5.0 ENVIRONMENTAL ASSESSMENT

5.1 Atmospheric Environment

5.1.1 Rationale for Selection as Valued Environmental Component

The Atmospheric Environment is the 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 typically characterized by climate, air quality and sound quality (noise). In the context of this EA, Atmospheric Environment is defined as the chemical and physical attributes of air and climate including, but not limited to, gaseous and atmospheric particulate emissions (dust), and noise.

The Project may result in noise and the release of various contaminants to the Atmospheric Environment. These vary depending on the Project activity (*e.g.*, potential noise and dust during the construction activities; and gaseous emissions during operation).

The Atmospheric Environment has been selected as a VEC not only due to the nature of potential Project-related atmospheric emissions, but also because of its intrinsic importance to the health and well being of humans, wildlife, vegetation and other biota. The Atmospheric Environment is an important pathway that could transport contaminants or transfer environmental effects to the freshwater, terrestrial and human environments.

This EA focuses on key aspects of the VEC as presented in Table 5.1.1. These aspects have been selected on the basis of consideration of the Project description (Chapter 3) and those Project-related emissions that are considered to be substantive.

Table 5.1.1 Key Aspects and Issues of Atmospheric Environment

Aspects of VEC on which the EA Focused	Issues Considered
Air Quality	• Air quality including gaseous and particulate emissions • Greenhouse gas emissions and global climate change
Climate	• Local climate environmental effects (microclimate and meteorology) • Weather patterns as they relate to highway construction, operation, and maintenance, including extreme conditions
Sound Quality	• Sound pressure levels, frequency and duration of noise producing activities

5.1.2 Environmental Assessment Boundaries

5.1.2.1 Spatial and Temporal

The spatial boundaries for the assessment of the atmospheric environment consist primarily of the area of disturbance associated with the Project. Project related environmental effects on air quality are generally not expected to extend beyond approximately 300 m of the RoW (Figure 3.2A-D, Appendix C). The 300 m range is generally sufficient for the dispersion of emissions from vehicle traffic and the dissipation of noise generated from heavy equipment operations. For greenhouse gases, the boundary is extended to include the Province of New Brunswick in the context of national and international emissions.

The temporal boundaries of the Project include periods of construction, and subsequent operation and maintenance of the Project in perpetuity.

5.1.2.2 Administrative and Technical

The technical factors for the Atmospheric Environment VECs pertain mainly to regulatory limits with respect to the release of air contaminants of concern to the ambient environment. These standards are set by regulatory authorities to reflect environmental protection objectives with the intent of being protective of air quality as well as human and environmental health.

Air Quality

Air quality will be assessed in the context of project related emissions and ground-level concentrations for the contaminants of interest. Project-related air quality contaminants of interest include:

- particulate matter (PM; total suspended particulate (TSP); and dust);
- particulate matter less than 10 microns (PM_{10});
- particulate matter less than 2.5 microns ($PM_{2.5}$);
- sulfur dioxide (SO_2);
- nitrogen oxides (NO_x);
- carbon monoxide (CO); and
- carbon dioxide (CO_2).

Since the Project will not result in measurable emissions of greenhouse gases other than CO_2, such as methane or nitrous oxide, effects from these gases are not expected to be substantial and are therefore not considered further in this assessment.

The National Ambient Air Quality Objectives and the New Brunswick Maximum Permissible Ground Level concentrations for specified contaminants of interest are presented in Table 5.1.2 for reference and comparison with measured data.

The maximum acceptable levels, above which immediate action should be taken to protect air quality, are also provided in Table 5.1.2 for comparison. There are no New Brunswick or national objectives or standards for PM_{10} (*i.e.,* Particulate Matter < 10 μm), and therefore values adopted by the Greater Vancouver Regional District and the optional values originally proposed in the 1998 Accord for PM_{10} are provided for comparison. The Canada Wide Standard for $PM_{2.5}$ (*i.e.,* Particulate Matter < 2.5 μm) for a 24-hour averaging period, to be achieved based on the 98th percentile measurement annually, averaged over three consecutive years, is also provided in Table 5.1.2. It should be noted that this latter standard does not come into effect until the year 2010.

Table 5.1.2 Canadian and New Brunswick Ambient Air Quality Objectives

Contaminant	Averaging Period	New Brunswick Maximum Permissible Ground Level Concentration for Acceptable Air Quality[1] (μg/m³)	National Ambient Air Quality Objectives, Maximum Desirable/Acceptable Levels[2] (μg/m³)
Total Suspended Particulate Matter	24-hr Annual	120 70*	- / 120 60 / 70
PM_{10}	24-hr[3,4] Annual[4]	- -	50 30
$PM_{2.5}$	24 hr[5]	-	30
SO_2	1-hr 24-hr Annual	900 300 60	450 / 900 150 / 300 30 / 60
NO_x (As NO_2)	1-hr 24-hr Annual	400 200 100	- / 400 - / - 60 / 100
CO	1-hr 8-hr	35,000 15,000	- -

Notes:
* = geometric mean
1. *Clean Air Act* for New Brunswick (1997) Air Quality Regulation, Schedule B – Maximum Permissible Ground Level Concentrations in Micrograms per Cubic Metre at Standard Conditions of 21°C and 101.3 kPa.
2. Canadian Environmental Protection Act, *Clean Air Act*, Ambient Air Quality Objectives Order, No. 1, Schedule 1.
3. Greater Vancouver Regional District (2001)
4. CCME (1998)
5. CCME (2000)

Sound Quality

Outdoor sound quality can be influenced by vehicle traffic and operation of heavy equipment such as bulldozers, trucks, or diesel generators, and by weather conditions such as temperature, humidity, wind direction and wind speed. Local topographical features such as hills or wooded areas may serve to attenuate sound levels. There may be sound reflections if the atmospheric mixing height is low (a few hundred metres), or if solid structures are located near the source of noise emissions.

Outdoor noise may be defined as unwanted sound and is often present at several different frequencies. The audible frequencies for humans are in the range 500-20,000 Hertz (Hz). The sound level pressure level or noise level is measured in decibels on three different scales: A, B and C. The A-weighted scale is generally used for most sound measurements, since it discriminates against frequencies less than 600 Hz, and measures sound levels which come closest to approximating risk of hearing damage in humans. Measured sound parameters are generally expressed as an "equivalent sound level" (L_{eq}) over a specified period of time (*e.g.,* 1 hour or 24 hours).

Regulatory Limits for Sound Quality

More general requirements from the Province of New Brunswick take the form that noise from any process must be controlled such that it does not cause substantial loss of enjoyment of the normal use of any property, or cause substantial interference with the normal conduct of business. In some cases, the hours of operation of a noise source may be restricted with a higher limit such as 65 decibels on the A-weighted scale (dB_A) for one period and another value such as 55 dB_A for another period during the same day. The noise from an operation may also be limited to a level that is less than 10 dB_A over the natural background measured as a 1-hour L_{eq}. While noise is defined as an air contaminant in the *Clean Air Act*, no specific noise guideline currently exists in New Brunswick. However, requirements stated in recent Certificates of Approval to operate from the NBDELG have included a maximum noise level of 55 dB_A at facility boundaries. Noise threshold values established in other jurisdictions and in the United States specifically for roadways vary from 55 to 70 dB_A and may be 1 hour or 24 hour standards. In the state of Maine, the threshold is established as an increase of 15 dB_A over existing noise levels. For the purpose of this assessment, the NBDOT guideline of 65 dB_A (24-hour L_{eq}) at Noise Sensitive Areas (NSAs) will be used (ADI Limited 2003).

Model Validation

In the assessment of the potential effects of the operation of the proposed TCH on sound quality, noise modelling is conducted to predict the sound pressure levels at NSAs near the proposed highway. Noise sensitive areas are those locations such as residences or areas near residences that may be sensitive to changes in noise before and after the highway construction is completed. The modelling is conducted using the Federal Highway Administration Traffic Noise Model (FHWA-TNM, Version 2.0) combined with local data on terrain, vegetation, traffic volumes and traffic composition in terms of the fraction of vehicles that are heavy trucks.

To ensure a high degree of accuracy in the model predictions used in this Environmental Assessment, model validation was conducted at eleven locations along existing roadways near the proposed TCH. The selection of the noise validation measurement locations was based on the proximity of receivers to the Project and the existence of a clear line of sight to the existing roadway. Validation measurement was conducted immediately adjacent to the roadways to ensure that only noise generated as a result of traffic on the roadways was measured. The locations and time of the measurement are presented in Table 5.1.3. The measurement locations are also presented graphically in Figures 3.2-A to 3.2-D.

Table 5.1.3 Noise Measurement Locations for Model Validation Purposes

Location for Model Validation Measurement	Latitude	Longitude	Date	Start Time	Stop Time
Beaconsfield Road	46° 42' 18.3"	67° 44' 24.9"	August 11, 2003	05:37 PM	06:42 PM
Bowmaster Flats	46° 40' 56.5"	67° 43' 41.7"	August 11, 2003	04:12 PM	05:17 PM
Route 560 Site B	46° 35' 33.0"	67° 44' 41.9"	August 8, 2003	03:41 PM	04:46 PM
B Smith Road	46° 31' 57.9"	67° 42' 11.1"	August 8, 2003	02:06 PM	03:11 PM
Backland Road	46° 29' 40.9"	67° 40' 25.2"	August 8, 2003	12:40 PM	01:48 PM
Sipprell Road	46° 28' 00.2"	67° 40' 04.1"	August 28, 2003	05:55 PM	06:57 PM
Route 110	46° 26' 24.9"	67° 39' 05.6"	August 8, 2003	09:26 AM	10:32 AM
Raymond Road	46° 19' 01.6"	67° 35' 19.4"	July 31, 2003	5:06 PM	5:50 PM
Estey Road	46° 16' 21.2"	67° 35' 19.7"	July 31, 2003	11:06 PM	12:06 PM
Palmer Road	46° 15' 03.2"	67° 36' 07.2"	July 31, 2003	11:33 AM	12:39 PM
Route 560 Site A	46° 11' 55.9"	67° 36' 36.3"	July 31, 2003	10:11 AM	11:14 AM

The 1-hour L_{eq} measured at each location was compared to the noise model prediction, which in turn was based on the traffic volumes observed during the noise monitoring events. The lower limit of human perception of a change in sound level is 3 dB_A. The results of the model validation are presented in Table 5.1.4. Overall, the model predictions are in good agreement with the measured values. For those predictions above 3 dB_A, estimates are conservative (*i.e.*, higher than measured). Therefore, the noise model is capable of providing a reasonably representative prediction of noise due to nearby vehicle traffic.

Table 5.1.4 Noise Model Validation

Noise Sensitive Area Monitor Location	Measured L_{eq} (dB_A)	Modelled L_{eq} (dB_A)	Difference L_{eq} (dB_A)
Estey Road	59.4	54.9	-4.5
Palmer Road	55.7	52.7	-3.0
Raymond Road	56.9	56.0	0.9
Route 560 Site A	64.3	60.6	-3.7
Route 110	62.2	59.5	2.7
Sipprell Road	53.7	51.4	-2.3
Backland Road	49.6	47.1	-2.5
B Smith Road	54.3	57.2	+2.9
Route 560 Site B	57.1	54.2	-2.9
Bowmaster Flats	66.0	70.3	+4.3
Beaconsfield Road	51.6	48.9	-2.7

M.L. = Monitor Location

5.1.3 Criteria for Establishing Threshold of Significance

A *significant residual environmental effect* on Air Quality is one that degrades the quality of the air such that the maximum Project-related ground-level concentration of the contaminants of concern (PM, SO_2, NO_X, and CO) leads to the exceedance of the ambient air quality standards.

In the absence of specific regulatory guidance on CO_2 emissions or ambient CO_2 concentrations, a *significant residual environmental effect* on Air Quality in terms of greenhouse gas emissions for this EA is considered to be a substantive increase to provincial releases (*i.e.*, >1% of total Provincial CO_2 emissions). This is in itself a conservatively set threshold as climate change is a global phenomenon to which New Brunswick is a small contributor in the national and global contexts.

A *significant residual environmental effect* with respect to Sound Quality may be defined as a noticeable change in noise level (an average of approximately 10 dB_A above background) over a sustained period (24-hour), or a frequent exceedance of the noise guideline level at an NSA ("Frequent" is defined as 1 day per month of 12 days per year). In the absence of official regulatory guidelines in New Brunswick for ambient noise, the current NBDOT noise limit of 65 dB_A (24-hour L_{eq}) will be used as the noise guideline level(ADI Limited 2003).

5.1.4 Existing Conditions

5.1.4.1 Climate

The climate of New Brunswick is typically continental. The proposed TCH will be located in a largely rural area 200 km or more inland from the Gulf of St. Lawrence and the North Atlantic Ocean. The area experiences a continental climate with large temperature swings with the seasons; cold with substantial snowfall in the winter and warm with high relative humidity in the summer.

The description of the climate for the Project is based upon climate normals from four Environment Canada weather stations located in the vicinity of the proposed project. These climate data are presented for each of the four weather stations, Woodstock, Aroostook, Saint-Léonard, and Grand Falls, in Tables 5.1.5 to 5.1.8, respectively. The weather data from these sites are considered to be an accurate representation of average weather conditions in the vicinity of the proposed TCH.

Table 5.1.5 Monthly Climate Normals – 1971-2000
Woodstock, New Brunswick
Long 46° 09' N Lat 67° 35' W, Elevation 153 m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
T extreme max (C)	13.3	16.5	23.9	31.5	35.6	35.6	36.7	39.4	34.4	30.0	22.8	16.1	--
T mean max (C)	-5.7	-3.3	2.4	9.3	18.1	22.8	25.5	24.6	19.1	11.9	4.6	-2.7	10.5
T mean min (C)	-17.2	-16.0	-8.8	-1.9	4.5	9.9	13.0	12.0	7.0	1.1	-3.9	-12.5	-1.1
T extreme min (C)	-43.5	-43.9	-37.2	-23.3	-9.4	-6.7	-1.1	-1.0	-6.7	-13.3	-25.0	-40.6	--
T daily mean (C)	-11.5	-9.7	-3.2	3.7	11.3	16.4	19.3	18.3	13.1	6.5	0.4	-7.6	4.8
Mean Precip (mm)	107.3	67.5	91.9	77.0	94.5	98.0	92.0	96.0	95.7	92.0	96.9	104.9	1113.5
Mean Snow Fall (cm)	74.4	48.5	53.6	20.6	0.5	0.0	0.0	0.0	0.1	2.7	21.6	56.7	278.9
Mean # days with Measurable Precipitation	11.3	9.1	11.0	11.0	12.3	11.8	11.3	11.1	10.7	10.8	11.8	12.7	134.8

Environment Canada 2002a.

Table 5.1.6 Monthly Climate Normals – 1971-2000
Aroostook, New Brunswick
Lat 46° 48' N, Long 67° 53' W, Elevation 91 m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
T extreme max (C)	14.5	13.5	23.9	29.5	34.0	36.1	35.6	37.2	32.8	29.4	21.1	16.1	--
T mean max (C)	-6.7	-4.4	1.8	8.9	17.4	22.5	24.9	23.7	18.3	11.2	3.8	-3.5	9.8
T mean min (C)	-18.3	-17.2	-9.6	-2.0	4.4	9.7	12.7	11.6	7.1	1.4	-4.0	-13.2	-1.4
T extreme min (C)	-43.9	-42.2	-36.7	-22.2	-11.1	-2.8	1.7	-0.6	-6.7	-13.9	-23.3	-42.8	--
T daily mean (C)	-12.5	-10.8	-3.9	3.5	10.9	16.1	18.8	17.7	12.7	6.4	-0.1	-8.3	4.2
Mean Precip (mm)	99.6	65.6	81.5	77.7	92.5	90.2	107.4	102.0	89.2	86.0	93.7	100.9	1086.3
Mean Snow Fall (cm)	72.0	51.4	52.3	24.1	0.6	0.0	0.0	0.0	0.1	2.9	31.8	63.6	298.8
Mean # days with Measurable Precipitation	12.3	9.8	12.9	13.2	13.5	12.0	13.5	12.1	11.1	12.7	12.6	13.5	149.2

Environment Canada 2002a.

Table 5.1.7 Monthly Climate Normals – 1971-2000
Saint-Léonard, New Brunswick
Long 47° 09' N Lat 67° 49' W, Elevation 243 m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
T extreme max (C)	11.7	14.4	17.7	28.1	34.6	32.7	34.2	34.6	31.2	23.7	18.7	12.7	--
T mean max (C)	-7.0	-5.8	0.7	7.8	16.6	21.5	23.8	22.7	17.4	10.2	2.4	-4.4	8.8
T mean min (C)	-18.4	-17.8	-10.3	-2.5	3.5	8.5	11.6	10.4	5.6	0.3	-5.9	-13.9	-2.4
T extreme min (C)	-36.8	-33.4	-33.6	-18.3	-5.6	-2.5	3.3	1.5	-6.3	-9.6	-23.2	-32.6	--
T daily mean (C)	-12.7	-11.8	-4.8	2.7	10.1	15.1	17.8	16.6	11.5	5.3	-1.7	-9.2	3.2
Mean Precip (mm)	115.2	64.6	74.0	77.8	88.6	97.0	111.6	109.3	95.0	93.8	85.0	79.8	1091.5
Mean Snow Fall (cm)	95.3	63.1	56.9	28.6	2.9	0.0	0.0	0.0	0.1	6.3	35.6	64.8	353.5
Mean # days with Measurable Precipitation	18	12.4	13.9	13.8	14.9	14.3	14.3	14.4	13.9	15.6	15.1	14.7	175.1

Environment Canada 2002a.

Table 5.1.8 Monthly Climate Normals – 1971-2000
Grand Falls Drummond, New Brunswick
Long 47° 02' N Lat 67° 42' W, Elevation 229 m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
T extreme max (C)	10.5	11.5	16.0	27.5	33.0	33.9	33.5	32.8	29.5	25.6	18.0	13.9	
T mean max (C)	-8.3	-5.9	0.1	7.1	16.2	20.9	23.3	22.2	16.6	9.7	2.2	-5.3	8.2
T mean min (C)	-17.7	-15.6	-9.5	-1.7	5.0	9.9	12.8	11.8	6.7	1.9	-4.3	-13.7	-1.2
T extreme min (C)	-36.7	-35.6	-38.0	-18.5	-7.8	0.0	2.8	0.0	-4.0	-9.4	-22.0	-34.0	
T daily mean (C)	-13.0	-10.8	-4.6	2.7	10.6	15.4	18.1	17.0	11.7	5.8	-1.1	-9.5	3.5
Mean Precip (mm)	94.4	65.8	81.5	77.5	86.2	101.2	117.5	126.8	99.6	91.3	92.1	100.8	1134.4
Mean Snow Fall (cm)	71.6	55.1	47.0	24.8	0.7	0.0	0.0	0.0	0.0	1.8	31.1	67.9	300.1
Mean # days with Measurable Precipitation	11.1	9.7	11.6	12.8	13.3	14.5	14.3	14.4	13.2	13.0	12.6	13.4	153.8

Environment Canada 2002a.

The climate data for all four sites are very similar. This similarity is expected since the sites are located relatively close together and in similar landscapes and climate differences are small and would be due to potential microclimate effects at these sites.

During the winter, the air mass is often cold and unaltered with an average daily temperature of -12.3°C in January. During the summer, the air mass is predominantly warm continental with an average July daily mean temperature of 18.5°C. The extreme maximum and minimum temperatures recorded in the region are 39.4°C and -43.9°C, respectively.

The average annual precipitation in the vicinity of the Project is 1099.9 mm, of which approximately 79% is in the form of rain. The frequency of precipitation is fairly consistent throughout the year, with peak amounts generally occurring during the months of July, August, September, December, and January.

The proposed TCH runs through many areas containing hills and valleys. Due to the potential for local terrain induced effects on wind patterns (wind speed and direction), a graphical presentation of the prevailing wind direction and velocity could vary highly depending on the site selected. For areas located in valleys, the prevailing wind direction is commonly along the valley.

Differences in wind patterns by geographic location, along the general traverse of the proposed project RoW (from north to south), are demonstrated in the wind rose plots for Saint-Léonard, New Brunswick, Caribou, Maine and Fredericton, New Brunswick (Figures 5.1.1 to 5.1.3, respectively). In all cases there is a substantial component from the northwest and the wind blows most frequently from the westerly directions. The average wind speed at the sites is 3.67 m/s, 4.08 m/s and 3.54 m/s, respectively. These values are representative of conditions within the vicinity of the Project.

5.1.4.2 Ambient Air Quality

The Province of New Brunswick, through the NBDELG, has been operating a network of ambient air monitoring stations within the province to measure air quality parameters in real time mode. Not all sites measure all pollutants, however the data presented for various monitoring locations are considered to be the most representative for the proposed TCH, where PM, PM_{10}, $PM_{2.5}$, SO_2, and NO_X were monitored. The monitoring stations considered in the analysis to establish existing conditions for the project are listed below:

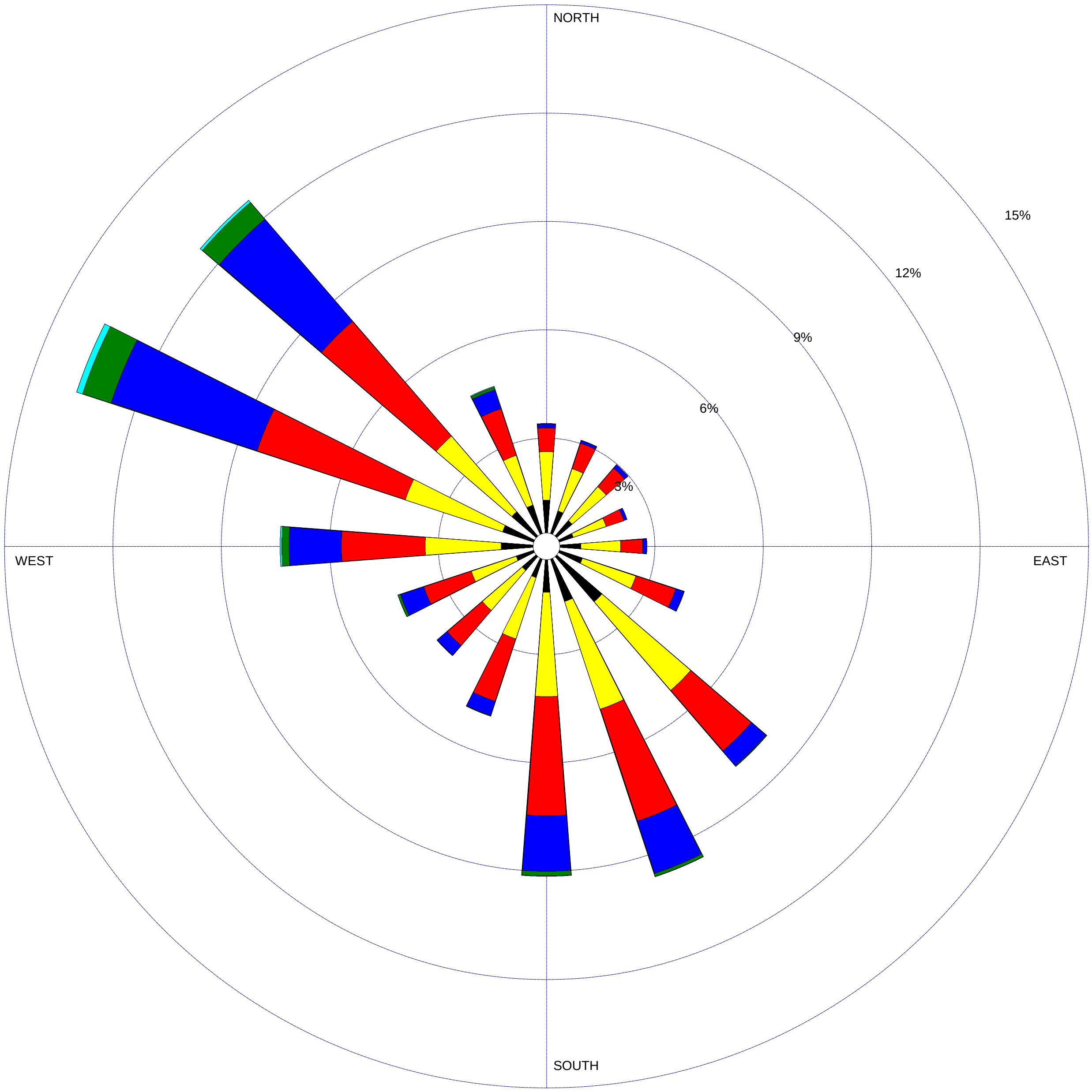
- Fredericton (York Street);
- Fredericton (Aberdeen Street);
- Nackawic;
- Canterbury;
- Saint-Léonard;
- Edmundston (Cormier); and
- Edmundston (Sacred Heart).

More detail on the air quality monitoring stations, the pollutant types and specific monitoring locations may be found in the annual publication by the NBDELG (2003a) and NBDOE in previous years (NBDOE 1999a, b, 2000) (the acronyms NBDELG and NBDOE are synonymous with the provincial Department of the Environment).

The Environmental Protection Service of Environment Canada (EPS) is responsible for the operation of several ambient air quality monitors across Canada. This network is referred to as the National Air Pollution Surveillance or NAPS network. The data from these monitoring activities is provided in summary reports published annually (Environment Canada 1998, 1999a, b, 2000, 2001a, b, 2002b).

The ambient air quality monitoring network in New Brunswick is operated cooperatively by Environment Canada and the NBDELG. Both agencies produce annual reports with detailed summaries of the measured data recorded each year. The reports differ in the presentation of the data. Environment Canada presents the data in percentile format with no interpretation while the NBDELG presents data summaries of means, trends and some interpretation of results. For this reason it is useful to provide a review of both sets of reports.

WIND ROSE PLOT
ST. LEONARD, NEW BRUNSWICK

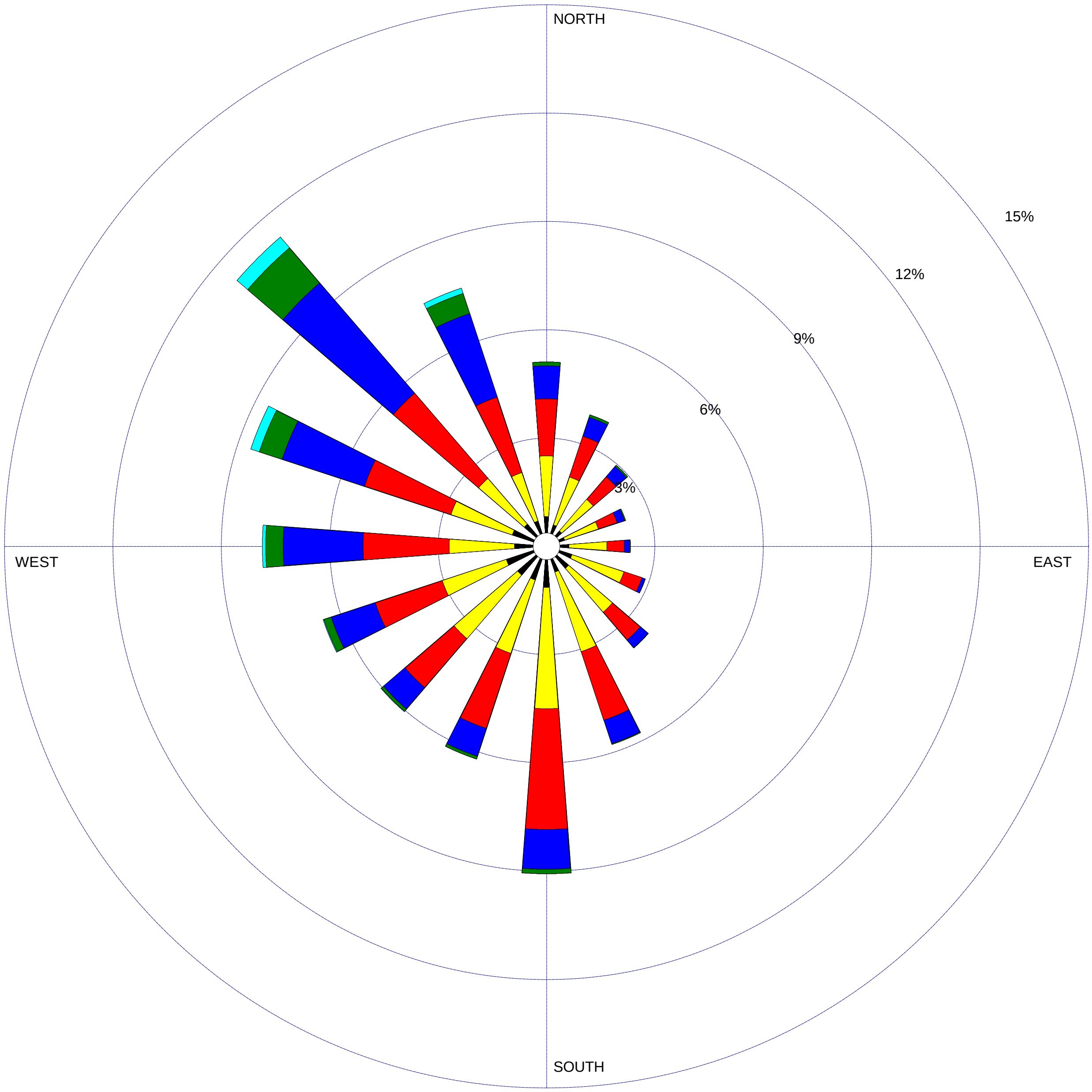


Wind Speed (m/s)	MODELER **ECS**	DATE **7/6/03**	COMPANY NAME **Jacques Whitford Environment Ltd.**
> 11.06 8.49 - 11.06 5.40 - 8.49 3.34 - 5.40 1.80 - 3.34 0.51 - 1.80	DISPLAY **Wind Speed**	UNIT **m/s**	COMMENTS **Meteorological Data** **St. Leonard Airport** **1986-1990**
	AVG. WIND SPEED **3.67 m/s**	CALM WINDS **2.91%**	
	ORIENTATION **Direction** **(blowing from)**	PLOT YEAR-DATE-TIME **1986** **Jan 1 - Dec 31** **Midnight - 11 PM**	PROJECT/PLOT NO. **Figure 5.1.1**

WRPLOT View 3.05 by Lakes Environmental Software - www.lakes-environmental.com

WIND ROSE PLOT

CARIBOU, MAINE

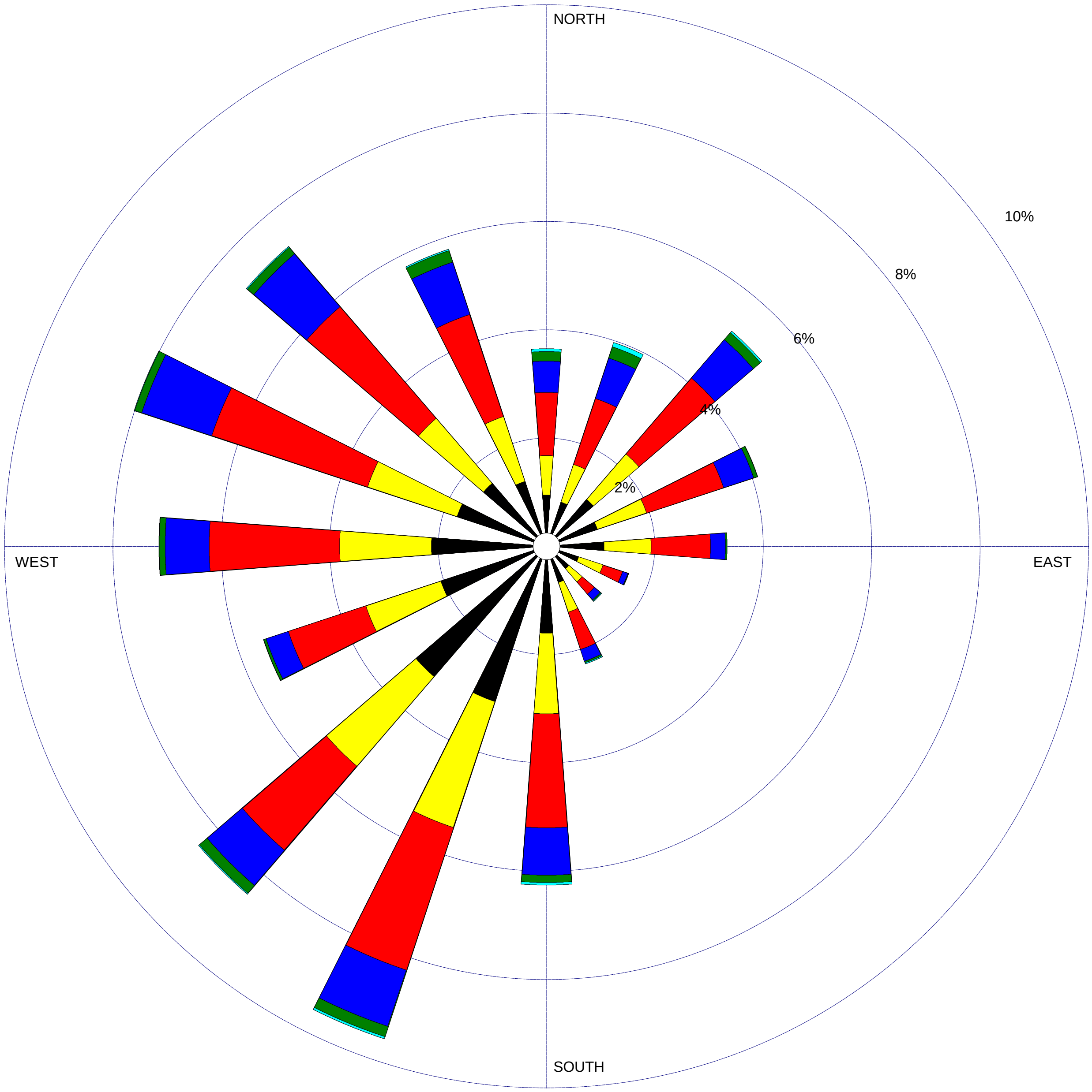


Wind Speed (m/s)	MODELER	DATE	COMPANY NAME
> 11.06	**MRS**	**1/19/01**	**Jacques Whitford Environment Ltd.**
8.49 - 11.06	DISPLAY: **Wind Speed**	UNIT: **m/s**	COMMENTS: **Meteorological Data 1985-1989**
5.40 - 8.49	AVG. WIND SPEED: **4.08 m/s**	CALM WINDS: **7.95%**	
3.34 - 5.40	ORIENTATION: **Direction (blowing from)**	PLOT YEAR-DATE-TIME: **1985 Jan 1 - Dec 31 Midnight - 11 PM**	PROJECT/PLOT NO. **Figure 5.1.2**
1.80 - 3.34			
0.51 - 1.80			

WRPLOT View 3.05 by Lakes Environmental Software - www.lakes-environmental.com

WIND ROSE PLOT

FREDERICTON, NEW BRUNSWICK



Wind Speed (m/s)	MODELER	DATE	COMPANY NAME
> 11.06	**MRS**	**3/6/01**	**Jacques Whitford Environment Ltd.**
8.49 - 11.06	DISPLAY: **Wind Speed**	UNIT: **m/s**	COMMENTS: **Meteorological Data Fredericton Airport 1995-2000**
5.40 - 8.49	AVG. WIND SPEED: **3.54 m/s**	CALM WINDS: **16.45%**	
3.34 - 5.40	ORIENTATION: **Direction (blowing from)**	PLOT YEAR-DATE-TIME: **1995 Jan 1 - Dec 31 Midnight - 11 PM**	PROJECT/PLOT NO.
1.80 - 3.34			
0.51 - 1.80			

Figure 5.1.3

WRPLOT View 3.05 by Lakes Environmental Software - www.lakes-environmental.com

5.1.4.2.1 Trends – Short Term 1995-2001

The information on short term trends in ambient air quality was obtained from the NBDELG's annual air quality report for the year 2001 (NBDELG 2003a), and from Environment Canada's National Air Pollution Surveillance (NAPS) Network Annual Summary for 2000 (Environment Canada 2001a). The reader is referred to these reports for more detailed information. It should be noted that not all parameters are measured at all of the monitoring locations. However, all parameters of interest are measured at a minimum of one of the stations considered. Some highlights of these reports are presented below. A summary of the ambient monitoring data from 1995 to 2001 is presented in Table 5.1.9.

Particulate Matter

Particulate matter (PM, also referred to as Total Suspended Particulate matter or TSP) in general, tends to be present as a result of local emissions and is therefore a potential local environmental effect rather than a regional issue. Nonetheless, data are presented for values measured at NBDELG's Fredericton (York Street) and Edmundston monitoring sites.

Exceedances of the 24-hour standard ranged from 6-14 days per year over the 1996 to 2000 data set at the Cormier Site in Edmundston. Higher values measured at the Cormier site are attributed to road dust from heavy traffic, due to the location of the monitor. The Sacred Heart site in Edmundston averages one exceedance of the 24-hour standard per year in 2001.

Exceedances of the 24-hour standard ranged from 0 to 2 per year for 1996 to 1998. Particulate matter was not monitored at the Fredericton monitoring station. There were four exceedances reported on both 1999 and 2000 and are attributed to construction activities occurring near the monitoring station.

The particulate matter monitor at the Nackawic station was installed and operational in 2000. There have been no exceedances of the 24-hour or annual standards and measured concentrations were low.

The measured annual average concentrations of PM in Edmundston ranged from 31-55 $\mu g/m^3$ (1996-2000). The annual average concentration for Fredericton ranged from 26-60 $\mu g/m^3$ from 1995-2001. In all cases, the measured concentrations were below the provincial standards.

Respirable Particulate Matter ($PM_{2.5}$)

Respirable particulate or $PM_{2.5}$ was also monitored continuously in 1999 and 2000 at the province's Fredericton monitoring station located on Aberdeen Street. Available data is not sufficient for a full comparison with the Canada Wide Standard (30 $\mu g/m^3$ as a 24-hour average, over three years). However, there was one exceedance in 1999 for 19 hours. No exceedances were observed in 2000. The 98th percentile value for 2000 was 18.0 $\mu g/m^3$, which is lower than 22.7 $\mu g/m^3$ from 1999.

Sulfur Dioxide

Ambient SO_2 concentrations are based on provincial data for Edmundston and Nackawic (monitoring of sulfur dioxide is not conducted at the other stations considered in the assessment). Compliance of the 1-hour and 24-hour SO_2 standards, expressed as the total number of hours below the applicable standards was 99.98% (two exceedances of the 1-hour standard in 2000) for the Cormier site and 100% (no exceedances) at the Sacred Heart site in 2000. There were no exceedances of the annual standard in 2000. There were no exceedances of the 1-hour, 24-hour annual standards in 2001.

The Nackawic monitoring station was established in 1999. Compliance of the standard has been 100% from 1999 to 2001.

Nitrogen Dioxide

Ambient nitrogen dioxide (NO_2) concentrations are based on the data for Fredericton (monitoring of nitrogen dioxide is not conducted at the other stations considered). There were no exceedances of the 1-hour, the 24-hour or annual standards observed in the provincial data for Fredericton, for the period 1996-2000 inclusive.

The measured annual concentration of NO_2 has gradually decreased over the past few years with the data ranging from 13-18 $\mu g/m^3$ over the 3-year period.

5.1.4.2.2 Trends Long-Term

Analysis of long-term trends has not been conducted as the monitoring stations considered for the assessment have been in operation for a relatively short time period and therefore data are not available to conduct a reliable trend analysis.

Table 5.1.9 Ambient Air Quality Monitoring Data 1995-2001

National Air Pollution Surveillance (NAPS) Network and NBDELG

SO_2 (µg/m^3) (Maximum)	1995	1996 Site F	1996 Site G	1997 Site F	1997 Site G	1998 Site F	1998 Site G	1999 Site F	1999 Site G	2000 Site C	2000 Site F	2000 Site G	2001 Site C	2001 Site F	2001 Site G
1-hour		245	320	314	173	331	143	615	113	64	454	99	76	244	-
24-hour		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annual Mean		18	8	10	6	10	4	12	4	1	14	6	1	12	-
Dataset (months)		12	12	12	12	12	12	12	12	12	12	5	12	12	-

NO_2 (µg/m^3) (98th percentile)	1995	1996	1997	1998	1999 Site B	2000 Site B	2001 Site B
1-hour					49	53	56
24-hour					34	40	56
Annual Mean					18	17	13
Dataset (months)					8	11	5

NO (µg/m^3) (98th percentile)	1995	1996	1997	1998	1999 Site B	2000 Site B	2001 Site B
1-hour					61	34	55
8-hour					43	22	36
Annual Mean					9	6	7
Dataset (months)					8	11	5

CO (µg/m^3) (98th percentile)	1995	1996	1997	1998	1999 Site B	2000 Site B	2001 Site B
1-hour					916	1472	1472
8-hour					916	1350	1227
24-hour					859	1227	982
Annual Mean					307	491	491
Dataset (months)					8	12	12

O_3 (µg/m^3) (98th percentile)	1995 Site D	1996 Site D	1997 Site D	1998 Site D	1999 Site B	1999 Site D	2000 Site B	2000 Site D	2000 Site E	2001 Site B	2001 Site D	2001 Site E
1-hour	96	110	94	98	80	96	90	90	90	84	86	108
8-hour	-	108	90	96	77	92	84	88	88	80	82	102
24-hour	84	102	82	90	67	86	77	82	82	71	79	92
Annual Mean	57	67	51	57	35	53	49	51	52	39	49	57
Dataset (months)	12	7	8	12	8	12	11	12	8	12	11	10

PM/TSP (µg/m^3) (90th percentile)	1995 Site A	1996 Site A	1996 Site F	1996 Site G	1997 Site A	1997 Site F	1997 Site G	1998 Site A	1998 Site F	1998 Site G	1999 Site A	1999 Site F	1999 Site G	2000 Site A	2000 Site C	2000 Site F	2000 Site G	2001 Site A	2001 Site C	2001 Site F	2001 Site G
24-hour	49	53	100	66	81	113	65	71	103	63	99	85	54	105	25	104	78	39	20	-	-
Annual Mean	33	33	55	36	42	50	31	42	55	34	60	-	-	54	-	50	40	26	-	-	-
Dataset (months)	12	12	12	12	12	12	12	12	12	12	11	12	12	11	12	7	4	1	12	12	-

PM 2.5 (µg/m^3) (98th percentile)	1995	1996	1997	1998	1999 Site B	2000 Site B	2001 Site B
1-hour					28	30	25
24-hour					22	23	17
Annual Mean					9	9	6
Dataset (months)					7	12	12

Site A – York Street, Fredericton (NAPS + NBDELG) Site B – Aberdeen Street, Fredericton (NAPS) Site C – Nackawic (Nackawic Pulp and Paper) Site D – Canterbury (NAPS + NBDELG)
Site E – Saint-Léonard (NAPS) Site F – Cormier, Edmundston (Fraser Papers) Site G – Sacred Heart, Edmundston (Fraser Papers)

NOTE: Not all parameters are measured at all of the sites

5.1.4.3 Sound Quality

Outdoor sound quality near roadways during construction and operation can be influenced by vehicle traffic, by the operation of heavy equipment such as bulldozers, trucks, or diesel generators, by blasting, and by weather conditions such as temperature, humidity, wind direction and wind speed. Local topographical features such as hills or wooded areas may serve to attenuate sound levels. There may be sound reflections if the atmospheric mixing height is low (a few hundred metres), or if solid structures are located near the source of noise emissions. Sound from traffic may increase during wet weather due to increased tire noise.

The sound quality, represented by existing sound pressure levels at the RoW boundaries, is expected to be typical of a rural, relatively remote area. In order to characterize the sound quality in the Assessment Area, a baseline noise assessment was conducted. This consisted of measuring the sound pressure levels at eleven locations representative of NSAs such as areas near residential homes or buildings, along the proposed RoW and comparing these with typical regulatory threshold values.

NSA 1 – Beaconsfield Road

This noise sensitive area is a residence located along the Beaconsfield Road as shown on Figure 3.2-A. The noise meter was located near the residence, approximately 15 m from the Beaconsfield Road, and approximately 880 m from the existing Route 2. The proposed TCH will be located approximately 200 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,000 vehicles per day for the Beaconsfield Road and 4210 vehicles per day on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 2 – Bowmaster Flats

This noise sensitive area is a residence located along the existing Route 2 as shown on Figure 3.2-A. The noise meter was located near the residence, approximately 30 m from the existing Route 2. The proposed TCH will be located approximately 100 m from the residential property on the opposite side to the residence as the existing Route 2.

The AADT in this area is estimated to be 4210 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 3 – Route 560 Site B (River De Chute)

This noise sensitive area is a residence located along Route 560 as shown on Figure 3.2-A. The noise meter was located near the residence, approximately 1,400 m from the existing Route 2. The proposed TCH will be located approximately 140 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,500 vehicles per day for Route 560 and 4210 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 4 – B Smith Road

This noise sensitive area is a residence located along the B Smith Road as shown on Figure 3.2-B. The noise meter was located near the residence, approximately 15 m from the B Smith Road and approximately 2,000 m from the existing Route 2. The proposed TCH will be located approximately 130 m from the residential property on the opposite side to the residence as the existing Route 2.

The AADT in this area is estimated to be 1,000 vehicles per day for the B Smith Road and 4210 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 5 – Backland Road

This noise sensitive area is a residence located along the Backland Road as shown on Figure 3.2-B. The noise meter was located near the residence, approximately 7 m from the Backland Road and over 2,000 m from the existing Route 2. The proposed TCH will be located approximately 70 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,000 vehicles per day for the Backland Road and 4580 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 6 – Sipprell Road

This noise sensitive area is a residence located along the Sipprell Road as shown on Figure 3.2-B. The noise meter was located near the residence, approximately 5 m from the Sipprell Road and over 2,000 m from the existing Route 2. The proposed TCH will be located approximately 300 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,000 vehicles per day for the Sipprell Road and 4580 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 7 – Route 110

This noise sensitive area is a residence located along Route 110 as shown on Figure 3.2-C. The noise meter was located west of the residence, approximately 8 m from Route 110 and over 2,000 m from the existing Route 2. The proposed TCH will be located approximately 150 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 3,080 vehicles per day for Route 110 and 4580 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 8 – Raymond Road

This noise sensitive area is a residence located along the Raymond Road as shown on Figure 3.2-C. The noise meter was located west of the residence, approximately 5 m from the Raymond Road and over 2,000 m from the existing Route 2. The proposed TCH will be located approximately 370 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,500 vehicles per day for the Raymond Road and 6530 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 9 – Estey Road

This noise sensitive area is a residence located along the Raymond Road as shown on Figure 3.2-D. The noise meter was located near the residence, approximately 4 m from the Estey Road and approximately 1,000 m from the existing Route 2. The proposed TCH will be located approximately 120 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,500 vehicles per day for Estey Road and 7960 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 10 – Palmer Road

This noise sensitive area is a residence located along the Raymond Road as shown on Figure 3.2-D. The noise meter was located west of the residence, approximately 5 m from the Palmer Road and approximately 1,000 m from the existing Route 2. The proposed TCH will be located approximately 200 m from the residential property on the opposite side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,000 vehicles per day for Palmer Road and 8790 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

NSA 11 – Route 560 Site A

This noise sensitive area is a residence located along Route 560 as shown on Figure 3.2-D. The noise meter was located east of the residence, approximately 8 m from Route 560 and approximately 100 m from the existing Route 2. The proposed TCH will be located approximately 80 m from the residential property on the same side of the residence as the existing Route 2.

The AADT in this area is estimated to be 1,980 vehicles per day for Route 560 and 8790 on Route 2 for the existing case (Tim Holyoke, pers. comm.). Traffic represents the primary source of the noise measured at this NSA.

Baseline Noise Assessment Results

Noise monitoring was conducted during the period of July 31 to August 11, 2003. Noise levels were measured at the locations using a Type 1 sound level meter (a Bruel & Kjaer Type 2236 and a Larson Davis System 824). Monitoring was conducted for one hour at each of the sites listed in Table 5.1.3 for model calibration purposes. Traffic counts and composition were also recorded. The measured data are considered to be representative of the sound level in the respective area. In addition, 24-hour sampling was conducted at two of the sites (Route 560 Site A, and B. Smith Road) in order to establish the variation over a full day. The 1 hour equivalent sound level (L_{eq}) values are presented in Table 5.1.10.

Table 5.1.10 Noise Monitoring Data Summary

Monitor Location	Date	Start Time	Stop Time	Total Traffic Flow (Vehicles)	% Heavy Trucks	Measured Noise Level L_{eq} (dB_A)
Beaconsfield Road	August 11, 2003	05:37 PM	06:42 PM	9	0	51.6
Bowmaster Flats	August 11, 2003	04:12 PM	05:17 PM	613	15.5	66.0
Route 560 Site B	August 8, 2003	03:41 PM	04:46 PM	25	4.0	57.1
B Smith Road	August 8, 2003	02:06 PM	03:11 PM	12	41.7	54.3
Backland Road	August 8, 2003	12:40 PM	01:48 PM	10	0	49.6
Sipprell Road	August 28, 2003	05:55 PM	06:57 PM	13	0	53.7

Table 5.1.10 Noise Monitoring Data Summary

Monitor Location	Date	Start Time	Stop Time	Total Traffic Flow (Vehicles)	% Heavy Trucks	Measured Noise Level L_{eq} (dB_A)
Route 110	August 8, 2003	09:26 AM	10:32 AM	177	19.2	62.2
Raymond Road	July 31, 2003	5:06 PM	5:50 PM	19	5.3	56.9
Estey Road	July 31, 2003	11:06 AM	12:06 PM	54	5.6	59.4
Palmer Road	July 31, 2003	11:33 AM	12:39 PM	9	11.1	55.7
Route 560 Site A	July 31, 2003	10:11 AM	11:14 AM	877	15.5	64.3

The values recorded at all locations demonstrate typical levels expected in rural areas and for the existing traffic volumes.

The results of the 24-hour monitoring conducted at the B. Smith Road and Route 560 Site A locations are presented graphically in Figures 5.1.4 and 5.1.5 respectively. At the time of monitoring, Route 560 had a more steady and larger traffic volume than the B Smith Road location, which is reflected in the trends presented where the Route 560 location (Figure 5.1.5) experienced levels near the guideline limit (hourly L_{eq} values between 60-63 dB_A during the day and 54-58 dB_A at night).

In both cases (24-hour L_{eq} values of 54 and 62 dB_A), the measurements did not exceed the NBDOT guideline of 65 dB_A (24-hour L_{eq}).

The data are representative of the existing conditions.

Figure 5.1.4 Noise Monitoring - 24 Hour Trend, B Smith Road

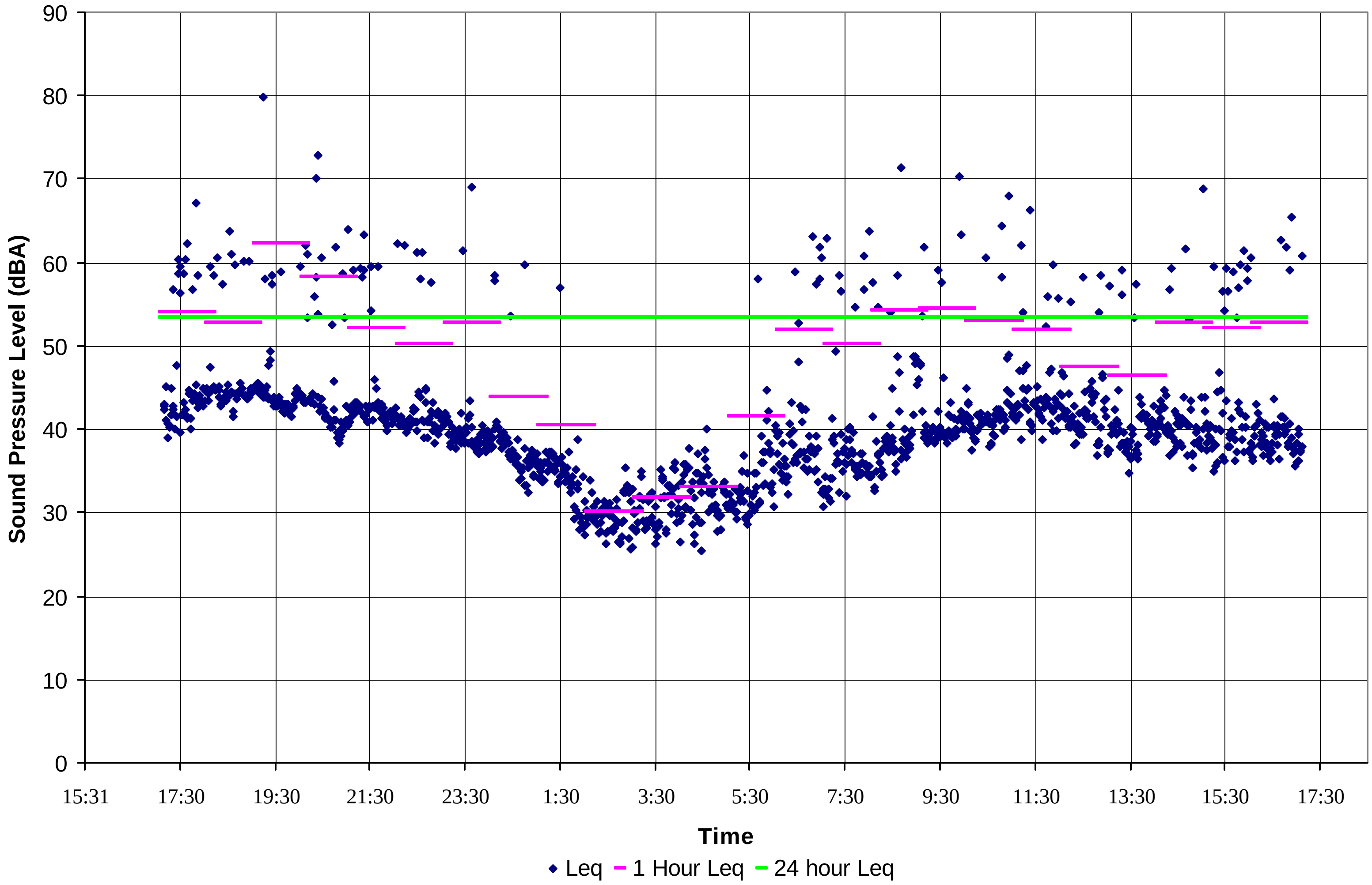
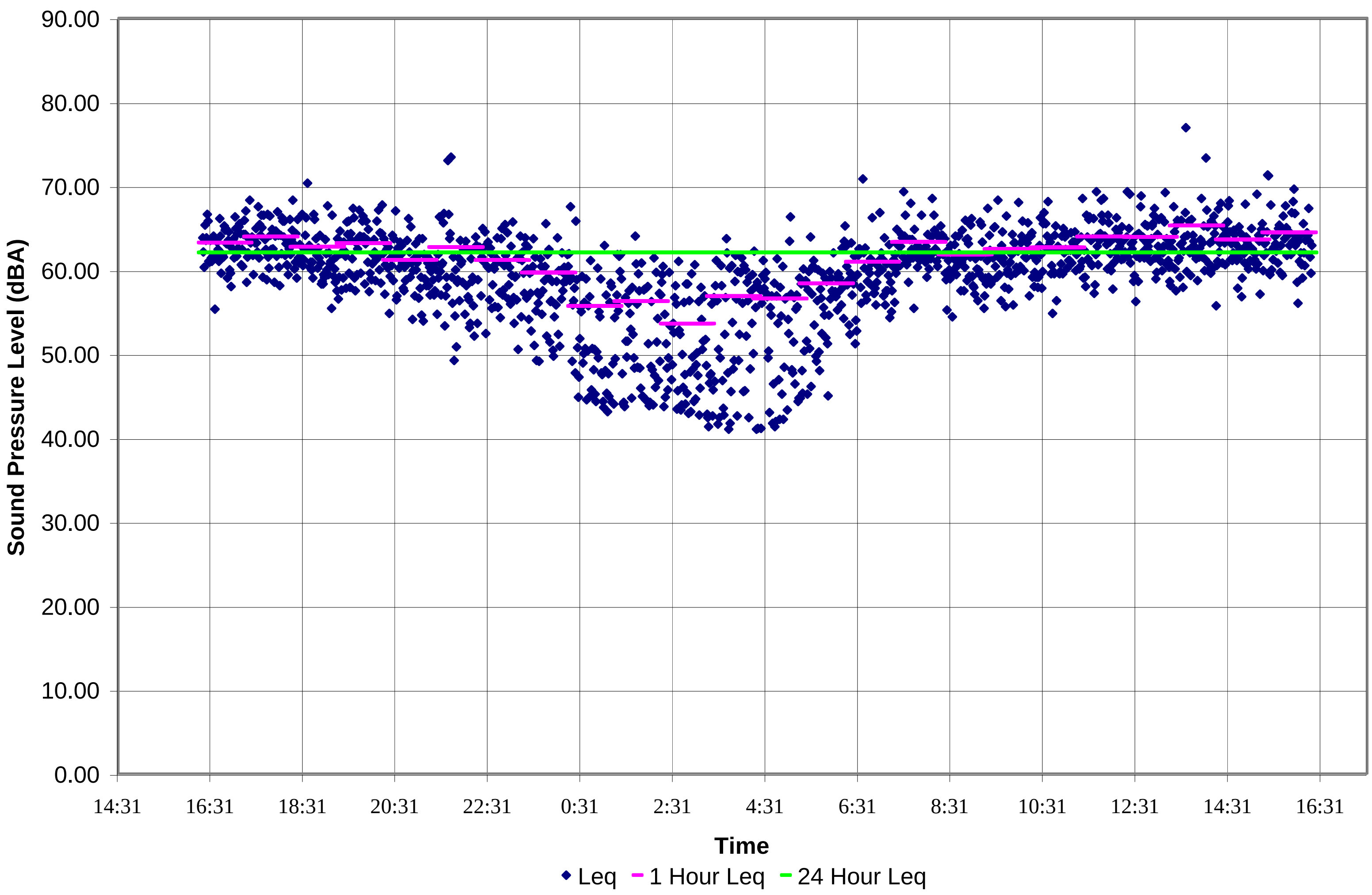


Figure 5.1.5 Noise Monitoring - 24 Hour Trend, Route 560



5.1.5 Environmental Effects Analysis

This section evaluates the significance of potential residual environmental effects resulting from the interaction of Project activities with the Atmospheric Environment. The proposed mitigation is included in the analysis.

5.1.5.1 Project-VEC Interactions

A summary of the potential environmental effects resulting from Project-VEC interactions, is provided in Table 5.1.11. The table is organized according to the various aspects of the VEC and each of the Project components assessed (*e.g.*, site preparation), as well as accidents, malfunctions and unplanned events.

Table 5.1.11 Project Activity – Environmental Effects Interaction Matrix for Atmospheric Environment

Potential Interactions Between Project Activities and Environmental Effects
Valued Environmental Component: ATMOSPHERIC ENVIRONMENT

Project Activities and Physical Works (see Table 4.1.1 for list of specific activities and works)	**Potential Environmental Effect**		
	Change in Air Quality	**Change in Sound Quality**	**Change in Local Climate**
Construction			
Site Preparation	✓	✓	
Roadbed Preparation	✓	✓	✓
Surfacing and Finishing	✓	✓	✓
Watercourse Crossing Structures	✓	✓	✓
Ancillary Structures and Facilities Construction	✓	✓	
Operation			
Winter Safety	✓	✓	
Proposed TCH Presence	✓	✓	
Maintenance			
Proposed TCH Maintenance	✓	✓	
Vegetation and Wildlife Management	✓	✓	
Accidents, Malfunctions and Unplanned Events			
Fires	✓	✓	

The data in Table 5.1.11 demonstrate that most Project activities will result in emissions to the atmosphere that will contribute to Project-related environmental effects on Air Quality. These are due to combustion gases and dust generated by project-related vehicles and equipment. All of the Project activities have some interaction with Sound Quality as well.

The potential for interaction of the project on climate, particularly microclimate effects, are primarily related to changes in wind patterns, snow deposition and the potential for cold air pooling. Wind patterns may be influenced from pressure and temperature differences on a regional scale due to differences in heating and cooling of land surfaces which can be characterized as either waterbodies, urban areas or rural areas. It is unlikely that Project-related emissions will cause any measurable difference or changes in air or land temperature.

Wind patterns at a more local level may be influenced by changes in topography such as large hills, mountains, or valleys. The presence of the topographical feature may substantially influence the wind flow at the earth's surface, especially with respect to wind direction and wind speed.

The construction of substantive rock cuts could alter the local microclimate by creating a wind tunnel effect, thereby increasing wind speeds within that area. However, the rock cuts and other changes in topography due to construction and operation of the proposed new highway are not expected to cause substantive changes in wind flow (direction or speed) and therefore are not expected to result in substantive changes in microclimate or climate patterns.

Deposition patterns of snow and associated accumulation of snow are likely to be redistributed due to topographical changes as a result of the construction and operation of the proposed new highway. The changes in the distribution of snow deposition and accumulation however, would be isolated to small areas along the proposed new highway and are not expected to be substantive.

Cold air pooling is a weather phenomenon where a cold air mass, being heavier than the surrounding air, flows along the ground in a down gradient direction and experiences a resistance to flow and forms a shallow pool. The resistance may be in the form of a simple barrier created by a change in elevation or other obstruction or a thick growth of vegetation that tends to slow down the flow of the cold air mass (Almkvist 1999; Environment Canada 1984).

In the case of roadways, if the roadway is located in a down gradient area (such as on the side of a hill) and if the elevation of the roadway is higher than the surrounding terrain, there is a potential for cold air pooling to occur. If the pooling occurs for long periods of time over large areas, there may be an adverse effect on the roadway due to cold air flow spillage across the roadway or there may be an adverse effect on the local vegetation because of the colder temperatures.

The topography, land use and cut and fill charts of the planned RoW were examined to assess the potential for cold air pooling. The locations of the planned cuts are in areas where there are large differences in the terrain elevations such that the roadbed would present a relatively small barrier to drainage flows of cold air. Thus in these instances, the existing drainage flows would not be significantly affected. There are three areas along the RoW where the terrain and fill locations coincide to cause a potential for cold air pooling. The land use at these locations is expected to be potato farming with rotation crops such as grain, oil seed and hay. Since these are considered frost resistant, no significant crop damage is expected to occur from cold air pooling.

As noted above, it is not anticipated that the construction and operation of the proposed highway will result in any substantive interaction with microclimate or climate including the primary or secondary climate parameters (temperature, wind characteristics, precipitation and sea states). Climate change environmental effects are therefore not considered further in the assessment.

5.1.5.1.1 Construction

Ambient Air Quality

Potential interactions between the construction activities and Ambient Air Quality are likely to occur in every phase of construction. During the construction phase, heavy equipment (including earth movers, excavation equipment and grading equipment) will be operated. There is potential for environmental effects from dust generated during the earth moving activities as well as emissions of combustion gases, including greenhouse gases (particularly carbon dioxide) from the construction equipment. In addition, there is potential for environmental effects due to emissions from the asphalt plants to be located and operated within the vicinity of the RoW.

Dust generation from construction activities, particularly during site preparation and sub-grade development will occur. Grubbing operations generally create few dust problems since the exposed soil is usually moist and the grubbed areas are seldom left exposed for extended periods. The removal of existing structures and roadways may create some particulate emissions. Blasting, handling of fill, dumping, grading and compaction are potential sources of airborne particulates, which may affect any residences within sight of the activity. Until the roadbed is paved, the movement of construction vehicles over unpaved roadways may generate airborne dust (suspended particulate matter), especially where these vehicles cross from the exposed area to a paved roadway. Dirt or mud clinging to the vehicles will be dispersed into the air as the vehicle accelerates or will fall onto the public roadway to be stirred up by other vehicles. In general, the dust is expected to disperse up to a distance of 300 m from the source.

Sound Quality

Interactions between the construction activities and the Sound Quality are likely for many construction activities. Changes in noise level can be expected due to activities such as blasting and the operation of the heavy equipment. Depending on the number and location of noise sensitive receptors (*i.e.*, residential properties, schools, and hospitals), and other factors affecting noise transmission (*i.e.*, vegetation, topography, meteorological conditions), the environmental effects of noise will vary.

Noise due to construction and noise due to operation of a highway are different in nature and the potential environmental effects may be different as well.

5.1.5.1.2 Operation

Ambient Air Quality

Interactions between the operation of the proposed TCH and Ambient Air Quality are expected to occur. Interactions of the emissions of combustion gases from the vehicle traffic and the Ambient Air Quality VEC are expected to occur primarily within the immediate vicinity of the Project.

Sound Quality

Interactions between the operation of the proposed TCH and Sound Quality are expected to occur. During operation (after construction is completed), the main source of noise will be the highway traffic which is transferred to the proposed TCH.

5.1.5.1.3 Maintenance

Ambient Air Quality

Interactions between the maintenance activities and Ambient Air Quality are expected to occur. During maintenance, mowing and vegetation control equipment, heavy equipment (possibly including paint striping equipment, earth movers, excavation equipment and grading equipment) will be operated. There is potential for environmental effects from dust generated due to some of the maintenance activities as well as emissions of combustion gases, including greenhouse gases (particularly carbon dioxide), from the equipment.

Sound Quality

Interactions between the maintenance of the proposed TCH and Sound Quality are expected to occur. During maintenance, the main sources of noise will be due to the operation of equipment used during maintenance activities, similar to those used during construction but also includes mowing and clearing equipment.

5.1.5.1.4 Accidents, Malfunctions and Unplanned Events

Ambient Air Quality

Potential interactions between the accidents, malfunctions and unplanned events, and the Ambient Air Quality VEC are expected to occur. The environmental effects on air quality related to these events would be limited primarily to environmental effects on air quality due to fires. There is potential for environmental effects on the environment from fine particles (smoke) due to fires.

Sound Quality

The Project may have some short term, isolated environmental effects on sound quality due to accidents, malfunctions and unplanned events.

5.1.5.2 Environmental Effects Analysis and Mitigation

The environmental effects analysis and mitigation for each of the Project phases is discussed in the following sections.

5.1.5.2.1 Construction

The environmental effects assessment matrix for the construction phase is presented in Table 5.1.12. A discussion of the environmental effects analysis and mitigation is provided below.

Table 5.1.12 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix
Valued Environmental Component: ATMOSPHERIC ENVIRONMENT
Phase: Construction

Project Activity (See Table 4.1.1 for list of specific activities and works)	**Potential Environmental Effects**	**Mitigation**	**Magnitude**	**Geographic Extent**	**Duration/Frequency**	**Reversibility**	**Ecological/Socio-Cultural and Economic Context**
Site Preparation	**Air Quality** • Dust Generation (A) • Combustion gases and dust emissions (A)	• Application of dust suppressant • Follow equipment maintenance schedules • Preserve natural vegetation where possible • Minimize activities that generate large quantities of fugitive dust during high winds	2	3	3/4	R	2
	Sound Quality • Noise emissions (A)	• Noise controls where possible (*e.g.,* mufflers) • Timing restrictions where warranted	2	3	3/4	R	2
	Greenhouse Gases (Air Quality) • Deforestation – reduction in carbon sequestration (A)	• Reforestation	2	4	5/6	1	2

Table 5.1.12 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix
Valued Environmental Component: ATMOSPHERIC ENVIRONMENT
Phase: Construction

Project Activity (See Table 4.1.1 for list of specific activities and works)	**Potential Environmental Effects**	**Mitigation**	**Magnitude**	**Geographic Extent**	**Duration/Frequency**	**Reversibility**	**Ecological/Socio-Cultural and Economic Context**
Roadbed Preparation	**Air Quality** • Dust Generation (A) • Combustion gases and dust emissions (A)	• Application of dust suppressant • Follow equipment maintenance schedules • Preserve natural vegetation where possible • Minimize activities that generate large quantities of fugitive dust during high winds	2	3	3/4	R	2
	Sound Quality • Noise emissions (A)	• Noise controls where possible (*e.g.,* mufflers) • Timing restrictions where warranted	2	3	3/4	R	2
Surfacing and Finishing	**Air Quality** • Dust Generation (A) • Combustion gases and dust emissions (A)	• Application of dust suppressant • Follow equipment maintenance schedules • Avoid activities that generate large quantities of fugitive dust during high wind events	2	3	3/4	R	2
	Sound Quality • Noise emissions (A)	• Noise controls where possible (*e.g.,* mufflers) • Timing restrictions where warranted	2	3	3/4	R	2
Watercourse Crossing Structures	**Air Quality** • Combustion gases and dust emissions (A)	• Application of dust suppressant • Follow equipment maintenance schedules • Preserve natural vegetation where possible • Minimize activities that generate large quantities of fugitive dust during high winds	2	1	3/2	R	2
	Sound Quality • Noise emissions (A)	• Noise controls where possible (*e.g.,* mufflers) • Timing restrictions where warranted	2	1	3/2	R	2
Ancillary Structures and Facilities Construction	**Air Quality** • Dust Generation (A) • Combustion gases and dust emissions (A)	• Application of dust suppressant • Follow equipment maintenance schedules • Preserve natural vegetation where possible • Minimize activities that generate large quantities of fugitive dust during high winds	2 2	3 3	3/4 3/4	R R	2 2

Table 5.1.12 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix
Valued Environmental Component: ATMOSPHERIC ENVIRONMENT
Phase: Construction

Project Activity (See Table 4.1.1 for list of specific activities and works)	**Potential Environmental Effects**	**Mitigation**	**Magnitude**	**Geographic Extent**	**Duration/Frequency**	**Reversibility**	**Ecological/Socio-Cultural and Economic Context**
	Sound Quality • Noise emissions (A)	• Noise controls where possible (*e.g.,* mufflers) • Timing restrictions where warranted	2	3	3/3	R	2

Key:

Magnitude:
1 = Low: *e.g.,* within normal variability of baseline conditions
2 = Medium: *e.g.,* increase/decrease with regard to baseline but within regulatory limits and objectives
3 = High: *e.g.,* singly or as a substantial contribution in combination with other sources causing exceedances or impingement upon limits and objectives beyond the project boundaries

Geographic Extent:
1 = <1 km^2
2 = 1-10 km^2
3 = 11-100 km^2
4 = 101 - 1,000 km^2
5 = 1,001 - 10,000 km^2
6 = >10,000 km^2

Duration:
1 = <1 month
2 = 1 - 12 months
3 = 13 - 36 months
4 = 37 - 72 months
5 = >72 months

Frequency:
1 = <11 events/year
2 = 11 - 50 events/year
3 = 51 - 100 events/year
4 = 101 - 200 events/year
5 = >200 events/year
6 = continuous

Reversibility:
R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:
1 = Relatively pristine area or area not adversely affected by human activity.
2 = Evidence of adverse environmental effects.

N/A = Not Applicable
(A) = adverse
(P) = positive

Ambient Air Quality

Ambient Air Quality may be affected during construction due to emissions associated with construction equipment operations (including asphalt plant emissions), changes in the greenhouse gas balance due to deforestation, and vehicle traffic on existing TCH. Each of these components is discussed below.

Highway Construction Activities

The amount and type of equipment used during construction will vary depending on the construction developer. The development of an inventory of construction equipment used in each phase is approximate and therefore existing information and professional judgement are used to assess the potential for environmental effects. Since paving of the highway involves relatively consistent equipment and resources based on the roadway geometry, the vehicle emissions inventory for the paving phase of construction was selected as the base model for modification and subsequent application to the other construction activities such as grading and the sub-base preparation.

Fugitive emissions such as road dust and dust from storage piles are transient in nature and difficult to characterize based on many factors such as the moisture in the soil, the level of activity at a particular location, and meteorological conditions at the time of the construction activities. Fugitive emissions will be mitigated by the application of dust suppressants such as water or calcium chloride during periods of heavy activity and/or dry periods to ensure that the airborne dust remains below the ambient standard. Limiting the extent of clearing and restricting activities during windy weather will further mitigate dust emissions. These dust suppression measures are reflected in Section 4.14 of the NBDOT EPP for construction (NBDOT 1998a).

For the purposes of this study, the following assumptions were made with regard to the development of the vehicle emissions inventory for the paving phase of construction:

- a single diesel paver, with an approximate flywheel power of 174 hp, is used per highway lane to be paved;
- paving rate is approximately 0.3 km of highway per hour of paving time;
- asphalt is laid down in three lifts over the entire stretch of each highway lane to be paved;
- four diesel asphalt compactors and 15 heavy-duty diesel hauling trucks accompany each paver during paving operations; and
- each truck hauls approximately 15 tonnes of asphalt from a portable asphalt plant, assuming a roundtrip distance of 10 km.

Emission factors and methodologies published by the US EPA for non-road diesel vehicles (US EPA, 2002) were used to estimate the emissions of sulfur dioxide, carbon dioxide, carbon monoxide, nitrogen oxides, and particulate matter (including PM_{10} and $PM_{2.5}$) for the paving phase of construction. Since most vehicles used during construction are powered with heavy duty diesel engines with approximately similar engine displacements, it is reasonable to assume that the proportion of heavy-duty vehicles per km of highway construction would remain fairly constant for all phases of construction.

For the purposes of this study and in order to provide a conservative estimate of vehicle emissions generated during construction, the yearly emissions from highway paving are considered to be equivalent to the yearly vehicle emissions from the other construction activities such as grading and subbase preparation as the relative proportion of vehicle types and hence diesel engines are comparative.

The operation of the associated asphalt plant(s) will be such that the applicable best available techniques for reducing emissions will be considered and implemented (CCME 2002). These techniques may include such things as application of dust suppressants and the use of emissions control technologies such as baghouses.

Emissions associated with asphalt plant operations were estimated using published emission factors (US EPA (2000) and assuming an asphalt tonnage requirement of 7,000 tonnes/km of four-lane highway, with a total highway length of 70.7 km.

The yearly and total emissions for each phase of the construction operations are provided in Table 5.1.13 for the parameters of interest.

Table 5.1.13 Construction Emissions Inventory – Construction Activities

Construction Activity	Timeframe	PM (T/year)	PM_{10} (T/year)	$PM_{2.5}$ (T/year)	SO_2 (T/year)	NO_X (T/year)	CO (T/year)	CO_2 (T/year)
Clearing and Grubbing	2004	1.09	0.98	0.88	0.48	21.6	10.8	1,498
Grading	2005	1.09	0.98	0.88	0.48	21.6	10.8	1,498
Gravel Subbase Application	2006	1.09	0.98	0.88	0.48	21.6	10.8	1,498
Highway Paving	2007	1.09	0.98	0.88	0.48	21.6	10.8	1,498
Asphalt Plant Emissions	2007	11.1	3.34	2.34	2.72	13.6	32.2	8,166
TOTAL	--	15.5	7.26	5.86	4.64	100	75.4	14,158

T = tonne (1,000 kg)

Greenhouse Gas Balance

Forest and agricultural ecosystems have the ability to remove carbon from the atmosphere (as CO_2), and incorporate this carbon into plant biomass. The decay of this biomass leads to increases in the amount of carbon in soils. Preservation of these carbon sinks is now recognized as an important measure in reducing atmospheric levels of CO_2. The Project will result in the disturbance of approximately 1,100 ha of land consisting of approximately 70% forested land, 20% agricultural land, which results in the potential loss of all carbon in the standing biomass on this land area. Construction activities will also lead to the loss of carbon from soils as a result of the disturbance of soils on the RoW. Loss of soil carbon occurs whenever soils are disturbed, and manipulated, and results from increased activity of soil micro-organisms. The 735 ha of forested lands removed from future production represents 1.2 % of the Carleton-Victoria Forest Products Marketing Board's annual volume from private lands (See Section 5.8.5.2.1).

For the purposes of assessing this environmental effect in the context of the other contaminants of interest, only the net increase in terms of carbon dioxide is considered. Therefore the net reduction in carbon sequestration (carbon dioxide absorption) due to deforestation and hence net increase in carbon dioxide in the atmosphere is considered. Calculations for the carbon sequestration component due to the harvesting activities was conducted using the factor of 3.67 tons (2,000 lbs) of CO_2 per year per acre of forest (ICF 1999).

Existing Vehicle Traffic

Emissions associated with vehicle traffic on the existing TCH were estimated using the average annual daily traffic volumes for vehicles and trucks as provided by NBDOT. The traffic data was used in conjunction with published US EPA emission factors from Mobile 5 (US EPA 2000) to determine the total emissions to the atmosphere per year for each contaminant of concern. The estimated emissions are presented in Table 5.1.13 of the summary.

Summary

A general inventory summarizing the emissions associated with the construction phase of the project for the contaminants of concern is presented in Table 5.1.14.

Table 5.1.14 Emissions Inventory Summary – Construction Phase

Source	SO_2 (T/year)	CO_2[A] (T/year)	CO (T/year)	NO_X (T/year)	PM (T/year)	PM_{10} (T/year)	$PM_{2.5}$ (T/year)
Existing Vehicle Traffic	120.5	41,934	3,454	297.2	40.17	36.2	32.5
Existing Truck Traffic	124.1	58,325	186	627.9	24.82	22.3	20.1
Construction Operations	0.48	1,498	10.8	21.6	1.09	0.98	0.88
Asphalt Plant Emissions[B]	2.7	8,170	32.2	13.6	11.1	3.34	2.34
Deforestation	NA	6,330	NA	NA	NA	NA	NA
TOTAL	247.8	116,257	3,683	960.3	77.18	62.82	55.82

[A] *Greenhouse gas of interest*

[B] *Asphalt plant emissions will only occur for one year of the construction phase*

The number and distribution of equipment used during typical construction practices are expected to have sufficient dispersion of these emissions to prevent a significant effect on local air quality. In addition, the use of properly maintained vehicles and equipment will ensure that vehicle emissions do not adversely affect ambient air quality.

Fugitive emissions such as road dust and dust from storage piles will be mitigated by the application of dust suppressants such as water or calcium chloride during periods of heavy activity and/or dry periods to ensure that the airborne dust remains below the ambient standard. Limiting the extent of clearing and restricting activities during windy weather will further mitigate dust emissions. These dust suppression measures are reflected in Section 4.14 of the NBDOT EPP (NBDOT 1998a).

The 735 ha of forested lands removed from the future production represents 1.2 % of the Carleton-Victoria Forest Products Marketing Board annual volume from private lands (See Section 5.8.5.2.1). Therefore, loss of carbon from standing forest biomass is considered to not be substantive in consideration of the extent of forest harvesting and re-forestation which now occurs in the region. During clearing operations, salvageable wood resources will be allocated for other processing, such as for use as fibre or lumber, with some of this carbon therefore being preserved in a non-atmospheric form. Minimizing the area of soil and vegetation disturbance during construction will help to mitigate losses of carbon from standing biomass and from soils. Although there will be a net loss of sequestered carbon due to vegetative loss, these are offset by emissions reductions during operation (Section 5.1.5.2.2).

Following construction activities, all areas with the exception of the road surfaces and shoulders, will be revegetated. Soil carbon will therefore be replenished over time once roadside vegetation becomes established and is maintained. The net loss of sequestered carbon due to vegetative loss is offset by emissions reductions during operation (Section 5.1.5.2.2) resulting in an overall decrease in CO_2 emissions.

The number and distribution of the equipment during typical construction practices will allow for sufficient dispersion of these emissions to prevent significant environmental effects on local air quality during most atmospheric conditions. The magnitude, frequency and duration of the construction activities are such that applicable air quality standards are unlikely to be exceeded within the EA boundaries. Therefore, the potential environmental effects of construction activities are considered not significant.

Sound Quality

Noise generated by construction activities is usually louder than normal highway operation, but is of relatively short duration and is also very localized and transient as the roadbuilding work proceeds along the RoW. Noise generated by construction can affect land use directly adjacent to the RoW in the vicinity of the construction activities. Construction will involve typical road building activities such as clearing and grubbing, roadbed preparation and grading, and paving operations. The noise outputs of construction machinery commonly used for these activities at a distance of 4.5 m from the equipment are presented in Table 5.1.15. The level of activity on construction sites will vary with the various phases of construction.

Table 5.1.15 Typical Construction Equipment Noise (Source: May 1978; Cowan 1994)

Equipment Powered By Internal Combustion Engines	Noise Level dB_A at 4.5 m (15 ft)
Earth Moving	
Compactors (Rollers)	75-87
Front Loaders	72-93
Backhoes	72-99
Tractors	76-96
Scrapers, Graders	80-94
Pavers	86-88
Trucks	82-94
Materials Handling	
Asphalt Paver	80-86
Concrete Mixers	77-85
Concrete Pumps	82-84
Cranes (Moveable)	75-86

Table 5.1.15 Typical Construction Equipment Noise (Source: May 1978; Cowan 1994)

Equipment Powered By Internal Combustion Engines	Noise Level dB_A at 4.5 m (15 ft)
Cranes (Derrick)	86-88
Stationary	
Pumps	68-72
Generators	72-82
Compressors	75-91
Impact Equipment	
Jack Hammers and Rock Drills	82-98
Impact Pile Drivers (Peaks)	95-105

Roadbed preparation and grading is the activity of longest duration and therefore will have the most potential for affecting nearby residents on a more sustained basis. Construction noise, for the purpose of this assessment, is assumed to be generated by three machines (grader, loader and dump truck), working in a group. Based on the median output levels described in the above table, this would give a combined sustained source level of about 92 dB_A at a distance of 15 m and would attenuate 6 dB_A for each doubling of distance as the source is localized (May 1978). As a result, any receptor within 400 m of the activity with no other mitigation present for noise would exceed 65 dB_A for a short duration, for daytime noise levels. Land clearing and roadbed paving are construction operations which are generally quieter and of shorter duration than roadbed preparation.

Mitigation of the noise during construction for the most directly affected areas (<100 m from construction site) will be accomplished by keeping the equipment in good working order with mufflers and restricting these activities to the daytime hours where warranted. This may not bring levels to within Guidelines at all times, however, actual levels are expected to be lower than the maximum predicted most of the time as the machines will be constantly moving around and will not always be at the nearest point to any particular residence. The work progression clause (Item 946.21 NBDOT (2003) Standard Specifications) states that grade work must be completed within 30 days in a given work area. That work area would then be left alone for an extended period (up to 1 year) until the developer returned to pave the area. In addition to this NBDOT will commit the developer to working from 7:00 am to 7:00 pm only and not before noon on Sundays in areas near NSAs. Asphalt and rock crusher plants will be located away from NSAs. Therefore, the noise levels are not expected to frequently exceed 24-hour L_{eq} of 65 dB_A during construction activities. However, higher sound pressure levels generated by these activities are of a short duration and are temporary.

The use of physical barriers to block noise is the most common method to control noise where scheduling or otherwise reducing noise at the source is not possible. This is not practical or warranted in this case based on the expected short duration of construction, the physical location of these areas in relation to the corridors, and the expense of constructing barriers on a temporary basis.

Occasional noise sources such as the dumping of rock may be louder than the working machinery (>125 dB_A at the source). However these high sound levels attenuate quickly due to their short duration (*e.g.*, tailgate slamming during dumping).

Since construction activities will be of relatively short duration and timing restricted where warranted (especially in close proximity to NSAs), construction noise is not expected to cause significant adverse environmental effects. Therefore, the potential environmental effects due to construction activities are considered not significant.

5.1.5.2.2 Operation

The environmental effects assessment matrix for the operation of the proposed TCH is presented in Table 5.1.16. A discussion of the environmental effects analysis and mitigation is provided below.

Table 5.1.16 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix
Valued Environmental Component: ATMOSPHERIC ENVIRONMENT
Phase Operation

Project Activity (See Table 4.1.1 for list of specific activities and works)	**Potential Environmental Effects**	**Mitigation**	**Magnitude**	**Geographic Extent**	**Duration/Frequency**	**Reversibility**	**Ecological/Socio-Cultural and Economic Context**
Winter Safety	**Air Quality** • Combustion gases and dust emissions (A)	• Follow equipment maintenance schedule	1	3	2/2	R	2
	Sound Quality • Noise emissions (A)	• Noise controls where possible (*e.g.*, mufflers)	1	3	2/2	R	2
Proposed TCH Presence	**Air Quality** • Combustion gases and dust emissions (A)	• No mitigation proposed	1	3	5/6	R	2
	Sound Quality • Noise emissions (A)	• No mitigation proposed	1	3	5/6	R	2

Key:

Magnitude:
1 = Low: *e.g.,* within normal variability of baseline conditions
2 = Medium: *e.g.,* increase/decrease with regard to baseline but within regulatory limits and objectives
3 = High: *e.g.,* singly or as a substantial contribution in combination with other sources causing exceedances or impingement upon limits and objectives beyond the project boundaries

Geographic Extent:
1 = <1 km^2
2 = 1-10 km^2
3 = 11-100 km^2
4 = 101 - 1,000 km^2
5 = 1,001 - 10,000 km^2
6 = >10,000 km^2

Duration:
1 = <1 month
2 = 1 - 12 months
3 = 13 - 36 months
4 = 37 - 72 months
5 = >72 months

Frequency:
1 = <11 events/year
2 = 11 - 50 events/year
3 = 51 - 100 events/year
4 = 101 - 200 events/year
5 = >200 events/year
6 = continuous

Reversibility:
R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:
1 = Relatively pristine area or area not adversely affected by human activity.
2 = Evidence of adverse environmental effects.

N/A = Not Applicable
(A) = adverse
(P) = positive

Ambient Air Quality

A general inventory of the emissions and greenhouse gas balance associated with the operation phase of the project for the contaminants of concern is presented in Table 5.1.17. Emissions associated with vehicle traffic include the total contribution from the proposed TCH and the existing TCH, were estimated using US EPA published emission factors from Mobile 5 as discussed in Section 5.1.5.2.1 for the construction phase. Calculations for the carbon sequestration due to the harvesting activities was conducted using the factor of 3.67 tons (2000 lbs) of CO_2 per year per acre of forest (ICF 1999).

Table 5.1.17 Vehicle Emissions Inventory/Greenhouse Gas Balance – Operation Phase

Source	SO_2 (T/year)	CO_2 (T/year)	CO (T/year)	NO_X (T/year)	PM (T/year)	PM_{10}	$PM_{2.5}$
Vehicle Traffic	114	39,511	3,255	280	37.8	34.0	30.6
Truck Traffic	115	54,112	173	583	23.0	20.7	18.6
Deforestation	NA	6,330	NA	NA	NA	NA	NA
TOTAL	229	99,953	3,428	863	60.8	54.7	49.2

T = tonnes

The proposed alignment has been planned as an express corridor, with free flowing traffic. This flow of traffic will result in less fluctuations in travel speed and therefore vehicle operation will be maintained at a more combustion-efficient operating speed. There will therefore be a reduced potential of local environmental effects from traffic. Improved traffic flow, on a regional scale, and more consistent and optimum operating speeds of the vehicles will reduce the overall emissions to the atmosphere. In addition, the designed length of the proposed TCH is shorter than the existing TCH, resulting in a reduced travel distance and hence a net reduction in overall emissions to the atmosphere associated with vehicle traffic. No mitigation is necessary for air emissions from highway traffic. A summary of the net change in emissions is presented in Table 5.1.18.

Table 5.1.18 Summary of Vehicle Emissions Inventory/Greenhouse Gas Balance

Source	SO_2 (T/year)	CO_2 (T/year)	CO (T/year)	NO_X (T/year)	PM (T/year)	PM_{10}	$PM_{2.5}$
Existing Traffic	245	100,259	3,641	925	65.0	58.5	52.6
Future Traffic*	229	93,623	3,429	863	60.8	54.7	49.2
Project Related Deforestation	NA	6,330	NA	NA	NA	NA	NA
Net Change (%)	-6.5	-0.3	-5.9	-6.8	-6.3	-6.3	-6.3

T = tonnes

** = based on total highway length, does not account for more efficient speed, better grades, or freer flow of traffic.*

Loss of carbon from standing forest biomass is considered to be minimal in consideration of the extent of forest harvesting and re-forestation which now occurs in the region. In addition, the reduction in CO_2 due to the reduced highway length and higher operating efficiency of the vehicles results in a net reduction overall of CO_2 associated with the project. All areas with the exception of the road surfaces and shoulders, will be re-vegetated. Soil carbon that is lost during construction will therefore be replenished over time once roadside vegetation becomes established and is maintained.

The increased speed limit on the new highway from 90 km/hour to 110 km/hour will add to the emissions loading in the region. However, improvements in fuel combustion technologies and alternate means such as hybrid vehicles will result in substantially better fuel economy in future. Smoother flow in traffic will also improve fuel economy. The incorporation of all of these factors into an estimate of emissions is difficult because the specific improvements are not easily characterized at this time. However, over the long term it is likely that the factor with the biggest influence on emissions will be a traffic volume increase of 3.73 per cent per year. This estimated increase in traffic volume and associated emissions is projected to occur irrespective of the Project and will result from external, non-Project related, socio-economic factors, and is therefore not considered to be a Project-induced environmental effect.

Overall, the improved traffic flow, the lower number of steep gradients on the new highway, the smoother alignment, the shorter highway length, and the larger RoW will help to minimize the potential for adverse effects on the environment.

Sound Quality

In order to predict the noise levels during highway operation, traffic data were obtained from ADI and NBDOT for the existing TCH. Using the average annual daily traffic volumes for vehicles and trucks, hourly traffic flows on the proposed TCH were assumed to be one 24^{th} of the AADT. It was assumed that all truck traffic (100%) and all non-local traffic (assumed to be 80%) will be redirected to the proposed TCH.

The noise prediction model was developed using vegetation and topographical maps of the Project, and the hourly traffic volumes and composition (in terms of the fraction of heavy trucks). The data were input into the traffic noise prediction model (Federal Highway Administration Traffic Noise Model – FHWA-TNM, Version 2.0) to predict the noise levels at the eleven locations, which represent the NSAs. The predicted noise levels from the model are considered to be representative of the 24-hour L_{eq} at the respective NSAs.

The noise modelling conducted for the environmental effects analysis was undertaken for each location to predict the 24-hour L_{eq} noise level at the NSA along the RoW likely to be most affected by the Project. Model assumptions included a tree height of 8.0 m, a road width of 3.66 m and on expectation that all heavy trucks and 80% of other traffic from the existing TCH will move to the Project. The hourly numbers of automobiles, motorcycles, buses and heavy trucks provided by ADI and NBDOT were used in the model to predict 24-hour L_{eq} (dB_A) at the nearest NSAs during operation of the proposed TCH.

The model predictions for both existing and future operations are presented in Table 5.1.19.

Table 5.1.19 Summary of Noise Assessment – Noise Model Predictions

NSA	Location	Distance to Existing Route 2 (m)	Distance to Proposed TCH (m)	Predicted 24 hr L_{EQ} (dB_A)		Comments
				Existing	Future With Project Operation	
1	Beaconsfield Road	950	200	40.3	46.7	Increase in noise due to the TCH traffic being closer to the NSA.
2	Bowmaster Flats	80	100	46.2	50.1	Increase in noise due to increased TCH traffic in area.
3	Route 560 Site B	1,360	140	44.8	49.2	Increase in noise due to the TCH traffic being closer to the NSA.
4	B Smith Road	1,900	130	47.5	52.6	Increase in noise due to the TCH traffic being closer to the NSA.
5	Backland Road	>2,000	70	47.3	52.5	Increase in noise due to the TCH traffic being closer to the NSA.
6	Sipprell Road	>2,000	300	34.7	40.6	Increase in noise due to the TCH traffic being closer to the NSA.
7	Route 110	>2,000	150	52.2	54.8	No discernable change in noise levels. Distances from the existing Route 2 and the proposed TCH to the NSA are similar.
8	Raymond Road	>2,000	370	51.7	53.3	No discernable change in noise levels. Distances from the existing Route 2 and the proposed TCH to the NSA are similar.
9	Estey Road	1,000	120	45.3	55.6	Increase in noise due to the TCH traffic being closer to the NSA.
10	Palmer Road	840	200	50.6	51.5	No discernable change in noise levels.
11	Route 560 Site A	270	80	54.2	55.6	No discernable change in noise levels. Currently a high volume of traffic in the area.

The traffic noise will be audible in the area, however the predicted levels are below the NBDOT guideline value of 65 dB_A at potential NSAs and are expected to be lower at further distances from the highway. In addition, there will be a positive environmental effect for areas along the existing TCH due to a predicted reduction in noise resulting from reduced traffic flow. Therefore, the potential environmental effects of Operation are considered not significant.

Projected future traffic volumes are anticipated to increase annually by 3.73% (based on a counter near Perth-Andover). A doubling of traffic volume results in approximately a 3 dB_A increase in noise level. This would occur approximately every 20 years, assuming a static growth rate and current technologies. However, noise reduction technology is likely to improve in the future. Therefore, the effects of increasing future traffic volumes on predicted future sound quality is predicted to be not significant.

5.1.5.2.3 Maintenance

The environmental effects assessment matrix for the maintenance phase is presented in Table 5.1.20. A discussion of the environmental effects analysis and mitigation is provided below.

Table 5.1.20 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix
Valued Environmental Component: ATMOSPHERIC ENVIRONMENT
Phase Maintenance

Project Activity (See Table 4.1.1 for list of specific activities and works)	**Potential Environmental Effects**	**Mitigation**	**Magnitude**	**Geographic Extent**	**Duration/Frequency**	**Reversibility**	**Ecological/Socio-Cultural and Economic Context**
Proposed TCH Maintenance	**Air Quality** • Combustion gases and dust emissions (A)	• Follow equipment maintenance schedule	1	3	2/2	R	2
	Sound Quality • Noise emissions (A)	• Noise controls where possible (*e.g.*, mufflers)	1	3	2/2	R	2
Vegetation and Wildlife Management	**Air Quality** • Combustion gases and dust emissions (A)	• Follow equipment maintenance schedule	1	3	2/2	R	2
	Sound Quality • Noise emissions (A)	• Noise controls where possible (*e.g.*, mufflers)	1	3	2/2	R	2

Key:

Magnitude:
1 = Low: *e.g.,* within normal variability of baseline conditions
2 = Medium: *e.g.,* increase/decrease with regard to baseline but within regulatory limits and objectives
3 = High: *e.g.,* singly or as a substantial contribution in combination with other sources causing exceedances or impingement upon limits and objectives beyond the project boundaries

Geographic Extent:
1 = <1 km^2
2 = 1-10 km^2
3 = 11-100 km^2
4 = 101 - 1,000 km^2
5 = 1,001 - 10,000 km^2
6 = >10,000 km^2

Duration:
1 = <1 month
2 = 1 - 12 months
3 = 13 - 36 months
4 = 37 - 72 months
5 = >72 months

Frequency:
1 = <11 events/year
2 = 11 - 50 events/year
3 = 51 - 100 events/year
4 = 101 - 200 events/year
5 = >200 events/year
6 = continuous

Reversibility:
R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:
1 = Relatively pristine area or area not adversely affected by human activity.
2 = Evidence of adverse environmental effects.

N/A = Not Applicable
(A) = adverse
(P) = positive

Ambient Air Quality

The magnitude, frequency and duration of the maintenance activities are such that applicable air quality standards are unlikely to be exceeded within the EA boundaries. Application of dust suppressants as per

Section 6.1.3 of the EPP such as water during periods of heavy activity and/or dry periods will ensure that the contribution to levels of airborne dust will remain within the ambient standards. The use of properly maintained vehicles and equipment will ensure that vehicle emissions do not adversely affect ambient air quality.

The number and distribution of the equipment during typical maintenance activities (mowing, vegetation clearing) will allow for sufficient dispersion of these emissions to prevent significant environmental effects on local air quality during most atmospheric conditions. Therefore, the potential environmental effects of Maintenance are considered not significant.

Sound Quality

Noise sources that are infrequent and of a short duration, such as the dumping of rock may be significantly louder than the working machinery (>125 dB_A at the source). However these high sound levels attenuate quickly due to their short duration.

Since the maintenance will typically be restricted to daylight hours and will be of relatively short duration, noise due to maintenance activities is not expected to cause any substantial adverse environmental effects. Therefore, the potential environmental effects of Maintenance are considered not significant.

5.1.5.2.4 Accidents, Malfunctions and Unplanned Events

The environmental effects assessment matrix for the accidents, malfunctions and unplanned events phase is presented in Table 5.1.21. A discussion of the environmental effects analysis and mitigation is provided below.

Table 5.1.21 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix
Valued Environmental Component: ATMOSPHERIC ENVIRONMENT
Phase Accidents, Malfunctions and Unplanned Events

Project Activity (See Table 4.1.1 for list of specific activities and works)	**Potential Environmental Effects**	**Mitigation**	**Magnitude**	**Geographic Extent**	**Duration/Frequency**	**Reversibility**	**Ecological/Socio-Cultural and Economic Context**
Fires	**Air Quality** • Combustion gases and dust emissions (A)	• Control and mitigate fires	1	3	1/1	R	2
	Sound Quality • Noise emissions (A)	• Noise controls where possible (*e.g.*, mufflers)	2	2	1/1	R	2

Table 5.1.21 Environmental Effects Assessment Matrix for Atmospheric Environment

Environmental Effects Assessment Matrix
Valued Environmental Component: ATMOSPHERIC ENVIRONMENT
Phase Accidents, Malfunctions and Unplanned Events

Project Activity (See Table 4.1.1 for list of specific activities and works)	**Potential Environmental Effects**	**Mitigation**	**Magnitude**	**Geographic Extent**	**Duration/Frequency**	**Reversibility**	**Ecological/Socio-Cultural and Economic Context**

Key:

Magnitude:
1 = Low: *e.g.,* within normal variability of baseline conditions
2 = Medium: *e.g.,* increase/decrease with regard to baseline but within regulatory limits and objectives
3 = High: *e.g.,* singly or as a substantial contribution in combination with other sources causing exceedances or impingement upon limits and objectives beyond the project boundaries

Geographic Extent:
1 = <1 km^2
2 = 1-10 km^2
3 = 11-100 km^2
4 = 101 - 1,000 km^2
5 = 1,001 - 10,000 km^2
6 = >10,000 km^2

Duration:
1 = <1 month
2 = 1 - 12 months
3 = 13 - 36 months
4 = 37 - 72 months
5 = >72 months

Frequency:
1 = <11 events/year
2 = 11 - 50 events/year
3 = 51 - 100 events/year
4 = 101 - 200 events/year
5 = >200 events/year
6 = continuous

Reversibility:
R = Reversible
I = Irreversible

Ecological/Socio-cultural and Economic Context:
1 = Relatively pristine area or area not adversely affected by human activity.
2 = Evidence of adverse environmental effects.

N/A = Not Applicable
(A) = adverse
(P) = positive

Ambient Air Quality

Potential interactions between the Accidents, Malfunctions and Unplanned Events, and Air Quality would be limited to effects caused by emissions of fine particles (smoke) from fires. Improved traffic flow and the divided highway design are expected to result in a reduction of accidents associated with the highway. As such, there would be a reduction in potential for fires associated with accidental events. Since the likelihood of these events to occur is low and since they would be of short duration and magnitude, the potential environmental effects due to Accidents, Malfunctions and Unplanned events are considered not significant.

Sound Quality

Potential interactions between the Accidents, Malfunctions and Unplanned Events, and Sound Quality would be of a short duration and would be infrequent. Since the likelihood of these events to occur is low and since they would be of short duration and magnitude, the potential environmental effects due to Accidents, Malfunctions and Unplanned events are considered not significant.

5.1.5.3 Determination of Significance

The overall results of the EA for the atmospheric environment are presented in a summary matrix (Table 5.1.22). The table also considers the level of confidence of the study team in this determination and the likelihood of potential environmental effects.

Table 5.1.22 Residual Environmental Effects Summary Matrix for Atmospheric Environment

Residual Environmental Effects Summary Matrix **Valued Environmental Component:** <u>ATMOSPHERIC ENVIRONMENT</u>				
Phase	**Residual Environmental Effects Rating**	**Level of Confidence**	**Likelihood**	
			Probability of Occurrence	**Scientific Certainty**
Construction	NS	3	3	3
Operation	NS	3	3	2
Maintenance	NS	3	3	3
Accidents, Malfunctions and Unplanned Events	NS	2	1	2
Project Overall	NS	3	3	3

Key
Residual Environmental Effect Rating:
S = Significant Adverse Environmental Effect
NS = Not-significant Adverse Environmental Effect
P = Positive Environmental Effect

Level of Confidence
1 = Low Level of Confidence
2 = Medium Level of Confidence
3 = High Level of Confidence

Probability of Occurrence: based on professional judgement
1 = Low Probability of Occurrence
2 = Medium Probability of Occurrence
3 = High Probability of Occurrence

Scientific Certainty: based on scientific information and statistical analysis or professional judgement
1 = Low Level of Confidence
2 = Medium Level of Confidence
3 = High Level of Confidence
N/A = Not Applicable
*As determined in consideration of established residual environmental effects rating criteria.

The residual environmental effects are considered not significant for all Project activities assessed.

Based on a consideration of the magnitude, frequency and duration of air emissions associated with the Project, the environmental effects of Project activities and potential accident scenarios, independently or together are either considered not significant for all aspects of the Atmospheric Environment VEC. This conclusion is made in consideration of the baseline for air quality and sound quality.

5.1.6 Monitoring and Follow-up

Measurable environmental effects to air quality from dust and noise will likely be localized to the specific construction activities during construction and relatively localized during operation. In addition, there are currently several ambient monitors operated by NAPS / NBDELG in areas surrounding the proposed RoW. Provided the recommended mitigative actions are taken, additional monitoring of ambient air quality and noise is not warranted.

However, noise monitoring may be required to address any complaints from residents living near the highway. Where warranted, noise monitoring will be conducted at specific NSAs, in accordance with methodologies acceptable to NBDELG.