

» **DESKTOP PALAEOLOGICAL HERITAGE IMPACT ASSESSEMENT REPORT  
ON THE SITE OF THE PROPOSED TRANSALLOYS (PTY) LTD'S POWER  
STATION TO BE LOCATED WITHIN PORTIONS 25, 26, 33, 34, 35, 36 AND 37  
OF THE FARM ELANDSFONTEIN 309 JS AND PORTIONS 20, 24 AND 38 OF  
THE FARM SCHOONGEZICHT 308 JS, MPUMALANGA PROVINCE**

Prepared for:

Heritage Contract and Archaeological Consulting CC

On Behalf of:

Transalloys (Pty) Ltd

Prepared By:

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Palaeontological Impact Assessment Report –Transalloys (Pty) Ltd’s proposed power station within Portions 25, 26, 33, 34, 35, 36 and 37 of the Farm Elandsfontein 309 JS and Portions 20, 24 and 38 of the Farm Schoongezicht 308 JS, Mpumalanga Province.

## **EXECUTIVE SUMMARY**

Transalloys (Pty) Ltd, a producer of export grade Siliconmanganese, as an energy intensive electricity user, proposes to develop a 150 MW Coal Fired Power Plant adjacent to its smelter complex near Emalahleni, Mpumalanga Province. The site is located approximately 8 km west of Emalahleni, south of the N4 highway and 1 km north of Clewer. The proposed power station is to be located adjacent to the existing Transalloys Complex. Five potential alternative sites, located within or directly adjacent to the Transalloys complex have been identified for the potential siting of the power plant and these sites lay wholly within Portions 25, 26, 33, 34, 35, 36 and 37 of the Farm Elandsfontein 309 JS and Portions 20, 24 and 38 of the Farm Schoongezicht 308 JS, in the Witbank Magisterial District, Emalahleni Local Municipality, Mpumalanga Province. Only one site will ultimately be identified for the construction of the power plant. Within each of these alternative sites it is anticipated that the footprint of the power station will be approximately 10 ha and that of the associated infrastructure is approximately 30 ha (i.e., 40 ha in total).

Transalloys (Pty) Ltd has appointed Savannah Environmental (Pty) Ltd, as independent consultants, to undertake a Scoping and Environmental Impact Assessment to identify and assess all potential environmental impacts associated with the proposed project for the area as identified, and propose appropriate mitigation measures in an Environmental Management Programme (EMP). Savannah Environmental (Pty) Ltd appointed Heritage Contracts and Archaeological Consulting CC to conduct the Heritage Impact Assessment component of the Scoping and Environmental Impact Assessment Studies. Heritage Contracts and Archaeological Consulting 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.

Infrastructure elements planned for the power station consist of:

- Main Plant House for one 150 MW unit;
- Auxiliary plant buildings, including administration building and warehouse
- Other operational support buildings;
- Maintenance workshops and storage facilities including electrical and instrument workshops and stores, and machine shop;
- Laboratory area for both routine testing and specialised analysis and investigation;
- Access roads;
- High voltage yard.

The associated infrastructure elements required include:

- In-plant coal stock yard and storage;
- Lime storage area;

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- 250 meter high stack;
- Overland coal conveyors – from coal discard dumps in the area;
- Water supply pipeline;
- Amenities including potable water, sanitary and sewer utilities;
- Electrical utility interconnection and telephone utilities;
- Sewage treatment plant;
- Access road and internal roads;
- Ash dump;
- Ash dump runoff ponds;
- Water storage reservoir for raw water supply;
- Raw water treatment plant;
- Zero effluent/evaporation ponds;
- Recycling pond.

The project area is completely underlain by Permian sediments of the Vryheid Formation, but it appears that there may also be a widespread regolith cover present. The Vryheid Formation is fossiliferous elsewhere in the Karoo Basin, but the fossiliferous potential of any possible regolith cover 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. However, the plant macrofossils and trace fossil assemblages known to occur within the Vryheid Formation are potentially scientifically significant. The possibility of a negative impact on the palaeontological heritage within the regolith is considered to be low, regardless of any fossil content, due to the extensive ploughing of the land surface and the generally uncommon and sporadic occurrence of fossils in the geological record in general. Any fossils that may occur within the uncultivated regions of the regolith cover may be scientifically significant. The probability of any significant negative impact upon the fossil assemblages contained within these two geological units is local in extent as they will be restricted to the area beneath the planned infrastructure elements.

The project has been assessed as being socially beneficial, herein, as it would provide employment opportunities within the region. 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 Heritage Impact Assessment study) on any of the five sites that remain viable alternatives following the completion of the Scoping Environmental Impact Assessment Phase. 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, thorough examinations 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

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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.

**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**

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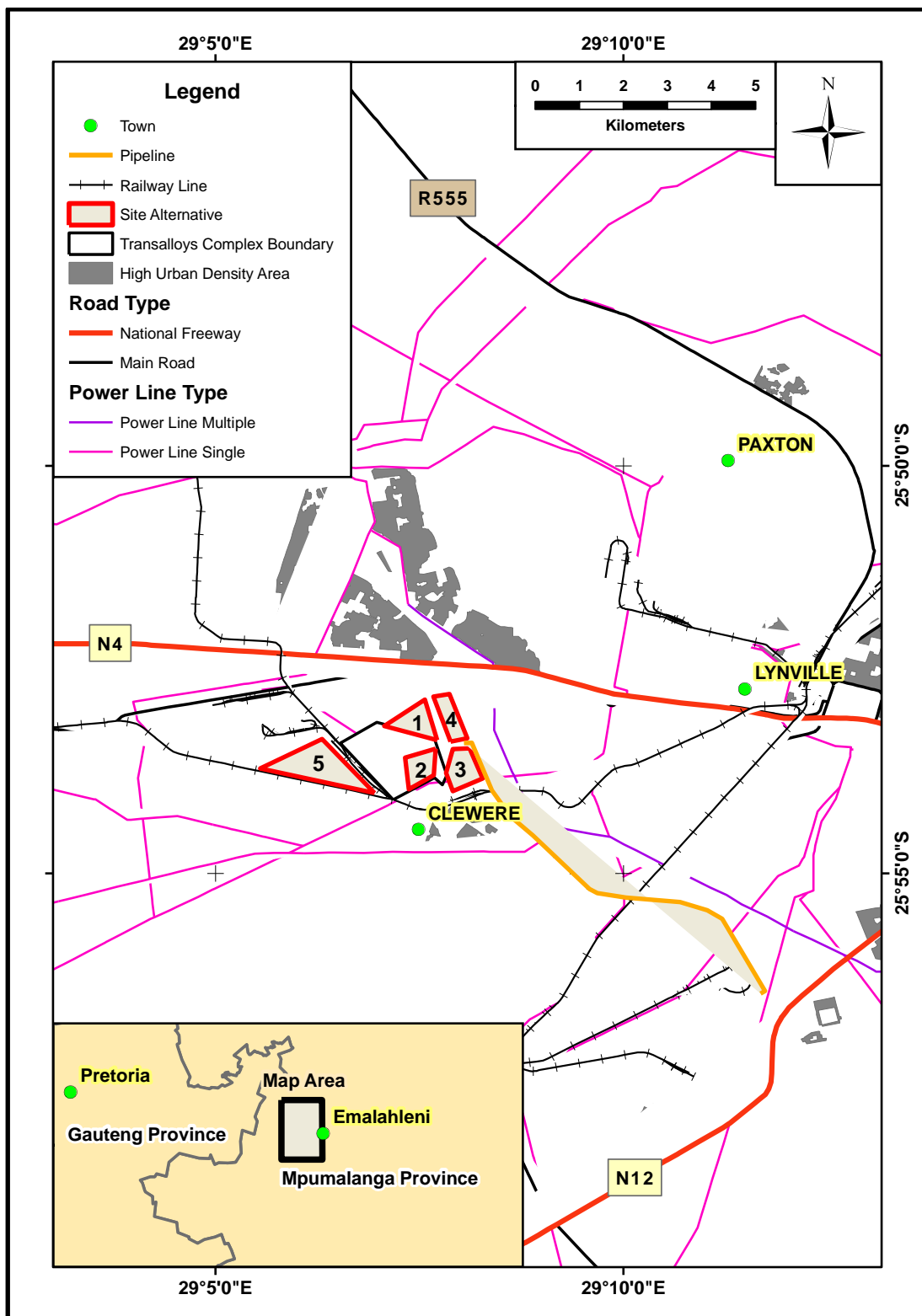
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## **2 TERMS OF REFERENCE AND SCOPE OF THE STUDY**

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.

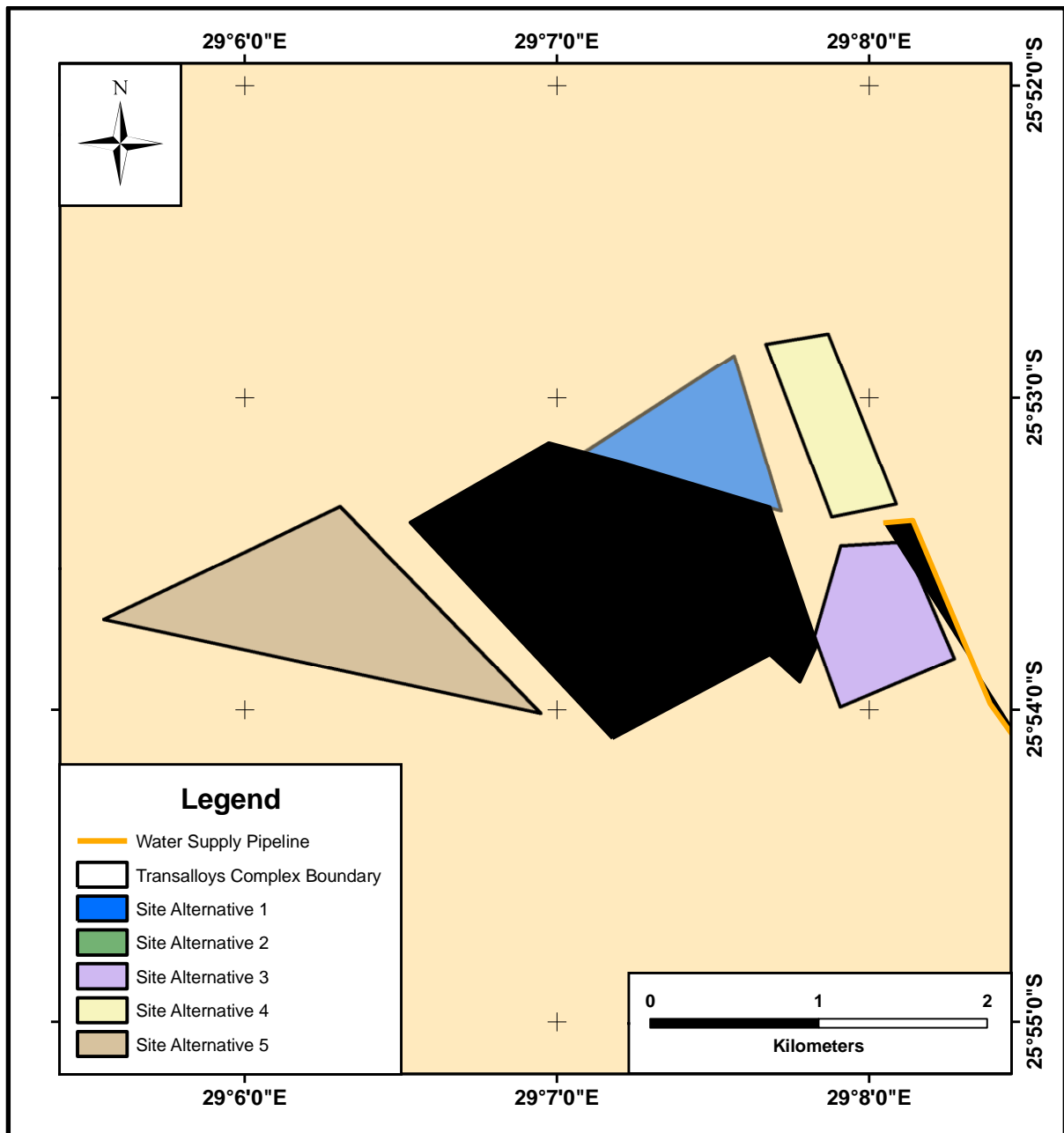
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**Figure 1:** Location map showing the position of the proposed project. The numerical labels within each red polygon coincide with the Site Alternative nomenclature utilised throughout this report.



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**Figure 2:** Close-up view of the location of the five Site Alternative locations for the proposed power station and the water supply pipeline relative to the existing Transalloys (Pty) Ltd’s complex.

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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,
- 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

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- 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.

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

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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.

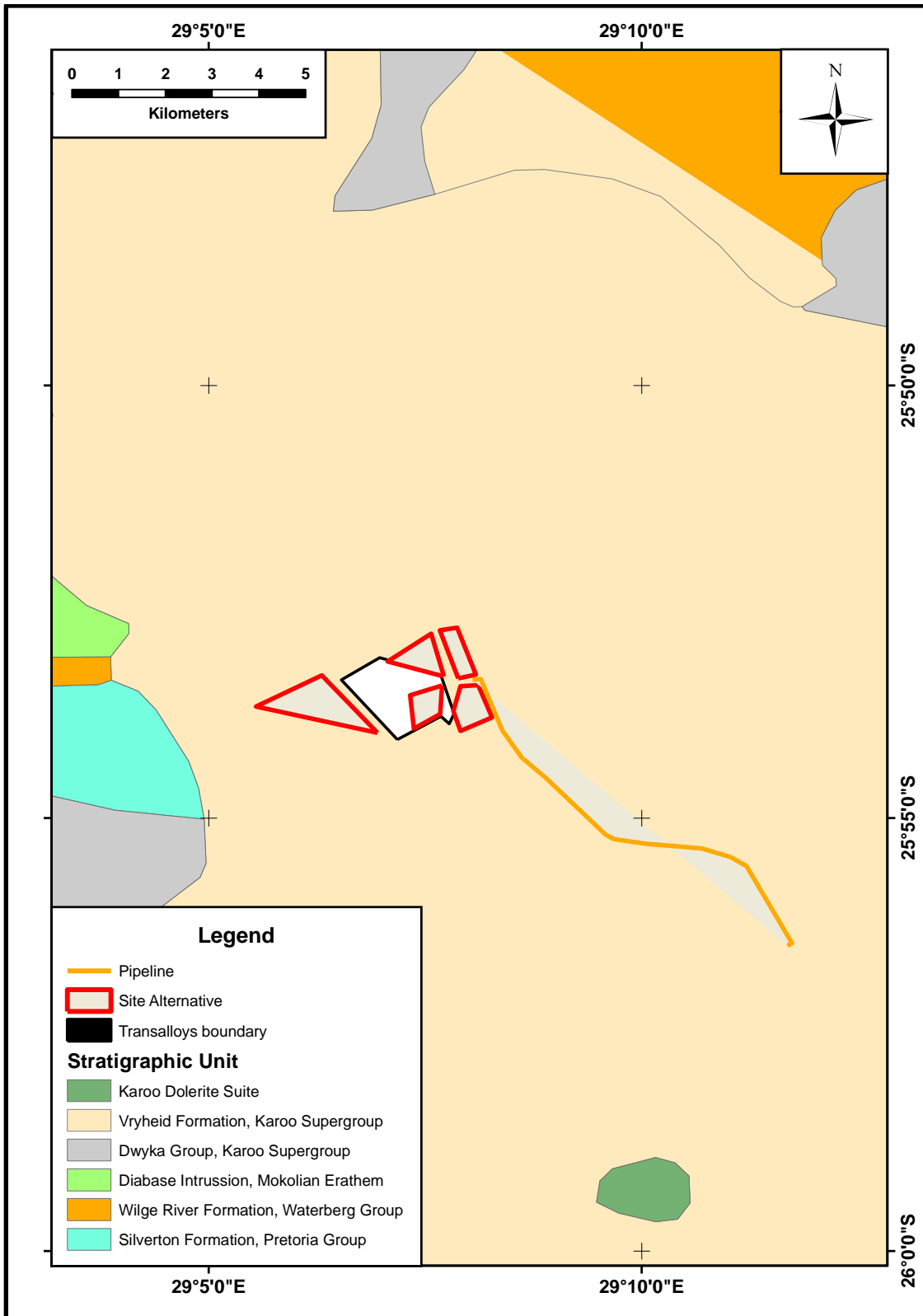
#### **5 INDEPENDENCE**

Dr Millstead was contracted as an independent consultant to conduct this Palaeontological Heritage Impact assessment study and shall receive fair remuneration for these professional services. Neither Dr Millstead nor BM Geological Services has any financial interest in Transalloys (Pty) Ltd or the proposed power station.

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

Figure 3 shows that the project area is predominantly underlain by Early Permian strata of the Vryheid Formation. In addition the Permian bedrock it is inferred that a widespread regolith cover is distributed across the project area. A summary of the characteristics of the Vryheid Formation and the inferred regolith cover and their fossiliferous potentials follows.

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**Figure 3:** Map of the bedrock geology underlying the project area and its immediate environs.

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## 6.1 Vryheid Formation

### 6.1.1 Geology

The entire extent of the project area is underlain by Early Permian strata of the Vryheid Formation, Ecca Group, Karoo Supergroup (Figure 3). The Vryheid Formation is composed of an interbedded series of 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.

### 6.1.1 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.

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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.

## **6.2 Regolith**

### 6.2.1 Geology

It is evident in Figure 4 and 5 that the project area has been extensively agriculturally cultivated (ploughed). It is inferred, therefore, that there may well be a cover of regolith present in the majority of the area (particularly in Site Alternative areas 1, 3, 4, and 5). There is no data to hand pertaining to the nature of the regolith cover (i.e., whether it is composed of soils or is alluvial/colluvial in origin).

### 6.2.2 Palaeontological potential

As the presence of a regolith cover is only inferred there is no data to hand concerning the genesis or age of the unit. The fossiliferous potential of the unit cannot be determined.

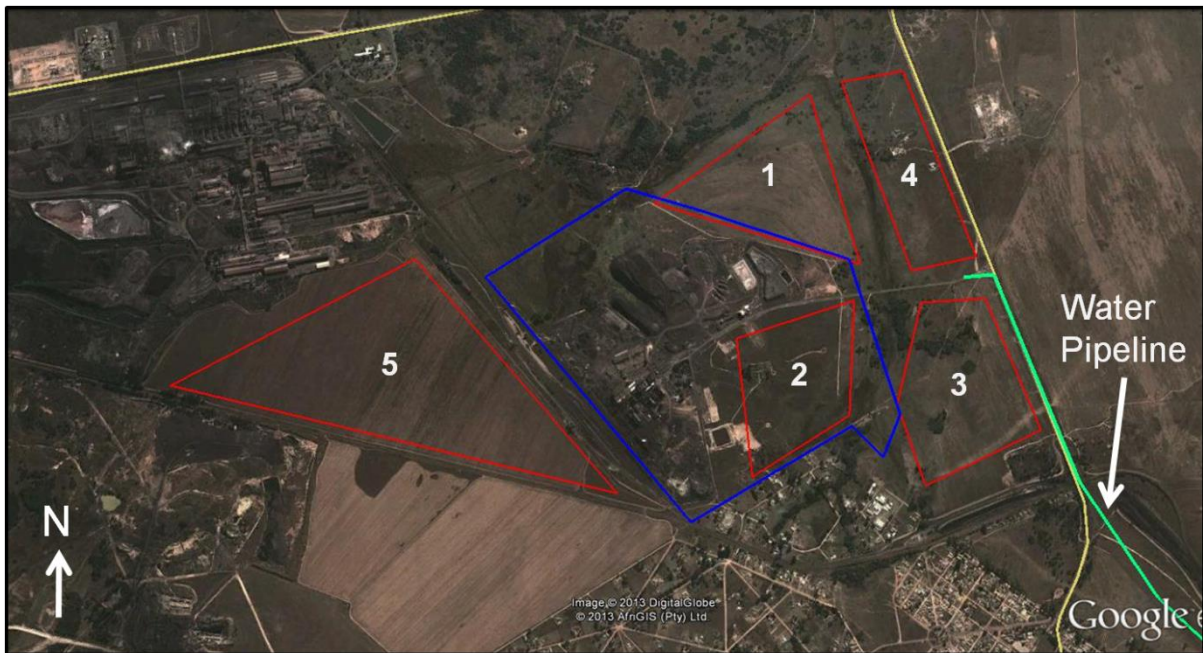
## **7 ENVIRONMENT OF THE PROPOSED PROJECT SITE**

The area of each of the five alternative areas is large and ranges between 37 and 114 ha. Examination of Google Earth imagery of the project area (Figure 4) suggests that the land surface of Site Alternatives 1, 3, 5 and possibly the southern portion of 4 are predominantly utilised for agriculture and appear to be extensively ploughed. Site Alternative 2 and the northern portions of Site 4 appear to be vegetated with grassland, but their utilisation is uncertain.

Examination of the spacing between topographic contour intervals (Figure 5) indicates that the majority of the project area consists of generally featureless landscape. However, Site Alternatives 1-4 are located along the margins of several small ephemeral drainage lines. However, no fluvial drainage lines are located within any of the five sites. Mucina and Rutherford (2006) indicate that the vegetation cover of the project area consists of Eastern Highveld Grassland (Figure 6) and that the conservation status of this vegetation unit is classified as endangered. However, as discussed above, it appears that this original grassland may only be preserved in Site Alternative 2 and possibly in parts of Site Alternative 4.

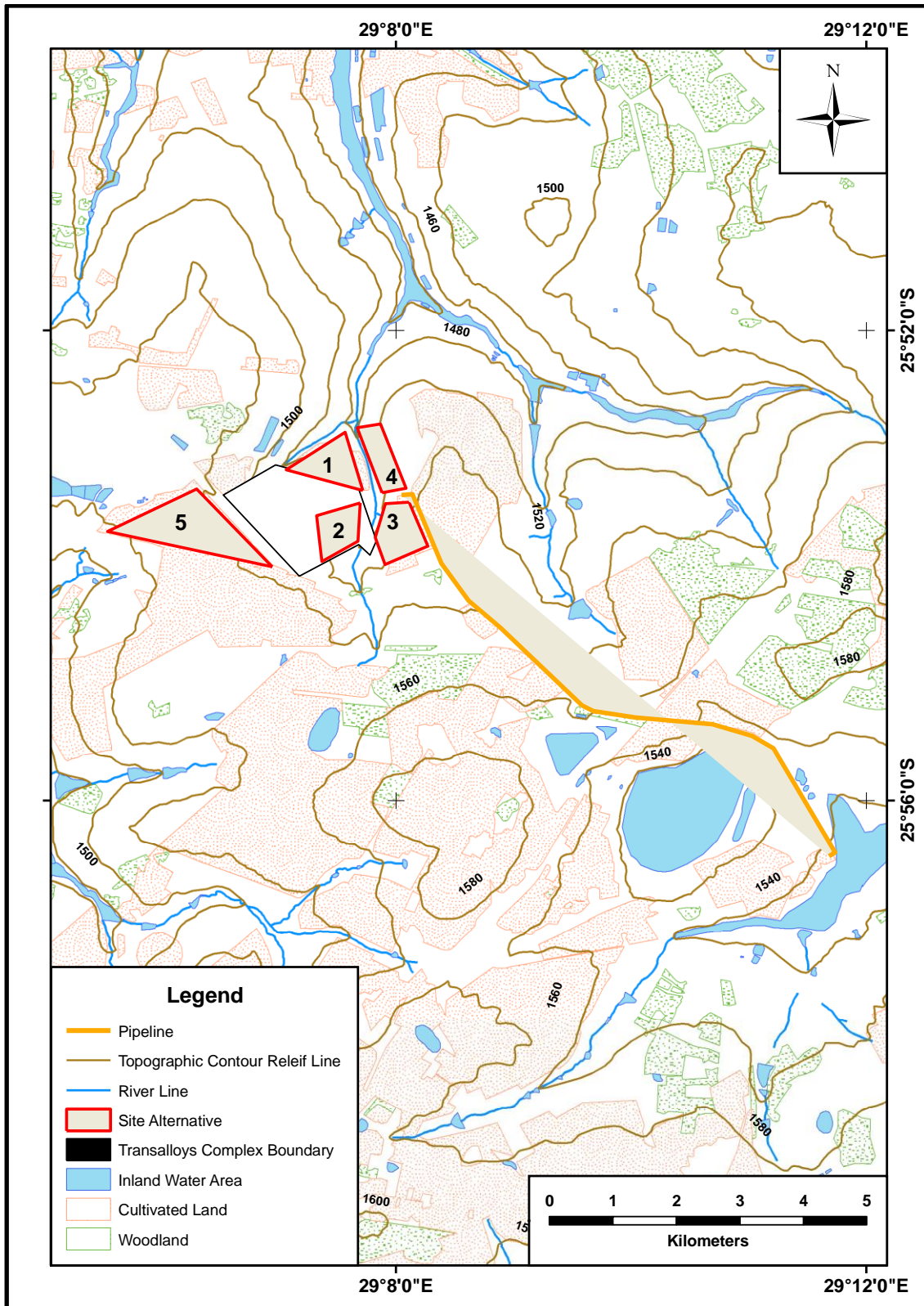


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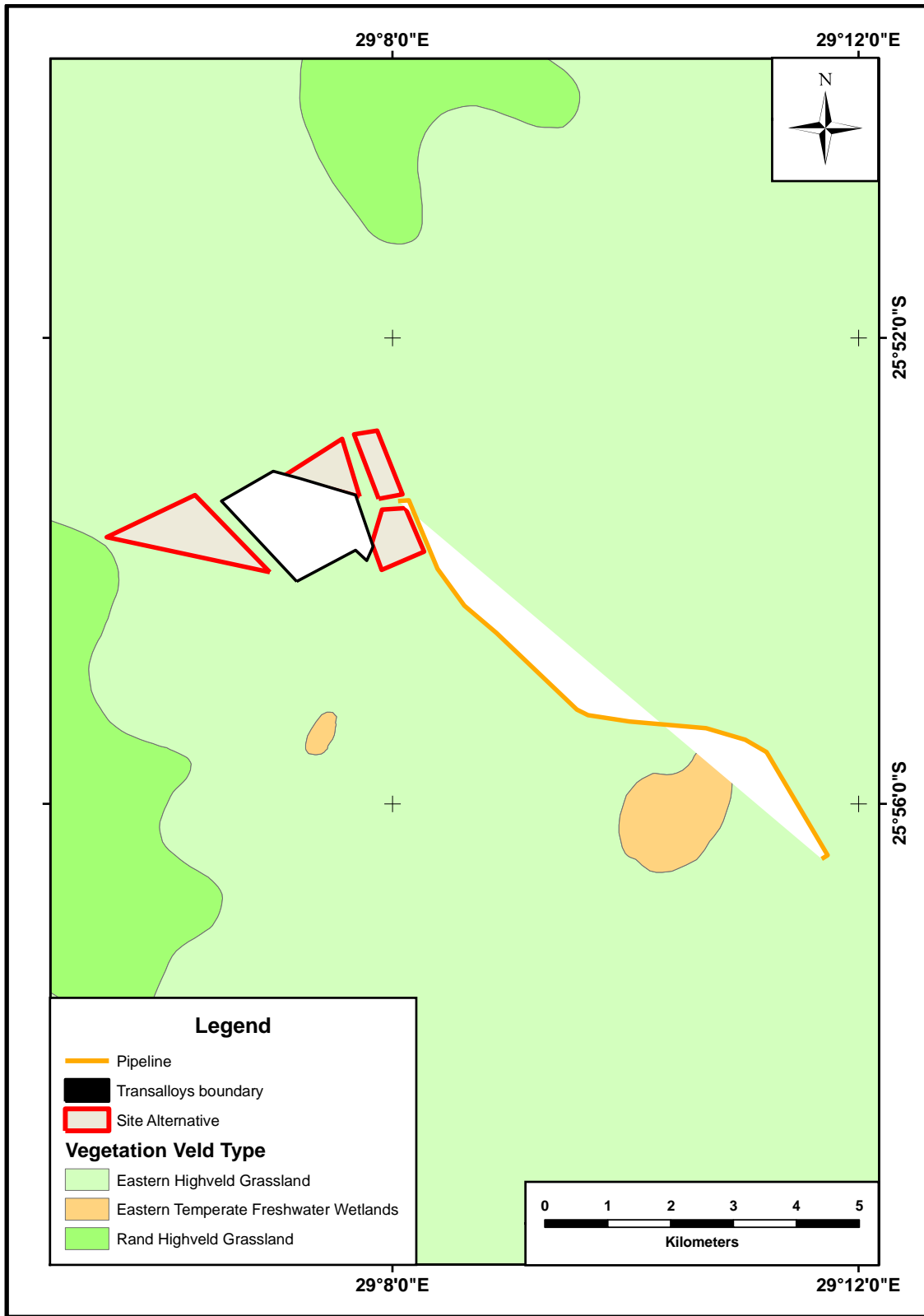
**Figure 4:** Google Earth image of the five power station Site Alternative areas (the numbered red polygons; numbering is as per the area identifications used elsewhere in this report). The boundary of the existing Transalloys (Pty) Ltd’s complex is shown as the blue polygon. It is evident from the image that the area has been extensively utilised for agricultural cultivation (ploughed) with Site Alternatives 1, 3, 5 and possibly 4 being affected. Site Alternative 2 and the northern portion of Alternative Site 4 appear to be vegetated with uncultivated grassland.

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**Figure 5:** 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 and has been extensively agriculturally cultivated (ploughed).

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**Figure 6:** 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 Power Station Infrastructure**

A list of the infrastructure required to comprise the power station is:

- Main Plant House for one 150 MW unit;
- Auxiliary plant buildings, including administration building and warehouse
- Other operational support buildings;
- Maintenance workshops and storage facilities including electrical and instrument workshops and stores, and machine shop;
- Laboratory area for both routine testing and specialised analysis and investigation;
- Access roads;
- High voltage yard.

The aerial footprint of this section of the project is expected to be approximately 10 ha.

### **8.2 Associated Infrastructure**

Non power station related infrastructural elements required to operate the facility includes:

- In-plant coal stock yard and storage;
- Lime storage area;
- 250 meter high stack;
- Overland coal conveyors – from coal discard dumps in the area;
- Water supply pipeline;
- Amenities including potable water, sanitary and sewer utilities;
- Electrical utility interconnection and telephone utilities;
- Sewage treatment plant;
- Access road and internal roads;
- Ash dump;
- Ash dump runoff ponds;
- Water storage reservoir for raw water supply;
- Raw water treatment plant;
- Zero effluent/evaporation ponds;
- Recycling pond.

The aerial footprint of this section of the project is expected to be approximately 30 ha.

### **8.3 Anticipated Effects of the Project Infrastructure**

It is assumed, herein, that any impacts on the palaeontological heritage of the area directly affected by the construction of these infrastructure elements will be limited to the immediate land surface or shallow subsurface where foundations are required for the

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buildings (i.e., the upper few metres in general, but possibly slightly deeper beneath the various proposed water storage ponds). Any negative impact associated with the development of these infrastructural elements will be restricted to the areas underlain by each infrastructure element.

## 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 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).

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### 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 project and which are not directly impacted will be unavailable for scientific study for the life of the existence of those features.

### 9.4 Probability of Impact

Five Site Alternative areas are identified for the proposed power station, but only one will be developed. Each of the five Site Alternative areas is aerially extensive (Alternative 1 = 46 ha, Alternative 2 = 37 ha, Alternative 3 = 38 ha, Alternative 4 = 48 ha and Alternative 5 = 114 ha); but the area to be affected by the proposed constructions is anticipated to be approximately 40 ha in total, regardless of the area selected. The Vryheid Formation strata, which underlies these sites, is fossiliferous (and occasionally richly so) elsewhere within the Karoo Basin. Thus, due to the large size of this projects development footprint there is a reasonable chance of fossil materials occurring within the site selected. 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.

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, its fossiliferous potential cannot be ascertained. However, it is evident in Figures 4 and 5 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 would have been destroyed, damaged or moved during the ploughing. 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**. There is no evidence of any potentially fossiliferous fluvial terraces being present within the area.

### 9.5 Significance of Impact

The Vryheid Formation is renowned for the presence of taxonomically diverse 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

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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 determining the depositional history of the formation and, as such, they are also of **high** scientific significance. The fossiliferous potential of the inferred regolith cover cannot be determined other than to state that fossils are generally uncommon and sporadic in their occurrence in the geological record. Thus, the probability of any negative effects on the palaeontological heritage of this unit, in the absence of other evidence, would be expected to be **low**. In those areas of regolith that have been previously ploughed the expected resulting destruction, damage or movement of any shallowly occurring fossils will mean that the probability of any negative impacts resulting from the proposed project is even lower than in the unploughed areas. This said, any fossils present within the regolith that have not been historically affected by agricultural cultivation are potentially of **high** scientific significance.

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.

## **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 in terms of the provision of employment opportunities within the region.

The Vryheid Formation does contain scientifically important and unique fossils elsewhere in the Karoo Basin. It is, therefore, possible that there are fossils of the highest scientific and cultural significance present within the sediments underlying the project area. The fossiliferous potential of the inferred regolith cover cannot be accurately determined herein. However, many fossil taxa are known from only a single fossil and



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the loss or damage to any single fossil or fossil locality can, accordingly, be potentially significant to the understanding of the fossil heritage of South Africa. Thus, any fossil material that may be present within the regolith unit is potentially of high cultural and scientific significance.

**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 any of the five Site Alternative areas that remain viable alternatives following the completion of the Scoping Environmental Impact Assessment Phase would allow a meaningful evaluation of the presence of potentially fossil-bearing strata within the target areas. A report should be compiled and submitted to SAHRA for 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



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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 the construction phases of the project 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 be discovered and be available for scientific study.

## **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**.

The chances of negatively impacting on a fossil in any particular area have been assessed herein as **moderate within the Vryheid formation and low in any regolith that may be present**. 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 case. The judgement on the significance of the fossil must be made by an experienced palaeontologist.

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## **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**

The project area reported on herein comprised five separate geographic areas that have been identified as potential locations for the construction of the proposed power station; only one will be developed. The development footprint of the project regardless of the site eventually selected is large (i.e., 10 ha for the power station and an additional 30 ha for the required associated infrastructure). However, as the potential heritage impacts are wholly restricted to the immediate area of the power plant and the related infrastructure elements the extent of any impact is characterised as **local**.

The effects of the construction of the power station and its required infrastructure elements will be restricted to the Vryheid Formation and any possible regolith cover present. It is interpreted herein that the effects of the construction of the project will in general be restricted to the immediate land surface and the upper few metres of the geological substrate. Several of the infrastructure elements (i.e., the water storage reservoir for raw water supply, the raw water treatment plant and the recycling pond) may require deeper excavations. 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.

The Vryheid Formation is fossiliferous (occasionally richly so) elsewhere in the Main Karoo Basin and, as such, fossils are potentially present and may be negatively impacted and the potential for any negative impact to the palaeontological heritage of the formation is categorised as **moderate**. The Vryheid Formation contains both plant macrofossils of the *Glossopteris* Flora and trace fossil assemblages that are potentially highly significant to the cultural and scientific heritage of South Africa. As such, the risk of a negative impact is moderate, but the significance of any negative impact on the fossil assemblages could potentially be **high**. A regolith cover is inferred to be present over much of the project area. The fossiliferous potential of this unit is assumed to be low due to the generally sporadic and scarce nature of fossils in the geological record in genera and, accordingly the potential for any negative impacts is assessed as **low**. In areas where the regolith has been historically ploughed it is probable that any shallowly occurring fossils that may be present have been destroyed, damaged or moved.

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Thus, in ploughed areas the probability of the proposed project resulting in any negative impacts is even lower than in unploughed 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 field investigation by a palaeontologist as part of a Full Palaeontological Heritage Impact Assessment of any of the five Site Alternative areas that remain viable alternatives following the completion of the Scoping Environmental Impact Assessment Phase would allow a meaningful evaluation of the presence of potentially fossil-bearing strata within the target areas.

A thorough field investigation by a palaeontologist as part of a Full Palaeontological Heritage Impact Assessment of any of the five Site Alternative areas that remain viable alternatives following the completion of the Scoping Environmental Impact Assessment Phase would allow a meaningful evaluation of the presence of potentially fossil-bearing strata within the target areas. This process 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 and appropriate damage mitigation processes could be determined. 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. Similarly, thorough examinations 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.

The social benefits of the project have been classified as beneficial, herein, as the project aims to provide employment opportunities within the power station. 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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