11 AIR QUALITY

This chapter describes the air quality impacts associated with the construction and operation of the Export, Lateral and Collection Header pipelines, which collectively comprise the Pipeline Component of the Queensland Curtis LNG (QCLNG) Project will traverse mostly isolated rural areas. However, there are several areas where these pipelines will be constructed in proximity to urban areas, specifically around Miles, Kogan, Wandoan, Taroom, Biloela, Yarwun and Gladstone. There may also be instances where the pipelines will be constructed near a sensitive receptor such as a residence.

The main potential impacts on air quality from Pipeline Component development are earthworks and transport on unsealed roads, activities which will generate dust. Emissions from the operation of an in-line compressor station may also impact upon air quality.

Having identified these potential impacts, there is a need to:

- ensure that the construction and operation of the pipelines does not adversely affect the air quality of these urban areas or existing sensitive receptors
- ensure that there will not be an unacceptable level of pollutants generated by the construction or operation of the pipelines.

11.1 PROJECT ENVIRONMENTAL OBJECTIVE AND VALUES

The Project environmental objective for air quality is to preserve ambient air quality to the extent that ecological health, public amenity or safety is maintained.

The sections that follow outline the existing environmental values relating to air.

The Environmental Protection (Air) Policy 2008 (EPP Air) specifically describes the environmental values relating to the air environment. These values relate to the suitability of air for life, health and wellbeing of humans and biodiversity. The EPP Air also specifies indicators and goals to protect identified environmental values for air and to provide an assessment and management framework for Queensland's air environment. The parameters for measuring the various air contaminants are set out in Schedule 1 of the EPP Air.

In addition to the EPP Air, BG Group has developed corporate global air quality standards that apply to its projects across the world. In cases where the BG Group standard is more stringent than the EPP Air standard, the BG Group standard applies.

11.1.1 Air Quality Objectives

The principal air pollutants considered in this assessment are associated with the combustion of coal seam gas (CSG) in the gas engines used to drive the in-line compressor. These pollutants are:

- oxides of nitrogen (NO_X), as nitrogen dioxide (NO_2)
- carbon monoxide (CO)
- ozone
- hydrocarbons (Volatile Organic Compounds (VOC) and Polycyclic Aromatic Hydrocarbons (PAH)).

Table 4.11.1 presents a summary of the relevant ambient air quality objectives under the EPP Air for criteria pollutants adopted for this assessment.

Table 4.11.1 Ambient Air Quality Objectives

Indicator	Environmental value	Averaging period	Air quality objective [1] (µg/m³)	Number of days of exceedence allowed
Nitrogen dioxide	Health and wellbeing	1-hour	250	1
		1-year	62	0
	Health and biodiversity of ecosystems	1-year	33	0
Carbon monoxide	Health and wellbeing	8-hour	11,000	1
Ozone	Health and wellbeing	1-hour	210	1
		4-hour	160	1

[1] Air quality objective at 0°C

In addition to the air pollutants detailed above, the combustion of CSG in gas-fired engines will produce small quantities of hydrocarbons. The air quality objectives for hydrocarbons have been obtained from various sources described in *Volume 3, Chapter 12*. A full list of hydrocarbons and their respective air quality objectives is presented in *Table 15, Appendix 3.5*.

QGC will not exceed air quality objectives as set by company guidelines where these are more stringent than EPP Air guidelines. In general, company standards are more stringent than the air quality objectives in EPP Air.

The following air quality objectives are set in company guidelines[1]:

- CO, 8hour – 10,000 µg/m³
- NO_2, 1 hour - 200 µg/m³
- NO_2, 1 year – 40 µg/m³ (health), 30 µg/m³ (ecosystems).

1 BG Group, BG Standard, Environment Air Quality Standard BGA-HSSE-ENV-ST-150, August 2007

11.1.2 Coal Seam Gas (CSG)

Table 4.11.2 presents the composition of CSG as extracted from the resource and which would be used as fuel gas for the in-line compressor. Emissions from the oxidation of sulphur compounds during the combustion of fuel gas or other reduced sulfur compounds have not been assessed because sulphur is not present in the CSG resource, and therefore sulphur dioxide is not present in combustion emissions.

Table 4.11.2 Average Composition of CSG Pre and Post Processing

Compound	Gas composition at extraction well pre-processing (mol%)	Gas composition post-compressor station for delivery to the LNG Facility (mol%)
Methane	97.51	97.80
Nitrogen	2.23	2.00
Ethane	0.01	0.02
Carbon Dioxide	0.22	0.16

11.1.3 Particulate Emissions

Particulate emissions have not been modelled for the following reasons:

- Due to the composition of the CSG used as the fuel source in the reciprocating engines of compressors, it is not expected that these engines will emit particulates.
- Any dust generated during construction will be temporary and only minor volumes of particulates are expected to be released following mitigation measures.
- Any dust generated during operations will be minor, and mitigation measures will reduce dust generation.
- Management measures for areas of high risk of asbestos dust (e.g. rail lines) will ensure that asbestos particles are not released to the atmosphere.

11.2 POTENTIAL IMPACTS AND MITIGATION METHODS

11.2.1 Construction Phase

The construction earthworks and associated vehicle movements are likely to generate dust that may become a nuisance in dry, windy weather conditions. No other major air contaminants are predicted to result from the construction of the pipelines as rail lines will be crossed using trenchless techniques.

Regular watering of tracks, roads and the pipeline routes during dry conditions will manage dust nuisance. This will enable gross earthworks and haul roads to have a damp surface which will minimise dust generation to the surrounding area. As a consequence, the resultant dust concentrations and dust fallout is anticipated to be within acceptable limits at all sites.

Other dust suppression methods to be employed include:

- wetting down soil stockpiles
- keeping stockpiles as low as possible
- ensuring any haul roads are well maintained
- driving at speeds to minimise dust generation.

On completion of pipeline construction, the corridor will be re-vegetated with grass seed to help protect the disturbed surface and encourage vegetation re-establishment. This will in turn bind the soil and further reduce dust nuisance.

11.2.2 Operational Phase

Operation of the pipelines will generate air emissions from the following sources:

- dust from ongoing management of the pipelines' RoW
- vented CSG from the pipelines
- one in-line compressor station.

11.2.2.1 Dust

Dust generated during operations will be minimal in comparison to construction. Dust concentrations and fallout are expected to be within acceptable limits.

11.2.2.2 Vented CSG

Hydrocarbon emissions from venting at various stages along the pipelines are likely to consist almost solely of unburnt CSG for which no air quality objectives have been published in either the EPP Air or National Environment Protection (Assessment of Site Contamination) Measure (or NSW of Victorian assessment standards). Vented CSG, comprising about 97 per cent methane, is not a risk to air quality. Issues relating to greenhouse gas generation are addressed in *Volume 7*.

11.2.2.3 In-line Compressor

The emissions generated from the gas transmission pipeline will be mainly from the in-line compressor located along the Export Pipeline. The in-line compressor is used to pressurise the gas and increase flow within the Export Pipeline.

The exact location, configuration and type of in-line compressor station has yet to be determined. For the purposes of estimating emissions, it was assumed that the in-line compressor would be similar to one field compressor station (FCS). That is, it would comprise eight screw compressors and be powered by gas-fired engines (assumed to be Caterpillar G3512 gas engines). A full description of an FCS is provided in *Volume 2, Chapter 7*. The performance characteristics of the Caterpillar G3512 gas engines with single stage Ariel screw compressors, to be located at the FCS, is presented in *Table 4.11.3.*

Table 4.11.3 Performance and Source Characteristics for Screw Compressors

Parameter	Units	Value
Engine power	bkW	705
LHV input	kW	2,097
Nominal engine efficiency	%	33.6
Nominal fuel consumption	MJ/bkW-hr	10.71
Stack height	m	7.2
Stack diameter	m	0.2603
Exhaust gas temperature	°C	460
Exhaust gas velocity	m/s	48.7
Exhaust mass flow rate (0°C, 1 Atm, wet)	kg/bkW-hr	6.11
Exhaust gas flow rate (0°C, 1 Atm, wet)	Nm^3/bkW-hr	4.86
Exhaust gas flow rate (actual stack conditions)	m^3/s	2.6
Normalised exhaust gas flow rate (0°C, 1 Atm)	Nm^3/s	0.96

Note 1: Exhaust gas oxygen content (dry) is 8.2 per cent
Note 2: All data under normal operating conditions at 100 per cent capacity

Table 4.11.4 presents the concentrations and emission rates for NO_X, CO and hydrocarbons for screw compressors.

Table 4.11.4 Emissions Data for Screw Compressors

Parameter	Concentration[1] (g/bkW-hr)	Emission rate (g/s)
Oxides of nitrogen (as NO_2)	2.68	0.558
Carbon monoxide	2.41	0.489
Total Hydrocarbons[2]	4.16	0.814
Formaldehyde	0.34	0.066
Acrolein[3]	-	$9x10^{-5}$

1 Information obtained from Caterpillar gas engine technical data sheet.
2 Total hydrocarbons as non-methane hydrocarbons and presented as methane equivalents.
3 Measured by Leeder Consulting, 7 May 2009, in G3512 screw compressor fuelled with CSG

Based on the United States Environmental Protection Agency (USEPA) AP-42 emission factors document for natural gas-fired reciprocating engines (*Natural Gas-fired Reciprocating Engines (Chapter 3.1))*, 52 separate hydrocarbons were identified, in addition to formaldehyde and acrolein, as contributing to total hydrocarbon emissions. Emission rates of these hydrocarbons are presented in *Table 5* of *Appendix 3.5.*

Assumptions Made in Modelling Hydrocarbons

To assess the impact of specific hydrocarbon emissions on environmental values, the USEPA AP-42 document, *Natural Gas-fired Reciprocating Engines (Chapter 3.1),* has been referenced to determine the potential composition of hydrocarbon emissions associated with the gas-fired reciprocating engine exhaust.

Preliminary dispersion modelling was conducted using the AP-42 emission factors for hydrocarbons. The preliminary dispersion modelling found some potential for elevated levels of acrolein. However, acrolein is unlikely to occur in the exhausts of the Caterpillar engines when fired on CSG because, unlike the natural gas that is used in the USA and is the basis of the AP-42 emission factors, the CSG does not contain propene, the necessary precursor for the formation of acrolein. This was demonstrated in sampling of emissions from existing G3512 reciprocating engines fuelled on CSG (Leeder Consulting, 2009). Consequently, acrolein emission rates have been characterised in this study using the results of Leeder Consulting sampling, which was carried out on existing QGC CSG-fired compressors, rather than AP-42.

In order to assess the potential impact of specific hydrocarbon emissions on environmental values other than acrolein and formaldehyde, the USEPA AP-42 emission factors have been referenced to determine the potential composition of hydrocarbon emissions associated with the gas-fired reciprocating engine exhaust.

11.2.2.4 Modelling In-Line Compressor Emissions

Air emissions modelling was not conducted for the in-line compressor. Modelling was conducted for a ‘‘production unit’’, which consists of:

- one central processing plant, comprising 10 Caterpillar 3608 gas engines with two stage Ariel reciprocating compressors
- three FCSs, comprising eight G3512 gas engines per FCS with single stage Ariel screw compressors.

One in-line compressor has approximately 17 per cent of the engine power of a production unit.

- Modelling of air pollutants from background sources has been carried out using the CSIRO’s TAPM (The Air Pollution Model) dispersion model to predict contributions to air quality levels. TAPM was used to derive meteorological information at three nominal site locations spread across the proposed Gas Field footprint.

- The in-line compressor will be situated approximately 150 to 200 km from the nearest Gas Field modelled production unit. The predicted climatic conditions at the in-line compressor station area are expected to be broadly similar to those modelled for a production unit. For details about climatic modelling, refer to *Volume 3, Chapter 12* and *Appendix 3.5, Section 5*.

TAPM generated meteorological information has been incorporated into the AUSPLUME dispersion model (former EPA approved air dispersion modelling software) to predict the impacts of NO_X, CO and hydrocarbons from a production unit.

For further details about TAPM and AUSPLUME modelling assumptions and parameters refer to *Appendix 3.5,* Section *6.* Modelling of emissions from compressor engines is described in *Volume 3, Chapter 12* and *Appendix 3.5*.

The results of modelling emissions from a production unit are presented in *Volume 3, Section 12.4*. These results are summarised below.

There are no exceedences of air quality objectives for:

- oxides of nitrogen (NO_X), as nitrogen dioxide (NO_2)
- carbon monoxide (CO)
- hydrocarbons
- ozone.

It can be concluded that since one in-line compressor causes approximately 17 per cent of the emissions of a production unit, the in-line compressor station will not cause emissions that exceed air quality objectives for oxides of nitrogen (NO_X), as nitrogen dioxide (NO_2), carbon monoxide (CO), hydrocarbons and ozone.

11.3 CONCLUSION

The main source of air emissions from the Pipeline Component of the Queensland Curtis LNG (QCLNG) project are screw compressors at the in-line compressor station. Emissions include oxides of nitrogen, carbon monoxide and hydrocarbons. A conservative approach has been adopted in modelling impacts on air quality, as the exact location of the in-line compressor station is not known at this stage of Project design.

Modelling results indicate that there will be no exceedences of air quality objectives for the Pipeline Component. Dust generated during the construction of the Export, Lateral and Collection Header pipelines will be managed through measures described in the Environmental Management Plan set out in *Volume 10*.

A summary of the impacts outlined in this chapter is provided in *Table 4.11.5.*

Table 4.11.5 *Summary of Impacts for Air*

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term
Impact extent	Local
Impact likelihood	High

Overall assessment of impact significance: negligible. Air emissions from the pipelines are not expected to exceed air quality objectives. If further testing and modelling proves otherwise, mitigation measures will be developed.