Energy Resources Australia Ltd

Environmental Risk Assessment - Ranger 3 Deeps Underground Mine Project

Report of Environmental Risk Workshop

Date	Rev.	Status	Prepared By	Checked By	Approved By	Approved By
2012-11-20	0	Approved for Use	S. Hewton	J. Fox	A. Murphy	P. Anderson
2012-10-12	B	Client Review	S. Hewton	J. Fox	A. Murphy	P. Anderson
2012-10-05	A	Internal Review	S. Hewton	J. Fox	A. Murphy	Not Required
			HATCH			Client

Table of Contents

1. Introduction

Hatch was engaged by Energy Resources Australia Ltd (ERA) to facilitate and document an environmental risk assessment of the Ranger 3 Deeps Underground Mine Project.

The purpose of the environmental risk assessment was to:

- Identify and evaluate the consequences and significance of the environment-related risks associated with the potential environmental, social and cultural heritage impacts of the Project.
- Inform the referral and Notice of Intent for the project required under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Northern Territory *Environmental Assessment Act,* respectively; and provide guidance in scoping environmental studies within the Project Prefeasibility Study.
- Initiate an ongoing iterative environmental risk process within the Project design, assessment and implementation.

Relevant standards that informed the environmental risk assessment included:

- ISO 31000:2009, Risk Management – Principles and Guidelines
- HB 203:2012, Managing Environment-related Risk
- ISO 14001:2004, Environmental Management Systems – Requirements.

2. Methodology

2.1 Preliminary Environmental Risk Register and Risk Scheme

A pre-workshop version of the Environmental Risk Register was prepared to provide the risk assessment scheme, definitions and risk matrix. The structure of the environmental risk register was such that it could be used to guide the facilitation of the workshop.

A preliminary list of relevant environmental components and potential mechanisms of interaction between the environment and project activities was developed prior to the workshop. As outlined in the Handbook for managing environment related risk[1], the identification of environment-related risks may require the consideration of impacts on the environment as well as impacts on the project activities arising from interactions with the environment. The preliminary list of environmental components and interactions included consideration of both these types of interactions.

The Environmental Risk Register allows for each risk to be described, and then relevant causes and resulting impacts to be identified. In order to understand environmental risks of and to a project, an understanding of the causes, impacts and factors that can affect the consequences and likelihoods is necessary. The environmental risk scheme used for this project was developed using a risk-based methodology previously used in environmental impact assessment projects in South Africa and Australia.

[1] HB 203:2012 Managing Environment-related Risk, Standards Australia

Factors that can affect the consequences of environment-related risk include the severity, extent and duration of resulting impacts. The definitions used to rate each of these are provided in Table 2-1. The convention for assigning a consequence to environment-related risk using these ratings is provided in Table 2-2.

Table 2-1: Rating Definitions for Risk-related Impacts

Severity	Definition
Low	Where the resulting impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected.
Medium	Where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive or vulnerable systems or communities are negatively affected.
High	Where natural, cultural or social functions and processes are altered to the extent that it will temporarily or permanently cease; and valued, important, sensitive or vulnerable systems or communities are substantially affected.
Extent (spatial limit)	**Definition**
Local	Site specific (Ranger Project Area) or immediate surroundings, including Jabiru.
Regional	Locality, ecosystem, province level - widespread e.g. Alligator Rivers Region or Kakadu National Park.
National	State or country level.
Duration	**Definition**
Short term	0 - 12 months
Medium term	1 year - 10 years
Long term	Where the resulting impact will continue until after operational life of the activity.
Permanent	Where the resulting impact will alter the social, cultural and natural environment forever.

Table 2-2: Convention for Assigning Consequence to Environment-related Risk

Consequence Rating	Severity	Extent	Duration
Very High	High	National	Permanent
	High	National	Long term
	High	National	Medium term
	High	Regional	Permanent
	High	Regional	Long term
	High	Regional	Medium term
	Medium	National	Permanent
	Medium	National	Long term
	Medium	National	Medium term
	Medium	Regional	Permanent
	Medium	Regional	Long term
High	High	National	Short term
	High	Local	Permanent
	High	Local	Long term
	High	Regional	Short term
	Medium	National	Short term

Consequence Rating	Severity	Extent	Duration
	Medium	Regional	Medium term
	Low	National	Permanent
	Low	National	Long term
	Low	Regional	Permanent
	Low	Regional	Long term
Moderate	High	Local	Medium term
	High	Local	Short term
	Medium	Regional	Short term
	Medium	Local	Permanent
	Medium	Local	Long term
	Medium	Local	Medium term
	Medium	Local	Short term
	Low	National	Medium term
	Low	National	Short term
	Low	Regional	Medium term
	Low	Local	Permanent
	Low	Local	Long term
Low	Low	Regional	Short term
	Low	Local	Medium term
	Low	Local	Short term

The last consideration made in the analysis of potential environment-related risks of a project is likelihood that the resulting impacts will occur. Table 2-3 provides the definitions developed for rating the likelihood of environmental risk-related impacts.

Table 2-3: Definitions of Likelihood of Environment-related Risk

Likelihood	Likelihood description	Frequency	Substance Exposure
Almost Certain	Recurring impact during the life-time of an operation/ project.	Occurs more than twice per year	Frequent (daily) exposure at > 10 x Occupational Exposure Limit.
Likely	Impact that may occur frequently during the life-time of an operation/ project.	Typically occurs once or twice per year	Frequent (daily) exposure at > Occupational Exposure Limit.
Possible	Impact that may occur during the life-time of an operation/ project.	Typically occurs in 1-10 years	Frequent (daily) exposure at > 50% Occupational Exposure Limit. Infrequent exposure at Occupational Exposure Limit.
Unlikely	Impact that is unlikely to occur during the life-time of an operation/project.	Typically occurs in 10-100 years	Frequent (daily) exposure at > 10% Occupational Exposure Limit. Infrequent exposure at > 50% of Occupational Exposure Limit.

2.2 Environmental Risk Workshop

The environmental risk workshop was facilitated by a Rio Tinto accredited Hatch Facilitator and attended by a diverse group of ERA project personnel. The workshop was held over two days on 25-26 September 2012.

Attendees included:

- Peter Anderson – ERA, Manager Major Project Approvals (2 days)
- Linda Pugh – ERA, Specialist Major Project Approvals (2 days)
- Sharon Paulka – ERA, Senior Closure & Radiation Advisor (2 days)
- Glenn Woodrow – ERA, Specialist Major Project Approvals (2 days)
- Ping Lu – ERA, Manager Ecology (2 days)
- Alan Tietzel – ERA, Chief Advisor (1 day)
- Janet Hamilton – ERA, Manager External Relations (1 day)
- Shelly Iles – ERA, Principal Advisor Environmental Studies (2 days)
- Dan McIntyre – ERA, Advisor Major Project Approvals (2 days)
- Nate Toll – ERA, Manager Water Sciences (2 days)
- John Murphy – ERA, Principle Mining Engineer (2 days)
- Marc Smith – ERA, Manager Communities & Heritage (1 day)
- Samantha Hewton – Hatch, Senior Environmental Specialist (2 days)
- Jeff Fox – Hatch, Risk Facilitator (2 days)

The process followed in the workshop included the following steps which are described in more detail in the following sections:

- Identification of environment-related risks (threats and opportunities)
- Assignment of relevant environmental components and mechanisms of interaction and the identification of causes, impacts and existing or planned controls
- Rating of consequence and likelihood
- Determination of significance of environment-related risks.

2.2.1 Identification of environment-related risks

It was agreed by the participants of the workshop to brainstorm potential risks of the project as the initial identification process. The relevant project areas listed in the draft EPBC Act referral document was used to guide the brainstorming session. These included the following:

- General project
- Construction
- Mine design

- Mining methods
- Ancillary facilities
- Processing
- Water management
- Workforce and contractors
- Power requirements
- Air quality and greenhouse gas emissions
- Radiation management
- Traffic management
- Rehabilitation and closure
- Land owners
- External stakeholders.

Risks were assigned, consolidated and added to under each of the project areas above during a number of brainstorming rounds. No suggestions were discarded, they were assigned as transferred risks or opportunities at a later stage of the process if they were considered not to be environment-related threats for this project. The transferred risks and opportunities were not further analysed during the course of the workshop or post-workshop reporting.

At the end of the risk identification process, the group reviewed the risks identified against the risk scheme and identified and assessed two risks which were not identified during the brainstorming sessions.

2.2.2 Assignment of environmental component and mechanism of project interaction

After the brainstorming rounds, each identified risk was considered and an environmental component and interaction was assigned. During this process, the preliminary list developed prior to the workshop was amended where necessary to fully describe the threats identified in the brainstorming session. Relevant environmental components and the possible interaction mechanisms between the project and the environment are provided in Table 2-4.

Table 2-4: Environmental Components and Mechanisms of Interaction

Environmental Component	Mechanism of Project Interaction
Air quality	Greenhouse gas emissions; particulate (dust); gases/blasting fumes; increase in radiation; National Pollutant Inventory notifiable contaminants; odour
Surface water flow	Discharge to receiving water; alteration to drainage pattern; water abstraction; increase in operational water
Surface water quality	Increase in turbidity; change in background composition; turbidity; water abstraction; contamination
Groundwater flow/quantity	Water abstraction; intersection of groundwater; recharge
Groundwater quality	Contamination; improved
Operational water	Increase in pond water; increase in process water; contamination
Soil	Removal; change in characteristics; contamination; mineral waste
Landform	Change in landform
Terrestrial and aquatic flora	Habitat disturbance/removal; competition from weed species; direct/indirect disturbance to listed species affecting viability; fire
Terrestrial and aquatic fauna	Habitat disturbance/removal; competition from pest species; introduction of predators; direct/indirect disturbance to listed species affecting viability; fire; mortality
Health and safety	Radiation exposure; workforce injury; contamination
Social/community	Land access; use of existing infrastructure/facilities; increased nuisance; change to visual amenity; change to land use; employment opportunities; change in housing availability; economic benefit; community engagement; public safety
Cultural heritage	Disturbance or damage to item or site; removal of item or site; discovery of new site/item of cultural significance; land owner engagement
Noise and vibration	Noise; vibration
Transportation	Change in traffic volume (light and heavy vehicles); increased hazardous materials/waste transport; requirement for police escort; change in road alignment or construction
Mineral resources	Sterilisation of viable mineral/natural resources; extraction
Climatic/Natural Events	Cyclones; earthquakes; bushfire/wildfire/grassfire; flood; rain; storms; extreme weather event

The final Environmental Risk Register, provided in Appendix A, has been ordered by environmental component, rather than project aspect, to better align with potential and/or planned environmental and social impact studies.

2.2.3 Rating of consequence and likelihood of identified environment-related risks

As described in Section 2.1, once the risk was described, then relevant causes and resulting impacts were identified. Each of the components of the impacts were rated using the definitions in Table 2-1, then a consequence rating was applied according to the convention outlined in Table 2-2.

That is, the consequence of the environment-related risk was determined according to the assessed extent, duration and intensity of the potential impacts. In all cases, the assignment of the ratings was done based on past experience and the professional judgement of the attendees at the workshop. It should be noted that existing or planned measures that may control the severity, extent or duration of the potential impacts were considered when assigning the ratings to the risks.

Similarly, a likelihood rating was assigned to each identified risk in accordance with the definitions contained in Table 2-3.

2.2.4 *Significance of environment-related risks*

The overall significance of the environment-related risks were assigned based on the combination of the consequence rating and the probability rating, as set out in Table 2-5 below. The Environment-related Risk Matrix below is similar to a 4 x 4 Risk Matrix traditionally used in Health and Safety Risk Assessments.

Table 2-5: Environment-related Risk Matrix

Significance of Risk		Consequence			
		Low	Moderate	High	Very High
Likelihood	Almost Certain	Moderate	High	Very High	Very High
	Likely	Moderate	High	High	Very High
	Possible	Low	Moderate	High	High
	Unlikely	Low	Low	Moderate	Moderate

The intention of the significance rating for risk is to highlight those environment-related risks that need further attention and consideration during the evaluation and design phases of the project.

2.2.5 *Final review*

Following the two day workshop, the anomalies found in the risk register were reviewed and then adjusted by a small group including the following people:

- Peter Anderson – ERA, Manager Major Project Approvals
- Glenn Woodrow – ERA, Specialist Major Project Approvals
- Samantha Hewton – Hatch, Senior Environmental Specialist
- Jeff Fox – Hatch, Risk Facilitator

This review included the deletion of duplicated risks as well as the evaluation of one risk which had been overlooked at the workshop.

2.3 Assumptions and Limitations

- Only those activities specified in the project description of the proposed underground mine activity, and not already approved to proceed as part of existing operations or exploration activities, were assessed.

- The “base case” if Ranger 3 Deeps project were not to proceed would be the continued operation of the Ranger processing plant utilising currently stockpiled low-grade ore with progressive rehabilitation of the existing operations.
- The project is bound by the authorised period of operation (to January 2021 with subsequent rehabilitation to January 2026) and potential impacts that may occur and persist over the timeframe of the project were considered to be of medium term duration.
- It is recognised that brainstorming, checklists and comparison with similar systems are valid methods of identifying potential environmental risks, however, they may not be sufficiently rigorous to ensure all threats and opportunities are identified.
- Due to the complexity of evaluating the consequences of environmental risks by severity, extent and duration in combination, any risks which affected multiple mechanisms of impact were treated as multiple risks.
- Risks identified as related to health and safety were difficult to assess for duration of impact. While severity of impacts was often ranked as high, the duration of impact was ranked as short term for injury.
- Where the current water management system was considered a control for a potential threat and associated impact, the high level of redundancy and small incremental change associated with the project were key considerations in establishing severity.
- The township of Jabiru was considered to be "local extent" for rating of potential impacts of air quality.
- Where the phrase “environment-related” is used in this report, all aspects, such as environment, social and cultural heritage, are included.

3. Risk Analysis

The risk analysis identified a total of 83 risks of which 69 were categorised as threats and 14 as opportunities. Only 56 of the new threats identified were analysed and evaluated, while 13 threats were not analysed or evaluated due to the fact they were business risks or associated with other projects, and these will be forwarded to the relevant parties. The opportunities have been recorded and noted but were not fully analysed or evaluated.

Figure 3-1 below shows the threat risk profile by class of risk, while Figure 3-2 shows the threat risk profile by the number of risks against each of the environmental components.

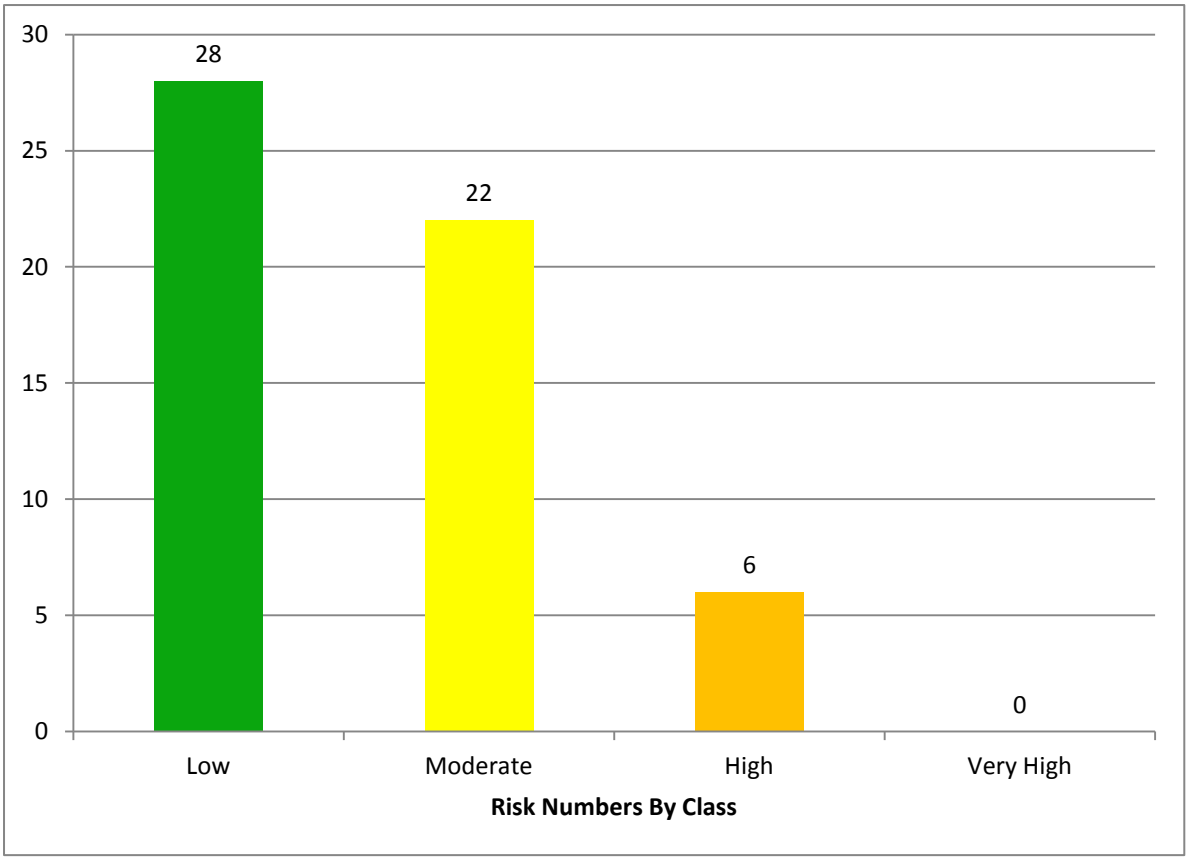

Figure 3-1: Threats by Risk Class

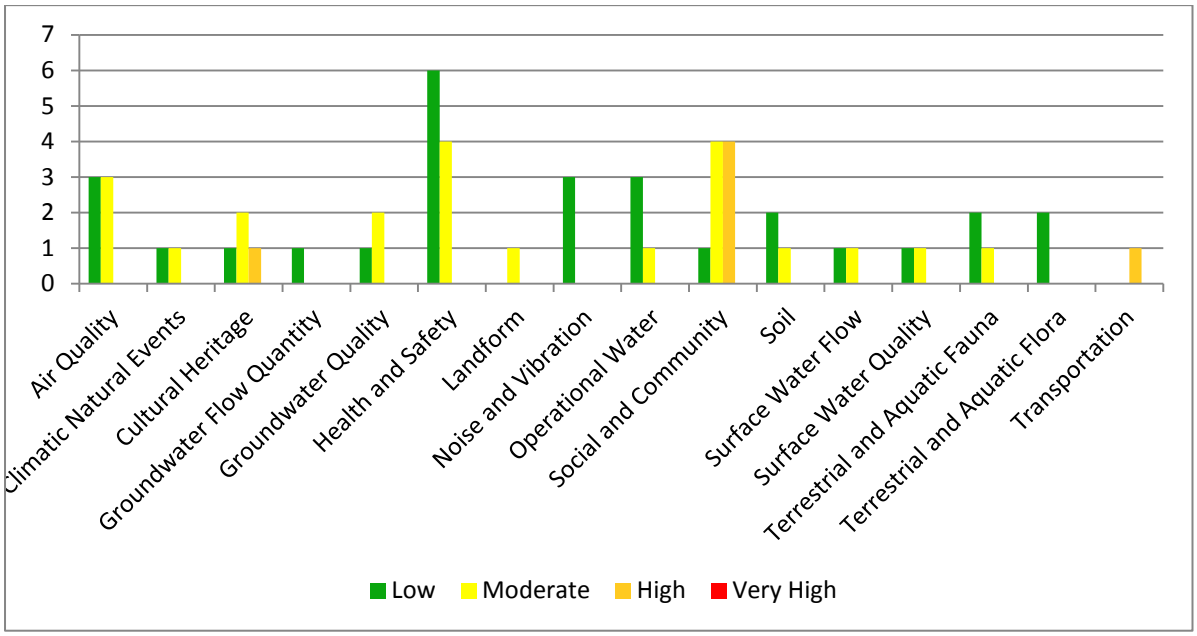

Figure 3-2: Threats by Environmental Component

There were no Very High Risks identified and six High Risks were identified during the risk analysis process; these are described in Table 3-1 below.

Table 3-1: Environment-related Risks with a High Significance

ID	Description[2]	Environmental Component	Action Plan Summary
TC03	Intersection or discovery of an anthropological site during mining leads to an impact on cultural significance.	Cultural Heritage	• Discuss and negotiate appropriate action with land owners. • Certificate from the Aboriginal Areas Protection Authority and cultural heritage baseline assessment.
TJ01	The design of vent and fans generates noise nuisance incompatible with traditional lifestyle and access, leading to decreased incentive for land owners to use nearby areas.	Social / Community	• Preliminary noise and vibration study has been conducted. • Repeat studies when final ventilation design is established and if necessary, in consultation with land owners, consider implementation of noise reduction technology.
TJ02	Design of vent and fans and thus changes to visual amenity are incompatible with traditional lifestyle and access.	Social / Community	• Undertake a visual amenity study and airborne contaminant dispersion modelling. • Dispersion modelling has and will include assessment of varied ventilation stack dimensions. • Discuss outcomes with land owners within the consultation process. Where alternative locations are technically feasible, take landowner preferences into account.
TJ07	Lack of co-ordination of engagement between ERA and land owners resulting in a loss of richness of information sharing, loss of land owner confidence in our strategy and a lack of respect for cultural values.	Social / Community	• Communication management plan. • Cultural heritage protocol. • Formal accountabilities allocated for communications within ERA.
TJ09	Perceived higher health, safety and environment risk with underground mining, leads to a lack of public support for the project.	Social / Community	• Quarterly stakeholder and community update includes information on Ranger 3 Deeps Project. • Communications plan.

[2] "Description" combines both mechanism of project interaction and potential environmental impact. These elements are listed separately in Appendix A

ID	Description[2]	Environmental Component	Action Plan Summary
TP01	Increased traffic on access highways, results in a spill of hazardous materials/waste causing environmental harm.	Transportation	• Specially engineered truck and trailer configurations and braking systems, route evaluations, continuous driver training and assessment, global positioning satellite tracking of truck location and speed, satellite telephones for emergency contact and emergency response facilities. • Controls on truck movements during the wet season.

Risk owners and risk management strategies will be identified for all High risks and risk details can be found in the risk register attached in Appendix A.

There were 28 Low class threats identified and there were 20 Moderate threats identified, and these can be found in the risk register attached in Appendix A.

Appendix A

Risk Register

Threats

Threats

Cat	Item	Environmental Components	Mechanism of Project Interaction	Project Area	Threat - Risk Description	Causes	Impacts	Existing Controls and/or planned controls	Additional Information	Severity	Extent	Duration	Consequence	Likelihood	Significance
TA		Air Quality													
TA	01	Air_quality	Particulate (dust)	Construction	Dust	Material haulage/movement General earthworks and vegetation clearing	Localised dust deposition on vegetation Health and safety of workers Aesthetic impact	Air conditioned cabs on operating equipment. Dust suppression (e.g. water trucks, etc). Personal protection equipment (PPE).		Low	Local	Short term	Low	Likely	Moderate
TA	02	Air_quality	Gases/blasting fumes	Mine Design	Require altered stope design/dimensions (waste ratio, surface area).	Adverse geotechnical conditions.	Increased radon emanation.	Exploration programme to inform R3D. Geotechnical modelling. Reinterpretation of geology.	Possibly decrease in radon emanation due to dilution factor of larger stopes.	Low	Local	Medium term	Low	Unlikely	Low
TA	03	Air_quality	Greenhouse gas emissions	Processing	Process emissions/GHG	High carbonate in ore	Increase in GHG intensity of process	Ore sorting to reduce carbonates.		Low	National	Medium term	Moderate	Possible	Moderate
TA	04	Air_quality	NPI notifiable contaminants	Power Requirements	Generator exhaust gases and particulates	diesel generation of power	Increased contaminant load to atmosphere	Selection of compliant generator sets.		Low	Local	Medium term	Low	Possible	Low
TA	05	Air_quality	Gases/blasting fumes	Air Quality & GHG Emissions	Particulates and gases from vent stacks	Need to ventilate mine	Cumulative impacts on flora, fauna and human health	Air quality modelling, ventilation system design, selection of low emission underground equipment.	Approx 90% particulate drops out near source	Low	Local	Medium term	Low	Unlikely	Low
TA	06	Air_quality	Increase in radiation	Radiation Management	Increased exposure to public, flora and fauna via vents.	Radon dispersion from vents. Dust dispersion from vents. Dust deposited onto bush foods and soils.	Increase radiation dose to public, flora and fauna from ventilation emissions.	Ventilation design and preliminary air dispersion modelling. The radiation risk to non-human biota (plants and animals) will be assessed using the ERICA tool. Air quality will be managed through ventilation, dust suppression to protect workers operating underground and in the vicinity of the portal. The operators' cabins will have noise suppression and be air conditioned.	Cool dry temperature inversion mornings can have higher radon decay products concentrations	High	Regional	Medium term	Very High	Unlikely	Moderate
TB		Climatic_Natural_Events													
TB	01	Climatic_Natural_Events	Bushfire/Wildfire/ Grassfire	General Project	Damage to infrastructure	Fire	Loss of habitat,	Fire management plan, emergency response team located close by.	Depends on time of year	Medium	Local	Medium term	Moderate	Possible	Moderate
TB	02	Climatic_Natural_Events	Extreme weather event	General Project	Extreme weather event	Cyclone with or without associated flooding, earthquake, storms,	Damage to infrastructure. Stress on water management system. Potential workforce injury	Design for extreme events. Emergency procedures.	Not a seismic zone - no history	Medium	Local	Short term	Moderate	Unlikely	Low
TC		Cultural_Heritage													
TC	01	Cultural Heritage	Disturbance or damage to item or site	External Stakeholders	Unauthorised destruction of recognised archaeological site.	Operator behaviour. Lack of communication as to site location/significance. Individual behaviour. Fire break. Inefficient operational procedures. Inaccurate cultural heritage GIS system. Poor quality of archaeological survey. Insufficient site wide awareness.	Direct disturbance or damage to a known cultural heritage sites resulting in: . Non-compliance leading to prosecution. . Loss of community trust. . Reputational damage. . Injunction in short-term to mine operations (Govt or Agreement driven). . Project delays.	Cultural Heritage Management System including physical barriers to identified sites, signage and land disturbance permit system. Operational controls. General induction. Cultural awareness training. Interim cultural heritage protocol. Code of conduct.		High	Regional	Medium term	Very High	Unlikely	Moderate
TC	02	Cultural Heritage	Disturbance or damage to item or site	External Stakeholders	Deterioration of cultural site.	Fire. Natural decay. Flood. Feral animals. Mine associated activities; e.g. dust, weed control.	Indirect disturbance or damage to a known cultural heritage sites resulting in: . Loss of community trust. . Reputational damage. . Financial impact.	Environmental management plan. Cultural Heritage Site monitoring (RPA), Cultural Heritage site management plan		Medium	Local	Medium term	Moderate	Unlikely	Low
TC	03	Cultural_Heritage	Discovery of new site/item of cultural significance	Mine Design	Discovery of an anthropological site	Mining intersects material with cultural significance.	Intersection or discovery of an anthropological site during mining leads to an impact on cultural significance.	Discuss and negotiate appropriate action with land owners. AAPA certificate and cultural Heritage baseline assessment.	This issue would be dealt with as it has been in the past in Pit 3, which was successful	Medium	Regional	Medium term	High	Possible	High
TC	04	Cultural_Heritage	Land owner engagement	Land Owners	Failing to observe cultural values	High staff turnover Inadequate understanding of cultural heritage management system Lack of respect	Erosion of cultural values Loss of trust, credibility, reputation	Cross cultural awareness training (staff and contractors) Parks awareness induction Recruitment screening processes Indigenous awareness and employment training for leaders Ongoing consultation with land owners to identify issues	ERA takes these issues seriously and has terminated people for breaches	Medium	Local	Short term	Moderate	Possible	Moderate

Threats

Threats

Cat	Item	Environmental Components	Mechanism of Project Interaction	Project Area	Threat - Risk Description	Causes	Impacts	Existing Controls and/or planned controls	Additional Information	Severity	Extent	Duration	Consequence	Likelihood	Significance
TD		Groundwater_flow_quantity													
TD	01	Groundwater_flow_quantity	intersection of groundwater	Water Management	Quantity of water inflow to underground workings greater than expected.	Unknown hydrogeology; Hitting ungrouted drill holes; water ingress from surface conduits; extreme rainfall flooding the mine; water management infrastructure incorrectly sized; Pond water inventory	Increased water management requirements. Impact on mining operations.	Planned (and ongoing) hydrogeological test work. Grouting of drill holes. Excess capacity in underground pumping systems. Operational systems and procedures. Cover drill holes. OPSIM forecasting for water management.	Closure studies being completed. Significant investment in new water treatment infrastructure; planned commissioning 2013.	Low	Local	Medium term	Low	Possible	Low
TE		Groundwater_quality													
TE	01	Groundwater_quality	contamination	Mining Methods	Loss of containment of tailings	Placing cemented tailings paste in Stopes	Contamination of groundwater via a loss of containment of tailings deposited as cemented paste backfill in underground stopes.	Cemented paste will be engineered such that it exhibits the characteristics associated with low permeability. Surrounding rock has low permeability. Backfilled stopes will be below 300 m.	Supported by substantial solute transport modelling	Medium	Regional	Long term	Very High	Unlikely	Moderate
TE	02	Groundwater_quality	contamination	Processing	Contamination of groundwater under tanks.	High carbonate in ore	Carbonate effervescence increases leading to tank overflow.	Ore sorting to reduce carbonates. Process controls. Leach tanks are bunded		Low	Local	Medium term	Low	Unlikely	Low
TE	03	Groundwater_quality	contamination	Rehabilitation & Closure	Underground mine workings provides a conduit to accessible environment from pit 3.	Method of backfill doesn't prevent solute transport	Accelerated solute transport via the underground workings acting as a conduit and providing a preferential pathway from Pit 3 backfill.	Solute transport modelling will continue supported by packer testing. Testing of paste for permeability. Cover hole drilling to provide advanced knowledge of wter quality and quantity before advancing the decline. backfill design.		Medium	Regional	Long term	Very High	Unlikely	Moderate
TF		Health_and_safety													
TF	01	Health_and_safety	Contamination	General Project	Potential interaction of NOX emissions from brine concentrator with ventilation intake system	Combusting fuel from Brine Concentrator power station Relative locations of power station and nearby infrastructure	Degradation of ambient air quality near decline entrance and underground air intake exceeding the level acceptable for human health	Relative location of elements in the model Future modelling based on base line measurements	Ground based monitoring to establish base line emissions Air quality modelling Risk assessment	Medium	Local	Medium term	Moderate	Possible	Moderate
TF	02	Health_and_safety	Workforce injury	General Project	Fire underground	Equipment fire Electrical faults	Heat and smoke in the decline. Shutdown of the ventilation system.	Fire suppression Management plans Emergency response team (ERT) Training	Could lead to reputation impact	Medium	Local	Short term	Moderate	Possible	Moderate
TF	03	Health_and_safety	Workforce injury	General Project	Fire on surface	Fire	Potential lost time injury	Fire management plan, emergency response team located close by.	Depends on time of year	High	Local	Medium term	Moderate	Unlikely	Low
TF	04	Health_and_safety	Workforce injury	Construction	Inflow from existing or unidentified drill holes	Improper abandonment of boreholes. Flooding at surface.	Underground flooding. Injury or entrapment of personnel.	Database of drill hole locations. Contingency in pumping systems. Accurate survey of drill holes in the area. Grouting. Drilling cover holes.	Infrastructure located away from Magela Creek. Existing vegetation buffer. Sediment control during construction.	High	Local	Short term	Moderate	Unlikely	Low
TF	05	Health_and_safety	Workforce injury	Mine Design	Impact of Pit 3 brines infiltrating R3D	Flow path from Pit 3 to Ranger 3 Deeps workings.	Health impact on workers.	Large barrier pillar between Pit 3 and Ranger 3 Deeps mine (200 m). Interra modelling will inform mine design.		Low	Local	Short term	Low	Possible	Low
TF	06	Health_and_safety	Workforce injury	Mining Methods	Uncontrolled stope collapse	Geotechnical conditions, failure of backfill,	Potential injury to personnel	Geotechnical modelling Ground support Tele-remote bogging Pre-charging of blast holes to minimise re-entry times.		High	Local	Short term	Moderate	Unlikely	Low
TF	07	Health_and_safety	Radiation exposure	Mining Methods	Build-up of radiation generating material in decline.	Overloading trucks leading to spillage, poor decline maintenance,	Increased exposure to radiation	Radiation management plan, Decline maintenance, Water sprays in decline, Loading procedures, Training		Low	Local	Short term	Low	Possible	Low
TF	08	Health_and_safety	Radiation exposure	Processing	Dust	Ore sorter operation	Increased radiation exposure to workers.	Dust extraction system	Radioactive dust	Low	Local	Medium term	Low	Likely	Moderate
TF	09	Health_and_safety	Workforce injury	Processing	Personnel injury from contact with contaminated water or exposure to low oxygen.	High carbonate in ore	Carbonate increases effervescence leading to a leach tank overflow. Leaching process generates oxygen depleted atmosphere.	Ore sorting to reduce carbonates. Process controls.		High	Local	Medium term	Moderate	Unlikely	Low

		Threats					Threats								
Cat	Item	Environmental Components	Mechanism of Project Interaction	Project Area	Threat - Risk Description	Causes	Impacts	Existing Controls and/or planned controls	Additional Information	Severity	Extent	Duration	Consequence	Likelihood	Significance
TF	10	Health_and_safety	Radiation exposure	Radiation Management	Radiation exposure to workers.	Vent system doesn't perform to design expectations; radiation exposure from paste backfill activity; power outage/ventilation failure causes unsafe conditions underground. Radiation exposure from uranium mineralisation. Ineffective concreting. Radon in groundwater.	Potential health issues associated with radiation exposure.	Ventilation system. Quality controlled shotcreting and regular monitoring. Shielding - e.g. shotcrete, underground equipment (enclosed cabins). Radiation monitoring including alarm systems. Semi-automated drilling; tele-remote loaders. Radiation officer. Radiation Management Plan. Ventilation officer. Air conditioned cabins. PPE - e.g. air stream helmets.	Ranger operates under a mature radiation management system.	High	Local	Medium term	Moderate	Possible	Moderate
TG		Landform													
TG	01	Landform	change in landform	Construction	Blasting underground	Construction of stopes and decline drive	Potential destabilisation of the Pit 3 walls.	Blast design using small blast holes, single hole initiation and electronic detonators. Use of qualified personnel. Approved drill and blast plans. Radar monitoring of the pit wall.		High	Local	Medium term	Moderate	Possible	Moderate
TH		Noise_and_Vibration													
TH	01	Noise_and_Vibration	noise	General Project	Cumulative noise signatures of existing infrastructure with vent systems	Multiple noise sources from existing and proposed infrastructure and their relative proximity to sensitive receptors	Potential exceedance of established criteria at sensitive receptors Potential community concerns due to change in noise signature	Purchasing requirements include specification for noise levels		Low	Local	Medium term	Low	Possible	Low
TH	02	Noise_and_Vibration	vibration	General Project	Cumulative vibration signatures of existing infrastructure with additional equipment and activities	Multiple vibration sources from existing and proposed infrastructure and their relative proximity to sensitive receptors	Potential exceedance of established criteria at sensitive receptors	Predictive modelling indicates no further controls are required	Monitoring regime and modelling in place during decline construction to support and augment predictive modelling	Low	Local	Medium term	Low	Unlikely	Low
TH	03	Noise_and_Vibration	noise	Construction	Noise	Noise from mobile construction equipment.	Noise signature exceeds acceptable standards at sensitive receptor locations. Risk of industrial noise induced hearing loss.	Advanced hygiene/noise management programme, which includes ongoing hearing testing, and PPE.		Low	Local	Short term	Low	Possible	Low
TI		Operational_water													
TI	01	Operational_water	Contamination	Mining Methods	Uncontrolled stope collapse	Geotechnical conditions, failure of backfill,	Contaminated water underground with potential to impact on water management Additional mineralised waste on surface.	Geotechnical modelling Ground support Paste design and quality control. If not retrievable, install paste line into stope and backfill		Low	Local	Short term	Low	Possible	Low
TI	02	Operational_water	Increase in process water	Processing	Increase in waste / solutes	High carbonate in ore	Additional water treatment requirement	Excess capacity in water management system. Ore sorting to reduce carbonates.		Medium	Local	Medium term	Moderate	Possible	Moderate
TI	03	Operational_water	Increase in process water	Water Management	Contamination of water underground.	Ingress of brine/tailings from pit to underground workings.	Increase of process water inventory. Contamination of underground water.	Releases will be consistent with the current water management plan.	Loss of containment of process water.	Low	Local	Short term	Low	Possible	Low
TI	04	Operational_water	Increase in pond water	Water Management	Change to pond water composition and quality.	Different mineralogy to our current waste rock increasing acid generation.	Increase in poor quality water on site.	ARD Management Plan. Exploration programme establishing mineralogy. Stockpile management plan.		Low	Local	Short term	Low	Possible	Low

		Threats					Threats							
Cat	Item	Environmental Components	Mechanism of Project Interaction	Project Area	Threat - Risk Description	Causes	Impacts	Existing Controls and/or planned controls	Additional Information	Severity	Extent	Duration	Consequence	Likelihood	Significance
TJ		Social_community													
TJ	01	Social_community	Increased nuisance	Ancillary Facilities	Design of vent and fans incompatible with traditional lifestyle and access	Requirement for vents in the MLAA.	The design of vent and fans generates noise nuisance incompatible with traditional lifestyle and access, leading to decreased incentive for land owners to use nearby areas.	Preliminary noise and vibration study has been conducted. Repeat when final ventilation design is established and if necessary, in consultaion with land owners, consider implementation of noise reduction technology.	Nuisance was to the community .	Medium	Local	Medium term	Moderate	Likely	High
TJ	02	Social_community	change to visual amenity	Ancillary Facilities	Design of vent and fans incompatible with traditional lifestyle and access	Requirement for vents in the MLAA.	Design of vent and fans, and thus changes to visual amenity are incompatible with traditional lifestyle and access,	Undertake a visual amenity assessment and airbourne contaminant dispersion modelling. Dispersion modelling has and will include assessment of varied ventilation stack dimensions. Discuss outcomes with land owners within the consultation process. Where alternative locations are technically feasible, take landowner preferences into account.	Rehabilitation of the heavily disturbed surrounding MLAA is proposed during the timeframe of the project.	Medium	Local	Medium term	Moderate	Likely	High
TJ	03	Social_community	Increased nuisance	Workforce & Contractors	Increase in workforce	Resource requirements for construction and operations	Increased ERA workforce leads to increased local social nuisance. Pressure on facilities; Inappropriate behaviour; Interactions which are offensive to traditional owners.	Tenancy agreements. Inductions - parks & cross cultural. Cross cultural training. Lobbying parks and shire. New resources. Code of conduct. Cardinal rules. The Way We Work. Council by laws. Parks management plan. Government laws and regulations. Community engagement with police, parks & shire.		Medium	Regional	Medium term	High	Unlikely	Moderate
TJ	04	Social_community	Employment opportunities	Workforce & Contractors	Lack of availability of requisite skills	Engaging interstate FIFO employees	The requisite skills for underground mining may increase reliance on interstate recruitment and may reduce local and regional employment opportunities.	Current recruitment strategy and employment conditions	ERA policy is to preference local, regional then national, but will be dependent of specific skills requirements for u/g mining No existing policy on interstate FIFO.	Medium	Regional	Medium term	High	Unlikely	Moderate
TJ	05	Social_community	change to visual amenity	Power Requirements	Generator exhaust plume	diesel generation of power	decrease of visual amenity	Selection of compliant generator sets.		Low	Local	Medium term	Low	Likely	Moderate
TJ	06	Social_community	community engagement	Rehabilitation & Closure	Interference with progressive rehabilitation	Concurrent underground mining during closure activities, overlapping areas	Concern from community regarding closure progress.	Progressive rehabilitation focus group, consultation and communication plan.		Low	Regional	Medium term	Moderate	Unlikely	Low
TJ	07	Social_community	community engagement	Land Owners	Lack of co-ordination of engagement between ERA and land owners	Not following communication plan Collaboration within ERA Availability of key land owner representatives Turn over of key staff within ERA and land owner group Inadequate understanding of key concerns and values by consulting party	Lack of co-ordination of engagement between ERA and land owners resulting in loss of richness of information sharing, lose land owner confidence in our strategy, and a lack of respect for cultural values.	Communication management plan Cultural heritage protocol Formal accountabilities allocated for communications within ERA	There is a strong existing relationship Lots of existing forums for communication like MTC, ARRAC, ARRTC; GAC are now formal members of MTC.	Medium	Regional	Medium term	High	Possible	High
TJ	08	Social_community	Employment opportunities	External Stakeholders	Perceived higher HSE risk with underground mining.	Lack of understanding/education High profile recent underground accidents Disproportionate media attention to underground mining accidents	Potential difficulty employing local indigenous workers Some existing open cut workforce reluctant to move to underground	Current recruitment strategy and employment conditions Indigenous employment team. Indigenous employment strategy. Strategic pathways relationships with education providers.	Higher radiation underground but still below acceptable levels	Low	Regional	Medium term	Moderate	Possible	Moderate
TJ	09	Social_community	community engagement	External Stakeholders	Perceived higher HSE risk with underground mining.	Lack of understanding/education High profile recent underground accidents Disproportionate media attention to underground mining accidents	Perceived high health, safety and environment risk with underground mining, leads to a lack of public support for the project.	Quarterly stakeholder and community update includes information on R3D Communications plan		Medium	National	Short term	High	Possible	High

Threats

Threats

Cat	Item	Environmental Components	Mechanism of Project Interaction	Project Area	Threat - Risk Description	Causes	Impacts	Existing Controls and/or planned controls	Additional Information	Severity	Extent	Duration	Consequence	Likelihood	Significance
TK		Soil													
TK	01	Soil	Contamination	Construction	Hydrocarbon spill	Equipment failure. Loss of containment.	Soil contamination	Dedicated refuelling bunded areas with secondary containment. Established procedures and training. Spill kits.		Low	Local	Short term	Low	Possible	Low
TK	02	Soil	mineral waste	Mine Design	Require altered stope design/dimensions (waste ratio, surface area).	Adverse geotechnical conditions.	Increased mineral waste. Increased carbonate from lower mine sequence/upper mine sequence contact. Greater surface area for water infiltration and radiation exposure.	Exploration programme to inform R3D. Geotechnical modelling. Reinterpretation of geology.		Low	Local	Medium term	Low	Unlikely	Low
TK	03	Soil	Contamination	Water Management	Fuel spills	Inappropriate handling Equipment failure	Hydrocarbon contamination of soil	Dedicated refuelling bunded areas with secondary containment. Established procedures and training. Spill kits.		Low	Local	Short term	Low	Likely	Moderate
TL		Surface_water_flow													
TL	01	Surface_water_flow	Increased in operational water	Construction	Inflow from existing or unidentified drill holes	Improper abandonment of boreholes. Flooding at surface.	Increase in water treatment.	Database of drill hole locations. Contingency in pumping systems. Accurate survey of drill holes in the area. Grouting. Drilling cover holes. Excess capacity and existing water management system.		Medium	Local	Medium term	Moderate	Unlikely	Low
TL	02	Surface_water_flow	alteration to drainage pattern	Water Management	Magela Creek water seeps to underground.	Conduit exists from Magela Creek into underground mine	Increased water management requirements. Impact on mining operations. Concern amongst land owners	Hydrogeological test work. Exploration decline to inform this potential risk.	Relative volume of underground workings compared with Magela Creek is such that impact will only be small	Medium	Regional	Medium term	High	Unlikely	Moderate
TM		Surface_water_quality													
TM	01	Surface_water_quality	contamination	Construction	Sediment and solute release to creek	Solute release to the creek from waste rock placed in catchment. Inadequate sediment and erosion controls. Burning too close to the creek line during construction.	Deterioration in water quality. Sedimentation of natural drainage lines. Biological effects.	Water management plan. Construction management plan to address the movement of waste rock and waste materials. Fire management plan, schedule and permits. Access restrictions.	Monitoring and water quality objectives. Continuous turbidity and EC sondes upstream and downstream of the proposed construction area.	High	Local	Short term	Moderate	Unlikely	Low
TM	02	Surface_water_quality	Contamination	Water Management	Fuel spills	Inappropriate handling Equipment failure	Hydrocarbon contamination of water leading to introduction to the surrounding environment.	Water/oil separation facility. Dedicated refuelling bunded areas with secondary containment. Established procedures and training. Spill kits.		Low	Local	Short term	Low	Likely	Moderate
TN		Terrestrial_and_aquatic_fauna													
TN	01	Terrestrial_and_aquatic_fauna	Habitat disturbance/removal	Construction	Land clearing and/or equipment movement.	Clearing does not comply with established procedures. Clearing necessary for additional infrastructure (e.g. vent shafts).	Disturbance of native vegetation. Injury or mortality from equipment movement and/or operation (e.g. static equipment - raise bore). Increased dust from disturbed sites. Sediment run-off. Increased spread/introduction of weeds.	Area has been subject to fauna surveys. Weed management plans. Clearing management plan and marked areas. Enforced weed quarantine on equipment. Land disturbance procedures. Training.	Infrastructure located away from Magela Creek. Existing vegetation buffer. Sediment control during construction.	Medium	Local	Short term	Moderate	Possible	Moderate
TN	02	Terrestrial_and_aquatic_fauna	Direct/indirect disturbance to listed species affecting viability	Ancillary Facilities	Increased noise from fans and other surface infrastructure	Requirement for surface infrastructure in the MLAA and within proximity of Magela Creek.	Fauna avoid area.	Noise control technology designed to meet sensitive receptor limits	Fauna report cited in Ranger Noise Management Plan states noise is a low risk for fauna	Low	Local	Medium term	Low	Possible	Low
TN	03	Terrestrial_and_aquatic_fauna	mortality	Ancillary Facilities	Fauna able to enter the vent shaft	Vent shafts not animal proof	Fauna (e.g. bats, birds) interact with fan assembly leading to injury or mortality	Consideration of barriers to fauna ingress.		Low	Local	Medium term	Low	Possible	Low
TO		Terrestrial_and_aquatic_flora													
TO	01	Terrestrial_and_aquatic_flora	Habitat disturbance/removal	Construction	Land clearing and/or equipment movement.	Clearing does not comply with established procedures. Clearing necessary for additional infrastructure (e.g. vent shafts).	Disturbance of native vegetation Increased dust from disturbed sites. Sediment run-off. Increased spread/introduction of weeds.	Weed survey. Weed management plan. Clearing management plan and marked areas. Enforced weed quarantine on equipment. Land disturbance procedures. Training.	MLAA heavily disturbed area from decades of irrigation and exploration activities. MLAA is proposed for rehabilitation.	Low	Local	Short term	Low	Possible	Low
TO	02	Terrestrial_and_aquatic_flora	Habitat disturbance/removal	Rehabilitation & Closure	Interference with progressive rehabilitation	Concurrent underground mining during closure activities, overlapping areas	Inhibiting rehabilitation e.g. Magela land application area (MLAA)	Small footprint of proposed project, dedicated ecology team		Low	Local	Medium term	Low	Unlikely	Low

		Threats					Threats							
Cat	Item	Environmental Components	Mechanism of Project Interaction	Project Area	Threat - Risk Description	Causes	Impacts	Existing Controls and/or planned controls	Additional Information	Severity	Extent	Duration	Consequence	Likelihood	Significance
TP		Transportation													
TP	01	Transportation	Increased hazardous materials/waste transport	Traffic Management	Increased traffic on access highways	Increased consumable requirements Carbonate in ore	Spill causing environmental harm	Specially engineered truck and trailer configurations and braking systems, route evaluations, continuous driver training and assessment, global positioning satellite tracking of truck location and speed, satellite telephones for emergency contact and emergency response facilities. Controls on truck movements during the wet season.		Medium	Regional	Medium term	High	Possible	High