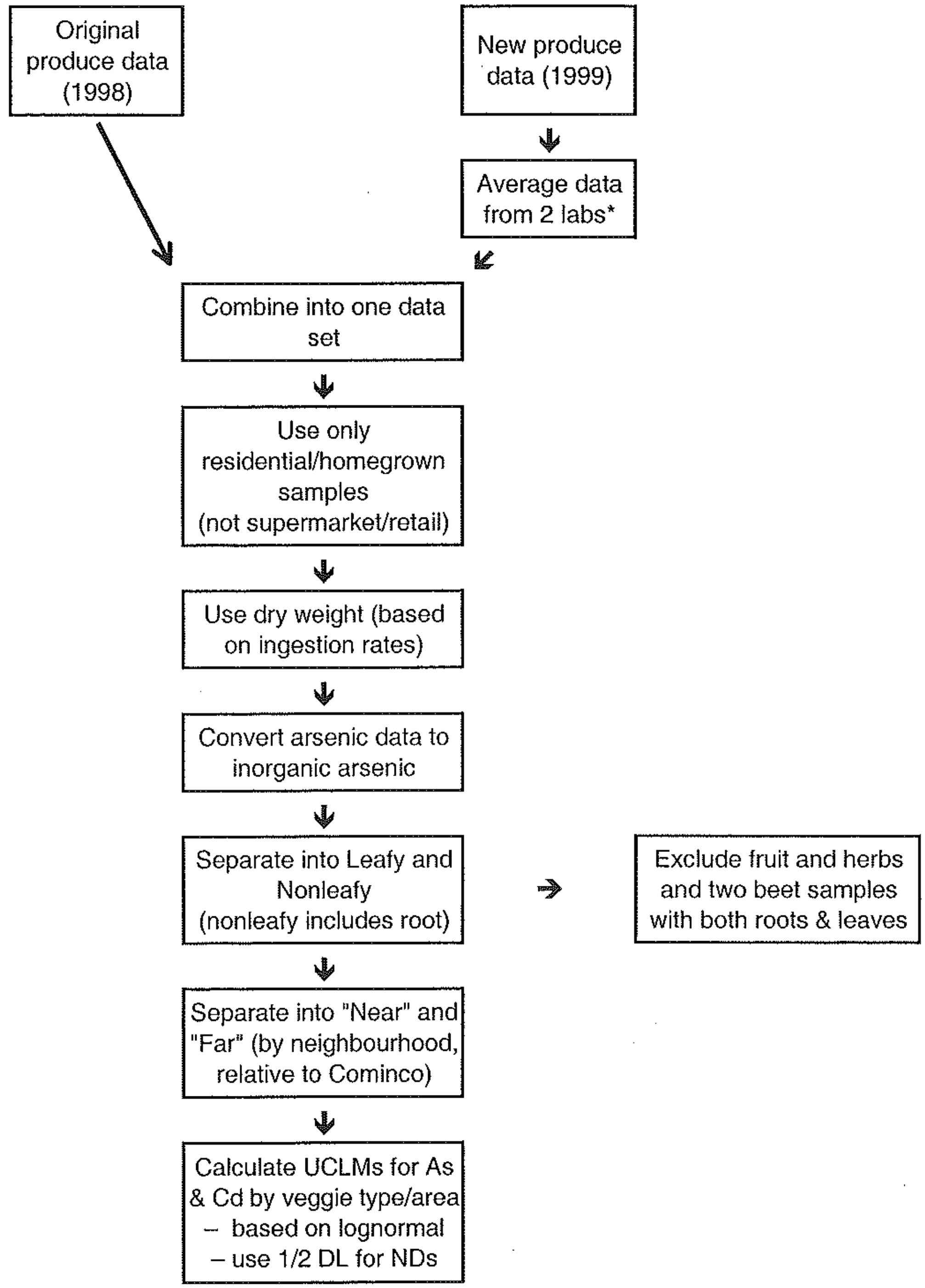

* Rules for averaging

If both results were detected, values were averaged normally.

If both results were non-detects, the lowest of the two detection limits was selected.

If one result was detected, and one result was a non-detect, and the detected value was lower than the non-detect, then the detected value was selected.

The case did not occur where one result was detected, and one was a non-detect, with the detected value being higher than the non-detect.

Figure 4. Data treatment for calculating produce exposure-point concentrations.

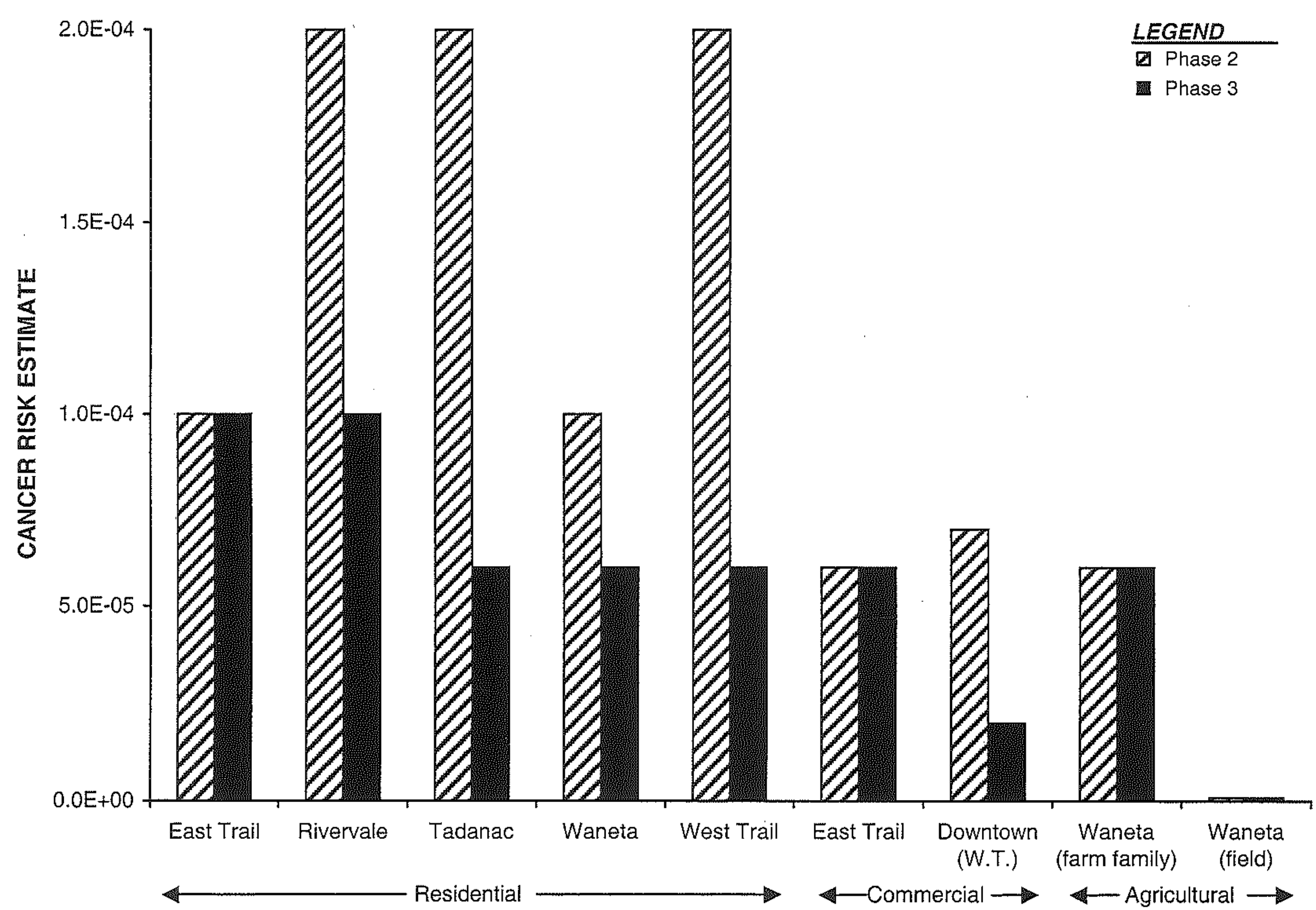

Figure 5. Comparison of Phase 2 and Phase 3 cancer risk estimates via inhalation (sum of all chemicals).

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Tables

Table 1. Chemicals of potential concern considered

	Eliminated in Phase 1	Eliminated in Phase 2	Evaluated in Phase 3
Antimony			●
Arsenic			●
Barium	X		
Beryllium	X		
Cadmium			●
Chromium	X		
Cobalt	X		
Copper	X		
Fluoride	X		
Mercury		X	
Molybdenum	X		
Nickel	X		
Selenium		X	
Silver	X	X	
Thallium		X	
Tin		X	
Vanadium	X		
Zinc		X	

Table 2. Summary of soil concentration data

(All concentration terms expresses as mg/kg)

Neighbourhood	Land Use[a]	Statistic	Antimony	Arsenic	Cadmium
East Trail	Commercial	Count	1	6	6
		Minimum	78.0	16.0	7.25
		Average	78.0	65.2	32.5
		Maximum	[78.0]	[185]	[103]
		UCLM	--	250	224
East Trail	Residential	Count	12	60	60
		Minimum	11.6	13.0	5.30
		Average	54.6	72.5	29.9
		Maximum	144	340	129
		UCLM	[107]	[92.0]	[37.2]
Rivervale	Residential	Count	15 [b]	15	15
		Minimum	8.35 [b]	13.0	2.27
		Average	67.6 [b]	87.8	9.26
		Maximum	350 [b]	420	30.0
		UCLM	[140] [b]	[169]	[14.3]
Tadanac	Residential	Count	13	15	15
		Minimum	12.5	17.2	5.90
		Average	47.7	74.0	25.7
		Maximum	103	140	37.9
		UCLM	[75.9]	[107]	[34.1]
Waneta	Agricultural	Count	6	6	6
		Minimum	10.0	15.9	2.90
		Average	25.2	41.2	7.27
		Maximum	[50.0]	[72.9]	[13.2]
		UCLM	63.9	87.6	13.3
Waneta	Residential	Count	1	4	4
		Minimum	26.0	3.00	1.30
		Average	26.0	16.5	3.42
		Maximum	[26.0]	[28.7]	[5.00]
		UCLM	--	975	17.4
West Trail	Commercial	Count	6 [b]	6	6
		Minimum	8.35 [b]	13.0	1.10
		Average	19.4 [b]	28.4	13.6
		Maximum	[28.0] [b]	[40.0]	[26.7]
		UCLM	31.1 [b]	43.5	246
West Trail	Residential	Count	14	53	53
		Minimum	3.60	12.3	4.00
		Average	20.5	49.2	23.5
		Maximum	53.5	190	88.0
		UCLM	[33.4]	[59.5]	[29.9]

Note: All calculations involving non-detects used one-half the detection limit.

UCLM – 95 percent Upper Confidence Limit on the Mean; calculated assuming a lognormal distribution

-- – not applicable

[ ] – indicates value selected as the exposure-point concentration.

[a] The "Residential" category includes areas designated as "Parks/Recreational", and the "Commercial" category includes areas designated as "Institutional."

[b] These values were predicted based on arsenic concentrations using the equation
$[\text{Antimony}] = 0.509 \times [\text{Arsenic}]^{1.075} \times 1.041$ (see text for details)

Table 3. House dust summary for Trail, B.C.

Neighbourhood	Statistic	Antimony	Arsenic	Cadmium
East Trail	Number of properties	7	7	7
	Minimum (mg/kg)	42.7	25.5	18.7
	Average (mg/kg)	79.4	48.9	36.1
	Maximum (mg/kg)	149.0	81.0	61.0
	UCLM (mg/kg)	[121.5]	[78.0]	[57.8]
Rivervale[a]	Number of properties	1	1	1
	Minimum (mg/kg)	40	26	21
	Average (mg/kg)	40	26	21
	Maximum (mg/kg)	40	26	21
	UCLM (mg/kg)	NA	NA	NA
Tadanac	Number of properties	6	6	6
	Minimum (mg/kg)	56.6	32.9	29.9
	Average (mg/kg)	111.7	63.9	53.6
	Maximum (mg/kg)	[180.5]	[100.0]	[90.0]
	UCLM (mg/kg)	221.8 [b]	108.6 [b]	92.8 [b]
Waneta	Number of properties	4	4	4
	Minimum (mg/kg)	9	7	6
	Average (mg/kg)	17.5	14.5	13.3
	Maximum (mg/kg)	[28.0]	[23.0]	[25.0]
	UCLM (mg/kg)	71.4 [b]	41.9 [b]	83.4 [b]
West Trail	Number of properties	9	9	9
	Minimum (mg/kg)	24.6	17.3	16.5
	Average (mg/kg)	53.6	41.4	38.2
	Maximum (mg/kg)	86.1	133.0	79.0
	UCLM (mg/kg)	[83.4]	[76.0]	[64.6]

Note: Data was compiled from two sampling events: April and August/September 1998. Duplicate samples taken on the same day were averaged first, then an average over time was calculated for each property, then summary statistics were calculated for each neighborhood.

UCLM – 95 percent upper confidence limit on the mean, calculated assuming a lognormal distribution

[ ] – value selected as exposure-point concentration; UCLM was selected unless it exceeded the maximum

[a] For the exposure-point concentration for Rivervale, soil concentrations were used because the sample size was larger. See text for details.

[b] UCLM exceeded the maximum value because of small number of samples, and/or high variability.

Table 4. Comparison of 1998 and 1999 produce sampling data from Trail, B.C.

	Arsenic (mg/kg dry wt.)						Cadmium (mg/kg dry wt.)					
	1998		1999 Cantest		1999 ASL		1998		1999 Cantest		1999 ASL	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Residential												
Leafy	0.05 U	3.7	0.29	4.1	0.19	4.4	2.5	32	1.7	18.7	1.1	35.8 [a]
Nonleafy	0.05 U	1.9	0.3 U	0.3 U	0.05 U	0.05 U	0.05 U	6.9	1.3	1.8	0.63	1.29
Root	0.05 U	0.92	0.1 U	0.28	0.05 U	0.25	0.8	8.1	0.2	7.6	0.18	6.75
Fruit	0.05 U	0.21	--	--	--	--	0.05 U	2.6	--	--	--	--
Total:	0.05 U	3.7	0.1 U	4.1	0.05 U	4.4	0.05 U	32	0.2	18.7	0.18	35.8
Supermarket												
Leafy	0.05	0.40	0.2 U	0.5 U	0.05 U	0.07	0.54	6.8	1.0	1.4	0.75	1.29
Nonleafy	0.05 U	0.42	--	--	--	--	0.05 U	0.50	--	--	--	--
Root	0.05 U	0.15	0.2 U	0.2 U	0.05 U	0.05 U	0.05 U	0.52	0.1	0.1	0.35	0.35
Fruit	--	--	--	--	--	--	--	--	--	--	--	--
Total:	0.05 U	0.42	0.2 U	0.5 U	0.05 U	0.07	0.05 U	6.8	0.1	1.4	0.35	1.29

Notes: The 1998 data summary excludes herbs and two beet samples that were a combination of both roots and leaves.
The 1998 supermarket data summary includes samples collected in September 1998 and January 1999.
U – undetected; value represents detection limit.

[a] The sample with this maximum cadmium result was not analyzed by Cantest because sample was too small to split.

Table 5. Comparison of produce concentrations from Trail sampling versus literature values

	Arsenic (mg/kg, dry wt.)							Cadmium (mg/kg, dry wt.)						
	Dabeka Values			Trail Residential Values			Ratio of Averages, Trail Res./Dabeka	De Pieri Values			Trail Residential Values			Ratio of Averages, Trail Res./De Pieri
Produce	Minimum	Maximum	Average	Minimum	Maximum	Average		Minimum	Maximum	Average	Minimum	Maximum	Average	
Beet	0.022 [a]	0.025 [a]	0.023 [a]	0.11 [b]	0.27 [b]	0.19 [b]	8				2.90 [b]	3.90 [b]	3.40 [b]	
Broccoli	0.001 [c]	0.055 [c]	0.018 [c]	0.09	0.09	0.09	5				0.60	0.60	0.60	
Carrot	0.001	0.048	0.023	0.03	0.92	0.21	9	0.21	0.50	0.34	0.80	8.10	3.68	11
Celery	0.016	0.050	0.032	0.23 [d]	0.23 [d]	0.23 [d]	7				6.90 [d]	6.90 [d]	6.90 [d]	
Corn	0.001	0.065	0.032	0.03	0.03	0.03	1	0.03	0.05	0.04	0.12	0.12	0.12	3
Cucumber	0.002	0.165	0.054	0.90	1.90	1.34	25				0.21	0.80	0.46	
Lettuce	0.001	0.054	0.024	0.03	4.25	1.39	58	0.28	0.39	0.34	1.40	35.8	13.1	39
Onion	0.001	0.100	0.028	0.08	0.08	0.08	3				0.80	1.00	0.90	
Pepper[e]	0.001	0.045	0.019	0.03	0.17	0.10	5				0.34	0.43	0.39	
Potato	0.001	0.055	0.028	0.03	0.09	0.05	2	0.05	1.74	0.37	0.21	1.00	0.62	2
Tomato	0.005	0.013	0.009	0.03	0.07	0.04	4				0.35	1.90	1.05	
Literature values with no matching data from Trail														
Cabbage								0.06	0.12	0.086				
Cauliflower	0.001	0.048	0.018					0.10	0.09	0.095				
Pea	0.001	0.020	0.007											
Mushroom	0.100	0.420	0.232											
Turnip	0.001 [f]	0.040 [f]	0.007 [f]					0.17	0.18	0.175				
Values from Trail with no matching data in selected literature														
Bean				0.03	0.08	0.05					0.03	0.17	0.11	
Beet leaves				1.10	1.10	1.10					13.0	13.0	13.0	
Beet, roots & leaves				0.51	5.50	3.01					12.3	15.7	14.0	
Chives				0.74	0.74	0.74					5.70	5.70	5.70	
Eggplant				0.12	0.12	0.12					2.90	2.90	2.90	
Kohlrabi				0.03	0.03	0.03					0.26	0.26	0.26	
Parsnip				0.06	0.06	0.06					1.50	1.50	1.50	
Pumpkin				0.03	0.08	0.06					0.25	0.26	0.26	
Radish				0.35	0.35	0.35					1.00	1.00	1.00	
Spinach				1.33	1.33	1.33					24.2	24.2	24.2	
Squash				0.03	0.25	0.10					0.11	0.31	0.22	
Swiss chard				0.18	1.17	0.43					6.04	31.00	12.0	
Zucchini				0.07	0.07	0.07					0.70	0.70	0.70	

Table 5. (cont.)

	Arsenic (mg/kg, dry wt.)				Cadmium (mg/kg, dry wt.)			
	Trail Retail Values			Ratio of Averages, Trail Retail / Dabeka	Trail Retail Values			Ratio of Averages, Trail Retail / De Pieri
Produce	Minimum	Maximum	Average		Minimum	Maximum	Average	
Beet	0.03	0.03	0.03	1	0.30	0.30	0.30	
Broccoli								
Carrot	0.03	0.03	0.03	1	0.03	0.47	0.22	0.6
Celery								
Corn								
Cucumber	0.03	0.42	0.21	4	0.03	0.12	0.05	
Lettuce	0.05	0.40	0.16	7	0.54	6.80	2.19	7
Onion								
Pepper[e]	0.09	0.2	0.15	8	0.24	0.50	0.37	
Potato								
Tomato	0.03	0.03	0.03	3	0.03	0.26	0.12	
Literature values with no matching data from Trail								
Cabbage								
Cauliflower								
Pea								
Mushroom								
Turnip								
Values from Trail with no matching data in selected literature								
Bean								
Beet leaves								
Beet, roots & leaves								
Chives								
Eggplant								
Kohlrabi								
Parsnip								
Pumpkin								
Radish	0.12	0.15	0.14		0.28	0.52	0.40	
Spinach	0.03	0.06	0.05		1.35	5.60	3.48	
Squash								
Swiss chard								
Zucchini								

Table 5. (cont.)

Sources: Dabeka, R.W., A.D. McKenzie, G.M.A. Lacroix, C. Cleroux, S. Bowe, R.A. Graham, H.B.S. Conacher, and P. Verdier. 1993. Survey of arsenic in total diet food composites and estimation of the dietary intake of arsenic by Canadian adults and children. J. AOAC International. 76:14–25.

De Pieri, L.A., W.T. Buckley, and C.G. Kowalenko. 1997. Cadmium and lead concentrations of commercially grown vegetables and of soils in the Lower Fraser Valley of British Columia. Can. J. Soil Sci. 77:51–57.

Note: Trail values include data from sampling events in August/September 1998, January 1999 (retail only), and July/August 1999.

Dabeka values were originally reported as mg/kg wet weight. They were converted to dry weight based on an assumption of 80% moisture for nonleafy produce, and 90% moisture for leafy produce.

[a] For beets, values from Dabeka were based on both raw and canned beets that had been cooked.

[b] For beets, these values from Trail include only the two samples which were roots only.

[c] For broccoli, values from Dabeka were based on a combination of raw and cooked broccoli.

[c] For celery, values from Trail excluded the sample that included roots.

[e] For peppers, Dabeka values were based on both green and red peppers; Trail values presented were based on green peppers (hot peppers were excluded).

[f] For turnips, Dabeka values were based on a combination of turnips and rutabagas.

Table 6. Total and inorganic arsenic in vegetables

Produce	From Schoof et al. 1999 Mean Values (ng/g wet weight) Total Arsenic	Inorganic Arsenic	Ratio of Inorganic to Total
Bean	2.1	1.2	0.57
Carrot	7.3	3.9	0.53
Corn	1.6	1.1	0.69
Cucumber	9.6	4.1	0.43
Lettuce	1.4	1.5	1.0
Onion	9.6	3.3	0.34
Peas	4.3	4.5	1.0
Potato	2.8	0.8	0.29
Spinach	5.1	6.1	1.0
Tomato	9.9	0.9	0.09
Swiss chard			1.0 [a]
Beet			0.50 [b]
Broccoli			0.50 [b]
Celery			0.50 [b]
Chives			0.50 [b]
Eggplant			0.50 [b]
Kohlrabi			0.50 [b]
Parsnip			0.50 [b]
Pepper			0.50 [b]
Pumpkin			0.50 [b]
Radish			0.50 [b]
Squash			0.50 [b]
Zucchini			0.50 [b]

Source: Schoof et al. 1999. A market basket survey of inorganic arsenic in food.

[a] Assumed to be equal to lettuce.

[b] Assumed to be equal to the average of all nonleafy vegetables for which values were available.

Table 7. Summary of residential/homegrown produce data, 1998–1999

	Number of Samples	Inorganic Arsenic (mg/kg dry wt.)				Cadmium (mg/kg dry wt.)			
		Minimum	Mean	Maximum	UCLM	Minimum	Mean	Maximum	UCLM
Leafy									
Near	28	0.03	1.5	4.25	[2.38]	1.4	14.8	35.8	[21.9]
Far	4	0.10	1.1	[3.20]	-- [a]	3.1	8.4	[13.8]	-- [a]
Nonleafy									
Near	42	0.002	0.17	0.82	[0.38]	0.03	2.3	8.10	[3.94]
Far	14	0.002	0.077	0.60	[0.46]	0.12	1.0	4.19	[2.00]

Notes: This summary incorporates data from sampling events from August 1998 to August 1999.
Arsenic data was converted to inorganic arsenic using the ratios shown in Table [as_inorg].
Four herb samples were excluded from the 1998 data.
Two beet samples were excluded because the samples consisted of both roots and leaves.
One sample of beet leaves was included with the leafy produce.
The nonleafy category includes root vegetables, but fruits were excluded.
Data from the two labs in 1999 were averaged before any other calculations were done.
Means were calculated based on a lognormal distribution.
UCLMs were calculated assuming a lognormal distribution, and using one-half the detection limit for non-detects.
[ ] Value selected as exposure-point concentration.

[a] UCLM exceeded maximum because of small sample size and high variability, so maximum was chosen as the exposure-point concentration (U.S. EPA 1992).

Table 8. Data used to calculate exposure-point concentrations for air

		Antimony	Arsenic	Cadmium
Residential	East Trail	NC	East Trail PM_{10} (Butler Park) 7/98–5/99	East Trail PM_{10} (Butler Park) 7/98–5/99
Residential	Rivervale	NC	Oasis PM_{10} 7/98–6/99	Oasis PM_{10} 7/98–6/99
Residential	Tadanac	Downtown TSP 7/97–6/98	West Trail PM_{10} 7/98–6/99	West Trail PM_{10} 7/98–6/99
Residential	Waneta	Columbia Gardens TSP 7/98–6/99	West Trail PM_{10} 7/98–6/99	West Trail PM_{10} 7/98–6/99
Residential	West Trail	West Trail PM_{10} 1/98–7/98	West Trail PM_{10} 7/98–6/99	West Trail PM_{10} 7/98–6/99
Commercial	West Trail (Downtown)	Downtown TSP 7/97–6/98	West Trail PM_{10} 7/98–6/99	West Trail PM_{10} 7/98–6/99
Commercial	East Trail	NC	East Trail PM_{10} (Butler Park) 7/98–5/99	East Trail PM_{10} (Butler Park) 7/98–5/99

Note: TSP data were used for assessing exposure to antimony only if no PM_{10} data were available. Because no PM_{10} data were available for the Columbia Gardens station, data from West Trail were incorporated (as per discussions with Steve Hilts, 9/99)

NC – no concentration data available

Table 9. Summary of air concentration data

(All concentration terms expressed as µg/m³)

Neighbourhood	Antimony	Arsenic	Cadmium
Columbia Gardens (TSP)			
Sampling period: July 1998 – June 1999			
Count	60	NA	NA
Minimum	0.0006	NA	NA
Mean	0.0077	NA	NA
Maximum	0.0440	NA	NA
UCLM	0.0095	NA	NA
East Trail (PM_{10})			
Sampling period: July 1998 – May 1999			
Count	--	28	28
Minimum	--	0.0012	0.0007
Mean	--	0.0168	0.0078
Maximum	--	0.0461	0.0590
UCLM	--	0.0256	0.0124
Oasis (PM_{10})			
Sampling period: July 1998 – June 1999			
Count	--	49	49
Minimum	--	0.0015	0.0003
Mean	--	0.0129	0.0059
Maximum	--	0.0563	0.0306
UCLM	--	0.0182	0.0091
West Trail (PM_{10})			
Sampling period: July 1998 – June 1999			
Count	34 [a]	49	49
Minimum	0.006 [a]	0.0016	0.0004
Mean	0.014 [a]	0.0076	0.0034
Maximum	0.055 [a]	0.0201	0.0386
UCLM	0.018 [a]	0.0099	0.0046
Downtown (TSP)			
Sampling period: July 1997 – June 1998			
Count	211	NA	NA
Minimum	0.003	NA	NA
Mean	0.022	NA	NA
Maximum	0.200	NA	NA
UCLM	0.025	NA	NA
Nelson (PM_{10}) [background]			
Sampling period: Jan. 1998 – Dec. 1998			
Count	--	29	29
Minimum	--	0.0006	0.0001
Mean	--	0.0006	0.0002
Maximum	--	0.0012	0.0005
UCLM	--	0.0007	0.0002

Note: All calculations involving non-detects used one-half the detection limit.
Means were calculating using a formula based on a lognormal distribution.

UCLM – 95 percent Upper Confidence Limit on the Mean; calculated assuming a lognormal distribution

[ ] – indicates value selected as the exposure-point concentration

-- – no data available

NA – this data not used for this evaluation

[a] Sampling period for West Trail antimony is January 1998 through July 1998

Table 10. Exposure-point concentration summary table

	Antimony	Arsenic	Cadmium
Residential soil (mg/kg)			
East Trail	107 *L*	92.0 *L*	37.2 *L*
Rivervale	140 *P,L*	169 *L*	14.3 *L*
Tadanac	75.9 *L*	107 *L*	34.1 *L*
Waneta	26.0 *M*	28.7 *M*	5.00 *M*
West Trail	33.4 *L*	59.5 *L*	29.9 *L*
Residential dust (mg/kg)			
East Trail	122 *L*	78.0 *L*	57.8 *L*
Rivervale[a]	140 *P,L*	169 *L*	14.3 *L*
Tadanac	181 *M*	100 *M*	90.0 *M*
Waneta	28.0 *M*	23.0 *M*	25.0 *M*
West Trail	83.4 *L*	76.0 *L*	64.6 *L*
Residential air (µg/m³)[b]			
East Trail	NC	0.0256 *L*	0.0124 *L*
Rivervale	NC	0.0182 *L*	0.0091 *L*
Tadanac	0.0250 *L*	0.0099 *L*	0.0046 *L*
Waneta	0.0095 *L*	0.0099 *L*	0.0046 *L*
West Trail	0.0180 *L*	0.0099 *L*	0.0046 *L*
Commercial soil (mg/kg)			
East Trail	78.0 *M*	185 *M*	103 *M*
West Trail (Downtown)	28.0 *P,M*	40.0 *M*	26.7 *M*
Commercial dust (mg/kg)[c]			
East Trail	122 *L*	78.0 *L*	57.8 *L*
West Trail (Downtown)	83.4 *L*	76.0 *L*	64.6 *L*
Commercial air (µg/m³)[b]			
East Trail	NC	0.0256 *L*	0.0124 *L*
West Trail (Downtown)	0.0250 *L*	0.0099 *L*	0.0046 *L*
Agricultural soil (mg/kg)	50.0 *M*	72.9 *M*	13.2 *M*
Produce, leafy (mg/kg, dry wt)			
Near site	NC	2.38 *L*[d]	21.9 *L*
Far from site	NC	3.20 *M*[d]	13.8 *M*
Produce, nonleafy (mg/kg, dry wt)			
Near site	NC	0.38 *L*[d]	3.94 *L*
Far from site	NC	0.46 *L*[d]	2.00 *L*

Note:

NC – no concentration data available

L – the exposure-point concentration for this analyte for this location is the UCLM

M – the exposure-point concentration for this analyte for this location is the maximum

P – the exposure-point concentration for this analyte for this location is predicted by the equation: $[\text{Antimony}] = 0.509 \times [\text{Arsenic}]^{1.075} \times 1.041$ (see text for details)

[a] For dust concentrations in Rivervale, only one dust sample was available. Therefore, the EPC was based on soil concentrations.

[b] See Table [air_source] for data used to calculate each value

[c] Used residential dust data.

[d] Inorganic arsenic concentrations.

Table 9. Summary of air concentration data

(All concentration terms expressed as µg/m³)

Neighbourhood	Antimony	Arsenic	Cadmium
Columbia Gardens (TSP)			
Sampling period: July 1998 – June 1999			
Count	60	NA	NA
Minimum	0.0006	NA	NA
Mean	0.0077	NA	NA
Maximum	0.0440	NA	NA
UCLM	[0.0095]	NA	NA
East Trail (PM_{10})			
Sampling period: July 1998 – May 1999			
Count	--	28	28
Minimum	--	0.0012	0.0007
Mean	--	0.0168	0.0078
Maximum	--	0.0461	0.0590
UCLM	--	[0.0256]	[0.0124]
Oasis (PM_{10})			
Sampling period: July 1998 – June 1999			
Count	--	49	49
Minimum	--	0.0015	0.0003
Mean	--	0.0129	0.0059
Maximum	--	0.0563	0.0306
UCLM	--	[0.0182]	[0.0091]
West Trail (PM_{10})			
Sampling period: July 1998 – June 1999			
Count	34 [a]	49	49
Minimum	0.006 [a]	0.0016	0.0004
Mean	0.014 [a]	0.0076	0.0034
Maximum	0.055 [a]	0.0201	0.0386
UCLM	[0.018] [a]	[0.0099]	[0.0046]
Downtown (TSP)			
Sampling period: July 1997 – June 1998			
Count	211	NA	NA
Minimum	0.003	NA	NA
Mean	0.022	NA	NA
Maximum	0.200	NA	NA
UCLM	[0.025]	NA	NA
Nelson (PM_{10}) [background]			
Sampling period: Jan. 1998 – Dec. 1998			
Count	--	29	29
Minimum	--	0.0006	0.0001
Mean	--	0.0006	0.0002
Maximum	--	0.0012	0.0005
UCLM	--	0.0007	0.0002

Note: All calculations involving non-detects used one-half the detection limit.
Means were calculating using a formula based on a lognormal distribution.
UCLM – 95 percent Upper Confidence Limit on the Mean; calculated assuming a lognormal distribution
[ ] – indicates value selected as the exposure-point concentration
-- – no data available
NA – this data not used for this evaluation

[a] Sampling period for West Trail antimony is January 1998 through July 1998

Table 10. Exposure-point concentration summary table

	Antimony	Arsenic	Cadmium
Residential soil (mg/kg)			
East Trail	107 *L*	92.0 *L*	37.2 *L*
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Tadanac	75.9 *L*	107 *L*	34.1 *L*
Waneta	26.0 *M*	28.7 *M*	5.00 *M*
West Trail	33.4 *L*	59.5 *L*	29.9 *L*
Residential dust (mg/kg)			
East Trail	122 *L*	78.0 *L*	57.8 *L*
Rivervale[a]	140 *P,L*	169 *L*	14.3 *L*
Tadanac	181 *M*	100 *M*	90.0 *M*
Waneta	28.0 *M*	23.0 *M*	25.0 *M*
West Trail	83.4 *L*	76.0 *L*	64.6 *L*
Residential air (µg/m^3)[b]			
East Trail	NC	0.0256 *L*	0.0124 *L*
Rivervale	NC	0.0182 *L*	0.0091 *L*
Tadanac	0.0250 *L*	0.0099 *L*	0.0046 *L*
Waneta	0.0095 *L*	0.0099 *L*	0.0046 *L*
West Trail	0.0180 *L*	0.0099 *L*	0.0046 *L*
Commercial soil (mg/kg)			
East Trail	78.0 *M*	185 *M*	103 *M*
West Trail (Downtown)	28.0 *P,M*	40.0 *M*	26.7 *M*
Commercial dust (mg/kg)[c]			
East Trail	122 *L*	78.0 *L*	57.8 *L*
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Near site	NC	2.38 *L*[d]	21.9 *L*
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Near site	NC	0.38 *L*[d]	3.94 *L*
Far from site	NC	0.46 *L*[d]	2.00 *L*

Note:

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L – the exposure-point concentration for this analyte for this location is the UCLM

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P – the exposure-point concentration for this analyte for this location is predicted by the equation: $[\text{Antimony}] = 0.509 \times [\text{Arsenic}]^{1.075} \times 1.041$ (see text for details)

[a] For dust concentrations in Rivervale, only one dust sample was available. Therefore, the EPC was based on soil concentrations.

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Mean	0.0077	NA	NA
Maximum	0.0440	NA	NA
UCLM	[0.0095]	NA	NA
East Trail (PM_{10})			
Sampling period: July 1998 – May 1999			
Count	--	28	28
Minimum	--	0.0012	0.0007
Mean	--	0.0168	0.0078
Maximum	--	0.0461	0.0590
UCLM	--	[0.0256]	[0.0124]
Oasis (PM_{10})			
Sampling period: July 1998 – June 1999			
Count	--	49	49
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Count	34 [a]	49	49
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UCLM	[0.018] [a]	[0.0099]	[0.0046]
Downtown (TSP)			
Sampling period: July 1997 – June 1998			
Count	211	NA	NA
Minimum	0.003	NA	NA
Mean	0.022	NA	NA
Maximum	0.200	NA	NA
UCLM	[0.025]	NA	NA
Nelson (PM_{10}) [background]			
Sampling period: Jan. 1998 – Dec. 1998			
Count	--	29	29
Minimum	--	0.0006	0.0001
Mean	--	0.0006	0.0002
Maximum	--	0.0012	0.0005
UCLM	--	0.0007	0.0002

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Waneta	26.0 *M*	28.7 *M*	5.00 *M*
West Trail	33.4 *L*	59.5 *L*	29.9 *L*
Residential dust (mg/kg)			
East Trail	122 *L*	78.0 *L*	57.8 *L*
Rivervale[a]	140 *P,L*	169 *L*	14.3 *L*
Tadanac	181 *M*	100 *M*	90.0 *M*
Waneta	28.0 *M*	23.0 *M*	25.0 *M*
West Trail	83.4 *L*	76.0 *L*	64.6 *L*
Residential air (µg/m³)[b]			
East Trail	NC	0.0256 *L*	0.0124 *L*
Rivervale	NC	0.0182 *L*	0.0091 *L*
Tadanac	0.0250 *L*	0.0099 *L*	0.0046 *L*
Waneta	0.0095 *L*	0.0099 *L*	0.0046 *L*
West Trail	0.0180 *L*	0.0099 *L*	0.0046 *L*
Commercial soil (mg/kg)			
East Trail	78.0 *M*	185 *M*	103 *M*
West Trail (Downtown)	28.0 *P,M*	40.0 *M*	26.7 *M*
Commercial dust (mg/kg)[c]			
East Trail	122 *L*	78.0 *L*	57.8 *L*
West Trail (Downtown)	83.4 *L*	76.0 *L*	64.6 *L*
Commercial air (µg/m³)[b]			
East Trail	NC	0.0256 *L*	0.0124 *L*
West Trail (Downtown)	0.0250 *L*	0.0099 *L*	0.0046 *L*
Agricultural soil (mg/kg)	50.0 *M*	72.9 *M*	13.2 *M*
Produce, leafy (mg/kg, dry wt)			
Near site	NC	2.38 *L*[d]	21.9 *L*
Far from site	NC	3.20 *M*[d]	13.8 *M*
Produce, nonleafy (mg/kg, dry wt)			
Near site	NC	0.38 *L*[d]	3.94 *L*
Far from site	NC	0.46 *L*[d]	2.00 *L*

Note:

NC – no concentration data available

L – the exposure-point concentration for this analyte for this location is the UCLM

M – the exposure-point concentration for this analyte for this location is the maximum

P – the exposure-point concentration for this analyte for this location is predicted by the equation: $[\text{Antimony}] = 0.509 \times [\text{Arsenic}]^{1.075} \times 1.041$ (see text for details)

[a] For dust concentrations in Rivervale, only one dust sample was available. Therefore, the EPC was based on soil concentrations.

[b] See Table [air_source] for data used to calculate each value

[c] Used residential dust data.

[d] Inorganic arsenic concentrations.

Table 11. Exposure assumptions, *Residential—Soil and dust ingestion*

Symbol	Definition	Value	Units	Source/Comment
C_s	Chemical concentration in soil	chemical-specific	mg/kg	
C_d	Chemical concentration in dust	chemical-specific	mg/kg	
IR_a	Ingestion rate, adult	20	mg/day	BCE 1996
IR_c	Ingestion rate, child	80	mg/day	BCE 1996
FS	Fraction ingested from source	1	unitless	
CF	Conversion factor	1E-06	kg/mg	
EF_s	Exposure frequency to soil	263	day/yr	BCE 1995; assumes 2 wks gone, and 3 month snowcover
EF_d	Exposure frequency to dust	350	day/yr	BCE 1996; assumes 2 wks gone
ED_a	Exposure duration, adult	70	yr	BCE 1996
ED_c	Exposure duration, child	4.5	yr	BCE 1996
FI_s	Fraction ingested from soil	0.30	unitless	BCE 1995
FI_d	Fraction ingested from dust	0.70	unitless	BCE 1995
RBA	Relative bioavailability	chemical-specific	unitless	Exponent 1998
BW_a	Body weight, adult	70	kg	BCE 1996
BW_c	Body weight, child	13	kg	BCE 1996
AT_c	Averaging time–carcinogenic	27,375	day	75 yr x 365 day/yr
$AT_{nc\text{-}a}$	Averaging time–noncarcinogenic, adult	25,550	day	ED_a x 365 day/yr
$AT_{nc\text{-}c}$	Averaging time–noncarcinogenic, child	1,643	day	ED_c x 365 day/yr
AT_L	Averaging time–noncarcinogenic, lifetime[a]	27,193	day	(ED_a + ED_c) x 365 day/yr

[a] Used only in the absorbed dose assessment for cadmium.

Cancer:

$$\text{Risk} = \frac{C_s \times IR_a \times FS \times CF \times EF_s \times ED_a \times FI_s \times RBA \times CSF}{BW_a \times AT_c} + \frac{C_d \times IR_a \times FS \times CF \times EF_a \times ED_a \times FI_d \times RBA \times CSF}{BW_a \times AT_c}$$

$$+ \frac{C_s \times IR_c \times FS \times CF \times EF_s \times ED_c \times FI_s \times RBA \times CSF}{BW_c \times AT_c} + \frac{C_d \times IR_c \times FS \times CF \times EF_c \times ED_c \times FI_d \times RBA \times CSF}{BW_c \times AT_c}$$

Non-cancer:

$$\text{Hazard Index, adult} = \frac{C_s \times IR_a \times FS \times CF \times EF_s \times ED_a \times FI_s \times RBA}{BW_a \times AT_{nc\text{-}a} \times RfD} + \frac{C_d \times IR_a \times FS \times CF \times EF_d \times ED_a \times FI_d \times RBA}{BW_a \times AT_{nc\text{-}a} \times RfD}$$

$$\text{Hazard Index, child} = \frac{C_s \times IR_c \times FS \times CF \times EF_s \times ED_c \times FI_s \times RBA}{BW_c \times AT_{nc\text{-}c} \times RfD} + \frac{C_d \times IR_c \times FS \times CF \times EF_s \times ED_c \times FI_d \times RBA}{BW_c \times AT_{nc\text{-}c} \times RfD}$$

Note: for assessing noncancer lifetime exposure to cadmium, AT_L replaces both $AT_{nc\text{-}a}$ and $AT_{nc\text{-}c}$ and the adult and child hazard indicies are summed.

Table 12. Exposure assumptions, *Residential—Inhalation*

Symbol	Definition	Value	Units	Source/Comment
C_A	Chemical concentration in air	chemical-specific	µg/m^3	
IR_a	Inhalation rate, adult	23	m^3/day	BCE 1996[a]
IR_c	Inhalation rate, child	5	m^3/day	BCE 1996[a]
CF	Conversion factor	1E-03	mg/µg	
FS	Fraction inhaled from source	1	unitless	
EF	Exposure frequency	350	day/yr	BCE 1996; assumes 2 wks gone
ED_a	Exposure duration, adult	70	yr	BCE 1996
ED_c	Exposure duration, child	4.5	yr	BCE 1996
ABS	Absorption fraction[b]	chemical-specific	unitless	
BW_a	Body weight, adult	70	kg	BCE 1996
BW_c	Body weight, child	13	kg	BCE 1996
AT_c	Averaging time–carcinogenic	27,375	day	75 yr x 365 day/yr
AT_L	Averaging time–noncarcinogenic, lifetime[b]	27,193	day	(ED_a + ED_c) x 365 day/yr

[a] Daily inhalation rate for long-term exposure periods, from BCE 1996.

[b] Used only in the absorbed dose assessment for cadmium.

Cancer:

$$\text{Risk} = \frac{C_A \times IR_a \times CF \times FS \times EF \times ED_a \times CSF}{BW_a \times AT_c} + \frac{C_A \times IR_c \times CF \times FS \times EF \times ED_c \times CSF}{BW_c \times AT_c}$$

Non-cancer:

$$\text{Hazard Index} = \frac{C_A}{RfC \times 1{,}000\ \mu g/mg}$$

Table 13. Exposure assumptions,
Consumption of homegrown produce

Symbol	Definition	Value	Units	Source/Comment
C_{leafy}	Chemical concentration in leafy produce	chemical-specific	mg/kg dry wt.	
$C_{nonleafy}$	Chemical concentration in nonleafy produce	chemical-specific	mg/kg dry wt.	
IR_{leafy}	Ingestion rate, leafy produce	3.2	g/day dry wt.	
$IR_{nonleafy}$	Ingestion rate, nonleafy produce	42.6	g/day dry wt.	
CF	Conversion factor	1E-03	kg/g	
FI	Fraction ingested from homegrown sources	0.07	unitless	
EF	Exposure frequency	365	day/yr	
ED	Exposure duration	70	yr	
ABS	Absorption fraction (dietary cadmium)[a]	chemical-specific	unitless	
BW	Body weight, adult	70	kg	
AT_c	Averaging time–carcinogenic	27,375	day	75 yr x 365 day/yr
AT_{nc}	Averaging time–noncarcinogenic	25,550	day	ED x 365 day/yr
AT_L	Averaging time–noncarcinogenic, lifetime[a]	25,550	day	ED x 365 day/yr

[a] Used only in the absorbed dose assessment for cadmium.

Cancer:

$$\text{Risk} = \frac{[(C_{leafy} \times IR_{leafy}) + (C_{nonleafy} \times IR_{nonleafy})] \times CF \times FI \times EF \times ED \times CSF}{BW \times AT_c}$$

Non-cancer:

$$\text{Hazard Index} = \frac{[(C_{leafy} \times IR_{leafy}) + (C_{nonleafy} \times IR_{nonleafy})] \times CF \times FI \times EF \times ED}{BW \times AT_{nc} \times RfD}$$

Non-cancer, absorbed dose for cadmium:

$$\text{Hazard Index} = \frac{[(C_{leafy} \times IR_{leafy}) + (C_{nonleafy} \times IR_{nonleafy})] \times CF \times FI \times EF \times ED \times ABS}{BW \times AT_L \times RfD_{absorbed}}$$

Table 14. Exposure assumptions, *Commercial—Soil and dust ingestion*

Symbol	Definition	Value	Units	Source/Comment
C_s	Chemical concentration in soil	chemical-specific	mg/kg	
C_d	Chemical concentration in dust	chemical-specific	mg/kg	
IR_a	Ingestion rate, adult	20	mg/day	BCE 1996
IR_c	Ingestion rate, child	80	mg/day	BCE 1996
FS_a	Fraction ingested from source, adult	0.6	unitless	BCE 1996; assumes 10 of 16 waking hours spent in commercial areas
FS_c	Fraction ingested from source, child	0.66	unitless	Assumes 8 of 12 waking hours spent in commercial areas
CF	Conversion factor	1E-06	kg/mg	
EF_{s-a}	Exposure frequency to soil, adult	185	day/yr	BCE 1996; assumes 5 day/wk and 3 months snowcover
EF_{s-c}	Exposure frequency to soil, child	185	day/yr	BCE 1996; assumes 5 day/wk and 3 months snowcover
EF_{d-a}	Exposure frequency to dust, adult	240	day/yr	CCME 1996; assumes 5 day/wk, 48 wk/yr
EF_{d-c}	Exposure frequency to dust, child	240	day/yr	CCME 1996; assumes 5 day/wk, 48 wk/yr
ED_a	Exposure duration, adult	70	yr	BCE 1996
ED_c	Exposure duration, child	4.5	yr	BCE 1996
FI_s	Fraction ingested from soil	0.30	unitless	BCE 1995
FI_d	Fraction ingested from dust	0.70	unitless	BCE 1995
RBA	Relative bioavailability	chemical-specific	unitless	Exponent 1998
BW_a	Body weight, adult	70	kg	BCE 1996
BW_c	Body weight, child	13	kg	BCE 1996
AT_c	Averaging time–carcinogenic	27,375	day	75 yr x 365 day/yr
AT_{nc-a}	Averaging time–noncarcinogenic, adult	25,550	day	ED_a x 365 day/yr
AT_{nc-c}	Averaging time–noncarcinogenic, child	1,643	day	ED_c x 365 day/yr
AT_L	Averaging time–noncarcinogenic, lifetime[a]	27,193	day	(ED_a + ED_c) x 365 day/yr

[a] Used only in the absorbed dose assessment for cadmium.

Cancer:

$$\text{Risk} = \frac{C_s \times IR_a \times FS_a \times CF \times EF_{s\text{-}a} \times ED_a \times FI_s \times RBA \times CSF}{BW_a \times AT_c} + \frac{C_d \times IR_a \times FS_a \times CF \times EF_{d\text{-}a} \times ED_a \times FI_d \times RBA \times CSF}{BW_a \times AT_c}$$

$$+ \frac{C_s \times IR_c \times FS_c \times CF \times EF_{s\text{-}c} \times ED_c \times FI_s \times RBA \times CSF}{BW_c \times AT_c} + \frac{C_d \times IR_c \times FS_c \times CF \times EF_{d\text{-}c} \times ED_c \times FI_d \times RBA \times CSF}{BW_c \times AT_c}$$

Non-cancer:

$$\text{Hazard Index, adult} = \frac{C_s \times IR_a \times FS_a \times CF \times EF_{s\text{-}a} \times ED_a \times FI_s \times RBA}{BW_a \times AT_{nc\text{-}a} \times RfD} + \frac{C_d \times IR_a \times FS_a \times CF \times EF_{d\text{-}a} \times ED_a \times FI_d \times RBA}{BW_a \times AT_{nc\text{-}a} \times RfD}$$

$$\text{Hazard Index, child} = \frac{C_s \times IR_c \times FS_c \times CF \times EF_{s\text{-}c} \times ED_c \times FI_s \times RBA}{BW_c \times AT_{nc\text{-}c} \times RfD} + \frac{C_d \times IR_c \times FS_c \times CF \times EF_{d\text{-}c} \times ED_c \times FI_d \times RBA}{BW_c \times AT_{nc\text{-}c} \times RfD}$$

Note: for assessing noncancer lifetime exposure to cadmium, AT_L replaces both AT_{nc-a} and AT_{nc-c} and the adult and child hazard indicies are summed.

Table 15. Exposure assumptions, *Commercial—Inhalation*

Symbol	Definition	Value	Units	Source/Comment
C_A	Chemical concentration in air	chemical-specific	µg/m^3	
IR_a	Inhalation rate, adult	1.3	m^3/hr	U.S. EPA 1997[a]
IR_c	Inhalation rate, child	0.7	m^3/hr	U.S. EPA 1997[b]
CF	Conversion factor	1E-03	mg/µg	
ET_a	Exposure time, adult	10	hr/day	CCME 1996
ET_c	Exposure time, child	8	hr/day	
EF_a	Exposure frequency, adult	240	day/yr	CCME 1996; assumes 5 day/wk, 48 wk/yr
EF_c	Exposure frequency, child	240	day/yr	CCME 1996; assumes 5 day/wk, 48 wk/yr
ED_a	Exposure duration, adult	70	yr	BCE 1996
ED_c	Exposure duration, child	4.5	yr	BCE 1996
ABS	Absorption fraction[c]	chemical-specific	unitless	
BW_a	Body weight, adult	70	kg	BCE 1996
BW_c	Body weight, child	13	kg	BCE 1996
AT_c	Averaging time–carcinogenic	27,375	day	75 yr x 365 day/yr
AT_L	Averaging time–noncarcinogenic, lifetime[c]	27,193	day	(ED_a + ED_c) x 365 day/yr

[a] Average inhalation rate for light and moderate activity levels during short-term exposure periods, from U.S. EPA 1997.
[b] Average inhalation rate for sedentary and light activity levels during short term exposure periods, from U.S. EPA 1997.
[c] Used only in the absorbed dose assessment for cadmium.

Cancer:

$$\textbf{Risk} = \frac{C_A \times IR_a \times CF \times ET_a \times EF_a \times ED_a \times CSF}{BW_a \times AT_c} + \frac{C_A \times IR_c \times CF \times ET_c \times EF_c \times ED_c \times CSF}{BW_c \times AT_c}$$

Non-cancer:

$$\textbf{Hazard Index} = \frac{C_A}{RfC \times 1{,}000\ \mu g/mg}$$

Table 16. Exposure assumptions,
Agricultural—Soil ingestion

Symbol	Definition	Value	Units	Source/Comment
C_s	Chemical concentration in soil	chemical-specific	mg/kg	
IR	Ingestion rate	480	mg/day	U.S. EPA 1995[a]
CF	Conversion factor	1E-06	kg/mg	
FS	Fraction ingested from source	1	unitless	
EF	Exposure frequency	14	day/yr	U.S. EPA 1995[a]
ED	Exposure duration	55	yr	Ages 15–70
RBA	Relative bioavailability	chemical-specific	unitless	Exponent 1998
BW	Body weight, adult	70	kg	BCE 1996
AT_c	Averaging time–carcinogenic	27,375	day	75 yr x 365 day/yr
AT_{nc}	Averaging time–noncarcinogenic	20,075	day	ED x 365 day/yr
AT_L	Averaging time–noncarcinogenic, lifetime[b]	20,075	day	ED x 365 day/yr

[a] Scenario evaluates possible high-level exposures associated with plowing or other high-contact-rate activities that might occur occasionally under an agricultural scenario. Value from U.S. EPA 1995, Baseline human health risk assessment: Anaconda Smelter NPL site.

[b] Used only in the absorbed dose assessment for cadmium.

Cancer:

$$\textbf{Risk} = \frac{C_s \times IR \times CF \times FS \times EF \times ED \times RBA \times CSF}{BW \times AT_c}$$

Non-cancer:

$$\textbf{Hazard Index} = \frac{C_s \times IR \times CF \times FS \times EF \times ED \times RBA}{BW \times AT_{nc} \times RfD}$$

Table 17. Exposure assumptions, *Agricultural—Inhalation*

Symbol	Definition	Value	Units	Source/Comment
C_s	Chemical concentration in soil	chemical-specific	mg/kg	
IR	Inhalation rate	1.6	m^3/hr	Fox 1990, U.S. EPA 1997[a]
PC_a	Particulate concentration in air	150	μg/m^3	U.S. EPA 1995[b]
CF	Conversion factor	1E-09	kg/μg	
FS	Fraction inhaled from source	1	unitless	
ET	Exposure time	8	hr/day	
EF	Exposure frequency	14	day/yr	
ED	Exposure duration	55	yr	Ages 15–70
ABS	Absorption fraction[c]	chemical-specific	unitless	
BW	Body weight, adult	70	kg	BCE 1996
AT_c	Averaging time–carcinogenic	27,375	day	75 yr x 365 day/yr
AT_L	Averaging time–noncarcinogenic, lifetime[c]	20,075	day	ED x 365 day/yr

[a] Fox 1990 used values for "moderate activity" from Exposure Factors Handbook, U.S. EPA 1989. These values have been updated by U.S. EPA, and the updated values are reflected here.

[b] The value was derived for dust loading to air for an agricultural worker during plowing activities. Units are expressed as μg of soil-derived respirable dust per m^3 of air. When multiplied by the metal concentration in soil, this yields the air-dust concentration of metals. U.S. EPA 1995, Baseline human health risk assessment: Anaconda Smelter NPL site.

[c] Used only in the absorbed dose assessment for cadmium.

Cancer:

$$\textbf{Risk} = \frac{C_s \times IR \times PC_a \times CF \times FS \times EF \times ED \times CSF}{BW \times AT_c}$$

Non-cancer:

$$\textbf{Hazard Index} = \frac{C_s \times PC_a \times CF}{RfC}$$

Table 18. Summary of exposures—noncancer (chronic daily intake)

Neighbourhood/Pathway			Antimony (mg/kg-day)	Arsenic (mg/kg-day)	Cadmium (mg/kg-day)
Residential scenarios					
East Trail					
	Adult	Ingestion, soil	6.6E-07	3.1E-06	7.6E-07
	Adult	Ingestion, dust	2.3E-06	8.2E-06	3.7E-06
	Adult	Ingestion, produce	--	2.4E-05	2.4E-04
	Child	Ingestion, soil	1.4E-05	6.7E-05	1.6E-05
	Child	Ingestion, dust	5.0E-05	1.8E-04	7.9E-05
Rivervale					
	Adult	Ingestion, soil	8.6E-07	5.7E-06	2.9E-07
	Adult	Ingestion, dust	2.7E-06	1.8E-05	9.1E-07
	Adult	Ingestion, produce	--	3.0E-05	1.3E-04
	Child	Ingestion, soil	1.9E-05	1.2E-04	6.3E-06
	Child	Ingestion, dust	5.8E-05	3.8E-04	1.9E-05
Tadanac					
	Adult	Ingestion, soil	4.7E-07	3.6E-06	6.9E-07
	Adult	Ingestion, dust	3.5E-06	1.1E-05	5.7E-06
	Adult	Ingestion, produce	--	2.4E-05	2.4E-04
	Child	Ingestion, soil	1.0E-05	7.8E-05	1.5E-05
	Child	Ingestion, dust	7.5E-05	2.3E-04	1.2E-04
Waneta					
	Adult	Ingestion, soil	1.6E-07	9.7E-07	1.0E-07
	Adult	Ingestion, dust	5.4E-07	2.4E-06	1.6E-06
	Adult	Ingestion, produce	--	3.0E-05	1.3E-04
	Child	Ingestion, soil	3.5E-06	2.1E-05	2.2E-06
	Child	Ingestion, dust	1.2E-05	5.2E-05	3.4E-05
West Trail					
	Adult	Ingestion, soil	2.1E-07	2.0E-06	6.1E-07
	Adult	Ingestion, dust	1.6E-06	8.0E-06	4.1E-06
	Adult	Ingestion, produce	--	2.4E-05	2.4E-04
	Child	Ingestion, soil	4.4E-06	4.4E-05	1.3E-05
	Child	Ingestion, dust	3.4E-05	1.7E-04	8.8E-05
Commercial scenarios					
East Trail					
	Adult	Ingestion, soil	2.0E-07	2.7E-06	8.9E-07
	Adult	Ingestion, dust	9.6E-07	3.4E-06	1.5E-06
	Child	Ingestion, soil	4.8E-06	6.3E-05	2.1E-05
	Child	Ingestion, dust	2.3E-05	8.0E-05	3.6E-05
West Trail (Downtown)					
	Adult	Ingestion, soil	7.3E-08	5.7E-07	2.3E-07
	Adult	Ingestion, dust	6.6E-07	3.3E-06	1.7E-06
	Child	Ingestion, soil	1.7E-06	1.4E-05	5.4E-06
	Child	Ingestion, dust	1.6E-05	7.8E-05	4.0E-05
Agricultural scenario					
Waneta (farm family)					
	Adult	Ingestion, soil	3.1E-07	2.5E-06	2.7E-07
	Adult	Ingestion, dust	9.6E-07	7.7E-06	8.4E-07
	Adult	Ingestion, produce	--	3.0E-05	1.3E-04
	Child	Ingestion, soil	6.7E-06	5.3E-05	5.8E-06
	Child	Ingestion, dust	2.1E-05	1.7E-04	1.8E-05
Waneta (field activities)					
	Adult	Ingestion, soil	1.3E-06	1.1E-05	1.1E-06

Note: Inhalation exposures are not included in this table because noncancerous hazard indices were calculated using a direct comparison of air concentration to an RfC, without involving any exposure factors.

-- – insufficient information to complete calculation

Table 19. Summary of exposures—cancer (chronic daily intakes)

Neighbourhood/Pathway	Antimony (mg/kg-day)	Arsenic (mg/kg-day)	Cadmium (mg/kg-day)
Residential scenarios			
East Trail			
Ingestion, soil	1.5E-06	7.0E-06	1.7E-06
Ingestion, dust	5.2E-06	1.8E-05	8.1E-06
Ingestion, produce	--	2.2E-05	2.2E-04
Inhalation	--	8.1E-06	3.9E-06
Rivervale			
Ingestion, soil	1.9E-06	1.3E-05	6.5E-07
Ingestion, dust	6.0E-06	4.0E-05	2.0E-06
Ingestion, produce	--	2.8E-05	1.2E-04
Inhalation	--	5.8E-06	2.9E-06
Tadanac			
Ingestion, soil	1.0E-06	8.1E-06	1.5E-06
Ingestion, dust	7.7E-06	2.3E-05	1.3E-05
Ingestion, produce	--	2.2E-05	2.2E-04
Inhalation	7.9E-06	3.1E-06	1.5E-06
Waneta			
Ingestion, soil	3.6E-07	2.2E-06	2.3E-07
Ingestion, dust	1.2E-06	5.4E-06	3.5E-06
Ingestion, produce	--	2.8E-05	1.2E-04
Inhalation	3.0E-06	3.1E-06	1.5E-06
West Trail			
Ingestion, soil	4.6E-07	4.5E-06	1.4E-06
Ingestion, dust	3.6E-06	1.8E-05	9.1E-06
Ingestion, produce	--	2.2E-05	2.2E-04
Inhalation	5.7E-06	3.1E-06	1.5E-06
Commercial scenarios			
East Trail			
Ingestion, soil	4.8E-07	6.2E-06	2.1E-06
Ingestion, dust	2.3E-06	8.0E-06	3.5E-06
Inhalation	--	3.4E-06	1.6E-06
West Trail (Downtown)			
Ingestion, soil	1.7E-07	1.4E-06	5.4E-07
Ingestion, dust	1.5E-06	7.8E-06	4.0E-06
Inhalation	3.3E-06	1.3E-06	6.0E-07
Agricultural scenario			
Waneta (farm family)			
Ingestion, soil	6.9E-07	5.5E-06	6.0E-07
Ingestion, dust	2.1E-06	1.7E-05	1.9E-06
Ingestion, produce	--	2.8E-05	1.2E-04
Inhalation	3.0E-06	3.1E-06	1.5E-06
Waneta (field activities)			
Ingestion, soil	9.6E-07	7.7E-06	8.4E-07
Inhalation	3.9E-08	5.6E-08	1.0E-08

Note: -- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

Table 20. Summary of exposures—cadmium absorbed dose (chronic daily intake, lifetime)

Neighbourhood/Pathway	Cadmium (mg/kg-day)
Residential scenarios	
East Trail	
Ingestion, soil/dust:	2.4E-07
Ingestion, produce:	5.9E-06
Inhalation:	9.9E-07
Total:	7.2E-06
Rivervale	
Ingestion, soil/dust:	6.5E-08
Ingestion, produce:	3.2E-06
Inhalation:	7.2E-07
Total:	4.0E-06
Tadanac	
Ingestion, soil/dust:	3.5E-07
Ingestion, produce:	5.9E-06
Inhalation:	3.7E-07
Total:	6.7E-06
Waneta	
Ingestion, soil/dust:	9.1E-08
Ingestion, produce:	3.2E-06
Inhalation:	3.7E-07
Total:	3.7E-06
West Trail	
Ingestion, soil/dust:	2.6E-07
Ingestion, produce:	5.9E-06
Inhalation:	3.7E-07
Total:	6.6E-06
Commercial scenarios	
East Trail	
Ingestion, soil/dust:	1.0E-07
Inhalation:	4.1E-07
Total:	5.1E-07
West Trail (Downtown)	
Ingestion, soil/dust:	7.1E-08
Inhalation:	1.5E-07
Total:	2.2E-07
Agricultural scenario	
Waneta (farm family)	
Ingestion, soil/dust:	6.0E-08
Ingestion, produce:	3.2E-06
Inhalation:	3.7E-07
Total:	3.7E-06
Waneta (field activities)	
Ingestion, soil	2.8E-08
Inhalation:	3.5E-09
Total:	3.1E-08

Note: Scientific notation examples

$3E\text{-}06 = 3 \times 10^{-6} = 0.000003$

$1.2E\text{-}05 = 1.2 \times 10^{-5} = 0.000012$

$5E{+}02 = 5 \times 10^{2} = 500$

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Table 21. Toxicity values for noncarcinogenic chemicals of potential concern

Chemical	RfD (mg/kg-day)	RfC (mg/m^3)	Critical Effect	Basis	Source	Date[a]
Oral route						
Antimony	4.0E-04 [b]	--	Longevity, blood glucose, and chlolesterol	Rat, chronic oral bioassay	IRIS	5/5/98
Arsenic	0.002 [b]	--	Skin, blood, CNS effects	--	HC/BCE 1995	1998
Cadmium	8.1E-04 [b]	--	Kidney toxicity	WHO tolerable daily intake	HC	1989
Cadmium, non-smokers	2.0E-05	--	Kidney toxicity	Absorbed dose, calculated	Exponent	July 1998
Cadmium, smokers	1.0E-05	--	Kidney toxicity	Absorbed dose, calculated	Exponent	July 1998
Inhalation route						
Antimony (antimony trioxide)	--	2.0E-04	Pulmonary toxicity, chronic interstitial inflammation	Rat, 1-year inhalation study	IRIS	5/5/98

Note: -- – not applicable, or not presented in source document
NA – not available
IRIS – EPA Integrated Risk Information System (IRIS), online electronic data files (U.S. EPA 1998).
HC – Health Canada. 1989 Priority substances list document for cadmium. Environmental Substances Division, Bureau of Chemical Hazards (Health Canada 1989).

[a] Indicates the date of the source document or the date of contact. For IRIS, it is the date of the last file update.

[b] Value from G. Fox, BC Environment Toxicologist, personal communication with G. Hook, Exponent Environmental Group, Boulder, Colorado, on 7/2/98, regarding BCE toxicity values.

Table 22. Toxicity values for carcinogenic chemicals of potential concern

Chemical	Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Weight of Evidence	Type of Cancer	Basis of Slope Factor	Source	Date[a]
Oral route						
Arsenic	1.75 [b]	I (carcinogenic to humans)	Skin cancer	Human, drinking water exposure	HC	1996
Inhalation route						
Arsenic	15 [b]	A (human carcinogen)	Lung cancer	Human, occupational exposure	IRIS	5/29/98
Cadmium	6.3 [b]	B1 (probable human carcinogen)	Lung cancer	Human, occupational exposure	IRIS	5/5/98

Note: -- – not applicable, or not presented in source document

NA – not available

HC – Health Canada. Health-based Tolerable Daily Intakes/concentrations and tumorigenic doses/concentrations for priority substances (Health Canada 1996)

IRIS – EPA Integrated Risk Information System (IRIS), online electronic chemical data files (U.S. EPA 1998)

[a] Indicates the date of the source document or the date of contact. For IRIS, it is the date of the last file update.

[b] Value from G. Fox, BC Environment Toxicologist, personal communication with G. Hook, Exponent Environmental Group, Boulder, Colorado, on 7/2/98, regarding BCE toxicity values.

Table 23a. Cancer risk estimates and noncancer hazard indices
Residential scenario—Soil and dust ingestion
East Trail

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Soil concentration	mg/kg	107	92.0	37.2	
Dust concentration	mg/kg	122	78.0	57.8	
Relative bioavailability	unitless	0.10	0.55	0.33	
Carcinogenic Effects					
Chronic daily intake, soil	mg/kg-day	1.5E-06	7.0E-06	1.7E-06	
Chronic daily intake, dust	mg/kg-day	5.2E-06	1.8E-05	8.1E-06	
Cancer slope factor, oral	$(mg/kg\text{-}day)^{-1}$	NA	1.75	NA	
Risk	unitless	--	4E-05	--	4E-05
Noncarcinogenic Effects					
Chronic daily intake, soil-adult	mg/kg-day	6.6E-07	3.1E-06	7.6E-07	
Chronic daily intake, dust-adult	mg/kg-day	2.3E-06	8.2E-06	3.7E-06	
Chronic daily intake, soil-child	mg/kg-day	1.4E-05	6.7E-05	1.6E-05	
Chronic daily intake, dust-child	mg/kg-day	5.0E-05	1.8E-04	7.9E-05	
Chronic daily intake, lifetime[a]	mg/kg-day	NA	NA	9.9E-06	
Reference dose, oral	mg/kg-day	4.0E-04	0.002	8.1E-04	
Hazard index, adult	unitless	8E-03	6E-03	NA	
Hazard index, child	unitless	2E-01	1E-01	NA	
Hazard index, lifetime[a]	unitless	NA	NA	1E-02	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] RfD for cadmium is based on lifetime accumulation. See text for further details.

Table 23b. Cancer risk estimates and noncancer hazard indices
Residential scenario—Inhalation
East Trail

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Air concentration	µg/m^3	NC	0.0256	0.0124	
Absorption fraction	unitless	0.50 [a]	0.33 [a]	0.25 [a]	
Carcinogenic Effects					
Chronic daily intake	mg/kg-day	--	8.1E-06	3.9E-06	
Cancer slope factor, inhalation	(mg/kg-day)$^{-1}$	NA	15	6.3	
Risk	unitless	--	1E-04	2E-05	1E-04
Noncarcinogenic Effects					
Reference concentration, inhalation	mg/m^3	2.0E-04	NA	NA	
Hazard index	unitless	--	--	--	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] Absorption fraction is not used in this case because the toxicity value is based on an administered dose, rather than an absorbed dose.

Table 24a. Cancer risk estimates and noncancer hazard indices
Residential scenario—Soil and dust ingestion
Rivervale

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Soil concentration	mg/kg	140	169	14.3	
Dust concentration	mg/kg	140	169	14.3	
Relative bioavailability	unitless	0.10	0.55	0.33	
Carcinogenic Effects					
Chronic daily intake, soil	mg/kg-day	1.9E-06	1.3E-05	6.5E-07	
Chronic daily intake, dust	mg/kg-day	6.0E-06	4.0E-05	2.0E-06	
Cancer slope factor, oral	$(mg/kg\text{-}day)^{-1}$	NA	1.75	NA	
Risk	unitless	--	9E-05	--	9E-05
Noncarcinogenic Effects					
Chronic daily intake, soil-adult	mg/kg-day	8.6E-07	5.7E-06	2.9E-07	
Chronic daily intake, dust-adult	mg/kg-day	2.7E-06	1.8E-05	9.1E-07	
Chronic daily intake, soil-child	mg/kg-day	1.9E-05	1.2E-04	6.3E-06	
Chronic daily intake, dust-child	mg/kg-day	5.8E-05	3.8E-04	1.9E-05	
Chronic daily intake, lifetime[a]	mg/kg-day	NA	NA	2.7E-06	
Reference dose, oral	mg/kg-day	4.0E-04	0.002	8.1E-04	
Hazard index, adult	unitless	9E-03	1E-02	NA	
Hazard index, child	unitless	2E-01	3E-01	NA	
Hazard index, lifetime[a]	unitless	NA	NA	3E-03	

Note:
NA -- not available or not applicable
NC -- no concentration data available
-- -- insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] RfD for cadmium is based on lifetime accumulation. See text for further details.

Table 24b. Cancer risk estimates and noncancer hazard indices
Residential scenario—Inhalation
Rivervale

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Air concentration	µg/m^3	NC	0.0182	0.0091	
Absorption fraction	unitless	0.50 [a]	0.33 [a]	0.25 [a]	
Carcinogenic Effects					
Chronic daily intake	mg/kg-day	--	5.8E-06	2.9E-06	
Cancer slope factor, inhalation	(mg/kg-day)$^{-1}$	NA	15	6.3	
Risk	unitless	--	9E-05	2E-05	1E-04
Noncarcinogenic Effects					
Reference concentration, inhalation	mg/m^3	2.0E-04	NA	NA	
Hazard index	unitless	--	--	--	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] Absorption fraction is not used in this case because the toxicity value is based on an administered dose, rather than an absorbed dose.

Table 25a. Cancer risk estimates and noncancer hazard indices
Residential scenario—Soil and dust ingestion
Tadanac

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Soil concentration	mg/kg	75.9	107	34.1	
Dust concentration	mg/kg	181	100	90	
Relative bioavailability	unitless	0.10	0.55	0.33	
Carcinogenic Effects					
Chronic daily intake, soil	mg/kg-day	1.0E-06	8.1E-06	1.5E-06	
Chronic daily intake, dust	mg/kg-day	7.7E-06	2.3E-05	1.3E-05	
Cancer slope factor, oral	$(mg/kg\text{-}day)^{-1}$	NA	1.75	NA	
Risk	unitless	--	6E-05	--	6E-05
Noncarcinogenic Effects					
Chronic daily intake, soil-adult	mg/kg-day	4.7E-07	3.6E-06	6.9E-07	
Chronic daily intake, dust-adult	mg/kg-day	3.5E-06	1.1E-05	5.7E-06	
Chronic daily intake, soil-child	mg/kg-day	1.0E-05	7.8E-05	1.5E-05	
Chronic daily intake, dust-child	mg/kg-day	7.5E-05	2.3E-04	1.2E-04	
Chronic daily intake, lifetime[a]	mg/kg-day	NA	NA	1.4E-05	
Reference dose, oral	mg/kg-day	4.0E-04	0.002	8.1E-04	
Hazard index, adult	unitless	1E-02	7E-03	NA	
Hazard index, child	unitless	2E-01	2E-01	NA	
Hazard index, lifetime[a]	unitless	NA	NA	2E-02	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] RfD for cadmium is based on lifetime accumulation. See text for further details.

Table 25b. Cancer risk estimates and noncancer hazard indices
Residential scenario—Inhalation
Tadanac

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Air concentration	µg/m^3	0.0250	0.0099	0.0046	
Absorption fraction	unitless	0.50 [a]	0.33 [a]	0.25 [a]	
Carcinogenic Effects					
Chronic daily intake	mg/kg-day	7.9E-06	3.1E-06	1.5E-06	
Cancer slope factor, inhalation	(mg/kg-day)$^{-1}$	NA	15	6.3	
Risk	unitless	--	5E-05	9E-06	6E-05
Noncarcinogenic Effects					
Reference concentration, inhalation	mg/m^3	2.0E-04	NA	NA	
Hazard index	unitless	1E-01	--	--	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] Absorption fraction is not used in this case because the toxicity value is based on an administered dose, rather than an absorbed dose.

Table 26a. Cancer risk estimates and noncancer hazard indices
Residential scenario—Soil and dust ingestion
Waneta

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Soil concentration	mg/kg	26.0	28.7	5.00	
Dust concentration	mg/kg	28.0	23.0	25.0	
Relative bioavailability	unitless	0.10	0.55	0.33	
Carcinogenic Effects					
Chronic daily intake, soil	mg/kg-day	3.6E-07	2.2E-06	2.3E-07	
Chronic daily intake, dust	mg/kg-day	1.2E-06	5.4E-06	3.5E-06	
Cancer slope factor, oral	$(mg/kg\text{-}day)^{-1}$	NA	1.75	NA	
Risk	unitless	--	1E-05	--	1E-05
Noncarcinogenic Effects					
Chronic daily intake, soil-adult	mg/kg-day	1.6E-07	9.7E-07	1.0E-07	
Chronic daily intake, dust-adult	mg/kg-day	5.4E-07	2.4E-06	1.6E-06	
Chronic daily intake, soil-child	mg/kg-day	3.5E-06	2.1E-05	2.2E-06	
Chronic daily intake, dust-child	mg/kg-day	1.2E-05	5.2E-05	3.4E-05	
Chronic daily intake, lifetime[a]	mg/kg-day	NA	NA	3.8E-06	
Reference dose, oral	mg/kg-day	4.0E-04	0.002	8.1E-04	
Hazard index, adult	unitless	2E-03	2E-03	NA	
Hazard index, child	unitless	4E-02	4E-02	NA	
Hazard index, lifetime[a]	unitless	NA	NA	5E-03	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] RfD for cadmium is based on lifetime accumulation. See text for further details.

Table 26b. Cancer risk estimates and noncancer hazard indices
Residential scenario—Inhalation
Waneta

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Air concentration	μg/m^3	0.0095	0.0099	0.0046	
Absorption fraction	unitless	0.50 [a]	0.33 [a]	0.25 [a]	
Carcinogenic Effects					
Chronic daily intake	mg/kg-day	3.0E-06	3.1E-06	1.5E-06	
Cancer slope factor, inhalation	(mg/kg-day)$^{-1}$	NA	15	6.3	
Risk	unitless	--	5E-05	9E-06	6E-05
Noncarcinogenic Effects					
Reference concentration, inhalation	mg/m^3	2.0E-04	NA	NA	
Hazard index	unitless	5E-02	--	--	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] Absorption fraction is not used in this case because the toxicity value is based on an administered dose, rather than an absorbed dose.

Table 27a. Cancer risk estimates and noncancer hazard indices
Residential scenario—Soil and dust ingestion
West Trail

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Soil concentration	mg/kg	33.4	59.5	29.9	
Dust concentration	mg/kg	83.4	76	64.6	
Relative bioavailability	unitless	0.10	0.55	0.33	
Carcinogenic Effects					
Chronic daily intake, soil	mg/kg-day	4.6E-07	4.5E-06	1.4E-06	
Chronic daily intake, dust	mg/kg-day	3.6E-06	1.8E-05	9.1E-06	
Cancer slope factor, oral	$(mg/kg\text{-}day)^{-1}$	NA	1.75	NA	
Risk	unitless	--	4E-05	--	4E-05
Noncarcinogenic Effects					
Chronic daily intake, soil-adult	mg/kg-day	2.1E-07	2.0E-06	6.1E-07	
Chronic daily intake, dust-adult	mg/kg-day	1.6E-06	8.0E-06	4.1E-06	
Chronic daily intake, soil-child	mg/kg-day	4.4E-06	4.4E-05	1.3E-05	
Chronic daily intake, dust-child	mg/kg-day	3.4E-05	1.7E-04	8.8E-05	
Chronic daily intake, lifetime[a]	mg/kg-day	NA	NA	1.1E-05	
Reference dose, oral	mg/kg-day	4.0E-04	0.002	8.1E-04	
Hazard index, adult	unitless	5E-03	5E-03	NA	
Hazard index, child	unitless	1E-01	1E-01	NA	
Hazard index, lifetime[a]	unitless	NA	NA	1E-02	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] RfD for cadmium is based on lifetime accumulation. See text for further details.

Table 27b. Cancer risk estimates and noncancer hazard indices
Residential scenario—Inhalation
West Trail

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Air concentration	µg/m^3	0.0180	0.0099	0.0046	
Absorption fraction	unitless	0.50 [a]	0.33 [a]	0.25 [a]	
Carcinogenic Effects					
Chronic daily intake	mg/kg-day	5.7E-06	3.1E-06	1.5E-06	
Cancer slope factor, inhalation	(mg/kg-day)$^{-1}$	NA	15	6.3	
Risk	unitless	--	5E-05	9E-06	6E-05
Noncarcinogenic Effects					
Reference concentration, inhalation	mg/m^3	2.0E-04	NA	NA	
Hazard index	unitless	9E-02	--	--	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] Absorption fraction is not used in this case because the toxicity value is based on an administered dose, rather than an absorbed dose.

Table 28a. Cancer risk estimates and noncancer hazard indices
Consumption of homegrown produce
Near site (including East Trail, Tadanac, and West Trail)

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Produce concentration, leafy	mg/kg dry wt.	NC	2.38	21.9	
Produce concentration, nonleafy	mg/kg dry wt.	NC	0.38	3.94	
Carcinogenic Effects					
Chronic daily intake	mg/kg-day	--	2.2E-05	2.2E-04	
Cancer slope factor, oral	$(mg/kg\text{-}day)^{-1}$	NA	1.75	NA	
Risk	unitless	--	4E-05	--	4E-05
Noncarcinogenic Effects					
Chronic daily intake	mg/kg-day	--	2.4E-05	2.4E-04	
Reference dose, oral	mg/kg-day	4.0E-04	0.002	8.1E-04	
Hazard index	unitless	--	1E-02	3E-01	

Note:
NA – not available or not applicable
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

Table 28b. Cancer risk estimates and noncancer hazard indices
Consumption of homegrown produce
Far from site (including Rivervale & Waneta)

Parameters		Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Produce concentration, leafy	mg/kg dry wt.	NC	3.20	13.8	
Produce concentration, nonleafy	mg/kg dry wt.	NC	0.46	2.00	
Carcinogenic Effects					
Chronic daily intake	mg/kg-day	--	2.8E-05	1.2E-04	
Cancer slope factor, oral	$(mg/kg\text{-}day)^{-1}$	NA	1.75	NA	
Risk	unitless	--	5E-05	--	5E-05
Noncarcinogenic Effects					
Chronic daily intake	mg/kg-day	--	3.0E-05	1.3E-04	
Reference dose, oral	mg/kg-day	4.0E-04	0.002	8.1E-04	
Hazard index	unitless	--	1E-02	2E-01	

Note:
NA – not available or not applicable
-- – insufficient information to complete calculation
Scientific notation examples:

3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

Table 29a. Cancer risk estimates and noncancer hazard indices
Commercial scenario—Soil and dust ingestion
East Trail

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Soil concentration	mg/kg	78.0	185	103	
Dust concentration	mg/kg	122	78	58	
Relative bioavailability	unitless	0.10	0.55	0.33	
Carcinogenic Effects					
Chronic daily intake, soil	mg/kg-day	4.8E-07	6.2E-06	2.1E-06	
Chronic daily intake, dust	mg/kg-day	2.3E-06	8.0E-06	3.5E-06	
Cancer slope factor, oral	$(mg/kg\text{-}day)^{-1}$	NA	1.75	NA	
Risk	unitless	--	2E-05	--	2E-05
Noncarcinogenic Effects					
Chronic daily intake, soil-adult	mg/kg-day	2.0E-07	2.7E-06	8.9E-07	
Chronic daily intake, dust-adult	mg/kg-day	9.6E-07	3.4E-06	1.5E-06	
Chronic daily intake, soil-child	mg/kg-day	4.8E-06	6.3E-05	2.1E-05	
Chronic daily intake, dust-child	mg/kg-day	2.3E-05	8.0E-05	3.6E-05	
Chronic daily intake, lifetime[a]	mg/kg-day	NA	NA	5.7E-06	
Reference dose, oral	mg/kg-day	4.0E-04	0.002	8.1E-04	
Hazard index, adult	unitless	3E-03	3E-03	NA	
Hazard index, child	unitless	7E-02	7E-02	NA	
Hazard index, lifetime[a]	unitless	NA	NA	7E-03	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:

$3E\text{-}06 = 3 \times 10^{-6} = 0.000003$

$1.2E\text{-}05 = 1.2 \times 10^{-5} = 0.000012$

$5E\text{+}02 = 5 \times 10^{2} = 500$

[a] RfD for cadmium is based on lifetime accumulation. See text for further details.

Table 29b. Cancer risk estimates and noncancer hazard indices
Commercial scenario—Inhalation
East Trail

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Air concentration	µg/m^3	NC	0.0256	0.0124	
Absorption fraction	unitless	0.50 [a]	0.33 [a]	0.25 [a]	
Carcinogenic Effects					
Chronic daily intake	mg/kg-day	--	3.4E-06	1.6E-06	
Cancer slope factor, inhalation	(mg/kg-day)$^{-1}$	NA	15	6.3	
Risk	unitless	--	5E-05	1E-05	6E-05
Noncarcinogenic Effects					
Reference concentration, inhalation	mg/m^3	2.0E-04	NA	NA	
Hazard index	unitless	--	--	--	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] Absorption fraction is not used in this case because the toxicity value is based on an administered dose, rather than an absorbed dose.

Table 30a. Cancer risk estimates and noncancer hazard indices
Commercial scenario—Soil and dust ingestion
West Trail (Downtown)

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Soil concentration	mg/kg	28.0	40.0	26.7	
Dust concentration	mg/kg	83.4	76.0	64.6	
Relative bioavailability	unitless	0.10	0.55	0.33	
Carcinogenic Effects					
Chronic daily intake, soil	mg/kg-day	1.7E-07	1.4E-06	5.4E-07	
Chronic daily intake, dust	mg/kg-day	1.5E-06	7.8E-06	4.0E-06	
Cancer slope factor, oral	$(mg/kg\text{-}day)^{-1}$	NA	1.75	NA	
Risk	unitless	--	2E-05	--	2E-05
Noncarcinogenic Effects					
Chronic daily intake, soil-adult	mg/kg-day	7.3E-08	5.7E-07	2.3E-07	
Chronic daily intake, dust-adult	mg/kg-day	6.6E-07	3.3E-06	1.7E-06	
Chronic daily intake, soil-child	mg/kg-day	1.7E-06	1.4E-05	5.4E-06	
Chronic daily intake, dust-child	mg/kg-day	1.6E-05	7.8E-05	4.0E-05	
Chronic daily intake, lifetime[a]	mg/kg-day	NA	NA	4.5E-06	
Reference dose, oral	mg/kg-day	4.0E-04	0.002	8.1E-04	
Hazard index, adult	unitless	2E-03	2E-03	NA	
Hazard index, child	unitless	4E-02	5E-02	NA	
Hazard index, lifetime[a]	unitless	NA	NA	6E-03	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] RfD for cadmium is based on lifetime accumulation. See text for further details.

Table 30b. Cancer risk estimates and noncancer hazard indices
Commercial scenario—Inhalation
West Trail (Downtown)

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Air concentration	µg/m^3	0.0250	0.0099	0.0046	
Absorption fraction	unitless	0.50 [a]	0.33 [a]	0.25 [a]	
Carcinogenic Effects					
Chronic daily intake	mg/kg-day	3.3E-06	1.3E-06	6.0E-07	
Cancer slope factor, inhalation	(mg/kg-day)$^{-1}$	NA	15	6.3	
Risk	unitless	--	2E-05	4E-06	2E-05
Noncarcinogenic Effects					
Reference concentration, inhalation	mg/m^3	2.0E-04	NA	NA	
Hazard index	unitless	1E-01	--	--	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] Absorption fraction is not used in this case because the toxicity value is based on an administered dose, rather than an absorbed dose.

Table 31a. Cancer risk estimates and noncancer hazard indices
Farm family scenario—Soil and dust ingestion
Waneta—Agricultural Areas

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Soil concentration	mg/kg	50.0	72.9	13.2	
Dust concentration	mg/kg	50.0	72.9	13.2	
Relative bioavailability	unitless	0.10	0.55	0.33	
Carcinogenic Effects					
Chronic daily intake, soil	mg/kg-day	6.9E-07	5.5E-06	6.0E-07	
Chronic daily intake, dust	mg/kg-day	2.1E-06	1.7E-05	1.9E-06	
Cancer slope factor, oral	$(mg/kg\text{-}day)^{-1}$	NA	1.75	NA	
Risk	unitless	--	4E-05	--	4E-05
Noncarcinogenic Effects					
Chronic daily intake, soil-adult	mg/kg-day	3.1E-07	2.5E-06	2.7E-07	
Chronic daily intake, dust-adult	mg/kg-day	9.6E-07	7.7E-06	8.4E-07	
Chronic daily intake, soil-child	mg/kg-day	6.7E-06	5.3E-05	5.8E-06	
Chronic daily intake, dust-child	mg/kg-day	2.1E-05	1.7E-04	1.8E-05	
Chronic daily intake, lifetime[a]	mg/kg-day	NA	NA	2.5E-06	
Reference dose, oral	mg/kg-day	4.0E-04	0.002	8.1E-04	
Hazard index, adult	unitless	3E-03	5E-03	NA	
Hazard index, child	unitless	7E-02	1E-01	NA	
Hazard index, lifetime[a]	unitless	NA	NA	3E-03	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
$3E\text{-}06 = 3 \times 10^{-6} = 0.000003$
$1.2E\text{-}05 = 1.2 \times 10^{-5} = 0.000012$
$5E{+}02 = 5 \times 10^{2} = 500$

[a] RfD for cadmium is based on lifetime accumulation. See text for further details.

Table 31b. Cancer risk estimates and noncancer hazard indices
Farm family scenario—Inhalation
Waneta—Agricultural Areas

Parameters	Units	Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Air concentration	µg/m^3	0.0095	0.0099	0.0046	
Absorption fraction	unitless	0.50 [a]	0.33 [a]	0.25 [a]	
Carcinogenic Effects					
Chronic daily intake	mg/kg-day	3.0E-06	3.1E-06	1.5E-06	
Cancer slope factor, inhalation	(mg/kg-day)$^{-1}$	NA	15	6.3	
Risk	unitless	--	5E-05	9E-06	6E-05
Noncarcinogenic Effects					
Reference concentration, inhalation	mg/m^3	2.0E-04	NA	NA	
Hazard index	unitless	5E-02	--	--	

Note:
NA – not available or not applicable
NC – no concentration data available
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] Absorption fraction is not used in this case because the toxicity value is based on an administered dose, rather than an absorbed dose.

Table 32a. Cancer risk estimates and noncancer hazard indices
Agricultural field activities scenario—Soil ingestion
Waneta

Parameters		Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Soil concentration	mg/kg	50.0	72.9	13.2	
Relative bioavailability	unitless	0.10	0.55	0.33	
Carcinogenic Effects					
Chronic daily intake	mg/kg-day	9.6E-07	7.7E-06	8.4E-07	
Cancer slope factor, oral	$(mg/kg\text{-}day)^{-1}$	NA	1.75	NA	
Risk	unitless	--	1E-05	--	1E-05
Noncarcinogenic Effects					
Chronic daily intake	mg/kg-day	1.3E-06	1.1E-05	1.1E-06	
Reference dose, oral	mg/kg-day	4.0E-04	0.002	8.1E-04	
Hazard index	unitless	3E-03	5E-03	1E-03	

Note:
NA – not available or not applicable
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

Table 32b. Cancer risk estimates and noncancer hazard indices
Agricultural field activities scenario—Soil inhalation
Waneta

Parameters		Antimony	Arsenic	Cadmium	All Chemicals
Chemical-specific terms					
Soil concentration	mg/kg	50.0	72.9	13.2	
Absorption fraction	unitless	0.50 [a]	0.33 [a]	0.25 [a]	
Carcinogenic Effects					
Chronic daily intake	mg/kg-day	3.9E-08	5.6E-08	1.0E-08	
Cancer slope factor, inhalation	$(mg/kg\text{-}day)^{-1}$	NA	15	6.3	
Risk	unitless	--	8E-07	6E-08	9E-07
Noncarcinogenic Effects					
Reference concentration, inhalation	mg/m^3	2.0E-04	NA	NA	
Hazard index	unitless	4E-02	--	--	

Note:
NA – not available or not applicable
-- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] Absorption fraction is not used in this case because the toxicity value is based on an administered dose, rather than an absorbed dose.

Table 33. Summary of noncancer hazard indices

Neighbourhood/Pathway		Antimony	Arsenic	Cadmium
Residential scenarios				
East Trail				
Adult	Ingestion, soil/dust	8E-03	6E-03	1E-02 [a]
Adult	Ingestion, produce	--	1E-02	3E-01
Child	Ingestion, soil/dust	2E-01	1E-01	NA
Adult & child	Inhalation	--	--	--
Rivervale				
Adult	Ingestion, soil/dust	9E-03	1E-02	3E-03 [a]
Adult	Ingestion, produce	--	1E-02	2E-01
Child	Ingestion, soil/dust	2E-01	3E-01	NA
Adult & child	Inhalation	--	--	--
Tadanac				
Adult	Ingestion, soil/dust	1E-02	7E-03	2E-02 [a]
Adult	Ingestion, produce	--	1E-02	3E-01
Child	Ingestion, soil/dust	2E-01	2E-01	NA
Adult & child	Inhalation	1E-01	--	--
Waneta				
Adult	Ingestion, soil/dust	2E-03	2E-03	5E-03 [a]
Adult	Ingestion, produce	--	1E-02	2E-01
Child	Ingestion, soil/dust	4E-02	4E-02	NA
Adult & child	Inhalation	5E-02	--	--
West Trail				
Adult	Ingestion, soil/dust	5E-03	5E-03	1E-02 [a]
Adult	Ingestion, produce	--	1E-02	3E-01
Child	Ingestion, soil/dust	1E-01	1E-01	NA
Adult & child	Inhalation	9E-02	--	--
Commercial scenarios				
East Trail				
Adult	Ingestion, soil/dust	3E-03	3E-03	7E-03 [a]
Child	Ingestion, soil/dust	7E-02	7E-02	NA
Adult & child	Inhalation	--	--	--
West Trail (Downtown)				
Adult	Ingestion, soil/dust	2E-03	2E-03	6E-03 [a]
Child	Ingestion, soil/dust	4E-02	5E-02	NA
Adult & child	Inhalation	1E-01	--	--
Agricultural scenario				
Waneta (farm family)				
Adult	Ingestion, soil/dust	3E-03	5E-03	3E-03 [a]
Adult	Ingestion, produce	--	1E-02	2E-01
Child	Ingestion, soil/dust	7E-02	1E-01	NA
Adult & child	Inhalation	5E-02	--	--
Waneta (field activities)				
Adult	Ingestion, soil/dust	3E-03	5E-03	1E-03
Adult	Inhalation	4E-02	--	--

Note: NA – not applicable
-- – insufficient information to complete calculation
Scientific notation examples
$3E\text{-}06 = 3 \times 10^{-6} = 0.000003$
$1.2E\text{-}05 = 1.2 \times 10^{-5} = 0.000012$
$5E{+}02 = 5 \times 10^{2} = 500$

[a] Cadmium hazard index applies to entire lifetime.

Table 34. Summary of cancer risk estimates

Neighbourhood/Pathway	Antimony	Arsenic	Cadmium	All Chemicals
Residential scenarios				
East Trail				
Ingestion, soil/dust	--	4E-05	--	4E-05
Ingestion, produce	--	4E-05	--	4E-05
Inhalation	--	1E-04	2E-05	1E-04
Total carcinogenic risk	--	2E-04	2E-05	2E-04
Rivervale				
Ingestion, soil/dust	--	9E-05	--	9E-05
Ingestion, produce	--	5E-05	--	5E-05
Inhalation	--	9E-05	2E-05	1E-04
Total carcinogenic risk	--	2E-04	2E-05	2E-04
Tadanac				
Ingestion, soil/dust	--	6E-05	--	6E-05
Ingestion, produce	--	4E-05	--	4E-05
Inhalation	--	5E-05	9E-06	6E-05
Total carcinogenic risk	--	1E-04	9E-06	2E-04
Waneta				
Ingestion, soil/dust	--	1E-05	--	1E-05
Ingestion, produce	--	5E-05	--	5E-05
Inhalation	--	5E-05	9E-06	6E-05
Total carcinogenic risk	--	1E-04	9E-06	1E-04
West Trail				
Ingestion, soil/dust	--	4E-05	--	4E-05
Ingestion, produce	--	4E-05	--	4E-05
Inhalation	--	5E-05	9E-06	6E-05
Total carcinogenic risk	--	1E-04	9E-06	1E-04
Commercial scenarios				
East Trail				
Ingestion, soil/dust	--	2E-05	--	2E-05
Inhalation	--	5E-05	1E-05	6E-05
Total carcinogenic risk	--	8E-05	1E-05	9E-05
West Trail (Downtown)				
Ingestion, soil/dust	--	2E-05	--	2E-05
Inhalation	--	2E-05	4E-06	2E-05
Total carcinogenic risk	--	4E-05	4E-06	4E-05
Agricultural scenario				
Waneta (farm family)				
Ingestion, soil/dust	--	4E-05	--	4E-05
Ingestion, produce	--	5E-05	--	5E-05
Inhalation	--	5E-05	9E-06	6E-05
Total carcinogenic risk	--	1E-04	9E-06	1E-04
Waneta (field activities)				
Ingestion, soil/dust	--	1E-05	--	1E-05
Inhalation	--	8E-07	6E-08	9E-07
Total carcinogenic risk	--	1E-05	6E-08	1E-05

Note: -- – insufficient information to complete calculation
Scientific notation examples:
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

Table 35. Summary of noncancer hazard indices, cadmium exposures—absorbed dose

Neighbourhood	Cadmium Hazard Index[a]	
	Non-Smokers	Smokers
Residential scenarios		
East Trail	4E-01	7E-01
Rivervale	2E-01	4E-01
Tadanac	3E-01	7E-01
Waneta	2E-01	4E-01
West Trail	3E-01	7E-01
Commercial scenarios		
East Trail	3E-02	5E-02
West Trail (Downtown)	1E-02	2E-02
Agricultural scenario		
Waneta (farm family)	2E-01	4E-01
Waneta (field activities)	2E-03	3E-03

Note: Scientific notation examples:

3E-06 = 3×10^{-6} = 0.000003

1.2E-05 = 1.2×10^{-5} = 0.000012

5E+02 = 5×10^{2} = 500

[a] Hazard index is calculated using an absorbed dose RfD, which applies to the total amount of cadmium absorbed from both ingestion and inhalation.

Table 36. Summary of key sources of uncertainty

Parameter	Source of Uncertainty	Probable Effect on Risk Estimate[a]		Options for Reducing Uncertainty
		Estimated Magnitude	Direction	
EXPOSURE				
Residence time	Assuming a 75-year residence time in Trail rather than a standard 30-year value	2.2x (cancer and absorbed dose cadmium risks only)	Overestimation	Access census data to determine patterns for the Trail population.
Soil ingestion rate	Incorporating assumption of a 80 mg/day childhood soil ingestion rate based on recommendations from BCE, rather than 50 mg/day as recommended by CCME	1.6x (child noncancer risks) 1.036x (lifetime exposure)	Overestimation Overestimation	Review technical bases for all recommendations, and select best value for the Trail population.
Soil arsenic bioavailabililty	Assuming 55% RBA for arsenic in soils rather than 20% value that could be supported	2.7x for ingestion of soil/dust	Overestimation	Conduct additional research to better characterize bioavailability of arsenic from soils.
Inhalation rates	Newer information regarding average annual inhalation rates indicates that the adult values incorporated into this assessment may be high, while child estimates may be low.	1.7x (adult) 0.6x (child) 1.6x (lifetime)	Overestimation Underestimation Overestimation	Assess the literature on inhalation rates and select the value that is most representative of the Trail population.
Antimony concentrations in soil	Few observations for some neighborhoods — predicted based on arsenic concentration data	0.93x–2.0x (based on E. & W. Trail)	Unknown	Collect additional data on antimony in soil
Outdoor air concentration	Incomplete PM_{10} data (used TSP data)	Unknown	Overestimation	Collect additional PM_{10} data
Indoor air concentration	No indoor air data—assumed equal to outdoor	1.5x	Overestimation	Collect indoor air samples
Concentration of CoPCs in local produce	Inadequate time course to identify trends in concentrations of CoPCs in produce. 1998 data indicate higher concentrations than 1999 data	2x for consumption of produce	Overestimation	Continue to collect data to determine whether there is a trend to decreasing concentration.

Table 36. (cont.)

Parameter	Source of Uncertainty	Probable Effect on Risk Estimate[a]		Options for Reducing Uncertainty
		Estimated Magnitude	Direction	
TOXICITY				
Oral RfD for arsenic	Technical basis for derivation unknown	Unknown	Likely overestimation	Technical reanalysis of toxicology data, or close tracking for updates to regulatory values
Oral RfD for antimony	Extrapolation required in derivation of RfD from animal studies	Up to 1000x (10x for animal to human; 10x for human variability; 10x for LOAEL to NOEL)	Overestimation	Technical reanalysis of toxicology data, or close tracking for updates to regulatory values
Inhalation RfC for antimony	Extrapolation required in derivation of RfC from animal studies	Up to 300x (3x for animal to human; 10x for human variability; 10x for data inadequacies)	Overestimation	Technical reanalysis of toxicology data, or close tracking for updates to regulatory values
Oral RfD for cadmium	Assumptions regarding accumulation in the kidney, and sources of exposure	Up to 8x	Overestimation	Technical reanalysis of toxicology data, or close tracking for updates to regulatory values
Oral RfD for cadmium	Interactions between cadmium and zinc	Unknown	Overestimation	Animal studies, or monitor literature for further developments.
CSF for arsenic	Extrapolation from high exposure to low exposure • Whether threshold exists • Whether doses are estimated correctly in study that forms the basis for the CSF • Applicability of study population to Canadian populations	Calculated risks represent an upper-bound estimate. Actual risks may be as low as zero.	Overestimation	Technical reanalysis of toxicology data, or close tracking for updates to regulatory values
CSF for cadmium	Extrapolation from high exposure to low exposure	Calculated risks represent an upper-bound estimate. Actual risks may be as low as zero.	Overestimate	Technical reanalysis of toxicology data, or close tracking for updates to regulatory values

[a] Applies equally to cancer and noncancer risk estimates unless otherwise noted.

Table 37. Comparison of Phase 2 and Phase 3 exposure-point concentrations for air

Location	Antimony		Arsenic		Cadmium	
	Phase 2	Phase 3	Phase 2	Phase 3	Phase 2	Phase 3
Residential air (µg/m³)						
East Trail	NC	NC	0.025 *M*	0.0256 *L*	0.014 *M*	0.0124 *L*
Rivervale	NC	NC	0.032 *L*	0.0182 *L*	0.010 *L*	0.0091 *L*
Tadanac	0.025 *L*	0.025 *L*	0.030 *L*	0.0099 *L*	0.014 *L*	0.0046 *L*
Waneta	0.005 *M*	0.0095 *L*	0.020 *M*	0.0099 *L*	0.020 *M*	0.0046 *L*
West Trail	0.018 *L*	0.018 *L*	0.038 *L*	0.0099 *L*	0.008 *L*	0.0046 *L*
Commercial air (µg/m³)						
Downtown	0.025 *L*	0.025 *L*	0.030 *L*	0.0099 *L*	0.014 *L*	0.0046 *L*
East Trail	NC	NC	0.025 *M*	0.0256 *L*	0.014 *M*	0.0124 *L*

Note: See attached table for information about the source of each value.
NC – no concentration data available
L – the exposure-point concentration for this analyte for this location is the UCLM
M – the exposure-point concentration for this analyte for this location is the maximum

Table 38. Comparison of Phase 2 & Phase 3 exposure-point concentrations for dust

	Antimony				Arsenic				Cadmium			
	Phase 2		Phase 3		Phase 2		Phase 3		Phase 2		Phase 3	
	EPC	n	EPC	n	EPC	n	EPC	n	EPC	n	EPC	n
Residential dust (mg/kg)												
East Trail	107 *L*	12	122 *L*	7	92.0 *L*	60	78.0 *L*	7	37.2 *L*	60	57.8 *L*	7
Rivervale	140 *P,L*	15	140 *P,L* [a]	15	169 *L*	15	169 *L* [a]	15	14.3 *L*	15	14.3 *L* [a]	15
Tadanac	75.9 *L*	13	181 *M*	6	107 *L*	15	100 *M*	6	34.1 *L*	15	90.0 *M*	6
Waneta	26.0 *M*	1	28.0 *M*	4	28.7 *M*	4	23.0 *M*	4	5.00 *M*	4	25.0 *M*	4
West Trail	33.4 *L*	14	83.4 *L*	9	59.5 *L*	53	76.0 *L*	9	29.9 *L*	53	64.6 *L*	9
Commercial dust (mg/kg) [b]												
East Trail	78.0 *M*	1	122 *L*	7	185 *M*	6	78.0 *L*	7	103 *M*	6	57.8 *L*	7
West Trail	28.0 *P,M*	6	83.4 *L*	9	40.0 *M*	6	76.0 *L*	9	26.7 *M*	6	64.6 *L*	9

Note: For Phase 2, dust concentrations were assumed to be equal to soil concentrations because no dust data were available.
Phase 3 dust concentrations were calculated from a compilation of results from samples taken in April 1998 and August/September 1998.
EPC – exposure-point concentration
n – number of values used to calculate EPC. Concentrations were pre-averaged over time at each location, so "n" represents the number of properties
L – the exposure-point concentration for this analyte for this neighbourhood is the UCLM
M – the exposure-point concentration for this analyte for this neighbourhood is the maximum
P – the exposure-point concentration for this analyte is predicted by the equation: $[Antimony] = 0.509 \times [Arsenic]^{1.075} \times 1.041$ (see text for details)

[a] For dust concentrations in Rivervale, only one dust sample was available. Therefore, the EPC was based on soil concentrations.
[b] No specific dust data are available for commercial areas. Therefore, dust concentrations from residential areas of East and West Trail were used to characterize dust concentrations in commercial areas of East and West Trail.

Table 39. Comparison of cancer risk estimates from Phase 2 and Phase 3

Neighbourhood/Pathway	Antimony Phase 2	Antimony Phase 3	Arsenic Phase 2	Arsenic Phase 3	Cadmium Phase 2	Cadmium Phase 3	All Chemicals Phase 2	All Chemicals Phase 3
Residential scenarios								
East Trail								
Ingestion, soil/dust	--	--	5E-05	4E-05	--	--	5E-05	4E-05
Ingestion, produce	NE	--	NE	4E-05	NE	--	NE	4E-05
Inhalation	--	--	1E-04	1E-04	3E-05	2E-05	1E-04	1E-04
Total carcinogenic risk	--	--	2E-04	2E-04	3E-05	2E-05	2E-04	2E-04
Rivervale								
Ingestion, soil/dust	--	--	9E-05	9E-05	--	--	9E-05	9E-05
Ingestion, produce	NE	--	NE	5E-05	NE	--	NE	5E-05
Inhalation	--	--	2E-04	9E-05	2E-05	2E-05	2E-04	1E-04
Total carcinogenic risk	--	--	2E-04	2E-04	2E-05	2E-05	3E-04	2E-04
Tadanac								
Ingestion, soil/dust	--	--	6E-05	6E-05	--	--	6E-05	6E-05
Ingestion, produce	NE	--	NE	4E-05	NE	--	NE	4E-05
Inhalation	--	--	1E-04	5E-05	3E-05	9E-06	2E-04	6E-05
Total carcinogenic risk	--	--	2E-04	1E-04	3E-05	9E-06	2E-04	2E-04
Waneta								
Ingestion, soil/dust	--	--	2E-05	1E-05	--	--	2E-05	1E-05
Ingestion, produce	NE	--	NE	5E-05	NE	--	NE	5E-05
Inhalation	--	--	9E-05	5E-05	4E-05	9E-06	1E-04	6E-05
Total carcinogenic risk	--	--	1E-04	1E-04	4E-05	9E-06	2E-04	1E-04
West Trail								
Ingestion, soil/dust	--	--	3E-05	4E-05	--	--	3E-05	4E-05
Ingestion, produce	NE	--	NE	4E-05	NE	--	NE	4E-05
Inhalation	--	--	2E-04	5E-05	2E-05	9E-06	2E-04	6E-05
Total carcinogenic risk	--	--	2E-04	1E-04	2E-05	9E-06	2E-04	1E-04
Commercial scenarios								
East Trail								
Ingestion, soil/dust	--	--	4E-05	2E-05	--	--	4E-05	2E-05
Inhalation	--	--	5E-05	5E-05	1E-05	1E-05	6E-05	6E-05
Total carcinogenic risk	--	--	9E-05	8E-05	1E-05	1E-05	1E-04	9E-05
West Trail (Downtown)								
Ingestion, soil/dust	--	--	1E-05	2E-05	--	--	1E-05	2E-05
Inhalation	--	--	6E-05	2E-05	1E-05	4E-06	7E-05	2E-05
Total carcinogenic risk	--	--	7E-05	4E-05	1E-05	4E-06	8E-05	4E-05
Agricultural scenario								
Waneta (farm family)								
Ingestion, soil/dust	--	--	4E-05	4E-05	--	--	4E-05	4E-05
Ingestion, produce	NE	--	NE	5E-05	NE	--	NE	5E-05
Inhalation	--	--	5E-05	5E-05	4E-06	9E-06	6E-05	6E-05
Total carcinogenic risk	--	--	9E-05	1E-04	4E-06	9E-06	1E-04	1E-04
Waneta (field activities)								
Ingestion, soil/dust	--	--	1E-05	1E-05	--	--	1E-05	1E-05
Inhalation	--	--	8E-07	8E-07	6E-08	6E-08	9E-07	9E-07
Total carcinogenic risk	--	--	1E-05	1E-05	6E-08	6E-08	1E-05	1E-05

Note: -- – insufficient information to complete calculation

NE – not evaluated for Phase 2

Scientific notation examples: 3E-06 = 3×10^{-6} = 0.000003

1.2E-05 = 1.2×10^{-5} = 0.000012

5E+02 = 5×10^{2} = 500

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Table __. Comparison of noncancer hazard indices from Phase 2 and Phase 3

Neighbourhood/Pathway		Antimony		Arsenic		Cadmium	
		Phase 2	Phase 3	Phase 2	Phase 3	Phase 2	Phase 3
Residential scenarios							
East Trail							
Adult	Ingestion, soil/dust	7E-03	8E-03	6E-03	6E-03	9E-03 [a]	1E-02 [a]
Adult	Ingestion, produce	NE	--	NE	1E-02	NE	3E-01
Child	Ingestion, soil/dust	1E-01	2E-01	1E-01	1E-01	NA	NA
Adult & child	Inhalation	--	--	--	--	--	--
Rivervale							
Adult	Ingestion, soil/dust	9E-03	9E-03	1E-02	1E-02	3E-03 [a]	3E-03 [a]
Adult	Ingestion, produce	NE	--	NE	1E-02	NE	2E-01
Child	Ingestion, soil/dust	2E-01	2E-01	3E-01	3E-01	NA	NA
Adult & child	Inhalation	--	--	--	--	--	--
Tadanac							
Adult	Ingestion, soil/dust	5E-03	1E-02	7E-03	7E-03	8E-03 [a]	2E-02 [a]
Adult	Ingestion, produce	NE	--	NE	1E-02	NE	3E-01
Child	Ingestion, soil/dust	1E-01	2E-01	2E-01	2E-01	NA	NA
Adult & child	Inhalation	1E-01	1E-01	--	--	--	--
Waneta							
Adult	Ingestion, soil/dust	2E-03	2E-03	2E-03	2E-03	1E-03 [a]	5E-03 [a]
Adult	Ingestion, produce	NE	--	NE	1E-02	NE	2E-01
Child	Ingestion, soil/dust	4E-02	4E-02	4E-02	4E-02	NA	NA
Adult & child	Inhalation	3E-02	5E-02	--	--	--	--
West Trail							
Adult	Ingestion, soil/dust	2E-03	5E-03	4E-03	5E-03	7E-03 [a]	1E-02 [a]
Adult	Ingestion, produce	NE	--	NE	1E-02	NE	3E-01
Child	Ingestion, soil/dust	5E-02	1E-01	9E-02	1E-01	NA	NA
Adult & child	Inhalation	9E-02	9E-02	--	--	--	--
Commercial scenarios							
East Trail							
Adult	Ingestion, soil/dust	2E-03	3E-03	5E-03	3E-03	1E-02 [a]	7E-03 [a]
Child	Ingestion, soil/dust	5E-02	7E-02	1E-01	7E-02	NA	NA
Adult & child	Inhalation	--	--	--	--	--	--
West Trail (Downtown)							
Adult	Ingestion, soil/dust	7E-04	2E-03	1E-03	2E-03	3E-03 [a]	6E-03 [a]
Child	Ingestion, soil/dust	2E-02	4E-02	3E-02	5E-02	NA	NA
Adult & child	Inhalation	1E-01	1E-01	--	--	--	--
Agricultural scenario							
Waneta (farm family)							
Adult	Ingestion, soil/dust	3E-03	3E-03	5E-03	5E-03	3E-03 [a]	3E-03 [a]
Adult	Ingestion, produce	NE	--	NE	1E-02	NE	2E-01
Child	Ingestion, soil/dust	7E-02	7E-02	1E-01	1E-01	NA	NA
Adult & child	Inhalation	4E-02	5E-02	--	--	--	--
Waneta (field activities)							
Adult	Ingestion, soil/dust	3E-03	3E-03	5E-03	5E-03	1E-03	1E-03
Adult	Inhalation	4E-02	4E-02	--	--	--	--

Note: NA – not applicable
-- – insufficient information to complete calculation
NE – not evaluated for Phase 2

Scientific notation examples
3E-06 = 3×10^{-6} = 0.000003
1.2E-05 = 1.2×10^{-5} = 0.000012
5E+02 = 5×10^{2} = 500

[a] Cadmium hazard index applies to entire lifetime.

Table __. Comparison of noncancer hazard indices, from Phase 2 and Phase 3, cadmium exposures—absorbed dose

	Cadmium Hazard Index[a]			
	Non-Smokers		Smokers	
Neighbourhood	Phase 2	Phase 3	Phase 2	Phase 3
Residential scenarios				
East Trail	6E-02	4E-01	1E-01	7E-01
Rivervale	4E-02	2E-01	9E-02	4E-01
Tadanac	6E-02	3E-01	1E-01	7E-01
Waneta	8E-02	2E-01	2E-01	4E-01
West Trail	4E-02	3E-01	8E-02	7E-01
Commercial scenarios				
East Trail	3E-02	3E-02	6E-02	5E-02
West Trail (Downtown)	2E-02	1E-02	5E-02	2E-02
Agricultural scenario				
Waneta (farm family)	8E-02	2E-01	2E-01	4E-01
Waneta (field activities)	2E-03	2E-03	3E-03	3E-03

Note: Scientific notation examples:

3E-06 = 3×10^{-6} = 0.000003

1.2E-05 = 1.2×10^{-5} = 0.000012

5E+02 = 5×10^{2} = 500

[a] Hazard index is calculated using an absorbed dose RfD, which applies to the total amount of cadmium absorbed from both ingestion and inhalation.

Appendix A

Data Tables Used in Risk Evaluation

Table A-1. Soil data used in risk evaluation

Property ID	UTM_X	UTM_Y	Neighbourhood	Land Use	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)
P890018	452159	5433859	Casino	Residential		13	1.5
P890138	451496	5433796	Casino	Residential		3	0.9
ET1	448674	5438413	East Trail	Park/Rec	54	85	16.2
ET2	448996	5438643	East Trail	Residential	34	44	16.2
ET3	449221	5438451	East Trail	Residential	75	91	33.5
G03	449516	5438082	East Trail	Park/Rec		13	9.2
G06	449057	5438442	East Trail	Residential		13	19.0
G07	449618	5438312	East Trail	Park/Rec		40	5.3
G14	449320	5438129	East Trail	Residential		60	32.0
G15	449166	5438309	East Trail	Residential		45	38.0
G16	448733	5438484	East Trail	Commercial		30	38.0
G17	448670	5438991	East Trail	Residential		55	16.0
G18	448467	5439244	East Trail	Park/Rec		13	12.0
G37	449980	5438226	East Trail	Park/Rec		65	9.7
G41	449667	5438149	East Trail	Commercial		65	8.6
G42	449497	5438257	East Trail	Residential		13	8.7
G43	449063	5438412	East Trail	Residential		35	11.0
G44	448819	5438467	East Trail	Commercial		55	13.0
G45	449321	5438268	East Trail	Residential		30	6.1
G46	449304	5438091	East Trail	Residential		140	75.0
Nov97-mapID-13[a]	449223	5438159	East Trail	Park/Rec	12		
Nov97-mapID-14[a]	448537	5439178	East Trail	Park/Rec	18		
Nov97-mapID-15[a]	448827	5438878	East Trail	Institutional	78		
P890019	448692	5438613	East Trail	Residential		61	21.6
P890024	448976	5438451	East Trail	Residential		256	52.6
P890109	448746	5438314	East Trail	Residential		13	7.0
P890110	448622	5438920	East Trail	Residential		13	6.1
P890111	449075	5438448	East Trail	Residential		69	15.6
P890154	448537	5438998	East Trail	Residential		39	11.4
P890162	448791	5438348	East Trail	Residential		117	55.0
P890197	449072	5438554	East Trail	Residential		85	62.5
P890198	449073	5438345	East Trail	Residential		88	36.6
P890200	449210	5438461	East Trail	Residential		67	33.4
P890216	448992	5438427	East Trail	Residential		13	5.4
P890219	449120	5438531	East Trail	Residential		21	8.2
P890220	449160	5438462	East Trail	Residential		91	41.8
P890238	449055	5438487	East Trail	Residential		117	41.9
P890262	449029	5438530	East Trail	Residential		39	30.3
P890263	449148	5438256	East Trail	Residential		53	19.8
P890300	449413	5438297	East Trail	Institutional		16	7.3
P890306	448375	5439214	East Trail	Park/Rec		18	9.8
P890307	449131	5438120	East Trail	Park/Rec		62	29.4
P900071	448758	5438676	East Trail	Residential	55	77	40.0
P910010	449179	5438419	East Trail	Residential		100	39.0
P910011	448651	5438712	East Trail	Residential		63	27.5
P910029	449467	5438405	East Trail	Residential		63	37.7
P910040	449033	5438519	East Trail	Residential		160	27.0
P910047	448986	5438370	East Trail	Residential		340	129
P910064	448449	5439123	East Trail	Residential		65	44.0
P910068	448514	5439052	East Trail	Residential		24	14.5
P910099	449721	5438178	East Trail	Residential		52	17.3
P910108	449426	5438172	East Trail	Residential	26	37	12.6

Table A-1. (cont.)

Property ID	UTM_X	UTM_Y	Neighbourhood	Land Use	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)
P910130	449316	5438284	East Trail	Residential		39	24.6
P910137	449275	5438386	East Trail	Residential		150	60.0
P910143	449856	5438231	East Trail	Residential		108	38.0
P910156	448849	5438694	East Trail	Residential		78	39.0
P910157	448575	5439034	East Trail	Residential		29	19.0
P910169	448747	5438510	East Trail	Commercial		185	103
P910172	448532	5438751	East Trail	Residential		88	23.5
P910178	448969	5438558	East Trail	Residential		125	63.0
P910203	449404	5438160	East Trail	Institutional		40	25.5
P910208	449040	5438602	East Trail	Residential		60	29.0
P910217	448634	5438981	East Trail	Residential		92	20.0
P910218	449588	5438104	East Trail	Residential		50	25.0
P920002	449144	5438581	East Trail	Residential		27	11.8
P920003	449271	5438232	East Trail	Residential		48	17.0
P920326	448914	5438487	East Trail	Residential	95	140	58.5
P940060	448698	5438592	East Trail	Residential	101	131	65.2
P970004	448780	5438817	East Trail	Residential	24	41	22.9
P970009	448131	5438033	East Trail	Residential	17	25	12.8
P980001	448657	5438602	East Trail	Residential	144	179	82.5
G04	450593	5438559	Glenmerry	Institutional		13	7.8
G05	450694	5438491	Glenmerry	Residential		13	4.6
G27	451084	5438277	Glenmerry	Residential		45	9.9
G28	450902	5438246	Glenmerry	Residential		25	7.9
G38	450889	5438331	Glenmerry	Residential		13	9.6
G70	450855	5438733	Glenmerry	Park/Rec		13	2.0
G71	451547	5438648	Glenmerry	Residential		13	12.0
P890006	450851	5438296	Glenmerry	Residential		95	10.3
P890020	451004	5438550	Glenmerry	Residential		32	7.0
P890027	451059	5438226	Glenmerry	Residential		87	17.5
P890048	452242	5438307	Glenmerry	Residential		25	8.3
P890054	451003	5438321	Glenmerry	Residential		20	4.9
P890056	451114	5438687	Glenmerry	Residential		51	16.0
P890091	451944	5438382	Glenmerry	Residential		22	7.7
P890125	451021	5438197	Glenmerry	Residential		40	5.8
P890139	451522	5438362	Glenmerry	Residential		39	6.9
P890169	451490	5438279	Glenmerry	Residential		68	17.0
P890177	451805	5438250	Glenmerry	Residential		9	2.7
P890196	450659	5438448	Glenmerry	Residential		13	12.9
P890229	451409	5438519	Glenmerry	Residential		113	18.7
P890237	450953	5438547	Glenmerry	Residential		56	17.3
P890280	450967	5438330	Glenmerry	Residential		56	12.0
P890287	451436	5438376	Glenmerry	Residential		58	12.7
P890301	451901	5438358	Glenmerry	Residential		21	3.1
P890308	450847	5438444	Glenmerry	Residential		11	4.6
P900029	450926	5438263	Glenmerry	Residential		187	78.5
P910023	450822	5438278	Glenmerry	Residential		35	15.0
P910041	451152	5438396	Glenmerry	Residential		22	13.3
P910063	451915	5438419	Glenmerry	Residential		73	12.5
P910123	451124	5438491	Glenmerry	Residential		35	12.0
P910166	451299	5438387	Glenmerry	Residential		45	11.0
P910182	451839	5438358	Glenmerry	Residential		24	16.5
P910188	450885	5438273	Glenmerry	Residential		13	9.1

Table A-1. (cont.)

Property ID	UTM_X	UTM_Y	Neighbourhood	Land Use	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)
P910210	451975	5438543	Glenmerry (Centennial Park)	Park/Rec		38	16.1
P910211	451019	5438841	Glenmerry (Andy Bileski Park)	Park/Rec		62	6.9
P910216	450708	5438453	Glenmerry	Residential		22	12.8
P920747	451284	5438507	Glenmerry	Residential		13	8.8
P950099	452064	5438316	Glenmerry	Residential		13	8.9
P950100	452272	5438313	Glenmerry	Residential		13	3.3
P950102	450685	5438478	Glenmerry	Residential		13	3.4
P950103	450922	5438193	Glenmerry	Residential		19	10.3
P950104	451858	5438318	Glenmerry	Residential		43	18.5
G20	445790	5438228	Lower Warfield	Residential		13	4.4
G21	445474	5437856	Lower Warfield	Residential		13	4.4
G63	446340	5438244	Lower Warfield (Annable)	Residential		13	4.9
G64	446703	5438266	Lower Warfield (Annable)	Residential		13	3.6
G65	446492	5438186	Lower Warfield (Annable)	Residential		13	5.5
LW1	446800	5439024	Lower Warfield	Industrial	60	78	20.9
LW2	446201	5439148	Lower Warfield	Industrial	24	27	7.5
LW3	445773	5438890	Lower Warfield	Industrial	10	14	11.1
P890005	445086	5437325	Lower Warfield	Residential		10	0.6
P890047	445173	5437536	Lower Warfield	Residential		8	2.2
P890049	445465	5437411	Lower Warfield	Residential		40	7.4
P890053	445403	5437699	Lower Warfield	Residential		11	3.2
P890092	445763	5438032	Lower Warfield	Residential		22	6.0
P890099	446588	5438183	Lower Warfield	Residential		27	15.0
P890105	445081	5437373	Lower Warfield	Residential		9	1.0
P890172	445677	5437665	Lower Warfield	Residential		18	3.1
P890182	445081	5437390	Lower Warfield	Residential		36	20.5
P890199	445426	5437819	Lower Warfield	Residential		10	4.5
P890211	446341	5437950	Lower Warfield	Residential		12	2.5
P890224	445610	5438035	Lower Warfield	Residential		24	4.2
P890267	445452	5437574	Lower Warfield	Residential		7	2.9
P890269	445221	5437637	Lower Warfield	Residential		10	1.3
P890278	445727	5437483	Lower Warfield	Residential		3	2.6
P890302	445116	5437676	Lower Warfield	Park/Rec		15	1.9
P890316	445769	5438436	Lower Warfield	Park/Rec		9	0.8
P890317	446316	5438364	Lower Warfield	Park/Rec		19	3.5
P890318	445618	5437910	Lower Warfield	Park/Rec		10	1.1
P890321	445876	5437993	Lower Warfield	Park/Rec		12	2.0
P890322	445116	5437676	Lower Warfield	Park/Rec		12	1.7
P890326	445154	5437511	Lower Warfield	Park/Rec		8	1.0
P910139	445135	5437144	Lower Warfield	Residential		13	5.3
P910142	444988	5437570	Lower Warfield	Residential		13	5.4
P910213	445378	5437756	Lower Warfield	Residential		13	4.1
P910214	445482	5437774	Lower Warfield	Residential		13	2.8
P890022	450022	5439274	Miral Heights	Residential		15	1.2
P890037	449953	5439302	Miral Heights	Residential		15	2.9
P890045	450033	5439290	Miral Heights	Residential		13	1.1
P890107	450071	5439074	Miral Heights	Residential		5	0.5
P890118	450045	5439210	Miral Heights	Residential		3	0.6
P890147	450060	5439054	Miral Heights	Residential		15	1.8
P890325	450089	5438978	Miral Heights	Park/Rec		10	2.9
P890113	456410	5435787	Montrose	Residential		11	3.8
P890268	457216	5436487	Montrose	Residential		13	2.6
P910117	456776	5436256	Montrose	Residential		13	1.8

Table A-1. (cont.)

Property ID	UTM_X	UTM_Y	Neighbourhood	Land Use	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)
P890064	445887	5442685	Oasis	Residential		22	6.6
P890163	445707	5442388	Oasis	Residential		13	4.0
P910025	445882	5442657	Oasis	Residential		13	14.0
P910055	445508	5442841	Oasis	Residential		22	3.8
G54	446270	5440868	Rivervale	Residential		80	8.3
G55	446275	5440968	Rivervale	Residential		210	16.0
G56	446211	5441236	Rivervale	Residential		80	4.6
G57	446136	5441313	Rivervale	Residential		40	5.2
G58	446171	5441480	Rivervale	Residential		70	5.7
G59	446110	5441579	Rivervale	Residential		140	9.3
G60	446088	5441691	Rivervale	Residential		420	30.0
G61	446030	5441322	Rivervale	Industrial		55	9.6
G62	446118	5441003	Rivervale	Industrial		175	12.0
P890039	446269	5441734	Rivervale	Residential		13	12.0
P890069	446262	5441434	Rivervale	Residential		30	4.1
P890209	446267	5441330	Rivervale	Residential		37	3.2
P890223	446196	5441637	Rivervale	Residential		24	5.2
P890230	446260	5441513	Rivervale	Residential		29	8.2
P890324	446263	5440980	Rivervale	Residential		17	2.3
P910161	446198	5441353	Rivervale	Residential		53	5.8
P910200	446429	5440728	Rivervale	Residential		75	19.0
G22	449958	5438318	Shavers Bench	Park/Rec		13	12.0
G23	449859	5438410	Shavers Bench	Residential		30	22.0
G24	449680	5438638	Shavers Bench	Residential		13	14.0
G25	449422	5438544	Shavers Bench	Park/Rec		35	8.4
G26	449486	5438533	Shavers Bench	Residential		13	20.0
G36	449351	5438710	Shavers Bench	Residential		13	4.4
G39	449882	5438292	Shavers Bench	Residential		25	29.0
G40	449812	5438315	Shavers Bench	Residential		25	20.0
P890033	449655	5438628	Shavers Bench	Residential		18	4.8
P890070	449266	5438651	Shavers Bench	Residential		8	4.4
P890076	449801	5438500	Shavers Bench	Residential		87	23.6
P890079	449760	5438483	Shavers Bench	Residential		42	14.1
P890112	449724	5438441	Shavers Bench	Residential		56	21.5
P890117	449592	5438656	Shavers Bench	Residential		60	15.3
P890129	449726	5438635	Shavers Bench	Residential		15	5.2
P890157	449924	5438544	Shavers Bench	Residential		37	7.6
P890159	449866	5438322	Shavers Bench	Residential		52	18.3
P890284	449683	5438517	Shavers Bench	Residential		15	13.7
P890285	449473	5438614	Shavers Bench	Residential		61	16.7
P890309	449945	5438442	Shavers Bench	Park/Rec		23	5.4
P890327	449309	5438642	Shavers Bench	Residential		13	5.2
P910001	449246	5438637	Shavers Bench	Residential		13	6.7
P910038	449789	5438296	Shavers Bench	Residential		27	10.2
P910097	449926	5438289	Shavers Bench	Residential		80	34.0
P910186	450095	5438665	Shavers Bench	Park/Rec		29	9.9
P950107	449481	5438447	Shavers Bench	Park/Rec		13	26.0
G10	447294	5440556	Sunningdale	Residential		30	13.0
G11	447494	5440371	Sunningdale	Residential		35	22.0
G12	447826	5440329	Sunningdale	Residential		13	9.8
G13	447967	5440090	Sunningdale	Park/Rec		25	5.7
G19	447825	5440424	Sunningdale	Residential		13	9.5
G29	447875	5440183	Sunningdale	Residential		13	12.0

Table A-1. (cont.)

Property ID	UTM_X	UTM_Y	Neighbourhood	Land Use	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)
G30	447788	5440240	Sunningdale	Residential		13	15.0
G31	447720	5440287	Sunningdale	Residential		30	18.0
G32	447679	5440360	Sunningdale	Residential		13	9.1
G33	447643	5440436	Sunningdale	Residential		13	16.0
G34	447553	5440828	Sunningdale	Residential		13	5.7
G35	447896	5440317	Sunningdale	Residential		13	4.3
P890135	447551	5440368	Sunningdale	Residential		30	3.2
P890190	447370	5440451	Sunningdale	Residential		43	12.4
P890232	447718	5440365	Sunningdale	Residential		11	1.6
P890251	447560	5440377	Sunningdale	Residential		48	11.3
P890312	447758	5440763	Sunningdale	Residential		11	5.1
P910135	447329	5440490	Sunningdale	Residential		13	11.1
P910141	447726	5440722	Sunningdale	Residential		43	11.7
P950105	447886	5440039	Sunningdale	Park/Rec		13	4.2
P950106	447893	5440107	Sunningdale	Park/Rec		13	10.8
SUN_UNK[a]	447531	5440506	Sunningdale	Park/Rec		19	5.9
G47	447759	5439321	Tadanac	Park/Rec		86	27.0
G49	446921	5439733	Tadanac	Industrial		110	38.0
G50	446971	5439688	Tadanac	Industrial		40	12.0
G51	447240	5439832	Tadanac	Industrial		570	195
G52	447411	5439676	Tadanac	Industrial		425	160
G53	447652	5439397	Tadanac	Industrial		635	200
Nov97-mapID-10[a]	447272	5439926	Tadanac	Institutional	65		
Nov97-mapID-11[a]	447322	5439995	Tadanac	Residential	68		
Nov97-mapID-12[a]	447389	5440094	Tadanac	Park/Rec	103		
Nov97-mapID-5[a]	447852	5439177	Tadanac	Residential	19		
Nov97-mapID-6[a]	447907	5439188	Tadanac	Residential	17		
Nov97-mapID-7[a]	447575	5439749	Tadanac	Residential	91		
Nov97-mapID-8[a]	447648	5439786	Tadanac	Residential	39		
Nov97-mapID-9[a]	447683	5439827	Tadanac	Park/Rec	37		
P890023	447451	5439784	Tadanac	Residential		43	18.7
P890071	447327	5439804	Tadanac	Residential		140	29.8
P890085	447492	5439815	Tadanac	Residential		117	36.0
P890122	447413	5439870	Tadanac	Residential		63	30.5
P890146	447845	5439430	Tadanac	Residential		35	18.2
P890217	447704	5439548	Tadanac	Residential		105	25.0
P890293	447559	5439779	Tadanac	Residential	34	51	16.6
P890305	447277	5439848	Tadanac	Institutional		67	22.6
P890313	447697	5439416	Tadanac	Park/Rec		36	34.8
P900003	447373	5439764	Tadanac	Residential		129	32.5
P900016	447588	5439627	Tadanac	Residential	49	60	22.5
P910209	447261	5439932	Tadanac	Institutional		103	41.2
P930065	447380	5439897	Tadanac	Residential	13	17	5.9
P950062	447329	5439933	Tadanac	Residential	59	114	37.9
P980004	447548	5439657	Tadanac	Residential	38	61	21.0
TAD1	447207	5439863	Tadanac	Industrial	395	469	133
TAD2	447230	5440003	Tadanac	Institutional	10	6	8.2
TAD3	447232	5439891	Tadanac	Institutional	28	67	10.9
TAD4	447476	5439646	Tadanac	Industrial	276	344	116
TAD5	447559	5439669	Tadanac	Residential	54	54	29.4
TAD6	447790	5439201	Tadanac	Industrial	104	127	35.7

Table A-1. (cont.)

Property ID	UTM_X	UTM_Y	Neighbourhood	Land Use	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)
G67	444804	5438109	Upper Warfield	Residential		30	4.7
G68	445014	5438029	Upper Warfield	Residential		13	1.3
G69	445078	5437963	Upper Warfield	Residential		13	4.5
P890014	445001	5437753	Upper Warfield	Residential		9	3.8
P890036	444718	5438140	Upper Warfield	Residential		3	2.0
P890038	445106	5437896	Upper Warfield	Residential		8	9.1
P890060	445016	5438048	Upper Warfield	Residential		3	0.8
P890116	444993	5437872	Upper Warfield	Residential		18	5.3
P890160	444898	5437951	Upper Warfield	Residential		11	1.6
P890234	444779	5438050	Upper Warfield	Residential		6	3.0
P890246	445087	5437747	Upper Warfield	Residential		3	1.4
P890272	444891	5437873	Upper Warfield	Residential		35	7.9
P890319	445185	5438099	Upper Warfield	Park/Rec		9	2.5
P890320	444711	5438043	Upper Warfield	Park/Rec		7	1.3
P910115	444815	5438163	Upper Warfield	Residential		13	2.6
G72	453690	5437380	Waneta	Commercial		40	3.2
G73	454502	5436914	Waneta	Residential		13	1.3
P890195	454753	5436919	Waneta	Commercial		13	6.0
P910212	454691	5436856	Waneta (Green Gables Park)	Commercial		13	3.2
P950001	455104	5436274	Waneta	Residential		3	2.7
P960001	454997	5437051	Waneta	Residential		21	4.7
WAN1	455406	5433861	Waneta	Commercial	10	22	4.2
WAN2	455570	5434894	Waneta	Park/Rec	26	29	5.0
WAN3	455666	5432688	Waneta	Agricultural	50	73	13.2
WAN4	455934	5433274	Waneta	Agricultural	10	16	8.3
WAN5	456146	5434863	Waneta	Agricultural	29	55	6.8
WAN6	456184	5432516	Waneta	Agricultural	32	49	6.5
WAN7	456292	5432953	Waneta	Agricultural	20	25	2.9
WAN8	456716	5433590	Waneta	Agricultural	10	29	5.9
G01	447911	5438259	West Trail	Industrial		35	46.0
G02	447833	5438330	West Trail	Commercial		30	11.0
G08	447766	5438042	West Trail	Residential		13	11.0
G09	447871	5438023	West Trail	Residential		13	9.0
G66	447260	5438619	West Trail	Industrial		25	9.4
Nov97-mapID-16[a]	447037	5438692	West Trail	Park/Rec	10		
Nov97-mapID-17[a]	447445	5438323	West Trail	Park/Rec	24		
Nov97-mapID-18[a]	448001	5438028	West Trail	Residential	9		
Nov97-mapID-19[a]	448435	5437679	West Trail	Park/Rec	21		
Nov97-mapID-20[a]	449193	5437599	West Trail	Park/Rec	12		
Nov97-mapID-21/2:	449057	5437820	West Trail	Residential	4		
P890002	448181	5438046	West Trail	Residential		45	35.0
P890043	447637	5438372	West Trail	Commercial		32	17.2
P890051	447894	5438158	West Trail	Residential		23	16.1
P890063	448049	5437730	West Trail	Residential		49	19.7
P890101	447641	5438015	West Trail	Residential		42	8.5
P890120	448262	5437867	West Trail	Residential		31	20.4
P890140	447619	5438356	West Trail	Commercial		29	26.7
P890144	447100	5438617	West Trail	Residential		21	18.1
P890167	446985	5438386	West Trail	Residential		18	4.6
P890173	447172	5438414	West Trail	Residential		36	14.0
P890176	447334	5438357	West Trail	Residential		57	29.4
P890179	448688	5437811	West Trail	Residential		57	17.9

Table A-1. (cont.)

Property ID	UTM_X	UTM_Y	Neighbourhood	Land Use	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)
P890188	448380	5437736	West Trail	Residential		26	4.8
P890189	447959	5437943	West Trail	Residential		40	13.8
P890193	448795	5437695	West Trail	Residential		21	4.7
P890208	449083	5437733	West Trail	Residential		75	14.7
P890231	448078	5437892	West Trail	Residential		40	15.1
P890241	447589	5438138	West Trail	Residential		18	4.0
P890253	448016	5437769	West Trail	Residential		30	9.1
P890256	448478	5437800	West Trail	Residential		81	33.7
P890258	448910	5437746	West Trail	Residential		28	9.3
P890276	449112	5437696	West Trail	Residential		48	33.0
P890279	447346	5438493	West Trail	Residential		25	14.5
P890290	448597	5437861	West Trail	Residential		73	34.0
P890303	448155	5437944	West Trail	Institutional		27	4.7
P890310	447838	5438058	West Trail	Residential		17	4.7
P890311	447436	5438332	West Trail	Park/Rec		26	17.4
P890315	448629	5437725	West Trail	Residential		15	4.8
P890323	447053	5438643	West Trail	Park/Rec		12	7.2
P900068	449211	5437719	West Trail	Residential		105	44.0
P910002	447514	5438267	West Trail	Residential		60	37.3
P910008	448812	5437780	West Trail	Residential		58	29.0
P910028	448584	5437811	West Trail	Residential		135	34.0
P910044	447462	5438234	West Trail	Residential		45	29.5
P910070	448791	5437790	West Trail	Residential		190	88.0
P910072	447377	5438474	West Trail	Commercial		40	21.0
P910092	447097	5438544	West Trail	Residential		112	79.0
P910093	448116	5437666	West Trail	Park/Rec		44	26.1
P910112	447575	5438232	West Trail	Residential		75	67.0
P910116	447460	5438214	West Trail	Residential	54	57	28.1
P910132	448184	5437675	West Trail	Residential		34	14.4
P910167	448056	5437848	West Trail	Residential		13	18.0
P910174	447504	5438275	West Trail	Residential		93	44.0
P910177	447354	5438350	West Trail	Residential		75	61.0
P910187	447387	5438308	West Trail	Residential		42	22.9
P910196	448280	5437908	West Trail	Residential		98	46.3
P910205	447211	5438539	West Trail	Residential		13	11.0
P910206	447766	5438288	West Trail	Commercial		13	1.1
P910215	448844	5437815	West Trail	Residential		170	32.0
P920494	448099	5438012	West Trail	Residential	18	35	11.4
P950053	447487	5438197	West Trail	Residential	14	26	7.9
P950072	447105	5438520	West Trail	Residential	29	27	17.5
P960025	447095	5438428	West Trail	Residential	13	22	10.6
P970016	447778	5437798	West Trail	Residential	11	22	10.3
P970017	449245	5437653	West Trail	Residential	29	38	17.5
P980002	449010	5437782	West Trail	Residential	40	45	32.3

Note: All values represent an average over time at each location.
Data used to calculate the average are from sampling events in 1989 through April 1998.
All non-detects are presented as one-half the detection limit.
A blank space indicates that the analyte was not measured at this location.

[a] Property ID assigned by Exponent for grouping purposes.

Table A-2. Dust data used in risk evaluation

Property ID	Date	Neighbourhood	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)
P890138	8/26/98	Casino	9	19	9
P920315	8/27/98	Casino	54	14	13
P980019	8/21/98	Casino	25	24	20
P900071	4/23/98	East Trail	48.4	26.7	18.4
P900071	8/3/98	East Trail	37	44	19
P910108	4/21/98	East Trail	45.1	22.0	15.5
P910108	8/10/98	East Trail	61	29	30
P920326	4/20/98	East Trail	147.0	81.9	55.0
P920326	8/11/98	East Trail	151	80	67
P940060	4/22/98	East Trail	62.0	31.2	24.0
P940060	8/6/98	East Trail	42	20	17
P970004	4/21/98	East Trail	83.8	56.5	39.5
P970004	8/7/98	East Trail	70	51	46
P970009	4/21/98	East Trail	83.4	66.9	38.8
P970009	8/13/98	East Trail	80	63	48
P980001	4/27/98	East Trail	93.5	51.4	36.3
P980001	8/11/98	East Trail	108	61	51
P890291	8/28/98	Glenmerry	59	44	42
P920747	8/20/98	Glenmerry	48	32	29
P930054	8/17/98	Glenmerry	105	62	80
P940040	8/17/98	Glenmerry	48	28	34
P950041	8/17/98	Glenmerry	40	24	24
P980012	8/18/98	Glenmerry	54	25	29
P910139	8/19/98	Lower Warfield	26	15	16
P910213	8/25/98	Lower Warfield	32	20	18
P980009	8/12/98	Lower Warfield	30	17	17
P980011	8/21/98	Lower Warfield	46	25	31
P980017	8/25/98	Lower Warfield	30	20	25
P980013	8/24/98	Miral Heights	72	41	49
P980023	8/28/98	Miral Heights	54	38	33
P890064	8/28/98	Oasis	37	43	18
P950013	8/13/98	Oasis	54	16	17
P980018	8/20/98	Oasis	42	51	18
P980021	9/2/98	Rivervale	40	26	21
P910118	9/8/98	Shavers Bench	79	55	40
P950028	8/18/98	Shavers Bench	72	50	37
P980015	8/27/98	Shavers Bench	61	43	25
P980016	8/28/98	Shavers Bench	82	43	35
P910085	8/20/98	Sunningdale	37	23	17
P910165	9/2/88	Sunningdale	89	73	47
P920405	9/3/98	Sunningdale	60	31	18
P950004	8/14/98	Sunningdale	47	25	24
P980014	9/1/98	Sunningdale	96	49	28
P980020	9/3/98	Sunningdale	85	51	53
P890023	9/3/98	Tadanac	170	100	90
P890293	4/22/98	Tadanac	56.6	32.9	30.5
P900016	4/27/98	Tadanac	57.1	41.9	29.9
P930065	4/23/98	Tadanac	175.0	85.8	61.4
P930065	8/25/98	Tadanac	186	92	85
P950062	4/27/98	Tadanac	56.4	38.7	27.1
P950062	8/7/98	Tadanac	91	52	52
P980004	4/27/98	Tadanac	129.0	80.1	53.3
P980004	8/10/98	Tadanac	136	68	64
P890014	8/24/98	Upper Warfield	27	32	18
P890050	8/11/98	Upper Warfield	42	37	23

Table A-2. (cont.)

Property ID	Date	Neighbourhood	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)
P910119	8/21/98	Upper Warfield	51	28	22
P930014	8/11/98	Upper Warfield	16	11	13
P980010	8/21/98	Upper Warfield	40	17	16
P920071	8/26/98	Waneta	9	13	7
P930007	8/24/98	Waneta	10	7	6
P980007	8/14/98	Waneta	23	15	15
P980008	8/14/98	Waneta	28	23	25
P910116	4/20/98	West Trail	69.4	47.2	54.2
P910116	8/3/98	West Trail	99	65	71
P920494	4/24/98	West Trail	60.5	33.9	33.5
P920494	8/19/98	West Trail	67	50	44
P930015	8/28/98	West Trail	83	133	79
P950053	4/20/98	West Trail	36.1	19.8	19.5
P950053	8/18/98	West Trail	136	50	72
P950072	4/21/98	West Trail	26.2	20.3	23.2
P950072	8/20/98	West Trail	23	16	18
P960025	4/27/98	West Trail	32.8	26.1	32.3
P960025	8/2/98	West Trail	66	40	55
P970016	4/23/98	West Trail	27.9	18.2	20.2
P970017	4/24/98	West Trail	34.4	17.3	17.2
P980002	4/22/98	West Trail	26.8	21.0	17.0
P980002	8/6/98	West Trail	31	19	16

Table A-3. Produce data used in risk evaluation

Property ID or Sample ID	Neighbourhood	Distance Category[a]	Produce Type[b]	Produce Description	Date Taken	Arsenic Ratio Inorganic/Total	Procduce Concentrations (mg/kg dry wt.) Arsenic[c]	Cadmium[c]	Inorganic Arsenic[d]	Arsenic Cantest	Arsenic ASL	Cadmium Cantest	Cadmium ASL
Residential													
P900071	East Trail	Near	Leafy	Lettuce	8/3/98	1.00	0.43	3.90	0.43				
P970004	East Trail	Near	Leafy	Spinach	8/7/98	1.00	1.33	24.20	1.33				
P910108	East Trail	Near	Leafy	Lettuce	8/10/98	1.00	0.89	7.50	0.89				
P920326	East Trail	Near	Leafy	Swiss chard	8/11/98	1.00	1.17	31.00	1.17				
P920747	Glenmerry	Near	Leafy	Lettuce	8/20/98	1.00	2.30	9.80	2.30				
P980017	Lower Warfield	Near	Leafy	Swiss chard	8/25/98	1.00	0.23	7.20	0.23				
P980023	Miral Heights	Near	Leafy	Lettuce	8/28/98	1.00	1.10	6.70	1.10				
P980016	Shavers Bench	Near	Leafy	Lettuce	8/28/98	1.00	1.80	24.30	1.80				
P920405	Sunningdale	Near	Leafy	Lettuce	9/3/98	1.00	1.00	5.70	1.00				
P980020	Sunningdale	Near	Leafy	Beet leaves	9/3/98	1.00	1.10	13.00	1.10				
P950062	Tadanac	Near	Leafy	Lettuce	8/7/98	1.00	3.70	14.90	3.70				
P890293	Tadanac	Near	Leafy	Lettuce	8/25/98	1.00	0.95	29.00	0.95				
P930065	Tadanac	Near	Leafy	Lettuce	8/25/98	1.00	2.30	31.50	2.30				
P890050	Upper Warfield	Near	Leafy	Lettuce	8/11/98	1.00	0.03	2.50	0.03				
P890050	Upper Warfield	Near	Leafy	Lettuce	8/11/98	1.00	0.53	4.00	0.53				
P960025	West Trail	Near	Leafy	Lettuce	8/2/98	1.00	0.57	4.00	0.57				
P910116	West Trail	Near	Leafy	Lettuce	8/3/98	1.00	0.86	30.00	0.86				
P980002	West Trail	Near	Leafy	Lettuce	8/6/98	1.00	1.40	32.00	1.40				
EH82 990723 4001	East Trail	Near	Leafy	Lettuce	7/23/99	1.00	1.31	4.28	1.31	1.7	0.91	5.3	3.26
EH82 990723 4002	East Trail	Near	Leafy	Swiss chard	7/23/99	1.00	0.31	6.04	0.31	0.31	0.3	6	6.08
EH82 990723 4010	Glenmerry	Near	Leafy	Lettuce	7/23/99	1.00	2.05	8.01	2.05	2.5	1.6	8.8	7.22
EH82 990723 4011	Glenmerry	Near	Leafy	Lettuce	7/23/99	1.00	1.10	11.83	1.10	1.3	0.9	15.3	8.36
EH82 990723 4008	Miral Heights	Near	Leafy	Lettuce	7/23/99	1.00	0.30	1.40	0.30	0.4	0.19	1.7	1.1
EH82 990723 4007	Shavers Bench	Near	Leafy	Lettuce	7/23/99	1.00	0.91	6.05	0.91	0.92	0.89	6.2	5.89
EH82 990723 4005	Tadanac	Near	Leafy	Lettuce	7/23/99	1.00	4.25	14.95	4.25	4.1	4.4	14.9	15
EH82 990723 4006	Tadanac	Near	Leafy	Lettuce	7/23/99	1.00	1.50	35.8	1.50	--[e]	1.5	--[e]	35.8
EH82 990723 4003	West Trail	Near	Leafy	Lettuce	7/23/99	1.00	1.90	17.90	1.90	1.9	1.9	18.7	17.1
EH82 990723 4004	West Trail	Near	Leafy	Swiss chard	7/23/99	1.00	0.28	6.73	0.28	0.29	0.26	8.1	5.35
P980019	Casino	Far	Leafy	Lettuce	8/21/98	1.00	0.10	3.10	0.10				
P890064	Oasis	Far	Leafy	Swiss chard	8/28/98	1.00	0.18	9.00	0.18				
P980022	Rivervale	Far	Leafy	Lettuce	8/26/98	1.00	3.20	13.80	3.20				
P980008	Waneta	Far	Leafy	Lettuce	8/14/98	1.00	0.25	5.60	0.25				
P940060	East Trail	Near	Nonleafy	Cucumber	8/6/98	0.43	1.90	0.80	0.82				
P940060	East Trail	Near	Nonleafy	Tomato	8/6/98	0.09	0.03	1.50	0.003				
P920326	East Trail	Near	Root	Carrot	8/11/98	0.53	0.92	8.10	0.49				
P980001	East Trail	Near	Nonleafy	Cucumber	8/11/98	0.43	1.64	0.43	0.71				
P970009	East Trail	Near	Nonleafy	Tomato	8/13/98	0.09	0.03	0.80	0.003				
P930054	Glenmerry	Near	Nonleafy	Pepper	8/17/98	0.50	0.12	0.80	0.06				
P940040	Glenmerry	Near	Nonleafy	Squash	8/17/98	0.50	0.03	0.25	0.02				

Table A-3. (cont.)

Property ID or Sample ID	Neighbourhood	Distance Category[a]	Produce Type[b]	Produce Description	Date Taken	Arsenic Ratio Inorganic/Total	Produce Concentrations (mg/kg dry wt.) Arsenic[c]	Cadmium[c]	Inorganic Arsenic[d]	Arsenic Cantest	Arsenic ASL	Cadmium Cantest	Cadmium ASL
Residential (cont.)													
P950041	Glenmerry	Near	Nonleafy	Cucumber	8/17/98	0.43	1.13	0.70	0.49				
P980012	Glenmerry	Near	Nonleafy	Tomato	8/18/98	0.09	0.07	1.90	0.01				
P890291	Glenmerry	Near	Root	Onion	8/28/98	0.34	0.08	1.00	0.03				
P980009	Lower Warfield	Near	Nonleafy	Celery	8/12/98	0.50	0.23	6.90	0.12				
P980009	Lower Warfield	Near	Nonleafy	Celery	8/12/98	0.50	0.20	6.00	0.10				
P980011	Lower Warfield	Near	Nonleafy	Eggplant	8/21/98	0.50	0.12	2.90	0.06				
P980017	Lower Warfield	Near	Root	Parsnip	8/25/98	0.50	0.06	1.50	0.03				
P980013	Miral Heights	Near	Nonleafy	Bean	8/24/98	0.57	0.03	0.17	0.02				
P980023	Miral Heights	Near	Nonleafy	Tomato	8/28/98	0.09	0.03	1.10	0.003				
P950028	Shavers Bench	Near	Root	Beet	8/18/98	0.50	0.27	3.90	0.14				
P980015	Shavers Bench	Near	Root	Carrot	8/27/98	0.53	0.08	2.60	0.04				
P980016	Shavers Bench	Near	Nonleafy	Cucumber	8/28/98	0.43	1.05	0.21	0.45				
P910118	Shavers Bench	Near	Nonleafy	Bean	9/8/98	0.57	0.03	0.13	0.02				
P910165	Sunningdale	Near	Nonleafy	Bean	9/2/98	0.57	0.08	0.03	0.05				
P950004	Sunningdale	Near	Nonleafy	Zucchini	8/14/98	0.50	0.07	0.70	0.04				
P910085	Sunningdale	Near	Root	Radish	8/20/98	0.50	0.35	1.00	0.18				
P980014	Sunningdale	Near	Nonleafy	Squash	9/1/98	0.50	0.03	0.11	0.02				
P920405	Sunningdale	Near	Nonleafy	Tomato	9/3/98	0.09	0.06	0.90	0.01				
P980020	Sunningdale	Near	Nonleafy	Cucumber	9/3/98	0.43	0.90	0.22	0.39				
P980004	Tadanac	Near	Root	Carrot	8/10/98	0.53	0.25	3.40	0.13				
P890023	Tadanac	Near	Nonleafy	Squash	9/3/98	0.50	0.25	0.31	0.13				
P930014	Upper Warfield	Near	Nonleafy	Pumpkin	8/11/98	0.50	0.08	0.26	0.04				
P910119	Upper Warfield	Near	Root	Onion	8/21/98	0.34	0.08	0.80	0.03				
P980010	Upper Warfield	Near	Nonleafy	Pepper	8/21/98	0.50	0.03	0.43	0.02				
P890014	Upper Warfield	Near	Root	Carrot	8/24/98	0.53	0.06	4.80	0.03				
P960025	West Trail	Near	Root	Potato	8/2/98	0.29	0.03	1.00	0.01				
P920494	West Trail	Near	Nonleafy	Chives	8/19/98	0.50	0.74	5.70	0.37				
P950072	West Trail	Near	Nonleafy	Pumpkin	8/20/98	0.50	0.03	0.25	0.02				
P930015	West Trail	Near	Root	Beet	8/28/98	0.50	0.11	2.90	0.06				
EH82 990806 4001	East Trail	Near	Root	Carrot	8/6/99	0.53	0.16	7.18	0.08	0.19	0.13	7.6	6.75
EH82 990808 4001	Glenmerry	Near	Nonleafy	Tomato	8/8/99	0.09	0.03	0.97	0.002	< 0.3	< 0.05	1.3	0.63
EH82 990808 4002	Glenmerry	Near	Root	Carrot	8/8/99	0.53	0.27	2.96	0.14	0.28	0.25	3.5	2.41
EH82 990723 4009	Miral Heights	Near	Root	Potato	7/23/99	0.29	0.03	0.21	0.01	< 0.1	< 0.05	0.23	0.18
EH82 990807 4002	Tadanac	Near	Nonleafy	Tomato	8/7/99	0.09	0.03	1.55	0.002	< 0.3	< 0.05	1.8	1.29
EH82 990807 4001	Tadanac	Near	Root	Carrot	8/7/99	0.53	0.19	2.71	0.10	0.21	0.17	1.8	3.62
P980019	Casino	Far	Nonleafy	Kohlrabi	8/21/98	0.50	0.03	0.26	0.02				
P890138	Casino	Far	Nonleafy	Tomato	8/26/98	0.09	0.03	0.35	0.003				
P920315	Casino	Far	Root	Carrot	8/27/98	0.53	0.03	0.80	0.02				
P950013	Oasis	Far	Nonleafy	Broccoli	8/13/98	0.50	0.09	0.60	0.05				

Table A-3. (cont.)

Property ID or Sample ID	Neighbourhood	Distance Category[a]	Produce Type[b]	Produce Description	Date Taken	Arsenic Ratio Inorganic/Total	Procduce Concentrations (mg/kg dry wt.) Arsenic[c]	Cadmium[c]	Inorganic Arsenic[d]	Arsenic Cantest	Arsenic ASL	Cadmium Cantest	Cadmium ASL
Residential (cont.)													
P980021	Rivervale	Far	Nonleafy	Pepper	9/2/98	0.50	0.17	0.34	0.09				
P980021	Rivervale	Far	Nonleafy	Tomato	9/2/98	0.09	0.03	0.80	0.003				
P980007	Waneta	Far	Nonleafy	Cucumber	8/14/98	0.43	1.39	0.40	0.60				
P980008	Waneta	Far	Root	Carrot	8/14/98	0.53	0.10	1.30	0.05				
P930007	Waneta	Far	Nonleafy	Tomato	8/24/98	0.09	0.03	0.49	0.003				
P980031	Waneta	Far	Root	Carrot	8/24/98	0.53	0.10	2.50	0.05				
P920071	Waneta	Far	Nonleafy	Corn	8/26/98	0.69	0.03	0.12	0.02				
EH82 990809 4002	Rivervale	Far	Nonleafy	Tomato	8/9/99	0.09	0.03	1.24	0.002	< 0.3	< 0.05	1.4	1.07
EH82 990809 4001	Rivervale	Far	Root	Carrot	8/9/99	0.53	0.12	4.19	0.06	< 0.2	0.12	3.6	4.77
EH82 990809 4003	Rivervale	Far	Root	Potato	8/9/99	0.29	0.09	0.64	0.02	0.11	0.06	0.8	0.48
Supermarket													
P980032	East Trail		Leafy	Lettuce	9/8/98	1.00	0.40	1.90	0.40				
P980032	East Trail		Leafy	Lettuce	9/8/98	1.00	0.20	2.00	0.20				
P980032	East Trail		Leafy	Lettuce	1/12/99	1.00	0.07	2.20	0.07				
P980032	East Trail		Leafy	Lettuce	1/12/99	1.00	0.12	6.80	0.12				
P980030	West Trail		Leafy	Lettuce	9/8/98	1.00	0.05	0.54	0.05				
P980030	West Trail		Leafy	Lettuce	9/8/98	1.00	0.12	1.70	0.12				
P980030	West Trail		Leafy	Spinach	9/8/98	1.00	0.06	5.60	0.06				
P980030	West Trail		Leafy	Lettuce	1/12/99	1.00	0.23	1.80	0.23				
P980030	West Trail		Leafy	Lettuce	1/12/99	1.00	0.21	1.90	0.21				
P980032	East Trail		Nonleafy	Cucumber	9/8/98	0.43	0.03	0.03	0.01				
P980032	East Trail		Nonleafy	Pepper	9/8/98	0.50	0.20	0.24	0.10				
P980032	East Trail		Nonleafy	Tomato	9/8/98	0.09	0.03	0.26	0.003				
P980032	East Trail		Nonleafy	Tomato	1/12/99	0.09	0.03	0.17	0.003				
P980032	East Trail		Nonleafy	Pepper	1/12/99	0.50	0.09	0.50	0.05				
P980032	East Trail		Nonleafy	Cucumber	1/12/99	0.43	0.30	0.03	0.13				
P980032	East Trail		Root	Carrot	9/8/98	0.53	0.03	0.47	0.02				
P980032	East Trail		Root	Radish	9/8/98	0.50	0.15	0.52	0.08				
P980032	East Trail		Root	Carrot	1/12/99	0.53	0.03	0.22	0.02				
P980032	East Trail		Root	Radish	1/12/99	0.50	0.12	0.28	0.06				
P980030	West Trail		Nonleafy	Cucumber	9/8/98	0.43	0.42	0.12	0.18				
P980030	West Trail		Nonleafy	Tomato	9/8/98	0.09	0.03	0.03	0.003				
P980030	West Trail		Nonleafy	Tomato	1/12/99	0.09	0.03	0.03	0.003				
P980030	West Trail		Nonleafy	Cucumber	1/12/99	0.43	0.08	0.03	0.03				
P980030	West Trail		Root	Beet	9/8/98	0.50	0.03	0.30	0.02				
P980030	West Trail		Root	Carrot	9/8/98	0.53	0.03	0.13	0.02				
P980030	West Trail		Root	Carrot	1/12/99	0.53	0.03	0.03	0.02				
EH82 990806 4002	Supermarket		Leafy	Lettuce	8/6/99	1.00	0.07	0.88	0.07	< 0.5	0.07	1	0.75
EH82 990806 4003	Supermarket		Leafy	Spinach	8/6/99	1.00	0.03	1.35	0.03	< 0.2	< 0.05	1.4	1.29
EH82 990806 4004	Supermarket		Root	Carrot	8/6/99	0.53	0.03	0.25	0.01	< 0.2	< 0.05	0.14	0.35

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Table A-3. (cont.)

Property ID or Sample ID	Neighbourhood	Distance Category[a]	Produce Type[b]	Produce Description	Date Taken	Arsenic Ratio Inorganic/Total	Procduce Concentrations (mg/kg dry wt.) Arsenic[c]	Cadmium[c]	Inorganic Arsenic[d]	Arsenic Cantest	Arsenic ASL	Cadmium Cantest	Cadmium ASL
Residential (excluded from risk assessment because of differing ingestion rates)													
P920326	East Trail	Near	Root & Leaf	Beet	8/11/98		5.50	12.30					
P980002	West Trail	Near	Root & Leaf	Beet	8/6/98		0.51	15.70					
P910108	East Trail	Near	Leafy	Herb	8/10/98		1.59	1.50					
P890291	Glenmerry	Near	Leafy	Herb	8/28/98		1.30	1.40					
P980011	Lower Warfield	Near	Leafy	Herb	8/21/98		0.31	1.20					
P980004	Tadanac	Near	Leafy	Herb	8/10/98		2.70	8.20					
P910139	Lower Warfield	Near	Fruit	Berry	8/19/98		0.21	0.60					
P910213	Lower Warfield	Near	Fruit	Berry	8/25/98		0.18	1.30					
P910118	Shavers Bench	Near	Fruit	Plum	9/8/98		0.07	0.03					
P910085	Sunningdale	Near	Fruit	Peach	8/20/98		0.15	0.31					
P950062	Tadanac	Near	Fruit	Berry	8/7/98		0.11	0.52					
P890014	Upper Warfield	Near	Fruit	Grape	8/24/98		0.03	0.03					
P950053	West Trail	Near	Fruit	Berry	8/18/98		0.13	2.60					
P960025	West Trail	Near	Fruit	Grape	8/2/98		0.03	0.03					
P890064	Oasis	Far	Fruit	Apple	8/28/98		0.03	0.03					
P980018	Oasis	Far	Fruit	Berry	8/20/98		0.10	0.70					
P980031	Waneta	Far	Fruit	Apple	8/24/98		0.03	0.03					
P920071	Waneta	Far	Fruit	Grape	8/26/98		0.03	0.03					

[a] Residential produce samples were grouped into two categories: those near the Cominco facility, and those that are far from the Cominco facility.

[b] Root vegetables were grouped with nonleafy produce for determination of exposure-point concentrations.

[c] For samples collected in 1999, this column represents an average of results from the two different labs. See text for details about averaging.

[d] Inorganic Arsenic = [Arsenic concentration] × [Ratio of inorganic arsenic to total arsenic].

[e] This sample was not analyzed by Cantest because sample was too small to split.

Table A-4. Air data used in risk evaluation: Columbia Gardens, 1998–1999

TLP_NO	Date	Antimony (μg/m³)	PM10[a]	NAPS[b]
PA-51	7/4/98	0.005	F	T
PA-51	7/10/98	0.018	F	T
PA-51	7/16/98	0.005	F	T
PA-51	7/22/98	0.005	F	T
PA-51	7/28/98	0.005	F	T
PA-51	8/3/98	0.018	F	T
PA-51	8/9/98	0.005	F	T
PA-51	8/15/98	0.005	F	T
PA-51	8/21/98	0.031	F	T
PA-51	8/27/98	0.005	F	T
PA-51	9/2/98	0.005	F	T
PA-51	9/8/98	0.005	F	T
PA-51	9/14/98	0.005	F	T
PA-51	9/20/98	0.005	F	T
PA-51	9/26/98	0.005	F	T
PA-51	10/2/98	0.005	F	T
PA-51	10/8/98	0.044	F	T
PA-51	10/14/98	0.005	F	T
PA-51	10/20/98	0.005	F	T
PA-51	11/1/98	0.005	F	T
PA-51	11/7/98	0.006	F	T
PA-51	11/13/98	0.005	F	T
PA-51	11/19/98	0.005	F	T
PA-51	11/25/98	0.005	F	T
PA-51	12/1/98	0.005	F	T
PA-51	12/7/98	0.005	F	T
PA-51	12/13/98	0.005	F	T
PA-51	12/19/98	0.005	F	T
PA-51	12/25/98	0.005	F	T
PA-51	12/31/98	0.005	F	T
PA-51	1/6/99	0.006	F	T
PA-51	1/12/99	0.006	F	T
PA-51	1/18/99	0.006	F	T
PA-51	1/24/99	0.006	F	T
PA-51	1/30/99	0.018	F	T
PA-51	2/5/99	0.006	F	T
PA-51	2/11/99	0.012	F	T
PA-51	2/17/99	0.004	F	T
PA-51	2/23/99	0.004	F	T
PA-51	3/1/99	0.007	F	T
PA-51	3/7/99	0.009	F	T
PA-51	3/13/99	0.044	F	T
PA-51	3/19/99	0.033	F	T
PA-51	3/25/99	0.001	F	T
PA-51	3/31/99	0.005	F	T
PA-51	4/6/99	0.001	F	T
PA-51	4/12/99	0.001	F	T
PA-51	4/18/99	0.006	F	T
PA-51	4/24/99	0.003	F	T
PA-51	4/30/99	0.002	F	T
PA-51	5/6/99	0.012	F	T

Table A-4. (cont.)

TLP_NO	Date	Antimony ($\mu g/m^3$)	PM10[a]	NAPS[b]
PA-51	5/12/99	0.001	F	T
PA-51	5/18/99	0.001	F	T
PA-51	5/24/99	0.008	F	T
PA-51	5/30/99	0.004	F	T
PA-51	6/5/99	0.006	F	T
PA-51	6/11/99	0.005	F	T
PA-51	6/17/99	0.008	F	T
PA-51	6/23/99	0.002	F	T
PA-51	6/29/99	0.006	F	T

Note: All non-detects are presented as one-half the detection limit.

[a] If the value in this column is "true," then the associated results are for PM_{10} particles. If the value is "false", then the associated results are for TSP particles.

[b] If the value in this column is "true," then the associated date is a National Air Pollution Surveillance date.

Table A-5. Air data used in risk evaluation: Butler Park (East Trail), 1998–1999

Original Philip I.D.	Date	Duration (hr)	Arsenic (µg/m^3)	Cadmium (µg/m^3)
Blank			< 0.0006	< 0.00006
98038912	Jul-98	24	0.0273	0.0120
98038914	Jul-98	24	0.0172	0.0179
98038916	Aug-98	24	0.0142	0.0101
98048696	Aug-98	24	0.0059	0.0023
98048698	Aug-98	24.2	0.0100	0.0037
98058418	Sep-98	24.2	0.0065	0.0024
98058420	Sep-98	24	0.0178	0.0073
99003520	Oct-98	24.1	0.0160	0.0044
99003522	Oct-98	24	0.0119	0.0038
99003524	Oct-98	24.1	0.0408	0.0100
99003526	Nov-98	24.1	0.0189	0.0080
99003528	Nov-98	24.1	0.0144	0.0044
99003530	Dec-98	24.1	0.0028	0.0007
99003532	Dec-98	24	0.0083	0.0033
99003534	Dec-98	24	0.0123	0.0048
99005758	Jan-99	23.9	0.0012	0.0012
99005760	Jan-99	23.9	0.0042	0.0010
99005762	Jan-99	24	0.0332	0.0104
99008341	Feb-99	24	0.0047	0.0023
99008343	Feb-99	24	0.0053	0.0014
99008344	Feb-99	24	0.0047	0.0020
99012408	Mar-99	24	0.0047	0.0020
99012409	Mar-99	24	0.0398	0.0091
99017119	Apr-99	24.1	0.0095	0.0061
99017121	Apr-99	24	0.0309	0.0086
99017123	Apr-99	24.1	0.0035	0.0133
99023703	May-99	24.1	0.0461	0.0590
99023705	May-99	24	0.0291	0.0085

Table A-6. Air data used in risk evaluation: Oasis, 1998–1999

Date	Arsenic (µg/m^3)	Cadmium (µg/m^3)
7/10/98	0.010	0.0046
7/16/98	0.010	0.0042
7/22/98	0.010	0.0038
7/28/98	0.010	0.0034
8/3/98	0.010	0.0030
8/9/98	0.010	0.0025
8/15/98	0.010	0.0020
8/21/98	0.010	0.0016
8/27/98	0.009	0.0011
9/2/98	0.009	0.0007
9/26/98	0.015	0.0081
11/1/98	0.008	0.0021
11/7/98	0.002	0.0007
11/13/98	0.020	0.0076
11/19/98	0.052	0.0054
11/25/98	0.008	0.0038
12/1/98	0.019	0.0038
12/7/98	0.016	0.0076
12/13/98	0.014	0.0084
12/19/98	0.004	0.0016
12/25/98	0.002	0.0003
12/31/98	0.027	0.0116
1/6/99	0.056	0.0306
1/18/99	0.037	0.0112
1/24/99	0.007	0.0027
1/30/98	0.010	0.0029
2/5/99	0.009	0.0041
2/11/99	0.018	0.0123
2/17/99	0.012	0.0037
2/23/99	0.036	0.0060
3/1/99	0.021	0.0090
3/7/99	0.007	0.0015
3/13/99	0.002	0.0003
3/19/99	0.002	0.0003
4/6/99	0.015	0.0067
4/12/99	0.022	0.0145
4/18/99	0.011	0.0015
4/24/99	0.002	0.0003
4/30/99	0.002	0.0157
5/6/99	0.005	0.0205
5/12/99	0.006	0.0026
5/18/99	0.005	0.0037
5/24/99	0.002	0.0003
5/30/99	0.002	0.0007
6/5/99	0.011	0.0022
6/11/99	0.002	0.0056
6/17/99	0.002	0.0003
6/23/99	0.004	0.0019
6/29/99	0.004	0.0036

Note: All non-detects are presented as one-half the detection limit.

Table A-7. Air data used in risk evaluation: West Trail, 1998–1999

Date	Arsenic ($\mu g/m^3$)	Cadmium ($\mu g/m^3$)
7/10/98	0.010	0.0044
7/16/98	0.010	0.0040
7/22/98	0.010	0.0036
7/28/98	0.010	0.0032
8/3/98	0.010	0.0028
8/9/98	0.010	0.0023
8/15/98	0.009	0.0017
8/21/98	0.009	0.0013
8/27/98	0.009	0.0008
9/26/98	0.012	0.0057
11/1/98	0.014	0.0036
11/7/98	0.002	0.0013
11/13/98	0.006	0.0013
11/19/98	0.013	0.0031
11/25/98	0.002	0.0005
12/1/98	0.002	0.0007
12/7/98	0.010	0.0080
12/13/98	0.008	0.0058
12/19/98	0.004	0.0017
12/25/98	0.002	0.0010
12/31/98	0.016	0.0017
1/6/99	0.002	0.0032
1/18/99	0.008	0.0012
1/24/99	0.002	0.0009
1/30/98	0.016	0.0062
2/5/99	0.002	0.0008
2/11/99	0.016	0.0178
2/17/99	0.004	0.0008
2/23/99	0.002	0.0004
3/1/99	0.003	0.0008
3/7/99	0.010	0.0054
3/13/99	0.005	0.0012
3/19/99	0.007	0.0027
3/25/99	0.002	0.0012
3/31/99	0.015	0.0042
4/6/99	0.004	0.0039
4/18/99	0.015	0.0058
4/24/99	0.004	0.0050
4/30/99	0.002	0.0023
5/6/99	0.020	0.0386
5/12/99	0.002	0.0008
5/18/99	0.002	0.0012
5/24/99	0.005	0.0027
5/30/99	0.002	0.0031
6/5/99	0.004	0.0019
6/11/99	0.007	0.0046
6/17/99	0.003	0.0019
6/23/99	0.004	0.0027
6/29/99	0.008	0.0015

Note: All non-detects are presented as one-half the detection limit.

Table A-8. Daily air concentration data used in risk evaluation, 1997–1998

TLP_NO	Name	Neighbourhood	P_X	P_Y	Date	Antimony (μg/m³)	PM10[a]	NAPS[b]
PA-11	Downtown	West Trail	448370	5438096	7/1/97	0.012	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/2/97	0.025	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/3/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	7/4/97	0.031	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/5/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/6/97	0.031	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/7/97	0.012	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/8/97	0.105	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/9/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	7/10/97	0.012	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/11/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/12/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/13/97	0.013	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/14/97	0.012	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/15/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	7/16/97	0.031	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/17/97	0.030	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/18/97	0.025	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/19/97	0.012	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/20/97	0.012	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/21/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	7/22/97	0.006	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/23/97	0.037	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/24/97	0.024	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/25/97	0.030	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/26/97	0.037	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/27/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	7/28/97	0.048	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/29/97	0.091	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/30/97	0.025	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	7/31/97	0.136	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/1/97	0.111	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/2/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	8/3/97	0.018	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/4/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/5/97	0.055	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/6/97	0.038	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/7/97	0.038	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/8/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	8/9/97	0.037	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/10/97	0.025	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/11/97	0.036	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/12/97	0.088	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/13/97	0.098	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/14/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	8/15/97	0.069	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/16/97	0.068	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/17/97	0.068	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/18/97	0.025	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/19/97	0.049	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/20/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	8/21/97	0.006	FALSE	FALSE

Table A-8. (cont.)

TLP_NO	Name	Neighbourhood	P_X	P_Y	Date	Antimony (µg/m³)	PM10[a]	NAPS[b]
PA-11	Downtown	West Trail	448370	5438096	8/22/97	0.061	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/23/97	0.012	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/24/97	0.013	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/25/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/26/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	8/27/97	0.006	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/28/97	0.012	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/29/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/30/97	0.012	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	8/31/97	0.018	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/1/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	9/2/97	0.074	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/3/97	0.037	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/4/97	0.012	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/5/97	0.018	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/6/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/7/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	9/9/97	0.018	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/10/97	0.049	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/11/97	0.031	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/12/97	0.025	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/13/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	9/14/97	0.037	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/15/97	0.019	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/16/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/17/97	0.076	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/18/97	0.112	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/19/97	0.135	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	9/20/97	0.025	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/21/97	0.006	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/22/97	0.044	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/23/97	0.097	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/26/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/27/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/28/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/29/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	9/30/97	0.011	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/1/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	10/2/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/3/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/4/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/5/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/6/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/7/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	10/8/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/9/97	0.032	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/10/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/11/97	0.012	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/12/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/13/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	10/14/97	0.006	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/15/97	0.012	FALSE	FALSE

Table A-8. (cont.)

TLP_NO	Name	Neighbourhood	P_X	P_Y	Date	Antimony (µg/m³)	PM10[a]	NAPS[b]
PA-11	Downtown	West Trail	448370	5438096	10/16/97	0.025	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/17/97	0.057	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/18/97	0.003	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/19/97	0.024	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	10/20/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/21/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/22/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/23/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/24/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/25/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	10/26/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/27/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/28/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/29/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/30/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	10/31/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	11/1/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/2/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/3/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/4/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/5/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/6/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	11/7/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/8/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/9/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/10/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/11/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/12/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	11/13/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/14/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/15/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/16/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/17/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/18/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	11/19/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/20/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/21/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/22/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/23/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/24/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	11/25/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/26/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/27/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/28/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/29/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	11/30/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	12/1/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/2/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/3/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/4/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/5/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/6/97		FALSE	TRUE

Table A-8. (cont.)

TLP_NO	Name	Neighbourhood	P_X	P_Y	Date	Antimony (µg/m³)	PM10[a]	NAPS[b]
PA-11	Downtown	West Trail	448370	5438096	12/7/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/8/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/9/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/10/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/11/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/12/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	12/13/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/14/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/15/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/16/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/17/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/18/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	12/19/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/20/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/21/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/22/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/23/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/24/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	12/25/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/26/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/27/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/28/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/29/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	12/30/97		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	12/31/97		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/1/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/2/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/3/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/4/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/5/98	0.005	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	1/6/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/7/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/8/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/9/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/10/98	0.040	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/11/98	0.020	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	1/12/98	0.090	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/13/98	0.030	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/14/98	0.020	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/15/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/16/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/17/98	0.020	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	1/18/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/19/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/20/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/21/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/22/98	0.200	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/23/98	0.030	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	1/24/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/25/98	0.020	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/26/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/27/98	0.040	FALSE	FALSE

Table A-8. (cont.)

TLP_NO	Name	Neighbourhood	P_X	P_Y	Date	Antimony (µg/m³)	PM10[a]	NAPS[b]
PA-11	Downtown	West Trail	448370	5438096	1/28/98	0.020	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/29/98	0.010	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	1/30/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	1/31/98	0.020	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/1/98	0.020	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/2/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/3/98	0.030	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/4/98	0.005	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	2/5/98	0.030	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/6/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/7/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/8/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/9/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/10/98	0.005	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	2/11/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/12/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/13/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/14/98	0.020	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/15/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/16/98	0.005	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	2/17/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/18/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/19/98	0.020	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/20/98	0.190	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/21/98	0.020	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/22/98	0.005	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	2/23/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/24/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/25/98	0.020	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/26/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/27/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	2/28/98	0.020	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	3/1/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/2/98	0.020	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/3/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/4/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/5/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/6/98	0.020	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	3/7/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/8/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/9/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/10/98	0.030	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/11/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/12/98	0.010	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	3/13/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/14/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/15/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/16/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/17/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/18/98	0.020	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	3/19/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/20/98	0.010	FALSE	FALSE

Table A-8. (cont.)

TLP_NO	Name	Neighbourhood	P_X	P_Y	Date	Antimony (µg/m³)	PM10[a]	NAPS[b]
PA-11	Downtown	West Trail	448370	5438096	3/21/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/22/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/23/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/24/98	0.100	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	3/25/98	0.050	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/26/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/27/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/28/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/29/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	3/30/98	0.005	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	3/31/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/1/98	0.040	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/2/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/3/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/4/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/5/98	0.020	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	4/6/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/7/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/8/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/9/98	0.020	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/10/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/11/98	0.005	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	4/12/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/13/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/14/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/15/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/16/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/17/98	0.020	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	4/18/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/19/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/20/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/21/98	0.040	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/22/98	0.070	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/23/98	0.020	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	4/24/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/25/98	0.005	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/26/98	0.030	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/27/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/28/98	0.020	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	4/29/98	0.010	FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	4/30/98	0.010	FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/1/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/2/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/3/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/4/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/5/98		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	5/6/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/7/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/8/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/9/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/10/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/11/98		FALSE	TRUE

Table A-8. (cont.)

TLP_NO	Name	Neighbourhood	P_X	P_Y	Date	Antimony (µg/m³)	PM10[a]	NAPS[b]
PA-11	Downtown	West Trail	448370	5438096	5/12/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/13/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/14/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/15/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/16/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/17/98		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	5/18/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/19/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/20/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/21/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/22/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/23/98		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	5/24/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/25/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/26/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/27/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/28/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/29/98		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	5/30/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	5/31/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/1/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/2/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/3/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/4/98		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	6/5/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/6/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/7/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/8/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/9/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/10/98		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	6/11/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/12/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/13/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/14/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/15/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/16/98		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	6/17/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/18/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/19/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/20/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/21/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/22/98		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	6/23/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/24/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/25/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/26/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/27/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/28/98		FALSE	TRUE
PA-11	Downtown	West Trail	448370	5438096	6/29/98		FALSE	FALSE
PA-11	Downtown	West Trail	448370	5438096	6/30/98		FALSE	FALSE

Table A-8. (cont.)

TLP_NO	Name	Neighbourhood	P_X	P_Y	Date	Antimony (µg/m[3])	PM10[a]	NAPS[b]
PA-56	West Trail	West Trail			1/5/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			1/11/98	0.012	TRUE	TRUE
PA-56	West Trail	West Trail			1/17/98	0.025	TRUE	TRUE
PA-56	West Trail	West Trail			1/23/98	0.012	TRUE	TRUE
PA-56	West Trail	West Trail			1/29/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			2/4/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			2/10/98	0.012	TRUE	TRUE
PA-56	West Trail	West Trail			2/16/98	0.012	TRUE	TRUE
PA-56	West Trail	West Trail			2/22/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			2/28/98	0.031	TRUE	TRUE
PA-56	West Trail	West Trail			3/6/98	0.018	TRUE	TRUE
PA-56	West Trail	West Trail			3/12/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			3/18/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			3/24/98	0.055	TRUE	TRUE
PA-56	West Trail	West Trail			3/30/98	0.018	TRUE	TRUE
PA-56	West Trail	West Trail			4/5/98	0.018	TRUE	TRUE
PA-56	West Trail	West Trail			4/11/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			4/17/98	0.018	TRUE	TRUE
PA-56	West Trail	West Trail			4/23/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			4/29/98	0.012	TRUE	TRUE
PA-56	West Trail	West Trail			5/5/98	0.012	TRUE	TRUE
PA-56	West Trail	West Trail			5/11/98	0.037	TRUE	TRUE
PA-56	West Trail	West Trail			5/17/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			5/23/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			5/29/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			6/4/98	0.031	TRUE	TRUE
PA-56	West Trail	West Trail			6/10/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			6/16/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			6/22/98	0.012	TRUE	TRUE
PA-56	West Trail	West Trail			6/28/98	0.025	TRUE	TRUE
PA-56	West Trail	West Trail			7/4/98	0.012	TRUE	TRUE
PA-56	West Trail	West Trail			7/10/98	0.018	TRUE	TRUE
PA-56	West Trail	West Trail			7/16/98	0.006	TRUE	TRUE
PA-56	West Trail	West Trail			7/22/98	0.006	TRUE	TRUE

Note: All non-detects are presented as one-half the detection limit.

[a] If the value in this column is "true," then the associated results are for PM_{10} particles. If the value is "false," then the associated results are for TSP particles.

[b] If the value in this column is "true," then the associated date is a National Air Pollution Surveillance date.

Appendix B

QC Results and Confirmatory Analyses for Produce

TRAIL LEAD PROGRAM

QC Results for Analysis of Local Produce Samples for Human Health Risk Assessment

August/September, 1998

Laboratory QC - Blanks

		Method Blank 1 (µg/g)	Method Blank 2 (µg/g)	Method Blank 3 (µg/g)	Method Blank 4 (µg/g)	Method Blank 5 (µg/g)	Method Blank 6 (µg/g)	Method Blank 7 (µg/g)	Method Blank 8 (µg/g)	Method Blank 9 (µg/g)	Method Blank 10 (µg/g)
Total Metals											
Arsenic	T-As	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	T-Cd	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

TRAIL LEAD PROGRAM

QC Results for Analysis of Local Produce Samples for Human Health Risk Assessment

August/September, 1998

Laboratory QC - Reference Materials

		1575 Target Value	1575 Found Value	1575 % Recovery	1575 Found Value	1575 % Recovery	1573 Target Value	1573 Found Value	1573 % Recovery	1573 Found Value	1573 % Recovery
Total Metals											
Arsenic	T-As	0.21	0.18	86%	0.19	90%	0.11	0.10	91%	0.10	91%
Cadmium	T-Cd	<0.5	<0.5		<0.5		1.5	1.4	93%	1.4	93%

Laboratory QC - Reference Materials

		1575 Target Value	1575 Found Value	1575 % Recovery	1575 Found Value	1575 % Recovery	1575 Target Value	1575 Found Value	1575 % Recovery	1575 Found Value	1575 % Recovery
Total Metals											
Arsenic	T-As	0.21	0.16	76%	0.19	90%	0.21	0.17	81%	0.18	86%
Cadmium	T-Cd	<0.5	<0.5		<0.5		<0.5	<0.5		<0.5	

Laboratory QC - Reference Materials

		1575 Target Value	1575 Found Value	1575 % Recovery	1575 Found Value	1575 % Recovery
Total Metals						
Arsenic	T-As	0.21	0.17	81%	0.19	90%
Cadmium	T-Cd	<0.5	<0.5		<0.5	

TRAIL LEAD PROGRAM

QC Results for Analysis of Local Produce Samples for Human Health Risk Assessment

August/September, 1998

Laboratory QC - Replicates

		EH82 980803 4003 (µg/g)	EH82 980803 4003a (µg/g)	RPD	EH82 980811 4004 (µg/g)	EH82 980811 4004a (µg/g)	RPD	EH82 980814 3005 (µg/g)	EH82 980814 3005a (µg/g)	RPD
Total Metals										
Arsenic	T-As	3.7	3.8	3%	<0.05	<0.05	n/a	0.10	0.10	0%
Cadmium	T-Cd	14.9	15.4	3%	2.5	2.6	4%	1.3	1.5	14%

Laboratory QC - Replicates

		EH82 980811 4003 (µg/g)	EH82 980811 4003a (µg/g)	RPD	EH82 980902 4001 (µg/g)	EH82 980902 4001a (µg/g)	RPD	EH82 980908 4003 (µg/g)	EH82 980908 4003a (µg/g)	RPD
Total Metals										
Arsenic	T-As	0.08	0.08	0%	<0.05	0.09	n/a	<0.05	<0.05	n/a
Cadmium	T-Cd	0.26	0.28	7%	0.8	0.8	0%	0.47	0.44	7%

Laboratory QC - Replicates

		EH82 980908 4011 (µg/g)	EH82 980908 4011a (µg/g)	RPD	EH82 980821 4001 (µg/g)	EH82 980821 4001a (µg/g)	RPD	EH82 980824 3004 (µg/g)	EH82 980824 3004a (µg/g)	RPD
Total Metals										
Arsenic	T-As	0.05	0.08	46%	0.10	0.09	11%	<0.05	<0.05	n/a
Cadmium	T-Cd	0.54	0.7	26%	3.1	3.4	9%	<0.05	<0.05	n/a

Laboratory QC - Replicates

		EH82 980825 4004 (µg/g)	EH82 980825 4004a (µg/g)	RPD	EH82 980827 4001 (µg/g)	EH82 980827 4001a (µg/g)	RPD	EH82 980828 4004 (µg/g)	EH82 980828 4004a (µg/g)	RPD
Total Metals										
Arsenic	T-As	0.18	0.19	5%	<0.05	<0.05	n/a	<0.05	<0.05	n/a
Cadmium	T-Cd	1.3	1.2	8%	0.8	0.5	46%	<0.05	<0.05	n/a

TRAIL LEAD PROGRAM

QC Results for Analysis of Local Produce Samples for Human Health Risk Assessment

August/September, 1998

Field QC - Duplicates

		EH82 980803 4002	EH82 980803 4011	RPD	EH82 980817 4002	EH82 980817 4003	RPD	EH82 980807 4002	EH82 980807 4003	RPD
Total Metals										
Arsenic	T-As	0.95	1.31	32%	<0.05	<0.05	n/a	<0.05	<0.05	n/a
Cadmium	T-Cd	29	36	22%	0.25	0.28	11%	1.0	1.0	0%

TRAIL LEAD PROGRAM

1999 Confirmatory Produce Sampling/Analysis

			Moisture			Arsenic			Cadmium		
Sample ID	Type	Neighbourhood	Cantest	ASL	R.P.D.	Cantest	ASL	R.P.D.	Cantest	ASL	R.P.D.
EH82 990723 4001	Lettuce	East Trail	95	93.9	1%	1.7	0.91	61%	5.3	3.26	48%
EH82 990723 4002	Swiss Chard	East Trail	88.7	87.8	1%	0.31	0.3	3%	6.0	6.08	1%
EH82 990723 4003	Lettuce	West Trail	93.7	92.3	2%	1.9	1.9	0%	18.7	17.1	9%
EH82 990723 4004	Swiss Chard	West Trail	92.5	90.5	2%	0.29	0.26	11%	8.1	5.35	41%
EH82 990723 4005	Lettuce	Tadanac	95.6	93.4	2%	4.1	4.4	7%	14.9	15	1%
EH82 990723 4006	Lettuce	Tadanac		96			1.5			35.8	
EH82 990723 4007	Lettuce	Shavers Bench	94.7	93.1	2%	0.92	0.89	3%	6.2	5.89	5%
EH82 990723 4008	Lettuce	Miral Heights	95.8	94.3	2%	0.4	0.19	71%	1.7	1.1	43%
EH82 990723 4009	Potato	Miral Heights	77.3	73.9	4%	< 0.1	<0.05		0.2	0.18	24%
EH82 990723 4010	Lettuce	Glenmerry	94.5	93.9	1%	2.5	1.6	44%	8.8	7.22	20%
EH82 990723 4011	Lettuce	Glenmerry	94.3	92.9	1%	1.3	0.9	36%	15.3	8.36	59%
EH82 990806 4001	Carrot	East Trail	91	90.3	1%	0.19	0.13	38%	7.6	6.75	12%
EH82 990806 4002	Lettuce	Supermarket	95.9	95	1%	< 0.5	0.07		1.0	0.75	29%
EH82 990806 4003	Spinach	Supermarket	90.7	91	0%	< 0.2	<0.05		1.4	1.29	8%
EH82 990806 4004	Carrot	Supermarket	88.1	87.3	1%	< 0.2	<0.05		0.1	0.35	86%
EH82 990807 4001	Carrot	Tadanac	91.8	91.2	1%	0.21	0.17	21%	1.8	3.62	67%
EH82 990807 4002	Tomato	Tadanac	94.1	94.4	0%	< 0.3	<0.05		1.8	1.29	33%
EH82 990808 4001	Tomato	Glenmerry	94.7	94.5	0%	< 0.3	<0.05		1.3	0.63	69%
EH82 990808 4002	Carrot	Glenmerry	90.4	90.8	0%	0.28	0.25	11%	3.5	2.41	37%
EH82 990809 4001	Carrot	Rivervale	90.6	89.3	1%	< 0.2	0.12		3.6	4.77	28%
EH82 990809 4002	Tomato	Rivervale	93.4	93.5	0%	< 0.3	<0.05		1.4	1.07	27%
EH82 990809 4003	Potato	Rivervale	78.8	74.5	6%	0.11	0.06	59%	0.8	0.48	50%

Certified Reference Material	Type	Lab		Found	Target	Recovery	Found	Target	Recovery
NIST 1573a	Tomato leaves	Cantest		0.125	0.112	112%	1.4	1.5	91%
NIST 1573a	Tomato leaves	ASL		0.09	0.112	80%	1.35	1.52	89%

TRAIL LEAD PROGRAM

1999 Confirmatory Produce Sampling/Analysis

			Lead			Zinc		
Sample ID	Type	Neighbourhood	Cantest	ASL	R.P.D.	Cantest	ASL	R.P.D.
EH82 990723 4001	Lettuce	East Trail	48.9	22.3	75%	257	145	56%
EH82 990723 4002	Swiss Chard	East Trail	9.3	8.3	11%	430	429	0%
EH82 990723 4003	Lettuce	West Trail	6.3	5.4	15%	445	384	15%
EH82 990723 4004	Swiss Chard	West Trail	5.9	5.2	13%	1120	798	34%
EH82 990723 4005	Lettuce	Tadanac	100	88.7	12%	393	325	19%
EH82 990723 4006	Lettuce	Tadanac		86.5			897	
EH82 990723 4007	Lettuce	Shavers Bench	10.4	5.2	67%	169	102	49%
EH82 990723 4008	Lettuce	Miral Heights	7.0	3.3	72%	119	86	32%
EH82 990723 4009	Potato	Miral Heights	0.2	<0.1		22.4	12.6	56%
EH82 990723 4010	Lettuce	Glenmerry	49.5	29.5	51%	292	223	27%
EH82 990723 4011	Lettuce	Glenmerry	17.1	7.1	83%	411	222	60%
EH82 990806 4001	Carrot	East Trail	19.7	13.3	39%	183	163	12%
EH82 990806 4002	Lettuce	Supermarket	0.6	0.2	105%	104	69	40%
EH82 990806 4003	Spinach	Supermarket	0.2	0.2	11%	66.8	46.7	35%
EH82 990806 4004	Carrot	Supermarket	0.2	<0.1		16.8	14.8	13%
EH82 990807 4001	Carrot	Tadanac	4.4	3	38%	81.7	57	36%
EH82 990807 4002	Tomato	Tadanac	5.4	0.2	186%	77.3	43.3	56%
EH82 990808 4001	Tomato	Glenmerry	0.5	0.2	82%	82.1	79	4%
EH82 990808 4002	Carrot	Glenmerry	6.9	6.2	11%	102	79	25%
EH82 990809 4001	Carrot	Rivervale	20.1	18.2	10%	171	163	5%
EH82 990809 4002	Tomato	Rivervale	2.6	0.8	106%	113	84	29%
EH82 990809 4003	Potato	Rivervale	4.1	1.5	93%	56.4	30.2	61%

Certified Reference Material	Type	Lab	Found	Target	Recovery	Found	Target	Recovery
NIST 1573a	Tomato leaves	Cantest		NC		25.3	30.9	82%
NIST 1573a	Tomato leaves	ASL		NC		29.9	30.9	97%