

**ANNEXURE I:**

**PALAEONTOLOGICAL ASSESSMENT:**



**DESKTOP PALAEOLOGICAL  
HERITAGE IMPACT ASSESSEMENT  
REPORT ON THE SITE OF THE  
PROPOSED BRAKFORTEIN COAL  
MINE TO BE LOCATED ON THE  
FARM BRAKFORTEIN 264 IR  
PORTIONS 16, 17, 22, 24, 25 AND  
27, MPUMALANGA PROVINCE**

8 October 2013

Prepared for:  
Cabanga Concepts CC

On behalf of:  
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**DESKTOP PALAEOLOGICAL HERITAGE IMPACT ASSESSEMENT REPORT ON  
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Prepared for:

Cabanga Concepts CC

On Behalf of:

Tegeta Exploration and Resources (Pty) Ltd

Prepared By:

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Palaeontological Impact Assessment Report – Proposed Tegeta Exploration and Resources (Pty) Ltd's Brakfontein coal mine on the farm Brakfontein 264 IR Portions 16, 17, 22, 24, 25 and 27, Mpumalanga Province

## **EXECUTIVE SUMMARY**

Tegeta Exploration and Resources (Pty) Ltd wishes to be granted a Mining Right in respect of coal. The site of the proposed mine lies approximately 18 km south-east of Delmas and 5 km west of Lionelton in the Victor Khanye local municipality, Mpumalanga Province. The area reported on, herein, occupies an area of approximately 509 ha and is wholly located within the farm Brakfontein 264 IR Portions 16, 17, 22, 24, 25 and 27.

Cabanga Concepts CC has been appointed to compile an Environmental Impact Assessment report and an Environmental Management Program Report to support an application for a Mining Right for coal on behalf of Tegeta Exploration and Resources (Pty) Ltd. SAHRA has indicated that a desktop Palaeontological Impact Assessment report must be undertaken over the project area and a report submitted. Cabanga Concepts CC has appointed BM Geological Services to provide that desktop Palaeontological Heritage Impact Assessment Report in respect of the proposed project.

The project area is completely underlain by sediments of the Vryheid Formation, but it appears that there may also be a ubiquitous cover of regolith. The mining operations will be confined to the rocks of the Vryheid Formation, but there may also be disruption to the possible regolith cover in the open cast mining area and in the areas of construction of the infrastructure elements. The mining operations will consist of both underground and open cast mining areas. Infrastructure elements planned for the site consist of offices, a processing plant and various top soil and rock spoil piles.

The Vryheid Formation is fossiliferous elsewhere in the Karoo Basin, but the fossil potential of any regolith cover within the area is uncertain. The potential for a negative impact on the fossil heritage of the area can be quantified in the following manner. The probability of a negative impact on the palaeontological heritage of the Vryheid Formation is moderate in the area to be open cast mined and low elsewhere within the project area. The possibility of a negative impact on the palaeontological heritage within the possible regolith is also considered as low due to the extensive ploughing of the land surface. However, the plant macrofossils and trace fossil assemblages known to occur within the Vryheid Formation are potentially scientifically significant. Thus, the probability of any significant negative impact upon the fossil assemblages contained within these geological units is restricted to the area of the open cast mining as well as the regolith beneath the planned infrastructure elements.

The project has been assessed as being socially beneficial, herein, as it would provide employment opportunities and either materials for the production of electricity or the provision of export income for the country. The possibility of any negative impact on the palaeontological heritage of the project area could be minimised by the conduct of a thorough site investigation by a palaeontologist (as part of a Full Palaeontological

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Heritage Impact Assessment study) prior to commencement of the project. This site investigation would make it possible that scientifically and/or culturally significant fossils may be discovered that would be otherwise damaged, destroyed or inadvertently moved. Similarly, a thorough examination should be made of all excavations as they are being performed. Should any fossil materials be identified during the construction phase, the excavations should be halted and SAHRA informed of the discovery. A potential positive outcome of these mitigation protocols could be that fossil materials become available for scientific study that would otherwise have been hidden within or beneath the regolith. Should such new palaeontological material be located as a result of this site investigation this could prove to have a positive effect on the understanding of the fossil record of South Africa and positively affect the palaeontological heritage of the country.

It is also recommended that as the probability of a negative impact on the fossil heritage of the area is high in the open cast mine (and low elsewhere) it is also suggested that regular inspections be made of the open pit exposures by a palaeontologist during the life of those mining operations. Should any fossil materials be identified by the palaeontologist, the significance of the fossil materials should be evaluated and appropriate damage mitigation processes put into place.

**In summary, this desktop study has not identified any palaeontological reason to prejudice the progression of this project, subject to adequate mitigation programs being put in place.**

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## **1. INTRODUCTION**

Tegeta Exploration and Resources (Pty) Ltd wishes to be granted a Mining Right in respect of coal. The site of the proposed mine lies approximately 18 km south-east of Delmas and approximately 5 km west of Lionelton, in the Victor Khanye local Municipality, Mpumalanga Province (Figure 1). The project occupies an area of approximately 509 ha and is wholly located within the farm Brakfontein 264 IR Portions 16, 17, 22, 24, 25 and 27.

Cabanga Concepts CC has been appointed to compile an Environmental Impact Assessment report and an Environmental Management Program Report to support an application for a Mining Right for coal on behalf of Tegeta Exploration and Resources (Pty) Ltd. Cabanga Concepts CC had previously compiled a Phase 1 Heritage Impact Assessment Report as part of this process and had submitted the document to the South African Heritage Resources Agency (SAHRA). SAHRA has indicated that a desktop Palaeontological Impact Assessment report must be undertaken over the project area and a report submitted. Cabanga Concepts CC has appointed BM Geological Services to provide a desktop Palaeontological Heritage Impact Assessment Report in respect of the proposed project that will form part of the final Heritage Impact assessment Report.

## **2. TERMS OF REFERENCE AND SCOPE OF THE STUDY**

The terms of reference for this study were as follows:-

- Conduct a desktop assessment of the potential impact of the proposed project on the palaeontological heritage of the project area.
- Describe the possible impact of the proposed development on the palaeontological heritage of the site, according to a standard set of conventions.
- Quantify the possible impact of the proposed development on the palaeontological heritage of the site, according to a standard set of conventions.
- Provide an overview of the applicable legislative framework.
- Make recommendations concerning future work programs as, and if, necessary.



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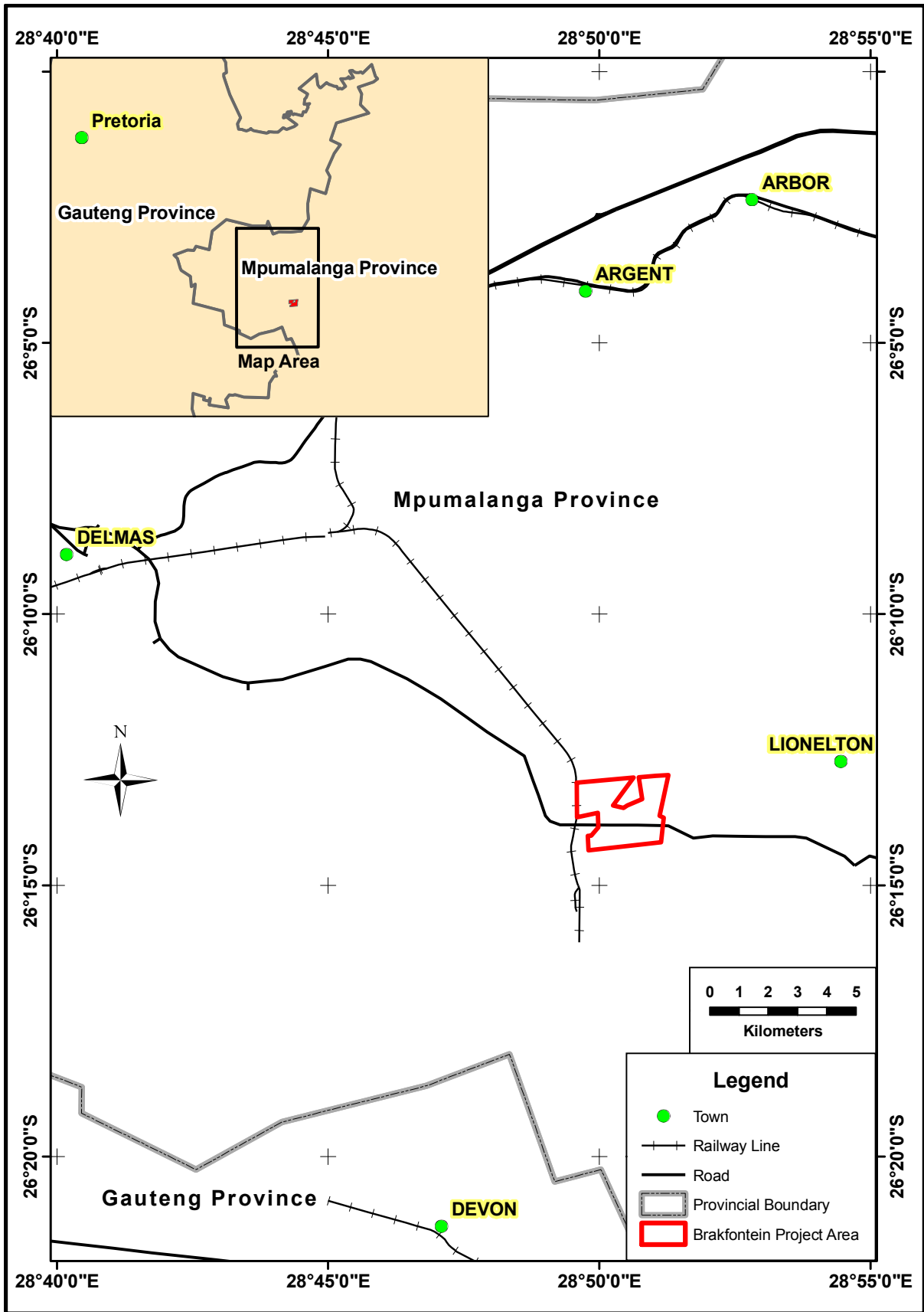


Figure 1: Location map showing the position of the proposed coal mine.

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### **3. LEGISLATIVE REQUIREMENTS**

South Africa's cultural resources are primarily dealt with in two Acts. These are the National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998).

#### **3.1 The National Heritage Resources Act**

The following are protected as cultural heritage resources by the National Heritage Resources Act:

- Archaeological artefacts, structures and sites older than 100 years,
- Ethnographic art objects (e.g. prehistoric rock art) and ethnography,
- Objects of decorative and visual arts,
- Military objects, structures and sites older than 75 years,
- Historical objects, structures and sites older than 60 years,
- Proclaimed heritage sites,
- Grave yards and graves older than 60 years,
- Meteorites and fossils,
- Objects, structures and sites of scientific or technological value.

The Act also states that those heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations must be considered part of the national estate and fall within the sphere of operations of heritage resources authorities. The national estate includes the following:

- Places, buildings, structures and equipment of cultural significance,
- Places to which oral traditions are attached or which are associated with living heritage,
- Historical settlements and townscapes,
- Landscapes and features of cultural significance,
- Geological sites of scientific or cultural importance,
- Sites of Archaeological and palaeontological importance,
- Graves and burial grounds,
- Sites of significance relating to the history of slavery,
- Movable objects (e.g. archaeological, palaeontological, meteorites, geological specimens, military, ethnographic, books etc.).

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### **3.2 Need for Impact Assessment Reports**

Section 38 of the Act stipulates that any person who intends to undertake an activity that falls within the following:

- The construction of a linear development (road, wall, power line, canal etc.) exceeding 300m in length,
- The construction of a bridge or similar structure exceeding 50 m in length,
- Any development or other activity that will change the character of a site and exceed 5 000 m<sup>2</sup> or involve three or more existing erven or subdivisions thereof,
- Re-zoning of a site exceeding 10 000 m<sup>2</sup>,
- Any other category provided for in the regulations of SAHRA or a provincial heritage authority.

must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development. If there is reason to believe that heritage resources will be affected by such development, the developer may be notified to submit an impact assessment report. A Palaeontological Impact Assessment (PIA) only looks at the potential impact of the development on palaeontological resources of the proposed area to be affected.

### **3.3 Legislation Specifically Pertinent to Palaeontology\***

\*Note: Section 2 of the Act defines "palaeontological" material as "any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains".

Section 35(4) of this Act specifically deals with archaeology, palaeontology and meteorites. The Act states that no person may, without a permit issued by the responsible heritage resources authority (national or provincial):

- Destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite,
- Destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite,

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- Trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
- Bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment that assists in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites,
- Alter or demolish any structure or part of a structure which is older than 60 years as protected.

The above mentioned palaeontological objects may only be disturbed or moved by a palaeontologist, after receiving a permit from the South African Heritage Resources Agency (SAHRA). In order to demolish such a site or structure, a destruction permit from SAHRA will also be needed.

Further to the above point, Section 35(3) of this Act indicates that “any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.”. Thus, regardless of the granting of any official clearance to proceed with any development based on an earlier assessment of its impact on the Palaeontological Heritage of an area, the development should be halted and the relevant authorities informed should fossil objects be uncovered during the progress of the development.

### **3.4 The National Environmental Management Act**

This Act does not provide the detailed protections and administrative procedures for the protection and management of the nation's Palaeontological Heritage as are detailed in the National Heritage Resources Act, but is more general in its application. In particular Section 2(2) of the Act states that environmental management must place people and their needs at the forefront of its concerns and, amongst other issues, serve their cultural interests equitably. Further to this point section 2(4)(a)(iii) states that disturbances of sites that constitute the nation's cultural heritage should be avoided, and where it cannot be avoided should be minimised and remedied.

Section 23(1) indicates that a general objective of integrated environmental management is to identify, predict and evaluate the actual and potential impact of activities upon the cultural heritage. This section also highlights the need to identify options for mitigating negative effects of activities with a view to minimising negative impacts.

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In order to give effect to the general objectives of integrated environmental management outlined in the Act the potential impact on cultural heritage of activities that require authorisation or permission by law must be investigated and assessed prior to their implementation and reported to the relevant organ of state. Thus, a survey and evaluation of cultural resources must be done in areas where development projects that will potentially negatively affect the cultural heritage will be performed. During this process the impact on the cultural heritage will be determined and proposals for the mitigation of the negative effects made.

#### **4. RELEVANT EXPERIENCE**

Dr Millstead holds a PhD in palaeontology and has previously been employed as a professional palaeontologist with the Council for Geoscience in South Africa. He is currently the principle of BM Geological Services and has sufficient knowledge of palaeontology and the relevant legislation required to produce this Palaeontological Impact Assessment Report. Dr Millstead is registered with the South African Council for Natural Scientific Professions (SACNASP), and is a member of the Palaeontological Society of South African and the Geological Society of South Africa.

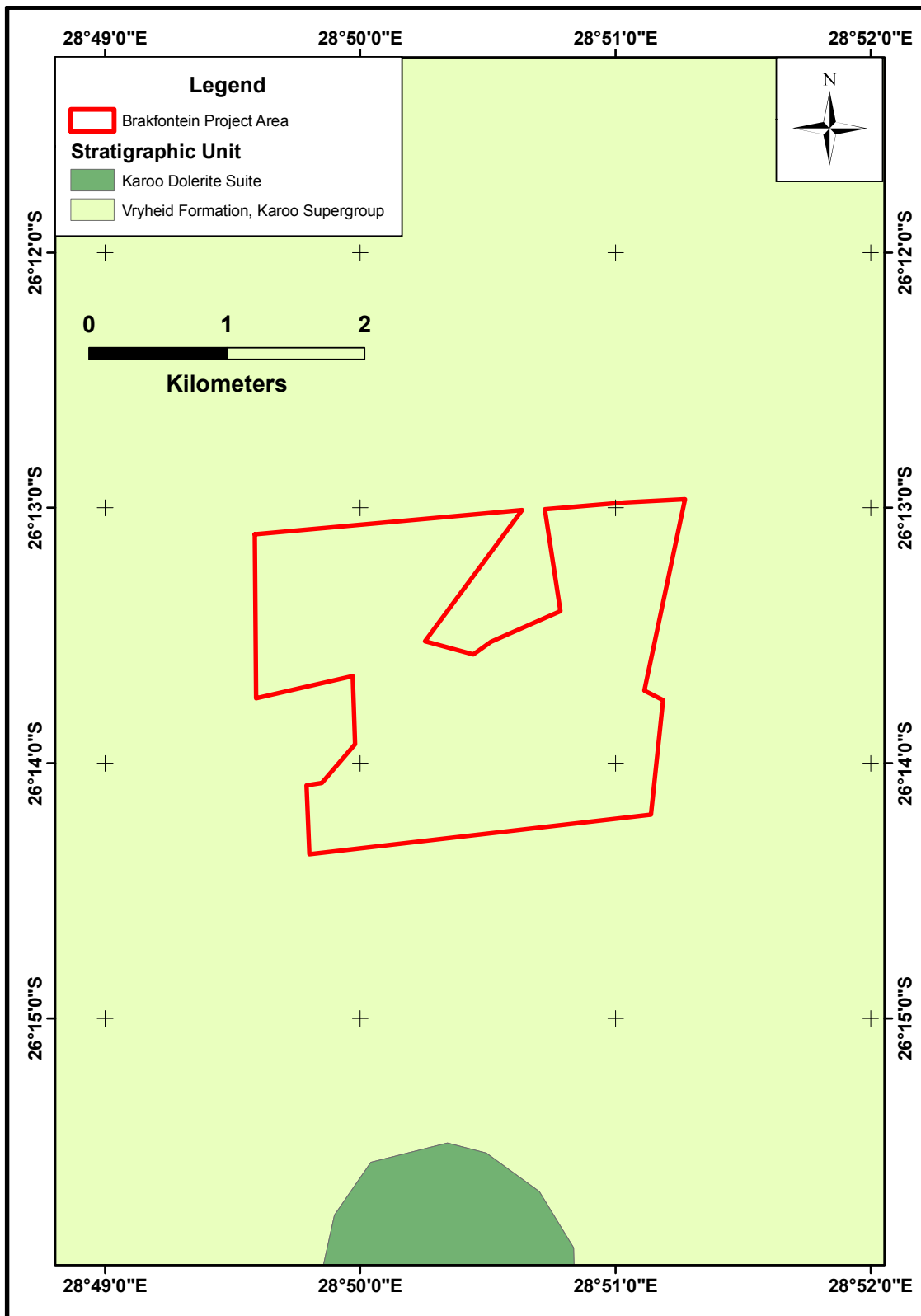
#### **5. INDEPENDENCE**

Dr Millstead was contracted as an independent consultant to conduct this Palaeontological Heritage Impact assessment study and shall receive remuneration for these professional services. Neither Dr Millstead nor BM Geological Services has any financial interest in Tegeta Exploration and Resources (Pty) Ltd, Cabanga Concepts CC or the proposed mining operations.

#### **6. GEOLOGY AND FOSSIL POTENTIAL**

Figure 2 shows that the project area is underlain by Early Permian strata of the Vryheid Formation. A summary of the characteristics of the Vryheid Formation and its fossiliferous potential follows.

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**Figure 2:** Map of the geology underlying the project area.

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## 6.1 Geology

The entire extent of the project area is underlain by Early Permian strata of the Vryheid Formation, Ecca Group, Karoo Supergroup (Figure 2). The Vryheid Formation is composed of an interbedded series of interbedded fluvio-lacustrine sandstones, carbonaceous mudstones and coal seams. The sequence was deposited within a deltaic depositional environment along the north-eastern margin of the Main Karoo Basin. The major coal seams occurring within this local region have been named (from oldest to youngest as the N<sup>o</sup>. 1-5 seams) and collectively their aerial extents constitute the Witbank Coalfield.

## 6.2 Palaeontological potential

The rocks of the Vryheid Formation are well known for the wealth of plant macrofossils of the *Glossopteris* flora that they contain. Although the coal seams contained within the formation are predominantly composed of organic matter of plant origin most of the plant material has been rendered unidentifiable at a taxonomic level via the coalification process. Plant macrofossils are, accordingly, primarily located within the mudstones and sandstones lying between, and as lithic partings within, the coal seams.

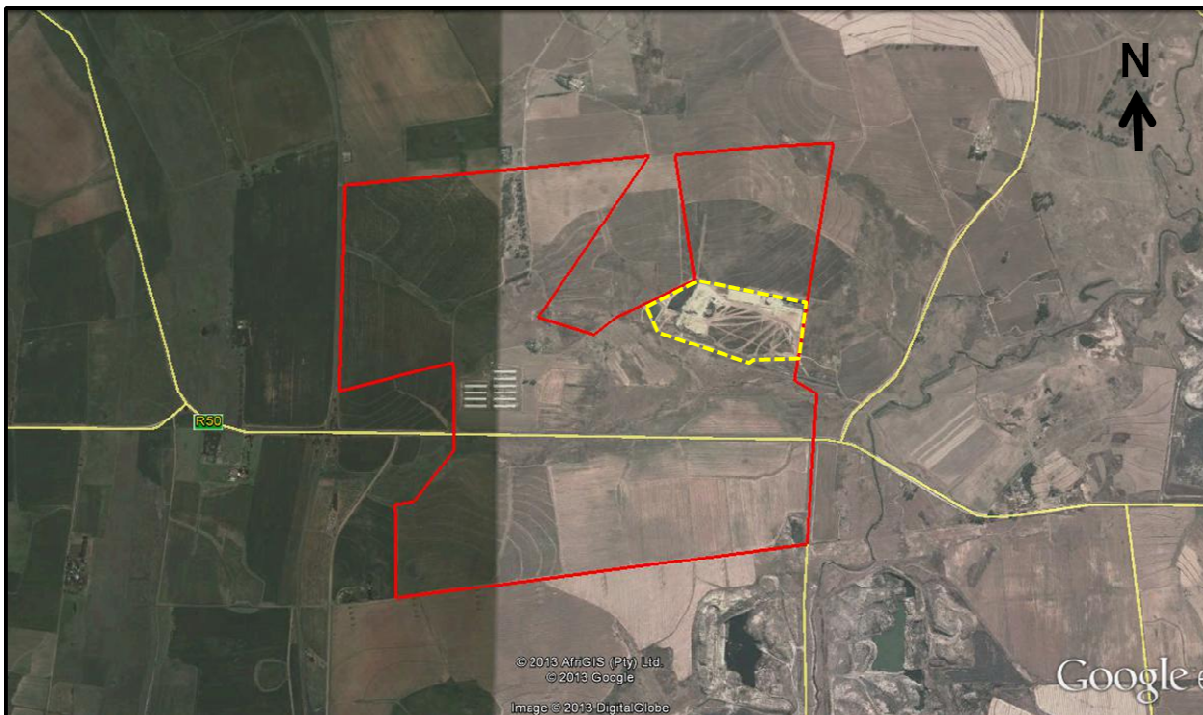
The presence of various trace fossil taxa is known within the Vryheid Formation [e.g., Mason *et al.*, (1983)]. Mason *et al.*, (1983) report the presence of examples of trace fossil assemblages assigned to the ichnospecies *Spirodesmos archimedeus*, representing the spiral trail or burrow of a deposit-feeding organism. These *Spirodesmos* traces were formed in a shallow-water environment as established on both sedimentary and ichnofacies evidence. Associated trace fossils include *Skolithos*, *Corophioides* and *Siphonichnus*, all of which are members of the *Skolithos* ichnofacies of Scilacher. The occurrence of *Spirodesmos* in this ichnofacies suggests that these strata were deposited in a marine basin.

Vertebrate fossils are unknown from the Vryheid Formation. Fossils of fish and the aquatic reptile *Mesosaurus* are known from age equivalent stratigraphic units elsewhere within the basin. It may be expected that aquatic vertebrate taxa may have been present within the waterways of the delta that deposited the Vryheid. It has been previously hypothesised that the absence of vertebrate fossil taxa within the Vryheid Formation may be due to an abundance of organic acids released from the coals and carbonaceous mudstones during the diagenetic process.

Terrestrial vertebrate faunas of the Karoo Basin are world renowned. However, fossils of this type are unknown in the Vryheid Formation and only appear in the stratigraphic record of southern Africa within the stratigraphically younger Beaufort Group.

## 7. ENVIRONMENT OF THE PROPOSED PROJECT SITE

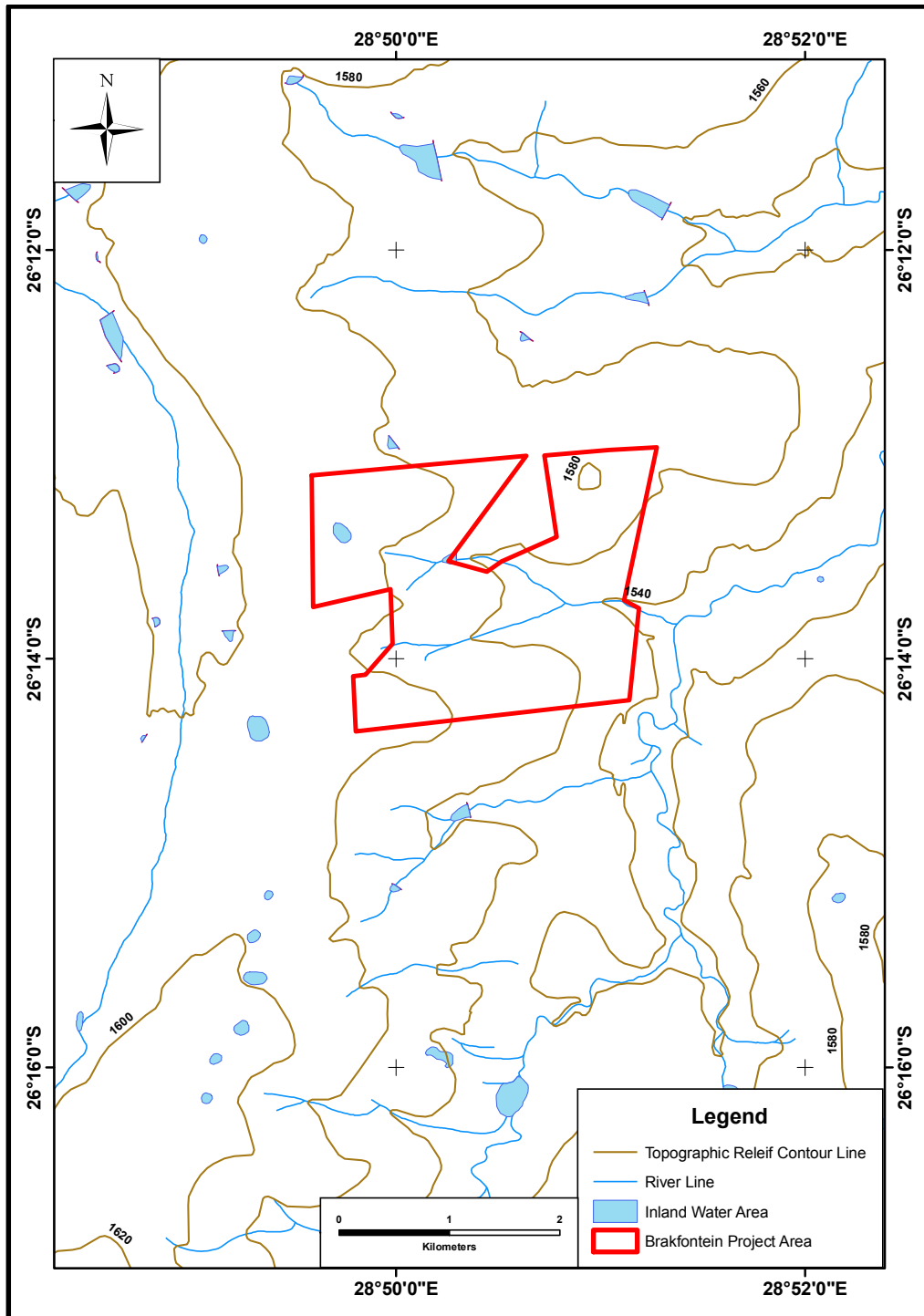
The project area is approximately 509 ha in extent. Examination of Google Earth imagery of the wider reporting area (Figure 3) suggests that the land surface of the area is predominantly utilised for agriculture and appears to be extensively ploughed. Man made features present include ten buildings located on the eastern margin of the project area and a road (the R50) traverses the area from east to west. There is a highly disturbed area occurring within the north-western corner of the area that appears to be an existing mine. Examination of the spacing between topographic contour intervals (Figure 4) indicates that the majority of the project area consists of featureless landscape. A simple, bifurcating drainage system is located in the centre of the project area and drains to the east (Figure 4). Mucina and Rutherford (2006) indicate that the vegetation cover of the project area consists of Eastern Highveld Grassland (Figure 5) and that the conservation status of this vegetation unit is classified as endangered.



**Figure 3:** Google Earth image of the project area (the red polygon). It is evident from the image that the area has been extensively utilised for agricultural cultivation (ploughed). An extensively disturbed area is evident on the eastern margin of the area, it is assumed, herein, that this feature is an existing mine (yellow stippled polygon).

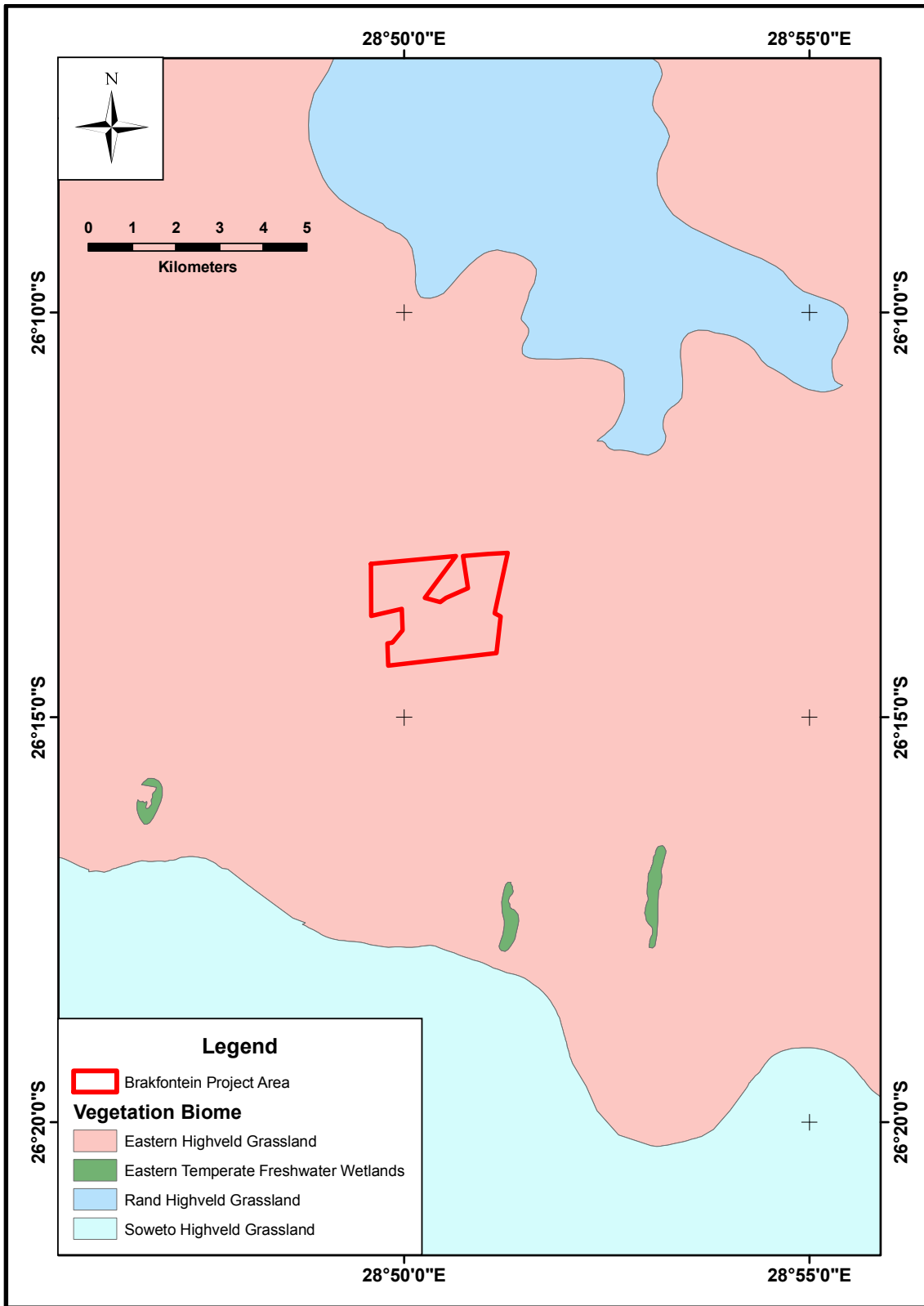


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**Figure 4:** Map of the project area and its immediate environs. The topographic contour interval is 20 m and, as such, it is clear that the region is generally flat, but slopes gently to the east. It is also evident that the surface drainage system is composed of a simple, bifurcating drainage system located in the centre of the area and draining towards the east.

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**Figure 5:** Map of the distribution of the vegetation veld types located within the project area (after Mucina and Rutherford, 2006).

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## **8. OVERVIEW OF SCOPE OF THE PROJECT**

The proposed project will consist of a mixture of areas to be mined using both open cut and underground mining techniques. The entire southern and much of the central portion of the area are planned for open cast mining while the north-western area is planned to be mined by underground board and pillar methodology. Much of the remaining area will be subject to the construction of plant, offices and top soil and spoils piles.

In the areas to be mined using open cast techniques it will be expected that all strata from the surface to the base of the deepest coal seam to be exploited will be completely and permanently disrupted. In the areas mined using underground board and pillar mining the surface geology will not initially be disturbed by the mining process, but there is a risk of mining induced subsidence and disruption of surface strata at a later juncture. Areas exploited by underground mining will have the majority of disruption to the geology confined to the targeted removal of the target coal seams with minimal removal or disruption of the overlying and intervening clastic sediments. Both the open cast and underground mining affects will be limited to the Vryheid Formation, with no disruption of any underlying stratigraphic units expected.

In the areas not directly affected by the mining process it is planned that there will be offices and a processing plant constructed. There will also be considerable extents of top soil and rock spoils piles developed. The impacts of these buildings and soil/rock piles should be restricted to the land surface and shallow subsurface.

## **9. IMPACT ASSESSMENT**

The potential impact of the proposed mining area is categorised below according to the following criteria:-

### **9.1 Nature of Impact**

The potential negative impacts of the proposed project on the palaeontological heritage of the area are:

- Damage or destruction of fossil materials during the construction of the project's infrastructural elements to the maximum depth of those excavations. Many fossil taxa (particularly vertebrate taxa) are known from only a single fossil and, thus, any fossil material is potentially highly significant. Accordingly, the loss or damage to any single fossil can be potentially significant to the understanding of the fossil heritage of South Africa and to the understanding of the evolution of life on Earth in general. Where fossil material is present and will be directly affected by the building

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or construction of the projects infrastructural elements the result will potentially be the irreversible damage or destruction of the fossil(s).

- Movement of fossil materials during the construction phase, such that they are no longer *in situ* when discovered. The fact that the fossils are not *in situ* would either significantly reduce or completely destroy their scientific significance.
- The loss of access for scientific study to any fossil materials present beneath infrastructural elements for the life span of the existence of those constructions and facilities.

## 9.2 Extent of impact

The possible extent of the permanent impact of the proposed project on the palaeontological heritage of South Africa is restricted to the damage, destruction or accidental relocation of fossil material caused by the excavations and construction of the necessary infrastructure elements forming part of the project. The possible source of a less permanent negative impact on the palaeontological heritage is the loss of access for scientific research to any fossil materials that become covered by the various infrastructural elements that comprise the project. The **extent of the area of potential impact is, accordingly, categorised as local** (i.e., restricted to the project site).

## 9.3 Duration of impact

The anticipated duration of the identified impact is assessed as potentially **permanent to long term**. This assessment is based on the fact that, in the absence of mitigation procedures (should fossil material be present within the area to be affected) the damage or destruction of any palaeontological materials will be permanent. Similarly, any fossil materials that exist below the planned built structures and infrastructural elements that will constitute the mine will be unavailable for scientific study for the life of the existence of those features.

## 9.4 Probability of impact

The Vryheid Formation strata are fossiliferous (and occasionally is richly so) elsewhere within the Karoo Basin and the area reported upon, herein, is aerially extensive (approximately 509 ha); as such there is a reasonable chance of fossil materials occurring within the rocks underlying the project area. The probability of any development affecting a fossil within the Vryheid Formation is generally moderate, due to the common, but sporadic occurrence of fossil deposits within the strata elsewhere in the region.

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The risk profile of a negative impact on the palaeontological heritage of the project area can be more precisely characterised according to the style of mining to be undertaken. In the open cast mining areas all rock strata will be disrupted from the surface down to the base of lowest coal seam being exploited. Accordingly, all fossils contained within the mined area will be affected. In the areas to be exploited using underground board and pillar methods the majority of the geological materials disrupted will be the coal seams and their contained lithic partings due to the more selective nature of the mining technique. The coal is predominantly unfossiliferous, despite being composed of plant matter, due to the destruction of plant morphological features during the coalification process. Thus, it is only within any lithic partings that fossils will be encountered and have any probability of being impacted. Lithic partings are not dominant components of coal seams generally. Accordingly, the probability of any negative impact on the palaeontological heritage of the Vryheid Formation to be open cast mined is **moderate** and that of the area mined by underground mining is **low**, but remains a possibility.

The fact that the entire extent of the project area appears to be utilised for agricultural cultivation (i.e., ploughing) suggests the presence of an aerially extensive regolith cover. The depth of the regolith is not determined, herein, but its presence suggests that the built structures and infrastructure features (such as spoils piles) that do not require deep disturbance of the land surface will have a low probability of impacting on the palaeontological heritage contained within the underlying Vryheid Formation. There is no data available pertaining to the nature of the regolith cover (i.e., whether it is composed of soils or is fluvial in origin) and, thus, their fossiliferous potential cannot be ascertained. However, it is evident in Figure 3 that the area has been extensively ploughed. It must follow that should any fossil materials have been originally present within the regolith and near surface these would have been destroyed, damaged or moved during the ploughing. There is no evidence of any potentially fossiliferous fluvial terraces being present within the area. The probability of any negative impact to the palaeontological heritage of the area contained within the regolith cover posed by the development is characterised as **low**.

## 9.5 Significance of the impact

The Vryheid Formation is renowned for the presence of plant macrofossils of the *Glossopteris* Flora. The *Glossopteris* Flora is an extremely scientifically significant fossil plant assemblage that documents the dominant flora of Gondwana during the Permian Period. There is a significant possibility of new and scientifically significant fossils being contained within any fossil accumulation and the negative impact resulting from the destruction, damage or loss of provenance by accidental movement would be of **high significance**. The trace fossil assemblages observable within the formation are not taxonomically diverse, but they are scientifically important for unravelling the

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depositional history of the formation and, as such, they are also of **high** scientific significance. When the significance of the fossils are taken in conjuncture with the probability of fossils being impacted and the direct impacts the mining is expected to have on the formation the significance of any negative impact on the palaeontological heritage of this formation is assessed as **high** within the areas to be open cast mined and **low** within the remainder of the project area.

The scientific and cultural significance of fossil materials is underscored by the fact that many fossil taxa are known from only a single fossil and, thus, any fossil material is potentially highly significant. Accordingly, the loss or damage to any single fossil can be potentially significant to the understanding of the fossil heritage of South Africa and to the understanding of the evolution of life on Earth in general. Where fossil material is present and will be directly affected by the building or construction of project infrastructural elements the result will potentially be the irreversible damage or destruction of the fossil(s).

The certainty of the exact *in situ* location of fossils and their precise location within the stratigraphic sequence is essential to the scientific value of fossils. The movement of any fossil material during the construction of the facility that results in the exact original location of the fossil becoming unknown will either greatly diminish or destroy the scientific value of the fossil.

**When the significance of the fossils are taken in conjuncture with the probability of fossils being impacted and the direct impacts the mining is expected to have on the formation, the significance of any negative impact on the palaeontological heritage of this formation is assessed as high within the areas to be open cast mined and low within the remainder of the project area.**

## **9.6 Severity / Benefit scale**

The proposed project is categorised, herein, as being potentially **beneficial**. This classification is based on the intention that the project will provide a benefit to the community either in terms of the provision of materials for provision of electricity to the stressed South African power grid or by provision of employment and export income for the country.

Many fossil taxa are known from only a single fossil and, thus, any fossil material is potentially highly significant. The Vryheid Formation does contain scientifically important and unique fossils; it is, therefore, possible that there are fossils of the highest scientific and cultural significance present within the sediments underlying the project area. The loss or damage to any single fossil or fossil locality can be potentially significant to the

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understanding of the fossil heritage of South. Thus, **although the likelihood of any disturbance of palaeontological materials is low to moderate, the severity of any impact is potentially high. The possibility of any negative impact on the palaeontological heritage of the area can, however, be minimised by the implementation of adequate damage mitigation procedures.** If appropriate damage mitigation is properly undertaken the benefit/severity scale for the project will lie within the beneficial category.

A potential secondary benefit of the project would be that the excavations resulting from the progress of the project may uncover fossils materials that were hidden beneath the surface exposures and, as such, would have remained unknown to science. If the planned excavations are inspected, while they are occurring, with a view to identifying any possible palaeontological materials present the possibility would be generated of being able to study and excavate fossil materials that would otherwise be hidden to scientific study.

## **9.7 Status**

Given the combination of factors discussed above, it is anticipated that as long as adequate mitigation processes are emplaced prior to commencement of the construction phase little to no negative effect on the palaeontological heritage of the area is anticipated. The proposed project would either supply raw materials for power generation and employment opportunities or provide valuable export income for the country; the project is determined as having a **positive status** herein.

## **10. DAMAGE MITIGATION, REVERSAL AND POTENTIAL IRREVERSABLE LOSS**

The degree to which the possible negative effects of the proposed project can be mitigated, reversed or will result in irreversible loss of the palaeontological heritage can be determined as discussed below.

### **10.1 Mitigation**

A thorough field investigation by a palaeontologist as part of a Full Palaeontological Heritage Impact Assessment of the site prior to the commencement of construction and mining would allow a meaningful evaluation of the presence of potentially fossil-bearing strata within the project area. A report should be compiled and submitted to SAHRA for their consideration. If fossil materials prove to be present the process would allow the determination of the significance of any such fossils. Should scientifically or culturally significant fossil material exist within the project area any negative impact upon the palaeontological heritage of the area could be mitigated by the excavation of the fossils (under permit from SAHRA) by a palaeontologist. The resultant fossils should then be

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lodged with an appropriately permitted institution. In the event that an excavation is impossible or inappropriate the fossil or fossil locality could be protected and the site of any planned construction moved to an alternative location.

It is also recommended that a close examination of all excavations be made during the construction and open cast mining phases while they are occurring. Should any fossil materials be identified, the excavations should be halted and SAHRA informed of the discovery. A significant potential benefit of the examination of the excavations associated with the construction of the project is that currently unobservable fossils may be uncovered. As long as the construction process is closely monitored it is possible that potentially significant fossil material may become available for scientific study.

As the probability of a negative impact on the fossil heritage of the area is high in the open cast mine (and low elsewhere) it is also suggested that regular inspections be made of the open pit exposures by a palaeontologist during the life of those mining operations. Should any fossil materials be identified by the palaeontologist, the significance of the fossil materials should be evaluated and appropriate damage mitigation processes put into place.

## **10.2 Reversal of damage**

Any damage to, or the destruction of, palaeontological materials or reduction of scientific value due to a loss of the original location is **irreversible**.

## **10.3 Degree of irreversible loss**

Once a fossil is damaged, destroyed or moved from its original position without its geographical position and stratigraphic location being recorded the **damage is irreversible**.

Fossils are usually scarce and sporadic in their occurrence and the chances of negatively impacting on a fossil in any particular area have been assessed herein as **low in general, but moderate within the area to be open cut mined**. However, any fossil material that may be contained within the strata underlying the project area is potentially of the **high scientific and cultural importance**. Thus, the potential always exists during construction and excavation within potentially fossiliferous rocks for the permanent and irreversible loss of extremely significant or irreplaceable fossil material. This said, many fossils are incomplete in their state of preservation or are examples of relatively common taxa. As such, just because a fossil is present it is not necessarily of great scientific value. Accordingly, not all fossils are necessarily culturally or scientifically significant and the potential degree of irreversible loss will vary from case to



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case. The judgement on the significance of the fossil must be made by an experienced palaeontologist.

## **11. ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE**

The information provided within this report was derived from a desktop study of available maps and scientific literature; no direct observation was made of the area as result of a site visit.

## **12. ENVIRONMENTAL IMPACT STATEMENT**

A Phase 1 Heritage Impact Assessment Report study has previously been conducted on the site of this application for a Mining Right in respect of coal and the report submitted to SAHRA by Cabanga Resources CC. This desktop study is in fulfilment of a request by SAHRA for a desktop palaeontological assessment report to be prepared and submitted to them in addition to the original Phase 1 report.

The site that forms the basis of this report is large (approximately 509 ha) in size. It is probable that a large proportion of the areal extent that will be affected by the proposed project will be directly affected by the mining activities as well as the infrastructural elements (e.g., offices, a processing plant and both top soil and rock spoils piles). However, as the potential heritage impacts are wholly restricted to the reporting area the extent of any impact is characterised as local.

The effects of the mining operation's disruption to geological strata will be predominantly restricted to the Vryheid Formation, with only minor superficial disruption of the possible regolith cover to be expected. The effects of the proposed mining on the palaeontological heritage of the area are different depending on the mining technique being utilised. The underground mining process is focused on the extraction of the coal seams with minimal disruption of the clastic sediments over and underlying each coal seam. The coal will be expected to be unfossiliferous, but any clastic, sedimentary partings contained within the coals may be richly fossiliferous. In the areas to be mined via open cast methods the entire rock sequence will be disrupted and removed from the surface to the base of the deepest coal seam to be utilised. Thus, in the open pit areas all fossil materials contained within the affected rocks will be potentially negatively impacted upon.

Any fossil materials that remain undiscovered beneath infrastructure elements after the construction of the project will only be negatively affected in so far as they will be unavailable for scientific study for the life expectancy of the infrastructural elements that comprise the project.

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This study has identified that the Vryheid Formation is fossiliferous elsewhere in the Main Karoo Basin and, as such, fossils are potentially present and may be negatively impacted. There is a potential for negative impact on the palaeontological heritage of the project area throughout the majority of its extent, but the potential risk is categorised as moderate within the open cast mining area and low in all other areas of the proposed project.

The fossils that may be anticipated to be present within the Vryheid Formation within the project area are potentially highly significant to the cultural and scientific heritage of South Africa. As such, the risk of a negative impact is low to moderate, but the significance of any negative impact on the fossil assemblages could potentially be high in the open cast mining area and low in all other areas. Any damage that occurs to such fossil material during the excavation and construction phase of the project would be permanent and irreversible.

The potential negative impact to the palaeontological heritage of the area can be minimised by the implementation of appropriate mitigation processes. A thorough site investigation of the outcrops of the area prior to commencement of the project by a palaeontologist (as part of a Full Palaeontological Heritage Impact Assessment study) would make it possible that scientifically and/or culturally significant fossils present within the area may be discovered that would otherwise be damaged, destroyed or inadvertently moved. A secondary advantage of such an investigation would be that any fossil materials located could prove to have a positive effect on the understanding of the fossil record of South Africa and positively affect the palaeontological heritage of the country. As the probability of a negative impact on the fossil heritage of the area is high in the open cast mine (and low elsewhere) it is also suggested that regular inspections be made of the open pit exposures by a palaeontologist during the life of those mining operations. Should any fossil materials be identified by the palaeontologist, the significance of the fossil materials should be evaluated and appropriate damage mitigation processes put into place.

The social benefits of the project have been classified as beneficial, herein, as the project aims to provide, in addition to employment opportunities, either the raw materials for power generation or the generation of export income for the country. As such **this desktop study has not identified any palaeontological reason to prejudice the progression of this project, subject to adequate mitigation programs being put in place.**

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8<sup>th</sup> October 2013