8.2 ATMOSPHERIC ENVIRONMENT

The Atmospheric Environment is a component of the environment that comprises the layer of air near the earth's surface to a height of approximately 10 km. The Atmospheric Environment has been selected as a valued environmental component (VEC) for this environmental impact assessment (EIA) because a healthy atmosphere helps sustain life and maintain the health and well-being of the biophysical environment. If not properly managed, releases of air contaminants (including greenhouse gases (GHGs)) to the atmosphere may cause adverse environmental effects on the air, the land and the waterways and on the interacting biological systems that depend on them, in the vicinity of the Project.

Changes to the Atmospheric Environment during Construction, Operation, and Decommissioning, Reclamation and Closure of the Project may occur due to emissions from the Project components during each phase, including emissions from heavy equipment used on-site, trucks used to deliver equipment and materials to the site, processing plant sources, fugitive emission sources, and passenger and heavy-duty vehicles. These sources generate emissions such as particulate matter, combustion gases, and greenhouse gases. Blasting, the movement of ore and rock, and wind erosion of exposed ground surfaces may also release particulate matter in the form of fugitive dust. Noise as an air contaminant is assessed separately in Section 8.3, Acoustic Environment.

The environmental effects assessment of the Atmospheric Environment is centered on a 25 km x 25 km area centred on the Project site. Within this Local Assessment Area (LAA, further defined later), there are recreational campsites (located approximately 1.5 km southeast of the location of the open pit for the Project) and permanent residences (located in Napadogan approximately 10 km to the northeast of the Project).

Existing (baseline) conditions for the Atmospheric Environment are based on published data from Environment Canada and the New Brunswick Department of Environment and Local Government (NBDELG), as well as on a Project-specific baseline air quality monitoring campaign conducted in the LAA (Stantec 2012b). The EIA considers an air contaminant and GHG emissions inventory developed for the Construction and Operation phases, as these phases are likely to generate the highest emissions of air contaminants and GHGs during the Project life. The environmental effects assessment relies on the emissions inventory and associated dispersion modelling of specific air contaminants, selected due to the magnitude of those emissions or because those contaminants are of ecological interest, for both Construction and Operation. Dispersion modelling provides predictions of ground-level concentrations and deposition of contaminants used to evaluate changes in the Atmospheric Environment. To evaluate the significance of these predicted changes, the results of the modelling are compared to objectives, guidelines and standards for the air contaminants of interest.

The dispersion modelling results show that during both Construction and Operation, ambient air quality standards and objectives are not expected to be exceeded at the nearest populated areas such as at the recreational campsites or at further distances such as within the community of Napadogan. The Project may cause the ambient concentrations of total particulate matter (PM) and particulate matter less than 10 microns (PM_{10}) to exceed ambient air quality objectives near the off-site access roads for the Project, as a result of road dust generation from Project-related traffic travelling on these unpaved roads. These off-site access roads are located in remote wooded areas where relatively few human receptors may be exposed to such dust, and any ambient concentrations in excess of those objectives are expected to be localized to within a few hundred metres of the roads, infrequent, and of short duration. Dusty conditions near the primary crusher for the Project during Operation may also cause the ambient 24-hour PM objective to be infrequently exceeded. Ambient hydrogen sulphide (H_2S) concentrations from the production of ammonium paratungstate (APT) may exceed the 10-minute odour threshold during Operation near the ore processing plant within the Project Development Area (PDA); however, the occurrence of these levels is limited to a small area within 20 m of the ore processing plant and is infrequent. No perceivable odour is anticipated beyond 20 m from the ore processing plant.

The estimated GHG emissions from Operation are considered to be low (less than 50,000 tonnes of carbon dioxide equivalent (CO_2e)) and similar in magnitude and GHG intensity to other metal mines in Canada.

Given these observations, as demonstrated by the analyses that follow, with the proposed mitigation and environmental protection measures, the residual environmental effects of a Change in Atmospheric Environment during all phases of the Project are not significant. Monitoring of fuel combustion volumes in Project-related stationary and mobile equipment is proposed to evaluate whether federal GHG reporting thresholds are reached. Monitoring programs for ambient air quality during Operation may be a requirement of the NBDELG-issued Certificate to Approval to Construct or to Operate.

8.2.1 Scope of Assessment

This section defines the scope of the EIA of the Atmospheric Environment in consideration of the nature of the regulatory setting, the issues identified during public and First Nations engagement activities, potential Project-VEC interactions, and existing knowledge.

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

The Atmospheric Environment is a component of the environment that comprises the layer of air near the earth's surface to a height of approximately 10 km. The Atmospheric Environment is a VEC because the atmosphere has an intrinsic or natural value, in that the atmosphere and its constituents help maintain the health and well-being of humans, wildlife, vegetation, and other biota. The atmosphere is a pathway for the transport, dispersion and deposition of air contaminants from source to receptor; if not properly managed, releases of air contaminants may cause adverse environmental effects on the air, the land, and the waterways and on the interacting biological systems that depend on them. Project-related emissions to the air may cause adverse environmental effects through the various transport, dispersion, deposition and transformation processes that occur in the atmosphere. Also, GHG emissions accumulate in the atmosphere and are thought to be a major factor in producing the greenhouse effect which influences climate.

Air quality in New Brunswick is regulated pursuant to the *Air Quality Regulation* under the *Clean Air Act*. Federally, the main instrument for managing air quality is the *Canadian Environmental Protection Act* (*CEPA*) as well as Canada-Wide Standards developed by the Canadian Council of Ministers of the Environment (CCME).

The Final Guidelines for the EIA of the Project (NBENV 2009) require that the existing environment for Atmospheric Environment describe climatic and ambient air quality data, and that the environmental assessment includes the environmental effects of the Construction, Operation/Maintenance and Decommissioning phases of the Project, including air quality, sound quality, odour and climate on a local and regional basis. Routine air contaminant emissions to be quantified include those from ore crushing, screening, stockpiles, vehicles and other transportation sources, road surfaces, and upset conditions including accidents and malfunctions. The potential environmental effects to climate change are also to be assessed. The Terms of Reference (Stantec 2012a) developed work plans to characterize and assess each of these aspects of the Atmospheric Environment in order to meet the Final Guideline requirements as well as the federal scope of the EIA under the *Canadian Environmental Assessment Act* (*CEAA*).

During engagement activities carried out for the Project, stakeholders raised concerns related to anticipated levels of dust that could arise from the Project, particularly from blasting as well as from routine process emissions. Concerns related to the potential for lead and arsenic in dust causing health problems were also noted, primarily during the public review of the Terms of Reference. Therefore, dust is a primary focus of the EIA. The human health and ecological risk assessment (HHERA) for the Project (Section 7.7) evaluates potential health risks associated with the Project, including dust. The assessment of environmental effects on human health is found in the Public Health and Safety VEC (Section 8.9).

The above requirements form the basis for the assessment of the potential environmental effects on Atmospheric Environment, as discussed in more detail in the following sections.

8.2.1.2 Selection of Environmental Effects and Measurable Parameters

The environmental assessment of the Atmospheric Environment focuses on the following environmental effect:

- Change in Atmospheric Environment.

A change in the atmospheric environment could include changes due to emissions of air contaminants including criteria air contaminants (CAC), non-criteria air contaminants (non-CAC), and greenhouse gases (GHG). Quantifying and characterizing any change in ambient air quality, greenhouse gas emissions, and odour arising from the Project is the main mechanism by which a Change in Atmospheric Environment is characterized and assessed.

Table 8.2.1 provides the measurable parameters used for the assessment of a Change in Atmospheric Environment and the rationale for their selection.

Table 8.2.1 Measurable Parameters for Atmospheric Environment

Environmental Effect	Measurable Parameter	Rationale for Selection of the Measurable Parameter
Change in Atmospheric Environment	Ground-level concentrations of Criteria Air Contaminants (CAC) and Non-Criteria Air Contaminants (non-CAC) ($\mu g/m^3$).	• Regulatory objectives, guidelines and/or standards exist provincially and/or federally for sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), total particulate matter (PM), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), ammonia (NH_3), hydrogen sulphide (H_2S), and others including specific trace metals and volatile organic compounds (VOCs).
	Ground-level concentrations of odourous compounds ($\mu g/m^3$).	• Odour-causing compounds may cause loss of enjoyment of property. Concentrations of odour compounds can be compared to odour thresholds.
	GHG emissions – carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) (in units of CO_2 equivalents per annum or CO_2e/a).	• Greenhouse gases are thought to be a major contributor to climate change worldwide, thus management of GHG emissions has become a concern for the general public, industry and government.
	GHG emissions intensity in units of tonnes CO_2e per tonne of product (t CO_2e/t product produced).	• To put the GHG emissions from the Project into context with respect to the industry profile as recommended in CEA Agency (2003) guidance.

These measurable parameters have a clear unit of measurement, and are central to the environmental effects assessment for the Atmospheric Environment. Input from regulatory agencies, stakeholders, and the professional judgement of the Study Team guided the selection of these parameters, based on knowledge of the regulatory frameworks governing air quality and GHG emissions as well as the results of field surveys conducted for the Project. The assessment of a Change in Atmospheric Environment requires knowledge of the constituents present in the atmosphere, both in magnitudes and as trends. Measured concentrations of air contaminants in the atmosphere at strategic locations for representative periods of time, and estimated emission rates from existing and Project related emission sources, supply this knowledge.

8.2.1.3 Temporal Boundaries

The temporal boundaries for the assessment of the potential environmental effects of the Project on the Atmospheric Environment 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 Atmospheric Environment include the year 2010, the latest year for which emissions and ambient air quality data has been published by the NBDELG, as well as the period of August 2011 to February 2012, during which Project-specific ambient air quality data was collected in the area near the Project.

8.2.1.4 Spatial Boundaries

The paragraphs below define the spatial boundaries for the environmental effects assessment of the Atmospheric Environment.

Project Development Area (PDA): The PDA 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 anticipated area within which Project-related environmental effects are expected. For the Atmospheric Environment, the LAA includes an area of 25 x 25 km centred on the PDA, and includes the PDA and any adjacent areas where Project-related environmental effects are expected. The LAA is shown in Figure 8.2.1.

Regional Assessment Area (RAA): The RAA for the Atmospheric Environment is limited to and includes the province of New Brunswick for air quality, and extends nationally and globally for greenhouse gases. 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. 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.

8.2.1.5 Administrative and Technical Boundaries

This section summarizes the administrative and technical boundaries used to assess the environmental effects of the Project on the Atmospheric Environment. The administrative and technical boundaries for the Atmospheric Environment pertain mainly to regulatory limits with respect to the release of air contaminants to the atmosphere and the presence of air contaminants in the ambient air. These standards and objectives are set by regulatory authorities to reflect environmental protection objectives for human and environmental health. As such, application of standards is an inherently conservative basis for environmental effects predictions.

Air quality in New Brunswick is regulated pursuant to the *Air Quality Regulation* under the *Clean Air Act*, administered by the NBDELG. The Regulation provides the requirements for facilities that are sources of air contaminants, regulated via the Certificate of Approval process. Schedules B and C of the Regulation provide the objectives for acceptable ambient air quality for Criteria Air Contaminants (CACs).

Federally, the main instrument for managing air quality is the *Canadian Environmental Protection Act* (*CEPA*) as well as Canada-Wide Standards developed under the CCME "Canada-Wide Accord on Environmental Harmonization" (CCME 2011). The standards include qualitative and quantitative standards, guidelines or objectives for protecting the environment and human health. A number of these exist to protect air quality, including ambient air quality objectives for particulate matter less than 2.5 microns ($PM_{2.5}$, also sometimes referred to as "respirable particulate matter") and ground-level ozone (O_3).

Predicted downwind ground-level concentrations (GLC) of air contaminants from the Project as determined from dispersion and deposition modelling are compared to applicable ambient air quality objectives, guidelines, and/or standards in New Brunswick (*Clean Air Act* and *Air Quality Regulation)*, as well as to Canada-Wide Standards (CWS), where they exist. The ambient objectives, guidelines and/or standards are developed by the regulatory agencies, including NBDELG and Environment Canada and others such as the Ontario Ministry of Environment (OMOE), to provide threshold values for assessing the extent of the potential environmental effects from a single emission source or a combination of emission sources within a particular airshed.

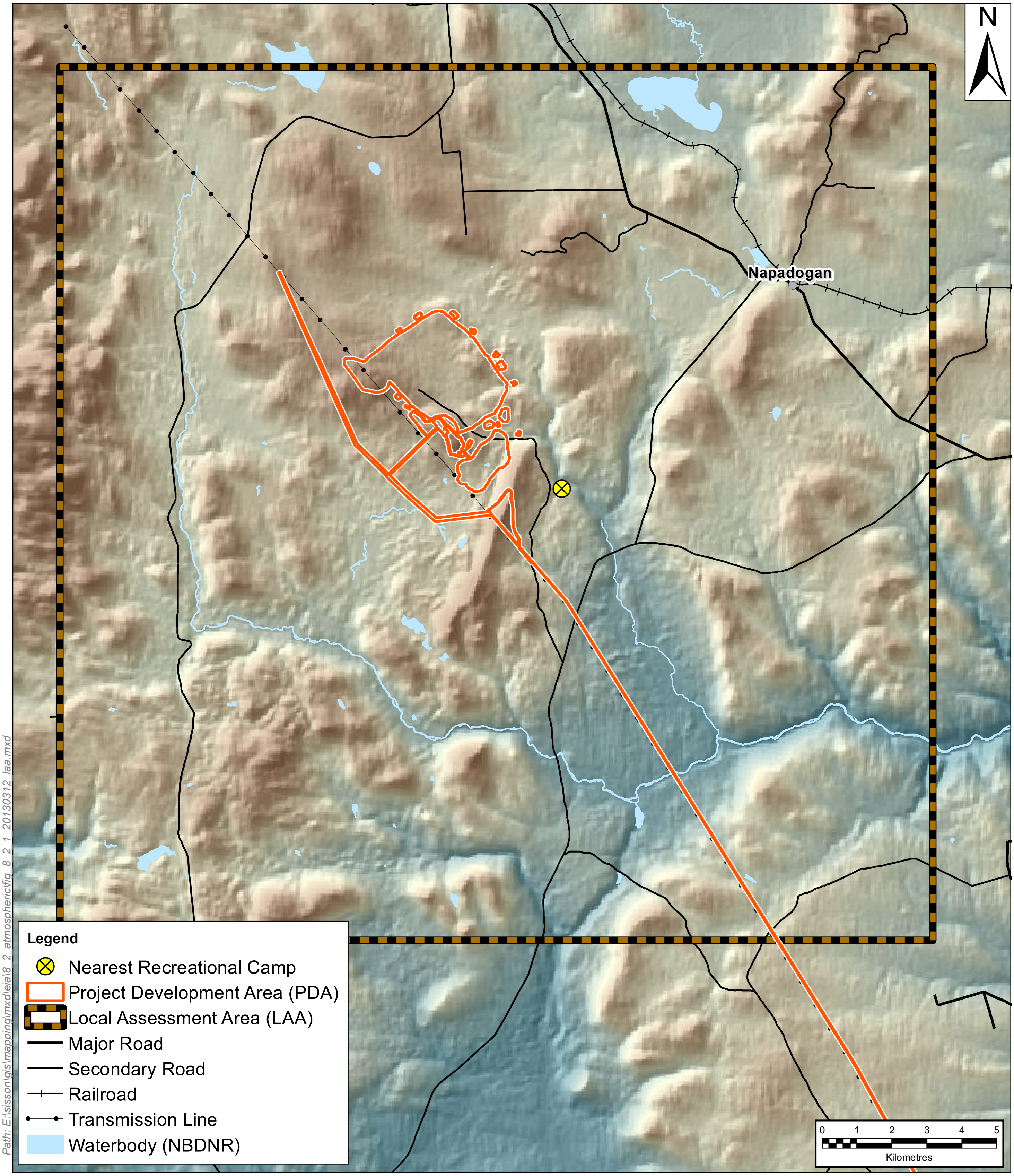
A summary of the ambient air quality objectives, guidelines and standards used in this EIA is presented in Table 8.2.2. These thresholds are a combination of the provincial and federal values from New Brunswick, Environment Canada, Ontario, and British Columbia. For some air contaminants, a threshold limit does not exist. These are, however, carried forward in the analysis and assessed as part of the HHERA.

Table 8.2.2 Summary of Ambient Air Quality Objectives, Standards, and Criteria

Compound[4]	Averaging Period	New Brunswick Maximum Permissible Ground-Level Concentration of Contaminant (µg/m³)*	Other Ambient Air Quality Objectives, Standards or Criteria (µg/m³)
Total Particulate Matter (PM)	24-hour Annual	120 70 (geometric mean)	-- --
Particulate Matter Less than 10 microns (PM_{10})	24-hour	--	50 [3]
Particulate Matter Less than 2.5 microns ($PM_{2.5}$)	24-hour	--	30 [1]
Sulphur Dioxide (SO_2)	1-hour 24-hour Annual	900 300 60	-- -- --
Nitrogen Oxides (NO_X) as Nitrogen Dioxide (NO_2)	1-hour 24-hour Annual	400 200 100	-- -- --
Hydrogen Sulphide (H_2S)	1-hour 24-hour	15 5	- -
Ammonia (NH_3)	24-hour	-	100 [2]
Decane	24-hour	--	60,000 [2]
Ethylbenzene	24-hour	--	1,000 [2]
Naphthalene	24-hour	--	22.5 [2]
Arsenic (As)	24-hour	--	0.3 [2]
Cadmium (Cd)	24-hour Annual	-- --	0.025 [2] 0.005 [2]
Chromium (Cr)	24-hour	--	0.5 [2]
Copper (Cu)	24-hour	--	50 [2]
Lead (Pb)	24-hour 30 days	-- --	0.5 [2] 0.2 [2]
Mercury (Hg)	24-hour	--	2 [2]
Molybdenum (Mo)	24-hour	--	120 [2]
Nickel (Ni)	24-hour Annual	-- --	0.2 [2] 0.04 [2]
Selenium (Se)	24-hour	--	10 [2]
Zinc (Zn)	24-hour	--	120 [2]

Notes:
-- No standard or objective available.

Source: * Schedule B, New Brunswick *Air Quality Regulation* 97-133 under the *Clean Air Act.*
1 CCME 2000, Canada-wide Standards for Particulate Matter (Based on 98th percentile of 3 year rolling average).
2 OMOE 2012, Ontario Ministry of Environment Ambient Air Quality Criteria.
3 BCMOE 2009, British Columbia Ministry of Environment Ambient Air Quality Objective for PM_{10}.
4 The VOCs selected for the assessment are based on the components of kerosene, which is expected to be released to the atmosphere from the APT Plant. As noted in the table above, the components include decane, ethylbenzene and naphthalene. The list of trace metals was selected based on species likely to be released from Project related sources in substantive quantities.



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 the Atmospheric Environment Sisson Project: Environmental Impact Assessment (EIA) Report, Napadogan, N.B.	Scale: 1:150,000	Project No.: 121810356	Data Sources: NBDNR	Fig. No.: 8.2.1
	Date: (dd/mm/yyyy) 12/03/2013	Dwn. By: JAB	Appd. By: DLM	
Client: Northcliff Resources Ltd.				

Stantec

Map: NAD83 CSRS NB Double Stereographic

Odourous compounds were identified by comparing published odour thresholds for the air contaminant list developed (Verschueren 1996; American Industrial Hygiene Association 1989; Amoore and Hautala 1983; Environment Canada 1984; van Gemert 2003; and Alberta Environment 2011). Table 8.2.3 provides the published odour thresholds used as a basis of comparison with the Project model outputs.

Table 8.2.3 Odour Thresholds

Contaminant	Odour Threshold*	
	ppm	µg/m^3
Decane	1.9	11,149
Ethylbenzene	0.07	289
Ammonia	3.3	2,312
Hydrogen sulphide	0.005	7.4
Naphthalene	0.01	50

Notes:
* Threshold concentrations are for a 10 minute averaging period. Odour threshold concentrations are derived from AIHA 1989, Amoore and Hautala 1983, Environment Canada 1984, van Gemert 2003, Verschueren 1996, OMOE 2008a, and Alberta Environment 2011.

Emissions of GHG are not currently regulated in New Brunswick; however, the Province published the "New Brunswick Climate Change Action Plan 2007-2012" (NBENV 2007) and is exploring mechanisms by which it could manage GHG emissions from substantive emission sources. Progress and summary reports are available from the NBDELG.

There are also no current federal regulations on GHG emissions applicable to the Project. The federal government released the latest version of *A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act* in May 2012 (Environment Canada 2012e). Canada officially withdrew its participation in the Kyoto Protocol in December 2011; however, the federal government committed to addressing climate change through a number of other initiatives, such as the October 2010 *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations*, proposed regulations for a GHG performance standard on new coal-fired electricity generation plants, and other initiatives. The federal government also announced proposed regulations for reduction of GHG emissions from new on-road heavy-duty vehicles in April 2012. No regulations specific to mining GHG emissions or off-road equipment have been announced.

With respect to federal guidance on assessing GHG emissions and climate change, the 2003 guidance of the Canadian Environmental Assessment Agency (CEA Agency) entitled "Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners" (CEA Agency 2003) is the most recently published guidance and was adopted for this EIA. The CEA Agency facilitated the development of this national guidance for the consideration of climate change in environmental assessments. The guidance recommends that to consider climate change in the context of EIA, net changes in GHG emissions as a result of a project be evaluated and detailed mitigation (described in a GHG Management Plan) be considered for the project in comparison to the industrial sector for the project, and to characterize project emissions as "low", "medium", or "high" (though these descriptors are not quantitatively defined in the guidance). Where Project emissions are medium or high, preparation of a GHG Management Plan is required.

The technical boundaries for air quality include:

- the inherent uncertainty in estimating emission rates from the Project at a preliminary stage of engineering design;
- scientific limitations in the ability of dispersion models to accurately predict the maximum ground-level concentrations and deposition rates due to the complex physics of the atmospheric processes that are difficult to simulate numerically; and
- the inherent spatial and temporal uncertainty in the measurements of ambient air contaminant concentrations.

These technical boundaries do not impede the environmental effects assessment, however. The emissions estimates are conservative or high according to Project activities. The dispersion model outputs used in the assessment are conservative in comparison to measured ambient air quality data. Dispersion models are accepted by regulatory agencies world-wide as an appropriate basis for environmental assessments. Sufficient technologies for measurement of ambient air contaminants currently exist to measure air contaminants to within the required accuracy for comparison to regulatory guidelines, objectives, and standards.

The main technical limitation in assessing environmental effects from GHG emissions on climate is that quantitative measurement of the change or effect due to a particular emission source or sources is not feasible. While GHG emissions can be reasonably quantified, it is not yet possible to measure the specific environmental effect of climate change (*i.e.,* the change in the environment) from any one individual facility's GHG emissions. A cause and effect relationship cannot be established between emissions from a specific facility and global climate change (CEA Agency 2003). However, it is widely recognized that global GHG emissions and potential consequent changes to global climate are a significant cumulative environmental effect. It is also recognized that the GHG emissions from the Project, no matter how small, will contribute to these significant cumulative environmental effects but the contribution will be small in a global context. As a result, Project-related GHG emissions will be assessed and Project significance will be based on the quantities of GHG emissions. The assessment also considers mitigation aimed at minimizing Project GHG emissions with the objective of compliance with future federal and/or provincial regulations. This approach is consistent with the CEA Agency guidance (CEA Agency 2003).

8.2.1.6 Residual Environmental Effects Significance Criteria

For air quality (including odour), a significant adverse residual environmental effect on the Atmospheric Environment is one that degrades the quality of the ambient air such that the maximum Project-related ground-level concentration plus the conservative background level of the air contaminant being assessed frequently exceeds the respective ambient air quality objective, guideline or standard. "Frequently" is defined as once per week for 1 hour objectives and once per month for 24 hour objectives.

For GHG Emissions (related to climate change), following guidance from the CEA Agency, *"the environmental assessment process cannot consider the bulk of GHG emitted from already existing developments. Furthermore, unlike most project-related environmental effects, the contribution of an individual project to climate change cannot be measured"* (CEA Agency 2003). It is, therefore, recognized that it is not possible to assess significance related to a measured environmental effect on climate change on a project-specific basis. At the same time, it is recognized that a scientific consensus is emerging in respect of global emissions of GHG and consequent changes to global climate as generally representing a significant cumulative environmental effect. Project emissions of GHG will contribute to these cumulative environmental effects, but the contribution, although measurable and potentially important in comparison to local and provincial levels, will be very small in a global context. Policies and regulations are being developed by the Government of Canada for regulating GHG emissions for specific sources or industry sectors.

Thus, instead of setting a specific significance criterion for an environmental effect related to GHG emissions or climate change and determining whether and how it can be met, the assessment involves estimating Project-related GHG emissions and considering the magnitude, intensity, and duration of Project emissions as directed by the CEA Agency guidance (CEA Agency 2003). Three categories are described in the CEA Agency guidance: "low", "medium", and "high". In this EIA, these are attributed quantitatively based on evaluation of GHG emissions from other industrial facilities and regulatory thresholds (such as reporting thresholds for GHG emissions to provincial and federal programs). For this EIA, the magnitude of the Project GHG emissions (on a tonnes CO_2e per annum basis) is based on the following criteria:

- less than 50,000 tonnes CO_2e per annum is considered "low" (since below this level, reporting to the federal program is not required);
- between 50,000 and 500,000 tonnes CO_2e per annum is considered "medium"; and
- greater than 500,000 tonnes CO_2e per annum is considered "high".

The quantitative levels used to define the low, medium, and high magnitudes of GHG emissions were revised from those presented in the Terms of Reference following the estimation of emissions from the Project. The levels were revised based on emissions from other mines in Canada and with respect to the federal reporting program. These revised levels represent a more conservative approach to evaluating the significance of Project GHG emissions on global climate.

As per the CEA Agency guidance, where the GHG emissions are considered to be either "medium" or "high", a GHG Management Plan must be prepared.

8.2.2 Existing Conditions

The following sections provide a summary discussion of the existing conditions for the Atmospheric Environment. The Baseline Ambient Air Quality Technical Report (Stantec 2012b) provides further details. This includes climate and meteorological data from meteorological stations in the region, as well as ambient air quality measurements made or collected by NBDELG along with data from ambient air quality monitors that were located in Napadogan during baseline studies for the Project.

8.2.2.1 Climate

The climate of New Brunswick is generally characterized as continental in the central and northern regions of the province, with more of a moderated climate in the southern and eastern regions of the province due to influence from the Atlantic Ocean. In the winter months, cold arctic air frequently flows across New Brunswick and most significant winter storms typically originate from the northeastern United States or the Gulf of Mexico. The winters are generally characterized as cold with significant snow falls. However, short mild spells often occur throughout the winter when the flow of arctic air from the north breaks down, often resulting in several freeze thaw cycles, which are more prevalent in southern areas. In summer, the air mass is generally warm with occasions of hot, humid air from the Gulf of Mexico, specifically in areas away from the influence of the ocean. In coastal areas, moist air from the Atlantic Ocean can produce frequent mild spells in winter and cooler moderated weather in the summer (Environment Canada 2000).

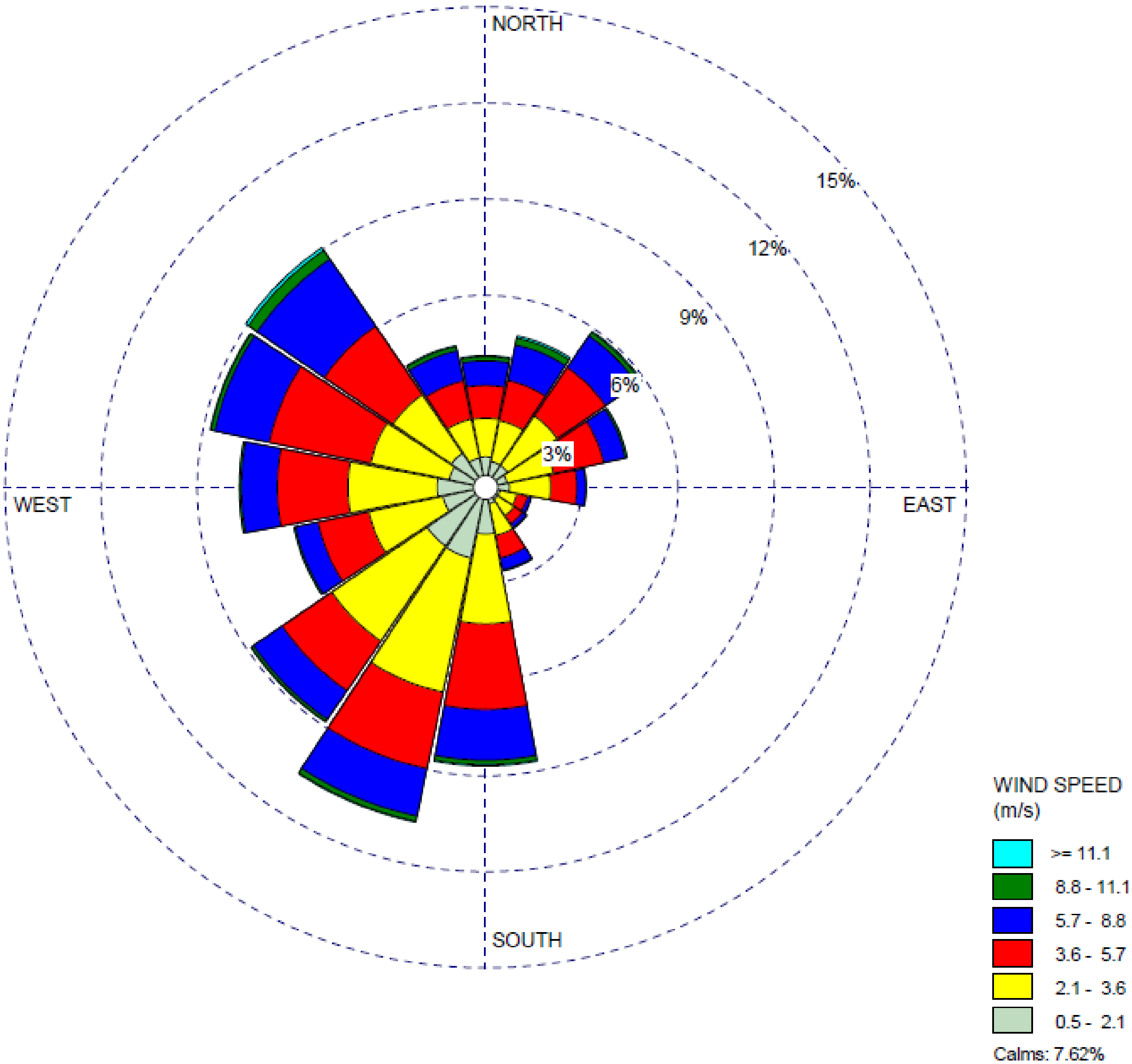
Further, topography has a limited influence on the climate in New Brunswick, except for localized effects in some locations due to areas of terrain relief or air flow along river valleys.

The most recent available climate normals (1971-2001) for the Fredericton Airport weather station are in Table 6.3.2. The Fredericton Airport weather data are generally representative of average weather conditions in Central New Brunswick. During the winter, the air mass is cold and unaltered with a January daily mean temperature of -9.8°C. In the summer, the air mass is predominantly warm continental with a July daily mean temperature of 19.3°C. The extreme maximum and minimum temperatures recorded are 37.2°C and -37.2°C, recorded during August and February, respectively. The average annual precipitation is 1,143.3 mm, of which 77.5% is in the form of rain. Extremes in daily precipitation occur in August and September and are in the range of 124.0 mm to 148.6 mm.

The average annual wind speed reported at the Fredericton Airport weather station is approximately 12.4 km/h. The maximum wind speeds occur in March with average speeds of 14.6 km/h and the minimum speeds occur in August at an average of 10.0 km/h. The average monthly wind speeds are higher in the winter than in the summer. The prevailing winds are from the south or southwest in summer and from the west or northwest in winter. Maximum hourly wind speeds, averaged from 1971 to 2000 for each month, range from 48 km/h and 80 km/h, while maximum gusts for the same period range from 93 km/h to 132 km/h. Occurrences of extreme winds are uncommon at Fredericton, as over the last three decades there has been an average of 2.3 and 0.3 days per year with winds ≥ 52 km/h and 63 km/h, respectively (Environment Canada 2012a).

Figure 8.2.2 is a wind rose plot for the Fredericton airport. The wind direction shown is the direction *from which* the wind blows, measured at a height of 10 m above grade. The relative length of a particular wind vector indicates the frequency of winds occurring from that direction and the various colours used for each vector indicate the range of wind speeds. Winds at the Fredericton Airport are frequently from the south, west, northwest and southwest directions. Winds from the north and northeast directions are also dominant. The most dominant direction occurs from the south. The highest wind speeds occur from the northwest and northeasterly directions, with the lowest wind speeds occurring most frequently from the south and southwesterly directions.

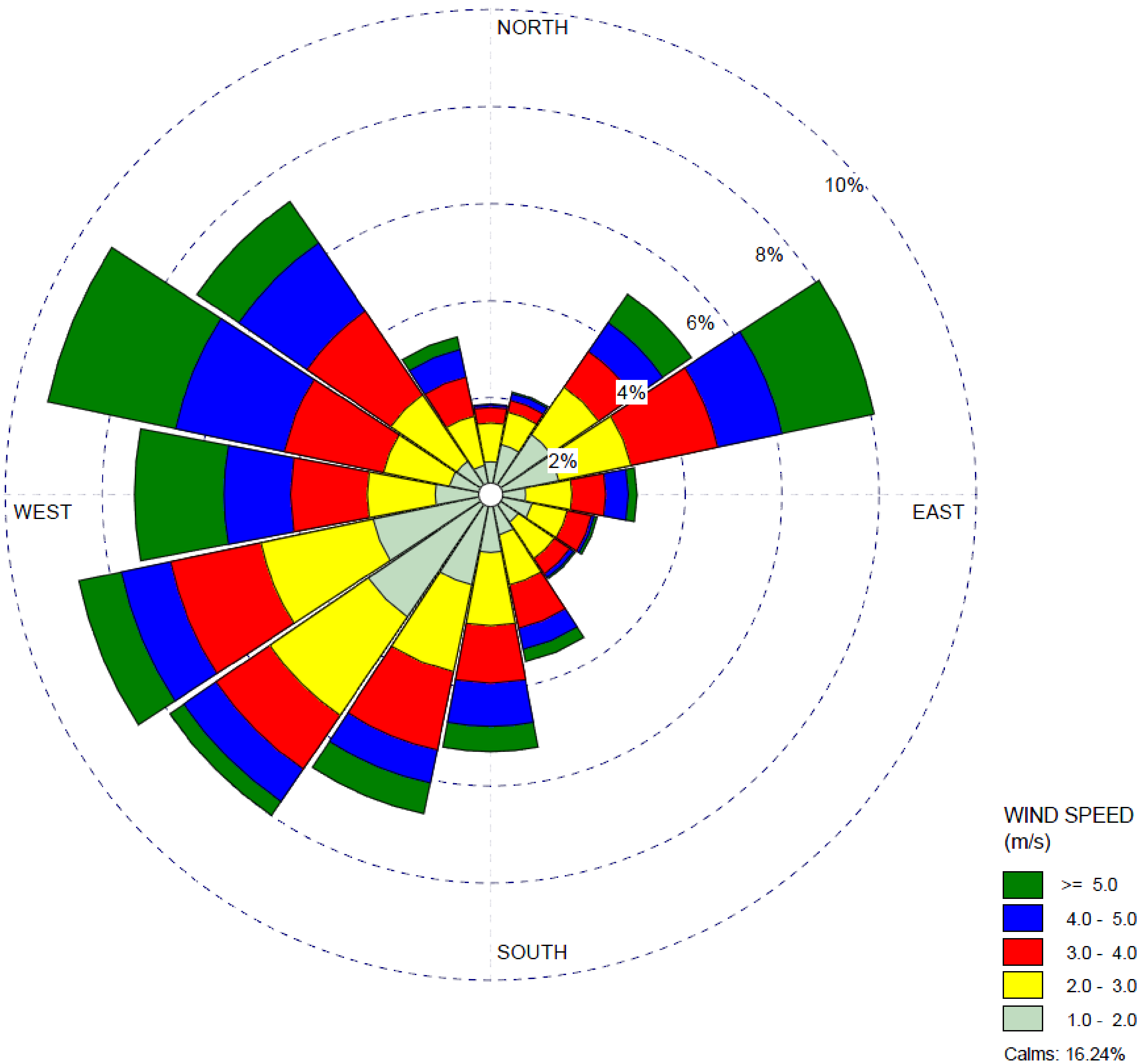
A meteorological station operated at the Project site since 2007. The parameters measured at the Sisson meteorological station include temperature, pressure, relative humidity, wind speed and direction, precipitation, solar radiation and snow depth. Due to limited evidence of station maintenance and quality assurance over the period of 2007 to the end of 2010, the data from spring 2011 to spring 2012 is the focus of the discussion presented herein.



Start Date:	1/1/2006 – 0:00	**Calm Winds:**	7.62 %	**Total Count:**	52022 hours
End Date:	12/3/2011 – 23:00	**Avg. Wind Speed:**	3.41 m/s		

Figure 8.2.2 Winds at the Fredericton Airport: 2006-2011

Figure 8.2.3 is a wind rose plot for the Sisson meteorological station. The wind direction is the direction from which the wind blows, and is measured at a height of 10 m above grade. At the Sisson site, winds from the southwest direction are the most dominant. Winds also prevail from the northeast and northwest directions, although not as frequently. The highest wind speeds occur most frequently from the northeast and northwest directions, with the lowest wind speeds most frequently occurring from the southwest direction.



Start Date:	4/16/2011 – 0:00	**Calm Winds:**	16.24 %	**Total Count:**	9706 hours
End Date:	5/24/2012 – 10:00	**Avg. Wind Speed:**	2.67 m/s		

Figure 8.2.3 Winds at the Sisson Meteorological Station: April 2011-May 2012

Table 8.2.4 provides a summary of the meteorological data logged at the Sisson meteorological station site from 2007 to 2011. The data in Table 8.2.4 are from the Knight Piésold Hydrometeorology report (Knight Piésold 2012d).

Table 8.2.4 Summary of Hourly Meteorological Data – Sisson Meteorological Tower Site

Parameter	2007-2011 Average Monthly Values												Annual
	Jan	Feb	Mar	Apl	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Average Temperature* (°C)	-12	-10	-4	2	9	14	16	15	12	5	0	-7	3
Maximum Temperature* (°C)	-8	-6	-2	6	12	17	20	17	15	8	6	-3	7
Minimum Temperature* (°C)	-17	-15	-7	-1	7	11	14	13	8	3	-4	-17	0
Average Relative Humidity (%)	82	82	67	71	71	78	79	81	80	81	78	86	78
Total Precipitation (mm)	85.1	72.3	62.5	110.2	92.3	151.2	118.4	151.1	98.3	134.1	94	111.8	1,281

Notes:
°C Degrees Celsius.
mm Millimetres.
* Approximate monthly average temperature values from Knight Piésold Hydrometeorology Report: Figure 2.3 Sisson Monthly Temperature (Knight Piésold 2012d).

8.2.2.2 Ambient Air Quality

As reported in Stantec (2012b), the NBDELG, in cooperation with Environment Canada and a number of industrial partners, operates a network of ambient air quality monitoring stations in various areas of the province. The NBDELG documents the results of this monitoring annually in the publication entitled “New Brunswick Air Quality Monitoring Results”, the most recent of which is available for the 2010 calendar year (NBDELG 2012c).

Based on the most recent available data from the NBDELG, compliance with the ambient air quality objectives is greater than 98% for the air contaminants measured at the monitoring sites in the provincial network in 2010 (NBDELG 2012c). Therefore, ambient air quality in New Brunswick is characterized as good most of the time, with few exceedances of the provincial ambient air quality objectives or Canada-wide Standards. Additionally, a gradual improvement in air quality was observed in the province in recent years when compared to historical levels, with 2010 having the highest levels of compliance with the provincial objectives on record (98%).

8.2.2.2.1 Provincial Ambient Air Quality Monitoring

This section presents available ambient air quality data to further describe the existing ambient air quality in Central New Brunswick. Additional information is provided in Stantec (2012b).

The annual air quality reports released by the NBDELG from 2008 to 2010 (NBENV 2010; NBENV 2011, NBDELG 2012c) provide data for the analysis that follows. The review includes data from the stations nearest to the Project, specifically the ambient air quality monitoring stations at Fredericton and

Nackawic, and focuses on total suspended particulate matter (PM), particulate matter less than 2.5 microns ($PM_{2.5}$), sulphur dioxide (SO_2), and nitrogen dioxide (NO_2) ground-level concentrations. Where appropriate, recent trends, maximum concentrations, and comparisons with provincial or national ambient air quality objectives are provided.

The air contaminant ground-level concentrations (PM, $PM_{2.5}$, SO_2 and NO_2) measured in 2008, 2009, and 2010 at both Fredericton and Nackawic were well below the applicable objectives and standards. The measured concentrations at both sites were generally consistent from year to year, and in some cases the concentrations decreased over time. However, the 2010 data still showed some elevated 1-hour and 24-hour maximum concentrations measured on occasion, though within regulatory standards.

These ambient monitoring stations are located in urban (Fredericton) and industrial (Nackawic) areas, respectively. Thus, the measured concentrations are likely to be higher at these two monitoring sites than at the Project site, due to the nearby sources of air contaminant emissions (*e.g.,* vehicle traffic and large industrial sources) in these areas and absence of substantive existing sources of emissions in the rural Project area. This is demonstrated when comparing NBDELG data with the baseline results from the Napadogan monitoring site below.

8.2.2.2.2 Ambient Air Quality Monitoring Within the LAA

There has been little, if any, ambient air quality monitoring conducted in the LAA in the past, and no data are available from published literature. Therefore, Stantec conducted an ambient air quality monitoring program in the LAA over a six month period to cover parts of three seasons (summer, fall and winter). The monitoring was carried out from August 2011 to February 2012 at a residence located at 29 Second Street in Napadogan (coordinates of the monitoring site are 46.41°N and 66.93°W). Napadogan was selected as the location for the baseline ambient air quality monitoring since it is the nearest residential area to the Project (approximately 10 km northeast of the proposed Project site). The monitoring station is located in a nearest residential area to the Project location, in a cleared, flat area, primarily free of obstructions in the immediate vicinity of the site.

Ambient air quality measurements collected between August 2011 and February 2012 included ground-level concentrations of PM, $PM_{2.5}$, SO_2 and NO_2. Table 8.2.5 summarizes the highest observed 24 hour average ground-level total suspended particulate matter concentrations by month, measured at Napadogan. Additional information is presented in Stantec (2012b).

Table 8.2.5 Highest Observed 24-hour Ground-Level Concentrations by Month – Total Suspended Particulate Matter (PM) – Napadogan

Month	Highest Observed 24-hour Ground-level PM Concentration during Month (µg/m^3)	New Brunswick Maximum Permissible Ground-level Concentration (µg/m^3)
August 2011	35.3	120
September 2011	28.4	
October 2011	20.5	
November 2011	10.4	
December 2011	8.7	
January 2012	8.8	
February 2012	7.1	

Notes:
Values in **bold** indicate a measured concentration in excess of the applicable objective, standard, or criterion.

Table 8.2.6 summarizes the highest observed 24-hour ground-level concentrations of $PM_{2.5}$ by month as measured at Napadogan.

Table 8.2.6 Highest Observed 24-hour Ground-Level Concentrations by Month – Particulate Matter Less Than 2.5 Microns ($PM_{2.5}$) – Napadogan

Month	Highest Observed 24-hour Ground-level $PM_{2.5}$ Concentration during Month ($\mu g/m^3$)	CCME Canada-wide Standard ($\mu g/m^3$)
August 2011	6.8	30
September 2011	8.1	
October 2011	3.9	
November 2011	4.3	
December 2011	4.2	
January 2012	3.8	
February 2012	5.1	

Notes:
Values in **bold** indicate a measured concentration in excess of the applicable objective, standard, or criterion.

The measured 24-hour average concentrations of PM and $PM_{2.5}$ were well below the NBDELG objective and CCME Canada-wide Standard, respectively. The highest measured concentrations were in August and September 2011. For the first five weeks of monitoring, road construction was present on Route 107 through Napadogan. During this time, the road surface was gravel, with ongoing intermittent construction activities. The road was re-surfaced with chip seal by September 12, 2011. Since the construction activities near the monitoring site generated some airborne dust, this is likely the cause for the higher concentrations of particulate matter measured during those months (August and September 2011).

Table 8.2.7 summarizes the highest observed ground-level concentrations of trace metals during the monitoring period at Napadogan.

Table 8.2.7 Highest Observed 24-hour Average Ground-Level Concentrations during Monitoring Period– Selected Trace Metals in PM – Napadogan

Trace Metal	Highest Observed 24-hour Ground-Level Concentration of Selected Trace Metal ($\mu g/m^3$)	Ontario Ministry of Environment (OMOE) Ambient Air Quality Criteria ($\mu g/m^3$)
Aluminum (Al)	0.34	-
Antimony (Sb)	0.004	25
Arsenic (As)	0.003	0.3
Barium (Ba)	0.003	10
Beryllium (Be)	0.0004	0.01
Bismuth (Bi)	0.003	-
Boron (B)	0.003	120
Cadmium (Cd)	0.001	0.025
Calcium (Ca)	0.12	-
Chromium (Cr)	0.001	0.5
Cobalt (Co)	0.001	0.1
Copper (Cu)	0.28	50
Iron (Fe)	0.63	4
Lead (Pb)	0.004	0.5
Magnesium (Mg)	0.16	-
Manganese (Mn)	0.02	0.4
Total Mercury (Hg)	<0.0001	2

Table 8.2.7 Highest Observed 24-hour Average Ground-Level Concentrations during Monitoring Period– Selected Trace Metals in PM – Napadogan

Trace Metal	Highest Observed 24-hour Ground-Level Concentration of Selected Trace Metal (µg/m³)	Ontario Ministry of Environment (OMOE) Ambient Air Quality Criteria (µg/m³)
Molybdenum (Mo)	0.001	120
Nickel (Ni)	0.002	0.2
Phosphorus (P)	0.06	-
Potassium (K)	0.16	-
Selenium (Se)	0.004	10
Silicon (Si)	0.10	-
Silver (Ag)	0.001	1
Sodium (Na)	0.35	-
Strontium (Sr)	0.001	120
Sulphur (S)	1.36	-
Thallium (Tl)	0.004	-
Tin (Sn)	0.004	10
Titanium (Ti)	0.02	120
Tungsten (W)	<0.001	-
Uranium (U)	0.03	-
Vanadium (V)	0.002	2
Zinc (Zn)	0.06	120
Zirconium (Zr)	0.007	-

Notes:
Values in **bold** indicate a measured concentration in excess of the applicable objective, standard, or criterion.
< not detected in sample, detection limit reported.

The measured concentrations of trace metals were well below the respective OMOE Ambient Air Quality Criteria, for those metals with criteria. For many of the trace metals, the measured concentrations were below the detection limit.

Table 8.2.8 provides the highest weekly ground-level concentrations of SO_2 and NO_2 by month as measured at Napadogan.

Table 8.2.8 Highest Observed Weekly Ground-Level Concentrations By Month – Sulphur Dioxide (SO_2) and Nitrogen Dioxide (NO_2) – Napadogan

Month	Highest Observed Weekly Sulphur Dioxide Ground-Level Concentration during Month(µg/m³)	New Brunswick Maximum Permissible Sulphur Dioxide Annual Average Ground-Level Concentration (µg/m³)	Highest Observed Weekly Nitrogen Dioxide Ground-Level Concentration during Month(µg/m³)	New Brunswick Maximum Permissible Nitrogen Dioxide Annual Average Ground-Level Concentration (µg/m³)
August 2011	<1.0	60	1.5	100
September 2011	1.3		0.9	
October 2011	<1.0		2.1	
November 2011	1.6		3.4	
December 2011	<1.0		2.8	
January 2012	1.6		4.7	
February 2012	1.0		4.7	

Notes:
Values in **bold** indicate a measured concentration in excess of the applicable objective, standard, or criterion.
< Not detected in sample, detection limit reported.

Since SO_2 and NO_2 measured concentrations (passive samples) are weekly averages, the measured values are not compared directly with any objectives, guidelines or criteria (as no regulatory values exist for weekly SO_2 or NO_2). The measured values for SO_2 and NO_2 were very low and near the detection limit of the monitoring method. Though a direct comparison of weekly averages to an annual average ground-level concentration is not fully valid because of the different time periods, this comparison has been done to put the measured values into some context in relation to objectives. The weekly average monitoring results are less than 1/50th of the standard in most cases when compared to the annual average maximum ground-level concentration for each parameter. This indicates very low background values for these parameters. These results are expected given the rural nature of the LAA, the lack of nearby influencing sources of emissions, and the relatively small influence of long-range transport of air pollutants into Central New Brunswick from other regions. The highest concentrations of NO_2 were measured in the late fall and winter months. This is likely a result of wood and oil combustion used for heat at nearby residences in the colder months. The highest SO_2 concentrations measured were close to and only slightly higher than the detection limit. For several of the weekly sample periods, the measured concentrations of SO_2 and NO_2 were below the detection limit.

Based on the baseline ambient air quality monitoring results, air quality in the Napadogan area near the Sisson site is representative of that found in a rural, sparsely populated area, with no substantive sources of air contaminant emissions nearby. Further, the measured concentrations at the Napadogan site are much lower than the concentrations measured in Fredericton and Nackawic.

Further details are provided in the Baseline Ambient Air Quality Technical Report (Stantec 2012b).

8.2.2.3 Air Contaminant and GHG Emissions

The existing air contaminant and GHG emissions in New Brunswick, presented below, are based on National Pollutant Release Inventory (NPRI) reported data for 2010. This is the most recent year of quality assured, published data available. The NPRI requires industrial facilities to report specific air contaminant emissions to Environment Canada when facility reporting thresholds are met. In 2010, 55 New Brunswick facilities reported criteria air contaminant emissions to the NPRI. Table 8.2.9 provides a summary of provincial and national air contaminant emissions as reported to the NPRI for the 2010 reporting year.

Table 8.2.9 2010 NPRI Air Contaminant Emissions Data – Provincial and National Totals

Value	Combustion Gases			Particulate Matter			Trace Metals		
	Sulphur Dioxide (tonnes)	Nitrogen Dioxide (tonnes)	Carbon Monoxide (tonnes)	PM (tonnes)	PM_{10} (tonnes)	$PM_{2.5}$ (tonnes)	Lead (Pb) (kg)	Cadmium (Cd) (kg)	Mercury (Hg) (kg)
Provincial Total Reported	33,263	43,221	235,707	383,686	101,864	24,790	18,111	875	148
National Total Reported	1,370,652	2,212,217	9,610,352	18,794,771	5,945,947	1,187,321	225,822	15,881	5,222
Provincial Percent of National	2.43%	1.95%	2.45%	2.04%	1.71%	2.09%	8.02%	5.51%	2.84%

Source: 2010 National Pollutant Release Inventory (Environment Canada 2012l).

Based on air contaminant emissions reported to the NPRI in 2010, particulate matter emissions are released in the largest quantities compared with other contaminants reported in the province of New Brunswick. Generally, releases of CACs (combustion gases and particulate matter) reported to the NPRI in New Brunswick account for approximately 2% of the reported national totals.

Greenhouse gases (GHG) of concern include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), among others. Provincial GHG emissions in 2010 (including industrial facilities, agriculture, vehicles, and natural sources) were 18,600 kilotonnes of carbon dioxide equivalent (CO_2e) (Environment Canada 2012j). Fifteen industrial facilities in New Brunswick reported GHG emissions to Environment Canada for 2010 for a total of 8,228 kilotonnes CO_2e (Environment Canada 2011). Major GHG emitters in New Brunswick include the Saint John Oil Refinery (35%), the Belledune Generating Station (32%), the Dalhousie Generating Station (11%), and Bayside Power in Saint John (9.4%).

Canada's GHG emissions in 2010 were 692,000 kilotonnes CO_2e (Environment Canada 2012d). New Brunswick's contribution to national GHG emissions is approximately 3%. The mining and oil and gas industries combined reported 38,200 kilotonnes CO_2e in 2010 (Environment Canada 2012d), representing approximately 6% of Canada's 2010 emissions.

Estimated carbon dioxide emissions globally are 34 Gt per year (CAIT 2012). Canada's contribution to global GHG emissions is approximately 2%.

8.2.3 Potential Project-VEC Interactions

Table 8.2.10 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 the Atmospheric Environment.

Table 8.2.10 Potential Project Environmental Effects to the Atmospheric Environment

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

Table 8.2.10 Potential Project Environmental Effects to the Atmospheric Environment

Project Activities and Physical Works	Potential Environmental Effects Change in Atmospheric Environment
Decommissioning, Reclamation and Closure	
Decommissioning	0
Reclamation	0
Closure	0
Post-Closure	0
Emissions and Wastes	1
Transportation	0
Employment and Expenditure	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 EA.

For convenience, all environmental effects of the Project on the Atmospheric Environment are assessed under the activity identified as "Emissions and Wastes" for each phase, so as to encompass all Project activities that generate emissions under a single activity during each Project phase. The interaction between Emissions and Wastes and a Change in Atmospheric Environment has been ranked as 2 during both the Construction and Operation phases, and ranked as 1 during Decommissioning, Reclamation and Closure. Potential environmental effects on GHG sinks in consideration of loss of forested area are also considered under Emissions and Wastes. Emissions and Wastes during Construction and Operation are the only activities that have the potential to influence the Atmospheric Environment. Thus, the interaction between all other Project activities listed in Table 8.2.10 and the Atmospheric Environment have been ranked as 0 and are by definition not significant.

Project activities during Decommissioning, Reclamation, and Closure will release air contaminants and GHGs in quantities that are similar to or less than those associated with Construction; thus Emissions and Wastes associated with Decommissioning, Reclamation and Closure are ranked as 1. Decommissioning, Reclamation and Closure activities should require less use of heavy mobile equipment (and therefore lower air contaminant emissions) than Construction, and there will be no emissions from blasting during this phase.

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 ranked as 0 or 1 in Table 8.2.10 including cumulative environmental effects, on the Atmospheric Environment during any phase of the Project are not significant, and are not considered further in the assessment.

8.2.4 Assessment of Project-Related Environmental Effects

A summary of the residual environmental effects resulting from interactions ranked as 2 on the Atmospheric Environment is provided in Table 8.2.11.

Table 8.2.11 Summary of Residual Project-Related Environmental Effects on the Atmospheric Environment

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 Atmospheric Environment	Construction • Emissions and Wastes	• Implementation of idling reduction program. • Application of water on the site access road and on-site roads within the PDA (but not on forest resource roads) as required to reduce dust generation. • Seeding and re-vegetation of topsoil and overburden storage piles as soon as possible after disturbance. • Implementation of equipment and vehicle maintenance program to improve operational efficiency and reduce emissions.	A	L	L	MT/ C	R	U	N	H	--	Y	No follow-up recommended. Conduct ambient particulate monitoring, if complaints are received.
	Operation • Emissions and Wastes	• All mitigation mentioned under Construction above. • Use of dust collection systems on the primary crusher and within the ore processing plant, and partial covering of ore conveyors. • Use of H_2S and NH_3 scrubbers on APT plant.	A	M	L	LT/ C	R	U	N	H	--	Y	No follow-up recommended. Conduct ambient particulate monitoring, if complaints are received. Record the volumes of fuel consumed in stationary and mobile equipment, as well as electricity consumption. Estimate direct GHG emissions for comparison with reporting threshold.

Table 8.2.11 Summary of Residual Project-Related Environmental Effects on the Atmospheric Environment

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					
	Decommissioning, Reclamation and Closure												
	Residual Environmental Effects for all Phases								N	H	--	Y	

KEY

Direction
P Positive.
A Adverse.

Magnitude
L Low: Air Quality is not affected or slightly affected but is well below objectives, guidelines, or standards; GHG Emissions < 50,000 t CO_2e/a.
M Medium: Air Quality is affected to values that are near but largely below the objectives, guidelines, or standards; GHG Emissions < 500,000 but > 50,000 t CO_2e/a).
H High: Air Quality is degraded to values that may substantially exceed objectives, guidelines, or standards; GHG Emissions > 500,000 t CO_2e/a.

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.

8.2.4.1 Potential Project Environmental Effects Mechanisms

Emissions of air contaminants and GHGs during Construction and Operation result from:

- vehicle and equipment movements on unpaved roads (fugitive dust);
- material handling and processing (fugitive dust);
- wind erosion on overburden storage piles and exposed surfaces of the tailings storage facility (TSF) (known as “tailings beaches”) (fugitive dust);
- drilling and blasting activities (fugitive dust);
- fuel combustion in mobile equipment and a package boiler during Operation providing heat and steam to the ore processing plant (combustion gases including GHGs); and
- operation of the ore processing plant and APT plant (particulate matter, VOC, and potentially odourous compounds including hydrogen sulphide and ammonia).

Indirect GHG emissions (*i.e.,* releases occurring at facilities that are not owned by the proponent due to electricity or heat requirements of the Project), will occur at power generating facilities that generate the electricity used by Project activities.

8.2.4.2 Mitigation of Project Environmental Effects

The following mitigation measures, through careful design and planning, will reduce the environmental effects of the Project on the Atmospheric Environment potentially resulting from the environmental effects mechanisms described above:

- implementation of idling reduction program;
- application of water sprays on the site access road connecting the Project site to the Fire Road as well as on-site roads within the PDA (but not on the forest resource roads) as required to minimize dust generation;
- seeding and re-vegetating topsoil and overburden storage piles as soon as possible after disturbance;
- Implementation of equipment and vehicle maintenance program to improve operational efficiency and reduce emissions.
- use of dust collection systems on the primary crusher and within the ore processing plant, and partial covering of ore conveyors; and
- use of H_2S and NH_3 scrubbers on APT plant.

8.2.4.3 Characterization of Residual Project Environmental Effects

As was shown in the dispersion modelling results in Section 7.1, the Project will not cause any exceedances of the ground-level air quality objectives for NO_2, SO_2, or CO during Construction at any receptors, including background. For PM, PM_{10} and $PM_{2.5}$, dispersion modelling predictions during Construction show that predicted maximum ground-level concentrations of these contaminants are well below the applicable objectives and standards at the nearest residences and recreational campsites. The results of the dispersion modelling indicate possible exceedances of the objectives, guidelines, or standards related to road generated dust during Construction. More specifically, predicted maximum ground-level concentrations of PM and PM_{10} may be above the respective objectives and standards on occasion, due to fugitive emissions resulting from road dust on off-site access roads (*i.e.,* on forest resource roads). This is predicted during extended periods of dry conditions, and will be mitigated by the use of water sprays on the site access road connecting the Project to the forest resource road network as well as on internal on-site roads within the PDA to reduce fugitive dust emissions; the frequency of watering will be increased during extremely dry periods to further reduce this emission source. Watering of the existing forest resource road network (*e.g.,* Napadogan Road, Fire Road, and Four Mile Brook Road) is not practical and would bring about safety considerations given the volumes of traffic currently travelling these roads; that stated, given that these roads are extensively used for forestry and other purposes currently and there is no indication that the resulting road dust levels are problematic currently, the incremental increase in traffic on these roads as a result of the Project is not expected to exacerbate ambient air quality. The site access road and internal site roads within the PDA are located in remote wooded areas with no nearby residences. Further, the predicted ground-level concentrations are based on worst-case conservative emissions estimates for the month during Construction with the highest anticipated vehicle traffic, and assuming no reduction in dust emissions due to watering. Therefore, localized, infrequent and brief exceedances are expected (near access roads) while vehicles pass during dry conditions, but this is not expected to be a frequent occurrence or to extend much beyond the immediate vicinity of where vehicles are travelling at the time.

For CACs during Operation, the dispersion modelling results presented in Section 7.1 indicated that there were no predicted exceedances of the ground-level air quality objectives for NO_2, SO_2, CO, NH_3 and H_2S, including background where applicable. Similarly, for PM, PM_{10} and $PM_{2.5}$ during Operation, dispersion modelling predictions during Operation show that the predicted maximum ground-level concentrations of these contaminants are below the applicable objectives and standards at the nearest residences and recreational campsites. The model predicts some exceedances of the 24-hour PM objective at three receptors near the primary crusher (approximately 20 m to the southwest of the crusher); however, the frequency of exceedance at these receptors is low (*i.e.*, up to four exceedances of the 24-hour PM objective over the 6-year meteorological file, or 0.2% of the time). Additionally, the model predicts maximum ground-level concentrations of PM and PM_{10} above objectives and standards on occasion, along off-site access roads. Fugitive emissions of road dust generated by vehicle movements on off-site access roads are the cause of these exceedances, specifically during extended periods of dry conditions. Road dust emissions will be mitigated by the use of water sprays on the site access road connecting the Project to the forest resource road network as well as on internal on-site roads within the PDA. The frequency of watering will be increased during extremely dry periods to further reduce this emission source. Again, it would not be practical to apply water to the existing forest resource road network (*e.g.,* Napadogan Road, Fire Road, and Four Mile Brook Road), but there is no indication that the road dust levels from traffic on these roads are problematic currently, and the small increase in traffic on these roads as a result of the Project is not expected to exacerbate ambient air quality. The site access road and internal on-site roads within the PDA are located in remote wooded areas with no nearby residences. It is noted that the emissions inventory developed for Operation was based on the Project facilities as they are conceived towards the end of the Operation phase, so as to encapsulate the highest potential area for fugitive emissions from the tailings beaches that could arise during the life of the Project, with all other emission sources remaining relatively constant through Operation. This represents a highly conservative approach. Further, the predicted concentrations presented above are based on worst case conservative emissions estimates, and assume no reduction in dust emissions due to watering. Therefore, localized, infrequent and brief exceedances are expected while vehicles pass during dry conditions (as during Construction). Exceedances of particulate matter objectives will not occur frequently, and will be largely localized to the immediate vicinity of where vehicles are travelling at the time.

During Operation, the model predicts maximum 10-minute H_2S ground-level concentrations above the odour threshold at four locations. At the receptor location with the maximum predicted 10-minute H_2S ground-level concentration, the odour threshold is infrequently exceeded (*i.e.,* nine occurrences over the 6-year meteorological file, or less than 0.03% of the time). These receptors are located within 20 m to the southwest of the APT plant, within the PDA. No perceivable odour is expected beyond approximately 20 m of the APT plant.

As was discussed in Section 7.2, direct annual GHG emissions during Construction are approximately 27,210 t CO_2e over a two-year construction period, or if split equally over both construction years, approximately 13,605 t CO_2e per year. During Operation, the estimated direct annual GHG emissions, including emissions from personnel, equipment, and material transportation, is 47,691 t CO_2e per year. This represents less than 0.3% of provincial GHG emissions, based on 2010 reported emissions. The GHG intensity of the Project is approximately 0.005 t CO_2e per tonne of ore mined. For comparison, the GHG intensity for a similarly-sized facility (*i.e.,* Mount Polley Mine) was 0.006 t CO_2e per tonne of ore mined. The Canada-wide average GHG intensity for metal mines is 0.014 t CO_2e per tonne of ore mined. The Project is below the Canadian average GHG intensity for metal mines.

As defined in the significance criteria for GHG emissions, facilities with GHG emissions less than 50,000 tonnes are considered a low emitter (as below this level reporting to the federal program is not required). Low emitters do not require a site specific GHG management plan.

The loss of carbon storage due to tree removal to accommodate the Project was conservatively estimated to be 8,419 t CO_2, based on the size of the PDA at 1,253 ha and assuming the entire PDA is forested. The total estimated CO_2 storage capacity in trees in New Brunswick is approximately 41 million tonnes of CO_2; therefore carbon sink loss as a result of the Project is considered negligible.

8.2.5 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 potential to cause environmental effects that overlap with those of the Project, as identified in Table 8.2.11. The potential cumulative environmental effects to the Atmospheric Environment are presented in Table 8.2.12, where each interaction with other projects is ranked as 0, 1, or 2 with respect to the nature and degree to which important Project-related environmental effects may overlap with those of other projects or activities that have been or will be carried out.

Table 8.2.12 Potential Cumulative Environmental Effects to the Atmospheric Environment

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

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.

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 the Atmospheric Environment. 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, but since the Project will not cause environmental effects on the Atmospheric Environment until Construction begins and well into Operation, there is no overlap with the environmental effects 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. Thus the interaction between the Project and those other past or present projects or activities has been ranked as 0 in Table 8.2.12 and their cumulative environmental effects in combination with those of the Project are rated not significant.

With respect to future Forestry and Agricultural Land Use, logging equipment and trucks release combustion gases and GHGs, and may cause fugitive road dust emissions during Operation. These emissions are transient as the logging operation continues and are not expected to be substantive. There are no known plans to increase forestry activities in the RAA beyond the sustainable levels that are currently being experienced and managed by NBDNR in concert with Crown Timber License Holders. Forestry activities carried out in the future could have overlapping environmental effects on the Atmospheric Environment with those of the Project, but given that background levels are already low as demonstrated by the ambient air quality monitoring conducted, it is not conceivable that such activities on their own or in combination with the Project would cause a long-term concern with respect to meeting ambient air quality objectives in this rural area.

Existing Industrial Land Use near the Project is represented by the Veneer Mill in Napadogan, the only substantive industrial emission source in the LAA. Given the relatively large distance between this mill and the Project (10 km), the future interactions between the veneer mill and the Project with respect to air quality will be minimal. In terms of GHG emissions, the spatial boundary is global and due to the very low GHG emissions from the Project compared to provincial and global emissions, the Project contribution to global GHG emissions is negligible. There are no known plans for future Industrial Land Use projects in the LAA at this time. The interaction between any future Industrial Land Use projects or activities and the Project would be addressed in an EIA that would be required for any substantive future industrial project, and the overlapping cumulative environmental effects with the Project would be assessed at that time.

The emission of air contaminants will not cause an exceedance of standards, objectives and guidelines beyond several hundred metres from the Project, and these predicted exceedances are very infrequent. The Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons, be it from past, present, or future activity of this nature, is not an emission generating activity and thus there are no overlapping environmental effects on Atmospheric Environment from these activities. The Project's environmental effects on the Atmospheric Environment will not interfere with the conduct of traditional activities that might occur in the RAA, and as such it is not expected that Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons will be substantively affected by the emissions arising from Construction or Operation of the Project.

Other than dust arising from vehicle traffic on unpaved roads, fugitive particulate matter from Project activities are not expected to reach the recreational campsites or the nearest residential receptors. There are no known plans for increasing recreational activities in the future, and thus no known overlapping environmental effects between future Recreational Land Use and those of the Project on Atmospheric Environment beyond those currently being experienced. The campsite road is unpaved so some dust is generated during dry periods. However, road dust is minimized due to the relatively low speeds that vehicles travel. Based on the dispersion modelling results, measurable environmental effects from the Project on the Atmospheric Environment are expected to be very infrequent with respect to Recreational Land Use. Other recreational land uses in the RAA including ATVing, snowmobiling, hunting, fishing, and trapping do not generate substantive emissions to the extent that their conduct would be expected to cause an exceedance of ambient air quality objectives or standards in combination with emissions from the Project.

At this time, there are no known planned future residential developments near the Project. The interaction between any future Residential Land Use projects or activities and the Project would be addressed in an EIA that would be required for any substantive future residential development project, and the overlapping cumulative environmental effects with the Project would be assessed at that time.

8.2.6 Determination of Significance

8.2.6.1 Residual Project Environmental Effects

The dispersion modelling carried out for the Project predicted some limited exceedances of the objectives and standards for particulate matter (including PM and PM_{10}) for both the Construction and Operation phases of the Project, as well as infrequent localized H_2S levels above the odour threshold within the Project site. However, these occurrences are expected to be infrequent (less than 0.2% of the time), localized near the site and access roads, and of short duration.

Annual direct GHG emissions from Operation were estimated to be 47,691 t CO_2e per year (including sources such as personnel, equipment, and material transportation), and less than one third that amount during Construction. This is below the significance criterion of 50,000 t CO_2e, which represents the threshold for reporting GHG emissions to the federal government.

Based on these results and the analyses that precede this section, with the proposed mitigation and environmental protection measures, the residual environmental effects of the Project on a Change in Atmospheric Environment during all phases of the Project are rated not significant. This conclusion has a high level of confidence as GHG and air contaminant emissions were estimated using conservative emission factors, assumptions, and activity levels.

8.2.6.2 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. Accordingly, the residual 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 Atmospheric Environment are rated not significant. This determination has a high level of confidence.

8.2.7 Follow-up or Monitoring

Follow-up to verify the environmental effects predictions or the effectiveness of mitigation will not be required.

During Construction, if complaints are received, monitoring of ambient particulate matter may be carried out to determine if concentrations at the nearest receptors are below the significance criteria.

Monitoring programs for ambient air quality during Operation may be a requirement of the NBDELG-issued Certificate to Approval for the mine. Such monitoring may consist of monitoring of PM, PM_{10}, or $PM_{2.5}$, or other air contaminants at the discretion of NBDELG. If complaints are received, Northcliff may carry out ambient monitoring to determine if ambient air quality objectives are being exceeded.

For GHG emissions, volumes of fuel combusted in stationary and mobile equipment during Operation should be tracked for the estimation of annual GHG emissions. This information can be used to evaluate whether federal reporting thresholds are reached and to evaluate potential provincial reporting requirements if they are established.