Proposed Katherine to Gove Gas Pipeline
Draft Environmental Impact Statement

Chapter 12
Air Quality

PACIFIC **ALUMINIUM**

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12 Air Quality

This chapter examines the sources of air emissions from construction and operation of the KGGP, their potential impacts on ambient air quality in the pipeline region and mitigation measures to be applied that will result in an acceptable residual impact. Consideration is given to air pollutants, dust and greenhouse gases in sections 12.1, 12.2 and 12.3, respectively.

The greenhouse gas emission reductions and anticipated improvements to air quality arising from the transition from fuel oil to gas at the Gove refinery is discussed as an important co-benefit of the KGGP project.

12.1 AIR POLLUTANTS

12.1.1 Description

Ambient Air quality

While the Top End region generally experiences good air quality, episodic reductions in air quality are associated with a significant contribution of particulate matter (PM_{10}) from annual burning of native vegetation in the dry season. In Darwin, the most populated and industrialised area in the NT, particles from fires are still the primary air pollutant of concern. Levels of particulate matter in the Darwin airshed occasionally exceed the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) standard during the dry season. Nitrogen oxides, sulphur dioxide, carbon monoxide, ozone and lead aerosols in Darwin have not been identified as a cause for concern, when assessed against the AAQ NEPM standards (NT EPA 2010).

No air quality monitoring information is available for the pipeline region; however, particulates from fires (as per Darwin) would be expected to be the major influence on ambient air quality.

Existing air pollutants and sources

The existing Gove Refinery, at the eastern end of the pipeline corridor, is the only significant industrial source of air emissions near the pipeline corridor. The Stuart Highway at the western end of the pipeline corridor is the only major highway in the vicinity of the pipeline corridor with vehicle emissions of note.

In the broader region, there are some significant facilities and sources of air emissions including:

- Katherine waste transfer station.
- Northern Cement Ltd – Mataranka Lime.
- Tindal Airport Refuelling Facility.
- Gapuwiyak (Lake Evella) Community Power Station.
- Gove Airport.

The likely emissions from these facilities are detailed in Appendix G.

Potential project air pollutants

The anticipated emissions of air pollutants from construction of the KGGP would arise from vehicle and mobile equipment exhausts as well as combustion emissions from power generation at camps.

Typical emissions would include:

- Carbon Monoxide (CO).
- Carbon Dioxide (CO_2).
- Oxides of Nitrogen (NO_x).
- Oxides of Sulphur (SO_x).
- Unburnt hydrocarbons*.

* Particulate matter is discussed in section 12.2

Minor emissions of air pollutants from vehicles and mobile equipment would occur during the commissioning phase. Additional emission sources of air pollutants would occur from compressor station start up when the compressor is purged with natural gas; and from pipeline and above ground facility venting operations. These sources would result in the emission of the following:

- Nitrogen gas (N_2) from gas purging.
- Natural gas from pipeline venting.

The emissions of air pollutants from construction and commissioning phases would be temporary and of short duration (less than 12 months).

The primary source of air pollutant emissions during operation of the pipeline would be combustion exhaust from the gas turbine operating at the King River compressor station (see Figure 2-5 for location). These emissions would be ongoing for the duration of the KGGP Project and were therefore modelled to predict the likely effects on ambient air quality and potential impacts.

Modelling (TAPM v4.0.5 dispersion) was undertaken to determine the likely ground level concentrations of air pollutants during operation of the compressor station. Background emissions information for modelling purposes was sourced from the National Pollutant Inventory. Observed meteorological data obtained from the Bureau of Meteorology was used to adjust and validate the modelled dataset. Modelling assumed use of a gas turbine incorporating a Caterpillar Solar Taurus 70 engine; employing the *SoLoNOx*™ dry, low NO_X emissions technology at the compressor station. The assumptions and full modelling methodology is described in Appendix G.

Sensitive receptors were identified during the Air Quality Study (Appendix G**)**. The primary factor identifying their location was the presence of dwellings in which humans will reside for extended periods of time and hence could be impacted upon by chronic exposure to emission of air pollutants.

12.1.2 Potential impacts from construction and operation

Potential impacts from air pollutants (excluding greenhouse gas effects) relate to:

- Low levels of nitrogen oxides can cause adverse effects in humans including irritation of the eyes, nose, throat and lungs. This can lead to coughing, shortness of breath, tiredness and nausea.
- Exposure to low levels of carbon monoxide can cause headaches, dizziness, light-headedness and fatigue. Carbon monoxide can also lead to long term health effects such as heart disease, damage to the nervous system and can cause birth defects.
- Photochemical smog is evidenced by the presence of ozone concentrations above the predefined background levels. Long term exposure to ozone has been shown to increase risk of death from respiratory illness and lung disease.

The NTEPA has adopted the AAQ NEPM (2003) standards as their general air quality objectives for human health across the Northern Territory (Table 12-1). The AAQ NEPM criteria for photochemical oxidants (as ozone) do not strictly apply in the context of the KGGP Project as they are based on urban areas with high vehicle usage.

Table 12-1: Adopted air quality assessment criteria for air pollutants

POLLUTANT	AVERAGING PERIOD	MAXIMUM CONCENTRATION	MAXIMUM ALLOWABLE EXCEEDENCES GOAL
Carbon monoxide (CO)	8 hours	11,244 µ/m^3	1 day a year
Nitrogen dioxide (NO_2)	1 hour	120 ppb	1 day a year
	1 year	30 ppb	none
Photochemical oxidants (as ozone, O_3)	1 hour	100 ppb	1 day a year
	4 hours	80 ppb	1 day a year
Sulphur dioxide (SO_2)	1 hour	200 ppb	1 day a year
	24 hours	80 ppb	1 day a year
	1 year	20 ppb	none

Note: Concentrations are expressed at Standard Conditions (Temperature = 0°C, Pressure = 101.325 kPa)

The results of the modelling of predicted ground level concentrations for air pollutant emissions from the King River compressor station are summarised (Table 12-2) and provided in more detail at Appendix G. This demonstrates the maximum predicted ground level concentrations for carbon monoxide, nitrogen dioxide, and ozone are well below NEPM assessment criteria.

Table 12-2: Predicted ground level concentrations for air pollutant emissions from King River compressor station

POLLUTANT	MAXIMUM PREDICTED GROUND LEVEL CONCENTRATION*	ASSESSMENT CRITERION (AAQ NEPM)
Carbon monoxide (CO)	3.8 µg/m^3	11,244 µ/m^3
Nitrogen dioxide:NO_2 (1 hour)	1 ppb	120 ppb
Nitrogen dioxide: NO_2 (1 year)	0.2 ppb	30 ppb
Photochemical oxidants :as ozone, O_3 (1 hour)	18.9 ppb	100 ppb
Photochemical oxidants :as ozone, O_3 (4 hour)	19 ppb	80 ppb

* rounded to one decimal place

12.1.3 Mitigation response and assessment of potential impact

Sensitive receptors potentially susceptible to air emissions from operation of the KGGP were identified in the Air Quality Assessment and included dwellings, the communities of Beswick, Barunga, Gunyangara, Birritjimi (Wallaby Beach) and Galupa. The closest of these to the major source of air emissions (King River compressor station) would be a group of single dwellings approximately 10 km from the compressor station. Modelled ground level concentrations of the pollutants of concern in the region around the compressor station indicate none are likely to approach relevant health or environmental criteria (Appendix G). The operation of the King River compressor station on local air quality and on nearby sensitive receptors is therefore predicted to be minimal.

Emissions of air pollutants during construction would be minor and temporary. Considering the absence of other significant sources of such emissions in the broader region and the likely good air quality across the airshed, they are unlikely to pose any significant adverse environmental or health risks

The KGGP would facilitate the change in fuel supply from fuel oil to natural gas at the Gove Refinery. Minor atmospheric emissions from the construction and operation of the KGGP are very small compared to the significant reductions in emissions and improvements in air quality at Gove, arising from the fuel transition.

Mitigation measures to be applied include corporate policy commitment and specific project management measures for air emissions.

Pacific Aluminium Corporate Policy

Pacific Aluminium's corporate 'HSE Performance Standard – Environment: Air Quality Control' requires all operations to have identified and minimised as far as reasonably practicable, air pollutant emissions and their potential impacts by efforts involving:

- Identification of significant pollutant emissions from all sources and their method of release into the environment.
- Identification and assessment of risk and prioritisation of potential health and environmental impacts associated with the exposure to air pollutant emissions.
- Identification of approved criteria on ambient air quality in line with internationally accepted regulations, guidelines and methodologies.
- Maintenance of effective operational controls commensurate with the degree of hazard/risk
- Implementation of a regulatory or site approved monitoring program.

Project air pollutant management measures

The primary approach to managing the impacts of construction and operation of the KGGP from emissions of air pollutants has been to ensure design, construction and operations programs reduce air emissions from venting or pipeline failure and to incorporate energy efficiency measures that will reduce fuel combustion and associated emissions (Table 12-3).

An Air Quality Management Plan (AQMP) will be developed and implemented to formalise these arrangements. A provisional AQMP can be found at Appendix O.

Measures already identified to ensure that air emissions are minimised during construction and operation will include periodic leak surveys to detect fugitive gas releases from the pipeline as required by AS2885.3 (the Australian Pipeline Standard for Operation and Maintenance of high pressure gas pipelines).

Table 12-3: Potential impacts and mitigation outcomes for management of air pollutants

POTENTIAL IMPACT	PROPOSED MITIGATION (ACTION)		ANTICIPATED EFFECT OF MITIGATION
	AVOIDANCE	MINIMSATION	
Human health effects from air emissions	• Design, testing, operation, maintenance in accordance with the Australian Pipeline and Industry Association's (APIA) *Code of Environmental Practice* (2009) and AS2885 'Pipelines–Gas and Liquid Petroleum' (Parts 1, 2, 3 & 5).	• Air emissions minimised through design, construction and operational and programs and formalised though Air Quality Management Plan at Appendix O. • Energy efficiency measures incorporated into the construction and operational phases to reduce emissions from fuel combustion. • Periodic leak surveys to detect fugitive gas releases from the pipeline as required by AS2885	Air emissions from construction and operation will not affect sensitive receptors. (Ongoing improvement in emissions at Gove from conversion of the Gove refinery from fuel oil to gas)

12.1.4 Summary – predicted environmental outcome

After mitigation is applied, construction and operation of the KGGP is expected to result in minor emissions of air pollutants and no impacts on sensitive receptors. The most significant of these emissions (from the King River compressor station) have been modelled and are predicted to have no significant detrimental impact on air quality in the region. A significant co-benefit of the KGGP project would be the transition of the Gove refinery from fuel oil to gas which would lead to significant reductions of emissions of sulphur dioxide and fine particulate matter (PM_{10}) and improvement in the local air quality in Gove.

12.2 AIRBORNE PARTICULATES

12.2.1 Description

Dust generation will be most significant during the construction phase of the KGGP and would be generated from:

- Clearing of vegetation and earth moving activities.
- Vehicle movement along unsealed roads and the construction corridor.
- Minor blasting (shallow depth rock fracturing) and trenching activities.
- Dust liftoff from exposed surfaces and windrows or soil stockpiles.

The major sources of dust generation would be from dust liftoff during clearing and trenching activities along the pipeline ROW and from vehicles transporting material and personnel to the construction corridor along unsealed roads and access tracks.

An Air Quality Assessment was conducted to evaluate the significance and potential impacts of these sources of airborne particulates. The full methodology and results of this assessment is presented in Appendix G.

Airborne particulate impacts from construction activity along the ROW were modelled (Ausplume v6.0) by simulating the construction activities over a segment of pipeline.

The majority of access points for construction traffic to the pipeline are via roads with current low traffic volumes or with no data available on the traffic volumes. Quantitative modelling of particulate matter emissions from these activities was therefore not undertaken and instead addressed qualitatively.

During operation of the KGGP dust would arise due to traffic from maintenance and inspection activities although in much smaller amounts than during construction. As the extent of dust generation would be expected to be low, this was not subject to modelling.

The compressor station at King River would be expected to have negligible particulate emissions and hence those emissions were not modelled.

12.2.2 Potential impacts of construction and operation

The potential impacts of airborne particulates include:

- Airborne particulates less than 10µm are generally accepted as the respirable threshold. As such, PM_{10} can settle in the bronchi. Elevated PM_{10} can lead to exacerbation of respiratory conditions, with a causal link also suggested to increased plaque deposition in the arteries (Cohen *et al.* 2005).
- Deposited dust (greater than PM_{10}) is likely to cover the leaves of vegetation and reduce photosynthetic potential.
- Smaller particulate matter has been shown to settle in the stomatal openings of leaf surfaces on vegetation, inhibiting gas exchange (Prajapati, 2012).

The NTEPA has adopted the AAQ NEPM (2003) standards as their general air quality objectives for human health across the Northern Territory (Table 12-4). There are no standards or air quality objectives for protection of vegetation from airborne particulates and accordingly these impacts have been addressed qualitatively.

Table 12-4: Adopted air quality assessment criteria for airborne particulates

POLLUTANT	AVERAGING PERIOD	MAXIMUM CONCENTRATION	MAXIMUM ALLOWABLE EXCEEDENCES GOAL
Particles (as PM_{10})	24 hours	50 µg/m^3	5 days a year
Vegetation criteria	Qualitative assessment		

Based on the results of the simulation (modelling) of particulate emissions from construction within the ROW, with increasing distance downwind from the construction activities there is increased dispersion of particulate matter resulting in decreased ground-level concentrations and decreased numbers of exceedences of the assessment criterion. Therefore the construction impact footprint with respect to airborne particulates has been defined as the distance downwind from the pipeline alignment in which the activities comply with the assessment criterion (shown in Table 12-4).

Two scenarios were modelled over a segment of the pipeline, relating to dispersion perpendicular downwind from the pipeline alignment and dispersion parallel downwind from the pipeline alignment.

The modelling indicates that the probable buffer distances perpendicular downwind from the alignment beyond which compliance with the AAQ NEPM goals are achieved would be as follows:

- Realistic Maximum Footprint 240 m.
- Worst Case Maximum Footprint 370 m.

The probable buffer distances parallel downwind from the alignment beyond which compliance with the AAQ NEPM goals are achieved are as follows:

- Realistic Maximum Footprint 170 m.
- Worst Case Maximum Footprint 620 m.

The methodology for the modelling assumes no specific dust mitigation measures are in place. Full modelling results and methodologies are presented in Appendix G.

12.2.3 Mitigation response and assessment of potential impact

Construction along the pipeline ROW

Modelling of dust generation from construction along the pipeline ROW indicates that one sensitive human receptor (Birritjimi) would fall within the area of the predicted impact described in section 12.2.2. Birritjimi is a group of approximately 25 residential houses at Wallaby Beach off Melville Bay Road, just east of the Gove refinery. Without specific dust mitigation measures this receptor technically has the potential to be impacted by ambient ground level concentrations of PM_{10}. There is however a low probability that construction activities would coincide with meteorological conditions that facilitate the production of high ground level concentrations of $PM1_{10}$. This is due to the dust-generating activities being localised, short-term and transient in nature. With mitigation (not factored into the modelling) the risk to human health is expected to be low (Table 12-5).

Qualitatively, it is likely that the risk presented to vegetation health from the increase in deposition of particulate matter from construction activities along the ROW is low, for the following reasons:

- Construction activities are not long-term sources of emissions reducing the total quantity of dust generated with the wet season rainfall following construction activities likely to remove dust deposited on foliage.
- The proposed excavation activities are significantly smaller in scale in comparison with activities commonly associated with vegetation impacts from deposited dust (e.g. open cut mines).
- The physical locations of the emission sources change as construction activities progress along the alignment, moving away from previously affected areas.
- The construction activities are not scheduled to occur at night, during times when meteorological conditions are often at their worst for pollutant dispersion purposes.
- The impact footprint is likely to be on a similar order to the PM_{10} ambient concentration impacts which are very small distance scales in comparison to the project.

Research into the effects of dust on vegetation also provides some indication of the relevance and severity of the impacts. Doley and Rossato (2010) established that a dust load (considering dusts which are chemically inert and do not markedly alter substrate pH) greater than 500mg/m^2/day could adversely impact plant growth. This research also found that rain events greater than 10mm may completely remove the plant dust load. Therefore, any deposited dust would be removed in the wet season following construction of the pipeline; with an approximate maximum period of overlay of seven months (and a considerably shorter period for areas of the ROW where activity occurs late in the construction phase).

Vehicle traffic

The potential impacts of particulate matter (dust) from vehicle traffic, has been assessed qualitatively. It is expected that emissions of particulate matter during the construction phase will increase significantly on unsealed roads (particularly the Central Arnhem Road) and other roads and tracks providing access to the ROW. However, as particulate emissions from moving vehicles are short-duration events from the point of view of a receptor and the period during which this region will be affected is short-term. Adverse impacts on human health are unlikely to be encountered. The potential risk to vegetation health is considered low for the reasons outlined above.

Minimal dust is likely to be generated during operation of the KGPP. On occasion, dust may be generated during inspection and maintenance activities, associated with vehicle movements and ground disturbance. For the reasons outlined above, operation impacts are likely to be negligible and infrequent.

Mitigation

The primary approach to managing the impacts of construction and operation of the KGGP on airborne particulates will be to ensure appropriate traffic management measures and ensure construction activities within the ROW incorporate specific practices to suppress dust generation. Monitoring of weather patterns during the construction phase will occur to predict adverse conditions, conducive to high dust generation. Where feasible, construction activities known to generate high levels of dust would be scheduled to avoid these weather conditions. Re-establishing and maintaining a stable and vegetated ROW will also be important to minimising ongoing dust issues.

Mitigation measures are summarised in Table 12-5. An Air Quality Management Plan (AQMP) incorporating dust management measures will be developed and implemented to formalise these arrangements. A provisional AQMP can be found at Appendix O. Additional measures relevant to reducing airborne particulates from construction and operational phases are contained in the Traffic Management Plan and Rehabilitation Plan.

Table 12-5: Potential impacts and mitigation outcomes for management of dust

POTENTIAL IMPACT	PROPOSED MITIGATION (ACTION)		ANTICIPATED EFFECT OF MITIGATION
	AVOIDANCE	MINIMSATION	
Respiratory effects on humans and reduced photosynthesis in vegetation	• Construction activities not at night when conditions most favourable to dust dispersal often occur. • Where feasible, construction activities known to generate high levels of dust scheduled to avoid adverse weather conditions.	• Vegetation removal reduced to minimum required. • Early rehabilitation of the construction corridor to assists in soil stabilisation (through a Rehabilitation Management Plan, Appendix O). • Dust suppression techniques and / or watering of pipeline ROW, unsealed roads and access routes.	Dust emissions from construction and operation will not affect sensitive receptors. Dust emissions will have a low impact on vegetation.

POTENTIAL IMPACT	PROPOSED MITIGATION (ACTION)		ANTICIPATED EFFECT OF MITIGATION
	AVOIDANCE	MINIMSATION	
		• Strict controls on vehicles speeds and restricting travel to approved roads and access tracks during construction (through a Traffic Management Plan (Appendix O) • During the site induction the workforce will be made aware of dust generation and control measures. • Exposed surfaces such as soil stockpiles/windrows and cleared areas, and the duration that these areas are exposed, will be minimised. • General housekeeping practices to ensure there is no accumulation of waste materials, within the construction area, that may generate dust.	

12.2.4 Summary – predicted environmental outcome

After mitigation is applied, construction of the KGGP is expected to result in localised, short term and transient airborne particulate emissions in the vicinity of the pipeline ROW and hence the risk to human health and vegetation is low. Birritjimi will be a particular focus for mitigation efforts as modelling indicates that without mitigation, ground level concentration of particulates could exceed the AAQ NEPM goal.

Airborne particulate emissions from traffic during the construction phase will increase significantly on unsealed roads (particularly the Central Arnhem Road) and other roads and tracks providing access to the ROW. However, these are short-duration events and the period during which this region will be affected is short-term. After mitigation, it is unlikely any adverse impacts will occur.

12.3 GREENHOUSE GAS EMISSIONS

12.3.1 Description

Increasing concentrations of anthropogenic greenhouse gases in the Earth's atmosphere is widely considered to be a key driver of climate change. Changes in the abundance of greenhouse gases such as carbon dioxide, methane and nitrous oxide in the atmosphere can alter the energy balance of the climate system (IPCC 2007).

For tropical northern Australia, a significant increase in temperature is predicted to:

- Lead to sea level rises and potentially greater storm surges, impacting on coastal settlements, infrastructure and ecosystems.
- Result in salt water intrusion into coastal wetlands.
- Increase the number of days over 35^{o}C leading to increased temperature related health problems and heat stress in agricultural systems.
- Potentially increase the proportion of intense tropical cyclones.
- Potentially increase the prevalence of mosquito-borne diseases.

(DCCEE 2013)

Existing greenhouse gas emissions

The Northern Territory greenhouse gas emissions were 14.7 million tonnes of CO_2-e annually in 2009-10 or 2.6% of Australia's emissions (DCCEE 2012). Stationary energy and agriculture are the main contributors to Northern Territory greenhouse gas emissions. In contrast to the rest of Australia, the principal source of emissions from agriculture in the Northern Territory is the burning of savannas (DCCEE 2012).

Potential project greenhouse gases

Construction, operation and maintenance of the KGGP would directly result in greenhouse gas emissions from:

- Fuel combustion (primarily diesel) by vehicles and power generation.
- Fuel combustion (gas) in compressors and heaters.
- Losses of natural gas from leaks, failures and maintenance operations (pigging).
- Venting of natural gas during maintenance of scraper stations or compressor station components.
- Venting of natural gas during compressor station operation.
- Venting of natural gas from the pipeline during major maintenance or repairs.
- Vegetation) clearing.

Relevant greenhouse gases would include combustion products such as CO_2, N_2O and methane.

A greenhouse gas assessment has been undertaken for the construction and operation of the KGGP (Appendix H). The assessment addressed the principles outlined in the Greenhouse Gas Protocol and the methodologies provided by the Australian Government's National Greenhouse and Energy Reporting (Measurement) Determination 2008.

The assessment addressed greenhouse gas emissions from a wide range of pipeline construction-related activities and from the operation of an in-line compressor gas turbine. The emission factors used in calculating emissions are detailed in Appendix H. Embedded-energy related emissions in steel pipeline sections and vegetation clearances were also included.

Direct (Scope 1) greenhouse gas emissions (from the combustion of fuels within the Project boundary) and indirect (Scope 3) greenhouse gas emissions (from the extraction, processing and transport of imported fuels outside of the Project boundary) associated with construction, were assessed (Table 12-6). Scope 2 greenhouse gas emissions arise from imported electricity, heat and steam generated outside of the Project boundary. Scope 2 greenhouse gas emissions were not assessed as relevant to the KGGP Project.

Table 12-6: Estimated greenhouse gas emissions from constructing the KGGP

Activity related to construction of the pipeline	Energy used	GHG emissions totals over the construction period (tonnes co_2-e)	
Grading, trenching, pipe-laying, backfilling	9126 kL diesel	Scope 1:	24,620
		Scope 3:	1,870
Transport of pipeline sections	421 kL diesel	Scope 1 :	1,140
		Scope 3:	90
Operate construction camps	3,890 kL diesel	Scope 1:	10,430
		Scope 3:	795
Fuel haulage	100 kL diesel	Scope 1:	270
		Scope 3:	20
Transport of camp infrastructure and plant	145 kL diesel	Scope 1:	290
		Scope 3:	30
Transport of workers	2340 kL diesel	Scope 1:	6,310
		Scope 3:	480
Water haulage	120 kL diesel	Scope 1:	320
		Scope 3:	25
Vegetation clearances	-	Scope 1:	247,907
Airline travel	-	Scope 3:	4,080
Embedded energy** emissions for steel pipes	-	Scope 3:	1,750 (per annum***

* based on 2054 hectares cleared
** emissions associated with the energy required in producing the steel
*** emissions amortised over 50 year pipeline lifetime

Excluding vegetation clearance and embedded energy, total emissions from construction of the KGGP would be approximately 50,800 tonnes CO_2-e (comprising 43,380 tonnes CO_2-e scope 1 emissions and 7390 tonnes CO_2-e scope 2 emissions). Vegetation clearance would release approximately 248,000 tonnes CO_2-e or 87% of all construction-related greenhouse gas emissions. Embedded energy related greenhouse gas emissions in the 603 km of steel pipeline, when annualised over an assumed 50-year lifetime would be relatively insignificant.

Greenhouse gas emissions from operation of the KGGP would mainly arise from a single in-line gas compressor turbine, from fugitive gas emissions and from venting activities (Table 12-7).

Table 12-7: Estimated greenhouse gas emissions from operating the KGGP

ACTIVITY RELATED TO OPERATING THE PIPELINE	SCOPE 1 GHG EMISSIONS PER ANNUM (TONNES CO_2-E)
Pipeline fugitive emissions	5,260
Compressor Station blowdown	1,990
Pipeline blowdown	5,760
Inline compressor gas consumption	28,900
Leaks around compressor seals	130
Total	**42,040**

The estimated annual greenhouse gas emissions from construction of the KGGP would comprise a 'one off' increase of approximately 2% in annual greenhouse gas emissions in the NT or 0.05% increase in Australia's annual emissions for the year of construction only (2014). This would be mostly attributable to vegetation clearance. Over the lifetime of the project, it is expected that approximately 60% of the pipeline ROW would naturally re-vegetate to native woody vegetation and therefore approximately 60% of the carbon sequestration potential of the vegetation can be recovered.

The ongoing greenhouse gas emissions from the operation of the KGGP would be small (estimated 42,000 tonnes CO_2-e per annum). A significant co-benefit of the KGGP would be to facilitate the conversion of the Gove refinery from heavy fuel oil to natural gas which would result in lower greenhouse gas emissions at the refinery. Taking into account the Scope 1 greenhouse gas emissions from operating the KGGP, the net reduction in greenhouse gas emissions would be approximately 336,000 tonnes CO_2-e per annum (Appendix I). The ongoing benefits to greenhouse gas emissions as a result of the supply of gas to the refinery far out-weigh the 'one-off' increase n emissions as a result of vegetation clearing and construction vehicle and power use in 2014.

12.3.2 Mitigation response and assessment of potential impact

Greenhouse gas emissions from construction derive largely from vegetation clearance and would be a small proportion of Australia's total greenhouse gas emissions. Over time, sequestration associated with a return to native woody vegetation over approximately 60% of the pipeline ROW would balance a considerable proportion of these emissions.

Greenhouse gas emissions from operation of the KGGP would comprise a negligible addition to Australia's national greenhouse gas emissions. When combined with reductions in greenhouse gas emissions at the Gove refinery (facilitated by the transition to gas), the Project results in net greenhouse gas emission savings each year of operation.

Mitigation measures to be applied include corporate policy commitment and specific project management measures for greenhouse gas emissions coupled with reporting.

Pacific Aluminium Corporate Policy

Greenhouse gas and energy assessments are conducted early in project development to ensure compliance with Pacific Aluminium's corporate 'HSE Performance Standard – Environment: Greenhouse Gas Emissions' which requires continuous improvement in minimising greenhouse gas emissions by:

- Identifying greenhouse gas sources.
- Evaluating and prioritising greenhouse gas sources according to significance.

- Designing and implementing a greenhouse gas and energy efficiency action plan containing the appropriate control, reduction and mitigation measures.

Consistent with Pacific Aluminium's HSE Performance Standard, during detailed design of the KGGP potential changes to the project design specific to reducing greenhouse gas emissions and improve energy efficiency will be identified. Opportunities will be highlighted and assessed against financial, feasibility and other business and market factors to evaluate possible implementation.

Measures already identified to ensure that greenhouse gas emissions are minimised during construction and operation will include:

- Optimising transport of the construction workforce and haulage of pipe and construction materials by for example ensuring vehicles are fully occupied where possible, the correct vehicles type is used and double trailers are used where regulations and road/access conditions permit.
- Using fuel efficient vehicles and machinery where practicable
- Maintaining diesel engines in the trucks and plant-laying equipment to prevent excessive exhaust emissions.
- Keeping the working area (and vegetation clearance) to the minimum required and maximising the speed and area of disturbed land to be rehabilitated.
- Allowing pressures in the line to decline prior to venting, thereby reducing the volume of gas released to the atmosphere.
- Ongoing monitoring of pipeline operating parameters, equipment status and malfunction alarms at remote facilities to enable early detection of gas release and minimise the volumes of gas vented where possible.

Examples of energy efficiency opportunities could include:

- Monitoring and tuning energy generation for optimal performance, enabling assessment of efficiency improvement options and early detection of any deterioration in efficiency to facilitate prompt remedial action.
- Improved efficiencies at workforce accommodation facilities.
- Programs to increase workforce awareness of energy efficiency and improve the efficiency of operating procedures.

Options for utilising renewable energy at remote pipeline facilities will be explored including the use of solar remote area power supply (RAPS).

Project greenhouse gas management measures

The primary approach to managing the contribution made by the KGGP project to greenhouse gas emissions and climate change (Table 12-8) has been to:

- Ensure design, operations and maintenance programs reduce greenhouse gas emissions from venting or pipeline failure to as low as reasonably practicable.
- Ensure vegetation clearance is minimised and rehabilitation of the project area is as rapid as possible.
- Incorporate energy efficiency measures into the construction and operation phases.

This will be supported by efforts to:

- Evaluate options for renewable energy for remote pipeline facilities.
- Comply with relevant statutory requirements and legislation relating to greenhouse gas emissions, including reporting requirements.

A Greenhouse Gas Emissions Management Plan (GGEMP) will be developed and implemented to formalise these arrangements. A provisional GGEMP can be found at Appendix O.

Reporting

The Commonwealth *National Greenhouse and Energy Reporting Act* 2007 (NGER Act) is a national framework for Australian corporations to report GHG emissions, and energy consumed and produced. The Act and supporting systems have been designed to provide a robust, quantitative database for the proposed Carbon Pricing Scheme.

Since 1 July 2008, corporations have been required to report Scope 1 and Scope 2 GHG emissions. In 2011-12, corporations were required to report if:

- They controlled facilities emitting more than 25,000 tonnes CO2-e, or produced or consumed more than 100 terajoules (TJ) of energy.
- Their corporate group emitted more than 50,000 tonnes CO2-e, or produced or consumed more than 200 TJ of energy.

The construction and operation of the KGGP will trigger the NGERs facility reporting threshold of 25,000 tonnes CO_2-e per annum of Scope 1 emissions and Pacific Aluminium will therefore report greenhouse gas emissions under the NGERs legislation.

The Commonwealth *Energy Efficiency Opportunities Act* 2006 (EEO Act) requires significant energy users, consuming over 0.5 petajoules (PJ) per annum of energy, to take part in a transparent process of energy efficiency assessment and reporting. Participants in the program are required to assess their energy use and report publicly on cost effective opportunities to improve energy efficiency. In particular, corporations must report publicly on opportunities with a financial payback period of less than four years.

Through the Clean Energy Future package, the Commonwealth Government has foreshadowed that EEO assessments will be expanded to include the design and commissioning phase for major new development projects (i.e. greenfield projects) and expansions. Proposed new regulations would require corporations to conduct an assessment at the design and commissioning phase. The amount of increased energy use that would trigger consideration of a site under the new EEO Greenfields Framework, range between 0.1 PJ and 0.5 PJ – the exact trigger level is yet to be determined.

If the extension to the EEO Act is implemented, then an Assessment Plan for the pipeline facility will need to be developed detailing how the assessment at the design stage will be undertaken.

Inline compressor gas turbines operated as part of the KGGP could consume more than 0.5 PJ per annum, requiring the pipeline operators to participate in the Energy Efficiency Opportunities program. As a greenfield development, an energy efficiency assessment may be required during the design phase of the project, depending on the timing of the detailed design schedule. This assessment is likely to require the consideration, documentation and reporting of a rigorous energy efficiency improvement process at each stage of the design and commissioning phases of the project.

Table 12-8 summarises the mitigation approaches for potential impacts of particular significance to greenhouse gas emissions.

Table 12-8: Potential impacts and mitigation outcomes for management of greenhouse gas emissions

POTENTIAL IMPACT	PROPOSED MITIGATION (ACTION)		ANTICIPATED EFFECT OF MITIGATION
	AVOIDANCE	MINIMISATION	
Increased effects of human induced climate change	• Investigate renewable energy options for remote pipeline facilities.	• Conversion of Gove refinery from fuel oil to gas • Vegetation clearance along the ROW and ancillary infrastructure kept to a minimum. • Greenhouse gas emissions minimised through design, operational and maintenance programs and formalised though Air Quality Management Plan. • Incorporate energy efficiency measures into the construction and operational phases. • Compliance with statutory requirements of Australian Government's Clean Energy Legislative Package including reporting requirements.	One off increase in greenhouse gas emissions during construction 2014, largely from vegetation clearance. Ongoing savings in greenhouse gas emissions from conversion of the Gove refinery from fuel oil to gas.

12.3.3 Summary – predicted environmental outcome

The KGGP project will generate a 'one off' increase in greenhouse gas emissions in the NT of approximately 2% during construction (2014).

When greenhouse gas emission reductions at the Gove refinery are accounted for, the small annual greenhouse gas emissions arising from operation of the KGGP (approximately 42,000 tonnes CO_2-e per annum) would be more than offset by the significant reductions in greenhouse gas emissions at the Gove refinery. The net reduction in greenhouse gas emissions would be approximately 336,000 tonnes CO_2-e per annum. This reduction in greenhouse gas emissions is a significant co-benefit of the KGGP project.

Annual emissions of greenhouse gases will be publicly reported, consistent with legal requirements. In addition, Pacific Aluminium will continue to monitor Northern Territory and Commonwealth developments for greenhouse gas emissions, and adopt a proactive approach for responding to carbon price signals or new compliance requirements that may arise.