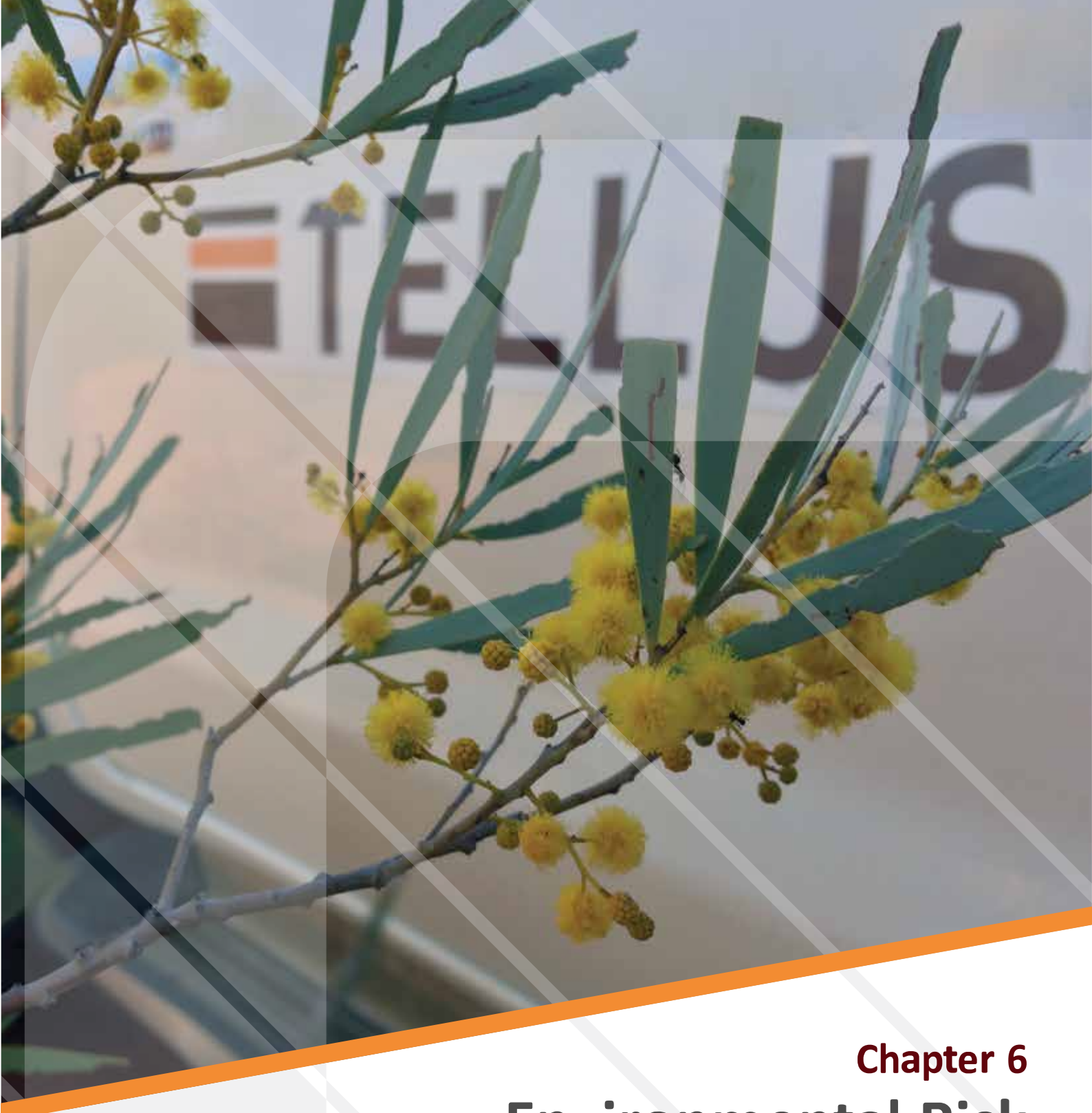

Chapter 6

Environmental Risk Assessment

TELLUS

This page has been left intentionally blank

Table of Contents

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

BFMP	Bushfire Management Plan
BMP	Biodiversity Management Plan
CRI	Composite Risk Index
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
NT	Northern Territory
SEMP	Sediment and Erosion Management Plan
WMP	Water Management Plan

6 ENVIRONMENTAL RISK ASSESSMENT

6.1 Introduction

Environmental risk assessment is the process undertaken to identify, evaluate and apply mitigation and control measures to the potential environmental risks of a proposed development. As the environmental impact assessment for the Proposal included input from a wide range of technical disciplines, a 'whole of Proposal' risk assessment was undertaken to promote a consistent benchmarking of the identified environmental risks.

A range of hazards were identified by the NT EPA through a preliminary assessment of the Proposal. The Proposal's risk assessment has assessed these hazards, as well as others identified by the proponent during a series of risk workshops.

Risk workshops were undertaken by the proponent at key milestones in the preparation of the EIS and Proposal design. The results of the workshops were collated into a detailed risk matrix which is presented in Appendix N.

The objectives and methodologies adopted for the assessment of direct and/or indirect risks during key phases of the Proposal, namely construction, operation, closure and rehabilitation, are summarised below.

6.2 Objectives

The Proposal's environmental risk assessment is undertaken to:

- Identify and discuss potential hazards generated or affected by the Proposal.
- Identify relevant potential direct and indirect consequences of the identified hazards, and determine their associated likelihood.
- Quantify and qualify risks to identify the key environmental issues that require detailed assessment, and to provide a mechanism to focus a range of management responses to adequately manage those risks.
- Identify levels of uncertainty about estimates of risks and the effectiveness of risk controls in mitigating risk.
- Identify stakeholders who may be subject to residual risks.
- Provide transparent and auditable guidance in decision making for mitigation prioritisation and escalation.
- Demonstrate that the Proposal represents best practicable technology, implementing Best Practicable Measures and industry standards, where applicable.

6.3 Risk assessment methodology

The risk assessment methodology has been devised by Tellus based upon the broad definitions and methodology and principles outlined in AS/NZS ISO 31000:2009. The standardised risk assessment for the Proposal involved the following steps:

- **Assessment criteria**
    - Develop a series of validated risk matrices.
    - Develop look-up tables for likelihood and consequence.
- **Establishing the context**
    - Describe the boundaries of the Proposal, functions and spatial scale for each area.
- **Identify the hazard(s)**
    - The identification of potential environmental hazards associated with various components ('aspects') of the Proposal.
    - Identifying the nature of the identified hazards ("beneficial", "neutral" or "adverse").
- **Analyse the risk (pre-mitigation)**
    - Assessing the 'likelihood' of an identified hazard occurring.
    - Defining the 'consequence' of the hazard occurring, as described by impacts of health & safety, environmental, financial, project delivery or social impacts.
    - As a product of the likelihood and consequence, determining the pre-mitigation composite risk index (i.e. 'risk'CRI = likelihood x consequence).
- **Identifying required mitigation**
    - Identify the mitigation required to control the 'likelihood' of that risk.
    - Identifying the mitigation required to control the 'consequence' of that risk.
    - Documenting the owner of those mitigation actions, the time and cost implications and detailing a review date.
- **Identify appropriate mitigation and/or management measures**
    - Discuss appropriate measures within risk workshops.
- **Analyse the risk (post mitigation)**
    - Reassessing the 'likelihood' of an identified hazard occurring in light of the implemented mitigation.
    - Reassessing the 'consequence' of the hazard occurring in light of the implemented mitigation.
    - As a product of the mitigated likelihood and consequence, determining the post-mitigation composite risk index (i.e. 'risk' CRI = likelihood x consequence).

The risks derived through the above methodology are presented on a dimensionless scale of 'extreme', 'high', medium' and 'low', which may be used within a multi-discipline analysis to provide a context for the evaluation of impacts which are essentially incomparable. For example, comparing the changes (both adverse and beneficial) to air quality with changes to other environmental considerations (e.g. water quality, heritage or noise) or socio economic impacts. The relative risk is provided as a dimensionless product of the defined values attributed to 'likelihood' and 'consequence'.

The determined risk may be used to highlight the relative environmental risk and to highlight the general requirement for the application of appropriate controls and mitigation. It is noted that the above approach is designed to provide an overall impact risk, and is not intended to represent the defining determination for the requirement for mitigation and control.

A standardised approach to evaluating risk does not replace the methodologies used by technical disciplines to identify or assess impacts, nor does it replace methods of impact assessment prescribed by existing guidance. Rather, it adds to the impact assessment by providing clear, more readily comparable conclusions regarding the significance of impacts.

The environmental and social systems, resources and receptors potentially affected by the Proposal were defined through desktop based research, field surveys and preliminary consultation with key agencies within the NT Government, regional stakeholders and local communities. A summary of the issues raised during consultation and how they were incorporated into the environmental assessment is provided in Chapter 5.

6.3.1 The nature of an identified hazard

By definition, a 'hazard' is described as a source of potential harm, but as the risk assessment methodology may be used to identify beneficial impacts in this context a 'hazard' is identified as impact of the Proposal (of "beneficial", "neutral" or "adverse" nature).

For the purposes of this assessment the descriptors presented in Table 6-1 are used to describe the nature of an identified hazard:

Table 6-1 Nature of a hazard

Nature	Descriptor
Beneficial	the hazard has a potential beneficial impact upon the environment
Neutral	the hazard has neither a beneficial or adverse impact on the environment. Occasionally, the term 'benign' is used. Typically, a hazard will be categorised as having a neutral nature post-mitigation.
Adverse	the hazard has a potentially adverse impact on the environment

6.3.2 Evaluating likelihood

The 'likelihood' of a hazard and an impact occurring can be described in terms of probability. Overlaying this is the need to recognise that uncertainty may be associated with potential risks occurring, particularly during the initial risk assessment process. Where scientific uncertainty exists, a precautionary approach was taken which identified a higher level of risk. Each identifiable impact can be assigned a likelihood of occurring, ranging from 'Remote' to 'Almost certain'.

In simplifying the 'likelihood' of potential hazards for the purpose of a risk assessment an element of subjectivity is introduced. The purpose of the risk assessment is not necessarily to agree on the probability of any particular impact, but to facilitate an understanding of the relative probability of different impacts.

The pre-mitigation assessment of likelihood needs to account for the probability of an identified hazard occurring, assuming the incorporation of 'designed-in' mitigation, that is, measures that would be required to comply with legislation, relevant guidance, or otherwise which is intrinsic to the design specification upon which the development proposal has been based.

Columns two to four in Table 6-2 give descriptions that elaborate on the possible likelihood categories. These are presented to help view the impact from different perspectives.

Table 6-2 Likelihood of a hazard

Likelihood	Description	Probability	Mid interval	Community outlook
Eliminated	Would not occur as a result of being designed out of the Proposal	P 0	0.00	Not affected
Remote	May occur only in exceptional circumstances	0.01<P<0.10	0.05	Few or no people affected or interested
Unlikely	Could occur at some time	0.11<P<0.40	0.25	Some people affected
Possible	Might occur at some time	0.41<P<0.60	0.50	Many people affected
Likely	Will probably occur in most circumstances	0.61<P<0.90	0.75	Most people affected
Almost certain	Is expected to occur in most circumstances	0.91<P<1.00	0.95	Almost everyone affected

6.3.3 Evaluating consequence

To determine the 'consequence' of an identified hazard, clearly described thresholds were developed which included the scale of potential impact, its geographic extent, duration, ecological and social sensitivity, reversibility, and potential cumulative effects.

In simplifying the potential 'consequence' of potential hazards for the purpose of a risk assessment an element of subjectivity is introduced. The purpose of the risk assessment is not necessarily to agree on the defined consequence of any particular hazard, but to facilitate an understanding of the relative impacts.

Consistent with the assumptions for 'likelihood', the pre-mitigation assessment of consequence needs to address the severity of an identified hazard occurring, assuming the incorporation of 'designed-in' mitigation, that is, measures would be required to comply with legislation, relevant guidance, or otherwise which is intrinsic to the design specification upon which the development proposal has been based.

Table 6-3 provides descriptions that elaborate on the possible consequence categories. These are presented to help view the impact from different perspectives.

Table 6-3 Consequence of a hazard

Consequence descriptor	Description (examples)				
	Health	Environmental	Financial Loss	Project Delivery	Social
Insignificant	No injuries.	None	Low financial loss.	Trivial.	Insignificant.
Minor	First aid treatment.	On-site release immediately contained.	Medium financial loss.	Project can be completed with changes.	Additional local engagement.
Moderate	Medical treatment required.	On-site release contained with outside assistance.	High financial loss.	Project can be completed with moderate changes.	Additional meetings.
Major	Extensive injuries.	Off-site release with no detrimental effects.	Loss of production capability Major financial loss.	Project can only be completed with major changes (redesign).	Reactive media plan, recovery plan, working committees.
Catastrophic	Death.	Toxic release off-site with detrimental effect.	Cessation of production capability / Huge financial loss.	Project incapable of completion / Unviable.	No social licence to operate.

6.3.4 Evaluating risk

The risk of an identified hazard (sometimes also called the 'significance') was determined as a product of the likelihood of the hazard and its consequence on the environment, resource, social value or receptor that it would potentially impact, or as a consequence to the delivery of the Proposal, assuming that the mitigation required to comply with legislation, relevant guidance and the design specifications for the Proposal have been implemented.

In order to standardise the significance rating assigned to potential environmental impacts, a matrix was developed and two multi-disciplinary workshops were held by key members of the EIA team in May 2015 and again in March 2016. A generic set of risk definitions is provided in Table 6-4 and this approach enables a consistent description of risks (of either 'adverse' or 'beneficial' nature). In each chapter, the significance criteria are made relevant to the topic being considered.

Table 6-4 Risk significance criteria

Significance	Criteria
Eliminated	As a consequence of mitigation, the likelihood and/or the consequence has been removed.
Low	These impacts are recognisable, but acceptable within the decision-making process. They are still important in the determination of environmental management requirements. These impacts tend to be short term, or temporary and at the local scale.
Medium	These impacts are relevant to decision making, particularly for determination of environmental management requirements. These impacts tend to range from long to short term, and occur over medium scale areas or focused within a localised area. Environmental receptors are moderately sensitive, and/or the impacts are of regional or local significance.
High	These impacts are likely to be of importance in the decision-making process. They tend to be permanent, or otherwise long to medium term, and can occur over large or medium scale areas. Environmental receptors are high to moderately sensitive, and/or the impacts are of state significance.
Extreme	These impacts are considered critical to the decision-making process. They tend to be permanent, or irreversible, or otherwise long term, and can occur over large scale areas. These effects are generally but not exclusively associated with sites and features of and/or the impacts of national importance. Typically, mitigation measures are unlikely to remove such effects.

6.3.5 Risk assessment matrix

Based on the assessment of likelihood and consequence, any foreseeable impact can be assigned a significance of risk, as defined in Table 6-4. The EIS is at this point intended to focus on potentially significant environmental risks and impacts.

Table 6-5 is to be read as a matrix, with consequence as a scale across the top row and likelihood as a scale on the left column. Any potential risks that fall in the top right of the matrix are therefore addressed as *key environmental issues requiring detailed environmental assessment* in the EIS. Risks that fall into the bottom right of the matrix are addressed as *other issues* in the EIS

Table 6-5 Risk significance matrix

Consequence / Likelihood	Eliminated	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Eliminated	High	High	High	Extreme	Extreme
Likely	Eliminated	Medium	Medium	High	High	Extreme
Possible	Eliminated	Low	Medium	Medium	High	High
Unlikely	Eliminated	Low	Low	Medium	Medium	High
Remote	Eliminated	Low	Low	Low	Medium	Medium
Eliminated	Eliminated	Eliminated	Eliminated	Eliminated	Eliminated	Eliminated

For example, a pre-mitigated hazard may be determined to be “possible” in likelihood and “minor” in terms of consequence. Using the matrix presented in Table 6-5, the pre-mitigated risk would be evaluated as being a “medium” risk.

6.3.6 Duration

This assessment also requires consideration of the duration of the impact. The definitions used to describe the duration of an identified hazard are provided in Table 6-6.

Table 6-6 Risk duration

Duration of environmental effects	Period
Temporary	Days to months
Short-term	Up to 1 year
Medium-term	From 1 to 5 years
Long-term	From 5 to 30 years (approval period)
Permanent/irreversible	Over multiple generations (post Facility closure)

The assessment is further required to assess potential risks in accordance with the EPBC Act Significant Impact Guidelines for Matters of National Environmental Significance (MNES), and as such mitigation measures may be proposed where the determined risk is less significant and/or where the duration of effects might be short-term or temporary.

6.3.7 Potential impacts

The preliminary assessment of the Proposal undertaken by the NT EPA identified a range of key environmental risks. These included:

- Biodiversity.
- Groundwater.
- Surface water and flooding.
- Cultural Heritage.
- Human health.
- Socio-economic values.
- Closure and rehabilitation.

Other risks, such as, fire, air quality, noise and vibration and visual amenity were also identified by the NT EPA.

The proponent took the above identified risks and developed a comprehensive assessment of each component. The results of that assessment are presented in the risk matrix in Appendix N. The assessment took into consideration outline management and mitigation measures including design changes within the development of the Proposal.

The residual risk assessment undertaken took into consideration additional mitigation measures to control and manage the 'likelihood' and/or 'consequence' and thereby reduce the significance of residual risks.

6.4 Pre-mitigation risk assessment

Each technical discipline considered both direct and indirect impacts of the Proposal by undertaking the following steps:

- Clearly identifying the cause / effect relationships between each action and impact.
- Taking a conservative approach by assuming the most significant likely magnitude of the relevant impact.
- Clearly stating factors affecting the worst case and likely case outcomes.

Indirect impacts were considered within the EIA for the Proposal. For example, vibration effects from the blasting of geological strata during mine shaft construction may potentially permanently dislodge rocks on surrounding hills which may result in indirect adverse effects on items of cultural heritage and/or visual amenity.

Refer to Table 6-10 for pre-mitigated risk assessment.

6.5 Mitigation and management measures

6.5.1 Introduction

After pre-mitigation risks were quantified, the proponent discussed and proposed relevant mitigation and management measures during the risk workshops. The mitigation and environmental management measures are explained within the following chapters of this EIS:

- Chapter 7 – Biodiversity.
- Chapter 8 – Groundwater.
- Chapter 9 – Surface water.
- Chapter 10 – Historic and Cultural Heritage.
- Chapter 11 – Human Health.
- Chapter 12 – Economic and Social.
- Chapter 13 – Closure and Rehabilitation.
- Chapter 14 – Bushfire.
- Chapter 15 – Air quality.
- Chapter 16 – Noise and vibration.
- Chapter 17 – Visual amenity.
- Chapter 18 – Other impacts.
- Chapter 18 – Cumulative impacts.
- Chapter 20 – Environmental management.

6.5.2 Key considerations

Key considerations for preferred mitigation measures were to:

- Respond to the appropriate level in the 'mitigation hierarchy' i.e. avoid; minimise; rehabilitate; manage; offset or compensate.
- Discuss if mitigation measures were reasonable and appropriate in terms of effort and expense to the significance and nature of the identified potential impact.

The level of mitigation measures proposed should respond to the significance of the relevant risks identified. For example, an impact considered to be of extreme significance would need to be met with a high level of mitigation that avoids, eliminates or makes provisions for offsetting (if required). Conversely, an impact that was considered to be of low significance may either not require mitigation or only require management by control of impacts through day to day management with occasional monitoring required as validation, for example. It is worth noting that a low significance

risk does not exclude the provision of mitigation, and the risk assessment demonstrates that a range of mitigation options would be provided to manage low significance risks.

6.5.3 Mitigation approach

Table 6-7 provides a summary of the approach that was implemented when developing mitigation and management measures. This approach ensured that the level of mitigation proposed for each impact was appropriate and in proportion to the level of impact significance.

Table 6-7 Management and mitigation measures

Initial impact significance rating	Mitigation response
Eliminated	No mitigation or management is typically required because the risk has been removed by either removing the risk through design changes and/or consultation with key stakeholders.
Low	Management of impacts should be addressed in day to day management. Monitoring may be required to validate that impacts are low.
Medium	Management of impact will be required and closely monitored to check that impacts are not more severe than predicted. Replacement may be required where consequence of the action on resources of low or moderate value is extreme (i.e. complete loss of the resource). Rehabilitate disturbed areas is likely and monitoring required to check effectiveness of mitigation measures.
High	High impacts must be avoided where ever possible and otherwise offset or fully compensated. An environmental bond must be in place. Ongoing monitoring is recommended to confirm effectiveness of mitigation and management measures.
Extreme	Risks must be designed out, eliminated or fully offset or compensated with offset and / or compensation measures in place before the project proceeds. International and national standards will need to be complied with and specialists with internationally or nationally recognised expertise should be involved in development and implementation of mitigation and offsetting. High level of ongoing monitoring is required to confirm effectiveness of mitigation measures and whether additional mitigation or other corrective actions are required.

As previously stated, the pre-mitigation risk assessment assumes the incorporation of 'designed-in' mitigation that is required to comply with legislation, relevant guidance, or otherwise which is intrinsic to the design specification upon which the Proposal has been based.

Once mitigation and management measures were identified, post-mitigation risks (sometimes called 'residual risks') were assessed. By managing the likelihood and consequence of a risk occurring through mitigation and/or management measures, the residual consequence of the same risk

occurring after mitigation would mean it would be managed (minimised or eliminated). The assessment of, and compliance with, international and national standards was undertaken in development and implementation of Proposal's mitigation and management techniques.

6.5.4 List of control and/or management measures

Future controls and mitigation measures that were identified during the risk workshops and factored into the assignment of the risk levels are listed in Table 6-8. Please note that the table is indicative only and the measures included in Table 6-8 are further detailed in Chapter 20 and would be further developed through detailed design and associated management plans.

Table 6-8 List of controls and mitigation measures

Category	Environmental control and/or mitigation measure
Occupational health and safety requirement	Personal protection equipment including equipment used in hazardous locations
	Occupational health screening and monitoring i.e. periodic blood testing, lung function etc.
	Testing for particulates and gases
	Provisions of full time emergency services
	Enforcement of safe working practices
	Provision of adequate safety measures for electrical equipment, working at height, confined spaces and other hazardous work conditions
Construction and operation	Monitoring of groundwater conditions
	Monitoring of surface water conditions
	Monitoring of air quality conditions
	Enforcement of policies and procedures for management of hazardous materials including chemical, fuels and explosives
	Effective contractor management
	Material Safety Data Sheets
	Surface water run-off management
	Bushfire buffer zones and hazard reduction measures
	Effective communication with key stakeholders
	Provisions of adequate ventilation, dust extraction and standard duct control and operating procedures for enclosed spaces
	Implementation of appropriate stock / land use management system
	Recycling materials where appropriate
	Requirement to undertake further modelling (groundwater)
	Above ground designs of surface infrastructure including aspect, wind directions, lighting
Standards	Compliance with Australian Dangerous Goods for transport of all hazardous goods
	Compliance with all applicable Australian (and other) Standards
Design of plant and equipment	Design in accordance with standards and conditions of consent
	Design for correct capacity
	Design to include environment and climate considerations.
Certification	ISO 9001
	ISO 14001
Other Tellus plans and polices	Enforce all environmental management plans
	Enforce all operational policies, such as employment policies, which will be required to be adopted as a minimum by all contractors and sub-contractors

Following the identification and recording of appropriate mitigation and management measures, a post mitigation risk assessment was undertaken to determine the magnitude and consequence of residual risks (see Table 6-10).

6.5.5 Confidence

The confidence of mitigation is assigned according to the descriptors in Table 6-9.

Table 6-9 Confidence descriptors for mitigation options

Confidence descriptor	Examples
High	• Proven Best Practice Measures (BPM). • Best Available Technology (BAT). • Environmentally Sound Management (ESM). • Policy and guidance.
Moderate	• Effective mitigation strategy and considered standard practice. • Is not documented as Best Practice Measures, Best Available Technology, Environmentally Sound Management, or satisfying all requirements of policy and guidance.
Low	• Technology has not been demonstrated in industry. • Not yet tried and/or tested.

6.6 Post mitigation risk assessment

Following the adoption of mitigation and environmental management measures, a second iteration of the risk assessment was undertaken to account for the potential effect of the adopted measures to control the likelihood and consequence of each risk. This is the post mitigation risk assessment.

Table 6-10 summarises the results of the pre-mitigation and post-mitigation risk assessment undertaken against the Proposal's identified risks. To promote transparency, each identified hazard is assessed as a pre-mitigation' risk, the proposed mitigation measures to be adopted, and then sequentially as the post-mitigation risk.

For the pre-mitigation and post-mitigation summary, Table 6-10 summarises:

- Likelihood, as defined in Table 6-2.
- Consequence, as defined in Table 6-3.
- Risk significance, as defined in Table 6-4 and determined from Table 6-5.
- Nature, as defined in Table 6-1.
- Duration, as defined Table 6-6.

Table 6-10 also summarises the environmental management and/or mitigation measures the proponent would adopt to avoid, reduce or minimise environmental risks. A confidence level (see Table 6-9) rating is assigned to each mitigation measure.

Table 6-10 Risk assessment

Risk identified by NT EPA during preliminary assessment	Hazard identified by the Proponent in the EIS	Pre-mitigated risks					Mitigation			Post-mitigated risks					Risk outcome
		Likelihood	Consequence	Risk ranking	Nature	Duration	Mitigation to reduce likelihood	Mitigation to reduce consequence	Confidence	Likelihood	Consequence	Risk ranking	Category	Duration	
Biodiversity (Chapter 7)	Loss of habitat and/or mortality of threatened fauna species	Possible	Major	High	Adverse	Long term	Biodiversity Management Plan (BMP)	BMP	Moderate	Unlikely	Major	Medium	Adverse	Long term	Risk reduced
	Removal of vegetation	Almost certain	Moderate	High	Adverse	Long term	BMP	BMP	Moderate	Almost certain	Minor	High	Adverse	Long term	Risk reduced
	Loss of fauna habitat from removal of vegetation	Almost certain	Moderate	High	Adverse	Long term	BMP	BMP	Moderate	Almost certain	Minor	High	Adverse	Long term	Risk reduced
	Habitat fragmentation from removal of vegetation	Almost certain	Moderate	High	Adverse	Temporary	BMP	BMP	Moderate	Possible	Moderate	Medium	Adverse	Long term	Risk reduced
	Fauna displacement injury or mortality from removal of vegetation	Possible	Moderate	Medium	Adverse	Temporary	BMP	BMP	Moderate	Unlikely	Minor	Low	Adverse	Short term	Risk reduced
	Fauna strike (vehicle)	Possible	Catastrophic	High	Adverse	Temporary	Traffic Management Plan	Speed restrictions	Moderate	Unlikely	Catastrophic	High	Adverse	Temporary	Risk reduced
	Removal of vegetation resulting in edge effects	Almost certain	Minor	High	Adverse	Temporary	BMP	BMP	Moderate	Possible	Minor	Medium	Adverse	Short term	Risk reduced
	Altered hydrology leading to flora mortality and loss of habitat	Possible	Minor	Medium	Adverse	Long term	Water Management Plan	Detailed engineering design	Moderate	Unlikely	Minor	Low	Adverse	Long term	Risk reduced
	Groundwater abstraction (at 50 m below ground level) impacting vegetation	Remote	Minor	Low	Neutral	Long term	Water Management Plan	Bore design	Moderate	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Risk reduced
	Contamination of soil and water	Possible	Minor	Medium	Adverse	Temporary	Sediment and Erosion Management Plan (SEMP)	Bunding and detailed engineering	Moderate	Eliminated	Minor	Eliminated	Neutral	Not applicable	Risk reduced
	Erosion and sedimentation of soils	Likely	Major	High	Adverse	Temporary	SEMP	Bunding and detailed engineering	Moderate	Unlikely	Major	Medium	Adverse	Temporary	Risk reduced
	Dust deposition from vehicle traffic and earthworks	Almost certain	Minor	High	Adverse	Short term	Air Quality Management Plan (AQMP)	AQMP	Moderate	Possible	Minor	Medium	Adverse	Temporary	Risk reduced
	Construction light, noise and vibration	Almost certain	Minor	High	Adverse	Temporary	Noise Management Plan (NMP)	NMP	Moderate	Likely	Minor	Medium	Adverse	Temporary	Risk reduced
	Operational light, noise and vibration	Almost certain	Minor	High	Adverse	Long term	NMP	NMP	Moderate	Likely	Minor	Medium	Adverse	Long term	Risk reduced
	Introduction and spread of weeds and invasive species	Likely	Minor	Medium	Adverse	Short term	Weed Management Plan	Weed Management Plan	Moderate	Unlikely	Minor	Low	Adverse	Short term	Risk reduced
	Increased predator species	Likely	Minor	Medium	Adverse	Short term	Pest Management Plan (PMP)	PMP	Moderate	Unlikely	Minor	Low	Adverse	Short term	Risk reduced
	Increased introduced fauna	Likely	Minor	Medium	Adverse	Short term	PMP	PMP	Moderate	Unlikely	Minor	Low	Adverse	Short term	Risk reduced

Risk identified by NT EPA during preliminary assessment	Hazard identified by the Proponent in the EIS	Pre-mitigated risks					Mitigation			Post-mitigated risks					Risk outcome
		Likelihood	Consequence	Risk ranking	Nature	Duration	Mitigation to reduce likelihood	Mitigation to reduce consequence	Confidence	Likelihood	Consequence	Risk ranking	Category	Duration	
	Bushfire	Possible	Catastrophic	High	Adverse	Short term	Bushfire Management Plan (BFMP)	BFMP	Moderate	Possible	Minor	Medium	Adverse	Short term	Risk reduced
	Salt erosion and spoil erosion	Likely	Catastrophic	Extreme	Adverse	Temporary	SEMP	SEMP	Moderate	Remote	Major	Medium	Adverse	Temporary	Risk reduced
	Soil compaction and topsoil loss	Possible	Minor	Medium	Adverse	Short term	SEMP	SEMP	Moderate	Unlikely	Minor	Low	Adverse	Short term	Risk reduced
Groundwater (Chapter 8)	Changes to groundwater levels	Almost certain	Minor	High	Adverse	Long term	Water Management Plan (WMP)	Do not over abstract	Moderate	Possible	Minor	Medium	Adverse	Short term	Risk reduced
	Changes to groundwater chemistry	Possible	Minor	Medium	Adverse	Short term	WMP	WMP	Moderate	Remote	Minor	Low	Adverse	Short term	Risk reduced
	Changes to groundwater flow (direction)	Possible	Moderate	Medium	Adverse	Long term	WMP	WMP	Moderate	Remote	Minor	Low	Adverse	Long term	Risk reduced
	Contamination of Horseshoe Bend Shale aquatards from drilling activities	Remote	Major	Medium	Adverse	Temporary	Design of decline and shafts in line with best practice techniques	Design of decline and shafts in line with best practice techniques	High	Eliminated	Major	Eliminated	Neutral	Not applicable	Risk reduced
	Contamination of Langra aquifer from drilling activities	Remote	Major	Medium	Adverse	Temporary	Design of decline and shafts in line with best practice techniques	Design of decline and shafts in line with best practice techniques	High	Eliminated	Major	Eliminated	Neutral	Not applicable	Risk reduced
	Contamination of Hermannsberg Formation groundwater from drilling activities	Remote	Major	Medium	Adverse	Temporary	Design of decline and shafts in line with best practice techniques	Design of decline and shafts in line with best practice techniques	High	Eliminated	Major	Eliminated	Neutral	Not applicable	Risk reduced
	Contamination of Stairway Sandstone groundwater from drilling activities	Remote	Minor	Low	Adverse	Temporary	Design of decline and shafts in line with best practice techniques	Design of decline and shafts in line with best practice techniques	High	Eliminated	Minor	Eliminated	Adverse	Not applicable	Risk reduced
	Contamination of Jay Creek Limestone groundwater from drilling activities	Remote	Minor	Low	Adverse	Temporary	Design of decline and shafts in line with best practice techniques	Design of decline and shafts in line with best practice techniques	Moderate	Eliminated	Minor	Eliminated	Adverse	Not applicable	Risk reduced
	Contamination of Titjikala water supply through loss of containment	Eliminated	Catastrophic	Eliminated	Neutral	Not applicable	No pathway	No pathway	Moderate	Eliminated	Catastrophic	Eliminated	Neutral	Not applicable	Risk same
	Contamination of Alice Springs aquifer through loss of containment	Eliminated	Catastrophic	Eliminated	Neutral	Not applicable	No pathway	No pathway	Moderate	Eliminated	Catastrophic	Eliminated	Neutral	Not applicable	Risk same

Risk identified by NT EPA during preliminary assessment	Hazard identified by the Proponent in the EIS	Pre-mitigated risks					Mitigation			Post-mitigated risks					Risk outcome
		Likelihood	Consequence	Risk ranking	Nature	Duration	Mitigation to reduce likelihood	Mitigation to reduce consequence	Confidence	Likelihood	Consequence	Risk ranking	Category	Duration	
	Contamination of Great Artesian Basin through loss of containment	Eliminated	Major	Eliminated	Neutral	Not applicable	No pathway	No pathway	Moderate	Eliminated	Major	Eliminated	Neutral	Not applicable	Risk same
	Contamination of livestock through loss of containment	Eliminated	Major	Eliminated	Neutral	Not applicable	Water Management Plan	Water Management Plan	Moderate	Eliminated	Major	Eliminated	Neutral	Same level of risk	Risk same
	Uncontrolled inflow of groundwater during construction	Unlikely	Minor	Low	Adverse	Temporary	Surface water design / bunding	Surface water design / bunding	Moderate	Remote	Minor	Low	Adverse	Temporary	Risk reduced
	Uncontrolled inflow of groundwater during operations	Remote	Catastrophic	Medium	Adverse	Temporary	Surface water design / bunding	Surface water design / bunding	Moderate	Remote	Major	Medium	Adverse	Temporary	Risk reduced
	Engineered uses of naturally occurring corrosive groundwater	Almost certain	Major	Extreme	Adverse	Long term	Management of saline waters / desalination	Management of saline waters / desalination	Moderate	Almost certain	Minor	High	Adverse	Long term	Risk reduced
	Over abstraction of groundwater leading to local or regional drawdown	Remote	Minor	Low	Adverse	Long term	Do not over abstract demand requirement and undertake groundwater monitoring	Do not over abstract demand requirement and undertake groundwater monitoring	Moderate	Eliminated	Minor	Eliminated	Neutral	Short term	Risk reduced
	Lack of groundwater for supply	Remote	Major	Medium	Adverse	Long term	Water Management Plan	Water Management Plan	Eliminated	Eliminated	Minor	Eliminated	neutral	Not applicable	Risk reduced
Surface water (Chapter 9)	Surface water ingress into decline area and general mining infrastructure	Likely	Moderate	High	Adverse	Temporary	SEMP	SEMP	Moderate	Remote	Moderate	Low	Adverse	Temporary	Risk reduced
	Contaminated surface water runoff off-site	Unlikely	Minor	Low	Adverse	Temporary	Water Management Plan and bunding	Water Management Plan and bunding	Moderate	Remote	Minor	Low	Adverse	Temporary	Risk reduced
	Salt dissolution and transport off-site	Likely	Major	High	Adverse	Long term	Water Management Plan and bunding	Water Management Plan and bunding	Moderate	Remote	Minor	Low	Adverse	Temporary	Risk reduced
	Flash flooding into mine infrastructure area	Possible	Major	High	Adverse	Temporary	Storm water drains / flood relief	Storm water drains / flood relief	Moderate	Remote	Moderate	Low	Adverse	Temporary	Risk reduced
	Flooding of access/haul roads	Likely	Moderate	High	Adverse	Temporary	SEMP	SEMP	Moderate	Possible	Minor	Medium	Adverse	Temporary	Risk reduced
	Soil erosion leading to excess sedimentation in watercourses	Possible	Major	High	Adverse	Long term	SEMP	SEMP	Moderate	Remote	Minor	Low	Adverse	Temporary	Risk reduced
	Contamination of regional surface waters (Hugh and Finke Rivers) through loss of containment	Remote	Major	Medium	Adverse	Short term	No pathway	No pathway	Moderate	Eliminated	Major	Eliminated	Adverse	Not applicable	Risk reduced

Risk identified by NT EPA during preliminary assessment	Hazard identified by the Proponent in the EIS	Pre-mitigated risks					Mitigation			Post-mitigated risks					Risk outcome
		Likelihood	Consequence	Risk ranking	Nature	Duration	Mitigation to reduce likelihood	Mitigation to reduce consequence	Confidence	Likelihood	Consequence	Risk ranking	Category	Duration	
	Contamination of Hugh River through loss of containment	Remote	Major	Medium	Adverse	Short term	Water Management Plan	SEMP	Moderate	Eliminated	Major	Eliminated	Not applicable	Not applicable	Risk reduced
	Contamination of Finke River through loss of containment	Remote	Major	Medium	Adverse	Short term	Water Management Plan	SEMP	Moderate	Eliminated	Major	Eliminated	Not applicable	Not applicable	Risk reduced
	Altered hydrology surrounding Maryvale Hills	Almost certain	Moderate	High	Adverse	Short term	Water Management Plan	SEMP	Moderate	Almost certain	Minor	High	Adverse	Short term	Risk reduced
	Altered hydrology surrounding the mine infrastructure area	Almost certain	Major	Extreme	Beneficial	Long term	Water Management Plan	SEMP	Moderate	Almost certain	Major	Extreme	Beneficial	Long term	Risk same
Historic and cultural heritage **(Chapter 10)**	Physical disturbance to known sites	Likely	Moderate	High	Adverse	Medium term	Cultural heritage field surveys / Cultural Heritage Management Plan (CHMP) /TO involvement	Cultural heritage field surveys / CHMP /TO involvement	Moderate	Eliminated	Moderate	Eliminated	Neutral	Short term	Risk reduced
	Physical disturbance to unknown sites	Remote	Moderate	Low	Adverse	Medium term	CHMP / TO involvement	CHMP / TO involvement	Moderate	Remote	Moderate	Low	Adverse	Temporary	Risk same
	Loss of trees (>5m) of value to traditional owners	Almost certain	Moderate	High	Adverse	Short term	Pre-clearance tree survey / TO involvement	Pre-clearance tree survey / TO involvement	Moderate	Almost certain	Minor	High	Adverse	Short term	Risk reduced
	Loss of scarred trees	Unlikely	Moderate	Medium	Adverse	Long term	CHMP/ TO involvement	CHMP / TO involvement	Moderate	Remote	Moderate	Low	Adverse	Temporary	Risk reduced
	Disturbance of sensitive land at the decline entry	Eliminated	Minor	Eliminated	Neutral	Not applicable	Vibration assessment	Blasting Management Plan	Moderate	Eliminated	Minor	Eliminated	Neutral	Not applicable	Risk same
Human health and safety **(Chapter 11)**	Exposure from dry waste	Unlikely	Moderate	Medium	Adverse	Long term	AQMP	AQMP	Moderate	Remote	Moderate	Low	Adverse	Temporary	Risk reduced
	Exposure from wet waste	Unlikely	Moderate	Medium	Adverse	Long term	AQMP	AQMP	Moderate	Remote	Moderate	Low	Adverse	Temporary	Risk reduced
	Exposure from fuel spills	Remote	Minor	Low	Adverse	Long term	Training	Emergency spill response	Moderate	Remote	Minor	Low	Adverse	Temporary	Risk same
	Exposure from surface traffic fumes	Remote	Minor	Low	Adverse	Long term	Enclosure air extraction	AQMP	Moderate	Remote	Minor	Low	Adverse	Temporary	Risk same
	Vehicle collision with pedestrians (above and below ground)	Likely	Catastrophic	Extreme	Adverse	Long term	Traffic Management Plan (TMP)	TMP	Moderate	Unlikely	Catastrophic	High	Adverse	Temporary	Risk reduced
	Vehicle accidents (above and below ground)	Likely	Catastrophic	Extreme	Adverse	Long term	TMP	TMP	Moderate	Unlikely	Catastrophic	High	Adverse	Long term	Risk reduced
	Exposure from mine gas extraction	Almost certain	Minor	High	Adverse	Long term	Emission design	AQMP	Moderate	Unlikely	Minor	Low	Adverse	Temporary	Risk reduced
	Ventilation failure	Likely	Moderate	High	Adverse	Medium term	Backup power supplies, management systems	AQMP	Moderate	Unlikely	Moderate	Medium	Adverse	Temporary	Risk reduced

Risk identified by NT EPA during preliminary assessment	Hazard identified by the Proponent in the EIS	Pre-mitigated risks					Mitigation			Post-mitigated risks					Risk outcome
		Likelihood	Consequence	Risk ranking	Nature	Duration	Mitigation to reduce likelihood	Mitigation to reduce consequence	Confidence	Likelihood	Consequence	Risk ranking	Category	Duration	
	Underground vehicle fire	Likely	Major	High	Adverse	Long term	Use of battery vehicles / isolation areas /	Emergency Response Management Plan (ERMP)	Moderate	Unlikely	Major	Medium	Adverse	Temporary	Risk reduced
	Underground vehicle exhaust exposure	Almost certain	Major	Extreme	Adverse	Long term	Ventilation design	ERMP	Moderate	Remote	Major	Medium	Adverse	Temporary	Risk reduced
	Heat stress above and below ground	Almost certain	Moderate	High	Adverse	Long term	Ventilation design and temperature controls	ERMP	Moderate	Unlikely	Moderate	Medium	Adverse	Long term	Risk reduced
	Construction accidents - surface infrastructure	Possible	Catastrophic	High	Adverse	Long term	Traffic Management Plan (TMP)	ERMP	Moderate	Remote	Catastrophic	Medium	Adverse	Long term	Risk reduced
	Construction accidents - underground infrastructure	Possible	Catastrophic	High	Adverse	Long term	TMP	ERMP	Moderate	Remote	Catastrophic	Medium	Adverse	Long term	Risk reduced
	Uncontrolled gas release - underground pressure release	Unlikely	Catastrophic	High	Adverse	Long term	Ventilation design / Health and Safety Plan / AQMP	ERMP	Moderate	Remote	Catastrophic	Medium	Adverse	Temporary	Risk reduced
	Uncontrolled gas release - underground ignition	Unlikely	Catastrophic	High	Adverse	Long term	Ventilation design / Health and Safety Plan / AQMP	ERMP	Moderate	Remote	Catastrophic	Medium	Adverse	Temporary	Risk reduced
	Uncontrolled gas release - underground asphyxiation	Unlikely	Catastrophic	High	Adverse	Long term	Ventilation design / Health and Safety Plan / AQMP	ERMP	Moderate	Remote	Catastrophic	Medium	Adverse	Temporary	Risk reduced
	Waste stability with heat	Unlikely	Major	Medium	Adverse	Long term	Waste Zoning Guide	Waste Zoning Guide	Moderate	Eliminated	Major	Eliminated	Neutral	Long term	Risk reduced
	Bites / stings	Almost certain	Catastrophic	Extreme	Adverse	Long term	Health and Safety Management Plan (HSMP)	HSMP	Moderate	Unlikely	Moderate	Medium	Adverse	Long term	Risk reduced
	Drugs and alcohol abuse	Almost certain	Major	Extreme	Adverse	Long term	HSMP	HSMP	Moderate	Remote	Major	Medium	Adverse	Long term	Risk reduced
	Strata / ground stability	Unlikely	Catastrophic	High	Adverse	Long term	Detailed geotechnical design	CEMP	Moderate	Remote	Catastrophic	Medium	Adverse	Long term	Risk reduced
	Mine drill and blasting	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Blasting Management Plan	CEMP	Moderate	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Risk same
	Ignition of flammable materials	Possible	Major	High	Adverse	Short term	HSMP	ERMP	Moderate	Unlikely	Major	Medium	Adverse	Short term	Risk reduced
	Fall from height	Possible	Catastrophic	High	Adverse	Medium term	HSMP	ERMP	Moderate	Unlikely	Catastrophic	High	Adverse	Medium term	Risk reduced
	Electrical incident	Possible	Major	High	Adverse	Short term	HSMP	ERMP	Moderate	Unlikely	Major	Medium	Adverse	Short term	Risk reduced
	Exposure from Naturally Occurring Radioactive Material (NORM)	Unlikely	Major	Medium	Adverse	Long term	Waste Zoning Guide	HSMP	Moderate	Eliminated	Major	Eliminated	Neutral	Not applicable	Risk reduced

Risk identified by NT EPA during preliminary assessment	Hazard identified by the Proponent in the EIS	Pre-mitigated risks					Mitigation			Post-mitigated risks					Risk outcome
		Likelihood	Consequence	Risk ranking	Nature	Duration	Mitigation to reduce likelihood	Mitigation to reduce consequence	Confidence	Likelihood	Consequence	Risk ranking	Category	Duration	
Socio economics **(Chapter 12)**	Community acceptance of the Proposal (Titjikala)	Possible	Major	High	Adverse	Long term	Community consultation	Community consultation	Moderate	Remote	Moderate	Low	Adverse	Short term	Risk reduced
	Community acceptance of the Proposal (Alice Springs)	Likely	Major	High	Adverse	Long term	Community consultation	Community consultation	Moderate	Unlikely	Moderate	Medium	Adverse	Short term	Risk reduced
	Regional acceptance of the Proposal (NT/Australia)	Unlikely	Major	Medium	Adverse	Long term	Community consultation	Community consultation	Moderate	Remote	Moderate	Low	Adverse	Temporary	Risk reduced
	Not mining salt (no product export)	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Community consultation	Community consultation	Moderate	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Risk same
	Not mining salt (no product local)	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Community consultation	Community consultation	Moderate	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Risk same
	Not mining salt (tourism)	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Community consultation	Community consultation	Moderate	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Risk same
	Not mining salt (employment)	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Community consultation	Community consultation	Moderate	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Risk same
	Not mining salt (royalties)	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Community consultation	Community consultation	Moderate	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Risk same
	Employment opportunities - construction	Almost certain	Major	Extreme	Beneficial	Long term	Community engagement and training programs	Community engagement and training programs	Moderate	Almost certain	Major	Extreme	Beneficial	Long term	Risk same
	Employment opportunities - operations	Almost certain	Major	Extreme	Beneficial	Long term	Community engagement and training programs	Community engagement and training programs	Moderate	Almost certain	Major	Extreme	Beneficial	Long term	Risk same
	Employment opportunities - ancillary employment	Almost certain	Moderate	High	Beneficial	Long term	Community engagement and training programs	Community engagement and training programs	Moderate	Almost certain	Major	Extreme	Beneficial	Long term	Risk reduced
Closure and rehabilitation **(Chapter 13)**	Room seal failure	Possible	Minor	Medium	Adverse	Long term	Design specifications	Rehabilitation Closure Plan	Moderate	Remote	Minor	Low	Adverse	Long term	Risk reduced
	Accident during surface to underground decommissioning	Remote	Catastrophic	Medium	Adverse	Short term	Health and Safety Mgmt Plan	Health and Safety Mgmt Plan	Moderate	Remote	Catastrophic	Medium	Adverse	Short term	Risk same
	Shaft seals fail	Remote	Major	Medium	Adverse	Short term	Design specifications	Rehabilitation Closure Plan	Moderate	Eliminated	Moderate	Eliminated	Adverse	Not applicable	Risk reduced
	Decline seals fail	Remote	Insignificant	Low	Neutral	Not applicable	Design specifications	Design specifications	Moderate	Eliminated	Insignificant	Eliminated	Neutral	Not applicable	Risk reduced
	No surface remediation (environmental)	Unlikely	Minor	Low	Adverse	Long term	Rehabilitation and Closure Plan	Rehabilitation and Closure Plan	Moderate	Remote	Minor	Low	Adverse	Long term	Risk reduced
	No surface remediation	Unlikely	Major	Medium	Adverse	Long term	Rehabilitation and Closure Plan	Rehabilitation and Closure Plan	Moderate	Remote	Major	Medium	Adverse	Long term	Risk reduced
	No groundwater monitoring	Remote	Moderate	Low	Adverse	Long term	Rehabilitation and Closure Plan	Rehabilitation and Closure Plan	Moderate	Remote	Minor	Low	Adverse	Long term	Risk reduced
	No gas monitoring is undertaken	Remote	Minor	Low	Adverse	Long term	Institutional control management	Institutional control management	Moderate	Eliminated	Minor	Eliminated	Adverse	Not applicable	Risk reduced

Risk identified by NT EPA during preliminary assessment	Hazard identified by the Proponent in the EIS	Pre-mitigated risks					Mitigation			Post-mitigated risks					Risk outcome
		Likelihood	Consequence	Risk ranking	Nature	Duration	Mitigation to reduce likelihood	Mitigation to reduce consequence	Confidence	Likelihood	Consequence	Risk ranking	Category	Duration	
	No institutional control period monitoring	Possible	Moderate	Medium	Neutral	Long term	Institutional control management	Institutional control management	Moderate	Unlikely	Minor	Low	Adverse	Long term	Risk reduced
	Future land uses (other land grazing)	Remote	Insignificant	Low	Adverse	Temporary	Institutional control management	Institutional control management	Moderate	Eliminated	Insignificant	Eliminated	Neutral	Temporary	Risk reduced
	Earthquakes	Remote	Insignificant	Low	Adverse	Long term	Geotechnical assessment	Detailed design	Moderate	Remote	Insignificant	Low	Adverse	Long term	Risk same
	Climate change	Possible	Insignificant	Low	Adverse	Long term	Post operational risk assessment	Detailed design /	Moderate	Possible	Insignificant	Low	Adverse	Long term	Risk same
	Human intrusion	Remote	Minor	Low	Adverse	Short term	Rehabilitation and Closure Plan	Institutional control management	Moderate	Eliminated	Minor	Eliminated	Not applicable	Not applicable	Risk reduced
Bushfire (Chapter 14)	Natural bushfires occurring	Possible	Major	High	Adverse	Short term	BFMP	BFMP	Moderate	Unlikely	Major	Medium	Adverse	Short term	Risk reduced
	Back burning on surrounding pastoral land	Possible	Major	High	Adverse	Short term	BFMP	BFMP	Moderate	Possible	Major	High	Adverse	Short term	Risk same
	Hot works resulting in spontaneous ignition	Possible	Major	High	Adverse	Short term	BFMP	BFMP	Moderate	Unlikely	Major	Medium	Adverse	Short term	Risk reduced
	Smoking cigarettes	Likely	Major	High	Adverse	Short term	BFMP	BFMP	Moderate	Likely	Major	High	Adverse	Short term	Risk same
	Increased ignition sources	Likely	Major	High	Adverse	Short term	BFMP	BFMP	Moderate	Unlikely	Major	Medium	Adverse	Short term	Risk reduced
	Flammable and/or volatile fuels	Likely	Major	High	Adverse	Short term	BFMP	BFMP	Moderate	Unlikely	Major	Medium	Adverse	Short term	Risk reduced
Air quality (Chapter 15) (A) (D) (E)	Construction phase impacts (construction traffic in Alice Springs)	Almost certain	Moderate	High	Adverse	Short-term	CEMP, mitigation measures identified	CEMP, mitigation measures identified	High	Almost certain	Insignificant	High	Adverse	Short-term	Risk reduced
	Emissions to air (combustion gases and particulates) from mining activities (NO2 at Chambers Pillar Campsite) (B) (F)	Likely	Major	High	Adverse	Long-term	AQMP, including stockpile management	USEPA Tier 4 emission standards, stockpile	High	Likely	Minor	Medium	Adverse	Long-term	Risk reduced
	Loss of containment of 1 TEU of product salt at the Chandler Facility impacting all receptors (C)	Possible	Insignificant	Low	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	waste handling procedures and restrictive load management to manage the volumes of similar materials	Moderate	Unlikely	Insignificant	Low	Adverse	Temporary	Risk reduced

Risk identified by NT EPA during preliminary assessment	Hazard identified by the Proponent in the EIS	Pre-mitigated risks					Mitigation			Post-mitigated risks					Risk outcome
		Likelihood	Consequence	Risk ranking	Nature	Duration	Mitigation to reduce likelihood	Mitigation to reduce consequence	Confidence	Likelihood	Consequence	Risk ranking	Category	Duration	
	Loss of containment of 1 TEU of solid waste (as beryllium) at the Chandler Facility affecting all receptors	Possible	Insignificant	Low	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	waste handling procedures and restrictive load management to manage the volumes of similar materials	Moderate	Unlikely	Insignificant	Low	Adverse	Temporary	Risk reduced
	Simultaneous loss of containment of 2 TEU of solid waste (as beryllium) at Chandler Facility	Unlikely	Insignificant	Low	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	waste handling procedures and restrictive load management to manage the volumes of similar materials	Moderate	Remote	Insignificant	Low	Adverse	Temporary	Risk reduced
	Loss of containment of 1 TEU liquid/sludge waste (as formaldehyde) at the Chandler Facility impacting Chambers Pillar Campground	Possible	Minor	Medium	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	waste handling procedures and restrictive load management to manage the volumes of similar materials	Moderate	Unlikely	Minor	Low	Adverse	Temporary	Risk reduced
	Simultaneous loss of containment of 2 TEU liquid/sludge waste (as formaldehyde) at Chandler Facility	Unlikely	Moderate	Medium	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	waste handling procedures and restrictive load management to manage the volumes of similar materials	Moderate	Remote	Moderate	Low	Adverse	Temporary	Risk reduced
	Loss of containment of 1 TEU of product salt at Apirnta Facility	Possible	Insignificant	Low	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	0	Moderate	Unlikely	Insignificant	Low	Adverse	Temporary	Risk reduced
	Loss of containment of 1 TEU of solid waste (as beryllium) at Apirnta Facility	Possible	Insignificant	Low	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	waste handling procedures and restrictive load management to manage the volumes of similar materials	Moderate	Unlikely	Insignificant	Low	Adverse	Temporary	Risk reduced

Risk identified by NT EPA during preliminary assessment	Hazard identified by the Proponent in the EIS	Pre-mitigated risks					Mitigation			Post-mitigated risks					Risk outcome
		Likelihood	Consequence	Risk ranking	Nature	Duration	Mitigation to reduce likelihood	Mitigation to reduce consequence	Confidence	Likelihood	Consequence	Risk ranking	Category	Duration	
	Simultaneous loss of containment of 2 TEU of solid waste (as beryllium) at Apirnta Facility	Unlikely	Insignificant	Low	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	waste handling procedures and restrictive load management to manage the volumes of similar materials	Moderate	Remote	Insignificant	Low	Adverse	Temporary	Risk reduced
	Loss of containment of 1 TEU liquid/sludge waste (as formaldehyde) at Apirnta Facility	Possible	Insignificant	Low	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	waste handling procedures and restrictive load management to manage the volumes of similar materials	Moderate	Unlikely	Insignificant	Low	Adverse	Temporary	Risk reduced
	Loss of containment of 1 TEU of product salt at Apirnta Facility	Possible	Insignificant	Low	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	0	Moderate	Unlikely	Insignificant	Low	Adverse	Temporary	Risk reduced
	Loss of containment of 1 TEU of solid waste (as beryllium) at Apirnta Facility	Possible	Insignificant	Low	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	waste handling procedures and restrictive load management to manage the volumes of similar materials	Moderate	Unlikely	Insignificant	Low	Adverse	Temporary	Risk reduced
	Simultaneous loss of containment of 2 TEU of solid waste (as beryllium) at Apirnta Facility	Unlikely	Insignificant	Low	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	waste handling procedures and restrictive load management to manage the volumes of similar materials	Moderate	Remote	Insignificant	Low	Adverse	Temporary	Risk reduced
	Loss of containment of 1 TEU liquid/sludge waste (as formaldehyde) at Apirnta Facility	Possible	Insignificant	Low	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	waste handling procedures and restrictive load management to manage the volumes of similar materials	Moderate	Unlikely	Insignificant	Low	Adverse	Temporary	Risk reduced

Risk identified by NT EPA during preliminary assessment	Hazard identified by the Proponent in the EIS	Pre-mitigated risks					Mitigation			Post-mitigated risks					Risk outcome
		Likelihood	Consequence	Risk ranking	Nature	Duration	Mitigation to reduce likelihood	Mitigation to reduce consequence	Confidence	Likelihood	Consequence	Risk ranking	Category	Duration	
	Simultaneous loss of containment of 2 TEU of solid waste (as beryllium) at Apirnta Facility	Unlikely	Insignificant	Low	Adverse	Temporary	EMS (including EMP), in-cab collision avoidance & communication	waste handling procedures and restrictive load management to manage the volumes of similar materials	Moderate	Remote	Insignificant	Low	Adverse	Temporary	Risk reduced
Noise and vibration) (Chapter 16	Blasting activities result in increased noise levels	Almost certain	Insignificant	High	Adverse	Temporary	Blasting Management Plan	Construction Environmental Mgmt Plan	Moderate	Likely	Insignificant	Medium	Adverse	Temporary	Risk reduced
	Blasting activities result in vibration	Almost certain	Major	Extreme	Adverse	Temporary	Blasting Management Plan	Construction Environmental Mgmt Plan	Moderate	Unlikely	Major	Medium	Adverse	Temporary	Risk reduced
	Blasting activities result in vibration on known items of cultural heritage significance	Possible	Major	High	Adverse	Long term	Blasting Management Plan	Construction Environmental Mgmt Plan	Moderate	Remote	Major	Medium	Adverse	Long term	Risk reduced
	Construction and operation noise	Almost certain	Moderate	High	Adverse	Temporary	Noise Mgmt Plan	Construction Environmental Mgmt Plan	Moderate	Possible	Minor	Medium	Adverse	Temporary	Risk reduced
Visual amenity (Chapter 17)	Visibility of above ground infrastructure	Almost certain	Minor	High	Adverse	Long term	Landscape Mgmt Plan	Consultation with Traditional Owners	Moderate	Unlikely	Minor	Low	Adverse	Long term	Risk reduced
	Visibility of decline entry	Almost certain	Minor	High	Adverse	Long term	Landscape Mgmt Plan	Consultation with Traditional Owners	Moderate	Unlikely	Minor	Low	Adverse	Long term	Risk reduced
	Visibility of spoil stockpiles	Almost certain	Minor	High	Adverse	Long term	Landscape Mgmt Plan	Consultation with Traditional Owners	Moderate	Unlikely	Minor	Low	Adverse	Long term	Risk reduced
	Visibility of run of mine salt stockpile	Almost certain	Minor	High	Adverse	Long term	Landscape Mgmt Plan	Consultation with Traditional Owners	Moderate	Unlikely	Minor	Low	Adverse	Long term	Risk reduced
	Visibility of detention/sedimentation ponds	Almost certain	Minor	High	Adverse	Long term	Landscape Mgmt Plan	Consultation with Traditional Owners	Moderate	Unlikely	Minor	Low	Adverse	Long term	Risk reduced
	Visibility of access roads	Almost certain	Minor	High	Adverse	Permanent	Landscape Mgmt Plan	Consultation with Traditional Owners	Moderate	Unlikely	Minor	Low	Adverse	Long term	Risk reduced
	Visibility of accommodation village	Almost certain	Minor	High	Adverse	Long term	Landscape Mgmt Plan	Consultation with Traditional Owners	Moderate	Unlikely	Minor	Low	Adverse	Long term	Risk reduced
	Subsidence causing changes to land form	Unlikely	Moderate	Medium	Adverse	Permanent	Landscape Mgmt Plan	Consultation with Traditional Owners	Moderate	Unlikely	Minor	Low	Adverse	Long term	Risk reduced

Note (A) Please note that Air Quality impacts have been assessed in the Technical Paper as risks for a range (or scale) of incidents, which are also categorised in terms of likelihood using industry definitions and statistical frequencies (defined as frequent, likely, occasional, unlikely, remote, incredible). Essentially the Air Quality Risk Assessment utilises a 3-dimensional risk assessment (sensitivity x consequence x likelihood), which for the purposes of presenting a holist EIS risk chapter, needs to be presented as a 2-dimenisonal risk assessment (likelihood x consequence).

(B) The risk assessment for mining activities is evaluated against a 'likely' likelihood, as the relevant metrics are short-term in nature (hourly to annual average statistics) when compared to the life of mine and the risks associated with accidental loss of containment.

(C) The risks associated with loss of containment have been assessed against 'possible' and 'unlikely' likelihood events.

(D) The definitions of likelihood used in this Chapter and in the Air Quality Risk Assessment are marginally different. For clarity, the following equivalence has been used:

Table 6.2 descriptor	AQRA descriptor
Almost certain	Frequent
Likely	Likely
Possible	Occasional
Unlikely	Unlikely
Remote	Remote

(E) The definitions of consequence used in this Chapter and in the Air Quality Risk Assessment are marginally different. For clarity, the following equivalence has been used:

Table 6.3 descriptor	AQRA descriptor
Catastrophic	} Substantial (>100% ST criterion)
Major	} Substantial (>50% ST criterion)
Moderate	Moderate (<25% ST criterion)
Minor	Slight (>10% ST criterion)
Insignificant	Negligible (<10% ST criterion)

(F) The pre-mitigation risk of 'high' is derived from the predicted 1-hour NO_2 impact at Chambers Pillar Campsite. The post-mitigated risk of 'medium' is derived from a conservative prediction of the 24-hour PM_{10} impacts at a number of off-site locations. The post-mitigated NO_2 consequence is 'insignificant'.

6.7 Discussion of risks

The preliminary review of the Proposal undertaken by the NT EPA identified eight 'key environmental risks' and four 'other risks'. The risk assessment undertaken by the proponent quantified a total of 136 hazards after two Proposal risk workshops.

The presentation of pre-mitigation and post mitigation risks associated with the Proposal are summarised in Table 6-10.

As discussed in Section 6.3.1, in the context of the EIS, a 'hazard' is identified as impact of the Proposal, and may be of "beneficial", "neutral" or "adverse" in nature. Of the 136 hazards identified, the pre-mitigation and post-mitigation breakdown illustrated in Table 6-11 by nature is observed.

Table 6-11 Quantification of pre-mitigated and post mitigated risks by nature

Risk summary	Pre-mitigation	Post-mitigation
	Count	Count
Adverse	118	106
Neutral	14	26
Beneficial	4	4
Total	136	136

As may be deduced from Table 6-11 the number of 'adverse' nature risks reduce from 118 (pre-mitigation) to 106 (post mitigation) and the number of 'neutral' nature risks increases from 14 (pre-mitigation) to 26 (post mitigation). Essentially this illustrates that 12 adverse risks have been eliminated to become 'neutral' in nature.

All risks identified by the proponent have been quantified using the methods detailed above and summarised in Table 6-12 and Figure 6-1.

Table 6-12 Quantification of pre-mitigated and post mitigated risk

Risk summary	Pre-mitigation	Post-mitigation
	Count	Count
Extreme	11	4
High	54	12
Medium	31	38
Low	29	51
Eliminated	11	31
Total	136	136

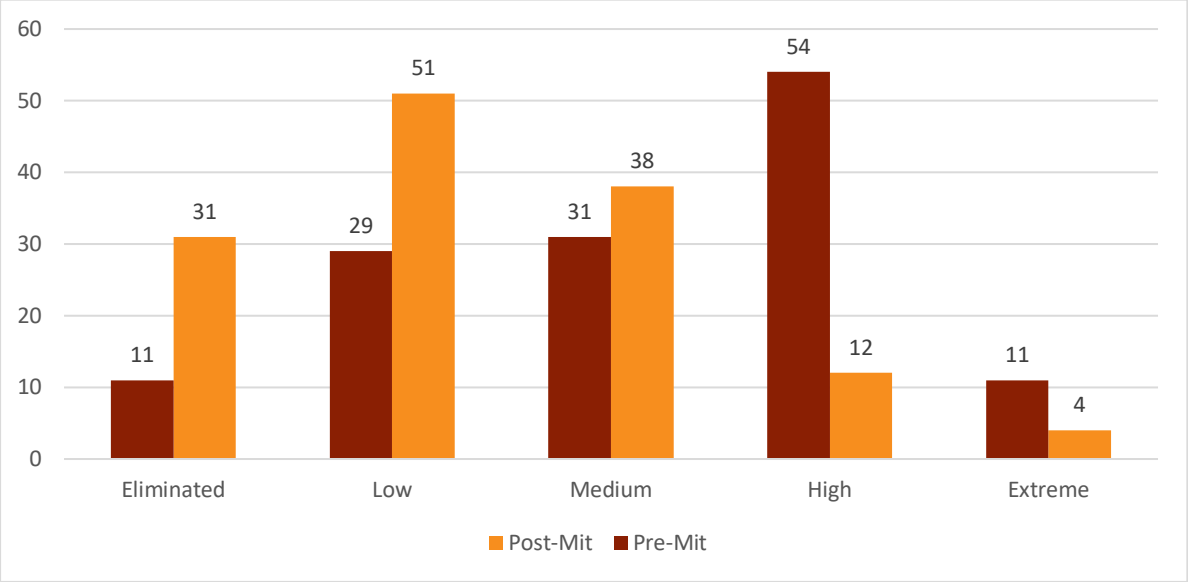

Figure 6-1 Risk summary of pre-mitigated and post mitigated risks

Figure 6-1 shows that with mitigation in place, a further 20 risks are eliminated from the total 136 risks identified at pre-mitigation stage. In addition, the number of low risks increased from 29 to 51, high risks decreased from 54 to 12 and extreme risks also decreased from 11 to 4. It is further noted that the 4 remaining 'extreme' risks are all "beneficial" in nature, relating to:

- Surface water: altered hydrology surrounding the infrastructure site.
- Socio-economics: employment opportunities – construction.
- Socio-economics: employment opportunities – operational.
- Socio-economics: employment opportunities – ancillary employment.

Following the analysis of mitigation and site specific environmental management measures and/or changes to design, the post mitigation assessment summarised in Figure 6-2 concludes the Proposal would:

- Increase the likelihood of 'eliminated' risk from 11 in pre-mitigation to 31 in post mitigation.
- Increase the likelihood of 'low' risk from 29 at pre-mitigation to 51 in post mitigation.
- Increase the likelihood of 'medium' risk from 31 at pre-mitigation to 38 in post mitigation.
- Decrease the likelihood of 'high' risk from 54 at pre-mitigation to 12 in post mitigation.
- Decrease the likelihood of 'extreme' risk from 11 at pre-mitigated risks to 4 in post mitigation

Generally there is a clear trend to reduce the majority of adverse nature 'high' and 'extreme' risks, and through targeted mitigation reduce these risks to 'medium', 'low' and 'eliminated'.

The risk summary outlined above is a product function of likelihood and consequence, and the mitigation identified targets either likelihood, consequence, or both factors to some degree (although not necessarily equally).

The effect of mitigation upon 'likelihood' is illustrated in Figure 6-2.

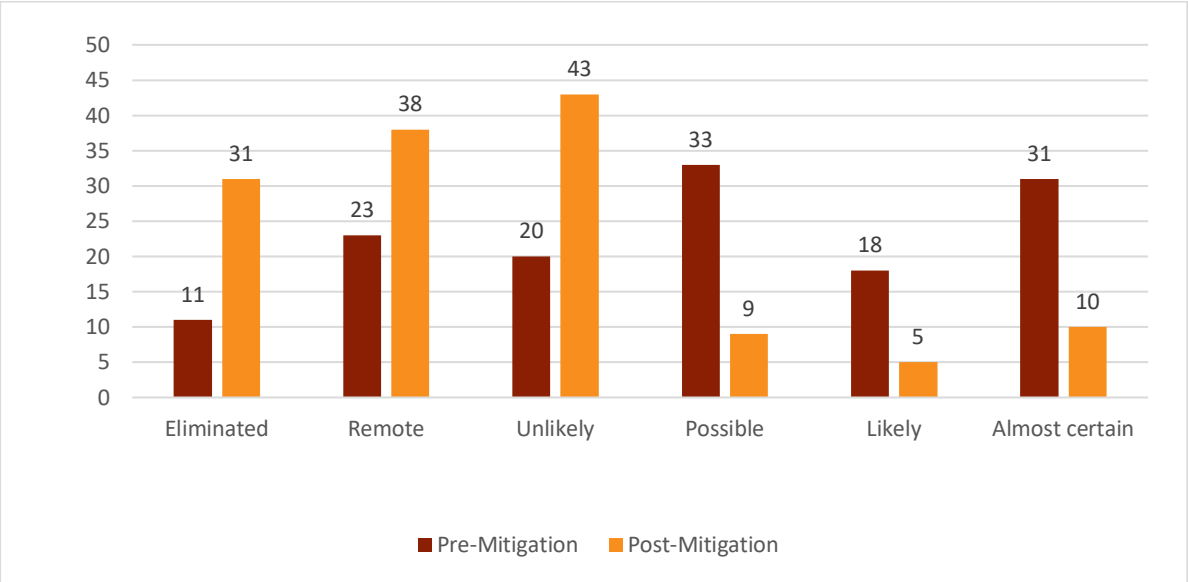

Figure 6-2 Likelihood of risks pre and post mitigation

Similarly, the consequence of the identified risks is reduced following the implementation of mitigation and environmental management measures (see Figure 6-3).

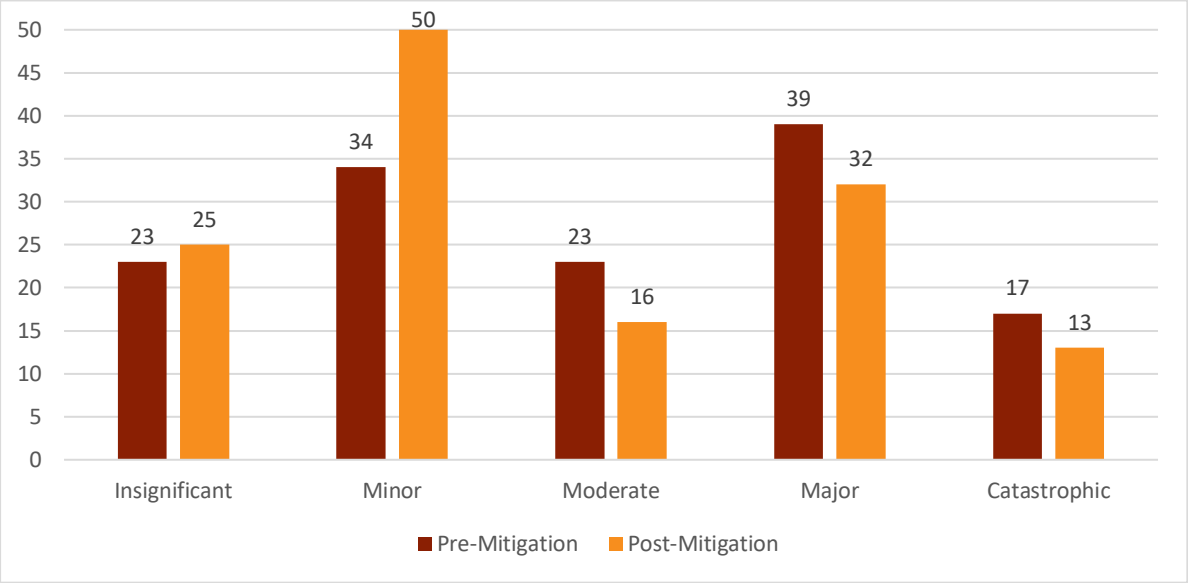

Figure 6-3 Consequence of risks pre and post mitigation

6.8 The Proposal's environmental impact assessment process

6.8.1 Background

A Notice of Intent was lodged on 16 November 2012 with the NT Government, Environment Protection Authority.

An EPBC Act referral was lodged December 2012 with the then Commonwealth Department of Sustainability, Environment, Water, Population and Communities (now Department of the Environment and Energy). The Proposal was determined to be a controlled action under the EPBC Act. The relevant controlling provision is listed threatened species and communities (section 18 and 18A).

In March 2013, the NT EPA decided that the Proposal required assessment under the NT *Environmental Assessment Act* at the level of an EIS. Draft Guidelines for Preparation of an EIS were issued by the NT EPA for public comment on the 22 June, 2013. Comments closed 5 July, 2013, and Final Guidelines for the Preparation of an Environmental Impact Statement (the 'EIS Guidelines') were issued by the NT EPA on 19 July, 2013.

In 2016, a variation to the 2013 final EIS Guidelines was submitted to the NT EPA. This EIS has been prepared to address the requirements set out in the *Terms of Reference for the Preparation of an Environmental Impact Statement – Chandler Salt Mine* (the 'Terms of Reference') issued by the NT EPA on 23 September, 2016, under the EA Act.

6.8.2 What is Environmental Impact Assessment

Environmental Impact Assessment (EIA) is a process that aims to improve the environmental design of a development proposal and provide decision-makers with sufficient information about the environmental effects of implementing a proposal (IEMA 2008).

Development consent for projects that are likely to have significant effects on the environment should be granted only after an assessment of the likely significant environmental effects of those projects has been carried out.

An EIS sets out the results of the EIA process. The EIS is submitted with an application for planning permission and provides environmental information about the scheme, including a description of the development, its predicted environmental impacts and the measures proposed to amend any adverse effects.

6.8.3 The EIA process for the proposal

Volume 3 presents the core of the impact assessment contained within this EIS, covering a wide range of technical disciplines. To enable a valid comparison to be made of the significance of impacts, a generallyconsistent approach has been applied to each technical issue contained within Volume 2.

In summary, this process involved:

- Establishing baseline conditions for each issue being discussed.
- Using the proposal description plus the construction, operational and decommissioning methodologies to understandthe proposal, its potential impacts, but also the mitigation inherent in the design.
- Assessing the potential impacts of the proposal using a consistent methodology for describing impacts.
- Describing the impacts without any additional mitigation.
- Describing the proposed mitigation for the particular issue being discussed.
- Describing the residual impacts that are anticipated to remain once additional mitigation is implemented.

This translates to a chapter format that is generally as follows:

- Introduction.
- Methodology.
- Existing environment (baseline conditions).
- Assessment of risk during construction.
- Assessment of risk during operation.
- Assessment of risk during closure and rehabilitation.
- Mitigation and monitoring.
- Summary of risk assessment.
- Conclusion.

The mitigation and management measures are summarised in Chapter 21 (Environmental management). The mitigation and management measures would be included in the construction, operational and decommissioning environmental management plans for the proposal.

Overall, the approach taken through the process of developing the environmental impact assessment was to firstly prevent or avoid significant impacts through design changes early in the proposal process, then seek to reduce impacts through the implementation of mitigation prescribed in management plans and, finally, where impacts cannot be adequately mitigated and residual impacts predominate, to compensate for the impact (i.e. through the provision of offsets).

6.8.4 Scoping

Issues and risks to be assessed were identified using a number of related processes. The EIS Guidelines provide the overall framework of specific matters to be addressed by the EIS.

A risk assessment process was also undertaken at the start of the assessment to help prioritise key issues and to develop the scope of the specialist investigations to be undertaken to support the preparation of the EIS.

Government and community stakeholders were also consulted to help identify their key issues, attitudes and concerns regarding the Proposal. Details regarding consultation is provided in Chapter 5.

6.8.5 Existing environment

Establishing the existing environment or baseline conditions involved a wide range of activities including:

- Review of published material (databases, reports, journals, etc.) and mapping from a range of sources.
- Undertaking issue-specific site surveys for key issues identified in the Proposal's ToR.
- Consultation with local, state and Commonwealth government agencies.
- Consultation with Traditional Owners and pastoralists.

6.8.6 Approach to impact assessment

A specific set of descriptors were developed to describe impacts in the EIS. This involves two the following aspects:

- **Significance assessment** - a generic set of significance criteria is defined (see Table 6-4) and enables consistent description of adverse and beneficial impacts. In each chapter the significance criteria are made relevant to the topic being considered. This assessment also requires consideration of the duration of the impact (see Table 6-6), and the relevant EPBC Act Significant Impact Guidelines for Matters of National Environmental Significance.
- **Risk rating** - using the risk framework detailed in Table 6-5, the overall impact is assessed by assessing the consequence of a hazard and its likelihood.
- **Duration** – As described in Table 6-6.

The approach ultimately assesses the residual risk taking into consideration any proposed mitigation measures identified as necessary to lower the significance, frequency or risk of an impact occurring Table 6-10).

6.8.7 Mitigation

As stated previously, the mitigation inherent in the design is included in the initial assessment of impacts. Following this, where necessary, additional mitigation is proposed for the Proposal (i.e. during detailed design) in order to reduce the significance or likelihood of an identified impact occurring. In describing mitigation measures in each chapter of the impact assessment within this EIS, the following is considered:

- A description of the predicted effectiveness of the mitigation measures.
- Any statutory or policy basis for the mitigation measures or offsets (if required).
- Whether the mitigation could be implemented by the proponent, or whether other parties were necessary for it to take effect.

The mitigation information has been used to inform and develop the relevant draft management plans attached to the EIS including:

- Environmental Management Plan.
- Waste Management Plan.
- Water Management Plan.
- Biodiversity Management Plan.
- Social Impact Management Plan.
- Rehabilitation and Closure Plan.

6.9 Cumulative impacts

Cumulative impacts can be defined as impacts on the environment, which result from the incremental impact of an action when added to other past, present or reasonably foreseeable future actions, regardless of what agency or person undertakes those other actions (Carroll *et al*. 2009).

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time or from a combination of concurrent effects from a single action. They can be additive, synergistic or interactive and can result in impacts that are larger, more significant and longer lasting than is the case with individual impacts and their effects. There is no defined process for undertaking cumulative impact assessments within Australia. Considerations related to cumulative impacts are included in the Commonwealth Environment Protection and Biodiversity Conservation Regulations 2000. They state the need to assess cumulative impacts in relation to World Heritage Areas and Ramsar sites but do not provide any guidance on scoping and carrying out the CIA.

Table 6-13 describes the approach taken for the Proposal in determining potential cumulative impacts.

Table 6-13 Cumulative impact methodology

Method	Comment
Spatial boundaries	Setting boundaries is the process of establishing the limits of the area to be assessed for cumulative impacts and the identification of activities within this boundary. The primary spatial boundary for the CIA is the project footprint – this is the area that is under project control and responsibility, i.e. the Project Area. However, boundaries can vary from issue to issue and need to reflect ecosystem requirements rather than artificial boundaries.
Temporal boundaries	Cumulative impacts during the construction phase are likely to be short-term and localised to the Project footprint and immediate surrounds. Operation phase impacts are more likely to be medium to long-term (e.g. continuing for more than two years after the activity has ceased, or ongoing) and to extend beyond the Project footprint.
Project approach	Cumulative impacts have been addressed separately within each of the individual chapters in order to reflect the differing spatial and temporal boundaries of each environmental aspect.

6.10 Conclusion

This environmental impact assessment process undertaken for this EIS has included a comprehensive risk assessment. The outcomes of the detailed risk assessment, the methods used to identify Proposal risks and, initiatives taken by the proponent to mitigate them, can demonstrate that:

- The proponent is aware of risks associated with all predictable aspects of the Proposal.
- The proponent has or will continue to undertake necessary studies to quantify risks.
- Prevention and mitigation of risks have been addressed in conceptual design.
- Risks can and would be managed effectively during construction, operation, decommissioning, closure and post-closure phases of the Proposal.
- Risks will continue to be assessed through the development of the Proposal i.e. in detailed design.

The information contained in this Chapter and in Appendix S has been provided to assist the reader understand the likelihood and consequence of each risk presented by the Proposal. The ranking of risks has been justified by adopting National standards. Supporting EIS studies, such as the operational and post-closure risk assessments (refer to Appendix F and G respectively) have provided sufficient quantitative analysis to indicate whether level of risks is likely to be acceptable, tolerable or non-existent. As indicated in Section 6.7, the implementation of appropriate mitigation and/or environmental management measures has reduced both the likelihood and consequence of Proposal risks.

Where uncertainty did exist for some risks, the proponent adopted the precautionary principle to ensure a conservative level was assessed.