



mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

ENVIRONMENTAL IMPACT ASSESSMENT REPORT
And
ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

SUBMITTED FOR ENVIRONMENTAL AUTHORIZATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED).

NAME OF APPLICANT: Lukisa JV Company (Pty) Ltd

TEL NO: 023 414 4566

FAX NO: 023 414 4566

POSTAL ADDRESS: P.O. Box 1225, Beaufort West, 6970

PHYSICAL ADDRESS: Site Office: 16 Stanbridge Street, Beaufort West

FILE REFERENCE NUMBER SAMRAD: WC 30/5/1/2/2/10071 MR,

SUBMISSION DATE: 25 January 2016

1. IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), the Minister must grant a prospecting or mining right if among others the mining ~~w~~ill not result in unacceptable pollution, ecological degradation or damage to the environment+.

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment and an Environmental Management Programme report in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the EIA Regulations, 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17 (1) (c) the competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

It is therefore an instruction that the prescribed reports required in respect of applications for an environmental authorisation for listed activities triggered by an application for a right or a permit are submitted in the exact format of, and provide all the information required in terms of, this template. Furthermore please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the information required is placed correctly in the relevant sections of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with un-interpreted information and that it unambiguously represents the interpretation of the applicant.

2. OBJECTIVE OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The objective of the environmental impact assessment process is to, through a consultative process-

- (a) determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
- (b) describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
- (c) identify the location of the development footprint within the preferred site based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;
- (d) determine the
 - (i) nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
 - (ii) degree to which these impacts
 - (aa) can be reversed;
 - (bb) may cause irreplaceable loss of resources, and
 - (cc) can be avoided, managed or mitigated;
- (e) identify the most ideal location for the activity within the preferred site based on the lowest level of environmental sensitivity identified during the assessment;
- (f) identify, assess, and rank the impacts the activity will impose on the preferred location through the life of the activity;
- (g) identify suitable measures to manage, avoid or mitigate identified impacts; and
- (h) identify residual risks that need to be managed and monitored.

PART A
SCOPE OF ASSESSMENT AND ENVIRONMENTAL IMPACT ASSESSMENT REPORT

3. Contact Person and correspondence address

a) Details of

i) Details of the EAP

Name of The Practitioner: Dr. R.H. Boer

Tel No.: +27 12 753 1284/5 or 2783 441 0239, 082 482 6202

Fax No. : 086 716 5576

e-mail address: rudy@ferretmining.co.za - Cc tim@ferretmining.co.za

ii) Expertise of the EAP.

(1) The qualifications of the EAP

(with evidence).

Rudy Boer graduated with a PhD (Geochemistry) in 1995 from the University of the Witwatersrand. He, furthermore, received post-graduate tuition during long-term sojourns at the following institutions:

Centre de Recherches sur la Geologie des Matieres Premieres Minerales et Energetiques (CREGU), Nancy, France;

Laboratoire de Spectrométrie de Vibrations, Université de Nancy I, Nancy, France;

Department of Geological Sciences, University of Michigan, Ann Arbor, United States of America.

After four years with the Economic Geology Research Unit, he joined the Department of Geology at the University of the Witwatersrand. During the eight years that he was employed at the University of the Witwatersrand, he was involved in a wide variety of applied economic geology and exploration geochemistry projects. Subsequently, he took up a professorship at the University of the Free State where his main responsibilities included the development, co-ordination and management of a newly introduced Masters degree programme in Mineral Resource Management. Rudy is a Fellow of the Geological Society of South Africa (Mem. No. 964609), from which he has also received the Jubilee Medal. He currently serves on several Water Research Commission Project Steering Committees and is registered with the South African Council for Natural Scientific Professions (Reg. No. 400010/03).

(2) Summary of the EAP's past experience.

(In carrying out the Environmental Impact Assessment Procedure)

He was author and co-author of more than 30 technical peer reviewed publications in international journals and approximately 40 extended abstracts published in conference proceedings, as well as numerous technical publications. He has also been responsible for the project management of over 140 environmental projects ranging from water use license applications to mining right environmental management plans. See Appendix 2 for further detail.

b) Description of the property.

Farm Name:	See attached Schedule 1 in Appendix 3
Application area (Ha)	152353.6718 Ha
Magisterial district:	Beaufort West
Distance and direction from nearest town	+/- 40km south-east of Beaufort West
21 digit Surveyor General Code for each farm portion	See attached Schedule 1 in Appendix 3

c) Locality map

(show nearest town, scale not smaller than 1:250000). See Attached Appendix 3.

d) Description of the scope of the proposed overall activity.

Provide a plan drawn to a scale acceptable to the competent authority but not less than 1: 10 000 that shows the location, and area (hectares) of all the aforesaid main and listed activities, and infrastructure to be placed on site

Lukisa JV Company (Pty) Ltd (Lukisa JVCo) and Tasman Pacific Minerals Limited (Tasman Pacific) together hold forty (40) prospecting rights covering an area of around seven thousand, five hundred and forty nine square kilometres (7,509 km²) for uranium and molybdenum in the Karoo region of South Africa (spread between the Western, Eastern and Northern Cape Provinces) approximately four hundred kilometres (400 km) northeast of Cape Town. The respective companies commenced exploration activities in 2005/2006 to evaluate historic deposits located on these properties and convert them to modern resource compliance standards.

Lukisa JVCo and Tasman Pacific, which are applying for mining rights for uranium ore (U) and molybdenum ore (Mo), are subsidiaries of Peninsula Energy Limited, an ASX-listed Australian company. The applications are for consolidated blocks of properties contained in the original prospecting right areas, but clustered according to geographic location in order to simplify the application areas and reduce administrative burden.

The proposed mining operation is to be known as the Tasman RSA Mines and will be operated as a single entity, but with multiple production centres feeding a central processing plant (CPP) to be located near the main orebody of the initial mining stages (within the Eastern Block application area). Therefore this Mining Work Programme (MWP) is designed for a single mining operation initially, but is submitted for all the individual mining right applications with reference to each application block and will be updated as additional resources and reserves are developed.

Open Pit and Underground Mining

Where orebodies lie close to the surface, they would be accessed by open cut mining, involving a pit and the removal of much overburden (overlying rock) as well as a lot of waste rock. Where orebodies are deeper, underground mining would be employed, involving construction of access shafts and tunnels but with less waste rock removed and less environmental impact. In either case, grade control is usually achieved by measuring radioactivity as a surrogate for uranium concentration. (The radiometric device detects associated radioactive minerals which are decay products of the uranium, rather than the uranium itself.) Concentrated ore would be transported from the satellite operation to the CPP at Rystkuil.

At the CPP:

Milling and Processing

Conventional mining practice with a mill where the ore is crushed and ground to liberate the mineral particles, then leached with sulfuric acid to dissolve the uranium oxides. would be used. The solution is then processed to recover the uranium.

Most of the ore is barren rock or other minerals which remain undissolved in the leaching process. These solids or 'tailings' are separated from the uranium-rich solution, usually by allowing them to settle out. The remaining solution is filtered and the uranium is recovered in some form of ion exchange (IX) or solvent extraction (SX) system. The uranium is then stripped from this and precipitated. The final chemical precipitate is filtered and dried.

Peroxide products can be dried at ambient temperatures to produce a product containing about 80% U₃O₈. Ammonium or sodium diuranate products are dried at high temperatures to convert the product to uranium oxide concentrate - U₃O₈ - about 85% uranium by mass. This is sometimes referred to as yellowcake, though it is usually khaki.

In the case of carbonate leaching the uranyl carbonate can be precipitated with an alkali, eg as sodium or magnesium diuranate.

The product is then packed into 200 litre steel drums which are sealed for shipment. The U₃O₈ is only mildly radioactive (the radiation level one metre from a drum of freshly-processed U₃O₈ is about half that . from cosmic rays - on a commercial jet flight).

(i) Listed and specified activities

NAME OF ACTIVITY (All activities including activities not listed) (E.g. Excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc...etc...etc.)	Aerial extent of the Activity Ha or m²	LISTED ACTIVITY Mark with an X where applicable or affected.	APPLICABLE LISTING NOTICE (GNR 544, GNR 545 or GNR 546)/NOT LISTED
CPP (RystKuיל Ptn 2): Storage hazardous goods Office; Parking; Dams; Slimes (ptn RE); Stockpiles; Mill; Crusher; Reagents; Thickener; Leach; Processing plant; Product storage; Water storage-reservoir; silt traps; Pollution control dam. Powerline	CPP = 25ha, Slimes = 193ha Ore = 51ha Volumes t.b.d 12MA@ 30km	14; 27, 56 2, 16, 17, 21, 15	GN R983 GN R984
Excavation, blasting, loading hauling, Equipment storage, berms, crushing Rystkuיל ptn 2: Pit 2a; Pit 2b; Pit 3a Stockpile	3.5ha;4.2ha; 4.6ha; 25.4 ha	56 3,15, 17,21	GN R983 GN R984
excavation, blasting, loading hauling, Equipment storage, Temporary office, berms, crushing Katdoorn kuיל ptn RE: Pit 12b + Stockpile	9.9ha, 17.5ha	56 3,15, 17,21	GN R983 GN R984
Excavation, blasting, loading hauling, Equipment storage, Temporary office, berms, crushing Kantkraal ptn RE: Pit 8, 9a, 10 + Stockpile Pit 13, stockpile Decline, stockpile	5ha, 5.4ha, 5ha, 27.3ha, 6ha,12.6ha, ô ' 12.8Ha	56 3,15, 17,21	GN R983 GN R984
Excavation, blasting, loading hauling, Equipment storage, Temporary office, berms, crushing, Chemical toilet. HaaneKuיל ptn 7: Pit 1a, 1b, 1c, Stockpile Pit 2a, Stockpile Pit 3c,3a&b, 3f, 3g, 3j, Stockpile HaaneKuיל Ptn 7&RE Pit 1e, 1d HaaneKuיל Ptn RE Pit 3i	5ha, 5ha, 10.5ha, 47.2ha 5.8ha, 14ha 1.8ha,5.8ha, 2.6ha, 2.1ha, 1.9ha, 53.5ha 2ha, 1ha 1.4ha	56 3,15, 17,21	GN R983 GN R984

Road upgrade, widening	No longer applicable. Existing rural roads will not be widened by 6m or more meters neither will they be lengthened by 1km or more.	NA	NA

(ii) Description of the activities to be undertaken

(Describe Methodology or technology to be employed, including the type of commodity to be mined and for a linear activity, a description of the route of the activity)

The Central Processing Plant (CPP) is proposed to be located at Ryst Kuil in the Eastern Block (approx. 40 km SE of Beaufort West). During initial 17 year mining period the following is applicable:

- É Total plan area of open pits = 136 ha
- É Total plan area of underground workings = 331 ha
- É Public provincial/secondary roads to be used = 45 km
- É Existing farm roads/tracks to be upgraded for haulage = 75 km
- É New haulage road sections to be built = 21 km
- É Estimated area required for stockpiles (waste/ore) and slimes dam = 535 ha (slimes dam volume = +/- 10.5 million tonnes)
- É CPP area = 25 ha

The main product to be produced is uranium oxide (U3O8) in the form of 'yellowcake'. The main by-product is molybdenum (may not be commercially extractable) and to a much lesser degree copper (Cu) and arsenic (As).

It is planned that the product will be road freighted to Beaufort West and then railed to Cape Town on the main national rail carrier. The mining company will apply to Eskom for twelve megavolt-ampere (12 MVA) grid connection for electricity supply to the CPP. Ground water is available in the area and this with the makeup water generated through mining should be sufficient to supply the mining and process requirements. A Water Use License (WUL) is being applied for. This application will include a storage dam which will be required to store and hold seven (7) days water supply to ensure there is no shortfall that could hamper mining and process operations.

The marketing and sales of U3O8 product currently focused on major nuclear power electricity generating utilities in international jurisdictions including Western Europe, Asia and the USA, as well as targeting South Africa's current plans to develop new nuclear power plants under its growing nuclear energy program.

Open cast mining methodology

The open cast surface mining will be standard opencast pit structures with access roads to a depth of not more than ±85 meters. Mining method will be traditional drill, blast, load and haul using trucks to deliver the material to the central processing plant.

Topsoil (where available) will be removed to its maximum in situ depth from all open pit and dump areas. This will be done by dozing the material onto windrows, loaded by an excavator and trucked

to a topsoil stockpile for storage. No vegetation will be removed prior to this operation. All vegetation and the existing seed bank is planned to be stockpiled together with the topsoil.

The hard overburden will be mined in benches of 10m. These benches will be drilled and blasted prior to an excavator and truck fleet loading and hauling to an appropriate dump site. The possible dump site consists of ex-pit overburden dumps adjacent to the open pit and old mined-out open pits from which no mining is taking place or are planned to take place in future. Overburden on the last bench above the ore will only be drilled and blasted down to the ore/waste contact. Ore and overburden will not be drilled and blasted together.

Due to the thin tabular nature of the ore deposit and the small size of the various open pits, virtually all the overburden will have to be mined before any ore production from any given pit will be possible. Because no clear visual distinction have been identified between the ore and waste material, strict grade control measure will need to be implemented using handheld instruments by the production geological department. All mined ore will be loaded by an excavator or front-end loader onto a truck and transported directly to the processing plant run of mine tip.

Underground mining methodology

For underground operations, board and pillar methods will be used:

- ~ High wall access roadways from the floor of mined out open pits
- ~ A single conveyor / access decline & return airway decline
- ~ A vertical shaft and winder system with ducted return air

Production sections will be established off from the seven roadway development. A development section consists of between six to nine (6 . 9) roadways (boards), with five metre (5 m) pillars between the boards. Thus the design dimensions of seven metre (7 m) wide boards and five metre (5 m) by five metre (5 m) pillars will be the standard throughout the planned underground working

The mining method will be Trackless Mechanised Board and pillar run on a two (2) shift cycle. Each stopping section will be made up of six to nine (6 . 9) boards. Board and pillar dimensions vary with depth below surface. For this report, seven metre (7 m) wide boards at one point eight metres (1.8 m) mining height and five metre (5 m) by five metre (5 m) pillars will be used. The pillars are cut by seven metre (7 m) wide holings.

e) Policy and Legislative Context

APPLICABLE LEGISLATION AND GUIDELINES USED TO COMPILE THE REPORT (A description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process);	REFERENCE WHERE APPLIED (i.e. Where in this document has it been explained how the development complies with and responds to the legislation and policy context)	HOW DOES THIS DEVELOPMENT COMPLY WITH AND RESPOND TO THE POLICY AND LEGISLATIVE CONTEXT (E.g In terms of the National Water Act:- Water Use License has/has not been applied for).
Constitution of South Africa (No. 108 of 1996)	Section 24	If successfully awarded a MR will have the responsibility of contributing towards a safe and sustainable environment for all.
National Environmental Management Act (NEMA) (Act No 107, 1998)	Section 1(29)	Initiation of listed activities involving mining.
Mineral and Petroleum Resource Development Act (MPRDA)	Section 27(2)	A mining right is required.
National Water Act, 39 of 1998 (NWA)	Section 21	A Water Use License exists for the operation.
National Environmental Management Waste Act (NEMWA) (Act No 59, 2008)	General	A Waste Management License for the establishment of the tailings facility.
National Nuclear Regulator Act (Act 47 of 1999)	General	A Certificate of Registration (COR) must be obtained prior to mining.

f) Need and desirability of the proposed activities.

(Motivate the need and desirability of the proposed development including the need and desirability of the activity in the context of the preferred location).

While uranium is used almost entirely for making electricity, a small proportion is used for the important task of producing medical isotopes. Some is also used in marine propulsion, especially naval.

Uranium is a naturally occurring element with an average concentration of 2.8 parts per million in the Earth's crust. Traces of it occur almost everywhere. It is more abundant than gold, silver or mercury, about the same as tin and slightly less abundant than cobalt, lead or molybdenum. Vast amounts of uranium also occur in the world's oceans, but in very low concentrations.

The current global demand for uranium is about 67,000 tU/yr (tonnes uranium per year). The vast majority is consumed by the power sector with a small amount also being used for medical and research purposes, and some for naval propulsion. At present, about 42% of uranium comes from conventional mines (open pit and underground) about 51% from in situ leach, and 7% is recovered as a by-product from other mineral extraction. From exploration or prospecting programmes during 2006 - 2007 it is established that 6% of the world uranium resource can be found in South Africa.

In South Africa, uranium production has generally been a by-product of gold or copper mining. In 1951, a company was formed to exploit the uranium-rich slurries from gold mining and in 1998 this became a subsidiary of AngloGold Ltd. It produces about 550 tU/yr from material trucked in from various gold mines.

The existence of the mineral resource within the application area and the international demand for uranium is the primary driver for the proposed mining project.

The availability and geographic location of the mineral resource that the applicant wishes to exploit determines the preferred location to a large degree. The open cast pits and underground stopeing is dictated by the geological structure.

Although the location of the minerals cannot be altered, the impact of the infrastructure associated with the mining operation would be investigated as part of the EIA process.

Key criteria for consideration when identifying need, alternatives and preferred location include practicable, feasible, relevant, reasonable and viable.

Assessment of alternatives would include a comprehensive comparison of all potential impacts, both direct and indirect and cumulative, on the environment. The goal of evaluating alternatives is to find the most effective way of meeting the need and purpose of the project either through enhancing the environmental benefits of the proposed activity, or through reducing or avoiding potentially significant negative impacts.

From a Socio-Economic perspective creating a baseline of the receiving environment enables a truthful means for comparison, identifying both opportunities and potential negative impacts as well as proposing methods to alleviate potential problems arising from the planned development.

The potential exists within the Central Karoo District Municipality (CKDM) for sound and sustainable economic growth with more equitable benefits and opportunities. Although some potential lies in the tourism sector, the transport and manufacturing sectors, in SMME development and in the agricultural sector, mining opportunities in the area may also enable development. Uranium mining is clearly identified in the 2013 Beaufort West Local Municipality (BWLM) Integrated Development Plan (IDP) as one of the opportunities available to address the critical problems of unemployment and lack of economic investment in the BWLM (Beaufort West, 2014)

g) Motivation for the preferred development footprint within the approved site including a full description of the process followed to reach the proposed development footprint within the approved site.

NB!! . This section is about the determination of the specific site layout and the location of infrastructure and activities on site, having taken into consideration the issues raised by interested and affected parties, and the consideration of alternatives to the initially proposed site layout.

i) Details of the development footprint alternatives considered.

With reference to the site plan provided as Appendix 4 and the location of the individual activities on site, provide details of the alternatives considered with respect to:

- (a) the property on which or location where it is proposed to undertake the activity;
- (b) the type of activity to be undertaken;
- (c) the design or layout of the activity;
- (d) the technology to be used in the activity;
- (e) the operational aspects of the activity; and
- (f) the option of not implementing the activity.

Mining Areas:

- a) the siting of open cast pits and underground operations is dictated by the geological resource. No alternative location could be reasonably considered for these aspects of the proposed development.

- b) The activity of mining and the methodology proposed by the applicant cannot reasonably be substituted considering the characteristics of the mineral deposit.

- c) Infrastructure Areas:

The siting of the proposed infrastructure was initially based on both the proximity to the mining operations to reduce haulage time and therefore reduce diesel consumption as well as on the topography of the specific areas. Rocky ridges, sloping topography and drainage channels (episodic drainage lines) were avoided where possible.

The data generated by the specialists provided further information for a recommended alternative position for the CPP and slimes/tailings facility specifically. This original proposed position and the final recommended position is provided in the Figure 4 of Appendix 3.

- d) Latest available mining and processing technology is planned to be utilised by the applicant. Technologies that improve efficiencies will be investigated and where feasible such will be implemented.
- e) Operational alternatives include the following:
 - shortest haul route calculation and ramp positioning to reduce diesel consumption
 - Roll over rehabilitation wherever possible to reduce double handling
 - Placement of overburden and ROM stockpiles to minimise additional handling and/or hauling.
 - Reduction of road traffic through multi-load deliveries to the CPP.
- f) Should this proposed mining activity not be implemented, the following will occur:
 - the historical mining legacy will remain the responsibility of the South African government to rehabilitate.
 - No additional revenue provided to the South African fiscus through royalties and taxes.
 - No further job creation will occur based on the mineral reserve present.

ii) Details of the Public Participation Process Followed

Describe the process undertaken to consult interested and affected parties including public meetings and one on one consultation. NB the affected parties must be specifically consulted regardless of whether or not they attended public meetings. (Information to be provided to affected parties must include sufficient detail of the intended operation to enable them to assess what impact the activities will have on them or on the use of their land.

See Appendix 6 for attached evidence

The public consultation process has been conducted as follows:

This section provides information about the public participation process:

Project inception

The following activities were undertaken during the project initiation and inception:

- “ Convening a preliminary meeting with key authorities to share information about the proposed project and for the participants to flag initial issues of concern that may cause delays in the project at a later stage and that will assist in finalising the technical, financial, environmental and public participation planning.

- “ Identification of I&APs

Automatically update details as and when information is distributed to or received from I&APs. This ongoing and up-to-date record of communication is an important requirement of the authorities for public involvement. An electronic copy of the I&AP database will be developed and updated.

Announcement of the project

Announcement of the project to a broad range of sectors of society within the surrounding community, as follows:

- “ An invitation letter personally addressed to I&APs captured on the database, accompanied by a Registration and Comment Sheet for I&APs to register their interest and to raise initial issues.

- “ A Background Information Document (BID) that will accompany the letters of invitation. The BID will contain the following information: a description of the basic assessment and mining right application and rationale for it; key issues in the area; environmental authorization and public participation process to be followed, opportunities to comment and a colour map indicating the study area.

- “ An advertisement in a Local newspaper was placed on 19 June 2015 on both English and Afrikaans in the Courier and The Advertiser Newspapers.

- “ Leaving BIDs, maps, letters and registration and comment sheets at selected public places

- “ All documents for public comment will be provided to the applicant in PDF format for posting on its web site. The web address/Drop box link was indicated on all documentation.

- “ Production of on-site notices to notify the public of the project

Notification of directly affected land owners:

Potentially directly affected land owners also contacted via telephone during the consultation Phase and their inputs with regards to the proposed project obtained.
Announcement of availability of Draft Scoping Report

The opportunity for a public meeting / open house was provided to IAP's to present the contents of the Draft Scoping Report; to solicit any issues I&APs may have and to provide them with an opportunity to comment on the Plan of

Participants who attended the public meeting / open house will receive a complete set of proceedings in the form of an Issues and Response Report afterwards with a request to verify that their issues were captured correctly. It is envisaged that a half-day public meeting / open house will take place at a venue and time suggested to I&AP's

Issues and Response Report

The Issues and Response Report is appended to the BA Report as well as the WULA amendment. The Issues and Response Report will be updated as the process proceeds, and is the key deliverable of the public participation process. The Issues and Response Report that will be issued as part of the BA Report. All written comment received from I&APs are included and personally acknowledged.

Progress feedback

I&APs receive progress feedback as and when milestones are achieved to maintain the momentum of the public participation process and to keep them informed.

Public Consultation progress:

The consultation process has been initiated through the generation of the following consultation documents:

- Site notices
- Newspaper advert
- Background information document (BID).

These documents are being reviewed by the applicant prior to announcement and publication.

Initial Public Consultation during 2014

To date the public consultation process was initiated with a public notice in English and Afrikaans placed in the Beaufort West Courier on 19 June 2014. The distribution of this newspaper includes Beaufort West Laingsburg, Prince Albert, Murraysburg, Leeu-Gamka, Victoria West, Nelspoort and Merweville. Background information letters have been posted to all the known land owners. In addition, 55 site notices were placed along public roads, in libraries, town halls etc throughout the application area. Copies of the public notice (and evidence of its publication), the letter and site notices from 2014 are available for review.

Public Consultation during 2015

The Project was again announced through advert/legal notices placed in Courier Newspaper as well as the Advertiser on 19 June 2015. Copies and evidence of their publication is available in Appendix 6. The Tasman RSA Mines Facebook page was also used for announcing the project and providing project related information. Evidence of the use of this page is also provided in Appendix 5.

The updated Background Information Document (BID) was again email and posted (where only a postal address was available) to all registered IAP's on the Project database.

Six (6) Public meetings were scheduled (see list for location and dates in BID Appendix 5). The first public meeting was held at the Municipal Library Hall in Aberdeen on 22 June 2015 from 5 - 7pm. This meeting was attended by 13 community members and farmers.

Site notices were placed in the notice board of the Municipal Offices in Beaufort West. See evidence in Appendix 6.

A one on one meeting was held with the owners of Bokvlei and De Pannen on the farm De Pannen on 23 June 2015. Specific project related information was provided during this meeting and questions were answered. The winter holiday period has made it difficult to meet face to face with all the land owners and therefore further meeting have been set up in the weeks to come.

The Department of Water and Sanitation has been engaged telephonically and a meeting is being confirmed within the week of 6 - 10 July 2015. The Department of Rural

Development and Land Reform has been engaged via telephone and follow up email correspondence. A meeting with this department has been provisionally set up for Monday 6 July 2015.

All comments and questions received during the public meeting were recorded in minutes. In addition, the questions and/or comments received via the Facebook page, email, sms etc have been included in the consultation database.

The public consultation process will be conducted in an ongoing fashion allowing interested and affected parties to continue to liaise and additional forums and focus group meetings will be conducted during July to October 2015 and possibly longer.

A facebook page "Tasman RSA Mine" is also used to inform I&AP's with regard to project progress.

iii) Summary of issues raised by I&Aps
 (Complete the table summarising comments and issues raised, and reaction to those responses)

Interested and Affected Parties List the names of persons consulted in this column, and Mark with an X where those who must be consulted were in fact consulted.	Date Comments Received	Issues raised	EAPs response to issues as mandated by the applicant	Section and paragraph reference in this report where the issues and or response were incorporated.
<u>AFFECTED PARTIES</u>				
Landowner/s				
			Due to the limited space available in this table, all data related to IAP interaction is provided in the Consultation Report in Appendix 6.	
Lawful occupier/s of the land				
Landowners or lawful occupiers on adjacent properties				
Municipal councillor				
Municipality				
Organs of state (Responsible for infrastructure that may be				

affected Roads Department, Eskom, Telkom, DWA e					
Communities					
Dept. Land Affairs					
Traditional Leaders					
Dept. Environmental Affairs					
Other Competent Authorities affected					
<u>OTHER AFFECTED PARTIES</u>					
<u>INTERESTED PARTIES</u>					

iv) The Environmental attributes associated with the development footprint alternatives.(The environmental attributed described must include socio-economic, social, heritage, cultural, geographical, physical and biological aspects)

(1) Baseline Environment

(a) Type of environment affected by the proposed activity.

(its current geographical, physical, biological, socio- economic, and cultural character).

RADIOLOGICAL

Please note that the Radiological Impact Assessment which includes the baseline conditions of the application area is included in the authorisation process to be submitted to the National Nuclear Regulator (NNR) during the course of 2016. This process will also be available for public input through a consultation process.

BIODIVERSITY

HABITAT

The general study area is regionally defined by a single vegetation type (Gamka-Karoo; Mucina and Rutherford 2006), which is reflected in the similar overall structure and form of the habitats across the individual study areas. This is largely due to similar local terrain characteristics and areas that were subjected to the same land use for decades. The defined habitat units that were used to determine fauna and flora probability of occurrence were subjectively delineated based on variances in vegetation composition and available satellite imagery. Habitat units were delineated using a combination of supervised and unsupervised clustering techniques using the latest Landsat 8 and Google Earth satellite imagery. The final clusters were then subjectively grouped into broad units using a majority filter in reference to field observations and knowledge of the study area. Manual adjustments were made where required.

Eleven broad habitat units were defined and delineated. For the sake of overall consistency, the overarching communities and habitats described in this report follow similar descriptions as those reported within the literature study, with minor adaptations or refinements. Three overarching communities describe the basic habitat substrate characteristics found within the study area. These are Rocky Community habitats, Stony Community habitats and Sedimentary Community habitats. Within these broad communities, habitats were separated and delineated based on their approximate position within the local terrain. "Ridges" were regarded as areas with local slopes of 5 degrees or more. "Slopes" were assigned to areas between 2 and 5 degrees. "Plains" were assigned to areas below 2 degrees. These morphological features, especially for slopes and plains, consist of very subtle changes within the landscape. The habitat units are discussed in detail in the report in Appendix 10.

FLORA

Species Inventory

The study areas exhibit typical dominant taxa as discussed in published broad descriptions of this area within the Nama-Karoo biome (Acocks, 1953; Mucina and Rutherford, 2006). Dominant genera within the study areas include Eriocephalus, Tripteris, Lycium, Pentzia, Pteronia, Rhigozum, Ruschia and Salsola, with a limited grass cover at the time of survey, but included Stipagrostis and Aristida genera as dominants.

Species richness is generally higher within the rocky habitats, supporting numerous species of mini-succulents. Previous studies conducted within the area indicated that slope, altitude, drainage and vegetation cover were the environmental factors most likely to explain spatial changes in vegetation composition (Ferguson et al., 2008) of which slope was the dominant determinant. Although no ordination analysis of plots was carried out for this assessment, semi-subjective analysis of the field data indicate that this is the case.

A complete floral species inventory by sample site is provided in Appendix 9.1 as Table 25 of the report in Appendix 10 of this EIA/EMP.

Species of Conservation Concern

Based on the vegetation analysis and the observations made during the field surveys it is evident that the area currently does show sound ecological functionality and although no Red-Listed plant species were observed, possibly due to the late seasonality of the survey, it does not eliminate the possibility of their occurrence. Four Orange-Listed floral species were identified during the field survey. Table 12 of the report shows the likelihood of occurrence for these species and those species previously recorded within the QDS's as queried from the PRECIS database. All habitat descriptions were taken directly from the Red List of South African Plants website (Redlist.sanbi.org, 2015).

Western Cape protected plant species include all species within the families Asclepiadaceae and Mesembryanthemaceae. In addition, species within the Aloe, Haworthia and Anacampseros genera, together with certain Euphorbia species are also protected. Since the initial biodiversity assessments were conducted within this area (Turgis 2008), all of the previously Red-Listed floral species have undergone changes in their conservation status. The species of conservation concern and their respective conservation status changes (since Turgis 2008) where applicable are indicated in Table 13 of the report.

MAMMALS

Previous studies

As stated, the biodiversity impact assessment for the Rijstkuil uranium mining application area District Beaufort West (Ferguson et. al., 2008) was consulted extensively. This study found that a total of 48 (updated from 47 in previous survey) mammal species are expected to be resident within the Rijstkuil uranium mining application area. As mammals have few major natural geographic barriers, this number is expected to remain the same for the current study. Of the expected species, 27 were directly observed in 2008. This number exceeds the current study, primarily due to the small mammal trapping across relatively representative habitat types within the study areas of both surveys. The current study sought to build upon the previous data set, assuming the inventory survey results from the previous study was accurate. For the species inventory, both data sets were pooled.

Current study

An additional 8 species were recorded during the current study, adding to the 27 species observed by Ferguson et al. (2008) and elevating the mammalian species inventory to 35 species in total. The final inventory is shown in Appendix 9.2 as Table 26. Of these species, all are classified as free roaming in some capacity, even though some ungulates such as springbok and blesbok may be classified as being semi-ranched. The result shows a medium rich mammal diversity (in comparison with other national studies carried out by the author [SL]) which is expected given the arid environment. The detailed field survey provided invaluable information regarding mammals within the study areas. The mammal inventory within the study areas shows all the relevant mammal species, likelihood of occurrence, EWT status, IUCN status and NEMBA status. Due to the inherently large variations in the mammalian taxa, each group must be assessed separately in the context of the study areas. Mammalian groups are defined and discussed below.

Small herbivores

Small herbivores are located throughout the study areas and were sighted frequently during the survey period. Steenbok (*Raphicerus campestris*) were sighted on numerous occasions with frequent records of spoor and scat recorded from all habitats. Rock hyrax (*Procavia capensis*) and porcupines (*Hystrix africaeaustralis*) were recorded frequently on camera traps and via spoor/signs and direct sightings. As a taxonomic group, small herbivores are far more resilient than their larger counterparts, primarily due to their ability to take refuge in a wider range of habitats. In addition, springhares (*Pedetes capensis*) and Cape hares (*Lepus capensis*) were very common throughout the study areas and surrounding habitats. Small herbivores are often amongst the last of the mammalian taxonomic groups to be eliminated in heavily disturbed or heavily utilised areas.

Large and medium herbivores

Larger herbivores that are found within the study area must be divided into naturally occurring or free-roaming and game farmed+or ranched. There may be some overlap for a given species which may be farmed on one property within the study areas, yet free roaming on another. Species that fall into this category include blesbok (*Damaliscus pygargus phillipsi*), kudu (*Tragelaphus strepsiceros*) and springbok (*Antidorcas marsupialis*). Overall, the study areas show only a moderate large herbivore habitat potential. Herbivores such as kudu and springbok were sighted frequently during the study period and appeared to be in excellent condition. Blesbok occurred as ranched species. Although the densities of this mammalian group were high, the diversity of the group is low. Overall, the study areas show evidence of a functional herbivore system which indicates that the trophic level of the

food chain is being adequately represented. However, it is clear from the veld condition that some areas are overstocked, possibly due to the localised high densities of sheep and to a lesser extent, goats.

Meso-carnivores

It appears that larger carnivores exhibit an insignificant presence throughout the study area and are considered to be largely absent. Meso-carnivores, however were significantly represented within the study areas. Relevant species include honey badger (*Mellivora capensis*), black-backed jackal (*Canis mesomelas*), water mongoose (*Atilax paludinosus*), bat-eared fox (*Otocyon megalotis*), African wild-cat (*Felis silvestris lybica*), Caracal (*Caracal caracal*) and Cape fox (*Vulpes chama*). The significant presence of the species could be explained by a number of factors. Firstly and most importantly, the food supply (especially within the feeding spectrum of meso-predators) is still highly functional with small mammals, birds, insects, reptiles and amphibians available in high densities and high diversity. The wetland areas may exhibit a sporadic high density of amphibians, whilst the vegetated areas, ridges and even human residential areas showed large densities of small mammals, nesting birds and reptiles, all of which are utilised (albeit in different ratios) by the above mentioned species. Insectivorous species such as aardwolf and bat-eared fox (and to a lesser extent Cape fox and black-backed jackal) have access to a large resource base which is typical of such arid environments. Aardwolf and bat-eared fox however is addressed in a separate category, despite its status as member of the Order Carnivora. Finally, meso-predators often react positively to the presence of humans (in the absence of large densities of African dogs and intensive persecution) and will readily forage on anthropogenic food sources. The primary reason for the low observed densities of caracals and black-backed jackal however is due to the significant influence of predator extermination programs taking place within the study area.

Small carnivores

This group includes smaller carnivores below 5 kg in mass. Relevant species include smaller species of mongoose, suricates (*Suricata suricata*) small-spotted cat (*Felis nigripes* is addressed in the Red-List section below), genets and polecats (*Ictonyx striatus*). Of these listed species, slender mongooses (*Galerella sanguinea*), yellow mongooses (*Cynictis penicillata*), small-grey mongoose (*Galerella pulverulenta*), and spotted genets (*Genetta genetta*) were seen frequently throughout the study area and region. These species are usually highly resilient and respond positively to human presence, as they readily utilise anthropogenic food sources or the rodents that are attracted to human settlements. They are also highly catholic in their habitat requirements, meaning that most habitat types are suitable to meet the ecological requirements of the species. Dietary requirements are equally broad, which increases the adaptability of the group and therefore their overall resilience. These species may be considered to be essential in controlling the spread of synanthropic or alien rodents.

Primates

Relevant species from this taxonomic group are limited to vervet monkeys (*Cercopithecus pygerythrus*) (baboons were not observed during the current study) which were frequently sighted, both within the study areas and the region as a whole. They were primarily limited to areas linked to available surface water and/or trees (drainage).

Large insectivores

Aardvarks (*Orycteropus afer*) are specialist insectivores that are very common within the study areas. They are a ~~key~~ keystone species whose burrows are utilised as refugia by numerous other animals. Although regionally common, areas showing high aardvark density (similar to that observed for the study areas) should show due consideration and earthworks may seriously impact on local populations. Aardwolf (*Proteles cristatus*) and bat-eared fox (*Otocyon megalotis*) can be counted as specialist insectivore species for the purposes of ecology, despite their status as carnivores. Aardwolf were particularly common throughout the study areas, with numerous individuals observed per night drive. The species is also particularly prone to collisions with vehicles and many individuals were observed along the roads between the study areas.

Photographic evidence of the some of the mammals recorded within the study area is shown in Figure 13 and Figure 14 of the Biodiversity Report in Appendix 10 of this report.

Species of conservation concern

Within the previous study (Ferguson et al. 2008), three errors were made in the classification of the Red-Listed species. The classifications of Barbour's rock mouse (*Petromyscus barbouri*) as Endangered

and the elephant shrew (*Macroscelides proboscideus*) and the spectacled dormouse (*Graphiurus ocellatus*) as Vulnerable are incorrect.

Of the observed and expected mammal species, the black-footed cat *Felis nigripes* (expected) is listed as Vulnerable while the honey badger *Mellivora capensis* (observed in the current study) is listed as Near Threatened (IUCN 2015). The Cape fox (*Vulpes chama*) (observed during the current survey) is protected by the NEMBA. It must be reiterated that Ferguson (2008) reported anecdotal records from interviews with local people of Critically Endangered riverine rabbit (*Bunolagus monticularis*) in the Ryst Kuil area but no significant tract of its typical habitat, including extensive stands of the tall soutsbos (*Salsola* sp.) along drainage lines, was encountered. It is thus unlikely that any significant population of this mammal occurs within the Ryst Kuil Main study area, which is the only study area with a defined drainage line.

Three of the observed mammal species within the study areas are Red-Listed in South Africa and two species are protected by NEMBA. The probability of occurrence for selected threatened and near threatened mammal species on the respective study areas is shown in Table 14 of the report.

Honey Badger (*Mellivora capensis*)

Honey badgers were recorded once through spoor tracking within the drainage line habitat of Quaggas Fontein. Their presence is not unusual, even though the study area does not represent a stronghold for the species. This species is often associated with more savanna type habitats encountered in the Kalahari and Bushveld. It is often subject to snaring and persecution due to its penchant for raiding commercial honey farms and chicken breeding facilities. The presence of honey badgers on the study area should be considered as a healthy ecological indicator and the NEMBA protection warrants due consideration.

Small-spotted cat (*Felis nigripes*)

This cat species is a relatively uncommon resident that is nationally protected. It was not observed during the survey period but is predicted to be resident within suitable habitats within the study areas, mostly associated with termitaria. Termitaria represent one of the most important micro habitat types within the greater study area and should form the cornerstone of the mitigation measures to ensure protection for this species.

Cape fox (*Vulpes chama*)

This canid species is a relatively uncommon resident that is nationally protected. The stronghold of this species is centered around more arid savanna systems and the Mpumalanga grassland habitats. It was not sighted during the survey period although road kill was seen within the greater study area. Despite widespread and intensive persecution by farmers, it is a relatively common species throughout its range and can be considered to be relatively resilient to impacts.

AVIFAUNA

A total of 66 species were recorded in the current study with nine species additions to the previous study carried out by Ferguson et al. (2008). The final combined avifaunal species list for the study areas is provided in Appendix 9.3 as Table 27 of the biodiversity report in Appendix 10 of this EIA/EMP. Photographic evidence of some avifaunal species located within the study areas is also shown. As mentioned previously, much of the study period was hampered by poor climatic conditions as well as large distances between study areas. The data gathered was not powerful enough in order to formulate guild profiles and therefore, the previous report was extensively relied upon to address gaps in the data.

The most important change from the previous study was the very frequent sightings of IUCN Endangered Ludwig's Bustard (*Neotis ludwigii*). This species was sighted at least once in each of the study areas and often on multiple occasions, showing at least a temporary residence within these study areas.

Species of Conservation Concern

Current study

According to the literature, 14 Red-Listed species are known to occur in the region with 9 species confirmed during the respective surveys, representing a very high success rate. Two of the species are globally Endangered, four of the species are globally Vulnerable species and three are globally Near-Threatened, while five are protected by NEMBA. These species are discussed below and the probability of occurrence for selected threatened and near threatened avifauna on the respective study areas is shown in Table 15 of the report. According to Table 15, 8 species can be expected regularly in the study areas. *A. paradisaea* and *N. ludwigii* are particularly widespread in the area.

Table 16 of the report represents a summary explanation of the Red-Listed species identified by SABAP 1 and SABAP 2 within the study area as a whole and relates to the detailed discussion provided below. The table illustrates the long term habitat suitability for the observed and high likelihood Red-Listed species. The remaining taxa are either (1) irregular to rare foraging visitors or (2) unlikely to be present on the study area due to the poor availability (surface cover) of suitable habitat on the study areas.

According to Table 15 of the report (which describes the likelihood of occurrence of Red-Listed species per study area) it is evident that the highest number of threatened and near threatened species could occur on De Pannen and Quaggas Fontein, although most of the study areas exhibit similar likelihoods of occurrence. These study areas are the only study areas characterised by some moderately unique habitat attributes and thus likely to provide foraging habitat for large terrestrial bird species (e.g. cranes, secretary bird and storks) and/ or wetland associates/ foraging migratory raptors.

In regards to the current study, it was deemed unnecessary that all species should be discussed in detail. Species such as lanner falcon and lesser kestrel as migrants incur pressures outside of the borders of South Africa and do not warrant intensive discussion here. Therefore, the select relevant species that are possibly susceptible to the proposed development have been discussed in detail below. Photographic evidence of Red-Listed species observed during the current study is provided in Figure 18 of the Biodiversity Report (Appendix 10).

Avifaunal Importance

Avifaunal importance relates to species diversity, endemism and the presence of topographical features or primary habitat units with the intrinsic ability to sustain avifaunal assemblages as well as species of conservation concern. It is clear that throughout the study area that most of the habitats are generic in their ability to support a high diversity of general avifaunal species, Red-Listed species and SCC. No unique geographical or topographical features exist which would cause the areas targeted for mining to be classified as a No Go+ area in regards to avifauna. However, due to the high diversity and density of the above mentioned Red-Listed species recorded during the survey, (including regionally and globally listed Endangered and Vulnerable birds), the region as a whole is considered to be an area of very high avifaunal importance and activities should be managed in a holistic manner at a policy level, prioritising mitigation and monitoring of avifaunal species of conservation concern.

Habitats with high avifauna sensitivities include the seasonal drainage lines and water sources:

- “ The seasonal drainage lines (e.g. Quaggas Fontein) and accompanying riparian trees are linear dispersal corridors for terrestrial bird species. Much higher species diversity (as well as a unique composition) was observed in this habitat and therefore, these systems are earmarked with high avifaunal importance. The drainage lines act as important flight corridors for wading birds between foraging and roosting sites.
- “ The surface water habitats (artificial dams) are vital in the landscape, primarily due to the very arid conditions prevailing within the region. Avifaunal species depend on an interconnected system of water features (artificial or otherwise) and, based on seasonality and prevailing climatic conditions, it is anticipated that these systems experience a frequent turnover of species over time (seasonally and long term). They often provide essential breeding habitat, foraging habitat and water resources for avifaunal species including large bodied species of conservation concern such as cranes, storks and bustards. When water is present, the impoundments and pan habitats provide ephemeral foraging habitat for regionally and national Vulnerable and Near-Threatened storks.
- “ The stony and rocky ridges act as prominent landmarks and foraging habitat for small diurnal birds of prey. It also provides potential hunting habitat for the Vulnerable Verreaux's eagle which hunts rock hyrax (common in these habitats) as a staple of their dietary requirements. The localised high population densities of rock hyrax within the study areas as well as the regional linkage to the koppie habitats, elevates the importance of this habitat for avifauna.

Areas with medium avifaunal sensitivities include rocky and open habitats:

- “ The rocky habitats provide structural complexity not available in the open karoo vegetation which provides for an increase in species diversity and often higher densities of avifauna due to the prey species that are found in this habitats; and
- “ The open karoo habitats (including old cultivated lands and grassland areas) that provide suitable foraging habitat for the Ludwig's Bustard (*Neotis ludwigii*), Kori Bustard (*Ardeotis kori*) and Secretary bird (*Sagittarius serpentarius*).

In summary, the following key findings include:

- " A high richness of Red-Listed and species of conservation concern occur within the study areas;
- " A total of 9 Red-Listed bird species were confirmed to be present in the study areas out of 12 possible species; and
- " High frequency of observations for the Near-Threatened Kori Bustard, the Endangered Ludwig's Bustard, the Near-Threatened Blue Crane and the Vulnerable Secretary bird.

HERPETOFAUNA

Inventory

The herpetofauna survey was considered to be very successful. Firstly, all study areas were accessed appropriately and spatial arrangement of sample sites are well distributed to represent the different habitat types. A total of 29 reptile species (over 200 individuals) and three amphibian species were observed in nine sampling days. The observed species respectively represents 64% and 27% of the expected number of reptile and amphibian species for this region. The species accumulation curves for reptile and amphibian sampling effort is shown in Figure 19 of the report (see Appendix 10). An appreciable plateau is reached for the reptile species accumulation curve towards the end of the sampling effort, indicating that the sampling intensity and duration was sufficient to detect the majority of species expected. Conversely, the low number of species and flat curve of the amphibian species accumulation curve indicate that sampling conditions were not optimal to detect the majority of the expected amphibian species. This is attributed to the hot and dry conditions experienced during the majority of the field survey and although some rain did fall towards the end of the survey, this was not sufficient to initiate breeding activity from most of the amphibian species. Photographic evidence of each species (except for *Varanus albigularis*) observed was taken during the survey and is shown in Figure 20 to Figure 23 of the report. The complete herpetofauna species inventory is provided in Appendix 9.1 of the report.

Herpetofauna Importance

As highlighted in Ferguson et al. (2008), herpetofauna in the Nama-Karoo biome likely form a major component of the vertebrate biomass on which many other predators rely (e.g. birds of conservation concern). No single species of great conservation concern is likely to be present within the study areas, predominantly because of the great extent of this biome and the regional vegetation type. However, all tortoises species are particularly at risk from isolation through fencing and collisions with vehicles and careful mitigation measures will need to be in place for the proposed development in order to minimise the potential impact on this group of reptiles.

CURRENT IMPACTS ON BIODIVERSITY

Several current ecological impacts were identified for the study areas. It is vital to adequately describe these current impacts as they serve to illustrate the status quo of the study areas and provide context to the impacts and mitigations section. The most obvious current impacts observed were:

- " Pollution and littering;
- " The presence of alien invasive / indigenous invasive plant species;
- " Fences causing direct mortalities of fauna;
- " Powerline infrastructure causing avifauna mortality;
- " Fencing inhibiting free movement of fauna;
- " Residential related presence of feral predators (cats and dogs);
- " Human settlement effects;
- " Livestock grazing;
- " Wildlife-vehicle collisions (WVC's);
- " Hunting (both legal and illegal);
- " Dust effects and the contamination of wetlands;
- " Rock collection to pack against fence bottoms;
- " Exploration drilling (both habitat destruction and unplugged drill holes); and
- " Previous attempts at agriculture (ploughed areas).

The full Biodiversity Report can be viewed in Appendix 10.

AIR QUALITY

Baseline air quality

There are few significant sources of air pollution in the district and ambient air quality is described as good (Western Cape Department of Environmental Affairs and Development Planning, 2010). Beaufort West experiences air quality impacts from vehicular sources, as it is located along the N1 highway. Heavy duty vehicles, such as freight trucks, generate high volumes of traffic-related

pollution in the town. These include CO, NO₂, PM₁₀ and VOC emissions. Particulate matter emissions, and ambient concentrations, are expected to be very high in low-income and informal residential areas where wood and other fuels are used for cooking and heating. Brick making operations also result in elevated particulate matter concentrations in the immediate vicinity of the activity. The updated state of air quality report includes the burning of tyres and waste at Beaufort West refuse site as an emission source (Western Cape Department of Environmental Affairs and Development Planning, 2012). This generates significant amounts of particulate matter and gaseous pollutants, as well as hazardous air pollutants.

No ambient air quality monitoring is conducted in the Central Karoo, but high volumes of dust are likely considering the arid climate and the vast sparsely vegetated areas, although winds are generally light. The implications of the light winds for air quality are poor dispersion of gaseous pollutants and fine particles. For larger particles, such as dust, poor dispersion implies that dust that does not travel large distances from pollution sources.

With regard to the air quality in the areas surrounding the project site, no ambient monitoring has been carried out to understand background concentrations. Exploration activities in the area resulted in emissions of dust that potentially impact on air quality. The main impacts are likely to be caused by entrainment of dust by heavy vehicles, gravel removed from boreholes and large areas of land cleared for examining test-cores and rock samples. Otherwise there are no other significant anthropogenic sources of air pollution in the immediate area. However, natural sources that also emit air pollutants include wind-blown dust generated by the arid climatic conditions.

The full Air Quality Report can be viewed in Appendix 11.

HERITAGE

The NID application, submitted on the 09 October 2015, included the Eastern Block of the Tasman RSA Karoo Project.

The NID response, dated 19 October 2015, required the following studies:

- ~ Impacts to archaeological heritage resources
- ~ Impacts to palaeontological heritage resources
- ~ Visual impacts of the proposed development
- ~ Impacts to the built environment including a detailed site development plan

Heritage Resources Identified: Palaeontology

Palaeontology (Appendix 1 of HIA Report in Appendix 12 of EIA/EMP Report)

The baseline palaeontological report was prepared by Prof B Rubidge of the Bernard Price Institute at the University of the Witwatersrand in 2008.

He notes that study area falls within the Karoo Supergroup, famous for its palaeontological wealth covering the period of almost 100 million years ago, from the Middle Permian to the Early Jurassic. This rock succession has yielded a rich fossil flora and tetrapod fauna and is internationally known for providing a window on the life of the vertebrate groups.

Geological units correspond to the Teekloof Formation, which is represented by three lithostratigraphic members: Poortjie, Hoedemaker and Oukloof. Fossils from adjoining farms are housed in collections at the Bernard Price Institute and comprise mainly dicynodonts.

The area that will be mined in the southern Karoo is of particular palaeontological interest for several reasons.

- ~ The rocks of the southern Beaufort Group host the oldest record of living fossil tetrapods in the southern hemisphere and provide one of very few records of Middle Permian continental biodiversity but have received very little research attention;
- ~ Since the Karoo Supergroup records two of the Big Five+ mass extinction events since the Cambrian explosion of live 540 million years ago, it is an excellent place to study biological diversity patterns through time and specifically to periods prior to a mass extinction event and the recovery after it.

Archaeology (Appendix 2 of HIA Report in Appendix 12 of EIA/EMP Report)

- “ A number of archaeological reports related to uranium prospecting have been conducted in this particular area over the last 10 years although not all the reports have been submitted to the heritage authorities because some were conducted as baseline studies;
- “ Surveys have identified scatters of ESA and MSA artefacts and occasional LSA material. Archaeological material is predominantly present in the form of isolated flakes and cores, which are difficult to ascribe to a particular time period and which do not occur in sufficient quantities to be termed a site. The majority were manufactured on indurated shales (hornfels) although some artefacts were manufactured from a chert band which crosses Ryst Kuil;
- “ References by Kinahan (2008) to Howieson's Poort material on open sites in the interior of the Karoo could not be verified;
- “ No significant archaeological resources were identified, with the exception of Site D009 on the farm Quaggasfontein. It is located on the banks of a dry river bed and will be covered by the stockpile material as a result of mining. This LSA stone scatter consists of a large quantity of chert, hornfels and some quartz artefacts, including cores, chips and chunks. Most significantly, it also includes two thumb nail scrapers, one drill, and one MRP/Scraper. There are also possible bone fragments. This site has been identified as being of sufficient significance (Field Grading: Grade IIIB), to warrant mitigation. Two fragments of Chinese porcelain (one with retouch), on the opposite bank from D009, suggest that the stream may have been the focus of limited pre-colonial settlement;
- “ The archaeological heritage of the area is considered to be of low significance.

Built Environment (Appendix 3 of HIA Report in Appendix 12 of EIA/EMP Report)

The heritage resources identified include the following farm buildings:

- “ The farmhouse of Water Gift (Haanekuil) is 2km north of the proposed mine. The haulage route will not run passed the house;
- “ The farmhouse of Rystkuil is 5km north-east of the proposed mine. The haulage route will run passed the house;
- “ The farmhouse of Katdoornkuil is 2km north-east of the proposed mine. The haulage route will not run passed the house;
- “ The R61, which links Beaufort West and Aberdeen, cuts through the landscape. Quaggasfontein and Ryst Kuil Mines lies to the south of the R61, while De Pannen is located to the north. The road is not considered to carry high volumes of traffic nor is it a popular tourist route. It has not been graded by Winter & Oberholzer (2014).
- “ Although technically the land is zoned as agricultural, in real terms the Cultural Landscape has the character of a wilderness. Occasional stock posts, dry stone kraals, fences, wind pumps, boundary beacons and tracks are the only apparent elements of human modification on the landscape. It appears, even in prehistoric times, to have been marginally inhabited.

Visual (Appendix 4 of HIA Report in Appendix 12 of EIA/EMP Report)

- “ The Baseline Visual study was undertaken by Steven Stead of the Ryst Kuil/De Pannen area in 2008;
- “ The area has a unique landscape character with endless plains on an arid plateau. The broad plains are broken by flat-topped mesas and kopjes. The built landscape is one of isolated farmsteads. The lack of development creates a strong wilderness sense of place;
- “ The R61, a regional road connecting Beaufort West and Aberdeen, bisects the Ryst Kuil/De Pannen blocks. The road therefore has a potential view corridor of the proposed mining area;
- “ The distance of the Ryst Kuil Block from the N1 is high and as a result of the undulating topography, visibility of potential mining impacts will be low;
- “ There are a number of Karoo farmsteads in the vicinity, and they are a unique feature of the Karoo vista. The receptors from these farmsteads would be highly sensitive to the landscape modifications posed by mining. Visual absorption capacity (VAC), in other words the ability of the landscape to conceal the proposed development, is moderate to low.

The full Built Environment Assessment Report and Heritage Impact Assessment Report and can be viewed in Appendix 12.

VISUAL

Factors from the Western Cape Provincial Spatial Development Framework (PSDF)

1. Steep Slopes

Excluding slopes greater than 1: 4 and other ecological exclusion zones will have the effect of further limiting development as these areas (mountains, hills, plains) should be excluded from the areas for which the density calculation applies.+(WCPSDF, Ch 8, Pg 57)

2. Visual Impact:

- a. Topography: The impact of human activity has had a pronounced impact on the natural landscape and the need to manage and control such impacts are key to protecting the scenic qualities and visual resources of the Province
- b. Architecture: Foreign or unsympathetic styles of site layout and buildings shall be discouraged in urban settlements and rural areas so as to strengthen the local sense of place and minimise visual impact. (PSDF, Ch 8, pg 27)

3. Sensitive areas and vegetation:

- a. For all new development proposals, evidence must be provided that no valuable indigenous habitat will be negatively impacted on.

4. Protect Biodiversity: Strategies:

- a. Prevent the inappropriate conversion of bio-diverse rich rural areas, existing agricultural activity and soil with agricultural potential and important cultural and scenic landscapes to other uses; (WCPSDF, Ch 8, Pg 51)
- b. Cumulative ecological and visual impacts as a result of increased development pressures (WCPSDF, Ch 4)

5. Central Karoo Issues

The vision of the Central Karoo SDF is to arrange, support and expand the inherent development potential of the Central Karoo in sustainable ways through integrated management that will ensure the economic advancement of the area to the benefit of the people. (WCPSDF, Ch 5, Pg 7)

a. Issues are summarised as follows:

- Arid area of depopulation;
- High percentages of human development problems although relatively few people;
- Veld management, biodiversity conservation and stock carrying capacity;
- Desertification from the westward movement of the Karoo. (WCPSDF, Ch 8, Pg 7)

b. Strategies

- Reinforce development potential and urban efficiencies of settlements with economic growth potential like Beaufort West, Prince Albert and Laingsburg;
- Support work of SANBI and Department of Agriculture Soil Conservation Committees to achieve synergy with veld management programs that will improve both biodiversity conservation and stock carrying capacity. (WCPSDF, Ch 8, Pg 76)

LOCALITY

The property is located to the south and south east of the town of Beaufort West which is situated at the north eastern edge of the Central Karoo. The property is intersected by the R61 which runs between Beaufort West and Aberdeen to the east and the R306 through Rietbron to the south east.

REGIONAL SENSE OF PLACE

The proposed development area needs to be assessed in terms of the current sense of place of the area, the unique quality or character of a place, whether natural, rural or urban, relating to its uniqueness, distinctiveness or strong identity, the spirit of a place. Within the regional context the property is located in the Central Karoo, approximately 50 kilometres to the east of the historical town of Beaufort West. This region incorporates the western part of a large, relatively flat basin between the escarpment in the north and the Cape Fold Belt mountains in the south. Altitude ranges from 500 to 1 100 m. (www.environment.gov.za.htm) The Central Karoo is one of the world's most unique arid zones due to its continuous fossil record over 50 million years, reflecting different time periods. It is also one of the largest sheep farming areas in the country. The carrying capacity of the land is low therefore the sheep farms are enormous with large distances between homesteads. Beaufort West is the oldest town in the Central Karoo and its municipality, proclaimed in 1837, is the oldest in South Africa. Beaufort West lies south of a ridge of hills between two rivers, the Gamka and Kuils, and to the north are the Nuweveld Mountains with 230-million years old rocks. It is one of the world's richest collecting grounds for fossils as the Karoo was once a swamp and fossils are well preserved (www.beaufortwestsa.co.za). In close vicinity to the town is the Karoo National Park, established northwest of Beaufort West in 1979, in order to preserve the typical central Karoo vegetation and serve as a haven for indigenous antelope species. The park is home to over 60 species of mammal including reintroduced species like the black rhino and mountain zebra. (On Route in South Africa)

The area has a unique landscape character with endless plains on an arid plateau, the largest of its kind outside Asia. The broad expanse of the plains is broken by flat-topped mesas and kopjes (conical hills), which display interesting stratigraphy, contorted fold structures and deeply striated glacial pavements. (www.tourismcapetown.co.za) The built landscape is one of isolated farmsteads and small country towns. The lack of development creates a strong wilderness sense of place and as a result of this landscape it is important to note the interdependence between the tourism industry and

the wilderness perception created by the vast open plains and striking mountains. (See Photographic Survey in Plate 2 of Visual Impact Report)

SENSE OF LIMITS

Visual limitations are created by development which exceeds the visual capacity of the landscape to absorb the change and results in a radical change to the sense of place of an area or region. (See Limitations Photographic Survey in Plate 3)

- Due to the inherent lack of available screening in context with the flatter, wide open vistas, there is a high potential for visual impact in the flat, arid Karoo landscapes. Thus it is of critical importance that development is managed in such a way that it does not detract from the elements which define significant landscape character specifically relating to the tourist industry in the country.
- Sense of limitations created by excessive massing of power lines, associated infrastructure and telecommunication towers in close proximity to the road.
- The low visual absorption capacities of the karoo landscape which have the potential to create high levels of impact in the foreground areas.
- Vertical structures located on prominent ridgelines create high levels of contrast to the mainly flat horizontal forms and lines of the karoo scape.

SOCIO-ECONOMIC ENVIRONMENT

Attributes associated with the sites

Baseline environment socio-economic and cultural character

This application is in support of the Eastern Block, situated in the Western Cape Province. The proposed mining activities stretch over different sections of the Eastern Cape, Western Cape and Northern Cape Provinces. It is therefore important to provide a holistic background of the project, instead of focusing on the activities and socio-economic baseline for the Eastern Block in particular. The majority of the project is situated in the Western Cape Province's Central Karoo District Municipality (CKDM). A smaller section, 344km² (34448.0346 ha) . the Kareepoort Block - forms part of the Camdeboo Local Municipality in the Eastern Cape Province, and some sections (The Fraserburg, Davidskol and Loxton Blocks) fall in the Northern Cape (to the extent of 133207 ha). The Quaggasfontein Block is situated directly next to the Eastern Block in the Western Cape's Central Karoo District (CKD) and the Beaufort West Local Municipality (BWLM). Therefore, an overview of the socio-economic situation in both the Beaufort-West Local Municipal area and the Central Karoo District (CKD) as a whole is provided.

Central Karoo District Municipality overview

The Central Karoo District Municipality (CKDM) is home to 1.2% of the Western Cape Province's total population, covering a vast space geographically. The majority of the population (76%) is coloured and Afrikaans speaking. The CKDM has a literacy rate of 73.4% and an immunisation rate of 89%, crime rate have decrease during the last three years while approximately 30% of the population is living in poverty (WCGPT, 2013).

The CKDM consist of three local municipalities: Beaufort West Local Municipality (BWLM), Laingsburg local municipality (LLM) and Prince Albert Local Municipality (PALM). Of these three, the BWLM is by far the largest, with 49 586 residents (in 13 089 households) compared to 8 2589 residents in 2 408 households in Laingsburg and 13136 in 3 578 households in Prince Albert. Beaufort West is also the seat of both the Central Karoo District Municipality (CKDM) and the Beaufort West Local Municipality (BWLM). The BWLM accounts for 88% of the total population of the CKDM (Beaufort west Municipality, 2014)

The population residing within the BWLM is mainly between the ages of 15 and 64 (62%) with a further 30% under the age of 15. Seventy four per cent (74%) of the population in the BWLM is coloured, 16.3% black, 9.2% white and only 0.5% is Asian or Indian. Population growth between 2001 and 2010 was at 1.4% annually. A housing backlog of between 4 867 and 5 100 was reported in 2012 (Beaufort West Municipality, 2014).

In the Central Karoo District Municipality 97% of the population reside in formal housing structures and this is reflected in each of the three local municipalities. According to the Beaufort West Municipality (2014), 82% of the population reside in the urban areas with 17.8% residing in rural areas around Beaufort West. As a result of the activities of mining companies in the vicinity of the town, the prices of middle-upper income houses have increased rapidly in 2008, however, average house prices have decreased somewhat from with the median price in 2013 dropping from R 240 000 to R 232 500 in 2014 (Cyberprop.com).

Household income, employment and poverty levels

Household income in a specific area is one of the best indicators of the welfare of an area and is indicative of the population's ability to secure for themselves shelter, food, clothes and education. According to the Western Cape Province Government Treasury (2013), the number of households with an income in the CKDM is as follows:

No. of households; No income; R1. R4800; R4801-R9600; R9601-R19200; R19201. R38400; R38401. R76800; R76801+							
CKDM	1593	-	-	-	-	-	-
BWLM	1240	430	759	2841	3112	2008	1453
LLA	128	47	69	502	612	525	544
PALM	228	118	220	702	956	613	743

The official unemployment rate in the BWLM is 25.5% while the unemployment rate amongst the youth (aged 15-34) is higher at 24.5%. In the adjacent Prince Albert Local municipality unemployment rates are lower at 19.4% (25% amongst youth) and in Laingsburg even lower at 17.9% (22% amongst the youth).

Using the human development index (HDI) as an indication of life expectancy, literacy and income in the CKD is amongst the worst off in the Western Cape. The CKD has an HDI of 0.6 (with a maximum of 1 indicating the highest level of human development), that has been increasing from 0.57 in 2001, to 0.59 in 2007 and 0.6 in 2010. Within the three municipal areas, Beaufort West is the better of the three with an HDI of 0.6, while Laingsburg has an HDI of 0.59 and Prince Albert 0.58. The WCGPT (2013) argues that these levels of development poses a huge challenge for the district to create more employment opportunities to improve the standard of living in the area.

Poverty levels amongst the population in the CKD are around 33%. According to the WCGPT (2013), poverty levels have been slowly decreasing from around 39% in 2001. It is estimated that in 2010, Prince Albert had the highest incidence of poverty with 43.3% of the population living in poverty, closely followed by Laingsburg at 36.1%; Beaufort West was reported to stand at 29.1% in 2010.

Housing and access to municipal services

With 97% of the population residing in formal housing structures across the three local municipalities, the general access to services such as flush toilets, weekly refuse removal, piped water and electricity for lighting purposes is quite good, but better in the BWLM than in Laingsburg LM or Prince Albert LM.

Table indicating Access to municipal services in the CKDM in 2011

Municipality	Flush Toilets	Weekly refuse removal	Piped Water	Electricity
BWLM	83.2%	83.7%	81.3%	92%
Laingsburg LM	68%	59%	66%	79%
Prince Albert LM	63%	73%	69%	86%

Source: StatsSA, 2011. www.statssa.gov.za/beaufort-west-municipality

Infrastructure backlogs, however, do exist in some of the smaller towns, with Murraysburg, Matjiesfontein, Leeu-Gamka and Prince Albert experiencing backlogs in terms of road transport, water provision, wastewater management and electricity transmission (MERO, 2013).

Education levels and access to education in CKD

The CKD has 26 secondary and primary schools, representing 1.9 % of schools in the Western Cape.

The schools in the BWLM represent 65.4% of the schools available in the CKMD, with 17 schools, thirteen of which are no-fee schools. This includes 4 secondary schools and 7 primary schools. In the CKDM only Beaufort West and Murraysburg have high schools, while Merweville and Nelspoort has intermediate schools. There are no known farm schools in the area. The educator-learner ratio is 1:36 (BWLM IDP, 2012). There is one FET college, South Cape College, in Beaufort West, offering national certificates in Tourism and office administration as well as occupational programmes in hair dressing, and some computer and skills programmes. The FET College does not offer technical training, requiring students to seek such education elsewhere (www.sccollege.co.za).

There is an academy for science and technology planned by PetroSA, which would offer technical training for skills needed in the mining industry, however, this programme is still in the planning phase.

CKD has one of the lowest levels of education in the Western Cape districts. About 5% of the population have tertiary education, and in some small town, such as Nelspoort, more than 52% of the population is illiterate. A survey undertaken by the CSIR in 2002 revealed that at least 20% of the

population of Beaufort West is illiterate (BWM, 2006b). 32% of the population over 14 years have had less than 7 years of formal education. The corresponding figure in the CKDM is 32%. According to the Department of Social Development in the Western Cape (2013), the literacy rates in 2011 in the Central Karoo was 73.4% compared to 90.5% in the City of Cape Town and 82.6% in the Eden district directly adjacent to the CKDM. The literacy levels across the CKDM are depicted in the table below.

Table indicating CKDM literacy levels

Municipality	Literacy rate
Western Cape	87.17%
CKDM	73.35%
BWLM	74.9%
LLA	69.97%
PALM	69.89%

Source: StatsSA and Western Cape Department of Social Development 2013

Health and access to healthcare in the CKD

The CKD has 1 Community Day Centre, 8 clinics with 3 satellite and 10 mobile clinics. In addition hereto it also has 4 district hospitals. Although the CKD has the lowest number of facilities for health care of all the districts in the Western Cape, it is still in excess of the requirements of the WHO guidelines of 10 000 people per facility.

In the Western Cape Province, 134 212 people are being treated for HIV and AIDS, 949 of which are situated in the CKD. The reported HIV and AIDS prevalence in the CKD as at the end of March 2013 based on the number of people receiving Anti-Retroviral Treatment (ARV) at official sites were 740 in Beaufort West, 131 in Prince Albert and 78 in Laingsburg, with a total of 949 in the CKD (WCPG, 2014).

Child health is a good indicator of a population's access to primary health care. The most important indicators are malnutrition (children under 5 severely underweight) and percentage of the children over the age of one that has been immunised. In the CKD, statistics show that levels of immunisation has decreased while the number of severely underweight children (per 1000) under the age of 5 has increased. This is distinctly true in the Prince Albert area and should be regarded as an early warning of declining health in the CKD (WCPGT, 2013). The number of births to women under the age of 18 has also increased in recent years, especially in the Prince Albert area.

Crime in the CKD in general has remained constant since 2004, with some fluctuations in incidents reported per year, for burglaries, sexual crimes and decreasing murders from 47 p.a. in 2004 to 27 reported in 2013, however, drug related crime has dramatically increased with 322 incidents reported in 2004, 743 in 2008, and more than 1000 in 2011, 2012 and 2013 each year.

Local economic development plans

Economic growth, according to the BWLM IDP was 4.1 per cent per annum, 2000 to 2010, District-wide employment contracted at a rate of 1.1 per cent per annum, mainly as a result of heavy job losses in agriculture, forestry & fishing; net job growth in the CKD's services industries and manufacturing and construction countered losses in agriculture. Construction (10.4% per annum) grew the fastest, but only contributes 5.3% of GDP; the other fast-growing sectors were manufacturing (9.7%) and finance, insurance, real estate & business service (8.1%); and the slowest growing sectors were agriculture, forestry & fishing (-2.0%); electricity & water (0.2%) and transport, storage & communication (1.7%). Agricultural sector is declining (2% per annum) and is causing other sectors to under-perform, e.g. retail, catering & accommodation and transport & storage. However, a notable feature of the regional economy is the vibrancy of its light industries and construction, while other services such as finance & business services are expanding rapidly (MERO, 2013).

The Central Karoo District's economy is forecast to grow at 3.6 per cent per annum between 2013 and 2017+ (MERO, 2013, p. 508). The following industries' contribution to the local economies is depicted in the table below:

Table indicating Central Karoo District Economies in 2013

Central Karoo District Economies	Economic contribution
Agriculture, Forestry and fishing	9.0%
Mining and quarrying	0.1%
Manufacturing	11.1%
Electricity, Gas and water	1.1%
Construction	5.6%
Wholesale & retail trade, catering and accommodation	13.9%
Transport, storage and communication	12.2%
Finance, insurance, real estate & business services	27.4%

Community, social and personal services	6.5%
General government	13.1%

Source: MERO, (2013).

The projected growth areas will aid in offsetting the envisaged reduced development in the electricity gas and water sector (-0.2%) and projected dismal growth of 0.5% in the agriculture, forestry and fishing sector. The areas that will lead to growth in the economic sector will most likely be as a result of the following activities:

Table indicating Growing sectors in the CKD

Growing sectors in CKD

Large manufacturing	6.1 %
Quarrying	5.7 %
Financial & related business sector	5.2%
Construction	4.4%

Source: MERO, (2013).

Local economic development plans (Beaufort West, 2014) include development of infrastructure such as piped water from the Gariep Dam, rerouting trucks through the town centre (by creating a freight village and inland port), upgrading the airport by tarring and extending the runway, and creating a waterfront. Key projects in the BWLM area include the several specific projects:

- " Pomegranate Project;
- " Essential Oils Project;
- " Chicken Farming and Lucerne Planting Project;
- " establishment of Youth and Women Cooperative; and
- " the revival of Hydroponic Tunnels Project.

Key investment opportunities have been identified by the CKDM (2013) as a

- " Freight village and inland port;
- " establishment of cold storage;
- " PPP with Score and Pep Stores;
- " Lesotho Highlands Water Project;
- " tourism gateway; and
- " the correctional facility.

Wesgro (2015), provide a summary of investment opportunities in the western cape during 2015 and 2016, highlight international investment opportunities in the Central Karoo District including:

- " The establishment of a School of Excellence by Petro SA in Beaufort West, which will focus on the development of maths and science as well as artisanal and specialist industry specific skills development.
- " The Central Karoo Economic Development Agency funded by the IDC is in the 2nd phase of establishment, their aim is to identify opportunities and facilitate investment in the Central Karoo District.
- " Sector specific mining indabas and conferences held in Beaufort West as a result of the increased attention on the CKD (shale gas projects).
- " Film and multimedia: The vast Karoo landscapes have performed a stand in role for a number of western movies as a substitute for the American %Wild West+. The Karoo may also be a substitute for the Australian Outback.
- " Metals and engineering services: There is opportunity to provide support to the shale gas industry in extraction and explorations. Growth in this sector in services centres close to the potential shale gas activities is expected. Expert engineers and metal workers will be required.
- " Tourism: There is the potential to upgrade the airstrip in Beaufort West. This will make tourist travels (business and leisure) and distribution of goods more efficient. The pre-feasibility study has been completed.
- " There is potential to develop a resort/luxury accommodation provider.

The CKD is a semi-desert, with a rural character, holding the smallest population in the largest geographical area of the Western Cape. Main activities include cheese and olive pressing in the Prince Albert area, sheep farming and production of deciduous fruit. Currently, the area does not participate extensively in the gas sector, major developments in the area may see the Central Karoo develop into one of the key gas hubs in South Africa. Initiatives and programmes run by gas companies such as PetroSA and Shell and other private companies may already have started to impact in the area, causing a knock-on effect in retail and tourism, the current drivers of the economy.

TRAFFIC and TRANSPORTATION

Existing Road Network

The important characteristics of the major roadway facilities in the vicinity of the subject sites are summarised in the Table below.

Table indicating Existing Roadway Facilities

Roadway	Classification	Posted Speed (km/h)	Road Surface
N1	National Road	120	Tar
N12	National Road	120	Tar
R61(TR35/1)	Provincial Trunk Road	120	Tar
R381(TR58/1)	Provincial Trunk Road	100/80	Tar/Gravel
R353 (TR73/1)	Provincial Trunk Road	100	Tar
R332 (MR411)	Provincial Main Road	80	Gravel
MR582	Provincial Main Road	80	Gravel
MR584	Provincial Main Road	80	Gravel
DR2310	Provincial Divisional Road	100/80	Tar/Gravel
DR2358	Provincial Divisional Road	80	Gravel
DR2370	Provincial Divisional Road	80	Gravel
DR2302	Provincial Divisional Road	80	Gravel
DR2304	Provincial Divisional Road	80	Gravel
DR2308	Provincial Divisional Road	80	Gravel

All the existing intersections are stop controlled intersections with stop-control on the minor roads. All the paved roads in the site vicinity are two lane roads one lane per direction. The N1 has 3.7m lanes with 2m paved shoulders and the N12 has 3.3m lanes with 2m gravel shoulders. All Provincial trunk roads and main roads also has 3.3m lanes with gravel shoulders. The gravel roads is typically 8m wide with narrower sections in some areas. Refer to Photo 1 to 4 for the typical cross-section of the major roads in the site vicinity.

DR1331 is a provincial divisional road, gravel road 6m wide.

Existing Traffic Volumes

The table below shows the current annual average daily traffic volumes (AADT), the peak hour volumes and the percentage heavy vehicles on the road network in the site vicinity.

Table indicating Traffic Volumes

Road	AADT	Peak Hour Volume	% Heavy Vehicles
N1	4 100	280	46%
N12	640	50	21%
R61(TR35/1)	680	50	15%
R381(TR58/1)	213	16	7%
R353 (TR73/1)	750	56	3%
R332 (MR411)	64	9	8%
MR582	19	5	5%
MR584	127	11	14%
DR2310	244	16	8%
DR2358	9	1	1%
DR2370	10	3	1%
DR2302	12	2	10%
DR2304	10	3	10%
DR2308	45	10	35%

These volumes are low and there is sufficient spare capacity along the road network to accommodate increases in traffic volumes. Based on historical traffic count information along the roads in the site vicinity, the traffic volumes along the roads in the site vicinity have not changed much over the past 10 years.

The traffic volumes on the roads in the site vicinity are low and there is sufficient spare capacity on the road network with the current infrastructure to accommodate the expected increase in traffic volumes associated with the proposed Karoo Uranium Mine.

Site Extent - approximately 72 600ha.

~ The site is mostly flat and the existing use is farm land. See Appendix 4 for the site layout of the Rystkuil Block.

Rystkuil Block Access

Access is proposed via an existing farm accesses off the DR2358, DR2370, R332 (MR411) & DR2304.

The photographs Appendix 6 shows the available shoulder sight distance (SSD) from the accesses.

Vogelfontein Access

Access is proposed via existing farm accesses off DR2310. The photographs below shows the available shoulder sight distance (SSD) along DR2310 from the access position. This is also the Kareepoort access.

PALAEONTOLOGY

Fossil discoveries from South Africa have greatly expanded knowledge of the development of life on Earth. In particular, the enormous palaeontological wealth of the Karoo Supergroup, covering a period of almost 100 million years from the Permian to the Jurassic, has enhanced understanding of the evolution of important tetrapod lineages, including mammals and dinosaurs (Rubidge, 1995b; Rubidge and Abdala, 2008; ;Rubidge and Sidor, 2001; Yates and Kitching, 2003), and has made an invaluable contribution to studies of Permian and Triassic Gondwanan floras (Plumstead, 1972; Lacey et al., 1975; Anderson and Anderson, 1985; Bamford, 1999; Gastaldo et al., 2005). These fossils provide the best record of continental Permian to Jurassic faunal biodiversity. Recent research has demonstrated the importance of Karoo fossils for global stratigraphic correlation and for the conceptualization of basin development models (Catuneanu et al., 1998; Rubidge, 2005).

Three-fifths of the surface area of South Africa is covered by rocks of the Karoo basin, and because of the relatively high topography of South Africa coupled with the relatively arid environment this rock succession has yielded a rich fossil flora and tetrapod fauna and is internationally known as the best window to understand the life of vertebrates on earth from the Middle Permian to the Early Jurassic (Smith et al., 1998; Rubidge and Sidor, 2001; Hancox and Rubidge, 2001). Vertebrate groups represented by fossils recovered from the Karoo are: fish (Bender and Hancox, 2003), amphibians (Hancox et al., 2000; Damiani, 2003; Damiani and Rubidge, 2003); herbivorous reptiles of large size known as pareiasaurids (Lee 1997a, 1997b), many groups of mammal-like reptiles or therapsids (Boonstra 1969; Rubidge and Hopson, 1990; Hancox and Rubidge, 1994, 2001; Rubidge, 1994; Rubidge and Kitching, 2003; Abdala, 2007), small lizard-like animals such as procolophonians and eosuchians (Cisneros, 2007), turtles (Gaffney and Kitching, 1994), dinosaurs;(Yates and Kitching, 2003; Yates, 2005) and primitive mammals (Gow, 1986). Many of the fossils from this basin are key fossils that have helped to understand the origin and evolution of mammals, turtles and dinosaurs (Rubidge, 1995a; Smith et al., 1998; Rubidge and Sidor, 2001; Rubidge, 2005).

This wealth of tetrapod fossils from the rocks of the Beaufort Group has enabled the establishment of an 8-fold biostratigraphic scheme (Keyser and Smith, 1977/78; Kitching, 1977; Rubidge, 1995b). Although a lithostratigraphic scheme has also been developed for these fluvially deposited rocks, the fact that no long-ranging marker beds are present in the Group means that biostratigraphy remains the most reliable method for long distance stratigraphic correlation. This biostratigraphic scheme has also enhanced intercontinental correlation of Permian and Triassic terrestrial deposits (e.g. Lucas, 1998; Rubidge, 2005).

Uranium anomalies have been found in different regions of the south-western portion of the Karoo Basin, resulting from an active exploration programme developed in the 1960s and 70s (Cole, 1980; Cole and Wipplinger, 1991, Kitching and Rubidge, 1993). Renewed uranium prospecting in the Karoo has led to the identification of an area between the districts of Aberdeen, Beaufort West and Rietbron which is currently being targeted for mining activities.

The area being prospected in the southern Karoo is of particular paleontological interest for several reasons. Numerous authors have linked dated periods of compressional deformation in the Cape Fold Belt (Hälbich 1983, 1992; Hälbich et al., 1983; Gresse et al., 1992) to sedimentary responses in the Karoo Basin (Rust, 1959, 1962, 1975; Hiller and Stavrakis, 1984; Turner, 1986; Cole, 1992; Veevers et al., 1994; Hancox and Rubidge, 1997; Catuneanu et al., 1998; Hancox, 1998). At present there is no consensus as to the cause-and-effect relationships, although most authors favour direct control in a unitary subsiding basin. One of the main problems hindering development of these models is a lack of good time resolution. In this regard fossils have proved useful, as enhanced understanding of the biostratigraphic distribution of plants and tetrapod faunas has led to improved time resolution of basinal depositional events for the subaerial continental deposits of the basin (Hancox and Rubidge, 1997, 2001). The rocks of the southern Beaufort Group host the oldest record of land living fossil tetrapods in the southern hemisphere (Rubidge 1995a, Rubidge 2005), and provide one of very few records of Middle Permian continental biodiversity but have received very little research attention since the seminal work of Boonstra (1969).

Raup and Sepkoski (1982) drew attention to the extinction events of the late Ordovician, Devonian, Permian, Triassic and Cretaceous as the five largest extinction events since the Cambrian explosion

of life 540 million years ago. With the threat of the current 'sixth extinction', global mass extinction events and their impact on the biota of the time are receiving increased attention. Because the Karoo Supergroup records two of these 'Big Five' events (Smith, 1995; Smith and Ward, 2001; Hancox et al., 2002), it is an excellent place to study biological diversity patterns through time, and specifically the periods prior to a mass extinction event and the recovery after it. Apart from the end Permian and end Triassic extinctions a marked faunal change also occurs at the end of the Middle Permian. The results of this extinction have been well researched in the marine realm but not yet in the continental realm as there is a paucity of fossil-bearing terrestrially deposited rocks of this period. The only place where rocks are preserved which were deposited in the continental realm during the Middle-Late Permian transition is in the Karoo of South Africa and fall within the Tapinocephalus Assemblage Zone (Rubidge, 1995b). These rocks could provide the key to understanding the floral and faunal changes that took place during the Permian, and may also provide important clues about the environmental changes that were occurring during this time. These are the rocks currently being targeted for uranium prospecting and mining.

Most of the areas under survey are topographically flat and covered by alluvium with the result that few fossil-bearing rock outcrops are present. Good exposures are present only on the farms Oorlogspoort, Vogel Fontein, Farm 157 and Jury Fontain. Small outcrops were observed in the farms Karree Poort, De Pannen, Klein Tavel Kop, Nieuw Jaars Fontein and Los Boomen and some good outcrops were also observed in Kant Kraal. The topography of the farm Klipstavels seems to suggest that there may be some good exposures, but proper searching of fossils was not possible.

Geological units of the outcrops in the area correspond to the Teekloof Formation, which is represented by three lithostratigraphic members: Poortjie, Hoedemaker and Oukloof. These members include fossil faunas of the Pristerognathus, Tropicostoma and Cistecephalus Assemblage Zones (Rubidge 1995). On some farms situated in close proximity to the studied area (e.g., Diepleegate), rocks of the Abrahamskraal Formation are present which could potentially yield fossils of the Tapinocephalus Assemblage Zone.

The farm Rooikop delivered no fossils, and although the farmer refused us access to look for fossils on the farm Klipstavels, from our drive onto the property we are able to ascertain that there was little possibility of finding fossils on the portion of the farm north of the homestead. On the small portion of the farm situated southwest of the homestead is slightly higher topography and there is a possibility of some outcrops in this area, but these are not of great importance for fossil prospecting.

The table below presents a summary of the fossils discovered on farms in the study area.

For the Palaeontology Report see Appendix 16.

NOISE

Characteristics of the Study area

The project area falls within the Nama-Karoo Biome and all are characterised by the Gamka Karoo regional vegetation type. The predominant land use type for this region is sheep and goat farming with large areas also dedicated specifically to game farming. The main reason for this is that the annual rainfall and soil conditions are not suitable for intensive agriculture. Although not without their ecological impacts, livestock and game farming in general does not cause severe transformation to the landscape in comparison to intensive agricultural practices.

The study area has a low population density with many historical homesteads no longer occupied and some falling into ruin. The topography is in many parts of the study area flat punctuated with low ridges and small kopjes. In the northern and north western parts of the study area the topography changes with the plateau as the altitude increases.

District Acoustic Character

The noise character of the rural Karoo has been assessed and documented by various studies. Under South African standards, various types of districts are classified according to their acoustic character. This acoustic character is provided in SANS 10103:2008 as provided in Table 3 1 of the NIA Report (Appendix 17). The SANS 10103:2008 document also provides the anticipated Categories of Community Group Responses as provided in Table 3 2 (Appendix 17) below when noise levels increase. The rural nature of the proposed mining sites and central processing plant has a well understood and documented acoustic character.

Desktop Assessment

The baseline noise assessment by JH Consulting (2011) in the area between Middelburg, Cradock and Queenstown, revealed field test results congruent with those described by SANS 10103:2008 (Table

2 1 above). Baseline test results for this study for LAeq ranged from 34,6 . 47,6 (dBA) where no traffic was present. The lowest Lmin during these assessments was 17,3 (dBA). These results are typical of a remote rural setting with acoustic character influenced mostly by wind, rustling of vegetation and bird song. The same study revealed the impact of traffic where the LAmin results ranged from 17,5 . 35,2 (dBA) and the LAeq ranged from 55,8 . 69,2 (dBA). These influences were characteristic of a tarred/paved rural main road with cars and light and heavy delivery vehicles travelling upwards of 80km/h. A M2 Environmental Connections Report (2012) for the Der Brochen Platinum Mine demonstrated similar sound pressure levels typical of a remote rural setting with LAeq from 31,7 . 59,9 (dBA).

For the Noise Impact Assessment Report see Appendix 17.

SURFACE and GROUND WATER

(For all references to Figures or Tables, please refer to the full report in Appendix 18.)

Location

The eastern portion of the Ryst Kuil study area is situated within the Fish to Mzimvubu - Tsitsikamma and Breede - Gouritz Water Management Area (WMA). The tertiary catchments are indicated on Figure 6 2 - Figure 6 7. It falls within eight quaternary catchments (J21A, J21B, J21C, J21E, L11G, L12A, L12B, and L22B) (Figure 6 17), with the proposed infrastructure limited to L11G and L12A. It is located within the Beaufort West and Aberdeen Plain Municipalities of the Central Karoo and Cacadu District Municipal areas, respectively. This study area falls partly within both the Western and Eastern Cape Provinces. The Quaggasfontein block is located in the J21A area. The Kareepoort block falls within the L23A area. The Western block covers D55A, J21B, J22C, J22D, J22E, J22H, J22J, J22K, and J24A. The Southern block includes J11B, J11C, J11D, J11G, J21D, J23B, J23C, J23E, J23F, J23G, J24C, and J24D (Figure 6 17).

Hydrocensus

A detailed hydrocensus of existing exploration boreholes and farmers' boreholes was undertaken. Much of the latter information was obtained from Government records (the NGDB). The hydrocensus checked groundwater levels, yields and use and basic chemistry based on field testing. Weather records were evaluated for input to an assessment of recharge.

SRK conducted a hydrocensus of groundwater users in the study area during 2007. Undertaking a hydrocensus is an effective and cost-efficient means of collecting hydrogeological information for an area. The aims of the hydrocensus were to collect groundwater-related information such as borehole positions, groundwater levels, groundwater quality and abstraction data. Further information was collected by FERRET during 2014 and 2015 on the use of the boreholes in the area, the water levels of boreholes, etc.

A total of 346 boreholes (non-exploration) were located during the SRK hydrocensus. Of these 191 are equipped with windpumps, 6 with solar pumps, 27 with turbine/electric pumps and 122 are not in use. The windpumps and solar pumps are used for stock watering and domestic use while the higher yielding motorized pumps are used for irrigation. The SRK hydrocensus data indicates that the average borehole yield is 1.28 L/s. This relatively low average yield can be attributed to the fact that most of the surveyed boreholes are shallow (average depth < 28 mbgl) and are sited on unscientific grounds. Even so a number of high yielding (>10 L/s) boreholes exist. Most of these boreholes, if not all, intersect sandstone beds, which is evidence of the good transmissivity of the sandstone aquifer. The relatively high average EC value of 250 mS/m is largely due to saline groundwater located in and along the Sout River. Groundwater sampled from borehole ERW10 for example had an extremely high EC of 1620 mS/m.

Overview of the Karoo Basin

Physiography

The Main Karoo Basin covers the greater part of the central region of South Africa. Surface altitudes range from 800 to 3650 m above mean sea level. Altitudes are highest in the east decreasing gradually as the surface slopes to the west. The generally flat to undulating topography is broken by the up-warped plateau edges and the escarpment.

A typical feature of the landscape of the Western Karoo Basin is the flat-topped hills, which are often capped by more resistant dolerite sills or sandstone beds, rising above the featureless and flat to undulating plains.

Outcrops are rare between hills due to the surface cover of calcrete, windblown sand, alluvium, colluvium and soil.

Dolerite sill and ring-complexes are often prominent features of the Karoo landscape. These structures are easily recognized on satellite images, where they often display a sub-circular saucer-like shape, the rims of which are commonly exposed as topographic highs forming ring-like outcrops.

Climate and Rainfall

The climate of the South Western Karoo Basin ranges from arid (MAP<200mm) to semi-arid (MAP<500mm) and is classified as a summer rainfall region. Mean annual rainfall (MAP) decreases from east (500mm) to the west (<200mm). The major drainage feature is the Orange River and its perennial tributaries. The rivers in the Western Karoo Basin are seasonal, flowing only for short periods of time following heavy rainfall (Woodford 2002).

During the summer months, moisture-laden air flows from the Indian Ocean giving rise to thunderstorm activity and rain. Evaporation is highest during the summer months, further depleting the available moisture in arid areas. The major source of groundwater recharge is rainfall.

Rainfall patterns in arid to semi-arid regions are irregular in terms of depths (mm), intensities (mm/hr) and footprints (km²). During wetter seasons the footprint is larger and sporadically generates local flash flooding and depression storage (Van Wyk 2010). Indirect recharge in these cases occurs as point-source recharge zones in an otherwise low potential diffuse recharge environment. Intermittent or episodic recharge events in semi-arid regions correlate with extraordinary rainfall events and instigate medium-term aquifer replenishment. Recharge in this climate is not necessarily an annual event (Vegter 1995).

A few mean annual groundwater recharge estimates for Karoo aquifers in semi-arid regions are listed by Vegter (1995) and range between 16 to 22 mm. In the arid region mean annual recharge varies between 5 to 15 mm.

Geology

The Main Karoo Basin has been controlled and shaped by four major geodynamic events (Woodford 2002):

- ~ Deposition of the Karoo sediments and the uplift of the Cape Fold Belt,
- ~ Intrusion of Karoo basalt and dolerite,
- ~ Intrusion of Kimberlite and localised mantle up-welling,
- ~ Modern geomorphology, deposition of recent sediments, uplift, cessation of regional tectonics.

The geology of the Main Karoo Basin is summarized from Woodford (2002). The present day Main Karoo Basin is in-filled with sedimentary strata which are capped by a 1.4 km thick unit of basaltic lava. Major lithostratigraphic units of the Karoo Supergroup are shown in Figure 6 16.

The lithostratigraphic units of the Karoo Supergroup outcrop concentrically around the Main Karoo Basin. Lateral facies changes, particularly in the lower half of the succession, have given rise to inter-tonguing of lithologies in various parts of the basin. No major regional unconformities are known to exist within the basin, with the possible exception of one at the base of the Molteno Formation (Woodford 2002).

Dwyka Group

The Dwyka Group sediments were deposited by glacial processes and consist mainly of diamictite (tillite) which is generally massive with little jointing. Subordinate rock types are conglomerate, sandstone, rhythmite and mudstone. The Dwyka diamictite consists of angular to rounded clasts of basement rock embedded in a clay and silt matrix. The Dwyka Group attains a maximum thickness of 800 metres in the southern parts of the basin. The water body was marine as shown by the presence of marine fossils in mudstone units.

Ecce Group

The Ecce Group sediments comprise a total of 16 formations, reflecting the lateral facies changes that characterise this succession. The formations present in the southern and western basins are briefly discussed below.

- ~ The Price Albert Formation (Lower Ecce) is confined to the south-western half of the Karoo Basin, with a variable thickness of 40 to 150 metres. The southern facies is characterised by predominant darkgrey, pyrite bearing, splintery shale and siltstone.
- ~ The Whitehill Formation (Lower Ecce) contains mudrock which weathers white on surface, making it a very useful marker unit. The dominant facies is black carbonaceous, pyrite-bearing shale. The shale is very thinly laminated and contains up to 14 per cent carbonaceous material. The thickness varies from 10 to 80 metres and contains the fossilized reptile Mesosaurus. This Formation is reported to be characterised by high groundwater salinity.
- ~ The Collingham Formation (Upper Ecce) comprises interbedded thin (average of 5 cm) continuous beds of hard dark-grey siliceous mudrock and very thin beds (average of 2 cm) of softer yellowish tuff (Bentonite).

The formation is generally between 30 and 70 metres thick with minor sandstone units occurring in the upper half of the formation.

- ~ The Vischkuil Formation (Upper Ecce) varies in thickness between 200 and 400 metres. It consists essentially of dark shale, alternating with subordinate fine-grained sandstone, siltstone and minor tuff layers. The presence of minor tuff beds in the shale indicates continued volcanic activity. An upward increase in thickness and abundance of sandstone exists.
- ~ Laingsburg Formation (Upper Ecce) comprises four sandstone-rich units separated by shale units and is approximately 400 metres thick. The thick massive sandstone units (up to 30 metres thick, with

individual beds up to 4 metres thick) are fine-grained to medium-grained with sharp upper and lower contacts. They grade upward into laminated siltstone and shale, which commonly contain uraniumified plant fragments.

- “ The Ripon Formation (Upper Ecca) is generally 600 - 700 metres thick. It consists of poorly sorted, fine to very-fine grained feldspathic sandstone alternating with dark grey clastic rhythmite and mudrock.
- “ The Fort Brown Formation (Upper Ecca) consists of rhythmite and mudrock with minor sandstone and displays an overall coarsening-upward sequence. The average thickness is about 1000 metres, this can vary from about 500 to 1,500 metres.
- “ The Waterford Formation of the South-Western Zone (Upper Ecca) comprises alternating very fine grained, feldspathic sandstone and mudrock or clastic rhythmite units. The formation thickness varies between 200 and 800 metres.
- “ The Tierberg Formation (Upper Ecca) is a predominantly argillaceous succession which reaches a maximum thickness of 700 metres along the western margins of the basin. It rests with a sharp contact on the Collingham or Whitehill Formations and grades up into the arenaceous Waterford or Adelaide Formations. The bulk of the Tierberg Formation comprises well-laminated, dark grey to black shale.

Clastic rhythmite occurs at various levels in the sequence.

- “ The Skoorsteenberg Formation (Upper Ecca) is an arenaceous unit located between the Tierberg and Kookfontein Formations in the south-western part of the basin. It attains a maximum thickness of 200 metres, and comprises five sandstone-rich units up to 65 metres thick with shale units separating them.
- “ The Kookfontein Formation (Upper Ecca) overlies the Skoorsteenberg Formation with a sharp contact and grades upwards into the Waterford Formation. It is a lateral equivalent of the Tierberg Formation and attains a maximum thickness of 300 metres. The lower part of the formation comprises horizontally laminated dark-grey shales alternating with clastic rhythmite, which form minor upward-thickening cycles.
- “ Waterford Formation of the North-Western Zone formerly named the Carnarvon Formation (Upper Ecca) outcrops along the north-western Basin (Figure 6 16) and reaches a maximum thickness of 250 metres.
- “ The Pietermaritzburg, Vryheid and Volksrust Formations occur in the northern and eastern parts of the Karoo Basin and are not discussed.

Beaufort Group

The Beaufort Group sediments comprises of the Adelaide and Tarkastad Subgroups.

The Adelaide Subgroup in the west comprises the Abrahamskraal, Teekloof and Balfour Formations.

The Adelaide Subgroup comprises predominantly mudstone. The Teekloof Formation is characterised by a greater relative abundance of red mudstone compared to the underlying and overlying units, in practise the boundaries are linked to specific sandstone-rich marker units (members). The arenaceous Poortjie and Oudeberg Members constitute the base of the Teekloof and Balfour Formations, respectively. In the western basin the Abrahamskraal and Teekloof Formations attain thicknesses of 2,500 and 1,400 metres, respectively. The Balfour Formation attains a maximum thickness of 2,000 metres.

The Tarkastad Subgroup in the central basin is characterised by a greater abundance of both sandstone and mudstone when compared to the Adelaide Subgroup. The subgroup has a maximum thickness of 2,000 metres and comprises a lower, sandstone rich Katberg Formation and an upper, mudstone rich Burgersdorp Formation. The sandstone and mudstone units of the Tarkastad Subgroup tend to form fining-upward cycles comparable to those of the Adelaide Subgroup.

Molteno Formation

The Molteno Formation attains a maximum thickness of 600 metres in the southern outcrop area. It comprises alternating medium-grained to coarse-grained, micaceous sandstones and grey mudrock, with sporadic uranium seams.

Elliot Formation

The Elliot Formation comprises an alternating sequence of maroon and green-grey mudrock and subordinate fine-grained to medium grained sandstone (yellowish grey to pale red) units. It attains a maximum thickness 500 metres.

Clarens Formation

The Clarens Formation represents the final phase of the Karoo sedimentation and consists mainly of windblown, fine-grained sandstone and siltstone. The Clarens Formation in the north is usually in the order of 100 metres thick. Minor basaltic lava flows, inter-layered with sandstone, occur in the upper most part of the Clarens.

Dolerite Intrusions

The Karoo Dolerite consists of an interconnected network of dykes and sills and it is not possible to single out any particular intrusive or tectonic event responsible for these intrusions. It, however,

appears that a very large number of fractures within the Karoo lithology were intruded simultaneously by magma and that the dolerite intrusive network acted as a shallow stockwork-like reservoir (Woodford 2002).

The emplacement of dykes within the Western Karoo Basin appears to be lithologically controlled (Woodford 2002) where a decrease in intrusion density is noted at the boundary between the lower and upper Eccca.

This boundary corresponds to the appearance of the first sandstone units in the Karoo Basin. The bulk of the dykes are strata bound and concentrate in the upper Eccca and Beaufort Groups (Adelaide and Tarkastad Subgroups), although some dykes are present in the lower Eccca and Dwyka Group. This indicates that the dykes propagate laterally along strike and not vertically (Woodford 2002).

Hydrology

The Karoo is characterised by its lack of surface water. The Karoo is drained by ephemeral rivers that are normally dry and flow at irregular intervals. Runoff occurs in shallow, sandy, ephemeral channels and sheet wash surfaces. In the proposed Ryst Kuil prospecting area, the most important drainage is the Sout River.

Runoff generally occurs as short-lived flows of varying intensity in response to rainfall in the catchment area. The Rietkuil area drains towards Leeu-Gamka via a number of ephemeral streams (such as the Rietkuil River, Boesmanskop River and Vlaefontein River).

Substantial groundwater resources exist within the Ryst Kuil Channel and specific measures will be required to protect this valuable resource.

The Kareepoort block operations drain into the Kariega River, whereas the Quaggasfontein block drain towards the Kwagga River. The Southern block drains into the Gamka and Buffels Rivers, whereas Matjieskloof drains into the Teekloof River. The Kantkraal block operations drain into the Amos River.

Regional and national context

Groundwater in the vicinity of the Sout River has electrical conductivity (EC) levels generally greater than 500 mS/m (BRGM, 1977). BRGM (1977) reported that the vertical quality variation within the Beaufort Group Aquifer can be significant, whereby groundwater towards the bottom of boreholes may be fresher than that towards the top (where the rocks are more weathered and closer to the alluvial aquifers). Elevated EC levels along the Sout River may be attributed to evaporation along the river, or drainage of the primary aquifers which is salty due to the evaporation, or the presence of fertilizers due to irrigation (BRGM, 1977). Based on the hydrochemistry of the Sout River and the underlying primary aquifers, it was shown that they are strongly hydraulically connected.

Using quality data from the National Groundwater Data Base (NGDB), it is interpreted that the dolerite ring structure between the Hannekuil East and Nieuw Jaars Fontein ore bodies may act as a hydraulic barrier. Based on the groundwater quality spatial distribution, groundwater within the structure is of a better quality than that outside the ring. Groundwater quality improves further away from the Sout River and the associated vlei.

Surface water quantity

All rivers in the study areas are non-perennial, i.e. rivers that only exist for a few days following a storm event.

The major river channels that go through the Ryst Kuil study area are the Amos, Juriesfontein, and Sout Rivers. The Amos and Juriesfontein Rivers drain in a south-easterly direction, while the Sout River drains in a southerly direction towards the Sout River vlei. The two watercourses draining the area in the vicinity of ore bodies, are the Amos River (about 500 m to the south of an ore body), and the Juriesfontein River (crossing on top of an ore body). The location of the proposed mining operations and the watercourses are shown in Figure 6 17.

The Amos River is characterised by low hydraulic gradients and consequently only fairly heavy rain will induce any significant surface runoff. The major river channels at the Rietkuil study area are the Boesmanskop and Gamka Rivers which drain in a southerly direction.

Streamflow

The mean annual runoff (MAR) for the different rivers was not measured. It is therefore necessary to assume that the rainfall-runoff response of the catchment is the same as that of the regional rainfall-runoff response as determined in the WR90 project (Midgley, Pitman & Middleton, 1994).

Using rainfall-runoff response parameters from the WR90 project, the runoff for the different rivers was simulated using the WRSM90 model. MAR for the different rivers are presented in Table 6 1.

Normal Dry Weather Flow

The normal dry weather flow is defined as the flow that occurs 70% of the time in the three driest months (namely May, June and July). No flow occurs in any of the watercourses during these three months.

Flood Peaks and Volumes

The Regional Maximum Flood (RMF) for each of the catchments was determined using the Kovacs TR137 method. Table 6 2 summarises the various peaks and volumes for their respective catchment nodes.

SCS Method was used to determine volumes for their respective catchment nodes for catchments having catchments smaller than to 500 km². Peak flows were estimated using the TR137 method.

6.4.7 Floodlines

Full floodline modeling to delineate 1 in 100 year floodlines was not feasible at this stage. This is due to a lack of detailed contour mapping, exacerbated by the fact that the area to be modelled is very flat. Areas sensitive to flooding were identified as any area within 100m of a river or water body. Figure 6 18 - Figure 6 22 shows the 100 m buffer area around the water bodies in the Ryst Kuil Channel.

The sensitive areas were identified:

The Quaggasfontein operation intersected by the Kwagga River, the Bokvlei Orebody which is intersected by the Juriesfontein River, the Niewer Jaars Fontein Orebody, intersected by the Skilpadkop River, and the Haanekuil West Orebody intersected by the Sout River.

6.4.8 River Diversions

River diversions on the Kwagga, Juriesfontein, Skilpadkop and Sout Rivers will have to be planned in future.

6.4.9 Surface Water Use

No reliable water use is possible from the various rivers in the vicinity of the mine due to the highly seasonal river flow. Nevertheless it is to be noted that numerous farmers from the area do have their own water dam.

6.4.10 Water Authority

The Department of Water and Sanitation (Western Cape Province) is the responsible water authority for most of the application blocks with Department of water and Sanitation (Eastern Cape) responsible for the Kareepoort Block, and the Beaufort West Local Municipality supplies potable water to the area.

Wetlands

No wetlands are known to occur within the affected catchments.

Surface water quality

The Rystkuil Project is located in an area which is currently predominantly used for agriculture. The streams that flow through the proposed mining area are non-perennial and therefore surface water usage from these streams could only take place during and for short periods after rainfall.

Potential use of surface water by surrounding communities and the environment is as follows:

domestic use is mainly limited to the informal communities (bathing and laundry), as farmers or other parties use or rely mostly on groundwater for domestic purposes due to the ephemeral nature of the streams,

livestock watering is possible only where goats and cattle drink from the streams when flow occurs, groundwater is the major source of irrigation water, members of the community could possibly make use of water from streams for irrigation during rainfall events and aquatic ecosystems do not exist as the rivers are dry except during storm events.

During the site visit in August 2007, no surface water quality samples could be taken as the streams were not flowing at the time. Limited surface water quality information is available for the area. Only four monitoring points from the Department of Water Affairs and Forestry (DWAF) database exists in this area:

Leeu-Gamka Dam (on the Leeu River),
Gamka Dam (on the Gamka River) and
Sout River (at Kamferskraal and at Klipkraal).

Only one of these rivers falls within the actual study area. The positions of the water quality monitoring points are indicated in Figure 6 14. As this will be a new mining activity the water quality is compared to DWAF Water Quality Guidelines for the identified users in the area. In line with the National Environmental Management Act (NEMA) Precautionary Principle, the guideline value for the most sensitive user/condition for each constituent monitored (identified resource protection value) is used for water quality assessment.

Table 7 1 summarises the different water quality guidelines and the identified resource protection value (IRP) associated with each constituent. Reasons for exceptions to the Precautionary Principle in terms of setting the IRP are cited below:

irrigation guidelines for TDS are overly conservative for subsistence farming, for which a wide range of suitable crops, tolerant to impaired water quality can be cultivated,
the rivers within the mining area would normally support only a limited aquatic ecosystem due to their ephemeral nature and
the aquatic ecosystem guidelines are considered overly stringent and unrealistic for moderately and significantly modified catchments.

The accepted approach for comparing water quality data to guideline values is for the 95th percentile values to be used for acute impacts and median values for chronic impacts (DWAF, Report number 30179 Date 15/12/08). When compared to the IRP (DWAF, 1999), the following trends are apparent: the Gamka Dam sampling point displays very good water qualities, well within the IRP, except for the Gamka Dam, the other monitoring points had 95th percentile values which exceeded the IRP in terms of sodium, the sample taken in the Sout River at Klipkraal had mean and 95th percentile values exceeding the IRP for both chloride and sodium, water quality in upper reaches of the Sout River is generally of higher standards and becomes mineralised downstream as a result of geology and evaporation from the river and it must be noted that the streams crossing the proposed mining areas are dry for most of the year and normally only flow directly after a rain storm.

TRAFFIC

All the existing intersections are stop controlled intersections with stop-control on the minor roads. All the paved roads in the site vicinity are two lane roads one lane per direction.

Existing Cross Sections and Surface Conditions

The N1 has 3.7m lanes with 2m paved shoulders and the N12 has 3.3m lanes with 2m gravel shoulders. All Provincial trunk roads and main roads also has 3.3m lanes with gravel shoulders. The gravel roads is typically 8m wide with narrower sections in some areas. Refer to Photo 1 to 4 in Appendix B for the typical cross-section of the major roads in the site vicinity.

Existing Traffic Volumes

The Annual Average Daily Traffic (AADT) and peak hour traffic volumes along the major roads in the area are summarised in the Table 2 below.

These volumes are low and there is sufficient spare capacity along the road network to accommodate increases in traffic volumes. Based on historical traffic count information along the roads in the site vicinity, the traffic volumes along the roads in the site vicinity have not changed much over the past 10 years. See the Graphs in Appendix C for illustrations of the daily variation in traffic flow along some of the major roads

For all references to Figures and Tables please see Appendix 15.

(b) Description of the current land uses.

The current land use in the application area is in its entirety agricultural. The farm land is used for small livestock farming which includes sheep and goats. In addition to these stock animals, free roaming spring buck also frequent the application area.

Soils are subject very shallow effective depth within semi-arid climatic conditions and are therefore mainly utilized for sheep farming.

(c) Description of specific environmental features and infrastructure on the site.

Infrastructure

Infrastructure with the application area is limited to two main activities.

Agricultural Activities

- Fence lines
- Access roads
- Stock watering points and windmills (some cement and plastic storage dams)
- Homesteads
- Kraals

Mining Activities

- Historical decline shaft (Camden Shaft 1970's)
- Crushing and screening superstructure (1970's)
- Prospecting bore holes
- Prospecting access routes
- Ventilation shafts (at Rystkuil)

Other Environmental Features include the following:

Geo-hydrology

Groundwater is a very important source, sometimes the only source, of potable water for rural communities, farms and towns in South Africa. The Karoo aquifers, which underlie approximately 50% of South Africa, can therefore be an important source of water for these communities. Unfortunately, this source is usually considered unreliable. This view can be ascribed to the complex geometry of these aquifers. This geometry was the result of two factors: the sedimentary processes responsible for the deposition of the formations, and the intrusion of dolerites at the fragmentation of Gondwanaland during the Jurassic age.

All indications are that the intrusion of the dolerites was caused by the widespread volcanism, at the beginning of the Jurassic Age, that ended the Karoo sedimentation. This magmatic activity was caused by the tectonic movement of Gondwanaland, during the late Triassic to early Cretaceous ages, which seems to have occurred in pulses. This interpretation is supported by the fact that one can clearly distinguish three types of dolerite intrusions in the Karoo landscape - sills, ring dykes and linear dykes. The ring dykes are conventionally regarded as undulating dolerite sills. However, a review of the historical evolution of the Karoo Supergroup of geological formations, suggested that it may be more natural to interpret the ring dykes as the peripheral dykes, often associated with laccolithic intrusions. This suggests that both the sills and ring dykes intruded as laccoliths, while the linear dykes intruded through matrix melting. This interpretation may be controversial, but has the advantage over conventional interpretations in that it provides a natural explanation for the existence of the structures, without invoking some rather esoteric mechanisms.

The contact zones of the ring dykes are often metamorphosed, which suggests that the temperature of the intruding magma was very high. It is thus virtually impossible to drill successful boreholes near ring dykes, especially positively weathered ring dykes.

The contact zones of linear dykes, on the other hand, are usually highly fractured. Most boreholes in Karoo aquifers are consequently sited along the linear dykes, because they are easy to detect, and there is a higher probability to strike a fracture near a dyke. However, the dykes are often impermeable and could thus act as a restrictive boundary for groundwater flow.

Karoo formations are best described as a heterogeneous, anisotropic and slightly fractured porous medium. The presence of horizontal fractures, moreover, implies that Karoo aquifers must always be viewed as multi-layered aquifers.

Surface Water

The major river channels that go through the Ryst Kuil study area are the Amos, Juriesfontein, and Sout Rivers. The Amos and Juriesfontein Rivers drain in a south-easterly direction, while the Sout River drains in a southerly direction towards the Sout River Vlei. The watercourse draining the area in the vicinity of the Bokvlei ore body, is the Juriesfontein (crossing on top of an ore body).

Streamflow

The mean annual runoff (MAR) for the different rivers was not measured. It is therefore necessary to assume that the rainfall-runoff response of the catchment is the same as that of the regional rainfall-runoff response as determined in the WR90 project (Midgley, Pitman & Middleton, 1994). Using rainfall-runoff response parameters from the WR90 project, the runoff for the different rivers was simulated using the WRSM90 model.

Normal Dry Weather Flow

The normal dry weather flow is defined as the flow that occurs 70% of the time in the three driest months (namely May, June and July). No flow occurs in any of the watercourses during these three months.

Flood Peaks and Volumes

The Regional Maximum Flood (RMF) for each of the catchments was determined using the Kovacs TR137 method. The various peaks and volumes for their

respective catchment nodes will be identified. SCS Method was used to determine volumes for their respective catchment nodes for catchments having catchments smaller than to 500 km². Peak flows can be estimated using the TR137 method.

Floodlines

Full floodline modeling to delineate 1 in 100 year floodlines was not feasible at this stage. This is due to a lack of detailed contour mapping, exacerbated by the fact that the area to be modelled is very flat. Areas sensitive to flooding will be identified as any area within 100m of a river or water body.

Sensitive area identified is intersection of the Bokvlei Orebody and the Juriesfontein River.

River Diversions

River diversions is not foreseen in the Eastern block area.

Surface Water Use

No reliable water use is possible from the various rivers in the vicinity of the mine due to the highly seasonal river flow. Nevertheless it is to be noted that numerous farmers from the area do have their own water dam.

Water Authority

The Department of Water and Sanitation (Western Cape Province) is the responsible water authority, and the Beaufort West Local Municipality supplies potable water to the area. The project area is located in the L11F, L11G, L12A, L12B, J21B, J21C, J21E Quaternary Drainage area with planned impacts in L11G, L12A and L12B.

Wetlands

No wetland impacts are known to occur within the project site.

Surface water quality

The Kareepoort Block Project is located in an area which is currently predominantly used for agriculture. The streams that flow through the proposed mining area are non-perennial and therefore surface water usage from these streams could only take place during and for short periods after rainfall.

Potential use of surface water by surrounding communities and the environment is as follows:

- ~ domestic use is mainly limited to the informal communities (bathing and laundry), as farmers or other parties use or rely mostly on groundwater for domestic purposes due to the ephemeral nature of the streams,
- ~ livestock watering is possible only where goats and cattle drink from the streams when flow occurs,
- ~ groundwater is the major source of irrigation water, members of the community could possibly make use of water from streams for irrigation during rainfall events; and
- ~ aquatic ecosystems do not exist as the rivers are dry except during storm events.

During the site visit, no surface water quality samples could be taken as the streams were not flowing at the time. Limited surface water quality information is available for the area. Only four monitoring points from the Department of Water and Sanitation (DWS) database exists in this area:

- ~ Leeu-Gamka Dam (on the Leeu River),
- ~ Gamka Dam (on the Gamka River) and
- ~ Sout River (at Kamferskraal and at Klipkraal).

Only one of these rivers falls within the actual study area.

The water quality monitoring points will be indicated, as this will be a new mining activity the water quality is compared to DWA Water Quality Guidelines for the identified users in the area. In line with the National Environmental Management Act (NEMA) Precautionary Principle, the guideline value for the most sensitive user/condition for each constituent monitored (identified resource protection value) is used for water quality assessment. Reasons for exceptions to the Precautionary Principle in terms of setting the IRP are cited below:

- ~ irrigation guidelines for TDS are overly conservative for subsistence farming, for which a wide range of suitable crops, tolerant to impaired water quality can be cultivated,
- ~ the river within the mining area would normally support only a limited aquatic ecosystem due to their ephemeral nature and the aquatic ecosystem guidelines

are considered overly stringent and unrealistic for moderately and significantly modified catchments.

Palaeontology

Small but palaeontologically important outcrops of the Cape Supergroup occur on the southwestern margins of the Northern Cape (E.g. Bokkeveld Plateau and Onder Bokkeveld regions). These sediments of Early Ordovician to Early Carboniferous age (c. 480 . 375 million years ago) were laid down within a shallow basin on the margins of the southern Supercontinent Gondwana, which at the time was drifting into high southern latitudes, towards the South Pole. Apart from impoverished trace fossil assemblages (E.g. arthropod trackways and burrows), fossils are sparse throughout the Early Ordovician to Early Devonian Table Mountain Group which is dominated by fluvial to occasionally estuarine sandstones. Post-glacial mudrocks of the Late Ordovician Cederberg Formation have yielded an important biota of exceptionally well-preserved primitive jawless fish, water scorpions and other invertebrates in the Western Cape. This unit also extends fractionally into the Northern Cape, where it is probably also highly fossiliferous. Alternating mudrocks and impure sandstones of the Early to Mid Devonian Bokkeveld Group contain world class assemblages of shallow marine trace fossils attributed to trilobites, starfish, molluscs and various unidentified burrowing invertebrates. Moulds of invertebrate shells (trilobites, brachiopods, molluscs etc) also found here closely resemble those from similar-aged beds elsewhere in Gondwana, such as present-day South America, Antarctica and the Falklands Islands. These once closely-connected areas all belong to what is known as the Malvinokaffric Faunal Realm or Province. Important remains of primitive fish (E.g. sharks, armour-plated placoderms, bony fish) and early land plants occur in possible deltaic to estuarine beds within the upper Bokkeveld succession. The Mid to Late Devonian Witteberg Group sediments are characterised by an abundance of shallow marine trace fossils (notably Spirophyton), though fragmentary land plants (E.g. lycopods) and impoverished shelly invertebrates also occur locally. By the time these sediments were deposited, the Cape Basin was situated close to the contemporary South Pole.

During an interval of some 150 million years, from Late Carboniferous through to Early Jurassic times, deposition of a very thick succession of Karoo Supergroup sediments took place within a number of intra-continental basins in the Northern Cape. The most extensive of these was the Main Karoo Basin. This basin now occupies the southern half of the province and in ancient Karoo times it was situated within the interior of the; Supercontinent Pangaea. The earliest Karoo sediments . massive glacial tillites of the Permocarboniferous Dwyka Group . are largely unfossiliferous, although thin intervals of interglacial and post-glacial mudrocks yield sparse fossils of marine invertebrates and fish (E.g. near Douglas) as well a small range of trace fossils generated by arthropods and fish.

Reddish sandy and pebbly glacial outwash sediments contain plant fossils (leaves, wood and other debris) of the Glossopteris Flora that soon colonised southern Pangaea following the final retreat of the Permocarboniferous ice sheets. Post-glacial flooding of the Karoo Basin established the Mid Permian Ecca Sea, stretching from southern Africa across to, then closely adjacent, South America. This extensive, but for the most part shallow, inland waterway was comparable to the modern Caspian Sea and was likewise brackish to freshwater for most of its existence. Sediments of the Ecca Group in the Northern Cape contain a wide range of fossils, from petrified tree trunks, pollen, spores and other Glossopteris Flora plant debris that was blown or rafted offshore during storms to moderately diverse trace fossil assemblages. Many of these traces are attributable to fish or non-marine arthropod groups such as crustaceans, king crabs and predatory eurypterids (water scorpions), the last of which reached lengths of two meters or more.

There is also a small range of molluscan, crustacean and insect body fossils, primitive bony fish, and . best known of all . well-preserved skeletons of aquatic mesosaurids. Early finds of these small swimming reptiles in both South Africa (Northern Cape, near Kimberley) and South America were made in the late

nineteenth and early twentieth centuries. They convinced some scientists, notably the famous South African geologist Alex du Toit - of the previous existence of a southern supercontinent, Gondwana, long before the idea of continental drift was accepted by most geologists. Tantalising, waterworn bone fragments and traces attributable to large, crocodile-sized temnospondyl amphibians are also recorded from the uppermost Ecca beds.

Infilling of most of the Ecca Sea by deltaic deposits established dry land across most of the Main Karoo Basin by Late Permian times. The fluvial and lacustrine deposits of the succeeding Beaufort Group are internationally famous for their exceptionally rich record of Permian vertebrates. These included various fish groups (notably primitive bony fish called palaeoniscoids), large amphibians which were the dominant aquatic predators, and heavily-armoured, rhino-like herbivorous reptiles called pareiasaurs. The most notable terrestrial animals, however, were a fascinating spectrum of herbivorous and carnivorous mammal-like reptiles or therapsids that dominated terrestrial ecosystems for much of the Permian interval. Their bones and teeth are common enough in the Karoo for them to be used as age-specific zone fossils for subdividing the Beaufort Group succession. As before, Beaufort Group vegetation was dominated by the Glossopteris Flora, although environmental circumstances rarely favoured the preservation of abundant plant fossils. These Beaufort sediments and their rich fossil biotas document the establishment of the oldest known complex ecosystems on land. They also provide an unparalleled record of the environmental and biological consequences of two Late Permian mass extinction events around 260 and 251 million years ago. The second of these, the end-Permian event, was the most catastrophic extinction ever recorded in the history of complex life on Earth and defines the end of the Palaeozoic Era. In the Northern Cape post-extinction fossil biotas of Early Triassic age - including various amphibians, therapsids and crocodile-like reptiles - are preserved only in the easternmost parts of the province.

Younger Triassic and Jurassic sediments of the Karoo Supergroup, together with their early mammal and dinosaur fossils, have unfortunately been lost to erosion in this region.

Karoo sedimentation was brought to a spectacular end by the eruption of vast volumes of basaltic lavas in the Early Jurassic Period, peaking around 183 million years ago. These volcanic eruptions heralded the approaching fragmentation of Gondwana and were probably the cause of a contemporary global extinction event. While the lavas themselves are not preserved in the Northern Cape, an extensive network of igneous intrusions associated with this period of intense magmatic activity are found here, most of them cross-cutting sediments of the older Karoo Supergroup. Unsurprisingly, these sills and dykes of the Karoo Dolerite Suite are unfossiliferous. Scattered, smaller scale igneous activity continued during the succeeding Cretaceous and earliest Neogene Periods. Much of this activity was related to rising plumes of hot mantle rocks beneath southern Africa as well as to incipient rifting of western Gondwana into separate African and South American continental blocks. The explosive intrusion of numerous kimberlite pipes in the Northern Cape interior (E.g. Kimberley, Victoria West and Gordonia areas) from Early Jurassic to Late Cretaceous times is of palaeontological as well as economic significance. Crater lake sediments preserved above some younger igneous pipes (E.g. Stompoor, Kangnas and Arnot pipes in Bushmanland, Salpeterkop near Sutherland) contain valuable fossilised remains of aquatic animals (fish, frogs, turtles, crustaceans etc) as well as of the surrounding vegetation and fauna (E.g. dinosaurs, birds, angiosperm leaves and pollens). These fossil biotas provide a rare glimpse of early African wildlife before and after the major extinction event that brought the Mesozoic Era to a close (65 Ma). (after SAHRA Palaeotechnical Report (March 2009), Palaeontological Heritage Of The Northern Cape, J. Almond & J. Pether).

(d) Environmental and current land use map.

(Show all environmental, and current land use features)

See Appendix 19 for the Land Use Map.

v) Impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts

(Provide a list of the potential impacts identified of the activities described in the initial site layout that will be undertaken, as informed by both the typical known impacts of such activities, and as informed by the consultations with affected parties together with the significance, probability, and duration of the impacts. Please indicate the extent to which they can be reversed, the extent to which they may cause irreplaceable loss of resources, and can be avoided, managed or mitigated).

HYDROLOGY (See Appendix 18 for all Figures and Tables)

Construction phase

During the construction phase, the following activities, which may impact detrimentally on the health of people or the environment, will be conducted:

- Construction of haul roads, workshops, diesel tanks, weighbridge etc
- Preparation of the subsoil and overburden stockpiling area
- Construction of the storm water diversion trenches
- Construction of settling dam
- Excavation of the initial box-cut; and
- Formation of the topsoil, subsoil and overburden stockpiles.

Construction of haul roads:

Haul roads will be constructed to link with existing roads to transport uranium from the opencast to the plant at the existing operation. The haul roads will be 6m wide and cover a distance of approximately 1 000m. The topsoil stripped from the construction of these haul roads will be utilised to form berms alongside these roads. The haul roads will cover a total area of approximately 0.6 ha.

Preparation of subsoil and overburden stockpiling areas

Topsoil from the subsoil and overburden-stockpiling area will be stripped to a depth of 300mm, and stockpiled on the topsoil stockpile. The subsoil and overburden stockpiling areas will cover a total area of approximately 3.6 ha, thus 10 800m³ of topsoil will be stripped and removed. The position of the subsoil and overburden stockpiling areas are indicated in the Mine surface infrastructure layout plan (Figure 6 8 - Figure 6 13).

Construction of the Storm water diversion trenches

The Storm water diversion trench will have a basal width of 1.0m, to a maximum depth of 1.0m. The upslope batter of the trench will be sloped at 1.4 and the down slope batter at 1:1. All material excavated during the construction of the trench will be used to construct a 1.0m high berm on the down slope side of the trench. This trench will divert all surface water runoff around the opencast area and stockpiling area.

Construction of the settling dam

Tasman uranium mine will appoint a civil engineer to oversee the construction of the settling dam and the storm water collection berms and trenches. The civil engineer will approve and confirm the construction of the settling dam, the storm water collection berms and trenches to design specifications. Before a box-cut can be excavated the evaporation dam, storm water berms and trenches must have been constructed. Geotechnical survey will be conducted on the soil and the results of the survey will be utilised to select appropriate material to be used during rehabilitation and construction. The surface area of the settling dam will be approximately 1.3 ha. The appointed civil engineer will sign off the constructed settling dam and the storm water berms/trenches after completion. All the design specifications and plans will be submitted to the Department of Water and Sanitation during the applications of water use licenses.

Excavation of the initial box-cut

An initial box-cut will be constructed on the northern section on the reserve. The box-cut will be approximately 40m wide and 300m long. Topsoil will be stripped to a depth of 300mm, thus approximately 3 600m³ will be removed to the topsoil stockpile. Subsoil will be stripped from the box-cut and stockpiled separately. Approximately 8 400m³ of subsoil will

be removed from the box-cut. Hard overburden material will be drilled, blasted and removed to the overburden stockpile. Approximately 202 651m³ of overburden material will be stockpiled on the overburden stockpile. Finally all uranium material will be drilled, blasted and removed to the processing facilities.

Topsoil, subsoil and overburden stockpiles

Note that topsoil will be removed from all stockpiling areas prior to formation of soft and hard overburden stockpiles. All topsoil, subsoil and overburden material will be removed during the construction phase. These will be stockpiled separately, to the west of the proposed operation (refer to Mining Layout Plan, Figure 6 8 - Figure 6 13). The size of the various stock piles and open pit are depicted in

No new impacts are expected during the establishment of the underground operation.

Adit will be excavated through the highwall of the open cast pit. All other infrastructure required for underground operations are in place due to the open cast operation, a prefabricated pool would be utilised as sump to store water for the continuous miner as part of water recycling process.

Operational Phase

In terms of the supply of mine water to the Rietkuil and Ryst Kuil areas, there are three distinct interconnected primary aquifers, which are located along river channel and underlie the Salt River vlei. Furthermore, two secondary aquifer systems are the Beaufort Group Aquifer and the Karoo Dolerite Aquifers. The Rietkuil study area may be divided into two groundwater units, divided by the northern dolerite structures. Due to the limited spatial extent of the primary aquifers along the rivers in the Rietkuil area, it is expected that their thickness is negligible. These aquifers are therefore not regarded as separate resource units. The Ryst Kuil study area may be divided into three resource units, based on the occurrence of the Beaufort Group Aquifer, thick (> 10 m) Salt River Aquifer, and massive outcropping dolerites towards the eastern extremity of the area.

Yields of boreholes drilled in the primary aquifers are also high, i.e. > 5 L/s. Randomly distributed high yielding boreholes in the Beaufort Group Aquifers have also been reported by farmers in the study area. No correlation between yields and geology could be made (SRK, 2007a).

The groundwater development potential along the Salt River Aquifer is good with high borehole yields and aquifer thickness being favourable. However, as groundwater quality is poor, desalinisation of the groundwater may be required if the groundwater is to be used for domestic purposes at the mine(s). The primary aquifers are most prominent along the Hannekuil West and East ore bodies.

Options such as desalination will also need to be looked at as the primary aquifer groundwater is brackish.

It was estimated that recharge for the Rietkuil study area is 33 Mm³/a (2.3 % of MAP), and that for the Ryst Kuil study area is 64 Mm³/a (2.4 % of MAP) (SRK, 2007b).

The Utilisable Groundwater Exploitation Potential for the Rietkuil study area is ~ 18 Mm³/a, and that for the Ryst Kuil study area is ~ 46 Mm³/a (SRK, 2007b).

Apparent high transmissivity values will mean that drawdown propagation could be extensive but of limited depth. Low hydraulic gradients, particularly in the Ryst Kuil area, should mean that any contaminant migration will be slow.

The results of the modelling exercises (SRK, 2007b) indicate that the impacts on groundwater due to mining of the ore may include the following:

- Eastern Block

Ryst Kuil

- “ The zone of influence extends for up to ~6 km, to the south-east and south-west.
- “ 34 private boreholes may be affected by dewatering with draw-downs of 1 to 50 m.
- “ Maximum inflows will vary from ~220 to 2000 m³/day with EC in the range 70 to 300 mS/m.
- “ Contamination from mine activities could impact 8 private boreholes, excluding effects of migration via preferential pathways.

Groundwater resources are generally locally available and utilised in small quantities, occur at shallow depths and vulnerable to overexploitation and drought (Golder, 2011).

The Karoo lithologies are characterised by very low primary porosity and permeability, <0.1% to <0.02%. Deep core holes (up 5550m) drilled in the late 60s confirmed that the permeabilities of the sandstone/siltstone are very low, and vary from 0.00 . 2 m/d for the Beaufort Group and 0.00 . 0.1m/d for Ecca Group. Overall the deep core logs have

confirmed that the vast majority of the deep Karoo sequence is composed of tight and cemented strata.

Weathering and fracturing within the Karoo rocks provides secondary porosity and permeability.

This zone controls the presence of groundwater and groundwater is widespread in the upper 50m and to a lesser extent the upper 100m of the geological profile. An analysis of fracture frequency struck in boreholes shows that the highest number of fractures are present with 10m of the water level, and reduces rapidly once below 50m. This confirms the majority of groundwater is present within 50 . 100m of ground surface.

The fractured contact zones of dolerite sills and especially dykes represent favoured targets for the siting and drilling of water supply boreholes.

The study has indicated:

- “ The depth of groundwater supply boreholes is mostly <150m, with the vast majority of boreholes (94.5% of 1756 records) reportedly <100m deep.
- “ Sustainable borehole yields are mostly between 0.5 and 2 L/s.
- “ Groundwater levels are generally shallow with 99% of reported levels <30m (1712 records) confirming that the groundwater resources are driven by rainfall recharge.
- “ Groundwater quality is variable but mostly potable. 82% of water is Class 0 or 1 and only 4.4% reported as Class 3 or 4 (2356 records).
- “ Groundwater is widely used for domestic, livestock watering and occasional irrigation. Registered annual water use is mostly agricultural (15.785Mm³) with 0.243Mm³ domestic use.
- “ Groundwater occurrence is controlled by the presence of secondary permeability associated with weathering and fracturing.
- “ The contact zones of dolerite dykes often represent linear aquifers and are an important target for the drilling of water supply boreholes.

Hannekuil

- “ The zone of influence extends up to ~6 km to the north and south.
- “ 11 private boreholes may be affected by dewatering with draw-downs of 5 to 65 m.
- “ Maximum inflows will vary from ~15 to 1900 m³/day, with an EC range of 300 to 500 mS/m, possibly lower.
- “ Only 2 boreholes are likely to be affected by mine contamination, excluding migration via preferential pathways.

BIODIVERSITY (See Appendix 10 for all Figures and Tables)

Loss of habitat and floral species of conservation concern due to removal of vegetation

Sensitive Receptor/s

Loss of habitat and plant individuals from a variety of floral species, including those of conservation concern, will occur as a direct result of vegetation clearing. Apart from the actual loss of species and habitat, secondary effects of vegetation loss can occur including the increased potential for soil erosion to take place, which increases the risk of additional and recurring habitat loss. In an extremely arid environment, the Karoo systems are susceptible to both stochastic and secondary effects (e.g. through sedimentation of waterways and the creation of suitable conditions for the establishment of alien and/or invasive species). Habitat fragmentation will occur whenever the connectivity between portions of habitat has been interrupted.

These areas have in most cases experienced some impacts associated with the current animal husbandry (i.e. sheep farming) and subsequent grazing impacts. In addition, habitat fragmentation and loss of connectivity have already taken place as a result of existing fences. The majority of the project infrastructure is likely to encompass a relatively small footprint and haul roads are likely to be comprised primarily of existing roads (upgraded or otherwise). In addition, the previous crushing facility is destined for rehabilitation to be placed back online, without increasing the current footprint area. Most of the project infrastructure encompasses habitats representing medium ecological sensitivity (reference to habitat sensitivity map) and haul roads are likely to encompass existing roads. Due to the dispersed nature of the Study Areas, it must be stated that the construction and operation of the pits and crushing facilities will inevitably contribute to the current impacts associated with the existing land uses and cumulative impacts should therefore be taken into consideration.

Overall, the habitats are botanically well connected within the landscape and this should be maintained for the construction and operations phase. From a faunal perspective, the connectivity is based upon prevailing environmental conditions within the landscape as well

as current human activities such as roads and fences. It is vital to highlight the importance of maintaining the status quo of the system, especially where species of conservation concern are prevalent.

Habitat lost will result in displacement of fauna and avifauna, with a greater shift to an alien/invasive and/or synanthropic species composition than what has already taken place as a result of the existing road infrastructure.

Project Attribute / Activity

A number of project activities are expected to lead directly to habitat loss as a result of vegetation removal. During the construction phase these include:

- “ Creation of access roads and servitudes;
- “ Project infrastructure construction;
- “ Bridge construction;
- “ Establishment of construction camps and laydown/parking areas;
- “ Creation of borrow pits; and
- “ Stochastic events such as fire

During the operational phase minimal additional habitat loss will occur as a direct result of the operation of the pits and/ or crushing facility. However, once the initial clearance has taken place, it is unlikely that further direct clearance will occur.

Embedded Controls

The following embedded controls have been included in the project design:

- “ Planning in the placement of construction camps and laydown areas to exclude sensitive habitats;
- “ Preservation of high value plant species in situ through a pre-construction walkover and botanical survey;
- “ Relocation of Red and Orange Listed species.
- “ Soil and sediment management to limit effects of erosion arising from vegetation clearing; and
- “ Rehabilitation of cleared areas by the planting of indigenous species after construction phase.

Pre-mitigation Impact Significance

Due to the relatively small project footprints, and current impacts, it is unlikely that the habitat lost will aggravate the sound ecological connectivity although on site Red and Orange Listed species may be lost. Overall, and primarily due to the relatively small project footprint size, the significance of the impact is deemed to be Low.

Mitigation Measures

- “ Minimise the footprint of construction and operation (maintenance) activities through appropriate planning. Each activity must be well planned to determine the minimum footprint required, which must be demarcated on the ground in advance (to reduce the potential of accidental spill-over and accidental damage into surrounding areas and to allow botanical experts to carry out a final sweep of the footprint areas in order to initiate possible relocation of Red and Orange Listed species). These areas must include vehicle parking areas, turning facilities, worker's toilet facilities, worker's camps, material and equipment lay down areas etc;
- “ Embedded erosion control measures should further aim to reduce the slope of cleared areas. Re-vegetation should be conducted with suitable indigenous vegetation to form a vegetation cover that will protect exposed surfaces and attempt to limit the loss of topsoil during high rainfall events while simultaneously reducing sedimentation of streams/rivers. First establish a suitable ground cover of grass to protect the soil surface followed by suitable tree species to provide shade, thereby creating a structured habitat where natural successional development will ultimately result in improved habitat, connectivity and biodiversity;
- “ Maximum use of existing cleared areas, areas of disturbance and road networks should be utilised;
- “ Provide permeable fencing adjacent known sensitive habitats (reference to habitat sensitivity map) to facilitate movement of faunal species;

Several rehabilitation measures can further decrease the magnitude of the anticipated impacts resulting from vegetation clearing:

- “ Implement a construction handover plan in which rehabilitation measures are defined and budgeted for. Re-vegetation trials must be undertaken to determine the most appropriate species for a particular habitat. Species should be selected on a basis of adaptive

management. i.e. perform trial runs on several species and select those species most suitable in achieving the desired result of establishing ground cover and increasing habitat functionality. A nursery should be established to propagate selected plant species for translocation and rehabilitation. Specific planting plans and schedules for each habitat type must be determined where rehabilitation will be required;

- “ Development of an operational monitoring programme to assess success and sustainability of rehabilitation and reclamation procedures applied. This monitoring programme will aid in continuous adaption of the rehabilitation process and will demonstrate whether the rehabilitation procedures in place are successful. Critical components that need to be monitored are:
 - o Re-vegetation success. It is essential to ensure that the re-vegetated areas are successfully proliferating and not dying or succumbing to alien invasive plant competition;
 - o Control of alien and invasive species. It is very important to ensure that continued control of alien and/or invasive species is taking place after the construction phase and during the operations phase and this must therefore be monitored adequately;
 - o Water quality monitoring. Runoff into seasonal pans should be monitored to ensure that rehabilitation procedures have sufficiently controlled any pollution and sedimentation likely to occur in the surrounding water dependent habitats.
- “ Establishment of a functional plant propagation facility with the capacity to supply the required trees and plants needed for minimization of soil erosion and other rehabilitation measures;

Possibility to introduce and/or enhance the spread of alien and /or invasive species

Sensitive Receptor/s

Establishment of alien and/or invasive species is considered to be one of the greatest threats to biodiversity on the planet. Construction camps, operational support facilities (waste disposal, mess facilities, sewerage treatment) as well as the influx of vehicles into potentially sensitive habitats are associated with rodent species (e.g. house rat *Rattus rattus* and house mouse *Mus musculus*), aggressive bird species (e.g. pied crows *Corvus albus*) and other scavenger taxa (including domestic cats and dogs). The house rat (*Rattus rattus*) can become established particularly quickly under such conditions and spread to other regions by being transported within construction equipment and machinery or trucks. Domestic cats can hybridise with local African wild cats (*Felis silvestris lybica*) significantly contaminating local gene pools. Furthermore, there is an increased risk of unintentional introduction of accidentally transported alien flora through construction and operational vehicle vectors. The clearing of vegetation involved with construction creates favourable conditions for the rapid colonisation and establishment of alien and invasive vegetation, which indirectly exacerbates the extent of habitat lost and alteration of ecological cycles.

The rapid colonization of cleared areas (e.g. project infrastructure areas and homesteads) by alien and /or invasive plant species and deliberate introductions by workers and management (e.g. livestock, pets and ornamental alien plants for decorative purposes) will negatively affect the native fauna and flora populations. This effectively results in the loss of habitat through displacement of flora by alien species with the subsequent loss / removal of sensitive fauna and avifauna due to alteration in ecological lifecycles. Finally, significant potential exists for direct mortality to occur in the form of predation from feral predators as well as the spreading of diseases. Sensitive systems such as the wetlands, pans and drainage lines are more susceptible than the other habitat prevalent within the Study Area. Some species such as *Opuntia ficus indica* and various *Eucalyptus* spp are easily controlled once their presence has been established on site and before large-scale infestation takes place.

Poor waste and sewerage management practices are often associated with alien/invasive fauna species (pigeons, crows, rats and mice). These pests outcompete native fauna, can carry diseases communicable to humans (e.g. histoplasmosis and possibly encephalitis) and other native fauna and they can easily spread to neighbouring communities as they are readily transported great distances within construction equipment/machinery/ore trucks. Furthermore, solid waste processing and disposal increases the opportunity for alien invasive insects (e.g. cockroach) to establish and proliferate due to easily accessible source of food.

Project Attribute / Activity

Project activities that are expected to result in improved access for local humans include:

- “ Creation of access roads and servitudes;
- “ Increased job opportunities during construction phase; and

“ Creation of support infrastructure.

Project activities that are expected to result in the generation of favourable conditions for alien and/or invasive species include:

“ Vegetation clearance;

“ Solid waste management during construction; and

“ Transport operations along the road corridor assisting with dispersal of alien and/or invasive species.

Embedded Controls

“ No specific embedded controls exist for the management of alien and/or invasive species. This occurs in part because of the unpredictable nature of alien species colonisation which should be managed using adaptive methods in response to the severity of site specific infestation.

Pre-mitigation Impact Significance

Current levels of habitat transformation are considered to be variable but mostly intact within large portions of the Study Area. The prevailing impacts affecting habitat integrity are more due to the current livestock agricultural practices rather than the current influence of alien/invasive species. However, some habitat degradation due to alien/ invasive species is already prevalent.

The future likelihood of inadvertent dispersal of alien invader species along road servitudes (especially transecting water courses, drainage lines and wetland/pans) to other natural areas is high. Uncontrolled spread of invasive and alien plant species serve to effectively "remove" utilizable habitat from native flora and fauna. This is because many invasive plants outcompete native vegetation and are either noxious or grow in such dense stands that foraging within them by native fauna is not possible. Alien invasive plants attract few native invertebrate species which can feed on them and thereby reduce the prey base available for insectivorous native fauna.

The significance of this impact will be Medium for the entire construction as well as operational phase of the development due to the prevalence of undesirable alien plant species within the region and the potential regional spread of these plants via the construction and maintenance trucks / vehicles transporting product. Due to the extreme and ecologically harsh environmental conditions within the greater Study Area, It is unlikely that alien and invasive plants can easily establish within the ecosystem, with only a small number of species expressing suitable traits for rapid and uncontrolled colonisation.

The likelihood that synanthropic mammals and avifauna will be attracted to construction camps and project infrastructure and is high since such species already exist in high densities within the region. All the effects previously described ensure that this impact is of High significance.

Mitigation Measures

“ Devise and implement an alien and /or invasive plant control policy which must attempt to prevent the spread of alien/invasive plant species through mechanical and chemical treatment.

o Where herbicide treatment is required, herbicides should be selected in line with international standards and must be applied by trained personnel only. Storage and use of herbicides will be as per the manufactures instructions. Herbicides must be clearly labelled at all times and application of these herbicides must be planned in consultation with an ecologist to ensure that the environment is not adversely affected; and

o Prohibiting the transport of all live plants, seeds or vegetative material; and

o The entire length of the haul road systems, all terminals and product storage areas will require frequent monitoring for the presence of alien invader plant species, and eradication measures must be implemented where required .

“ Walk-in capture traps should be deployed wherever construction camps as well as operational infrastructure are established. Capture traps should be used in order to eliminate only alien species such as *Mus musculus*, *Rattus rattus* and *Rattus norvegicus* and not native rodents which should be released unharmed upon capture by an Environmental Control Officer. Captured alien rodent species must be killed humanely and incinerated. Rodent-specific poisons can be used inside walk-in capture traps in highly transformed areas where significant assemblages of native rodents are not expected. This will ensure that poison is not spread to the surrounding environment and/ or to native predators (reptiles, owls, mammals) causing native predator deaths (see below);

“ All rodent poison controls should be strictly monitored by the Environmental Control Officer in order to prevent poisoning of native small mammals and/or cause accidental mortalities of rodent predators such as snakes, raptors, owls, small predators and meso-predators.;

- “ All deliveries of food stuff must be subject to stringent quarantine and quality controls to avoid pests in transit;
- “ A strict zero-tolerance approach to the trade in faunal species must be implemented for all staff and contractors. This will not only avoid establishment of alien faunal species but also help control the spread of diseases;
- “ Sensitive areas such as wetlands , streams and rivers will require buffering (150 m) from construction activities and waste disposal to prevent spread of alien invasive plant species in these very sensitive and susceptible habitats;
- “ Waste, especially domestic waste, should not be stored for more than a week before being removed (by appropriate closed-bin structures) and processed according to International health standards. All areas where domestic waste is temporarily stored should be securely covered to avoid attracting birds and rodents. Trapping for rodents should be intensive and continuous around waste storage sites.
- “ Open areas should be cleared of alien and invasive plants (chemical and mechanical control, dispose of these appropriately to avoid spread) and re-vegetated with suitable indigenous plants;
- “ Continued eradication of alien rodents is advised throughout the construction and operation phases especially around infrastructure;
- “ Development of a monitoring programme to assess success and sustainability of alien and invasive species management. This monitoring programme will aid in continuous adaption of the rehabilitation process and will demonstrate whether the rehabilitation procedures in place are successful. Two of the critical components that need to be monitored are:
 - o Re-vegetation success. It is essential to ensure that the re-vegetated areas are successfully proliferating and not dying or succumbing to alien invasive plant competition; and
 - o Control of alien and invasive species. It is very important to ensure that continued control of alien and invasive species is taking place and this must therefore be monitored closely.

Post-mitigation Impact Significance

Through the implementation of physical and chemical control measures of alien and invasive plants and by preventing the spread of alien rodents during all phases of the development, impacts related to alien invasive species (such as spread of diseases) can be greatly reduced. It is unlikely that the threat of alien and invasive species will be eradicated completely due to the potential rapidity of colonisation and proliferation as well as the %ife of project+threat potential. However, the post mitigation significance of this impact is Low.

Loss of Fauna (bushmeat and pet trade) and loss of targeted high value flora species (tradable species [succulents])

Sensitive Receptor/s

Poaching for the purposes of this study refers to the illegal removal of fauna and flora for the purposes of sale, consumption or trade. The issue is an ever increasing problem throughout Africa and is threatening the conservation of numerous fauna and flora species. With increased access to isolated / fragmented populations of fauna and flora and with a potential transport medium (road servitudes), trade in bushmeat, collection of species for the pet trade (especially chelonians) and removal of high value floral species becomes more probable and profitable. Illegal harvesting contributes significantly to biodiversity loss (including Red-Listed species) and ultimately the loss of ecological processes at the population, community and ecosystem levels. Furthermore, loss of biodiversity will ultimately affect local human populations in regards to ecosystem services and education potential.

Project Attribute Activity

Loss of fauna and targeted high value flora species (tradable species [succulents]) and the facilitated transport of these items due to increased access provided by associated roads will largely occur as a result of upgrading of access and service roads. This can be considered to be a secondary impact of the project activities.

A few project activities are expected to lead indirectly to loss of fauna and targeted high value flora species as a result of bushmeat and logging / illegal trading respectively. During the construction phase these include:

- “ In-migration of local people due to increased access for local communities by means of temporary roads used during construction;
- “ Potential facilitated transport by means of the illegal use of construction vehicles for the export of tradable and consumable fauna and flora species

Embedded controls

The following embedded controls have been included in the project design:

“ A Biodiversity Protection Policy with action plans to prevent any and all unauthorised removal of biodiversity from the project area.

Pre-mitigation Impact Significance

It must be stated that current level of illegal consumption and trade of fauna and flora species in the region is currently not quantified. However, the potential for a highly significant increase in such activities is very high given the extreme densities of chelonians, collectible succulents and the potential for an increased presence of humans within highly sensitive areas as well as increased access. Organised worker transport may also allow for increased transport opportunities for species of tradable and consumable species. Therefore, the significance of this impact is expected to be High with regards loss of high value fauna and flora species.

Mitigation Measures

“ The transport and trade of high value floral species along the road servitudes should be monitored at designated security points and random search points. Trespassers should be prosecuted through the applicable National laws in the trade of species; and

“ The use of the servitudes by local inhabitants should be prevented by appropriate locked gates preventing unauthorised use of the road servitudes with a vehicle.

Post Mitigation Impact Significance

The post impact significance from loss of fauna and high value flora species is expected to be Low if embedded controls and mitigation measures are applied throughout the life of project.

Direct Mortality of faunal species through vehicles (or vehicle related) collision

Sensitive Receptor/s

It is axiomatic to the nature of the development (a series of spread out pits and infrastructure development areas connected by a series of public and farm roads) that vehicles will provide unavoidably high levels of logistical and project support. Vehicles are defined as support vehicles (e.g. bakkies / pickups), staff vehicles (light passenger vehicles), large and slow moving construction vehicles (such as earth moving/ drill rigs) that will be either self propelled or towed (construction phase) and large haul trucks (operations). Due to the obvious increase in vehicle presence through the project, it is unavoidable that collision related mortality will increase significantly. This factor is compounded by two extremely important factors:

- 1) There are a plethora of susceptible faunal species throughout the region, namely chelonians (tortoises and terrapins), small to medium sized nocturnal mammals and medium to large walking/flying bird species. All these species are highly characteristic of the karoo biome system where the open habitats with harsh climatic conditions are conducive to the ecology of the species. The susceptibilities are described below;

Chelonians: There are an extremely high density of terrapins (which are associated with temporary water systems) and especially tortoises which exhibit seasonal booms linked to early spring related mating and foraging behaviour. Much of the movement of these species are linked to roads due to easy movement as well as the barrier effects of fences (described below) and they are extremely susceptible to mostly diurnal moving traffic of all speeds above 40 km ph.

Small to medium nocturnal mammals: Species such as meso-carnivores (bat-eared fox, striped polecat, aardwolf, cape fox, black-backed jackal and hares) were all observed dead on the roads (both tar and dirt) road and are highly susceptible to bright lights and high speed vehicles.

Medium to large walking/ flying bird species: These species include cranes, korhaans, bustards and guineafowl. The susceptibility of these species to collision varies in accordance to the species and they are especially prone to high speed collisions.

- 2) Farm fences are designed to separate land portions, especially along different property boundaries as well as along road boundaries. These fences often are relatively impenetrable (with the exception of burrows, weak points and breakages) and approximately 1.5 metres high. Without adequate road servitude space (effectively allowing escape or buffer space for animals), animals may run to avoid vehicles and collide with fences, causing death. In addition, these fence systems funnel slow moving fauna such as chelonians onto roads which concentrate on the open surfaces, often exacerbated by roadside water accumulations and green flush vegetation. Therefore, fence systems cause both direct mortality as well as indirect mortality due to the negative association with vehicles.

In relation to site-specific sensitivity to this impact, it will be directly related to the quality of the road networks, speed limits and associated fencing.

Project Attribute Activity

The construction and to a greater extent, the product haul road operation (presence of moving trucks) is expected to result in increased fauna mortality.

Pre-mitigation Impact Significance

The quantification matrix of the impact shows that the significance of this impact will be High throughout the project but for the operational phase especially. Susceptible species have been described above. It must be stated that due to the presence of fences, even areas not allowing high speeds of vehicles exhibit High significance due to the susceptibility of the faunal species as well as the presence of fences.

Embedded controls

The following embedded controls have been included in the project design:

- “ All vehicle speeds, through the use of satellite tracking should be limited to 80 km ph (maximum).
- “ Speed humps need to be placed at pre-determined locations to force project vehicles to reduce speed.

Mitigation Measures

- “ The ECO should monitor live animal observations in order to monitor trends in animal populations and thus implement adaptable mitigation of vehicle movements.
- “ Road mortalities should be monitored by both vehicle operators (for personal incidents only) and the ECO (all road kill on periodic monitoring basis as well as specific incidents) with trends being monitored and subject to review as part of the monthly reporting. Monitoring should occur via a logbook system where staff takes note of the date, time and location of the sighting/ incident. This will allow determination of the locations where the greatest likelihood exists of causing a road mortality and mitigate against it through both the embedded measures mentioned above (reducing vehicle speeds in sensitive areas) and below (e.g. fauna underpasses, fence removals and seasonal speed reductions). Finally, mitigation should be adaptable to the onsite situation which may vary over time;
- “ Reduce direct mortalities either by removing fences in identified sensitive areas or indeed, increasing the buffer area either side of the road by 50 metres either side, in order to allow fauna to have an escape area away from impenetrable fences.
- “ Reduce direct mortalities by allowing for fauna to cross the roads, particularly where the roads cross a sensitive natural habitat (e.g. wetlands or artificial water points). This can be achieved by constructing fauna underpasses under the roads (large culverts or large open-ended concrete pipes laid into the raised roads). These underpasses should be used in conjunction with "fauna barriers" which prevent the most susceptible small fauna from crossing the roads on the surface by directing them towards the underpasses where they can cross under the roads safely. It is important to note that utilization of underpasses is strongly dependent on animal body size (larger culverts are more successful) and the surrounding habitat (Mata et. al 2005); and
- “ All staff operating motor vehicles must undergo an environmental induction training courses that includes instruction on the need to comply with speed limits, to respect all forms of wildlife (especially reptiles and amphibians) and, wherever possible, prevent accidental road kills of fauna. Dead mammals should never be handled due to the risk of rabies and snakes should only be handled after inductions have taken place due to the risks of post-mortem invenomation. Drivers not complying with speed limits should be subject to penalties.

Post-Mitigation Impact Significance

By implementing a monitoring program for recording animal activity observations (alive and dead) and applying mitigation measures to areas of high sensitivity, it is expected that the impact of collisions can be significantly reduced. Support measures focused around appropriate staff training are also extremely important for the success of the mitigation measures. Realignment of the roads may not be possible due to the dual role as public access ways. Overall, Post-Mitigation significance is expected to be Low.

Disruption / alteration of ecological life cycles (breeding, migration, feeding) due to lighting, noise and dust

Sensitive Receptor/s

Eradication of vegetation may also result from secondary effects other than direct removal. An example includes loss of vegetation or decreased nutrient content of as a result of heavy coating by dust (environmental and vehicle associated) associated with construction

activities and product transport during operations, which directly results in the loss of habitat (removal of vegetation) or indirectly through reduced utilisation of dust-coated vegetation by sensitive fauna and avifauna. This disrupts / alters the ecological life cycles of sensitive fauna and avifauna.

Construction and operation activities of project infrastructure including the operation of machinery and vehicles, earthworks, construction of infrastructure and the operation of large machinery will cause vibrations to be transmitted through the ground and sound waves through the air which can disturb certain fauna species and cause displacement of sensitive individual species. Although direct mortality is unlikely, interrupted breeding and displacement of large bodied avifaunal species is a likely impact, especially from ongoing crusher operations (as opposed to intermittent blasting of pit areas). Local atmospheric factors (e.g. wind and temperature) may increase the area of influence and should be taken into account for receptors at distances greater than 300 m. The effects of ongoing vibration and noise effects on the breeding of birds have been recorded in European environments and overwhelmingly in song birds. The impacts on large bodied African species are largely unknown.

In regards to light pollution, insects are attracted to lighting at night and in turn attract other predators (e.g. bats, toads and snakes) bringing them into close contact with humans and potentially resulting in faunal mortalities. Furthermore, lighting can blind night-migrating birds, leading to collisions with infrastructure and resulting in mortalities.

Project Attribute / Activity

During all phases of the project infrastructure construction and operation the use of heavy machinery will result in the elevation of noise and dust levels. Work at night will require illumination from portable lights. During construction this impact arises from:

- “ Earth moving equipment (light, noise and dust);
- “ Portable lighting (light);
- “ Blasting (noise and dust); and
- “ Construction vehicles (dust).

During operation this impact arises from:

- “ Crushing plant (light, noise, product dust);
- “ Support Infrastructure
- “ Vehicles (light, noise, dust).

Embedded controls

- “ Equipment with low noise emissions will be procured;
- “ Loud work stations will have sound insulation;
- “ A grievance mechanism for I and AP complaints about construction noise and dust generation will be established, filed and handled;
- “ A dust monitoring system will be implemented;
- “ Water or dust control agents will be used in working areas; and
- “ Haul roads will be sprayed on a regular basis in designated susceptible areas.

Pre Mitigation impact significance

It is likely that prevailing dust effects will cause the most significant effects on the prevailing environments, including the elimination of habitats. In addition, the scale of dust effects is significantly higher (in comparison with light and sound) due to the greater surface areas of roads in comparison to the project footprints (with the exception of the crushing plant).

In their environment and in order to function ecologically (breed, feed, demarcate territory), birds and amphibians must be able to discriminate mating calls from other background noise. Amphibians have the advantage of being able to distinguish only the calls of their species while excluding other ambient frequencies, although extremely loud noises or vibrations will have a negative impact. Birds however are susceptible to displacement effects of ambient noise as calls are crucial in the isolation of species, pair bond formation, display, territorial defence, danger, advertisement of food sources and flock cohesion. However, it is the scale of the impact that dictates the severity of the sensitivity. It is likely that localised effects of project infrastructure may be severe but will not necessarily affect the regional populations, especially of nomadic large bodied species (including those of conservation concern). Therefore, the risk of completely removing source populations from ecosystems is unlikely to be high given that the project footprints are relatively small and are located within areas of current farmlands which are themselves, subject to disturbances.

In regards to light effects, the significance will be low.

Mitigation Measures

All control measures to avoid, minimize and rehabilitate the impacts of dust and noise are already mentioned in the embedded controls sections. For lighting the following mitigation measures are required:

- “ Reduce exterior lighting to that necessary for safe operation, and implement operational strategies to reduce spill light. Use non-UV lights where possible, as light emitted at one wavelength has a Low level of attraction to insects. This will reduce the likelihood of attracting insects and their predators; and
- “ Design lighting strategies that address or minimise items such as degree of spill light, use of up lights and use of lights with red wavelengths. Down lighting is preferred as are lights with blue or green wavelength. This will reduce the likelihood of blinding avifauna.

Post Mitigation Impact Significance

Post-mitigation significance of the impact of the potential for disrupting / altering ecological lifecycles due to lighting, dust and noise pollution should be negligible to Low if all of the embedded controls and precautionary mitigation measures are applied.

General contamination of water, wetland, pan, habitat and food resources through flow of radioactive material

Sensitive Receptor/s

It is possible that accumulated or accidental contamination of wetland/pan systems may occur through sub-surface or surface flow of potentially radioactive material. Radioactive dust or waste product may, through normal hydrological processes, flow or seep into highly sensitive pans or wetlands downstream of infrastructure such as the crushing yards or indeed, the pits themselves. The use of water may be required for extraction of the product, further exacerbating the significance of the impact.

The impacts of the radioactive material contaminating wetland systems will occur downstream of the sub-surface and/ or surface flow. The impacts include:

- a) Contamination of food supplies and subsequent bioaccumulation through the faunal food chain.
- b) Long term contamination of water systems and pans

Project Attribute / Activity

The project activities that may directly contribute to the contamination of wetland/ pan systems from radioactive material include:

- “ The use of water for extraction activities causing contamination of hydrological systems linked to downstream wetland and pan systems
- “ Radioactive dust contamination into subsurface hydrology systems through normal extraction activities
- “ Normal storage of product being subjected to stochastic events (floods) causing contamination

Embedded Controls

The following embedded controls have been included in the project design:

- “ Dust suppression control measures
- “ Correct product treatment and storage
- “ Soil and sediment management to limit effects of erosion on drainage channels;
- “ Real time monitoring probes linked to remote sensing base stations need to be place in areas of sub surface and surface water flow in order to immediately detect elevated levels of contamination in order to initiate emergency measures.
- “ Emergency measures such as a tailing dam facility and other engineering solutions designed to prevent contamination must be implemented in accordance with best practice standards for uranium ore extraction and processing.

Pre-mitigation Impact Significance

The contamination of hydrological systems and the subsequent significance of such effects cannot be accurately quantified without understanding the following:

- a) The concentration of radioactive product
- b) The storage and characteristics of the project design
- c) The geohydrological attributes of the sub-surface flow regime
- d) The surface flow attributes

As drainage lines are limited in the landscape as well their potential to distribute potential contaminants, these systems are considered to be ecologically sensitive. Taking into account the limitations of knowledge concerning the above factors, the precautionary principle should still be applied to the potential impact of contamination. The significance of this impact is therefore regarded as High.

Mitigation Measures

“ Unusually, the actual mitigation measures for this specific impact may in fact cause an additional set of impacts which require separate discussion below.

Post Mitigation Impact Significance

The actual mitigation measures as well as the application of the embedded measures and best practice procedures for processing radioactive material will in most likelihood dramatically reduce the significance of this impact to Low. However, the subsequent impacts of the actual mitigation measures must be analysed in isolation.

Wetland contamination and the indirect impact of alteration of hydrological regimes as a mitigation measure for the prevention of wetland contamination

Sensitive Receptor/s

Through discussion with the project geologists and project managers, it has been stated that alterations in hydrological regime (flow of surface and sub-surface water) may be necessary in order to prevent possible contamination of wetland systems which is described as an Impact (see above). It must be stated that at this point of the study, no official site-development plan has been put forward to measure the EIA matrix against. The issue of the contamination are diametrically opposed in regards to the appropriate mitigations meaning that both the impact and the potential mitigation measures may have negative impacts. The concern is that sub-surface or surface flow of potentially radioactive material may, through normal hydrological processes, flow or seep into highly sensitive pans or wetlands.

The mitigation measures may and obstruct / alter the natural flow of water across the landscape through physical (engineering) prevention/ alterations in hydrological regime due to infrastructure. The impacts are secondary and will:

- a) Manifest downstream of the infrastructure;
- b) May, overtime prevent natural recharge of pan/ wetland systems which will therefore cause drying of downstream inundated or seasonally inundated habitats;
- c) The drying of wetlands may cause long term eradication of associated vegetation through loss of available water or loss of vital nutrients which are replenished by normal sedimentation;
- d) Loss of wetland habitat may disrupt / alter the ecological life cycles of fauna and avifauna leading to skewed ecosystem dynamics;
- e) Any diverting of water flow may create poor drainage, temporary inundations and may therefore cause further vegetation losses. These inundations may have the secondary effect of creating habitat for avifauna and aquatic avifauna which may therefore become exposed to radioactive water; and
- f) The creation of hard surfaces (including roads) may result in localised erosion.

Project Attribute / Activity

The engineering diversion activities that are expected to lead directly to alteration of the hydrological regime include:

- “ Creation of access roads and servitudes;
- “ Sub-surface elimination of drainage lines/ seep lines
- “ Berm construction;
- “ Artificial impoundments
- “ Establishment of construction camps and laydown/parking areas; and
- “ Creation of borrow pits.

Embedded Controls

The following embedded controls have been included in the project design:

- “ Placement of construction camps and laydown areas to exclude sensitive habitats such as rivers etc;
- “ Soil and sediment management to limit effects of erosion on drainage channels; and
- “ Rehabilitation of cleared areas by the planting of indigenous species after construction phase (erosion control)

Pre Mitigation Impact Significance

The alteration of hydrological regimes within the potentially affected hydrological regime effectively results in the loss of habitat and the displacement of species on a large and interconnected scale. Because drainage lines are limited in the landscape and not resilient

to perturbation they are considered to be ecologically sensitive. The significance of this impact is therefore High.

Mitigation Measures

“ The engineering solutions required to facilitate the mitigation measures are subject to further discussion with the client.

Post Mitigation Impact Significance

Considerable mitigation of this anticipated impact is captured in the embedded controls and best practise standards which will reduce the significance of the impact to Medium.

Sensitive habitat contamination/ destruction as a result of chemical spills of uncontrolled erosion/ sedimentation

Sensitive Receptor/s

This impact refers to contamination in the absence of radioactive material. Pollution, via chemicals or sedimentation, of a particular habitat can effectively "remove" a habitat from utilisation by biota as well as cause direct mortalities (poisoning) which is why it is considered as an impact of habitat loss and fauna displacement / mortality. This is of particular concern when sensitive habitats such as wetlands, pans and drainage lines are polluted because the pollution is usually spread to a larger area and therefore has a greater effect on the ecosystem than if it were contained in a small area. Negative effects on habitats associated with the haul road corridors are likely to occur as well.

Project Attribute / Activity

The removal of vegetation as a direct result of construction increases the potential for soil erosion to take place, which results in increased sediment loads (suspended solids), transporting with it nutrients and potential pollutants (dissolved/transported chemicals/compounds) into waterways and wetlands. Pollution or sedimentation of surface water, pans, drainage lines and wetland areas can affect plant growth and aquatic (and aquatic associated) organisms negatively. In addition, toxins or sediments can make surface water unpalatable and/ or toxic. While this represents an important impact from an aquatic ecology perspective, it nevertheless also heavily influences terrestrial ecological processes and species. For example, increase concentrations of suspended solids in streams may cause them to become murky or opaque which will result in the loss of foraging habitat for many piscivorous bird and fish species that hunt by sight. During all phases of the project infrastructure construction and operation as well as haul road upgrades and use, the threat of the spillage of dangerous chemicals (including hydrocarbons) from construction / maintenance machinery or the spillage of product, is inherent. In addition, the risk of human operating error (accidental) or equipment failure can lead to chemical spills e.g. diesel fuel (hydrocarbon) spills.

A number of project activities are expected to lead directly to increased sedimentation and chemical runoff. During the construction phase these include:

- “ All activities resulting in the removal of vegetation and or alteration in hydrological regimes
- “ Transportation of product which includes dust effects of driving of dirt roads
- “ Creation of product stockpiles.
- “ Servicing an operations of machinery and water related extraction techniques

During the operational phase minimal additional vegetation will be removed although the potential for rainwater runoff from earth and product stockpiles will still persist.

Embedded controls

The following embedded controls have been included in the project design:

- “ Product stockpiles will be kept as small as possible and established away from surface water drainage lines / waterways;
- “ Sediment traps will be constructed according to industry best practice;
- “ The use of flocculants will be minimised;
- “ Silt fences will be implemented where necessary;
- “ Geo-textile stabilisation of stockpiles and exposed soil surfaces will be implemented;
- “ Mulch or trackifiers and topsoil will be used where needed to rehabilitate open areas;
- “ Construction vehicles and machinery will be serviced regularly and away from sensitive habitats;
- “ Dirty water runoff will be discharged after sediment and pollutants have been trapped;
- “ Erosion prevention and sediment control measures will be implemented through best construction management practices (BMPs); and
- “ Dust suppression source water should be free of contaminants.
- “ Machinery and vehicle service will be done off-site away from watercourses / drainage lines;

- “ A dedicated storage facility according to industry best practice will be constructed away from sensitive habitat types;
- “ Accidental hydrocarbon spills will be cleaned rapidly;
- “ SOP's will be developed and enforced for handling of hydrocarbons;
- “ Water quality monitoring around potential spill areas will be carried out;
- “ Hydrocarbon collection and separation systems according to industry best practice will be installed at required areas;
- “ All drainage lines, pans and wetlands will be protected by 100 m buffers indicated on construction drawings for activities relating to potentially hazardous chemicals or involving large quantities of hydrocarbons; and
- “ Drip trays and oil absorbents will be used on all areas where construction equipment is stored.

Pre-mitigation impact significance

In the absence of exact information on the location, composition and quantity of chemical spills, massive sedimentation events, project operation details, preferred haul road routes, haul road routes and upgrades and multiple other construction and operational details, it is difficult to accurately estimate the significance of the impact. Pollution of any type has a negative effect on ecology and if coupled with sensitive habitats (wetlands, pans, and drainage lines) can result in an impact of High significance. It is prudent to apply the precautionary approach and assume that all wetland associated habitat is sensitive and since the location of pollution events cannot be predicted, the significance of this impact should be considered as Medium (to High depending on the risks) throughout the Study Area.

Mitigation Measures

Due to the well-known and major significance of this impact numerous embedded controls exist to minimise the likelihood and magnitude thereof. Only one additional mitigation measure requires discussion:

- “ Care should be taken not to over-water during dust suppression activities which can lead to runoff containing high loads of suspended solids and dissolved / transported chemicals / compounds that ultimately enter the wetlands.
- “ Real time monitoring probes linked to remote sensing base stations need to be place in areas of sub surface and surface water flow in order to immediately detect elevated levels of contamination in order to initiate emergency measures.
- “ Chemical spill cleanup kits must be stationed at all sites where spills are probable, especially in conjunction with sensitive habitats such as close proximity to aquatic habitats. Several staff should be trained in the chemical cleanup procedure and at least one member of this unit must be on duty at all times.
- “ If extensive spills have occurred, the area must be rehabilitated appropriately. This will require consultation with an ecologist specialized in the rehabilitation of polluted habitats. This will further decrease the magnitude of the anticipated impacts arising from accidental spill.

Post-Mitigation Impact Significance

Through the application of the embedded controls and mitigation measures, the Significance of the Impact is anticipated to be Low.

AIR QUALITY (For all Figures and Tables see Appendix 11)

Mining process

Open cast mining is typically carried out in open pits, using conventional open pit methods, hydraulic excavators and a fleet of haul trucks. The total planned area for open pits is 136 ha. Mining activities typically include the removal of topsoil and overburden and its storage, drilling and blasting, hauling, crushing, and stockpiling of the final products and waste products. These activities typically result in the generation of dust, or particulates. Pollutants such as sulphur dioxide (SO₂), oxides of nitrogen (NO_X), respirable particulate matter (PM₁₀) and volatile organic compounds (VOC) resulting from vehicle and equipment exhaust emissions also occur.

The open cast surface mining will be standard opencast pit structures with access roads to a depth of not more than ±85 meters. Mining method will be traditional drill, blast, load and haul using trucks to deliver the material to the processing plant. Topsoil (if any) will be removed to a maximum depth of 30cm where possible from all open pit and dump areas. This will be done by bulldozing the material onto windrows, loaded by an excavator and trucked to a topsoil stockpile for storage. No vegetation will be removed prior to this

operation. All vegetation will be stockpiled together with the topsoil. The hard overburden will be mined in benches of 10m. These benches will be drilled and blasted prior to an excavator and truck fleet loading and hauling to an appropriate dump site. The possible dump site consists of ex-pit overburden dumps adjacent to the open pit and old mined-out open pits from which no mining is taking place or are planned to take place in future. Overburden on the last bench above the ore will only be drilled and blasted down to the ore/waste contact. Ore and overburden will not be drilled and blasted together.

Due to the thin tabular nature of the ore deposit and the small size of the various open pits, virtually all the overburden will have to be mined before any ore production from any given pit will be possible. Because no clear visual distinction have been identified between the ore and waste material, strict grade control measure will need to be implemented using handheld instruments by the production geological department. All mined ore will be loaded by an excavator or front-end loader onto a truck and transported directly to the processing plant run of mine tip.

For the underground the board and pillar method will be used. High wall access roadways from the floor of mined out open pits. A single conveyor / access decline & return airway decline. A vertical shaft and winder system with ducted return air. Production sections will be established off from the seven roadway development. A development section consists of between six to nine (6 . 9) roadways (boards), with five metre (5 m) pillars between the boards. Thus the design dimensions of seven metre (7 m) wide boards and five metre (5 m) by five metre (5 m) pillars will be the standard throughout the planned underground working. The mining method will be Trackless Mechanised Board and pillar run on a two (2) shift cycle. Each stopping section will be made up of six to nine (6 . 9) boards. Board and pillar dimensions vary with depth below surface. For this report, seven metre (7 m) wide boards at one point eight metres (1.8 m) mining height and five metre (5 m) by five metre (5 m) pillars will be used. The pillars are cut by seven metre (7 m) wide holdings

Air pollutants

The main air pollutant resulting from mining is particulates. Emissions of other pollutants from vehicle and equipment exhausts and from spontaneous combustion are generally small by comparison. Particulates therefore warrant further discussion.

Particulate matter (PM) is a broad term used to describe airborne particles found in the atmosphere. These include soil dust, dirt, soot, smoke, pollen, ash, aerosols and liquid droplets. The particle size and chemical composition are the most distinguishing characteristics of PM. Particle size has the greatest influence on the behaviour of PM in the atmosphere, with smaller particles tending to have longer residence times than larger ones. PM is categorised according to particle size. Total suspended particulates (TSP) consist of all sizes of particles suspended within the air smaller than 100 micrometres (μm). TSP is useful for understanding nuisance effects of PM, e.g. settling on houses, deposition and discolouration of buildings.

PM10 describes all particulate matter in the atmosphere with a diameter equal to or less than 10 μm . Sometimes referred to as coarse particles, they are generally emitted from motor vehicles (primarily those using diesel engines), factory and utility smokestacks, construction sites, tilled fields, unpaved roads, stone crushing, and burning of wood. Natural sources include sea spray, windblown dust and volcanoes. Coarse particles tend to have relatively short residence times as they settle out rapidly and PM10 is generally found relatively close to the source except in strong winds.

PM2.5 describes all particulate matter in the atmosphere with a diameter equal or less than 2.5 μm . They are often called fine particles, and are mostly related to combustion (motor vehicles, smelting, incinerators), rather than mechanical processes as is the case with PM10. PM2.5 may be suspended in the atmosphere for long periods and can be transported over large distances. Fine particles can form in the atmosphere in three ways: when particles form from the gas phase, when gas molecules aggregate or cluster together without the aid of an existing surface to form a new particle, or from reactions of gases to form vapours that nucleate to form particles.

Particulate matter may contain both organic and inorganic pollutants. The extent, to which particulates are considered harmful, depends on their chemical composition and size. Very fine particulates pose the greatest health risk, as they can penetrate deep into the lung as opposed to larger particles that may be filtered out through the airwaysq natural mechanisms. In normal nasal breathing, particles larger than 10 m are typically removed from the air stream as it passes through the nose and upper respiratory airways Particles between 3 m and 10 m are be deposited on the mucociliary escalator in the upper airways. Only particles in the range of 1 m to 2 m penetrate deeper where deposition in

the alveoli of the lung can occur (WHO, 2003). Coarse particles (PM10 to PM2.5) can accumulate in the respiratory system and aggravate health problems such as asthma. PM2.5 can penetrate deeply into the lungs, are more likely to contribute to the health effects (e.g. premature mortality and hospital admissions) than coarse particles (WHO, 2003).

There are direct and cumulative impacts on human health associated with the operational phase of the mine. The impacts result primarily from the emission of dust and other pollutants from the mining operations. There have been stakeholder concerns regarding the transport of U ore and the impact on roads because of increased traffic volumes. The main roads are the N1 to the South East and the R61 running through the Ryst Kruil site and 75 km of existing farm roads will be upgraded for haulage and 45 km of secondary routes will be used.

The first 4 years of the mine will be open cast and the subsequent 17 years will be underground mining. This has implications for emissions as they are likely to decrease when underground mining is implemented. Wind entrainment of particulates from tailings storage facilities is a function of the physical size of the TSF and the nature of the exposed surface, i.e. the moisture content, the amount of vegetation cover, the size of the particles on the surface and wind speed.

There are various dust suppression measures to limit the emission of particulate matter from these and other sources. This may include the development and implementation of a fugitive dust control plan and ambient dust monitoring. The emissions of particulates from will add to the existing particulate concentrations. The potential exists to increase the frequency of exceedance of the ambient standards for particulates around the proposed mine and in the surrounding environment.

SIGNIFICANT IMPACTS

Total ambient impacts comprise activities from mining, processing, waste storage and vehicle entrainment on roads. Ambient impacts from blasting are not included in the aggregated concentrations. This is due to the episodic nature of blasting and emission profile around the blast radius, which results in sporadic emission generation clearing efficiently in a short timescale. The aggregated ambient concentrations of PM10 and PM2.5 for all sources are presented with vehicle entrainment from unsurfaced roads (Figure 7-17 and Figure 7-18), and thereafter excluding this source (Figure 7-19 and Figure 7-20). This highlights the significant contribution to PM10 and PM2.5 levels from unsurfaced roads. It also allows an interpretation of the contribution from other activities at the mine, at a lower scale.

Total predicted ambient impacts, when the contribution from unsurfaced roads are included, are very high and exceed the ambient standards for daily and annual averaging periods for PM10 and PM2.5. Particulate matter concentrations are excessive in the immediate area of the activity, up to 15 km, and decrease significantly away from the source.

For the figure referred to above and to see the full Air Quality Report see Appendix 11.

SOIL (See full report in Appendix 19)

Activity;
Open pits (topsoil stripping);
Impact;
Soil productivity(land capability and current land use cease at pit footprint);
Duration;
Life of mining process until pit is backfilled and rehabilitated;
Probability; Extent; Significance
Definite ; Pit footprint only; High until rehabilitated

Activity;
Waste stockpiles; topsoil stripping;
Impact;
Soil productivity, land capability and current land use cease at stockpile footprint;
Duration;
Life of mining process until stockpile is removed and footprint rehabilitated;
Probability; Extent; Significance
Definite; Stockpile footprint only; High until rehabilitated

Activity
 Diesel storage tanks;
 Impact;
 Possible hydrocarbon soil pollution;
 Duration;
 May take place at any time during mining operation;
 Probability; Extent; Significance
 Low; Close vicinity of storage tanks; Low

Activity;
 Ablution blocks, access roads, haul roads;
 Impact;
 Soil productivity, land capability and current land use cease at stockpile footprint;
 Duration;
 Life of mining process until structure is removed and footprint rehabilitated;
 Probability; Extent; Significance
 Definite; Footprint of structures only; Moderate until rehabilitated.

HERITAGE (See full report in Appendix 12)

Anticipated Impacts on Heritage Resources

Palaeontology

- “ Due to the flat topography and the fact that the rocks of the Karoo Supergroup are covered in alluvium, very little opportunity exists for palaeontologists to examine the fossil potential of the area. Indeed, Rubidge (2008) stresses %because of the total lack of outcrops in the study area, these are not outcrops which would normally have been prospected for fossils by palaeontologists;”
- “ Because of poor outcrops, both palaeontological and lithological data is poorly known and any additional information is of importance;
- “ While mining activities will be intrusive from an environmental perspective, excavations will enhance possibilities for finding new fossil evidence in this poorly-known part of the Karoo Basin. Mining is considered to have a generally beneficial impact from the palaeontological perspective.

Archaeology

- “ The archaeological survey, and earlier surveys, confirms that archaeological material is present in the form of isolated flakes and cores and there are very few obvious archaeological %sites;”
- “ The only exception is Site D009 on the farm Quaggasfontein which will be destroyed when it is covered in stock pile material;
- “ It is anticipated that the impact of the proposed mining development on archaeological material will be very low.

Built Environment

- “ Beaufort West is at least 9km from the closest mining location, that of Quaggasfontein, and the mining activities will not be visible from the town;
- “ There is no listed conservation worthy buildings or places of celebrated heritage significance in the area;
- “ No demolition of farm buildings is proposed;
- “ While some of the existing farm houses contain 19th century fabric, very few have anything more than low heritage significance;
- “ Katdoornkuil, near Ryst Kuil Extension, has been given a field grading of Grade IIIC, although it is in a derelict condition. There will be no impacts on the farm house;
- “ The proposed haulage routes will not run passed any farmhouses with the exception of the farmhouse of Ryst Kuil, which is not rated as conservation worthy. No impacts are expected;
- “ The proposed mining operations will not be visible from N1. Limited impacts will be experienced from the R61 which is not considered a scenic route;
- “ Due to the lack of screening in the context of wide open vistas, there is a potential for visual impact in the flat, arid Karoo landscape but farmsteads are sparse. Impacts to the Cultural Landscape are considered to be very limited.

Visual

Visual impacts occur when developments exceeds the visual capacity of the landscape to absorb the change and results in a radical change to the sense of place of the area or region.

- “ As a result of the flat horizontal landscape character visibility is high and the viewshed extends over a large area;
- “ Due to the inherent lack of available screening in the context with the flatter, wide open vistas, there is a high potential for visual impact in the flat arid Karoo landscapes.
- “ It is important that development is managed in such a way that does not detract from the elements which define significant landscape character, specifically relating to the tourism industry.

SEIA (See full report in Appendix 14)

Assessment of impact during construction

This section has a description of the potential impacts identified, followed by a determination of the significance of the impact and finally a presentation of the proposed mitigation measures.

Demographics changes

Influx

Changes in the demographics of the population due to influx of workers both temporarily and permanently employed during construction of the mine. Potential positive impacts may include an increase in employment of some people in the local population, resulting in increased economic activity such as retail activity, investment and changes in the housing market. Potential negative impacts may include an increase in social ills such as alcohol abuse, unlicensed gambling, predatory money lending services and sex trades. An influx of workers may also lead to the construction and erection of temporary and illegal housing.

Employment opportunities

Although employment opportunities are created by the proposed project, current skills levels and training of the community may not provide a good fit with the skills required at the mine. Potential positive impacts include employment opportunities at various skills levels while potential negative impacts include skills levels that are not well matched with the mine requirements and employees with appropriate skills are brought from elsewhere.

Economic displacement through land use restrictions

Changes in land use may occur as a result of restricted access to mining sites. Farming activities may be disrupted, water use and land access may be impacted.

Infrastructure and services

Community access to infrastructure and services may change as a result of the proposed project. Access to hospitals, clinics, educational facilities, piped water, electricity, and emergency services may change to some extent, primarily due to more people making use of the facilities. Potential positive impacts may include an increase in the tax payer base enabling municipal development in line with the municipal development plans. There may be a slight increase in patients making use of health care facilities in the area, and an increased pressure on infrastructure and services.

Housing need and construction

Changes in number of people living/working in the area will lead to a demand for housing at the appropriate level of income. In some instances this may result in more temporary housing being erected if not otherwise catered for, however, this may also lead to increased demand for accommodation in existing establishments during construction. This may present a business opportunity for development of housing, should the current supply not be sufficient. This may also lead to increases in need for rental and houses on the market. A potential negative impact is that new housing development that does not support the character of the area, negatively impacting on the character of the area and as a result the tourism potential. Insufficient housing may lead to urban sprawl or informal settlements.

Increase in economic activity

An increase in the employment levels and/or income earning population in the towns may cause an increase in economic activity in the towns.

Changes in cultural heritage and identity . Sense of placeaffecting tourism

Tourism in the surrounding areas is based on the character of the towns. Tourism is a major economic contributor in the area as well. Potential positive impacts include increased use of accommodation providers in the tourism industry for temporary workers and consultants. However, changes may impact on the sense of placefor population and tourists (such as noise, dust, air quality, light pollution and visible degradation in vegetation); potentially leading to a decrease in the tourism industry, resulting in job losses over the long term.

Please note that other impacts on sense of place, also covered in specialist reports are waste management, dust, traffic, noise and the visual impact of mine dumps and dust particularly in the vicinity of the central processing plant.

The following table shows the significance of the impacts identified during the construction period of development, both before and after mitigation; followed by a description of the proposed mitigation measures.

Operation phase

Demographic changes: Stabilised employment

Stabilised employment is expected during the operational phase. Although people with scarce skills may be sourced from outside of the development area, training during construction phase will allow more relevant skills in the local community during recruitment for operational phase.

Infrastructure and services

Community access to infrastructure and services may change as a result of the proposed project.

Long term accommodation: Housing

An increase in the permanent formal housing stock available in the towns. Potential positive impact: Development of formal housing of good standard. Potential negative impact: Failure to address permanent formal housing need, may result in development of out of character houses, negatively impacting on the character of the town

Economic activity

An increase in the employment levels and/or income earning population in the towns may cause an increase in economic activity in the towns.

Changes in cultural heritage and identity . Sense of place affecting tourism

Tourism in the vicinity of Beaufort West is based on the character of the towns. Tourism is a major economic contributor.

Potential positive impacts: Increased use of accommodation providers in the tourism industry for temporary workers and consultants. Development of modern housing using the local vernacular architecture to increase accommodation for workers. Potential negative impacts: Changes to the sense of place for population and tourists (such as noise, dust, air quality, light pollution and visible degradation in vegetation). Decrease in the tourism industry, resulting in job losses over the long term

Decommissioning

Reduction of employment opportunities

During decommissioning, employment opportunities will most probably decrease during decommissioning and closure phases.

Changes in economic benefits

Business and individual who are economically dependent on the mine will experience a loss of income, resulting in a decrease in the economic activity in the town.

TRAFFIC (See full report in Appendix 15)

The expected effects of traffic that would be generated by the proposed development during peak hours were analysed as follows:

- “ The background traffic volumes were determined for the study network in the vicinity of the site. These are the traffic volumes that would be on the road network in the absence of the proposed development (No go Alternative);
- “ A growth factor was applied to account for regional growth
- “ Construction Phase Traffic
- “ Site-generated trips were estimated for the proposed development;
- “ The construction phase traffic and the assigned site-generated traffic from the proposed development were added to the background traffic volumes to determine the total traffic conditions with the development completed.

Year 2019 Background Traffic Conditions (No go alternative)

For the purposes of this study, year 2019 background traffic volumes were developed by applying a 3.0 percent annual traffic growth rate to the existing traffic volumes on the major links. This estimated growth rate was assumed to allow for the additional traffic volumes that will be generated by other in-process and future developments in the area.

Due to the low traffic volumes the current road network will continue to operate at acceptable levels-of-service during the background conditions. The surface conditions of some of the gravel roads in the site vicinity will continue to deteriorate without proper maintenance. The

gravel surfaces of the Provincial Main Roads in the site vicinity are in fair condition and these roads can accommodate the expected growth in traffic volumes in the year 2019 Background conditions.

Construction Phase

It is not expected that the construction phase will generate a significant number of vehicles. Some large pieces of equipment need to be delivered to the site, which typically includes the following:

- “ Haul trucks (50ton),
- “ Face shovels,
- “ Wheeled loaders, Dozers, Graders,
- “ Jaw crusher, Cone crushers and
- “ Conveyors

The following activities will probably occur during the construction phase:

- “ Construction of access roads,
- “ Stripping and moving of topsoil,
- “ Excavation and construction of the leach pads,
- “ Construction of the office building and workshop,

The access roads will be constructed mainly of local materials sourced from the mining site and borrow-pits in the area. There are existing borrow-pits in the area, but it is not known if these are open. It is possible that licences will be required to utilise these borrow-pits for the construction of the access roads. For private access roads the developer can determine the specification for the access roads. Typically the access roads should be six metres wide to accommodate heavy vehicles. The layer works of these access roads will vary depending on the quality of the in-situ material. The typical layer work design for this type of access road is a 300 millimetre gravel layer with a 100 to 150 millimetre wearing course. The wearing course is optional, but will minimise the maintenance required on the access road. The wearing course will also have to be sourced from a commercial source, which has a cost implication. The volume of material required for road construction purposes can only be determined during a more detailed design process, but based on the information above it can be roughly 2 000m³ gravel and 1 000m³ wearing course material per one kilometre of road.

The mining equipment and other building material will be trucked to site and it is expected that most of the construction traffic will come via the N1 through Beaufort West. It is expected that during the peak of the construction phase of the Karoo Uranium Mine the number of additional trips on the road network will be less than 100 trips during an average eight hour day, which includes an estimated 20 percent truck traffic. This means that the estimated construction traffic during the peak construction period will be approximately 12 additional vehicular trips (10 light & 2 heavy) during the typical week day peak hours on the road network. These traffic volumes are low in terms of the intersection and road network operation and the impact is more related to a nuisance factor with regards to possible noise and dust pollution. A recommended mitigation measure to reduce the possible dust pollution is to spray the access roads with water on a regular basis (once a day) during the peak construction period. The grey water produced through the Beaufort West Municipal sewage works could be suitable for this purpose and it is recommended that the developer explore this proposal with the local municipal authority.

Operational Phase

Equipment

Based on information received from the developer and information sourced from other similar projects it is estimated that the following equipment will be required on site during the operational phase.

Trip Generation

Estimates of the peak hour vehicle trips for new developments are typically based on empirical observations at similar land uses. The estimates summarised in Table 4 are based on information provided by the developer. These assumptions are based on the expected production during the operational phase and are considered the worst case scenario.

Based on the information above it is expected that the mine will generate approximately 200 new daily trips of which most will be truck traffic during the peak operational phase. Based on an average of 20 hour operational time per day it means 10 new trips during any hour of the day.

Trip Distribution and Assignment

It is expected that all of the operational trips to/from the processing plant will come from Beaufort West via the existing road network. Most of the trucks delivering the equipment and components are expected to come via the N1 through Beaufort West. The trucks

transporting the ore between the mines and the processing plant during the initial mining phase will use a section of the R306, a section of the R61 and sections of Provincial Divisional and Minor Roads in the site vicinity. Refer to Figure 5 for a layout indicating the initial mining infrastructure and haul routes.

Transport Impact

Based on the expected number of construction and operational trips generated by the proposed Karoo Uranium Mine the existing road network has sufficient capacity to accommodate the additional trips from an operational perspective. Gravel roads such as the R306 can accommodate between 300 and 400 vehicles per day, depending on the type of vehicles. During construction and operational phases it is expected that road surface of the gravel roads will require maintenance at regular intervals. It is recommended that the access roads be sprayed with water at least once a day to reduce dust pollution. A possible water source for this purpose is the grey water produced through the Beaufort West Municipal sewage works. The proposed mining will be phased over a 30 year period with the initial mining activity occurring over approximately 17 years. Based on the project phasing as indicated in Figure 4 in Appendix A it is not expected that the cumulative impact on any section of road in the site vicinity will be more than 200 trips per day. As the mining activity expands to other mining sites production at the initial mining sites will reduce and the net impact on any public road is not expected to exceed 200 vehicles per day.

In the long term, as the mining areas to the north of Beaufort West becomes active, some of the gravel sections of the Provincial Roads in the site vicinity will need to be upgraded to accommodate the additional truck traffic associated with the mining activity. A detail assessment of the R381 need to be conducted, specifically through the pass areas.

All the tarred National and Provincial Roads are in a fair condition and the additional traffic associated with the mining activities in the area will be well within the capacity of the roads in the area. No specific upgrades are recommended along the general road network.

Gravel Loss

Several methods are available for the prediction of gravel loss on gravel roads based on traffic volumes and wearing coarse characteristics. The guideline document TRH20 provides the following model for the estimation of gravel loss:

$$\text{AGL} = 3,65[\text{ADT}(0,059 + 0,0027\text{N} - 0,0006\text{P}26) - 0,367\text{N} - 0,0014\text{PF} + 0,0474\text{P}26]$$

Where:

- o AGL = annual gravel loss
- o ADT = average daily traffic (per direction)
- o N = Weinert N-value = 7.5 for this area based on weather and rainfall.
- o P26 = percentage passing the 26,5mm sieve
- o PF = product of plastic limit and percent passing 0,075mm sieve

The average annual gravel loss was estimated based on the above model and the results are included in Table 1. From the results of the analysis it is evident that the increase in gravel loss along these roads will be significant.

Alternative Development Proposals

There is no viable project alternative since Tasman RSA Mines is considering the only economically and technically viable mining methods to extract the commercially viable uranium and molybdenum deposits.

The only other realistic alternative to the proposed mining activity is livestock farming, which is the current activity on the farms.

RADIOLOGICAL IMPACT ASSESSMENT

In operations and activities involving uranium mining, it is possible for radioactive material to be released to the environment, affecting members of the public as well as the non-human biota. Radiation exposure arising from the mining and processing of uranium, warrant appropriate regulatory attention to ensure the protection of persons and the environment.

Uranium mining in South Africa is authorised by the National Nuclear Regulator (NNR) in accordance with the provisions of the National Nuclear Regulator Act (NNRA) [1]. These requirements are further elaborated in the Regulations on Safety Standards and Regulatory Practices (SSRP) [2], which were promulgated in accordance with Section 36 of the NNRA. The SSRP contains the principal radiation protection and nuclear safety requirements and more specifically, requires a prior radiological impact assessment before mining and processing of uranium ore may be performed. The SSRP also specifies objectives such as operational safety assessment, controls and limitations on operation, maintenance and inspection programme, staffing and qualification, radiation protection, environmental monitoring etc.

Overview of the radiological impact assessment methodology

Members of the public and non-human biota can be exposed to radiation via external or internal pathways associated with radioactive releases during mining and operation of processing facilities. These external and internal sources of radiation exposure include the following:

- “ Direct exposure from a point source of ionizing radiation;
- “ Exposure from a plume of radionuclides in the atmosphere (cloud shine) or in water;
- “ Contact exposure from radionuclides on the skin;
- “ Radionuclides deposited on the soil or sediment or building surface or vegetation;
- “ Radionuclides inhaled from the atmosphere;
- “ Radionuclides in the soil and water ingested through foodstuffs;
- “ Radon emanated from various sources; and
- “ Inhalation and ingestion of re-suspended radionuclides in soil and sediment.

The radiological impact assessment process is a systematic process and has to demonstrate safety of the public and protection of the environment around uranium mining and processing facilities and consists of the following elements:

- “ Site Description - A description of where the facility or plant is located;
- “ Process Description - A detailed description of all activities and processes at the plant, which could result in public exposure;
- “ Source Term Characterisation - A detailed description of all the radionuclides present, their quantities, chemical and physical form, decay constants, dose conversion factors, absorption classes, and any other relevant information to the safety assessment;
- “ Exposure Pathways - Identification of all intake and radiation exposure pathways relevant to the safety assessment;
- “ Critical Group (Representative Person) and Representative Animals and Plants Identification - Identification of all members of the public receiving the highest radiation doses, their habitat, agricultural and social activities that could impact on radiation doses;
- “ Assessment Criteria - The dose criteria to members of the public, contained in the legislative and regulatory framework, that should not be exceeded as a result of activities and operations at facilities;
- “ Public Dose Assessment - A complete dose assessment which should take into account all the exposure pathways and scenarios which requires some form of modelling based on conservative or reasonable assumptions.
- “ Radiological risk to non-human biota (no specific regulatory criteria as for humans)

The NNR reviews the radiological impact assessment against regulatory criteria, all assumptions and parameters, including data from sampling and analysis programmes, before acceptance or approval of the submission and granting of a certificate of authorisation.

vi) **Methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks;**

(Describe how the significance, probability, and duration of the aforesaid identified impacts that were identified through the consultation process was determined in order to decide the extent to which the initial site layout needs revision).

Method for assessment of identified impacts

The evaluation distinguishes between significantly adverse and beneficial impacts and allocates significance against national regulations, standards and quality objectives governing:

- “ Health and Safety
- “ Protection of Environmentally Sensitive areas
- “ Land use
- “ Pollution levels

Irreversible impacts are also identified.

The significance of the impacts is determined through the consideration of the following criteria:

- “ Probability . Likelihood of the impact occurring
- “ Area - the extent over which the impact will be experienced.
- “ Duration - the period over which the impact will be experienced.

" Intensity - the degree to which the impact affects the health and welfare of humans and the environment (includes the consideration of unknown risks, reversibility of the impact, violation of laws, precedents for future actions and cumulative effects).

The above criteria are expressed for each impact in tabular form according to the following definitions:

PROBABILITY	DEFINITION
Low	There is a slight possibility (0 . 30%) that the impact will occur.
Medium	There is a 30 . 70 % possibility that the impact will occur
High	The impact is definitely expected to occur (70% +) or is already occurring.

AREA	DEFINITION
Small	0 . 50ha
Medium	51 . 200 ha
Large	200+ ha

Duration	DEFINITION
Short	0 . 5 years
Medium	5 . 50 years
Long	51 . 200 years
Permanent	200+ years

Intensity	DEFINITION
Low	" Does not contravene any laws
	" Is within environmental standards or objectives
	" Will not constitute a precedent for future actions
	" Is reversible
	" Will have a slight impact on the health and welfare of humans or the environment.
Medium	" Does not contravene any laws
	" Will not constitute a precedent for future actions
	" Is not within environmental standards or objectives
	" Is not irreversible
" Will have a moderate impact on the health and welfare of humans or the environment.	
High	" Contravene laws
	" May constitute a precedent for future actions
	" Is not within environmental standards or objectives
	" Is irreversible
	" Will have a significant impact on the health and welfare of humans or the environment.

SIGNIFICANCE	DEFINITION
Negligible	The impact is insubstantial and does not require management
Low	The impact is of little importance, but requires management.
Medium	The impact is important; management is required to reduce negative impacts to acceptable levels.
High	The impact is of great importance, negative impacts could render options or the entire project unacceptable if they cannot be reduced or counteracted by significantly positive impacts, and management of these impacts is essential.
Positive	The impact, although having no significant negative impacts, may in fact contribute to environmental or economical health.

vii) The positive and negative impacts that the proposed activity (in terms of the initial site layout) and alternatives will have on the environment and the community that may be affected.

(Provide a discussion in terms of advantages and disadvantages of the initial site layout compared to alternative layout options to accommodate concerns raised by affected parties)

FIRST ALTERNATIVE: CPP & TAILINGS POSITION

To view the layout of the first alternative for the Central Processing Plant (CPP) please see Figure 4 in Appendix 3.

No significant positive benefits can be attributed to this first alternative plant and tailing facility position.

The negative impacts that were identified during the environmental impact assessment process related to the overlap of the southern corner of the tailings facility over steeper topography. In addition, the CPP footprint would also have impacted on this topographical feature. Data presented in the Biodiversity Report (See Appendix 10) described the potential impacts on steeper topography with rocky or stoney community habitats as follows:

The rocky communities include all rocky habitats, with rocks defined here as any stone or rock exceeding 200mm in size. This therefore includes bedrock habitats. The communities were subdivided based on their morphological positions within the landscape i.e. ridge, slope or plain.

Rocky Ridges specifically refer to habitats where bedrock and boulders protrude significantly from the ground surface giving rise to deep cracks / fissures. These habitats are limited to steep slopes within the study area and often include their associated ridge-top bedrock habitats. Ridges that lack this specific characteristic were classified as Stony Ridges (refer below) even if stone sizes exceeded 200mm in size. The floral structure consists of a mixture between tall shrubs interspersed with lower-growing karoo bushes and grasses. Floral species typically associated with Rocky Ridges include *Rhigozumobovatum*, *Merxmuellera dura*, *Eriocephalus ericoides*, *Pteronia adenocarpa*, *Indigofera nigromontana*, *Euphorbia stellispina* and *Euphorbia ferox*.

Rocky slopes and plains refer to habitats that consist of stones / rocks exceeding 200mm in size usually interspersed with patches of low protruding bedrock. These habitats are located along the upper-slopes through to the plains as indicated by the local terrain morphology of each study area. The floral structure consists of predominantly intermediate shrubs and karoo bushes with infrequent occurrences of small trees/ taller shrubs. Floral species associated with these habitats include scattered and rare individual tree species of *Searsiaburchelli*, *Carissabispinosa* and *Maytenuspolyacantha*. Shrubs and grasses include *Rhigozumobovatum*, *Tragus koelerioides*, *Eriocephalus ericoides*, *Gnidia deserticola*, *Pteronia glomerata* and *Ruschia spinosa*. Inconspicuous small succulents include *Crassula corallina*.

The stony communities include all stony habitats, with stones defined here as any stone or rock between 11 and 200mm in size. The communities were subdivided based on their morphological positions within the landscape i.e. ridge, slope, plain.

Stony ridges specifically refer to ridge habitats where bedrock / boulders fail to protrude significantly from the ground surface to provide deep cracks / fissures despite stone or rock sizes exceeding 200mm in size. Floral species typically associated with Stony Ridges include *Ruschiaspinosa*, *Pentziaincana*, *Pteroniaglomerata* and *Hermanniagrandidiflora*. Inconspicuous small succulents found within these communities include *Pleiospilos* spp. and *Crassula* cf. *columnaris*.

No comments have been received from any IAP's regarding the position of the CPP and tailings facility.

FINAL ALTERNATIVE: CPP & TAILINGS POSITION

The positive impacts that can be associated with this final recommended position of the CPP and tailings facility is the mitigation of the potential impacts on the steeper rockier/stonier slopes on the southern side of the original position.

viii) The possible mitigation measures that could be applied and the level of risk.

(With regard to the issues and concerns raised by affected parties provide a list of the issues raised and an assessment/ discussion of the mitigations or site layout alternatives available to accommodate or address their concerns, together with an assessment of the impacts or risks associated with the mitigation or alternatives considered).

AIR QUALITY

It is important that an emission control and reduction strategy is designed and implemented, ensuring that the contribution to ambient concentrations is minimised. To this end, recommendations to further control and mitigate particulate matter emissions during construction, operations and decommissioning are included for consideration for inclusion in the EMP.

Table 9 1: Mitigation plan for consideration for EMP

Construction

Mitigation: Action/control	Responsibility	Timeframe
Roads could be tarred or traffic control measures implemented to limit vehicle-entrained dust from unsurfaced roads e.g. by limiting vehicle speeds and restricting traffic volumes. Unpaved road surfaces could be sprayed with a surfactant to bind the silt.	Responsible Person: Construction Project Manager	Time: During construction
Stabilise open areas with dust palliative, gravel or similar	Construction Project Manager	During construction

Operations

Mitigation: Action/control	Responsibility	Timeframe
Roads could be tarred or traffic control measures implemented to limit vehicle-entrained dust from unpaved roads e.g. by limiting vehicle speeds and restricting traffic volumes.	Site Manager	During operations
Application of chemical surfactant to bind road surfaces be maintained on on-going basis.	Site Manager	During operations
The sidewalls of the tailings dam could be vegetated/covered as they rise, and the cover maintained to reduce the exposed area and limit wind entrainment.		
The top of the tailings dam should be kept moist to bind the surface dust and prevent wind entrainment of dust.	Site manager	During operations
Waste rock stockpiles could be vegetated/covered as they rise, and the cover maintained to reduce the exposed area and limit wind entrainment.	Site Manager	During operations
The ore stockpile could be lightly moistened to reduce wind-entrained dust.	Site Manager	During operations
Investigate the use of dust suppression or particulate filtration for underground workings to reduce particulate emissions vented to the atmosphere	Site Manager	During operations
Stabilise open areas with dust palliative, gravel or similar	Site Manager	During operations
Abatement measures are suggested for the dryer. This includes consideration of design parameters, and control technology such as fabric filtration.	Site Manager	During operations
Dust fallout monitoring is suggested on site boundaries in the vicinity of populated areas to determine impacts of particulate emissions on ambient environment	Site Manager	During operations
Use of dust covers are suggested on vehicles transporting rock and ore to reduce particulate generation	Site Manager	During operations

Decommissioning

Mitigation: Action/control	Responsibility	Timeframe
Roads could be tarred or traffic control measures implemented to limit vehicle-entrained dust from unpaved roads e.g. by limiting vehicle speeds and restricting traffic volumes. Unpaved road surfaces could be sprayed with a surfactant to ensure high moisture content which will bind the silt.	Site Manager	During decommissioning
The sidewalls of the tailings dam should be completely vegetated or covered with rock, and the cover should be maintained continuously to reduce the exposed area and limit wind entrainment. The top of the tailings dam must be kept covered with material or vegetation to bind the surface dust and prevent wind entrainment of dust.	Site manager	During decommissioning
Waste rock stockpiles should be completely vegetated/covered, and the cover should be maintained continuously to reduce the exposed area and limit wind entrainment.	Site Manager	During decommissioning
Stabilise open areas with dust palliative, gravel or similar	Site manager	During decommissioning

Rehabilitation of waste rock stockpile and tailings dam site are recommended to reduce ongoing future impacts
Site manager During decommissioning
Rehabilitation of mine roads is recommended to reduce wind-entrained particulate generation
Site manager During decommissioning

BIODIVERSITY

Loss of habitat and floral species of conservation concern due to removal of vegetation

Embedded Controls

The following embedded controls have been included in the project design:

- “ Planning in the placement of construction camps and laydown areas to exclude sensitive habitats;
- “ Preservation of high value plant species in situ through a pre-construction walkover and botanical survey;
- “ Relocation of Red and Orange Listed species.
- “ Soil and sediment management to limit effects of erosion arising from vegetation clearing; and
- “ Rehabilitation of cleared areas by the planting of indigenous species after construction phase.

Pre-mitigation Impact Significance

Due to the relatively small project footprints, and current impacts, it is unlikely that the habitat lost will aggravate the sound ecological connectivity although on site Red and Orange Listed species may be lost. Overall, and primarily due to the relatively small project footprint size, the significance of the impact is deemed to be Low.

Mitigation Measures

- “ Minimise the footprint of construction and operation (maintenance) activities through appropriate planning. Each activity must be well planned to determine the minimum footprint required, which must be demarcated on the ground in advance (to reduce the potential of accidental spill-over and accidental damage into surrounding areas and to allow botanical experts to carry out a final sweep of the footprint areas in order to initiate possible relocation of Red and Orange Listed species). These areas must include vehicle parking areas, turning facilities, worker's toilet facilities, worker's camps, material and equipment lay down areas etc;
- “ Embedded erosion control measures should further aim to reduce the slope of cleared areas. Re-vegetation should be conducted with suitable indigenous vegetation to form a vegetation cover that will protect exposed surfaces and attempt to limit the loss of topsoil during high rainfall events while simultaneously reducing sedimentation of streams/rivers. First establish a suitable ground cover of grass to protect the soil surface followed by suitable tree species to provide shade, thereby creating a structured habitat where natural successional development will ultimately result in improved habitat, connectivity and biodiversity;
- “ Maximum use of existing cleared areas, areas of disturbance and road networks should be utilised;
- “ Provide permeable fencing adjacent known sensitive habitats (reference to habitat sensitivity map) to facilitate movement of faunal species;

Several rehabilitation measures can further decrease the magnitude of the anticipated impacts resulting from vegetation clearing:

- “ Implement a construction handover plan in which rehabilitation measures are defined and budgeted for. Re-vegetation trials must be undertaken to determine the most appropriate species for a particular habitat. Species should be selected on a basis of adaptive management. i.e. perform trial runs on several species and select those species most suitable in achieving the desired result of establishing ground cover and increasing habitat functionality. A nursery should be established to propagate selected plant species for translocation and rehabilitation. Specific planting plans and schedules for each habitat type must be determined where rehabilitation will be required;
- “ Development of an operational monitoring programme to assess success and sustainability of rehabilitation and reclamation procedures applied. This monitoring programme will aid in continuous adaption of the rehabilitation process and will demonstrate whether the rehabilitation procedures in place are successful. Critical components that need to be monitored are:
 - o Re-vegetation success. It is essential to ensure that the re-vegetated areas are successfully proliferating and not dying or succumbing to alien invasive plant competition;

- o Control of alien and invasive species. It is very important to ensure that continued control of alien and/or invasive species is taking place after the construction phase and during the operations phase and this must therefore be monitored adequately;
- o Water quality monitoring. Runoff into seasonal pans should be monitored to ensure that rehabilitation procedures have sufficiently controlled any pollution and sedimentation likely to occur in the surrounding water dependent habitats.
- “ Establishment of a functional plant propagation facility with the capacity to supply the required trees and plants needed for minimization of soil erosion and other rehabilitation measures;

Possibility to introduce and/or enhance the spread of alien and /or invasive species

Embedded Controls

- “ No specific embedded controls exist for the management of alien and/or invasive species. This occurs in part because of the unpredictable nature of alien species colonisation which should be managed using adaptive methods in response to the severity of site specific infestation.

Pre-mitigation Impact Significance

Current levels of habitat transformation are considered to be variable but mostly intact within large portions of the Study Area. The prevailing impacts affecting habitat integrity are more due to the current livestock agricultural practices rather than the current influence of alien/ invasive species. However, some habitat degradation due to alien/ invasive species is already prevalent.

The future likelihood of inadvertent dispersal of alien invader species along road servitudes (especially transecting water courses, drainage lines and wetland/pans) to other natural areas is high. Uncontrolled spread of invasive and alien plant species serve to effectively "remove" utilizable habitat from native flora and fauna. This is because many invasive plants outcompete native vegetation and are either noxious or grow in such dense stands that foraging within them by native fauna is not possible. Alien invasive plants attract few native invertebrate species which can feed on them and thereby reduce the prey base available for insectivorous native fauna.

The significance of this impact will be Medium for the entire construction as well as operational phase of the development due to the prevalence of undesirable alien plant species within the region and the potential regional spread of these plants via the construction and maintenance trucks / vehicles transporting product. Due to the extreme and ecologically harsh environmental conditions within the greater Study Area, It is unlikely that alien and invasive plants can easily establish within the ecosystem, with only a small number of species expressing suitable traits for rapid and uncontrolled colonisation.

The likelihood that synanthropic mammals and avifauna will be attracted to construction camps and project infrastructure and is high since such species already exist in high densities within the region. All the effects previously described ensure that this impact is of High significance.

Mitigation Measures

- “ Devise and implement an alien and /or invasive plant control policy which must attempt to prevent the spread of alien/invasive plant species through mechanical and chemical treatment.
- o Where herbicide treatment is required, herbicides should be selected in line with international standards and must be applied by trained personnel only. Storage and use of herbicides will be as per the manufactures instructions. Herbicides must be clearly labelled at all times and application of these herbicides must be planned in consultation with an ecologist to ensure that the environment is not adversely affected; and
- o Prohibiting the transport of all live plants, seeds or vegetative material; and
- o The entire length of the haul road systems, all terminals and product storage areas will require frequent monitoring for the presence of alien invader plant species, and eradication measures must be implemented where required .
- “ Walk-in capture traps should be deployed wherever construction camps as well as operational infrastructure are established. Capture traps should be used in order to eliminate only alien species such as *Mus musculus*, *Rattus rattus* and *Rattus norvegicus* and not native rodents which should be released unharmed upon capture by an Environmental Control Officer. Captured alien rodent species must be killed humanely and incinerated. Rodent-specific poisons can be used inside walk-in capture traps in highly transformed areas where significant assemblages of native rodents are not expected. This will ensure that poison is not spread to the surrounding environment and/ or to native predators (reptiles, owls, mammals) causing native predator deaths (see below);

- “ All rodent poison controls should be strictly monitored by the Environmental Control Officer in order to prevent poisoning of native small mammals and/or cause accidental mortalities of rodent predators such as snakes, raptors, owls, small predators and meso-predators.;
- “ All deliveries of food stuff must be subject to stringent quarantine and quality controls to avoid pests in transit;
- “ A strict zero-tolerance approach to the trade in faunal species must be implemented for all staff and contractors. This will not only avoid establishment of alien faunal species but also help control the spread of diseases;
- “ Sensitive areas such as wetlands , streams and rivers will require buffering (150 m) from construction activities and waste disposal to prevent spread of alien invasive plant species in these very sensitive and susceptible habitats;
- “ Waste, especially domestic waste, should not be stored for more than a week before being removed (by appropriate closed-bin structures) and processed according to International health standards. All areas where domestic waste is temporarily stored should be securely covered to avoid attracting birds and rodents. Trapping for rodents should be intensive and continuous around waste storage sites.
- “ Open areas should be cleared of alien and invasive plants (chemical and mechanical control, dispose of these appropriately to avoid spread) and re-vegetated with suitable indigenous plants;
- “ Continued eradication of alien rodents is advised throughout the construction and operation phases especially around infrastructure;
- “ Development of a monitoring programme to assess success and sustainability of alien and invasive species management. This monitoring programme will aid in continuous adaption of the rehabilitation process and will demonstrate whether the rehabilitation procedures in place are successful. Two of the critical components that need to be monitored are:
 - o Re-vegetation success. It is essential to ensure that the re-vegetated areas are successfully proliferating and not dying or succumbing to alien invasive plant competition; and
 - o Control of alien and invasive species. It is very important to ensure that continued control of alien and invasive species is taking place and this must therefore be monitored closely.

Post-mitigation Impact Significance

Through the implementation of physical and chemical control measures of alien and invasive plants and by preventing the spread of alien rodents during all phases of the development, impacts related to alien invasive species (such as spread of diseases) can be greatly reduced. It is unlikely that the threat of alien and invasive species will be eradicated completely due to the potential rapidity of colonisation and proliferation as well as the ~~life~~ of project+threat potential. However, the post mitigation significance of this impact is Low.

Loss of Fauna (bushmeat and pet trade) and loss of targeted high value flora species (tradable species [succulents])

Embedded controls

The following embedded controls have been included in the project design:

- “ A Biodiversity Protection Policy with action plans to prevent any and all unauthorised removal of biodiversity from the project area.

Pre-mitigation Impact Significance

It must be stated that current level of illegal consumption and trade of fauna and flora species in the region is currently not quantified. However, the potential for a highly significant increase in such activities is very high given the extreme densities of chelonians, collectible succulents and the potential for an increased presence of humans within highly sensitive areas as well as increased access. Organised worker transport may also allow for increased transport opportunities for species of tradable and consumable species. Therefore, the significance of this impact is expected to be High with regards loss of high value fauna and flora species.

Mitigation Measures

- “ The transport and trade of high value floral species along the road servitudes should be monitored at designated security points and random search points. Trespassers should be prosecuted through the applicable National laws in the trade of species; and
- “ The use of the servitudes by local inhabitants should be prevented by appropriate locked gates preventing unauthorized use of the road servitudes with a vehicle.

Post Mitigation Impact Significance

The post impact significance from loss of fauna and high value flora species is expected to be Low if embedded controls and mitigation measures are applied throughout the life of project.

Direct Mortality of faunal species through vehicles (or vehicle related) collision

Pre-mitigation Impact Significance

The quantification matrix of the impact shows that the significance of this impact will be High throughout the project but for the operational phase especially. Susceptible species have been described above. It must be stated that due to the presence of fences, even areas not allowing high speeds of vehicles exhibit High significance due to the susceptibility of the faunal species as well as the presence of fences.

Embedded controls

The following embedded controls have been included in the project design:

- “ All vehicle speeds, through the use of satellite tracking should be limited to 80 km ph (maximum).
- “ Speed humps need to be placed at pre-determined locations to force project vehicles to reduce speed.

Mitigation Measures

- “ The ECO should monitor live animal observations in order to monitor trends in animal populations and thus implement adaptable mitigation of vehicle movements.
- “ Road mortalities should be monitored by both vehicle operators (for personal incidents only) and the ECO (all road kill on periodic monitoring basis as well as specific incidents) with trends being monitored and subject to review as part of the monthly reporting. Monitoring should occur via a logbook system where staff takes note of the date, time and location of the sighting/ incident. This will allow determination of the locations where the greatest likelihood exists of causing a road mortality and mitigate against it through both the embedded measures mentioned above (reducing vehicle speeds in sensitive areas) and below (e.g. fauna underpasses, fence removals and seasonal speed reductions). Finally, mitigation should be adaptable to the onsite situation which may vary over time;
- “ Reduce direct mortalities either by removing fences in identified sensitive areas or indeed, increasing the buffer area either side of the road by 50 metres either side, in order to allow fauna to have an escape area away from impenetrable fences.
- “ Reduce direct mortalities by allowing for fauna to cross the roads, particularly where the roads cross a sensitive natural habitat (e.g. wetlands or artificial water points). This can be achieved by constructing fauna underpasses under the roads (large culverts or large open-ended concrete pipes laid into the raised roads). These underpasses should be used in conjunction with "fauna barriers" which prevent the most susceptible small fauna from crossing the roads on the surface by directing them towards the underpasses where they can cross under the roads safely. It is important to note that utilization of underpasses is strongly dependent on animal body size (larger culverts are more successful) and the surrounding habitat (Mata et. al 2005); and
- “ All staff operating motor vehicles must undergo an environmental induction training courses that includes instruction on the need to comply with speed limits, to respect all forms of wildlife (especially reptiles and amphibians) and, wherever possible, prevent accidental road kills of fauna. Dead mammals should never be handled due to the risk of rabies and snakes should only be handled after inductions have taken place due to the risks of post-mortem in venomation. Drivers not complying with speed limits should be subject to penalties.

Post-Mitigation Impact Significance

By implementing a monitoring program for recording animal activity observations (alive and dead) and applying mitigation measures to areas of high sensitivity, it is expected that the impact of collisions can be significantly reduced. Support measures focused around appropriate staff training are also extremely important for the success of the mitigation measures. Realignment of the roads may not be possible due to the dual role as public access ways. Overall, Post-Mitigation significance is expected to be Low.

Disruption / alteration of ecological life cycles (breeding, migration, feeding) due to lighting, noise and dust

Embedded controls

- “ Equipment with low noise emissions will be procured;
- “ Loud work stations will have sound insulation;
- “ A grievance mechanism for I and AP complaints about construction noise and dust generation will be established, filed and handled;
- “ A dust monitoring system will be implemented;
- “ Water or dust control agents will be used in working areas; and

“ Haul roads will be sprayed on a regular basis in designated susceptible areas.

Pre Mitigation impact significance

It is likely that prevailing dust effects will cause the most significant effects on the prevailing environments, including the elimination of habitats. In addition, the scale of dust effects is significantly higher (in comparison with light and sound) due to the greater surface areas of roads in comparison to the project footprints (with the exception of the crushing plant).

In their environment and in order to function ecologically (breed, feed, demarcate territory), birds and amphibians must be able to discriminate mating calls from other background noise. Amphibians have the advantage of being able to distinguish only the calls of their species while excluding other ambient frequencies, although extremely loud noises or vibrations will have a negative impact. Birds however are susceptible to displacement effects of ambient noise as calls are crucial in the isolation of species, pair bond formation, display, territorial defence, danger, advertisement of food sources and flock cohesion. However, it is the scale of the impact that dictates the severity of the sensitivity. It is likely that localised effects of project infrastructure may be severe but will not necessarily affect the regional populations, especially of nomadic large bodied species (including those of conservation concern). Therefore, the risk of completely removing source populations from ecosystems is unlikely to be high given that the project footprints are relatively small and are located within areas of current farmlands which are themselves, subject to disturbances.

In regards to light effects, the significance will be low.

Mitigation Measures

All control measures to avoid, minimize and rehabilitate the impacts of dust and noise are already mentioned in the embedded controls sections. For lighting the following mitigation measures are required:

“ Reduce exterior lighting to that necessary for safe operation, and implement operational strategies to reduce spill light. Use non-UV lights where possible, as light emitted at one wavelength has a Low level of attraction to insects. This will reduce the likelihood of attracting insects and their predators; and

“ Design lighting strategies that address or minimise items such as degree of spill light, use of up lights and use of lights with red wavelengths. Down lighting is preferred as are lights with blue or green wavelength. This will reduce the likelihood of blinding avifauna.

Post Mitigation Impact Significance

Post-mitigation significance of the impact of the potential for disrupting / altering ecological lifecycles due to lighting, dust and noise pollution should be negligible to Low if all of the embedded controls and precautionary mitigation measures are applied.

General contamination of water, wetland, pan, habitat and food resources through the potential release of radioactive material

Embedded Controls

The following embedded controls have been included in the project design:

“ Dust suppression control measures

“ Correct product treatment and storage

“ Soil and sediment management to limit effects of erosion on drainage channels;

“ Real time monitoring probes linked to remote sensing base stations need to be placed in areas of sub surface and surface water flow in order to immediately detect elevated levels of contamination in order to initiate emergency measures.

“ Emergency measures such as a tailing dam facility and other engineering solutions designed to prevent contamination must be implemented in accordance with best practice standards for uranium ore extraction and processing.

Pre-mitigation Impact Significance

The contamination of hydrological systems and the subsequent significance of such effects cannot be accurately quantified without understanding the following:

- a) The concentration of radioactive product
- b) The storage and characteristics of the project design
- c) The geohydrological attributes of the sub-surface flow regime
- d) The surface flow attributes

As drainage lines are limited in the landscape as well their potential to distribute potential contaminants, these systems are considered to be ecologically sensitive. Taking into account the limitations of knowledge concerning the above factors, the precautionary principle should still be applied to the potential impact of contamination. The significance of this impact is therefore regarded as High.

Mitigation Measures

“ Unusually, the actual mitigation measures for this specific impact may in fact cause an additional set of impacts which require separate discussion below.

Post Mitigation Impact Significance

The actual mitigation measures as well as the application of the embedded measures and best practice procedures for processing radioactive material will in most likelihood dramatically reduce the significance of this impact to Low. However, the subsequent impacts of the actual mitigation measures must be analysed in isolation.

Wetland contamination and the indirect impact of alteration of hydrological regimes as a mitigation measure for the prevention of wetland contamination

Embedded Controls

The following embedded controls have been included in the project design:

- “ Placement of construction camps and laydown areas to exclude sensitive habitats such as rivers etc;
- “ Soil and sediment management to limit effects of erosion on drainage channels; and
- “ Rehabilitation of cleared areas by the planting of indigenous species after construction phase (erosion control)

Pre Mitigation Impact Significance

The alteration of hydrological regimes within the potentially affected hydrological regime effectively results in the loss of habitat and the displacement of species on a large and interconnected scale. Because drainage lines are limited in the landscape and not resilient to perturbation they are considered to be ecologically sensitive. The significance of this impact is therefore High.

Mitigation Measures

“ The engineering solutions required to facilitate the mitigation measures are subject to further discussion with the client.

Post Mitigation Impact Significance

Considerable mitigation of this anticipated impact is captured in the embedded controls and best practise standards which will reduce the significance of the impact to Medium.

Sensitive habitat contamination/ destruction as a result of chemical spills of uncontrolled erosion/ sedimentation

Embedded controls

The following embedded controls have been included in the project design:

- “ Product stockpiles will be kept as small as possible and established away from surface water drainage lines / waterways;
- “ Sediment traps will be constructed according to industry best practice;
- “ The use of flocculants will be minimised;
- “ Silt fences will be implemented where necessary;
- “ Geo-textile stabilisation of stockpiles and exposed soil surfaces will be implemented;
- “ Mulch or trackifiers and topsoil will be used where needed to rehabilitate open areas;
- “ Construction vehicles and machinery will be serviced regularly and away from sensitive habitats;
- “ Dirty water runoff will be discharged after sediment and pollutants have been trapped;
- “ Erosion prevention and sediment control measures will be implemented through best construction management practices (BMPs); and
- “ Dust suppression source water should be free of contaminants.
- “ Machinery and vehicle service will be done off-site away from watercourses / drainage lines;
- “ A dedicated storage facility according to industry best practice will be constructed away from sensitive habitat types;
- “ Accidental hydrocarbon spills will be cleaned rapidly;
- “ SOP's will be developed and enforced for handling of hydrocarbons;
- “ Water quality monitoring around potential spill areas will be carried out;
- “ Hydrocarbon collection and separation systems according to industry best practice will be installed at required areas;
- “ All drainage lines, pans and wetlands will be protected by 100 m buffers indicated on construction drawings for activities relating to potentially hazardous chemicals or involving large quantities of hydrocarbons; and
- “ Drip trays and oil absorbents will be used on all areas where construction equipment is stored.

Pre-mitigation impact significance

In the absence of exact information on the location, composition and quantity of chemical spills, massive sedimentation events, project operation details, preferred haul road routes, haul road routes and upgrades and multiple other construction and operational details, it is difficult to accurately estimate the significance of the impact. Pollution of any type has a negative effect on ecology and if coupled with sensitive habitats (wetlands, pans, and drainage lines) can result in an impact of High significance. It is prudent to apply the precautionary approach and assume that all wetland associated habitat is sensitive and since the location of pollution events cannot be predicted, the significance of this impact should be considered as Medium (to High depending on the risks) throughout the Study Area.

Mitigation Measures

Due to the well-known and major significance of this impact numerous embedded controls exist to minimise the likelihood and magnitude thereof. Only one additional mitigation measure requires discussion:

- “ Care should be taken not to over-water during dust suppression activities which can lead to runoff containing high loads of suspended solids and dissolved / transported chemicals / compounds that ultimately enter the wetlands.
- “ Real time monitoring probes linked to remote sensing base stations need to be placed in areas of sub surface and surface water flow in order to immediately detect elevated levels of contamination in order to initiate emergency measures.
- “ Chemical spill cleanup kits must be stationed at all sites where spills are probable, especially in conjunction with sensitive habitats such as close proximity to aquatic habitats. Several staff should be trained in the chemical cleanup procedure and at least one member of this unit must be on duty at all times.
- “ If extensive spills have occurred, the area must be rehabilitated appropriately. This will require consultation with an ecologist specialized in the rehabilitation of polluted habitats. This will further decrease the magnitude of the anticipated impacts arising from accidental spill.

Post-Mitigation Impact Significance

Through the application of the embedded controls and mitigation measures, the Significance of the Impact is anticipated to be Low.

SURFACE AND GROUND WATER

The following are examples of mitigation measures that could be applied to reduce water resource impacts of a project depending upon site- and project-specific conditions. Impacts to water resources are related to the project footprint (e.g., land disturbance, erosion, changes in runoff patterns, and hydrological alterations), project emissions (e.g., sediment runoff, acid mine drainage, and water releases), and resource use (e.g., water extraction). Many impacts can be reduced or avoided when considered during the siting and design phase.

The recommendation would be to develop a final set of mitigation measures for any project in consultation with the appropriate government resource management agencies and stakeholders. Conduct these consultations early in the project development process and preferably prior to final project siting and design.

Siting and Design Mitigation Measures

Siting and design considerations that mitigate impacts include:

- “ Identify and avoid unstable slopes and local factors that can cause slope instability (groundwater conditions, precipitation, seismic activity, slope angles, and geologic structure).
- “ Research local hydrogeology. Identify areas of groundwater discharge and recharge and their potential relationships with surface water bodies and groundwater quality. Avoid creating hydrologic conduits between two aquifers.
- “ Minimize the planned amount of land to be disturbed as much as possible.
- “ Use special construction techniques in areas of steep slopes, erodible soils, and stream crossings.
- “ Construct drainage ditches only where necessary. Use appropriate structures at culvert outlets to prevent erosion.
- “ ;Do not alter existing drainage systems, especially in sensitive areas such as erodible soils or steep slopes.
- “ Permanent impoundments, including seep discharges, must meet the performance standards, including having water quality suitable for the intended post-mining use.

- “ Handle earth materials and runoff in a manner that minimizes the formation of acid mine drainage, prevents adding suspended solids to stream flow, and otherwise prevents water pollution. Construct sedimentation structures near the disturbed area to impound surface water runoff and sediment. Maintain as necessary, including discharge of water meeting applicable water quality standards, so as not to exceed designed storage capacity.

General Mitigation Measures

General mitigation practices and principles that could apply to any or all phases of a uranium mine project include:

- “ Apply erosion controls relative to possible soil erosion from vehicular traffic.
- “ Save topsoil removed during mining and decommissioning activities and use to reclaim disturbed areas.
- “ Avoid creating excessive slopes during excavation and blasting operations.
- “ Closely monitor activities near aquifer recharge areas to reduce potential contamination of the aquifer.
- “ Dispose of excess excavation materials in approved areas to control erosion and minimize leaching of hazardous materials.
- “ Reclaim or apply protective covering on disturbed soils as quickly as possible.
- “ Clean and maintain catch basins, drainage ditches, and culverts regularly.
- “ Limit pesticide use to non-persistent, immobile pesticides.
- “ Backfill or re-contour strip-mined or contour-mined areas with excess excavation material generated during construction.
- “ Obtain borrow material from authorized and permitted sites

HERITAGE

Archaeological Recommendations

- “ It is recommended that Site D009 on Quaggasfontein is mitigated before destruction. A surface collection may be sufficient. It is recommended that mitigation should involve setting up a grid across the site and collecting and recording the archaeological material. Some sieving of sub-surface material may be required;
- “ No mitigation is required for any of the other isolated artefact scatters on the Quaggasfontein, Ryst Kuil and De Pannen Blocks;
- “ If any human remains are uncovered during construction, the ECO should have the area fenced off and contact HWC (Tel: 021 483 5959) immediately;
- “ If there are any significant changes to the layout of the facilities, the new designs should be assessed by a heritage practitioner.

Built Environment Recommendations

- “ No demolition of any farm buildings may be undertaken without an assessment of the significance of the buildings by the heritage authority;
- “ If any of the existing farm buildings is used for mining accommodation, then the approval of the relevant heritage compliance authority is necessary if any building alterations;
- “ Haulage routes should avoid passing in close proximity to farm buildings;
- “ In the event that unmarked graves are uncovered during mining, work in the immediate area should cease and the find reported to the heritage authority and an archaeologist. Human remains must not be removed from the site and the area must be cordoned off until a formal exhumation and investigation can be put in place.

NOISE

There are various ways in which the noise impact of the mining activities can be mitigated.

This includes one or more of the following:

- Allowing a setback (buffer zone) of at least 500 meters (even with the berm in place) between the closest mining activities and sensitive receptors at night.
- Reducing the number simultaneous activities (operation planning and management).
- Ensuring that all equipment and machinery are well maintained and equipped with silencers (where possible).
- Considering the noise emission characteristics of equipment when selecting equipment for a project/operation.
- A combination of the above options.

PALAEOTOLOGY

Palaeontological Recommendations

- “ Rubidge (2008) recommends that a palaeontologist show the geologists from the mining companies how to recognize fossils and that they monitor excavations for any possible fossil discoveries;
- “ Although not specifically requested by Rubidge, it is recommended that the Fossil Protocol is implemented;
- “ If any fossils are uncovered, they should be reported to a recognized South African Palaeontological Research Centre, so that they can be excavated and stored for future research purposes.

RADIATION

Mitigation measures for the protection of surface and ground water as well as those described for the suppression of fugitive dust will all play an important role in the minimisation of radiological risk. These controls are described in the relevant sections of this report (Air Quality and Surface and Ground Water) however these will be dealt with in great detail in the Radiological Impact Assessment (RIA).

All recommended mitigation measures for the potential radiological impacts will be presented in the Radiological Impact Assessment Report (RIA) submitted to the National Nuclear Regulator as part of the Certificate of Registration process (authorisation process).

SEIA

The following mitigation measures are provided for the Construction Phase

Clear communication of available employment to minimise population influx.

Clearly communicated preference for local people to work in the mine.

Clearly define and communicate the required number of jobs and skills.

Recruit from the local community first, regardless of the required skills level.

Establish a labour desk to enable effective communication.

Train un-skilled and semi-skilled workers.

Use existing and local construction businesses as subcontractors.

The extent will be determined and mitigation measures will be included in the Social and Labour Plan

Establish Grievance procedure prior to the commencement of the project. Clearly communicate this procedure to the public, ensuring ongoing interaction with the community affected, building trust.

Where strong water resources are identified, share information with farmers, improve use after rehabilitation.

Take increased population into consideration during infrastructure planning in consultation with the local municipality.

Integrate of both temporary and permanent employees into the community. Housing among existing housing, not removed from current economic hub will enable spending in the economic zone, avoid creation of housing that would not be used later on, or that does not fit in with the character of the town.

Construction is a growing industry in BWLM, opportunities to provide adequate accommodation for mine employees pose a viable entrepreneurship avenue.

Enlist current businesses and vendors.

Explore the possibility of using local suppliers of goods and services by drawing up a list of services offered.

Make information of required supplies and services available to the community to encourage tenders from the local area.

Housing and development should occur within the town's urban edge and uphold the character of the town, by contributing architecturally to the town.

Architects and urban planners should be used when housing is developed/planned.

See air quality impact assessment and mitigation suggestions.

Mitigation: Potential traffic impacts and mitigation measures may require greater financial and/or technical inputs due to the terrain and minimal existing infrastructure.

Explore the possibility of using railways that pass by every large town in the CKD

The following mitigation measures are provided for the Operational Phase

Training during construction phase will allow for local people to be employed during operation phase. Establishment of a training centre, to assist in skills development of locals..

Municipal Planning should take this into consideration

Due to the character of the towns of Beaufort West, Merweville and the CKD, urban planning and architects should be used when housing is developed to improve on the existing nature of the town.

Clearly identify and communicate the additional housing need to construction companies and developers who may be able to take up the opportunity to develop new housing in the area. Compile a list of local suppliers of goods and services by drawing up a list of services offered. Continually source from local enterprises.

Housing and development should occur within the town's urban edge and uphold the character of the town, by contributing architecturally to the town. Architects and urban planners should be used when housing is developed/planned.

The following mitigation measures are provided for the Decommissioning Phase

Develop a retrenchment and training programme. Identify alternate developments using similar skills.

Development of skills, training and diversifying of business opportunities throughout the lifetime of the mine is recommended. This will ensure relevant qualification and experiences and enable better employment opportunities after decommissioning of the mine.

SOILS, Land use and Land Capability

Construction:

Structures which are erected without removing the soil layer should be demolished and the soil surface should be cleaned and properly levelled. For linear structures such as haul roads the soil layer can be graded in to berms along the road which can be spread back over the road during the decommissioning phase.

The mitigation measures required to mitigate the impacts on the soil will also mitigate land capability therefore, structures which are erected without removing the soil layer should be demolished and the soil surface should be cleaned and properly levelled. For linear structures such as haul roads the soil layer can be graded in to berms along the road which can be spread back over the road during the decommissioning phase.

By mitigating the soil, the grazing land capability will be restored, but the grazing land use will not be restored if the vegetation is not re-established. The only mitigation for land use is to re-establish vegetation. It is assumed that the vegetation will not be re-established and it will take many years after the decommissioning phase for natural succession of the vegetation in such an arid climate.

Operational:

The topsoil at open pit footprints will be removed to a depth of 200-300 mm depending on the soil depth and stockpiled at a suitable position. During the construction and or decommissioning phase the pits will be backfilled (assumed). The topsoil will be replaced and evenly spread over the backfilled pit footprint. Some reduction of the original soil quality and stability will however be unavoidable.

By mitigating the soil, the grazing land capability will be restored, but the grazing land use will not be restored if the vegetation is not re-established. The only mitigation for land use is to re-establish vegetation. It is assumed that the vegetation will not be re-established and it will take many years after the decommissioning phase for natural succession of the vegetation, especially in such an arid climate.

Contain the footprints of stockpiles as far as possible. Remove stockpiles as soon as possible. Ripping of the surface after removal of the stockpile to alleviate soil compaction.

By mitigating the soil, the grazing land capability will be restored, but the grazing land use will not be restored if the vegetation is not re-established. The only mitigation for land use is to re-establish vegetation. It is assumed that the vegetation will not be re-established and it will take many years after the decommissioning phase for natural succession of the vegetation, especially in such an arid climate.

Decommissioning

For structures that will remain after the decommissioning phase such as the slimes dam, all topsoil should be removed at the footprint and stockpiled. During the operation phase the soil should be used to progressively rehabilitate the facility (if possible) or it should be stored until the decommissioning phase and rehabilitation should then be done as far as possible with the available amount of soil.

(See appendix 5)

TRAFFIC

This traffic impact analysis resulted in the following conclusions and recommendations.

Existing Traffic Conditions

“ The current demand on the existing road network in the site vicinity is low and the road network and intersections operate at acceptable levels of service.

“ The gravel surfaces of the Provincial Main Roads in the site vicinity are in fair condition.

2019 Background Traffic Conditions (No go Alternative)

“ A growth rate of 3 percent per annum was applied to the existing traffic volumes to determine the 2019 background traffic conditions.

“ The road network will continue to operate at acceptable levels-of-service in the future during the worst peak hours of the year without the proposed development.

“ The surface conditions of some of the gravel roads will continue to deteriorate without proper maintenance.

“ The gravel surfaces of the Provincial Main Roads are in fair condition and these roads can accommodate the expected growth in traffic volumes on these roads in the year 2019 Background conditions

Construction Phase

“ It is expected that the construction phase of the proposed development could generate approximately 100 vehicular trips during the average weekday of which approximately 20 percent will be heavy truck traffic.

“ Regional transport routes are via the N1 through the town of Beaufort West and Rail transport is also possible via the existing Beaufort West Station.

“ Access to the different mine sites are proposed via existing farm access roads and there are no access spacing or shoulder sight distance issues.

“ During construction it is expected that gravel road surfaces will require maintenance at regular intervals and it is recommended that the gravel roads be watered on a regular basis (once a day) during the peak construction period. The grey water produced through the Beaufort West Municipal sewage works can be a suitable water source for this purpose.

“ Some minor geometric upgrades might be required along some sections of the roads, specifically at the bridges, to accommodate abnormal load vehicles during the construction phase. However, the frequency of these abnormal load vehicles will be low and it is recommended that during the planning process for the transport of heavy equipment these areas/roads with the possible restrictions should be avoided if possible.

Operational Phase

“ It is expected that the mine will generate approximately 200 new daily trips during the peak operational phase.

“ The existing road network has sufficient capacity to accommodate the additional trips from an operational perspective.

“ A gravel road such can accommodate between 300 and 400 vehicles per day, which means that surfacing of these roads will not be required. However, the truck traffic between the mine sites and the processing plant will have a significant impact on the gravel road surfaces and it is recommended that the gravel roads be watered once or twice a day to reduce gravel loss.

“ Based on the project phasing it is not expected that the cumulative impact on any section of road in the site vicinity will be more than 200 trips per day.

“ In the long term, as the mining areas to the north of Beaufort West becomes active, some of the gravel sections of the Provincial Roads in the site vicinity will need to be upgraded to accommodate the additional truck traffic associated with the mining activity. A detail assessment of the R381 need to be conducted, specifically through the pass areas.

“ All the tarred National and Provincial Roads are in a fair condition and the additional traffic associated with the mining activities in the area will be well within the capacity of the roads in the area.

Alternative Development Proposal

“ There is no viable project alternative since Tasman RSA Mines is considering the only economically and technically viable mining methods to extract the commercially viable uranium and molybdenum deposits.

“ The only other realistic alternative to the proposed mining activity is livestock farming, which is the current activity on the farms.

VISUAL

Stead (2008) makes no specific recommendations with respect visual mitigation in his Baseline Assessment and the following recommendations are extracted from his report:

“ Avoid visual impacts to the R61 which will be bisected by the Ryst Kuil/De Pannen mining blocks. While the route will have a potential view corridor across the mining operations, it is

- important to note that the R61 is not rated as having scenic qualities and is commonly used as a short cut to the N1;
- ~ Avoid visual impacts to Karoo farmsteads and Karoo landscapes that have outstanding rural qualities. However, only one farmstead (Kat Doorn Kuil) was identified as having potential Grade III C significance and it is located at least 2km from the Ryst Kuil Extension mining area;
- ~ Avoid impacts on visually prominent ridgelines and skylines on the property.

If there are any significant changes to the layout of the facility, the new design should be assessed by a heritage practitioner.

ix) Motivation where no alternative sites were considered.

NA - an alternative site for the CPP and Tailing facility was considered and then adopted by the applicant.

x) Statement motivating the alternative development location within the overall site. (Provide a statement motivating the final site layout that is proposed)

The application area (Eastern Block) is a area with historical mining dating back to the 1970's. The mineralization/ore deposit dictates to a large degree where the open cast pits and underground operations are planned
 The initial location of the planned Central Processing Plant (CPP) and tailings facility was amended to the final location (see Figure 4 in Appendix 3). No macro alternative site (i.e. outside the Rystkuil channel/east block) can be considered for the CPP and related infrastructure.

h) Full description of the process undertaken to identify, assess and rank the impacts and risks the activity will impose on the preferred site (In respect of the final site layout plan) through the life of the activity. (Including (i) a description of all environmental issues and risks that were identified during the environmental impact assessment process and (ii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.)

Impact Assessment identification was conducted through the following means:

- Anticipated standard open cast quarry impacts
- Site visit to the existing open cast pit
- Review of historic mine data

The evaluation distinguishes between significantly adverse and beneficial impacts and allocates significance against national regulations, standards and quality objectives governing:

- ~ Health and Safety
- ~ Protection of Environmentally Sensitive areas
- ~ Land use
- ~ Pollution levels

Irreversible impacts are also identified.

The significance of the impacts is determined through the consideration of the following criteria:

- ~ Probability . Likelihood of the impact occurring

- ~ Area - the extent over which the impact will be experienced.
- ~ Duration - the period over which the impact will be experienced.
- ~ Intensity - the degree to which the impact affects the health and welfare of humans and the environment (includes the consideration of unknown risks, reversibility of the impact, violation of laws, precedents for future actions and cumulative effects).

The above criteria are expressed for each impact in tabular form according to the following definitions:

PROBABILITY DEFINITION

- Low There is a slight possibility (0 . 30%) that the impact will occur.
- Medium There is a 30 . 70 % possibility that the impact will occur
- High The impact is definitely expected to occur (70% +) or is already occurring.

AREA DEFINITION

- Small 0 . 50ha
- Medium 51 . 200 ha
- Large 200+ ha

Duration DEFINITION

- Short 0 . 5 years
- Medium 5 . 50 years
- Long 51 . 200 years
- Permanent 200+ years

Intensity DEFINITION

- Low ~ Does not contravene any laws
 - ~ Is within environmental standards or objectives
 - ~ Will not constitute a precedent for future actions
 - ~ Is reversible
 - ~ Will have a slight impact on the health and welfare of humans or the environment.
- Medium ~ Does not contravene any laws
 - ~ Will not constitute a precedent for future actions
 - ~ Is not within environmental standards or objectives
 - ~ Is not irreversible
 - ~ Will have a moderate impact on the health and welfare of humans or the environment.
- High ~ Contravene laws
 - ~ May constitute a precedent for future actions
 - ~ Is not within environmental standards or objectives
 - ~ Is irreversible
 - ~ Will have a significant impact on the health and welfare of humans or the environment.

SIGNIFICANCE DEFINITION

- Negligible The impact is insubstantial and does not require management
- Low The impact is of little importance, but requires management.
- Medium The impact is important; management is required to reduce negative impacts to acceptable levels.
- High The impact is of great importance, negative impacts could render options or the entire project unacceptable if they cannot be reduced or counteracted by significantly positive impacts, and management of these impacts is essential.
- Positive The impact, although having no significant negative impacts, may in fact contribute to environmental or economical health.

It should be noted that the core impact assessment methodology was uniform throughout the various specialist studies with some variation in presentation format and terminology specific to discipline.

i) Assessment of each identified potentially significant impact and risk

(This section of the report must consider all the known typical impacts of each of the activities (including those that could or should have been identified by knowledgeable persons) and not only those that were raised by registered interested and affected parties).

ACTIVITY whether listed or not listed. (E.g. Excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc...etc...etc.).	POTENTIAL IMPACT (e.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc....etc...)	ASPECTS AFFECTED	PHASE In which impact is anticipated (e.g. Construction, commissioning, operational Decommissioning, closure, post-closure)	SIGNIFICANCE if not mitigated	MITIGATION TYPE (modify, remedy, control, or stop) through (e.g. noise control measures, storm-water control, dust control, rehabilitation, design measures, blasting controls, avoidance, relocation, alternative activity etc. etc) E.g. Modify through alternative method. Control through noise control Control through management and monitoring through rehabilitation..	SIGNIFICANCE if mitigated
Due to the limited space provided in this template, the impact assessment tables have been compiled in an Appendix. Please refer to Appendix 5.						

The supporting impact assessment conducted by the EAP must be attached as an appendix, marked **Appendix**

j) Summary of specialist reports.

(This summary must be completed if any specialist reports informed the impact assessment and final site layout process and must be in the following tabular form):-

LIST OF STUDIES UNDERTAKEN	RECOMMENDATIONS OF SPECIALIST REPORTS	SPECIALIST RECOMMENDATIONS THAT HAVE BEEN INCLUDED IN THE EIA REPORT (Mark with an X where applicable)	REFERENCE TO APPLICABLE SECTION OF REPORT WHERE SPECIALIST RECOMMENDATIONS HAVE BEEN INCLUDED.
Air Quality Impact Assessment	<p>It is important that an emission control and reduction strategy is designed and implemented, ensuring that the contribution to ambient concentrations is minimised. To this end, recommendations to further control and mitigate particulate matter emissions during construction, operations and decommissioning are included for consideration for inclusion in the EMP. It includes measures such as:</p> <p>“ Roads could be tarred or traffic control measures implemented to limit vehicle-entrained dust from unsurfaced roads e.g. by limiting vehicle speeds and restricting traffic volumes.</p> <p>“ The sidewalls of the tailings dam could be vegetated/covered as they rise, and the cover maintained to reduce the exposed area and limit wind entrainment.</p> <p>“ Stabilise open areas with dust palliative, gravel or similar.</p>	X	Viii
Biodiversity Impact Assessment	<p>“ Minimise the footprint of construction and operation (maintenance) activities through appropriate planning. Each activity must be well planned to determine the minimum footprint required, which must be demarcated on the ground in advance (to reduce the potential of accidental spill-over and accidental damage into surrounding areas and to allow botanical experts to carry out a final sweep of the footprint areas in order to initiate possible relocation of Red and Orange Listed species). These areas must include vehicle parking areas, turning facilities, worker's toilet facilities, worker's camps, material and equipment lay down areas etc;</p> <p>“ Embedded erosion control measures should further aim to reduce the slope of cleared areas. Re-vegetation should be conducted with suitable indigenous vegetation to form a vegetation cover that will protect exposed surfaces and attempt to limit the loss of topsoil during high rainfall events while simultaneously reducing sedimentation of streams/rivers. First establish a suitable ground cover of grass to protect</p>	X	Viii

	<p>the soil surface followed by suitable tree species to provide shade, thereby creating a structured habitat where natural successional development will ultimately result in improved habitat, connectivity and biodiversity;</p> <p>“ Maximum use of existing cleared areas, areas of disturbance and road networks should be utilised;</p> <p>“ Provide permeable fencing adjacent known sensitive habitats (reference to habitat sensitivity map) to facilitate movement of faunal species;</p> <p>Several rehabilitation measures can further decrease the magnitude of the anticipated impacts resulting from vegetation clearing:</p> <p>“ Implement a construction handover plan in which rehabilitation measures are defined and budgeted for. Re-vegetation trials must be undertaken to determine the most appropriate species for a particular habitat. Species should be selected on a basis of adaptive management. i.e. perform trial runs on several species and select those species most suitable in achieving the desired result of establishing ground cover and increasing habitat functionality. A nursery should be established to propagate selected plant species for translocation and rehabilitation. Specific planting plans and schedules for each habitat type must be determined where rehabilitation will be required;</p> <p>“ Development of an operational monitoring programme to assess success and sustainability of rehabilitation and reclamation procedures applied. This monitoring programme will aid in continuous adaptation of the rehabilitation process and will demonstrate whether the rehabilitation procedures in place are successful. Critical components that need to be monitored are:</p> <ul style="list-style-type: none"> o Re-vegetation success. It is essential to ensure that the re-vegetated areas are successfully proliferating and not dying or succumbing to alien invasive plant competition; o Control of alien and invasive species. It is very important to ensure that continued control of alien and/or invasive species is taking place after the construction phase and during the operations phase and this must therefore be monitored adequately; o Water quality monitoring. Runoff into seasonal pans should be monitored to ensure that rehabilitation procedures have sufficiently controlled any pollution and sedimentation likely to occur in the surrounding water dependent habitats. <p>“ Establishment of a functional plant propagation facility with the capacity to supply the required trees and plants needed for minimization of soil erosion and other rehabilitation measures;</p>		
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	<p>~ Devise and implement an alien and /or invasive plant control policy which must attempt to prevent the spread of alien/invasive plant species through mechanical and chemical treatment.</p> <ul style="list-style-type: none"> o Where herbicide treatment is required, herbicides should be selected in line with international standards and must be applied by trained personnel only. Storage and use of herbicides will be as per the manufactures instructions. Herbicides must be clearly labelled at all times and application of these herbicides must be planned in consultation with an ecologist to ensure that the environment is not adversely affected; and o Prohibiting the transport of all live plants, seeds or vegetative material; and o The entire length of the haul road systems, all terminals and product storage areas will require frequent monitoring for the presence of alien invader plant species, and eradication measures must be implemented where required . <p>~ Walk-in capture traps should be deployed wherever construction camps as well as operational infrastructure are established. Capture traps should be used in order to eliminate only alien species such as Mus musculus, Rattus rattus and Rattus norvegicus and not native rodents which should be released unharmed upon capture by an Environmental Control Officer. Captured alien rodent species must be killed humanely and incinerated. Rodent-specific poisons can be used inside walk-in capture traps in highly transformed areas where significant assemblages of native rodents are not expected. This will ensure that poison is not spread to the surrounding environment and/ or to native predators (reptiles, owls, mammals) causing native predator deaths (see below);</p> <p>~ All rodent poison controls should be strictly monitored by the Environmental Control Officer in order to prevent poisoning of native small mammals and/or cause accidental mortalities of rodent predators such as snakes, raptors, owls, small predators and meso-predators.;</p> <p>~ All deliveries of food stuff must be subject to stringent quarantine and quality controls to avoid pests in transit;</p> <p>~ A strict zero-tolerance approach to the trade in faunal species must be implemented for all staff and contractors. This will not only avoid establishment of alien faunal species but also help control the spread of diseases;</p> <p>~ Sensitive areas such as wetlands , streams and rivers will require buffering (150 m) from construction activities and waste disposal to prevent spread of alien invasive plant species in these very sensitive and susceptible habitats;</p> <p>~ Waste, especially domestic waste, should not be stored for more than a week before being removed (by appropriate closed-bin structures)</p>		
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and processed according to International health standards. All areas where domestic waste is temporarily stored should be securely covered to avoid attracting birds and rodents. Trapping for rodents should be intensive and continuous around waste storage sites.

“ Open areas should be cleared of alien and invasive plants (chemical and mechanical control, dispose of these appropriately to avoid spread) and re-vegetated with suitable indigenous plants;

“ Continued eradication of alien rodents is advised throughout the construction and operation phases especially around infrastructure;

“ Development of a monitoring programme to assess success and sustainability of alien and invasive species management. This monitoring programme will aid in continuous adaption of the rehabilitation process and will demonstrate whether the rehabilitation procedures in place are successful. Two of the critical components that need to be monitored are:

o Re-vegetation success. It is essential to ensure that the re-vegetated areas are successfully proliferating and not dying or succumbing to alien invasive plant competition; and

o Control of alien and invasive species. It is very important to ensure that continued control of alien and invasive species is taking place and this must therefore be monitored closely.

“ The transport and trade of high value floral species along the road servitudes should be monitored at designated security points and random search points. Trespassers should be prosecuted through the applicable National laws in the trade of species; and

“ The use of the servitudes by local inhabitants should be prevented by appropriate locked gates preventing unauthorized use of the road servitudes with a vehicle.

“ The ECO should monitor live animal observations in order to monitor trends in animal populations and thus implement adaptable mitigation of vehicle movements.

“ Road mortalities should be monitored by both vehicle operators (for personal incidents only) and the ECO (all road kill on periodic monitoring basis as well as specific incidents) with trends being monitored and subject to review as part of the monthly reporting. Monitoring should occur via a logbook system where staff takes note of the date, time and location of the sighting/ incident. This will allow determination of the locations where the greatest likelihood exists of causing a road mortality and mitigate against it through both the embedded measures mentioned above (reducing vehicle speeds in sensitive areas) and below (e.g. fauna underpasses, fence removals and seasonal speed reductions). Finally,

mitigation should be adaptable to the onsite situation which may vary over time;

" Reduce direct mortalities either by removing fences in identified sensitive areas or indeed, increasing the buffer area either side of the road by 50 metres either side, in order to allow fauna to have an escape area away from impenetrable fences.

" Reduce direct mortalities by allowing for fauna to cross the roads, particularly where the roads cross a sensitive natural habitat (e.g. wetlands or artificial water points). This can be achieved by constructing fauna underpasses under the roads (large culverts or large open-ended concrete pipes laid into the raised roads). These underpasses should be used in conjunction with "fauna barriers" which prevent the most susceptible small fauna from crossing the roads on the surface by directing them towards the underpasses where they can cross under the roads safely. It is important to note that utilization of underpasses is strongly dependent on animal body size (larger culverts are more successful) and the surrounding habitat (Mata et. al 2005); and

" All staff operating motor vehicles must undergo an environmental induction training courses that includes instruction on the need to comply with speed limits, to respect all forms of wildlife (especially reptiles and amphibians) and, wherever possible, prevent accidental road kills of fauna. Dead mammals should never be handled due to the risk of rabies and snakes should only be handled after inductions have taken place due to the risks of post-mortem invenomation. Drivers not complying with speed limits should be subject to penalties.

All control measures to avoid, minimize and rehabilitate the impacts of dust and noise are already mentioned in the embedded controls sections. For lighting the following mitigation measures are required:

" Reduce exterior lighting to that necessary for safe operation, and implement operational strategies to reduce spill light. Use non-UV lights where possible, as light emitted at one wavelength has a Low level of attraction to insects. This will reduce the likelihood of attracting insects and their predators; and

" Design lighting strategies that address or minimise items such as degree of spill light, use of up lights and use of lights with red wavelengths. Down lighting is preferred as are lights with blue or green wavelength. This will reduce the likelihood of blinding avifauna.

Due to the well-known and major significance of this impact numerous embedded controls exist to minimise the likelihood and magnitude thereof. Only one additional mitigation measure requires discussion:

	<p>“ Care should be taken not to over-water during dust suppression activities which can lead to runoff containing high loads of suspended solids and dissolved / transported chemicals / compounds that ultimately enter the wetlands.</p> <p>“ Real time monitoring probes linked to remote sensing base stations need to be place in areas of sub surface and surface water flow in order to immediately detect elevated levels of contamination in order to initiate emergency measures.</p> <p>“ Chemical spill cleanup kits must be stationed at all sites where spills are probable, especially in conjunction with sensitive habitats such as close proximity to aquatic habitats. Several staff should be trained in the chemical cleanup procedure and at least one member of this unit must be on duty at all times.</p> <p>“ If extensive spills have occurred, the area must be rehabilitated appropriately. This will require consultation with an ecologist specialized in the rehabilitation of polluted habitats. This will further decrease the magnitude of the anticipated impacts arising from accidental spill.</p>		
Heritage & Built Env Impact Assessment	<p>Archaeology</p> <p>“ It is recommended that Site D009 on Quaggasfontein is mitigated before destruction. A surface collection may be sufficient as there does not appear to be any depth to the site. It is recommended that mitigation should involve setting up a grid across the site and collecting and recording the archaeological material. Some sieving of sub-surface material may be required;</p> <p>“ No mitigation is required for any of the other isolated artefact scatters on the Quaggasfontein, Ryst Kuil and De Pannen Blocks.</p> <p>“ If there are any significant changes to the layout of the facilities, the new designs should be assessed by a heritage practitioner.</p> <p>Built Environment</p> <p>“ No demolition of any farm buildings may be undertaken without an assessment of the significance of the buildings by the heritage authority;</p> <p>“ If any of the existing farm buildings is used for mining accommodation, then the approval of the relevant heritage compliance authority is necessary for any building alterations;</p> <p>“ Haulage routes should avoid passing in close proximity to farm buildings;</p> <p>“ In the event that unmarked graves are uncovered during mining, the ECO should have the area fenced off and contact HWC (Tel: 021 483 5959) immediately. Human remains must not be removed from the site and the area must be cordoned off until a formal exhumation and</p>	X	Viii

	investigation can be put in place.		
Visual Impact Assessment	<p>Visual</p> <p>Stead (2008) makes no specific recommendations with respect visual mitigation in his Baseline Assessment and the following recommendations are extracted from his report:</p> <p>“ Avoid visual impacts to the R61 which will be bisected by the Ryst Kuil/De Pannen mining blocks. While the route will have a potential view corridor across the mining operations, it is important to note that the R61 is not rated as having scenic qualities and is commonly used as a short cut to the N1;</p> <p>“ Avoid visual impacts to Karoo farmsteads and Karoo landscapes that have outstanding rural qualities. However, only one farmstead (Katdoornkuil) was identified as having potential Grade IIIC significance and it is located at least 2km from the Ryst Kuil Extension mining area;</p> <p>“ Avoid impacts on visually prominent ridgelines and skylines on the property.</p> <p>If there are any significant changes to the layout of the facility, the new design should be assessed by a heritage practitioner.</p>	X	Viii
Socio Economic Impact Assessment	<p>The following mitigation measures are provided for the Construction Phase</p> <p>Clear communication of available employment to minimise population influx.</p> <p>Clearly communicated preference for local people to work in the mine.</p> <p>Clearly define and communicate the required number of jobs and skills.</p> <p>Recruit from the local community first, regardless of the required skills level.</p> <p>Establish a labour desk to enable effective communication.</p> <p>Train un-skilled and semi-skilled workers.</p> <p>Use existing and local construction businesses as subcontractors.</p> <p>The extent will be determined and mitigation measures will be included in the Social and Labour Plan</p> <p>Establish Grievance procedure prior to the commencement of the project.</p> <p>Clearly communicate this procedure to the public, ensuring ongoing interaction with the community affected, building trust.</p> <p>Where strong water resources are identified, share information with farmers, improve use after rehabilitation.</p> <p>Take increased population into consideration during infrastructure</p>	X	Viii

	<p>planning in consultation with the local municipality. Integrate of both temporary and permanent employees into the community. Housing among existing housing, not removed from current economic hub will enable spending in the economic zone, avoid creation of housing that would not be used later on, or that does not fit in with the character of the town. Construction is a growing industry in BWLM, opportunities to provide adequate accommodation for mine employees pose a viable entrepreneurship avenue. Enlist current businesses and vendors. Explore the possibility of using local suppliers of goods and services by drawing up a list of services offered. Make information of required supplies and services available to the community to encourage tenders from the local area. Housing and development should occur within the town's urban edge and uphold the character of the town, by contributing architecturally to the town. Architects and urban planners should be used when housing is developed/planned. See air quality impact assessment and mitigation suggestions. Mitigation: Potential traffic impacts and mitigation measures may require greater financial and/or technical inputs due to the terrain and minimal existing infrastructure. Explore the possibility of using railways that pass by every large town in the CKD</p> <p>The following mitigation measures are provided for the Operational Phase Training during construction phase will allow for local people to be employed during operation phase. Establishment of a training centre, to assist in skills development of locals.. Municipal Planning should take this into consideration Due to the character of the towns of Beaufort West, Merweville and the CKD, urban planning and architects should be used when housing is developed to improve on the existing nature of the town. Clearly identify and communication the additional housing need to construction companies and developers who may be able to take up the opportunity to develop new housing in the area. Compile a list of local suppliers of goods and services by drawing up a list of services offered. Continually source from local enterprises. Housing and development should occur within the town's urban edge and uphold the character of the town, by contributing architecturally to the town. Architects and urban planners should be used when housing is</p>		
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	<p>developed/planned.</p> <p>The following mitigation measures are provided for the Decommissioning Phase</p> <p>Develop a retrenchment and training programme. Identify alternate developments using similar skills.</p> <p>Development of skills, training and diversifying of business opportunities throughout the lifetime of the mine is recommended. This will ensure relevant qualification and experiences and enable better employment opportunities after decommissioning of the mine.</p>		
<p>Traffic Impact Assessment</p>	<p>This traffic impact analysis resulted in the following conclusions and recommendations.</p> <p>Existing Traffic Conditions</p> <p>" The current demand on the existing road network in the site vicinity is low and the road network and intersections operate at acceptable levels of service.</p> <p>" The gravel surfaces of the Provincial Main Roads in the site vicinity are in fair condition.</p> <p>2019 Background Traffic Conditions (No go Alternative)</p> <p>" A growth rate of 3 percent per annum was applied to the existing traffic volumes to determine the 2019 background traffic conditions.</p> <p>" The road network will continue to operate at acceptable levels-of-service in the future during the worst peak hours of the year without the proposed development.</p> <p>" The surface conditions of some of the gravel roads will continue to deteriorate without proper maintenance.</p> <p>" The gravel surfaces of the Provincial Main Roads are in fair condition and these roads can accommodate the expected growth in traffic volumes on these roads in the year 2019 Background conditions</p> <p>Construction Phase</p> <p>" It is expected that the construction phase of the proposed development could generate approximately 100 vehicular trips during the average weekday of which approximately 20 percent will be heavy truck traffic.</p> <p>" Regional transport routes are via the N1 through the town of Beaufort West and Rail transport is also possible via the existing Beaufort West Station.</p> <p>" Access to the different mine sites are proposed via existing farm access roads and there are no access spacing or shoulder sight distance issues.</p> <p>" During construction it is expected that gravel road surfaces will require maintenance at regular intervals and it is recommended that the</p>	<p>X</p>	<p>Viii</p>

	<p>gravel roads be watered on a regular basis (once a day) during the peak construction period. The grey water produced through the Beaufort West Municipal sewage works can be a suitable water source for this purpose.</p> <p>" Some minor geometric upgrades might be required along some sections of the roads, specifically at the bridges, to accommodate abnormal load vehicles during the construction phase. However, the frequency of these abnormal load vehicles will be low and it is recommended that during the planning process for the transport of heavy equipment these areas/roads with the possible restrictions should be avoided if possible.</p> <p>Operational Phase</p> <p>" It is expected that the mine will generate approximately 200 new daily trips during the peak operational phase.</p> <p>" The existing road network has sufficient capacity to accommodate the additional trips from an operational perspective.</p> <p>" A gravel road such can accommodate between 300 and 400 vehicles per day, which means that surfacing of these roads will not be required. However, the truck traffic between the mine sites and the processing plant will have a significant impact on the gravel road surfaces and it is recommended that the gravel roads be watered once or twice a day to reduce gravel loss.</p> <p>" Based on the project phasing it is not expected that the cumulative impact on any section of road in the site vicinity will be more than 200 trips per day.</p> <p>" In the long term, as the mining areas to the north of Beaufort West becomes active, some of the gravel sections of the Provincial Roads in the site vicinity will need to be upgraded to accommodate the additional truck traffic associated with the mining activity. A detail assessment of the R381 need to be conducted, specifically through the pass areas.</p> <p>" All the tarred National and Provincial Roads are in a fair condition and the additional traffic associated with the mining activities in the area will be well within the capacity of the roads in the area.</p> <p>Alternative Development Proposal</p> <p>" There is no viable project alternative since Tasman RSA Mines is considering the only economically and technically viable mining methods to extract the commercially viable uranium and molybdenum deposits.</p> <p>" The only other realistic alternative to the proposed mining activity is livestock farming, which is the current activity on the farms.</p>		
Palaeontology Impact Assessment	<p>Palaeontology</p> <p>" The first phase of the mining operations at Quaggasfontein, Ryst Kuil and De Pannen will occur over a 17 year period, thus ongoing monitoring by a palaeontologist will not be possible;</p>	X	Viii

	<p>~ Rubidge (2008) recommends that a palaeontologist show the geologists from the mining company how to recognize fossils and that they monitor excavations for any possible fossil discoveries;</p> <p>~ Although not specifically requested by Rubidge, this report recommends that the Fossil Protocol is implemented;</p> <p>~ If any fossils are uncovered, they should be reported to a recognized South African Palaeontological Research Centre, so that they can be excavated with a Workplan and stored for future research purposes.</p>		
Noise Impact Assessment	<p>There are various ways in which the noise impact of the mining activities can be mitigated.</p> <p>This includes one or more of the following:</p> <ul style="list-style-type: none"> - Allowing a setback (buffer zone) of at least 500 meters (even with the berm in place) between the closest mining activities and sensitive receptors at night. - Reducing the number simultaneous activities (operation planning and management). - Ensuring that all equipment and machinery are well maintained and equipped with silencers (where possible). - Considering the noise emission characteristics of equipment when selecting equipment for a project/operation. - A combination of the above options. 	X	Viii
Surface and Ground Water Impact Assessment	<p>The following are examples of mitigation measures that could be applied to reduce water resource impacts of a project depending upon site- and project-specific conditions. Impacts to water resources are related to the project footprint (e.g., land disturbance, erosion, changes in runoff patterns, and hydrological alterations), project emissions (e.g., sediment runoff, acid mine drainage, and water releases), and resource use (e.g., water extraction). Many impacts can be reduced or avoided when considered during the siting and design phase.</p> <p>The recommendation would be to develop a final set of mitigation measures for any project in consultation with the appropriate government resource management agencies and stakeholders. Conduct these consultations early in the project development process and preferably prior to final project siting and design.</p> <p>Siting and Design Mitigation Measures</p> <p>Siting and design considerations that mitigate impacts include:</p> <p>~ Identify and avoid unstable slopes and local factors that can cause slope instability (groundwater conditions, precipitation, seismic activity, slope angles, and geologic structure).</p> <p>~ Research local hydrogeology. Identify areas of groundwater</p>	X	Viii

discharge and recharge and their potential relationships with surface water bodies and groundwater quality. Avoid creating hydrologic conduits between two aquifers.

" Minimize the planned amount of land to be disturbed as much as possible.

" Use special construction techniques in areas of steep slopes, erodible soils, and stream crossings.

" Construct drainage ditches only where necessary. Use appropriate structures at culvert outlets to prevent erosion.

" ;Do not alter existing drainage systems, especially in sensitive areas such as erodible soils or steep slopes.

" Permanent impoundments, including seep discharges, must meet the performance standards, including having water quality suitable for the intended post-mining use.

" Handle earth materials and runoff in a manner that minimizes the formation of acid mine drainage, prevents adding suspended solids to stream flow, and otherwise prevents water pollution. Construct sedimentation structures near the disturbed area to impound surface water runoff and sediment. Maintain as necessary, including discharge of water meeting applicable water quality standards, so as not to exceed designed storage capacity.

General Mitigation Measures

General mitigation practices and principles that could apply to any or all phases of a uranium mine project include:

" Apply erosion controls relative to possible soil erosion from vehicular traffic.

" Save topsoil removed during mining and decommissioning activities and use to reclaim disturbed areas.

" Avoid creating excessive slopes during excavation and blasting operations.

" Closely monitor activities near aquifer recharge areas to reduce potential contamination of the aquifer.

" Dispose of excess excavation materials in approved areas to control erosion and minimize leaching of hazardous materials.

" Reclaim or apply protective covering on disturbed soils as quickly as possible.

" Clean and maintain catch basins, drainage ditches, and culverts regularly.

" Limit pesticide use to non-persistent, immobile pesticides.

" Backfill or re-contour strip-mined or contour-mined areas with excess excavation material generated during construction.

	<p>~ Obtain borrow material from authorized and permitted sites</p>		
<p>Soil Impact Assessment</p>	<p>During stripping and stockpiling the following principles should be aimed for:</p> <p>~ Prevent mixing of high quality topsoil (A and B-horizons) with low quality underlying material to ensure sufficient volumes of high quality soil for rehabilitation. The quality of soil earmarked for rehabilitation purposes significantly deteriorates when the high quality topsoil is mixed with the underlying poorer quality material (clay layers, calcrete, plinthite, weathered rock etc). This results in significant deterioration in the quality of the soils physical and chemical properties and a decline in the soil fertility necessary for re-vegetation. The deterioration in soil quality also significantly increases the susceptibility of rehabilitated soils for erosion and seal and crust formation.</p> <p>~ Separate stockpiling of different soil type groups to obtain the highest post-mining land capability. Topsoil quality or potential is not just limited to the grade of soil generally referred to as topsoil but can vary from very high to low due to various properties. Soil properties of different soil types can vary substantially e.g. high quality red and yellow well-drained soils and low quality grey poorly drained wetland soils can occur over very short distances in the same field. Mixing of different soil types results in rapid changes in soil properties and characteristics such as texture, infiltration rates and water holding capacity over short distances after replacement, which will definitely adversely affect the post-mining land capability.</p> <p>~ Separate stripping, stockpiling and replacing of soil horizons (A and B-horizon) in the original natural sequence to combat hardsetting and compaction, maintain soil fertility and conserve the natural seed source. The higher soil fertility of the A-horizon, especially phosphorus and carbon contents, declines significantly when it is mixed with the B-horizon, resulting in poorer re-vegetation success. It also increases the susceptibility to compaction and hard setting. The A-horizon also serves as a seed source which will enhance the re-establishing of natural species. The A and B-horizons should be stripped and stockpiled separately and replaced with the A-horizon overlying the B-horizon. Contrary to the general perception, separate stockpiling of different soil types and horizons does not have significant cost implications for the mine and only requires planning and continuing management. For specific impacts see Appendix 5. The impacts on soils and land capability can be reduced to acceptable</p>	<p>X</p>	<p>Viii</p>

	levels by replacement of the topsoil after the lifespan of facilities. The impact of current land use is hard to mitigated because the re-establishment of vegetation in such an arid climatic area is hardly possible..		
Radiological Impact Assessment	<p>The radiological impact assessment process is a systematic process and has to demonstrate safety of the public and protection of the environment around uranium mining and processing facilities and consists of the following elements:</p> <ul style="list-style-type: none"> " Site Description - A description of where the facility or plant is located; " Process Description - A detailed description of all activities and processes at the plant, which could result in public exposure; " Source Term Characterisation - A detailed description of all the radionuclides present, their quantities, chemical and physical form, decay constants, dose conversion factors, absorption classes, and any other relevant information to the safety assessment; " Exposure Pathways - Identification of all intake and radiation exposure pathways relevant to the safety assessment; " Critical Group (Representative Person) and Representative Animals and Plants Identification - Identification of all members of the public receiving the highest radiation doses, their habitat, agricultural and social activities that could impact on radiation doses; " Assessment Criteria - The dose criteria to members of the public, contained in the legislative and regulatory framework, that should not be exceeded as a result of activities and operations at facilities; " Public Dose Assessment - A complete dose assessment which should take into account all the exposure pathways and scenarios which requires some form of modelling based on conservative or reasonable assumptions. " Radiological risk to non-human biota (no specific regulatory criteria as for humans) <p>The NNR reviews the radiological impact assessment against regulatory criteria, all assumptions and parameters, including data from sampling and analysis programmes, before acceptance or approval of the submission and granting of a certificate of authorisation.</p>		Included in the RIA Report to be submitted to the NNR in 2016.

Attach copies of Specialist Reports as appendices

Please see all Specialist Report in Appendices 10 - 19.

k) Environmental impact statement

(i) Summary of the key findings of the environmental impact assessment;

SURFACE & GROUND WATER

In the Eastern Block of the entire Tasman RSA Mines Karoo project the following refers:

The main conclusions to be drawn from the current state of knowledge of the Karoo groundwater investigation are:

General

The main aquifer is the Ryst Kuil Channel Sandstone which has a variable thickness up to 45 m to depths of 120m below surface. The ore body is hosted within this sandstone;

Aquifer transmissivity and borehole yields are highest in the south-west and decrease to the northeast. This is a function of sandstone lithology and thickness and structure. There is also a fairly strong E-W anisotropy with respect to transmissivity;

The monitoring network installed in November 2007 shows mostly very low amplitude (~0.1 m) fluctuations in groundwater levels. Greater fluctuations (<1 m) occur in response to pumping from nearby (<500 m) farmer's boreholes or exploration rig supply boreholes. There is no evidence of any regional depletion of aquifer groundwater levels despite the recent drought conditions.

Water Supply

Mine operations will require ~3 600 m³/day for 10 to 15 years, i.e ~1,314 Mm³/annum. The General Authorization for the study area is zero. A licence application will therefore have to be submitted to the DWS to cover groundwater abstraction for supply;

The projected mine water requirements can probably be met in the Ryst Kuil Mine area but not in the other mine areas. Water quality in the secondary aquifer in the Ryst Kuil area is relatively good with a projected EC of <150 mS/m;

Groundwater from the hydrogeological exploration boreholes falls within the lower limits of Class II with respect to drinking water standards. This water would therefore be suitable for domestic consumption during the projected mining time period.

BIODIVERSITY

The Gamka-Karoo regional vegetation type occupies an area of 2,031,811 ha of which 99.5% is still remaining and 1.9% is protected (Mucina and Rutherford 2006). The combined area of the proposed development (exclusive use rights, not pit area) is approximately 3227.5 ha (Table 25), which represents a potential transformation to the Gamka-Karoo vegetation type of only 0.16 %. This is expressed numerically in the table below. Given the fact that the majority of this vegetation type is intact and that it is found over such a large expanse, the surface area transformation that can be expected from the proposed development is considered to be insignificant. However, the two major potentially significant impacts anticipated from this development, which are radioactive dust and radioactive contaminated water discharge, . If not adequately controlled, these aspects have the potential to influence a much larger area than the development footprint. If such impacts were to occur they are expected to be of long-lasting duration and severe in magnitude, making them highly significant.

HERITAGE

Palaeontology

" The first phase of the mining operations at Quaggasfontein, Ryst Kuil and De Pannen will occur over a 17 year period, thus ongoing monitoring by a palaeontologist will not be possible;

" Rubidge (2008) recommends that a palaeontologist show the geologists from the mining company how to recognize fossils and that they monitor excavations for any possible fossil discoveries;

" Although not specifically requested by Rubidge, this report recommends that the Fossil Protocol is implemented;

" If any fossils are uncovered, they should be reported to a recognized South African Palaeontological Research Centre, so that they can be excavated with a Workplan and stored for future research purposes.

Archaeology

" It is recommended that Site D009 on Quaggasfontein is mitigated before destruction. A surface collection may be sufficient as there does not appear to be any depth to the site. It is recommended that mitigation should involve setting up a grid across the site and collecting and recording the archaeological material. Some sieving of sub-surface material may be required;

" No mitigation is required for any of the other isolated artefact scatters on the Quaggasfontein, Ryst Kuil and De Pannen Blocks.

" If there are any significant changes to the layout of the facilities, the new designs should be assessed by a heritage practitioner.

Built Environment

" No demolition of any farm buildings may be undertaken without an assessment of the significance of the buildings by the heritage authority;

" If any of the existing farm buildings is used for mining accommodation, then the approval of the relevant heritage compliance authority is necessary for any building alterations;

" Haulage routes should avoid passing in close proximity to farm buildings;

" In the event that unmarked graves are uncovered during mining, the ECO should have the area fenced off and contact HWC (Tel: 021 483 5959) immediately. Human remains must not be removed from the site and the area must be cordoned off until a formal exhumation and investigation can be put in place.

Visual

Stead (2008) makes no specific recommendations with respect visual mitigation in his Baseline Assessment and the following recommendations are extracted from his report:

" Avoid visual impacts to the R61 which will be bisected by the Ryst Kuil/De Pannen mining blocks. While the route will have a potential view corridor across the mining operations, it is important to note that the R61 is not rated as having scenic qualities and is commonly used as a short cut to the N1;

" Avoid visual impacts to Karoo farmsteads and Karoo landscapes that have outstanding rural qualities. However, only one farmstead (Katdoornkuil) was identified as having potential Grade IIIC significance and it is located at least 2km from the Ryst Kuil Extension mining area;

" Avoid impacts on visually prominent ridgelines and skylines on the property. If there are any significant changes to the layout of the facility, the new design should be assessed by a heritage practitioner.

SEIA

Although many potential impacts are identified and mitigation measures are suggested, not all of the impacts may be expressly experienced in the Eastern Block, however due to the integrated nature of any changes in the socio-economic fabric of any population, this report highlight the socio-economic impacts of the proposed mine in the whole district and not the Eastern Block only.

The concluding remarks from the following specialists raised no impacts where the level of risk could not be adequately controlled through the implementation of adequate mitigation measures:

- Air Quality
- Noise

TRAFFIC

Existing Traffic Conditions

" The current demand on the existing road network in the site vicinity is low and the road network and intersections operate at acceptable levels of service.

" The gravel surfaces of the Provincial Main Roads in the site vicinity are in fair condition.

2019 Background Traffic Conditions (No go Alternative)

" A growth rate of 3 percent per annum was applied to the existing traffic volumes to determine the 2019 background traffic conditions.

" The road network will continue to operate at acceptable levels-of-service in the future during the worst peak hours of the year without the proposed development.

" The surface conditions of some of the gravel roads will continue to deteriorate without proper maintenance.

" The gravel surfaces of the Provincial Main Roads are in fair condition and these roads can accommodate the expected growth in traffic volumes on these roads in the year 2019 Background conditions

Construction Phase

" It is expected that the construction phase of the proposed development could generate approximately 100 vehicular trips during the average weekday of which approximately 20 percent will be heavy truck traffic.

" Regional transport routes are via the N1 through the town of Beaufort West and Rail transport is also possible via the existing Beaufort West Station.

" Access to the different mine sites are proposed via existing farm access roads and there are no access spacing or shoulder sight distance issues.

" During construction it is expected that gravel road surfaces will require maintenance at regular intervals and it is recommended that the gravel roads be watered on a regular basis (once a day) during the peak construction period. The grey water produced through the Beaufort West Municipal sewage works can be a suitable water source for this purpose.

" Some minor geometric upgrades might be required along some sections of the roads, specifically at the bridges, to accommodate abnormal load vehicles during the construction phase. However, the frequency of these abnormal load vehicles will be low and it is recommended that during the planning process for the transport of heavy equipment these areas/roads with the possible restrictions should be avoided if possible.

Operational Phase

" It is expected that the mine will generate approximately 200 new daily trips during the peak operational phase.

" The existing road network has sufficient capacity to accommodate the additional trips from an operational perspective.

" A gravel road such can accommodate between 300 and 400 vehicles per day, which means that surfacing of these roads will not be required. However, the truck traffic between the mine sites and the processing plant will have a significant impact on the gravel road surfaces and it is recommended that the gravel roads be watered once or twice a day to reduce gravel loss.

" Based on the project phasing it is not expected that the cumulative impact on any section of road in the site vicinity will be more than 200 trips per day.

" In the long term, as the mining areas to the north of Beaufort West becomes active, some of the gravel sections of the Provincial Roads in the site vicinity will need to be upgraded to accommodate the additional truck traffic associated with the mining activity. A detail assessment of the R381 need to be conducted, specifically through the pass areas.

" All the tarred National and Provincial Roads are in a fair condition and the additional traffic associated with the mining activities in the area will be well within the capacity of the roads in the area.

Alternative Development Proposal

" There is no viable project alternative since Tasman RSA Mines is considering the only economically and technically viable mining methods to extract the commercially viable uranium and molybdenum deposits.

" The only other realistic alternative to the proposed mining activity is livestock farming, which is the current activity on the farms.

Noise

Attenuation of noise over distance is anticipated to be the greatest factor to mitigate community response to elevated noise levels within the vicinity of the mining operations. The closest sensitive receptors within the East block are further than 1500m from the noise source.

(ii) Final Site Map

Provide a map at an appropriate scale which superimposes the proposed overall activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers. Attach as **Appendix**

See Appendix 3 for final Regulation 2:2 plan and Final Site map.

(iii) Summary of the positive and negative implications and risks of the proposed activity and identified alternatives;

In summary the potential positive impacts of this project are as follows:

- Job creation
- small business development
- Community benefit through SLP implementation
- Tax contribution to National Fiscus
- export of yellow cake for international processing

In summary the potential negative impacts of this project are as follows:

- Impact on Karoo sense of place
- Impact on local air quality
- Increased environmental noise in vicinity of operations
- Ground water draw down adjacent to mining areas
- Possible surface and ground water contamination
- Fauna and Flora impact within development footprints
- Fauna loss through alien species introduction, direct vehicle collision
- Impact on unpaved roads through increased traffic

l) Proposed impact management objectives and the impact management outcomes for inclusion in the EMPr;

Based on the assessment and where applicable the recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation.

Impact Management Objectives and Action plan: See Appendix 7

m) Final proposed alternatives.

(Provide an explanation for the final layout of the infrastructure and activities on the overall site as shown on the final site map together with the reasons why they are the final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment)

The Final proposed site layout is provided in Appendix 4. No reasons or motivation was provided by the specialist team for the relocation of any of the infrastructure other than the Central processing Plant (CPP) and tailings facility as discussed above in this document.

n) Aspects for inclusion as conditions of Authorisation.

Any aspects which have not formed part of the EMPr that must be made conditions of the Environmental Authorisation

All aspects for inclusion as conditions of authorisation have been included above in the Sections (viii) and (j) above.

o) Description of any assumptions, uncertainties and gaps in knowledge.

(Which relate to the assessment and mitigation measures proposed)

In the Ground and Surface Water report, the following gaps were identified:

The following actions are recommended:

- Update this evaluation with the new mining area/decline dewatering information;
- Update the modelling with detailed mine plans. The scenarios run to date all assume open pit mines but with no information on pit geometry or mine infrastructure.

p) Reasoned opinion as to whether the proposed activity should or should not be authorised

i) Reasons why the activity should be authorized or not.

While uranium is used almost entirely for making electricity, a small proportion is used for the important task of producing medical isotopes. Some is also used in marine propulsion, especially naval.

Uranium is a naturally occurring element with an average concentration of 2.8 parts per million in the Earth's crust. Traces of it occur almost everywhere. It is more abundant than gold, silver or mercury, about the same as tin and slightly less abundant than cobalt, lead or molybdenum. Vast amounts of uranium also occur in the world's oceans, but in very low concentrations.

The current global demand for uranium is about 67,000 tU/yr (tonnes uranium per year). The vast majority is consumed by the power sector with a small amount also being used for medical and research purposes, and some for naval propulsion. At present, about 42% of uranium comes from conventional mines (open pit and underground) about 51% from in situ leach, and 7% is recovered as a by-product from other mineral extraction. From exploration or prospecting programmes during 2006 - 2007 it is established that 6% of the world uranium resource can be found in South Africa.

In South Africa, uranium production has generally been a by-product of gold or copper mining. In 1951, a company was formed to exploit the uranium-rich slurries from gold mining and in 1998 this became a subsidiary of AngloGold Ltd. It produces about 550 tU/yr from material trucked in from various gold mines.

The existence of the mineral resource within the application area and the international demand for uranium is the primary driver for the proposed mining project.

The availability and geographic location of the mineral resource that the applicant wishes to exploit determines the preferred location to a large degree. The open cast pits and underground stoping is dictated by the geological structure.

Although the location of the minerals cannot be altered, the impact of the infrastructure associated with the mining operation would be investigated as part of the EIA process.

Key criteria for consideration when identifying need, alternatives and preferred location include practicable, feasible, relevant, reasonable and viable.

Assessment of alternatives would include a comprehensive comparison of all potential impacts, both direct and indirect and cumulative, on the environment. The goal of evaluating alternatives is to find the most effective way of meeting the need and purpose of the project either through enhancing the environmental benefits of the proposed activity, or through reducing or avoiding potentially significant negative impacts.

From a Socio-Economic perspective creating a baseline of the receiving environment enables a truthful means for comparison, identifying both opportunities and potential negative impacts as well as proposing methods to alleviate potential problems arising from the planned development.

The potential exists within the Central Karoo District Municipality (CKDM) for sound and sustainable economic growth with more equitable benefits and opportunities. Although some potential lies in the tourism sector, the transport and manufacturing sectors, in SMME development and in the agricultural sector, mining opportunities in the area may also enable development. Uranium mining is clearly identified in the 2013 Beaufort West Local Municipality (BWLM) Integrated Development Plan (IDP) as one of the opportunities available to address the critical problems of unemployment and lack of economic investment in the BWLM (Beaufort West, 2014)

If this proposed mining is not authorised the following applies:

- No further economic gain (both local and national) from the mineral resource will be realised.
- No further direct or indirect employment will be generated.
- The existing unrehabilitated trial mine will become the responsibility of the South African government for final rehabilitation and long term monitoring.

It is the opinion of this EAP that no critical risks have been identified for the proposed mining project that cannot adequately be mitigated and/or controlled. Therefore it is recommended that this proposed mining project be authorised in order to realise the identified economic benefits.

ii) Conditions that must be included in the authorisation

(1) Specific conditions to be included into the compilation and approval of EMPr

A specific condition recommended is for the initiation of a Water Forum for the Project to meet in Beaufort West on a quarterly basis. Within this forum the client (mine) should present existing and updated water quality data as well as draw down data. Information and/or anomalies can be discussed and the forum can provide a platform to address impacts. The forum must be open to land owners, neighbouring farmers, the municipality and any interested affected party.

See Appendix 9 for the Monitoring Programme.

(2) Rehabilitation requirements

The following rehabilitation criteria have been recommended by the various specialists:

Air Quality

- Rehabilitation of open and exposed surfaces is assumed as a component of the mine decommissioning process to mitigate on-going impacts post-closure.
- Rehabilitation of waste rock stockpile and tailings dam site are recommended to reduce ongoing future impacts.
- Rehabilitation of mine roads is recommended to reduce wind-entrained particulate generation

Biodiversity

Implement a construction handover plan in which rehabilitation measures are defined and budgeted for. Re-vegetation trials must be undertaken to determine the most appropriate species for a particular habitat. Species should be selected on a basis of adaptive management. i.e. perform trial runs on several species and select those species most suitable in achieving the desired result of establishing ground cover and increasing habitat functionality. A nursery should be established to propagate selected plant species for translocation and rehabilitation. Specific planting plans and schedules for each habitat type must be determined where rehabilitation will be required;

Development of an operational monitoring programme to assess success and sustainability of rehabilitation and reclamation procedures applied. This monitoring programme will aid in continuous adaption of the rehabilitation process and will demonstrate whether the rehabilitation procedures in place are successful. Critical components that need to be monitored are:

Re-vegetation success. It is essential to ensure that the re-vegetated areas are successfully proliferating and not dying or succumbing to alien invasive plant competition;

Control of alien and invasive species. It is very important to ensure that continued control of alien and/or invasive species is taking place after the construction phase and during the operations phase and this must therefore be monitored adequately;

Water quality monitoring. Runoff into seasonal pans should be monitored to ensure that rehabilitation procedures have sufficiently controlled any pollution and sedimentation likely to occur in the surrounding water dependent habitats.

" Establishment of a functional plant propagation facility with the capacity to supply the required trees and plants needed for minimization of soil erosion and other rehabilitation measures.

Ground and Surface Water

- Geotechnical survey will be conducted on the soil and the results of the survey will be utilised to select appropriate material to be used during rehabilitation and construction.

The following site specific rehabilitation requirements are recommended:

- Where possible roll over rehabilitation should be implemented.
- Where roll over rehabilitation is not possible, stockpiling of overburden should be kept to the smallest possible footprint.
- Due to the slow vegetative growth rate in the karoo biome, rock cladding should be considered for the side walls of the tailings facility.

q) **Period for which the Environmental Authorisation is required.**

30 years

r) **Undertaking**

Confirm that the undertaking required to meet the requirements of this section is provided at the end of the EMPr and is applicable to both the Basic assessment report and the Environmental Management Programme report.

I, the undersigned and duly authorised thereto by Lukisa JVCo have studied and understand the contents of this Environmental Impact Assessment and Environmental Management Programme and duly undertake to adhere to the conditions as set out therein.

Signed at on thisday of2016

.....
Signature of applicant

.....
Designation

s) **Financial Provision**

State the amount that is required to both manage and rehabilitate the environment in respect of rehabilitation.

i) **Explain how the aforesaid amount was derived.**

The Financial Provision calculated and committed to this mining right application amounts to: R5,204,773.84 for the first year of the construction phase.

The Financial Provisioning has been calculated according to the quantum provided by the DMR in February 2015. The CPIX was used for inflationary adjustment of 5% of the Master Rates (applicable) over 12 months. See Appendix 8.

Factors considered for the Financial Provisioning Quantum calculation:

- See Maps included in Appendix 8.

ii) **Confirm that this amount can be provided for from operating expenditure.**

(Confirm that the amount, is anticipated to be an operating cost and is provided for as such in the Mining

work programme, Financial and Technical Competence Report or Prospecting Work Programme as the case may be).

Lukisa JV Co will provide a guarantee for this amount (R5,204,773.84) and submit such to the DMR. Annual revision of the quantum will be provided to the DMR and applicable adjustments made to the guarantee.

t) Deviations from the approved scoping report and plan of study.

i) Deviations from the methodology used in determining the significance of potential environmental impacts and risks.

(Provide a list of activities in respect of which the approved scoping report was deviated from, the reference in this report identifying where the deviation was made, and a brief description of the extent of the deviation).

No deviation has taken place from the anticipated methodology and implementation from the Scoping Phase. Only a variation in presentation format and in some cases terminology. See Appendix 5.

ii) Motivation for the deviation.

Not applicable.

u) Other Information required by the competent Authority

i) Compliance with the provisions of sections 24(4)(a) and (b) read with section 24 (3) (a) and (7) of the National Environmental Management Act (Act 107 of 1998). the EIA report must include the:-

(1) Impact on the socio-economic conditions of any directly affected person. (Provide the results of Investigation, assessment, and evaluation of the impact of the mining, bulk sampling or alluvial diamond prospecting on any directly affected person including the landowner, lawful occupier, or, where applicable, potential beneficiaries of any land restitution claim, attach the investigation report as **Appendix 2.19.1** and confirm that the applicable mitigation is reflected in 2.5.3; 2.11.6.and 2.12.herein).

Assessment of impact during construction

This section has a description of the potential impacts identified, followed by a determination of the significance of the impact and finally a presentation of the proposed mitigation measures.

Demographics changes

Influx

Changes in the demographics of the population due to influx of workers both temporarily and permanently employed during construction of the mine. Potential positive impacts may include an increase in employment of some people in the local population, resulting in increased economic activity such as retail activity, investment and changes in the housing market. Potential negative impacts may include an increase in social ills such as alcohol abuse, unlicensed gambling, predatory money lending services and sex trades. An influx of workers may also lead to the construction and erection of temporary and illegal housing.

Employment opportunities

Although employment opportunities are created by the proposed project, current skills levels and training of the community may not provide a good fit with the skills required at the mine. Potential positive impacts include employment opportunities at various skills levels while potential negative impacts include skills levels that are not well matched with the mine requirements and employees with appropriate skills are brought from elsewhere.

Economic displacement through land use restrictions

Changes in land use may occur as a result of restricted access to mining sites. Farming activities may be disrupted, water use and land access may be impacted.

Infrastructure and services

Community access to infrastructure and services may change as a result of the proposed project.

Access to hospitals, clinics, educational facilities, piped water, electricity, and emergency services may change to some extent, primarily due to more people making use of the facilities. Potential positive impacts may include an increase in the tax payer base enabling municipal development in line with the municipal development plans. There may be a slight increase in patients making use of health care facilities in the area, and an increased pressure on infrastructure and services.

Housing need and construction

Changes in number of people living/working in the area will lead to a demand for housing at the appropriate level of income. In some instances this may result in more temporary housing being erected if not otherwise catered for, however, this may also lead to increased demand for accommodation in existing establishments during construction. This may present a business opportunity for development of housing, should the current supply not be sufficient. This may also lead to increases in need for rental and houses on the market. A potential negative impact is that new housing development that does not support the character of the area, negatively impacting on the character of the area and as a result the tourism potential. Insufficient housing may lead to urban sprawl or informal settlements.

Increase in economic activity

An increase in the employment levels and/or income earning population in the towns may cause an increase in economic activity in the towns.

Changes in cultural heritage and identity . Sense of place affecting tourism

Tourism in the surrounding areas is based on the character of the towns. Tourism is a major economic contributor in the area as well. Potential positive impacts include increased use of accommodation providers in the tourism industry for temporary workers and consultants. However, changes may impact on the sense of place for population and tourists (such as noise, dust, air quality, light pollution and visible degradation in vegetation); potentially leading to a decrease in the tourism industry, resulting in job losses over the long term. Please note that other impacts on sense of place, also covered in specialist reports are waste management, dust, traffic, noise and the visual impact of mine dumps and dust particularly in the vicinity of the central processing plant.

The following table shows the significance of the impacts identified during the construction period of development, both before and after mitigation; followed by a description of the proposed mitigation measures.

Operation phase

Demographic changes: Stabilised employment

Stabilised employment is expected during the operational phase. Although people with scarce skills may be sourced from outside of the development area, training during construction phase will allow more relevant skills in the local community during recruitment for operational phase.

Infrastructure and services

Community access to infrastructure and services may change as a result of the proposed project.

Long term accommodation: Housing

An increase in the permanent formal housing stock available in the towns. Potential positive impact: Development of formal housing of good standard. Potential negative impact: Failure to address permanent formal housing need, may result in development of out of character houses, negatively impacting on the character of the town

Economic activity

An increase in the employment levels and/or income earning population in the towns may cause an increase in economic activity in the towns.

Changes in cultural heritage and identity . Sense of place affecting tourism

Tourism in the vicinity of Beaufort West is based on the character of the towns. Tourism is a major economic contributor.

Potential positive impacts: Increased use of accommodation providers in the tourism industry for temporary workers and consultants. Development of modern housing using the local vernacular architecture to increase accommodation for workers. Potential negative impacts: Changes to the sense of place for population and tourists (such as noise, dust, air quality, light pollution and visible degradation in vegetation). Decrease in the tourism industry, resulting in job losses over the long term

Decommissioning

Reduction of employment opportunities

During decommissioning, employment opportunities will most probably decrease during decommissioning and closure phases.

Changes in economic benefits

Business and individual who are economically dependent on the mine will experience a loss of income, resulting in a decrease in the economic activity in the town.

(2) Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act.

(Provide the results of Investigation, assessment, and evaluation of the impact of the mining, bulk sampling or alluvial diamond prospecting on any national estate referred to in section 3(2) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) with the exception of the national estate contemplated in section 3(2)(j)(vi) and (vii) of that Act, attach the investigation report as **Appendix 2.19.2** and confirm that the applicable mitigation is reflected in 2.5.3; 2.11.6. and 2.12. herein).

The HIA Report summarised the following:

- “ A number of archaeological reports related to uranium prospecting have been conducted in this particular area over the last 10 years although not all the reports have been submitted to the heritage authorities because some were conducted as baseline studies;
- “ Surveys have identified scatters of ESA and MSA artefacts and occasional LSA material. Archaeological material is predominantly present in the form of isolated flakes and cores, which are difficult to ascribe to a particular time period and which do not occur in sufficient quantities to be termed a ~~site~~. The majority were manufactured on indurated shales (hornfels) although some artefacts were manufactured from a chert band which crosses Ryst Kuil;
- “ References by Kinahan (2008) to Howieson’s Poort material on open sites in the interior of the Karoo could not be verified;
- “ No significant archaeological resources were identified, with the exception of Site D009 on the farm Quaggasfontein. It is located on the banks of a dry river bed and will be covered by the stockpile material as a result of mining. This LSA stone scatter consists of a large quantity of chert, hornfels and some quartz artefacts, including cores, chips and chunks. Most significantly, it also includes two thumb nail scrapers, one drill, and one MRP/Scraper. There are also possible bone fragments. This site has been identified as being of sufficient significance (Field Grading: Grade IIIB), to warrant mitigation. Two fragments of Chinese porcelain (one with retouch), on the opposite bank from D009, suggest that the stream may have been the focus of limited pre-colonial settlement;
- “ The archaeological heritage of the area is considered to be of low significance..

v) Other matters required in terms of sections 24(4)(a) and (b) of the Act.

(the EAP managing the application must provide the competent authority with detailed, written proof of an investigation as required by section 24(4)(b)(i) of the Act and motivation if no reasonable or feasible alternatives, as contemplated in sub-regulation 22(2)(h), exist. The EAP must attach such motivation as **Appendix 4**).

Please note Appendix 4 includes the Project Site Specific Plans and includes the final layout plan which includes the amended location of the Central Processing Plant (CPP) and Tailings facility.

Mining Areas:

- a) the siting of open cast pits and underground operations is dictated by the geological resource. No alternative location could be reasonably considered for these aspects of the proposed development.
- b) The activity of mining and the methodology proposed by the applicant cannot reasonably be substituted considering the characteristics of the mineral deposit.
- c) Infrastructure Areas:

The siting of the proposed infrastructure was initially based on both the proximity to the mining operations to reduce haulage time and therefore reduce diesel consumption as well as on the topography

of the specific areas. Rocky ridges, sloping topography and drainage channels (episodic drainage lines) were avoided where possible.

The data generated by the specialists provided further information for a recommended alternative position for the CPP and slimes/tailings facility specifically. This original proposed position and the final recommended position is provided in the Figure 4 of Appendix 3.

- d) Latest available mining and processing technology is planned to be utilised by the applicant. Technologies that improve efficiencies will be investigated and where feasible such will be implemented.
- e) Operational alternatives include the following:
- shortest haul route calculation and ramp positioning to reduce diesel consumption
 - Roll over rehabilitation wherever possible to reduce double handling
 - Placement of overburden and ROM stockpiles to minimise additional handling and/or hauling.
 - Reduction of road traffic through multi-load deliveries to the CPP.
- f) Should this proposed mining activity not be implemented, the following will occur:
- the historical mining legacy will remain the responsibility of the South African government to rehabilitate.
 - No additional revenue provided to the South African fiscus through royalties and taxes.
 - No further job creation will occur based on the mineral reserve present.

PART B

ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

1) Draft environmental management programme.

- a) **Details of the EAP**, (Confirm that the requirement for the provision of the details and expertise of the EAP are already included in PART A, section 1(a) herein as required).

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- b) **Description of the Aspects of the Activity** (Confirm that the requirement to describe the aspects of the activity that are covered by the draft environmental management programme is already included in PART A, section (1)(h) herein as required).

Applicable environmental aspects are included in Part A Sec (1)(h) above.

c) Composite Map

(Provide a map (**Attached as an Appendix**) at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that any areas that should be avoided, including buffers)

See Appendix 4. The applicable infrastructure has been superimposed over the sensitivity maps generated by the specialist team. In the Eastern Block only the biodeiversity and surface and ground water sensitivity maps are applicable in this case.

d) Description of Impact management objectives including management statements

- i) **Determination of closure objectives.** (ensure that the closure objectives are informed by the type of environment described in 2.4 herein)

Primary Mine closure Objective

Objectives: To minimise all impacts of mining on the environment during and after the mine closure and to return the mining environment as close as possible to re-mining conditions taking into consideration the environmental and anthropogenic conditions.

Geology

The mining of uranium ore is a core function of the mine, thus the geological profile will be impacted upon. No mitigation measures can be implemented.

However, all geological impact must be limited to the target mining area only.

Topography

Objective: To minimise the impacts of mining on the topography.

Specific goals:

1. Ensure that the operations have a minimum impact on the topography of the area.
2. Ensure that the formation of the waste and ROM stockpile has a minimum impact on the topography of the area.

Technical/Management Option:

The Mine Surveyor will conduct all surveys, and plot all data, timeously, and will, in conjunction with the Mine Manager or his appointed representative, ensure that stockpile heights remain within reasonable limits to reduce view shed impact.

Soil

Objective: To minimise the impacts of mining on soil.

Specific goals:

1. Ensure that diesel, oil and other hazardous chemical substances (HCS) spillages do not impact significantly on soils.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that the mining plan is followed and topsoil and subsoil is utilised as required within the mining area. The ECO will ensure that the maximum amount of topsoil is removed from all areas to be affected, and that the topsoil is stockpiled separately.

Land capability and use

Objective: To minimise the impacts of mining on land capability and post closure use.

Specific goals:

1. Ensure that soil movement does not result in severe reduction of land capability and post closure use.

Technical/Management Option:

The Mine Manager or his appointed representative (ECO) will ensure that the mining plan is followed when top soil stripping and rehabilitation is conducted.

Flora

Objective: To minimise the impacts of mining on natural vegetation.

Specific goals:

1. Ensure all identified species in the Biodiversity report that require removal and transplanting for future rehabilitation are treated accordingly.
2. Containing all access and vehicle/equipment movement with designated footprint areas.
3. Ensure that removal of soil during the mining operation has minimum impact on natural vegetation by maintaining a viable seed bank.

Technical/Management Option:

The Mine Manager or the environmental control officer will ensure that daily inspections are carried out over construction and operational areas. A suitably qualified person will be employed to conduct vegetation surveys prior to topsoil stripping.

Fauna

Objective: To minimise the impacts of mining on the existing fauna.

Action:

- ~ All employees will be instructed that poaching will not be tolerated on the mining area and adjacent farms. Employees transgressing this will be subject to disciplinary action and possible dismissal (within Labour regulations).
- ~ Environmental training will include the importance of avoiding road kill through adequate speed limit control and reporting individual sightings within the road reserve to the ECO.

Management:

The Mine Manager will ensure that employees are aware and educated regarding the protected animals including those perceived to be dangerous.

Surface water

Objective: To minimise the impacts of mining on surface water.

Specific goals:

1. Ensure that construction of the pollution control dam and storm water diversion trenches have the least possible impact on the surface water runoff patterns, and thus loss of MAR within the catchments.
2. Ensure that the excavation of the box-cut has the least possible impact on the surface water runoff patterns, and thus loss of MAR within all catchments.
3. Ensure that all contaminated water is either piped or carried in a lined trench to the PCD.
4. Ensure that all runoff from the tailings facility during rainfall events is contained within the lined catchment drains to the PCD.
5. Provide for emergency lined overflow and containment dam for the PCD.

Technical/Management Option:

The applicant must appoint a civil engineering team to oversee the construction of the pollution control structures and the storm water collection berms and trenches and all lining. The civil engineer will approve and confirm the construction of the pollution control dam, the storm water collection berms and trenches to design specifications. Before a box-cut can be excavated the evaporation dam, storm water berms and trenches must have been constructed. A Geotechnical survey will be conducted on the soil and the results of the survey will be utilised to select appropriate material to be used during rehabilitation and construction. The appointed civil engineer will sign off the constructed settling dam and the storm water berms/trenches after completion. All the design specifications and plans will be submitted to the Department of Water and Sanitation. A surveyor will ensure that the PCD, diversion berms/trenches and box-cuts are positioned and constructed according to design specifications. The Mine Manager or environmental contractor will ensure that the said structures are constructed and maintained during the operational phase.

Surface water quality

Objective: To minimise all potential impacts on surface water quality.

Specific goals:

1. Ensure that potential impacts from chemical leakages on surface water quality are mitigated through correct storage on protected areas.

2. Ensure that dirty water captured within the mine, does not interact with clean water within the site boundaries.
3. Adequate spill remediation material must be stored on site for immediate action when required.

Technical/Management Option:

The Mine Manager will ensure that services of a suitably qualified person is utilised for the installation of the diesel tank and oil separator according to supplier design specifications and operated accordingly. The Mine Manager or his appointed representative will ensure that the diversion trenches are constructed timeously, lined adequately and that the water quality monitoring program is initiated.

Groundwater

Objective: To minimise the impacts of mining on groundwater.

Specific goals:

1. Ensure that the impacts from lowering of groundwater levels during mining are minimised.
2. Ensure that direct monitoring of ground water levels is implemented in appropriately selected monitoring bore holes.
3. Ensure that groundwater quality is monitored monthly with investigation and action (where applicable) into any anomaly.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that water within the pit working is pumped into the sump before being pumped into either the reservoir dams or the PCD and that the structures are managed properly. The Mine Manager or his appointed representative will ensure that the groundwater monitoring programme is implemented, maintained and improved as new long term data is recorded and interpreted.

Air quality

Objective: To minimise the potential impacts on the atmosphere.

Specific goals:

1. Ensure that impacts from diesel fumes generated by machinery on the atmosphere is minimised.
2. Ensure that impacts from dust generated by wind is minimised.
3. Ensure that impacts from dust generated by blasting and vehicle and equipment movement is minimised.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that all machinery are maintained and in good repair. The Environmental Co-ordinator will ensure that dust suppression is undertaken as per the prescribed stipulations.

Sensitive Landscapes

Construction and operational activities will avoid sensitive landscapes outside those authorised within the planned mine and infrastructure footprint. Within these areas all documented mitigation and control methods must be implemented and maintained.

Noise and vibrations

Objective: To minimise the impacts of noise and vibrations on the health of people and the environment.

Specific goals:

1. Ensure that noise impacts on machine operators and/or residences are minimised.

Technical/Management Option:

The Mine Safety Officer will ensure that hearing protection devices are issued and used.

Visual Aspects

Objective: To reduce the impacts on the overall visual and aesthetics of the area surrounding and within the proposed RSC to residences and landowners.

Specific goals:

1. Ensure that dust generated by wind and movement of machinery is minimised to have minimum visual impacts.
2. Elevation of overburden and ROM stockpiles should be maintained below 10m to reduce view shed impact.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that the dust suppression program is initiated and kept up to date, that the transport companies obey the speed limits, and that the clean-house policy is maintained. All stockpiles will be maintained at required heights.

Socio-economic impacts

Objective: To maximise the positive impacts from the proposed mining while minimising potential negative impacts.

Specific goals:

1. Maintain cordial relationships with all identified Interested and Affected parties.
2. Ensure that noise and dust impacts on surrounding landowners is minimised.
3. Ensure that influx of labourers seeking employment is reduced.
4. Ensure good communication with communities regarding the needs of the operation from small businesses and other potential service providers.

Technical/Management Option:

The Mine Manager or his appointed representative would ensure that all necessary measures are implemented to ensure that adequate communication takes place between the mine, land owners and communities.

Interested and Affected Parties

Objective: To minimise the negative impacts of construction on all Interested and Affected Parties.

Specific goals:

5. Maintain cordial relationships with all identified Interested and Affected parties.
6. Ensure that noise and dust impacts on surrounding landowners is minimised.
7. Ensure that influx of labourers seeking employment is reduced.

Technical/Management Option:

The Mine Manager or his appointed representative would ensure that all machineries are maintained in good working order. The Mine Manger or his appointed representative will

ensure that no labourers are house on the mine premises. The Mine Manager or his appointed representative will attend all I&AP forum meetings.

For specific Actions for each objective see Appendix 7.

ii) **The process for managing any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of undertaking a listed activity.**

Geology

The mining of uranium ore is a core function of the mine, thus the geological profile will be impacted upon. No mitigation measures can be implemented.

However, all geological impact must be limited to the target mining area only.

Topography

Objective: To minimise the impacts of mining on the topography.

Specific goals:

1. Ensure that the operations have a minimum impact on the topography of the area.
2. Ensure that the formation of the waste and ROM stockpile has a minimum impact on the topography of the area.

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The Mine Manager or his appointed representative will ensure that the mining plan is followed and topsoil and subsoil is utilised as required within the mining area. The ECO will ensure that the maximum amount of topsoil is removed from all areas to be affected, and that the topsoil is stockpiled separately.

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Objective: To minimise the impacts of mining on land capability and post closure use.

Specific goals:

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Technical/Management Option:

The Mine Manager or his appointed representative (ECO) will ensure that the mining plan is followed when top soil stripping and rehabilitation is conducted.

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Objective: To minimise the impacts of mining on natural vegetation.

Specific goals:

1. Ensure all identified species in the Biodiversity report that require removal and transplanting for future rehabilitation are treated accordingly.
2. Containing all access and vehicle/equipment movement with designated footprint areas.
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Objective: To minimise the impacts of mining on the existing fauna.

Action:

- ~ All employees will be instructed that poaching will not be tolerated on the mining area and adjacent farms. Employees transgressing this will be subject to disciplinary action and possible dismissal (within Labour regulations).
- ~ Environmental training will include the importance of avoiding road kill through adequate speed limit control and reporting individual sightings within the road reserve to the ECO.

Management:

The Mine Manager will ensure that employees are aware and educated regarding the protected animals including those perceived to be dangerous.

Surface water

Objective: To minimise the impacts of mining on surface water.

Specific goals:

1. Ensure that construction of the pollution control dam and storm water diversion trenches have the least possible impact on the surface water runoff patterns, and thus loss of MAR within the catchments.
2. Ensure that the excavation of the box-cut has the least possible impact on the surface water runoff patterns, and thus loss of MAR within all catchments.
3. Ensure that all contaminated water is either piped or carried in a lined trench to the PCD.
4. Ensure that all runoff from the tailings facility during rainfall events is contained within the lined catchment drains to the PCD.
5. Provide for emergency lined overflow and containment dam for the PCD.

Technical/Management Option:

The applicant must appoint a civil engineering team to oversee the construction of the pollution control structures and the storm water collection berms and trenches and all lining. The civil engineer will approve and confirm the construction of the pollution control dam, the storm water collection berms and trenches to design specifications. Before a box-cut can be excavated the evaporation dam, storm water berms and trenches must have been constructed. A Geotechnical survey will be conducted on the soil and the results of the

survey will be utilised to select appropriate material to be used during rehabilitation and construction. The appointed civil engineer will sign off the constructed settling dam and the storm water berms/trenches after completion. All the design specifications and plans will be submitted to the Department of Water and Sanitation. A surveyor will ensure that the PCD, diversion berms/trenches and box-cuts are positioned and constructed according to design specifications. The Mine Manger or environmental contractor will ensure that the said structures are constructed and maintained during the operational phase.

Surface water quality

Objective: To minimise all potential impacts on surface water quality.

Specific goals:

1. Ensure that potential impacts from chemical leakages on surface water quality are mitigated through correct storage on protected areas.
2. Ensure that dirty water captured within the mine, does not interact with clean water within the site boundaries.
3. Adequate spill remediation material must be stored on site for immediate action when required.

Technical/Management Option:

The Mine Manager will ensure that services of a suitably qualified person is utilised for the installation of the diesel tank and oil separator according to supplier design specifications and operated accordingly. The Mine Manager or his appointed representative will ensure that the diversion trenches are constructed timeously, lined adequately and that the water quality monitoring program is initiated.

Groundwater

Objective: To minimise the impacts of mining on groundwater.

Specific goals:

1. Ensure that the impacts from lowering of groundwater levels during mining are minimised.
2. Ensure that direct monitoring of ground water levels is implemented in appropriately selected monitoring bore holes.
3. Ensure that groundwater quality is monitored monthly with investigation and action (where applicable) into any anomaly.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that water within the pit working is pumped into the sump before being pumped into either the reservoir dams or the PCD and that the structures are managed properly. The Mine Manager or his appointed representative will ensure that the groundwater monitoring programme is implemented, maintained and improved as new long term data is recorded and interpreted.

Air quality

Objective: To minimise the potential impacts on the atmosphere.

Specific goals:

1. Ensure that impacts from diesel fumes generated by machinery on the atmosphere is minimised.
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3. Ensure that impacts from dust generated by blasting and vehicle and equipment movement is minimised.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that all machinery are maintained and in good repair. The Environmental Co-ordinator will ensure that dust suppression is undertaken as per the prescribed stipulations.

Sensitive Landscapes

Construction and operational activities will avoid sensitive landscapes outside those authorised within the planned mine and infrastructure footprint. Within these areas all documented mitigation and control methods must be implemented and maintained.

Noise and vibrations

Objective: To minimise the impacts of noise and vibrations on the health of people and the environment.

Specific goals:

1. Ensure that noise impacts on machine operators and/or residences are minimised.

Technical/Management Option:

The Mine Safety Officer will ensure that hearing protection devices are issued and used.

Visual Aspects

Objective: To reduce the impacts on the overall visual and aesthetics of the area surrounding and within the proposed project area to residences and landowners.

Specific goals:

1. Ensure that dust generated by wind and movement of machinery is minimised to have minimum visual impacts.
2. Elevation of overburden and ROM stockpiles should be maintained below 10m to reduce view shed impact.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that the dust suppression program is initiated and kept up to date, that the transport companies obey the speed limits, and that the clean-house policy is maintained. All stockpiles will be maintained at required heights.

Socio-economic impacts

Objective: To maximise the positive impacts from the proposed mining while minimising potential negative impacts.

Specific goals:

1. Maintain cordial relationships with all identified Interested and Affected parties.
2. Ensure that noise and dust impacts on surrounding landowners is minimised.
3. Ensure that influx of labourers seeking employment is reduced.
4. Ensure good communication with communities regarding the needs of the operation from small businesses and other potential service providers.

Technical/Management Option:

The Mine Manager or his appointed representative would ensure that all necessary measures are implemented to ensure that adequate communication takes place between the mine, land owners and communities.

Interested and Affected Parties

Objective: To minimise the negative impacts of construction on all Interested and Affected Parties.

Specific goals:

5. Maintain cordial relationships with all identified Interested and Affected parties.
6. Ensure that noise and dust impacts on surrounding landowners is minimised.
7. Ensure that influx of labourers seeking employment is reduced.

Technical/Management Option:

The Mine Manager or his appointed representative would ensure that all machineries are maintained in good working order. The Mine Manger or his appointed representative will ensure that no labourers are house on the mine premises. The Mine Manager or his appointed representative will attend all I&AP forum meetings.

For specific Actions for each objective see Appendix 7.

- iii) **Potential risk of Acid Mine Drainage.** (Indicate whether or not the mining can result in acid mine drainage).

Acid Mine Drainage

The water quality monitoring results of the groundwater at Ryst Kuil showing slightly elevated SO₄ concentrations (120 to 370 mg/L). These enhanced values are likely derived from the oxidation of pyrite that occurs fairly extensively in the argillaceous rocks and in the joint network. However, the concentration of the pyrite is not high enough to pose any serious threat of the development of acid mine drainage. Thus, the potential risk associated with acid mine drainage is low. Other sources relating to the elevated SO₄ concentrations are the dissolution of gypsum and / or anhydrite which in turn, is associated with evaporites in the area (SRK, 1979). Furthermore, a result of incorporation of salts from evaporated surface water into the next recharge cycle, which is a common feature of arid areas.

- iv) **Steps taken to investigate, assess, and evaluate the impact of acid mine drainage.**

The steps that are taken to investigate, assess and evaluate the impact of acid mine drainage will be focussed on the regular monitoring of groundwater at the boreholes indicate in Appendix 9 of this report.

v) **Engineering or mine design solutions to be implemented to avoid or remedy acid mine drainage.**

Engineering and mine design options to minimize the impact of acid mine drainage will include the prevention of mine water emanating from underground or surface workings to accumulate in unwanted areas. Ponding of water containing elevated SO₄ should be prevented. This would also mitigate the cumulative effect of acid mine drainage.

vi) **Measures that will be put in place to remedy any residual or cumulative impact that may result from acid mine drainage.**

It is anticipated that the controls provided for ground and surface water contamination will adequately mitigate the potential risk of residual or cumulative impacts of AMD. However, should regular monitoring data demonstrate that AMD concentrations are increasing in specific locations, appropriate remediation action will be implemented by the applicant.

vii) **Volumes and rate of water use required for the mining, trenching or bulk sampling operation.**

Mine operations will require ~3 600 m³/day for 10 to 15 years, i.e ~1,314 Mm³/annum. The General Authorization for the study area is zero. A licence application will therefore have to be submitted to the DWS to cover groundwater abstraction for supply;

The projected mine water requirements can probably be met in the Ryst Kuil Mine area but not in the other mine areas. Water quality in the secondary aquifer in the Ryst Kuil area is relatively good with a projected EC of <150 mS/m;

Groundwater from the hydrogeological exploration boreholes falls within the lower limits of Class II with respect to drinking water standards. This water would therefore be suitable for domestic consumption during the projected mining time period.

viii) **Has a water use licence has been applied for?**

A Water Use License Application (WULA) under Section 21 of the National Water Act will be initiated in 2016. A initial site meeting with the Department of Water and Sanitation (Eastern Cape and Western Cape) was held in 2015. Engagement with these departments as well as the Beaufort West local authority with regard to water use and management will be ongoing through a Water Forum to be established by the applicant in 2016.

ix) Impacts to be mitigated in their respective phases

Measures to rehabilitate the environment affected by the undertaking of any listed activity

ACTIVITIES	PHASE	SIZE AND SCALE of disturbance	MITIGATION MEASURES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
(as listed in 2.11.1)	of operation in which activity will take place. State; Planning and design, Pre-Constructionq Construction, Operational, Rehabilitation, Closure, Post closure.	(volumes, tonnages and hectares or m²)	(describe how each of the recommendations in herein will remedy the cause of pollution or degradation and migration of pollutants)	(A description of how each of the recommendations herein will comply with any prescribed environmental management standards or practices that have been identified by Competent Authorities)	Describe the time period when the measures in the environmental management programme must be implemented Measures must be implemented when required. With regard to Rehabilitation specifically this must take place at the earliest opportunity. .With regard to Rehabilitation, therefore state either:-. Upon cessation of the individual activity or. Upon the cessation of mining, bulk sampling or alluvial diamond prospecting as the case may be.
Due to limited space in this table, please see Appendix 5 for greater detail					

e) Impact Management Outcomes

(A description of impact management outcomes, identifying the standard of impact management required for the aspects contemplated in paragraph ());

<p>ACTIVITY whether listed or not listed.</p> <p>(E.g. Excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc...etc...etc.).</p>	<p>POTENTIAL IMPACT</p> <p>(e.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc....etc...)</p>	<p>ASPECTS AFFECTED</p>	<p>PHASE In which impact is anticipated</p> <p>(e.g. Construction, commissioning, operational Decommissioning, closure, post-closure)</p>	<p>MITIGATION TYPE</p> <p>(modify, remedy, control, or stop) through (e.g. noise control measures, storm-water control, dust control, rehabilitation, design measures, blasting controls, avoidance, relocation, alternative activity etc. etc)</p> <p>E.g.</p> <ul style="list-style-type: none"> • Modify through alternative method. • Control through noise control • Control through management and monitoring • Remedy through rehabilitation.. 	<p>STANDARD TO BE ACHIEVED</p> <p>(Impact avoided, noise levels, dust levels, rehabilitation standards, end use objectives) etc.</p>
<p>See Appendix 5 and 7 for more detail. An example is provided below.</p>					
<p>Drilling, Blasting, Load & Haul, crush, screen, product stockpile, loading & transport from site</p>	<p>Fugitive dust emission, noise, possible surface and ground water contamination and consumption of raw materials</p>	<p>Air, soil, surface water, ground water.</p>	<p>Operational Phase and Decommissioning Phase</p>	<p>Noise: all reasonable mechanical controls through the proper use and maintenance of exhausts/mufflers. Dust: daily use of water for dust suppression. Use of chemical bonding agent if required. Monthly monitoring of dust fall out levels and actions taken where necessary. Surface Water: all interaction between surface water and contaminated surface/equipment minimised. Separation of clean and dirty areas through use of berms and trenches. Monitoring through monthly sampling of surface waters. Ground Water: all interaction between ground</p>	<p>Noise: Levels maintained below those that result in increased complaints from IAP's Dust: Maintained within Residential Limits</p> <p>Surface Water: Quality levels not impacts adversely from baseline conditions and within catchment DWS parameters</p> <p>Ground Water: Quality levels not impacts adversely from baseline conditions and within catchment DWS</p>

				<p>water and contaminated surface/equipment minimised. Seperation of clean and dirty areas through use of berms and trenches. Monitoring through monthly sampling of ground waters.</p>	<p>parameters</p> <p>Various SANS codes: SANS 10103:2008 (Env noise) & SANS 10328:2003 (Noise EIA); SANS 5667-6:2006 (sampling rivers and streams); SANS 1929: 2011; (Air Pollutants) SANS 5667-11:2015 (sampling Ground Water)</p>

f) Impact Management Actions

(A description of impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs (c) and (d) will be achieved).

ACTIVITY whether listed or not listed. (E.g. Excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc...etc...etc.).	POTENTIAL IMPACT (e.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc....etc...)	MITIGATION TYPE (modify, remedy, control, or stop) through (e.g. noise control measures, storm-water control, dust control, rehabilitation, design measures, blasting controls, avoidance, relocation, alternative activity etc. etc) E.g. • Modify through alternative method. • Control through noise control • Control through management and monitoring Remedy through rehabilitation..	TIME PERIOD FOR IMPLEMENTATION Describe the time period when the measures in the environmental management programme must be implemented Measures must be implemented when required. With regard to Rehabilitation specifically this must take place at the earliest opportunity. .With regard to Rehabilitation, therefore state either:-.. Upon cessation of the individual activity or. Upon the cessation of mining, bulk sampling or alluvial diamond prospecting as the case may be.	COMPLIANCE WITH STANDARDS (A description of how each of the recommendations in 2.11.6 read with 2.12 and 2.15.2 herein will comply with any prescribed environmental management standards or practices that have been identified by Competent Authorities)
See Appendix 5 for more detail				
Drilling, Blasting, Load & Haul	Dust, noise, diesel/chem spillage	Control through monitoring and measurement. Dust fall out monitoring and noise assessment. Reduction of fugitive dust emissions through suppression with water. Noise control through proper use and maintenance of exhausts/mufflers.	Throughout operational phase	Various SANS codes: SANS 10103:2008 (Env noise) & SANS 10328:2003 (Noise EIA); SANS 5667-6:2006 (sampling rivers and streams); SANS 1929: 2011; (Air Pollutants) SANS 5667-11:2015 (sampling Ground Water)
ROM Stockpile, Crush and screen	Dust, noise diesel/chem spillage	Control through monitoring and measurement. Dust fall out monitoring and noise assessment. Reduction of fugitive dust emissions	Throughout operational phase	Various SANS codes: SANS 10103:2008 (Env noise) & SANS 10328:2003 (Noise EIA); SANS 5667-6:2006 (sampling rivers and streams); SANS

		through suppression with water. Noise control through proper use and maintenance of exhausts/mufflers.		1929: 2011; (Air Pollutants) SANS 5667-11:2015 (sampling Ground Water)
Product stockpile and loading	Dust, noise diesel/chem spillage, surface water contamination	Control through monitoring and measurement. Daily inspections and record keeping. Dust fall out monitoring and noise assessment. Reduction of fugitive dust emissions through suppression with water. Noise control through proper use and maintenance of exhausts/mufflers.	Throughout operational phase	Various SANS codes.
See Appendix 5 for more detail				

i)

Financial Provision

(1) Determination of the amount of Financial Provision.

(a) Describe the closure objectives and the extent to which they have been aligned to the baseline environment described under Regulation 22 (2) (d) as described in 2.4 herein.

Mine closure Objectives

Objectives: To minimise all impacts of mining on the environment during and after the mine closure.

Specific goals:

1. To manage the effects of the mining activities on the environment using the Best Available Technology.
2. To return the area to as close as possible to its pre-mining environment upon closure.
3. To return post mining land use as close as possible to grazing potential.

Action plan:

Infrastructure areas

No mining related surface infrastructure would remain on the area after closure. All haul roads that will not be used after closure will be ripped, at 90 degree to inherent slope and seeded with the seed mixture recommended for the area.

Ongoing seepage control

Long term pollution plum development is anticipated to be <500m. See appendix 18 for post closure seepage estimation.

Mine residue deposits

The mine tailings facility will remain in perpetuity. The long term management of this facility will depend on the design and construction. Rock cladding of the slopes and final top will reduce long term dust emissions.

Sealing of underground workings and rehabilitation of dangerous excavations

Submission of information

Complaints/IAP's register

The complaints register will be maintained during the decommissioning phase, and submitted at the end of the decommissioning phase (expected to take approximately two years) to the Department of Mineral Resources.

Mining plan

The final mining plan, indicating the total extent of the opencast and underground workings will be submitted to the Department of Mineral Resources within one year after decommissioning.

Water quality monitoring reports

An Bi-annual reports will be generated detailing water quality trends experienced during the construction and operational phase, and highlighting areas of concern. This report will be submitted to the Department of Water and Sanitation as well as presented in summarised form at the Water Forum.

Environmental Audit Reports

The final performance assessment report will be submitted to the Department of Mineral Resources and forwarded to other relevant State Departments. This performance assessment will continue until closure is gained. The frequency and basis on which the report will be submitted will be determined by the Department of Mineral Resources.

Maintenance

Water Monitoring

The recommended water quality and quantity monitoring program will be continued, until it can be shown that water quality (surface and

groundwater) is both stable and within acceptable guidelines and limits, as determined by the relevant State Departments. Frequency of monitoring will remain monthly for the surface water monitoring points and 3-monthly for groundwater monitoring points for the first three years after closure. Thereafter, the frequency for surface water monitoring points will decrease to 3-monthly and the groundwater monitoring points to 6-monthly. This will again be reviewed after a further two years.

Surface Subsidence

No surface subsidence is anticipated.

- (b) **Confirm specifically that the environmental objectives in relation to closure have been consulted with landowner and interested and affected parties.**

These closure objectives will be communicated to IAP's over a 30 day comment period from 25 January 2016 till 25 February 2016. All comments, concerns or questions will be recorded in the Consultation Report update.

- (c) **Provide a rehabilitation plan that describes and shows the scale and aerial extent of the main mining activities, including the anticipated mining area at the time of closure.**

See Appendix 8 for the rehabilitation plans.

- (d) **Explain why it can be confirmed that the rehabilitation plan is compatible with the closure objectives.**

The rehabilitation plan requires the backfilling of all open cast voids (a final void may be required for ground water management) and topsoiling. Re-vegetation will be conducted even though the growth phases in the Karoo biome are extremely slow. Other impacted areas will also be ripped and rehabilitated.

- (e) **Calculate and state the quantum of the financial provision required to manage and rehabilitate the environment in accordance with the applicable guideline.**

The Financial Provision calculated and committed to for this mining right application amounts to:

R5,204,773.84 for the first year of operation.

The Financial Provisioning has been calculated according to the quantum provided by the DMR in February 2015. The CPIX was used for inflationary adjustment of 5% of the Master Rates (applicable) over 12 months. See Appendix 8.

The anticipated financial provisioning for the entire Life of Mine for the East Block Mining Area (17 years) and the Central Processing Plant (CPP) (30 years) is calculated to be R143,566,955.91. See Appendix 8.

(f) Confirm that the financial provision will be provided as determined.

The required quantum for the project will be provided for, in a form of a bank guarantee from a South African registered bank, in terms of Regulation 53 (1)(b) of the MPRDA, 2002.

Lukisa JvCo will annually review the quantum for the financial provision of the mine in terms of Regulation 54(3) of the MPRDA, 2002. Depending on the outcomes of the review, annual contributions will be adjusted to ensure that sufficient funds are available for rehabilitation during the decommissioning, closure and post closure phases; hence any inadequacies with regard to the financial provision will be rectified. An adjusted bank guarantee will be submitted annually to the Department of Mineral Resources.

l) Indicate the frequency of the submission of the performance assessment report.

Lukisa JvCo will submit a annual EMP Performance Assessment Report to the DMR.

m) Environmental Awareness Plan

(1) Manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work.

In terms of section 39 (3) (c) of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002), Lukisa JVco must compile and implement an environmental awareness plan. The above-mentioned environmental awareness plan must describe the manner in which the mine (in this case Tasman RSA Mines) will inform their employees of any environmental risk which may result from their work and the manner in which the environmental risk will be addressed to avoid pollution or/and degradation of the environment. This document therefore concerns the details of the environmental awareness plan for Lukisa JvCo as required by the Mineral and Petroleum Resources development Act, 2002 (Act 28 of 2002).

In view of the above, Lukisa JVco has developed an environmental awareness plan for the proposed Tasman RSA Mines, which is explained in more detail below.

Note that the responsible person will revise these environmental awareness procedures from time to time. The date of commencement of the revised procedure will always be indicated to prevent confusion, in this case after the issuing of mining right to Lukisa JVCo. This Environmental Awareness (Standard Training Procedure) sets out the mine's training objectives regarding to environmental awareness. It is a stand-alone procedure, which serves to improve awareness, training and competency in the environmental field. It contains no detail on the actual training initiatives but rather serves to ensure that a responsible person is appointed to deal with and increase environmental awareness on the mine.

Scope

This Environmental Training Standard Procedure sets out the mine's training objectives regarding environmental awareness. It is a stand-alone procedure, which serves to improve awareness, training and competency in the environmental field. It contains no detail on the actual training initiatives but rather serves to ensure that a responsible person is appointed to deal with and increase environmental awareness on the mine.

Objectives

The following are the objectives set for this standard procedure:

- To explain and aid the personnel involved in training with regards EMS;
- To clarify the EMS training and ensure that all employees are correctly instructed with regards to the environment.

Safety risks associated with activity

There were no hazards identified in applying this standard procedure.

Responsibilities

In the case where there is no training department on site, a responsible person should be identified (Mine Manager, Environmental Officer or Consultant) to ensure that the objective of this procedure is met.

Legal requirements

The following legislation and standards apply to this Standard Procedure/;

- " Employment Equity Act 55 of 1998 . AREAS WHERE EMPLOYMENT EQUITY ARE DEFINED, INCLUDING TRAINING & DEVELOPMENY
- " National Environment Management Act 77 of 1998 . RECOMMENDATIONS FOR INSTITUTIONAL CO-OPERATION

“ Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002) .
DEVELOPMENT OF AN ENVIRONMENTAL AWARENESS PLAN

Activity procedures

Induction Programme

An Induction Programme, which will include environmental awareness programme, will be established for Tasman RSA Mines. During the training sessions various topics will be discussed such as, but not limited to: Water Pollution Prevention, Good Environmental Housekeeping etc. Through the Induction Programme, the mine manager safety officer, or any other responsible appointed person shall ensure that all staff receives training in:

“ Administrative requirements and procedures, which will include the Environmental Emergency Procedures.

“ Resource conservation and environmental reporting and general environmental awareness for mine related environmental issues.

All employees (including contractor employees) will undergo Tasman RSA Mines Induction. This induction includes training and awareness on environmental issues on the mine and is compulsory for all new employees. The induction programme will as mentioned above, have an environmental management component. On an annual basis the environmental section of the induction gets updated to ensure that it is up to date. Consideration should be given to:

- Significant environmental impacts as identified in the EMP
- Procedures: environmental awareness and emergency procedures
- Trends in incidents
- Trends in audit findings

Trainee needs

The identification of environmental training and environmental awareness needs are derived from an analysis of the role different categories of employees play at the mine. The following categories are considered, viz:

- Senior Management
- Middle management (Environmental Officers)
- Supervisors
- Operators
- Visitors and contractors

Each of these categories has different responsibilities and therefore has different knowledge requirements and environmental awareness training needs to obtain that knowledge.

Training Planning

Identified and agreed training needs shall be included in budgets. Course attendance (other than at the internal induction courses) shall be scheduled on the basis of the importance of task contribution to the maintenance, effectiveness and improvement of the objective.

General environmental awareness training

General awareness training will be offered to operators, processors and the other various sections of the mine during the safety toolbox talks. This will be conducted on rotational basis.

New environmental awareness topics are determined and new topics are introduced after all the shifts have received training/awareness on the current topic. The following will be undertaken to ensure that the above awareness training is conducted:

- A monthly environmental awareness topic for discussion will be distributed to all mine sections. These topics will be discussed at the safety toolbox talks, by SHE (Safety, Health and Environmental) reps/environmental officers if available.
- The topics will also be displayed on the notice boards of all mine sections
- Ad hoc environmental awareness sessions to various departments/sections will be conducted on request. The presentations will focus on the environmental issues relevant to individual tasks.

Job specific environmental awareness training

Job specific training will be developed to address urgent training needs as identified/required. The training material will focus on the following:

- Waste prevention and control (implementation of the waste management procedure).
- Water management (Leaking pipes and taps)
- Hydrocarbon and chemical spill reporting and clean up
- Storing and handling of chemicals
- Rehabilitation
- Dust management on the mine

Supervisory staff within specific mine sections will be equipped with the necessary knowledge and information to guide their employees on environmental aspects applicable in performing a specific task.

Competency training

Management (training official/environmental officer if available) is responsible for the environmental competency and awareness training of middle management and supervisors. This training will be conducted on both a one to one basis and through workshops. If required, external organizations may be requested to provide training to selected employees (e.g. EMP auditing). Competence and the effectiveness of training and development initiatives will be determined through the following:

- Trend analysis and reporting
- Analysis of work areas during visits and audits
- Trend analysis of monthly incidents (or zero tolerance if available) as recorded per mine sections.

Certification

Photocopies of certificates issued after completion of a training course shall be maintained in the staff members file and Management records

Records

Environmental awareness and training records will be kept at a safe and accessible place on site.

(2) Manner in which risks will be dealt with in order to avoid pollution or the degradation of the environment.

Implementation of controls and mitigation measures are paramount to the control of risks. It is the endeavour of Lukisa JVCo and its contractors to adequately implement all planned controls and mitigatory measure that are reasonable and practicable in order to minimise risk.

Monitoring of such risks (i.e. surface water monitoring) will evaluate the degree of mitigation of each risk.

See Appendix 5, 7 and 9.

n) Specific information required by the Competent Authority

(Among others, Confirm that the financial provision will be reviewed annually).

The Financial Provisioning will be reviewed annually by the applicant and submitted to the DMR.

2) UNDERTAKING

The EAP herewith confirms

- a)** the correctness of the information provided in the reports
- b)** the inclusion of comments and inputs from stakeholders and I&APs ;

- c) the inclusion of inputs and recommendations from the specialist reports where relevant; and
- d) the acceptability of the project in relation to the finding of the assessment and level of mitigation proposed;

-END-