8.9 PUBLIC HEALTH AND SAFETY

Public Health relates to the physical health and well-being of the human/public community surrounding the Project. The potential for public health concerns include those associated with releases to the environment, human health factors, potable water supplies, and several types of accidents, malfunctions and unplanned events. Public Health can be assessed both in light of long term (chronic) conditions as well as short-term (acute) conditions, and can be affected by air quality, drinking water quality and food, among other factors.

Public Safety relates to the prevention and protection of workers and the general population from all manners of injury, damage or harm associated with potential Project-related accidents, malfunctions or unplanned events (*e.g.,* fuel spill, vehicle collisions). Public Safety is generally assessed with regard to acute (short-term) incidents or environmental effects, resulting primarily from accidents, malfunctions and unplanned events. Chronic (long-term) environmental effects are addressed through engineering design or mitigation aimed at addressing Public Safety concerns.

Public Health and Safety was selected as a valued environmental component (VEC) because the public and Aboriginal people who use the area near the Project for hunting, fishing, trapping, and recreational activities could be exposed to emissions to the atmosphere and releases to the aquatic environment from the Project.

Among other uses, the area surrounding the Project is used primarily for forest resource harvesting, but also for hunting and fishing, trapping, and recreational activities such as hiking, all-terrain vehicle (ATV) riding, and snowmobiling. The lands of central New Brunswick, including the Project Development Area (PDA, defined later) are reported to be used by Aboriginal persons for traditional hunting, fishing, trapping, gathering, subsistence and related purposes. Several recreational campsites (including cabins) are also located near the Project, approximately 1.5 km east of the open pit location.

As authorized by approvals and permits that will be issued for the Project following the EIA, the Project will release air and water emissions and thus release contaminants into the air, water, and/or soil. The conditions of those approvals and permits will define the acceptable quality and quantity of those releases. Despite this, any chemical, from the most benign to the most toxic, has the potential to cause environmental effects; it is the concentration, duration of exposure, and route by which people come into contact with a particular chemical that determines if it may cause harm to their health.

A Human Health and Ecological Risk Assessment (HHERA) was completed to assist in the assessment of potential environmental effects on Public Health during Construction, Operation, and Decommissioning, Reclamation and Closure of the Project (Section 7.7). The potential human and ecological health risks were assessed for both the existing (Baseline) and future (Project + Baseline) conditions, and were evaluated in the context of the existing health status of residents of the LAA and RAA.

With respect to Public Health, health risks associated with existing (Baseline) concentrations of a number of metals (*i.e.,* arsenic, chromium, cobalt, lead, manganese, methyl mercury, and thallium) found in the environment near the Project were determined through the HHERA to be high in relation to accepted benchmarks (even in the absence of the Project), thus potentially contributing to risks to Aboriginal receptors that may currently be obtaining 100% of their game, 20% of their fish, and 10% of their total vegetation from the Project area. Predicted health risks associated with Project-related activities were generally similar to baseline health risks, with the exception of health risks associated with predicted concentrations of arsenic, boron, cobalt, and thallium in fish tissues, as well as from arsenic in surface water. However, further examination of these data determined that concentrations of these metals are similar to published fish tissue concentrations from other reference locations or natural areas or meet fish tissue guidelines (where available).

The Project's environmental effects on Public Health and Safety will be minimized by the application of standard mitigation and environmental management practices and procedures used in the mining industry. Mitigation measures described for the Atmospheric Environment (Section 8.2), Water Resources (Section 8.4), and Aquatic Environment (Section 8.5) are also protective of Public Health. Project-related emissions and wastes will be controlled to an extent that they are in compliance with air quality or health-based standards, and as such, the Project is anticipated to not substantively affect the existing health status of residents in surrounding areas. The Construction, Operation, Decommissioning, Reclamation and Closure of the Project will not cause significant environmental effects to a Change in Public Health. An extensive follow-up program developed to monitor the environmental effects of the Project on downstream water and fish tissue quality in particular (see Section 8.5) is recommended to verify these EIA predictions and assist in planning and adaptive management for the Project, should environmental conditions become of concern.

With respect to Public Safety, all phases of the Project as planned will be carried out in compliance with the applicable occupational health and safety as well as public safety legislation of the Province of New Brunswick and the Government of Canada. Mitigation, planning, and environmental management measures developed in support of the Project will assist in minimizing the risks of accidents, malfunctions or unplanned events that could otherwise be a cause for concern with regard to Public Safety. The Construction, Operation, and Decommissioning, Reclamation and Closure of the Project will not cause significant environmental effects to a Change in Public Safety as the activities during these phases will be carried out in compliance with the laws that exist to protect the safety of workers and the public, and because considerable care has been taken by the Proponent to plan, prepare for, and respond to unplanned events that could lead to public safety concerns.

Overall, the potential environmental effects of the Project on Public Health and Safety (including cumulative environmental effects) were rated not significant for all phases of the Project.

8.9.1 Scope of Assessment

This section defines the scope of the environmental assessment of Public Health and Safety in consideration of the nature of the regulatory setting, issues identified during public consultation and First Nations engagement activities, the Final Guidelines (NBENV 2009) and Terms of Reference (Stantec 2012a), potential Project-VEC interactions, and existing knowledge.

8.9.1.1 Rationale for Selection of Valued Environmental Component, Regulatory Context, and Issues Raised During Engagement

Public Health and Safety was selected as a VEC because the public and Aboriginal people who use the area near the Project for hunting, fishing, trapping, and recreational activities could be exposed to emissions to the atmosphere and releases to the freshwater environment from the Project. As reflected in issues and concerns raised during engagement activities, Public Health and Safety is important to local stakeholders, Aboriginal persons, and the general public as they want to understand, and be sure they will not be exposed to, potential adverse environmental effects on their health that could arise from exposure to contaminants released from the Project.

The Final Guidelines (NBENV 2009) and Terms of Reference (Stantec 2012a) require that Public Health be assessed for both short-term and long-term conditions, and that the potential environmental effects of effluents and emissions on air quality, drinking water quality, and food be considered. The Final Guidelines specify that assessment of the potential for environmental effects on public health must be carried out by conducting a HHERA. The safety of employees and the public are also to be assessed.

During public, stakeholder, and Aboriginal engagement activities carried out in support of the Project, issues were raised related to dust generated by blasting and process emissions. Specifically, questions were asked about the potential for the trace metals in dust to cause health problems as a result of inhalation, and deposition of atmospheric dust on country foods. First Nations raised the concern that Project releases could affect the fish, vegetation and wildlife in the area, upon which they depend for traditional and subsistence purposes. These issues are included in this assessment.

The Final Guidelines and Terms of Reference include the requirement to assess public safety and worker health and safety. In the context of this EIA, public safety also includes the safety of workers.

8.9.1.2 Selection of Environmental Effects and Measurable Parameters

The environmental assessment of Public Health and Safety is focused on the following environmental effects:

- Change in Public Health; and
- Change in Public Safety.

A Change in Public Health refers to the health of those people living, working or enjoying recreational or traditional activities in the vicinity of the Project, including workers employed by the Project that live or enjoy recreational activities near the Project. While on the site, workers employed by the Project will be subject to applicable occupational health and safety laws of the Province of New Brunswick; therefore, this condition is encapsulated in the assessment of a Change in Public Safety.

The measurable parameters used for the assessment of a Change in Public Health are based on the risk characterization predictions derived in the HHERA (Section 7.7). The measurable parameters used for the assessment of a Change in Public Safety relate to compliance with safety Acts, Regulations, Codes, Standards and accepted benchmarks that are intended to protect public and occupational safety. The measurable parameters used for the assessment of the environmental effects presented above, and the rationale for their selection, are provided in Table 8.9.1.

Table 8.9.1 Measurable Parameters for Public Health and Safety

Environmental Effect	Measurable Parameter	Rationale for Selection of the Measurable Parameter
Change in Public Health	Concentration Ratio (CR) (dimensionless)	• The CR is appropriate for the evaluation of a non-carcinogenic Change in Public Health from short-term and long-term exposures to contaminants in air (*i.e.,* exposure via inhalation). In human health risk assessment (HHRA), the CR is the ratio between the predicted or actual concentration of a contaminant in air and its tolerable concentration for humans (as determined by health-based objectives, guidelines and standards established by regulatory agencies).
	Hazard Quotient (HQ) (dimensionless)	• The HQ is the basis upon which changes in long-term health risks are assessed for human oral/dermal exposure to non-carcinogens via multiple pathways. In an HHRA, the HQ is the ratio between the predicted/actual oral/dermal exposure dose of a contaminant (determined based on measured or predicted concentrations in environmental media) and its human tolerable exposure dose (published by regulatory agencies).
	Incremental Lifetime Cancer Risk (ILCR) (dimensionless)	• The ILCR is the basis upon which Project-related changes in long-term health risks are assessed for carcinogens. For inhalation exposures, ILCR is the product of the predicted or actual concentration of a contaminant in air and the Unit Risk (UR) (published by regulatory agencies). In an HHRA, for oral and dermal exposures, ILCR is the product of a receptor's predicted exposure to a carcinogen (determined based on measured or predicted concentrations in environmental media) and a Cancer Slope Factor (CSF) (published by regulatory agencies).
Change in Public Safety	Compliance/Non-Compliance with Safety Acts, Regulations, Codes and Standards	• Various provincial and federal Acts, Regulations, codes and standards have been developed to protect public safety as well as the health and safety of workers in an occupational environment. These laws, regulations, codes and standards have been developed by governments to protect public and worker safety.

8.9.1.3 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on Public Health and Safety include the three phases of Construction, Operation, and Decommissioning, Reclamation and Closure as defined in Chapter 3.

The temporal boundaries for the characterization of existing conditions for Public Health and Safety are limited to summer 2011, when Project-specific soil and biota data were collected in the area near the Project for use in the HHERA (Stantec 2012h).

8.9.1.4 Spatial Boundaries

The spatial boundaries for the environmental effects assessment of Public Health and Safety are defined below.

Project Development Area (PDA): The PDA (Figure 8.9.1) is the most basic and immediate area of the Project, and consists of the area of physical disturbance associated with Construction and Operation of the Project. Specifically, the PDA consists of an area of approximately 1,253 hectares (ha) that includes: the open pit; ore processing plant; storage areas; TSF; quarry; the relocated Fire Road and new Project site access road, and new and relocated power transmission lines. The PDA is the area represented by the physical Project footprint as detailed in Chapter 3.

Local Assessment Area (LAA): The LAA is the maximum area within which Project-related environmental effects can be predicted or measured with a reasonable degree of accuracy and confidence. For Public Health and Safety, the LAA includes an area of 20 x 20 km centred on the PDA, and includes the PDA and any adjacent areas where Project-related environmental effects could be expected. The LAA is shown in Figure 8.9.1. The LAA corresponds to the "HHERA Study Area" described in Section 7.7.2 and shown in Figure 7.7.3.

Regional Assessment Area (RAA): The RAA is the area within which the Project's environmental effects may overlap or accumulate with the environmental effects of other projects or activities that have been or will be carried out. For Public Health and Safety, the spatial boundaries used as the basis for the baseline health status (*i.e.,* former Health Region 3) have been identified as the RAA. The extent to which cumulative environmental effects may occur depends on physical and biological conditions and the type and location of other past, present, or reasonably foreseeable future projects or activities that have been or will be carried out, as defined within the RAA. The RAA is shown in Figure 8.9.2.

8.9.1.5 Administrative and Technical Boundaries

The administrative boundaries for the assessment of a Change in Public Health are governed by the accepted methodologies and guidelines for the conduct of HHERA in Canada, which follow a standard risk assessment paradigm accepted by the federal and provincial governments as described in the HHERA (Section 7.7).

With few exceptions, the toxicity of each contaminant (*i.e.,* the capacity to produce a harmful endpoint or physiological injury) is expressed as an exposure dose, and compared to a tolerable dose or threshold level that has been published by an appropriate regulatory agency (*e.g.*, Health Canada, USEPA). Below this threshold, health endpoints, (*i.e.,* effects from the contaminant, such as carcinogenicity or toxicity) are not experienced. If the threshold dose is exceeded, health endpoints may (but do not necessarily) occur. The risk of a health endpoint occurrence, and the severity of the potential health-related environmental effect, would depend on the level of exposure received, with more severe health-related environmental effects occurring with increased exposure. These health risks are expressed as Concentration Ratios (CRs) or as Hazard Quotients (HQs), as noted in Table 8.9.1.

Concentration Ratios (CR) were used to evaluate the health risks from short-term and long-term exposure to contaminants in air. CR values were calculated by dividing the predicted ground-level air concentration (1-hour, 24-hour, or annual average) by the appropriate ambient air guideline as were identified in Section 8.2.1.5 (*i.e.,* the Administrative and Technical Boundaries section of the Atmospheric Environment VEC) or threshold concentration as published by an appropriate health agency (*e.g.*, Health Canada, US EPA). For assessment of non-carcinogenic health risks due to short- and long-term direct inhalation of COPC by people, a benchmark of CR<1.0 was used for comparison of calculated CR (*i.e.*, if the CR value is less than 1.0, then the measured or predicted concentration in air is less than the threshold value published by an appropriate regulatory agency). In general, the risks associated with direct inhalation are distinct from those associated with oral and dermal exposures and are therefore assessed separately.

People are potentially exposed to contaminants through five main media (*i.e.*, air, water, soil, food, and consumer products), and Health Canada (2010a) and the Canadian Council of Ministers of the Environment (CCME 2006) assume that no more than 20% of a person's daily intake comes from any one medium (*i.e.*, 100% divided by 5 media is 20%). This translates into a HQ where the threshold of toxicity is 0.2. To be consistent with this guidance, the potential health risks (HQs) associated with water, soil, and country foods were compared to the benchmark of 0.2.

When predicted human health risks are less than the benchmark (*e.g.*, CR<1.0, HQ<0.2), the health risks are considered negligible and an adverse Change in Public Health is not expected (Health Canada 2010a). If predicted human health risks are higher than the benchmark, it does not necessarily indicate a health problem but rather triggers a review in more depth (Health Canada 2010c; Alberta Health and Wellness 2011). A review of such HQ and CR values is important since both the exposure estimates and the toxicological criteria are based on a series of conservative assumptions, particularly when considering the reasonable maximum "worst-case" exposure scenarios.

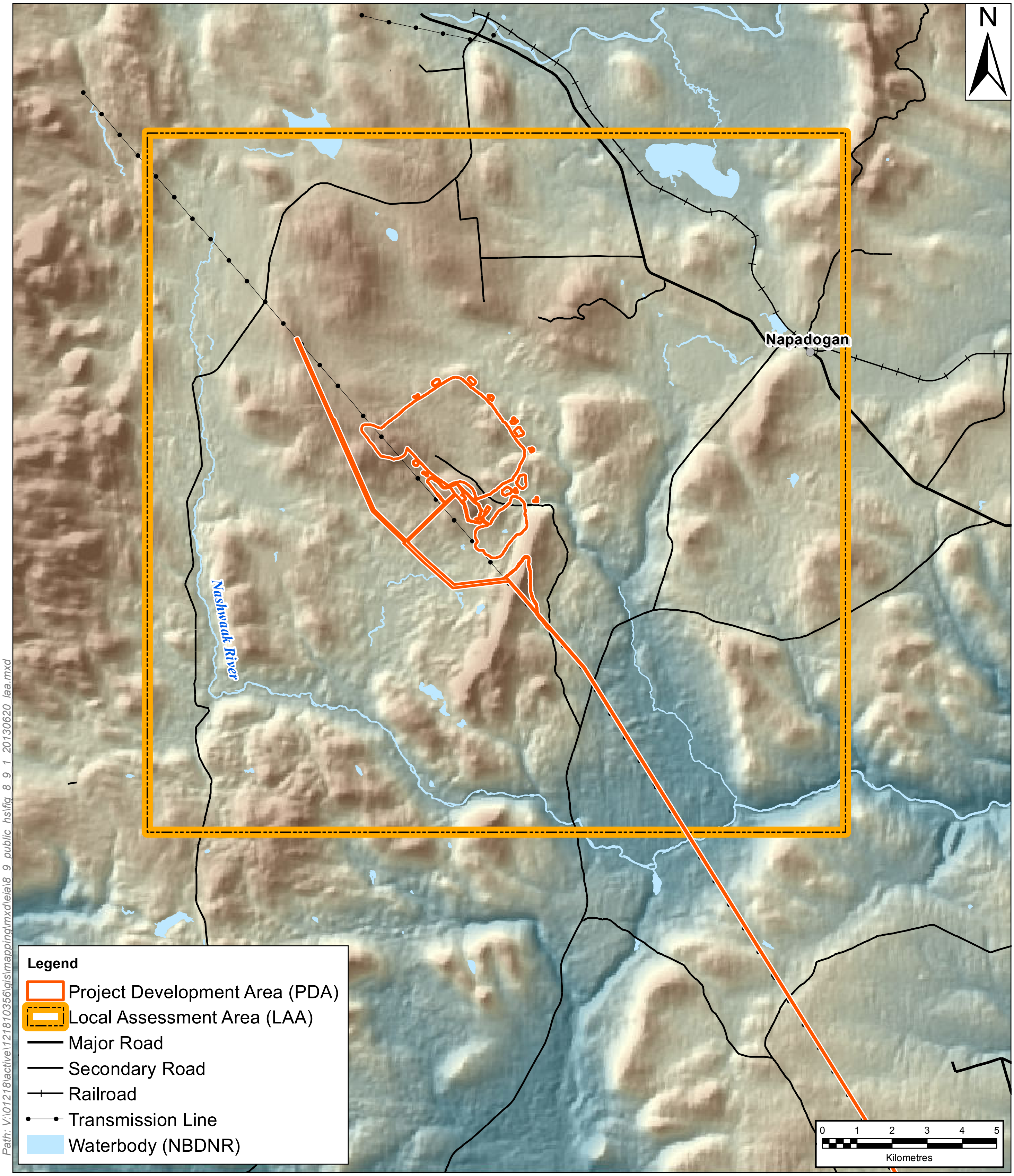
A possible exception to this "threshold" principle involves the actions of certain chemical carcinogens that alter genetic material to produce certain forms of cancer and are not considered to have a protective threshold. Although there is no threshold for cancer toxicity, there is a government-accepted level of increased Incremental Lifetime Cancer Risk (ILCR) above background of 1 person exposed in a population of 100,000 (expressed as 1E-05) that is used to assess potential cancer risk (Health Canada 2012a; Atlantic PIRI 2012: Alberta Health and Wellness 2011). Administrative boundaries for other VECs (*e.g.,* air quality objectives as part of the Atmospheric Environment VEC in Section 8.2, Health Canada Guidelines for Canadian Drinking Water Quality as part of the Water Resources VEC in Section 8.4) are also applicable to a Change in Public Health.

The administrative boundaries for a Change in Public Safety are established by various governing standards including the Canada Labour Code, the *Transportation of Dangerous Goods Act* and Regulations, the New Brunswick *Employment Standards Act*, and the New Brunswick *Occupational Health and Safety Act* and Regulations. These are applicable to the Project and will be followed through all phases of the Project.

For the assessment of inhalation routes of exposures, and the assessment of exposures to soil, game, and plants, the quantitative portion of the HHERA was largely (and conservatively) based on the Operation phase, as air contaminant emissions will be highest during this phase (Section 7.7). To assess the potential exposures via surface water and fish, the HHERA considered the maximum annual average surface water concentration as predicted for all three phases. The HHERA conservatively assumed that individuals would be exposed to these concentrations in air, soil, water, and food for up to 80 years, corresponding to roughly the average life expectancy of an individual.

Technical boundaries for Public Health and Safety include:

- the inherent uncertainty in all HHERAs, due to data gaps or knowledge gaps, which leads to conservatism (erring on the side of overstating, rather than understating risk) for toxicological values used, and assumed receptor characteristics and behaviours;



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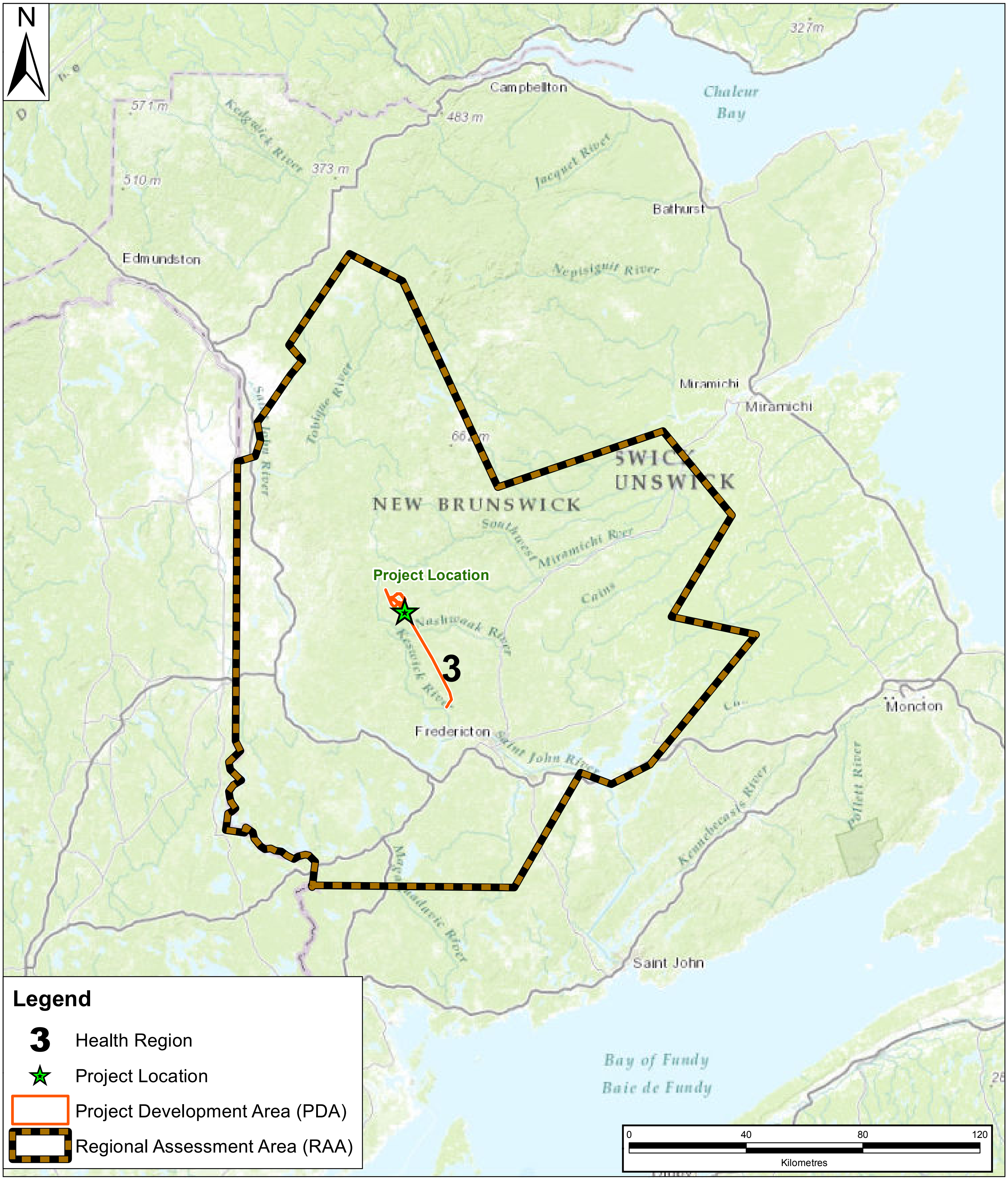
NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC PROJECT AND SHOULD NOT BE USED FOR OTHER PURPOSES.

Project Development Area (PDA), and Local Assessment Area (LAA) for Public Health and Safety Sisson Project: Environmental Impact Assessment (EIA) Report, Napadogan, N.B.	Scale: 1:150,000	Project No.: 121810356	Data Sources: NBDNR	Fig. No.: 8.9.1
	Date: (dd/mm/yyyy) 23/11/2014	Dwn. By: JAB	Appd. By: DLM	
Client: Sisson Mines Ltd.				

Stantec

Map: NAD83 CSRS NB Double Stereographic



NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC PROJECT AND SHOULD NOT BE USED FOR OTHER PURPOSES.

Regional Assessment Area (RAA) for Public Health and Safety

Sisson Project:
Environmental Impact Assessment (EIA) Report, Napadogan, N.B.

Client: Sisson Mines Ltd.

Scale:	Project No.:	Data Sources:	Fig. No.:
1:1,800,000	121810356	Service Layer Credits: Sources: Esri, DeLorme, HERE, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community	8.9.2

Date: (dd/mm/yyyy)	Dwn. By:	Appd. By:
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Stantec

Map: NAD83 CSRS NB Double Stereographic

- the inherent uncertainty in estimating air emission rates and source terms for geocontaminant modelling from the Project at a feasibility level of engineering design;
- the inherent uncertainty of fate and transport models used to predict future concentrations; and
- the variability in the baseline sampling programs used to reduce data gaps regarding existing concentrations of contaminants in environment.

8.9.1.6 Residual Environmental Effects Significance Criteria

A significant adverse residual environmental effect for a Change in Public Health is one that results in the Project-related environmental exposures that are predicted through the HHERA to exceed the objectives established by a recognized health organization and are likely to result in a long-term, substantive change in the public health status.

A significant adverse residual environmental effect for a Change in Public Safety is one where the Project directly and substantially endangers the safety of the public and/or Project employees to such an extent that an immediate danger exists to the life and/or health of the public and/or employees as a result of the Project, and for which planned design features, mitigation, or environmental management measures are unsuccessful at minimizing or eliminating the risks to public safety.

8.9.2 Existing Conditions

The existing conditions with respect to Public Health and Safety have been established using two scientific approaches:

- A review of the current health status of residents in the RAA, as documented by the New Brunswick Department of Health and other organizations; and
- A predictive quantitative risk assessment of the potential health risks (*e.g.,* CR, HQ, LCR) associated with human exposure to existing concentrations of contaminants in the environment.

8.9.2.1 Current Health Status

Information contained in the health indicators released by the Office of the Chief Medical Officer of Health (New Brunswick Department of Health, NBDOH) and statistics provided by the Canadian Cancer Society and the New Brunswick Cancer Network were used to describe the existing health status of residents within the LAA and RAA. The following health indicators (and reference documents) were used to describe the health status of the population:

- mortality (NBDOH 2011a);
- cancer incidence (Canadian Cancer Society 2012; NBDOH n.d.);
- cardiovascular disease (Heart and Stroke Foundation 2013; Statistics Canada 2012f; NBHC 2011;
- neurodegenerative diseases (NBDOH 2012a);

- mental health (NBDOH 2011b);
- obesity (NBDOH 2012b);
- teenage pregnancy (NBDOH 2011c);
- injury (NBDOH 2012c);
- injuries in sport, recreation and exercise (NBDOH 2013); and
- workplace health and safety (WorkSafe NB 2012; AWCBC 2013; HRSDC 2013).

Where available, information was summarized for former Health Region 3 (*i.e.,* the RAA and the nearest Health Region to the Project), which is now part of the Horizon Health Network, and compared to the rest of the population of New Brunswick where applicable.

Since health status is often affected by age, employment, income and education, demographic characteristics are important factors to consider in the discussion of Public health. See Section 6.4 (Socioeconomic Setting) for a summary of demographic characteristics in the vicinity of the Project.

8.9.2.1.1 Mortality

In 2009, the crude mortality rate (or number of deaths per year) in Health Region 3 was 78 per 10,000 population, which was slightly less than the provincial rate of 83.9 per 10,000. Between 2005 and 2009, the premature mortality rate in Health Region 3 (which reflects death before the age of 75) was 33 per 10,000, which was similar to the provincial rate of 34 per 10,000 (NBDOH 2011a).

For both crude and premature mortality rates, the leading cause of death was cancer followed by heart disease. For crude mortality rates, diseases of the respiratory system were the third leading cause of death, but external injuries were the third leading cause of death in those younger than 75 years. For those under 20 years of age, the primary cause of death was external injury followed by conditions originating in the perinatal period (NBDOH 2011a).

In Health Region 3, life expectancy at birth for those born from 2005-2007 is 79.5 years; the provincial average is 80 years. In 2009, the infant mortality rate in New Brunswick was 5.2 per 1,000 live births, which was similar to the national average of 5.1 per 1,000 live births (NBDOH 2011a).

8.9.2.1.2 Cancer Incidence

Cancer is the leading cause of death in Canada (Canadian Cancer Society 2012). In 2012, the Canadian Cancer Society estimated that approximately 186,400 Canadians would be diagnosed with cancer and that approximately 75,700 would die from cancer that year. Based on current cancer incidence and mortality rates for Canada, the lifetime probability of developing cancer is 2 in 5, and approximately 1 in 4 Canadians will die of the disease (Canadian Cancer Society 2012). Over half of all new cancers are lung, colorectal, breast, and prostate cancers.

In New Brunswick, death due to cancers represents the leading cause of mortality. The Canadian Cancer Society estimated that approximately 5,000 New Brunswickers would be diagnosed with, and approximately 1,900 would die from, cancer in 2012 (Canadian Cancer Society 2012). Although lung cancer is the leading cause of cancer death for both men and women in New Brunswick, the most frequently diagnosed cancer for men is prostate cancer, and for women, breast cancer (Canadian Cancer Society 2012; NBDOH n.d.).

Cancer incidence rates are often reported as age-standardized cancer incidence rates. Age-standardized rates represent a proportional comparison to the incidence rate that would have been expected if the population had been of a standard composition in terms of age and gender. According to the New Brunswick Cancer Network (NBDOH n.d.), from 2002-2006 the age-standardized cancer incidence rates for women in Health Region 3 were similar to the provincial rates for breast and lung cancer but were slightly lower for colorectal cancer (36.7 per 100,000, versus 42.0 per 100,000 for the province). The age-standardized mortality rates were similar to those for the province for all three of these cancers. For males, the age-standardized cancer incidence rates in Health Region 3 were lower than the provincial rates for prostate cancer (123.8 per 100,000, versus 139.3 per 100,000 for the province) and lung cancer (80.4 per 100,000, versus 89.7 per 100,000 for the province) but were similar for colorectal cancer (59.9 per 100,000, versus 62.5 per 100,000 for the province). Age-standardized mortality rates for men in Health Region 3 were the same as the province for prostate cancer but were lower for lung cancer (71.8 per 100,000, versus 76.5 per 100,000 for the province) and colorectal cancer (22.1 per 100,000, versus 25.5 per 100,000 for the province).

8.9.2.1.3 Cardiovascular Disease

Heart disease and stroke (cardiovascular disease) are the second and third leading causes of death in Canada, respectively (Heart and Stroke Foundation 2013; Statistics Canada 2012f). In 2009, 26.6% of all deaths in Canada were attributable to cardiovascular disease; 26.4% of all male deaths and 26.7% of all female deaths (Statistics Canada 2012f). It is estimated that every 7 minutes, someone dies from heart disease or stroke in Canada (Heart and Stroke Foundation 2013).

In New Brunswick, heart disease and stroke are also the second and third leading causes of death, respectively, and accounted for 26.1% of all deaths in 2009 (Statistics Canada 2012f). In Health Region 3, premature deaths from heart disease and stroke resulted in an average of 101.7 years of life lost per 10,000 from 2005-2009, as opposed to 98.1 years of life lost per 10,000 for all of New Brunswick (NBHC 2011). In 2011, heart disease was the eighth most common chronic health condition in both Health Region 3 and the Province; however, its prevalence was slightly lower in Health Region 3 (7.9% versus 8.3%) (NBHC 2011).

In 2010, various cardiovascular conditions were the fourth, fifth, ninth, and tenth most frequent reasons for hospital admissions in Health Region 3, which was closely mirrored by the reasons for hospital admissions in the Province (fourth, fifth, eighth, and ninth) (NBHC 2011).

8.9.2.1.4 Neurodegenerative Diseases

Neurodegenerative diseases are debilitating conditions in which nerve cells are progressively damaged and/or lost, resulting in problems with movement and/or mental functioning. In 2008, 53 per 10,000 people in New Brunswick were hospitalized with Alzheimer’s disease, Parkinson’s disease, multiple sclerosis, motor neuron disease, or Huntington's disease. Of this number, 29 per 10,000 were hospitalized for Alzheimer's disease and 11 per 10,000 for Parkinson's disease. Rates were slightly higher in Health Region 3 compared to the province, with 32 per 10,000 hospitalized with Alzheimer's disease and 15 per 10,000 hospitalized with Parkinson's disease. Seventeen per 10,000 in Health Region 3 were hospitalized with other neurodegenerative diseases (NBDOH 2012a).

8.9.2.1.5 Mental Health

According to the Canadian Community Health Survey (CCHS) conducted in 2010, 75.3% of people 12 years of age and older in Health Region 3 reported their mental health as excellent or very good, as opposed to 68.3% throughout New Brunswick (NBDOH (2011b). New Brunswick had the third lowest proportion of its population reporting positive mental health status among all the provinces and territories in Canada. Since 2003, the proportion of the population in Health Region 3 reporting excellent or very good mental health increased from 67.1% to 75.3%, while the proportion of the population of New Brunswick reporting excellent or very good mental health remained relatively stable (67.6% to 68.3%) (NBDOH 2011b).

Mental health is closely associated with overall health. The proportion of the population in Health Region 3 reporting their health status, defined as a person's perceived physical, mental and social well-being, as excellent or very good was 52.6%, which was less than the proportion for New Brunswick (53.5%) and Canada (60.1%) (NBDOH 2011b).

The percentage of all hospitalizations and care days due to mental and behavioural disorders in New Brunswick from 2005-2006 was 6% and 10.8%, respectively, which were less than the averages for Canada (7.6% and 16.1%, respectively). From 2005-06 to 2008-09, mood and anxiety disorders resulted in an average of 89 per 1,000 hospitalizations and medical attention (NBDOH 2011b).

Closely linked with mental health problems, suicide rates have decreased in New Brunswick from an average of 101 per year from 1995 to 1999, to an average of 93 per year for the five-year period from 2005-2009. From 2000-2009, the average annual suicide rate in New Brunswick was 1.2 per 10,000 (NBDOH 2011b).

8.9.2.1.6 Obesity

Overweight and obesity is a growing concern worldwide. A person having a body mass index (BMI) between 25.0 and 29.9 kg/m^2 is considered to be in the overweight class and a BMI of 30.0 kg/m^2 or more is obese. According to the 2009-2010 CCHS, 63.5% of adults and 20.9% of children and youth in Health Region 3 were overweight or obese (NBDOH 2012b). These rates were similar to the provincial average for adults (63%) but less than the average for children and youth (24%). The national average was 52% for adults and 19.9% for children and youth (NBDOH 2012b).

Factors contributing to overweight and obesity include poor diet and physical inactivity. Relative to the province as a whole, a greater proportion of children and youth in Health Region 3 consumed fruits and vegetables 5 times or more per day and were moderately active or active during leisure time in 2009-2010.

Early infant nutrition, including the contribution of breastfeeding to optimal physical growth, can reduce the risk of obesity. In 2011, a greater percentage of newborns in Health Region 3 were breastfed relative to the provincial average initiation rate (*i.e.,* approximately 78% in Health Region 3 compared to 76% in all of New Brunswick) (NBDOH 2012b).

8.9.2.1.7 Teenage Pregnancy

Teenage pregnancy is used as a health indicator because of the short- and long-term consequences (*e.g.,* pregnancy-related complications, education levels attained, career opportunities) for mothers and infants. In 2009, the teen pregnancy rate, which includes all registered live births, stillbirths, and therapeutic abortions, in Health Region 3 was 21 per 1,000 females aged 15-19, which was 19% of all teen pregnancies in the province. The New Brunswick teen pregnancy rate was 25.9 per 1,000 females aged 15-19. Although teen pregnancy rates fluctuate each year, they remained relatively stable from 2000-2009 in New Brunswick, while rates in Health Region 3 exhibited a downward trend. From 2000-2007, teen fertility rates, which includes only registered live births, in New Brunswick were consistently higher than the average for Canada (19.8 versus 14.0 per 1,000 females aged 15-19) (NBDOH 2011c).

8.9.2.1.8 Injury

Injuries result in the limitation of normal activities and can affect mental and social well-being. In 2009 and 2010 CCHS, 15.2% of people aged 12 and over in Health Region 3 reported having sustained injuries over the previous year which limited normal activities. This was slightly higher than the provincial average of 14% (NBDOH 2012c).

Since 2000, hospitalization due to injuries in New Brunswick was primarily the result of falls (58%) followed by motor vehicle incidents (14%); there have been approximately 5,600 acute-care hospitalizations resulting from injuries. Unintentional injuries account for 75% of all fatal injuries in New Brunswick, which primarily result from motor vehicle traffic incidents (28%) and falls (19%) (NBDOH 2012c).

For children and youth in New Brunswick, unintentional injury is one of the primary causes of hospitalization and death. In 2009-2010, 45% of deaths for those aged 15-24 were the result of unintentional injury (NBDOH 2012c).

For adults of working age, injuries primarily occur as a result of motor vehicle incidents and injuries in the workplace or at home during leisure activities. For older adults, falls are the primary cause of injury resulting in morbidity, loss of independence and mortality (NBDOH 2012c).

8.9.2.1.9 Injuries in Sport, Recreation and Exercise

According to the 2011 CCHS, approximately half (51%) of the population in New Brunswick aged 12 and over reported being at least moderately active, which was similar to the national average of 53.8% (NBDOH 2013). While the most popular leisure activities listed were walking, gardening, home exercise, jogging/running, swimming and bicycling, hospitalization in New Brunswick occurred most commonly as a result of bicycling (1.2 per 10,000), skiing/snowboarding (0.6 per 10,000) and playground falls (0.5 per 10,000) (NBDOH 2013).

Cycling results in the greatest number of leisure activity-related injuries in New Brunswick. From 2005-2009, an average of 87 acute-care hospitalizations occurred each year as a result of cycling injuries. This number decreased from 1990 as a result of mandatory bike helmet legislation. In 2009-2010, 52.4% of New Brunswickers aged 12 years and older used a helmet while riding a bicycle, while approximately 62% of those in Health Region 3 wore a bike helmet. The Canadian average was 36.9% (NBDOH 2013).

8.9.2.1.10 Workplace Health and Safety

The workplace injury frequency rate in New Brunswick has been steadily declining since 2008. In 2012 the estimated workplace injury frequency rate was 2.99 injuries/100 full time employees, down from 3.09 injuries/100 full time employees in 2011. In addition, the frequency of lost-time injuries in New Brunswick is below the national average (WorkSafe NB 2012). In 2011 there were 1.26 lost-time injuries/100 employees in New Brunswick, while the national average was 1.72 injuries/100 employees (WorkSafe NB 2012; AWCBC 2013).

In Canada, the construction and manufacturing industries have the highest rate of workplace injury, at 24.5 injuries/1000 employed workers and 24.0 injuries/1,000 employed workers respectively in 2008. In comparison, the rate of workplace injury in the mining and quarrying sector was 9.9 injuries/1,000 employed workers in 2008, slightly below the electricity, gas, and water industries and the agriculture, hunting and forestry industries which each had 2008 rates of 11.5 injuries/1,000 employed workers. The financial sector had the lowest workplace injury rate in Canada in 2008, 0.6 injuries/1,000 employed workers (HRSDC 2013).

8.9.2.2 Predicted Baseline Human Health Risks – Existing Environmental Contaminant Concentrations

The existing concentrations of various contaminants in air, surface water, sediment, soil, and biota were established for the LAA (Stantec 2012b; 2012d; 2012h). Existing concentrations of contaminants in ambient air in the LAA were presented in Tables 7.1.6 and 7.1.7. Concentrations of contaminants in other environmental media are presented in Table 7.7.5 (soil), Table 7.7.6 (water), Table 7.7.8 (forage), Table 7.7.9 (berries), Table 7.7.12 (wild game) and Table 7.7.14 (fish carcass).

Using these existing concentrations, the estimated baseline human health risks associated with the exposure of people to existing (background) concentrations of contaminants in the environment within the LAA could be estimated as part of the HHERA (Section 7.7) using the same methodology for assessing Project-related health risks for a Change in Public Health, namely the following.

- Use Concentration Ratios (CR) to evaluate the non-carcinogenic health risk from baseline exposures to contaminants in air.
- Use Hazard Quotients (HQ) to express the baseline non-carcinogenic health risk from long-term exposures to contaminants via multiple pathways.
- Use Lifetime Cancer Risk (LCR) to express the baseline carcinogenic health risk from long-term exposures to contaminants in air or via multiple pathways.

- The CR and HQ values are calculated as described in the HHERA Summary (Section 7.7) and Table 8.9.1, and can be compared to the benchmarks described in the HHERA Summary (Section 7.7) (*i.e.,* CR less than 1.0 and HQ less than 0.2).

The Lifetime Cancer Risk (LCR) is a measure used to assess risks related to contaminants that are capable of producing cancer, similar to the ILCR described in Table 8.9.1. Unlike ILCR, LCR includes the consideration of cancer risks from background or existing sources. Since regulators have not recommended an acceptable benchmark LCR for exposure to carcinogens associated with background or baseline conditions, interpretation of the significance of the LCR values is difficult. As noted in Section 8.9.2.1.2, the lifetime probability of developing cancer is 2 in 5.

Baseline health risks were calculated for each of the contaminants of potential concern (COPCs). The identification of COPCs is described in the HHERA Summary (Section 7.7). Because baseline health risks rely on the existing measured concentrations of the contaminants in the environment, the risk estimates incorporate both the natural background concentrations of contaminants and any potential accumulation of contaminants from existing anthropogenic sources. The baseline health risks are reported in the HHERA Summary (Section 7.7), and are summarized below.

8.9.2.2.1 Predicted Baseline Health Risks via Inhalation

The estimate of baseline ambient air contaminant concentrations near the Project for relevant averaging periods considers monitoring data from the baseline monitoring conducted by Northcliff at Napadogan (Stantec 2012b), as well as regional monitoring data from the NBDELG, as described in Section 7.1. Background 1-hour and 24-hour concentrations are the maximum 90^{th} percentiles of the baseline data, while background average annual concentrations are the six month averages of the data collected at Napadogan (Section 7.1). These concentrations were compared to inhalation toxicity reference values, published by regulatory agencies to determine the individual contaminant CR and LCR as appropriate (Section 7.7). The results are described below.

The health risks related to exposures to the criteria air contaminants (CAC) were evaluated for both short-term and long-term exposures. Short-term exposures were calculated using the 1-hour and 24-hour concentrations and long-term exposures were calculated using the average annual concentrations. The CR values for each of the CAC are summarized in Table 7.7.22 (Section 7.7). The CR for all CAC for each of the exposure periods considered for the Baseline Case were less than 1.0 (the benchmark); thus the health risks associated with the existing baseline concentrations through the inhalation pathway meet the relevant benchmark.

The health risks related to exposures to the other (non-criteria air contaminant, or non-CAC) COPCs were evaluated for both short-term and long-term exposures. The CR values for each of the non-CAC are summarized in Table 7.7.24 (Section 7.7). The CR for all non-CAC for each of the exposure periods considered for the Baseline Case were less than 1.0 (the benchmark); thus the health risks associated with the existing baseline concentrations through the inhalation pathway meet the relevant benchmark.

For lifetime inhalation exposures, Health Canada (2010b) identified potential carcinogenic endpoints for only three of the metals (namely arsenic, chromium, and nickel). The LCR associated with the baseline annual average concentrations for each is summarized in Table 7.7.26 (Section 7.7). The LCR values ranged from 1.4E-06 to 1.4E-05; however, there is no benchmark for LCR values.

8.9.2.2.2 Predicted Baseline Health Risks via Ingestion of and Dermal Contact with Soil

Baseline soil concentrations in the LAA were estimated using data from the baseline monitoring conducted by Northcliff (Stantec 2012h). The potential health risks were determined for toddlers and adults who may be exposed to soil within the LAA through incidental ingestion of soil, direct dermal contact with soil, and inhalation of dust from soil while present in the LAA (assumed to be 2 days per week for 52 weeks per year).

The maximum health risks for the toddler (*i.e.*, the more sensitive life stage for non-carcinogens) are summarized in Table 7.7.27 (Section 7.7), while carcinogenic risks associated with a lifetime of exposure to the existing soil concentrations are summarized in Table 7.7.31 (Section 7.7). The maximum health risks for a toddler are all less than the benchmark (*i.e.*, CR<0.2); there are no benchmarks for lifetime cancer risks from background exposures. Based on these results, the health risks associated with the existing baseline concentrations in soil meet the relevant benchmark.

8.9.2.2.3 Predicted Baseline Health Risks via Ingestion of Food

Hunting and fishing were identified as activities potentially occurring within the LAA, and as such the potential health risks associated with consumption of food obtained within the LAA were estimated. The health risks were based on published consumption rates for members of First Nations as these are higher than those of non-Aboriginal hunters and fishers. For the purposes of estimating health risks, the HHERA considered an Aboriginal receptor that obtains 100% of their game, 20% of their fish, and 10% of their total vegetation from the LAA. Baseline concentrations of fish and vegetation (forage and berries) were estimated using data from the baseline monitoring program conducted by Northcliff (Stantec 2012h). Although large game tissue samples were not obtained, modelling was used to estimate baseline concentrations of metals in game (*i.e.*, moose) as described in the HHERA (Section 7.7).

The potential health risks were determined for toddlers and adults who may obtain their food (game, fish, and vegetation) within the LAA. The maximum health risks for the toddler (*i.e.*, the more sensitive life stage for non-carcinogens) are summarized in Table 7.7.31 (Section 7.7), while carcinogenic risks associated with a lifetime of exposure to the existing food concentrations are summarized in Table 7.7.33 (Section 7.7).

The maximum health risks for a toddler are less than the benchmark (*i.e.*, CR<0.2), with the exception of chromium, cobalt, manganese, methyl mercury, and thallium. Health risks associated with chromium and manganese relate primarily to the consumption of vegetation, while health risks associated with cobalt and thallium are primarily related to the predicted baseline concentrations in game (*i.e.*, moose). Health risks associated with methyl mercury are related to the consumption of fish. Note that these are predictions of potential risk from exposure to baseline (or existing) environmental conditions in the LAA and are not Project-related.

8.9.2.2.4 Predicted Baseline Health Risks via Ingestion of Water

Baseline water concentrations in the LAA were estimated using data from the baseline monitoring conducted by Northcliff (Knight Piésold 2012e). Several of the recreational campsites are believed to collect surface water originating from springs. As noted in Section 8.4.4.3.2, these springs are likely present as the result of localized, shallow interflow from precipitation and are unlikely to be affected by Project activities. Though the spring-fed tributaries are unaffected and there are no other known users of surface or groundwater in the LAA as drinking water (*i.e.,* no public water supplies and no residential wells within the LAA), the potential health risks were determined for toddlers and adults who may decide to drink water from the streams while in the LAA, assumed to be 2 days per week for 52 weeks per year. The maximum health risks for the toddler (*i.e.,* the more sensitive life stage for non-carcinogens) are summarized in Table 7.7.32 (Section 7.7), while carcinogenic risks associated with a lifetime of exposure to the existing water concentrations are summarized in Table 7.7.33 (Section 7.7). The maximum health risks for a toddler are all less than the benchmark (*i.e.*, CR<0.2); there are no benchmarks for lifetime cancer risks from background exposures. Based on these results, the health risks associated with the existing baseline concentrations in surface water meet the relevant benchmark.

8.9.3 Potential Project-VEC Interactions

Table 8.9.2 lists each Project activity and physical work for the Project. The activities are ranked as 0, 1, or 2 based on the level of interaction of each activity or physical work with Public Health and Safety.

Table 8.9.2 Potential Project Environmental Effects to Public Health and Safety

Project Activities and Physical Works	Potential Environmental Effects	
	Change in Public Health	Change in Public Safety
Construction		
Site Preparation of Open Pit, TSF, and Buildings and Ancillary Facilities	0	1
Physical Construction and Installation of Project Facilities	0	1
Physical Construction of Transmission Lines and Associated Infrastructure	0	1
Physical Construction of Realigned Fire Road, New Site Access Road, and Internal Site Roads	0	1
Implementation of Fish Habitat Offsetting/Compensation Plan	0	0
Emissions and Wastes	2	0
Transportation	0	0
Employment and Expenditure	0	0
Operation		
Mining	0	1
Ore Processing	0	1
Mine Waste and Water Management	2	0
Linear Facilities Presence, Operation, and Maintenance	0	0
Emissions and Wastes	2	0
Transportation	0	0
Employment and Expenditure	0	0

Table 8.9.2 Potential Project Environmental Effects to Public Health and Safety

Project Activities and Physical Works	Potential Environmental Effects	
	Change in Public Health	Change in Public Safety
Decommissioning, Reclamation and Closure		
Decommissioning	0	1
Reclamation	0	1
Closure	0	0
Post-Closure	0	0
Emissions and Wastes	2	0
Transportation	0	0
Employment and Expenditure	0	0

Project-Related Environmental Effects
Notes:
Project-Related Environmental Effects were ranked as follows:
0 No substantive interaction. The environmental effects are rated not significant and are not considered further in this report.
1 Interaction will occur. However, based on past experience and professional judgment, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices and/or permit conditions.. The environmental effects are rated not significant and are not considered further in this report.
2 Interaction may, even with codified mitigation and/or permit conditions, result in a potentially significant environmental effect and/or is important to regulatory and/or public interest. Potential environmental effects are considered further and in more detail in the EIA.

8.9.3.1 Potential Interactions With a Change in Public Health

Public Health may be affected from direct (*e.g.*, inhalation) and indirect (*e.g.*, ingestion of fish or game) exposure to contaminants emitted from Project activities and physical works. Activities that are not expected to generate any (or negligible) amounts of emissions from any component of the Project during any phase of the Project are not expected to interact with a Change in Public Health. The interactions between these activities and a Change in Public Health are ranked as 0 in Table 8.9.2 and include most Project activities associated with the three phases of Construction, Operation, and Decommissioning, Reclamation and Closure. Consistent with the Atmospheric Environment (Section 8.2), all Project activities that generate emissions were assessed under the activity identified as “Emissions and Wastes” for each phase so as to encompass all Project activities that generate air emissions under a single activity during each Project phase.

The interaction between Emissions and Wastes and a Change in Public Health has been ranked as 2 in Table 8.9.2 during each of the three phases of Construction, Operation, and Decommissioning, Reclamation and Closure. Project-related emissions of air contaminants during both the Construction and Operation phases may interact with a Change in Public Health by causing elevated health risks via the inhalation pathway from ground-level concentrations of contaminants. Thus, the interactions between Emissions and Wastes and a Change in Public Health during Construction and Operation have been ranked as 2 in Table 8.9.2 and are evaluated further below.

The interaction between Mine Waste and Water Management during Operation and a Change in Public Health has been ranked as 2 in Table 8.9.2. Mine Waste and Water Management includes the management seepage and surplus water from the TSF during Operation. This is further evaluated below. Note that during Construction, there is no mining activity and thus no seepage or surplus water from the TSF. During Decommissioning, Reclamation and Closure, there is no active generation of mine waste and hence no Mine Waste and Water Management activity. Seepage from the TSF treatment of wastewater from the pit lake and ongoing seepage from the TSF during Decommissioning, Reclamation and Closure is considered under the activity Emissions and Wastes, discussed below.

During the Decommissioning, Reclamation and Closure phase, Project-related activities should require less use of heavy mobile equipment than Construction and there will be no emissions from blasting during this phase. Though the Decommissioning, Reclamation and Closure phase will release air contaminants in quantities that are likely similar to or less than those associated with Construction (Section 8.2), the release of seepage from the TSF throughout this phase as well as treated wastewater from the lake formed by the former open pit during Post-Closure may result in elevated concentrations of trace metals in receiving waters. Thus, Emissions and Wastes associated with Decommissioning, Reclamation and Closure are ranked as 2 in Table 8.9.2 and require further evaluation.

Thus, in consideration of the nature of the interactions and the planned implementation of known and proven mitigation, the potential environmental effects of all Project activities and physical works that were ranked as 0 or 1 in Table 8.9.2, including cumulative environmental effects, on a Change in Public Health during any phase of the Project are rated not significant with a high level of confidence, and are not considered further in the assessment.

8.9.3.2 Potential Interactions With a Change in Public Safety

The Project will not interact with a Change in Public Safety in any substantive way during Construction, Operation, or Decommissioning, Reclamation and Closure of the Project. There may be some limited interactions during each of the Project phases, but all interactions are ranked as 0 or 1 in Table 8.9.2 as the interaction would not be significant. These interactions and associated environmental effects on a Change in Public Safety will be mitigated by compliance with health and safety legislation, use of best practices for the operation of a mine (*e.g.,* to minimize fly rock and other hazards), and safety by design. Public access to the Project site will be limited by an entrance gate and the presence of security personnel, and an appropriate exclusion zone to act as a safety buffer surrounding the site. Traffic-related safety issues are addressed separately under Section 8.15 (Transportation) and Section 8.17 (Accidents, Malfunctions and Unplanned Events), and are thus not addressed as part of Public Health and Safety.

Safety risks to workers will be reduced by complying with the requirements of various governing standards including the *Canada Labour Code*, the *Transportation of Dangerous Goods Act* and Regulations, the New Brunswick *Employment Standards Act*, and the New Brunswick *Occupational Health and Safety Act* and Regulations. The Project will necessarily need to comply with these and other legislation to protect the safety of Project employees and contractors in order to remain in compliance. Other than for Accidents, Malfunctions and Unplanned Events (which are assessed in Section 8.17), there is no mechanism by which the Project would directly endanger the safety of the public at large. Adherence to public safety codes and regulations, including the National Building Code, Canadian Dam Association guidelines, and Canadian Standards Association codes and standards, among others, will help ensure that the Project is carried out in a safe manner to protect workers and the public at large. With the application of, and compliance with, these Acts, regulations, and standards, including the application of safety and measures to restrict access that are known to effectively mitigate the predicted environmental effects, the potential interactions of all Project activities and physical works associated with the Project as planned with a Change in Public Safety are ranked as either 0 or 1 in Table 8.9.2, and are not substantive. Should a serious risk to a Change in Public Safety arise from Project activities, this would be considered an accident, malfunction or unplanned event. The environmental effects of Project-related Accidents, Malfunctions and Unplanned Events are assessed in Section 8.17 of this EIA Report.

Thus, the potential environmental effects of all Project works and physical activities that were ranked as 0 or 1 in Table 8.9.2 on a Change in Public Safety during all phases of the Project as planned, including cumulative environmental effects, are rated not significant, with a high level of confidence. A Change in Public Safety is thus not considered further in this assessment. The potential for Project-related accidents, malfunctions or unplanned events to cause a Change in Public Safety are addressed in Section 8.17, and traffic-related safety concerns are addressed in Section 8.15 (Transportation).

8.9.4 Assessment of Project-Related Environmental Effects

A summary of the environmental effects assessment and prediction of residual environmental effects resulting from interactions ranked as 2 on Public Health and Safety is provided in Table 8.9.3.

Table 8.9.3 Summary of Residual Project-Related Environmental Effects on Public Health and Safety

Potential Residual Project-Related Environmental Effects	Project Phases, Activities, and Physical Works	Mitigation / Compensation Measures	Residual Environmental Effects Characteristics						Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects?	Recommended Follow-up or Monitoring
			Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/ Socioeconomic Context					
Change in Public Health	Construction • Emissions and Wastes.	• All mitigation measures noted in Section 8.2 to reduce air contaminant emissions. • All mitigation measures noted in Sections 8.4 and 8.5 to reduce metal loading to streams.	A	L	L	MT/ C	R	U	N	H	--	Y	All surface water quality monitoring recommended in Section 8.4.
	Operation • Mine Waste and Water Management. • Emissions and Wastes.	• All mitigation measures noted in Section 8.2 to reduce air contaminant emissions. • All mitigation measures noted in Sections 8.4 and 8.5 to reduce metal loading to streams.	A	M	L	LT/C	I	U	N	M	--	Y	Surface water quality monitoring (metals) recommended as noted in Section 8.4 and fish tissue studies (metals) as noted in Section 8.5. As discussed in Section 8.13, though the EIA confidently predicted no significant environmental effects to traditional foods, SML will monitor potential environmental effects at 2 to 3 traditional use sites identified by First Nations for harvesting of country foods (*e.g.,* fiddleheads, berries, medicinal plants). This will be carried out prior to Construction, and again within 5 years of the start of Operation.
	Decommissioning, Reclamation and Closure • Emissions and Wastes.	• All mitigation measures noted in Sections 8.4 and 8.5 to reduce metal loading to streams.	A	M	L	LT/C	I	U	N	M	--	Y	All surface water quality monitoring (metals) recommended as noted in Section 8.4 and fish tissue studies (metals) as noted in Section 8.5.

Table 8.9.3 Summary of Residual Project-Related Environmental Effects on Public Health and Safety

Potential Residual Project-Related Environmental Effects	Project Phases, Activities, and Physical Works	Mitigation / Compensation Measures	Residual Environmental Effects Characteristics: Direction	Magnitude	Geographic Extent	Duration and Frequency	Reversibility	Ecological/ Socioeconomic Context	Significance	Prediction Confidence	Likelihood	Cumulative Environmental Effects?	Recommended Follow-up or Monitoring
	Residual Environmental Effects for all Phases								N	M	--	Y	

KEY

Direction
- P Positive.
- A Adverse.

Magnitude
- N Negligible: Project-related environmental exposures are below the benchmarks established by a recognized health organization (*i.e.,* HQ<0.2; CR< 1.0; ILCR<1E-05) and/or do not affect the public health status.
- L Low: Project-related environmental exposures are approaching the benchmarks established by a recognized health organization (*i.e.,* 0.2<HQ≤2.0; 1.0<CR≤2.0; 1E-05<ILCR≤1E-04) and/or are unlikely to substantially change the public health status.
- M Medium: Project-related environmental exposures are predicted to exceed the benchmarks established by a recognized health organization (*i.e.,* 2.0<HQ≤10.0; 2.0<CR≤10.0; 1E-04<ILCR≤1E-03) and/or are may result in a long-term, substantive change in the public health status.
- H High: Project-related environmental exposures are predicted to substantially exceed the benchmarks established by a recognized health organization (*i.e.,* HQ>10.0; CR>10.0; ILCR>1E-03) and/or are likely to result in a long-term, substantive change in the public health status.

Geographic Extent
- S Site-specific: Within the PDA.
- L Local: Within the LAA.
- R Regional: Within the RAA.

Duration
- ST Short-term: Occurs and lasts for short periods (*e.g.,* days/weeks).
- MT Medium-term: Occurs and lasts for extended periods of time (*e.g.,* years).
- LT Long-term: Occurs during Construction and/or Operation and lasts for the life of Project.
- P Permanent: Occurs during Construction and Operation and beyond.

Frequency
- O Occurs once.
- S Occurs sporadically at irregular intervals.
- R Occurs on a regular basis and at regular intervals.
- C Continuous.

Reversibility
- R Reversible.
- I Irreversible.

Ecological/Socioeconomic Context
- U Undisturbed: Area relatively or not adversely affected by human activity.
- D Developed: Area has been substantially previously disturbed by human development or human development is still present.
- N/A Not Applicable.

Significance
- S Significant.
- N Not Significant.

Prediction Confidence

Confidence in the significance prediction, based on scientific information and statistical analysis, professional judgment and known effectiveness of mitigation:
- L Low level of confidence.
- M Moderate level of confidence.
- H High level of confidence.

Likelihood

If a significant environmental effect is predicted, the likelihood of that significant environmental effect occurring, based on professional judgment:
- L Low probability of occurrence.
- M Medium probability of occurrence.
- H High probability of occurrence.

Cumulative Environmental Effects?
- Y Potential for environmental effect to interact with the environmental effects of other past, present or foreseeable projects or activities in RAA.
- N Environmental effect will not or is not likely to interact with the environmental effects of other past, present or foreseeable projects or activities in RAA.

8.9.4.1 Potential Project Environmental Effects Mechanisms

The interaction between Emissions and Wastes and a Change in Public Health has been ranked as 2 in Table 8.9.2 for all three phases of Construction, Operation, and Decommissioning, Reclamation and Closure. Emissions of air contaminants during Construction and Operation may result from various activities as described in Section 8.2.4.1, and have the potential to directly influence the air quality. Air contaminant emissions may also result in dustfall, whereby some of the contaminants will deposit onto the ground and may move through the environment, potentially increasing concentrations in the soil, plants, and wild game, as described in the HHERA (Section 7.7). Seepage from the TSF during the Decommissioning, Reclamation and Closure phase, and treated water release from the pit lake during Post-Closure, are also included in Emissions and Wastes.

The interaction between Mine Waste and Water Management during Operation and a Change in Public Health has been ranked as 2 in Table 8.9.2. During Operation, the storage of water, tailings and waste rock within the TSF will create a potential source of metals enrichment for water contained in the tailings voids (and perhaps in the water in the supernatant pond) that may result in seepage of metal enriched water through the TSF embankments, migrating through groundwater towards the local streams. Perimeter engineered drainage collection channels at the toe of the TSF embankments, and lined water management ponds, will collect most of this seepage; however, some seepage will escape to the receiving environment, potentially affecting the stream water quality. Changes in stream water quality may also result in changes in fish tissue quality. Additionally, mine contact water from the Project site will be collected in the TSF and will be re-used as process water such that no release of water from the TSF is required for the first seven years of Operation. However, starting at about Year 8 of Operation, water in the TSF will be in a surplus condition and will be treated as necessary to meet discharge standards and subsequently released to the receiving environment via the former Sisson Brook. This release will continue throughout the Operation phase, but will cease at Closure as any surplus water is directed to the former open pit to form a lake. Any surplus water needing to be released during Operation will be treated at an on-site treatment plant to meet the applicable standards (including those of the *Metal Mining Effluent Regulations* (*MMER*) and as may be contained in provincial Certificates of Approval), and released in a controlled manner with appropriate monitoring and within permitted limits. Even though the treated water will meet discharge standards (necessarily to remain in compliance with environmental legislation and permit requirements), it has the potential to affect water quality in the receiving environment, and subsequently the quality of the fish in the receiving environment.

During Decommissioning, Reclamation and Closure, seepage of metal enriched water from the TSF is expected to continue. This activity is addressed under the Emissions and Wastes activity during this phase. During Closure, there will be no release of water to the receiving environment from either the open pit or the TSF, as surplus water from the TSF will be directed to the open pit so as to fill it to form a lake. Once the pit is full, Post-Closure begins and surplus pit lake water will be treated as long necessary to meet discharge permit requirements prior to release to the former Sisson Brook channel. Even though the treated water will necessarily meet discharge permit requirements, it has the potential to affect the stream water quality in the receiving environment and subsequently the fish tissue quality.

8.9.4.2 Mitigation of Project Environmental Effects

A number of mitigation measures, through careful design and planning, will reduce the environmental effects of the Project on Public Health and Safety resulting from the environmental effects mechanisms described above. These mitigation measures include those that reduce air contaminant emissions and those that reduce potential metal loadings to the streams.

Mitigation measures as described in Section 8.2.4.2 will be employed to reduce air contaminant emissions during Construction and Operation and to reduce people's exposure to the Project-related air emissions. These include the implementation of an idling reduction policy, the application of water sprays on the site access road and internal site roads in the PDA, the use of dust collection systems on the primary crusher and within the ore processing plant, and the use of scrubbers on the APT plant, among others.

Additionally, mitigation measures as described in Sections 8.4.4.2 and 8.5.4.2 will be employed to reduce metal loadings to the streams, including collection and treatment of surplus mine contact water before discharge to the environment, construction of engineered drainage channels to collect TSF embankment run-off and seepage, flooding the open pit during Closure to minimize the potential for metal leaching and acid rock drainage (ML/ARD) from the pit walls, and provision of water treatment to meet discharge permit requirements post-Closure.

8.9.4.3 Characterization of Residual Project Environmental Effects

During the Construction, Operation, Decommissioning, Reclamation and Closure phases, potential environmental effects mechanisms that could result in a Change in Public Health, primarily include those activities that may result in a change in the air quality or a change in the water quality of the streams. Some of the contaminants will deposit onto the ground and may move through the environment, potentially increasing concentrations of metals in the soil, plants and wild game, while changes in water quality may increase concentrations of metals in fish. People may inhale the contaminants in air, they may ingest food (*i.e.*, wild game, vegetation, or fish), they may drink water from the streams, and/or they may come into contact with the soil.

As discussed in Section 7.7, the potential for a significant adverse environmental effect on a Change in Public Health is determined by the standard risk assessment paradigm that depends on:

- the toxicity of the contaminant;
- the amount (or dose) of the contaminant to which the person is exposed, and
- the duration of the exposure.

A Change in Public Health could result from short-term exposure or long-term exposure to the contaminant. The type of Change in Public Health associated with exposure to a contaminant is dependent on the specific toxicological properties of that contaminant.

The HHERA (Section 7.7) derived health risk estimates (*i.e.*, CR, HQ, and ILCR) associated with Project-related air contaminant emissions and potential discharges to the streams. The CR and HQ indicate the magnitude of the risk as a proportion of a tolerable concentration or exposure dose, while the ILCR indicates the magnitude of the incidental increase in the cancer rate. When Project-related predicted health risks are less than the benchmark (*i.e.*, CR<1.0, HQ<0.2, ILCR<1E-05), the potential for an adverse Change in Public Health from the Project is considered negligible. Conversely, if predicted human health risks are higher than the benchmark, it does not necessarily indicate a health problem, but rather triggers a review in more depth (Health Canada 2010c; Alberta Health and Wellness 2011). Benchmarks for negligible health risk provided by regulatory agencies were originally adopted to address contaminated sites, where concentrations in the exposure media can be determined through direct sampling and analysis.

The use of multiple conservative modelling approaches and reasonable maximum exposure scenarios means that a non-negligible health risk does not necessarily indicate that adverse changes in public health are occurring or will occur, but is helpful for understanding the potential risks for the purposes of the conservatively-based EIA process. The magnitude of the health risk estimates above the benchmarks is therefore a qualitative measure of the potential for an adverse Change in Public Health to occur. This approach is similar to the approaches adopted by regulatory agencies such as the USEPA (1989) and Cal EPA (2004). Table 8.9.3 summarizes these qualitative measures with respect to the magnitude of the potential for a Change in Public Health.

The environmental effects on a Change in Public Health from short-term exposures are generally considered to be reversible. For short-term exposures, people may experience a Change in Public Health (*e.g.*, eye irritation) for the duration of the exposure; but once the exposure has ended, the environmental effect will be reversed (*e.g.*, eyes are no longer irritated). The potential health risks from short-term exposure can be decreased by reducing the air contaminant concentrations or by limiting the potential exposure of people to contaminant air concentrations that are higher than the tolerable concentrations provided by regulatory agencies.

The environmental effects of health risks associated with long-term exposures, including cancer health risks, are considered to be generally irreversible. For example, for toddlers exposed to elevated levels of lead for an extended period (as evidenced by high blood lead levels), the literature suggests that the developmental neurotoxicity of lead is not reversible and persists after exposures cease and blood lead concentrations return to normal (Health Canada 2012c). Some health conditions, however, may be considered reversible if the exposure ceases (for example, in the case of asthma), but to be conservative, this EIA considers these environmental effects to be irreversible.

8.9.4.3.1 Health Risks via Inhalation

The dispersion of COPC in ambient air were modelled for Construction (CAC) and Operation (CAC and non-CAC) (Section 7.1), and the resulting ambient air concentrations were used as inputs to the HHERA to estimate potential health risks associated with short-term (1-hour and 24-hour) and long-term (annual average) inhalation exposures to contaminants released from the Project. The health risk estimates (*i.e.*, CR and ILCR) were used to evaluate the potential magnitude of the residual environmental effects associated with the Project. Health risks were initially estimated for the location of the maximum ground-level concentrations (GLCs).

The health risks related to exposures to the CAC for both short-term and long-term exposures are summarized in Table 7.7.22 (Section 7.7), while health risks related to exposures to non-CAC are summarized in Table 7.7.24 (Section 7.7). Although both the Construction and Operation phases were considered for the assessment, maximum contaminant ground-level concentrations in air during Operation were determined to be higher than those during Construction (Section 7.1) and hence the maximum health risks via inhalation are associated with the Operation phase. As noted in 8.9.3.1, air contaminant emissions during Decommissioning, Reclamation and Closure are expected to be less than those during either Construction or Operation.

For the Project + Baseline Case during Operation, the health risks associated with inhalation exposures were generally less than the benchmark of CR<1.0, with the exception of short term (1-hour or 24-hour) exposures for total particulate matter (PM), aluminum, arsenic, and manganese. However, the maximum GLC for these contaminants is located near the boundary of the quarry and TSF area, as indicated in Section 7.1. Given the low likelihood of a person being present at the same place within the PDA and at the same time of the occurrence of the maximum GLC, it is important to evaluate the risks related to exposures at the locations where people reside, and more generally within the LAA, to evaluate the likelihood of exposure. The CR values associated with the maximum predicted concentrations for PM, aluminum, arsenic, and manganese at the previously identified recreational campsites and nearest residences at Napadogan (Section 7.1, Section 7.7), as well as at each of the HHERA receptor locations, were reviewed (Table 7.7.23 and Table 7.7.25, Section 7.7). The results indicate that the concentrations of all COPCs at the recreational campsites, nearest residences, and HHERA receptor locations are less than the benchmark (*i.e.*, CR<1.0).

For lifetime inhalation exposures, Health Canada (2010b) identified potential carcinogenic endpoints for only three of the metals (arsenic, chromium, and nickel). The LCR associated with the Project + Baseline Case for each of these contaminants is summarized in Table 7.7.30 (Section 7.7). The LCR values ranged from 1.7E-06 to 1.6E-05; however, there is no benchmark for LCR values. The Incremental Lifetime Cancer Risks (ILCRs) from the Project Alone are also provided in Table 7.7.30 (Section 7.7). Each of the ILCR values is less than the benchmark (*i.e.*, ILCR <1E-05).

8.9.4.3.2 Health Risks via Ingestion of Soil and Dermal Contact with Soil

Deposition modeling results from the dispersion and deposition model (Section 7.1) were used to assess the potential for dustfall from Project activities to change the soil quality. The total amount of deposition from the model during Operation (*i.e.*, phase during which deposition of metal-enriched particulates onto soil would be highest) were added to the baseline soil concentrations to predict future soil concentrations (Section 7.7). These maximum soil concentrations were then assumed to remain constant throughout a typical human lifetime (*i.e.*, 80 years). The potential health risks were determined for toddlers and adults who may be exposed to soil within the LAA through incidental ingestion of soil, direct dermal contact with soil, and inhalation of dust from soil.

The maximum health risks for the toddler (*i.e.*, the more sensitive life stage for non-carcinogens) are summarized in Table 7.7.27 (Section 7.7), while carcinogenic risks associated with a lifetime of exposure to the predicted soil concentrations are summarized in Table 7.7.28 (Section 7.7). The maximum health risks are all less than the benchmarks (*i.e.*, CR<0.2 and ILCR<1E-05). Based on these results, the health risks associated with the predicted concentrations in soil during Operation meet the relevant benchmark.

8.9.4.3.3 Health Risks via Ingestion of Food

The HHERA estimated the potential health risks for toddlers and adults who may obtain their food (*e.g.,* game, fish, and vegetation) within the LAA. Predicted soil concentrations were used to estimate the potential change in metal concentrations in game and vegetation associated with Project activities, while the results of the maximum average annual concentrations of contaminants in surface water during Operation and Decommissioning, Reclamation and Closure as predicted by the water quality modeling (Section 7.6) were used to estimate the potential change in fish tissue concentrations associated with the Project, as described in Section 7.7.

The maximum health risks for the toddler (*i.e*., the more sensitive life stage for non-carcinogens) are summarized in Table 7.7.31 (Section 7.7), while carcinogenic risks associated with a lifetime of exposure are summarized in Table 7.7.33 (Section 7.7). The maximum health risks for a toddler are less than the benchmark (*i.e*., HQ<0.2), with the exception of boron, chromium, cobalt, lead, manganese, methyl mercury, and thallium. However, the health risks associated with chromium, lead, manganese, and methyl mercury did not increase substantially relative to the health risks associated with the existing conditions (*i.e*., Baseline Case), as indicated by a change in health risk that is less than 10% relative to existing (Baseline) conditions.

Review of the health risks associated with boron, cobalt, and thallium (Table 7.7.32, Section 7.7) indicate that the change in health risks associated with the Project is associated with fish consumption. As discussed in detail in the HHERA (Section 7.7), there is a high degree of conservatism in these health risk predictions, including the conservative assumptions in the water quality modeling, in the modeling of fish tissue concentrations from surface water concentrations, and in the assumed annual fish consumption rates from the LAA.

Boron was not detected in existing fish carcass, which is consistent with observations by Allen *et al.* (2001), and predicted surface water concentrations of boron are similar to average surface water concentrations in the United States (ATSDR 2010). These results suggest that predicted fish tissue concentrations in boron may be highly conservative. Changes in health risks associated with Project-related environmental effects are less than 0.2 (value used by Health Canada (2010a) for cases where background exposures already exceed the screening level). Predicted fish tissue concentrations for thallium were compared to published fish tissue concentrations obtained from reference locations or natural areas (Gutleb *et al.* 2002; and Lin *et al.* 2001) and were found to be similar (Section 7.7), indicating that predicted Project-related environmental effects are within range of natural variability.

The maximum incremental cancer risk associated with a lifetime exposure of arsenic in food is higher than the benchmark (*i.e.,* ILCR>1E-05, with the change in cancer risk associated almost entirely with fish consumption (Table 7.7.34, Section 7.7). However, similar to other metals in fish, there is a high degree of conservatism in the arsenic health risk predictions. Baseline concentrations of arsenic in fish from the LAA are generally higher than the concentrations in fish obtained from reference locations or natural areas (Gutleb *et al.* 2002; Hinck *et al.* 2009; and Schmitt 2004). However, as discussed in the HHERA (Section 7.7), there is considerable information available regarding health risks associated with arsenic in fish tissues, including published fish tissue guidelines (CFIA 2007). Both baseline and predicted future fish tissue concentrations are less than the published Canadian fish tissue guideline for arsenic.

As the Project is not expected to substantially affect the quality of game or vegetation in the LAA, there is a high degree of conservatism in the health risk estimates for fish consumption, and the HHERA indicates a low to moderate magnitude of the estimates health risks, the Project-related environmental effects on food are not likely to result in a long-term, substantive Change in Public Health.

8.9.4.3.4 Health Risks via Ingestion of Water

Although the streams in the LAA have not been identified as a potable water supply, the HHERA considered the possibility that people using the area (*e.g.*, for recreation, hunting, fishing) may drink water from the streams on occasion. Using the modelled water quality results (Section 7.6), the maximum health risks for the toddler (based on the highest annual average concentration from Operation and Decommissioning, Reclamation and Closure) are summarized in Table 7.7.29 (Section 7.7), while carcinogenic risks associated with a lifetime of exposure to the predicted water concentrations are summarized in Table 7.7.30 (Section 7.7). With the exception of the ingestion of arsenic in surface water, the maximum health risks are all less than the benchmarks (*i.e.*, CR<0.2 and ILCR<1E-05). However, as reported in Section 7.7.3.4.3.4, the maximum ILCRs associated with ingestion of arsenic in surface water at the HHERA receptor locations was greater than the benchmark of 1 in 100,000 (*i.e.*, ILCR<1E-05) for the Project Alone Case and the Project + Baseline Case. Based on these results, the predicted increases in COPC concentrations in surface water represent a non-negligible health risk to those who may occasionally drink from the streams while in the LAA. The calculated ILCR is based on model predictions that annual average arsenic concentrations in surface water will increase from 0.00069 mg/L to 0.00455 mg/L. These annual average arsenic concentrations for the Project + Baseline case meet the Canadian Drinking Water Quality Guideline of 0.010 mg/L (Health Canada 2012); however, the estimated lifetime cancer risk associated with the ingestion of drinking water containing arsenic at 0.010 mg/L is greater than the risk level that is considered by Health Canada to be “essentially negligible”.

As discussed in Section 7.7.3.4.3.4, the oral slope factor of 1.8 (mg/kg-day)$^{-1}$ used in this assessment was derived by Health Canada based in the incidence of internal (lung, bladder, and liver) cancers in a population in southwestern Taiwan exposed to arsenic levels ranging from 0.35 to 1.14 mg/L of arsenic in their drinking water (Health Canada 2006). Health Canada (2006) acknowledged that the extrapolation method used to estimate the risks of internal organ cancers from exposure to low levels of arsenic, as well as confounding factors (*e.g.*, genetic differences, differences in health status, arsenic metabolism, and nutritional status of the southwestern Taiwanese study population), may lead to an overestimate of the risks of internal organ cancers.

Although water from small spring-fed tributaries to Napadogan Brook was observed to be used at recreational campsites, the Napadogan Brook is not a known to be a regular source of drinking water. Therefore, potential exposures to the water are expected to be intermittent, and the assumption that water from the brook would be the sole source of water to a person for two days a week for 80 years overstates the risk. The maximum predicted annual average concentration of arsenic in Napadogan Brook of 0.00455 mg/L is very unlikely to result in health effects since:

- Napadogan Brook is not used as a regular supply of potable water;
- the predicted concentration meets the Canadian Drinking Water Quality Guideline for arsenic of 0.010 mg/L; and

- recent epidemiological studies have not found an association between cancer risks and arsenic in drinking water at concentrations less than 0.010 mg/L.

Overall, and based on these results, the health risks associated with occasional drinking of surface water while in the LAA meet the relevant benchmark, except for arsenic, which is unlikely to result in substantive adverse health effects. Monitoring of surface water quality downstream of the PDA during Operation will provide information to confirm these predictions, or to trigger adaptive management measures to address unacceptable concentrations of arsenic, should they occur.

8.9.4.3.5 Summary

Overall, the Project activities are not expected to result in short-term exposures above the health-based ambient air quality guidelines established by regulatory agencies at the recreational campsites, nearest residences in Napadogan, or the HHERA receptor locations. As well, the Project is not expected to affect the health risks for long-term inhalation exposures, exposure to soil, or ingestion of water. Project-related activities have the potential to affect the health risks for consumption of food. Specifically, the health risks associated with predicted future concentrations of arsenic, boron, cobalt and thallium in fish associated Project activities are higher than the benchmarks and more than 10% higher than the calculated health risks for the existing conditions. However, given the degree of conservatism, the similarity of predicted fish tissue concentrations to concentrations in fish from other areas of Canada and North America obtained from reference locations or natural areas and compliance with Canadian fish tissue guidelines, and the low to moderate level of risk, a long-term change in health is not expected.

8.9.5 Assessment of Cumulative Environmental Effects

In addition to the Project environmental effects discussed above, an assessment of the potential cumulative environmental effects was conducted for other projects or activities that have been or will be carried out which have potential to cause environmental effects that overlap with those of the Project, as identified in Table 8.9.3. Table 8.9.4 below presents the potential cumulative environmental effects to Public Health and Safety, and ranks each interaction of the environmental effects of the Project in combination with other projects or activities as 0, 1, or 2 with respect to the nature and degree to which important Project-related environmental effects overlap with those of other projects or activities.

Table 8.9.4 Potential Cumulative Environmental Effects to Public Health and Safety

Other Projects or Activities With Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects	
	Change in Public Health	Change in Public Safety
Past or Present Projects or Activities That Have Been Carried Out		
Industrial Land Use (Past or Present)	0	0
Forestry and Agricultural Land Use (Past or Present)	0	0
Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons (Past or Present)	0	0
Recreational Land Use (Past or Present)	0	0
Residential Land Use (Past or Present)	0	0
Future Projects or Activities That Will Be Carried Out		
Industrial Land Use (Future)	1	0
Forestry and Agricultural Land Use (Future)	1	0
Current Use of Land and Resources for Traditional	0	0

Table 8.9.4 Potential Cumulative Environmental Effects to Public Health and Safety

Other Projects or Activities With Potential for Cumulative Environmental Effects	Potential Cumulative Environmental Effects	
	Change in Public Health	Change in Public Safety
Purposes by Aboriginal Persons (Future)		
Recreational Land Use (Future)	0	0
Planned Residential Development (Future)	1	0
Cumulative Environmental Effects		

Notes:
Cumulative environmental effects were ranked as follows:
0 Project environmental effects do not act cumulatively with those of other Projects and Activities.
1 Project environmental effects act cumulatively with those of other Project and Activities, but are unlikely to result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects but will not measurably change the state of the VEC.
2 Project environmental effects act cumulatively with those of other project and activities, and may result in significant cumulative environmental effects OR Project environmental effects act cumulatively with existing significant levels of cumulative environmental effects and may measurably change the state of the VEC.

For a Change in Public Safety, there are no other past, present or reasonably foreseeable projects or activities for which the environmental effects would be expected to overlap those of the Project, and as such the interactions of the Project in combination with all past, present or future projects or activities that have been or will be carried out on a Change in Public Safety have all been ranked as 0 in Table 8.9.4. Therefore, the cumulative environmental effects of the Project in combination with other projects or activities that have been or will be carried out on a Change in Public Safety during all phases are rated not significant and are not discussed further.

There are no other past or present projects or activities that have been carried out for which the environmental effects would be expected to overlap those of the Project on a Change in Public Health. For a cumulative environmental effect to occur, the environmental effects of the Project must overlap those of other projects or activities both spatially and temporally. There is no overlap of the environmental effects of the Project with those of past or present Industrial Land Use, past or present Forestry and Agricultural Land Use, past or present Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, past or present Recreational Land Use, or past or present Residential Land Use identified within the RAA that will interact with a Change in Public Health in a substantive way. Thus, the interaction between the Project and those other past or present projects or activities that have been carried out has been ranked as 0 in Table 8.9.4 for all activities and their cumulative environmental effects in combination with those of the Project are rated not significant.

Future Industrial Land Use, future Forestry and Agricultural Land Use, and future Residential Land Use were identified as having some potential for cumulative environmental effects to occur in combination with the Project, and were ranked as 1 in Table 8.9.4. These activities may release combustion gases or cause fugitive dust emissions which could be inhaled by the public. However, given that background levels are already low as demonstrated by the ambient air monitoring conducted (Section 8.2.2), these activities on their own or in combination with the Project would not cause a long-term concern with respect to air quality in this rural area (Section 8.2.4). They would also not be expected to cause a substantive change to the quality of surface water or groundwater beyond the existing background levels. As such, these other future projects or activities are unlikely to result in significant cumulative environmental effects to a Change in Public Health.

8.9.6 Determination of Significance

8.9.6.1 Residual Project Environmental Effects

To characterize the environmental effects of the Project on a Change in Public Health, the potential health risks associated with the Project activities were assessed for both short-term exposures and long-term exposures. Health risk estimates for short-term exposures at the recreational campsites, nearest residences in Napadogan, and HHERA receptor locations meet the appropriate benchmarks. The Project is not expected to affect the health risks for long-term inhalation exposures, exposure to soil, or ingestion of water. Project-related activities have the potential to affect the health risks for consumption of fish for some metals; however, given the degree of conservatism and the low to moderate level of risk, a long-term change in health status is not expected.

The Project will not cause significant environmental effects to a Change in Public Safety. Public access to the site will be limited by an entrance gate and the presence of security personnel. The safety risks to workers will be mitigated by complying with the requirements of various governing standards and regulations. As a result, the Project will not directly or substantially endanger the safety of the public and/or Project employees.

With the proposed mitigation and environmental protection measures, the residual environmental effects of the Project on a Change in Public Health or a Change in Public Safety during all phases of the Project are rated not significant. This conclusion has been made with a moderate level of confidence, in view of some of the uncertainties associated with the water quality predictions and the inherent conservatism in the water quality, air quality, and HHERA modelling predictions.

8.9.6.2 Residual Cumulative Environmental Effects

The characterization of the potential cumulative environmental effects and associated mechanisms, combined with the proposed mitigation measures, demonstrates that there will be very limited overlap between the environmental effects of the Project and those of other projects or activities that have been or will be carried out. As such, the residual cumulative environmental effects of the Project on a Change in Public Health or a Change in Public Health and Safety during all phases of the Project are rated not significant. This determination has been made with a high level of confidence.

8.9.7 Follow-up or Monitoring

As noted in Table 8.9.4, there is no specific follow-up or monitoring required to verify the environmental effects predictions or the effectiveness of mitigation for Public Health and Safety. However, follow-up and/or monitoring programs as recommended for Water Resources (Section 8.4.6) and Aquatic Environment (Section 8.5.6) are also relevant for Public Health and Safety, and the results of these follow-up measures will be used to confirm the environmental effects predictions for Public Health and Safety in view of the modelling uncertainties and conservatisms discussed in this Section.

As was discussed in Section 8.4.6 (Water Resources) and Section 8.5.6 (Aquatic Environment) and as elaborated in Chapter 9, follow-up and/or monitoring programs will verify the potential changes in trace metal concentrations in fish tissue concentrations, as is predicted to occur due to the predicted changes in trace metal concentrations in water, as follows.

- Sample the surface water quality in McBean and Napadogan brooks to confirm the water quality in the receiving environments. Increasing trends in arsenic, boron, thallium, or zinc that approach the water quality predictions will result in a review of the fish tissue concentrations. Details of the water quality monitoring program are presented in Chapter 9.

- If surface water quality monitoring indicates that concentrations of arsenic, boron, thallium, or zinc are approaching the water quality predictions, fish tissue studies will be undertaken to confirm that the measured concentrations in fish tissues would not result in adverse environmental effects to people who consume fish. Details of the fish tissue studies are presented in Chapter 9.

Finally, as will be discussed in Section 8.13, though the EIA confidently predicted no significant environmental effects to traditional foods, SML will monitor potential environmental effects at 2 to 3 traditional use sites identified by First Nations for harvesting of country foods (*e.g.,* fiddleheads, berries, medicinal plants). This will be carried out prior to Construction, and again within 5 years of the start of Operation.