EMP: Drilling of Exploration Borehole
2015 / 06 / 18 Env

UJ-CIMERA Karoo Research Initiative (KARIN) Drilling Project, Ceres Area.

Prepared for: Prof Nicolas Beukes (UJ)

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EMP: Drilling of Exploration Borehole

UJ-CIMERA: Karoo Research Initiative (KARIN) Drilling Project, Ceres Area.

2 July 2015

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1. GENERAL INFORMATION

AGES North West (Pty) Ltd was appointed by Professor Nicolas Beukes from the University of Johannesburg to complete an Environmental Management Plan for the proposed drilling of a 600 meter borehole for research purposes. The proposed drilling will take place on the farm Zandfontein 89 in the Ceres District, Western Cape Province.

The property is an abandoned old cultivated irrigation plot with no original vegetation preserved. The drilling site will be a 50 X 50m fenced site. The borehole is estimated to have a diameter of 96mm and be 600m deep to reach the target of the Dwyka Group. Water will be extracted 750m from the drilling site for cooling purposes of the drill being used. The borehole will be drilled 25-30 meters per 24-hour shift that will not last more than 25 days. There will be two drilling teams working shifts to continue the drilling process.

AGES did research regarding the proposed project to assure that there is no environmental authorisation necessary. The proposed drilling does not trigger any activity of GNR 983, 984 & 985. The project will also use 5000 litres of water per day that will be extracted from a well 750 meters from the drilling site. This does not require a general authorisation or license for the water usage.

The specific layout plan may be adapted as the sensitivity requires, but will include approximately the following:

- An 800m deep borehole (maximum).
- 96mm diameter
- Cementations or casings to avoid water losses underground.
- Cementations when by chance encounter excessive artesian water.

The core to be drilled on Zandfontein 89 has two main objectives:

To obtain samples of the Karoo succession in an area not affected by the intrusion of later high-temperature dolerite sills ((i) to determine the age of the rocks and where they originally come from, (ii) to study the ancient magnetic field of the earth, (iii) to look at the ancient pollen and Microfossils and the marine micro plankton, and (iv) to investigate the maturity of the rocks, and to see if it might be possible for these rocks to carry gas).

To sample the composition of deep ground water and to monitor the composition over time by installing a piezometer (to see how deep- and shallow ground water interact with each other). This area in the southern Tankwa Karoo is the only one available in South Africa where it is possible to intersect the stratigraphic succession at relatively shallow depth without the presence of dolerite intrusions and outside the area of deformation related to the Cape folded mountain belt.

1.1 Legal requirements

AGES did research regarding the proposed project to assure that there is no environmental authorisation necessary. The proposed drilling does not trigger any activity of GNR 983, 984 & 985. The project will also use 5000 litres of water per day for 25 days that will be extracted from a well 750 meters from the drilling site. This does not require a water use license for the water usage, but falls under general authorisation, section 21(a) of the National Water Act, 36 of 1998. Please see appendix E, for the DMR Approval letter.

Two public meetings were held to informe the public about the proposed drilling project. These meetings took place in April and June of 2015. Please see appendix C for the minutes and meetings discussions.

1.2 Project objective

The objective of this document is to ensure that all legal requirements are and will be met during the proposed project, to identify impacts as well as the mitigation measures contained in the EMP that must be adhered to during the different phases of the proposed project and to construct a monitoring program to help the Environmental Officer to identify compliance and non-compliance.

This EMP is therefore also applicable to possible future development/Drilling that can take place on the site.

1.3 Environmental Management Plan Objective

The purpose of the Environmental Management Plan (EMP) is to ensure thorough environmental considerations during the short life cycle of the proposed activity.

The objective of the EMP is also to provide adequate measures and / or recommendations to ensure that the identified environmental impacts during the different phases of the proposed project are kept to a minimum and that the most appropriate rehabilitation measures are

correctly implemented to ensure the overall integrity of the proposed site.

The mitigation measures stated in the Environmental Management Plan must be adhered to as indicated for the different phases.

It must be insured that the responsible persons have access to the project monitoring program included in the EMP and that all relevant parties are aware of the route that needs to be followed when appropriate action is required.

The Environmental Management Plan must be incorporated into the planning and appointment documents since this will ensure that:

- The contractor is aware of the EMP at the commencement of the project.
- The EMP is presented in a form and language that is familiar to the contractor
- The contractor is able to cost for compliance.
- The EMP is binding within a well-defined legal framework.

Copies of the Environmental Management Plan must be kept at the site office and copies must also be distributed to senior contract personnel. All senior personnel must familiarise themselves with the contents of the EMP.

The details contained in the EMP must be followed and implemented by the contractor during the project.

It is important to take note that the EMP is a living document and will remain a draft, which must be adapted to changing conditions on site.

This document must also be provided to and explained to the relevant contractors who may be appointed for other phases of possible future development.

2 ASPECTS OF ACTIVITY

The EMP will cover the following aspects of the activity during different phases of the project. Please see Appendix F for a time line of the project.

2.1 EARTHWORKS AND VEGETATION CLEARANCE:

Preparation of the site for the drilling of a 600-meter borehole.

2.2 SOLID WASTE MANAGEMENT:

This includes the appropriate management measures regarding cement, cement bags and accumulated waste. The regular removal of waste to an approved facility and the provision of adequate wind and animal proof waste bins or skips on site are of utmost importance. Sorting and recycling of waste should be promoted.

2.3 SANITATION:

The appropriate management measures for sewage during the project life cycle.

2.4 OIL, FUEL AND LUBRICANTS ON SITE:

Appropriate safety measures for accidental spillages will be covered as well as appropriate storage of oil, diesel and lubricants.

2.5 LOSS OF TOPSOIL AND POSSIBLE SOIL EROSION DURING DRILLING ACTIVITIES:

Measures to manage possible soil loss as well as soil erosion measures must be covered.

2.6 WATER USE:

Water must be used sparingly and measures must be dealt with. The Department of water and sanitation, in terms of general authorisation, has granted the use of water from a borehole. The authorisation falls under Section 21(a) of the National Water Act, 36 of 1998. Water use will not exceed $5m^3$ per day. General Authorisation allows for up to $10m^3$ per day in the quaternary catchment.

2.7 HERITAGE: MEASURES

The EMP will discuss procedures to be taken should any archaeological finds be made during the project life cycle.

2.8 BIODIVERSITY (ECOLOGICAL ASPECTS)

Mitigation and management measures are provided for vegetation clearance, fauna/wildlife and the use of herbicides and pesticides.

2.9 VISUAL ASPECTS

Rehabilitation measures are provided to restore the developed area to what it was before the activity took place.

2.10 SAFETY AND SECURITY:

Safety and security measures for the activity will be covered. This relates to open trenches, fire risks, excessive speed on site, working with heavy machinery and the general safety of Drilling workers.

2.11 SOCIO – ECONOMIC:

Job creation is included in the EMP.

3 ENVIRONMENTAL MONITORING

3.1 ENVIRONMENTAL CONTROL OFFICER (ECO)

The roles and responsibilities of the ECO must include:

- Ensuring that the necessary environmental authorizations and permits have been obtained.
- Monitoring and verifying that the EMP is adhered to at all times and taking actions if the specifications are not followed.
- Monitoring and verifying that environmental impacts are kept to the minimum.
- Assisting the contractor in finding environmentally responsible solutions to environmental problems.
- Giving a report back on the environmental issues on a daily basis.
- Keeping record of all activities/incidences on site in the site diary concerning the environment.
- Inspecting the site and surrounding areas regularly with regard to compliance with the EMP.
- Keeping a register of complaints in the site office and recording and dealing with any community complaints or issues.
- Monitoring the undertaking by the contractor of environmental awareness training for all new personnel on site.
- Ensuring that activities on site comply with other relevant environmental legislation if it is applicable.
- Issuing of warnings for contravention of the EMP.
- Compile monitoring checklist.
- Keep a photographic record of progress on site from an environmental perspective.
- Assisting the engineer in finding environmentally responsible solutions to problems.

- Keeping accurate and detailed records of these inspections.

3.2 CONTRACTOR

The Contractor shall have the following responsibilities:

- To implement all provisions of the Drilling EMP. If the Contractor encounters difficulties with specifications, he / she must discuss alternative approaches with the Resident Engineer and/or the ECO prior to proceeding.
- To ensure that all staff and Sub-Contractors are familiar with the EMP.
- To make personnel aware of environmental issues and to ensure they show adequate consideration of the environmental aspects of the project.
- To report any incidents of non-compliance with the EMP to the resident Engineer and/or the ECO.
- To rehabilitate any sensitive environments damaged due to the Contractor's negligence. This shall be done in accordance with the resident engineer and ECO's specifications.

4 ENVIRONMENTAL AWARENESS PLAN

The goal of the awareness plan is to help employees make environmentally conscious decisions in the work place and in their private lives. The description below illustrates the manner in which –

- The applicant intends to inform his/her employees of any environmental risk which may result from their work; and
- Risks must be dealt with in order to avoid pollution or degradation of the environment.

4.1 ENVIRONMENTAL AWARENESS TRAINING

The contractor must ensure that adequate environmental awareness training of senior site personnel takes place and that all personnel receive an induction presentation on the importance and implications of the EMP. It is the contractor's responsibility to provide the site foreman with no less than one hour's environmental training and to ensure that the foreman has sufficient understanding to pass the acquired information to Drilling workers. The contractor must also ensure that all site personnel have a basic level of environmental awareness training topics to personnel should include:

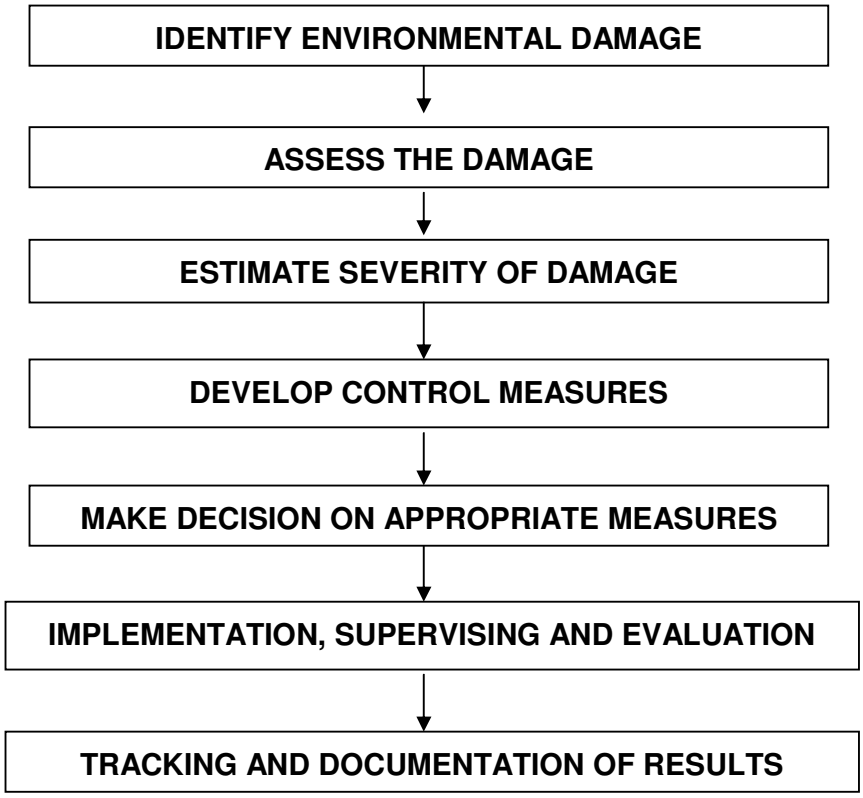
- An explanation of the importance of complying with the EMP.
- Discussion of the potential impacts of the project on the environment.
- The benefits of improved personnel performance.
- Employees' roles and responsibilities, including emergency preparedness
- Explanation of the mitigation measures that must be implemented when carrying out their activities.
- Explanation of the specifics of the EMP and its specification (no-go areas etc.)
- Explanation of the management structure of individuals responsible for matters pertaining to the EMP.

4.2 METHODS OF INFORMING PERSONNEL

The contractor can use the following methods to inform personnel:

- Use translators where necessary
- Use the principal agent /ECO officer to explain more difficult/technical issues and to answer questions
- The use of pictures and real life examples are encouraged as these tend to be more easily remembered.
- Make use of environmental awareness posters.
- Make Drilling workers aware that they are not to make excessive noise.
- Explain the “clean site” policy
- Environmentally introduce all contractors, sub-contractors and their staff.

5 MANAGING PROCESS FOR ENVIRONMENTAL DAMAGE/INCIDENTS



- An emergency or incident response plan for possible environmental damages or incidents which could be caused by the undertaking of the proposed activity or any other related activities should be developed if it is applicable. All senior personnel should familiarise themselves with this plan or procedure and should ensure that all staff are provided with a proper induction session in this regard.

- In case of large spillages such as oil or petrol/Diesel from the drilling machinery the spills response team and applicable authorities must be notified immediately.

- Waste management must be strictly controlled and monitored. Only approved waste disposal methods must be followed. The contractor must ensure that all site personnel are instructed in the proper disposal of waste. The contractor should also submit a method statement detailing waste management practices (storage, provision of bins, site clean-up schedule and waste bin cleaning schedule).

6 PHASES OF ACTIVITY

Planning and design		
Operational Phase		
Rehabilitation measures / phase		**Operational Phase**

6.1 EMP: IMPACTS AND MITIGATION MEASURES: PLANNING AND DESIGN PHASE

PHASE 1: PLANNING AND DESIGN				
Activity that causes the impact	***Specific Impacts***	***Mitigation measures required***	***Responsible***	***Time frame***
Planning and design actions	Impacts on various aspects of the environment	The following are considered mitigation measures prior to the drilling project. • An Environmental Management Plan (EMP) must be compiled and signed-off by the University and the contractor. • An incident/non-compliance register and complaints register must be drawn up and kept up to date. These documents must be available to interested Departments on request. • An Environmental Control Officer (ECO) must be appointed. • Environmental training for all staff and contractors must be done. • All personnel must be aware of the impacts and hazards and mitigation measures associated with the tasks they perform. • All authorizations required for the development of the site must be obtained prior to the project starting.	University & EAP	Before commencement of Drilling

6.2 EMP: IMPACTS & MITIGATION MEASURES: OPERATIONAL PHASE

OPERATIONAL PHASE				
Activity that causes impact	***Specific Impacts***	***Mitigation and Management measures***	***Responsible***	***Time frame***
IMPACT: Air Pollution				
Movement of Drilling vehicles on roads	• Air Pollution caused by excessive **dust** formation in and around the Drilling zones • Public nuisance to nearby residents	• The speed of vehicles moving on the Drilling sites should be kept as low as possible to reduce the generation of dust and noise. • Access roads should be maintained and is the responsibility of the Contractors. • The unnecessary removal of vegetation must be avoided and no vegetation clearance must take place beyond the planned perimeters of Drilling sites.	University & contractor	When appropriate – especially during severe climatic conditions
• Burning of cleared vegetation and solid waste or litter • The use of fires for cooking and heating at or near the Drilling sites	Air pollution caused by excessive **smoke**	• Cleared vegetation from Drilling activities must not be stockpiled for extensive periods. Re-vegetate as soon as possible after pipeline is placed in ground. • No solid waste, litter or cleared vegetation may be burned. • A sufficient number of wind and animal proof waste bins must be placed at strategic places at the Drilling site. • Gas stoves should preferably be used for cooking purposes (only at Drilling camp)	University & contractor	During Drilling phase Continuously. Solid waste and litter to be removed on a weekly basis

OPERATIONAL PHASE				
Activity that causes impact	***Specific Impacts***	***Mitigation and Management measures***	***Responsible***	***Time frame***
IMPACT: Noise				
• Movement of Drilling **vehicles** on Drilling sites and during the use of heavy machinery (Drilling)	• Disturbance and nuisance to adjacent residents • **Health** risk to workers	• All noise levels must be controlled at source. • Contractors must comply with Provincial noise regulations. • Drilling machinery must be fitted with noise mufflers and maintained properly. • All employees must be given the necessary ear protection gear. Protective clothing must be provided by contractor and inspected before Drilling commences. • Drilling will be continuous for 24 hours a day with two teams working shifts. There will not be any work on Sundays.	University & contractor	During Drilling Continuously
IMPACT: Ground – and Surface Water Pollution (QUALITY)				
• The storage and disposal drilling rubble	• Pollution of **water resources**	• Any solid waste generated during the Drilling phase (including, plastic, rubble, drill muds, plant material, waste metals, waste concrete, etc.) must be collected and kept in adequate containers. These materials must not be allowed to stockpile for extensive periods and must be removed on a weekly basis by an approved contractor to an approved landfill site.	University& contractor	Continuous and weekly removal of solid waste
• Oils and Lubricants used during drilling process	• Water pollution	• Biodegradable polymers, petroleum free, water based fluids that are environmentally friendly should be used during the drilling process for cooling of drill strings and diamond drill bits.	University& contractor	Continuous
• Water losses encountered to the sides of borehole	• Pollution of water Resources	• When the borehole encounters water losses to the side of the shaft, the cracks should be sealed using casings or cementation to avoid any water losses in cracks.	University & Contractor	Continuous
• Deep aquifers contaminate shallow aquifers	• Potable ground water pollution	• When the drilling contractor encounters deep aquifers, cementations should be applied to avoid pollution of shallow aquifers.	University & Contractor	Continuous

OPERATIONAL PHASE				
Activity that causes impact	***Specific Impacts***	***Mitigation and Management measures***	***Responsible***	***Time frame***
• Storm water over roads and cleared areas	• **Siltation and erosion o**f streams and water courses	• The removal of vegetation should be confined to Drilling areas - the removal of vegetation close to drainage sections must be avoided • Appropriate stabilization and soil protection measures should be implemented on exposed areas and especially steeper sloping sections close to drainage systems.	Engineer, University & contractor	Continuous
• Solid Waste Disposal and littering on site	• Pollution of **water resources** • Impact on the **health** of humans and bio-diversity	• Solid and domestic waste must be kept in adequate wind and animal proof waste bins or skips and disposed of weekly at a registered landfill site. • No contaminants (soaps, detergents, lime, glues, paints, cement, or fuels) to be discharged in nearby drainage sections.	University & contractor	Solid waste and litter to be removed on a weekly basis to an approved landfill site
• Sanitation seepage and spillage from temporary chemical toilets	• Pollution of **water resources** • Impact on the **health** of humans and bio-diversity	• Chemical sanitation facilities that do not rely on seepage of liquids should preferably be used on site and at the Drilling camp. • An approved company must empty these toilets at a licensed facility on a weekly basis. • Chemical toilets must be placed on level sections and not closer than 100 metres from any drainage sections. • Any leaks or spillages that do occur must be cleaned up immediately in the appropriate way	University& contractor	Chemical toilets to be emptied at a licensed facility by an approved contractor on a weekly basis

OPERATIONAL PHASE				
Activity that causes impact	***Specific Impacts***	***Mitigation and Management measures***	***Responsible***	***Time frame***
• Spillage of fuel and lubricants from vehicles and temporary fuel or storage containers.	Ground and surface water pollution Ground and surface water pollution.	• Oil and fuel spills should be checked for frequently and take action immediately when needed. • No vehicle may be extensively repaired on site. Emergency repairs should be done in marked maintenance yard. If emergency repairs are necessary that cannot take place in maintenance yard, the responsible contractor should be informed and he/she should ensure necessary environmental precautions. • Oil absorbent fibres must be used to contain oil and fuel spilt • Chemicals must be stored in a bunded area with an impermeable base, which is capable of containing 110% of the bunded material. When the impermeable surface is no longer required, the plastic sheet along with the contaminated soil must be disposed of off-site at a registered landfill.	Contractor and Spills Response team Spillages must be reported to contractor and cleaned up immediately	Continuous during Drilling phase Any spillages must be reported to the on-site contractor and cleaned up immediately
Spillage of fuel and lubricants from drilling vehicles and temporary fuel or storage containers.	Ground and surface water pollution Ground and surface water pollution.	• If necessary the servicing (oil, fuel) of Drilling vehicles or machinery must not be done on Drilling sites but rather at an approved servicing station in town. If not possible, spill or drip trays must be used during repairs of Drilling vehicles or machines. • Symbolic safety signs (SABS 1186) must be erected at storage facilities & tank capacities must be clearly indicated (in accordance with SABS 0232); • No smoking is to be allowed in the vicinity of storage or dispensing areas (smoking is only to be allowed in designated “safe” areas); • Adequate fire-fighting equipment must be available on site at sufficient areas.	Contractor and Spills Response team Spillages must be reported to contractor and cleaned up immediately	Continuous during Drilling phase Any spillages must be reported to the on-site contractor and cleaned up immediately

OPERATIONAL PHASE				
Activity that causes impact	***Specific Impacts***	***Mitigation and Management measures***	***Responsible***	***Time frame***
• Spillages and leaks and waste from Drilling activities (e.g. mixing of concrete, cement, etc. & dangerous chemicals used during or after drilling.)	• Pollution **of water resources**	• An appropriate storage area for dangerous chemicals at the Drilling camp should be identified and designated. • Parking areas for chemical storage zones must be prepared with a plastic liner under the soil or that is covered with gravel. • The storage & use of chemicals at the Drilling camp/site camp & Drilling sites must take place with the utmost care & the appropriate Material Safety Data Sheet must be available and followed during such storage and use. • The mentioned Material Safety Data Sheet should also include information on the ecological impacts and measures to minimise the negative environmental impacts during accidental spills. • On-site arrangements must be in place to limit the risk of spillages, and to limit the extent of such spillages where they do occur. However, should spills occur , they must be cleaned up immediately and the waste product stored for safe transport to the depot, after which it may be disposed of at a classified waste dump for hazardous chemical substances • Spill can be impounded with sand, earth, and sawdust or specifically designed impounding and absorbing agents. • Waste (spills, scrapings, flushings and contaminated product) must only be disposed of at classified waste disposal sites.	University & contractor & Spills Response Team	Continuous and when applicable Once off Daily inspections required Continuous - regular inspections required by contractor during the drilling operation
IMPACT: Water Use (QUANTITY)				
Drilling process	Overuse of available **water source**	• Water (for drilling, drinking or cooking) should not be wasted and workers must be educated on the value and importance of available water sources. • Taps or water pipes that are used must be regularly inspected for any leaks.	University & contractor	Continuous during the Drilling phase

OPERATIONAL PHASE				
Activity that causes impact	***Specific Impacts***	***Mitigation and Management measures***	***Responsible***	***Time frame***
IMPACT: Archaeological/Cultural				
Drilling activities e.g. vegetation clearance	Destruction of archaeological evidence and heritage -possible loss of heritage	• **Care must be taken during the activity to ensure that anything of archaeological value, which is unearthed, is recorded**. • In the event of a heritage object being unearthed, Drilling work that could impact on the object should be stopped and the discovery must be reported to the heritage specialist. • A GPS reading of the site where findings were made - must be taken. • Under no circumstances may the contractor, his employees, his subcontractor's employees remove, destroy or interfere with archaeological artefacts.	University and contractor (if applicable)	• Time from when the discovery is made • Continuous and during Drilling phase
IMPACT: Loss of Biodiversity				
• Road kill as a result of reckless driving • Movement of vehicles on site	Loss and/or damage of indigenous fauna to the area	• The speed of Drilling vehicles must be kept as low as possible. Designated Drilling roads should only be used whenever possible. • Vehicles must only use existing access roads to and from the site.	University & Contractor	Continuous - throughout the Drilling phase
Clearing of vegetation for drilling areas and roads	• Loss of biodiversity (fauna and flora) • Unnecessary damage to biodiversity (indigenous flora and habitat)	• Clearance of vegetation must be restricted to actual Drilling sections and Drilling machines must not be allowed to move outside the demarcated areas. • The cleared vegetation must not be burnt as it causes a loss of nutrients and organic material. It also causes air pollution and a fire hazard.	University & contractor	Continuous and during Drilling

OPERATIONAL PHASE				
Activity that causes impact	***Specific Impacts***	***Mitigation and Management measures***	***Responsible***	***Time frame***
• Intentional killing of fauna. • Use of Arial Structures	Loss of indigenous fauna to the area	• No animals may be captured, or killed during the activity. This restriction includes collection of fauna as pets, food or for use as muti. • Strict rules and penalties against the snaring, killing, catching or poaching of any animals will be enforced for all personnel and temporary workers. • Nesting sites of birds must not be disturbed unless it is necessary for the development. • Yellow lights that don't attract insects should be used as lighting in the Drilling camp and only clear lighting at the drilling point.	Contractor & ECO	Continuous as and when applicable Must be provided before Drilling roads are use
Littering / accumulation of solid waste on site	• Public nuisance • Loss/death of indigenous fauna and flora	• Litter and other waste must not be allowed to accumulate at the Drilling sites. • Bins / containers must be emptied / removed on a weekly basis to an approved landfill or waste disposal facility. • Regular clean- up programs must be put into effect.	University & Contractor	Continuous - throughout the Drilling phase
Accidental fires	• Destruction / loss of indigenous vegetation • Loss /damage of fauna • Los / damage to biodiversity	• All measures must be taken to prevent veld fires from occurring on Drilling site and development site • No open fires are allowed at the Drilling sites • General fire-fighting equipment (e.g. portable fire extinguishers or fire hoses) must be available at the Drilling sites.	Contractor	Continuous. Personal to be trained and updated on a regular basis regarding fire risks and the use of fire fighting equipment

OPERATIONAL PHASE				
Activity that causes impact	***Specific Impacts***	***Mitigation and Management measures***	***Responsible***	***Time frame***
IMPACT: Soil Pollution and Degradation				
Geo-technical characteristics of soils at sites	Damage to structures and infrastructure	• A site specific engineering geological investigation should be conducted prior to the activity.	Contractor	Continuous as Drilling progresses
Operation of drilling vehicles	Soil pollution: Oil/Diesel spillages	• Machinery and vehicles must be checked, serviced and maintained daily to prevent oil and fuel leaks. • Used parts, including oil filters are to be contained and disposed of at a site suitably licensed for such waste products. • Oil absorbent fibres must be used to contain oil spills in water	University & contractor	Continuous during pre-Drilling phase
Sludge containing lubricants and oil during drilling process	Soil pollution	• Biodegradable polymers, petroleum free, water based fluids that are environmentally friendly should be used during the drilling process for cooling of drill strings and diamond drill bits. • Sludge from the drilling process should be stored in skip containers and be transported to Enviroserve that will handle the waste. Enviroserve will provide the contractor with a certificate that will show compliance.	University & contractor	Continuous
Spillage of fuel and lubricants from vehicles and temporary fuel or storage containers.	Contamination of topsoil	• Drilling vehicles and machinery must be well serviced and maintained to prevent oil and fuel leaks. • The servicing (oil, fuel) of Drilling vehicles or machinery must if possible not be done on site but rather at an approved servicing station in town. • Spill trays or protective lining must be placed under Drilling vehicles when parked at one place for longer periods. This measure is especially important when leakages or damage is suspected.	Contractor	Continuous and When applicable

OPERATIONAL PHASE				
Activity that causes impact	***Specific Impacts***	***Mitigation and Management measures***	***Responsible***	***Time frame***
Mixing of cement etc. and other products on exposed soils	Soil pollution	• Mixing/decanting of chemical and hazardous substances must take place either on a tray or on an impermeable surface. Waste from these should then be disposed of at a recognized waste disposal site. The use of lime, cement or other powders must not take place during excessively windy conditions. • All canisters that may be used to transport the hazardous materials to the point of use must be regularly checked for leaks. • Regular clean-up programs should be put into effect throughout the premises to limit the impact of littering caused by drilling activities. • To prevent pollution, the establishment of static tanks at the Drilling camp must be planned properly.	Contractor and Spills response Team if necessary	Continuous and when applicable Once off Daily inspections required
Storm water over roads, and cleared areas	Loss of topsoil: Erosion	• Removal of vegetation to be limited to the activity area.	Contractor	Continuous as drilling progresses
Solid waste and litter	Soil pollution and Public Nuisance	• Litter and other waste must not be allowed to lie around at the drilling sites. • Solid waste must be kept in suitable containers and disposed of on a weekly basis to an approved disposal site. • Any possible drilling rubble or litter must be removed to an approved landfill site	University & Contractor	Continuous on a weekly basis
Spillage from temporary chemical toilets	Contamination of soil	• Chemical sanitation facilities that do not rely on seepage of liquids should be used on site and at the drilling camp. • These toilets must be serviced and emptied on a weekly basis (if applicable) by an appropriate company so that no spills/leaks take place. • Chemical toilets must be placed on level sections and not closer than 100 metres from any drainage sections. • Any leaks or spillages occurring must be cleaned up in the appropriate manner immediately.	Contractor	Chemical toilets to be emptied by an approved contractor to a licensed facility on a weekly basis

OPERATIONAL PHASE				
Activity that causes impact	***Specific Impacts***	***Mitigation and Management measures***	***Responsible***	***Time frame***
Removal of vegetation	Increased soil erosion, increase in silt loads and sedimentation, especially in drainage channel.	**Permanent erosion control plans should focus on the establishment of stable native vegetation communities**. **Other mitigation measures needed to prevent soil erosion include:** • Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the drilling camp and Work Areas. • Repair all erosion damage as soon as possible and not later than six months before the termination of the Maintenance Period to allow for sufficient rehabilitation growth.	Engineer and contractor on site	Drilling phase, before rainy season
Increase in the soil degradation (erosion) occurring on site, especially along steeper slopes and cleared sections	• Soil erosion • Soil degradation	• An efficient slope-stabilizing program must be implemented along the steep slopes of the Drilling site to manage the unnecessary loss of soil. This can be done by using cut-off trenches, geo-textile siltation barriers, re-vegetation with indigenous vegetation and covering of slopes with mesh or similar material. An engineer should be consulted to assist in this regard. • The movement of Drilling vehicles must be limited to the Drilling areas to limit the unnecessary clearance of vegetation and the associated risk of erosion.	Contractor & Engineer	When applicable
<u>IMPACT:</u> Visual/Aesthetics and Landscape Character				
Drilling activities (presence of heavy vehicles and equipment)	Negative Visual impact	• Drilling vehicles and machinery should if possible be parked and placed at the Drilling/site camp at night	Contractor	When applicable
Loss vegetative cover Erosion scars	Negative Visual impact	• Re–vegetation of cleared/eroded areas with indigenous plant species must take place as soon as possible after the disturbance has ceased.	Contractor & ECO	When applicable and during pre-drilling phase
Litter and solid Drilling waste generated	Negative Visual impact	• Litter and solid Drilling waste must be controlled and removed to an approved facility.	Contractor	Regular removal of solid waste.

OPERATIONAL PHASE				
Activity that causes impact	***Specific Impacts***	***Mitigation and Management measures***	***Responsible***	***Time frame***
Presence of lights	• Visual disturbance • Loss of life to insectivores attracted by insects at lights • Aesthetical features of surrounding landscape features	• Security lights should be directed downwards towards the Drilling site. • Yellow lights are preferred. • Care must be taken that only the most important and necessary lighting is used at night during drilling hours.	Contractor & University	Once off
IMPACT: Socio Economic				
Drilling activities Temporary job creation	• Positive socio-economic impact (Job creation) • Reduce unemployment	• Local labour must be used wherever possible	Contractor	When applicable
Drilling activities (presence of heavy vehicles and equipment)	Disruptions to residents and specific landowners.	• Applicable road signage informing the public on when and where the activities take place must be provided at strategic places up to and close to the Drilling site well in advance. • Relevant land owners must be informed in advance of proposed activities	Contractor and University	Once off and maintained
IMPACT: Health and Safety				
Drilling activities	Accidents and injuries to Drilling workers	• The contractor shall conform to all stipulations of the Occupational Health and Safety act (Act 85 of 1993) and the Regulations applicable. The Act requires the designation of a Health and Safety representative when more than 20 employees are employed. • Drilling workers must be supplied with the necessary safety equipment required to perform tasks. • Only authorised personnel are allowed to stay and move on site.	Contractor	Once off and closely monitored

OPERATIONAL PHASE				
Activity that causes impact	***Specific Impacts***	***Mitigation and Management measures***	***Responsible***	***Time frame***
Material Laydown Area	Influence vegetation cover	• Materials lay down area must be established in already disturbed areas. Recommendation of using the already disturbed area near the old siphon. • All Drilling materials shall be stored within the property, which is already disturbed.	Contractor	Daily during Drilling phase
Drilling activities	Accidents/ injuries to general public	• Necessary signboards (information) must be placed close to or in the direction to the proposed development site	University, Contractor	Once off and regularly inspected.
Trespassing and illegal access onto private land	• Theft, robbery and assaults	• No trespassing onto private land or nearby residences is allowed. • Strict measures must be taken against offenders.	University& Contractor	Regular monitoring Safety of workers
Temporary Drilling camp – poor waste management and unhygienic conditions (if applicable)	Diseases contracted by Drilling workers	• Provide information and awareness to Drilling workers at the Drilling camp regarding health and hygiene. • Provide safe and hygienic ablution and cooking facilities for the Drilling workers at the Drilling camp.	Contractor	Continuous – weekly inspection
Excessive speed of vehicles	Safety and health risk to humans and fauna	• Safety act (Act 85 of 1993) and the Regulations applicable. The Act requires the designation of a Health and Safety representative when more than 20 employees are employed. • Speed control of vehicles on all roads must be exercised for the safety of people and fauna.	University and contractor	During Drilling

OPERATIONAL PHASE				
Activity that causes impact	***Specific Impacts***	***Mitigation and Management measures***	***Responsible***	***Time frame***
Accidental Fires Burning of waste and vegetation	• Destruction of property • Danger to human life	• All measures must be taken to prevent veld fires from occurring on site during Drilling activities or as a result of negligence • Fire breaks should comply with the National Veld and Forest Fire Act 101 of 1998 (Chapter 4: Duty to Prepare and maintain firebreaks). If applicable, firebreaks must be made around the perimeter of the whole development, as well as around the individual properties. • An emergency plan must be in place so that any uncontrolled fire can be handled in the most efficient manner. • General fire fighting equipment (e.g. portable fire extinguishers or fire hoses) must be available at the Drilling/site camp • Personnel must be given the appropriate training in the use of the fire fighting equipment and other emergency procedures. • No open fires must be made at the proposed Drilling site.	University& contractor	Firebreaks during appropriate climatic conditions before drilling commences.

6.3 EMP: IMPACTS AND MITIGATION MEASURES: REHABILITATION MEASURES

REHABILITATION MEASURES FOR OPERATIONAL ACTIVITIES					
Activity that causes impact	***Specific Impacts***	***Mitigation & Management measures***	***Responsible***	***Time frame***	***Monitoring***
Earthworks and vegetation clearance	• Loss of plant species & habitat • Loss of indigenous flora and fauna	• Any exposed sections of the Drilling site should be shaped as close as possible to the surrounding landscape features. • Sludge from the drilling process should be stored in skip containers and be transported to Enviroserve. • Any exotic plant species must be removed to an approved landfill site.	Contractor	As soon as possible/ continuous during operation / rehabilitation	Environmental Officer
Solid waste accumulation	• Visual • Attract vermin and spread of diseases • Soil and water pollution	• Remove all accumulated waste to an approved landfill site. • Provide a sufficient number of wind and animal proof waste bins on site.	Contractor	Immediately as soon as possible/ continuous during activity / rehabilitation	Environmental Officer
Spillages of fuel, oils and other lubricants	• Soil and water pollution	• Remove any spillages of fuel or other lubricants by following the appropriate spill response procedures. • Collected fuel and other lubricants must be taken to an approved facility for such products.	Contractor	Immediately as soon as possible/ continuous during operation / rehabilitation	Environmental Officer
Clearing of site – exposed soil	Loss of topsoil and erosion	• Cover any exposed sections with indigenous plant species • Inspect after heavy rains	Contractor	As soon as possible/ continuous during operation / rehabilitation	Environmental Officer

REHABILITATION MEASURES FOR OPERATIONAL ACTIVITIES					
Activity that causes impact	***Specific Impacts***	***Mitigation & Management measures***	***Responsible***	***Time frame***	***Monitoring***
Open borehole	Water pollution and Safety	• For further studies the borehole should be closed according to the standards of the Department of Water and Sanitation. • If borehole not to be used again. It should be filled according to the industry standards, this could mean pressure grouting the hole closed.	Contractor and University	End of activity	Environmental Officer
Excessive artesian water	Shallow ground water pollution	• When the borehole encounters water losses to the side of the shaft, the cracks should be sealed using casings or cementation to avoid any water losses in cracks. • When the drilling contractor encounters deep aquifers, cementations should be applied to avoid pollution of shallow aquifers.	Contractor and University	Continuous	Environmental Officer

7 ENVIRONMENTAL MONITORING PROGRAM – OPERATIONAL PHASE

OPERATIONAL PHASE								
Environmental Component	***Monitoring frequency***					**Monitoring method**	***Action/Remedial action***	***Responsible***
	Once off per site	***When applicable***	***Continuously / daily***	***Weekly***	***Monthly***			
IMPACT: Air quality and noise								
Movement of drilling machinery etc. **Impacts:** • Air pollution from excessive vehicle emissions and smoke • Air pollution from excessive dust • Nuisance to surrounding public • Noise pollution from vehicles and people • Negative impact on health						Visual, Site inspection	• Mitigation measures to be followed • Vehicle and machinery maintenance program to be followed. • Speed of Drilling vehicles on site must be controlled	Contractor
Burning of waste (cleared vegetation and solid waste or litter) **Impact:** Air Pollution caused by excessive Smoke						Visual Site Inspection	• No burning of waste / vegetation • Strict measures for non – compliance. Fines to contractors	contractor
The use of fires for cooking and heating at or near the Drilling sites **Impact:** Air Pollution caused by excessive Smoke Fires						Site Inspection	• No open fires by Drilling workers for heat or cooking. • Gas stoves should preferably be used only in Drilling camp • Fines to contractor if it occurs	Contractor

OPERATIONAL PHASE								
Environmental Component	***Monitoring frequency***					**Monitoring method**	***Action/Remedial action***	***Responsible***
	Once off per site	***When applicable***	***Continuously / daily***	***Weekly***	***Monthly***			
IMPACT: Surface and ground water quality								
Big quantities water over roads and cleared areas Migration of contaminants of site **Impacts**: • Soil erosion • Water Pollution and health risk						• Site Inspection.	• Removal of vegetation to be limited to drilling areas only. • Appropriate stabilization and soil protection measures must be in place • Remove drill muds in storage tanks to approved municipal dumping sites. • Follow mitigation measures	Contractor
Solid waste disposal – (Surface and ground water pollution) **Impacts**: • Soil erosion • Water Pollution and health risk						• Site Inspection	• Follow mitigation measures • Remove drill muds in storage tanks to approved municipal dumping sites. • Remove waste on a constant basis to approved landfill sites • Solid waste to be kept in adequate containers and removed and disposed of	Contractor

OPERATIONAL PHASE								
Environmental Component	***Monitoring frequency***					**Monitoring method**	***Action/Remedial action***	***Responsible***
	Once off per site	***When applicable***	***Continuously / daily***	***Weekly***	***Monthly***			
Sanitation – Spillages and seepage from temporary sanitation facilities **Impact**: Water pollution and health risk						• Visual Site Inspection • Obtain records from contractor of weekly removal of sewage and inspections	• Fines if contractors do not comply • Proof that chemical toilets are emptied once a week must be provided to the Environmental Officer (EO) • Mitigation measures to be followed	University& Contractor
Spillage of fuel and lubricants from vehicles **Impact:** Water Pollution and health risk						Visual inspection.	• Report the problem immediately and clean up as soon as possible. • Follow mitigation measures.	Contractor
Excessive artesian water **Impact**: Deep aquifers contaminating shallow aquifers						Obtain records from contractor	• Cementations used to avoid the contamination from deep aquifers. • Use casings or cementation to avoid water losses in borehole.	Contractor

OPERATIONAL PHASE								
Environmental Component	***Monitoring frequency***					**Monitoring method**	***Action/Remedial action***	***Responsible***
	Once off per site	***When applicable***	***Continuously / daily***	***Weekly***	***Monthly***			
Dangerous chemicals used during drilling (spills, leakages and waste) **Impact:** Water Pollution and health risk						Site inspection	• Follow mitigation measures • Use biodegradable polymers • Use petroleum free, water based fluids. • Report problem and clean up as soon as possible.	Contractor
IMPACT: Water use (Quantity)								
Drilling process and activities Dust suppression measures **Impact:** Possible over consumption of water resources						• Visual Site Inspection	• Water must be used wisely • Check pipes for leaks and repair as soon as possible. • Follow mitigation steps.	Contractor
IMPACT: Archaeological/Cultural								
Drilling, soil clearance and vegetation clearance **Impact**: Destruction / loss of archaeological evidence and heritage						Visual inspections	• No heritage remains may be tampered with • Undetected subterranean heritage remains on the terrain must be reported to a Heritage specialist	University

OPERATIONAL PHASE								
Environmental Component	***Monitoring frequency***					**Monitoring method**	***Action/Remedial action***	***Responsible***
	Once off per site	***When applicable***	***Continuously / daily***	***Weekly***	***Monthly***			
IMPACT: Ecology (Fauna and Flora)								
Movement of vehicles on site Speeding resulting in death to animals **Impact:** Animal mortalities						• Visual	• Speed of Drilling vehicles on site must be kept as low as possible. • Fines given to transgressors	Contractor
Clearing of vegetation for activity **Impact**: • Loss of indigenous flora and unnecessary damage to sensitive habitat sections • Loss of habitats						• Visual Site Inspections	• Mitigation measures must be adhered to. • Large (>3m) trees should be protected as far as possible • Consult with ECO. • Clearance area and movement should be restricted to project area	Contractor
Killing, snaring, capturing or collection of animals Lighting close to access sections **Impact:** Loss of indigenous fauna						• Visual / Observation	• No animals may be killed • Only necessary lighting must be used • Follow mitigation measures	Contractor

OPERATIONAL PHASE								
Environmental Component	***Monitoring frequency***					**Monitoring method**	***Action/Remedial action***	***Responsible***
	Once off per site	***When applicable***	***Continuously / daily***	***Weekly***	***Monthly***			
Use of poisons **Impact:** Loss of indigenous fauna & Flora						• Visual Site Inspection	• Only ecologically friendly products to be used. • Only agricultural acceptable to be used. • Follow mitigation measures.	Contractor
Littering on site Accumulation of solid waste in area **Impact:** • Loss/death of indigenous fauna • Public nuisance						• Visual Site Inspection.	• Follow mitigation measures. • Provide waste bins and empty on a regular basis to an approved landfill site.	Contractor
Accidental fires **Impact:** loss/death of biodiversity						• Site Inspection. • All safety measures must be in place to prevent veld fires	• No open fires are allowed. • Follow mitigation measures.	Contractor
Stockpiling of Drilling material **Impact:** • Spreading of exotic invasive plant species • Degradation of natural drainage systems						• Visual inspection	• Materials must not be allowed to stockpile for extensive periods. • Follow mitigation measures	Contractor

OPERATIONAL PHASE								
Environmental Component	***Monitoring frequency***					**Monitoring method**	***Action/Remedial action***	***Responsible***
	Once off per site	***When applicable***	***Continuously / daily***	***Weekly***	***Monthly***			
IMPACT: Soil pollution and degradation								
Operation of Drilling vehicles • Spillage of fuel and lubricants from vehicles **Impact:** Contamination of topsoil						• Visual inspections	• Clean up immediately • Maintenance program must be followed • Use biodegradable polymers for lubricating and cooling of drill bits and strings. • Use petroleum free, water based fluids during drilling process. • Mitigation measures to be followed	Contractor
Drilling activities • Sludge from the drilling process, spillages from mixing of cement and other products on exposed soils **Impact:** Contamination of topsoil						• Site Inspection • View certificate showing delivery of sludge to Enviroserve	• Clean up immediately • Gather sludge in skip containers and transport to Enviroserve. • A protective lining must be placed on exposed soils before the mixing of products	Contractor

OPERATIONAL PHASE								
Environmental Component	***Monitoring frequency***					**Monitoring method**	***Action/Remedial action***	***Responsible***
	Once off per site	***When applicable***	***Continuously / daily***	***Weekly***	***Monthly***			
Spillages from temporary sanitation facilities **Impact:** Soil Pollution						• Site visits • Proof of regular disposal of sewage must be provided to the EO	• Empty sanitation facilities on a regular basis.	Contractor
Storm water over roads and cleared areas **Impact:** Loss of top soil: Erosion						• Site visits	• Keep movement of vehicles to project area and disturbed areas. • Re-vegetate cleared areas as soon as possible • Follow mitigation measures	Contractor
Presence of Solid waste and litter **Impact:** • Loss of top soil: Erosion • Soil pollution and • Public nuisance						• Visual Site Inspection • Proof of weekly removal of waste must be provided to the EO	• Clean Drilling area on a regular basis • Follow mitigation steps	Contractor
IMPACT: Visual/Aesthetic and Landscape Characteristics								
Drilling activities • Presence of heavy vehicles and equipment, • Temporary structures, foundations and materials **Impact:** Visual impact						• Visual inspection	• Follow mitigation steps • Restore area to state it was before the activity was started	Contractor

OPERATIONAL PHASE								
Environmental Component	***Monitoring frequency***					**Monitoring method**	***Action/Remedial action***	***Responsible***
	Once off per site	***When applicable***	***Continuously / daily***	***Weekly***	***Monthly***			
Removal of vegetative cover **Impact:** Erosion scars– (Visual impact)						• Visual inspection	• Large trees must be protected as far as possible during vegetation clearance • Follow mitigation steps • Obtain advice from ECO	Contractor
Presence of Litter and solid Drilling waste **Impact:** Visual impact						• Site Inspection	• Clean up on a regular basis	Contractor
Presence of Lights **Impact**: • Nuisance. • Loss of life to insectivores attracted by insects at lights • Visual disturbance to public						• Visual inspection	• Appropriate lighting to be installed at site (yellow). • Light be faced in a downward position. • Only necessary lighting to be used during the activity at night	University
IMPACT: Socio economic								
Disruptions to residents and specific land owners **Impact:** • Social disturbance to public						• Site visit.	• Remedial action as required • Notice must be provided according to regulations of the Road Safety Act.	University, Engineer

OPERATIONAL PHASE								
Environmental Component	***Monitoring frequency***					**Monitoring method**	***Action/Remedial action***	***Responsible***
	Once off per site	***When applicable***	***Continuously / daily***	***Weekly***	***Monthly***			
Temporary job creation **Impact:** • Reduce unemployment • Create positive social impact						• Site visit	• Remedial action as required • Local people must be used wherever possible for jobs created	Contractor
IMPACT: Health and Safety								
Accidental fires Burning of waste **Impact:** • Destruction of adjacent property • Danger to human life						• Site Inspection	• Follow mitigation measures • All safety measures to prevent veld fires must be in place.	Contractor
Movement in and around the site • Speeding on site • Trespassing onto private land **Impact:** • Increased risk on safety and security of public and Drilling workers						• Site visits	• Fines to contractors for non - compliance • Follow mitigation measures	University& Contractor

OPERATIONAL PHASE								
Environmental Component	***Monitoring frequency***					**Monitoring method**	***Action/Remedial action***	***Responsible***
	Once off per site	***When applicable***	***Continuously / daily***	***Weekly***	***Monthly***			
End of drilling activity **Impact:** Water pollution and dangerous for people and fauna						• Visual inspection	• Close the borehole according to the standards of the Department of Water and Sanitation if it is to be used again. • If borehole will not be used again it should be closed according to industry standards.	University
Drilling activities • Accidents and injuries to Drilling workers and public **Impact:** Increased risk on safety of people						• Site Inspection	• Fines to contractors for non - compliance • Warning signs and safety • Workers should have all safety gear required • Follow mitigation measures	Contractor

OPERATIONAL PHASE								
Environmental Component	***Monitoring frequency***					**Monitoring method**	***Action/Remedial action***	***Responsible***
	Once off per site	***When applicable***	***Continuously / daily***	***Weekly***	***Monthly***			
Drilling Activities • Presence of Temporary project camp • Overload of sanitation systems, sanitation system placed too close to drainage systems • Leaks and spillages into drainage sections • Poor waste management • Unhygienic conditions **Impact:** • Increased risk on safety of people • Water pollution • Increased risk on health of people.						• Site inspection	• Follow mitigation measures • Training sessions on hygiene to be presented to workers • One chemical / enviro-loo toilet for every 15 workers must be contained. • Toilets may not be closer than 100 metres from drainage sections and must be placed on level ground	Contractor

7.1 APPENDIX A: LOCALITY MAP

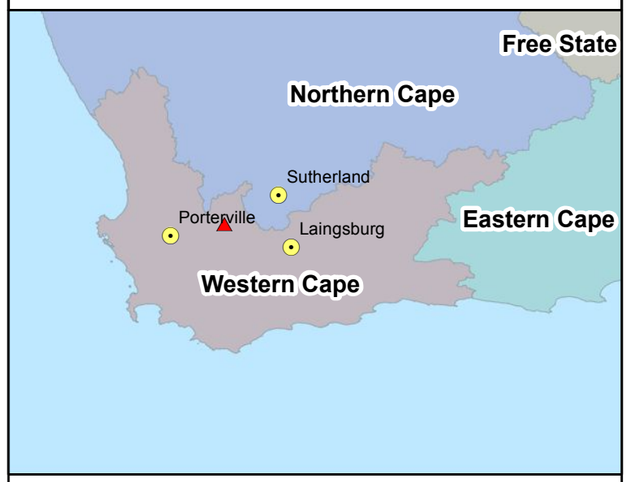
7.2 APPENDIX B: SITE PHOTOGRAPHS

7.3 APPENDIX C: MINUTES OF MEETINGS

7.4 APPENDIX D: GEOLOGICAL MAP

7.5 APPENDIX E: DMR APPROVAL LETTER

CIMERA-KARIN Exploration Borehole, Western Cape Province



Legend

- Borehole drill location

NORTH WEST OFFICE
76 Steve Biko Avenue
Potchefstroom 2531
Tel: +27 18 297 6588
Fax: +27 18 297 4813

Locality Map

N

0 0.5 1 Kilometers

Date Compiled: 2015/07/02	Compiled by: M Prinsloo
Datum: WGS 1984	Scale (on A3) 1:25 000

CIMERA-Karin Information for Local Community

The DST-NRF Centre of Excellence for Integrated Mineral and Energy Resource Analysis (CIMERA hosted at the University of Johannesburg) Plan to Drill for Academic Research Purposes on the farm Zandfontein 89, Ceres District.

Compiled by Prof. NJ Beukes, Director CIMERA, UJ.
E-mail: nbeukes@uj.ac.za. Cellphone 082 807 5037 in collaboration with other research team members (see below).

Introduction

Following on a meeting we had with the community early in April at "Die Padstal" about the Karoo Research Initiative (KARIN Project) as one of the research projects of the DST-NRF Centre of Excellence CIMERA we would now like to present more detail on the location of the drill hole, analyses to be undertaken, equipment to be used and number of people involved.

Following the meeting (of which the minutes were circulated by Hein Lange), several farm owners indicated to us that they would not object if we wanted to drill on their properties.

After careful consideration from a combined environmental and geological perspective, we selected a locality on the farm Zandfontein 89 owned by Drs Blomerus. The location is situated on an abandoned old cultivated irrigation plot with no original vegetation preserved and served by existing roads (see Google image below). The hole is estimated to be 600 m deep to reach our end target namely the glacial deposits of the Dwyka Group (see estimated core log attached). The environmental impact of transport, establishment of 50X50m fenced drill camp, and the actual drilling of a 96mm diameter hole could thus be considered virtually zero. We also have permission to extract water from a well some 750 m away from the actual drill site. This well, that has sufficient yield to provide us with the estimated 5000 liters per day required for drilling, has not been used up to now and we would be able to pipe water from it, after installing a simple submersible pump, to the drill site so that carting of water by road would not be required. We hope to be able to drill 25-30 m per 24-hour shift that would mean completion of the hole in about a month's time.

Control and Inspection of Drilling Procedure

Hein Lange of “Die Padstal” has a key for entrance to Zandfontein 89, according to an agreement he has with the owners (Drs Blomerus), and he would be able to directly inspect the drilling procedure and keep the owners fully informed. We could also organize an open day for persons to visit the drill camp and see what we do. However, that will have to be done in consultation with the owners of the farm and especially Hein Lange, mainly to keep vehicle use on the farm roads to a minimum. Also the immediate area around the drill within the drill camp would be marked off and would normally not be accessible because of safety specifications and would require hard hats, safety boots and a safety induction.

In addition CIMERA-Karin would have an independent geological drilling manager (Aleck Birch, a SACNAS-Registered geologist) on site to oversee drilling, monitor geological conditions and to properly curate the core and packing into core boxes. We shall have a postgraduate student to assist him.

The core would, after completion of drilling, be transported to the National Core Store Facility of the Council of Geoscience at Donkerhoek near Pretoria where it would be available for all interested parties to investigate after completion of sampling by scientists immediately involved with the Karin project at present. All data obtained on the core would in end be available on open file and/or published in Scientific Journals.

Scientific Studies to be Undertaken on Core

The core we plan to drill on Zandfontein 89 (referred to as KARIN 3, see map and diagram below) has two main objectives, namely
a) to obtain samples of the Karoo succession in an area not affected by the intrusion of later high-temperature dolerite sills and
b) to sample the composition of deep ground water and to monitor the composition over time by installing a piezometer. This area in the southern Tankwa Karoo is the only one available in South Africa where we can intersect the stratigraphic succession we are interested in at relatively shallow depth without the presence of dolerite intrusions and outside the area of deformation related to the Cape folded mountain belt.

The work we plan to do on the drill core is outlined in the attached figure

and would involve the following:

a) Stratigraphy and sedimentology of the succession to determine environment of deposition and especially the transition from glacial deposits of the Dwyka Group to deep marine rocks of the Ecca Group from 300 – 250 million years ago.
b) Paleomagnetic studies to determine plate tectonic movement at the time (270 million years ago) away from the South pole.
c) Micropaleontological studies on fossil spores, pollen and phytoplankton to investigate the evolution of land plants and marine microorganisms in the period.
d) Analyses of the composition of organic matter in the rocks and their maturity to establish whether they have produced oil or gas in geological history.
e) Determine the composition of deep ground water in the hole, if we intersect water, and monitor changes in flow and composition over time (see figure attached).
f) Test for the possible presence of natural gas in selected samples of core extracted from the hole. These gas desorption tests shall have to be done on site shortly after core has come out the hole because any natural gas that may be present typically very rapidly escapes into the air after core samples are brought to surface.

After completion of drilling we would also undertake electrical logging of the hole involving the following methods.

a) Directional survey with gyroscope (we start drilling vertical but with flexibility of steel in say a 600m deep hole the core shall deflect from vertical and we require that direction to obtain oriented core)
b) Acoustic televiewer mapping of the inside of the hole so that we can re-orientate the core that was extracted from it.
c) Eh and pH of groundwater in the hole.

Scientists involved in analyses of this core are:

a) Stratigraphers and sedimentologists from the Council of Geoscience at Belville (specifically Dr Doug Cole), University of Pretoria (Prof Altermann) and UJ (Dr van Niekerk and Prof Beukes)
b) Paleomagnetic studies (Prof Michiel de Kock at UJ)
c) Micropaleontological studies and organic carbon analyses and gas analyses (Profs Annette Götz, UP and Nicola Wagner, UJ)
d) Ground water monitoring and analyses (Dr. Luc Chevalier, Council of Geoscience, Belville and Prof. Danie Vermeulen, Institute for Groundwater Studies, Univ. Free State).
e) Analyses of electrical logs (Dr Musa Manzi, Geophysics Department,

University of the Witwatersrand).

Drilling Procedure

We are awaiting final approval of the drilling tender and selected drilling contractor by the Management Executive Committee of the University of Johannesburg. Thus it is not possible to provide the name of the successful bidder for the tender at this stage. However, we can supply a general outline of the process as specified in the document that went out with the invitation for tenders and standard manpower requirements for such drilling operations.

The drill would be capable of drilling to at least 800 m deep and is not too big a machine. It will be transported in and out on a low-bed for which the existing roads are suitable.

Drilling would be done water-based with only biodegradable polymers added to “lubricate” and cool down drill strings and diamond drill bits. All drill muds would be collected in closed containers and transported to suitable municipal dumpsites. If water losses are encountered the sides of the hole would be sealed with either casing or by cementation. Cementation would take place if we by chance would encounter excessive artesian water for example.

Strict health, safety and environmental protection measurements (complying to National Standards) are prescribed to the drilling contractor in the tender contract.

Drilling would take place 24 hours a day except for Sundays by two crews of six persons each (driller, scribe, 2 x spanner hands, driver, supervisor or manager per shift). The crew would be housed in mobile homes in the drill camp. However we are also investigating an option to house them at a nearby guest lodge but the final decision would come from the Manager of the drilling company.

Support vehicles would typically include a truck in order of about 8 tons for transport of drill strings and pipes and two bakkies (single and double cab) for transport of crew.

We may have one or two visits by top management of the drilling company. Dr Doug Cole from the Council of Geoscience would visit to assist with description of the rock succession (he is a Karoo specialist). On-site geophysical logging of the hole and testing of core would involve a couple

of short visits by small (2-3 persons) technical operating teams.

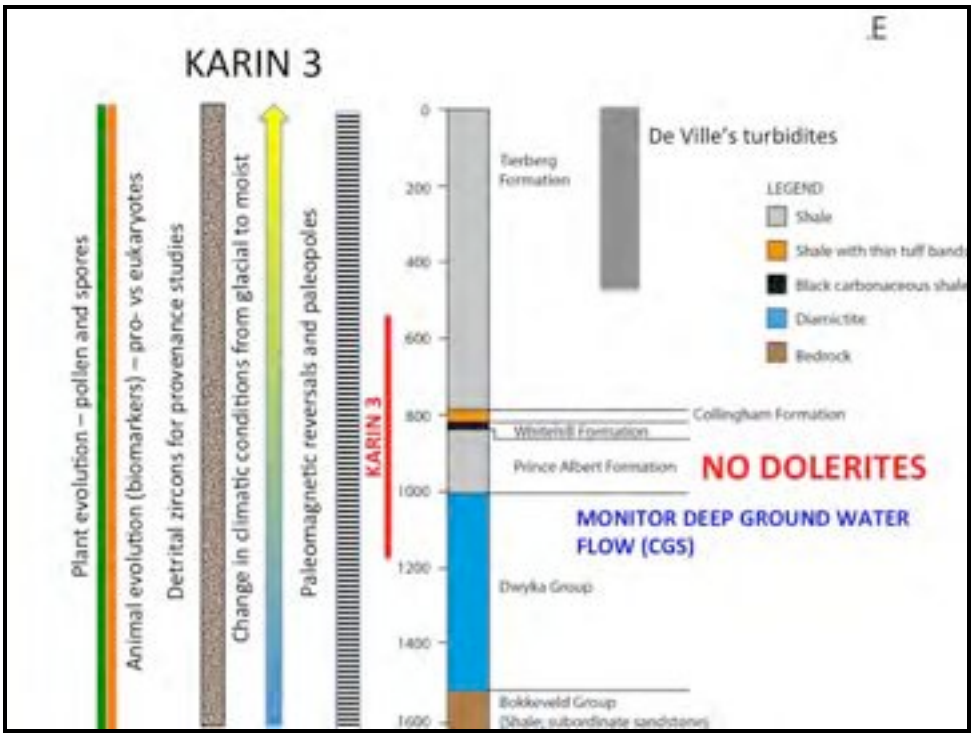


Figure illustrating scientific analysis planned on core of the Ceres Area on Zandfontein 89 (Karin3)

Proposed location of Karin 3 core and 50X50m drill camp on abandoned old irrigation land with no original plant cover preserved on Zandfontein 89.

General minutes of the meeting between community members of the Tankwa-Karoo and the representatives of the DST-NRF CIMERA-KARIN research project on the 27th of June 2015.

Minutes compiled by Dr Herman van Niekerk
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Dr Herman van Niekerk from the University of Johannesburg thanked all the people present as well as Mr Hein Lange for the use of the community hall and asked the audience if anybody they know who should be present had arrived or not. Everybody agreed that all was present and the meeting started at 10:12 am. Prof Beukes from DST-NRF CIMERA stated that the meeting was to inform the members of the Tankwa Karoo community as well as other interested parties as to what researchers wanted to achieve by drilling a borehole in the Tankwa Karoo. He proceeded to give an introduction to DST-NRF CIMERA and the KARIN project, as well as the purpose of the research project, which is mainly to retrieve fresh samples that will be used in conducting research into the rocks of the Karoo Supergroup.

Prof Beukes discussed the structure of DST-NRF CIMERA in a bit more detail and introduced the research organisational structure of the Centre of Excellence. Prof Beukes then pointed out that this KARIN drilling project is not the first such project undertaken by him and his team, with previous deep drilling projects completed in the Northern Cape Province and the Barberton Mountain Land. In addition, he has recently been approached by the international scientific community to lead a drilling project to further understand the evolution of early life.

Prof Beukes explained how scientist from all over the country defined a research project into the Karoo basins as part of the larger research plan of CIMERA.. Some of the economic questions that the scientists wanted to answer were (i) the nature of the deep coal in Africa, and (ii) the extraction and use of coal bed methane. The scientists also found that not much was known about possible fracking in South Africa, and that questions around this should be researched.

The KARIN project was then introduced and the different research themes, which include provenance studies, stratigraphy, micropaleontology, seismics and economic potential, were mentioned as well as the scientists who would be working in these fields. Prof Beukes said that sponsorship of this research is always an issue and that Shell is a sponsor, but that the money received from Shell and other donors will still not be enough to conduct all the research envisaged, and that he will be looking for additional funding from elsewhere.

Prof Beukes than showed a series of slides in which the locations of the KARIN drill holes are indicated, and explained why these localities were selected. He also mentioned that there is not currently enough funding to drill the KARIN 1 bore hole. Prof Beukes then proceeded to indicate the distribution of dolerites in the Karoo and that said that these rocks intrude at a temperature of 1100° Celsius. He then pointed out that these dolerites might have burnt off any possible shale gas. Prof Beukes stated that, in that part of the Tankwa Karoo, there are no dolerites and that is one of the reasons why DST-NRF CIMERA wants to drill the hole KARIN 3 on the farm Zandfontein. This hole will then be compared to a hole near Willowvale in the Eastern Cape Province where dolerite intrusions are very common. He then showed the map produced by Dr Doug Cole from the Council for Geoscience on the potential for shale gas occurrences and possible fracking in South Africa, and pointed out that none of the holes for the KARIN project will be drilled anywhere near the areas in South Africa where there might be potential for shale gas extraction.

Prof Beukes then showed a satellite image of the farm Zandfontein where KARIN 3 will be drilled, and indicted that the hole will be drilled in already disturbed land. He also stated that this would not be a duplication of the rocks drilled by Dr D. Wickens.

The difference between drilling for fracking and drilling for rock core, as in the KARIN project, was discussed and a sample of drill core of the same diameter as what will be retrieved through the KARIN 3 hole was presented to the meeting to study.

Prof Beukes then explained in detail the scientific reasons behind KARIN 3 and what the scientists want to achieve. This includes looking at the provenance of the rocks, the stable isotopes, micropaleontology, the study of the evolution of eukaryotes, to name a few, but also to measure the amount of gas in the Whitehill Formation as the samples are extracted. He indicted that if he did not do this, it would just simply be bad science.

A community member then asked that if the scientists obtain all these answers, with whom will the intellectual property then reside? In other words, he asked "Will Shell be able to use any of the results?" Prof Beukes replied that there might be data that Shell will be able to use, but he then made it clear that this was not contract research, but sponsored research. The same community member then said that it is interesting to him about which companies were giving funding for this research. Prof Beukes answered by saying that this is unfortunately how it works if you want to conduct research - you get funding from companies who have a interest in the field you are working in. You will not get funding from a coal mining company to do research in the field of gold, and the same applies here.

Another member of the community then asked if there was a hidden fracking agenda in the project, and if any of the information coming forth from the project will lead to fracking. Prof Beukes answered that there are no hidden agendas and that the data derived from this project will give information for the future,

and if it is found that there is no potential for shale gas, the whole fracking issue might just disappear. Mr Jonathan Deal from the Treasure Karoo Action Group then requested that the presentations are first finished before questions are asked.

Prof Beukes then continued and showed photographs of the geology of the Tankwa Karoo and explained that this area also has many geological wonders which should be preserved together will the fauna and flora.

Prof Beukes returned to the KARIN 3 bore hole and explained, in more detail, that the scientists wanted to use the samples derived from the drill core (i) to determine the age of the rocks and where they originally come from, (ii) to study the ancient magnetic field of the earth, (iii) to look at the ancient pollen and microfossils and the marine micro plankton, and (iv) to investigate the maturity of the rocks, and to see if it might be possible for these rocks to carry gas. He said that the Karoo contains abundant dolerites that might have burnt off the gas, and that close to the Cape Fold Belt, the rocks of the Karoo might have been compressed too much to carry any gas. He stated that it will be important to study the Whitehill Formation, and to see how much gas it actually carries. It will be the first time in South Africa that anybody will actually look at this issue. Prof Beukes also indicted that is important to understand the dolerite structure because these control groundwater flow, and that it will be important to have some idea how this and possible gas extraction in the future will be related. He also said that wire-line logging will be conducted, and the deep groundwater levels and geochemistry will be determined. It will be important, he said, to have an idea of the levels and composition of the deep groundwater as a reference for the future.

Finally, Prof Beukes said that the KARIN project is part of a much larger project to study the rocks of the Karoo Supergroup in South America, India and other localities.

Prof Beukes than ended by thanking Mr Hein Lange and Ms Susan de Kock for communicating this meeting to the community of the Tankwa Karoo.

Ms Kate Robey, a hydrogeologist from the Council for Geoscience, then gave a presentation on the ground water monitoring part of the KARIN project. She stated that they would be investigating the deep-water formations and their possible impact on the shallow water. She mentioned that 60% of the towns in South Africa is dependent on groundwater. Further research is needed as we do not know how the deep groundwater and shallow groundwater interact, and that there is not enough information about the quality of the shallow and deep groundwater. She said that water samples will be taken from existing wells in a 10-kilometre radius from the KARIN 3 borehole location and she asked farmers to make contact with her so that she can sample their wells. She also stated that all the results would be available to all interested parties.

A community member then asked if the deep groundwater will contaminate the shallow groundwater if the KARIN 3 borehole was drilled. Ms Robey answered

in the negative and that the possibility is very small. The member of the community then said that it is impossible to control it. Engineers from the drilling company Geoserve, who will be drilling the borehole, replied that it is controllable if the right procedures are followed and if the drill hole is designed in the correct way. They will be able to control and stop possible cross contamination while drilling KARIN 3.

The engineers from Geoserve, the drilling company that was selected though the tender process to drill the KARIN 3 borehole, then gave a presentation on their company and their drilling methods and strategies. The issue of groundwater contamination was again addressed and it was explained how this will not happen if casings are employed correctly. They also stated that all data regarding the drilling process would be available at all times. They explained their plan on how they will limit any surface contamination, and how the area will be rehabilitated if any traces of contaminants are found on the ground in the area where the drilling was conducted after the process was completed. Labour aspects were discussed, and it was pointed out that the drilling crew will be 5 to 6 people that will work 12 hour shifts.

The meeting was then opened for general discussion and Mr Jonathan Deal from the Trans Karoo Action Group addressed the meeting. He asked what are the rights of the community in the light that communities can protest against mining and exploration, but in the end, in South Africa mining will always win. He also pointed out that even though this is the case, South Africa has very strong environmental laws. Mr Deal addressed Prof Beukes and said that he can see what Prof Beukes wanted to achieve with the research project and that it would have been a lot easier to for him to accept it all if Shell and Bundu were not in some way involved. He also mentioned that he and his group are not just environmentalists, but that they do understand that the environment must support all of us. Mr Deal pointed out that coal bed methane extraction and fracking are very dangerous. He stated that, although the government has issued regulations regarding shale gas exploration, these will be challenged.

Mr Deal then referred to the KARIN project and stated that they wanted to see that the project, its organisation and execution was to take place in line with current regulations. They wanted to see the involvement of a environmental consultant and the creation of an “environmental plan”. Waste water management and water use licences must also be addressed, and that they would like to see all the contracts between Shell and DST-NRF CIMERA. Mr Deal again addressed Prof Beukes and stated that he “does not paint Prof Beukes with the same brush as with which he paints Shell”.

Mr Deal said that, under the guidance of an environmental consultant, they want to see that all the information regarding this project must be published and that the community must be involved. He then stated that “today was very well done”.

Mr Deal also stated that they, the TKAG, does not want Shell to be able to use this project and its success as a public relations exercise. Mr Deal also said that he had no issues with the research to be conducted on the groundwater.

Prof Beukes replied to Mr Deal's comments and stated that Enviroserve will be used to handle any waste that will be produced. He mentioned that very little waste would be produced during the drilling of the hole. Regarding the involvement of an environmentalist, Prof Beukes said that NEMA documents were completed but that this drilling site does not trigger any NEMA regulations and, therefore, no environmental impact studies are needed.

Prof Beukes also stated that the Department of Mineral Resources (DMR) knows about the KARIN project and that he has received a letter from the DMR in which they approve the drilling as it will not result in the issue of exploration licences and will not result in any mining activities.

Prof Beukes then said that the dilemma with Shell is the fact that we can only get funding to conduct research from companies who are interested in the rocks you want to study. In this case, if you want to do research on the rocks of the Karoo basin, it will only be the coal and petroleum companies who will sponsor you.

Mr Deal than also pointed out that the data obtained from this research might in the end indicate that fracking cannot take place, to which Prof Beukes replied that indeed, nobody knows. Dr Doug Cole from the Council for Geoscience said that the mining companies looked at old data, and the old data is pretty useless if we want to know something about the gas potential. He also mentioned that if the groundwater of the Dwyka is under pressure, it will be very dangerous to do fracking, and nobody knows if this is the case or not.

A member of the community then asked Mr Deal if he came into this process late. Mr Deal answered: "Yes, I did". The member of the community then asked Mr Deal for his contact details. Prof Beukes admitted that Mr Deal probably should have been involved earlier.

A member of the community then asked Prof Beukes what will happen after the data of the project has been released and if the scientists can be trusted. Prof Beukes said that he can be trusted and the member of the community then angrily stated that he worked in the mining industry for many years all over the world, and that scientists can never be trusted. He then left the meeting.

Ms Susan de Kock then stated that she asked Mr Deal to be involved and some of the community members agreed and asked Mr Deal to be their voice.

Prof Beukes said that he would try and explain the matters in the letter written to him by Mr Deal and emailed to him in the early hours of the morning of the 27th of June 2015 in more detail.

A question was then asked about the application for a water use licence. Prof Beukes said that it was not needed, as the amount of water to be used is very little. Ms Robey from the Council for Geoscience confirmed this.

Mr Hein Lange than addressed the meeting and stated that there are double standards being applied. He said that there are people who want to tell us what they want to do and they are being scrutinised, while Dr Wickens just drilled holes and that there are now problems with his holes and nothing is being done about this. Mr Deal said that there are no double standards as he was not aware of these holes until now. Prof Beukes intervened and stated that the holes drilled by Dr Wickens were research holes drilled in collaboration with universities in the United Kingdom. These holes were drilled to study ancient deep-sea sediments and not for gas or gas exploration. Dr Wickens stated that all the issues with the holes that he drilled have been thoroughly explained through his attorney and that nothing was done in a manner as to hide it from the community. He stated that these were research holes that they have been subjected to environmental processes and than no NEMA issues were triggered. Dr Wickens then returned to the KARIN project and stated that we cannot talk to the government about the issue of fracking if we do not speak from a position of power, and this mean that we have to be informed, and we can only be in such a position by conducting research.

Ms De Kock then said that "the scientists want to do their homework and she wants Mr Deal to do her homework". She wants them to find a good midway. She stated that the credibility of the research team is not under question.

Mr Deal said that he will write to Prof Beukes and he will ask some questions, as to, for instance, the timeline of the drilling. Mr Deal said to Prof Beukes that if he would commit to make information available, they will work together. Prof Beukes replied by saying that he will write and reply to Mr Deal's questions, but it is important that the drilling must start by the 15th of July 2015. The question was again asked as to when the planned starting date will be. Prof Beukes said it will be the 15th of July and the drilling will be completed in 25 days.

The meeting was adjourned at 12:25 pm.

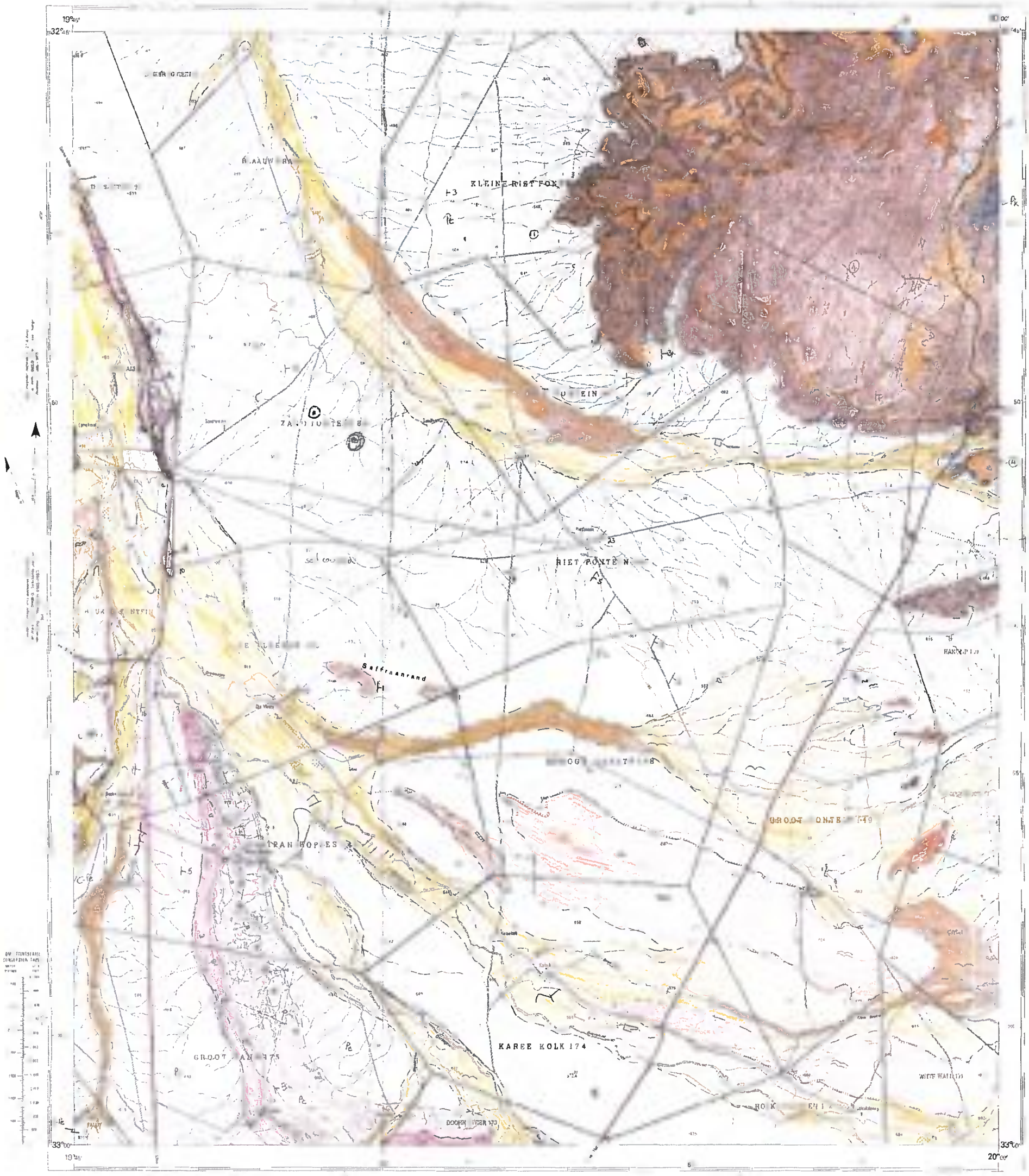
Herman Van Niekerk

---End---

1:50 000 SUID-AFRIKA / SOUTH AFRICA

3219DD KAREEKOLK

3219DD KAREEKOLK



1:50 000

VERKLARING

INDEX TO SHEETS

3219DD KARFFKOLK

mineral resources
Department:
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Per Fascimile
Department of Geology
University of Johannesburg
On behalf of Rapicorp 122 (Pty) Ltd
P.O. Box 534
Aucklandpark
2006
Att: Prof J Beukes

Dear Sir

ACADEMIC SCIENTIFIC DRILLING PROJECT ON THE FARM ZANDFONTEIN NO 89 IN CERES

We refer to the above mentioned matter, and our considerations are as follows:

The Department of Mineral Resources has evaluated your proposed project and the associated activities and we have no objections to your proposed project, as it does not constitute mining and it will not trigger any mining or prospecting right applications in terms of the Minerals and Petroleum Resources Development Act, as amended, Act 49 of 2008.

You are advised that should your activities change and they trigger any activities listed in terms of 2014 EIA regulations, promulgated in terms of National Environmental Management Act, Act 107 of 1998. You will be required to apply for an environmental authorization.

Yours faithfully

REGIONAL MANAGER
WESTERN CAPE REGIONAL OFFICE

DATE: 25/06/15

ACTION PLAN CIMERA KARIN PROJECT - ZANDFONTEIN 89

	STATUS	Week 1					Week 2							Week 3							Week 4							Week 5				Working Days
		Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	
		15-Jul	16-Jul	17-Jul	18-Jul	19-Jul	20-Jul	21-Jul	22-Jul	23-Jul	24-Jul	25-Jul	26-Jul	27-Jul	28-Jul	29-Jul	30-Jul	31-Jul	01-Aug	02-Aug	03-Aug	04-Aug	05-Aug	06-Aug	07-Aug	08-Aug	09-Aug	10-Aug	11-Aug	12-Aug	13-Aug	
NOTIFY: ENVIRONMENTALIST - SITE ESTABLISHMENT FOR 16/07/2015		1																													1
EST EVENING - STAFF ARRIVAL ON SITE TANKWA PADSTAL																															
NOTIFY: ENVIRONMENTALIST FOR PUMPING WATER FOR 17/07/2015																															1
CAMP ESTABLISHMENT MORNING 0600 - 10H00			1																												
SITE CREW SAFETY INDUCTION 10H00 - 11h00																															
MIDDAY START DRILL SITE ESTABLISHMENT 11H00																															
SITE ESTABLISHMENT - PUMP WATER 12h00 17/06/2015				1																											1
DRILLING - START HOLE PQ3 to depth of 6m Ream hole 200mm. Insert 168mm Casing and grout in place							2																								2
Drill PQ3 to competent rock formation, ream 5'9/16 insert 141mm casing									2																						2
Continue Drilling PQ3 to approx. 100m. Past fresh water aquafir											3																				3
Remove 141mm casing. Ream hole to 150mm in dia.Insert 114mm casing and grout in place. Install Gas diverter .														3																	3
Start HQ production Drilling until EOH depth 600m																	10														10
Insert Van Ruth Packer at desired depth above salt aquafir. Grout entire hole																										2					2
Demobilization and Rehabilitation process																												3			3
																															28