

ANNEXURE I:

DESKTOP PALAEOONTOLOGICAL IMPACT ASSESSMENT:



**DESKTOP PALAEOLOGICAL
HERITAGE IMPACT ASSESSEMENT
REPORT ON THE SITE OF THE
VIERFONTEIN COAL MINE
LOCATED ON PORTION 44 AND
THE REMAINING EXTENT OF
PORTION 31 THE FARM
VIERFONTEIN 61 IS,
MPUMALANGA PROVINCE**

8 October 2013

Prepared for:
Cabanga Concepts CC

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**DESKTOP PALAEOLOGICAL HERITAGE IMPACT ASSESSEMENT REPORT ON
THE SITE OF THE VIERFONTEIN COAL MINE LOCATED ON PORTION 44 AND THE
REMAINING EXTENT OF PORTION 31 THE FARM VIERFONTEIN 61 IS,
MPUMALANGA PROVINCE**

Prepared for:

Cabanga Concepts CC

On Behalf of:

Idwala Coal (Pty) Ltd

Prepared By:

Dr B.D. Millstead

Palaeontological Impact Assessment Report – Proposed Idwala Coal (Pty) Ltd's Vierfontein coal mine within Portion 44 and the Remaining Extent of Portion 31 of the farm Vierfontein 61 IS, Mpumalanga Province.

EXECUTIVE SUMMARY

Idwala Coal (Pty) Ltd wishes to amend aspects of a Mining Right they hold in respect of coal. The site of the mine lies approximately 15 km northwest of Kriel and 16 km south-east of Ogies, in the Emalahleni Magisterial District, Kriel Local Municipality, Mpumalanga Province. The application area lies wholly within Portion 44 and the Remaining Extent of Portion 31 of the farm Vierfontein 61 IS. The application area occupies an aerial extent of approximately 154 ha.

Cabanga Concepts CC was contracted by Idwala Coal (Pty) Ltd to compile an Environmental Management Program (EMP) in support of a NEMA Section 24(g) application for rectification and continuation of certain listed activities associated with the mining on the farm Vierfontein 61 IS, as well as a Section 102 EMP amendment in terms of the Mineral and Petroleum Resources Development Act (MPRDA). 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.

The project area is almost completely underlain by sediments of the Vryheid Formation, but the south-western corner and entire southern margin of the area are underlain by igneous rocks of the Labowa Granite Suite. Inspection of satellite imagery suggests that the northern (underlying the proposed open cut mine) and the north-eastern corner (underlying a river line) may bear a cover of regolith. The mining operations will primarily be confined to Vryheid Formation, but there may be disruption to any regolith cover in the affected area as well.

The future open cast pit will be confined to the northern portions of the project area. The central and southern portions have previously been mined via open cast methods. Mining related infrastructure already exists on site within the north-eastern corner of the property, and this infrastructure will continue to be utilised for the future open cast pit. Infrastructure on site includes:

- Access road is in place.
- Electrical supply – (Eskom).
- Mining pit and access ramp.
- Topsoil and subsoil stockpiles.
- Water management facilities.
- Temporary mine office.

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- Diesel tank.

New infrastructure elements that will need to be produced include top soil and waste rock stockpiles as well as screening and crushing plants. These new infrastructure elements are planned to be located within the area of the existing open cast pit located in the central and southern portions of the project area.

The Vryheid Formation is fossiliferous elsewhere in the Karoo Basin (containing both plant macrofossils and trace fossil assemblages) and the fossils are potentially scientifically significant. As such, any negative impact resulting from the proposed mining activities upon the fossils contained within the formation would be potentially highly significant. The probability of any negative impact on the Vryheid Formation is characterised as moderate in the area of the open cast mine pit, nil in the historically mined area and low everywhere else in the project area. Interpretation of satellite imagery suggests that the northern and north-eastern corners of the project area may be covered by regolith. The type and thickness of the regolith are unknown and, so is its palaeontological potential. The possibility of a negative impact on the palaeontological heritage within the regolith is also considered as low, regardless of the fossil content, in the area to be open cast mined due to the extensive ploughing of the land surface. The possibility of a negative impact on the palaeontological heritage of any regolith occurring within the environs of a tributary of the Oliphants River is nil, as the western extent was historically mined through and no future mining or infrastructure elements are planned to occur in the eastern portions of the project area. A historically mined area occupying the majority of the central and southern portions of the project area will have been extensively disturbed during the mining process and the potential for a negative impact on the palaeontological heritage within this region is determined as being nil.

The project has been assessed as being socially beneficial, herein, as it would provide continued 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 (as part of a Full Palaeontological Heritage Impact Assessment study) by a palaeontologist prior to commencement of the project. The palaeontological investigation should be carried out on the area to be open cast mined in the future. 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 performed in areas outside of the historically mined area as they are being made. 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

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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 be made 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

Idwala Coal (Pty) Ltd has been granted a Mining Right in respect of coal. The site of the proposed mine lies approximately 15 km northwest of Kriel and 16 km south east of Ogies, Emalahleni Magisterial District, Kriel Local Municipality, Mpumalanga Province. The application area lies wholly within Portion 44 and the Remaining Extent of Portion 31 of the farm Vierfontein 61 IS. The application area occupies an aerial extent of approximately 154 ha.

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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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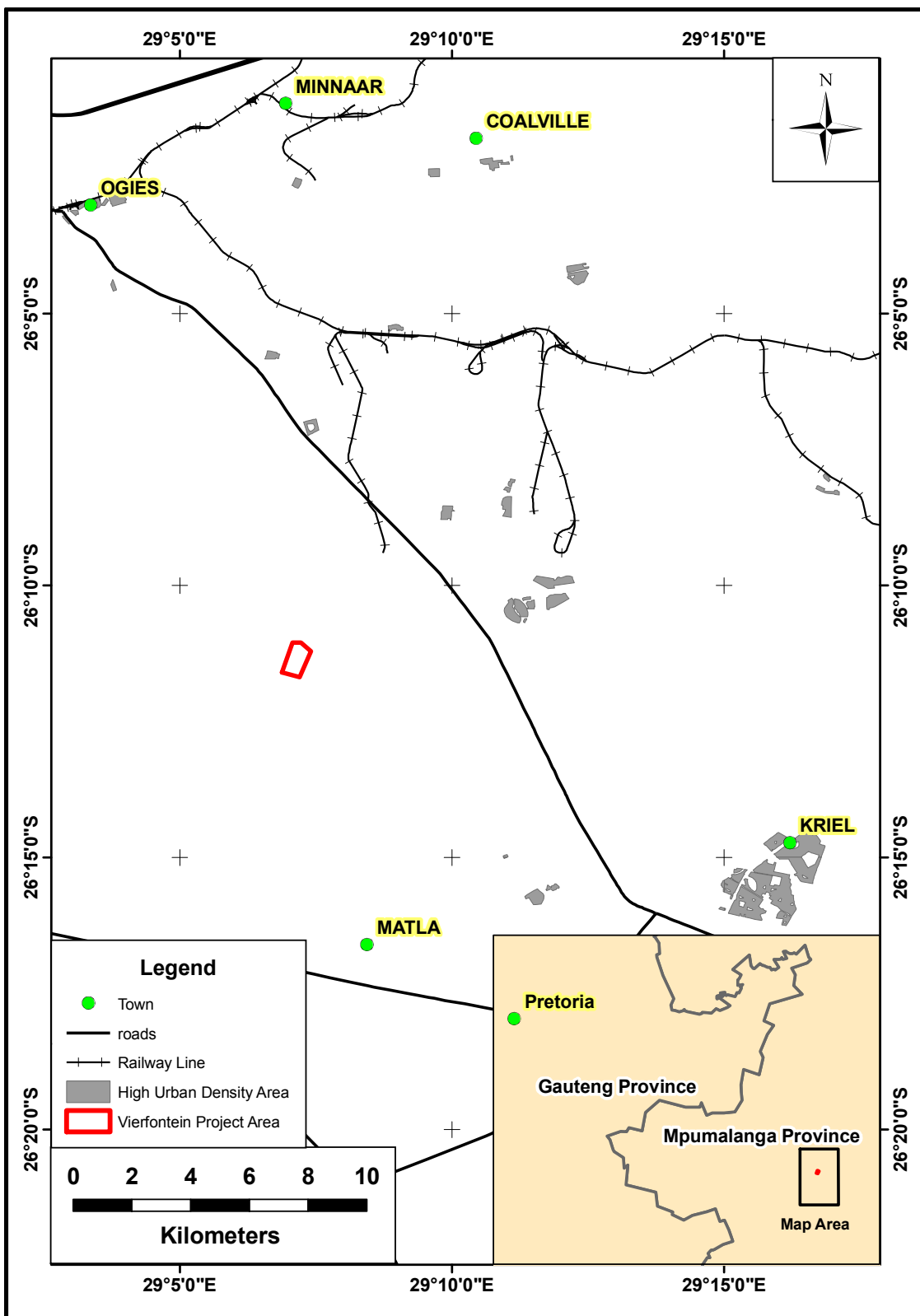


Figure 1: Location map showing the position of the Vierfontein Colliery.

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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 m² or involve three or more existing erven or subdivisions thereof,
- Re-zoning of a site exceeding 10 000 m²,
- 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 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 Idwala Coal (Pty) Ltd, Cabanga Concepts CC or the proposed mining operations.

6 GEOLOGY AND FOSSIL POTENTIAL

Figure 2 shows that the project area is predominantly underlain by Early Permian strata of the Vryheid Formation. The south-eastern corner and southern margin of the project area is underlain by Vaalian (2,500 to 2050 Ma) rocks of the Lebowa Granite Suite. A summary of the characteristics of the Vryheid Formation and Lebowa granite Suite and their fossiliferous potential follows.

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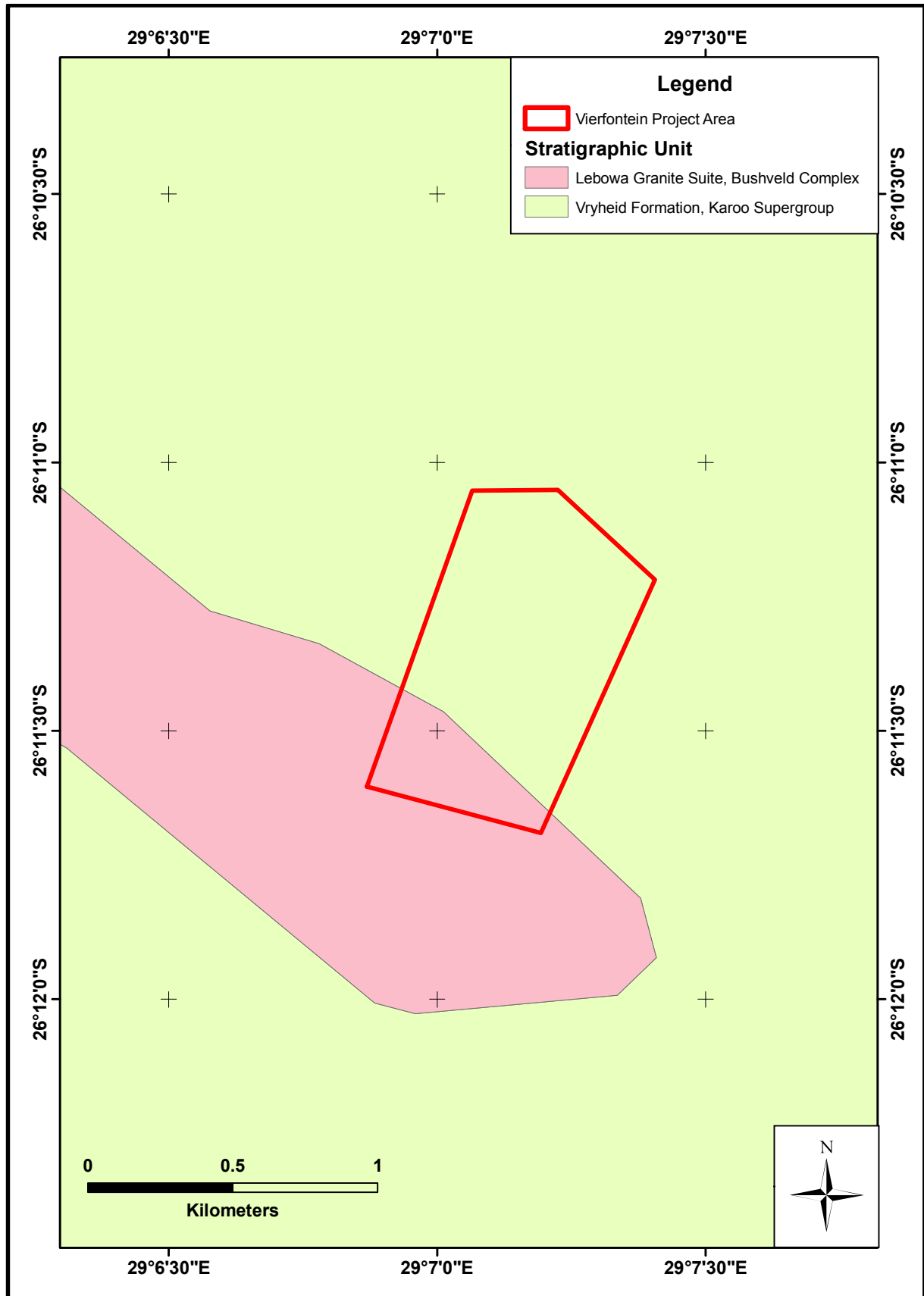


Figure 2: Map of the geology underlying the project area.

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6.1 Lebowa Granite Suite

6.1.1 Geology

The Lebowa Granite Suite is part of the more extensive Bushveld Igneous Complex. The stratigraphic unit is composed of the Makhutso, Nebo and Steelpoortpark Granites that are collectively up to 9 km thick. These granites represent a series of sheeted intrusions that were emplaced between 2057 and 2053 Ma. Compositionally, the granites of the Lebowa Granite Suite are predominantly alkali feldspar granites with iron-rich ferromagnesian minerals and silica contents that generally fall in the range 71-77% SiO₂.

6.1.2 Paleontological Potential

The rocks of the Lebowa Granite Suite are wholly composed of coarse grained igneous intrusive rocks that were emplaced as magma and crystallised at great depth below the Earth's surface. Accordingly, the granites of this lithological unit have nil palaeontological potential.

6.2 Vryheid Formation

6.2.1 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^o. 1-5 seams) and collectively their aerial extents constitute the Witbank Coalfield.

6.2.2 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.

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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 area subject to this report is approximately 154 ha in extent. Examination of Google Earth imagery of the wider reporting area (Figure 3) suggests that the majority of the land surface of the project area is currently the site of an existing coal mine. The existing mine infrastructure elements are present in the north-eastern corner of the project area. The northern-most portion of the area (north of an existing road) is utilised for agriculture and appears to be extensively ploughed. The north-eastern margin of the area appears to be a depression extensively vegetated with grassland.

Examination of the spacing between topographic contour intervals (Figure 4) indicates that the majority of the project area consists of featureless landscape that slopes gently towards the south-east. The grassed topographic depression described above coincides with the location of a fluvial drainage line that runs through the south 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.

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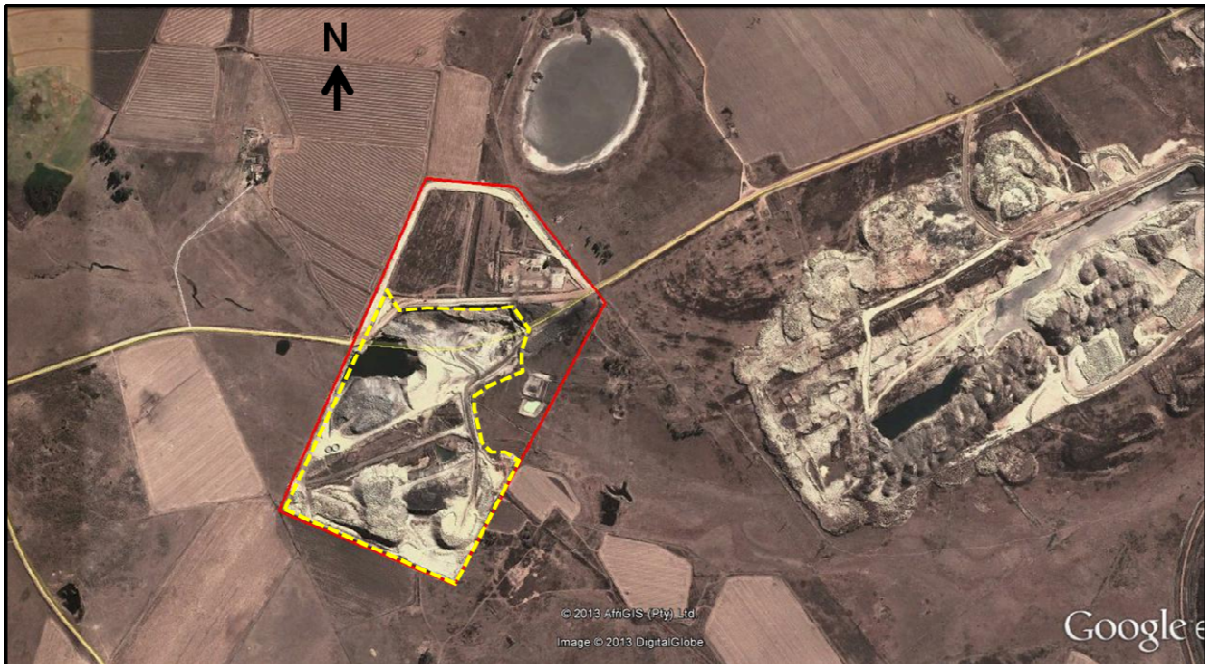


Figure 3: Google Earth image of the project area (the red polygon). It is evident from the image that the area has been extensively utilised for agricultural cultivation (ploughed). An extensively disturbed area is evident in the central and southern portions of the area (yellow stippled polygon) this feature is the historical open cast pit.

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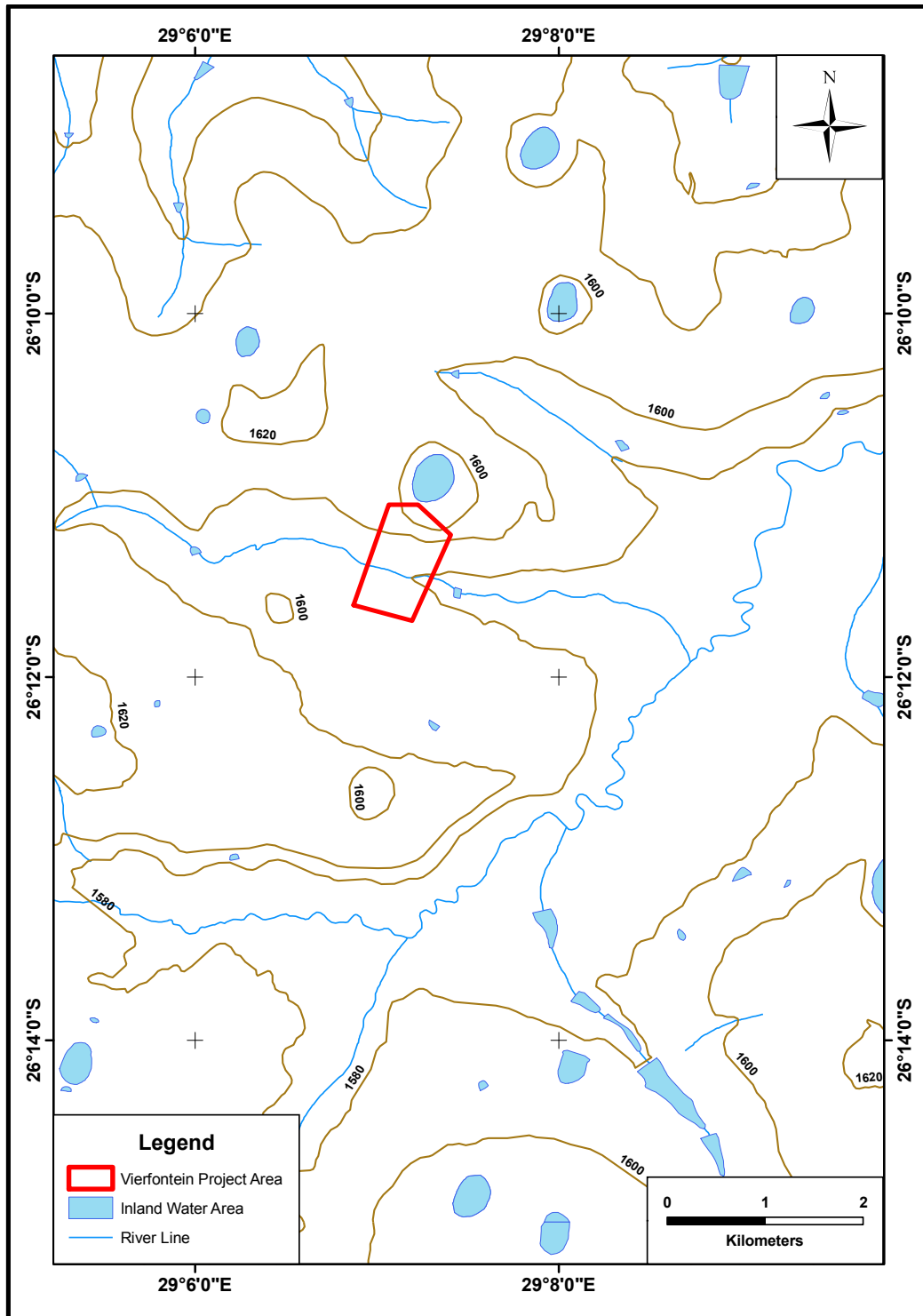


Figure 4: Map of the project area and its immediate environs. The topographic contour interval is 20 m and, as such, it is clear that the region is generally flat, but slopes gently to the south-west away from the foot of Ysterkop. The Oliphants River is coincident with much of the northern boundary of the project area. A small tributary of the Oliphants River drains easterly across the central portion of the area.

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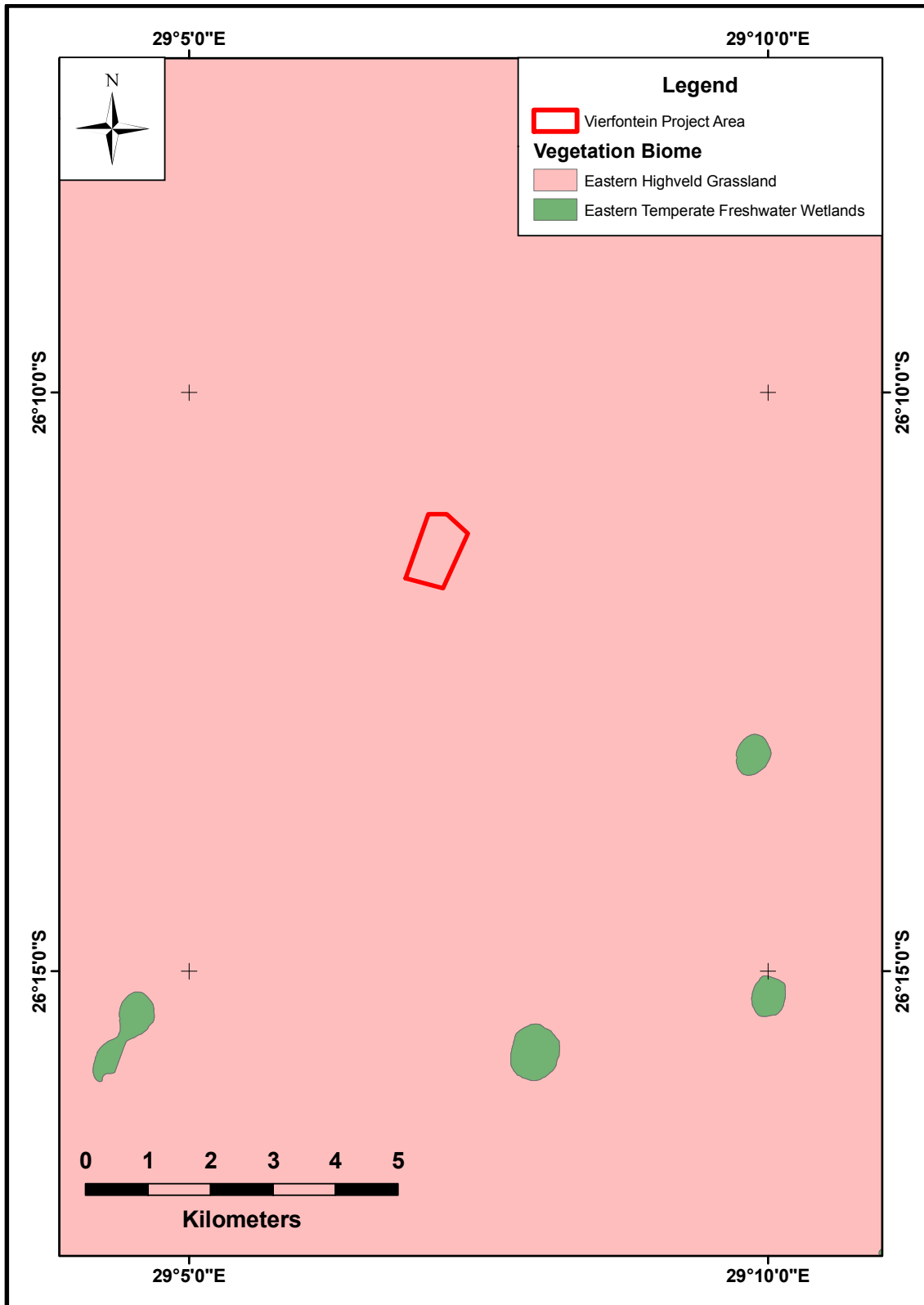


Figure 5: Map of the distribution of the vegetation veld types located within the project area and its immediate environs (after Mucina and Rutherford, 2006).

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8 OVERVIEW OF SCOPE OF THE PROJECT

8.1 Mining Operations

A box-cut will be established along the strike of the coal deposit, adjacent to the highwall of the previously mined open cast pit that occupies the majority of the project area in the centre and south of the project area (Figure 6). The mining process to be implemented is similar to the conventional open cast strip mining method currently used on other collieries in Witbank and Middelburg. The central western and southern portions of the project area are planned to be the site of stockpiles, a crusher and a screener.

8.2 Mine Infrastructure

A list of the existing infrastructure at the colliery includes:

- Access road is in place.
- Electrical supply – (Eskom).
- Mining pit and access ramp.
- Topsoil and subsoil stockpiles.
- Water management facilities.
- Temporary mine office.
- Diesel tank

8.3 Effects of the mining and infrastructure development

In the areas to be mined 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. The open cast 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 development of the open cast pit it is planned that there will be a number of infrastructural elements constructed (a crusher and a screener) as well as a number of soil/waste rock piles. However, these features will be located within the area of the existing open cast pit.

9 IMPACT ASSESSMENT

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

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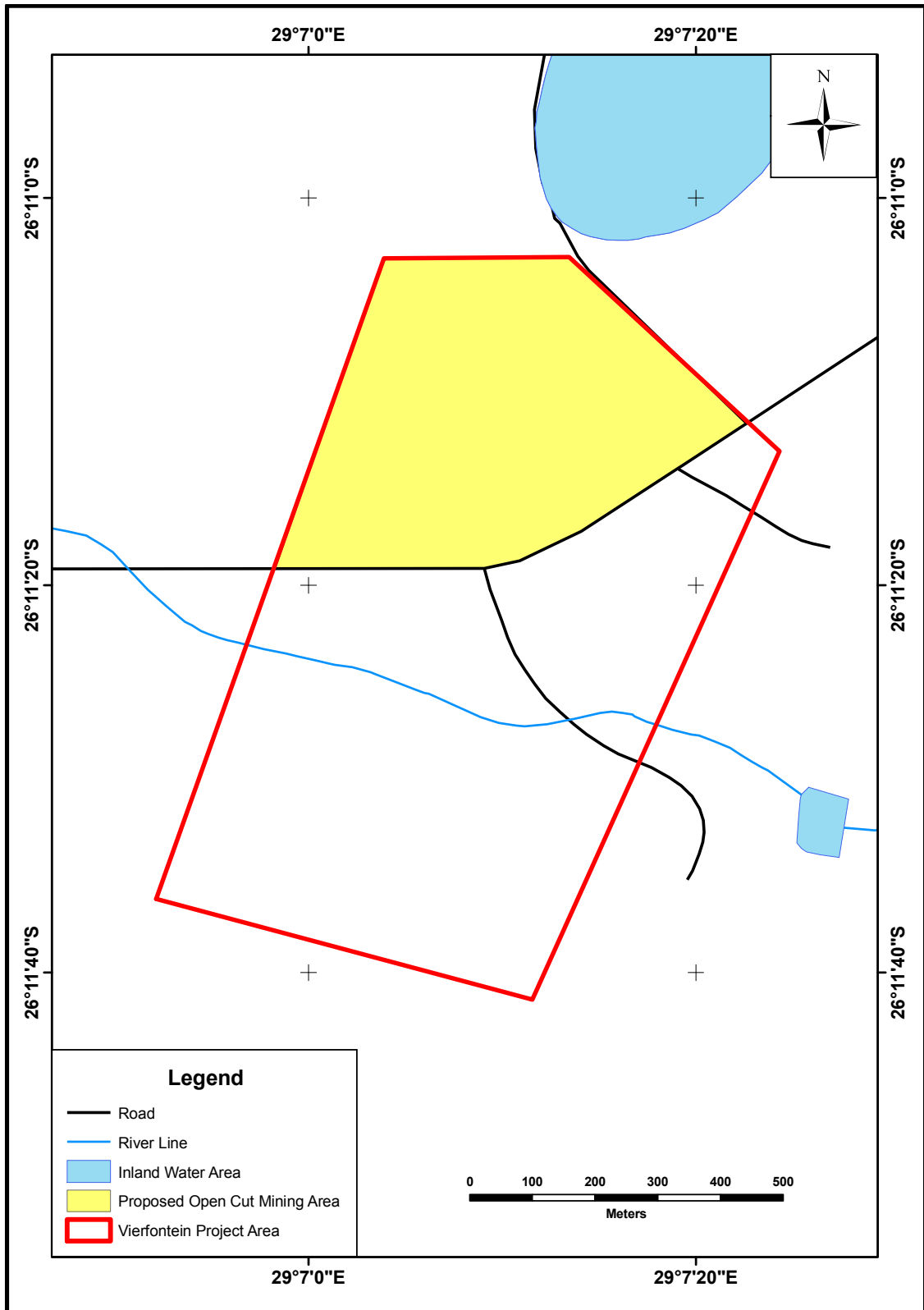


Figure 6: Boundary of the project area showing the location of the area to be open cast mined.

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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 project infrastructural elements to a 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 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

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

In the proposed 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.

The geological strata to the lower limits of the mining operations and any regolith occurring within the area occupied by the existing open cast pit (Figure 3) can be expected to have been historically completely disrupted. Any fossils that may have been present will have been destroyed, damaged or removed due to the mining operations. It is probable that the depths of mining in the proposed open cut will be the same as those in the historical mine, as the same coal seams are involved. No fossil materials of any scientific or cultural value can be expected to be present within this region.

Those areas of the project area that lie beneath the planned open cast pit (Figure 3) as well as the fluvial drainage line in the north-eastern corner (Figure 4) appear to bear a regolith cover based on the presence of ploughed areas and the well grassed nature of the fluvial drainage line. There is no data available pertaining to the nature (i.e., whether it is composed of soils or is fluvial in origin) or thickness of the regolith cover and, thus, their fossiliferous potential cannot be ascertained. It is, however, 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 ploughed regolith and have been located near surface they will have been destroyed, damaged or moved during the ploughing. No new mining or mine infrastructure is planned to be located upon the regolith associated with the fluvial drainage line, and as such, no negative impact can be expected in the region as a result of the mining operations. 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**.

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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 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.

Thus, while the probability of a negative impact on the palaeontological heritage contained within the Vryheid Formation strata underlying the project area is categorised as moderate within the area to be open cast mined and low within the remainder of the project area the significance of any negative impact posed by the project on the palaeontological heritage is categorised as high within the open cast mining areas and low in the remainder of the project area.

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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 employment opportunities as well as materials for the electricity to the stressed South African power grid or by the generation of 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 elsewhere and, as such, it is 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 understanding of the fossil heritage of South. Thus, **although the likelihood of any disturbance of palaeontological materials is moderate in the area to be mined and low elsewhere, 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.

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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 extent of the area to be open cast mined prior to the commencement of construction and the future open cast pit 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 its 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 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 any excavations that are required for the construction of infrastructure. 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 be made 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 it is also suggested that regular inspections be made of the open pit exposures be made 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**.

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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 **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 necessary significant culturally or scientifically significant and the potential degree of irreversible loss will vary from case to 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 in support of a NEMA Section 24(g) application for rectification and continuation of certain listed activities associated with the mining on the project area, as well as a Section 102 EMP amendment in terms of the Mineral and Petroleum Resources Development Act (MPRDA). SAHRA has requested that a desktop Palaeontological Heritage Impact Assessment Report be prepared and submitted to them in support of the earlier Phase 1 Heritage Impact assessment Report; this report is in fulfilment of that request.

The site that forms the basis of this report is large (approximately 154 ha) in size. It is planned that the majority of the areal extent that will be affected by the proposed project. However, the proposed open cast pit will be restricted to a much smaller portion of the area confined to the north of the project area (Figure 5). Much of the of the area occupied by the existing open cast pit will be covered by waste rock and top soil

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stockpiles, with a minor proportion being reserved for a crusher and a screener. As the potential heritage impacts are wholly restricted to the reporting area the extent of any negative impact is characterised as local.

The effects of the mining operations disruption to geological strata will be predominantly restricted to the Vryheid Formation, with only minor superficial disruption of any regolith cover expected. 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 planned open pit areas all fossil materials contained within the affected rocks will be potentially negatively impacted upon.

The area of the existing open pit will probably have been completely disturbed by the mining process and any fossil materials will have been destroyed, damaged or removed. Any disruption of the strata within the historical mine area will not pose any negative impact on the palaeontological heritage of the area.

The new infrastructure elements (i.e., the waste rock and top soil stockpiles, crusher and the screener) will be located within the area of the existing open cast pit. Due to the profound disruption of the Vryheid Formation and its contained fossils by the historical mining it is expected that the potential for a negative impact on the palaeontological heritage here is nil.

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 future open cast pit and low to nil 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 future open cast pit area and low to nil 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 to be open cast mined as well as those areas not contained within the area of the existing open cast pit) prior to commencement of

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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 be otherwise 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 moderate in the open cast mine (but low elsewhere) it is also suggested that regular inspections be made of the open pit exposures be made 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.**

13 REFERENCES

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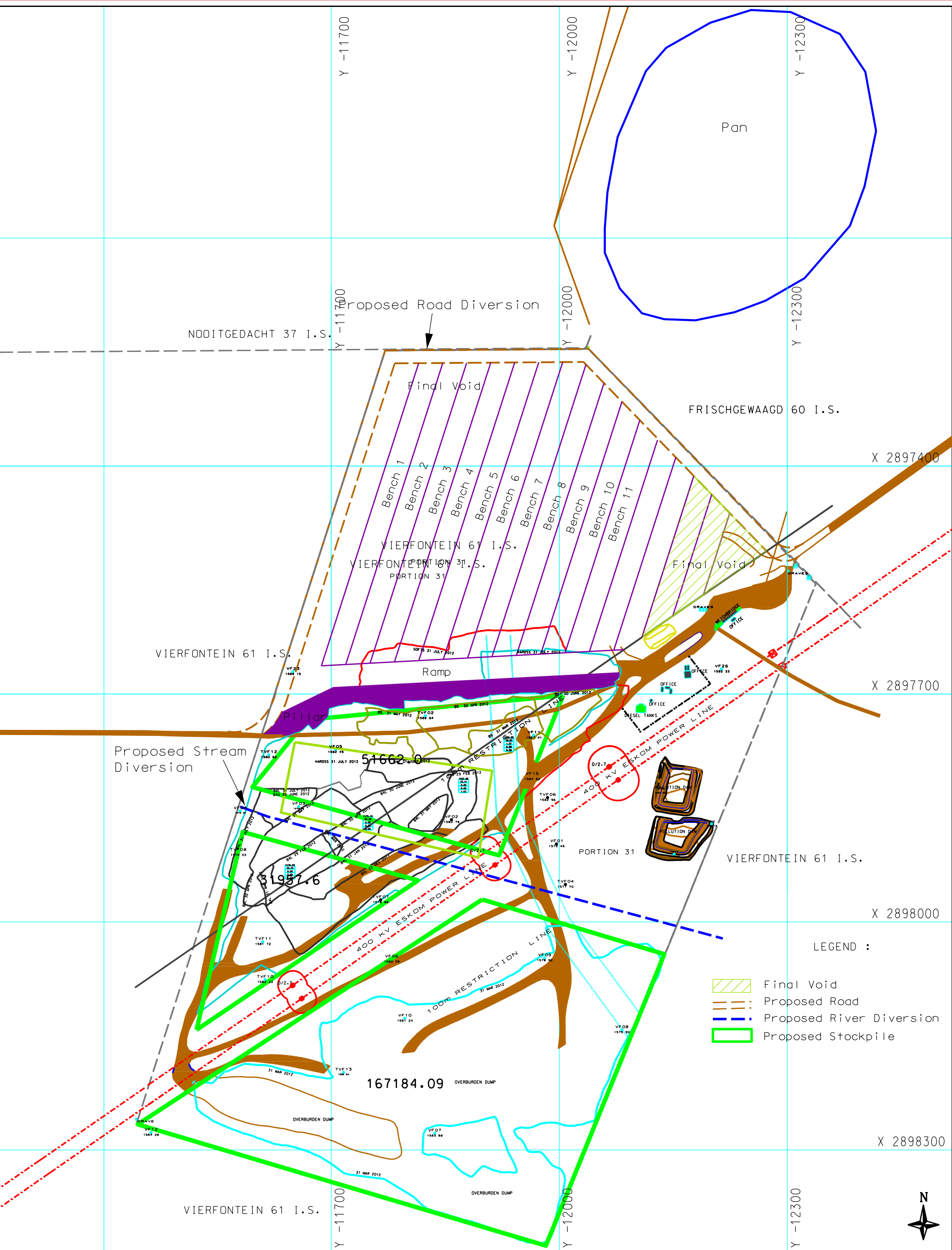
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Dr B.D. Millstead

2nd October 2013

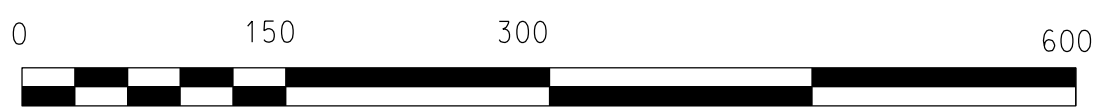
ANNEXURE II:

FINAL MINE PLAN:



LEGEND :

- Final Void
- Proposed Road
- Proposed River Diversion
- Proposed Stockpile



Vierfontein Colliery
 General Surface Plan
 Strip Advance South to North
 March 2013

