



# **Katherine to Gove Gas Pipeline**

## **Notice of Intent**

Prepared for  
**Pacific Aluminium**

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**PACIFIC ALUMINIUM**

Pacific Aluminium: Alcan Gove Pty Limited ACN: 000 453 663

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# Abbreviations

ABBREVIATION	DESCRIPTION
AAPA	Aboriginal Areas Protection Authority
EA Act	Environmental Assessment Act (Northern Territory)
EIS	Environmental Impact Statement
ELA	Ecological Australia Pty Ltd
EMP	Environmental Management Plan
EPBC Act	Environment Protection and Biodiversity Conservation Act (Commonwealth)
HDD	Horizontal Directional Drilling
IPA	Indigenous Protected Area
KGGP	Katherine to Gove Gas Pipeline
MLV	Main Line Valve
NLC	Northern Land Council
NOI	Notice of Intent
NT	Northern Territory
NT EPA	NT Environment Protection Authority
TTP	Trans Territory Pipeline

# Overview

Pacific Aluminium (Alcan Gove Pty Limited ACN: 000 453 663) proposes to construct a natural gas pipeline to its bauxite mine and alumina refinery at Gove, north east Arnhem Land. The pipeline will commence at a point south of Katherine and follow a north easterly route of 600 km to Gove.

This Notice of Intent (NOI) provides an overview of the proposed Katherine to Gove Gas Pipeline (KGGP) for the purposes of:

- Notifying the Northern Territory Government of the proposal.
- Summarising the relevant environmental features along the pipeline route, the potential impacts and the measures proposed to mitigate environmental risks.
- Providing the Northern Territory Minister Lands, Planning and Environment with sufficient information to determine whether formal environmental assessment of the project is required (pursuant clause 8 of the Administrative Procedures of the *Environmental Assessment Act*).
- Providing sufficient information for Guidelines to be prepared by the NT Environment Protection Authority, should a decision be made to require the preparation of an Environmental Impact Statement or a Public Environment Report.

The Notice of Intent has been written to the requirements set out in Guidelines for NOIs prepared by the NT Government.

The KGGP follows a 600 km section of the corridor put forward under an earlier Trans Territory Pipeline (TTP) proposal which was subject to a partially completed EIS. The TTP proposal did not proceed however, considerable work was undertaken to understand the existing environmental values and develop appropriate environmental monitoring, safeguards and management systems to mitigate environmental risks.

Given the close alignment of the KGGP proposal to the earlier TTP, this NOI draws substantially from the TTP EIS documentation and serves primarily to provide clarity around the details of the new pipeline proposal. Information on some elements of the pipeline design and construction are not yet fully determined and will be clarified during the ongoing design phase. The KGGP is proposed to commence near kilometre point (KP) 350 of the earlier TTP proposal. References to KPs in this document have been translated from the TTP documentation by subtracting 350 km, to provide an approximate location on the new KGGP route.

Pacific Aluminium anticipates that the KGGP proposal will require formal environmental assessment. Information on the existing environment, key risks and mitigation methods are therefore summarised in the NOI and will be refined and elaborated upon (if required) in subsequent assessment documentation.

Pacific Aluminium intends to rely significantly on the relevant information contained in studies prepared for the TTP but acknowledges that this information needs to be brought into a contemporary setting. Additional studies to update information in respect of some critical areas such as terrestrial fauna are anticipated. New surveys are currently underway and will continue in the dry season of 2013, to build on the information gathered for the TTP.

In parallel with the lodgement of this NOI, Pacific Aluminium has referred the KGGP proposal to the Federal Government for consideration under the *Environment Protection and Biodiversity Conservation Act*.



# 1 Introduction

## 1.1 PROJECT HISTORY

Pacific Aluminium (Swiss Aluminium Australia Ltd (SAAL) (ACN 008 589 099) and Gove Aluminium Limited (GAL) (ACN 000 640 353) in a 70%/30% unincorporated joint venture) own a bauxite mine and alumina refinery at Gove, 650km east of Darwin in north east Arnhem Land. The Gove mine and refinery are operated by Alcan Gove Pty Limited (ACN 000 453 663), a subsidiary of SAAL and GAL. The Gove refinery was constructed in the late 1960's, and production of bauxite began in 1972. The Gove facility is one of the world's leading bauxite mining and alumina processing operations. High grade bauxite is mined, refined into alumina and then shipped for smelting. The operation includes a mine, refinery, residue disposal area, steam power station, port and ship loading facilities. Refining operations at Gove were significantly expanded as part of the G3 Project, completed in 2007.

Power to the Gove refinery and mining operations is currently generated from imported fuel oil. In early 2000 consideration was given to sourcing an alternate fuel option. The Trans Territory Pipeline (TTP) was proposed in 2003 by Alcan Gove Pty Limited in association with the Blacktip Joint Venture participants (Woodside and ENI Australia) to deliver natural gas from the offshore Blacktip gas field, via a processing plant at Wadeye and on to Gove, 940km to the east.

The TTP proposal was referred to both the Northern Territory and Federal Governments and both determined that formal environmental assessment was required at the Environmental Impact Statement (EIS) level. The Federal Government determined that the TTP proposal was a 'controlled action' under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). The controlling provisions were listed threatened species and communities; and listed migratory species. The Federal Government (pursuant to the relevant Bilateral Agreement with the Northern Territory) agreed to rely on the environmental assessment outcomes of the Northern Territory process conducted pursuant to the *Environmental Assessment Act 1982* (the EA Act).

Alcan Gove Pty Limited and the Blacktip Joint Venture participants released a draft EIS for public comment in November 2004 but subsequently determined not to proceed with the TTP project. The EIS process for the TTP project was not completed and is currently 'on hold' with the NT EPA.

Pacific Aluminium now intends to revisit the gas option for its Gove operations by constructing the Katherine to Gove Gas Pipeline (KGGP). A shorter pipeline, connecting to the existing pipeline infrastructure is proposed.

The Gove operations face challenging global market conditions particularly related to high fuel oil prices and exchange rates and a low alumina price. The delivery of competitively priced gas and conversion of the refinery will provide significant efficiencies to the mining and refinery operations, helping to underpin the long term operating life of the refinery and sustaining the significant regional economic benefits that accrue to the community of Nhulunbuy, the Traditional Owners, employees, suppliers and customers.

Conversion of the Gove operations to gas will achieve significant greenhouse gas emission reductions. The EIS for the G3 expansion of the Gove Refinery estimated that greenhouse gas emissions from the expanded refinery would be reduced by 787,105 tonnes of carbon dioxide equivalent per annum, when converted from fuel oil to natural gas. The emission rate per tonne of alumina produced was predicted to reduce from 0.79 to 0.59 following the conversion to gas.

## 1.2 PROPONENT

The project proponent of the Katherine to Gove Gas Pipeline is Alcan Gove Pty Limited (ACN 000 453 663), a subsidiary of Swiss Aluminium Australia Ltd (ACN 008 589 099) and Gove Aluminium Limited (ACN 000 640 353), an unincorporated joint venture which owns the Gove bauxite mine and alumina refinery.

The key contact for the proponent is:

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## 1.3 CONSULTANT

Eco Logical Australia Pty Ltd (ABN 87 096 512 088) is providing environmental consulting services to Pacific Aluminium (Alcan Gove Pty Limited) for the purposes of preparing this Notice of Intent.

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## 2 Project Description

### 2.1 LOCATION

The proposed KGGP traverses a 600 km route from south of Katherine to Gove (**Figure1**).

The detailed design of the route is currently under review but is not expected to vary significantly from the design work completed for the relevant section of the TTP. The KGGP will connect with the existing NT Gas Pipeline at a yet to be determined location south of Katherine, allowing delivery of gas to Gove.

The overall project envelope is defined by the points in **Table 1**.

**Table 1: Points of project envelope**

LATITUDE	LONGITUDE
-12.30476	136.86456
-15.21722	132.25792
-14.53194	132.32455
-12.27621	136.76938
-12.18103	136.7789
-12.29524	136.86456
-12.30476	136.86456

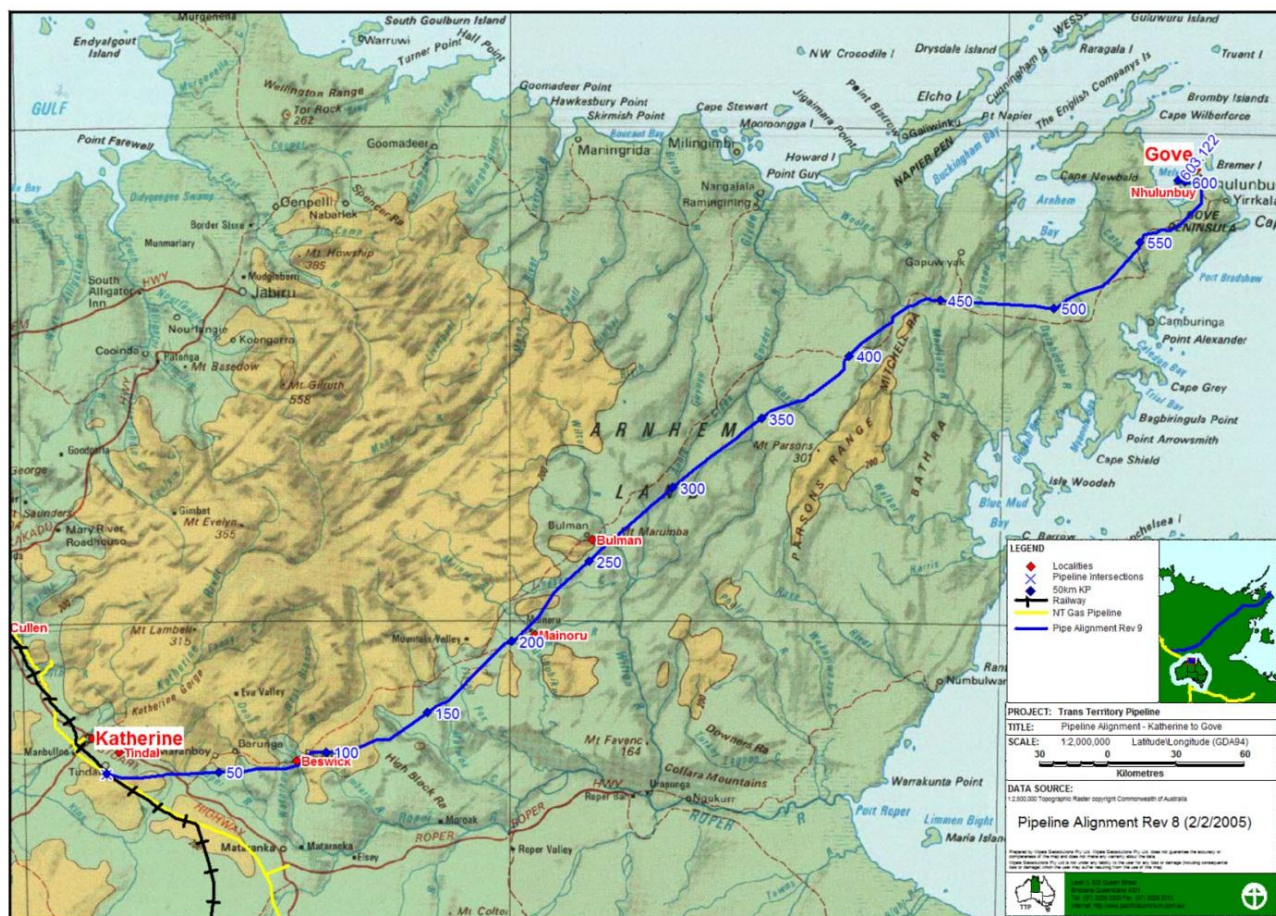


Figure 1: Indicative location of the proposed Katherine to Gove Gas Pipeline

## 2.2 TIME FRAME FOR IMPLEMENTATION

Key milestones for the KGGP are as follows:

2012-13	Environmental and land access approvals finalised
2013	Engineering / design
2014	Pipeline construction (dry season)
2015	Gas delivery to the Gove Refinery

## 2.3 PIPELINE DESIGN

The KGGP will be constructed of high-tensile steel. Individual pipe lengths will be welded together onsite, field coated and buried with a minimum depth of cover of 750 mm. Depth of cover will vary depending on the conditions of the terrain and the surrounding land use. The pipeline coating, above ground pipe work, equipment and fittings will be designed for an operational life of 50 years.

The pipeline will be designed and constructed in accordance with AS2885. The indicative design specifications of the pipeline design are presented in **Table 2**. These specifications will be refined and updated during the detailed design phase.

**Table 2: Pipeline design specifications**

PARAMETER	SPECIFICATION
Length	~600 km (buried)
Nominal capacity	30-50 PJ/a
Outside diameter	304.8 - 406.4 mm (12" – 16")
Minimum wall thickness	9.0 mm
Operating pressure	15.3 MPa
Cathodic protection	Impressed current
Design life	50 years

## 2.4 CONSTRUCTION OF THE PIPELINE

The pipeline will be constructed in two sections or 'spreads' over the 2014 dry season.

Construction activities for the pipeline will generally be contained within a 30 m wide corridor with the use of existing roads/tracks for access and cleared areas for additional laydown areas as far as practicable.

Although all construction activities will generally be contained within the construction corridor, it may be necessary to increase the width of the construction corridor over short lengths in certain areas where increased working space is required for constructing river, rail and road crossings and in rocky areas. The corridor is not proposed to be fenced during construction, except at points of public access or deep excavations.

The corridor will be cleared of vegetation (in particular heavy vegetation such as large trees), retaining root stock in the ground where possible, to promote stability and reduce erosion. Approximately 1,900 ha of native vegetation will be cleared along the pipeline route, and small areas for ancillary infrastructure such as compressor stations and construction camps.

The centreline of the pipeline route will be graded and levelled to the required gradient using graders, backhoes and bulldozers. Topsoil and associated seed stores will be stripped from the work area and stored separately from other stockpiled soil, for subsequent use in rehabilitation. Topsoil will be stored on either side of the corridor, away from fence lines, tracks, stock routes and existing or constructed drainage.

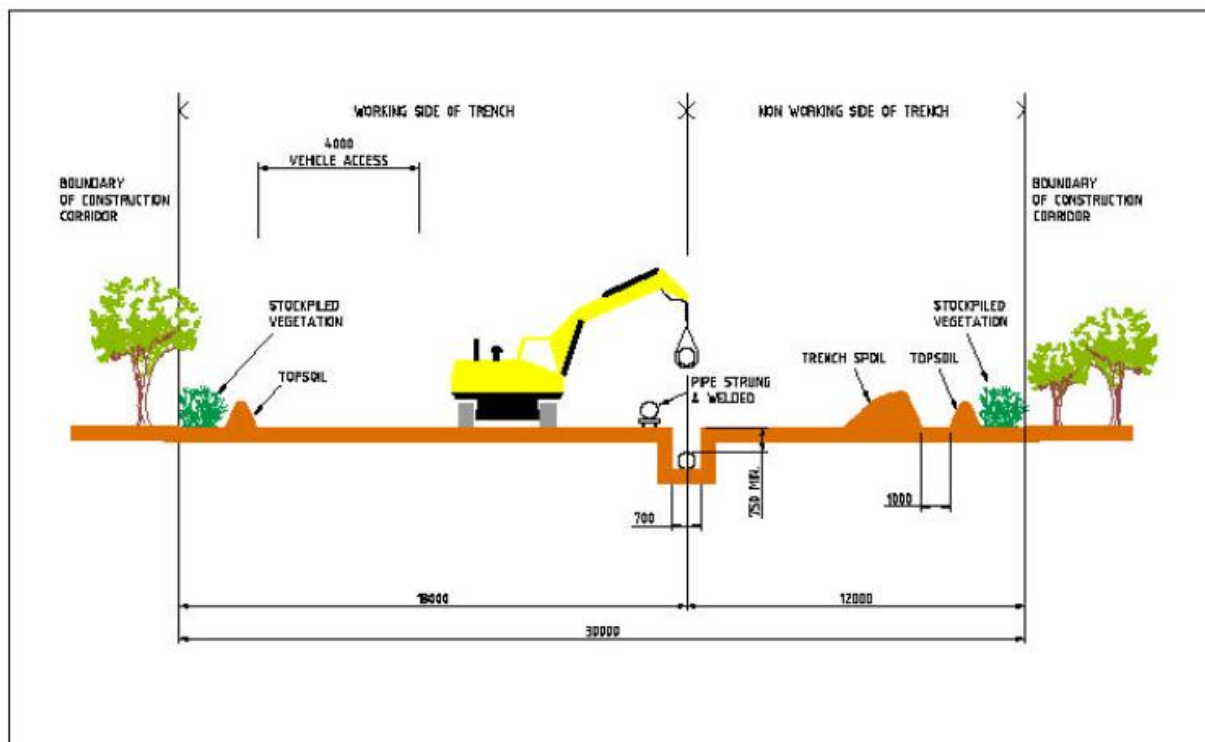
A trench will be dug, into which the pipe will be installed. The trench will be prepared using excavators, trenching machines, rock saws or by drilling and blasting as required by the nature of the ground. The length of open trench will be kept to the minimum necessary to allow for the pipe to be efficiently installed. Wherever the trench is easily accessible to the public, it will be clearly marked by bunting and hazard lights. Breaks in the trench will be left to facilitate stock and wildlife crossing and methods will

be adopted to prevent fauna entrapment. The approximate top of pipe depth in most areas will be 750 mm, at road crossings 1200 mm and 1500 mm at rivers. **Figure 2** shows a generalised layout of the construction corridor for the pipeline.

The pipe used to construct the pipeline will be transported to site on trucks. The pipe will be laid out adjacent to the trench, bent as required and set on skids which protect the pipe coating from damage. Once the pipe is strung, a line-up crew will position the pipe using side boom tractors and line-up clamps, allowing the pipe to then be welded together prior to placement in the trench. Following welding, joint coatings will be applied to the joints to prevent corrosion. Each weld will be subject to an inspection to test for compliance with specification, thus ensuring the integrity of each weld.

Laying of the pipe will involve 'padding' being placed along the base of the trench where required, to ensure that sharp stones or rocky protrusions in the bottom of the trench do not damage the pipeline coating. Sand or fine soil will be applied to a depth of around 150 mm. This material will either be sifted from the trench spoil by a purpose built padding machine, or will be imported from borrow pits.

The pipe will be lowered into the trench using side-boom tractors, followed by a covering of more graded material. The trench will then be backfilled in the reverse order to which it was excavated, using the stockpiled soil adjacent to the trench. The trench will be compacted using a rubber-tyred grader. Where the pipeline passes through solid rock it may be necessary to import material for backfilling however trenching spoil will be used wherever possible. If additional material is required it will be sourced from borrow pits. Where the pipeline is installed along a steep grade it will be necessary to install trench breakers to avoid erosion of the trench. Either stabilised sandbags or a urethane foam sprayed in-situ may be used for the construction of the trench breakers. Once the pipeline is laid, the pipeline will be hydrostatically tested for strength and potential leaks by filling with water and pressurising to greater than the normal operating pressure.



**Figure 2: Generalised layout of the construction corridor**

## 2.5 CONSTRUCTION OF CROSSINGS

Although the requirement for crossings has been avoided where possible, the proposed route will require the pipeline to cross several watercourses, roads and infrastructure corridors. Specialised techniques for installing the pipeline will be employed at crossing locations. The approach to construction at these crossings will reflect environmental and cultural sensitivities to avoid/minimise impacts to these areas, whilst providing the best technical solution. In most cases construction of crossings will require additional areas of temporary access outside the 30 m corridor.

### 2.5.1 Road and infrastructure crossings

Sealed road crossings are proposed to be horizontally bored using an auger. Waste material from horizontal boring will be stockpiled, and re-used as a source of fill for other pipeline sections if appropriate, or otherwise disposed of in an approved manner. In addition to the sealed roads, it is proposed that the Melville Bay Road will be horizontally bored.

All unsealed road crossings are proposed to be by open-cut method, subject to the approval of the relevant road authority. A trench will be excavated in a similar fashion to that employed for standard trenching. The welded pipe is placed in the trench and the excavated material returned. The disturbed area is then reinstated. Vehicle access will be maintained across the trench by the use of bypasses or steel plates. Trenches will remain open for the shortest possible time period to minimise impacts on traffic. All road surfaces will be returned to a standard equal to that prior to construction. Appropriate signage and other traffic control measures will be employed to ensure safety at all times.

The Adelaide–Darwin rail line crossing is the only rail crossing. This crossing is proposed to be horizontally bored.

### 2.5.2 Watercourse crossings

During the early project design phase, watercourse crossings played a key role (together with other environmental, social, economic and technical aspects) in determining the most appropriate route for the KGGP. Major revisions were made to the preferred route in order to avoid areas of environmental or cultural sensitivities and to provide the best engineering option. Minor refinements to the pipeline corridor and locations of watercourse crossings were also made to avoid environmentally and culturally sensitive areas.

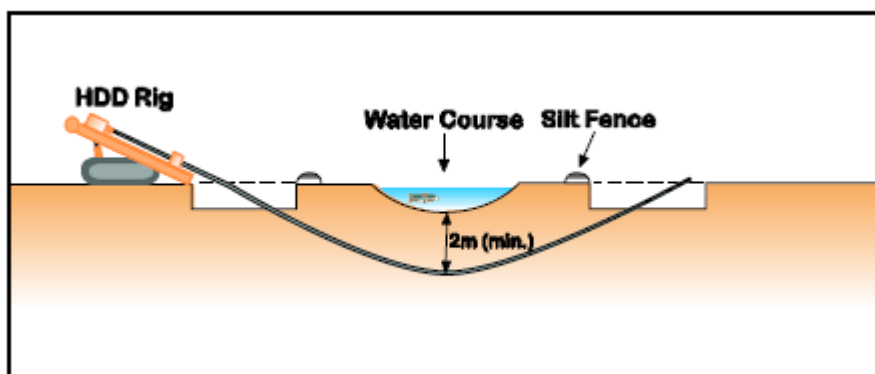
The method used at each watercourse crossing will be dependent on environmental factors, geotechnical constraints and stakeholder views in regards to the significance of the watercourse. Open-cut and Horizontal Directional Drilling (HDD) are the preferred construction methods.

Open-cut crossings will involve the excavation of a trench in a similar fashion to that employed for standard trenching. Open cut trenching of flowing water courses will be avoided unless required for geotechnical reasons. If the open-cut method is required in respect of flowing water courses then stream flow will be diverted. Flow diversion will involve temporarily damming the watercourse and pumping the flow around work areas. The water, which is pumped around the area, will be suitably filtered or settled before being reintroduced to the watercourse. This activity would be short term, generally taking up to one week per crossing. Silt fencing will be installed where required to prevent run-off and to contain stockpiled spoil.

Following pipeline laying, the trench will be backfilled initially with a 150 mm sand surround followed by coarse silt free material or, depending on quality, the excavated material. Loose rocks or “rip-rap” may be placed on the banks or in the stream to reduce the risk of erosion and seeding or seed mats will be placed along the slopes, if required.



HDD involves drilling a hole into the ground at one side of the crossing at a 10–15° angle, drilling a curved hole with the drill surfacing on the other side of the crossing (**Figure 3**). The hole acts like a tunnel through which the pipeline is threaded. Drilling is conducted by a specially designed drill rig and operated by a specialist contractor. This technique usually results in a stockpile or tanks full of saturated cuttings and drilling mud displaced from the hole. This material will be disposed of in an approved manner.



**Figure 3: Horizontal Directional Drilling**

The HDD method will be preferred where the long term stability of the crossing is of concern or for ecological reasons, particularly to protect significant riparian vegetation or conservation values. The identification of crossings requiring HDD is the subject of further consideration during the engineering and design phase.

## 2.6 ACCESS TRACKS

During construction, access will be required along the construction corridor and to the campsites, pipe stockpiles, water bores and borrow pits. The majority of heavy equipment will be transported along existing roads, which are generally sealed or gravel roads, however upgrades to the roads and ongoing maintenance will be required in particular areas to ensure that any sections of road, bridges and grids are capable of carrying the loads of pipe trucks and heavy equipment floats.

Although the Central Arnhem Road often parallels the proposed pipeline route, in many sections there is a distance of up to 25 km between the road and the corridor. New access tracks will be constructed between the roads and the corridor to minimise the movement of heavy traffic and to allow permanent access for operation personnel once the pipeline is constructed.

The following key considerations will be taken into account in the access track selection process:

- Existing tracks to be used where possible, although the establishment of additional new tracks will be necessary
- Tracks will be adequately spaced apart to minimise the distance travelled
- The construction corridor will be used in preference to a track in areas where high road maintenance is expected, such as sand and soft soil
- Access will be provided to either side of a watercourse, to enable construction traffic to reach both sides whilst avoiding the need for installing crossings.



Additional access tracks may be required to access local water bores and watercourses supplying water for dust suppression, potable use and for hydrotesting. These access tracks will be identified in detail following an investigation into water source options.

## 2.7 OTHER FACILITIES

A number of facilities will be required at intervals along the pipeline for safety, maintenance and pipeline integrity purposes. These facilities will include:

- Meter stations
- Main line valves
- Scraper stations
- Compressor stations.

Where possible, facilities will be located to allow easy access via existing roads and tracks, and in areas that are not deemed to be culturally or environmentally sensitive. The locations of such facilities are also strongly influenced by design and engineering requirements.

A meter station will be installed at the end of the pipeline, at the Gove Gate Station within the existing Gove Refinery. The meter station will be used to measure the volume of gas exiting the pipeline. The meter station will include a gas analyser and flow computers and will provide information that is essential for commercial transactions associated with the supply of gas.

In accordance with AS2885, main line valves will be required at intervals along the length of the pipeline as a safety measure to enable the isolation of sections of the pipeline in the event of an emergency or leak. Main line valve facilities will be equipped with vent valves both upstream and downstream of the main line valve to enable venting of the gas from the isolated section. The main line valves will be buried, apart from the operating handle and the vents that will be located above ground.

Scraper stations allow the manual introduction and retrieval of internal mobile inspection and cleaning tools, 'pigs', into and out of the pipeline during operations. The pigs are launched using the pig launcher, sent through the line using the pressure of the gas, and are retrieved from the pig receiver.

Compressor stations are primarily used to boost the pressure of gas, as the gas demand increases. One compressor station is proposed. The pipeline may require additional compression at a later stage, as the Gove gas demand increases and/or as other customers are added.

## 2.8 ACCOMMODATION CAMPS

A construction workforce of approximately 600 personnel (2 x 300 man spreads) is anticipated.

It is proposed that the majority of construction personnel will be accommodated in purpose-built, mobile construction camps that are strategically located along the pipeline route. The exception to this is likely to be the use of Katherine as a base for small numbers of personnel associated with construction and commissioning operations that are remote from construction camps.

Up to 300 personnel would be accommodated in a single construction camp. In some instances a second 'fly camp' may be required simultaneously, where the distance makes travelling from the single main camp unproductive. In the event of two camps operating at once, it is likely that the main camp would hold up to 200 people and have a footprint of approximately 500 m x 500 m and the smaller

second camp would contain in the order of 100 people and have a footprint of approximately 300 m x 300 m.

The main construction camps will consist of approximately 120 transportable buildings and ancillary services for water storage, power generation, communications and maintenance facilities. Fly camps will require the same facilities as the main camps.

The locations of the construction camps are still to be confirmed. Existing cleared or degraded areas will be used as far as practicable but additional clearing for their construction may be required. To minimise travelling time, camps are likely to be located approximately 120 km apart. During the construction period, it is expected that there will be three stages of camp transportation: mobilisation at the start; relocation during construction (or conversion from main to fly camp); and demobilisation of all facilities at the end of the construction period. Camp relocation will consist of transporting the accommodation huts and other facilities by road to the new location. Most camp locations will be used for approximately two months.

## 2.9 WATER AND POWER

During construction, water will be required for activities such as dust suppression, HDD, hydrotest and camp supplies. The water may be sourced from local bores, rivers and creeks, trucked from existing bores or council supplies, or new bores may be required to be drilled. Potable water may be piped in from watercourses, wells or bores, and treated, or trucked in from the nearest existing source. Identification of water sources will be finalised during the stages of final design. Water usage during construction of the pipeline is likely to be required at the following volumes:

- Fully occupied 300-man camp – 45,000 litres per day
- Dust control along the worst track stretches – 100,000 litres per day
- Hydrotest – volumes to be estimated depending on final pipeline diameter and extent of feasible reuse
- HDD – 8,000 litres per day.

Diesel generators will be used to supply electricity to the construction camps with fuel brought onto site via existing roads or new access tracks.

## 2.10 WASTE

Waste will be generated in varying amounts throughout all phases of the project, although it is expected that the majority of waste will be generated during construction and commissioning.

During the life of the project, waste will arise from three main waste streams: non-hazardous, liquid and hazardous. Non-hazardous wastes will include inert construction material, domestic putrescible waste including food scraps and packaging waste. Construction camps will be a significant source of non-hazardous waste.

Liquid waste will include sewage which will be treated on site and disposed of in accordance with statutory requirements. The type of sewage treatment to be implemented at the construction camps and along the corridor will be determined during detailed design.

Dewatering of the pipeline following hydrotesting, will generate significant volumes of liquid waste. Disposal options will largely depend on the water quality and the receiving landform and might include:

- Release and drain
- Dust control
- Evaporation ponds
- Irrigation.

Hazardous materials such as hydrocarbons (oil, fuel and lubricants) will be used in minimal quantities during construction.

A waste inventory will be developed during the design phase and the preferred treatment and disposal methods identified.

## 2.11 EMISSIONS

### 2.11.1 Atmospheric

The main atmospheric emissions likely to arise during pipeline construction are from vehicle and mobile equipment exhausts as well as combustion emissions from power generation at camps. During commissioning, air pollutants will be similar to those generated during construction but will also include:

- Compressor station start up when the compressor is purged with natural gas
- Pipeline and above ground facility venting operations.

During operation there will be several sources of atmospheric emissions. Emissions will occur from venting of the pipeline during maintenance at MLVs or compressor stations, with minimal emissions associated with the day-to-day operation of the pipeline.

Greenhouse gases (GHG) will be generated during construction from fleet, plant and equipment use.

### 2.11.2 Dust

Dust generation will be most significant during the construction and commissioning phases of the project and will be generated from:

- Clearing of vegetation
- Earth moving activities
- Vehicle movement along unsealed roads and the construction corridor
- Blasting and trenching activities
- Trench padding
- Backfill activities.

During maintenance operations dust will arise due to traffic, although in much smaller amounts than during construction as only occasional inspections of the pipeline are required.

### 2.11.3 Noise and vibration

Noise is expected to be emitted to varying degrees during construction of pipeline and above ground facilities, as well as during operations and planned maintenance.

Sensitive Receptors within 5 km of the pipeline include:

- Beswick Township – approximately 2 km away
- Mainoru – approximately 4 km away

- Dhamiyaka – approximately 3.5 km away
- Nhulunbuy – approximately 3 km away.

Noise emissions from the various stages of pipeline construction include:

- Clear and grade
- Blasting
- Rock hammering
- Trenching and stringing
- Welding and joint coating
- Hydrotesting and dewatering
- Padding, shading and backfilling
- String and road crossings
- Restoration and rehabilitation
- Commissioning.

During commissioning significant noise generation will be attributed to start-up of the compressor stations and above ground facilities; although at most facilities this will be short-lived. Gas fill is likely to provide the most significant noise sources, as air and nitrogen will be vented.

Vibration may be caused by mechanical equipment such as generators, vehicles and earth-moving equipment that are likely to operate during the construction phase.

Where dictated by the ground conditions, blasting will be used to assist during trench construction and is likely to be required near the Mitchell Ranges (approx. KP420 to KP440). However, other areas may be identified during construction. Noise and vibration will be generated from the blasting itself and from the 'airtracks' used to drill the holes.

#### **2.11.4 Light**

Minimal lighting is proposed during construction as night-time works are generally not conducted. However, temporary lighting will be installed for hydrotesting, which is the only planned night-time construction activity. All lighting used will comply with regulatory safety requirements.

Lighting will also be required around the construction camps and at pipe storage areas. During operation, industrial lighting will be required in and around the compressor stations. The lighting of these facilities will be designed to ensure that the light levels are sufficient for safety and plant operations.

## **2.12 OPERATION OF THE PIPELINE**

The pipeline, associated above ground facilities (main line valves and scraper stations) and compressor stations will be operated and maintained in accordance with the Australian Standard and appropriate industry guidelines.

Prior to start-up, a Safety and Operating Plan (SOP) will be prepared for the pipeline. This plan will be the overarching document that draws together the engineering and operation details. The SOP will ensure comprehensive information is available to personnel regarding operations, inspections and maintenance of all facilities. Emergency and reporting procedures will also be in place. Plans and procedures will be reviewed and updated if significant incremental change has occurred.

Water requirements during operation will be minimal.

Waste streams produced during operation will be similar to the construction phase but in significantly smaller quantities and volumes. As all facilities will be unmanned, waste will only be generated during general maintenance or repair routines along the pipeline or at the above ground facilities. All waste will be removed and disposed of in an approved manner and in accordance with regulatory requirements.

Compressor stations will be powered by gas turbines, driven by fuel off-take gas obtained from the pipeline. The use of this gas will be metered and monitored.

Greenhouse gas emissions will be generated from:

- Pipeline fugitive losses and planned venting
- Gas heater
- Compressor station operations
- Major pipeline venting (~ 5 yearly)
- Maintenance and inspection vehicles

Other atmospheric emissions during the operation of the pipeline include NO(x), SO(x) and venting hydrocarbons (**Table 3**).

Noise emissions during operation will largely be associated with maintenance activities.

**Table 3: Atmospheric emissions during operation**

SOURCE	EMISSION
Compressor Station	Combustion emissions: CO(x) NO(x) Hydrocarbons (CH <sub>4</sub> , C <sub>2</sub> H <sub>6</sub> , etc)
MLV and Scraper Facility	Natural gas emitted during pigging, significant venting or emergency venting
Pipeline fugitive losses - valve flange leaks, vents etc	Combustion emissions COx NOx SOx Hydrocarbons (CH <sub>4</sub> , C <sub>2</sub> H <sub>6</sub> , etc)

### 2.12.1 Inspections

Internal inspection of the pipeline will focus on detection of corrosion, and will involve an intelligent pig inspecting the full circumference and length of the pipeline. Inspections using the intelligent pig are generally carried out once every five years or in accordance with the conditions of the pipeline licence.

External inspections will be carried out along the pipeline construction corridor at scheduled intervals throughout the life of the pipeline. Inspections will focus on checking the integrity of the pipeline and identifying any new or changed threats to the pipeline. Due to the nature of the major creek crossings and the remoteness of the pipeline, the inspections are likely to be two to six monthly. Inspections may

also be carried out after heavy rainfall, or other significant events. More frequent monitoring may be scheduled for major creek crossings or sections with a known risk of erosion or flooding.

### 2.12.2 Maintenance

An inspection and maintenance programme will be carried out by approved and appropriately trained personnel and will include the pipeline, all above ground facilities, compressor stations and the cathodic protection system.

A maintenance and operations base will be located near Katherine for central access to the pipeline and all facilities. All remote controlled functions will be directed from a centralised control room.

Routine maintenance activities will occur at the main line valves (MLVs), scraper stations and compressor stations located along the main pipeline route. To allow maintenance to take place a small volume of gas must be vented from the pipeline when the pig launchers and receivers are depressurised.

Regular maintenance of above ground facilities and compressor stations will be carried out to ensure that the control, safety and operating systems are functioning correctly and reliably.

## 2.13 REHABILITATION

Clean up and rehabilitation measures will be applied to the pipeline corridor, access tracks and camp sites in consultation with the relevant land holder/owner following construction. Generally, clean up and rehabilitation will involve removal of construction and material waste, surface contouring, respraying topsoil, replanting vegetation and reseeding. In certain areas a low 'formed camber' of material may be allowed to remain over the trench line to allow for possible subsidence. The formed camber will be broken at regular intervals to prevent disruption to surface water flows. Native vegetation will be allowed to re-establish over disturbed areas (with the exception of the vehicle access track). However, deep rooted trees will not be allowed to re-establish over the buried pipeline.

Provision is proposed for vehicle access along the corridor following restoration however this will be restricted to a single 4WD track adjacent to the pipeline. This area will be kept free of trees and re-spread brush, but grass coverage will be encouraged. The track will be used for commissioning and maintenance during pipeline operations.

It is anticipated that land users will be able to resume their previous activities on top of the pipeline providing that excavation activities are not undertaken and deep rooting vegetation does not establish.

The majority of the areas disturbed by construction of the KGGP will be rehabilitated (**Table 4**).

**Table 4: Summary of disturbance required for the development of the KGGP**

COMPONENT OF THE ACTION	DEVELOPMENT FOOTPRINT (ha)	PROPORTION TO BE RAHABILITATED (ha)
KGGP centreline	600 km X 30m = 1,800 ha	1,560 ha*
Construction access tracks	Unknown as yet to be determined	100%
Compressor stations (1 at this stage and possibly 1 additional)	2.25-4.5 ha	0
Scraper stations	0 (within pipeline corridor)	0
Meter station	0 (inside refinery footprint)	0
Gove gas station	70 m X 30 m = 0.21 ha	0
Construction camps**	3 camps 500m X 500m = 75 ha 2 camps 300m X 300m = 18 ha Total = 93 ha	93 ha

\*permanent access track alongside pipeline route (not to be rehabilitated) is 4m wide (p5-42 of TTP EIS) => residual corridor to be rehabilitated is 600km X 26m

\*\*assume 5 camps (120km apart over 600km route)

## 2.14 DECOMMISSIONING

The pipeline will be designed with an operational life of 50 years.

The objective of decommissioning is to close down operations and abandon the project sites, leaving the environment as near as practicable to its original condition. Decommissioning will be carried out in accordance with legislation, guidelines and industry best available technology at the end of the project life. In general, decommissioning requirements are project-specific, being considered on a case-by-case basis and assessing both the environmental and commercial costs.

There are typically three options involved in the decommissioning of a pipeline. These are:

- Suspension
- Abandonment
- Removal.

Leaving the pipeline in-situ will usually be environmentally preferable to the disturbance associated with excavating to remove the pipeline. It is therefore likely that the pipeline will remain buried.

Under either suspension or abandonment methods, the pipeline will be disconnected from the system. If the suspension method is applied, the pipeline will be filled with an inert material such as nitrogen, and maintained as per an operating pipeline. If the abandonment method is applied then the pipeline will be disconnected from the cathodic protection system and left to degrade. All above ground facilities and supporting structures would be removed and these areas reinstated.

Decommissioning of the pipeline will comply with legislative requirements, relevant Australian Standards and industry practice in force at the time of abandonment, and in consultation with landowners. A detailed decommissioning plan and rehabilitation programme will be developed and implemented in consultation with landowners and relevant authorities at the time of decommissioning to ensure that the area is suitably rehabilitated.



### 3 Legal framework and approval requirements

The KGGP will be constructed and operated in accordance with a range of Northern Territory and Commonwealth legislation relating to planning, environmental assessment and management, and indigenous cultural heritage (**Table 5**).

**Table 5: Indicative approvals required for the KGGP**

LEGISLATION	MATTERS REQUIRING APPROVAL OR CONSIDERATION
<b>Federal</b>	
Environment Protection and Biodiversity Conservation Act	Impacts to Listed Threatened and Migratory Species
Aboriginal Land Rights (Northern Territory) Act	Negotiations around the granting of an interest in land held by a Land Trust
Native Title Act	Compulsory acquisition of, consultations about, or negotiation over impacts on native title rights
<b>Northern Territory</b>	
Aboriginal Land Act	Entering Aboriginal Freehold lands
Energy Pipelines Act	Accessing land for surveys and pipeline operational licence
Environmental Assessment Act	Impacts on the environment
Heritage Act	Disturbance of sites of Aboriginal archaeology, Macassan or European heritage
Lands Acquisition Act	Access for surveys
Northern Territory Aboriginal Sacred Sites Act	Protection of Aboriginal sacred sites
Waste Management and Pollution Control Act	Solid and hazardous waste disposal
Water Act	Discharge into waterways

## 4 Existing environment, key risks and mitigation

### 4.1 ECONOMIC SETTING

The major economic activity within the region traversed by the KGGP is mining and pastoral enterprise. There are a number of prospective mining areas subject to exploration leases along the KGGP corridor however the major mining activity in the region is the bauxite mine and refinery at Gove. The proposed pipeline route passes through the existing Special Mineral Lease 11, which is owned by Pacific Aluminium (Swiss Aluminium Australia Ltd and Gove Aluminium Limited in a 70%/30% unincorporated joint venture) and operated and managed by Pacific Aluminium (Alcan Gove Pty Limited). Operations at this location include the bauxite mine, conveyor corridor and alumina refinery.

### 4.2 REGIONAL SETTING

#### 4.2.1 Land tenure and use

The majority of the proposed pipeline route traverses Aboriginal freehold lands and pastoral lease (in the south western section). A small proportion of the route lies on Crown Lease. Depending on the location of the connection of the KGGP to the NT Gas Pipeline, the route may pass through a number of freehold properties in the Katherine region.

Aboriginal freehold land along the pipeline corridor is held by the Beswick Aboriginal Land Trust and the Arnhem Land Aboriginal Land Trust. Pastoral Lands include Mainoru, Mountain Valley, Goondooloo and Moroak pastoral leases.

#### 4.2.2 Population centres

Katherine and Nhulunbuy are the main townships in the vicinity of the KGGP.

Katherine is located 317 km south of Darwin on the Stuart Highway and has approximately 10,000 inhabitants. The KGGP will connect with the existing NT Gas Pipeline at a yet to be determined location between Katherine and Mataranka (approximately 20 km south of Katherine).

Nhulunbuy is a township and community of approximately 5000 people. Township facilities also service the local Aboriginal Communities of Yirrkala and Gunyangara and remote Aboriginal homelands. Nhulunbuy has become an important commercial and administrative regional centre for Arnhem Land. The two major employers are the Government and Pacific Aluminium's bauxite mining and alumina refining operations.

Within the vicinity of the KGGP there are a number of smaller communities with populations of less than 1,000 persons. These include: Barunga (Bamyili), Bulman, Weemol, Beswick, Tindal, Barrapunta, Dhunganda, Donydji, Galingar, Dhamiyaka, Gurumuru, Dhalinybuy, Baghetti, Mobarn, and Maranboy (Figure 4).

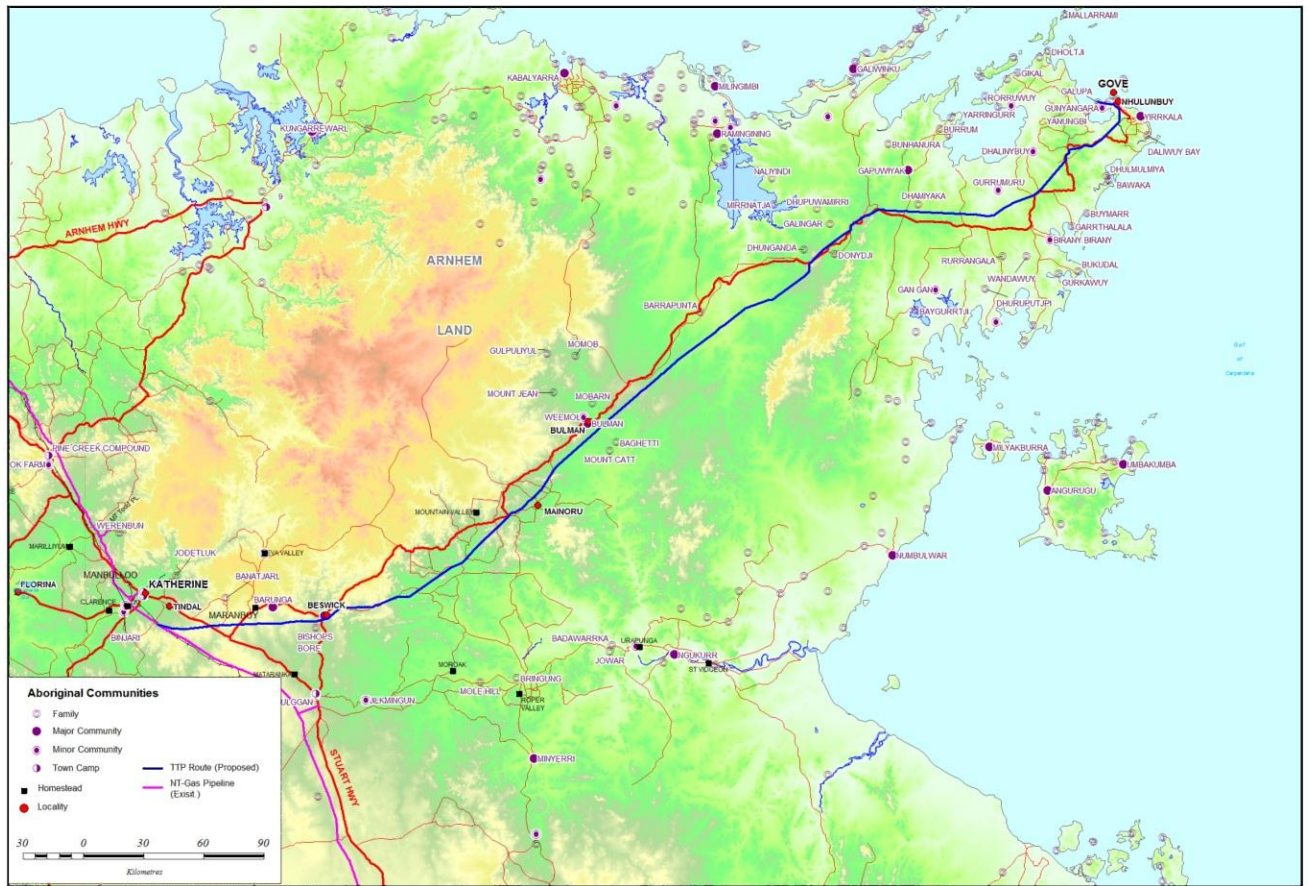


Figure 4: Population centres along the KGGP route

#### 4.2.3 Local Government Authorities (LGAs)

The KGGP corridor traverses the LGAs of Katherine Town Council, Roper Gulf Shire and East Arnhem Shire. At Gove, the pipeline corridor also traverses the Township of Nhulunbuy which is managed by the Nhulunbuy Corporation Limited.

None of the local governments have an approving role for the pipeline although they will be consulted during the design and construction phases.

### 4.3 PHYSICAL SETTING

#### 4.3.1 Climate

The climate across the region traversed by the KGGP is typical of the 'Top End' of the NT, being characterised by a 'dry season' from May to September and a 'wet season' from October to April. Mean annual rainfall at Tindal is 1081 mm with January the wettest month (267 mm). At the other end of the KGGP route, the climate is reflective of coastal tropical conditions. Nhulunbuy has a mean annual rainfall of 1471 mm with February the wettest month (283 mm) (BoM 2012).

Temperatures across the KGGP route follow the seasonal patterns of the wet and dry seasons. June is the coolest month at Tindal with a mean maximum of 29.7° C and a mean minimum of 14° C. July is the coolest month in Nhulunbuy with a mean maximum of 27.7 ° C and mean minimum of 20.2° C (BoM 2012).

### 4.3.2 Topography and landforms

To the east of Katherine the KGGP passes through the High Black Range and skirts the edge of Arnhem Land Plateau for approximately 200 km of its total length. The pipeline will then transect the Mitchell Ranges along the eastern section of the route, before reaching the Gove Peninsula. **Table 6** describes the general topography along sections of the pipeline route.

**Table 6: Topography along the KGGP route**

PIPELINE KP*	TOPOGRAPHY
0–80	Generally limited topographic variation. Some stream crossings and undulations may be encountered..
80–110	Large topographic variations as valleys and ridges associated with a mountain/hills system.
110–390	Flood plain area with flats and seasonal streamlines associated with drainage from the Arnhem Plateau to the north-west of the area.
390-430	Large topographic variations as valleys and ridges associated with the northern portion of the Mitchell Ranges.
430-525	Flood plain area with flats and seasonal streamlines associated with monsoonal drainage lines.
525–550	Large topographic variations as valleys and ridges associated with a mountain/hill system.
550–600	Flat topography with a slope towards the coast. Some tidal-influenced streams may be encountered.

\* Approximate

## 4.4 ENVIRONMENTAL SETTING

### 4.4.1 Overview

The KGGP traverses four bioregions identified in the Interim Biogeographic Regionalisation of Australia (Environment Australia 2000). These are the Daly Basin, Gulf Fall and Uplands, Central Arnhem and Arnhem Coastal bioregions.

### 4.4.2 National Parks, conservation reserves and Indigenous Protected Areas (IPAs)

Conservation is an important land management activity within the broader region traversed by the proposed pipeline. The pipeline route does not pass through any declared national parks or reserves. The proximity of the pipeline corridor to nearby national parks and reserves is shown in **Table 7**.

**Table 7: Proximity of the proposed KGGP to National Parks and reserves**

PARK OR RESERVE	DISTANCE FROM THE KGGP (KM)
Cutta Cutta Caves Nature Reserve	3
Nitmiluk National Park	21
Kakadu National Park	62
Elsey National Park	35
Limmen National Park	92

The most significant National Park in the region is Kakadu National Park which is located approximately 60 km to the north of the proposed pipeline route. This park is classified as a World Heritage Site by the United Nations Educational Scientific and Cultural Organisation (UNESCO). Kakadu is also an internationally designated RAMSAR site.

Nitmiluk National Park (292,000 ha) is owned by the Jawoyn Aboriginal people and is jointly managed with the Parks and Wildlife Commission of the Northern Territory.

Cutta Cutta Caves Nature Reserve was designated as a nature park in 1967. As many as five species of bats frequent the caves including the ghost bat (*Macroderma gigas*) and the orange horse-shoe bat (*Rhinonictis aurantius*) which are considered rare and highly specialised species. In addition, around 170 species of birds have been recorded in the park including the Hooded Parrot (*Psephotus dissimilis*) and the endangered Gouldian Finch (*Erythrura gouldiae*) (PWC 2012).

In the northern most section, the pipeline corridor traverses two Indigenous Protected Areas (IPAs): Dhimurru IPA and the Laynhapuy IPA. These are areas of land (and sea), for which the traditional Aboriginal owners have entered into a voluntary agreement with the Federal Government for the purposes of promoting and conserving biodiversity and cultural values. IPAs form part of the National Reserve System. Together, the Dhimurru IPA and the Laynhapuy IPA comprise the northeast corner of Arnhem Land, with the exception of Nhulunbuy township and other settled areas.

#### **4.4.3 Sites of conservation significance**

The Northern Territory Government has identified 67 sites of conservation significance across the NT. These sites represent some of the most important areas for biodiversity conservation. The KGGP is proposed to pass through the 'Gove Peninsula and north-east Arnhem coast' site of conservation significance. This area largely overlaps the Dhimurru and Laynhapuy IPAs and has been identified in recognition of ecological values that include 18 threatened species. A number of species are restricted within the NT to the north-east Arnhem region, with biogeographic affinities with Cape York. (DLRM 2012)

### **4.5 ENVIRONMENT AND KEY RISKS**

#### **4.5.1 Landform and soils**

##### ***Existing environment***

The proposed KGGP will traverse a range of landforms and soils, most of which have the potential to erode if not adequately managed. Published soils and land system data sets were reviewed and mapped during the TTP EIS investigations however they did not provide the detail required for full interpretation of the soils and their potential erodibility. Further field sampling was undertaken along the pipeline corridor and the results presented in Volume II (Appendices C and D) to the TTP draft EIS. Additional ground observation prior and during construction was considered necessary to validate decisions on appropriate preventative and management options.

Lowland river and wetland systems in the Latram River Valley and Goromuru River Valley in the northern section of the KGGP route were identified in the TTP studies as having the potential for acid sulphate soils. Soil samples were taken at these locations and while most contained clays at depth, none were considered wet suggesting they were unlikely to be acid sulphate soils.

Karst features are known in the region to the north of the pipeline route between KP0 and the Stuart Highway near Katherine. Here the route nears the southern extremity of the Tindall Limestone. In this

region the pipeline route passes 3km to the south of the Cutta Cutta Caves Nature Reserve (Golder Associates 2004).

### ***Potential impacts***

Risks from water erosion are high during the Top End's wet season when rainfall intensity can be extreme. Slope is a critical factor in determining erodibility of soils and landscapes in northern Australia where significant soil erosion can occur even on exceptionally low slopes.

Potential impacts relating to soil erosion, compaction and sedimentation are primarily associated with construction activities but will also be relevant post-construction. Activities involving removal of vegetation, alteration of runoff and disturbance of soils will heighten erosion risk and require careful management. Such activities include trenching, stockpiling, cutting and filling, and construction and use of infrastructure such as borrow pits, roads, temporary work camps and associated above ground facilities (such as scraper, MLV and compressor stations). Erosion risk will be particularly high in relation to watercourse crossings with potential downstream sedimentation and turbidity impacts.

Oxidation of any acid sulphate soils exposed during trenching for the pipeline has the potential to release sulphuric acid into the environment with consequent potential adverse impacts on water quality, flora and fauna. However, no acid sulphate soils have been identified to date in the pipeline corridor.

There is a potential that pipeline construction will disturb karst features near Katherine however, geotechnical investigations for the TTP indicated no obvious sinkholes on the pipeline route in this area (Golder Associates 2004).

### ***Management and mitigation***

The pipeline will be buried below ground and rehabilitated very quickly after installation. Significant topographical features have been avoided as far as practical during the route selection process.

A detailed Erosion and Sediment Control Plan will be developed in accordance with NT Government and best-practice guidelines. The plan will identify site-specific construction techniques, management requirements and guidelines for all disturbed areas and will specifically address: the mitigation of impacts at watercourse crossings (for which a specific plan will be developed); progressive rehabilitation throughout construction to minimise exposure of bare soil; and stormwater and drainage management systems for facility sites. HDD techniques will be used to install the pipeline across water courses where bank stability is of concern.

Additional field investigations are intended to clarify the risks of acid sulphate soils in the areas already identified. Should the results from these investigations indicate that acid sulphate soils are present and will be disturbed during construction, an Acid Sulphate Soils Management plan will be prepared to mitigate the potential impacts.

## **4.5.2 Flora and vegetation**

### ***Existing environment***

The KGGP route passes largely through Aboriginal freehold lands with undisturbed vegetation communities that are in good ecological condition. Where the route passes through pastoral leases, vegetation cover is generally intact, although in some areas the impacts of weeds, cattle and feral animals are evident (EcOz 2004b).

The vegetation patterns along the route were described by EcOz (2004b) and are presented in **Table 8**.

Table 8: Vegetation along the KGGP

KP*	VEGETATION PATTERNS
0 to 50	Gently undulating sandy plains dominated by <i>Eucalyptus tetrodonta</i> open forest often with <i>Corymbia bleeseri</i> , <i>Corymbia dichromophloia</i> , <i>Corymbia latifolia</i> and <i>Erythrophleum chlorostachys</i> , and tussock grasses in the understorey.
50 to 75 (Waterhouse River)	Undulating plains dominated by <i>Eucalyptus tectifica</i> and <i>Corymbia latifolia</i> open woodland to woodland with <i>Themeda triandra</i> , <i>Heteropogon contortus</i> and <i>Sarga</i> spp. tussock grasses in the understorey. The plains are dissected by channels of Beswick Creek and Waterhouse River with fringing forests dominated by <i>Melaleuca</i> spp. and <i>Eucalyptus camaldulensis</i> and a dense mid storey of species such as <i>Pandanus aquaticus</i> and <i>Barringtonia acutangula</i> .
75 (Waterhouse River) to 110	Low sandstone hills and rises with areas of rugged dissected plateaux and rocky ridges dominated by either <i>Eucalyptus miniata</i> and <i>E. tetrodonta</i> forest with <i>Eucalyptus phoenicea</i> and <i>Corymbia bleeseri</i> , or <i>Corymbia latifolia</i> , <i>Eucalyptus tectifica</i> and <i>Corymbia foelscheana</i> open woodland, both with tussock grasses in the understorey. The broad fluvial corridor associated with the Chambers River meanders through the hills and is dominated by a fringing forest of <i>Eucalyptus camaldulensis</i> .
110 to 190	Level to gently undulating plains with clay soils dominated by <i>Eucalyptus tectifica</i> and <i>Corymbia latifolia</i> woodland with a variety of co-dominant species in the understorey including <i>Mnesithea rottboellioides</i> , <i>Arundinella nepalensis</i> , <i>Heteropogon contortus</i> and <i>Schizachyrium fragile</i> . The plains are dissected by broad fluvial corridors and low hills and rises on siltstone which are dominated by <i>Melaleuca</i> spp. and <i>Eucalyptus pruinosa</i> open woodland with a sparse understorey of tussock grasses and <i>Eriachne</i> spp.
190 to 220	Gently undulating to hilly terrain on basalt, and low hills and rises on siltstone, both dominated by open woodlands of <i>Eucalyptus patellaris</i> , <i>Corymbia confertiflora</i> , <i>Corymbia terminalis</i> , <i>Corymbia bella</i> and <i>Eucalyptus tectifica</i> , with tussock grasses in the understorey. <i>Melaleuca</i> spp. Open woodlands with <i>Triodia</i> spp. and <i>Sarga</i> spp. grasses in the understorey occur in wetter areas. Broad fluvial corridors are associated with the Mainoru River and Wilton River. The fringing forests are dominated by <i>Melaleuca cajuputi</i> closed forest and <i>Casuarina cunninghamiana</i> and <i>Lophostemon lactifluus</i> respectively.
220 to 420	Undulating slopes with rises and low hills, dominated by <i>Eucalyptus miniata</i> and <i>E. tetrodonta</i> woodlands to open forests with <i>Petalostigma quadriloculare</i> , <i>Triodia</i> spp., <i>Sarga</i> spp. and <i>Eriachne</i> spp. in the understorey. East of the Wilton River the country grades into gently undulating sand plains dominated by <i>Eucalyptus miniata</i> and <i>E. tetrodonta</i> woodlands to open forests, sometimes with <i>Callitris intratropica</i> . The vegetation has a notably dense shrubby understorey dominated by a variety of species including <i>Pachynema complanatum</i> , <i>Acacia</i> spp., <i>Fimbristylis</i> spp., <i>Hibbertia dealbata</i> , <i>Schizachyrium fragile</i> and <i>Triodia</i> spp. (Spinifex). Isolated swamp depressions and alluvial floodplains associated with the Annie Creek and Goyder River systems typically support <i>Melaleuca</i> spp. closed forests with <i>Eriachne</i> sp in the understorey. The fringing riparian forests are dominated by <i>Melaleuca</i> spp. with <i>Pandanus aquaticus</i> , <i>Acacia leptocarpa</i> and <i>Barringtonia acutangula</i> .

KP*	VEGETATION PATTERNS
420 to 430 (Mitchell Ranges)	Elevated rocky plateaux and rolling to steep hills dominated by open woodland of <i>Eucalyptus tetradonta</i> , <i>E. miniata</i> , <i>E. phoenicea</i> and <i>Callitris intratropica</i> .
430 (Mitchell Ranges) to 530 (Cato River)	Gently undulating sandy plains dominated by <i>Eucalyptus tetradonta</i> and <i>E. miniata</i> woodlands to forests with tussock grasses in the understorey. The sandy plains are dissected by floodplains and channels associated with the Goromuru River, Boggy Creek and the Cato River, which are dominated by forests of <i>Melaleuca viridiflora</i> and <i>Lophostemon lactifluus</i> with <i>Imperata cylindrica</i> and other sedge species in the understorey.
530 (Cato River) to Alcan Gove Refinery	Gently undulating plains associated with bauxite, dominated by <i>Eucalyptus tetradonta</i> woodland to forest with <i>Sarga</i> spp. tussock grasses in the understorey. <i>Eucalyptus miniata</i> is notably absent as a co-dominant in the vegetation east of the Cato River. The plains are dissected by narrow floodplains and channels associated with the Giddy River, Latram River and coastal inlets on the east coast of the Gove Peninsula, which are typically dominated by closed forest of <i>Melaleuca</i> spp., <i>Corymbia polycarpa</i> and <i>Lophostemon lactifluus</i> with <i>Imperata cylindrica</i> in the understorey.

\* Approximate

Vegetation communities of conservation significance occurring along the KGGP route include: riparian corridors, wetlands (swamps and floodplains), monsoon vine forests and sandstone communities. Vegetation surveys for the TTP project recorded one threatened species *Pternandra coerulescens* (EcOz 2004b).

### Potential impacts

Potential significant impacts on vegetation and flora have been minimised during the design phase of the project by locating the pipeline corridor and infrastructure to avoid vegetation communities of high conservation value. Residual potential impacts from construction, maintenance and operation of the pipeline could be expected to include:

- Loss of vegetation from clearing activities (approximately 1,900 ha from pipeline clearing and ancillary infrastructure)
- Degradation of sensitive vegetation communities and habitats from the introduction and spread of exotic species or edge effects
- Indirect impacts to adjacent vegetation through unauthorised access erosion/sedimentation and/or dust deposition
- Increase in bushfire risk from the introduction of ignition sources during and following construction.

### Management and mitigation

The potential impacts of vegetation removal will be mitigated through implementation of detailed vegetation clearing and rehabilitation plans that will ensure stabilisation of cleared land, rehabilitation with native plants species, monitoring to minimise erosion/sedimentation impacts and weed hygiene measures. Pre-clearing procedures will ensure that clearing boundaries are clearly marked to ensure no impact outside of the approved corridor/footprint.



A fire management plan will be prepared and implemented.

Horizontal directional drilling will be used to minimize impacts on riparian vegetation at significant water crossings. A 500 m buffer is to be maintained around monsoon vine forest patches.

#### 4.5.3 Fauna

##### *Existing environment*

The following major fauna habitats were identified within or near to the pipeline route (EcOz 2004a):

- Eucalyptus forests and woodlands
- Floodplains
- Riparian corridors
- Sandstone communities
- Permanent and seasonal swamps
- Monsoon rainforest patches.

Desktop and field surveys of terrestrial and aquatic fauna for the TTP project were conducted during the 2003 early wet season and the 2004 dry season. A total of 157 fauna species were recorded within the KGGP section of the TTP alignment. This included 17 amphibians, 33 reptiles, 92 birds and 15 mammals (EcOz 2004a).

An aquatic fauna survey of the TTP route was undertaken in 2003-04. The survey found healthy fish assemblages in the rivers to be crossed by the KGGP including a number of new records for the Northern Territory and range extensions. The highest species diversity was recorded from the Cato River (Wilson and Brooks 2004).

Information from 03-04 TTP EIS studies (EcOz 2004a, Wilson and Brooks 2004) together with information from the EPBC Act Species Profile Database (SPRAT) has been used to provide an indication of the potential occurrence of fauna species of conservation significance under the *Territory Parks and Wildlife Conservation Act* (**Table 9**). Further survey of the pipeline route is proposed for the early wet season 2012 and early dry season 2013 and will provide the basis for further developing this assessment.

**Table 9: Species of NT conservation significance likely to occur within or near the KGGP corridor.**

SPECIES	STATUS	LIKELIHOOD OF OCCURRENCE*
<b>Birds</b>		
<i>Erythrotriorchis radiates</i> (Red Goshawk)	Vulnerable	<b>Likely.</b> Several Records of this species in NT Fauna Atlas in proximity to pipeline route. Suitable habitats present.
<i>Erythrura gouldiae</i> (Gouldian Finch)	Endangered	<b>Recorded.</b> Gouldian Finch has been recorded in field surveys at Chambers River (approx. KP 100). Suitable habitat for this species is present between approximately KP0 and KP110.
<i>Falcunculus frontatus whitei</i> (Crested Shrike-tit (northern))	Vulnerable	<b>Likely.</b> Suitable habitats occur across the pipeline corridor. Few records of this species are known regionally, however there have been recent records in the Maranboy region (near KP 40 and within 5 km of the KGGP) (Ward 2008).

SPECIES	STATUS	LIKELIHOOD OF OCCURRENCE*
<i>Rostratula australis</i> (Australian Painted Snipe)	Vulnerable	<b>Possible.</b> Shallow inland wetlands comprise the preferred habitat of this species, some of which occurs along the pipeline route.
<i>Tyto novaehollandiae kimberli</i> (Masked Owl (northern))	Vulnerable	<b>Possible.</b> Preferred habitat consists of riverine forest, rainforest, open forest, paperbark swamp and the edge of mangroves. Some habitat present along corridor.
<i>Geophaps smithii smithii</i> (Partridge pigeon (eastern))	Vulnerable	<b>Likely.</b> Prefers primarily open forest and woodland habitat which is present along the corridor.
Insects		
<i>Euploea alcatheae enastri</i> (Gove Crow Butterfly)	Endangered	<b>Unlikely.</b> Pipeline route has been designed to avoid habitat for this species.
Mammals		
<i>Conilurus penicillatus</i> (Brush-tailed Rabbit-rat, Brush-tailed Tree-rat)	Vulnerable	<b>Possible.</b> The pipeline corridor is located well south of the primary distribution of this species. However NT Fauna Atlas shows some records further south towards the pipeline corridor.
<i>Dasyurus hallucatus</i> (Northern Quoll)	Critically endangered	<b>Likely.</b> Preferred habitat occurs across full length of the pipeline and this species has been recorded to the west of the pipeline route.
<i>Macrotis lagotis</i> (Greater Bilby)	Vulnerable	<b>Highly Unlikely.</b> Pipeline corridor lies well north of the known distribution of this species and limited habitat present.
<i>Notomys aquilo</i> (Northern Hopping-mouse)	Vulnerable	<b>Unlikely.</b> Largely restricted to sandy substrates, particularly those supporting floristically diverse heathlands and/or grasslands (Woinarski et al. 1999 as cited in Alcan Gove 2004). Majority of specimens known from Groote Eylandt and coastal north-eastern Arnhem Land and preferred habitat not present.
<i>Phascogale pirata</i> (Northern Brush-tailed Phascogale)	Vulnerable	<b>Possible.</b> Pipeline well south of recent records although old records exist from around Katherine and Gove. Preferred habitats present in site.
<i>Mesembriomys macrurus</i> (Golden-backed Tree-rat)	Critically endangered	<b>Possible.</b> Small areas of suitable riverine habitat may be present within pipeline corridor.
<i>Isodon auratus auratus</i> (Golden bandicoot)	Endangered	<b>Possible.</b> Habitat preference comprises hummock grass and shrublands on sandstone and vine thicket.
Reptiles		
<i>Bellatorias obiri</i> (Arnhem Land Egernia)	Vulnerable	<b>Unlikely.</b> Largely restricted to sandstone outcrops, typically with extensive fissures and cave systems.
Amphibians		
<i>Rana daemeli</i> (Wood Frog)	Near threatened	<b>Recorded.</b> Wood frog was recorded at Giddy and Cato Rivers during 2003-04 survey for the TTP EIS

Sharks		
<i>Pristis microdon</i> (Freshwater Sawfish)	Vulnerable	<b>Possible.</b> Historically, the Freshwater Sawfish has been reported in the lower reaches of several rivers in Eastern Arnhem Land including the Goyder River and Cato River.

\*Likelihood definitions:

Recorded – Recorded within the corridor.

Highly unlikely – No preferred habitat in corridor and known populations a large distance away from corridor.

Unlikely – Preferred habitat or similar available in corridor but known populations a large distance away from the corridor.

Possible – Preferred habitat or similar available in corridor and known populations in close proximity to the corridor.

Likely – Preferred habitat or similar available in corridor and known populations in close proximity to the corridor.

### Potential impacts

The project has the potential to directly or indirectly impact terrestrial and aquatic fauna through construction, maintenance and operation of the gas pipeline, particularly through disturbance and vegetation removal along the corridor and at sensitive sites such as river crossings where erosion and sedimentation impacts could occur. Key potential impacts include:

- Removal and fragmentation of fauna habitats
- Changes to sediment load or water chemistry in adjacent watercourses
- Mortality due to disturbance during construction
- Fauna capture and mortality in the open trench during construction
- Introduction and spread of weed and feral species.

### Management and mitigation

Physical disturbance and vegetation removal along the pipeline corridor will be kept to the minimum necessary. Rehabilitation will be planned prior to construction and will be staged with the scheduling of trenching to minimise the lag between clearing and rehabilitation and revegetation. Water crossings will be constructed early in the dry season and will be designed to avoid permanent waterholes that provide fauna refuges. Horizontal directional drilling will be used for sensitive river crossings. Trenches will be open for the minimum possible period, escape ramps will be installed and the open trench will be monitored by qualified wildlife handlers. An exotic species management plan will be developed to prevent introduction or spread of weeds and pest species. Habitat fragmentation will be reduced by allowing revegetation over the installed pipeline (with the exception of deep rooted plants).

#### 4.5.4 Surface water and groundwater hydrology

##### Existing environment

River basins and the major permanent rivers crossed by the KGGP are:

- Daly River Basin (minor extent near Katherine)
- Roper River Basin – Wilton River, Waterhouse River
- Goyder River Basin – Goyder River
- Buckingham River Basin – Buckingham River, Cato River, Giddy River and Latram River.

The KGGP also crosses a number of other creeks and streams as well as numerous lesser drainage features.

Many wetlands occur within the region traversed by the KGGP including the internationally significant Arafura Swamp in central Arnhem Land (approximately 25 km northwest of the KGGP at the closest point), seasonally inundated floodplains, permanent and semi-permanent freshwater lake systems and ephemeral saline lakes.

The KGGP traverses shallow, high-yielding aquifers that have high resource value and environmental beneficial uses that would be sensitive to development impacts. Relatively minor groundwater extraction occurs in the Roper, Goyder and Buckingham river basins for small community supplies. Groundwater features at Cutta Cutta Caves and Mataranka are down-gradient from the KGGP and are important for tourism (EWL 2004).

### ***Potential impacts***

Potential impacts from constructing the KGGP include erosion and sedimentation, adverse changes to the quality of surface water and groundwater (including chemical contamination) and a decline in the health of aquatic flora and fauna and wetland ecosystems.

These impacts may potentially occur from a range of activities associated with pipeline construction including vegetation and soil disturbance, road and borrow pit construction, fuel and chemical storage, disposal of sewage and grey water and sourcing and disposal of hydrotest water.

### ***Management and mitigation***

Careful route selection has resulted in the avoidance of many wetland and other surface water features. Horizontal Directional Drilling is proposed at seven sensitive watercourse crossings to further reduce potential impacts.

A range of preventative and management measures will be developed and implemented within a number of management plans including:

- Erosion and Sediment Control Plan
- Watercourse Crossing Construction Management Plan
- Acid Sulphate Soils Management Plan
- Waste Management Plan
- Hydrotest Management Plan
- Spill Contingency Plan.

## **4.5.5 Weeds and Exotic Fauna Species**

### ***Existing environment***

Fourteen weed species declared under the *Weeds Management Act* were identified in the 2004 field surveys and desk top review undertaken for the TTP EIS. At that time, weeds were most prevalent on land under pastoral lease (EcOz 2004b). Since development of the TTP EIS, additional weed declarations have occurred (most notably Gamba Grass *Andropogon gayanus*) and zoning changes have been made regarding management requirements under the Act.

Infestations of the Yellow Crazy Ant (*Anoplolepis gracilipes*) are known from disturbed sites at Nhulunbuy and at other sites in the northern portion of the KGGP route, particularly where the route

comes into close proximity with the Central Arnhem Highway. Yellow Crazy Ants are at greatest risk of spread from September to November when new queens are dispersing (Hoffmann B pers com).

### ***Potential impacts***

The potential introduction and spread of weed and exotic fauna species will be a critical issue in the construction and management of the Katherine to Gove Gas Pipeline. Without appropriate controls, weed species could be introduced and spread into areas that are relatively weed-free, especially in areas through north-east Arnhem Land. The transport of Crazy Ants would also be a significant risk in the absence of appropriate controls.

The greatest risks will occur during construction when there will be significant disturbance associated with vegetation clearance and the transport of vehicles, equipment and materials across the project area.

### ***Management and mitigation***

An Exotic Species and Weed Management Plan will be developed and implemented to minimise potential impact. The plan will specify appropriate hygiene measures including the need for all plant, equipment and vehicles to be cleaned and will include workforce inductions and briefings to increase awareness and understanding of the risks and mitigation procedures. The Management Plan would have a specific program for control of Yellow Crazy Ants.

Rehabilitation and landscaping will be undertaken in accordance with a Rehabilitation Management Plan, which will specify the use of native vegetation species. All disturbed areas will be monitored for weed establishment.

## **4.5.6 Fire**

### ***Existing environment***

Bushfires are frequent and widespread throughout the grassy savannas of Northern Australia. Depending on seasonal conditions bushfires can occur in the Top End anytime between March and December each year. Much of the region through which the KGGP traverses is burnt on an annual basis.

### ***Potential impacts***

A controlled burning program will be implemented to minimise the impacts of wildfire on the construction work force and infrastructure. This will entail the lighting of small strategic patch burns early in the dry season at many points along the pipeline route. The integrity of the vegetation in and around the project area could be diminished by more frequent planned and unplanned fires.

### ***Management and mitigation***

A Fire Management Plan will be prepared to address bushfire prevention and management during construction and maintenance of the KGGP, including training and the controlled burn program,

The controlled burn program will be developed in association with relevant stakeholders using the latest fire management technologies and information. This Plan will detail all aspects of the controlled burning program including the coordination of weed and fire management activities, workforce inductions and the use of skilled personnel in all aspects of fire management. Post construction of the KGGP, access along the pipeline route will not be encouraged other than for routine maintenance purposes.

#### 4.5.7 Greenhouse emissions

##### ***Existing environment***

Total greenhouse gas emissions from the Northern Territory (including land use, land use change and forestry) were 14.7 million tonnes of carbon dioxide equivalent during 2009-10. This represented 2.6% of national emissions (Dept Climate Change and Efficiency, 2012). Stationary energy and agriculture are the sectors contributing the majority of Northern Territory greenhouse gas emissions. The principal source of emissions from agriculture is the burning of savannas (Dept Climate Change and Efficiency, 2012).

##### ***Potential Impacts***

The construction and operation of the KGGP will lead to greenhouse gas emissions from:

- Vehicles
- Power generation
- Fugitive releases
- Pipeline venting
- Land clearing
- Control burning.

The TTP environmental studies predicted that operation of the compressor stations would comprise the major emissions during operation of the pipeline. It is anticipated that the KGGP will be constructed and operated differently to the TTP proposal. Revised greenhouse gas emission estimations will be undertaken and submitted in the EIS documentation.

##### ***Mitigation***

The KGGP will operate within the national legislative and policy context including carbon pricing mechanisms and the National Greenhouse and Energy Reporting Scheme. Additional measures will be considered during the preparation of the Greenhouse Gas Emissions Management Plan.

#### 4.5.8 Archaeology and historic heritage

##### ***Existing Environment***

Macassan and Aboriginal archaeological sites are protected under the Northern Territory *Heritage Act*. Consent is required to disturb or destroy archaeological sites. European heritage sites are afforded protection under the *Heritage Act* if formally declared. The Federal EPBC Act protects heritage sites of national significance.

Two field surveys were carried out along the proposed pipeline route as part of the TTP EIS to identify archaeological and heritage sites. The results of these surveys were documented in Appendix L, Volume 2 of the TTP draft EIS.

For the section of the pipeline route now comprising the KGGP proposal, 13 archaeological sites and number of background scatters were located during the survey (Begnaze 2004).

The locations of above ground infrastructure for the KGGP are yet to be determined. Archaeological surveys will be undertaken for these sites as required. An additional archaeological survey will also be

undertaken for an area of the pipeline corridor that was not able to be surveyed during the TTP EIS. This section is between KP395 and KP430 (approx.) in the Mitchell Ranges of north-east Arnhem Land.

Sacred sites are dealt with in Section 5.

### ***Potential Impacts***

The potential impacts on archaeological and heritage sites have been significantly reduced through careful route selection during the design phase to avoid known sites.

Nine of the identified archaeological sites and a number of the background scatters are located within 200 m of the centre line of the proposed KGGP route and are vulnerable to disturbance during the construction of the pipeline. It should be noted that a section of the KGGP remains to be surveyed (Begnaze 2004).

None of the archaeological sites identified within 200 m of the centreline of the pipeline are of high significance. One site was assessed as moderate-high significance (Begnaze 2004).

All background scatters located during the surveys have been assessed as having low archaeological significance. The methods used during the survey ensured that the artefact's location, dimensions, type and raw material were documented. Consequently, the isolated artefacts have little potential for contributing to further knowledge (Begnaze 2004).

There are no sites of European heritage declared under the Heritage Act that will be disturbed during construction of the pipeline.

A recent search of the register of national heritage sites indicated that there are no registered sites that will be impacted upon by construction of the pipeline.

### ***Management and mitigation***

A Cultural Heritage Management Plan will be developed to collate all preventative and management measures that will be implemented to protect archaeological and historic heritage values. Sites with moderate to high archaeological significance will be given various levels of protection, including temporary fencing of the site during construction, and restrictions on work within a certain distance from the site. Where it is deemed that it is not feasible to protect archaeological sites of low significance, consent to disturb will be sought under the *Heritage Act* and through consultation with traditional Aboriginal owners.

An archaeologist will be in attendance during pipeline trenching.

## 5 Aboriginal sacred site clearance

Considerable consultation with traditional owners on the protection of sacred sites along the KGGP corridor was undertaken during the preparation of the TTP draft EIS.

Pacific Aluminium acknowledges that the earlier consultations and ground surveys conducted through the TTP EIS process will need to be updated by instigating the appropriate consultative processes through AAPA and the NLC. Initial discussions with the NLC have commenced and Pacific Aluminium places a high priority on working with traditional owners to ensure that construction and operation of the KGGP does not damage or impact any sacred sites along the corridor.

In addition to updating the earlier work on sacred sites, Pacific Aluminium will instigate new consultative processes for an area of the pipeline corridor that was not able to be surveyed during the TTP EIS. This section is between KP395 and KP430 (approx.) in the Mitchell Ranges of north-east Arnhem Land.



## 6 Environmental management and commitments

### 6.1 ENVIRONMENTAL MANAGEMENT PLANS

The key environmental risks from constructing and operating the KGPP are:

- Loss of habitat for threatened species from land clearing or habitat fragmentation
- Wildlife mortality from construction activities and trench fall during the period in which the pipeline trench is open
- Disturbance to aquatic fauna during construction across water courses
- Erosion, runoff and soil compaction from trenching and reinstatement
- Alteration of natural drainage and hydrology particularly during construction across water courses
- Localised pollution from inappropriate waste disposal, particularly liquid wastes.
- Emissions of greenhouse gases and their contribution to global climate change
- Introduction or spread of invasive species along the pipeline corridor, particularly Gamba Grass and Yellow Crazy Ant
- Altered fire regimes resulting from new ignition sources, planned hazard reduction or unauthorised use of the pipeline route to access currently inaccessible areas
- Disturbance or destruction of indigenous cultural heritage
- Physical hazards from accidents or equipment failures

**Table 10** summarises the risks, potential impacts and approaches to mitigation that will be applied to during construction of the KGPP.

In further developing the KGPP proposal, Environmental Management Plans (EMPs) will be developed for the critical environmental risks. At a minimum, the following EMPs will be required:

- Terrestrial and Aquatic Fauna Management Plan
- Erosion and Sediment Control Management Plan
- Rehabilitation Management Plan
- Waste Management Plan
- Acid Sulphate Soils Management Plan
- Watercourse Crossing Construction Management Plan
- Groundwater and Surface Water Protection Management Plan
- Hydrotest Management Plan
- Dust Management Plan
- Noise Management Plan
- Vegetation Clearing Management Plan
- Weed and Exotic Species Management Plan
- Fire Management Plan
- Traffic Management Plan
- Social Impact Management Plan
- Cultural Heritage Management Plan
- Gas Venting Management Plan
- Greenhouse Gas Emissions Management Plan

- Decommissioning Plan.

EMPs will be developed and implemented for the main stages of the development, including: construction; operation and decommissioning. Potentially the aforementioned EMPs will be packaged under a broader Construction Management Plan, Operational Management Plan, and Decommissioning Plan to bring together all the individual EMPs in accordance with recognised standards and applicable NT legislation for the relevant phase of the project.

The EMPs will detail measures to minimise actual and potential impacts associated with all phases of the KGGP, describing or referencing the procedures and equipment proposed to prevent, monitor and manage possible impacts. They will outline measures to ensure compliance with all relevant environmental regulations and standards. The EMPs will also identify the timing and scope of individual components and serve as a compliance document, recording the progress of management commitments and their conformity with requirements set by authorities and community expectations.

The EMPs will be developed further following the completion of the environmental assessment phase and finalisation of the project design.

Pacific Aluminium will establish the performance outcomes to be achieved through EMPs. Delivery of those outcomes and the detailed preparation of the EMPs will be the responsibility of an owner operator for the pipeline and will be secured contractually. The EMPs will include monitoring actions to continually assess the achievement of these outcomes and propose contingency measures/remedial actions to implement should monitoring indicate these are not being achieved.

## 6.2 MONITORING

Specific environmental monitoring programmes will be established within the EMPs and implemented during all phases of the KGGP project.

The monitoring programmes will be outlined in detail within the EMP, and will include:

- Information needed to provide a suitable baseline for subsequent monitoring
- The timing and frequency of monitoring
- Policies for evaluating and amending the monitoring programme.

At a minimum monitoring will focus on avoiding wildlife mortality (open trench), managing ecological impacts, weeds and other invasive species, erosion and sediment control, biting insects and water quality.

Monitoring programs will be finalised during the detailed design phase and submitted for approval with the EMPs.

Table 10: Potential impacts and approach to mitigation during construction of the KGGP

RISK	SOURCE	POTENTIAL IMPACT	MITIGATION
Physical Environment			
Erosion, runoff and soil compaction	<p>Development of stockpiles and trenches, and 'cut and fill' activities.</p> <p>Vegetation clearing, earthworks for trenching of the pipeline and construction of infrastructure.</p> <p>Road upgrades and borrow pits.</p> <p>Vehicle movements.</p>	<p>Localised changes to topography and the physical environment.</p> <p>Increased run-off leading to erosion of soil and subsequent deposition.</p> <p>Soil compaction.</p> <p>Soil loss via wind or water erosion.</p> <p>Increased sediment load of waterways.</p>	<p>Watercourse crossings on the corridor and access tracks will be sited and constructed in accordance with accepted engineering standards and environmental protection guidelines in order to minimise downstream impacts.</p> <p>Vegetation will be cleared and rehabilitated progressively throughout construction to minimise the period that bare soil is left exposed to erosion.</p> <p>Rehabilitation of disturbed areas will be undertaken as soon as possible during the work season following construction, and prior to the onset of the wet season.</p> <p>A storm water and drainage management system will be developed and implemented for the facility sites including compressor and scraper stations.</p> <p>An <b>Erosion and Sediment Control Management Plan</b> will be developed and implemented</p>
Visual impact during construction	<p>Construction camps, vehicles operating along the pipeline construction corridor.</p>	<p>Negative Impacts on visual aesthetics.</p>	<p>A <b>Rehabilitation Management Plan</b> will be developed and implemented to reduce potential visual intrusion.</p> <p>A <b>Traffic Management Plan</b> will be developed and implemented prior to construction activities. The plan will include restrictions and speed limitations to reduce the generation of suspended dust along unsealed tracks.</p> <p>A <b>Waste Management Plan</b> will be</p>

RISK	SOURCE	POTENTIAL IMPACT	MITIGATION
			developed and implemented to ensure good housekeeping practices and that all construction areas are left in a good condition.
Alteration of natural drainage and hydrology and pollution of ground water and surface	<p>Disturbance of vegetation and soils and acid sulphate soils during construction. Road construction/ upgrade and borrow pits.</p> <p>Disposal of sewage and greywater from construction camps.</p> <p>Sourcing and disposal of hydrotest water.</p>	<p>Erosion and sedimentation, chemical contamination of waterways and death of aquatic flora and fauna.</p> <p>Adverse changes to water quality of surface water and groundwater.</p> <p>Decline in health of wetland ecosystems and other groundwater dependant systems.</p>	<p>An <b>Erosion and Sediment Control Plan</b> will be developed and implemented.</p> <p>An <b>Acid Sulphate Soils Management Plan</b> will be developed and implemented.</p> <p>A <b>Waste Management Plan</b> will be developed and implemented.</p> <p>A <b>Watercourse Crossing Construction Management Plan</b> will be developed and implemented.</p> <p>A <b>Hydrotest Management Plan</b> will be developed and implemented.</p> <p>A <b>Spill Contingency Plan</b> will be developed and implemented.</p>
Ecological Environment			
Disturbance/ injury/ death to fauna	<p>Vegetation clearing, earthworks, blasting, vehicle and traffic movement.</p> <p>Fauna capture in pipeline trench.</p>	<p>Habitat loss and disturbance.</p> <p>Disturbance/ injury/ death of individual fauna.</p> <p>Disturbance of species of conservation significance.</p> <p>Introduction and spread of weeds and exotic fauna species.</p>	<p>The pipeline trench will be open for the minimum amount of time possible and will be interrupted with frequent "escape ramps" while open.</p> <p>Trenches will be inspected by an experienced wildlife handler throughout the day.</p> <p>Any wildlife that is unable to escape will be removed from trenches, identified, recorded and released into nearby vegetated areas.</p> <p>Wildlife data will be provided to the Northern Territory Parks and Wildlife Service.</p>

RISK	SOURCE	POTENTIAL IMPACT	MITIGATION
			<p>Direct impacts on ecologically sensitive and significant habitat areas will be avoided wherever possible.</p> <p>A <b>Dust Management Plan</b> will be developed and implemented.</p> <p>A <b>Noise Management Plan</b> will be developed and implemented.</p>
Disturbance/damage/destruction of vegetation and flora	Vegetation clearing, earthworks and vehicle and traffic movement.	<p>Loss of vegetation.</p> <p>Degradation of sensitive vegetation communities and habitats.</p> <p>Disturbance to species of conservation significance.</p> <p>Introduction and spread of weed species.</p>	<p>Construction activities will disturb only the minimum area of vegetation necessary.</p> <p>Access during construction and operation will be via environmentally approved access tracks and the pipeline corridor only.</p> <p>The construction workforce will be informed about their obligations to protect native vegetation.</p> <p>A <b>Vegetation Clearing Management Plan</b> will be prepared and implemented.</p> <p>A <b>Rehabilitation Management Plan</b> will be developed and implemented.</p>
Disturbance/damage/destruction of aquatic ecosystems and species	<p>Clearing of riparian vegetation and construction of watercourse crossings.</p> <p>Road construction\upgrade and borrow pits.</p> <p>Vehicle and traffic movements.</p> <p>Translocation of water between catchments.</p>	<p>Disturbance and loss of aquatic habitats.</p> <p>Changes to species composition of aquatic flora and fauna.</p> <p>Reduced fecundity and death of aquatic fauna and flora.</p> <p>Restriction of fish passage.</p> <p>Translocation of pests and diseases</p>	<p>An <b>Erosion and Sediment Control Management Plan</b> will be developed and implemented.</p> <p>A <b>Watercourse Crossing Construction Management Plan</b> will be developed and implemented.</p> <p>A <b>Hydrotest Management Plan</b> will be developed and implemented.</p>
Disturbance/damage/destruction of flora and fauna species of conservation significance	<p>Vegetation clearing and earthworks.</p> <p>Vehicle and traffic movement.</p>	<p>Destruction or damage to a range of habitats and species.</p>	<p>A <b>Watercourse Crossing Management Plan</b> will be developed.</p> <p>A <b>Weed and Exotic Species</b></p>

RISK	SOURCE	POTENTIAL IMPACT	MITIGATION
	Construction of access routes and borrow pits.		<p><b>Management Plan</b> will be developed and implemented.</p> <p>A <b>Fire Management Plan</b> will be developed and implemented.</p>
Disturbance/damage/destruction to ecologically sensitive habitats	<p>Vegetation clearing and earthworks.</p> <p>Vehicle and traffic movement.</p> <p>Construction of access routes and borrow pits.</p>	Damage to and loss of riparian corridor habitats, aquatic habitats, wetland habitats and monsoon rainforest habitats.	<p>Access to ecologically sensitive areas will be prohibited.</p> <p>Construction activities will be planned for the dry season.</p> <p>Rehabilitation of disturbed areas will be undertaken as soon as possible during the work season following construction, and prior to the onset of the wet season.</p> <p>Rehabilitation success will be frequently monitored at watercourses and areas of saturated soils.</p> <p>A monitoring and maintenance programme will be implemented to regularly check the condition of each watercourse crossing for the duration of operation, and repair damage caused by erosion as necessary.</p>
Introduction or spread of weeds and exotic fauna	<p>Clearing of native vegetation and earthworks.</p> <p>Movement of vehicles, plant and construction materials.</p> <p>Construction of access routes and borrow pits.</p>	<p>Introduction and spread of weeds.</p> <p>Spread of Cane Toads and Yellow Crazy Ants.</p> <p>Displacement of native flora and fauna species.</p> <p>Direct competition for resources (for example water, habitat) with existing fauna and/or flora.</p>	<p>An <b>Exotic Species and Weed Management Plan</b> will be developed and implemented.</p> <p>Rehabilitation and landscaping will be undertaken in accordance with a <b>Rehabilitation Management Plan</b>, which will specify that only native vegetation species will be used.</p> <p>Inductions and briefings will take place to increase the awareness of weed management issues.</p>
Planned fire	Deliberate ignition of vegetation to reduce fire risk.	<p>Alteration of habitat.</p> <p>Maintenance of ecosystem dynamics.</p>	A <b>Fire Management Plan</b> will be prepared and implemented.

RISK	SOURCE	POTENTIAL IMPACT	MITIGATION
Small chemical or hydrocarbon spills	Transport or refuelling accidents, poor packaging, rupturing of tanks, improper handling or use of construction materials and accidents	Soil, surface and groundwater contamination.  Aquatic and terrestrial habitat destruction/ modification.  Air emissions.	A <b>Waste Management Plan</b> will be developed and implemented.  A <b>Spill Contingency Plan</b> will be developed and implemented.  Vehicles will be equipped with spill response kits.
Dust emissions	Dust Emissions.  Trucks transporting material and workforce to the construction corridor along access roads, trenching, backfill and padding operations, earth moving activities, and open stockpiles.	Potential impacts include health impacts, loss of topsoil, disturbance to vegetation and amenity.	Stringent controls on vehicle speeds will be applied through development of a <b>Traffic Management Plan</b> and by restricting travel to designated roads during construction.  A <b>Dust Management Plan</b> will be developed and implemented prior to construction activities.
Economic, land use and archaeological			
Land tenure and land Use	Presence of construction crew, vehicles and machinery and construction footprint.  Presence of permanent access road and above ground facilities.	Permanent loss of land associated with the presence of some newly established permanent access roads and above ground facilities.  Temporary loss of potential crop growing areas associated with the construction footprint.  Degraded land due to poor reinstatement and waste management practises.  Restriction on excavation and building on land directly above the buried pipeline.  Restriction on planting of deep-rooted vegetation above the buried pipeline.  Temporary loss of access during construction.  Providing unintentional third party access.	Clearance for construction will not commence until all relevant agreements are in place with landowners in accordance with Northern Territory legislation and KGGP project requirements.  The pipeline will be buried and is not likely to result in any long term disturbance to existing land use practices.  Permanent access roads will be minimised to approximately 4 m wide to accommodate access for operations and maintenance vehicles.  A <b>Traffic Management Plan</b> will be developed and implemented which will specify designated access routes.  A <b>Waste Management Plan</b> will be developed and implemented which will

RISK	SOURCE	POTENTIAL IMPACT	MITIGATION
		Prohibition of shooting in the vicinity of compressor stations.	<p>specify clean up measures along the construction corridor and all other construction sites.</p> <p>A <b>Rehabilitation Management Plan</b> will be developed and implemented which will specify procedures for effective restoration.</p> <p>A <b>Social Impact Management Plan</b> will be developed and implemented.</p>
Archaeology and historic heritage	<p>HDD, surveying, clearing of vegetation, pipeline trenching.</p> <p>All site works, vehicle, plant and equipment movements.</p> <p>Rehabilitation works.</p>	Destruction of or damage to archaeological and cultural material.	<p>An archaeologist will be in attendance during pipeline trenching.</p> <p>An <b>Erosion and Sediment Control Management Plan</b> will be developed and implemented.</p> <p>A <b>Cultural Heritage Management Plan</b> will be developed and implemented to address protection and management of archaeological and other cultural heritage matters.</p>
Aboriginal Sites of Significance	<p>HDD, surveying.</p> <p>Clearing of vegetation, pipeline trenching.</p> <p>All site works.</p> <p>Vehicle, plant and equipment movements.</p> <p>Rehabilitation works.</p>	<p>Disturbance to Aboriginal sacred sites through off-road driving, sourcing of fill or raw materials and through exploration of the area surrounding the pipeline development by the construction workforce.</p> <p>Inappropriate access by the construction and operation workforces.</p>	<p>A <b>Cultural Heritage Management Plan</b> will be developed.</p> <p>Where necessary traditional Aboriginal owners will be employed as monitors during development/construction activities.</p> <p>Disturbance of areas of current traditional usage will be kept to a minimum during construction.</p> <p>The project personnel will be thoroughly briefed on prohibited areas, and rules and disciplinary measures will apply where breaches occur.</p> <p>Construction and operation personnel will</p>



RISK	SOURCE	POTENTIAL IMPACT	MITIGATION
			undertake cross-cultural awareness training to ensure positive and effective inter-cultural communication
Aboriginal environmental cultural values	Environmental disturbance during the construction and operation of the pipeline.	Aboriginal environmental cultural values (including hunting, gathering, other cultural resource uses and the broader relationships between Aboriginal people and their environment) may be impacted by the environmental disturbance, particularly during the pipeline construction.	<p>A methodology has been developed to assess and protect Aboriginal environmental cultural values, in collaboration with traditional Aboriginal owners, the broader Aboriginal community and key Indigenous organisations and technical experts.</p> <p>Specific measures to avoid or minimise impacts on Aboriginal environmental cultural values will be incorporated into Cultural Heritage Management Plans.</p>
Transport network, infrastructure and utilities	<p>Increased construction traffic, including large pipe trucks, along main roads and through rural through townships.</p> <p>Construction of pipeline crossings at roads and railway lines.</p> <p>Water abstraction from bores used by local communities and landowners.</p> <p>Waste disposal during pipeline construction.</p>	<p>Incidental creation of an 'unofficial highway' to rural and Aboriginal areas along the construction corridor.</p> <p>Deterioration of road integrity.</p> <p>Increased pressure on existing air services and accommodation services.</p> <p>Draw down of aquifers and hence bores used by local communities and landowners.</p> <p>Increased pressure on existing local solid waste handling facilities.</p> <p>Damage to electrical cables and rupture of existing pipelines (for example Northern Territory Gas Pipeline).</p>	<p>Prior to significant use a joint assessment of road conditions by the KGGP project team and the road authorities will take place for all roads intended to be used by the project.</p> <p>Infrastructure upgrades will be undertaken where required prior to commencement of construction in consultation with relevant local government departments, landowners and regulatory authorities.</p> <p>A <b>Traffic Management Plan</b> will be developed specifying speed limits.</p> <p>A <b>Groundwater and Surface Water Protection Management Plan</b> will be implemented.</p> <p>A <b>Waste Management Plan</b> will be implemented to identify appropriate waste handling facilities and confirm expected waste volumes.</p>

RISK	SOURCE	POTENTIAL IMPACT	MITIGATION
Economic environment	Construction and operational phases	<p>Potential impacts are likely to be positive.</p> <p>A wide range of economic benefits from the TTP will potentially be delivered to the local area, the Northern Territory and Australia, including, employment benefits and business opportunities.</p>	<p>Opportunities exist for participation by Northern Territory based businesses.</p> <p>Where possible, emphasis will be placed on optimising the utilisation of the local indigenous population.</p>

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