Chapter 14
Land Use, Infrastructure and Amenity Considerations

PACIFIC ALUMINIUM

Contents

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14 Land Use, Infrastructure and Amenity Considerations

This Chapter discusses the relevant potential impacts of the KGGP Project on existing land use in the region, infrastructure networks and amenity issues such as noise and visual impact.

14.1 LAND TENURE AND LAND USE

14.1.1 Description

Current tenure and use of lands through which the pipeline would pass are described in Section 4.3.1 (Chapter 4: Existing Environment).

14.1.2 Potential impacts of construction and operation

Agricultural, Pastoral Enterprises

Potential impacts would include the following:

- Temporary loss of access to grazing land inside the 100 m pipeline corridor during construction.
- Temporary interference with stock movement during the construction period.
- Stock loss or injury from trench fall during construction.
- Permanent loss of a small amount of land through creation and maintenance of essential access roads and above-ground infrastructure (including the compressor station at King River; three main line valves outside the Pacific Aluminium leased areas; and scraper station, and anode beds). This includes some restriction from further development of land above the pipeline (as land cannot be excavated or infrastructure built over the buried pipeline and within the ROW).
- Degradation of land or watercourses as a result of unsuccessful rehabilitation spread of weeds, ignition of fires and poor waste management practices.
- Reduction in water available for stock.
- Permanent removal of deep-rooting trees directly above and immediately adjacent to the pipeline.
- Unauthorised access to land from public use of the ROW or permanent access tracks.

Mining or petroleum industries

Potential impacts on mining or petroleum industries relate to restrictions on excavation activities or infrastructure development of land above the installed pipeline.

Aboriginal Land

Potential impacts on Aboriginal Land would include the following:

- Temporary loss of access during construction (for public safety).
- Entry onto Aboriginal lands by workers and other staff associated with construction and operation of the pipeline.
- Entry of unauthorised persons onto Aboriginal lands using the ROW or new or improved access roads and potential disturbance or unauthorised visitation to Aboriginal sacred sites and other cultural heritage sites.
- Limitations on the use of firearms (for hunting) within the vicinity of above ground pipeline infrastructure.

- Loss of habitat for cultural uses (including traditional hunting) during construction and, over the longer term, from the existence of the ROW and above ground structures.
- Degradation of habitat through the introduction or spread of exotic plants (weeds) and feral animals, which might also alter the nature and frequency of fires (through greater fuel loads from Mission Grass, Gamba Grass and other weed species) and threaten native fauna (e.g. to Gove Crow Butterfly, from spread of Yellow Crazy Ants).
- Restriction on the use of land within the ROW and areas utilised for above-ground infrastructure.

14.1.3 Mitigation responses and potential environmental outcomes

The proposed KGGP route does not pass through any commercial plantations or lands used for native forestry, and only a small portion of the route crosses agricultural land. The pastoral properties crossed by the pipeline are large and therefore only a small portion of their lands would be affected. During construction, there would be potential for some interference with stock movements. Detailed consultation with the pastoral lessee would occur prior to, during and post construction. Mitigation options would include temporary fencing around areas of high concern and temporary movement of stock away from the ROW. These impacts would be temporary, with the majority of construction occurring over a 9 month period across the whole of the pipeline corridor, and, for any given section of the ROW, construction activity is likely to occur over an approximately 90-day period.

Under good trenching conditions, the open trench would be exposed for a distance of approximately 40 km and up to approximately 60 km in more difficult trenching conditions. The trench would be open for 2-3 weeks. Risks to stock falling into the open trench would be managed in consultation with the pastoral lessee and would include consideration of constructing temporary crossing points (gated and fenced) across the ROW. Potential impacts on water for stock are unlikely. The Water Supply and Adaptive Management Strategy for the project set out in Chapter 7 would ensure that water extraction during the construction period would not appreciably impact local water supplies. This would be discussed with the pastoral lessee to ensure current watering points for stock have been addressed.

Over the longer term, limitations on excavation would not be expected to significantly affect pastoral enterprises and normal rangeland grazing activities, and stock movement can coexist with the ROW. During operation, the pipeline would be inspected intermittently for safety checks and routine maintenance. Notification would be provided in advance to the relevant pastoral lessee to ensure minimal impact on grazing and other pastoral activities. Impacts on agricultural and pastoral operations are therefore expected to be low.

The pipeline route avoids mining leases with active operations occurring, other than Pacific Aluminium's own bauxite mine and alumina refinery leased areas. The pipeline would however, pass through a number of mining tenements as indicated in Section 4.3.1. Whereas no impacts are anticipated on mining tenements during the relatively short construction period, parts of mineral leases on lands within the 30 m pipeline ROW would not be able to be developed, for safety reasons. The affected lands would, however, comprise a very small proportion of any one mining lease and, therefore, loss of access to this land is expected to be negligible.

Pacific Aluminium is consulting with and in negotiations with the NLC, on behalf of Aboriginal traditional owners, to reach agreements that minimise interference with existing uses of Aboriginal lands affected by the KGGP Project. Opportunities for training and employment would be identified, including in the two IPAs, where Pacific Aluminium will seek to support existing environmental management programs run by Dhimurru and Yirralka Rangers, e.g. control and management of weeds, feral animals and fire. The EMP for the KGGP Project will be developed in consultation with Aboriginal land owners and include indigenous participation in its delivery, to ensure that the project

does not have unacceptable impacts on the efficiency or effectiveness of current land management practices by indigenous ranger groups (see Chapter 11 of this Draft EIS).

Pacific Aluminium is aware that a number of sites of special cultural and environmental significance (including Crystal Springs and other Aboriginal sacred sites) occur within the Project Area and that Aboriginal landowners are particularly concerned about unauthorised access to such places. These issues are dealt with in Chapters 13 and 15 of this Draft EIS and in the EMP (Appendix O). Particular care will be taken (in consultation with Aboriginal land owners) to ensure that neither the ROW nor permanent access tracks required for the project, become a point of entry for unauthorised access (for example, by installing gates or other barriers at high risk areas), noting that the many rivers crossed by the ROW would provide natural break points limiting such access.

Potential impacts on landholoders, including degradation or loss of habitat; alteration to watercourses; unsuccessful rehabilitation; and spread of weeds or fires on their lands are dealt with in Chapters 6 to 9 and 17. Mitigation measures relevant to land tenure and use will be incorporated in a range of targeted management plans (e.g. Weed Management Plan) comprising the over-arching Environmental Management Plan (EMP). Provisional management plans are provided in the Draft EMP (Appendix O).

Table 14-1 summarises the mitigation approaches for potential impacts on land tenure and use.

14.1.4 Summary – predicted environmental outcome

After mitigation is applied, construction and operation of the KGGP would result in a low impact on current and future land use because of the:

- Remoteness of the region through which the pipeline would pass.
- Low population density across the majority of the pipeline route.
- Small development area (footprint) following rehabilitation.
- Short period of construction.
- Capacity for many land uses that do not involve excavation, to coexist with installed pipeline infrastructure (exclusive tenure is not required).
- Natural features such as river crossings that will limit unauthorised public access to the ROW and permanent access tracks over the long term.

Minor restrictions on excavation of land or construction of buildings immediately above the buried pipeline would occur over a narrow area no greater than approximately 2,000 ha, spread over a distance of approximately 600 km.

14.2 UTILITIES

Construction of the KGGP would require communications systems, supply of water and power, a waste management system, and access to medical and other services that meet the needs of the project; are reliable and suited to the remoteness of the project area; and do not result in unacceptable impacts on current users of these systems.

Table 14-1: Potential impacts and mitigation outcomes for land tenure and use

POTENTIAL IMPACT	PROPOSED MITIGATION (ACTION)		ANTICIPATED EFFECT OF MITIGATION
	AVOIDANCE	MINIMISATION	
Loss of land for agricultural or pastoral purposes	• Project area avoids any commercial forestry operations • No restriction on grazing activities within the reinstated ROW	• ROW disturbance reduced to minimum required. • Pipeline buried.	Negligible loss of land for primary production purposes.
Interference with activities associated with primary production	• Temporary fencing during construction period, in consultation with landholders • No restriction on grazing activities within the reinstated ROW	• ROW disturbance reduced to minimum required. • Active rehabilitation of the ROW. • Period of construction disturbance reduced as far as possible. • Temporary shifting of stock, temporary stock crossings across open trench and other measures in consultation with pastoral lessee. • Water supply and adaptive management strategy to minimise conflict with stock watering	Interference with pastoral activities limited as far as possible during construction period. Negligible interference with pastoral activities during operational phase.
Loss of access for mining or petroleum development	• Project area avoids existing mining or petroleum operations (with exception of Alcan Gove bauxite mine)	• ROW reduced to minimum required. • Excavation restrictions limited to immediate vicinity of pipeline	Negligible loss of access of land to mining and petroleum development.
Unauthorised access to lands	• Construction access tracks that are not required during operational phase would be rehabilitated. • ROW and new access tracks will avoid Aboriginal sacred sites.	• No bridges, culverts of other structures created across watercourses – access track along ROW would therefore be drivable only for sections rather than the whole pipeline corridor. • Installation of gates or other barriers at high risk areas. • Code of conduct and inductions for pipeline workforce, limiting access to areas outside the immediate construction zone.	Instances of unauthorised access to Aboriginal sacred sites reduced to as low as possible. Minimal instances of unauthorised access to other Aboriginal lands.

14.2.1 Description

Communications

High frequency communication systems are proposed along the construction corridor for voice radio coverage during construction. Satellite communication systems would also be used. During construction, each of the five construction camps would have high speed internet and voice communications via satellite to Gove, Darwin, Brisbane and each camp. In addition, a VHF radio system would be installed along the pipeline route for mobile vehicle communications.

Operation of the Pipeline System would be by a Supervisory Control and Data Acquisition System (SCADA), using satellite communications and back-up communication systems at Gove and Katherine.

Power

Diesel generators would be used to supply electricity to the five construction camps.

Operational power for the compressor station (at King River) would be powered by gas turbines, driven by fuel off-take gas from the pipeline. The compressor station would be designed to have 4.5 MW of initial installed power.

Power for supporting pipeline infrastructure, such as scraper stations, would be provided by Remote Area Power Supply (RAPS), using solar electric (photovoltaic) panels with a battery system (for power storage in absence of available light).

Water

The proponent plans to access water for construction from surface watercourses, from local groundwater (bores), trucked from existing bores or council supplied, or new bores, if required. A water supply and adaptive management strategy (Chapter 7) is proposed to guide the utilisation of water resources and ensure that water requirements for the project are extracted sustainably. Groundwater quality is generally considered to be good, with low total dissolved solids (TDS) and requiring minimal treatment for potable use only and no treatment required for construction use.

Wastes

During construction of the pipeline, solid waste would be generated at the construction camps and at the construction site. Local waste disposal sites may be utilised for these wastes, where appropriate and acceptable to the managing authority. If this was not possible, then solid waste would be transported to licensed landfill facilities at either Katherine or Gove.

During operation, very limited waste would be generated by the small number of personnel monitoring and servicing the pipeline and ancillary infrastructure (e.g. scraper stations).

Other services

The construction workforce would need access to routine health and emergency medical services and associated infrastructure (detailed in Chapter 15: Social and Economic Considerations and Chapter 16: Health and Safety).

Construction workers and camp-based personnel providing services to workers at the camps would also need or desire access to laundry facilities, catering, recreational/entertainment services.

14.2.2 Potential impacts of construction and operation

Communications.

The Department of Defence (DoD) have asked the project team to ensure there is no potential interference with DoD installations (including the RAAF Base Tindal and JORN radar facility (transponder) at Nhulunbuy, in addition to other telecommunication systems) from communication systems employed on the project.

Power

Large infrastructure projects can potentially increase demand for power beyond the capacity of local power generation infrastructure to supply both the resident population and the construction workforce, leading to brown-outs or black-outs.

Water

Supply of water to the project could potentially impact local water supplies in the region either directly by competing for water from those sources or indirectly by changing the hydrological regime that supplies those resources.

Wastes

Disposal of waste at local waste disposal sites could increase maintenance costs and significant volumes could reduce the effective life of the facility. Disposal of waste materials that are beyond the design of the facility could cause site contamination.

Other services

The project would provide resources to service the routine health and medical requirements of the workforce (detailed in Chapters 15 and 16). Commercial arrangements would be developed to ensure any required emergency evacuation can be accommodated. Impacts arising from the demands for services required by construction camps (outside of utilities addressed above) would be limited to the transport requirements required to meet catering, laundry and other needs (since the actual services would be provided within the camp itself).

14.2.3 Mitigation response and predicted environmental outcome

Communications

Interference with other communication in the region would be avoided through securing licences to operate on approved frequencies (for radio communications). The key concern here has been registered by the DoD. Any communications infrastructure required will be installed only after ensuring no conflict with the planning restrictions imposed on the lands bordering the DoD installations.

The proponent has liaised with DoD, in outlining project requirements and understanding DoD concerns, and the management approaches proposed would avoid interference with DoD communications. Pacific Aluminium will identify appropriate construction and operational personnel to establish and maintain a working relationship with the RAAF Base Tindal Services Manager, to ensure open and timely engagement to resolve any emerging issues.

Power

Power for the construction phase of the project would be provided by diesel generators, both at the ROW and for powering the five construction camps. During the operational phase, the compressor station at King River would be powered from off-take gas from the pipeline. Power for scraper stations and other ancillary infrastructure would be provided by RAPS, using solar electric panels with battery storage.

The project would therefore be self-sufficient in respect of power requirements and electricity would not be accessed from any of the remote communities near construction camps. The KGGP Project is therefore not expected to adversely impact the supply of power to any users in the region.

Water

The water supply and adaptive management strategy for the project set out in Chapter 7 would ensure that water extraction during the construction period does not impact on local water supplies. The strategy adopts a flexible approach to sourcing water and avoiding any impacts on local water supplies would be a key consideration in decision making.

The primary focus of the water supply and adaptive management strategy is directed towards surface water resources. Groundwater may be required in some locations where dry season surface water flows may be too low for sustainable extraction. In the unlikely situation where there is inadequate surface water or groundwater resource, or the water quality is poor, two options for municipal supply have been identified:

- **Katherine** - a borefield 3km east of the town provides Katherine with approximately 40% of the annual supply of 4,039 ML is from these groundwater bores.
- **Gove WCD** - The settlements of Nhulunbuy and Yirrkala obtain their water supplies from the aquifer but the major user is the Gove operation. Production bores are typically 80 metres deep and supply up to 60 L/sec each. The total supply from the borefield is 1697 ML/year.

Given the current use of these water supply systems, it is anticipated that this water could be used to supplement the small volumes that may be required where surface water or groundwater could not supply the western or eastern end of the KGGP Project, respectively. In the event of such arrangements being necessary, significant impacts of short term water extraction from construction of the KGGP on these water supplies are not anticipated.

Waste Management

Potential impacts on local landfill facilities arising from solid wastes generated by the KGGP Project would be temporary but potentially significant for those facilities in the region that are already at the limits of capacity. To mitigate these impacts a strong focus on solid waste avoidance and minimisation will be maintained throughout the construction phase and in particular at construction camps. Waste segregation and recycling options would be explored through back loading to Katherine. Solid waste would be transported to licensed facilities, including at Katherine or Nhulunbuy. These arrangements would be fully developed through a Waste Management Plan. A Provisional Waste Management Plan is provided in Appendix O.

During operation, very limited waste would be generated, and this would be transported to waste disposal facilities at Katherine or Gove.

Other services

Details on health and medical services to be provided to construction workers are detailed in Chapters 15 and 16.

Potential impacts arising from transport required to service construction camp facilities is addressed in Sections 14-3 and14-4 (of this Draft EIS) and the Traffic Management Plan contained in Appendix O.

Table 14-2 summarises the mitigation approaches for potential impacts on utilities and infrastructure.

Table 14-2: Potential impacts and mitigation outcomes for utilities and infrastructure

POTENTIAL IMPACT	PROPOSED MITIGATION (ACTION)		ANTICIPATED EFFECT OF MITIGATION
	AVOIDANCE	MINIMISATION	
Interference with Department of Defence installations	• Obtaining licences to operate on frequencies used exclusively by the pipeline workforce • Telecommunication towers and masts will not be erected within the 15 km boundary of RAAF Base Tindal	• Engagement between constructor and DoD during period of construction	No adverse impacts on the operation of Department of Defence facilities
Demand on local power supplies leading to blackouts	• Power supplied by diesel generators, off-take gas and remote area power supply		No impact on the supply of power to local communities
Demand on local water supplies, leading to reduction in local supply	• Water Supply and Adaptive Management Strategy • Project water requirements temporary and within sustainable limits		No impact on the water supplies to communities in the pipeline region
Demand on local waste facilities, leading to reduction in landfill life or inappropriate disposal	• Solid waste avoidance strategies embedded in Waste Management Plan	• Waste minimisation and recycling strategies embedded into Waste Management Plan. • Transport of solid waste to licensed landfills at Katherine and Nhulunbuy if required.	No significant impact on the effective life of solid waste facilities in the region
Demand on local health/medical, laundry, entertainment and other services, leading to difficulties for residents seeking medical attention		• Routine and emergency health/medical services to be provided by proponent. • Other services provided by and within construction camps	No to minimal impact on the supply of health/medical, laundry, entertainment and other services to local communities.

14.2.4 Summary – predicted environmental outcome

After mitigation is applied construction and operation of the KGGP Project is expected to have no unacceptable impacts on existing communication systems, power, water, waste, health/medical facilities or other services used by the communities in the vicinity of the project.

14.3 TRANSPORT INFRASTRUCTURE

14.3.1 Description

Key aspects of the construction phase relevant to potential impacts on transport infrastructure include:

- Construction of the pipeline along two construction spreads: one proposed to start at KP0 (south of Katherine) in April 2014 and the other at Gove (KP603), starting in May 2014. The pipeline construction spreads are planned to meet in the Goyder River area (KP363) in the third week of October 2014 (see Appendix V for detailed route maps).
- The pipeline may cross one railway, and would cross the Stuart Highway and a number of arterial roads. Sealed roads and the Melville Bay Road would be crossed using horizontal boring techniques. Unsealed roads would be crossed using open trench techniques (see Appendix V for detailed route maps).
- The Darwin and Gove ports would be used to import the majority of construction materials via ship. Shipments of pipe would most likely originate in Asia and would utilise recognised shipping lanes. It is anticipated that pipe would be delivered either in two shipments to Darwin and two shipments to Gove, or a single shipment to offload pipe at both Darwin and Gove.
- Pipeline segments from Darwin and Gove ports would be transported to laydown areas at Katherine and Gove (using pipeline delivery trucks), from which the pipe segments would be transported either directly to the pipeline ROW or to additional laydown facilities at Camp 2, Camp 3 and Camp 4 for later distribution to the ROW.
- Pipeline delivery trucks from Darwin Port (East Arm Wharf) would use the Stuart Highway and Central Arnhem Road. Pipeline delivery trucks from Gove Port would use the Central Arnhem Road and Melville Bay Road. Local roads, where available, would be used to transport the pipe segments to the ROW; however, some new access roads would be required to facilitate access to portions of the ROW and the construction camps.
- Pipe segments for KP530.0 to KP603.5 would be transported directly to the ROW from Gove Port.
- Five temporary construction camps would be constructed to house the construction workforce of approximately 780 personnel at its peak. The construction camps would be located near road access. The construction workforce would be transported daily to the work area from the construction camp.
- The construction workforce would work a 28 day on / 9 day off, fly in – fly out (FIFO) roster, flying in and out of Katherine and Gove Airports. A range of potential shift change timings has been considered, ranging from all of the construction staff leaving simultaneously to progressive and staggered shift changes.

These aspects are detailed in Chapter 2.

14.3.2 Existing transport networks

The roads currently proposed for use by the KGGP Project to transport personnel and materials are briefly described below.

Stuart Highway

The Stuart Highway is a National Highway that connects the Northern Territory and Darwin to South Australia. The Stuart Highway commences in the Darwin Central Business district and continues as a sealed four lane median divided carriageway to the Cox Peninsula Road intersection in Livingstone. From the Cox Peninsula Road, the Stuart Highway continues south as a two-lane, two-way rural

highway to Katherine. In the town of Katherine, the Stuart Highway becomes an urban four-lane median divided carriageway until 100 m west of Cyprus Street. South of Cyprus Street, the Stuart Highway continues south as a two-lane, two-way rural highway.

The KGGP Project would utilise the following sections of the Stuart Highway:

- Tiger Brennan Drive interchange to Central Arnhem Road – delivery of materials (including pipe) from the East Arm Wharf (Darwin) to the Project site.
- Bagot Road (Darwin) to Central Arnhem Road – delivery of materials and consumables from Darwin to the Project site.
- Victoria Highway (Katherine) to Central Arnhem Road – access to the ROW for personnel and materials.
- Carson Drive (Tindal RAAF Base/Katherine Airport) to Central Arnhem Road – access the Katherine Airport for FIFO personnel.

Victoria Highway

The Victoria Highway is a National Highway that connects the Northern Territory and Darwin to Western Australia. The road is a sealed two-way, two-lane carriageway over the length to be potentially utilised by the KGGP Project.

Genesee & Wyoming Australia (GWA) operate a multimodal freight terminal at Katherine. Access to the freight terminal is via the Victoria Highway, approximately 500m south west of the railway crossing.

The KGGP Project may use the Victoria Highway for accessing the tie-in to the Amadeus pipeline and for the first 500m of pipeline construction. If pipe segments were to be railed to site (in lieu of being shipped to the East Arm Wharf or Gove Port) then pipe delivery trucks may also use the Victoria Highway.

Tiger Brennan Drive (Berrimah Road to Stuart Highway)

Tiger Brennan Drive is a Northern Territory Government controlled road that provides the main alternate east-west route to Stuart Highway. In late 2010 an extension from Berrimah Road to Stuart Highway was opened, including a grade separated interchange with the Stuart Highway. The extension is a four lane, median divided carriageway.

This section of Tiger Brennan Drive would be utilised by the KGGP Project to deliver materials (including pipe) from the East Arm Wharf to the Project site.

Berrimah Road (Tiger Brennan Drive to East Arm Wharf)

Berrimah Road provides a key link between Stuart Highway and East Arm Wharf. The road is four lane, median divided carriageway from Tiger Brennan Drive to Wishart Road, and then a two lane, two way undivided road from Wishart Road to East Arm Wharf, except for a section of four lane median divided carriageway as the road approaches East Arm Wharf, with a truck passing / turning / parking zone and weighbridge facilities within the median.

This section of Tiger Brennan Drive would be utilised by the KGGP Project to deliver materials (including pipe) from the East Arm Wharf to the Project site.

Central Arnhem Road

The Central Arnhem Road is an arterial road that extends from the Stuart Highway to Nhulunbuy. The Central Arnhem Road is predominately an unsealed gravel, two-way rural road in excess of nine (9) metres wide; however, there are sections of road that have a 3 m – 3.5 m sealed central lane, including a section from the intersection with the Stuart Highway.

The road condition is generally described as poor with corrugations, dips washouts, bulldust and loose gravel for the majority of its length. The road crosses two major rivers - the Wilton River near Bulman Aboriginal Community (KP260) and the Goyder River near Barrapunta (KP361). As a result of inadequate flood capacity, sections of Central Arnhem Road are often closed for six months during the wet season.

The Central Arnhem Road runs parallel with the proposed KGGP corridor and would be the road most heavily impacted by KGGP Project traffic. It would be used for the delivery of materials to the ROW and temporary construction camps, as well as for the movement of the workforce between the temporary construction camps and the ROW and between temporary construction camps and the Katherine or Gove Airports, as the workforce enters and exits the project area.

Melville Bay Road

Melville Bay Road is operated and maintained by Nhulunbuy Corporation Ltd and is a two-way, two-lane sealed road that provides access to Gove and the Gove Airport. The road has a seal approximately seven (7) metres wide.

Local Government and LGANT Roads

The local roads within the study area are managed by the Roper Gulf Shire Council, the Katherine Town Council, the East Arnhem Shire Council and the Local Government Association of the NT. The local roads are predominately two-way unsealed roads.

The local roads would generally be used by the KGGP Project traffic to;

- Provide access for materials and personnel to the ROW.
- To provide access for the movement of personnel to / from the temporary construction camps and the ROW.
- To provide access for the movement of materials to the temporary construction camps.
- To provide access for the movement of FIFO workforce to / from the temporary construction camps and the Katherine and Gove Airports.

Traffic Volumes

A summary of the existing traffic volumes at selected locations is given in Table 14-3. Other than as noted in Table 14-3, no traffic count information was available on the local government and LGANT roads; therefore, for a number of the roads, an approximation of the daily flows was made based on the road function and the count information from linking roads.

Crash History and Safety Assessment

Information on crash history from 2000 to 2012 was obtained for the Stuart Highway, Central Arnhem Road and Melville Bay Road. A report on the *Safe System Approach to Heavy Vehicles in the Greater Darwin Area* prepared by the Darwin Region Heavy Vehicle Task Force in June 2011 found that most intersections along the Stuart Highway were fit for purpose for heavy vehicles however the intersections could be improved by the addition of longer slip lanes and merge lanes.

Table 14-3: Existing Traffic Volumes

ROAD NAME	ROAD SECTION	2011 AADT*	HEAVY VEHICLES (%)
Stuart Highway	Bagot Road to Tiger Brennan Drive Interchange	17580 - 18332	
	Tiger Brennan Drive Interchange to Howard Springs Road	18376 - 21222	
	Howard Springs Drive to Arnhem Highway	11765 -15743	
	Arnhem Highway to Peninsular Road	5139 - 7124	11
	Peninsular Road to Kakadu Highway	1199-3411	11
	Kakadu Highway to Victoria Highway (Katherine)	1427-4944	18
	Victoria Highway to Cypress Street (Katherine)	6589 - 9634	
	Cypress Street to Napier Street	554	32
	Napier Street to Central Arnhem Road	554	32
Tiger Brennan Drive	Berrimah Road to Stuart Highway	15410 (Note 1**)	
Berrimah Road	Tiger Brennan Drive to East Arm Wharf	4952	
Victoria Highway	Stuart Highway to Amadeus pipeline	4219	19
Carlson Drive		500(Note2)	
Napier Street		50 (Note 3)	
King River Road		50 (Note 3)	
Central Arnhem Road	Stuart Highway to Goondooloo Road	113 - 157	21
	Goondooloo Road to Melville Bay Road	27 - 35	14
Melville Bay Road	Airport to Central Arnhem Road	200 (Note 4)	
	Central Arnhem Road to Gove Port	200 (Note 4)	
Bishop Bore Access Road		10 (Note 5)	
Goondooloo Road		10 (Note 5)	
Mountain Valley Road		10 (Note 5)	
Mainoru Road		10 (Note 5)	
Mainoru Station Road		10 (Note 5)	
Mount Catt Road		10 (Note 5)	
Mount Catt Road North		10 (Note 5)	
Dhunganda Road		10 (Note 5)	
Gapuwiyak Road		50 (Note 6)	

ROAD NAME	ROAD SECTION	2011 AADT*	HEAVY VEHICLES (%)
Gurrumurru Road		10 (Note 5)	
Gungyala Track		10 (Note 5)	

* Average Annual Daily Traffic

Notes

1) A traffic count was not available for this section of Tiger Brennan Drive, the count shown is that recorded on Tiger Brennan Drive immediately to the west of the Berrimbah Road intersection.
2) A traffic count was not available for Carlson Drive; a nominal 500 vpd has been adopted based on the road function as an access road to the Katherine Airport.
3) Traffic counts were not available, a nominal 50 vpd was adopted based on the roads access function.
4) Traffic count data was not available for Melville Bay Road, a nominal 200 vpd was adopted based on the local access function of the road.
5) Traffic count data was not available, a nominal 10 vpd was adopted based on the local access function of the roads.
6) Traffic count approximation provided by a representative of East Arnhem Shire Council.

No safety assessment information was available to be reviewed on the Central Arnhem Road. This road is generally unsealed, has a poor pavement condition, and is prone to flooding, corrugations and bull dust. Use of the road during the wet season is restricted and often the road is closed at this time.

The review of the accident crash history has generally indicated that the majority of fatalities that have occurred are typically single vehicles accidents and not specifically related to a sub-standard road element.

Bridges

There are a number of existing bridges on the roads to be utilised by the Project traffic, however there are no known issues or load limits on these structures. The bridges include a number on the Stuart Highway and Victoria Highway, and an overpass over the rail line on Berrimah Road.

There are currently three bridge and floodway projects under construction on the Central Arnhem Road at Mainoru River, Goyder River and Badalngarrmirri (Donydji) River crossings. These are expected to be completed in 2014.

Rail Network

It is not currently proposed to utilise the rail network for the delivery of personnel and materials, although this will be subject to final review during detailed engineering.

The project roads cross the existing rail network on the Stuart Highway at Katherine, on the Victoria Highway and on Berrimah Road. At these locations the road and rail networks are grade separated incorporating a road bridge over rail, except on Berrimah Road within the East Arm Wharf where there is an existing at grade rail crossing.

Aerodromes

There are two regional airports that are proposed to be used by the KGGP Project. These are located at Gove and Katherine.

Gove Airport currently services the mining town of Nhulunbuy and a number of Aboriginal communities. The airport is located approximately fourteen kilometres from the Nhulunbuy town centre on Melville Road and is owned by Pacific Aluminium and operated and maintained by Nhulunbuy Corporation Ltd. Gove airport underwent a major upgrade in 2005 and has the capacity to

cater for 100,000 passengers per annum. The runway is capable of handling Boeing 737-400 series aircraft.

The Katherine Tindal Civilian Airport is located at RAAF Base Tindal approximately 15 km south of the Katherine town centre, along the Stuart Highway. The Katherine Town Council established a working agreement with the Tindal RAAF Base in the early 1990s for the joint usage of the airstrip and associated facilities. The shared runway has the capacity to accommodate aircraft as large as a 737–400 or equivalent.

There are a number of other regional aerodromes operated by the Northern Territory Government that may, subject to further assessment during the detailed design stage, be utilised by the KGGP Project. These include the aerodromes at Gapuwiyak, Barunga, Beswick and Bulman-Delara.

Shipping

The Port of Darwin (East Arm Wharf) is a major supply and support centre for the region's offshore oil and gas industry and is capable of handling a diverse range of cargoes, including dry bulk imports and exports, bulk liquids, containers, general cargo and livestock exports.

The Port of Gove services Pacific Aluminium's Gove operations. All cargo for Nhulunbuy and surrounding areas is also handled through the Port of Gove. Approximately 130 ships enter the harbour per year, carrying around 50,000 tonnes of material each.

14.3.3 Potential impacts of construction and operation

The impacts of additional transport requirements from the KGGP Project on transport infrastructure relate primarily to the construction phase. Transport requirements during the operational phase are very small. The potential impacts of operational traffic are therefore negligible and have not been considered further.

Traffic and roads

Construction of the KGGP would temporarily increase traffic on Northern Territory Government controlled roads and minor local government roads in the Roper Gulf Shire, Katherine Town Council and East Arnhem Shire areas. Potential impacts of additional traffic would include:

- Damage and additional wear on road surfaces and associated infrastructure.
- Potential increase in traffic congestion.
- Potential increased risk of vehicle accidents.
- Increased traffic noise (discussed in section 14.4.3)

Predicted traffic generated from the KGGP Project as a percentage of background traffic (Table 14-4) indicate that during 2014, all road segments, with the exception of the following, would experience traffic increases of greater than 5 per cent:

- Stuart Highway north of Peninsular Road and through Katherine.
- Tiger Brennan Drive.
- Berrimah Road.
- Victoria Highway.
- Carlson Drive.

Table 14-4: Predicted 2014 traffic volumes as a percentage of background traffic

ROAD NAME	ROAD SECTION	2014 AADT (NOTE 1)	PEAK 2014 DAILY PROJECT TRAFFIC (NOTES 2 & 3)	PROJECT TRAFFIC PERCENTAGE OF BACKGROUND TRAFFIC
Stuart Highway	Bagot Road to Tiger Brennan Drive Interchange	19210 - 20032	10	0.1%
	Tiger Brennan Drive Interchange to Howard Springs Road	20080 - 23190	85 (25)	0.4%
	Howard Springs Drive to Arnhem Highway	12856 -17203	85 (25)	0.7%
	Arnhem Highway to Peninsular Road	5616 - 7785	85 (25)	1.5%
	Peninsular Road to Kakadu Highway	1310-3727	85 (25)	6.5%
	Kakadu Highway to Victoria Highway (Katherine)	1559-5402	85 (25)	5.5%
	Victoria Highway to Cypress Street (Katherine)	7200 - 10527	65 (19)	0.9%
	Cypress Street to Napier Street	605	88 (21)	14.5%
	Napier Street to Central Arnhem Road	605	211 (39)	34.9%
Tiger Brennan Drive	Berrimah Road to Stuart Highway	16389	85 (25)	0.5%
Berrimah Road	Tiger Brennan Drive to East Arm Wharf	5411	85 (25)	1.6%
Victoria Highway	Stuart Highway to Amadeus pipeline	4610	99 (11)	2.1%
Carlson Drive		500	23 (1)	4,6%
Napier Street		50	99 (11)	198%
King River Road		50	72 (4)	144%
Central Arnhem Road	Stuart Highway to Goondooloo Road	123 - 172	281 (49)	228%
	Goondooloo Road to Melville Bay Road	30 - 38	273 (45)	922%
Melville Bay Road	Airport to Central Arnhem Road	200	23 (1)	23%
	Central Arnhem Road to Gove Port	200	145 (27)	145%
Bishop Bore Access Road		10	72 (4)	720%
Goondooloo Road		10	105 (15)	1050%
Mountain Valley Road		10	105 (15)	1050%
Mainouru Road		10	79 (9)	790%
Mainouru Station Road		10	104 (11)	1040%
Mount Catt Road		10	123 (12)	1230%
Mount Catt Road North		10	78 (6)	780%

ROAD NAME	ROAD SECTION	2014 AADT (NOTE 1)	PEAK 2014 DAILY PROJECT TRAFFIC (NOTES 2 & 3)	PROJECT TRAFFIC PERCENTAGE OF BACKGROUND TRAFFIC
Dhunganda Road		10	90 (9)	900%
Gapuwiyak Road		50	78 (5)	780%
Gurrumurru Road		10	84 (9)	840%
Gungyala Track		10	72 (5)	720%

Notes
1) The 2014 AADT has been calculated from the 2011 AADT based on a 3% per annum compound growth rate
2) The peak daily Project traffic volume is the highest peak value along the road section under consideration
3) The figures in brackets are the Average Annual Daily Project traffic (AADT) volumes.

Shipping

Construction of the KGGP would result in a minor increase in ship movements to the ports at Darwin and Gove (maximum of two per port). Potential impacts would arise in respect of:

- Vessel access to the port.
- Berth utilisation.
- Storage areas.

Ships up to 58,000 Deadweight Tonnage (DWT) would deliver pipe for the KGGP Project to the ports at Darwin and Gove. Ships of this size (sometimes called Handysize) typically operate in a large number of geographically dispersed global trades, mainly carrying grains and minor bulks including steel products, forest products and fertilizers. These vessels are well suited for small ports with length and draft restrictions and also lacking transhipment infrastructure.

In the case of the Port of Darwin, the pipes would be offloaded at the East Arm Wharf which has a berth that caters for container vessels and currently handles general and other cargo. The navigation channel to East Arm Wharf is accessible to vessels drawing 11 m in all tidal conditions and consequently there would be no access issues at the Port of Darwin for size of vessel proposed to deliver pipe for the KGGP Project.

At the Port of Gove, the General Cargo Terminal is designated for vessels up to 25,000 DWT with the depth of water at the berth of 9 m. The ships delivering the pipe are likely to be larger than this capacity and require a greater draft than is available. Alternative options would therefore be required and are discussed in section 14.3.4 below. It is understood that the Bulk Terminal at Gove is not suitable for off-loading pipe, due to access restrictions imposed by the approach bridge, which is not suitable for semi-trailer traffic. The navigation approaches to the Port of Gove are not considered to be a restriction. A plan for the delivery and off load of pipes at the Gove port will be completed during detailed design.

Berth utilisation is influenced by the number of vessel calls and the time at berth for each vessel. Two additional vessel calls at each port would result from the shipment and unloading of pipes.

In relation to the time at berth for the pipe delivery vessels, in the case of Darwin there are 10,000 pipes per shipment and for Gove there are 7,000 pipes per shipment. The estimated unloading time (subject to confirmation by the shipping line) would be 17.4 days at Darwin and 12.1 days at Gove.

Aerodromes

The maximum number of personnel likely to utilise either airport (worst case) is approximately 400 at a shift change. This equates to an additional 3 to 4 chartered flights per shift change if 737-400 aircraft are used. It is likely that shift change would be staggered and that the actual number of personnel changing shift on any day would be less than 400. A decision on the most appropriate shift change roster will be made during the detailed design stage.

14.3.4 Mitigation responses and potential environmental outcomes

Roads and traffic

The sections of the Stuart Highway that could potentially be impacted by traffic from the KGGP Project (i.e. subject to greater than 5% increase compared to background) are two way, two lane sealed rural sections of roadway. With the addition of the project traffic, these sections of road would continue to operate well below capacity. Consequently, there would be a negligible impact on the road operation and safety of the Stuart Highway. The section of the Central Arnhem Road comprising a single seal carriageway between the Stuart Highway and Goondooloo Road would be at capacity under the existing traffic conditions. The sections of Central Arnhem Road which are unsealed gravel pavements with a minimum formation width of 10m are operating below capacity under existing traffic conditions.

While modelling of likely traffic flows has been undertaken, this is presently being refined utilising the latest assumptions on vehicles required to support the project. The results of the modelling will be utilised to ascertain whether any sections of the road require upgrade to accommodate the expected traffic flows. It is anticipated that Pacific Aluminium would contribute toward these upgrades, to be carried out through the road authority.

During the construction phase, traffic generated from the KGGP Project would impact the road pavement along the Central Arnhem Road for a short duration (generally less than twelve (12) months); however, as the road is generally unsealed (or has a single lane seal in sections) and the project traffic is a significant proportion of the background traffic during this period, it is expected that there would be a significant impact on the pavement which would require an increased maintenance regime. To mitigate the impact it is proposed to adopt the following approach;

- Prior to construction activities commencing, a joint inspection with a representative of the relevant road authority would be held to assess and record the condition of the road pavement.
- Agreement would be reached with the relevant road authority with respect to any pavement upgrades required prior to any project traffic using the Central Arnhem Road. Pacific Aluminium would contribute to the cost of these initial pavement upgrades.
- Pacific Aluminium would maintain the Central Arnhem Road during use of the road for the construction of the KGGP Project. The maintenance would include grading of the unsealed road and pothole patching of the sealed road pavements.
- A post construction inspection of the Central Arnhem Road would be undertaken with a representative of the relative road authority and compared to the record prior to construction. If, in consultation with the relevant road authority, it is agreed that rehabilitation works are required to ensure that the roads pavement is in no worse state compared with the condition at the start of construction activities, then Pacific Aluminium would make a contribution for the cost of rehabilitation works.

Melville Bay Road would continue to operate well below capacity and therefore traffic from the KGGP Project would have a negligible impact on the road operation and safety.

A number of existing local unsealed gravel roads and tracks would be utilised by traffic generated by the KGGP Project in order to access the ROW and construction camps and laydown areas. The existing volumes on these roads are low (10 - 50 vehicles per day); however, the project traffic could be in the range of 70 to 125 vehicles per day. The impact on these roads, although temporary, would be significant.

Mitigation of pavement impacts on local roads used to access the ROW and construction camps and laydowns, would comprise measures equivalent to that described above for the Central Arnhem Road.

Shipping

Berth utilisation at the two ports required for offloading of pipe is influenced by the number of vessel calls and the time at berth for each vessel. As the number of additional vessel calls at each port associated with the offloading of pipes is only two, this factor would be unlikely have a large impact on berth utilisation.

In the case of Darwin, the berth utilisation at East Arm Wharf in 2012 was 39%. The industry standard for full capacity is considered to be 65%. Hence there is spare berth capacity for an additional two vessel calls associated with the unloading of pipes. The time at berth however, would be considerable and would need to be coordinated with port authorities to avoid disruption to other operations at the port.

Detailed work is required to determine the most effective means of offloading pipes at the Gove port however berth utilisation is unlikely to present an issue as it is considered that there is sufficient spare capacity in the port to accommodate the proposed two additional vessel calls.

The storage area required to accommodate the pipes unload from each vessel would require significant consideration. In the case of Darwin, the port has good road and rail linkages to the East Arm Wharf, and the East Arm area is provided with adequate hardstand and storage area. The storage of pipes at Darwin Port, whilst a significant logistical exercise, is considered to be adequate.

In the case of Gove, the port is not set up for handling large parcels of import cargo. A solution for this will be developed during the detailed engineering phase of the project.

Aerodromes

The airports to be used for the KGGP Project are capable of accommodating the additional aircraft movements associated with the maximum of 3-4 additional chartered flights associated with a shift change. The additional flights would be within the operating parameters of the respective airports and significant noise issues are not envisaged. No specific mitigation is proposed.

The potential impacts of the construction of the KGGP on transport infrastructure fall most significantly on the road network. Issues remain for the appropriate configuration of shipping transport through the ports of Darwin and Gove; however, these are logistical challenges for the project rather than activities that need to be mitigated. The focus on mitigating potential impacts on transport is therefore on the potential impacts on the road network, particularly the Central Arnhem Road and local roads and access tracks. The primary approach to mitigating construction impacts the road network would be to strategically upgrade sections to ensure a standard of road construction that would operate below capacity with the anticipated additional traffic volumes, and to enter into agreements with relevant road authorities to ensure pavement of affected roads are maintained and rehabilitated post construction to a standard equivalent to condition at commencement of construction. This would

involve a financial contribution to the relevant road authority from Pacific Aluminium for maintenance activities attributable to the construction activities.

Table 14-5 summarises the mitigation approaches for potential impacts on transport infrastructure.

Safety issues to the workforce and public from additional traffic are addressed in Chapter 16 and the Provisional Traffic Management Plan at Appendix O.

Table 14-5: Potential impacts and mitigation outcomes for road transport infrastructure

POTENTIAL IMPACT	PROPOSED MITIGATION (ACTION)		ANTICIPATED EFFECT OF MITIGATION
	AVOIDANCE	MINIMISATION	
Increased maintenance required for roads, from more frequent traffic		• Joint inspection of Central Arnhem Road with relevant road authority to assess and record the road pavement condition • agreement and contribution to any required pavement upgrades prior to construction activity • proponent to maintain road for duration of construction • joint post construction inspection and contribution towards rehabilitation works required to return to condition at commencement of construction	Road pavements are suitable for use by construction traffic. Impacts on road pavements from construction activity are rectified and roads are returned to a condition equivalent to that at commencement of construction.
Capacity of road to safely accommodate additional traffic is exceeded	• Ensure that prior to use, the minimum gravel formation width on the unsealed sections of Central Arnhem Road is adequate for the expected increase in traffic volumes from the project. • Ensure that prior to use, the minimum gravel formation width on local roads and access roads is adequate for the expected increase in traffic volumes from the project, taking into account some of the access tracks will be temporary.	• Appropriate traffic management controls be employed where safety concerns are present e.g. traffic controllers, regular use of lay by areas, reduced speeds through areas of concern.	Capacity of roads to safely accommodate construction traffic would not be exceeded.

14.3.5 Summary – predicted environmental outcome

After mitigation is applied, construction of the KGGP is expected to result in negligible impacts on air transport and shipping (port) infrastructure, and a low impact on road infrastructure. By strategically

upgrading sections of road to the relevant standards, the capacity of roads to safely accommodate construction traffic should not be exceeded. A program of road assessment, strategic upgrade, maintenance and rehabilitation conducted in consultation with local road authorities and with financial contribution from Pacific Aluminium would ensure all road pavements are suitable for use by construction traffic and that road pavements are returned to a condition equivalent to that at commencement of construction.

14.4 NOISE AND VIBRATION

14.4.1 Description

Noise and vibration has the potential to cause nuisance and discomfort to surrounding sensitive receptors (locations) such as residences, communities, public localities, and terrestrial fauna. The construction and operation of the KGGP Project would involve the following noise and vibration-emitting activities:

Construction activities

- Transport and haulage.
- Clear and grade.
- Blasting preparation.
- Rock hammering.
- Trenching, trench breaking, stringing, bending and lowering of pipes.
- Welding and joint coating.
- Hydrotesting, dewatering and drying.
- Padding, shading and backfilling.
- String and pit tie-ins and road crossings.
- Restoration and rehabilitation.
- Commissioning.

Operation activities

- General access maintenance.
- Maintenance and potential emergency venting.
- Compressor facility.
- A noise and vibration assessment for the KGGP Project was conducted and a summary of the methodology and key findings are provided below. Full details are provided in Appendix L. The assessment aimed to address the requirements of Sections 4.9 and 6.8.2 of the EIS Guidelines by assessing the potential noise and vibration impacts associated with the construction and operation of the pipeline at known sensitive receptors.
- No residential receptors were identified within 5 km of the proposed construction camps.

14.4.2 Methodology

Sensitive Receptors

A desktop review of surrounding land uses was undertaken to identify land uses and receptor locations close to the proposed pipeline corridor. Key settlements within 2 km of the pipeline were identified as potential sensitive human receptors as follows:

- Beswick Township which is a small community with numerous dwellings located on the Central Arnhem Highway approximately 1.5 km north of the proposed pipeline corridor.
- Nhulunbuy, which supports the bauxite mine and alumina refinery, is located on the Gove Peninsula at the northern tip of Arnhem Land, with a population of approximately 3,800 permanent residents. It is approximately 1 km north east of the proposed pipeline corridor.

- Birritjimi (Wallaby Beach) which is a small community located west of Nhulunbuy on the Gove peninsula. It is approximately 250 m north of the proposed pipeline corridor.
- Galupa which is a small community located south of the Gove Refinery on the Gove peninsula. It is approximately 850 m south of the proposed pipeline corridor.

Sensitive receptors beyond 2 km were not considered for assessment as modelling indicated that noise levels would be within guideline limits at these distances.

Noise Assessment Criteria

The following criteria were used to assess the noise levels at the sensitive receptors:

- Northern Territory Environment Protection Authority: Noise guidelines for development sites – In the Northern Territory.
- Western Australia Environmental Protection (Noise) Regulations 1997. The Western Australian noise Regulations have been referenced as the Northern Territory legislation is not prescriptive in regards to the specific criteria for noise to be used in the implementation of the Environmental Protection objectives.
- Based on the ambient noise levels obtained from the background noise monitoring, the specific noise criteria for the construction impacts during the daytime only are shown in Table 14-6. In order to assess night time noise impacts the noise WA Environmental Protection (Noise) Regulations were referenced, as the NTEPA construction guidelines have no night time criteria.
- For noise from operation of the KGGP, the assigned noise levels, shown in Table 14-7, identifies three types of assigned levels: L_{Amax}, L_{A1} and L_{A10}.
- There are no known government policies or other widely-accepted guidelines in respect to the noise levels which may be acceptable to wildlife. There have been limited studies on the impacts that noise has on the behaviour and health of birds and mammals. Most studies completed indicate that species (both mammals and birds) may begin to avoid habitats when sound levels reach 70dB(A) to 90dB(A) (FHWA 2004, Dawe and Goosem 2008).
- With respect to peak noise levels, the US Department of Transport Federal Highway Administration (FHWA) (2004) studies of various species determined that startled responses of terrestrial fauna occur from around the 80-90dB(A) range. For example, birds may flush from the nest in response to a sudden loud noise, but in most cases they will return within ten minutes. Similar results were found by Dawe and Goosem (2008).

Table 14-6: Specific construction noise criteria

TYPE OF RECEPTOR	L_{Aeq}(15minute) CONSTRUCTION NOISE MANAGEMENT LEVEL dBA			
	Beswick	Nhulunbuy	Birritjimi	Galupa
Residential	54	67	65	67
Mixed commercial/residential	60	60	60	60
Commercial	65	65	65	65
Industrial	70	70	70	70

Note that due to high ambient noise levels measured within the Gove Peninsula that the criteria for the residential receivers are higher than that for a commercial receiver.

Table 14-7: Table of assigned noise levels for operational noise

TYPE OF PREMISES RECEIVING NOISE	TIME OF DAY	ASSIGNED LEVEL dB		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises at locations within 15 m of a building directly associated with a noise sensitive use	0700 to 1900 hours Monday to Saturday	45 + influencing factor[1]	55 + influencing factor[1]	65 + influencing factor[1]
	0900 to 1900 hours Sunday and public holidays	40 + influencing factor[1]	50 + influencing factor[1]	65 + influencing factor[1]
	1900 to 2200 hours all days	40 + influencing factor[1]	50 + influencing factor[1]	55 + influencing factor[1]
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35 + influencing factor[1]	45 + influencing factor[1]	55 + influencing factor[1]
Noise sensitive premises at locations further than 15 m from a building directly associated with a noise sensitive use	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises	All hours	65	80	90

1 The "influencing factor" is calculated for each noise-sensitive premises receiving noise. It takes into account the amount of industrial and commercial land and the presence of major roads within a 450 m radius around the noise receptor.
The "influencing factor" will range from zero to about 20 in most cases.

In reference to mammals, Manci *et al*. (1998) state that:

> Sound levels above about 90dB(A) are likely to be adversive to mammals and are associated with a number of behaviours such as retreat from the sound source, freezing, or a strong startle response. Sound levels below about 90dB(A) usually cause much less adversive behaviour. Laboratory studies of domestic mammals have indicated that behavioural responses vary with noise types and levels, and that domestic animals appear to acclimate to some sound disturbances.

Vibration assessment criteria

The following assessment criteria were used to assess the vibration levels at the sensitive receptors:

- British Standard 7385: Part 2-1993 Evaluation and Measurement for Vibration in Buildings Part 2.
- US Bureau of Mines, RI 8485-1980.
- Australian and New Zealand Environment Council (ANZEC) guidelines Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration (ANZEC guidelines) - 1990.

The British Standard 7385: Part 2-1993 *Evaluation and Measurement for Vibration in Buildings Part 2* is a definitive standard against which the likelihood of building damage from ground vibration can be assessed. This is the Standard recommended in Australian Standard AS 2187: Part 2-2006 *Explosives - Storage and Use – Part 2: Use of Explosives* as the guideline values and assessment methods "are applicable to Australian conditions".

The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

The guide values from this standard for transient vibration judged to result in a minimal risk of cosmetic damage to residential buildings and industrial buildings are presented numerically in Table 14-8. The standard goes on to state that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 14-10 and major damage to a building structure may occur at values greater than four times the tabulated values.

Table 14-8: Transient vibration guide values for cosmetic damage

LINE	TYPE OF BUILDING	PEAK COMPONENT PARTICLE VELOCITY IN FREQUENCY RANGE OF PREDOMINANT PULSE	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Based largely on work carried out by the US Bureau of Mines, the US Office of Surface Mining has presented regulatory limits for airblast from blasting (depending on the low frequency limit of the measuring system) (Table 14-9).

Table 14-9: Regulatory limits for airblast from blasting

LOW FREQUENCY LIMIT	PEAK AIRBLAST LEVEL LIMIT
2 Hz or lower	132 dB Linear
6 Hz or lower	130 dB Linear

The probabilities of damage to windows exposed to a single airblast event are as shown in Table 14-10.

Table 14-10: Probability of window damage from airblast (USBM, RI 8485-1980)

AIRBLAST dB LINEAR	LEVEL kPa	PROBABILITY OF DAMAGE	EFFECTS AND COMMENTS
140	0.2	0.01%	"No damage" - windows rattle
150	0.6	0.5%	Very occasional failure
160	2.0	20%	Substantial failures
180	20.0	95%	Almost all fail

The ground vibration and airblast levels which cause concern or discomfort to residents are significantly lower than the damage limits. The relevant criteria for airblast are presented in Table 14-11.

Table 14-11: Airblast limits for residents (from Environmental Protection (Noise) Regulations 1997 – WA)

	MONDAY TO FRIDAY	SUNDAYS & PUBLIC HOLIDAYS	OTHER TIMES
	7:00am to 6:00pm	7:00am to 6:00pm	6:00 pm to 7:00am
Peak limit from ANY blast	125 dBL	120 dBL	90 dBL
Peak limit for 9 of 10 consecutive blasts	120 dBL	115 dBL	-

Modelling of noise

The construction noise assessment model was prepared using the SoundPLAN 7.1 Industrial Module and the CONCAWE method was used to undertake the noise assessment.

The SoundPLAN model included the climatic parameters outlined in the Western Australia Environmental Protection Authority *Guidance for the Assessment of Environmental Factors Environmental Noise*, *Draft No.8*, and topography, soft ground adsorption, and buildings for the areas around the sensitive receptors were inputted into the model.

The potential for machinery to emit noise is quantified as the Sound Power Level (SWL) expressed in A-weighted decibels (dBA). At the receptor, the received noise is quantified as the sound pressure level (SPL) expressed in dBA. The SWLs used in the modelling were sourced from an extensive database of measurements of different plant and also with reference to work undertaken for the TTP project. These are described fully in Appendix L.

For the purposes of assessing the noise impacts of the construction of the pipeline a number of scenarios were considered that are indicative of the likely works to be undertaken.

The plant items for each construction scenario were placed along the nearest pipeline location to the identified receptors; the configuration of plant items along the chosen pipeline location in the scenarios was different at each receptor location to simulate likely construction activities in each location. For each activity it was assumed that only one activity was in operation in the localised area (approx. 100 m) of the pipeline nearest to the receptor. This was on the basis that any additional activity would probably be either further up or down the pipeline ROW and therefore further away from the receptor.

Noise levels were predicted for the operational phase using distance attenuation calculations to establish predicted noise levels at different distances from the compressor station and pressure regulating facility. Noise levels were also predicted at sensitive receptors for planned maintenance at facilities close to nearby receptors.

It is anticipated that only the compressor station at the King River MLV and pressure release regulating facility at the Giddy River scraper station are likely to involve plant items with the potential to emit significant noise levels.

Planned maintenance events are anticipated to be as follows:

- Six monthly pigging to clean pipeline. The significant noise source from this activity is gas release and the estimated SWL for this is 110 dBA.

- Scraper facility shut down venting. This only occurs on equipment failure or every five years. The estimated SWL for this is 110 dBA.

Both these activities would last thirty seconds in duration and would be in accordance with the frequency stipulated in the pipeline licence.

Due to the low traffic volumes on Central Arnhem Road and Melville Bay Road and also the small increase of traffic on Stuart Highway it was considered inappropriate to model noise emissions from traffic; however, given the relatively significant temporary increases in traffic from the construction activities at Barunga and Nhulunbuy, a qualitative assessment of noise impacts was undertaken. The traffic noise assessment considered the following potential sensitive receptors:

- Stuart Highway through Katherine.
- Central Arnhem Road passing Barunga.
- Melville Bay Road through Nhulunbuy.

Modelling of vibration

The predicted vibration and airblast emission levels were based on the highest Maximum Instantaneous Charge (MIC) that can be used without resulting in any exceedances and for comparison, 75% of that value. This was a 'worst case scenario' approach, as some blasting activities would be determined during detailed design; however, it is anticipated that the actual charge mass used during the pipeline construction would be significantly below the MIC.

14.4.3 Potential impacts of construction and operation

Construction noise from Right of Way

Table 14-12 provides the predicted noise levels at the nearest sensitive receptors compared against the relevant criteria (explained in Section 4.4.2). Exceedances of relevant noise criteria are shown in bold.

Construction noise from traffic

Stuart Highway through Katherine.

The highest recorded traffic flow along the section of Stuart Highway that will be used by construction traffic and passes through Katherine was 2,282 vehicles per day (in 2011). The anticipated construction traffic volume along the route will be an additional 65 vehicles per day. Due to the higher existing traffic count in Katherine and lower predicted increase in traffic from construction activities, Katherine residents should not experience any notable increase in noise levels.

Central Arnhem Road

The highest recorded traffic flow along the central section of Central Arnhem Road passing Barunga that will be used by construction traffic was 157 vehicles per day (in 2011). The anticipated construction traffic volume along the route will be as high as an additional 281 vehicles per day.

No existing traffic data is available for the northern section of the Central Arnhem Road (locally called the Melville Bay Road). The nearest traffic count data is for Central Arnhem Road intersection with Dhupuma Road (near Nhulunbuy) which is 66 vehicles per day (in 2011). It is assumed that as Melville Bay Road is located near to an urban area that it would have a greater traffic flow than this. The anticipated construction traffic volume along this route will be 145 vehicles per day.

Table 14-12: Assessment of construction noise

ACTIVITY		BESWICK		NHULUNBUY		BIRRITJIMI		GALUPA	
		SPECIFIC CRITERIA L_{AEQ} DB	PREDICTED L_{AEQ} DB	SPECIFIC CRITERIA L_{AEQ} DB	PREDICTED L_{AEQ} DB	SPECIFIC CRITERIA L_{AEQ} DB	PREDICTED L_{AEQ} DB	SPECIFIC CRITERIA L_{AEQ} DB	PREDICTED L_{AEQ} DB
Clear and Grade		54	34	67	43	65	63	67	45
Blasting Preparation		54	30	N/A	N/A	N/A	N/A	N/A	N/A
Rock Hammer		N/A	N/A	67	54[1]	65	**73**[1]	67	55[1]
Trenching, trench breaking, stringing, bending and lowering pipe.		54	42	67	51	65	**70**	67	53
Welding and Joint Coating		54	32	67	41	65	64	67	48
Hydrotesting, dewatering and drying	Day Time	54	32	67	41	65	58	67	43
	Night Time	35[2]	33	35[2]	**41**	35[2]	**58**	41[2]	**43**
Padding, shading and backfilling		54	36	67	45	65	64	67	47
String and pit tie ins and road crossings		54	36	67	41	65	63	67	42
Restoration and rehabilitation		54	36	67	43	65	64	67	47
Commissioning		54	35	67	44	65	62	67	46

[1]+10 dB Correction applied for impulsiveness.

[2]No night time criteria in the NTEPA construction guidelines, WA noise Regulations night time criteria referenced.

Due to the rural nature of the proposed pipeline route and low traffic volumes on the surrounding roads, peak construction traffic would temporarily significantly increase existing traffic volumes and noise received at Barunga and Nhulunbuy.

Operational Noise

The predicted noise levels at the nearest sensitive receptors to the compressor station / pressure regulating facility would be below L_{A10} 27 dB. There are no known sensitive receptors within 5km of operational noise sources and this noise level (including the correction of plus 5 dB for tonality) is compliant with the criteria at all times.

The predicted noise levels from planned maintenance activities at the nearest noise sensitive receptor compared against the specific criteria are shown in Table 14-13.

Table 14-13: Assessment of planned maintenance

RECEPTOR	SPECIFIC CRITERIA L_{A10} dB		PREDICTED L_{A10} dB[1]		
			BLOW DOWN	PIGGING	SCRAPER FACILITY VENTING
Nhulunbuy	Day	45	**47**[2]	>10[3]	>10[3]
	Evening	40			
	Night	35			
Galupa	Day	51	39[3]	29[3]	29[3]
	Evening	46			
	Night	41			
Birritjimi	Day	45	34[3]	24[3]	24[3]
	Evening	40			
	Night	35			

1 Including +5 dB correction for tonality

2 Nhulunbuy MLV Facility

3 Gove Refinery Scraper Facility

The predicted noise levels from blowdown activities at Nhulunbuy exceed the day evening and night noise criteria.

Anticipated increases in construction noise would be relatively minor and localised. Therefore the potential impacts of construction noise on terrestrial fauna would be negligible.

Vibration (Blasting)

It is proposed to undertake blasting operations where rock is found that cannot be otherwise excavated (by chain trencher) within the trench depth required. It is anticipated that blasting is likely to be within the Mitchell Ranges and potentially in the vicinity of Beswick.

As no sensitive receptors could be identified within 5 km of the proposed pipeline route within the Mitchell Ranges, vibration and air blast levels would not cause any structural damage or nuisance to sensitive receptors.

A blasting assessment was undertaken with reference to the nearest receptor within Beswick to the blasting operations. The predicted blast emission levels presented in Table 14-14 indicate that the blast emissions at all receptors are likely to comply with the WA *Environmental Protection (Noise)*

Regulations 1997 recommended airblast limit (i.e. 115 dB) and the ANZEC guidelines for ground vibration (i.e. 5 mm/s) at the nearest receptors.

Table 14-14: Predicted overburden blast emissions

Assessment Location	Distance to Blast km	Peak Vector Sum (PVS) Vibration mm/s			Peak Linear Airblast dB re 20µPa		
		Criteria	MIC 178 kg	75%MIC 134 kg	Criteria	MIC 178 kg	75% MIC 134 kg
Beswick	1.5	5	1	0.8	115	115	114

Note: This assessment assumes the actual blast parameters would be designed to ensure the ANZEC guidelines are met at all receptors.

The blasting assessment also demonstrated that:

- The predicted levels of ground vibration for a permissible MIC of 178 kg at all nearby receptors would comply with the ANZEC general human comfort criterion (of 5 mm/s) and consequently with the ANZEC maximum human comfort criterion, as well as the BS 7385 structural damage criterion of 15 mm/s (at 4 Hz) under the indicative MIC range at all residences within Beswick.
- The predicted levels of peak airblast at all receptors would comply with the *Environmental Protection (Noise) Regulations 1997 (WA)* airblast criterion of 115 dB Linear for the indicative MIC range at all residences within Beswick.
- The predicted levels of peak airblast are below the US Bureau of Mines damage limit of 132 dB Linear (2 Hz cut off) at all non-mine receptors.

14.4.4 Mitigation response and predicted environmental outcome

Construction noise from ROW

The predicted noise levels at the receptors at Beswick, Nhulunbuy and Galupa for all construction activities are compliant with the day time criteria contained within the NTEPA construction guidelines.

Due to their proximity to the proposed pipeline corridor, the predicted noise levels at the receptors within Birritjimi exceed the criteria contained within the NTEPA construction guidelines for the following scenarios:

- Rock hammer.
- Trenching, trench breaking, stringing, bending and lowering the pipe.

All the remaining day time scenarios at Birritjimi are within the criteria contained within the NTEPA construction guidelines.

In order to reduce the impact from construction noise at Birritjimi from these activities, it is proposed to implement the following noise management measures:

- When rock hammering, localised acoustic shrouds around the plant would be used.
- Noisy plant would be fitted with engine and muffler kits.
- A temporary barrier along the southern side of Birritjimi would be erected.
- The numbers of plant operating simultaneously, in particular the number of semi-trailers during the trenching activities would be limited.
- Fixed plant items would be located as far from Birritjimi as practical and placed behind temporary acoustic barriers.

- Noisy work operations would be avoided during the night time period whenever possible.

The only significant construction activity proposed to take place during the night time period is hydrotesting of the pipeline. The noise levels from this activity would potentially exceed noise criteria at Nhulunbuy, Birritjimi and Galupa; however, the plant associated with this activity can be placed at fill points along the pipeline to ensure that they do not have an impact on these receptors. Consideration will therefore be given to locating fill points for hydrotesting at least 2 km from a nearby receptor so as not to cause a night time noise impact.

Adherence to the noise criteria will be ensured through the development of a Noise and Vibration Management Plan. The noise management plan will include mitigation strategies to reduce daytime noise from activities close to Birritjimi and to reduce night time noise from hydrotesting that could impact at Nhulunbuy, Galupa and Birritjimi. The Noise and Vibration Management Plan will detail a complaint management procedure and community consultation strategies. A Provisional Noise and Vibration Management Plan is provided at Appendix O.

The majority of the construction activities for the pipeline would occur over a short period of approximately six months and over a shorter period (approximately 90 days) in any one location. Impacts on wildlife from construction noise are expected to be localised and temporary. Notwithstanding, construction activities would avoid, as far as practicable, sudden loud or impulsive or impact noises in the vicinity of known significant active wildlife breeding areas.

Construction noise from traffic

The diurnal daily peak construction traffic would occur around 6.00 am and 6.00 pm. Traffic noise impacts are therefore not expected to cause any adverse impacts on nearby communities; however, adverse driver behaviour, particularly along routes close to residences and at any stage during the night time period, could potentially cause annoyance to local residents. The following management measures or considerations would be addressed through the Noise and Vibration Management Plan:

- Driver behaviour induction and training.
- Limiting non-essential construction traffic to the daytime period.
- Consideration of heavy vehicle transportation times.
- Notification to residents within 500 m of a construction traffic route prior to construction.

Noise from operations

Due to the large separation distance between the compressor station / pressure regulating facility and the nearest receptors, the predicted noise levels based on the estimated sound power levels of the facilities and their operations, are within the assessment criteria.

Planned maintenance was also assessed and exceedance of the assessment criteria for blowdown would be likely at Nhulunbuy. Blow downs are likely to occur once every five years for eight hours and therefore are not an ongoing issue. To further minimise potential operational noise impacts, management measures proposed at Nhulunbuy include the following:

- Locating vents as far away as practicable from sensitive receptors.
- Consideration of fitting silencers to the vents at Nhulunbuy MLV.
- Notification of sensitive receptors within 5 km of a vent, at least 48 hours prior to an event and in accordance with a specific noise management plan.
- Scheduling planned maintenance for the day time period, where possible.

Vibration (blasting)

Based on the results of the blast emission assessment the predicted vibration and airblast levels based on the Maximum Instantaneous Charge would be within the relevant criteria and therefore the vibration impact on the nearby sensitive receptors would be low.

Adherence to the nominated criteria will be managed by restricting the charge mass used for each to within the Maximum Instantaneous Charge.

Table 14-15 summarises the mitigation approaches for potential impacts on noise and vibration.

Table 14-15: Potential impacts and mitigation outcomes for noise and vibration

POTENTIAL IMPACT	PROPOSED MITIGATION (ACTION)		ANTICIPATED EFFECT OF MITIGATION
	AVOIDANCE	MINIMISATION	
Excessive construction noise at sensitive receptor	• Pipeline avoids close proximity to majority of sensitive receptors. • Little night time construction.	• Majority noise emitting activities during daylight hours. • Limiting the numbers of plant operating simultaneously near sensitive receptors. • Planning for an additional set back from sensitive receptors when locating noise emitting activities. • Attenuating noise by use of acoustic controls, silencers, noise barriers when in close proximity to residences. • Relocating fill points for hydrostatic testing away from sensitive receptors • Notification to residents prior to construction. • Limiting non-essential construction traffic to day-time	No exceedance of relevant noise criteria for majority of sensitive receptors. Where modelling indicates potential exceedance of noise criteria to sensitive receptor, noise levels reduced to an acceptable level.
Excessive operational noise at sensitive receptor	• Pipeline avoids close proximity to majority of sensitive receptors • Location of compressor station away from sensitive receptors	• Locating vents as far away as practicable from sensitive receptors. • Consideration of fitting silencers to the vents at Nhulunbuy MLV. • Notification of sensitive receptors at least 48 hours prior to blow down event. • Scheduling planned maintenance for the day time period, where possible	No exceedance of relevant noise criteria to sensitive receptors for operation of the compressor station. Infrequent exceedance of noise criteria associated with blow down activities near Nhulunbuy
Excessive vibration at sensitive receptor, from blasting	• Restricting the charge mass used		Vibration and airblast levels based on the Maximum Instantaneous Charge would be within the relevant vibration criteria

14.4.5 Summary – predicted environmental outcome

The location of the KGGP and associated construction activities are sufficiently distant from the majority of sensitive receptors that noise would be within the relevant noise criteria. Daytime noise from construction activities close to Birritjimi and night time construction noise from hydrotesting near Nhulunbuy, Galupa and Birritjimi could exceed noise critieria. Infrequent venting during the operational phase may exceed noise criteria at Nhulunbuy. Mitigation measures addressing timing and location of noise generation and implementation of noise attenuation controls would reduce these potential exceedances to an acceptable level. Vibration and airblast levels from any blasting during construction are predicted to be within the relevant criteria and are therefore unlikely to cause impacts on any sensitive receptors.

14.5 VISUAL AMENITY

14.5.1 Description

The KGGP project is located in an area of the Northern Territory that is generally remote from tourist routes, significant tourist attractions or major population centres.

Key vantage points where visual impacts would be possible would primarily occur along roads, particularly at points where roads and the ROW run parallel to one another in close proximity or where roads and the ROW intersect.

The pipeline would cross the Stuart Highway at approximately KP26 (Appendix V). The Average Annual Daily Traffic in the section of the Stuart Highway near this crossing is approximately 550. The pipeline would not run parallel the Stuart Highway.

After crossing the Stuart Highway, the pipeline corridor broadly runs parallel to the Central Arnhem Road. At its most distant point the ROW would be approximately 24 km from the Central Arnhem Road (near KP140). The pipeline would cross the Central Arnhem Road nine times at the following approximate points: KP40, 398, 424, 429, 432, 443, 520, 548, and 574. For access reasons, all construction camps would be located on the Central Arnhem Road.

The Central Arnhem Road currently experiences light traffic. The only community directly entered by the pipeline corridor, would be Nhulunbuy.

14.5.2 Potential impacts of construction and operation

Potential visual impacts from construction of the KGGP would mainly arise from:

- Construction camps.
- Vegetation clearance.
- Storage of construction materials such as pipe at laydown areas.

Potential visual impacts over longer term would arise from:

- Above ground infrastructure.
- Pipeline markers.
- The rehabilitated ROW.

14.5.3 Mitigation responses and predicted environmental outcomes

As the pipeline corridor does not run parallel the Stuart Highway, visual impacts would be limited to the point of crossing. At the Stuart Highway crossing, the ROW would be in a vegetated landscape and perpendicular to the highway, rather than at an angle which would potentially expand the field of view of the disturbance. Visual impact is therefore likely to be limited to a narrow (30 m) width of

disturbance. The ROW would be visible from vehicles travelling at high speed along the highway and it would therefore rapidly disappear from view. At the point of crossing there would be a line of sight along the ROW of a short section of approximately 460 m before bends in the pipeline would remove disturbance from view. Other linear disturbance also occurs within 140 m of the crossing. The crossing of the ROW at the Stuart Highway would therefore have a negligible visual impact.

Construction activity along the ROW and the temporary construction camps would be visible from points along the Central Arnhem Road. Some screening of construction camps using a native vegetation buffer would be employed to reduce visual impacts. Camps would however be removed following completion of construction activity and the sites rehabilitated. The visual impacts of construction activity and camps would be temporary and minor in nature given the use of the Central Arnhem Road. The reinstated ROW and pipeline markers would be observable at points along the Central Arnhem Road where the ROW comes into close proximity. With rehabilitation and native vegetation regrowth over parts of the ROW, visual impacts would reduce over time. Permanent above ground facilities such as the compressor station are located in remote locations away from significant visitation. Wherever possible, screening would be employed, ensuring that the visual impacts of these facilities would be minimal. Given the light traffic on the Central Arnhem Road, visual impacts from permanent disturbance along the ROW and above-ground infrastructure are therefore expected to be low.

Table 14-16 summarises the mitigation approaches for potential visual impacts.

Table 14-16: Potential impacts and mitigation outcomes for management of visual impacts

POTENTIAL IMPACT	PROPOSED MITIGATION (ACTION)		ANTICIPATED EFFECT OF MITIGATION
	AVOIDANCE	MINIMISATION	
Visibility of construction activity and temporary facilities	• Location away from major tourist routes or areas of high visitation	• Minimising width of ROW as far as possible. • Screening and subsequent rehabilitation of construction camps	Some construction activity would be visible but temporary in nature
Visibility of above-ground infrastructure and rehabilitated ROW	• Location away from major tourist routes or areas of high visitation • Crossing perpendicular to Stuart Highway	• Active rehabilitation of ROW through Rehabilitation Management Plan • Screening of Compressor Station • Above ground facilities painted in neutral tones	Few people will see ROW or above ground infrastructure

14.5.4 Summary – predicted environmental outcome

After mitigation is applied, construction and operation of the KGGP would result in a low visual impact, within a region that is generally remote from tourist routes, significant tourist attractions or major population centres.

14.6 TOURISM AND RECREATIONAL AREAS

14.6.1 Description

Tourism is a significant contributor to the regional and NT economy, with 1.2 million visitors in the NT in 2010-2011, spending $1.4 billion in that financial year.

The greatest recreational and tourist use of lands within the region that would be traversed by the pipeline corridor are within the first 50 km (Katherine region) and last 50 km (Nhulunbuy/Yirrkala region), with services and administration provided by these regional population centres.

Residents and tourists (domestic and international) enjoy the natural beauty of each region (rivers and watercourses, gorges, hot springs, and landscapes); explore and engage with Aboriginal art and culture and the European history of area; engage in a range of sport, kayaking, fishing and bushwalking. Recreational fishing off the East Arnhem coast and in the river systems of the Katherine Region and East Arnhem Land is also a popular attraction for locals and visitors to the region.

While there is recreation and tourist use of lands within the broader region of the pipeline corridor, the tourism and recreational values within the immediate vicinity of the pipeline corridor is very limited.

14.6.2 Potential impacts of construction and operation

Construction of the pipeline would not restrict access by road to regional centres such as Katherine and Nhulunbuy.

Access to the majority of land along the pipeline corridor is restricted because it is Aboriginal land, requiring permits or permission for entry. A permit from the NLC is required to travel the Central Arnhem Road from the Stuart Highway to Nhulunbuy. The majority of the remaining lands along the pipeline corridor are pastoral leases requiring permission for access.

Potential impacts on recreational use and tourism are therefore generally limited to the remaining open access areas and areas where the NLC, Dhimurru Aboriginal Corporation and Laynhapuy Homelands Association Inc. issue permits, particularly in relation to the IPAs they manage. Potential impacts would include unauthorised access, increased visitation by construction workforce through authorised use and potential downstream impacts from construction across watercourses. These impacts and proposed mitigation are discussed in Chapters 7, 11, 13 and 15.

14.6.3 Summary – predicted environmental outcome

The majority of lands in the vicinity of the pipeline do not contribute significantly to tourist use or the NT or regional tourism industry. Permits from the Aboriginal land owners or permission from pastoral lessees are required for access to these lands.

The high use areas are at each end of the pipeline, with the two population centres of Katherine and Nhulunbuy providing tourist and recreational services, products and infrastructure. Construction and operation of the KGGP would have no significant impact on the recreation and tourism values in these areas.