5.0 ATMOSPHERIC ENVIRONMENT EFFECTS ASSESSMENT

This section of the Environmental Assessment Certificate (EAC) Application (the Application) presents the assessment of the potential adverse effects of the proposed Eagle Mountain – Woodfibre Gas Pipeline Project (the proposed Project) on the Acoustic Environment, Air Quality and Greenhouse Gas (GHG) Emissions Valued Components (VCs) during construction, operations, and decommissioning of the proposed Project.

The following subsections explain the selection process of the VCs, Acoustic Environment, Air Quality and GHG Emissions, as well as the associated Key Indicators (KIs): sound levels; criteria air contaminants (CACs); carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); perfluorocarbons (PFCs); hydrofluorocarbons (HFCs); and sulphur hexafluoride (SF_6). The Acoustic, Air Quality and GHG Emissions technical reports inform the description and characterization of the baseline conditions. The potential adverse effects of the proposed Project on the Acoustic, Air Quality and GHG Emissions VCs have been identified and analyzed, as measures with reference to the KIs. Proposed measures to mitigate the potential adverse effects on the VCs are also identified. Any residual adverse effects on the VCs have been characterized using the criteria set out in Section 3.6 of the Application Information Requirements (AIR) and a determination of significance has been made. Any cumulative adverse effects likely to result from the residual adverse effects of the proposed Project interacting with the residual adverse effects of past, present and reasonably foreseeable developments have also been assessed.

5.1 Selection of Valued Components and Key Indicators

The British Columbia Environmental Assessment Office (BC EAO) defines VCs as components of the natural and human environment that are considered by the proponent, public, Aboriginal groups, scientists and other technical specialists, and government agencies involved in the assessment process to have scientific, ecological, economic, social, cultural, archaeological, historical or other importance (BC EAO 2013). KIs are metrics used to measure and report on the condition and trend of a VC, and are identified to further focus and facilitate the analysis of the effects of a proposed Project on the selected VCs (BC EAO 2014).

The selection of the Acoustic Environment, Air Quality and GHG Emissions VCs as well as the associated KIs was based on: the ability to accurately capture, quantify and report on potential atmospheric effects arising from the proposed Project; the ability to identify changes or trends in the atmospheric environment; the general concerns of the public, stakeholders and Aboriginal communities; feedback from regulatory agencies; relevant scientific literature; related policies, regulations and management plans; experience gained with previous projects of similar scope and magnitude; and the professional judgement of the assessment team. The VCs were selected based on FortisBC Energy Inc.'s (FortisBC's) current understanding of what is important to them as the proponent as well as the public and the government agencies involved in the Application process. FortisBC's understanding of VCs is founded on the legacy of having operated the natural gas transmission and distribution systems in southern BC for over 20 years. The KIs were selected based on their potential to represent the interactions between the identified VCs and the proposed Project. Interactions could include direct and indirect effects from the proposed Project components or operations as well as cumulative adverse effects arising from the interactions between other projects and the proposed Project. For instance, the magnitude of sound levels at any particular receptor is a measure of multiple sources of noise in an area. Similarly, levels of CACs and GHGs can be used as measures of existing emission sources, Project-related emission sources, and any additional reasonably foreseeable emission sources. The proposed VCs and associated KIs were discussed during the Working Group meeting held October 25, 2013 in Vancouver, BC. There was general agreement by the participants of the workshops that the proposed Acoustic Environment, Air Quality and GHG Emissions VCs as well as the associated KIs were appropriate for evaluating the effects of proposed Project activities on the atmospheric environment. Appropriate measurable parameters have been developed for use in measuring potential adverse effects on the KIs. On November 10, 2014 the BC EAO issued the AIR for the proposed Project, which outlines the VCs and KIs assessed in this Application.

Table 5.1-1 provides a summary of the VCs, KIs, rationale and measureable parameters used in the assessment of potential adverse effects of the proposed Project on the Acoustic Environment, Air Quality and GHG Emissions VCs.

TABLE 5.1-1

VALUED COMPONENTS, KEY INDICATORS, RATIONALE AND MEASURABLE PARAMETERS FOR THE ATMOSPHERIC ENVIRONMENT

VC	KI(s)	Rationale	Measureable Parameter
Acoustic Environment	Sound levels	• Acoustic Environment was selected as a VC to capture potential Project effects related to noise during construction and operation. • Sound levels were identified as a KI to facilitate the analysis of the proposed Project's interaction with the acoustic environment.	• Decibels of sound
Air Quality	CACs: • Carbon monoxide (CO) • Nitrogen oxides (NO_x) • Sulphur dioxide (SO_2) • Particulate matter (PM_{10} and $PM_{2.5}$) • Volatile Organic Compounds (VOCs)	• Air Quality was selected as a VC to capture potential Project effects related to air. • CACs were identified as a KI to quantify and report on changes to air quality.	• Ambient concentrations of CACs • Atmospheric emissions estimates
GHG Emissions	CO_2 CH_4 N_2O PFCs* HFCs* SF_6*	• GHG Emissions were selected as a VC to address general public concerns about GHGs. • Specific GHGs were identified as KIs to report on the condition and trend of Project-related GHG emissions.	• Atmospheric emissions estimates

Note: * PFCs and HFCs are not expected to be associated with the proposed Project and are, therefore, not discussed further in the effects assessment. In addition, the proposed Project does not involve installation of equipment with SF_6 volumes worth quantifying or reportable under the *BC GHG Reporting Regulation* and, therefore, are not discussed further in this assessment. See the GHG Emissions Technical Report (Volume 2, Appendix 1E) for a detailed description of GHGs and their sources.

5.2 Assessment Boundaries

Assessment boundaries are used to set a frame of reference for the assessment of the Acoustic Environment, Air Quality and GHG Emissions VCs. The following subsections outline the assessment boundaries used for the assessment of potential adverse effects on the Acoustic Environment, Air Quality and GHG Emissions VCs.

5.2.1 Spatial Boundaries

Due to the nature of the atmosphere and differences in the scale of transport and effects associated with the Atmospheric Environment VCs, each VC (Acoustic Environment, Air Quality and GHG Emissions) was given unique spatial boundaries for this assessment.

For the purposes of the assessment of the Atmospheric Environment VCs, the spatial boundaries are the Acoustic Environment Local Study Area (LSA) and Regional Study Area (RSA), the Air Quality RSA, and the GHG Emissions international study area. The Air Quality LSA is considered equivalent to the Air Quality RSA. The reason for this is because a smaller area within which most of the potential Project air quality effects may occur does not exist. A single study area (Air Quality RSA) was used to accommodate the potential effects of the proposed Project on the Air Quality VC, in addition to encompassing other CAC sources with emissions that may interact cumulatively with those of the proposed Project.

These boundaries are set relevant to the proposed pipeline centre line; the Project Footprint (a 35 m wide band following the proposed route and representing the land area likely directly affected by construction activities); and to either the central point or fence line of permanent facilities. In general, the LSA is set to reflect the proposed Project's zone of influence (ZOI) for a specific element, whereas the RSA is intended to reflect the proposed Project's interaction with existing and reasonable foreseeable developments (*i.e.*, sources of noise or atmospheric emissions).

Table 5.2-1 describes the spatial boundaries and rationale for the Atmospheric Environment VCs. The Acoustic Environment LSA and RSA as well as the Air Quality RSA are shown in Figures 5.2-1 and 5.2-2, respectively. Because the study area for the GHG Emissions VC is international, no map is provided.

TABLE 5.2-1

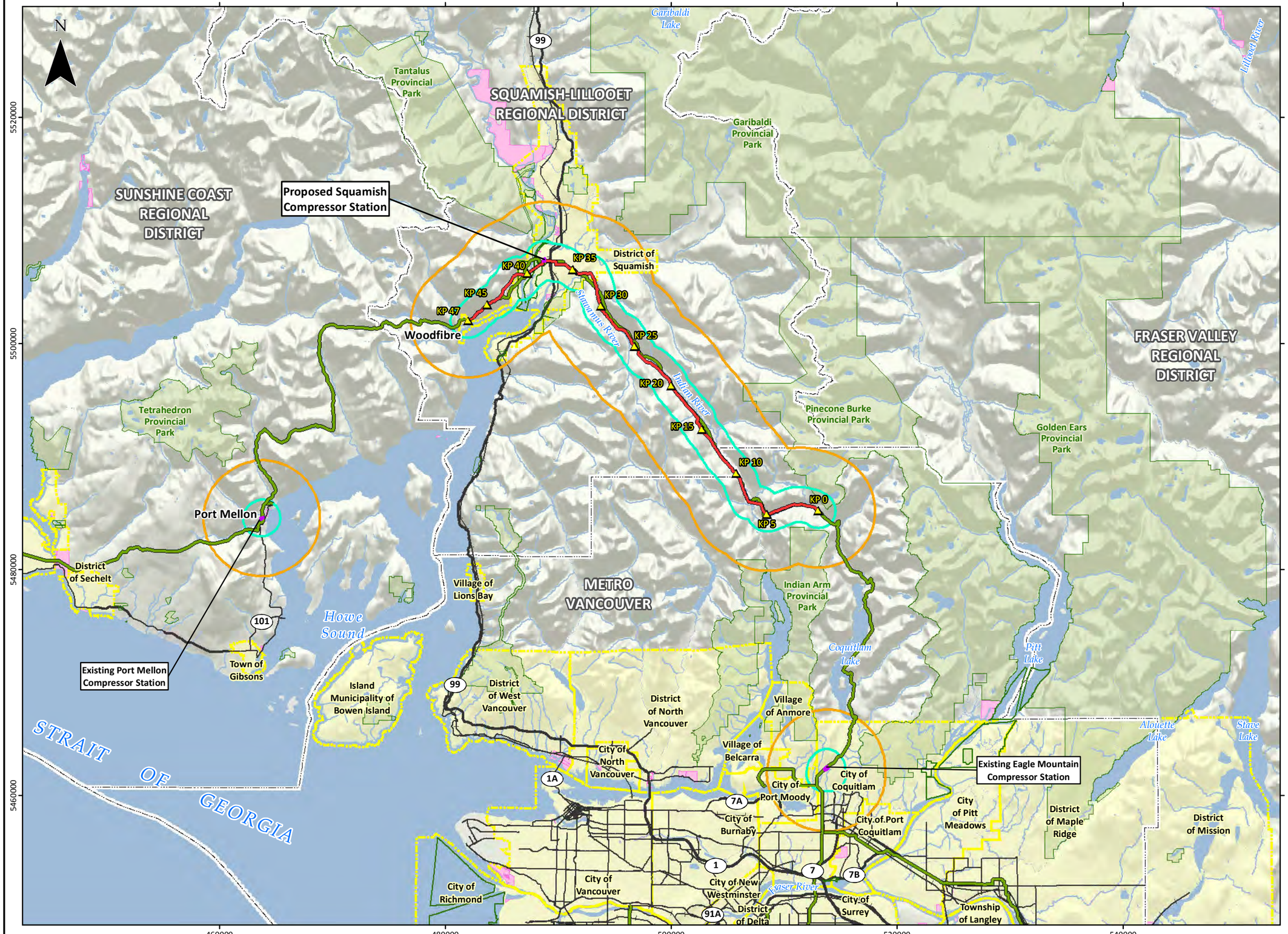
SPATIAL BOUNDARIES FOR THE ATMOSPHERIC ENVIRONMENT VALUED COMPONENTS

VC	Spatial Boundary	Rationale
Acoustic Environment	Project Footprint: the area within the fence line of the proposed facilities, and the land area that will be directly disturbed by the proposed Project construction and clean-up activities, including associated physical works and activities (*e.g.*, permanent right-of-way, temporary construction camps and temporary workspaces for construction).	Past projects, key regulatory documents and input from regulatory agencies as well as the Working Group, Aboriginal engagement or public consultation, and professional judgment.
	LSA: an area extending 1.5 km from the proposed Project Footprint.	The distance of 1.5 km from the proposed Project is in accordance with the BC Oil and Gas Commission (BC OGC) (2009) *BC Noise Control Best Practices Guideline* as the maximum distance from a facility fence line where permissible sound levels (PSLs) must be met (or the nearest residence, whichever is closer).
	RSA: an area extending up to 5 km from the proposed Project Footprint to include any nearby residences that may be affected by the proposed Project.	An area represented by up to 5 km from the proposed Project Footprint was set to account for potential adverse cumulative adverse effects occurring due to the existence of other developments and activities.
Air Quality	RSA: a 20 km band (10 km on both sides of the proposed pipeline centre line) and a 10 km radius around facility centre points.	There are two main considerations for establishing Project spatial boundaries for the Air Quality VC: • no changes are expected to the combustion-related emissions of CACs at the compressor stations; and • although minor, changes are expected to venting emissions (VOCs). VOCs are considered a regional pollutant due to their contribution to ground-level ozone (O_3) formation, which may occur hundreds of kilometres from the point of release. An Air Quality RSA was derived based on the Project Footprint as a 20 km band (10 km on either side of the pipeline centre line) and a 10 km radius around facility centre points. The Air Quality RSA will account for the cumulative adverse effects of the proposed Project acting in combination with existing and reasonably foreseeable developments. The Air Quality LSA is considered equivalent to the Air Quality RSA for the points noted above; in particular, a smaller area within which most of the potential Project air quality effects may occur does not exist.
GHG Emissions	International Study Area	Because GHGs are associated with climate change, which is an international phenomenon, the study area for GHG emissions is international in scale to reflect the ZOI.

5.2.1.1 Application Corridor

The Application Corridor is defined as the area in which the proposed pipeline will be constructed. The Application Corridor is generally 300 m wide but varies in width from 150 m to approximately 650 m in some locations to account for various routing considerations, potential extra workspace requirements and areas where no work will be conducted. Reference points along the Application Corridor are referred to as KPs. KPs are located every 1 km and are used to reference features or specific locations in the Application Corridor.

The pipeline will be constructed within the Application Corridor on a right-of-way to be granted through authorizations and approvals from the BC OGC as well as other permitting agencies. The Project Footprint is the physical area within the Application Corridor that will be directly disturbed by the proposed Project (both pipeline and associated facilities) construction activities, including associated physical works and activities.



FORTIS BC

January 2015

FIGURE 5.2-1

ACOUSTIC ENVIRONMENT STUDY AREA BOUNDARIES

EAGLE MOUNTAIN-WOODFIBRE GAS PIPELINE PROJECT

- Kilometre Post
- Compressor Station
- Proposed Pipeline
- Existing FortisBC Pipeline
- Acoustic Local Study Area
- Acoustic Regional Study Area
- Highway
- Road
- Railway
- Watercourse
- Waterbody
- Municipality
- Regional District
- Park/Protected Area
- First Nations Reserve

SCALE: 1:320,000

0 4 8 12 km

(All Locations Approximate)

tera A CH2M HILL Company

CH2M HILL Project Number 492434

UTM Zone 10 North. NAD 1983.

Proposed Pipeline, KPs: Universal Pegasus International (UPI) 07-14-2014; Existing Pipeline: FortisBC 2012; Compressor Stations: UPI 07-23-2014; Roads: NRCan 2014; Railways: NRCan 2012; Hydrography: NRCan. 2009, IHS Inc. 2004 and BC MFLNRO 2008; Municipal Boundaries, Regional Districts: BC MFLNRO 2007; Parks, Wildlife Management Areas: BC MFLNRO 2008; First Nation Reserves: Government of Canada 2014; Hillshade: TERA Environmental Consultants 2008.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

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FIGURE 5.2-2

AIR QUALITY STUDY AREA BOUNDARIES

EAGLE MOUNTAIN-WOODFIBRE GAS PIPELINE PROJECT

- Kilometre Post
- Compressor Station
- Proposed Pipeline
- Existing FortisBC Pipeline
- Air Quality Regional Study Area
- Highway
- Road
- Railway
- Watercourse
- Waterbody
- Municipality
- Regional District
- Park/Protected Area
- First Nations Reserve

SCALE: 1:320,000

0 4 8 12 km

(All Locations Approximate)

tera A CH2M HILL Company

CH2M HILL Project Number 492434

UTM Zone 10 North. NAD 1983.

Proposed Pipeline, KPs: Universal Pegasus International (UPI) 07-14-2014; Existing Pipeline: FortisBC 2012; Compressor Stations: UPI 07-23-2014; Roads: NRCan 2014; Railways: NRCan 2012; Hydrography: NRCan. 2009, IHS Inc. 2004 and BC MFLNRO 2008; Municipal Boundaries, Regional Districts: BC MFLNRO 2007; Parks, Wildlife Management Areas: BC MFLNRO 2008; First Nation Reserves: Government of Canada 2014; Hillshade: TERA Environmental Consultants 2008.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

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BRITISH COLUMBIA

Squamish

Vancouver

Victoria

USA

N

5520000

5500000

5480000

5460000

460000 480000 500000 520000 540000

Garibaldi Lake

Lillooet River

Tantalus Provincial Park

SQUAMISH-LILLOOET REGIONAL DISTRICT

Garibaldi Provincial Park

SUNSHINE COAST REGIONAL DISTRICT

Proposed Squamish Compressor Station

District of Squamish

KP 40

KP 35

KP 45

KP 30

KP 47

Woodfibre

Squamish River

KP 25

KP 20

Indian River

KP 15

KP 10

KP 0

KP 5

FRASER VALLEY REGIONAL DISTRICT

Pinecone Burke Provincial Park

Golden Ears Provincial Park

Tetrahedron Provincial Park

Port Mellon

District of Sechelt

Village of Lions Bay

METRO VANCOUVER

Indian Arm Provincial Park

Howe Sound

101

Town of Gibsons

Existing Port Mellon Compressor Station

Island Municipality of Bowen Island

99

District of West Vancouver

District of North Vancouver

Village of Anmore

Coquitlam Lake

Pitt Lake

Alouette Lake

Stave Lake

STRAIT OF GEORGIA

City of North Vancouver

Village of Belcarra

1A

City of Coquitlam

Existing Eagle Mountain Compressor Station

City of Port Moody

7A

City of Burnaby

City of Port Coquitlam

City of Pitt Meadows

District of Maple Ridge

District of Mission

1

City of New Westminster

Fraser River

7

7B

City of Vancouver

City of Richmond

91A

District of Delta

City of Surrey

Township of Langley

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5.2.2 Temporal Boundaries

The time frames used in the assessment of the proposed Project will include the construction, operations and decommissioning or abandonment phases. The construction phase includes surveying, clearing, soil conservation, grading, trenching, welding, lowering in, backfilling, testing and post-construction restoration for the proposed Project. Construction activities are assumed to begin in approximately Q3 2015 with an in-service date of approximately Q4 2016. Restoration activities will commence following final clean-up and continue through 2017. The operations phase is expected to start following the in-service date and will extend for a term estimated to exceed 50 years. Decommissioning or abandonment will occur after the useful life of the pipeline is deemed complete and may involve removal, abandonment-in-place or a combination of abandonment-in-place and removal. FortisBC will follow industry standards and regulations in effect at the time of decommissioning or abandonment.

The potential residual adverse effects for the Acoustic, Air Quality and GHG Emissions VCs can potentially occur during all phases of the proposed Project (*i.e.,* construction, operations and decommissioning or abandonment).

5.2.3 Administrative Boundaries

Administrative boundaries refer to the effects of political, economic or social boundaries on an environmental assessment. There are a number of jurisdictions that influence the methods and terms of the atmospheric effects assessment. Subsection 5.3 Regulatory and Policy Setting lists those jurisdictions and presents in detail three separate groups of regulations pertaining to the Acoustic Environment, Air Quality and GHG Emissions VCs.

For instance, local, municipal noise bylaws, such as those in Coquitlam, Squamish and the Squamish-Lillooet Regional District (SLRD), affect thresholds used in the assessment of the potential effects of the proposed Project on the Acoustic Environment, Air Quality and GHG Emissions VCs, and may also influence the selection of appropriate mitigation measures.

The Eagle Mountain compressor station, located in the City of Coquitlam, is part of Metro Vancouver, which has its own air quality and GHG management plan in addition to unique air quality objectives and emissions permitting and reporting guidelines. These are separate stand-alone policies that are exclusive to Metro Vancouver and separate from the BC provincial air quality or emissions guidelines and regulations. As such, local policies and bylaws must be adhered to the same extent as provincial and federal regulations.

5.2.4 Technical Boundaries

Technical boundaries refer to the ability of a proponent to predict effects of a proposed project. In general relationships between the atmospheric environment and Project-related emissions of noise, airborne contaminants and GHGs are well understood. However, atmospheric modelling has inherent levels of uncertainty that are only partly overcome by using accurate and realistic inputs. More detailed information on the levels of uncertainty is provided in the Acoustic Environment Technical Report (Volume 2, Appendix 1C).

Similarly, GHG emission estimates have their own limitations as they are based on average emission factors rather than directly measured values. Although the effect of the proposed Project on the GHG Emissions VC can be estimated with confidence, the proposed Project's effect on climate change is more difficult to measure due to the international spatial scale and complexities involved in GHG and climate interactions. Instead, simple comparisons with local, provincial and federal totals must be used in assessing the proposed Project's effect on GHG emissions and contribution to international climate change. The limitations and error associated with the GHG emissions estimates are described in more detail in the GHG Emissions Technical Report (Volume 2, Appendix 1E).

5.3 Regulatory and Policy Setting

There are a number of regulations, policies and guidelines that influence how potential effects of the proposed Project on the Acoustic Environment, Air Quality and GHG Emissions VCs are assessed or how proposed Project activities may be carried out. Information on regulatory tools under different jurisdictional scales for each of the Acoustic Environment, Air Quality and GHG Emissions VCs is provided in the following subsections.

5.3.1 Acoustic Environment

The legislation, regulations, bylaws and guidelines that framed the assessment of the potential effects of the proposed Project on the Acoustic Environment VC are outlined below.

5.3.1.1 Health Canada's Useful Information for Environmental Assessments, Section 6

Health Canada's Useful Information for Environmental Assessments (Health Canada 2010) provides beneficial information under the federal authority of Health Canada for conducting environmental assessments at the federal and provincial levels. Health Canada does not have any enforceable noise guidelines or thresholds of its own, so it draws on various internationally recognized acoustic standards in reference to noise assessments. While Health Canada is in the process of developing a detailed guidance document that is specific to noise assessments in Canada, Section 6 of this preliminary document suggests the following:

- sensitive noise receptors (*i.e.*, residences, schools, etc.) and areas with a "reasonable expectation of peace and quiet" should be identified and mapped in reference to the proposed facility;
- existing or baseline sound levels at receptors should be determined for both daytime and nighttime, and included on the map of receptors;
- all potential noise sources associated with a project's construction, operations and decommissioning as well as any tonal, low frequency, impulsive or highly impulsive noise sources should be identified and their associated sound levels estimated;
- the noise levels anticipated at receptor locations during project operation should be predicted and compared with baseline levels during daytime and nighttime, and, if warranted, predicted following the application of mitigation measures;
- the severity of any predicted changes in noise levels should be evaluated and, where health effects are predicted, Health Canada advises employing mitigation measures, including community consultation;
- plans for noise management and complaint resolution should be prepared as required; and
- the expected duration and frequency of noise due to construction and any other non-continuous activities should be determined for guidance on whether activities can be considered short-term with regard to complaint levels.

Events such as construction, which typically lasts less than 2 months at any given location, are considered by Health Canada to be temporary in duration and community consultation is advised. For events of less than 1 year, Health Canada considers mitigation to be required in cases where widespread complaints or strong community reaction are predicted. For a duration of greater than 1 year, such as operational noise, where predicted noise levels are in the range of 45-75 dB, Health Canada advises the evaluation of health impact endpoints based on the percentage of those likely to become highly annoyed (HA) and proposes mitigation when that percentage increases by > 6.5% or when the predicted noise levels exceed 75 dB.

5.3.1.2 British Columbia Noise Control Best Practices Guideline

The BC OGC sets PSLs for activities under its jurisdiction. The *BC Noise Control Best Practices Guideline* does not set limits for temporary or construction noise, but does recommend restricting these activities to daytime hours (7:00 to 22:00), ensuring all equipment is fitted with appropriate muffler systems, taking advantage of existing physical barriers and screening, and advising residents of noise events and using scheduling to limit disruption. The noise limits (or PSLs) in the guideline are, therefore, only relevant to the effects of operation of the proposed Project on the Acoustic Environment VC.

The daytime PSL is defined as a sum of the Basic Sound Level (BSL), which is determined by both the density of dwellings and distance to transportation sources (*i.e.*, roadways, airports or rail lines), the daytime adjustment that accounts for sound levels commonly being 10 dB higher in the daytime, and two other adjustments that are: (1) a seasonal or background level adjustment if summertime BSLs are not appropriate due to seasonal or other background noise (non-industry) conditions; and (2) is an adjustment for noise sources that are considered temporary (*i.e*., < 60 days). The guideline states that the BC OGC should be consulted prior to making seasonal or background level adjustments to the PSL calculation.

Noise Impact Assessments (NIAs) are required by the guideline to achieve reporting requirements and show that facilities meet all requirements set out in the guideline, including the PSL. In addition to calculating the PSL, operators are asked to identify all facility noise sources and their sound/pressure levels, and to estimate the noise levels received at the nearest or most likely affected dwelling using a noise model. Noise levels at dwellings are compared with the calculated PSL to determine compliance with the guideline. All assumptions and methodology used in the modelling of noise and PSL estimates must also be presented in the NIA.

5.3.1.3 Workers Compensation Act, Occupational Health and Safety Regulation (BC Reg. 296/97 as amended), Section 7 (BC Reg. 382/2004, s.1)

Section 7.3 of the *Workers Compensation Act* sets the maximum daily noise exposure level of workers at 85 dBA L_{EX} (L_{EX} represents the noise exposure level averaged over an 8 hour work day) and the maximum peak sound level is set to 140 dBC (dBC is decibels measured using the C sound filter that measures more high frequency sounds). Furthermore, according to Section 7.3, if a worker may be exposed to noise levels exceeding 82 dBA L_{EX}, employers must monitor those noise levels according to standards of the Canadian Standards Association. If noise exceeds either daily or peak noise standards, an employer must establish a noise control and hearing conservation program, and adopt other measures as described in Sections 7.5 through 7.8 of the Act, such as engineered noise control and noise hazard signage. Noise calculation methods are provided in the WorkSafeBC (2007) Basic Noise Calculations document.

5.3.1.4 City of Coquitlam Noise Regulation Bylaw No. 1233, 1982

The City of Coquitlam noise bylaw states that no person shall make or cause, or permit to be made or caused, any noise in or on a public or private place which disturbs, or tends to disturb, the quiet, peace, rest enjoyment, comfort, or convenience of any person or persons in the neighbourhood or vicinity. The bylaw does not specify PSLs in decibels, however, allowed time for construction is clearly defined in the Construction Hours section of the bylaw. Construction is limited to the hours of 7:00 to 22:00 and piles are not permitted to be driven into the ground before 9:00 hours or after 17:00 hours on a Saturday. Construction activities that cause any sound disturbance are not permitted at any time on Sundays. When it is considered impossible or impractical to comply with these bylaw provisions, an exception may be granted by the City Council or by the General Manager of Engineering and Public Works.

5.3.1.5 District of Squamish Noise Regulation Bylaw No. 2312, 2014

On March 18, 2014 the *District of Squamish Noise Regulation Bylaw No. 2312, 2014* was adopted and the previous noise bylaw, *District of Squamish Noise Regulation Bylaw No. 1901, 2005,* was repealed. This new bylaw makes it an offence for construction noise to be made from construction activity during the following hours:

- before 7:00 AM or after 9:00 PM on any day other than Saturday, Sunday or a statutory holiday; or
- before 8:00 AM or after 7:00 PM on Saturdays, Sundays or statutory holidays.

Construction noise means any noise, sound or vibration made on or associated with a construction site including one's own property:

- in carrying on work in connection with the construction, reconstruction, alteration, repair, or demolition of any building structure or thing;
- in carrying on any excavation, filling or other operation; or
- in moving, or operating any machine, engine or equipment.

A Temporary Noise Exemption Permit may be obtained for those construction activities that are exceptionally noisy or for construction activity that must extend beyond the allowable hours because of exigent circumstances (District of Squamish 2014).

5.3.1.6 Squamish-Lillooet Regional District, Electoral Area 'D' Noise Regulation Bylaw No. 1234, 2011

No individual or owner of real property is permitted to make noise that disturbs the quiet, peace, rest, enjoyment, comfort or convenience of individuals, or the public. Noise from the operation of machinery or equipment and noise made during construction activities is prohibited between the hours of 22:00 and 7:00 on weekdays, and between the hours of 22:00 and 8:00 on weekends and holidays.

5.3.2 Air Quality

The legislation, regulations, bylaws, standards and guidelines that framed the assessment of the potential effects of the proposed Project on the Air Quality VC are outlined below.

5.3.2.1 Canadian Environmental Protection Act, 1999

Part 3 of the *Canadian Environmental Protection Act, 1999* (*CEPA*) provides guidance on information gathering, objectives, guidelines and Codes of Practice (COPs). In particular, Subsection 41(1) of the *CEPA* mandates the federal reporting of pollutants discharged to air, land or water to the National Pollutant Release Inventory (NPRI). Annual NPRI reporting requirements are published in the Canada Gazette and, as of the 2013 reporting year, upstream oil and gas facilities characterized by 20,000 or more annual employee hours, and emitting above and beyond substance-specific thresholds (also published in the Canada Gazette) are required to be reported to the NPRI. Sources reporting air releases to the NPRI are used to help characterize the existing air quality in the Air Quality RSA and are considered in the cumulative effects assessment in Subsection 5.4.3.

Part 4 of the *CEPA* deals with pollution prevention under which a Notice, also published in the Canada Gazette, may require any person or class of person to prepare a pollution prevention plan for any substance or group of substances. The proposed Project is known to emit CACs (*e.g.*, VOCs, CO, NOx) in amounts reportable to the NPRI. Therefore, CAC reporting requirements and Part 4 of the *CEPA* are considered directly relevant to the assessment of the effects of the proposed Project on the Air Quality VC.

5.3.2.2 Environmental Management Act, Waste Discharge Regulation (BC Reg. 320/2004)

The provincial *Environmental Management Act, Waste Discharge Regulation* regulates the release and disposal of wastes to land, water and air in BC. Section 6(2) and Section 6(3) of the *Environmental Management Act* prohibit the introduction of waste in the course of conducting a prescribed industry trade or business, or waste produced by a prescribed activity or person, respectively. Those prescribed industries and activities that are subject to Sections 6(2) and 6(3) of the *Environmental Management Act* are listed in Schedules 1 and 2 of the *Waste Discharge Regulation.* These prescribed industries and activities require authorization to emit pollutants under the auspices of the *Environmental Management*

Act. Industries that are not prescribed under one of the two Schedules do not require authorizations to introduce waste into the environment, however, the releases must not cause pollution as per Section 6(4) of the *Environmental Management Act*. The *Environmental Management Act* defines pollution as the presence in the environment of substances or contaminants that substantially alter or impair the usefulness of that environment.

Listed and regulated activities in Schedule 1 that are relevant to the proposed Project include (6) the Burning of Vegetative Debris, (8) the Burning or Incineration of Wood Residue, (28) the Oil and Gas Industry - Large, and (33) the Pipeline Industry with (an) Approved Operating Plan. For the purpose of Schedule 1, Oil and Gas Industry - Large are those establishments that in any 15 day period discharge or remove 30 tonnes of total sulphur or more, or that discharge or remove 4 tonnes of VOCs or more. Under this regulation, CH_4 is not considered a VOC for the purpose of CAC management in accordance with the United States Code of Federal Regulations, Title 40, Part 51, Section 51.100, which has been adopted by the BC OGC (2006). Schedule 1 activities are subject to Section 6(2) of the *Environmental Management Act*, which states that waste may not be introduced to the environment in the course of conducting a prescribed industry, trade or business. However, according to Section 6(5)(a), releases may occur by valid permit or approval, regulation, operational certificate, an order or a waste management plan, including permits and approvals from a relevant jurisdiction. Schedule 1 activities, due to the complexity of their discharges, are authorized under site-specific authorizations or regulations (BC Ministry of Environment [BC MOE] 2007).

Under Schedule 2, listed facilities that are relevant to the proposed Project include (15) the Oil and Gas Industry - Small and (17) the Pipeline Transport Industry. The Oil and Gas Industry - Small is defined as those oil and gas establishments emitting less than 30 tonnes of sulphur and less than 4 tonnes of VOCs over a 15 day period. The Pipeline Transport Industry is defined as establishments engaged in the operating or maintaining of pipeline for the transport of natural gas and crude oil that do not include an operating plan. Schedule 2 activities are subject to Section 6(3) of the *Environmental Management Act*, which states that waste may not be introduced to the environment by a prescribed activity or operation. However, according to Section 6(5)(a), as described above, releases may occur by valid permit or approval, regulation, operational certificate, an order or a waste management plan, including permits and approvals from a relevant jurisdiction. These *Waste Discharge Regulation* Schedule 2 releases are also governed by industry COPs, and if such a COP exists, no site-specific permit or authorization is required (BC MOE 2007). COPs are industry-wide regulations governing the discharge of waste from prescribed activities or industries. Although no specific codes for oil and gas are listed in Schedule 2, the BC *Oil and Gas Waste Regulation* authorizes waste discharges to the environment from most of the upstream oil and gas facilities prescribed in Schedule 2, as discussed below. In addition, the BC *Open Burning and Smoke Control Regulation* is a targeted COP under the *Environmental Management Act*, and is also discussed in more detail below.

The *Waste Discharge Regulation* sets fees for the release of contaminants and wastes, including CO, total hydrocarbons, NO_x as nitrogen dioxide (NO_2) equivalents, sulphur and sulphur oxides (SO_x) as SO_2 equivalents, total particulate, total reduced sulphur (TRS) compounds, VOCs and other contaminants.

5.3.2.3 Oil and Gas Waste Regulation (BC Reg. 254/2005)

The provincial *Oil and Gas Waste Regulation* does not apply to the Large Oil and Gas Industry sources prescribed in Schedule 1 of the *Waste Discharge Regulation* as summarized above. More specifically, it does not apply to those facilities that remove or discharge 30 tonnes of sulphur or more, or that remove or discharge 4 tonnes of VOCs or more over a 15 day period, thereby excluding those sources characterized as Oil and Gas - Large by the *Waste Discharge Regulation*. Meanwhile, the *Oil and Gas Waste Regulation* does not apply to all Schedule 2 (*i.e.*, Oil and Gas Industry - Small) operations and also excludes those facilities where the total combined power of all compressor drivers, pump drivers or electricity generator drivers at a facility exceed 3,000 kilowatts (kW).

The *Oil and Gas Waste Regulation* applies to those Schedule 2 (small) facilities where the combined total power of each of these components is less than 3,000 kW. Under Subsection 6(1), registration and authorization of operations under the *Oil and Gas Waste Regulation* are required for: those facilities where the cumulative rated power of all compressor drivers, the cumulative rated power of all oil pumps and the cumulative rated power of all electricity generator drivers is less than 3,000 kW but greater than

600 kW; processing plants; line heaters and treaters that have a rating of 150 kW or higher; there is a flare stack of 12 m or greater in height; there is a completed environmental impact assessment as well as additional requirements; and various facilities where individual drivers with a rated power of greater than 100 kW must meet the NO_x emission standards set forth in Schedule 1. Operators of these facilities must submit a registration report.

5.3.2.4 Open Burning Smoke Control Regulation (BC Reg. 145/93)

As a COP under the *Environmental Management Act,* the *Open Burning and Smoke Control Regulation* governs the burning of vegetative material that causes the introduction of pollutants into the environment as prohibited by the *Environmental Management Act* in Sections 6(2), 6(3) and 6(4). The *Open Burning and Smoke Control Regulation* was enacted in 1993 and has not been substantially revised since that time. However, a revised regulation is expected that will further the primary objective of minimizing human health impacts as well as facilitating compliance, minimizing costs and ensuring consistency in the *Open Burning and Smoke Control Regulation*'s enactment.

A waste discharge permit or approval is required before burning (*i.e.*, releasing contaminants) under the *Environmental Management Act* and may be provided by the BC MOE or Metro Vancouver when within the boundaries of these jurisdictions. The *Open Burning and Smoke Control Regulation* sets forth those conditions of burning under which an *Environmental Management Act* permit or approval is not required. Land clearing is a regulated activity under the *Open Burning and Smoke Control Regulation*. In addition to prohibiting the burning of non-vegetative matter or other prohibited materials (such as treated lumber), the *Open Burning and Smoke Control Regulation* states that: reasonable actions must be taken to reduce burning volumes (*e.g.*, by marketing timber); only material from the site of burning can be burned; burning must take place at least 100 m from the nearest residence or 500 m from a school or hospital; no fire bans are in place; that, when required, permits have been issued by the local municipality under the *Forest Practices Code* of BC; the fire is continuously fed; there are adequate numbers of staff available; open burning is carried out in accordance with other requirements, including the Open Burning Smoke Control Practice in Schedule B; and the venting index is good (*i.e.*, 55-100) while burning is occurring. The venting index is a measure of atmospheric mixing that is determined by both wind speed and the depth of the mixing layer. The more mixing, the greater the dispersion of smoke and the more favourable it is to burn. The venting index is calculated daily and can be obtained from the BC MOE.

The Open Burning Smoke Control Practice in Schedule B of the *Open Burning and Smoke Control Regulation* regulates the control of smoke in Category A and B areas. In Category A areas, where smoke could have a high impact, such as the populated areas of Squamish or the Lower Fraser Valley (LFV), burning must be extinguished with 72 hours of ignition, there must be a minimum of 15 days between burn events on the same property and only 4 burns are permitted to occur on the same parcel of land in a given year.

5.3.2.5 Environmental Impact Assessment Regulation (BC Reg. 330/81)

This regulation applies to assessments conducted under Section 78 of the *Environmental Management Act*. Section 2 specifically states that such assessments must include an assessment of the detrimental and beneficial impacts upon the environment of air quality. It prescribes that this assessment must also include a description of the existing state of the environment (*i.e.*, air quality) as well as the identification of any anticipated project-related impacts and mitigation measures.

5.3.2.6 Wildfire Act (SBC 2004) and Wildfire Regulation (BC Reg. 38/2005)

Any open burning as a result of land clearing must occur within the regulatory guidelines of the *Wildfire Act* (SBC 2004), which permits fire for carrying out industrial activity, including land clearing. This applies to the prescribed municipalities listed in Section 2.1 of the *Wildfire Regulation*, but does not apply within the municipal boundaries of the City of Vancouver and other municipalities with their own local fire bylaws.

Under the *Wildfire Act*, burning is used as a means of carrying out mandatory debris disposal left over as slash from clearing in order to abate fire hazards. Except during prescribed activities, fires cannot be lit or permitted within 1 km of forest or grassland. All burning is still subject to the *Open Burning and Smoke Control Regulation*. The *Wildfire Regulation* also prescribes fire extinguishing, fire controls and

supervision methods that must be observed in the use of fire to clear debris. All relevant regulations will be abided by during any land clearing and related activities, including those laid out in the *Forest and Range Practices Act* (SBC 2002). However, the requirements of the *Wildfire Act* and *Forest and Range Practices Act* do not provide standards for or define the air quality in terms of air pollutants' concentrations, other than prescribing burning restrictions which limit emission of air pollutants.

5.3.2.7 Ambient Air Quality Objectives

Ambient Air Quality Objectives (AAQO) or Standards are pollutant concentration thresholds that are set to protect human and environmental health across Canada. These limits provide regulatory benchmarks against which pollutant concentrations can be measured.

Canada has developed a number of AAQO and Canada-wide standards that are continuously evolving as an understanding of air pollution and effects science improves. Regulatory objectives for CACs include the BC AAQO, the National AAQO (NAAQO) and the Canadian Council of Ministers of the Environment (CCME) Canadian Ambient Air Quality Standards (CAAQS). The CAAQS for $PM_{2.5}$ and O_3 will replace the current CCME Canada Wide Standards (CWS) in 2015.

For some contaminants such as PM, CO and SO_2, BC has developed its own unique AAQO. For other substances, BC has adopted NAAQO or CAAQS. Both Canada and BC have three different levels of objectives. BC levels A, B and C roughly correspond to the NAAQO maximum desirable (MDL), maximum acceptable (MAL) and maximum tolerable (MTL) levels. For the purpose of the assessment of the potential effects of the proposed Project on the Air Quality VC, measured and predicted concentrations are compared with the most stringent applicable AAQO. This means that either the BC level A or the NAAQO MDL was used as a threshold to determine potential adverse effects. This offered a conservative estimate with greater protection of human and environmental health. Where there existed both a provincial and federal AAQO, the lower (more stringent) of the two was chosen.

The AAQO presented in Table 5.3-1 represent the current (most stringent) objectives used in BC for indicator and non-indicator substances measured at representative monitoring stations within and around the Air Quality RSA. The values in Table 5.3-1 are used as thresholds for comparison with predicted emissions of the proposed Project, measured background concentrations, and the predicted cumulative concentrations arising from the proposed Project in combination with existing and future emission sources in order to assess the potential adverse effects of the proposed Project on the Air Quality VC.

TABLE 5.3-1

AMBIENT AIR QUALITY OBJECTIVES AND STANDARDS USED IN BRITISH COLUMBIA

Contaminant	Averaging Period	Level	AAQO		Adopted Date	Date Last Reviewed	Source
			µg/m³	ppb			
CO	1 hour	A	14,300	13,000	1975	--	Pollutant Control Objectives (PCOs) for food-processing, agriculturally-oriented and other misc. industries
		B	28,000	25,000			
		C	35,000	30,000			
	8 hour	A	5,500	5,000	1975	--	PCOs for food-processing, agriculturally-oriented and other misc. industries
		B	11,000	10,000			
		C	14,300	13,000			
NO_2	1 hour	MAL	188	100	1975	2014	BC Interim AAQO[1]
						1989	NAAQO
		MTL	1,000	532	1978		
	24 hour	MAL	200	106	1975		
		MTL	300	160	1978		
	Annual	MDL	60	32	1975		
		MAL	100	53			

TABLE 5.3-1 Cont'd

Contaminant	Averaging Period	Level	AAQO		Adopted Date	Date Last Reviewed	Source
			µg/m³	ppb			
O_3	1 hour	MDL	100	51	1974	--	NAAQO
		MAL	160	82	1974	1989	
		MTL	300	153	1978	--	
	8 hour	CAAQS	123	63[2]	2013	--	CAAQS
	24 hour	MDL	30	15	1974	1989	NAAQO
		MAL	50	26	1974		
	Annual	MAL	30	15	1974		
PM < 2.5 µm ($PM_{2.5}$)	24 hour	BC AAQO	25[3]	--	2008	--	BC AAQO
		CAAQS	28[4]	--	2013	--	CAAQS
	Annual	BC AAQO	8[2]		2005	--	BC AAQO
		Provincial Planning Goal	6[2]		2005		
		CAAQS	10[5]	--	2013	--	CAAQS
PM < 10 µm (PM_{10})	24 hour	BC AAQO	50	--	2005	--	BC AAQO
SO_2	1 hour	A or Lower	200	75	2014	--	BC Interim AAQO[1]
					1974-79	--	PCOs for various sectors
		B or Upper	900	340			
		C	900	340			
	3 hour	Lower	375	140	1979	--	
		Upper	665	250			
	24 hour	A or Lower	160	60	1974-79	--	
		B or Upper	260	100		--	
		C	360	140		--	
	Annual	A or Lower	25	10	1974-79	--	
		B	50	20			
		C	80	30			
TRS Compounds Measured as Hydrogen Sulfide	1 hour	A	7	5	1977	--	PCOs for the forest products industry
		B	28	20			
	24 hour	A	3	2	1977	--	
		B	6	4			

Sources: BC MOE 2013, 2014d, CCME 2012, Health Canada and Environment Canada 1998

Notes:
1 New BC Interim Objectives were established for NO_2 and SO_2 as per BC MOE communication on October 10, 2014 regarding world's cleanest LNG facilities.
2 Based on fourth highest daily 8 hour maximum averaged over 3 consecutive years.
3 Based on annual 98th percentile value.
4 Based on annual 98th percentile value averaged over 3 consecutive years.
5 Based on annual average value averaged over 3 consecutive years.
- A, B, C: Provincial Levels A, B and C, PCOs (BC AAQO).

5.3.2.8 Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities

Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities, developed by Cheminfo Services Inc. (2005), was reviewed in order to identify best practices for the management of CAC, PM and VOC emissions from the proposed Project construction activities. The best practices and mitigation outlined in this document cover the full spectrum of construction activities of the proposed Project, including design, site preparation, fabrication, landscaping and demolition. The focus of the document is on actions that can achieve reductions in PM and VOC emissions as well as some practices that may lead to reductions in SO_x, NO_x and GHG emissions. The best practices include both pollution prevention practices as well as options that control pollution after it has been generated.

5.3.2.9 Greater Vancouver Regional District Air Quality Management Bylaw No. 1082, 2008

The Greater Vancouver Regional District (now Metro Vancouver) Air Quality Management Bylaw No. 1082 prohibits the discharging of any air contaminant by any person conducting any industry, trade or business, and prohibits the disposal of any waste by burning or incineration. Exceptions to this are provided when the discharge, for example: is made in accordance with the terms and conditions of an emission regulation; is carried out in accordance with a permit or order; is from a gas or propane furnace of < 0.1 MW; is from a compliant motor vehicle; is from burning regulated through either the BC *Wildfire Act* (SBC 2004) or the BC *Weed Control Act* (RSBC 1996); or the discharge is less than 199 kg of CO and less than 5 kg of each of SO_x and NO_x per day. Also, like the *Environmental Management Act*, no discharge of a contaminant may cause pollution.

Therefore, for larger sources such as compressor stations, emissions permits are required. Permits may limit the frequency, quantity and nature of an air contaminant permitted to be discharged, as well as additional requirements that may include monitoring, building, record keeping and other activities. However, the district director may provide an approval for the release of air contaminants for a period of up to 15 months without issuing a permit. Both permits and approvals can be amended or renewed under certain circumstances and provisions.

The Air Quality Management Bylaw also provides powers for making orders in regard to information, pollution prevention and pollution abatement, and allows for the establishment of fees or fines and enforcement. It also allows for the development of additional bylaws for the purpose of emissions regulation, prohibitions, requirements and the rates of payments of fees.

5.3.2.10 Greater Vancouver Regional District Air Quality Management Fees Regulation Bylaw No. 1083, 2008

The Greater Vancouver Regional District (now Metro Vancouver) Air Quality Management Fees Regulation Bylaw No. 1083 was developed under the authority of the Air Quality Management Bylaw No. 1082 to determine the rates and requirements of fee payments related to the permitted or approved emission of atmospheric contaminants. The bylaw states that anyone holding a permit or approval to emit must pay annual fees. Those annual fee amounts are calculated by multiplying the permitted discharge by the corresponding per tonne fee rate for a specific contaminant as listed in Table 1. It sets fees for permit applications and an annual base fee. It also sets provisions for fee reductions or credits for permit holders that are in compliance with their permits.

5.3.2.11 Sea-to-Sky Burning and Smoke Control Strategic Framework

In general, this framework aims to reduce smoke and associated burning in the Sea-to-Sky area. It suggests that when open burning must be carried out (*e.g.*, during land clearing), that the BC Ministry of Forests, Lands and Natural Resource Operations best management practices for woody debris management be followed. The framework recommends the use of other disposal methods, such as salvage and chipping, for the disposal of waste slash. The main objective of the framework is to considerably reduce the burning of biomass, particularly wood residues, and recommends finding and creating markets for wood residue products. Overall, the goal is to reduce burning and related smoke as much as practical.

5.3.2.12 Metro Vancouver's Ambient Air Quality Objectives

Metro Vancouver (formerly the Greater Vancouver Regional District) is the only municipality in BC to develop its own list of AAQO. These AAQO are shown in Table 5.3-2.

Although most of the AAQO adopted by Metro Vancouver are similar to those used in BC (see Table 5.3-1), the two sets of AAQO do vary. The AAQO for CO, for instance, fall between the BC Level C and Level B objectives for 1 hour averages, but fall between the BC Level B and Level A objectives for 8 hour averages. The Metro Vancouver 1 hour NO_2 AAQO is lower than the NAAQO MAL for 1 hour and annual exposures, however, the O_3 thresholds are equivalent to the NAAQO MAL for 1 hour averages and close to the CAAQS for 8 hour exposure thresholds. In developing their AAQO, Metro Vancouver

looked to international objectives and scientific literature for guidance, and Metro Vancouver's AAQO are frequently updated as new information and science comes to light.

TABLE 5.3-2

METRO VANCOUVER'S AMBIENT AIR QUALITY OBJECTIVES

Air Contaminant	Averaging Time	AAQO	
		g/m³	ppb
CO	1 hour	30,000	26,500
	8 hour	10,000	8,800
NO_2	1 hour	200	107
	Annual	40	22
SO_2	1 hour	450	174
	24 hour	125	48
	Annual	30	12
O_3	1 hour	160	82
	8 hour	126	65
PM < 2.5 µm ($PM_{2.5}$)	24 hour	50	--
	Annual	20	--
PM < 10 µm (PM_{10})	24 hour	25	--
	Annual	8 (6)	--

Source: Metro Vancouver 2011

5.3.3 Greenhouse Gas Emissions

The legislation, regulations and policies that framed the assessment of the potential effects of the proposed Project on the GHG Emissions VC are outlined below.

5.3.3.1 Copenhagen Accord

The Copenhagen Accord is an international agreement adopted in 2009 at the 15th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), of which Canada is a member. It is the most recent principal policy instrument of the Kyoto Protocol and establishes Canada's national GHG emissions reduction goal at 17% below 2005 levels by 2020, which aligns with the GHG emission reduction targets of the United States.

The Copenhagen Accord acknowledges climate change as one of the greatest challenges of our time and aims to stabilize atmospheric GHG concentrations at levels to prevent "dangerous anthropogenic interference with the climate system". The goal is to achieve this through long-term international co-operative action in keeping global temperature increase from exceeding 2°C. The accord also discusses biannual reporting on behalf of parties to the convention, the development of nationally appropriate mitigation options, and reducing GHG emissions from deforestation and forest degradation.

As part of Canada's commitment to the Copenhagen Accord, facilities currently emitting greater than 50,000 tonnes of CO_2 equivalent per year (e/y) must report their emissions as per Canada's GHG Emissions Reporting Program, which is discussed more in the next section. These sources then make up the national and provincial totals reported to the UNFCCC as presented in Subsection 5.4.4.

5.3.3.2 Canadian Environmental Protection Act, 1999

Under the authority of Section 46 of the *CEPA*, facilities meeting criteria specified in the annual notice with respect to the reporting of GHG emissions, published in the Canada Gazette, must report GHG emissions for the previous year annually on or before June 1. For the 2013 reporting year, the reporting threshold was set at 50,000 tonnes of CO_2 e/y. Emissions of GHGs arising from the combustion of biomass are reported separately. In general, guidelines for reporting follow those of the UNFCCC and values are used in producing the National Inventory Report (NIR), which is referred to for national and provincial GHG emission totals in Subsection 5.4.4. Land clearing activities and indirect emissions such as those arising from electricity usage do not need to be included in totals or reports under *CEPA* requirements (Environment Canada 2013a).

5.3.3.3 Western Climate Initiative

The Western Climate Initiative (WCI), formerly the Western Regional Climate Action Initiative, is a cross-border North American independent collaboration founded in April 2007 with the goal of developing and implementing emissions trading policies, and combating climate change at a regional level. Members include: the western States of Arizona, California, Montana, New Mexico, Oregon, Utah, and Washington; the Canadian provinces of BC, Manitoba, Ontario and Québec; and various North American Aboriginal nations and Mexican states as observers. Another goal of the initiative is to provide net economic benefits to partners and the region as a whole.

The WCI has set the GHG emission target at a 15% reduction over 2005 levels by 2020 (WCI 2007). A flexible market-based cap-and-trade mechanism is central to the initiative, and upon its implementation in January 2012, the program represented an estimated two-thirds of the GHG emissions from member jurisdictions. It is expected that by full implementation in 2015 the program will represent 90% of member emissions. The initiative offers a wide-range of offset opportunities with a single offset being equivalent to the removal of 1 metric tonne of atmospheric carbon dioxide equivalent (CO_2e). Land clearing and forestry are not subject to the emission caps of the initiative, although activities in this sector (*e.g.*, tree planting) can be used to acquire credits (WCI 2012). As of early summer 2014, the WCI had not yet developed emission caps for the oil and gas, energy or other sectors.

The WCI mandates GHG reporting by member jurisdictions and provides standard methods by which partners can estimate their GHG emissions from mandatory reporting facilities (*i.e.*, those emitting 10,000 tonnes of CO_2 e/y from combined sources beginning in 2010) as laid out in WCI.1 Section (a)(1) of the *Final Essential Requirements of Mandatory Reporting* (WCI 2011). Of particular relevance is WCI.20, which lays out requirements for General Stationary Combustion Sources and WCI.350 for Natural Gas Transmission and Distribution, under which the existing FortisBC pipeline and compressor system already report. Results from this reporting were used to characterize existing emissions in the GHG Emissions Technical Report (Volume 2, Appendix 1E). Emission factors and estimation methods in the *Final Essential Requirements of Mandatory Reporting* document (WCI 2011) were also referenced in the estimation of GHG emissions from the proposed Project. WCI.353 sets the requirements for fugitive emissions from compressor valves, connectors, open-ended lines and pressure relief valves or meters.

For the purposes of WCI, carbon sequestration is considered permanent when it continues for more than 100 years, in accordance with UNFCCC definitions (WCI 2010). The 100-year time interval is also used in radiative forcing calculations of Global Warming Potential (GWP) for GHGs other than CO_2, and in accordance with the UNFCCC (see the GHG Emissions Technical Report in Volume 2, Appendix 1E). The concept of permanence is especially important when considering emissions in terms of land clearing proposed for the proposed Project, despite not being approached by the WCI.

5.3.3.4 Bill 18 – Greenhouse Gas Reduction (Cap and Trade) Act, 2010

The BC 2010 GHG *Reduction (Cap and Trade) Act* enforces obligations for reporting of GHG emissions attributable to operations over the reporting period by regulated operators. It also defines appeals and offences related to reporting and inspection. The *GHG Reduction (Cap and Trade) Act* regulates the process of reporting of GHG emissions, however, technical aspects such as emission factors and other provincial reporting requirements under the *GHG Reduction (Cap and Trade) Act* are defined according to the WCI discussed above.

5.3.3.5 Bill 44 – Greenhouse Gas Reduction Targets Act, 2007

The Province of BC has developed policy mechanisms under its Climate Action Plan for mitigating and adapting to human-induced climate change. BC's 2007 *GHG Reduction Targets Act* makes commitments to reduce GHG emissions by 33% over 2007 levels by 2020, and 80% over 2007 levels by 2050.

BC's Pacific Carbon Trust began as a mechanism to carry out activities as described by both *Bill 44 - GHG Reduction Targets Act* and *Bill 18 – GHG Reduction (Cap and Trade) Act*. The Pacific Carbon Trust is a Crown (public) corporation developed to purchase and sell carbon offsets. These offsets are produced by the agriculture, oil and gas, transportation and forestry industries, and are a source of public sector offsets to either gain or maintain carbon neutrality as specified in the *GHG Reduction Targets Act* (Pacific Carbon Trust 2014).

Under the *GHG Reduction Targets Act,* the province must release a Progress to Targets report every 2 years that tracks GHG reduction progress compared with the original Climate Action Plan.

5.3.3.6 Emission Offsets Regulation (BC Reg. 393/2008)

The *Emission Offsets Regulation* under the *GHG Reduction Targets Act* defines the approach for developing a project plan for a GHG emission offset project. The *Emission Offsets Regulation* permits eligible projects to receive carbon offsets for activities involving: GHG storage, capture or sequestration; removal using a controlled sink; or the avoidance of emissions from controlled reservoirs. Projects that reduce emissions at existing sources may also be eligible. The mitigation measures identified for the proposed Project may also be eligible to receive carbon offset credits under the *Emission Offsets Regulation* because the measures, such as tree replanting (*i.e.*, reacquiring carbon storage) along the proposed pipeline corridor or reduction of natural gas venting through equipment upgrades are reducing the emissions at source.

5.3.3.7 Reporting Regulation (BC Reg. 272/2009)

The *Reporting Regulation* under the *GHG Reduction (Cap and Trade) Act* applies to industrial GHG emitters. The regulation contains definitions, methodologies and requirements for calculating and reporting GHG emissions in BC. Section 6 mandates that any individual facility or linear facilities operation emitting 10,000 tonnes of CO_2 e/y or greater in GHG emissions must report these emissions on an annual basis. Facilities include all buildings, structures, equipment and stationary items located on a single site or at multiple contiguous sites. The proposed Project is considered a single facility under the regulation, or more specifically, a linear facilities operation under Section 1(1) and Table 2, Schedule A of the regulation.

Methodologies set out in Tables 1 and 2 of Schedule A define how GHG emissions should be calculated under the *Reporting Regulation* and according to the WCI. However, for the purpose of this assessment, the other GHG estimation methodologies were also used when specific methodology was not available (*e.g.*, estimation of emissions from construction vehicles and equipment) or recommendations from regulatory bodies were obtained (*e.g.*, land clearing related calculations) which were better suited to assess the proposed Project activities.

Sources for which GHG estimate should be made under the regulation in relation to the proposed Project include venting and fugitive sources (WCI.350), stationary combustion sources (WCI.020) and electricity generation (WCI.040). Within these source categories are more specific reporting requirements and methods for reciprocating or centrifugal compressor venting, blowdown vent stacks, equipment leaks and other venting sources. Mobile combustion emissions (*i.e.*, vehicles and barges associated with construction or maintenance activities) are not required to be estimated or reported by linear facilities operations under the *Reporting Regulation*. However, these emissions are still required to be estimated as part of the GHG Emissions Assessment and, therefore, have been estimated despite not being included in facility totals for the purpose of provincial reporting.

5.3.3.8 British Columbia's Climate Action Plan

The BC Climate Action Plan enables local governments to develop their own climate change and GHG-related policies and programs, including low carbon economic growth or carbon sequestration programs. First produced in 2008, there have since been three Progress to Targets reports produced, the most recent being for 2014.

The 2008 plan provides actions for every sector to reduce the GHG emissions contributing to international climate change. The plan refers to the BC Energy Plan in terms of energy industry commitments. Of relevance to the proposed Project are requirements that BC Hydro will acquire 50% of its *"incremental energy needs through conservation by 2020"*. Conservation includes reducing energy consumption and increasing energy efficiency at all levels. Therefore, in the future, the energy mix provided to the proposed Project by BC Hydro for its electricity needs, including electrically-driven compressor turbines, may change drastically.

The BC Climate Action Plan also includes a Bioenergy Strategy, which affects the markets available for waste wood produced from land clearing activities, and may facilitate biomass marketing and use (as

opposed to burning) of these wastes as pellets, cellulosic ethanol and other renewable fuels, which will substantially reduce the GHG emissions associated with construction or, specifically, land clearing activities for the proposed Project. The BC Climate Action Plan promotes the production of manufactured building products from cleared timber to aid in carbon sequestration as well as the replanting of young trees that take up higher levels of atmospheric CO_2 compared to their more mature counterparts, and suggests that the province's forests are a chief ally in the battle against climate change.

The 2014 Climate Action Progress Report (BC MOE 2014a) states that BC reached its target of a 6% reduction in GHG emissions over 2007 levels by 2012. The report gives no specific progress updates for the energy or oil and gas subsectors.

5.3.3.9 Bill 5 - 2010, Zero Net Deforestation Act

The purpose of *Bill 5 – Zero Net Deforestation Act* is to achieve zero net deforestation in BC by December 31, 2015. It also states that a report must be produced by the government each consecutive evenly numbered year on the progress towards zero net deforestation made to date. For all areas of deforestation, all of which must be reported, an equal area must be afforested. Therefore, all deforestation as a result of the proposed Project must be reported. For more details on this, see the GHG Emissions Technical Report (Volume 2, Appendix 1E).

5.3.3.10 Bill 27 - 2008, Local Government (Green Communities) Statutes Amendment Act, 2008

The BC *Local Government (Green Communities) Statutes Amendment Act, 2008* requires that regional districts include targets, policies and actions to reduce GHG emissions as part of their regional growth strategies. Some of these requirements may be part of the land use plans described in the following subsection.

5.3.4 Land Use Plans

The proposed Project crosses lands that are guided by a variety of regional and municipal land use plans. In addition, the proposed Project crosses areas covered by two Aboriginal planning documents. These documents are the *Tsleil-Waututh Nation Stewardship Policy* (Tsleil-Waututh Nation 2009) and the Tsleil-Waututh Nation Comprehensive Community Plan (Tsleil-Waututh Nation 2010). The *Tsleil-Waututh Nation Stewardship Policy* applies to all of the surface and subsurface air, land, water, cultural and other natural resources within the Tsleil-Waututh consultation area, however, there are no specific goals or objectives related to the Acoustic Environment, Air Quality and GHG Emissions VCs (Tsleil-Waututh Nation 2009). Similarly, the Tsleil-Waututh Nation Comprehensive Community Plan has no specific goals or objectives related to the Acoustic Environment, Air Quality and GHG Emissions VCs (Tsleil-Waututh Nation 2010).

Table 5.3-3 provides a summary of the plans that are crossed by the proposed Project that have goals or objectives related to the Acoustic Environment, Air Quality and GHG Emissions VCs.

TABLE 5.3-3

LAND AND RESOURCE MANAGEMENT PLANS APPLICABLE TO THE ATMOSPHERIC ENVIRONMENT VALUED COMPONENTS

Plan Name	Guidance Applicable to Atmospheric Environment VCs
Regional and Municipal Plans	
Sea-to-Sky AQMP (SSAQMP) (Sea-to-Sky Air Quality Coordinating Committee 2007)	• Uses an adaptive management framework with air quality as a co-management option for GHG reductions. • Sets goals to address a number of issues, including human, environmental and economic health, and issues of climate change, visibility and odour. • Actions to achieve these goals include reduction (or elimination) of vehicle idling, the use of the best available technology for construction vehicles and the development of a smoke control strategy. • A review of the SSAQMP, released April 30, 2014, is as follows: – points out poor visibility that may impact regional transport, outdoor recreation and tourism industries; – reports episodes of elevated fine $PM_{2.5}$ that exceeded the province's planning goal for annual average concentrations at Squamish in 2011 and 2012; – reports an episode in January 2014 that led to 24 hour rolling averages exceeding the 24 hour $PM_{2.5}$ objective in Whistler; and – reports occasional exceedances of the tropospheric O_3 objective in Squamish, and fairly frequent exceedances of the odour threshold (5 ppb) for TRS compounds in Langdale and occasionally Squamish. • Existing concerns regarding these pollutants make it even more important that the proposed Project limit its emissions of CACs and other pollutants to the greatest extent practical. • Specifically, the Sea-to-Sky Clean Air Society's vision is that in 2025: "Communities in the Sea-to-Sky Airshed will enjoy clean air that sustains and contributes to the health of our residents and guests, our economy and our environment and wildlife." (Zirnhelt and Rankin 2014).
Metro Vancouver Integrated Air Quality and GHG Management Plan (Metro Vancouver 2011)	• A long-term vision of healthy, clean and clear air for current as well as future generations. • It places air quality within Metro Vancouver's Sustainability Framework. • The plan is built on three goals: – protect public health and the environment; – improve visual air quality; and – minimize the region's contribution to international climate change. • Measures of goals include the percent change in emissions of both pollutants and GHGs by sector, and the number of days with poor air quality or visibility. • Targets of goals include reducing particulates from diesel vehicles and equipment 50% by 2015 compared with 2005 levels.
Metro Vancouver Integrated Air Quality and GHG Management Plan (Metro Vancouver 2011) (cont'd)	• Targets also include reducing GHGs 15% by 2015 and 33% by 2020 over 2007 levels. • The plan gives particular attention to PM emissions, largely from diesel fuel. • It aligns with other government initiatives such as the federal Air Quality Management System, GHG targets (17% below 2005 levels by 2020), upcoming regulations for heavy-duty trucks, and new (2012) Transport Canada Marine Emissions Standards for sulphur, nitrogen and fine particles. • The plan establishes leverage from the BC Climate Action Plan and support from the BC MOE. • It plans continued measurement and monitoring of air pollutants.
Consolidated Environmental Management Plan for Burrard Inlet (Burrard Inlet Environment Action Program [BIEAP] 2011)	• This plan contains a section on air quality under the heading of Existing Planning Initiatives in Burrard Inlet. • It describes Metro Vancouver's legal obligation to monitor local air quality and control atmospheric emissions, including those from industry (*i.e.*, those not included in the Community Energy and Emissions Inventory [CEEI]). • Various marine vessel measures and protocols are mentioned, such as the International Maritime Organization's designation of Burrard Inlet as an Emission Control Area and the Northwest Ports Clean Air Strategy that will affect any barge-related traffic from the proposed Project, and, most importantly, the mandatory use of locally compliant fuel sources. • It cites the Metro Vancouver Integrated Air Quality and GHG Management Plan in terms of strategies and measures to control emissions of contaminants and GHGs. • Climate change is addressed indirectly through partnerships with the Ports of Metro Vancouver (which has its own Air Action Program and EcoAction Program work to reduce emissions from marine vessels), Seattle and Tacoma to deal with port-related contributions to both air pollution and climate change.
Sea-to-Sky Land and Resource Management Plan (Government of BC 2008)	• Although the Sea to Sky Land and Resource Management Plan (LRMP) does not specifically contain plans or goals directly related to air quality, it does state in Appendix 2: Lil'wat Nation Territorial Vision that the traditional territory is recognized for "its wilderness area, clean water and air and health populations of animals, plants and fish", and makes reference to these factors as elements that sustain the health of the community. • This LRMP also does not make any direct reference to climate change or GHGs, however, it does forbid the commercial harvesting of any timber within Wildland Zones (27% of the plan area) or within other areas, such as the upper slopes of In-SHUCK-ch Mountain and identified cultural areas, which in turn reduces clearing-related emissions of GHGs.

Note: * The text in this table represents a paraphrase from the land use plans.

5.4 Existing Conditions

The discussion of the proposed Project relative to the atmospheric environment is based on the VCs listed in Table 5.1-1. By describing atmospheric conditions in terms of existing sound levels, existing ambient air contaminant concentrations and existing GHG emissions, it is possible to assess and evaluate the potential adverse effects of the proposed Project on each atmospheric environment VC. Each VC is discussed individually below, except where two VCs share a specific condition such as climate. Because climate influences all three atmospheric VCs, it is presented first, apart from the respective subsection of each VC.

Acoustic environment information is based on background noise measurements conducted as part of this Application, as well as local site surveys and maps. Detailed acoustic environment information is contained in the Acoustic Environment Technical Report (Volume 2, Appendix 1C).

Air quality information is based on: existing background air monitoring data available from the BC MOE; emissions information for existing sources as reported in the Environment Canada NPRI; and in the BC MOE repository for air emission sources requiring authorization under the *Environmental Management Act, Waste Discharge Regulation*. Detailed air quality information is contained in the Air Quality Technical Report (Volume 2, Appendix 1D).

Lastly, information on GHG emissions is obtained from existing GHG inventories produced at the federal, provincial and local levels as well as GHG reports made for the existing pipeline and compressor stations. Detailed GHG emissions information is contained in the GHG Emissions Technical Report (Volume 2, Appendix 1E).

5.4.1 Local Climate and Meteorology

The proposed Project region is characterized by a Pacific maritime climate dominated by winter low pressure systems that bring mild, wet weather with rain at lower elevations and snow at higher altitudes as well as summer high pressure systems that create warm and dry conditions. Characterized by complex coastal terrain, the area is prone to strong vertical and horizontal gradients in pressure, temperature and moisture, which have influence over local climate and air flow.

This complex coastal and urban terrain also creates unique boundary layer conditions and pollutant flow regimes. The LFV, which features the cities of Vancouver and Coquitlam (both part of Metro Vancouver, the latter of which is the location of the Eagle Mountain compressor station), is dominated by transportation sector emission sources that are transported eastward up the valley towards Maple Ridge. The local meteorological conditions also influence the vertical distribution of pollutants. A combination of ocean and mountains produces localized wind patterns and boundary layer stability, which, in addition to larger scale boundary layer stratification, can lead to the complex vertical layering and diurnal patterning of pollutants. In early morning, pollutants are typically advected offshore due to a remnant nighttime land breeze and katabatic wind. Towards noon, this flow reverses due to land heating, and pollutants are advected inland by the sea breeze and anabatic winds eastward up the LFV as well as northward up the Sea-to-Sky corridor (Krzyzanowski *et al.* 2006, Meyn *et al.* 2004). Anabatic winds also cause pollutants to be transported to higher elevations where mountain venting can push them into the free atmosphere, or, as observed in the LFV, pollutants may persist aloft nocturnally and become recirculated in the daytime convective boundary layer (Krzyzanowski *et al.* 2006).

The BC MOE reports meteorological data recorded at certain sites near the proposed Project. Meteorological parameters are measured (from east to west) at the following locations:

- Golden Ears Elementary School in Maple Ridge, approximately 20 km southeast of the Eagle Mountain compressor station in the LFV;
- Douglas College in Coquitlam, approximately 3.5 km southeast of the Eagle Mountain compressor station;
- on Burnaby Mountain south of Vancouver, approximately 9 km southwest of the Eagle Mountain compressor station;

- in Squamish at a location approximately 2 km south of KP 38 and the proposed Squamish compressor station site;
- approximately 1.6 km northeast of the existing Port Mellon compressor station; and
- at the Langdale Ferry Terminal, approximately 9 km south of the existing Port Mellon compressor station.

These sites, the locations of which are shown in Figure 5.4-1 and listed in Table 5.4-1, were used to summarize temperature, relative humidity, wind speed and wind direction. Wind speed and wind direction are the major variables reported at these sites that affect the transport of air pollutants.

TABLE 5.4-1

STATIONS PROVIDING SHORT-TERM METEOROLOGICAL DATA (2011 to 2013)

Station Name	Latitude	Longitude	Elevation (m above sea level [asl])
Maple Ridge - Golden Ears Elementary	49.215	-122.582	100.0
Coquitlam - Douglas College[1]	49.288	-122.791	61.0
Burnaby Mountain[1]	49.280	-122.922	360.0
Squamish	49.700	-123.154	10.0
Port Mellon	49.523	-123.482	3.0
Langdale Ferry Terminal	49.434	-123.472	15.0

Source: BC MOE 2013

Note: 1 The Coquitlam and Burnaby Mountain stations did not begin collecting meteorological data until January 12, 2012.

Although only two (Coquitlam and Squamish) of the six BC MOE meteorological stations above are located along the Application Corridor and within the Air Quality RSA, climatic conditions from the additional locations are presented here to illustrate variation within the general area of the proposed Project and provide a basic setting in which the proposed Project is located. In addition, due to the nature of meteorological transport and long atmospheric lifetime of long-range pollutants, Maple Ridge represents a possible destination of any long-range pollutants such as O_3 that may be associated with the proposed Project's emissions of precursor NO_x or VOCs.

Three years of data from each location were used to characterize existing climate (January 1, 2011 to December 31, 2013), except for the Coquitlam and Burnaby Mountain sites, which did not begin collecting meteorological data until January 12, 2012. Each of these meteorological stations also measured concentration of CACs over the same period. However, these provincial monitoring stations lack measurements of precipitation and do not represent data over the long-term. Therefore, Environment Canada's climate normals were used to supplement these local station data and provide long-term characteristic measurements of temperature, humidity and precipitation.

Climate normal datasets from Environment Canada each represent approximately 30 years of measurements (1981 to 2010) that were gathered at stations (from east to west) in Maple Ridge at: Kanaka Creek; Coquitlam on Como Lake Avenue; Burnaby at Simon Fraser University (SFU), which is also on Burnaby Mountain; Squamish at STP Central; and Woodfibre. Table 5.4-2 provides the spatial coordinates and elevation for those long-term monitoring sites used to characterize the proposed Project's surrounding climate due to their accurate representation of the area and availability of long-term meteorological data. Station locations are mapped in Figure 5.4-2.

TABLE 5.4-2

STATIONS PROVIDING LONG-RANGE CLIMATE DATA (CLIMATE NORMALS) (1981 to 2010)

Station Name	Latitude	Longitude	Elevation (m asl)
Maple Ridge - Kanaka Creek	49.211	-122.507	76.0
Coquitlam - Como Lake Avenue	49.269	-122.866	160.0
Burnaby - SFU	49.278	-122.918	365.8
Squamish - STP Central	49.733	-123.150	6.1
Woodfibre	49.581	-123.889	3.5

Source: Government of Canada 2013

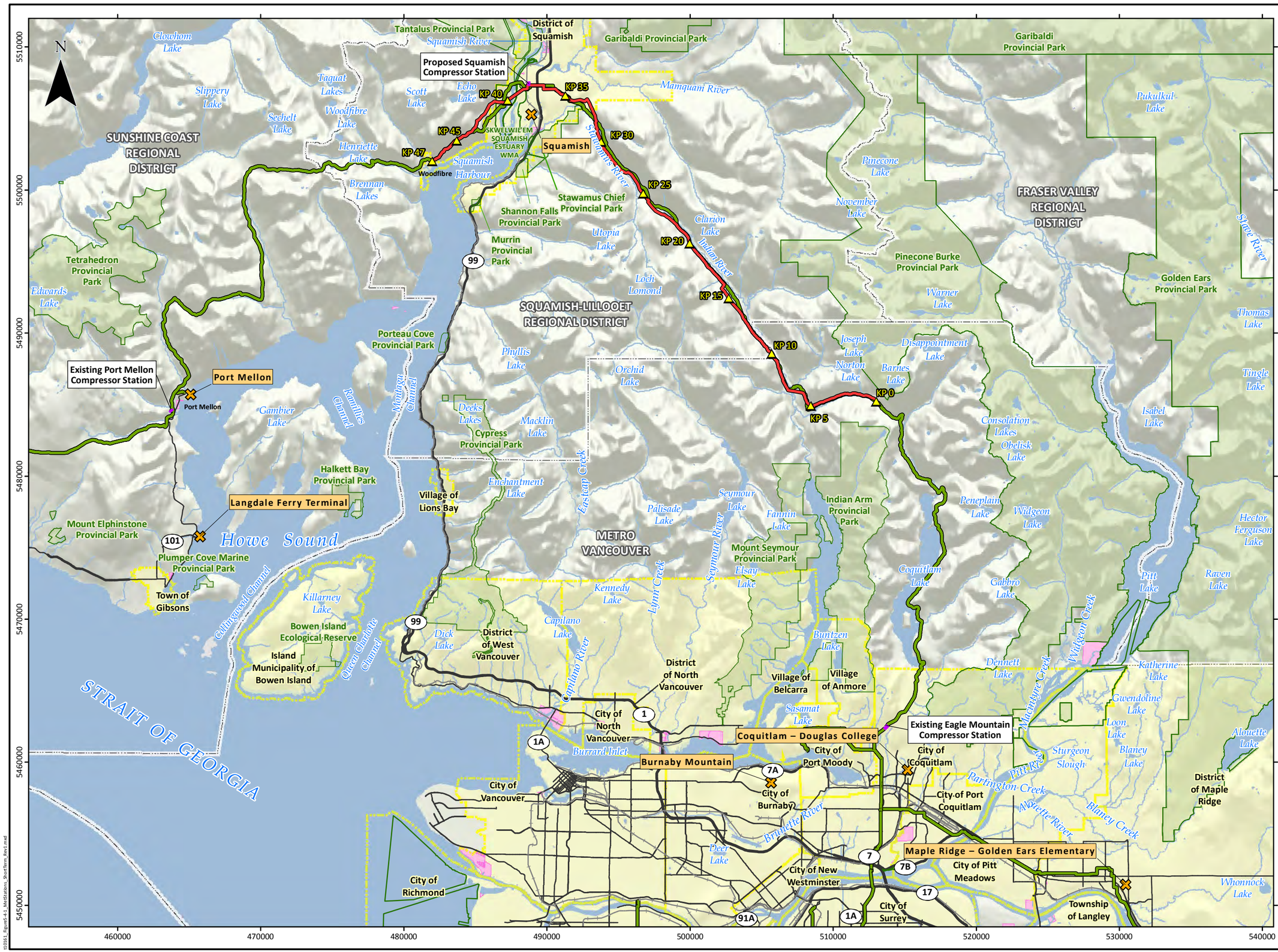

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FIGURE 5.4-1

LOCATIONS OF METEOROLOGICAL STATIONS PROVIDING SHORT-TERM CLIMATE DATA

EAGLE MOUNTAIN-WOODFIBRE GAS PIPELINE PROJECT

- Meteorological Station - Short Term
- Kilometre Post
- Compressor Station
- Proposed Pipeline
- Existing FortisBC Pipeline
- Highway
- Road
- Railway
- Watercourse
- Waterbody
- Municipality
- Regional District
- Park/Protected Area
- First Nations Reserve

SCALE: 1:250,000

0 2 4 6 8 km

(All Locations Approximate)

tera A CH2M HILL Company

CH2M HILL Project Number 492434

UTM Zone 10 North. NAD 1983.

Proposed Pipeline, KPs: Universal Pegasus International (UPI) 07-14-2014; Existing Pipeline: FortisBC 2012; Compressor Stations: UPI 07-23-2014; Meteorological Stations (Short Term): BC MOE 2013; Roads: NRCan 2014; Railways: NRCan 2012; Hydrography: NRCan. 2009, IHS Inc. 2004 and BC MFLNRO 2008; Municipal Boundaries, Regional Districts: BC MFLNRO 2007; Parks, Wildlife Management Areas: BC MFLNRO 2008; First Nation Reserves: Government of Canada 2014;Hillshade: TERA Environmental Consultants 2008.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

Mapped By: DN | Checked By: JRO

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FORTIS BC

January 2015

FIGURE 5.4-2

LOCATIONS OF METEOROLOGICAL STATIONS PROVIDING LONG-RANGE CLIMATE DATA

EAGLE MOUNTAIN-WOODFIBRE GAS PIPELINE PROJECT

- Meteorological Station - Long Range
- Kilometre Post
- Compressor Station
- Proposed Pipeline
- Existing FortisBC Pipeline
- Highway
- Road
- Railway
- Watercourse
- Waterbody
- Municipality
- Regional District
- Park/Protected Area
- First Nations Reserve

SCALE: 1:320,000

0 2 4 6 8 10 km

(All Locations Approximate)

tera A CH2M HILL Company

CH2M HILL Project Number 492434

UTM Zone 10 North. NAD 1983.

Proposed Pipeline, KPs: Universal Pegasus International (UPI) 07-14-2014; Existing Pipeline: FortisBC 2012; Compressor Stations: UPI 07-23-2014; Meteorological Station Locations (Long Range): Government of Canada 2013; Roads: NRCan 2014; Railways: NRCan 2012; Hydrography: NRCan. 2009, IHS Inc. 2004 and BC MFLNRO 2008; Municipal Boundaries, Regional Districts: BC MFLNRO 2007; Parks, Wildlife Management Areas: BC MFLNRO 2008; First Nation Reserves: Government of Canada 2014; Hillshade: TERA Environmental Consultants 2008.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

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5.4.1.1 Temperature

Ambient temperature can influence how pollutants, GHGs and noise are transported in the atmosphere. Temperature can also influence the chemistry and formation of some pollutants, and an increase in international mean ambient temperature is the primary outcome of GHG emissions as well as the cause of international climate change.

Ambient air temperatures are presented as climate normals at the Environment Canada long-term monitoring stations. Four of the five stations in Table 5.4-2 (*i.e.*, all stations except Coquitlam) have long-term temperature measurements from 1981 to 2010. Monthly means of daily averages, daily maximums and daily minimums from 1981 to 2010 are presented in Table 5.4-3 and Figure 5.4-3. Overall, temperatures between the four sites have been observed to be similar across seasons, with mild winters and warm summers, however, Maple Ridge and Squamish have been recorded as slightly warmer than Burnaby and Woodfibre.

TABLE 5.4-3

SUMMARY OF LONG-TERM DAILY EXTREME AND MEAN MONTHLY TEMPERATURES (CLIMATE NORMALS)

Station	Parameter	Temperature (°C)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maple Ridge - Kanaka Creek	Mean Daily Avg.	2.5	4.0	6.5	9.6	12.5	15.2	17.7	17.8	15.0	10.0	5.4	2.4
	Mean Daily Max.	5.0	7.8	10.9	14.9	17.9	20.5	23.8	24.1	21.1	14.1	8.1	4.6
	Mean Daily Min.	0.0	0.1	1.9	4.3	7.1	9.9	11.7	11.6	8.9	5.9	2.8	0.2
Burnaby - SFU	Mean Daily Avg.	3.6	4.3	6.2	8.7	11.8	14.4	17.0	17.2	14.6	9.5	5.3	2.9
	Mean Daily Max.	5.8	6.8	9.3	12.4	15.6	18.2	21.2	21.2	18	12	7.5	5.1
	Mean Daily Min.	1.4	1.7	3.1	4.9	7.9	10.5	12.7	13.2	11.1	7	3	0.8
Squamish - STP Central	Mean Daily Avg.	2.2	3.9	6.7	9.6	12.8	15.4	17.7	17.8	14.8	9.8	4.8	1.6
	Mean Daily Max.	5.2	7.7	11.6	14.4	18.1	20.4	23.2	23.6	20.9	14.3	7.7	4.2
	Mean Daily Min.	-0.9	-0.1	1.8	4.7	7.5	10.3	12.1	11.9	8.7	5.4	1.8	-1.1
Woodfibre	Mean Daily Avg.	--	4.9	9.4	10.5	12.9	--	16.1	17.6	13.9	9.7	--	--
	Mean Daily Max.	--	8.7	13.3	14.4	16.8	--	19.4	21.8	17.5	13.6	--	--
	Mean Daily Min.	--	1.1	5.5	6.5	8.9	--	12.7	13.3	9.7	5.6	--	--

Note: -- Indicates that data was unavailable for that particular month.

Although long-term climate normals such as those presented for temperature in Table 5.4-3 are useful in describing general climatic conditions, long-term trend data are required to look at any changes over time. These long-term trends are especially important when considering the proposed Project's contribution to climate change with added GHG emissions.

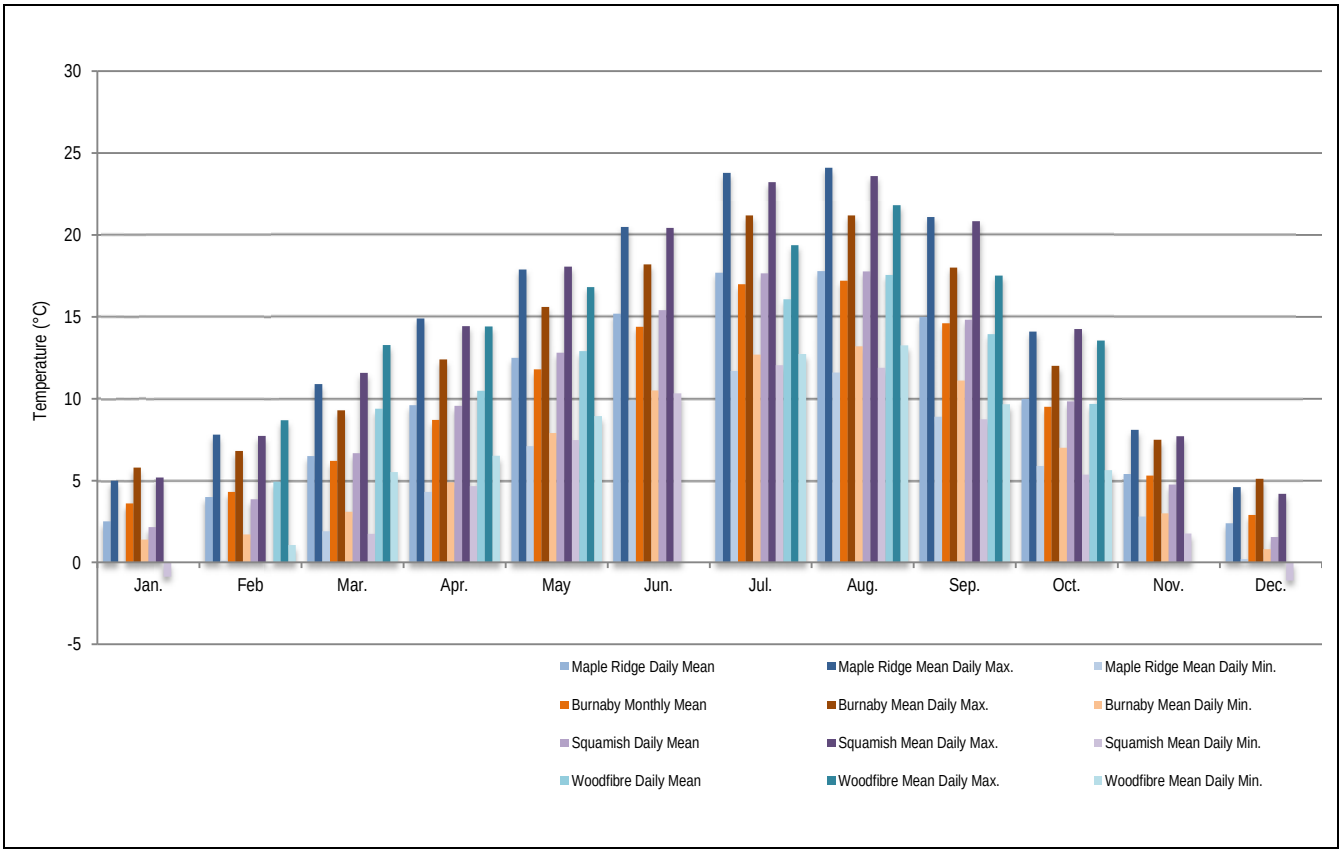


Figure 5.4-3 Long-Term Monthly Mean Daily Air Temperatures

5.4.1.2 Precipitation

Precipitation influences the scavenging or deposition of atmospheric pollutants. It also causes noise and affects how we perceive other sounds in our acoustic environment. Changes in precipitation patterns and amounts are also anticipated results of international climate change.

Long-term precipitation data were collected as part of the climate normals dataset for a 30 year period spanning from 1981 to 2010 (Government of Canada 2013). Long-term, daily rainfall, snowfall and total precipitation are presented as monthly means and maximums in Figures 5.4-4, 5.4-5 and 5.4-6, respectively, and in detail in Table 5.4-4.

TABLE 5.4-4

LONG-TERM MONTHLY MEAN AND DAILY MAXIMUM RAINFALL, SNOWFALL AND TOTAL PRECIPITATION MEASURED AT MAPLE RIDGE, COQUITLAM, BURNABY, SQUAMISH AND WOODFIBRE

Station	Parameter	Rainfall (mm)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maple Ridge - Kanaka Creek	Monthly Mean	252.4	138.2	167.9	144.0	132.4	90.0	59.4	63.3	82.5	188.9	301.8	218.6
	Daily Maximum	93.4	92.6	90.0	55.0	55.6	39.6	64.0	60.7	54.4	149.2	105.8	62.0
Coquitlam - Como Lake Ave.	Monthly Mean	253.4	170.2	165.6	141.1	112.6	88.4	59.1	66.4	75.8	190.1	302.7	230.2
	Daily Maximum	102.0	75.2	107.6	61.0	60.8	42.6	48.6	70.2	58.4	83.1	96.6	100.3
Burnaby - SFU	Monthly Mean	256.5	163.2	171.2	152.7	119.9	101.4	64.7	64.5	92.2	209.8	303.6	220.8
	Daily Maximum	171.5	86.0	89.0	82.6	47.8	61.8	78.7	58.6	94.0	119.1	80.0	101.9
Squamish - STP Central	Monthly Mean	295.1	228.6	179.5	160.8	113.6	84.2	58.8	61.0	75.4	262.2	372.4	234.0
	Daily Maximum	87.4	109.6	69.4	79.0	49.2	34.8	50.2	79.2	52.2	122.8	123.8	93.2
Woodfibre	Monthly Mean	399.8	228.3	273.5	187.1	147.2	106.3	71.8	73.3	102.6	324.8	469.6	355.8
	Daily Maximum	197.1	115.0	115.2	87.6	60.2	77.0	86.4	111.5	112.8	135.0	168.0	132.8

TABLE 5.4-4 Cont'd

Station	Parameter	Snowfall (cm)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maple Ridge - Kanaka Creek	Monthly Mean	23.4	7.9	6.4	0.1	0.1	0.0	0.0	0.0	0.0	0.1	6.4	18.1
	Daily Maximum	28.0	27.0	21.4	1.0	2.4	0.0	0.0	0.0	0.0	1.3	15.0	31.6
Coquitlam - Como Lake Ave.	Monthly Mean	24.3	11.4	4.1	0.5	0.1	0.1	0.7	0.0	0.0	0.3	5.8	20.0
	Daily Maximum	28.6	30.4	15.0	7.0	2.0	2.0	13.6	0.0	0.0	4.4	18.8	35.6
Burnaby - SFU	Monthly Mean	24.3	15.1	10.9	1.7	0.1	0.0	0.0	0.0	0.0	0.2	8.0	29.0
	Daily Maximum	30.5	49.0	30.0	13.6	1.5	0.0	0.0	0.0	0.0	3.0	22.9	50.0
Squamish - STP Central	Monthly Mean	27.9	21.7	6.8	0.1	0.0	0.0	0.0	0.0	0.0	0.5	11.7	28.6
	Daily Maximum	24.6	29.6	45.0	1.0	0.0	0.0	0.0	0.0	0.0	6.8	36.0	34.4
Woodfibre	Monthly Mean	24.3	11.2	5.1	0.1	0.0	0.0	0.0	0.0	0.0	0.5	9.6	13.0
	Daily Maximum	53.3	56.0	34.3	1.0	0.0	0.0	0.0	0.0	0.0	11.0	30.0	61.0
Station	Parameter	Total Precipitation (mm)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maple Ridge - Kanaka Creek	Monthly Mean	275.8	146.1	174.3	144.1	132.5	90.0	59.4	63.3	82.5	189.0	308.2	236.7
	Daily Maximum	93.4	92.6	90.0	55.0	55.6	39.6	64.0	60.7	54.4	149.2	105.8	62.0
Coquitlam - Como Lake Ave.	Monthly Mean	277.7	181.6	169.7	141.6	112.7	88.5	59.8	66.4	75.8	190.4	308.5	250.1
	Daily Maximum	102.0	75.2	107.6	61.0	60.8	42.6	48.6	70.2	58.4	83.1	96.6	100.3
Burnaby - SFU	Monthly Mean	280.9	178.4	182.1	154.4	120.0	101.4	64.7	64.5	92.2	210.1	311.6	249.8
	Daily Maximum	171.5	86.0	89.0	83.3	47.8	61.8	78.7	58.6	94.0	119.1	80.0	101.9
Squamish - STP Central	Monthly Mean	323.0	250.3	186.3	160.9	113.6	84.2	58.8	61.0	75.4	262.6	384.1	262.5
	Daily Maximum	87.4	109.6	69.4	79.0	49.2	34.8	50.2	79.2	52.2	122.8	123.8	94.2
Woodfibre	Monthly Mean	424.1	239.4	278.6	187.2	147.2	106.3	71.8	73.3	102.6	325.3	479.2	368.8
	Daily Maximum	197.1	115.0	115.2	87.6	60.2	77.0	86.4	111.5	112.8	135.0	171.5	132.8

At all sites, rainfall has been observed to be heavier in the fall and winter months (October to March). Woodfibre has received the most rainfall of all sites, followed by Squamish, and maximum daily rainfall has also been the highest at Woodfibre (Figure 5.4-4). Some precipitation has generally fallen as snow at all sites from November to March, with the most snow falling in Burnaby and Squamish, and the most extreme snowfall occurring at Woodfibre (Figure 5.4-5). Overall, precipitation amounts have been recorded as similar between sites and much lower in late spring and summer months (May to September) than they are in fall and winter (October to February). Woodfibre has received the highest amount of mean total monthly precipitation (Figure 5.4-6).

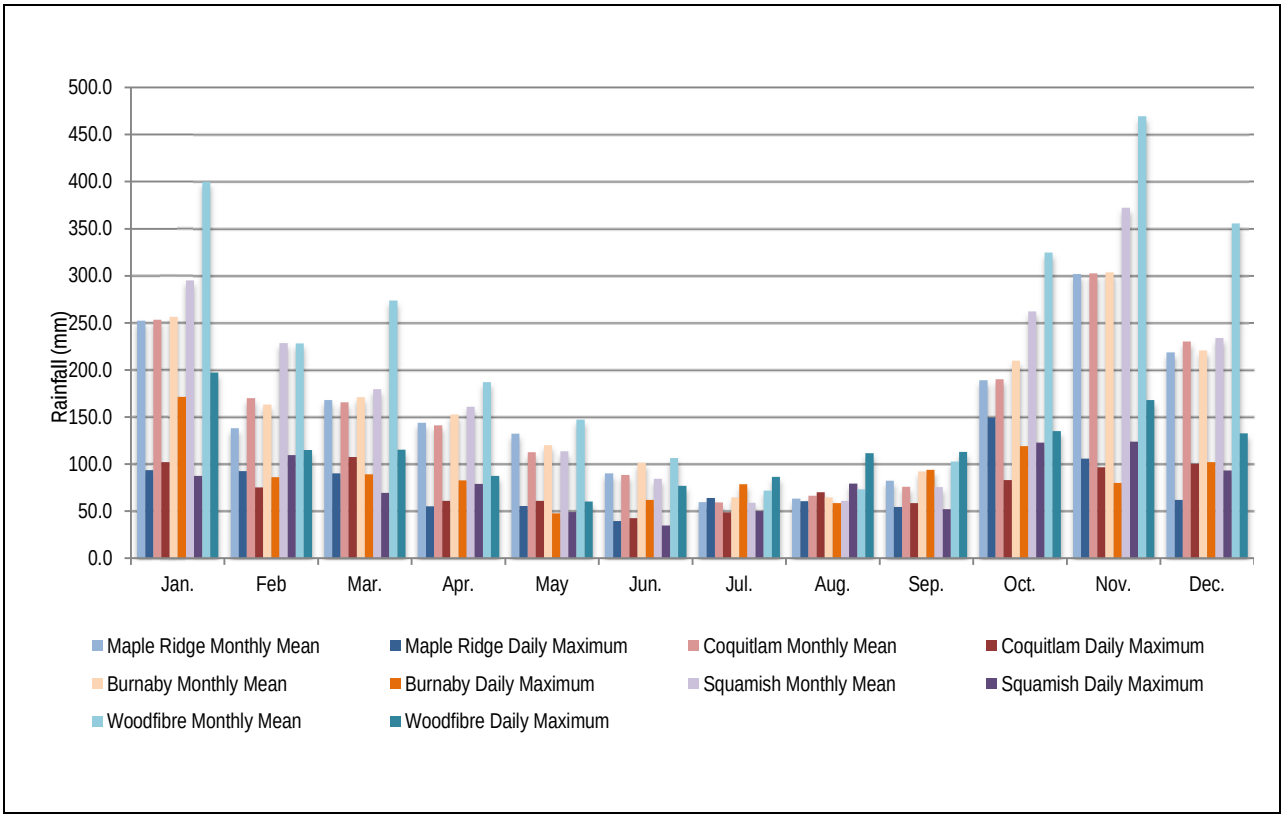


Figure 5.4-4 Long-Term Monthly Mean and Maximum Rainfall at Maple Ridge, Coquitlam, Burnaby, Squamish and Woodfibre

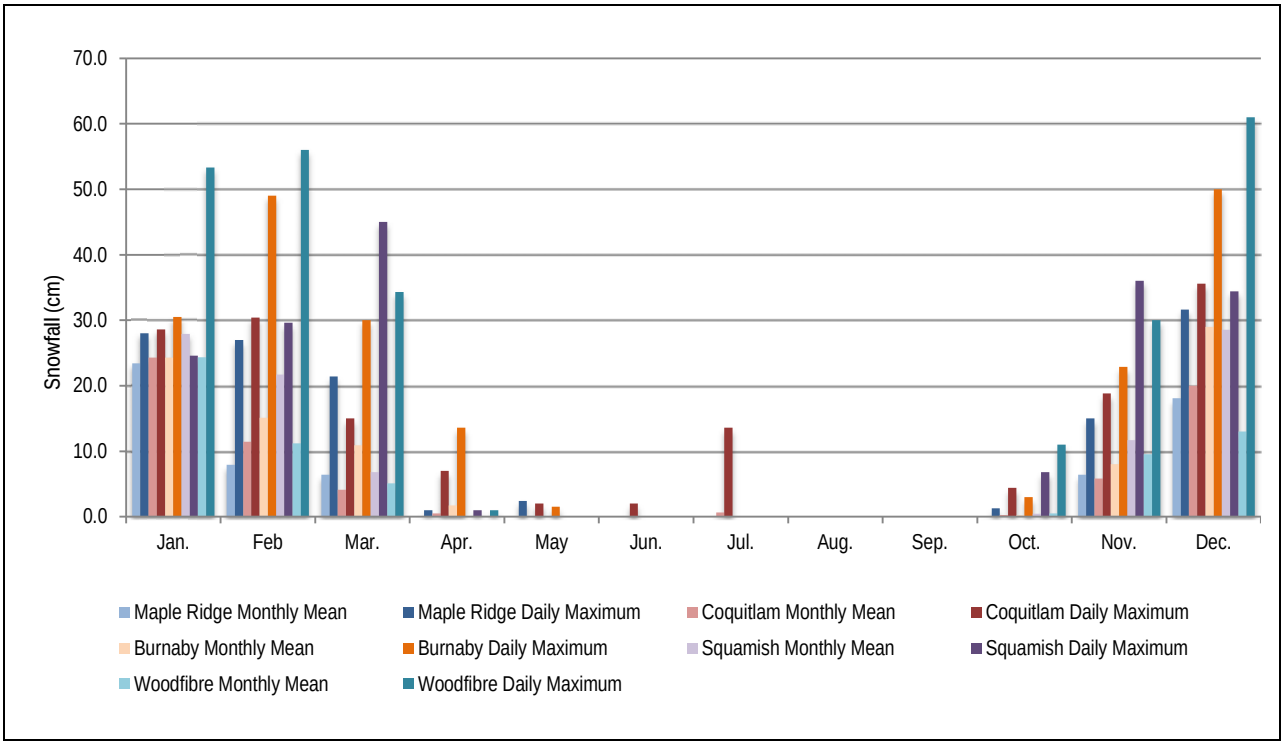


Figure 5.4-5 Long-Term Monthly Mean and Maximum Snowfall at Maple Ridge, Coquitlam, Burnaby, Squamish and Woodfibre

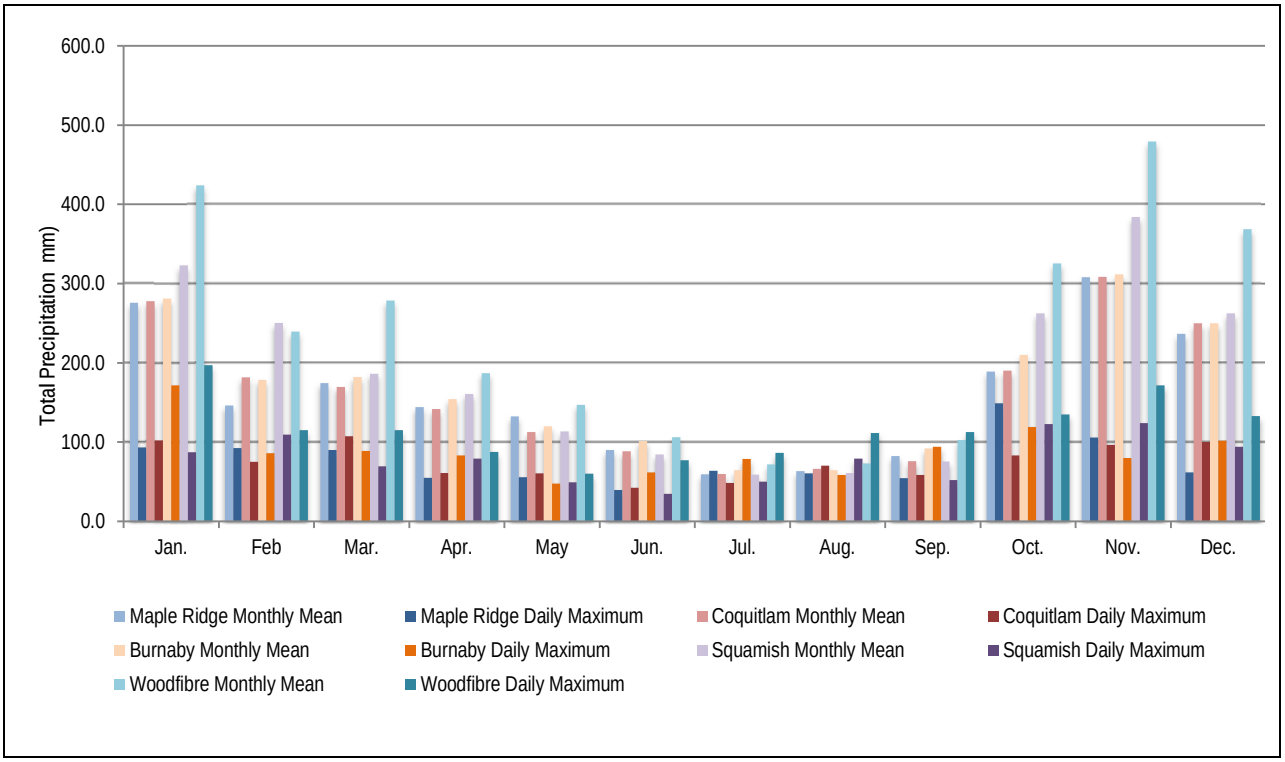


Figure 5.4-6 Long-Term Monthly Mean and Maximum Total Precipitation at Maple Ridge, Coquitlam, Burnaby, Squamish and Woodfibre

5.4.1.3 Wind

Wind is the climatic parameter that most influences air pollutant dispersion and fate. Wind speed and direction are responsible for the transport, mixing and dilution of atmospheric contaminants. Figures 5.4-7 and 5.4-8 show wind roses produced using scalar wind data for the Howe Sounds stations (Squamish, Langdale and Port Mellon), and the Coquitlam station.

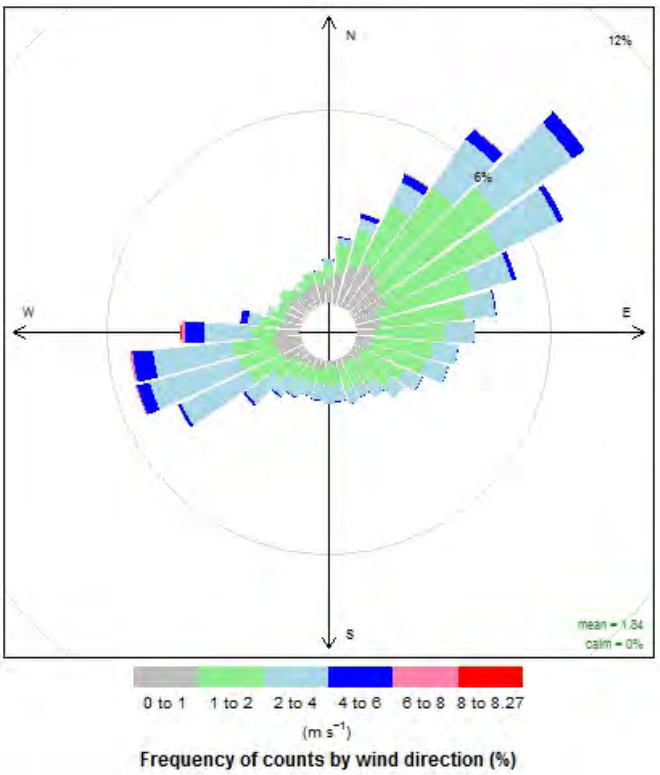


Figure 5.4-7 Wind Rose for Coquitlam

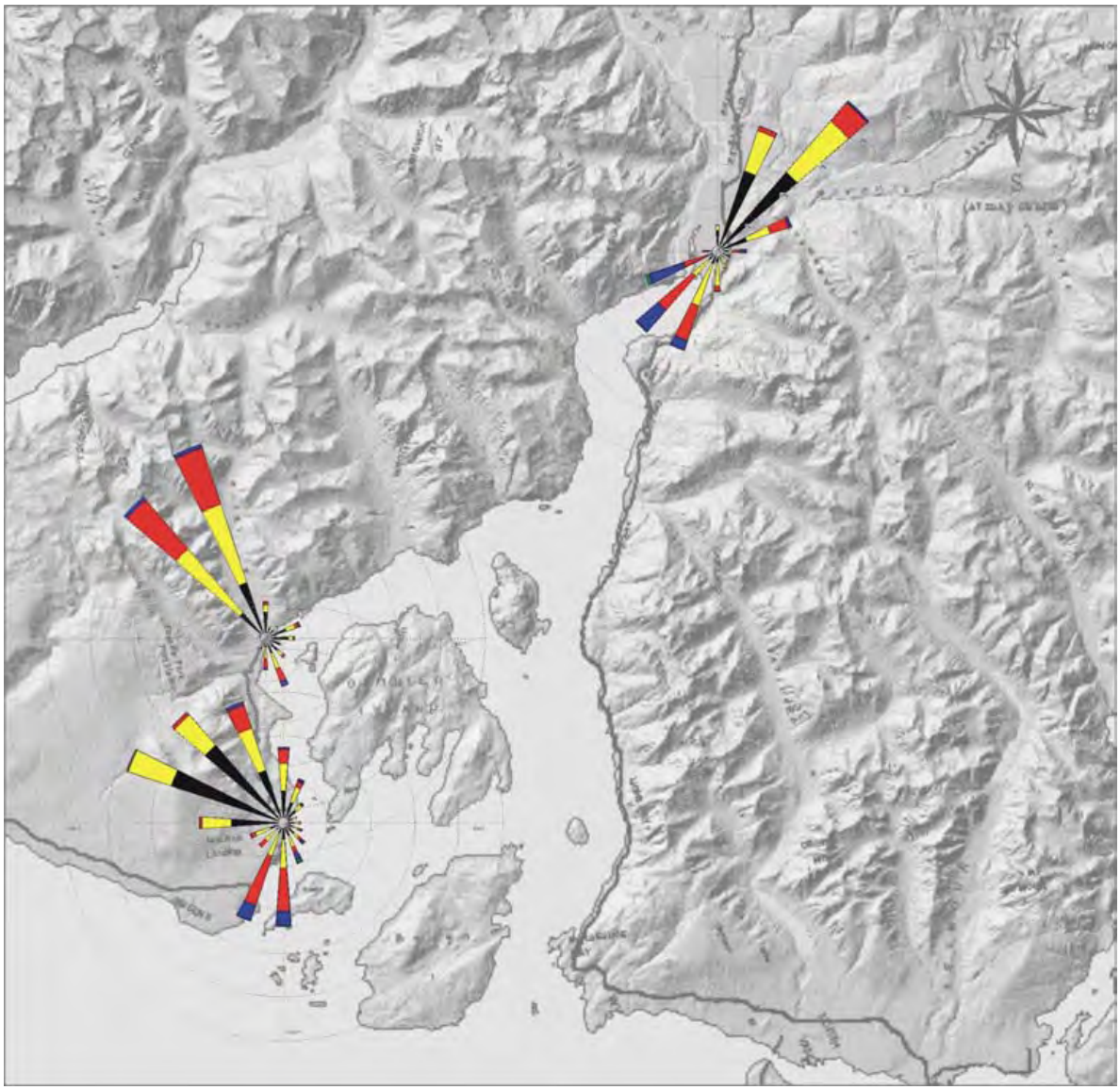


Figure 5.4-8 Wind Rose for the Howe Sound stations

Coquitlam has been characterized by strong winds (> 8.8 m/s) predominantly from the northeast (Figure 5.4-7) and less often from the south-southwest, with no obvious seasonal pattern. Coquitlam is the only site of the four presented with winds that were never classified as calm (< 1 m/s). Squamish, to the northwest of Coquitlam at the northern reaches of Howe Sound, has recorded calmer winds (< 8.8 m/s) with a strong southerly dominance and occasional light gusts from the northeast (Figure 5.4-8). Langdale's winds have been recorded as calmer again, with predominantly west-northwest winds of less of < 2.1 m/s and some stronger gusts from the south (Figure 5.4-8). Port Mellon's winds have been observed as near exclusively from the northwest and north-northwest with rare gusts from the southeast or east-northeast (Figure 5.4-8).

5.4.2 Acoustic Environment

Existing projects and activities that might lead to human-caused changes in the environment of the proposed Project are listed in Volume 1, Part B, Section 3.0, Subsection 3.9.1.1 of the Application. Several of these activities alter the Acoustic Environment LSA around the existing or proposed compressor stations at Eagle Mountain (V1), Squamish (V2) and Port Mellon (V3). Urban and rural residential development, as well as transportation, have increased the ambient sound levels (ASLs) of the Acoustic Environment LSA over the last century, mostly due to increased vehicle traffic, construction, and assorted building noises (fans, heat pumps, etc.). Forestry and utility activities have also increased the ASLs of the Acoustic Environment LSA over the last century, with different changes based on location. For example, forestry-related operations near the existing Port Mellon compressor station (V3) have increased the sound levels of the acoustic environment LSA around Port Mellon. Similarly, the BC Hydro substation near the existing Eagle Mountain compressor station (V1) has increased the ASL of the area over the past century. Agriculture, mining, and oil and gas development are not conducted in the acoustic environment LSA of the compressor stations so did not affect the ASL.

Emissions of noise from the proposed Project are broken down into emissions from construction and operations. The assessment of the potential effects of the proposed Project on the Acoustic Environment VC considers operational emissions as a whole, however, emissions occur primarily from compressor station operations. Background information on the existing acoustic environment is based on field studies that measured existing sound levels (*i.e.*, background noise) at the proposed and existing compressor station locations. Background measurements at the Eagle Mountain and Port Mellon compressor stations include sound levels with and without the existing compressor in operation in accordance with the *BC Noise Control Best Practices Guideline*, which requires ambient sound surveys to be made without the influence of any energy-related components (BC OGC 2009). Detailed information on the methodology used for the assessment of the effects of the proposed Project on the Acoustic Environment VC is provided in the Acoustic Environment Technical Report (Volume 2, Appendix 1C).

Background measurements of existing noise levels were made in Coquitlam near the Eagle Mountain compressor station site on May 27, 2014 and in Squamish near the proposed Squamish compressor station sites on May 30 and June 1, 2014. Background measurements were also conducted on September 22 and 23, 2014 near the Port Mellon compressor station. The precise locations of background noise measurements taken in Coquitlam, Squamish and Port Mellon are given in Figures 5.4-9, 5.4-10 and 5.4-11, respectively, and are summarized in Table 5.4-5.

TABLE 5.4-5

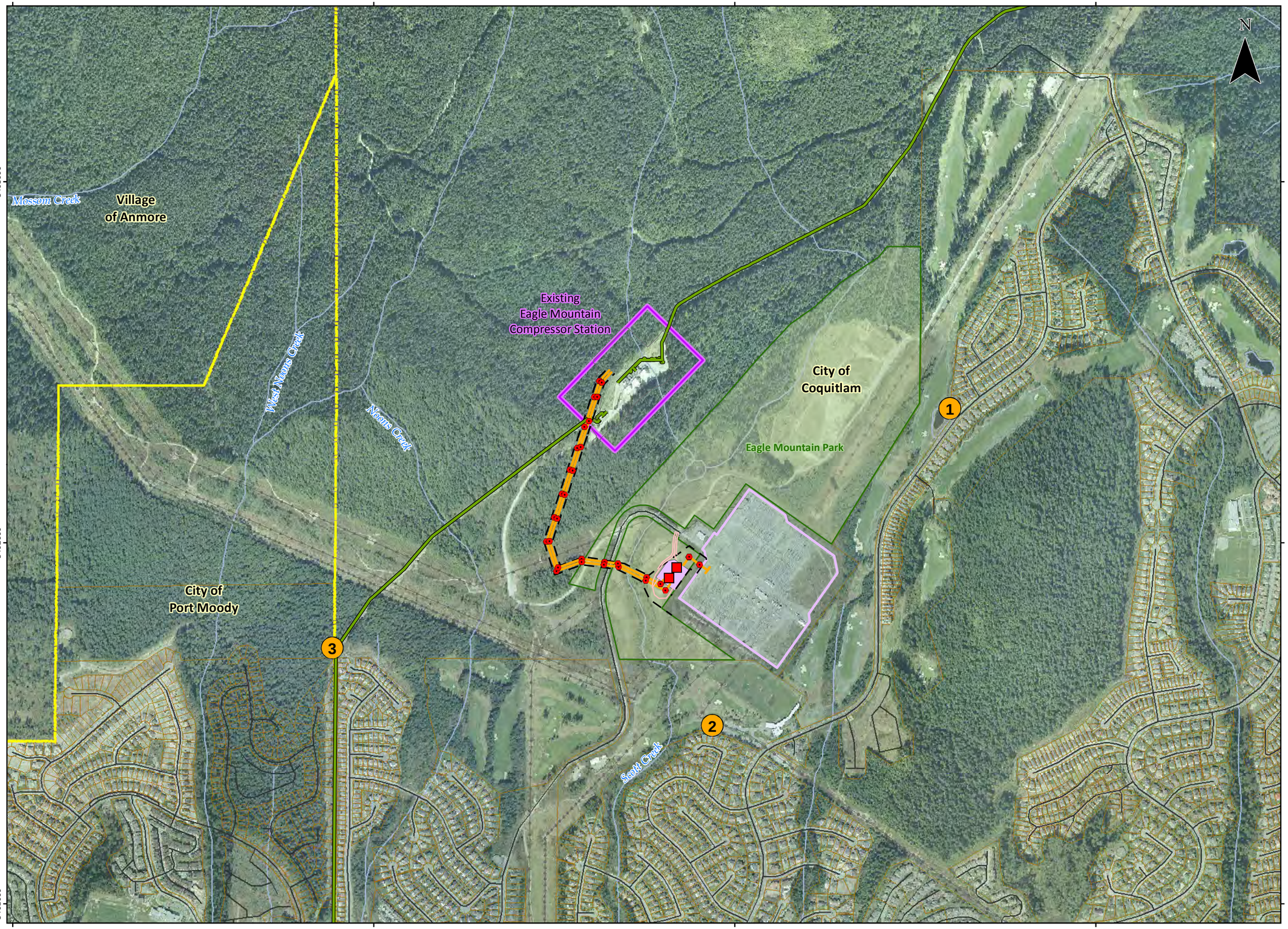
NOISE MONITORING LOCATIONS

Location Identifier	Compressor Area	Description	Monitoring Dates	Notes
1	Coquitlam	East of compressor, off Parkway Boulevard (514589E 5462410N)	May 27, 2014	Existing compressor shut-down between 14:00 and 22:00.
2	Coquitlam	Behind parking lot of Westwood Golf Academy (486059E 5461487N)	May 27, 2014	Existing compressor shut-down between 14:00 and 22:00.
3	Coquitlam	FortisBC right-of-way above Platinum Lane (512888E 5461702N)	May 27, 2014	Existing compressor shut-down between 14:00 and 22:00.
4	Squamish	West end of Pioneer Way (488689E 5508143N)	May 30 and June 1, 2014	--

TABLE 5.4-5 Cont'd

Location Identifier	Compressor Area	Description	Monitoring Dates	Notes
5	Squamish	Sandman Hotel, Discovery Way (489145E 5508123N)	May 30, 2014	--
6	Squamish	Magee Street (489810E 5507404N)	May 30 and June 1, 2014	--
7	Squamish	Loggers Lane, north of Finch Drive (488864E 5506874N)	June 1, 2014	--
8	Port Mellon	North end of Dunham Road (E464070 N5484672)	September 22 and 23, 2014	Existing compressor from 17:00 on September 22 to 01:00 on September 23.
9	Port Mellon	Open field north of Port Mellon Highway (E463904 N5484557)	September 22 and 23, 2014	Existing compressor from 17:00 on September 22 to 01:00 on September 23.
12[1]	Port Mellon	South end of Dunham road (E464189 N5484682)	September 22 and 23, 2014	Existing compressor from 17:00 on September 22 to 01:00 on September 23.

Note: 1 Locations 10 and 11 were monitored, however, the results were not required for the analysis so they are not reported.



FORTIS BC

January 2015

FIGURE 5.4-9

LOCATIONS OF BACKGROUND NOISE MEASUREMENTS TAKEN IN COQUITLAM EAGLE MOUNTAIN - WOODFIBRE GAS PIPELINE PROJECT

- Noise Monitoring Location
- Proposed Borehole
- Proposed Structure
- Existing FortisBC Pipeline
- Compressor Station
- Proposed Substation
- Existing Substation
- Proposed Access Road
- Proposed Overhead Line
- Proposed Right-of-Way
- Transmission Line
- Highway
- Road
- Railway
- Watercourse
- Municipality
- Park/Protected Area
- First Nations Reserve
- Private Property Parcel

SCALE: 1:10,000

0 100 200 300 400 m

(All Locations Approximate)

tera A CH2M HILL Company

CH2M HILL Project Number 492434

UTM Zone 10 North. NAD 1983.

Existing Pipeline: FortisBC 2012; Compressor Stations: UPI 07-23-2014; Noise Monitoring Locations: approximated from SNC-Lavalin 2014; Transmission Lines: DBS Energy Services Inc 06-04-2014 (V1); Private Parcels: ICIS 03-24-2014; Roads: NRCan 2014; Railways: NRCan 2012; Hydrography: NRCan. 2009, IHS Inc. 2004 and BC MFLNRO 2008; Municipal Boundaries: BC MFLNRO 2007; Parks, Wildlife Management Areas: BC MFLNRO 2008; First Nation Reserves: Government of Canada 2014; LiDAR Imagery: Atlantic Group 11-13-2013; Base Imagery: Province of British Columbia Web Map Service, Colour Imagery 2009, Black & White Imagery 1996.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

Mapped By: JRO	Checked By: DN

t10361_Figure5-4-11_BackgroundNoise_Coquitlam_Rev1.mxd

FORTIS BC

January 2015

FIGURE 5.4-10

LOCATIONS OF BACKGROUND NOISE MEASUREMENTS TAKEN IN SQUAMISH EAGLE MOUNTAIN - WOODFIBRE GAS PIPELINE PROJECT

- Noise Monitoring Location
- Kilometre Post (1 km)
- Kilometre Post (100 m)
- Proposed Pipeline
- Existing FortisBC Pipeline
- Compressor Station
- Proposed Substation
- Proposed Transmission Line
- Transmission Line
- Highway
- Road
- Railway
- Watercourse
- Municipality
- Park/Protected Area
- First Nations Reserve
- Private Property Parcel
- Skwelwil'em Squamish Estuary Wildlife Management Area

SCALE: 1:10,000

0 100 200 300 400 m

(All Locations Approximate)

tera A CH2M HILL Company

CH2M HILL Project Number 492434

UTM Zone 10 North. NAD 1983.

Proposed Pipeline Route, Kilometre Posts: Universal Pegasus Inc (UPI) 07-14-2014; Existing Pipeline: FortisBC 2012; Compressor Stations: UPI 07-23-2014; Transmission Lines: DBS Energy Services Inc 06-05-2014 (V2); Noise Monitoring Locations: approximated from SNC-Lavalin 2014; Private Parcels: ICIS 03-24-2014; Roads: NRCan 2014; Railways: NRCan 2012; Hydrography: NRCan. 2009, IHS Inc. 2004 and BC MFLNRO 2008; Municipal Boundaries: BC MFLNRO 2007; Parks, Wildlife Management Areas: BC MFLNRO 2008; First Nation Reserves: Government of Canada 2014; LiDAR Imagery: Atlantic Group 11-13-2013; Base Imagery: Province of British Columbia Web Map Service, Colour Imagery 2009, Black & White Imagery 1996.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

Mapped By: JRO | Checked By: DN

N

Squamish River

Brackendale Eagles Provincial Park

YEKWAUPSUM 18

YEKWAUPSUM 19

Pioneer Way

Mamquam River

Proposed Squamish Compressor Station

99

Loggers Ln

Finch Dr

KP 38

KP 37

KP 36

District of Squamish

KP 39

Magee St

Newport Rd

Monmouth Creek

KP 40

Skwelwil'em Squamish Estuary WMA

4 5 6 7

5508000

5507000

487000 488000 489000 490000

t:\016\1_Figure\5-4-12_BackgroundNoise_Squamish_Rev1.mxd

FORTIS BC

January 2015

FIGURE 5.4-11

LOCATIONS OF BACKGROUND NOISE MEASUREMENTS TAKEN IN PORT MELLON EAGLE MOUNTAIN - WOODFIBRE GAS PIPELINE PROJECT

N

Rainy River

McNair Creek

KAIKALAHUN 25

8

12

9

101

Thornbrough Channel

Existing Port Mellon Compressor Station

Dakota Creek

5485000

5484000

463000

464000

465000

- Noise Monitoring Location
- Compressor Station
- Existing FortisBC Pipeline
- Highway 99
- Resource Road
- Watercourse
- First Nations Reserve
- Private Property Parcel

SCALE: 1:10,000

0 100 200 300 400 m

(All Locations Approximate)

tera A CH2M HILL Company

CH2M HILL Project Number 492434

UTM Zone 10 North. NAD 1983.

Existing Pipeline: FortisBC 2012; Compressor Stations: UPI 07-23-2014; Noise Monitoring Locations: approximated from SNC-Lavalin 2014; Private Parcels: ICIS 03-24-2014; Roads: NRCan 2014; Hydrography: NRCan. 2009, IHS Inc. 2004 and BC MFLNRO 2008; Municipal Boundaries: BC MFLNRO 2008; First Nation Reserves: Government of Canada 2014; Base Imagery: Province of British Columbia Web Map Service, Colour Imagery 2009, Black & White Imagery 1996.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

Mapped By: TFB | Checked By: JRO

110161_Figure5-4-13_BackgroundNoise_Port_Mellon_Rev06.mxd

Sound level measurements are given as daytime and nighttime averages in Table 5.4-6, and sound level temporal trends for all locations are provided in Figures D-1 through D-10 in the Acoustic Environment Technical Report (Volume 2, Appendix 1C).

TABLE 5.4-6

DAYTIME AND NIGHTTIME SOUND LEVELS

Date	Sound Level Metric* (dBA)	Monitoring Site								
		Coquitlam			Squamish				Port Mellon[2,3]	
		1	2	3	4	5	6	7	8	12[4]
May 27, 2014	Ld	57	47	45	--[1]	--	--	--	--	--
	Ln	56	41	40	--	--	--	--	--	--
	Ldn	63	49	48	--	--	--	--	--	--
	LAF90	35	36	36	--	--	--	--	--	--
May 30, 2014	Ld	--	--	--	56	58	56	--	--	--
	Ln	--	--	--	53	49	49	--	--	--
	Ldn	--	--	--	60	58	57	--	--	--
	LAF90	--	--	--	39	39	34	--	--	--
June 1, 2014	Ld	--	--	--	55	--	56	62	--	--
	Ln	--	--	--	53	--	47	52	--	--
	Ldn	--	--	--	60	--	57	62	--	--
	LAF90	--	--	--	45	--	37	36	--	--
September 22, 2014	Ln	--	--	--	--	--	--	--	43	40

Notes: * Ld = Equivalent sound pressure level measured between 0700 and 2200; Ln = Equivalent sound pressure level measured between 2200 and 0700; Ldn = Adjusted equivalent sound pressure level for day-night period; LAF90 = Sound pressure level using the A sound filter that is equalled or exceeded 90% of the measurement period.

1 (-) Indicates that sound measurements were not taken at that time and location.

2 At Port Mellon, monitoring continued 10 hours, mostly during nighttime, therefore, Ld, Ldn and LAF90 are not provided.

3 The shorter readings at Port Mellon were sufficient to characterize the acoustic environment LSA as there was a limited number of noise sources and background levels were stable.

4 Sites 9, 10 and 11 were monitored (for quality assurance purposes), however, the results were not required for the analysis, therefore, they are not reported.

The major existing sources of noise around the Eagle Mountain compressor station are vehicle traffic and wildlife noises. Other noise sources include the existing compressor unit, impulse events from the nearby BC Hydro Meridian substation (*i.e.*, circuit breakers tripping) and airplane flyovers, as well as some localized noise from water features and wildlife.

At the proposed Squamish compressor station site, existing noise is caused mostly by traffic and rail emissions, as well as some machinery and equipment noise from the nearby industrial park.

At the Port Mellon compressor station, existing noise at the nearby residences is caused by McNair Creek and vehicle traffic. In general, there are a limited number of noise sources near the Port Mellon compressor station compared to other monitoring locations and background levels are usually stable.

In general, the acoustic environment at all compressor station sites is a function of traffic density, short-term construction activities and existing energy-related components (*i.e.*, the existing compressor units at Eagle Mountain and Port Mellon).

5.4.3 Air Quality

Expected emissions of air contaminants from the proposed Project are broken down into emissions from construction and operations. Air quality is further broken down into equipment and vehicular emissions as well as land clearing during construction. The assessment of the potential effects of the proposed Project on the Air Quality VC considers operational emissions as a whole. This assessment is based on existing ambient monitoring data, existing point source emissions datasets (*i.e.*, NPRI and BC MOE permits and authorizations) and Project-based emissions estimates. Detailed information on the methodology used for the assessment of the potential effects of the proposed Project on the Air Quality VC is provided in the Air Quality Technical Report (Volume 2, Appendix 1D).

5.4.3.1 Existing Air Quality

Both local and regional air quality have changed in the LFV due to anthropogenic activities. Most notably, the combustion of fuels for home heating, industrial applications, power generation and transportation increased with population over the past 2 centuries, causing increased emissions. Combustion releases CACs, which further react to form additional contaminants in the atmosphere. Air pollution in the LFV was largely localized to areas in proximity to the emission sources 100 years ago. However, as the population grew, air pollution eventually became a regional issue due to a greater number of sources in the valley and widespread mixing of the contaminants within the larger "airshed".

Similar to other countries, Canada implemented standards to limit the amount of impurities in available fuels to reduce the relative amount of pollution that would be formed with their use. Similarly, emission standards were introduced to key sources of pollution, such as the automobile, to reduce the per-unit emission levels. Only in this way could the air quality be preserved (or improved) as population dramatically increased.

Air quality is measured by the concentration of a particular contaminant in the ambient air. As such, federal ambient air quality objectives have existed in Canada since the 1970s and ambient monitoring data for the CACs have been collected since that time. Due to the government-imposed fuel and emission standards, air quality concentrations have generally improved (lowered) in urban centers such as the LFV since the 1980s (Metro Vancouver 2010). However, due to an increased awareness of the potential health effects of air pollution, Canada has expressed its Keeping Clean Areas Clean and Continuous Improvement principles within the Canada Wide Standards for $PM_{2.5}$ and O_3 to prevent local increases in contaminant concentrations, and to prevent additional source contributions to regional air quality (CCME 2007).

Existing ambient air quality was determined in the proposed Project area by use of monitoring stations for CACs, which include NO_2, SO_2, CO, VOCs, PM (as total PM, PM_{10} and $PM_{2.5}$) and ammonia (NH_3). There are no ambient standards for VOCs and NH_3 (and therefore they are not commonly monitored in the ambient air), but they are included in this list for their potential to form secondary contaminants in the atmosphere. O_3 is a secondary contaminant that is formed from precursor concentrations of NO_x, including NO_2, and VOCs in the presence of ultraviolet radiation (*i.e.*, sunlight). O_3 concentrations are commonly evaluated across Canada due to their potential to adversely impact human and environmental health.

The proposed Project crosses remote rural areas with low levels of local CAC emissions as well as urban coastal areas with emission sources dominated by the transportation sectors, including marine sources. The proposed Project crosses Highway 99 at KP 38 in Squamish, 0.507 km from the proposed Squamish compressor station site. Highway 7 is located within 3.9 km of the existing Eagle Mountain compressor station. The proposed Project crosses a rail line at KP 38.4, which runs parallel to the proposed route for a distance of approximately 0.3 km from KP 38.1 to KP 38.4. Marine traffic occurs in and out of the Squamish Harbour near KP 40 and the proposed Squamish compressor station as well as near the existing Port Mellon compressor station. Marine traffic also occurs in the Burrard Inlet heading east towards Coquitlam. Based on review of local ambient air quality monitoring results and industrial emission sources in the region it is assumed that local highway, rail, and marine traffic also contribute to emissions of NO_x, CO, VOCs as well as PM in the region (*e.g.*, these emission sources are within what would be considered existing air quality). The LFV is known to funnel urban pollutants eastward to more remote areas due to interactions between land sea breezes and katabatic or anabatic winds. The proposed Project area is also subject to biogenic emissions, primarily VOCs from coniferous forest.

Existing ambient air quality along the proposed Project was determined using publicly available data from monitoring stations in southern BC. The stations were selected based on their proximity and relevance to the proposed Project. A 3 year period from January 1, 2011 to December 31, 2013 was chosen to represent the most recent background conditions while providing a long enough term to be adequately compared with ambient air quality objectives and standards. Five air quality monitoring stations were selected including (from east to west): Maple Ridge; Coquitlam; Burnaby; Squamish; and Langdale. Relevant statistical summaries for the air contaminants monitored are provided in the Air Quality Technical Report (Volume 2, Appendix 1D).

Overall, a review of the data suggests that air quality in the region is compliant with the relevant regional, provincial and national objectives and standards due to most CAC concentrations being well below their corresponding AAQOs. However, the data showed some exceedances for O_3 and TRS compounds.

5.4.3.2 Existing Compressor Station Emissions Estimates

Existing emission sources of CACs include the three existing compressor units and associated turbines at Eagle Mountain in Coquitlam and the single existing compressor unit and associated turbine at Port Mellon. The maximum annual emissions from each of these sites are captured in their emission permits as required under the *Environmental Management Act, Waste Discharge Regulation*. The permits restrict the amounts of NO_x only as emissions of the other air contaminants are considered low. However, the expected release amounts of these other air contaminants can be estimated by use of gas turbine emission factors prepared by the United States Environmental Protection Agency (US EPA).

Existing combustion emissions at the Eagle Mountain and Port Mellon compressor stations were calculated by applying emission rates to the discharge levels from each turbine. NO_x emissions are monitored by FortisBC with use of a Predictive Emissions Monitoring System (PEMS) and, in addition, can be estimated from allowed permit levels of NO_x concentrations in the exhaust stream. Information on the existing permitted releases from these sites for 2013 is given in Table 5.4-7.

TABLE 5.4-7

EXISTING COMBUSTION EMISSIONS FOR 2013 FROM THE EAGLE MOUNTAIN AND PORT MELLON COMPRESSOR STATIONS

Site	Unit/Source	CAC Emissions (tonnes/year)					
		CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	VOCs
Eagle Mountain	Permit for Compressor 1	18.50	28.96	0.06	1.49	0.11	0.47
	Permit for Compressor 2	17.68	28.96	0.06	1.42	0.11	0.45
	Permit for Compressor 3	28.37	37.84	0.10	2.28	0.17	0.73
	Total - Permit	65.38	95.76	0.22	5.26	0.38	1.67
	Total - Actual*	19.21	22.99	0.07	1.55	0.11	0.49
Port Mellon	Permit for Compressor 1	21.84	34.66	0.08	1.76	0.13	0.56
	Total - Permit	21.84	34.66	0.08	1.76	0.13	0.56
	Total - Actual*	2.14	3.28	0.01	0.17	0.01	0.06

Note: * Actual emissions were determined from data collected at each station during the year (natural gas consumption and PEMS data for NO_x).

Existing emission sources also include points and occurrences of natural gas venting. Natural gas may be vented to the atmosphere for several reasons, including maintenance and emergency situations. No flaring occurs at the compressor stations, so this vented gas has the same composition as the gas in the pipeline. The vented and transported gas is expected to have the same composition along the entire proposed pipeline route and at all three compressor stations.

Table 5.4-8 presents venting emissions estimates at the existing Eagle Mountain and Port Mellon compressor stations for 2013.

TABLE 5.4-8

EXISTING VENTING EMISSIONS FOR 2013 FROM THE EAGLE MOUNTAIN AND PORT MELLON COMPRESSOR STATIONS

Source		Gas Volume (standard cubic metres [scm])	Emissions Estimates (kg)						
			Propane	I-Butane	N-Butane	I-Pentane	N-Pentane	Hexane	Total VOCs
Eagle Mountain	Compressor station blowdowns	61,209	532.3	105.9	116.1	40.5	29	49.9	873.8
	Dry gas seal leaks	14,539	126.4	25.2	27.6	9.6	6.9	11.8	207.5
	Compressor equipment leaks	2,812	24.5	4.9	5.3	1.9	1.3	2.3	40.1
	Total	78,560	683.3	135.9	149	51.9	37.3	64	1,121.4
Port Mellon	Compressor station blowdowns	2,444	21.2	4.3	4.6	1.6	1.1	1.9	35
	Dry gas seal leaks	9,363	81.4	16.2	17.8	6.2	4.4	7.6	133.7
	Compressor equipment leaks	1,097	9.5	1.9	2.1	0.7	0.5	0.9	15.7
	Total	12,904	112.1	22.4	24.5	8.5	6.0	10.4	184

The venting emissions estimates are based on actual performance data from FortisBC. Review of historical performance included the years 2012 and 2013 as the average venting volumes in those years were considered the most up-to-date representation of operational venting according to the professional judgement of the assessment team.

5.4.3.3 Proposed Project Emissions

The following subsections describe emissions and provide estimates for the level of emissions that can be expected from the construction and operations of the proposed Project.

Compressor Station Emissions

New compressor units at the existing Eagle Mountain compressor station and the proposed Squamish compressor station will be electric motor driven (EMD), resulting in no change to the current permit-level combustion emissions at Eagle Mountain (see Table 5.4-7) and no combustion-related emissions at the proposed Squamish compressor station. The new EMD compressor units will be base loaded at Eagle Mountain, with the existing gas turbines used to supplement capacity as required by downstream pipeline loads. Although a new, second gas turbine compressor package will be added at the existing Port Mellon compressor station to increase operational efficiencies, it will not be operated at the same time as the current, existing compressor, and, therefore, there will be no net change to the existing permitted combustion emissions at Port Mellon. As such, these combustion emissions from the Eagle Mountain and Squamish compressor stations have not been considered further in the assessment.

Fugitive emissions are expected to change as a result of the new compressor units. Compressor purges, compressor blowdowns and equipment leaks will be associated with the new units. Estimates of the annual gas volumes that would be vented were developed by FortisBC. These volumes were used to estimate the total annual Project-related fugitive emissions at the compressor stations and these estimates are provided in Table 5.4-9.

TABLE 5.4-9

ESTIMATED ANNUAL VENTING EMISSIONS FOR THE PROPOSED PROJECT

Source/Activity		Gas Volume (scm)	VOC Emission Estimates (kg)						
			Propane	I-Butane	N-Butane	I-Pentane	N-Pentane	Hexane	Total VOCs
Eagle Mountain Station	Blowdowns	71,583	622.6	123.9	135.8	47.3	34.0	58.3	1,021.8
	Dry gas seal leaks	11,198	97.4	19.4	21.2	7.4	5.3	9.1	159.8
	Compressor leaks	2,812	24.5	4.9	5.3	1.9	1.3	2.3	40.1
Squamish Station	Blowdowns	71,583	622.6	123.9	135.8	47.3	34.0	58.3	1,021.8
	Dry gas seal leaks	11,198	97.4	19.4	21.2	7.4	5.3	9.1	159.8
	Compressor leaks	2,812	24.5	4.9	5.3	1.9	1.3	2.3	40.1
Port Mellon Station	Blowdowns	7,003	60.9	12.1	13.3	4.6	3.3	5.7	100.0
	Dry gas seal leaks	5,599	48.7	9.7	10.6	3.7	2.7	4.6	79.9
	Compressor leaks	1,406	12.2	2.4	2.7	0.9	0.7	1.1	20.1
Pipeline	Pneumatic block/valves	1,242	10.89	2.17	2.37	0.83	0.59	1.02	17.87
	Meter station losses	29	0.2	0.0	0.1	0.0	0.0	0.0	0.4
Total		186,465	1,622	323	354	123	88	152	2,662

Pipeline In-Line Inspection Tool Emissions

Pipeline in-line inspection (ILI) is expected to occur once every 5 years with the venting of pipeline ILI tool barrels during the procedure. FortisBC estimates a total volume of 38 scm for this procedure, accounting for the physical volume of the ILI tool barrels and gas pressure adjustment. To present the pipeline venting emissions estimates in the same manner as the compressor station emissions, the blowdown volume during pipeline ILI is divided by five to represent annual emissions due to this procedure. Largest emissions associated with pipeline ILI include leaks and vents from pneumatic block and ILI tool valve sites, which were estimated as 1,242 scm annually. The estimated annual pipeline ILI emissions, including minor leaks and vents, are included in Table 5.4-9.

Emissions from Construction

Construction activities for the proposed Project are anticipated to begin in Q3 2015 and be completed by Q4 2016. Construction work on the facilities (*i.e.*, compressor stations, electrical substations) is planned to commence in Q3 2015 and be completed by Q4 2016. Pipeline construction is anticipated to begin with logging and land clearing activities in Q3 2015, with construction on the actual pipeline planned to begin in Q2 2016 and to be completed in less than 1 year (*i.e.*, by Q4 2016). Construction activities will generally occur on a schedule of 10 hours per day, 6 days per week, throughout the construction period.

The workforce for the proposed Project will require transportation to and from the construction sites. The workforce will start off small, peak during mid-construction and then taper off towards the end of the construction period. Although specific workforce numbers cannot be accurately forecasted, the maximum workforce at any one time is expected to be approximately 516 workers. More detailed workforce information and scheduling is provided in the Economic, Social and Health Technical Report (Volume 2, Appendix 1M), and was used to assist in estimates of vehicle, ferry and other transport or equipment usage for the proposed Project. A summary of the estimated construction equipment and usage rates, including transportation vehicles, trip information and barge activity, is provided in the Air Quality Technical Report (Volume 2, Appendix 1D).

CAC emission estimates for all proposed Project construction and related transportation activities are summarized in Table 5.4-10.

TABLE 5.4-10

CONSTRUCTION EMISSION ESTIMATES FOR THE PROPOSED PROJECT

Activity	Source	CAC Emission Estimates (kg)					
		NO_x	SO_x	CO	VOCs	PM_{10}	$PM_{2.5}$
Construction	Logging	4,507.0	8.4	1,828.8	429.6	338.2	325.0
	Pipeline construction	71,327.6	112.1	31,893.4	5,042.0	4,804.5	4,652.6
	Eagle Mountain and Squamish compressor stations	1,505.3	3.0	608.9	76.2	57.4	51.7
	Electrical Transmission line (Eagle Mountain)	22,138.2	37.8	8,149.6	1,677.6	1,479.7	1,432.8
	Electrical Transmission line (Squamish)	22,198.5	36.7	7,986.7	1,578.8	1,390.3	1,345.5
Total - Construction		121,676.5	198.0	50,467.4	8,804.2	8,070.0	7,807.6
Barge/Ferry	Woodfibre	1,993.9	1.0	166.2	75.5	37.8	37.8
	Squamish Landing	1,036.8	0.5	86.4	39.3	19.6	19.6
	Squamish Harbour	677.9	0.3	56.5	25.7	12.8	12.8
	Indian Arm	2,658.5	1.3	221.5	100.7	50.4	50.4
	Ferries – Indian Arm	17,723.5	8.5	1,477.0	671.3	335.7	335.7
	Ferries – Other Locations	18,609.7	8.9	1,550.8	704.9	352.5	352.5
Total - Barge/Ferry		42,700.4	20.4	3,558.4	1,617.4	808.7	808.7
Total - All Sources		164,377.0	218.4	54,025.8	10,421.6	8,878.7	8,616.3

Venting emissions are also expected during construction due to several activities, including the following.

- Blowdown from the existing Eagle Mountain compressor station to accommodate the tie-in of the new compressors.
- The venting of 10-inch and 12-inch ILI tool barrels at the launcher-receiver station at KP 0 to tie-in the proposed NPS 24 pipe.
- Purging of the entire length of the proposed 24-inch pipeline prior to entering full operations.
- Venting 45 km of the existing FortisBC pipeline to allow installation of valves and flanges during tie-in of 24-inch pipe at the proposed Woodfibre LNG export facility.
- Venting of the existing FortisBC pipe for installation of valves and flanges during tie-in of the proposed Squamish compressor station.

Total Estimated Proposed Project Emissions

Total estimated CAC emissions for construction and operations of the proposed Project are identified in Tables 5.4-11 and 5.4-12 (based on 2013 emissions), respectively. The construction emissions are one-time emissions, expected to be released over an approximate 18 month period, whereas the operations emissions are annual and continuous.

TABLE 5.4-11

TOTAL ESTIMATED EMISSIONS FOR CONSTRUCTION OF THE PROPOSED PROJECT

Project Phase	Source	CAC Emission Estimates (tonnes)					
		NO_x	SO_x	CO	VOCs	PM_{10}	$PM_{2.5}$
Construction	Terrestrial	121.7	0.2	50.5	8.8	8	7.8
	Marine	42.7	0.02	3.6	1.6	0.8	0.8
	One-time venting	--	0.0	--	1.6	--	--
	Total - Construction	164.4	0.22	54.1	12	8.9	8.6

Note: -- Indicates that a type of CAC is not applicable to a given emission source and, therefore, no value is presented.

TABLE 5.4-12

TOTAL ESTIMATED ANNUAL EMISSIONS FOR OPERATIONS OF THE PROPOSED PROJECT

Project Phase	Source	CAC Emission Estimates (tonnes/yr)					
		NO_x	SO_x	CO	VOCs	PM_{10}	$PM_{2.5}$
Operations	Eagle Mountain - Combustion[1]	95.8	0.2	65.4	1.7	5.3	0.4
	Eagle Mountain - Venting	--	0.0	--	1.2	--	--
	Squamish - Combustion	--	--	--	--	--	--
	Squamish - Venting	--	0.0	--	1.2	--	--
	Port Mellon - Combustion[1]	34.7	0.1	21.8	0.6	1.8	0.1
	Port Mellon - Venting	--	0.0	--	0.2	--	--
	Pipeline Venting	--	--	--	--	--	--
	Total - Operations	130.4	0.3	87.2	4.9	7.1	0.5

Notes: 1 Indicates existing permitted combustion emissions at Eagle Mountain and Port Mellon. No net increase in combustion emissions is expected at the Eagle Mountain compressor station where EMD compression is planned. The second gas-fired turbine compressor package planned at Port Mellon compressor station is not anticipated to operate at the same time as the existing compressor, and, therefore, no net change to the existing permitted combustion emissions are expected at Port Mellon.

-- Indicates that a type of CAC is not applicable to a given emission source and, therefore, no value is presented.

5.4.4 Greenhouse Gas Emissions

Project emissions of GHGs result from construction and operations activities. Construction emissions are a result of equipment/vehicular emissions and emissions from land clearing. Operational emissions are separated into indirect emissions (*i.e.*, from the use of imported electricity), direct emissions (*i.e.*, from on-site fuel combustion) and fugitive emissions (*i.e.*, from venting or leaks that occur due to daily operation or routine maintenance). Information on existing GHG emissions is based on a variety of sources. These include local, provincial and federal GHG inventory reports, as well as existing GHG emissions at the Eagle Mountain and Port Mellon compressor stations. Detailed information on the methodology used for the assessment of the effects of the proposed Project on the GHG Emissions VC is provided in the GHG Emissions Technical Report (Volume 2, Appendix 1E).

5.4.4.1 Existing Greenhouse Gas Emissions

BC has its own history of contribution to climate change. Many activities in BC are known to contribute to GHG emissions and climate change for decades and beyond. Some activities contributing anthropogenic GHG emissions have started as early as the late 1700s and early 1800s (*e.g.*, timber production and forest management), and some are relatively new, for example oil and gas infrastructure development, dating back to the 1950s (refer to Assessment Methodology [Volume 1, Part B, Section 3.0]). BC established its Climate Action Plan in 2008 (BC MOE 2008) and chose to focus on the following groups of activities (otherwise called sectors) contributing to climate change: transportation; buildings; waste; agriculture; industry; energy; and forestry. The impacts of climate change on environmental, economic,

social and health settings in BC can be described with the following statement from BC's Climate Action Plan:

> "*Many parts of British Columbia have been warming at a rate that, in some cases, is more than twice the global average. Over the last 50 - 100 years, B.C. has lost up to 50 per cent of its snow pack, and total annual precipitation has increased by about 20 per cent. At the same time, our communities have been experiencing longer summer droughts as weather patterns grow increasingly erratic. This is consistent with IPPC findings that note that global warming is greatest over land and at the highest northern latitudes*" (BC MOE 2014a).

BC municipalities and regional districts track local emissions in accordance with the CEEI program as part of the province's commitment to reduce GHG emissions by 33% over 2007 levels by 2020. In BC, 45% of emissions are estimated to be under municipal control (BC MOE 2014b). The local GHG inventories characterize only the on-road, solid waste and buildings emissions (*i.e.*, those emissions with municipal influence). Therefore, there are no sector-specific comparisons for the proposed Project made at this scale. Municipal sector emissions do not represent total emissions for their respective municipality or district. Total emissions are expected to be approximately double (with municipal emissions representing 45%) those totals provided for Burnaby, Coquitlam, the Fraser River Valley Regional District (FVRD) and unassociated areas, Maple Ridge, Metro Vancouver, the Sunshine Coast Regional District (SCRD), the SLRD, the District of Squamish and the City of Vancouver (see Table 5.4-13). CEEI reports are intended to be produced every 2 years, however, at the time of writing this Application, the most recent data available for these local jurisdictions was from 2010 GHG emissions reports.

TABLE 5.4-13

ANNUAL GREENHOUSE GAS EMISSIONS REPORTED AT MUNICIPALITIES AND REGIONAL DISTRICTS FOR THE YEAR 2010

Jurisdiction	GHG Emissions (tonnes of CO_2 e/y)
Burnaby	987,450
Coquitlam	581,039
FVRD	1,737,362
FVRD Unincorporated Areas	125,008
Maple Ridge	345,275
Metro Vancouver	11,354,700
Metro Vancouver Unincorporated Areas	43,363
SCRD	170,247
SCRD Unincorporated Areas	82,553
SLRD	257,448
SLRD Unincorporated Areas	29,073
District of Squamish	88,538
City of Vancouver	2,647,101

Source: BC MOE 2014b

The urban area of Metro Vancouver has recorded the highest GHG emissions, nearly four times that of the City of Vancouver, which has recorded emissions that are the second highest. The FVRD also has observed relatively high GHG emissions. Because the regional districts presented in Table 5.4-13 represent much larger areas and populations than the smaller municipalities, their GHG emissions are also much larger. Figure 1.3-1 in Volume 1, Part A, Section 1.0 Proposed Project Overview provides a map of the regional location of the proposed Project, including nearby municipalities and regional districts.

The existing emissions of GHGs at the local, provincial and national scales were used to assess the proposed Project's potential effects on the GHG Emissions VC through simple comparison as per the Canadian Environmental Assessment (CEA) Agency's Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners (CEA Agency 2003). However, to provide a more detailed comparison of GHG emissions, provincial and federal GHG emissions are also presented as totals for the energy sector specifically, as this sector is considered the most relevant to the proposed Project of all other sector divisions. Table 5.4-14 provides GHG totals for BC and Canada for the years

2010 (to be consistent with local CEEI reports above), 2011 and 2012, the most recent inventory years available. Data were obtained from Part 3 of Canada's annual NIR (Environment Canada 2013b) that was submitted to and obtained from the UNFCCC. Although summaries are available for the pipeline sector through the NIR, these emissions are due to combustion-related activities used to transport materials through pipelines and are considered to be a subsector of transportation. As the proposed Project does not require increase in current use of fuel to transport gas through the pipelines, this subsector is not considered relevant for comparison. Therefore, this subsector was considered less relevant to the analysis of the effects of the proposed Project on the GHG Emissions VC than that of the energy industry as a whole. However, the energy sector in this case includes all energy sector emissions, including transportation, manufacturing and fugitive sources. More detailed summaries of provincial and national GHG emissions, separated by individual GHGs, are also provided in Volume 2, Appendix 1E.

TABLE 5.4-14

ANNUAL PROVINCIAL AND NATIONAL GREENHOUSE GAS EMISSIONS REPORTED IN YEARS 2010, 2011 AND 2012

Jurisdiction	Tonnes of CO_2 e/y					
	Total GHG Emissions			Energy Sector GHG Emissions		
	2010	2011	2012	2010	2011	2012
BC	59,700,000	60,100,000	60,100,000	49,900,000	50,600,000	50,500,000
Canada	699,000,000	701,000,000	699,000,000	570,000,000	573,000,000	566,000,000

Sources: BC MOE 2014c, Environment Canada 2013b

From the provincial and national GHG summaries presented in Table 5.4-14, it is seen that total GHG emissions increased slightly in BC between 2010 and 2011, and remained stable for 2012, and that energy sector emissions followed a similar trend. Federal GHG emissions followed a similar trend to BC, increasing slightly in 2011 and then declining again in 2012. Both the BC and Canada total GHG emissions follow the same trend as energy emissions and emissions from the energy sector make up more than 80% of total emissions (excluding Land Use, Land-use Change and Forestry [LULUCF]) in both jurisdictions.

The information presented in Table 5.4-14 illustrates that neither the province nor the country are showing the stable or incremental decreases in GHGs that are required to meet the provincial and federal emission reduction targets. Despite the energy sector contributing the majority of GHG emissions at both scales/jurisdictions and having quite stable emissions since 1990, some subsectors of the energy sector have experienced reductions in annual GHG emissions. For example, GHG emissions associated with energy use from the manufacturing industry declined by 38% between 2012 and 1990, and national GHG emissions from the same sector declined by 23% over the same period. In contrast, fugitive emissions from the natural gas sector increased nationally by approximately 42% from 1990 to 2012, and fugitive emissions from the oil and gas sector as a whole increased by 49% in BC over the same period (Environment Canada 2013b). Fugitive emissions from the proposed Project are discussed in more detail at the national and provincial levels in the GHG Emissions Technical Report (Volume 2, Appendix 1E).

The existing compressor stations (Eagle Mountain and Port Mellon) are also associated with existing levels of GHG emissions. These are reported annually as per the WCI regulations (*i.e.*, WCI.20 and WCI.350) and in accordance with the BC *Reporting Regulation* under the *GHG Reduction (Cap and Trade) Act*. Existing emissions of GHGs from the three compressor units and related natural gas turbines at Eagle Mountain in Coquitlam, and from the existing, single compressor unit-associated gas turbine at Port Mellon are summarized in Table 5.4-15. A more detailed description of these emissions is given in the GHG Emissions Technical Report (Volume 2, Appendix 1E).

TABLE 5.4-15

GREENHOUSE GAS EMISSIONS FROM THE EXISTING COMPRESSOR STATIONS

Compressor Station	Element	Total GHG (tonnes of CO_2e t/y)[1]
Eagle Mountain	Stationary Combustion	25,495
	Venting	1,442
	Fugitive and Leaks	45.5
	Total	26,983
Port Mellon	Stationary Combustion	2,830
	Venting	246
	Fugitive and Leaks	0.53
	Total	3,077
Both Sites Total		60,119

Source: Ross pers. comm.

Note: 1 See the GHG Emissions Technical Report (Volume 2, Appendix 1E) for the GWPs used and a breakdown by individual GHGs.

5.4.4.2 Construction Emissions

This subsection describes the expected GHG emissions from construction of the proposed Project. The GHG emissions were estimated using methods described in the GHG Emissions Technical Report (Volume 2, Appendix 1E).

Construction Vehicles and Equipment

Numerous types of vehicles and equipment will be used for the construction of the proposed Project. The GHG Emissions Technical Report (Volume 2, Appendix 1E) provides a detailed list of the vehicles and equipment planned for use in construction activities. Assumptions on vehicle make and model were made based on standard industry practice, consultation with FortisBC and the experience of the assessment team with projects of similar size.

The details of planned on and off-road transportation as well as equipment needs were used to run US EPA models. A summary of estimated GHG emissions calculated for on and off-road vehicles as well as construction equipment is provided in Table 5.4-16.

TABLE 5.4-16

SUMMARY OF CONSTRUCTION EQUIPMENT AND ON AND OFF-ROAD VEHICLE GREENHOUSE GAS EMISSION ESTIMATES FOR PROPOSED PROJECT CONSTRUCTION

Activity	Emission Estimates			
	CO_2 (kt)	CH_4 (kt)*	N_2O (kt)*	GHGs (tonnes of CO_2 e/y)
On-road Vehicles and Construction Equipment				
Logging and clearing	0.06	1.22E-06	2.05E-07	0.06
Pipeline construction	0.15	1.19E-06	7.88E-07	0.15
Compressor stations construction (Eagle Mountain and Squamish)	0.08	1.12E-06	3.56E-07	0.08
Electrical transmission line and substation construction - Eagle Mountain	0.05	9.68E-07	1.8E-07	0.05
Electrical transmission line and substation construction - Squamish	0.06	1.27E-06	2.19E-07	0.06
Total - On-road Vehicles and Construction Equipment	0.39	5.76E-06	1.75E-06	0.39
Off-road Vehicles				
Logging and clearing	0.84	4.75E-05	3.48E-04	0.94
Pipeline construction	11.52	6.51E-04	4.78E-03	12.96
Compressor stations construction (Eagle Mountain and Squamish)	0.17	9.65E-06	7.10E-05	0.19

TABLE 5.4-16 Cont'd

Activity	Emission Estimates			
	CO_2 (kt)	CH_4 (kt)*	N_2O (kt)*	GHGs (tonnes of CO_2 e/y)
On-road Vehicles and Construction Equipment				
Electrical transmission line and substation construction - Eagle Mountain	4.02	2.27E-04	1.67E-03	4.53
Electrical transmission line and substation construction - Squamish	3.90	2.20E-04	1.62E-03	4.39
Total - Off-road Vehicles	20.46	1.16E-03	8.48E-03	23.01
Total - All Vehicles (On and Off-road) and Construction Equipment	20.85	1.16E-03	8.48E-03	23.41

Notes: * CH_4 and N_2O results are presented in scientific (exponential) notation due to the low order of magnitude of the results.
- kt = kilotonne.

Marine Traffic

Existing barge landings at Indian Arm and Woodfibre will be used during proposed Project construction and two new temporary barge landings are planned in the Squamish River. These landings will serve as sites for the loading and off-loading of equipment, materials, personnel and supplies during proposed Project construction.

It is anticipated that ferries or barges will be used to transport personnel and equipment to three main locations: 1) Woodfibre - to existing loading and delivery points; 2) Indian Arm - to existing loading and delivery points; and 3) the Squamish River - from existing loading points to new temporary landing sites on the west side of the Squamish River.

The average travel distance and operating hours of marine vessels anticipated for proposed Project construction as well as estimated GHG emissions from marine traffic are provided in Table 5.4-17.

TABLE 5.4-17

ESTIMATED MARINE VESSEL TRAFFIC AND ASSOCIATED GREENHOUSE GAS EMISSIONS DURING PROPOSED PROJECT CONSTRUCTION

	Landing Site	Total No. Trips	Average Distance[1] (km)	Total[2] Distance (km)	Total Hours	Fuel[3] (t)	CO_2 (t)	CH_4 (t)	N_2O (t)	CO_2e[4] (t)
Materials and Equipment Transportation	Woodfibre	100	15	1,500	101	32.5	101.2	0.0006	0.0026	102.0
	Squamish 1	52	15	780	53	16.9	52.6	0.0003	0.0013	53.0
	Squamish 2	34	15	510	34	11.0	34.4	0.0002	0.0009	34.7
	Indian Arm	40	50	2,000	135	43.3	134.9	0.0008	0.0034	136.0
Personnel Transportation	Indian Arm	200	50	10,000	450	288.7	899.6	0.0054	0.0228	906.5
	Woodfibre and Squamish	700	15	10,500	472	303.1	944.6	0.0056	0.0240	951.9
Totals		1,126	--	25,290	1,246	695.5	2,167.4	0.013	0.055	2,184

Notes: 1 Denotes average round-trip distance.
2 Total distance calculations assume average speed of 8 knots.
3 Fuel consumption estimates assume 5,000 HP engine power for ferries and 2,500 HP for tugs.
4 When calculating total CO_2e, individual GWPs were applied (*i.e.*, 1 for CO_2, 25 for CH_4 and 298 for N_2O).

Land Clearing

Although vegetation is currently managed or controlled along much of the existing FortisBC right-of-way, some tree removal and land clearing will be required along the Project Footprint. An estimated area of 213 ha within the Project Footprint will be cleared. The width of clearing was estimated to be approximately 45 m (see Volume 1, Part B, Section 1.0). Upon completion of construction activities, portions of the cleared area will be replanted, leaving an 18 m (*i.e.*, 9 m on each side of the trench line)

wide clear permanent right-of-way. The area of permanently cleared space was calculated to be 75.3 ha in total (*i.e.*, out of 213 ha of temporary cleared area, 137.7 ha will be replanted). Deforestation area estimates were used to calculate GHG emissions from land clearing activities associated with the proposed Project. The results of these GHG emissions calculations are provided in the GHG Emissions Technical Report (Volume 2, Appendix 1E).

Other Construction Phase Emissions

There are additional sources of GHG emissions that may occur as part of one-time events during the construction phase. These events include venting of residual natural gas from new or existing infrastructure and are expected to occur prior to the proposed Project being fully operational. The main GHG released during these events is CH_4, which forms approximately 95% of vented gas.

Based on expected one-time venting volumes, GHG emissions were calculated using 2013 average specific gravity (586 g/scm) and composition of the export gas. A summary of GHG emissions related to one-time venting events is provided in Table 5.4-18.

TABLE 5.4-18

ESTIMATED GREENHOUSE GAS EMISSIONS FROM ONE-TIME VENTING EVENTS DURING CONSTRUCTION

Emission Type	Emission Estimate (tonnes)
Natural gas venting from one-time events	65.3
CH_4	59
CO_2	1
GHGs* (CO_2e)	1,477

Note: * GHGs include CH_4 multiplied by its GWP plus CO_2. No N_2O is expected since it is not present in export gas.

5.4.4.3 Operations Emissions

This subsection describes the expected GHG emissions from operations of the proposed Project. The GHG emissions were estimated using methods described in the GHG Emissions Technical Report (Volume 2, Appendix 1E).

Pipeline - In-Line Inspection Tool and Fugitive Emissions

The largest GHG emission source during pipeline operations is the venting of pipeline ILI tool barrels (the receivers or launchers of pipeline cleaner or ILI tool) during pipeline inspection or cleaning activities. During these events, natural gas is released into the atmosphere from ILI tool launchers and receivers. ILI tool launching and receiving is a well-controlled process where the volumes of natural gas released under normal operational conditions mainly depend on the size of ILI tool barrels, pressure of natural gas within them and the frequency of ILI events.

Other sources of GHG emissions from the pipeline during operations include fugitive emissions from pneumatic blocks, ILI tool valve sites and from equipment at meter stations. Equipment at meter stations includes various connectors, pressure relief devices, pressure regulators and flow meters.

Gas venting volumes expected from pipeline operations were estimated by FortisBC and used for calculating GHG emissions estimates. These estimates are provided in detail in the GHG Emissions Technical Report (Volume 2, Appendix 1E) and a summary is provided in Table 5.4-19.

TABLE 5.4-19

ESTIMATED ANNUAL GREENHOUSE GAS EMISSIONS DURING PIPELINE OPERATIONS

Emission Type	Emission Estimate (tonnes/year)
Annual natural gas release from pipeline operation	0.74
CH_4	0.67
CO_2	0.011
GHGs* (CO_2e)	16.8

Note: * GHGs include CH_4 multiplied by its GWP plus CO_2. No N_2O is expected since it is not present in export gas.

Facilities

The following subsections describe expected sources of GHG emissions during operations of the proposed Project facilities.

Compressor Units and Auxiliary Equipment

Proposed compressor development at Squamish as well as upgrades at Eagle Mountain and Port Mellon are sources of long-term releases of direct (from gas venting at Port Mellon) and indirect (from electricity consumption at Eagle Mountain and Squamish) GHG emissions associated with proposed Project operations.

The upgrades at the existing Port Mellon compressor station are associated with the installation of a new compressor unit and related natural gas-fired turbine. The new unit at Port Mellon will act to increase operational efficiencies and will operate 49% of the time. The equipment specifics and estimated GHG emissions of the new compressor unit at Port Mellon are provided in the GHG Emissions Technical Report (Volume 2, Appendix 1E).

At the existing Eagle Mountain compressor station in Coquitlam, two new compressor units will each have one low pressure and one high pressure compressor body running in tandem and driven by a single electric motor for a total of four new compressor bodies. Each site is proposed to be near full operating capacity 365 days of the year, however, operation is assumed 98% of the time to allow for shut-downs and maintenance. At the proposed Squamish compressor station, the two proposed compressor units will each operate roughly half of the time, or 49% each.

The new compressor units at Eagle Mountain and Squamish will run on electricity supplied by BC Hydro, rather than conventional gas turbine driven compressors. The electrically-driven compressors will substantially reduce the direct emissions of GHGs associated with the proposed Project when compared with conventional natural gas fueled turbines. Because the new compressors at Eagle Mountain and Squamish will run on electricity from the grid, their GHG emissions are calculated based on their expected power usage, which is determined by the type of engine, its HP, efficiency and annual hours of operation.

There is also an expected increase in electricity consumption from auxiliary equipment associated with the proposed Project. The increased electricity usage from auxiliary equipment includes gas cooler motors at Eagle Mountain and Squamish, the cathodic protection system and the custody transfer system. Estimates of indirect GHG emissions from electricity usage during proposed Project operations is provided in the GHG Emissions Technical Report (Volume 2, Appendix 1E).

Dry Gas Seals

The new compressor units at all three sites (Eagle Mountain, Squamish and Port Mellon) will use dry gas seals. Wet gas seals on compressors require venting each time the unit is stopped or started. The new dry gas-sealed compressors enter into a pressurized hold mode when stopped, thereby reducing GHG emissions (*i.e.*, CH_4 release). Although some gas escapes, it is notably less than what is experienced with wet gas seals. This reduction in venting episodes will reduce the proposed Project's venting emissions and overall GHGs. The volume of leaks from dry gas seals were estimated by FortisBC and used to calculate GHG emission estimates. These estimates are provided in detail in the GHG Emissions Technical Report (Volume 2, Appendix 1E).

Regular Purging, Blowdowns and Continuous Leaks

During activities such as maintenance, planned compressor station shut-downs or emergency shut-downs and compressor unit start-ups or testing, a complete or partial blowdown of the compressor units or other major equipment is required for safety reasons. These activities result in GHG emissions (*i.e.*, release of CH_4) and CO_2, which are present in natural gas. There are also small pieces of equipment (*e.g.*, control valves, meters and connectors), which are an integral part of compressor stations and the source of unavoidable natural gas leaks. The installation of new compressor units at Eagle Mountain, Squamish and Port Mellon will add to the existing GHG emissions from regular compressor blowdowns and equipment leaks. The amount of natural gas vented during compressor station blowdowns and from equipment leaks was estimated by FortisBC based on the historical performance of existing, similar equipment and planned equipment specifications. Those estimates and known gas properties were used to calculate GHG emission estimates associated with compressor station operations and are provided in the GHG Emissions Technical Report (Volume 2, Appendix 1E).

5.4.5 Traditional Land Use

Traditional Land Use (TLU) information was not available at the time of writing to inform the atmospheric environment assessment. Refer to Volume 1, Part C – Aboriginal Groups Information Requirements for information on TLU.

5.5 Acoustic Environment Effects Assessment

This subsection describes potential adverse effects of the proposed Project on the Acoustic VC characterization of residual adverse effects on the acoustic environment after the application of mitigation measures as well as an assessment of the significance of the residual adverse effects. Potential cumulative adverse effects and follow-up monitoring regarding the acoustic environment are also addressed in this subsection.

The assessment is based on characteristics and conditions provided in Subsection 5.4 and the Acoustic Environment Technical Report (Volume 2, Appendix 1C).

5.5.1 Identification of Potential Effects and Residual Adverse Effects

The potential adverse effects of the proposed Project on the Acoustic Environment VC are based on the results of the acoustic assessment performed for the proposed Project. The assessment of the potential Project effects on the Acoustic Environment VC focused primarily on the long-term noise emissions associated with the operation of the proposed compressor stations and included the use of models to determine the change in overall sound levels. The potential adverse effects of the construction of the proposed Project on the Acoustic Environment VC was assessed on a qualitative basis. Measured noise was added to modelled Project noise to determine the expected sound levels associated with the proposed Project and for comparison with the PSL, calculated according to the *BC Noise Control Best Practices Guideline* (BC OGC 2009). The acoustic environment assessment methodology was developed through a literature review as well as the experience of the assessment team. Information on issues and concerns raised by the public and Working Group is provided in Volume 1, Part A, Section 2.0 Environmental Assessment Process, and information on Aboriginal consultation and engagement is provided in Section 18.0 Background and Consultation of Volume 1, Part C – Aboriginal Groups Information Requirements.

5.5.1.1 Mitigation Measures

The summary of recommended mitigation measures provided in Table 5.5-1 was developed in accordance with industry and provincial regulatory guidelines, including the *BC Noise Control Best Practices Guideline* (BC OGC 2009), Section 6 of Health Canada's Useful Information for Environmental Assessments (Health Canada 2010), and the *Workers Compensation Act, Occupational Health and Safety Regulation* as well as in accordance with FortisBC standards. Through the implementation of these measures, the proposed Project will meet the objectives of the *BC Noise Control Best Practices Guideline*, other relevant regulations and bylaws in Subsection 5.3 as well as the objectives of land use plans as provided in Table 5.3-3, and that it will cause minimal disturbance to nearby residents or land and resource users.

Information on the mitigation hierarchy used in applying mitigation measures provided in Table 5.5-1 is provided in Volume 1, Part B, Section 3.0 Assessment Methodology.

TABLE 5.5-1

POTENTIAL ADVERSE EFFECTS, MITIGATION MEASURES AND RESIDUAL ADVERSE EFFECTS OF THE PROPOSED PROJECT ON THE ACOUSTIC ENVIRONMENT

Project Phase	KI/Potential Adverse Effect	Project Component/ Location/ Activity	Spatial Boundary[1]	Key Recommendations/Mitigation Measures	Potential Residual Adverse Effect(s)
Acoustic Environment - Sound Levels					
Construction and Decommissioning	Increase in daytime ASLs from vehicles and equipment	All proposed Project components/ Entire route	LSA	• Schedule construction activities within 1.5 km of residences, cabins, campgrounds or parks during the period from 7:00 to 22:00 in accordance with the BC OGC *BC Noise Control Best Practices Guideline* and adhere to applicable noise bylaws (District of Squamish Bylaw No. 2312, 2014) or approval conditions. • Use well-maintained equipment to reduce air pollution and noise. • Limit idling. • Seek to schedule heavy vehicle access for materials deliveries in areas close to residences for daytime, non-peak hours to the extent practical to reduce nighttime traffic near residences between the hours of 22:00 and 7:00. • Notify potentially affected residents of any major construction activities that will be conducted at night. • Use “drive-through” site access for roads and temporary storage areas, where practical and appropriate, to reduce the use of vehicle backup alarms.	• Increase in sound levels during construction and decommissioning
Operations	Increase in sound levels associated with gas cooling units and compressor turbines	Compressor stations	LSA	• Comply with appropriate provincial and municipal regulatory guidelines related to noise during construction as well as operation of compressor stations to reduce disturbance related to noise.	• Increase in sound levels during operations

Note: 1 LSA = Acoustic Environment LSA

Decommissioning is associated with similar activities as construction, and, therefore, has the same mitigation measures. However, the decommissioning phase will be shorter and less intensive than the construction phase. Therefore, the potential adverse effects on the Acoustic Environment VC during decommissioning of the proposed Project are considered to be similar to, but of lower intensity than, the potential adverse effects of construction. For this reason, the potential adverse effects of decommissioning on the Acoustic Environment VC were considered together with the effects of construction.

5.5.2 Residual Adverse Effects and Their Significance

The potential residual adverse effects of the operations of the proposed Project on the Acoustic Environment VC are discussed in a quantitative manner by analyzing existing sound levels along with the contribution of the proposed Project to ASLs through modelling. Acoustic modelling was done in accordance with the International Standards Organization 9613-2:1996 Acoustics - Attenuation of sound during propagation outdoors – Part 2: General method of calculation. The significance of the potential residual adverse effects of the construction and decommissioning of the proposed Project was assessed on a qualitative basis.

5.5.2.1 Significance Threshold

The regulatory thresholds presented in the *BC Noise Control Best Practices Guideline* (BC OGC 2009) describe the PSLs for the acoustic environment. A potential residual effect on the acoustic environment is considered significant when it exceeds the PSL. Following the BC OGC (2009) guidelines, the PSL for the residences nearest to the Eagle Mountain and Squamish compressor station sites is 48 dBA at night and 58 dBA during the day. The PSL for the residences nearest to the Port Mellon compressor station is lower because of the lower population density, and has been defined as 40 dBA at night and 50 dBA during the day.

Table 5.5-2 provides the characterization of the potential residual adverse effects of the construction, operations and decommissioning of the proposed Project on the Acoustic Environment VC. The rationale used to characterize each of the residual adverse effects is provided below.

The potential residual adverse effects on the Acoustic Environment VC associated with the construction, operations and decommissioning of the proposed Project (Table 5.5-1) are:

- increase in sound levels during construction and decommissioning; and
- increase in sound levels during operations.

TABLE 5.5-2

CHARACTERIZATION OF POTENTIAL RESIDUAL ADVERSE EFFECTS OF THE PROPOSED PROJECT ON THE ACOUSTIC ENVIRONMENT

Residual Adverse Effect	Criteria Rating	Effects Characterization Rationale	Follow-up and Monitoring
Acoustic Environment - Sound Levels			
Increase in sound levels during construction and decommissioning	Context: The acoustic environment has moderate to high resilience to imposed stresses depending on the existing environment as well as the distance between the sound emission sources and the nearest receptors.		
	Spatial boundary[1]: LSA	Sound levels associated with the construction and decommissioning will extend into the LSA.	No follow-up is required as construction-related noise is not expected to be substantial and should be managed using controls consistent with best practices. FortisBC will follow-up on any noise complaints and take steps to reduce the noise levels to PSL.
	Duration: Short-term	Noise emissions from equipment and vehicles are limited to the construction or decommissioning phase only.	
	Frequency: Isolated	Noise emissions are confined to the construction or decommissioning phase.	
	Reversibility: Short-term	The period over which the change in sound level extends is the construction or decommissioning period. However, at any specific location along the proposed route, all sound level changes will cease when construction activities have finished.	
	Magnitude: Low	Noise from construction and decommissioning will be perceptible but within regulatory guidelines.	
	Probability of Occurrence: High	Equipment and vehicles used for construction and decommissioning activities will result in additional noise to the acoustic environment.	
	Confidence: Moderate to high	Based on the experience of the assessment team and assessment results.	
	Significance: Not significant	Changes to the acoustic environment will be within regulatory guidelines and significance thresholds.	

TABLE 5.5-2 Cont'd

Residual Effect	Criteria Rating	Effects Characterization Rationale	Follow-up and Monitoring
Increase in sound levels during operations	Context: The acoustic environment has moderate to high resilience to imposed stresses depending on the existing environment as well as the distance between the sound emission sources and the nearest receptors.		
	Spatial boundary[1]: LSA	Sound levels associated with the compressor stations will extend into the LSA (*i.e.*, up to 1.5 km from the compressor station site fence lines).	No follow-up is required for areas outside the Acoustic Environment LSA around the compressor stations as the proposed Project's new components are predicted to produce sound levels below PSL recommended by BC OGC and the change in calculated %HA at the receptors does not exceed Health Canada guidelines. FortisBC will follow-up on any noise complaints and take steps to reduce the noise levels to PSL.
	Duration: Long-term	The compressor stations will emit noise throughout the operations phase of the proposed Project.	
	Frequency: Continuous	The compressor stations operate continuously throughout the operations phase of the proposed Project.	
	Reversibility: Long-term	The acoustic environment will return to its original state with no residual adverse effects once compressor station operations end.	
	Magnitude: Medium	Noise from compressor station operations is perceptible but is within regulatory guidelines.	
	Probability of Occurrence: High	The gas cooling units and compressor turbines will result in additional noise to the acoustic environment.	
	Confidence: Moderate to high	Based on the experience of the assessment team and the application of conservative acoustic modeling.	
	Significance: Not significant	Changes to the acoustic environment will be within regulatory guidelines and significance thresholds.	

Note: 1 LSA = Acoustic Environment LSA.

5.5.2.2 Determination of Significance

The following subsections provide information on the determination of significance based on the characterization of potential cumulative adverse effects in Table 5.5-2.

Sound Levels

Increase in Sound Levels During Construction and Decommissioning

Noise arising from construction activities will occur along the entire Application Corridor and is considered to have a negative impact balance. However, the residual adverse effects of a short-term increase in nuisance noise will be limited to areas in proximity to human receptors. The linear progression of pipeline construction results in an approximately 1 month duration of concentrated construction activity at any given location. Construction activities within 1.5 km of receptors will be scheduled during the period from 7:00 to 22:00 in accordance with the BC OGC (2009), and will adhere to applicable noise bylaws or approval conditions. Construction equipment and vehicles will be equipped with noise abatement equipment (*e.g.*, mufflers). The residual effect of construction noise is of low magnitude and reversible in the short-term and, therefore, considered not significant. Decommissioning is associated with similar activities as construction, and, therefore, has the same effects characterization. The rationale for all the significance criteria is provided in Table 5.5-2.

Increase in Sound Levels During Operations

According to the noise modelling conducted for the proposed Project (see the Acoustic Environment Technical Report in Volume 2, Appendix 1C), operational sound levels are expected to comply with the PSL (58/48 dBA day/night for Eagle Mountain and Squamish, and 50/40 dBA day/night for Port Mellon) within 1.5 km from the fence lines of the Eagle Mountain, Squamish and Port Mellon compressor station sites. Sound will emanate from the gas cooling units and compressor units 24 hours a day, 365 days a year, except during shut-down, maintenance or upset, for the life of the proposed Project (*i.e.*, 50+ years)

and is, therefore, considered long-term in duration and continuous in frequency. However, upon decommissioning, all sound associated with the proposed Project will cease. An increase of < 0.2% HA persons is expected, well below the Health Canada threshold of 6.5% HA. There is a maximum of 63 dBA and 62 dBA Ldn of existing background sound at Eagle Mountain and Squamish, and 43 dBA Ln at Port Mellon. Some level of sound will emanate from the gas cooling units and compressor turbines, and the determination of significance is based on a good understanding of cause-effect relationships as well as data pertinent to the proposed Project area. The effect on the Acoustic Environment VC of an increase in sound levels associated with gas cooling units and compressor turbines is, therefore, considered not significant. The rationale for all the significance criteria is provided in Table 5.5-2.

5.5.2.3 Risk Analysis

On the basis of the known risks associated with increased sound levels and the Acoustic Environment VC, as well as the mitigation measures to be implemented and the moderate to high resilience of the Acoustic Environment LSA to effects related to sound levels, additional risk analysis is not required.

5.5.3 Cumulative Effects Assessment

The cumulative effects assessment for the Acoustic Environment VC was conducted in accordance with the AIR for the proposed Project (BC EAO 2014) and BC EAO guidance. Refer to Volume 1, Part B, Section 3.0 Assessment Methodology for a detailed explanation of the cumulative effects assessment methods adopted for the proposed Project.

5.5.4 Activities and Projects Considered for the Cumulative Effects Assessment

The list of potential projects and activities outlined in Tables A3.1-1 to A3.1-3 in Appendix A3.1 of Volume 1, Part B, Section 3.0 Assessment Methodology were reviewed to determine which projects and activities are located within the Acoustic Environment RSA, and to facilitate the identification of any overlapping residual adverse effects from other projects and activities on the Acoustic Environment VC.

Table 5.5-3 provides a list of reasonably foreseeable developments located in the Acoustic Environment RSA considered in the evaluation of cumulative adverse effects on the sound levels KI.

TABLE 5.5-3

REASONABLY FORESEEABLE DEVELOPMENTS IN THE ACOUSTIC ENVIRONMENT REGIONAL STUDY AREA

Applicant	Development Name	Development Type	Location
AltaGas Ltd.	Rainy River Hydroelectric Project	Run-of-River Hydroelectric	Howe Sound
BC Hydro	Interior to Lower Mainland Project	Electrical transmission Line	Between Merritt, BC and Coquitlam, BC
Run of River Power Inc.	Mamquam Power Cluster	Hydroelectric	Whistler, BC
Sea to Sky Power Corporation	Skookum Creek Power Project	Run-of-River Hydroelectric	Squamish, BC
Woodfibre LNG Limited	Woodfibre LNG	LNG Facility	7 km southwest of Squamish, BC

5.5.5 Identification of Potential Cumulative Adverse Effects

The potential and likely residual adverse effects associated with the Acoustic Environment VC are listed in Table 5.5-4 along with the identification of existing activities and reasonably foreseeable projects with potential to act in combination with the proposed Project.

TABLE 5.5-4

POTENTIAL RESIDUAL ADVERSE EFFECTS OF THE PROPOSED PROJECT ON THE ACOUSTIC ENVIRONMENT CONSIDERED FOR THE CUMULATIVE EFFECTS ASSESSMENT

Project Phase	Potential Residual Adverse Effect	Project Component/Location/ Activity	Spatial Boundary	Potential Cumulative Adverse Effect	Existing Activity/Reasonably Foreseeable Developments Acting in Combination with the Proposed Project
Construction, Operations and Decommissioning	Increase in sound levels during construction, operations and decommissioning	All proposed Project components/Entire route	RSA	No potential cumulative adverse effects are anticipated. The interaction between the potential residual adverse effects as well as other existing and reasonably foreseeable developments is considered negligible due to the localized nature of the potential residual adverse effects.	• Existing energy facilities have been included as part of the existing acoustic environment. • None of the identified reasonably foreseeable developments (see Table 5.5-3) are expected to act cumulatively with the proposed Project and cause adverse effects on the Acoustic Environment VC.

Note: 1 RSA = Acoustic Environment RSA

5.5.6 Cumulative Adverse Effects and Their Significance

As mentioned in Subsection 5.5.2, the noise modelling conducted for the proposed Project shows operational sound levels are expected to comply with the PSL (58/48 dBA day/night) within 1.5 km from the fence lines of the Eagle Mountain, Squamish and Port Mellon compressor station sites (see the Acoustic Environment Technical Report in Volume 2, Appendix 1C). An increase of < 0.2% HA persons is expected, well below the Health Canada threshold of 6.5% HA. There is maximum 63 dBA and 62 dBA Ldn of existing background sound at Eagle Mountain and Squamish, and 43 dBA Ln at Port Mellon. Due to the extent of sound levels occurring within the LSA, there is no interaction of the residual adverse effects of the proposed Project with residual adverse effects of reasonably foreseeable developments in Table 5.5-3.

5.5.7 Follow-up Strategy

Follow-up will be conducted to monitor for the overall adverse effects of the proposed Project, however, no specific follow-up program is required for the Acoustic Environment VC around the compressor stations because the proposed Project components are predicted to produce sound levels below the PSL recommended by the BC OGC, and the change in calculated %HA at the receptors does not exceed Health Canada guidelines. FortisBC will follow-up on any noise complaints and take steps to reduce the noise levels to below the PSL recommended by the BC OGC.

5.5.8 Summary of Assessment of Potential Adverse Effects on the Acoustic Environment

There are no situations where there is a high probability of occurrence of a permanent or long-term potential residual effect on the Acoustic Environment VC of high magnitude that cannot be technically or economically mitigated. In addition, the expected sound levels do not exceed the PSLs presented in the *BC Noise Control Best Practices Guideline* (BC OGC 2009). With the implementation of mitigation, the residual adverse effects on the Acoustic Environment VC have been determined to be not significant.

5.6 Air Quality Effects Assessment

This subsection describes potential adverse effects of the proposed Project on the Air Quality VC characterization of residual adverse effects on Air Quality after the application of mitigation measures, and an assessment of the significance of the residual adverse effects. Potential cumulative adverse effects and follow-up monitoring regarding the Air Quality VC are also addressed in this subsection.

The assessment is based on characteristics and conditions provided in Subsection 5.4 and the Air Quality Technical Report (Volume 2, Appendix 1D).

5.6.1 Identification of Potential Effects and Residual Adverse Effects

The potential adverse effects on the Air Quality VC associated with the proposed Project are based on the results of the air quality assessment performed for the proposed Project. The air quality assessment included a quantitative review of existing air quality and climate conditions as well as CAC emissions expected from the proposed Project (see the Air Quality Technical Report in Volume 2, Appendix 1D).

The Air Quality assessment methodology was developed through a review of existing information, information provided by FortisBC and Solaris Management Consultants Inc. (assumed compressor equipment suppliers) as well as through consultation with Metro Vancouver and the BC OGC, and was based on the professional experience of the assessment team. Information on issues and concerns raised by the public as well as the Working Group is provided in Volume 1, Part A, Section 2.0 Environmental Assessment Process, and information on Aboriginal consultation and engagement is provided in Section 18.0 Background and Consultation of Volume 1, Part C – Aboriginal Groups Information Requirements.

5.6.1.1 Mitigation Measures

The summary of recommended mitigation measures provided in Table 5.6-1 was developed in accordance with industry and regulatory guidelines, including *CEPA*, the BC *Environmental Management Act*, including the *Waste Discharge Regulation*, *Oil and Gas Waste Regulation* and *Open Burning and Smoke Control Regulation*, the *Wildfire Regulation* under the BC *Wildfire Act*, Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities (ChemInfo Services Inc. 2005), and federal, provincial and regional AAQO (BC MOE 2013, CCME 2012, Health Canada and Environment Canada 1998, Metro Vancouver 2011), as well as in accordance with local bylaws and FortisBC standards. Through the implementation of these measures, the proposed Project will meet the regulations and guidelines in Subsection 5.3 as well as the objectives of land use plans as provided in Table 5.3-3.

Information on the mitigation hierarchy used in applying mitigation measures provided in Table 5.6-1 is provided in Volume 1, Part B, Section 3.0 Assessment Methodology.

TABLE 5.6-1

POTENTIAL ADVERSE EFFECTS, MITIGATION MEASURES AND RESIDUAL ADVERSE EFFECTS OF THE PROPOSED PROJECT ON AIR QUALITY

Project Phase	KI/Potential Adverse Effect	Project Component/ Location Activity	Spatial Boundary[1]	Key Recommendations/Mitigation Measures	Potential Residual Adverse Effect(s)
Air Quality - CACs					
Construction and Decommissioning	CAC emissions from the use of equipment and vehicles	All proposed Project components/ Entire route	RSA	• Use well-maintained equipment to reduce air pollution and noise. • Limit idling. • Use multi-passenger vehicles for the transport of crews to and from the job sites, to the extent practical, to reduce emissions during construction.	• Elevated concentrations of CAC emissions from the use of equipment and vehicles
Construction and Decommissioning	Fugitive dust emissions from land disturbance and transport on unpaved roads	All proposed Project components/ Entire route	RSA	• Use dust control measures during hot and dry weather	• No residual adverse effects identified

TABLE 5.6-1 Cont'd

Project Phase	KI/Potential Adverse Effect	Project Component/ Location Activity	Spatial Boundary[1]	Key Recommendations/Mitigation Measures	Potential Residual Adverse Effect(s)
Construction	Smoke emissions from burning associated with land clearing	All proposed Project components/ Entire route	RSA	• Seek to reduce open burning and market as much cleared timber as practical to reduce emissions of smoke (PM) and GHGs. • Implement techniques to limit smoke production, including limiting pile size, reducing fuel moisture content, maintaining loose burning piles free of soil and using burn sloops or large capacity shredders. • Avoid locating burn piles on peat-rich soils, as identified by the Environmental Inspector, in order to limit the risk of residual fires after construction. Locate burn piles on exposed soils (*i.e.*, where topsoil salvage has been conducted), or on burning sleds or sloops.	• Elevated concentrations of CAC emissions, particularly PM, from burning associated with land clearing
Operations	Fugitive, non-CH_4 VOC emissions associated with venting and leaks	Compressor stations	RSA	• Weld pipe connections and other fittings to the extent practical to reduce fugitive emissions during operation. • To the extent practical, seek to reduce venting to reduce emissions of CH_4 and VOCs during regular operation. • To the extent practical, install electric drives (Squamish V2 and Coquitlam V1) to reduce direct emissions of GHGs and CACs.	• Elevated concentrations of CAC emissions during operations due to fugitive, non-CH_4 VOC emissions associated with venting and leaks

Note: 1 RSA = Air Quality RSA.

Decommissioning is associated with similar activities as construction and, therefore, has the same mitigation measures. However, the decommissioning phase will be shorter and less intensive than the construction phase (*i.e.,* no appreciable land clearing and no pipe welding). Therefore, the effects on the Air Quality VC of the decommissioning of the proposed Project are considered to be similar to, but of lower intensity, than the effects of construction. For this reason, the potential adverse effects of decommissioning on the Air Quality VC were considered together with the effects of construction.

5.6.2 Residual Adverse Effects and Their Significance

The potential residual adverse effects of the construction, operations and decommissioning of the proposed Project on the Air Quality VC are discussed in a quantitative manner by analyzing existing CAC emissions and those CAC emissions expected to be associated with the proposed Project.

5.6.2.1 Significance Threshold

For the Air Quality VC the most important criteria ratings are magnitude and duration, because magnitude and duration form the basis of AAQO (see Tables 5.3-1 and 5.3-2) that are used to assess the effects of CAC emissions from the proposed Project on Air Quality. The thresholds provided in Tables 5.3-1 and 5.3-2 for AAQO were used to determine the significance of potential adverse effects on the Air Quality VC.

No increase of CACs that could adversely affect localized air quality concentrations is expected for the proposed Project given the use of new, electrically-driven compressor turbines. As there is no on-site combustion associated with the use of electrically-driven compressors turbines, the proposed Project is not expected to contribute to local CAC concentrations.

Table 5.6-2 provides the characterization of the potential residual adverse effects of the proposed Project on the Air Quality VC. The rationale used to characterize each of the residual adverse effects is provided below. An evaluation of significance is not required for those potential adverse effects where no residual adverse effect is identified (*i.e.*, fugitive dust emissions from land disturbance and transport on unpaved

roads). The potential adverse effects associated with fugitive dust from surface disturbance and transport on unpaved roads activities will be eliminated through the implementation of mitigation measures (see Table 5.6-1).

The potential residual adverse effects on the Air Quality VC associated with the construction, operations and decommissioning of the proposed Project (Table 5.6-1) are:

- elevated concentrations of CAC emissions from the use of construction equipment and vehicles;
- elevated concentrations of CAC emissions, particularly PM, from burning of residual wood material associated with land clearing; and
- elevated concentrations of CAC emissions during operations due to fugitive, non-CH_4 VOC emissions associated with venting and leaks.

TABLE 5.6-2

CHARACTERIZATION OF POTENTIAL RESIDUAL ADVERSE EFFECTS OF THE PROPOSED PROJECT ON AIR QUALITY

Residual Adverse Effect	Criteria Rating	Effects Characterization Rationale	Follow-up and Monitoring
Air Quality - CACs			
Elevated concentrations of CAC emissions from the use of equipment and vehicles	Context: Internal combustion engines on vehicles and equipment will emit, in the short-term, CO, NO_x and PM as well as small amounts of VOCs and SO_x (from low sulphur diesel fuel), which are expected to dissipate once construction or decommissioning is complete.		
	Spatial boundary[1]: RSA	CAC emissions associated with equipment and vehicles will not be detectable outside the RSA.	There is no follow-up or monitoring required in relation to construction or decommissioning emissions.
	Duration: Short-term	Emissions from equipment and vehicles are limited to the construction or decommissioning phase only.	
	Frequency: Isolated	The emissions are confined to the construction or decommissioning phase.	
	Reversibility: Immediate	Once construction or decommissioning is complete, the emissions will cease and air quality effects will be reversed within 2 days.	
	Magnitude: Low	Air quality effects from construction or decommissioning within the RSA will be detectable but well below regulatory guidelines (*i.e.*, AAQOs).	
	Probability of Occurrence: High	Internal combustion engines on vehicles used for construction or decommissioning will emit CACs.	
	Confidence: High	Based on a good understanding of the cause-effect relationships associated with air quality in the proposed Project area.	
	Significance: Not significant	The residual effect is from an isolated event of low magnitude that is short-term in duration and immediately reversible, and does not exceed AAQO thresholds.	

TABLE 5.6-2 Cont'd

Residual Adverse Effect	Criteria Rating	Effects Characterization Rationale	Follow-up and Monitoring
Elevated concentrations of CAC emissions, particularly PM, from burning associated with land clearing	Context: Burning of biomass in association with land clearing will release smoke containing CACs, in particular PM, which are expected to dissipate once construction is complete.		
	Spatial boundary: RSA	CAC emissions associated with burning are not expected to be detectable outside the RSA.	Weather conditions will be monitored closely and burning will only be conducted when conditions are suitable for promoting adequate dispersion and dilution of the smoke plume, and as prescribed by the burning permit to be obtained from BC MFLNRO.
	Duration: Short-term	The events causing an increase in CAC emissions will only occur during the construction phase.	
	Frequency: Isolated	The events causing CAC emissions are confined to the construction phase.	
	Reversibility: Immediate	Once construction is complete, the emissions will cease and air quality effects will be reversed within 2 days.	
	Magnitude: Medium	Concentrations of CACs related to burning will remain within AAQO for PM.	
	Probability of Occurrence: High	Burning associated with land clearing will create CAC emissions.	
	Confidence: High	Based on a good understanding of the cause-effect relationships associated with air quality in the proposed Project area.	
	Significance: Not significant	The residual effect is from an isolated event of medium magnitude that is short-term in duration and immediately reversible, and does not exceed AAQO thresholds.	
Elevated concentrations of CACs during operations due to fugitive, non-CH_4 VOC emissions associated with venting and leaks	Context: Regular purging and blowdown of gas compressors will be required during routine maintenance as well as emergency shut-downs, and unavoidable equipment leaks will happen and associated venting will release VOCs (a separate group of CACs), which are expected to dissipate once venting is complete.		
	Spatial boundary: RSA	Emissions of n-m VOCs will not be detectable outside of the RSA.	Emissions during operations will be monitored and estimated to ensure compliance with regulatory permits as well as approvals.
	Duration: Long-term	Some of the events leading to leaks and fugitive emissions will occur continuously over the life of the proposed Project.	
	Frequency: Periodic to continuous	Although some of the events that lead to venting and leaks will occur intermittently over the life of the proposed Project (*e.g.,* blowdowns, starts and stops, ILI), others will be continuous (*e.g.*, dry gas seals, flanges and connectors).	
	Reversibility: Immediate	The events leading to fugitive n-m VOCs will cease on decommissioning once the line is cleared and related effects will reverse within 2 days.	
	Magnitude: Negligible	Vented and leaked volumes are small and n-m VOCs make up < 2% of the gas stream. Their resulting effects on air quality will not be detectable over background emissions, particularly given the current levels of biogenic, forest-emitted, n-m VOCs in the proposed Project area.	
	Probability of Occurrence: High	Fugitive venting and leaks will occur in association with the proposed Project.	
	Confidence: High	Based on a good understanding of the cause-effect relationships associated with air quality in the proposed Project area.	
	Significance: Not Significant	The residual effect is negligible in magnitude, immediately reversible and does not exceed AAQO thresholds.	

Note: 1 RSA = Air Quality RSA.

5.6.2.1 Determination of Significance

The following subsections provide information on the determination of significance based on the characterization of potential cumulative adverse effects in Table 5.6-2.

Criteria Air Contaminants

Elevated Concentrations of Criteria Air Contaminant Emissions from the Use of Equipment and Vehicles

A variety of on and off-road vehicles as well as equipment will used during construction and decommissioning of the proposed Project, and are listed in the Air Quality Technical Report (Volume 2, Appendix 1D). In addition, ferries and barges will be used to transport some workers and materials during the construction phase. Existing emissions in the proposed Project area are dominated by the transport sector, including existing marine traffic. Compared with the number of cars on the road in Metro Vancouver in addition to commercial transport trucks and rail, emissions from the proposed Project are considered very low in magnitude. Except for areas very near (within 500 m) to construction or decommissioning activities, CAC emissions from Project vehicles and equipment will not be detectable above existing ambient levels, and these emissions will not be detectable outside of the Air Quality RSA.

Construction and decommissioning emissions will be short-term and will only occur for approximately 4 months at a time in any 1 location along the proposed pipeline route, and for no more than 1 year at compressor station sites. Construction and decommissioning are isolated, one-time events at any location and are confined to their respective phases only. Any effects caused by construction or decommissioning emissions are immediately reversed once construction or decommissioning is complete.

All vehicles will use fuel (primarily diesel) and, therefore, be associated with some amount of CACs, including CO, NO_x, PM and VOCs as well as small, near negligible amounts of SO_2 associated with the sulphur in diesel fuel. Emissions from construction and decommissioning equipment were estimated using standard industry tools and emission factors, and were assessed with a good understanding of existing emissions in the region as well as the relationships that lead to poor air quality in the region. The assessment of the impacts of CACs from construction and decommissioning equipment on air quality was also based on the expertise of the assessment team. Because the potential residual effect is considered to be low magnitude and short-term in duration and does not exceed AAQO thresholds, the effect of construction and decommissioning equipment emissions on air quality in the RSA is considered not significant. The rationale for all the significance criteria is provided in Table 5.6-2.

Elevated Concentrations of Criteria Air Contaminant Emissions, Particularly Particulate Matter, from Burning Associated with Land Clearing

A portion of the Project Footprint (approximately 33%) will occur along the existing FortisBC pipeline right-of-way and other existing disturbances (*e.g.*, transmission lines, roads, etc.). Although existing disturbances have already been cleared and undergo regular vegetation management, some new clearing for the proposed Project will still be required. Some areas may require widening of the right-of-way, while the compressor station site at Eagle Mountain will require some new clearing for site expansion and establishment. It is estimated conservatively that approximately 213.1 ha of land with merchantable timber will be cleared from the Project Footprint. Non-merchantable timber and vegetative matter cleared from the Project Footprint will be burned or chipped. This burning will produce smoke, which, depending on the weather conditions, will cause CAC concentrations to increase, particularly levels of PM. During these burning events, levels of PM may, depending on the ambient conditions, approach applicable AAQO, but are expected to remain within acceptable thresholds and are, therefore, considered to be of medium magnitude.

The burning that causes smoke will be a short-term and isolated event occurring only once at any one location where it is required, and the associated effects are immediately reversible once the burning is completed. Therefore, the effect on the Air Quality VC of smoke associated with land clearing for the proposed Project is considered not significant. The rationale for all the significance criteria is provided in Table 5.6-2.

Elevated Concentrations of Criteria Air Contaminant Emissions during Operations due to Fugitive, Non-Methane Volatile Organic Compound Emissions Associated with Venting and Leaks

Most of the venting and fugitive releases associated with facility and pipeline operation are more relevant in terms of GHG emissions (discussed in Section 5.7), because the gas released during these events is approximately 95% CH_4, which is a GHG. Another 3% is ethane, which, according to the US EPA and as adopted by Environment Canada, is, like CH_4, not considered to be reactive in terms of O_3 formation (Environment Canada 2013c). Approximately 1% of the gas to be vented is made up of non-CH_4 VOCs that are considered reactive *(i.e.*, non-CH_4 and non-ethane VOCs that contribute to secondary O_3 formation), and, therefore, the magnitude of these emissions is considered negligible. These emissions are minor in comparison to the magnitude of biogenic non-CH_4 VOC emissions produced by coniferous and deciduous forest trees in the region (*e.g.*, isoprene, α-pinene and β-pinene) (Drewitt *et al.* 1998). These biogenic non-CH_4 VOCs also have maximum incremental reactivities that range from approximately 3-19 times those of the propane and n-butane non-CH_4 VOCs expected to be released during operations of the proposed Project due to venting and leaks (Carter 1994). A full description of the composition of gas to be transported by the proposed Project is provided in the Air Quality Technical Report (Volume 2, Appendix 1D).

These non-CH_4 VOC emissions associated with venting and leaks will be continuous and long-term, occurring over the life of the proposed Project, but the magnitude of their release is considered negligible and this judgement is based on the assessment team's in-depth understanding of the cause-effect relationships affecting secondary O_3 production in the region. The potential residual effect will not exceed AAQO thresholds and is, therefore, considered not significant. The rationale for all the significance criteria is provided in Table 5.6-2.

5.6.2.2 Risk Analysis

Risk that may be associated with proposed Project emissions relates to their incremental impact on ambient air quality through increased CAC concentrations. CAC emissions from vehicles and construction equipment are short-term, immediately reversible and are not expected to act cumulatively with existing emission sources in the RSA (see Table 5.6-5) due to the expected amounts. VOC emissions from venting during operations are expected on a regular basis, however, they are not continuous (except equipment leaks which are extremely small) and are not expected to alter existing ambient air quality. Heavy compounds (usually butane and heavier) constitute less than 1% of gas to be vented (see Volume 2, Appendix 1D) and lighter constituents dissipate immediately. Therefore, increase in CAC concentrations during proposed Project construction activities and operation was assumed to be short-term and of low magnitude. No incremental impact on air quality is expected and, therefore, additional risk analysis is not required.

5.6.3 Cumulative Effects Assessment

The cumulative effects assessment for Air Quality was conducted in accordance with the AIR for the proposed Project (BC EAO 2014) and BC EAO guidance. Refer to Volume 1, Part B, Section 3.0 Assessment Methodology for a detailed explanation of the cumulative effects assessment methods adopted for the proposed Project.

5.6.4 Activities and Projects Considered for the Cumulative Effects Assessment

The list of potential projects and activities outlined in Tables A3.1-1 to A3.1-3 in Appendix A3.1 of Volume 1, Part B, Section 3.0 Assessment Methodology were reviewed to determine which projects and activities are located within the Air Quality RSA, and to facilitate the identification of any overlapping residual adverse effects from other projects and activities on the Air Quality VC.

Reasonably foreseeable developments in the Air Quality RSA are listed in Table 5.6-3.

TABLE 5.6-3

REASONABLY FORESEEABLE DEVELOPMENTS IN THE AIR QUALITY REGIONAL STUDY AREA

Applicant	Development Name	Development Type	Location
Garibaldi at Squamish Inc. c/o Aquilini Development and Construction Inc.	Garibaldi at Squamish Resort Project	Tourist Destination Resort	Brohm Ridge, approximately 15 km north of Squamish, BC
AltaGas Ltd.	Rainy River Hydroelectric Project	Run-of-River Hydroelectric	Howe Sound
BC Hydro	Interior to Lower Mainland Project	Electrical Transmission Line	Between Merritt, BC and Coquitlam, BC
BluEarth Renewables Inc.	Culliton Creek Power Project	Run-of-River Hydroelectric	20 km north of Squamish, BC
Box Canyon Hydro Corporation/Sound Energy Inc.	Box Canyon Hydroelectric Project	Hydroelectric	Port Mellon, BC
Run of River Power Inc.	Mamquam Power Cluster	Hydroelectric	Whistler, BC
Sea to Sky Power Corporation	Skookum Creek Power Project	Run-of-River Hydroelectric	Squamish, BC
Kinder Morgan Canada Inc.	Trans Mountain Expansion	Pipeline	Edmonton, Alberta to Burnaby, BC
Woodfibre LNG Limited	Woodfibre LNG	LNG Facility	7 km southwest of Squamish, BC
Burnco Rock Products Ltd.	Burnco Aggregate Project	Sand and Gravel Mine	Northwest shore of Howe Sound, approximately 22 km west-southwest of Squamish, BC

Of the reasonably foreseeable developments listed in Table 5.6-3, the Burnco Aggregate Project has the most potential (although minimal) to act cumulatively with the proposed Project to adversely affect air quality in the Air Quality RSA due to the creation of localized dust. The operation of the Burnco Aggregate Project is expected to exceed 24 million tonnes of sand and gravel with an expected economic life of 16 years. In its Application Terms of Reference, it is stated that dispersion modelling may be required, however, this will be confirmed once the initial identification of emission sources has been conducted and a screening level assessment has been conducted.

5.6.5 Identification of Potential Cumulative Adverse Effects

The potential and likely residual adverse effects associated with Air Quality are listed in Table 5.6-4 along with the identification of existing activities and reasonably foreseeable projects acting in combination with the proposed Project.

TABLE 5.6-4

POTENTIAL RESIDUAL ADVERSE EFFECTS OF THE PROPOSED PROJECT ON AIR QUALITY CONSIDERED FOR THE CUMULATIVE EFFECTS ASSESSMENT

Project Phase	Potential Residual Adverse Effect	Project Component/Location/ Activity	Spatial Boundary	Potential Cumulative Adverse Effect	Existing Activity/Reasonably Foreseeable Developments Acting in Combination with the Proposed Project
Construction and Decommissioning	Elevated concentrations of CAC emissions from the use of equipment and vehicles	All proposed Project components/ Entire route	RSA	Proposed Project contribution to elevated concentrations of CAC emissions	• Existing and reasonably foreseeable sources include: transportation and infrastructure projects; hydropower developments; utility activities; mineral resource developments; off-roading recreational activities; other natural gas facilities; and traffic on roads, highways and waterways in the RSA.
Construction	Elevated concentrations of CAC emissions, particularly PM, from burning associated with land clearing	All proposed Project components/ Entire route	RSA		

TABLE 5.6-4 Cont'd

Project Phase	Potential Residual Adverse Effect	Project Component/Location/ Activity	Spatial Boundary	Potential Cumulative Adverse Effect	Existing Activity/Reasonably Foreseeable Developments Acting in Combination with the Proposed Project
Operations	Elevated concentrations of CAC emissions during operations due to fugitive, non-CH_4 VOC emissions associated with venting and leaks	Compressor stations	RSA	No potential cumulative effect is anticipated. The interaction between the potential residual effect and other existing and reasonably foreseeable developments is considered negligible due to the minor and localized nature of the potential residual effect.	• None of identified reasonably foreseeable developments (see Table 5.6-3) are expected to act cumulatively with the proposed Project and cause adverse effects on Air Quality VCs due to the low magnitude of emissions expected from the proposed Project.

Note: 1 RSA = Air Quality RSA.

A quantitative assessment of potential combined effects on the Air Quality VC was deemed to be the most appropriate approach for the cumulative effects assessment. Existing emissions and projected future air emissions from the proposed Project construction and operations in the Air Quality RSA are summarized in Table 5.6-5.

There are few major existing emissions sources within the Air Quality RSA that were identified through Environment Canada's NPRI for 2012. There are additional emission sources located within the Air Quality RSA that do not meet the NPRI reporting thresholds, but require a waste discharge permit or approval under the BC *Environmental Management Act*, *Waste Discharge Regulation*. All of these potential sources of existing emissions in the Air Quality RSA were considered in the calculation of existing emissions presented in Table 5.6-5. Emissions from transportation sources were not considered in the emission estimates. More information on existing emissions sources is provided in the Air Quality Technical Report (Volume 2, Appendix 1D).

TABLE 5.6-5

EXISTING AND PROPOSED PROJECT EMISSIONS IN THE AIR QUALITY REGIONAL STUDY AREA

Source	Emissions Estimates (tonnes)					
	NO_x	SO_x	CO	VOCs	PM_{10}	$PM_{2.5}$
Emissions from existing FortisBC compressor stations (Eagle Mountain and Port Mellon)	130.4	0.3	87.2	0.4	7.0	7.0
Emissions from proposed Project construction (one-time)	119.1	0.1	35.3	8.1	6.0	5.8
Emissions from proposed Project operations (annual)	130.4	0.3	87.2	6.2	7.0	7.0
Emissions from all existing sources in the RSA (including FortisBC)	1,478.5	1,570.5	773.5	317.2	285.8	218.5

Increase in CAC concentrations during proposed Project construction activities and operation was assumed to be short-term, and of low magnitude. Project emissions are not expected to act cumulatively with existing and reasonably foreseeable projects due to small amounts of expected CAC emissions. Therefore, no additional mitigation beyond the proposed Project-specific mitigation already presented in Table 5.6-1 is deemed to be warranted to address the adverse cumulative effects on the Air Quality VC.

5.6.6 Cumulative Adverse Effects and Their Significance

Table 5.6-6 provides the characterization of potential cumulative effects of the proposed Project on the Air Quality VC. The rationale used to characterize each of the cumulative adverse effects is provided below.

TABLE 5.6-6

CHARACTERIZATION OF POTENTIAL CUMULATIVE ADVERSE EFFECTS OF THE PROPOSED PROJECT ON AIR QUALITY

Cumulative Adverse Effect	Criteria Rating	Effects Characterization Rationale	Follow-up and Monitoring
Air Quality - CACs			
Proposed Project contribution to elevated concentrations of CAC emissions	Context: The small emission quantities result in low sensitivity and high resilience of the atmospheric environment to potential adverse effects on air quality. Existing air quality in and near the Air Quality RSA is characterized as compliant with BC AAQO and the proposed Project is not predicted to change this characterization.		
	Spatial boundary[1]: RSA	CAC emissions associated with burning or equipment and vehicles are not expected to be detectable outside the RSA.	Weather conditions will be monitored closely and burning will only be conducted when conditions are suitable for promoting adequate dispersion and dilution of the plume. No follow-up or monitoring is required in relation to vehicle and equipment emissions during construction or decommissioning.
	Duration: Short-term	The events causing an increase in CAC emissions will only occur during the construction phase.	
	Frequency: Isolated	The events causing CAC emissions are confined to the construction phase.	
	Reversibility: Immediate	Once construction is complete, the emissions will cease and potential air quality effects will be reversed within 2 days.	
	Magnitude: Medium	Concentrations of CACs related to burning or vehicle and equipment operation will remain within AAQO.	
	Probability of Occurrence: High	Burning of residual wood material associated with land clearing as well as the use of equipment and vehicles with internal combustion engines will create CAC emissions.	
	Confidence: High	Based on a good understanding of the cause-effect relationships associated with air quality in the proposed Project area.	
	Significance: Not significant	The residual effect is from an isolated event of medium magnitude that is short-term in duration and immediately reversible, and does not exceed AAQO thresholds.	

Notes: 1 RSA = Air Quality RSA.

5.6.6.1 Determination of Significance

The following subsections provide information on the determination of significance based on the characterization of potential cumulative adverse effects in Table 5.6-6.

Criteria Air Contaminants

Proposed Project Contribution to Elevated Concentrations of Criteria Air Contaminant Emissions

The proposed Project construction and decommissioning CAC emissions may act cumulatively with other emission sources in the Air Quality RSA, however, these effects are considered negligible in comparison to other developments as well as transportation sources in the broader region. Emissions during construction of the proposed Project are of a similar magnitude to proposed Project operations (see Table 5.6-5) but occur over a shorter time frame (approximately 18 months). These emissions will be localized and focused to areas under development at any particular time.

Based on the estimated emissions for the proposed Project, air quality in the RSA is expected to remain compliant with BC AAQOs and the proposed Project's contribution to elevated concentrations of CAC emissions is predicted to be not significant. The rationale for all the significance criteria is provided in Table 5.6-6.

5.6.7 Follow-up Strategy

Follow-up will be conducted to monitor for the overall effects of the proposed Project, however, no specific follow-up program is required for vehicle and equipment emissions during construction or decommissioning as these activities are short-term, and expected CAC emissions effects are reversible

immediately (*i.e.*, CAC concentrations are expected to return to normal once construction activities cease). VOC emissions from equipment leaks during operations will be monitored on a regular basis through leak detection surveys, and venting volumes from compressors blowdown as well as purging events will be estimated and reported in accordance with the requirements of the BC *Reporting Regulation*. For burning during construction, conditions of the burning permit from the BC MFLNRO will be followed, and weather conditions will be monitored closely for burning to be conducted only when conditions are suitable for promoting adequate dispersion and dilution of the smoke plume. All emissions will be continuously monitored during operations to ensure compliance with regulatory permits and approvals.

The proposed pipeline and facilities will be monitored throughout operations according to the methods and programs outlined in Volume 1, Part E, Section 24.0 Follow-up Programs. FortisBC will construct and implement a supervisory control and data acquisition system for the proposed Project in order to monitor pipeline integrity as well as respond efficiently to potential damages or abnormalities in the system.

5.6.8 Summary of Assessment of Potential Adverse Effects on Air Quality

There are no situations where there is a high probability of occurrence of a permanent or long-term potential residual effect or cumulative effect on the Air Quality VC of high magnitude that cannot be technically or economically mitigated. With the implementation of mitigation, the residual adverse effects and cumulative adverse effects on the Air Quality VC have been determined to be not significant.

5.7 Greenhouse Gas Emissions Effects Assessment

This subsection describes potential adverse effects of the proposed Project on the GHG Emissions VC, characterization of residual adverse effects on the GHG Emissions VC after the application of mitigation measures and an assessment of the significance of the residual adverse effects. Potential cumulative adverse effects and follow-up monitoring regarding the GHG Emissions VC are also addressed in this subsection. The potential adverse effects of GHG emissions during and as a result of activities associated with the proposed Project have been considered in terms of their contribution to national, provincial and sector-based totals. As mentioned in Subsection 5.1, PFCs, HFCs and SF_6 are not expected to be associated with the proposed Project and are, therefore, not assessed.

The assessment is based on characteristics and conditions provided in Subsection 5.4 and the GHG Emissions Technical Report (Volume 2, Appendix 1E).

5.7.1 Identification of Potential Effects and Residual Adverse Effects

The potential adverse effects on GHG Emissions associated with the proposed Project are based on the results of the GHG emissions assessment performed for the proposed Project. The GHG Emissions assessment included: the use of existing GHG inventories at the local, provincial, federal and sector levels; the use of existing GHG emissions data for the existing compressor stations (*i.e.*, Eagle Mountain and Port Mellon); and a variety of mathematical tools and emission factors to estimate proposed Project GHG emissions as well as their expected contribution to various levels of GHGs. Consultations with the BC Climate Action Secretariat and BC MFLNRO as well as a review of relevant guidelines and literature were conducted to ensure that appropriate methodologies were followed in the calculation of GHG emissions and in the assessment of the proposed Project's overall contribution to climate change. The proposed Project's potential effects are GHG emissions from construction activities (*e.g.*, burning of residual wood material and use of fossil fuel based vehicles) and operations (*e.g.*, natural gas venting and fugitive emissions). GHG emissions increase GHG concentrations globally and the build-up of GHGs in the atmosphere is the primary reason for climate change (Environment Canada 2014). Therefore, accurate estimation of Project-related GHG emission volumes was a focus of the assessment team in order to identify potential effects (*i.e.*, Project contribution to climate change). Consultations and methodological reviews were conducted to ensure the accuracy of GHG emission estimations. A conservative (*i.e.*, yielding higher results) approach was taken whenever data limitations were identified. Calculated Project operational GHG emissions are compared with relevant sector GHG emissions at provincial and federal levels in Table 5.7-1.

TABLE 5.7-1

COMPARISON OF PROJECT OPERATIONAL GHG EMISSIONS WITH PROVINCIAL AND FEDERAL LEVELS IN RELEVANT SECTORS

Proposed Project Operational GHG Emissions		Comparison with Federal and BC Level GHG Emissions				
Proposed Project Activities	GHG Emissions (CO_2e kt/y)	Sectors in 2012 National Inventory Report	Federal GHG Emissions (kt CO_2e)	Project GHG as % of Federal GHG[1]	BC GHG Emissions (kt CO_2e)	Project GHG as % of BC GHG
Stationary Combustion	11.1	Stationary Combustion: Mining and Oil and Gas Extraction	40,900	0.03%	1,760	0.63%
Venting in Pipeline Operation	16.8	Transportation: Pipelines	5,700	0.29%	799	2.10%
Venting in Facilities Operation	2.47	Fugitive Sources: Natural Gas	19,000	0.01%	5,900	0.04%
Indirect GHG Emissions	91.4	Stationary Combustion: Electricity and Heat Generation	88,300	0.10%	494	18.50%

Source: Environment Canada (2013b).

Note: 1 Latest available data on national GHG emission levels is the 2012 National Inventory Report, therefore, expected proposed Project emissions are compared with 2012 data.

Information on issues and concerns raised by the public as well as the Working Group is provided in Volume 1, Part A, Section 2.0 Environmental Assessment Process, and information on Aboriginal consultation and engagement is provided in Section 18.0 Background and Consultation of Volume 1, Part C – Aboriginal Groups Information Requirements.

5.7.1.1 Mitigation Measures

The summary of recommended mitigation measures provided in Table 5.7-1 was developed in accordance with industry and provincial regulatory guidelines, including the BC *GHG Reduction (Cap and Trade) Act,* the BC *GHG Reduction Targets Act,* the BC Climate Action Plan, the BC *Emission Offsets Regulation, Reporting Regulation*, the BC OGC (2013) *Flaring and Venting Reduction Guideline* and Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities (ChemInfo Services Inc. 2005) as well as in accordance with FortisBC standards. Through the implementation of these measures, the proposed Project will meet the regulations, guidelines and policies in Subsection 5.3 as well as the objectives of land use plans relating to the atmospheric environment as provided in Table 5.3-3.

Information on the mitigation hierarchy used in applying mitigation measures provided in Table 5.7-1 is provided in Volume 1, Part B, Section 3.0 Assessment Methodology.

TABLE 5.7-2

POTENTIAL ADVERSE EFFECTS, MITIGATION MEASURES AND RESIDUAL ADVERSE EFFECTS OF THE PROPOSED PROJECT ON GREENHOUSE GAS EMISSIONS

Project Phase	KI/Potential Adverse Effect	Project Component/Location/ Activity	Spatial Boundary	Key Recommendations/Mitigation Measures	Potential Residual Adverse Effect(s)
GHG Emissions - Emissions of CO_2, CH_4 and N_2O					
Construction and Decommissioning	Increase in CO_2 and N_2O from internal combustion engines used in equipment and vehicles	All proposed Project components/ Entire route	International	• Use well-maintained equipment to reduce air pollution and noise. • Limit idling. • Use multi-passenger vehicles for the transport of crews to and from the job sites, to the extent practical, to reduce emissions during construction.	• Increase in GHG emissions associated with equipment and vehicles

TABLE 5.7-2 Cont'd

Project Phase	KI/Potential Adverse Effect	Project Component/Location/ Activity	Spatial Boundary	Key Recommendations/Mitigation Measures	Potential Residual Adverse Effect(s)
Construction	Increase in GHGs associated with land clearing activities	All proposed Project components/ Entire route	International	• Salvage timber in accordance with the Project-specific Timber Salvage Plan (to be developed prior to construction). • Retain non-salvageable timber, where warranted, for use as chips, mulch, corduroy, slash berms or rollback. Locations where rollback or slash berms are to be used are indicated on the Environmental Worksheets and will be determined in the field by the Environmental Inspector in consultation with the Construction Manager and Contractor. The amount of timber retained for use as rollback, slash berms or corduroy will be determined by the Environmental Inspector in consultation with the Contractor. Mark or identify non-merchantable timber retained for use as rollback or slash berms. Rollback and slash berm windrows will be protected and not disposed of or used as corduroy.	• Increase in GHG emissions associated with land clearing activities
Operations	Increase in indirect GHG emissions from electricity consumption (*i.e.*, compressor turbines)	Compressor stations	International	• Weld pipe connections and other fittings to the extent practical to reduce fugitive emissions during operation. • To the extent practical, seek to reduce venting to reduce emissions of CH_4 and VOCs during regular operation. • To the extent practical, coordinate tie-ins for new facilities during planned outages and already planned blowdowns of existing facilities to reduce venting of natural gas. • To the extent practical, install electric drives (Squamish V2 and Coquitlam V1) to reduce direct emissions of GHGs and CACs. • Install dry gas seals on all new compressor stations to reduce CH_4 losses from normal operating procedures.	• Increase in indirect GHG emissions from electricity consumption during operations
Operations	Increase in CH_4 and CO_2 emissions from the venting at facilities and pipeline	Pipeline and compressor stations	International		• Increase in GHG emissions from venting during operations
Operations	Increase in CH_4 and CO_2 from fugitive sources (*i.e.*, leaks from valves, connectors, etc.)	All proposed Project components/ Entire route	International	• Seek to reduce "stand-by running" (idling units) or "test running" of compressors during maintenance activities to the extent practical. • Seek to reduce fugitive emissions through regular inspection and maintenance of block valves, valves at ILI facilities, and maintenance of connectors, pressure relief devices, and pressure regulators at flow meter stations.	• Increase in GHG emissions from fugitive sources during operations

5.7.2 Residual Adverse Effects and Their Significance

The potential residual adverse effects of the construction, operations and decommissioning of the proposed Project on the GHG Emissions VC are discussed in a quantitative manner by analyzing the contribution of specific proposed Project elements to GHG emissions using a variety of tools and methods based on the best available science. A full description of the methodology is given in the GHG Emissions Technical Report (Volume 2, Appendix 1E).

5.7.2.1 Significance Threshold

GHG emissions contribute to climate change, which is international in scale. GHG emissions are long-lived in the atmosphere with lifetimes of >100 years (Environment Canada 2013d). Emissions from LULUCF, which are relevant to the proposed Project's land clearing activities are conventionally considered over 20-year periods (UNFCCC 2013) - the typical length of a managed forest rotation. The international and long-lived nature of GHGs and their impact make the criteria ratings of spatial scale, duration, frequency and reversibility less relevant to GHG emissions than to the other Atmospheric Environment VCs whose impacts and regulatory thresholds are rooted in their duration and frequency

and whose effects are usually only experienced during the event that causes them (with the exception of long-term damage or injury to human or environmental health). Therefore, for the GHG Emissions VC, the most important significance criteria rating is magnitude and if a potential adverse effect is rated "high" in magnitude, it is considered significant regardless of the other significance criteria ratings (*i.e.,* duration, frequency, reversibility and probability).

Table 5.7-2 provides the characterization of the potential residual adverse effects of the proposed Project on GHG Emissions. The rationale used to characterize each of the residual adverse effects is provided below.

The potential residual adverse effects on the GHG Emissions VC associated with the construction, operations and decommissioning of the proposed Project (Table 5.7-1) are:

- increase in GHG emissions associated with equipment and vehicles;
- increase in GHG emissions associated with land clearing activities;
- increase in indirect GHG emissions from electricity consumption during operations;
- increase in GHG emissions from venting during operations ; and
- increase in GHG emissions from fugitive sources during operations.

TABLE 5.7-3

CHARACTERIZATION OF POTENTIAL RESIDUAL ADVERSE EFFECTS OF THE PROPOSED PROJECT ON GREENHOUSE GAS EMISSIONS

Residual Adverse Effect	Criteria Rating	Effects Characterization Rationale	Follow-up and Monitoring
GHG Emissions - CO_2, CH_4 and N_2O			
Increase in GHG emissions associated with equipment and vehicles	Context: The combustion of fuel (usually diesel) in construction equipment and vehicles releases CO_2 and N_2O to the atmosphere, which contribute to the GHG build-up in the atmosphere (usually considered in a 100-year time frame) responsible for climate change.		
	Spatial boundary: International	GHG emissions affect climate change, which is an international phenomenon.	No follow-up or monitoring is required for the increase in GHG emissions from construction vehicles and equipment as these emissions are from a short-term event, and the amount of expected emissions is considered insignificant from a climate change perspective.
	Duration: Short-term	The event causing the increase in GHG emissions is limited to the construction or decommissioning phase.	
	Frequency: Isolated	The event causing an increase in GHG emissions is confined to the construction or decommissioning phase.	
	Reversibility: Permanent	Due to the long atmospheric lifetime of GHGs (100+ years), the effects are not considered reversible.	
	Magnitude: Low	The level of GHG emissions associated with proposed Project construction or decommissioning are small compared with existing emission sources and inventory totals.	
	Probability of Occurrence: High	The combustion of fuel used in vehicles and equipment will release GHGs.	
	Confidence: High	Based on a thorough understanding of cause-effect relationships and the experience of the assessment team.	
	Significance: Not significant	Due to the low magnitude of the potential residual effect.	

TABLE 5.7-3 Cont'd

Residual Adverse Effect	Criteria Rating	Effects Characterization Rationale	Follow-up and Monitoring
Increase in GHG emissions associated with land clearing activities	Context: The clearing of vegetation reduces carbon storage potential, and burning of residual wood material directly releases CO_2 and N_2O to the atmosphere, which contribute to the GHG build-up in the atmosphere (usually considered in 100-year time frame) responsible for climate change.		
	Spatial boundary: International	GHG emissions affect climate change, which is an international phenomenon.	No follow-up or monitoring is required for the increase in GHG emissions from land clearing as burning of residual wood material will be limited to the areas where tree salvage is not feasible and lost carbon storage potential will be partially reacquired by tree replanting in the Project Footprint.
	Duration: Short-term	The event causing the increase in GHG emission is limited to the construction phase.	
	Frequency: Isolated	The event causing an increase in GHG emissions is confined to the construction phase.	
	Reversibility: Permanent	Due to the long atmospheric lifetime of GHGs (100+ years), the effects are not considered reversible.	
	Magnitude: Medium	GHG emissions associated with land clearing will be within regulatory reporting guidelines.	
	Probability of Occurrence: High	Land clearing will lead to an increase in GHG emissions.	
	Confidence: High	Based on a thorough understanding of cause-effect relationships and the experience of the assessment team.	
	Significance: Not significant	Due to the medium magnitude of the potential residual effect.	
Increase in indirect GHG emissions from electricity consumption during operations	Context: Electrically-fired compressor turbines will indirectly increase GHG emissions to the atmosphere, which contribute to the GHG build-up in the atmosphere (usually considered in a 100-year time frame) responsible for climate change.		
	Spatial boundary: International	GHG emissions affect climate change, which is an international phenomenon	No follow-up or monitoring is required for the increase in indirect GHG emissions from electricity consumption as the amount of expected emissions is considered insignificant from a climate change perspective.
	Duration: Long-term	The use of compressor turbines will occur for the life of the proposed Project.	
	Frequency: Continuous	Turbine use and related emissions will occur continuously over the life of the proposed Project.	
	Reversibility: Permanent	Due to the long atmospheric lifetime of GHGs (100+ years), the effects are not considered reversible.	
	Magnitude: Low	Indirect GHG emissions associated with electricity use do not require federal or provincial reporting.	
	Probability of Occurrence: High	Electrically-driven turbines will lead to the indirect emission of GHGs.	
	Confidence: High	Based on a thorough understanding of cause-effect relationships and the experience of the assessment team.	
	Significance: Not significant	Due to the low magnitude of the potential residual effect.	
Increase in GHG emissions from venting during operations	Context: Some routine and non-routine venting of natural gas containing CH_4 and CO_2 will be required as part of normal operating procedures. CH_4 and CO_2 emissions to the atmosphere contribute to the GHG build-up in the atmosphere (usually considered in a 100-year time frame) responsible for climate change.		
	Spatial boundary: International	GHG emissions affect climate change, which is an international phenomenon.	Venting rates and volumes will be recorded as well as reported to the appropriate authorities as set out in applicable regulations and permits.
	Duration: Long-term	Venting will occur for the life of the proposed Project as part of normal operations.	
	Frequency: Continuous	Some of the venting (such as venting from dry gas seals) will occur continuously over the life of the proposed Project.	
	Reversibility: Permanent	Due to the long atmospheric lifetime of GHGs (100+ years), the effects are not considered reversible.	

TABLE 5.7-3 Cont'd

Residual Adverse Effect	Criteria Rating	Effects Characterization Rationale	Follow-up and Monitoring
Increase in GHG emissions from venting during operations (cont'd)	Magnitude: Medium	The GHG emissions associated with venting will be within provincial and federal GHG reporting requirements.	See above
	Probability of Occurrence: High	Some venting will be required and will lead to the emission of GHGs.	
	Confidence: High	Based on a thorough understanding of cause-effect relationships and the experience of the assessment team.	
	Significance: Not significant	Due to the medium magnitude of the potential residual effect.	
Increase in GHG emissions from fugitive sources during operations	Context: Leaks from valves, flanges, connectors and other sources will release gas containing CH_4 and CO_2, which contribute to the GHG build-up in the atmosphere (usually considered in a 100-year time frame) responsible for climate change.		
	Spatial boundary: International	GHG emissions affect climate change, which is an international phenomenon.	Fugitive emissions from facilities' equipment will be monitored on a regular basis through leak detection surveys, and the volumes will be estimated and reported in accordance with the requirements of the BC *Reporting Regulation*. The pipeline and associated facilities will be monitored throughout the life of the proposed Project for damage or abnormalities that could result in unexpected leaks.
	Duration: Long-term	Leaks and other fugitive emissions are expected to occur over the life of the proposed Project.	
	Frequency: Periodic to continuous	Leaks from damage and wear are expected to occur intermittently but repeatedly over the life of the proposed Project, whereas fugitive emissions from valves and flanges are expected to occur continuously over the life of the proposed Project.	
	Reversibility: Permanent	Due to the long atmospheric lifetime of GHGs (100+ years), the effects are not considered reversible.	
	Magnitude: Low	Fugitive GHG emissions will be measurable, but will be well below provincial and federal reporting requirements.	
	Probability of Occurrence: High	Some fugitive emissions of GHGs will occur.	
	Confidence: High	Based on a thorough understanding of cause-effect relationships and the experience of the assessment team.	
	Significance: Not significant	Due to the low magnitude of the potential residual effect.	

5.7.2.2 Determination of Significance

The following subsections provide information on the determination of significance based on the characterization of potential cumulative adverse effects in Table 5.7-2.

$\underline{CO_2, CH_4, N_2O}$

Increase in Greenhouse Gas Emissions Associated with Equipment and Vehicles

Internal combustion engines, such as those associated with construction vehicles and equipment, emit CO_2, and to a lesser extent N_2O as part of the combustion process. Decommissioning activities will be less intensive than construction but will require similar types of equipment that emit GHGs. Construction will occur for a period of 18 to 24 months with approximately four months of activities occurring in any one location at a time. Decommissioning activities will be similarly short-term at any given location. Therefore, the emissions of GHGs associated with these events are considered to be short-term in duration and isolated in frequency. Because of the long lifetime of GHGs (≥ 100 years), this residual effect is considered permanent and is international in scale due to the boundless nature of climate change caused by GHGs. Vehicles and equipment, including, but not limited to, trucks, dozers, graders, cable cranes and barges, will be used to transport equipment and workers as well as carry out the physical construction or decommissioning of the pipeline and associated facilities. A high level of understanding of the cause-effect relationships leading to GHG emissions, as well as the emissions associated with the proposed Project's specific equipment requirements means that the confidence in estimates of GHGs

from these activities is high. Despite the high confidence and likelihood of these emissions, their magnitude will be low in comparison with existing sources of GHGs in the region and in comparison with local, provincial or federal GHG inventories. Furthermore, temporary construction sources are not required to report emissions to federal, provincial or regional (*e.g.,* WCI) GHG inventories. Therefore, this effect is considered not significant. The rationale for all the significance criteria is provided in Table 5.7-2.

Increase in GHG Emissions Associated with Land Clearing Activities

Although approximately 33% of the proposed Project will parallel existing disturbances, some land clearing will be required. The majority of cleared timber will be marketed, however, some burning of stumps, residual debris and non-marketable timber will be required where the use of timber as chips, mulch, corduroy, slash berms or rollback is not practical. Some of this debris may also be marketed as biomass fuel. Of what will need to be cleared, without carbon storage, or burnt without energy usage, the duration of emission will be short-term in any one area (< 1 week) and the frequency will be isolated due to the confinement of land clearing activities to the construction phase. Due to the long-lived nature of GHGs in the atmosphere and the time lag associated with climate change outcomes, this effect is not considered reversible. The GHG emissions associated with land clearing are considering to be of medium magnitude, because the total release of GHGs from these activities will be within regulatory guidelines such as BC's *Reporting Regulation* and the WCI's reporting mandates. Furthermore, emissions from LULUCF are reported separately as part of these requirements and therefore these emissions will not trigger any regulatory compliance. For these reasons the GHG emissions associated with land clearing are considered not significant. The rationale for all the significance criteria is provided in Table 5.7-2.

Increase in Indirect GHG Emissions from Electricity Consumption during Operations

Electrically-driven compressors will require the use of electricity from the grid supplied by BC Hydro. The new compressor units at Eagle Mountain and Squamish will utilize electricity from the grid to power the electric motor drives of those compressors. The use of efficient and well-maintained equipment will limit the GHGs associated with these activities, however, at all three facility sites at least one compressor will be in operation all the time (*i.e.*, 24 hours a day and 365 days a year) for the life of the proposed Project. Therefore, the residual effect of GHG emissions from electrically-driven compressors is considered to be long-term and continuous. Due to the long-lived nature of GHGs in the atmosphere and the time lag associated with climate change outcomes, this effect is not considered reversible. Given that indirect GHG emissions associated with electricity consumption do not need to be reported under regional, provincial and federal reporting requirements such as those laid out in the BC *Reporting Regulation* or the WCI reporting mandates, this effect is considered to be low magnitude. These GHG emissions are reported by the power producer or supplier directly (in this case BC Hydro). Based on the experience of the assessment team and a good understanding of cause-effect relationships affecting indirect GHGs and climate change, the confidence of this significance evaluation is high. Therefore, the potential adverse effect of indirect GHG emissions associated with EMD compressors is considered not significant. The rationale for all the significance criteria is provided in Table 5.7-2.

Increase in Greenhouse Gas Emissions from Venting during Operations

Venting is the release of gas from the transmission system. Venting is required during occasional events such as shut-downs and start-ups associated with maintenance activities, blowdowns required for tie-ins or maintenance, and limited continuous venting occurs during operations from dry gas seals on compressor units. Because these events will be required and will occur throughout the life of the proposed Project, the duration of this effect is considered long-term and its frequency is considered continuous. Due to the long-lived nature of GHGs in the atmosphere and the time lag associated with climate change outcomes, this effect is not considered reversible. The magnitude of venting emissions is considered to be medium, because venting emissions will be within federal, provincial or regional GHG reporting requirements, such as those laid out in the BC *Reporting Regulation* or the WCI reporting mandates. Although venting emissions will occur throughout the operations phase, due to their medium magnitude, this potential adverse effect is considered not significant. The conclusion regarding significance was made with a high degree of confidence based on the experience of the assessment team and the well understood cause-effect relationships of venting emissions of GHGs and climate change as a whole. The rationale for all the significance criteria is provided in Table 5.7-2.

Increase in Greenhouse Gas Emissions from Fugitive Sources during Operations

FortisBC has an ongoing fugitive emission management plan and conducts annual leak surveys to better address fugitive emissions. Since implementation, FortisBC has observed significant reductions of fugitive emissions from sources such as flanges, valve stems, isolation and vent valves. FortisBC is audited by a third-party to verify its reporting methods and amounts.

Natural gas pipelines and their associated equipment do leak. At any non-welded connector, flange or valve, some level of CH_4 (and trace CO_2 due to gas composition) is expected to escape continuously throughout the life of the proposed Project. Leaks may also occur periodically due to equipment wear or upset. Because the gas being lost is a marketable product, it is in the proponent's best interests to limit leaks from equipment and facilities as much as practical. However, because these events cannot be completely avoided, they will occur throughout the life of the proposed Project. As mentioned, some emissions will occur continuously throughout operation (*i.e.*, valve and connector leaks), whereas others will occur periodically due to wear or damage. Therefore, the duration of this effect is considered to be long-term and its frequency is considered to be periodic to continuous. Due to the long-lived nature of GHGs in the atmosphere and the time lag associated with climate change outcomes, this effect is not considered reversible. The magnitude of this potential adverse effect is considered to be low, because the fugitive volumes will be well below federal, provincial or regional GHG reporting requirements, such as those laid out in the BC *Reporting Regulation* or the WCI reporting mandates. Although fugitive emissions will occur throughout the operations phase, due to the low magnitude, this potential adverse effect is considered not significant. The conclusion regarding significance was made with a high degree of confidence based on the experience of the assessment team and a good understanding of cause-effect relationships of fugitive emissions of GHGs and climate change as a whole. The rationale for all the significance criteria is provided in Table 5.7-2.

5.7.2.3 Risk Analysis

The magnitude of potential adverse effects of GHG emissions from proposed Project construction activities, fugitive GHG emissions and indirect GHG emissions is considered to be low because of insignificant emission amounts from a global climate change perspective. The magnitude of potential adverse effects of GHG emissions from venting during Project operation is considered to be low because it is expected that FortisBC will follow industry best practices as well as all applicable regulatory guidelines and directives in emissions management. The proposed Project's overall potential to contribute to global climate change is considered extremely small (see Volume 2, Appendix 1E).

On the basis of the known risks associated with GHG emissions and the international scale of potential residual adverse effects, it was decided that additional risk analysis is not required.

5.7.3 Cumulative Effects Assessment

As acknowledged in the scientific community and amongst policymakers, no individual activity is responsible for global effects on climate due to GHG emissions. It is recognized that a scientific consensus is emerging that suggests global emissions of GHGs and consequent changes to global climate represent a substantial cumulative effect (International Panel on Climate Change 2007). The proposed Project's GHG emissions will contribute to these cumulative adverse effects, but the contribution, though measurable and potentially important in comparison to provincial and national levels, will not be significant in a global context. Therefore, given the inherently cumulative nature of GHGs and their contribution to climate change, it was deemed unnecessary to conduct a cumulative effects assessment of GHG emissions for the proposed Project. Volume 1, Part B, Section 17.0 Effects of the Environment on the Project assesses the effects of future climate scenarios on the proposed Project.

5.7.4 Follow-up Strategy

Follow-up will be conducted to monitor for the overall environmental effects of the proposed Project. However, as explained in Table 5.7-2, no specific follow-up program is required for GHG emissions from construction equipment and vehicles, land clearing activities or indirect GHG emissions from electricity consumption.

For GHG emissions during operations, natural gas venting rates as well as volumes will be recorded and reported to the appropriate authorities as set out in applicable regulations and permits. Fugitive emissions from facilities' equipment will be monitored on a regular basis through leak detection surveys, and the volumes will be estimated and reported in accordance with the requirements of the BC *Reporting Regulation.* The proposed pipeline and facilities will be monitored throughout operations according to the methods and programs outlined in Volume 1, Part E, Section 24.0 Follow-up Programs. FortisBC will construct and implement a supervisory control and data acquisition system for the proposed Project in order to monitor pipeline integrity and respond efficiently to potential damage or abnormalities in the system.

5.7.5 Summary of Assessment of Potential Adverse Effects on Greenhouse Gas Emissions

There are no situations where there is a high probability of occurrence of a permanent or long-term potential residual effect or cumulative effect on the GHG Emissions VC of high magnitude that cannot be technically or economically mitigated. With the implementation of mitigation, the residual adverse effects and cumulative adverse effects on the GHG Emission VC have been determined to be not significant.

5.8 References

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TERA wishes to acknowledge those people identified in the Personal Communications for their assistance in supplying information and comments incorporated into this report.

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5.8.3 GIS and Mapping References

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