Chapter 5
Risk Assessment

PACIFIC **ALUMINIUM**

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5 Risk Assessment

5.1 INTRODUCTION

Section 6 of the NT EPA Guidelines for the Preparation of an Environmental Impact Statement for the KGGP project (January 2013) requires a risk assessment approach to the EIS.

In accordance with the EIS Guidelines specific emphasis on the identification, analysis and treatment of risks through a whole-of-project risk assessment has been undertaken. The risk assessment:

- Acknowledges and discusses the full range of risks presented by the project, including those of special concern to the public.
- Quantifies and ranks risks so that the reasons for proposed management responses are clear.
- Acknowledges levels of uncertainty regarding estimates of risk and the effectiveness of risk controls.
- Explicitly identifies those members of the community expected to accept residual risks and their consequences, providing better understanding of equity issues.

This risk assessment approach has assisted in identifying the potential impacts with a greater environmental risk, and therefore where environmental impact assessment and management should be focussed.

This Chapter describes the risk assessment methodology used for the KGGP Project, provides the mitigated and unmitigated risk rankings, and a summary of the key findings of the risk assessment.

Some of the management measures provided in this risk assessment refer to measures described in the Environmental Management Plan (EMP) (Appendix O). As a result, this risk assessment should be read in conjunction with the EMP to appreciate the management measures considered when undertaking the risk assessment.

5.2 RISK ASSESSMENT METHODOLOGY

The environmental impact assessment of the KGGP project has been undertaken using a systematic risk-based approach based on international best practice standards, including:

- AS/NZS ISO 31000:2009: Risk management - Principles and Guidelines (Standard).
- HB 158:2010: Delivering assurance based on ISO 31000:2009 Risk management – Principles and Guidelines (Handbook).
- HB 203:2012: Managing environment-related risk (Handbook).
- HB 436:2004: Risk Management Guidelines Companion to AS/NZS 4360:2004 (Handbook).

The risk assessment also considered environmental risk assessment guidelines for other Australian states, including the WA Environmental Protection Authority draft Application of Risk-based Assessment of EIA (2009), and the NSW Department of Planning Assessment Guideline – Multilevel Risk Assessment (2011).

The process of the risk assessment involved the following steps:

- Communication and consultation.
- Establish the context.
- Risk assessment.
  - Risk identification
  - Risk analysis
  - Risk evaluation
- Risk treatment.
- Monitoring and review.
- Recording the risk management process.

The risk assessment process is depicted conceptually in Figure 5-1 and described in Sections 5.2.1 to 5.2.4.

5.2.1 Establishing the context

A risk assessment for the biophysical environment (refer Section 5.2.3) and a socio-economic risk assessment (refer Section 5.2.4) were conducted separately. The risk assessment for the biophysical environment included an assessment of risks to human health and safety, biodiversity, water quality and sites of Aboriginal and historic cultural heritage. The socio-economic risk assessment included economic and social risks. In collaboration between Pacific Aluminium, Worley Parsons and Eco Logical Australia, the objectives, scope and risk criteria were developed for the KGGP project.

The following objectives for the risk assessment were agreed:

- Address section 6 of the KGGP project EIS Guidelines requirements for the risk assessment.
- Address Pacific Aluminium's risk assessment requirements.
- Undertake a process to identify key environmental risks as a result of the KGGP project.
- Identify and propose appropriate management measures to reduce the risks to as low as reasonably possible.

The scope of this risk assessment includes all activities directly related to the construction, operation or decommissioning of the KGGP Project.

Risk criteria were developed for each 'environmental aspect' and 'environmental factor' (environment in the risk assessment has been defined in its broader sense to include for example cultural heritage). An environmental aspect is a feature or characteristic of the KGGP Project that has the potential to affect the environment or associated social values (e.g. vegetation clearance). An environmental factor is the receptor that the aspect may potentially impact (e.g. threatened flora and fauna species).

Following identification of the environmental aspects and factors, definitions for likelihood of occurrence and the consequence were developed (Section 5.2.2).

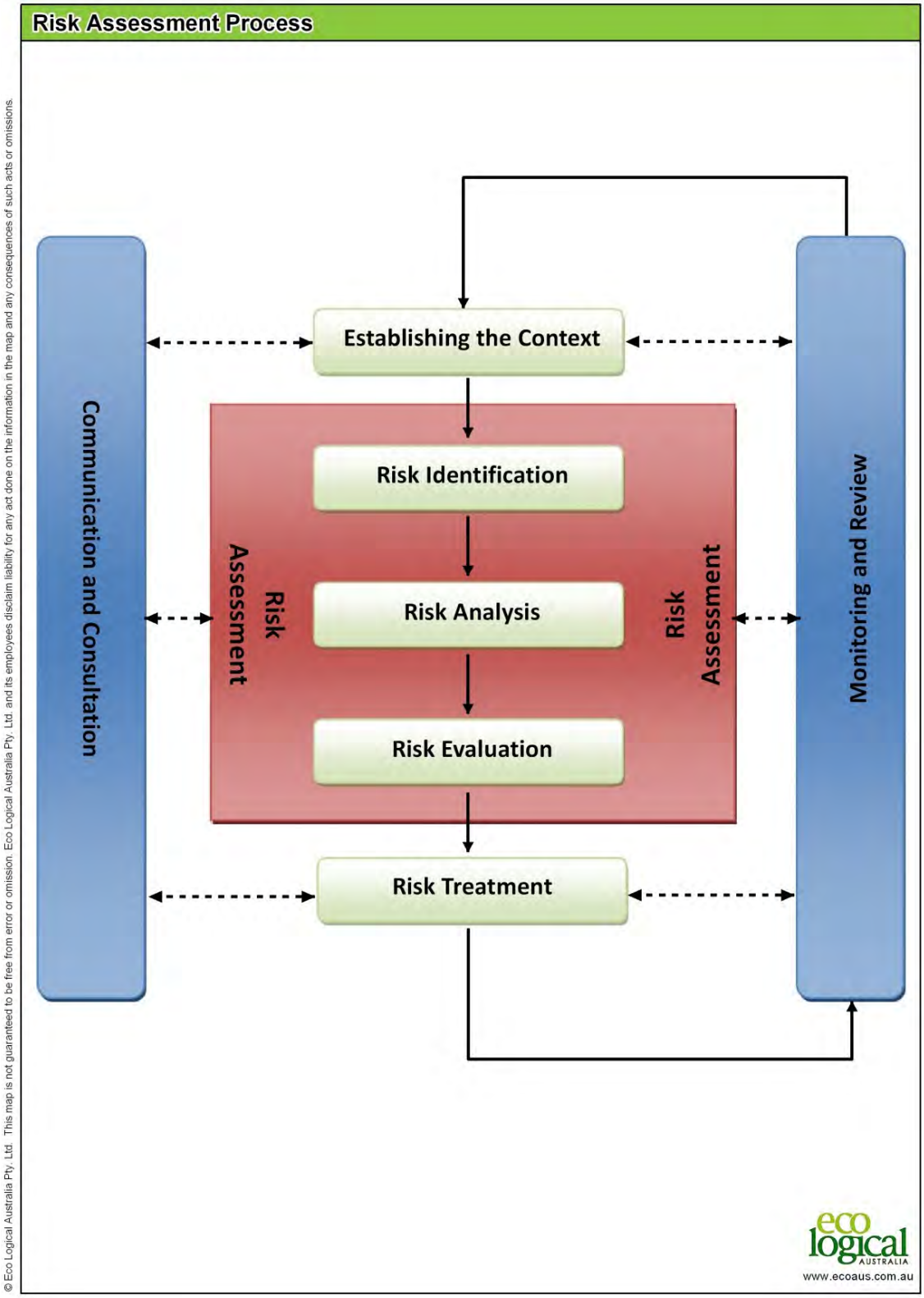

Figure 5-1: Risk assessment process

5.2.2 Risk assessment – safety, biophysical and cultural heritage environment

In accordance with AS/NZS ISO 31000:2009, the risk assessment process consisted of risk identification, risk analysis and risk evaluation, which is described in the following sections.

Risk identification

The aim of risk identification is to generate a comprehensive list of risks based on those activities in construction, operation or decommissioning of the KGGP Project that may have an environmental impact.

A list of environmental risks was developed in collaboration between Pacific Aluminium, Worley Parsons and Eco Logical Australia which included environmental aspects (activities) and environmental factors (receptors). The list was developed using internal knowledge of the processes and activities for gas pipelines, internal knowledge of potential environmental impacts from a gas pipeline, consultation with environmental specialists and their assessment reports, and other existing relevant information such as other impact assessments for gas pipelines.

Risk analysis, evaluation and treatment

The likelihood (Table 5-1) and consequences (Table 5-2 to Table 5-11) were defined for each aspect (element or activity of a project that interacts with the environment) and factor (component of the environment affected by environmental aspect, or 'receptor') relevant to the project. The consequence definitions were developed specifically for each factor and customised for the KGGP Project.

Environmental aspects relevant to the project and considered in the risk assessment were:

- Vegetation clearing.
- Excavation.
- Water use/ groundwater extraction.
- Energy/ electricity use.
- Physical presence of infrastructure.
- Vehicle movements.
- Fire ignition.
- Liquid (including septic) and solid waste disposal.
- Spills and leaks.
- Atmospheric emissions (excluding dust).
- Dust emissions.
- Light emissions.
- Noise and vibration emissions.

Environmental factors relevant to the project and considered in the risk assessment were:

- Amenity (affecting the public and/or project workforce).
- Human health and safety (affecting the public and/or project workforce).
- Existing services and infrastructure.
- Vegetation and flora (terrestrial, aquatic).
- Fauna (terrestrial, aquatic).
- Soils and landforms.
- Surface water (including watercourses, wetlands, etc.).
- Groundwater.
- Aboriginal and cultural heritage.
- Air (quality).

The risk ratings were determined for each aspect and factor by using the risk matrix (Table 5-12). The definitions for the risk ratings are provided in Table 5-13.

Risk ratings were initially determined with the assumption that minimum standards would be met without the implementation of additional management controls or risk assessment. Minimum standards would include compliance with legislative and corporate requirements or with operating practices commonly used for construction, operation and decommissioning of gas pipelines in the NT. Knowledge of the likely occurrence of flora and fauna species (particularly threatened species and ecological communities) were addressed in the initial (pre-mitigation) risk assessment. Public perception and government policy were also considered when assigning the risk ratings. The level of certainty, given the information available for each aspect and factor, was addressed (Table 5-14).

In addition to assigning the individual risk ratings, the assessment also:

- Summarised the available information for each factor.
- Defined terms such as 'local', 'regional', 'short term', and 'long term' (Table 5-15).
- Determined uncertainties and confidence levels.
- Undertook an initial determination of further management controls for potential medium and high risks.
- Determined additive risk levels for each factor.

Following this evaluation and identification of treatments, the residual risk ratings were determined (Table 5-16). Ratings relevant to risks from and to the pipeline relating to public and worker safety were drawn from the Preliminary Risk Assessment Report conducted in accordance with AS2885 and included as Appendix N.

Table 5-1: Definition of likelihood

LIKELIHOOD/PROBABILITY		
A	**Almost certain**	Common repeating occurrence that is ongoing. Frequency interval (multiple events): more than twice per year; probability (single events): more than 25%.
B	**Likely**	Known to occur or will probably occur at some time and in most circumstances. Frequency interval (multiple events): from once per year to twice per year; probability (single events): from 10% to 25%.
C	**Possible**	Could occur at some time but not often. Frequency interval (multiple events): from once in 10 years to once per year; probability (single events): from 1% to 10%.
D	**Unlikely**	Could potentially occur at some time but highly unlikely. Frequency interval (multiple events): from once in 100 years to once in 10 years; probability (single events): from 0.1% to 1%.
E	**Rare**	Practically impossible, will only occur in very rare circumstances. Frequency interval (multiple events): less than once in 100 years; probability (single events): less than 0.1%.

Table 5-2: Consequence definitions for amenity (affecting the public and/or project workforce)

1	2	3	4	5
MINOR	MEDIUM	SERIOUS	MAJOR	CATASTROPHIC
• No noticeable change to landform or vista as viewed from sensitive premises (e.g. private residence, National Park)	• Local and seasonal change to landform or vista as viewed from sensitive premises (e.g. private residence, National Park)	• Local and short-term, or widespread and seasonal change to landform or vista as viewed from sensitive premises (e.g. private residence, National Park)	• Local and long-term, or widespread and short-term change to landform or vista as viewed from sensitive premises (e.g. private residence, National Park)	• Widespread and long-term change to landform or vista as viewed from sensitive premises (e.g. private residence, National Park)
• Noise emissions do not exceed relevant noise guidelines	• Seasonal, local increase in noise levels exceeding relevant noise guidelines	• Short-term, local increase in noise levels exceeding relevant noise guidelines	• Long-term, local increase in noise levels exceeding relevant noise guidelines	• Long-term, regional increase in noise levels exceeding relevant noise guidelines
• No effect on traffic congestion	• Seasonal, local increase in traffic congestion	• Short-term, local increase in traffic congestion	• Short-term, regional increase in traffic congestion	• Long-term, regional increase in traffic congestion
• No measureable visual impact resulting from light emissions	• Local and seasonal visual impact resulting from light emissions	• Local and short-term, or widespread and seasonal visual impact resulting from light emissions	• Local and long-term, or widespread and short-term visual impact resulting from light emissions	• Widespread and long-term visual impact resulting from light emissions

Table 5-3: Consequence definitions for human health and safety (affecting the public and/or project workforce)

1	2	3	4	5
MINOR	MEDIUM	SERIOUS	MAJOR	CATASTROPHIC
• No injuries or first aid required	• Basic first aid treatment required	• Medical attention required	• Permanent injury or illness	• Loss of life
• No increase in vehicle accidents	• Increase of <2 annual non-fatal vehicle accidents	• Increase of 2-5 annual non-fatal vehicle accidents	• Increase of 5-10 annual non-fatal vehicle accidents	• Increase of >10 annual non-fatal vehicle accidents • Fatal vehicle accident

1	2	3	4	5
MINOR	MEDIUM	SERIOUS	MAJOR	CATASTROPHIC
				resulting from project
• No contamination of drinking/irrigation water	• Seasonal, local contamination of drinking/irrigation water exceeding ANZECC/ARMCANZ Water Quality guidelines	• Short-term, local, contamination of drinking/irrigation water exceeding ANZECC/ARMCANZ Water Quality guidelines	• Long-term, local contamination of drinking/irrigation water exceeding ANZECC/ARMCANZ Water Quality guidelines	• Long-term, regional contamination of drinking/irrigation water exceeding ANZECC/ARMCANZ Water Quality guidelines
• No increase in the number of biting insects and/or breeding areas	• Seasonal, local increase in the number of biting insects and/or breeding areas	• Short-term, local increase in the number of biting insects and/or breeding areas	• Short-term, regional increase in the number of biting insects and/or breeding areas.	• Long-term, regional increase in the number of biting insects and/or breeding areas, epidemic level and human health risk

Table 5-4: Consequence definitions for existing services and infrastructure

1	2	3	4	5
MINOR	MEDIUM	SERIOUS	MAJOR	CATASTROPHIC
• No change to existing facilities (e.g. waste disposal)	• Existing facilities overloaded up to 110% of capacity	• Existing facilities under pressure, overloaded between 110-150% of capacity	• Existing facilities overloaded between 150-175% of capacity	• Existing facilities overloaded beyond 175% of capacity; emergency management required
• No deterioration of road integrity	• Seasonal, local deterioration of road integrity	• Short-term, local deterioration of road integrity	• Short-term, regional, deterioration of road integrity	• Long-term, regional deterioration of road integrity
• No competition for existing utility resources	• Short-term, isolated exceedance in requirement of water/power to support	• Short-term, local exceedance in requirement of water/power to support	• Short-term, regional competing demand for water/power from existing	• Long-term, regional water shortage/power under-supply

1	2	3	4	5
MINOR	MEDIUM	SERIOUS	MAJOR	CATASTROPHIC
	the project	the project	sources	

Table 5-5: Consequence definitions for vegetation and flora (terrestrial and aquatic)

1	2	3	4	5
MINOR	MEDIUM	SERIOUS	MAJOR	CATASTROPHIC
• No loss and/or minor local degradation of TEC • Minor local loss and/or moderate local degradation of significant (non-threatened) vegetation community	• Minor local loss and/or moderate local degradation of TEC • Moderate local loss and/or substantial local degradation of significant (non-threatened) vegetation community	• Moderate local loss and/or substantial local degradation of TEC • Substantial local loss and/or moderate regional degradation of significant (non-threatened) vegetation community	• Substantial local loss and/or moderate regional degradation of TEC • Moderate regional loss and/or substantial regional degradation of significant (non-threatened) vegetation community	• Moderate regional loss and/or substantial regional degradation of TEC • Substantial regional loss and/or substantial regional degradation of significant (non-threatened) vegetation community
• No loss of individuals of threatened flora species	• Minor local decrease in size of population(s) of threatened flora species	• Moderate local decrease in size of population(s) of threatened flora species	• Substantial local decrease in size of population(s) of threatened flora species	• Moderate regional decrease in size of population(s) of threatened flora species

Table 5-6: Consequence definitions for fauna (terrestrial and aquatic)

1	2	3	4	5
MINOR	MEDIUM	SERIOUS	MAJOR	CATASTROPHIC
• No loss of threatened species habitat	• Minor local loss of threatened species habitat	• Moderate local loss of threatened species habitat	• Substantial local loss of threatened species habitat	• Moderate or substantial regional loss of threatened

1	2	3	4	5
MINOR	MEDIUM	SERIOUS	MAJOR	CATASTROPHIC
• Minor local habitat modification[1] and/or lifecycle disruption[2] for a threatened species	• Moderate local habitat modification[1] and/or lifecycle disruption[2] for a threatened species	• Substantial local habitat modification[1] and/or lifecycle disruption[2] for a threatened species	• Moderate regional habitat modification[1] and/or lifecycle disruption[2] for a threatened species	species habitat • Substantial regional habitat modification[1] and/or lifecycle disruption[2] for a threatened species
• No loss of individuals of threatened fauna species	• Minor local decrease in size of population(s) of threatened fauna species	• Moderate local decrease in size of population(s) of threatened fauna species	• Substantial local decrease in size of population(s) of threatened fauna species	• Moderate or substantial regional decrease in size of population(s) of threatened fauna species

[1] Habitat modification can include fragmentation, and alteration of fire regimes, nutrient cycles and/or hydrological cycles; [2] Lifecycle disruptions can include disruption of breeding, feeding, migration, resting behaviour, etc.

Table 5-7: Consequence definitions for soils and landforms

1	2	3	4	5
MINOR	MEDIUM	SERIOUS	MAJOR	CATASTROPHIC
• Minor leak or spill contained within bunded area	• Minor leak or spill affecting soil around bunded area; minimal response and clean-up required	• Leak or spill affecting soil; Clean-up procedures required	• Major leak or spill affecting soil beyond storage area, some minor permanent impacts	• Leak or spill causing widespread environmental impact to soil in the region, some permanent impacts

Table 5-8: Consequence definitions for surface water

1	2	3	4	5
MINOR	MEDIUM	SERIOUS	MAJOR	CATASTROPHIC
• No detectable change to background water quality; no exceedance of background and applicable ANZECC/ARMCANZ Water Quality guidelines	• Local, short-term, minor exceedance of background and applicable ANZECC/ARMCANZ Water Quality guidelines	• Local, long-term OR widespread, short-term, exceedance of background and applicable ANZECC/ARMCANZ Water Quality guidelines	• Local, permanent OR widespread, long-term exceedance of background and applicable ANZECC/ARMCANZ Water Quality guidelines	• Major exceedance of background and applicable ANZECC/ARMCANZ Water Quality guidelines that is widespread and permanent • Widespread, permanent exceedance of background and applicable ANZECC/ARMCANZ Water Quality guidelines
• No detectable change to surface water hydrology or flow regimes (including no loss or reduction of number and/or volume of dry season remnant pools	• Local, short-term change in surface water hydrology and flow regimes that can be readily remediated • Non-significant change in surface water hydrology and flow regimes that are local and short-term, and that can be easily remediated	• Significant change in surface water hydrology and flow regimes that is either widespread and short-term, or local and long-term	• Significant change in surface water hydrology and flow regimes that is either widespread and long-term, or local and permanent	• Significant change in surface water hydrology and flow regimes that is widespread and permanent

Table 5-9: Consequence definitions for groundwater

1	2	3	4	5
MINOR	MEDIUM	SERIOUS	MAJOR	CATASTROPHIC
• No detectable change to background water quality; no exceedance of background and applicable ANZECC/ARMCANZ Water Quality guidelines	• Local, short-term, minor exceedance of background and applicable ANZECC/ARMCANZ Water Quality guidelines	• Major exceedance of background and applicable ANZECC/ARMCANZ Water Quality guidelines that is either localised and long-term, or widespread and short-term	• Major exceedance of background and applicable ANZECC/ARMCANZ Water Quality guidelines that is either widespread and long-term, or local and permanent	• Major exceedance of background and applicable ANZECC/ARMCANZ Water Quality guidelines that is widespread and permanent

Table 5-10: Consequence definitions for Aboriginal and cultural heritage

1	2	3	4	5
MINOR	MEDIUM	SERIOUS	MAJOR	CATASTROPHIC
• No Historic and/or Cultural Heritage sites disturbed	• Some Historic and/or Cultural Heritage sites required to be remediated/ repaired/ rehabilitated with no permanent damage	• Some Historic and/or Cultural Heritage sites required to be remediated/ repaired/ rehabilitated with some temporary damage	• Some Historic and/or Cultural Heritage sites required to be remediated/ repaired/ rehabilitated, some permanent damage	• Some Historic and/or Cultural Heritage sites required to be remediated/ repaired/ rehabilitated, permanent damage to most sites

Table 5-11: Consequence definitions for air quality

1	2	3	4	5
MINOR	MEDIUM	SERIOUS	MAJOR	CATASTROPHIC
• No measureable air quality impacts (including dust; PM_{10})	• Local short-term and minor exceedance(s) of standards • Ground-level concentrations at identified sensitive receptors represents a small increase over the NEPM baseline conditions	• Localised long-term change in air quality • Ground level concentrations at identified sensitive receptors represent a significant increase over the NEPM baseline conditions or reduce the remaining air-shed capacity for particular key pollutants • Occasional exceedance(s) of NEPM over a wide population area	• Regional short-term change in air quality • Frequent exceedance(s) of NEPM* over a wide population area	• Regional long-term change in air quality • Continuous exceedance(s) of NEPM over a wide population area

*NEPM - National ambient air quality standards

[2] Key emissions include NO_x, O_3, Sulphur dioxide (SO_2) and dust (PM_{10})

Table 5-12: Risk matrix

		Consequence	1	2	3	4	5
			Minor	Medium	Serious	Major	Catastrophic
Likelihood	A	Almost Certain	**Moderate**	**High**	**Critical**	**Critical**	**Critical**
	B	Likely	**Moderate**	**High**	**High**	**Critical**	**Critical**
	C	Possible	**Low**	**Moderate**	**High**	**Critical**	**Critical**
	D	Unlikely	**Low**	**Low**	**Moderate**	**High**	**Critical**
	E	Rare	**Low**	**Low**	**Moderate**	**High**	**High**

Table 5-13: Risk rating, risk class and associated risk management response

RATING	CLASS	RISK MANAGEMENT RESPONSE
Critical	Class IV	Risks that significantly exceed the risk acceptance threshold and need urgent and immediate attention.
High	Class III	Risks that exceed the risk acceptance threshold and require proactive management. Includes risks for which proactive actions have been taken, but further risk reduction is impracticable; however, active monitoring is required and the latter requires the signoff by Business Unit senior management.
Moderate	Class II	Risks that lie on the risk acceptance threshold and require active monitoring. The implementation of additional measures could be used to reduce the risk further.
Low	Class I	Risks that are below the risk acceptance threshold and do not require active management. Certain risks could require additional monitoring.

Table 5-14: Certainty level matrix

LEVEL	1	2	3	4	5
Certainty	UNCERTAIN	LOW	MODERATE	HIGH	CERTAIN
Description	• Perception only; • No information or knowledge forms the basis of the opinion.	• Perception based; • Some Information known on process but not directly relevant to region, or information at a regional level has significant limitations.	• Limited information is known; • Expert knowledge would lead to this outcome, some differences in opinion.	• Information is known; • Process has been described and documented at a regional level and experts can verify this position.	• Information is known and well represents the specific nature of the process; • Described and documented at a regional level and experts would be expected to agree on this position.

Table 5-15: Definition of terms

FACTOR	DEFINITION
Long-term	More than 10 years (greater than 2x construction period)
Short-term	1-10 years (up to 2x construction period)
Seasonal	<1 year
Local	Within KGGP footprint (100 m corridor)
Widespread	Outside and beyond KGGP footprint (but within the 100 km corridor)
Regional	Across the entire region
NEPM	National Environmental Protection Measures
Wetland values	Water quality, water supply, flood protection, erosion control, flora and fauna community structure, species diversity and abundance
Species habitat	Includes preferred species habitat, habitat where the species is located and habitat that has the potential to support the species (but the species may not currently occur there)

Table 5-16: Project risk assessment for safety, bio-physical and cultural heritage impacts

ENVIRONMENTAL ASPECT (ACTIVITY)	ENVIRONMENTAL FACTOR (RECEPTOR)	POTENTIAL IMPACT (CHANGE/ EFFECT)	CONSEQUENCE	LIKELIHOOD	INHERENT RISK	ASSUMPTIONS/ COMMENTS	POTENTIAL MITIGATION	CONSEQUENCE	LIKELIHOOD	RESIDUAL RISK	ASSUMPTIONS/ COMMENTS	CERTAINTY
Vegetation clearing	Human health and safety	Injury/ loss of life due to machinery accident	5	E	H		Safety management plans including work procedures, job hazard analysis, risk assessment and management and emergency response	4	E	H		H
Vegetation clearing	Vegetation and flora	Disturbance/ loss of terrestrial and aquatic flora species and vegetation communities (non-threatened), including regional/downstream impacts due to degradation of habitat caused by sediment deposition, physical modification of watercourse, etc or facilitated by spread of weeds	3	A	C	Pipeline is near or crossing - creeks and riparian vegetation - ephemeral wetlands - monsoon vine forest - patches of Callitris pine Basic reinstatement, revegetation or rehabilitation of ROW	Progressive rehabilitation of the 30 m ROW, construction camps and temporary access tracks through active measures (Rehabilitation Management Plan) and natural regrowth Revegetate disturbed areas with a dense cover of appropriate native grasses based on the level of risk and the reasonable expectations of relevant stakeholders Low risk areas will also be rehabilitated according to the procedures outlined in the Provisional Soil and Land Management Plan, but these areas are likely to regenerate naturally and therefore no active revegetation would be undertaken Use of HDD avoids disturbance of significant riparian vegetation Weed management measures as per Weed Management Plan	2	C	M	Vegetation survey and adjustments to pipeline corridor during route selection indicate avoidance of monsoon rainforest patches and majority of wetland habitats. The majority of vegetation groups impacted by clearing are widespread in the wider regions Impact from clearing is short – medium term: 60% of ROW rehabilitates to native woody vegetation (near pre-construction condition) over long term. Construction camp sites and majority of construction access tracks rehabilitated in full Erosion, revegetation, and aquatic monitoring will assess effectiveness of rehabilitation and if corrective actions are required	M
		Disturbance/loss of TECs	2	C	M	Broad habitat mapping of TEC (Arnhem Plateau Sandstone Shrubland Complex) indicates potential occurrence in pipeline corridor Sandstone heath vegetation may occur within the unsurveyed section near Mitchell Ranges, but is unlikely to qualify as a TEC	Pipeline route avoids topography most likely to hold TEC and initial flora survey records no TEC is likely to occur within ROW Fire Management Plan contains measures to reduce risk of accidental fire ignition from project activities spreading to TEC (key threat)	2	D	L	Further field survey to confirm avoidance	H
		Disturbance/ loss of EPBC and/or NT listed threatened species)	2	C	M	Pipeline passes through bioregions known to contain threatened flora species and area of high endemism (Gove Peninsula)	Pipeline route avoids – flora survey records no threatened flora species in ROW	2	D	L	Arenga Palm (EPBC listed) now not considered present in the NT following taxonomic review *Pternandra coerulescens* (listed as vulnerable under NT TPWC Act) has been recorded close to pipeline corridor but not found in flora survey. To be confirmed through 2013 dry season survey	H
Vegetation clearing	Fauna	Disturbance/ loss/ degradation of habitat (including aquatic habitat, e.g. waterholes)	3	A	C	Pipeline crosses potential habitat for one or more threatened fauna species. Sensitive riparian habitats can't be avoided by route selection	Pipeline route avoids sensitive or restricted habitats as much as possible. Progressive rehabilitation of the 30 m ROW, construction camps and temporary	2	C	M	Vegetation survey and adjustments to pipeline corridor during rout selection indicate avoidance of monsoon rainforest patches and majority of wetland habitats. Majority of vegetation	M

ENVIRONMENTAL ASPECT (ACTIVITY)	ENVIRONMENTAL FACTOR (RECEPTOR)	POTENTIAL IMPACT (CHANGE/ EFFECT)	CONSEQUENCE	LIKELIHOOD	INHERENT RISK	ASSUMPTIONS/ COMMENTS	POTENTIAL MITIGATION	CONSEQUENCE	LIKELIHOOD	RESIDUAL RISK	ASSUMPTIONS/ COMMENTS	CERTAINTY
							access tracks through active measures (Rehabilitation Management Plan) and natural regrowth Revegetate disturbed areas with a dense cover of appropriate native grasses based on the level of risk and the reasonable expectations of relevant stakeholders. Low risk areas will also be rehabilitated according to the procedures outlined in the Provisional Soil and Land Management Plan, but these areas are likely to regenerate naturally and therefore no active revegetation would be undertaken Avoidance of Gouldian Finch breeding habitat Avoidance of known Gove Crow Butterfly habitat Avoidance of significant riparian habitats through use of HDD Weed management measures as per Weed Management Plan				groups impacted by clearing are widespread in the wider regions Impact from clearing is short – medium term: 60% of ROW rehabilitates to native woody vegetation (near pre-construction condition) over long term. Construction camp sites and majority of construction access tracks rehabilitated in full Erosion, revegetation, and aquatic monitoring will assess effectiveness of mitigation and if corrective actions are required	
		Fragmentation of habitat (including aquatic habitat)	1	C	L	Construction occurs during dry season and aquatic habitat is reinstated prior to wet season Clearing causes a linear fragmentation (30 m width), representing a minor barrier for most flora and fauna species No fencing, or other barriers	Use of HDD avoids riparian disturbance to majority of significant watercourses Active rehabilitation of riparian vegetation for dry (open trenched) watercourses Progressive rehabilitation of the 30 m ROW through active measures (Rehabilitation Management Plan) and natural regrowth	1	D	L	Habitat fragmentation is temporary. 60% of ROW rehabilitates to native woody vegetation, reducing width of linear fragmentation	H
Vegetation clearing	Surface water	Degradation of surface water quality due to erosion of soils and landforms	2	B	H	Construction only during dry season and landform reinstated prior to wet season	Sediment controls in place during and post construction until landforms have stabilised again Use of HDD avoids disturbance in close proximity to majority of significant watercourses Progressive revegetation of the ROW and other disturbed areas (Rehabilitation Management Plan) Specific rehabilitation measures for watercourses that are open trenched (not flowing) including use of rip rap	1	D	L		H
Vegetation clearing	Aboriginal and cultural heritage	Damage to sites outside project area due to clearing beyond project area boundary	3	C	H	Sacred sites identified with Restricted Work Areas Archaeological sites identified through survey	Fencing and signage Recording on project GIS Consultation with Aboriginal traditional owners	2	D	L	Clearing boundaries clearly marked Archaeologist on-site for preclearance survey for identified higher risk areas	H

ENVIRONMENTAL ASPECT (ACTIVITY)	ENVIRONMENTAL FACTOR (RECEPTOR)	POTENTIAL IMPACT (CHANGE/ EFFECT)	CONSEQUENCE	LIKELIHOOD	INHERENT RISK	ASSUMPTIONS/ COMMENTS	POTENTIAL MITIGATION	CONSEQUENCE	LIKELIHOOD	RESIDUAL RISK	ASSUMPTIONS/ COMMENTS	CERTAINTY
						No nearby declared heritage places	Work procedures (including land access protocol) and induction					
Excavation	Human health and safety	Injury/ loss of life (public and/or project workforce) due to falling into trench	5	E	H	Standard work procedures.	Where easily accessible to the public, trench clearly marked by bunting and hazard lights	4	E	H		H
Excavation	Fauna	Mortality of individuals due to capture in trench	3	A	C	One or more threatened species is susceptible to falling in trench (e.g. reptile, small mammal) Entire length of trench is open Happens on regular basis	Progressive rehabilitation of trench Climbing aids inside the trench Continuous monitoring of trench by wildlife handlers and removal of affected wildlife	2	C	M		H
Excavation	Soils and landforms	Contamination of soils due to exposure of acid sulphate soils	3	C	H	Preliminary screening using land system data indicates corridor does not traverse areas of high ASS risk; But is located adjacent to these areas and within 3 land systems indicative of the formation of inland ASS	Specific ASS sampling of risk areas within three land systems indicative of formation of inland ASS Development of specific ASS Management Plan and control measures, if sampling indicates presence of ASS	1	D	L		H
Excavation	Surface water	Degradation of surface water quality (contamination/ acidification) due to exposure of acid sulphate soils	3	C	H	As above	As above	1	D	L		H
Excavation	Groundwater	Degradation of groundwater quality (contamination/ acidification) due to exposure of acid sulphate soils	3	D	M	As above	As above	1	D	L		H
Excavation	Aboriginal and cultural heritage	Damage to undocumented (buried) sites/ skeletal remains	3	D	M	Narrow disturbance Avoids more likely archaeological areas	Archaeologist present during pegging of ROW and trenching in accordance with Cultural Heritage Management Plan	2	D	L		H
Water use/ groundwater extraction	Existing services and infrastructure	Strain on public water supply	1	E	L	Construction camps located away from major communities. Minimal workforce in Katherine or Gove. Potable water supplies most likely from local surface or groundwater. Water carting from town supply as back up only		1	E	L		H
Water use/ groundwater extraction	Vegetation and flora	Disturbance/ loss of groundwater-dependent vegetation	2	D	L	Groundwater not the primary source of water for the project and would be temporary Extraction within licence conditions issued pursuant to Water Act	Monitoring of water extraction and adaptive management arrangements for groundwater sources where extraction may approach sustainable yield	1	E	L		H
Water use/ groundwater extraction	Fauna	Reduced habitat availability due to disturbance/ loss of groundwater-dependent vegetation	2	D	L	Groundwater not the primary source of water for the project and would be temporary Extraction according to Water Supply and Adaptive Management Strategy	Monitoring of water extraction and adaptive management arrangements for groundwater sources where extraction may approach sustainable yield	1	E	L		H
		Reduced availability of drinking water due to reduced groundwater discharge to	1	E	L	Groundwater not the primary source of water for the project and would be	Monitoring of water extraction and adaptive management arrangements for	1	E	L		H

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		surface waterbodies, wetlands, etc				temporary Extraction according to Water Supply and Adaptive Management Strategy	groundwater sources where extraction may approach sustainable yield					
Water use/ groundwater extraction	Surface water	Altered surface water hydrology due to reduced groundwater discharge to surface waterbodies, wetlands, etc	1	E	L	Groundwater not the primary source of water for the project and would be temporary Extraction according to Water Supply and Adaptive Management Strategy	Monitoring of water extraction and adaptive management arrangements for groundwater sources where extraction may approach sustainable yield	1	E	L		H
Water use/ groundwater extraction	Aboriginal and cultural heritage	Altered character of ethnographic sites dependent on groundwater discharge (e.g. waterholes, springs, etc.)	2	D	L	Groundwater not the primary source of water for the project and would be temporary Extraction according to Water Supply and Adaptive Management Strategy	Monitoring of water extraction and adaptive management arrangements for groundwater sources where extraction may approach sustainable yield Consultation with Aboriginal traditional owners	1	D	L		H
Energy/ electricity use	Existing services and infrastructure	Strain on public power supply	1	E	L	No requirement for public power supply. Project would generate own power for construction and operational phase		1	E	L		H
Physical presence of infrastructure	Amenity	Visual impact to public	2	E	L	Limited above ground infrastructure - permanent compressor station, scraper stations, pipeline markers etc Clearance of 30m ROW Temporary construction camps, laydown areas and other works Infrastructure is not near Katherine or dwellings. At Gove, infrastructure is located in industrial landscape near mining and refinery operations	Buffer and screening at construction camps and permanent above ground infrastructure Active rehabilitation measures and natural regrowth of ROW to reduce visual impact of disturbance	1	E	L		H
Physical presence of infrastructure	Human health and safety	Injury/ loss of life (public) due to trespassing, third party interference with the project such as deep ripping, installation of new underground services, mining development, road maintenance, unauthorised tapping of gas pipeline, shooting of infrastructure etc	4	D	H	Location of the pipeline is remote and away from any densely populated area Separation by burial - pipeline is buried with a minimum depth of cover of 750 mm Heavy wall pipe provided at road crossings; standard pipe wall thickness offers some resistance to penetration from equipment Above ground facilities have been limited to only those that are necessary and will be fenced and have clear warning signs. Buildings will be alarmed to indicate unauthorised access Deep ripping or blade ploughing is not anticipated along the pipeline route Post hole digging for fencing is likely to be the highest farming threat to the pipeline	Landholder engagement, communication – advice on risks of digging and hunting in the immediate vicinity of the pipeline Specific landholder agreements aimed at limiting activity to non-threatening activity within the ROW Patrols - aerial and drive-by Signage - clearly visible in both directions and located at both sides creeks, rivers and roads and spacing of less than 500 m along ROW	4	E	H		H

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Physical presence of infrastructure	Vegetation and flora	Degradation of vegetation community due to spread of weeds and feral animals	3	B	H	Weeds and feral animals already exist in project area -ROW and roads may facilitate their increased dispersal Increased frequency and/or intensity of fire due to higher fuel loads from grassy weeds	Measures incorporated into Weed Management Plan including blow/wash down areas Measures incorporated into Introduced Fauna Management Plan	2	C	M	Risks greatest for weeds.	M
Physical presence of infrastructure	Fauna	Degradation of fauna habitat (including aquatic habitat) and loss of individuals due to predation by feral animals	3	C	H	Feral animals already exist in Project area, ROW and roads may facilitate increased dispersal Presence of Yellow Crazy Ants in Gove Peninsula - disturbance and subsequent spread by transporting soil	Measures incorporated into Introduced Fauna Management Plan including blow / wash-down and inspection procedures of earth moving equipment in areas susceptible to Yellow Crazy Ant infestation	2	C	M		H
Physical presence of infrastructure	Surface water	Degradation of surface water quality due to spread of feral animals	1	D	L	Feral pigs and buffalo already present in significant numbers in the region - existence of ROW unlikely to increase access to favourable habitat	Measures incorporated into Introduced Fauna Management Plan	1	D	L		M
Physical presence of infrastructure	Aboriginal and cultural heritage	Altered character of Aboriginal sacred sites due to increased visitatio/ damage caused by feral animals	1	D	L	Feral pigs and buffalo already present in significant numbers in the region - existence of ROW unlikely to increase access to favourable habitat	Measures incorporated into Introduced Fauna Management Plan	1	D	L		M
Vehicle movements	Amenity	Annoyance/ traffic impacts due to increased vehicle movements on public roads	2	C	M	Assume project materials transported through Darwin, Katherine and Gove for up to a year Construction workforce accommodated on-site at construction camps. Fly- in, fly-out from Katherine and Gove Limited number of sensitive receptors	Traffic Management Plan including journey management planning	2	D	L		M
Vehicle movements	Human health and safety	Injury/ loss of life (public and project workforce) due to traffic accident on public, or project roads	2	C	M	Review of the accident crash history has generally indicated that the majority of fatalities that have occurred on affected road network are typically single vehicles accidents and not specifically related to a sub-standard road element Chapter 14 indicates project traffic will have a negligible impact on the road operation and safety	Traffic Management Plan and Traffic Guidance Scheme for the project Safe operation of vehicle requirements including journey management plan, headlights on at all times, safety inspection Preventative vehicle maintenance Driver communications Fatigue management and driver training Alcohol and drugs policy Incident management and reporting Road link safety upgrades	1	D	L		M
Vehicle movements	Existing services and infrastructure	Deterioration of road integrity	2	B	H	Stuart Highway pavement is not expected to be considerably impacted Possible significant impact on Central Arnhem Road pavement - requiring an increased maintenance regime Negligible impacts on intersections with	Proponent to enter into agreed arrangements to assist in avoiding deterioration of Central Arnhem Road during construction	1	D	L		H

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						exception of Central Arnhem Road-local access roads and Local access roads to ROW No significant impacts on bridges						
Vehicle movements	Vegetation and flora	Degradation of vegetation community/ alteration of community composition due to introduction and/or spread of weeds	3	B	H	Vehicle movements for Project activities only (i.e. not considering unauthorised public use) No vehicle and personnel weed hygiene management measures No direct weed control measures Already some places in project area with weeds, and project may facilitate dispersal into new areas Increased frequency and/or intensity of fire due to higher fuel loads from weeds	Measures included in Weed Management Plan including vehicle wash/blow-down procedures at high risk areas	2	C	M		M
Vehicle movements	Fauna	Degradation of fauna habitat due to introduction and/or spread of weeds	2	B	H	Vehicle movements for Project activities only (i.e. not considering unauthorised public use) No vehicle and personnel weed hygiene management measures No direct weed control measures Already some places in project area with weeds, and project may facilitate dispersal into new areas Increased frequency and/or intensity of fire due to higher fuel loads from weeds	Measures in Weed Management Plan including vehicle wash/blow-down procedures at high risk areas	2	C	M		M
		Loss of individuals (mortality due to vehicle strike)	1	B	M	Generally daytime only traffice Does not address falling in trench Significant vehicle movements limited to construction phase (less than 12 months).	Measures in Traffic Management Plan including speed limits – appropriate signage, induction for drivers, monitored and enforced	1	C	L		H
Fire ignition	Human health and safety	Injury/ loss of life (public and project workforce) due to wildfire caused or exacerbated by project activities (e.g. due to presence of combustible materials at work site)	3	C	H	Accidental fire ignition caused by the project Immediate attempts to extinguish the fire fail	Prevention of fire ignition and uncontrollable fires through: staff safety training, standard work procedures, fire emergency plan for workers, including communication and evacuation protocols, spark arrestors on all earth moving equipment Establishment of fire breaks around construction camps and laydown areas Fire and weed management plan with a focus on the reduction of fuel loads at the construction sites and the risk of uncontrollable fires esp. in late dry season	2	D	L		H

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Fire ignition	Existing services and infrastructure	Disruption to utility supply as a result of damage due to wildfire caused or exacerbated by project activities	2	D	L	Accidental fire ignition caused by the project Immediate attempts to extinguish the fire fail	Prevention of fire ignition and uncontrollable fires through: staff safety training, standard work procedures, fire emergency plan for workers, including communication and evacuation protocols, spark arrestors on all earth moving equipment Establishment of fire breaks around construction camps and laydown areas Fire and weed management plan with a focus on the reduction of fuel loads at the construction sites and the risk of uncontrollable fires esp. in late dry season	1	E	L		H
Fire ignition	Vegetation and flora	Disturbance/ loss of terrestrial and aquatic flora species and vegetation communities (non-threatened).	3	C	H	Accidental fire ignition caused by the project Immediate attempts to extinguish the fire fail Significant for fire sensitive species and communities such as Callitris Pine and monsoon rainforest Potential additive effect of grassy weed species such as Gamba Grass if colonise ROW	Prevention of fire ignition and uncontrollable fires through: staff safety training, standard work procedures, fire emergency plan for workers, including communication and evacuation protocols, spark arrestors on all earth moving equipment Establishment of fire breaks around construction camps and laydown areas Fire and weed management plan with a focus on the reduction of fuel loads at the construction sites and the risk of uncontrollable fires esp. in late dry season	2	D	L		M
		Degradation of habitat caused by sediment deposition, physical modification of watercourse, etc	1	D	L	Accidental fire ignition caused by the project Immediate attempts to extinguish the fire fail	As above	1	D	L		M
		Disturbance/loss of conservation significant vegetation communities (e.g. TECs)	2	C	M	Accidental fire ignition caused by the project Immediate attempts to extinguish the fire fail Based on field and aerial survey records no TEC (Arnhem Plateau Sandstone Heath Complex) does occur within pipeline corridor. Sandstone heath vegetation may occur within the unsurveyed section, but is unlikely to qualify as a TEC Fire may spread into TEC in the region	As above	1	D	L		M
		Disturbance/loss of conservation significant flora species (e.g. EPBC listed threatened species)	2	C	M	Accidental fire ignition caused by the project Immediate attempts to extinguish the fire fail	As above	1	D	L		M

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						Based on current knowledge no EPBC listed plant species occur within the pipeline corridor Fire spreading to conservation significant flora species in the region						
Fire ignition	Fauna	Loss of individuals (including aquatic fauna due to input of silt, ash, etc. caused by wildfire)	4	D	H	Accidental fire ignition caused by the project Immediate attempts to extinguish the fire fail Gouldian finch habitat and population in close proximity, and habitat of Gove Crow Butterfly (at least several kms away) could be impacted by significant wildfires driven across the landscape by strong winds	As above Fire Avoidance and Management Plan, with training and induction for all workers and effective response personnel, equipment and procedures for immediate extinguishing of inadvertent fires	2	C	M		M
		Fragmentation of habitat	4	D	H	Accidental fire ignition caused by the project Immediate attempts to extinguish the fire fail Fragmentation by wildfires occurs in the general region at least every 2-5 years with some areas being burnt annually	See above Fire Management Plan, with training and induction for all workers and effective response personnel, equipment and procedures for immediate extinguishing of inadvertent fires	2	C	M		M
		Disturbance/ loss of habitat or food sources (including aquatic habitat due to input of silt, ash, etc. caused by wildfire)	4	D	H	Accidental fire ignition caused by the project Immediate attempts to extinguish the fire fail Majority of habitats within the pipeline corridor are adapted to fire and regularly exposed to it Fire sensitive habitats in the region are mainly riparian areas, monsoon rainforest and stands of Callitris pine Gouldian Finch is a granivorous bird relying on various grass seeds becoming available throughout the year. Food availability would be interrupted immediately (burning of grass seeds) and in the short- term (delaying seed production for up to 3 years in some species)	See above Fire Management Plan, with training and induction for all workers and effective response personnel, equipment and procedures for immediate extinguishing of inadvertent fires	2	C	M		M
Fire ignition	Surface water	Degradation of surface water quality due to input of silt, ash, etc. caused by wildfire	2	D	L	Accidental fire ignition caused by the project Immediate attempts to extinguish the fire fail Gouldian Finch have absolute dependence on remnant dry season waterholes	As above	1	D	L		H

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Fire ignition	Aboriginal and cultural heritage	Damage to sites outside project area due to wildfire caused or exacerbated by project activities	2	D	L	Accidental fire ignition caused by the project Immediate attempts to extinguish the fire fail Fire already occurring frequently in the landscape	As above	1	D	L		H
Fire ignition	Air (quality)	Generation of smoke, dust and ash due to wildfire caused or exacerbated by project activities	2	D	L	Accidental fire ignition caused by the project Immediate attempts to extinguish the fire fail Fire already impacting on air quality in the region (particulates)	As above	1	D	L		H
Liquid (including septic) and solid waste disposal	Human health and safety	Illness/ loss of life (public and project workforce) due to contamination of public drinking water supply resulting from improper disposal of waste	2	D	L	Package treatment plants will treat sewage on-site to health standards		2	D	L		H
Liquid (including septic) and solid waste disposal	Existing services and infrastructure	Strain on existing waste disposal facilities	1	D	L	Package treatment plants will treat sewage on-site Solid waste transported to approved facilities outside of project area		1	D	L		H
Liquid (including septic) and solid waste disposal	Vegetation and flora	Disturbance/loss of significant non-threatened flora species and vegetation communities (including aquatic) due to disposal/discharge of hydrostatic pressure testing water	2	C	M	Some inundation of land Construction during dry season Water is indiscriminately discharged Hydrostatic test water not enter a flowing water course Sewage treatment using package treatment Solid waste disposal to approved sites	Hydrotest water is discharged consistent with measures in the Hydrology and Water Quality Management Plan	2	D	L		H
		Disturbance/loss of. TECs due to disposal/discharge of hydrostatic pressure testing water	2	D	L	TEC occurs on upland areas – most likely above discharge points Construction during dry season Water is indiscriminately discharged Hydrostatic test water not enter a flowing water course Sewage treatment using package treatment Solid waste disposal to approved sites	Hydrotest water is discharged consistent with measures in the Hydrology and Water Quality Management Plan	1	D	L		H
		Disturbance/ loss of conservation significant flora species (e.g. listed threatened species) due to disposal/ discharge of hydrostatic pressure testing water	2	C	M	Threatened flora species in catchment where discharge occurs Construction during dry season Water is indiscriminately discharged	Hydrotest water is discharged consistent with measures in the Hydrology and Water Quality Management Plan	2	D	L		H

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						Hydrostatic test water not enter a flowing water course Sewage treatment using package treatment Solid waste disposal to approved sites						
Liquid (including septic) and solid waste disposal	Fauna	Disturbance/ loss/ degradation of terrestrial and aquatic habitat (e.g. waterholes) due to disposal/ discharge of hydrostatic pressure testing water	2	C	M	Construction during dry season Water is indiscriminately discharged Hydrostatic test water not discharged to a flowing watercourse Sewage treatment using package treatment Solid waste disposal to approved sites	Hydrotest water is discharged consistent with measures in the Hydrology and Water Quality Management Plan	2	D	L		H
Liquid (including septic) and solid waste disposal	Surface water	Degradation of surface water quality due to wastewater disposal/ discharge of hydrostatic testing water	2	C	M	Construction during dry season Water is indiscriminately discharged Hydrostatic test water not discharged to a flowing water course Sewage treatment using package treatment Solid waste disposal to approved sites	Hydrotest water is discharged consistent with measures in the Hydrology and Water Quality Management Plan	2	D	L		H
Liquid (including septic) and solid waste disposal	Groundwater	Contamination of groundwater due to due to wastewater disposal/ discharge of hydrostatic testing water	2	E	L	Construction during dry season Water is indiscriminately discharged Hydrostatic test water not discharged to a flowing water course Sewage treatment using package treatment Solid waste disposal to approved sites Majority of discharge would be evaporated, or taken up by vegetation or soil	Hydrotest water is discharged consistent with measures in the Hydrology and Water Quality Management Plan	1	E	L		H
Liquid (including septic) and solid waste disposal	Aboriginal and cultural heritage	Damage to sites outside project area due to wastewater disposal/ discharge of hydrostatic testing water	2	D	L	Construction during dry season Water is indiscriminately discharged Hydrostatic test water not discharged to a flowing water course Sewage treatment using package treatment Solid waste disposal to approved sites Restricted work areas and heritage places identified and avoided when determining discharge locations	Measures in the Cultural Heritage Management Plan and Hydrology and Water Quality Management Plan	1	D	L		H
Spills and leaks	Human health and safety	Illness/ loss of life (public and project workforce) due to contamination of public drinking water supply	2	D	L	Project doesn't interact with any known public water supplies	Measures contained in the Hydrology and Water Quality Management Plan and Waste Management Plan	1	D	L		H

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Spills and leaks	Vegetation and flora	Disturbance/ loss of general terrestrial and aquatic flora species and vegetation communities due to chemical/ hydrocarbon spill/ leak	1	D	L	Hydrocarbon is key potential issue, due to volumes compared with other potential chemicals used Storages bunded Could occur due to failure of transport vehicle tank or hose	Measures contained in Hydrology and Water Quality Management Plan and Waste Management Plan including documented inventory of hazardous materials, spill response procedures and equipment, servicing of equipment in workshops	1	D	L		H
		Disturbance/ loss of conservation significant vegetation communities (e.g. TECs) due to chemical/ hydrocarbon spill/ leak	2	D	L	Hydrocarbon is key potential issue, due to volumes compared with other potential chemicals used Storages bunded Could occur due to failure of transport vehicle tank or hose	Measures contained in Hydrology and Water Quality Management Plan and Waste Management Plan including documented inventory of hazardous materials, spill response procedures and equipment, servicing of equipment in workshops	1	D	L		H
		Disturbance/ loss of conservation significant flora species (e.g. EPBC listed threatened species) due to chemical/ hydrocarbon spill/ leak	2	D	L	Hydrocarbon is key potential issue, due to volumes compared with other potential chemicals used Storages bunded Could occur due to failure of transport vehicle tank or hose	Measures contained in Hydrology and Water Quality Management Plan and Waste Management Plan including documented inventory of hazardous materials, spill response procedures and equipment, servicing of equipment in workshops	1	D	L		H
Spills and leaks	Fauna	Contamination/ loss of general terrestrial and aquatic fauna and fauna habitat	2	D	L	Hydrocarbon is key potential issue, due to volumes compared with other potential chemicals used Storages bunded Could occur due to failure of transport vehicle tank or hose	Measures contained in Hydrology and Water Quality Management Plan and Waste Management Plan including documented inventory of hazardous materials, spill response procedures and equipment, servicing of equipment in workshops	1	D	L		H
Spills and leaks	Soils and landforms	Contamination of soil	3	D	M	Hydrocarbon is key potential issue, due to volumes compared with other potential chemicals used Storages bunded Could occur due to failure of transport vehicle tank or hose	Measures contained in Hydrology and Water Quality Management Plan and Waste Management Plan including documented inventory of hazardous materials, spill response procedures and equipment, servicing of equipment in workshops	1	D	L		H
Spills and leaks	Surface water	Degradation of surface water quality (contamination) due to chemical/ hydrocarbon spill/ leak	3	E	M	Hydrocarbon is key potential issue, due to volumes compared with other potential chemicals used Storages bunded Could occur due to failure of transport vehicle tank or hose Soil absorbs most of the spill.	Measures contained in Hydrology and Water Quality Management Plan and Waste Management Plan including documented inventory of hazardous materials, spill response procedures and equipment, servicing of equipment in workshops	1	D	L		H
Spills and leaks	Groundwater	Degradation of groundwater quality (contamination) due to chemical/ hydrocarbon spill/ leak	2	D	L	Hydrocarbon is key potential issue, due to volumes compared with other potential chemicals used Storages bunded Could occur due to failure of transport	Measures contained in Hydrology and Water Quality Management Plan and Waste Management Plan including documented inventory of hazardous materials, spill response procedures and	1	D	L		H

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						vehicle tank or hose Soil absorbs most of the spill. Quantities stored unlikely to find pathways to groundwater contamination if spilt	equipment, servicing of equipment in workshops					
Atmospheric emissions (excl. dust)	Air (quality)	Degradation of air quality	1	B	M	Exhaust emissions from vehicles and machinery Venting during operation Compressor station operation – standard emission controls	Measures contained in Air Quality Management Plan including efficient use of vehicles, vehicle maintenance, periodic inspection of pipeline for leaks, maintenance of emission controls at compressor station	1	D	L	Modelling of air emissions from compressor station for pollutants of concern indicate AAQ NEPM levels will not be exceeded for sensitive receptors	H
Dust emissions	Human health and safety	Traffic incident caused by excessive dust generation near public roads	4	D	H	Dust along access tracks during construction Basic dust suppression	Dust management measures including watering, traffic management, adherence to speed limits	C	2	M		H
Dust emissions	Vegetation and flora	Disturbance/ loss of general terrestrial flora species and vegetation communities (including aquatic) due to dust deposition	2	C	M	Dust during clearing activities, and in open areas and along access tracks during construction Basic dust suppression measures Communities and species not known to be susceptible to dust	Dust management measures including watering, traffic management, minimising land clearing, active rehabilitation (rehabilitation management plan), adherence to speed limits	1	D	L		H
		Disturbance/ loss of conservation significant vegetation communities (e.g. TECs) due to dust deposition	2	C	M	Broad habitat mapping of TEC (Arnhem Plateau Sandstone Shrubland Complex) indicates potential occurrence in pipeline corridor Sandstone heath vegetation may occur within the unsurveyed section near Mitchell Ranges, but is unlikely to qualify as a TEC. Dust impacts highly localised and proximate to areas of disturbance. Basic dust suppression measures	Dust management measures including watering, traffic management, minimising land clearing, active rehabilitation (rehabilitation management plan), adherence to speed limits	1	D	L		H
		Disturbance/ loss of conservation significant flora species (e.g. EPBC listed threatened species) due to dust deposition	2	C	M	Pipeline passes through bioregions known to contain threatened flora species and area of high endemism (Gove Peninsula). Dust impacts highly localised and proximate to areas of disturbance. Basic dust suppression measures	Dust management measures including watering, traffic management, minimising land clearing, active rehabilitation (rehabilitation management plan), adherence to speed limits	1	D	L	Arenga Palm (EPBC listed) now not considered present in the NT following taxonomic review *Pternandra coerulescens* (listed as vulnerable under NT TPWC Act) has been recorded close to pipeline corridor but not found in flora survey. To be confirmed through 2013 dry season survey	H
Dust emissions	Fauna	Degradation of terrestrial nesting/ roosting/foraging habitat due to dust	2	C	M	Dust during clearing activities, and in open areas and along access roads during	Dust management measures including watering, traffic management, minimising	1	D	L		M

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		deposition				construction Basic dust suppression measures Dust mainly during dry season Communities and species not known to be susceptible to dust Gouldian Finch rely on water holes during late dry season	land clearing, active rehabilitation (rehabilitation management plan), adherence to speed limits					
Dust emissions	Surface water	Disturbance/loss of aquatic fauna and degradation of aquatic habitats due to dust deposition, including downstream impacts	1	D	L	Dust during clearing activities, and in open areas and along access tracks during construction Dust mainly during dry season Basic dust suppression measures	Dust management measures including watering, traffic management, minimising land clearing, active rehabilitation (rehabilitation management plan), adherence to speed limits	1	D	L		
Dust emissions	Surface water	Degradation of surface water quality due to dust deposition/ sedimentation	1	D	L	Dust during clearing activities, and in open areas and along access tracks during construction Dust mainly during dry season Basic dust suppression measures	Dust management measures including watering, traffic management, minimising land clearing, active rehabilitation (rehabilitation management plan), adherence to speed limits	1	E	L		
Dust emissions	Air (quality)	Degradation of air quality	2	C	M	Dust during clearing activities, and in open areas and along access tracks during construction Dust mainly during dry season Basic dust suppression measures	Dust management measures including watering, traffic management, minimising land clearing, active rehabilitation (rehabilitation management plan), adherence to speed limits	1	C	L	Air quality assessment indicates dust levels from ROW construction within air quality standards except for one sensitive receptor (Birritjimi at Wallaby Beach just east of Gove Refinery) Dust along roads not modelled but likely to be more significant	H
Light emissions	Amenity	Visual impact to public	1	D	L	Mostly remote location with small population – limited number of sensitive receptors No directional lighting Light emissions may be present but night time work is limited		1	D	L		H
Light emissions	Fauna	Disruption to nesting/ roosting/ foraging habitats and/or behaviour	1	D	L	No directional lighting Light emissions may be present but night time work is limited. No threatened bats known or likely to occur		1	D	L		H
Noise and vibration emissions	Amenity	Excessive noise levels at nearby public/ sensitive premises	2	C	M	Mostly remote location with small population – limited number of sensitive receptors Noise may be continuous from 6 am – 6 pm (daylight hours) Limited night time work	Measures in Noise and Vibration Management Plan including screening or enclosing stationary equipment, turning mobile equipment off when not in use (where practicable)	2	D	L	Birritjimi (just east of Gove Refinery) only sensitive receptor where noise modelling indicates noise would exceed guidelines	M
Noise and vibration emissions	Fauna	Disruption to nesting/ roosting/ foraging habitats and/or behaviour	2	C	M	Noise may be continuous from 6 am – 6 pm (daylight hours)	Measures in Noise and Vibration Management Plan including screening or	2	D	L		M

ENVIRONMENTAL ASPECT (ACTIVITY)	ENVIRONMENTAL FACTOR (RECEPTOR)	POTENTIAL IMPACT (CHANGE/ EFFECT)	CONSEQUENCE	LIKELIHOOD	INHERENT RISK	ASSUMPTIONS/ COMMENTS	POTENTIAL MITIGATION	CONSEQUENCE	LIKELIHOOD	RESIDUAL RISK	ASSUMPTIONS/ COMMENTS	CERTAINTY
						Blasting is limited to shallow depth rock fracturing only in discrete areas (possibly Mitchell Ranges) and only single blasts in any one location Assume shallow depth rock fracturing at any time of day	enclosing stationary equipment, turning mobile equipment off when not in use (where practicable)					
Noise and vibration emissions	Aboriginal and cultural heritage	Altered character of Aboriginal sacred sites or heritage places sites caused by vibration impacts (e.g. subsidence)	2	D	L	Blasting is limited to shallow depth rock fracturing only in discrete areas and only single blasts in any one location Predicted vibration assessed as being within the relevant criteria	Measures in Noise and Vibration Management Plan	2	D	L		H

5.2.3 Risk assessment – socio economic

The risks assessment for socio-economic impacts was conducted within the Social Impact Assessment (Appendix M). As potential positive as well as negative socio-economic impacts (Table 5-17) would accrue from the KGGP Project, the methodology and approach to the risk assessment incorporated some key differences to assessment risks for the biophysical environment and accordingly is presented separately.

Each identified likely impact or opportunity was assessed in terms of its potential consequence and significance, using a tailored impact rating mechanism. The impact rating mechanism applies a number of assessment parameters which are summarised below and outlined in detail in the Social Impact Assessment (Appendix M).

- Project phase (construction, operation, decommissioning).
- Extent of the impact (site, local, regional, national): defined at Table 5-18.
- Duration of the impact (short-term, medium-term, long-term, permanent / irreversible); defined at Table 5-19.
- Severity of the impact (negligible, low, medium, high, very high): defined at Table 5-20.
- Probability (impossible, unlikely, possible, probable, almost certain): defined at Table 5-21.

The above parameters were then applied to assess and rank impacts in terms of consequence and significance, for both positive and negative impacts. Consequence and significance definitions are provided at Table 5-22, the risk ratings for each impact at Table 5-23 and summarised in Table 5-24. The complete risk methodology is detailed in Appendix M.

Stakeholder perceptions of likely Project-related impacts and opportunities were sought through consultations. This ensured that both real and perceived risks were considered.

Through the impact assessment process, impacts were grouped and categorised according to the following aspects:

- Economic development and employment.
- Land and country.
- Community safety.
- Social values and community cohesion.
- Infrastructure and services.

Table 5-17: Definitions of the nature of potential socio-economic impacts

Positive:	Impacts have a positive or uplifting effect on the project-affected community and stakeholders. The quality of life of affected individuals, households or communities is improved.
Negative:	Impacts have a negative or adverse effect on the project-affected community and stakeholders. The quality of life of affected individuals, households or communities is diminished.
Neutral:	Impacts are neither positive nor negative in nature and have no meaningful effect on project-affected communities and stakeholders.

Table 5-18: Definition of spatial extent of socio-economic impacts

6	International
5	National (within defined national boundaries)
4	NT (within defined state boundaries)
3	Regional (within regional council boundaries, or 100 km of pipeline corridor)
2	Local communities (within 20 km of pipeline corridor)
1	Site-specific (within 200 m of pipeline corridor)

Table 5-19: Definition of duration of socio-economic impacts

4	Permanent / irreversible (more than 50 years)
3	Long term (2 – 50 years duration)
2	Medium term (6 months – 2 years duration)
1	Short term (1 – 6 months duration)

Table 5-20: Definition of severity of socio-economic impacts

4	**Very High** Irreparable damage to/destruction of highly valued items of great cultural significance, irreversible reputation damage or a complete breakdown of social order. Affects a large proportion of society.
	Enduring positive impact on social, economic and cultural environment for a large number of people.
3	**High** Serious social issues/temporary cease of systems functioning or wide-reaching community dissent.
	Significant improvement to social, economic or cultural environment or quality of life for a large number of affected people.
2	**Medium** Moderate social issues and/or moderately significant damage to items of cultural significance. Social environment altered but systems continue to function. Localised community impact but may require long term management.
	Moderate improvement to social, economic or cultural environment or quality of life for affected people.
1	**Low** Minor changes to the social environment, which are easily reversible over time; Localised impact among a small group of impacted stakeholders.
	Minor improvement to quality of life and/or social functioning for a small number of individuals or groups.
0	**Negligible** No discernible impacts on the local population, repairable over time. Temporary impairment of the availability of items of cultural significance. Affects only very few people.
	No discernible improvement to quality of life and/or the social, economic or cultural environment. Affects only very few people.

Table 5-21: Definition of probability of socio-economic impacts

4	Almost certain (>90% chance)
3	Probable (51% - 90% chance)
2	Possible (11% – 50% chance)
1	Unlikely (<10% chance)
0	Impossible

Table 5-22: Consequence and significance definitions

SIGNIFICANCE SCORE	NEGATIVE	POSITIVE
< 25 **L O W**	An acceptable impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. Results in short-term effect on the social and/or cultural environment.	Minor positive changes for a small group of people. Impacts result in a short-term benefit or improvement to the social and/or cultural context. Benefits can be enhanced through the application of management strategies.
	An important impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but in conjunction with other impacts may prevent its implementation. Results in a negative medium to long-term effect on the social and/or cultural environment.	A benefit or improvement of medium significance, which can be enhanced through the application of management measures. In combination with other project benefits, the impact has the potential to leverage community support. Results in a positive medium to long-term effect on the social and/or cultural environment.
51 – 75 **H I G H**	A serious impact, if not mitigated, may prevent the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term change to the social environment and result in severe effects.	A substantial benefit or improvement to the social or cultural environment, or quality of life of a large group of people. The benefit can be enhanced to include a broader group of people, and would be considered by the community as a good and long-term advantage for beneficiaries.
> 75 **V E R Y H I G H**	A very serious impact which may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are irreversible and usually result in very severe effects for a large group of people.	A wide-reaching, permanent and extremely significant benefit for whole communities. It would be difficult to enhance the benefit further, and the opportunity is likely to be sustained over future generations.

Consequence = Extent + Duration + Severity
Significance = Consequence x Probability
*Produces score / 60
**Normalised to a percentage score / 100

Table 5-23: Project risk assessment – socio economic impacts

IMPACT SUMMARY			IMPACT SIGNIFICANCE BEFORE MITIGATION								IMPACT SIGNIFICANCE AFTER MITIGATION							
Social Impact	**Affected Stakeholders**	**Project Phase**	**Nature (P / N)**	**Extent**	**Duration**	**Severity**	**Consequence**	**Probability**	**Significance / 56**	**Significance / 100**	**Nature (P / N)**	**Extent**	**Duration**	**Severity**	**Consequence**	**Probability**	**Significance / 56**	**Significance / 100**
ECONOMIC DEVLEOPMENT AND EMPLOYMENT																		
Sustaining the economic and employment benefits of the refinery at Gove	Refinery workforce Local communities Local business community Local and State government	Const & Ops	P	4	3	4	11	4	44	79	P	4	3	4	11	4	44	79
Potential direct employment opportunities for local communities	Local communities	Construction	P	3	2	1	6	4	24	43	P	3	2	2	7	4	28	50
Potential direct training and development opportunities for local communities	Local communities	Construction	P	3	1	1	5	2	10	18	P	3	1	2	6	3	18	32
Potential procurement and contracting opportunities for local businesses	Local business community	Const & Ops	P	3	2	1	6	2	12	21	P	3	2	2	7	3	21	38
LAND AND COUNTRY																		
Increased access of traditional lands by workers and other non-local people without necessary permits	Traditional Owners	Const & Ops	N	2	2	3	7	3	21	38	N	2	2	3	7	1	7	13
Potential for sacred sites and significant areas to be disturbed or damaged due to increased access	Traditional Owners Local communities	Construction	N	1	2	3	6	2	12	21	N	1	2	3	6	1	6	11
Potential for negative environmental impacts on features of value to communities, e.g. waterfalls, springs, billabongs and river crossing and catchment areas	Traditional Owners Local communities	Construction	N	2	2	3	7	2	14	25	N	2	2	3	7	1	7	13
COMMUNITY SAFETY																		
Heightened road safety risk due to increased movement of traffic and machinery through the Project area	Project workforce Local communities	Const & Ops	N	2	3	2	7	3	21	38	N	2	3	2	7	2	14	25
Potential risk of gas leaks and explosions	Project workforce Local communities	Const & Ops	N	2	3	3	8	2	16	29	N	2	3	3	8	1	8	14
Theft and vandalism of Project infrastructure and equipment	Project owners	Const & Ops	N	1	3	2	6	2	12	21	N	1	3	2	6	1	6	11
Increased incidence of communicable disease due to population influx	Project workforce Local communities	Construction	N	2	2	2	6	2	12	21	N	2	2	1	5	1	5	9

IMPACT SUMMARY			IMPACT SIGNIFICANCE BEFORE MITIGATION								IMPACT SIGNIFICANCE AFTER MITIGATION							
Social Impact	**Affected Stakeholders**	**Project Phase**	**Nature (P / N)**	**Extent**	**Duration**	**Severity**	**Consequence**	**Probability**	**Significance / 56**	**Significance / 100**	**Nature (P / N)**	**Extent**	**Duration**	**Severity**	**Consequence**	**Probability**	**Significance / 56**	**Significance / 100**
SOCIAL VALUES AND COMMUNITY COHESION																		
Continued viability and vitality of Nhulunbuy community through sustained operation of the refinery	Local communities	Const & Ops	P	3	3	3	9	4	36	64	P	3	3	3	9	4	36	64
Increase in community conflict and anxiety related to use of traditional lands and introduction of non-local workforce	Project workforce Local communities	Construction	N	2	2	2	6	3	18	30	N	2	2	1	5	2	10	18
Increase in the occurrence of social ills (e.g. alcohol and substance abuse) through the introduction of non-resident workers	Project workforce Local communities	Construction	N	3	2	3	8	3	24	40	N	3	2	3	8	1	8	14
INFRASTRUCTURE AND SERVICES																		
Decreased housing and accommodation affordability and availability in local communities	Project workforce Local communities	Construction	N	2	2	3	7	2	14	25	N	2	2	2	6	1	6	11
Increased pressure on local health and emergency services due to increased non-resident population	Health service providers Local communities	Construction	N	3	2	3	8	3	24	43	N	3	2	3	8	2	16	29
Potential impacts on the functioning of other industry infrastructure through Project placement and increased demand for services	Local industries	Construction	N	1	2	2	5	2	10	18	N	1	2	2	5	1	5	9
UNPLANNED CLOSURE																		
Unforeseen closure event or non-completion of the pipeline project	Project workforce Local communities Government agencies	Decommissioning	N	4	3	4	11	2	22	39	N	4	3	2	9	2	18	32

5.2.4 Monitoring and review

The risk analysis, evaluation and treatment allowed all bio-physical risks identified to be reduced. However, management measures are required to be implemented during the construction, operation and decommissioning of the KGGP Project in order to maintain this level of risk.

To manage the risks of the KGGP Project, Pacific Aluminium has an environmental management programme, which includes the EMP (Appendix O). The EMP provides management measures to be implemented for each of the environmental factors identified in the risk assessment. When developing the management measures in the EMP, Pacific Aluminium used the following management hierarchy to reduce the risks to as low as reasonably practicable:

- Avoid – avoid the impact by not undertaking the activity.
- Minimise – limit the severity of the impact.
- Rectify – repair affected site as soon as possible.
- Reduce – eliminate impact over time.
- Offset – significant residual impacts on critical and high value assets.

Management measures in the EMP include project design aspects, specific actions, specific limits or targets, and monitoring programmes with triggers.

In respect of socio-economic impacts the SIMP has been structured to reflect the objectives of a number of Pacific Aluminium documents, including the company's 'Communities Policy and Standard' and it's 'Social Risk Analysis Guideline'. Impacts that were identified in the risk analysis as being significant have been grouped into categories, so that social impact management actions could be targeted. Mitigation and management strategies have been developed based on a hierarchy of controls, where Pacific Aluminium seeks first to avoid impacts, if not possible then to minimise the extent of impacts, then mitigate through management controls and remedial measures. Where Project impacts are positive in nature, actions have also been proposed to optimise or enhance these benefits for local and regional communities. The SIMP has been developed in consultation with a number of key stakeholders as part of the SIA process. Engagement aimed to identify community and stakeholder suggestions for potential mitigation measures, as well as where implementation of management strategies could be achieved through local partnerships. Where relevant, these partnerships or shared responsibilities will be incorporated into the social management plans over time so that maximum local benefit can be achieved.

5.3 SUMMARY OF ENVIRONMENTAL RISK ASSESSMENT

5.3.1 Safety, biophysical and cultural heritage

The risk analysis enabled the EIS to prioritise the key assessment issues and to identify where additional management measures may be required.

The following environmental aspects generated pre-mitigation risk ratings as medium or above:

- Vegetation clearing
- Excavation.
- Physical presence of infrastructure.
- Vehicle movements.
- Fire ignition.

- Liquid waste disposal.
- Spills and leaks.
- Atmospheric emissions (including dust).
- Noise and vibration.

These pre-mitigation risks were used to focus analysis in the 'impact chapters' of the Draft EIS (Chapters 6-16) and the development of mitigation strategies presented in the EMP (Appendix O).

After mitigation all risks were reduced. Most risks were rated as low. Those rated medium or higher were the subject of particular attention in the development of management sub-plans in the EMP and included risks to:

- Human safety and health from equipment used during vegetation clearing, third party interference to the pipeline infrastructure and dust.
- Flora, vegetation communities and fauna habitat from vegetation clearance.
- Wildlife from trench-fall.
- Flora, vegetation and fauna habitats from spread of weeds and feral animals due to both vehicle movements during construction and the existence of the ROW.
- Habitat quality from fire.

5.3.2 Socio-economic

The risk ratings are summarised in Table 5-24. The risk analysis, evaluation and treatment allowed all negative socio-economic risks identified to be rated at medium or low and all positive risks identified to be rated at medium to very high. Management measures are required to be implemented in order to maintain this level of risk and this is detailed in the Social Impact Management Plan (SIMP) at Appendix M.

Table 5-24: Social impact risk assessment summary

		SIGNIFICANCE OF RISK		
	PROJECT PHASE	TYPE	BEFORE MITIGATION	AFTER MITIGATION
ECONOMIC DEVELOPMENT AND EMPLOYMENT				
Sustaining the economic and employment benefits of the refinery at Gove	Construction and operation	Positive	Very high	Very high
Potential direct employment opportunities for local communities	Construction	Positive	Medium	Medium
Potential direct training and development opportunities for local communities	Construction	Positive	Low	Medium
Potential procurement and contracting opportunities for local businesses	Construction and operation	Positive	Low	Medium
LAND AND COUNTRY				
Increased access of traditional lands by workers and other non-local people without necessary permits	Construction and operation	Negative	Medium	Low
Potential for sacred sites and significant areas to be disturbed or damaged due to increased access.	Construction	Negative	Low	Low
Potential for negative environmental impacts on features of value to communities, e.g. waterfalls, springs, billabongs and river crossing and catchment areas	Construction	Negative	Medium	Low
COMMUNITY SAFETY				
Heightened road safety risk due to increased movement of traffic and machinery through the Project area	Construction and operation	Negative	Medium	Medium
Potential risk of gas leaks and explosions	Construction and operation	Negative	Medium	Low
Theft and vandalism of Project infrastructure and equipment	Construction and operation	Negative	Low	Low
Increased incidence of communicable disease due to population influx	Construction	Negative	Low	Low
SOCIAL VALUES AND COMMUNITY COHESION				
Continued viability and vitality of Nhulunbuy community through sustained operation of the refinery	Construction and operation	Positive	High	High
Increase in community conflict and anxiety related to use of traditional lands and introduction of non-local workforce	Construction	Negative	Medium	Low
Increase in the occurrence of social ills (e.g. alcohol and substance abuse) through the introduction of non-resident workers	Construction	Negative	Medium	Low
INFRASTRUCTURE AND SERVICES				
Decreased housing and accommodation affordability and availability in local communities	Construction	Negative	Medium	Low
Increased pressure on local health and emergency services due to increased non-resident population	Construction	Negative	Medium	Medium
Potential impacts on the functioning of other industry infrastructure through Project placement and increased demand for services	Construction	Negative	Low	Low
UNPLANNED CLOSURE				
Unforeseen closure event or non-completion of the pipeline project	Decommissioning	Negative	Medium	Medium