



**DESKTOP PALAEOLOGICAL
HERITAGE IMPACT ASSESSMENT
REPORT ON THE SITE OF A
MINING PERMIT TO MINE
AGGREGATE ON A PORTION OF
THE REMAINING EXTENT OF
PORTION 2 OF
THE FARM WITKLOOF 408 JT,
NEAR CAROLINA, MPUMALANGA
PROVINCE**

10 July 2017

Prepared for:
Heritage Contracts and Archaeological
Consulting CC.

On behalf of:
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**DESKTOP PALAEOLOGICAL HERITAGE IMPACT ASSESSMENT REPORT ON
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On behalf of:

B&E International (Pty) Ltd

Prepared By:

Dr B.D. Millstead

EXECUTIVE SUMMARY

B&E International (Pty) Ltd intends to apply for a Mining Permit to mine for aggregate on 4.9 ha of the remaining extent of Portion 2 of the farm Witkloof 408 JT, which falls in the Albert Luthuli Local Municipality in the Gert Sibande administrative district, Mpumalanga Province.

The proposed mining operation is situated approximately 14.55 km north-west of Carolina and 0.7 km east of the R33. The area earmarked for the proposed mining falls on a section of the farm that was previously used as an existing quarry and the intention of this application is to increase the existing quarry. An alternative site has also been proposed for mining, but is not preferred by the company for a number of reasons, including the fact that the natural area will need to be disturbed for the quarry to be established. Any negative impacts to the palaeontological heritage of the region will be limited to the footprint area of the construction activities and, as such, the extent of any impact is accordingly characterised as local.

The site of the preferred project location is almost completely underlain by strata of the Magaliesberg Formation. The site of the preferred alternative project location is underlain by rocks belonging to both the Magaliesberg Formation and the Late Carboniferous/Early Permian glaciogene sediments of the Dwyka Group.

Any negative impacts to the palaeontological heritage of the region will result from the infrastructure construction activities and to the extraction of the rocks material targeted for utilisation as aggregate. It is assumed, herein, that the construction of the infrastructure elements that will comprise the project will only impact upon the uppermost 1-2 m of the land surface. The depth of the quarry void is not known at the time of compilation of this report, but the depth of the historical mine void that exists in the area but it appears (from inspection of Google earth imagery) to be in the order of meters rather than from tens of meters.

Dwyka Group sediments are known to contain rare plant macrofossil assemblages belonging to the *Glossopteris* Flora, equally uncommon arthropod and palynomorph assemblages. Should plant macrofossils of the *Glossopteris* Flora or trace fossil assemblages be present they would be scientifically significant. The rocks of the Magaliesberg Formation are unfossiliferous; any impacts upon those rocks resulting from the proposed quarrying activities will have nil impact upon the palaeontological heritage of South Africa.

Damage mitigation protocols recommended for the preferred project location and the preferred alternative project location are as follow:

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Preferred Project Location

Should the mining project precede within the preferred project location no damage mitigation procedures are required

Preferred alternative Location

Should the mining project proceed within the preferred project alternative area no damage mitigation procedures are required on the area underlain by rocks of the Magaliesberg Formation.

In the area underlain by Dwyka Group, sediments the following damage mitigation protocols should be put into place:

- Biannual (six monthly) inspections of the mine void should be conducted by a qualified palaeontologist and a palaeontological audit report submitted to SAHRA;
- That palaeontological audit report should make necessary recommendations to mitigate any negative impact on the palaeontological heritage of the region.
- A suitable member of staff of the mining operation (e.g., the environmental officer) should be trained to recognise the types of fossils that may reasonably be expected to occur within the Dwyka Group sediments.
- Should macrofossil materials be unearthed during the excavations associated with the project the excavations in that area should be halted in that location and SAHRA informed of the discovery (see Section 3.3 above) and a palaeontologist contracted to evaluate their importance.
- Should scientifically or culturally significant fossil material exist within the project area any negative impact upon it could be mitigated by its excavation (under permit from SAHRA) by a palaeontologist and the resultant material being lodged with an appropriately permitted institution. In the event that an excavation is impossible or inappropriate, the fossil or fossil locality should be protected and the fossil site excluded from any further construction activities.

This study has not identified any palaeontological reason to prejudice the redevelopment of the Witkloof Quarry Project subject the proposed damage mitigation protocols being enacted.

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1 INTRODUCTION

B&E International (Pty) Ltd intends to apply for a Mining Permit to mine for aggregate on 4.9 ha of the remaining extent of Portion 2 of the farm Witkloof 408 JT, which falls in the Albert Luthuli Local Municipality in the Gert Sibande administrative district, Mpumalanga Province (Figure 1).

The proposed mining operation is situated approximately 14.55 km north-west of Carolina and 0.7 km east of the R33. The area earmarked for the proposed mining falls on a section of the farm that was previously used as an existing quarry and the intention of this application is to increase the existing quarry (Figure 2). An alternative site has also been proposed for mining (Figure 2), but is not preferred by the company for a number of reasons, including the fact that the natural area will need to be disturbed for the quarry to be established. This site will be included in the discussion following for completeness of discussion. The GPS coordinates of the proposed mining area and the preferred alternative area are as follow (Table 1):

CORNER POINT	PREFERRED LOCATION		PREFERRED ALTERNATIVE LOCATION	
	Latitude	longitude	Latitude	longitude
A	25.964892 S	30.023357 E	25.966287 S	30.021722 E
B	25.966291 S	30.021705 E	25.968253 S	30.023456 E
C	25.967790 S	30.023021 E	25.969258 S	30.022011 E
D	25.966602 S	30.024680 E	25.967659 S	30.020373 E

Table 1: Corner points of the preferred project location and the preferred alternative location (decimal degree format).

B&E International (Pty) Ltd has appointed Green Minded Environmental to compile a basic assessment process to obtain environmental authorisation. Green Minded Environmental appointed Heritage Contracts and Archaeological Consulting CC to conduct an Archaeological Impact Assessment for the proposed project. 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 area.

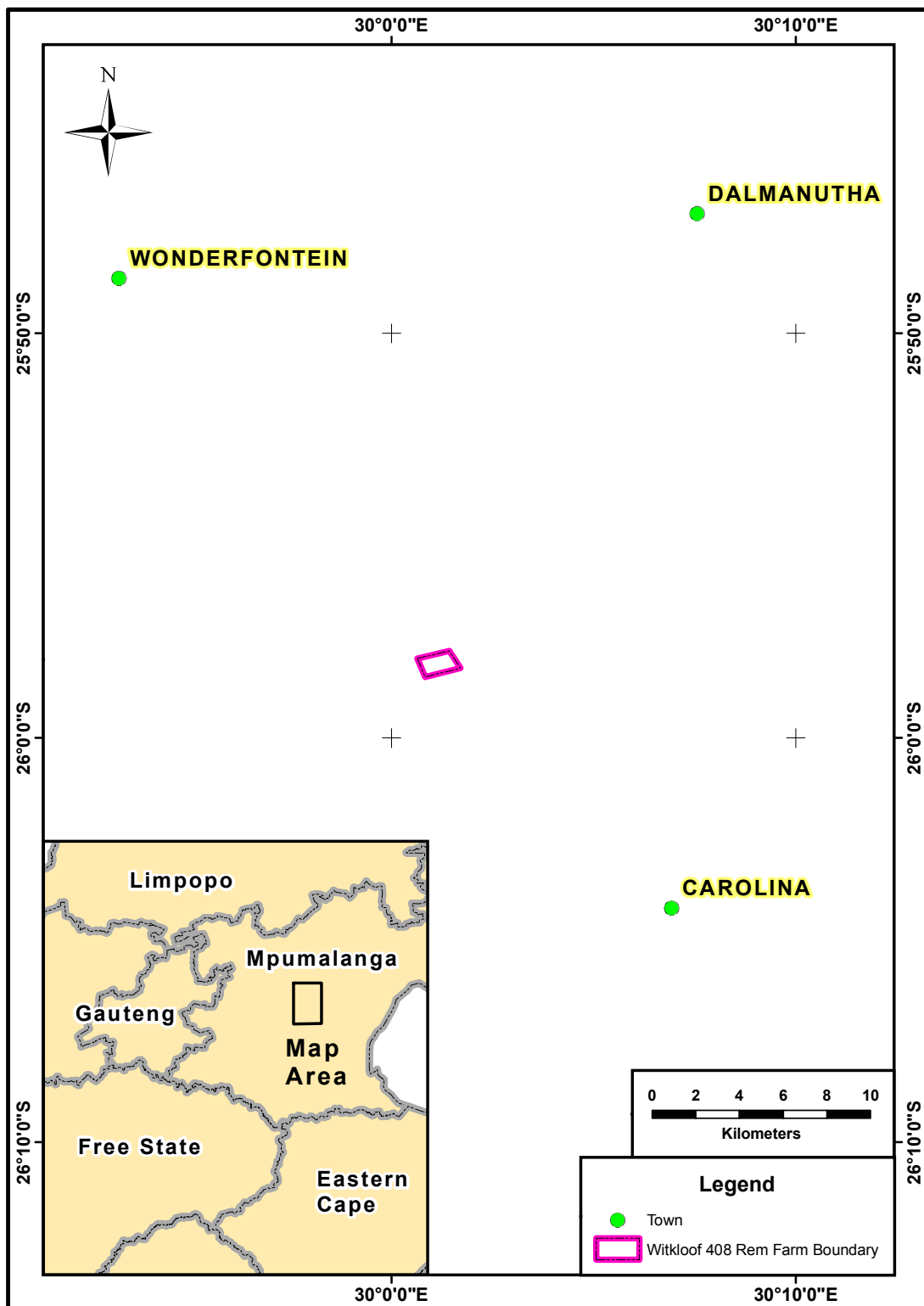


Figure 1: Map showing the location of the Remaining Extent of Portion 2 of the farm Witkloof 408 JT that will contain the proposed Witkloof Quarry Project.

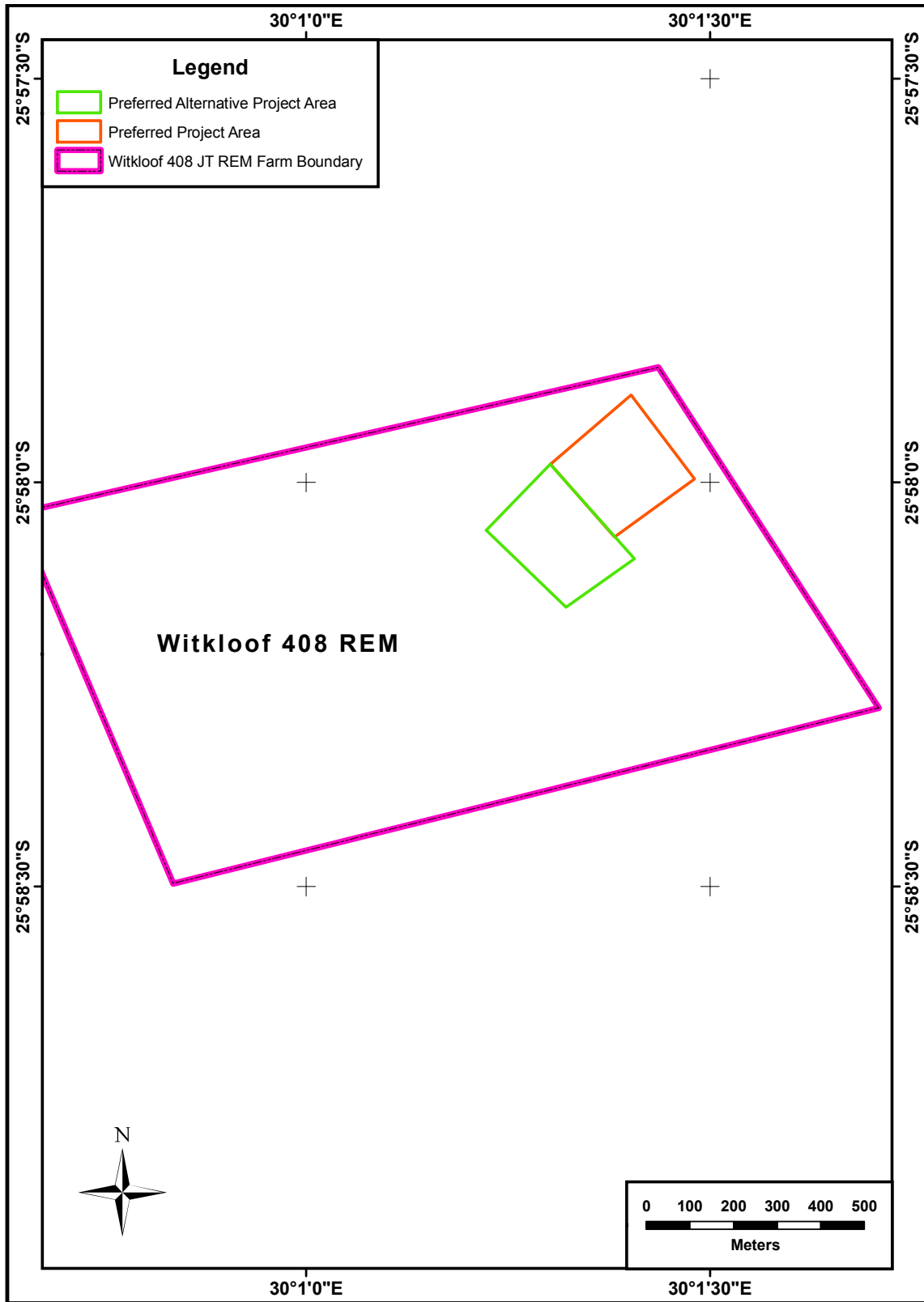


Figure 2: The location of the preferred project area and the preferred alternative project area within the boundary of the farm Witkloof 408 JT REM.

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.

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,

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- 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.).

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 300 m 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):

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- 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
- 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 [as amended]

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 of 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 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 a Fellow the Geological Society of South Africa.

5 INDEPENDENCE

Dr Millstead was appointed to conduct this Palaeontological Heritage Impact Assessment study as an independent consultant and shall receive fair remuneration for these professional services. Neither Dr Millstead nor BM Geological Services has any financial interest in B&E International (Pty) Ltd, the proposed mining project or any associated persons or companies.

6 GEOLOGY AND FOSSIL POTENTIAL

Figure 3 shows that the preferred project location and its associated infrastructure elements is almost entirely underlain by the Archaean strata of the Magaliesberg Formation, Transvaal Supergroup. The preferred alternative project location is underlain by strata belonging to the Archaean strata of the Magaliesberg Formation (Transvaal Supergroup) and Late Carboniferous/Early Permian sediments of the Dwyka Group (Karoo Supergroup). A summary of the characteristics of the geological units and their fossiliferous potentials follows.

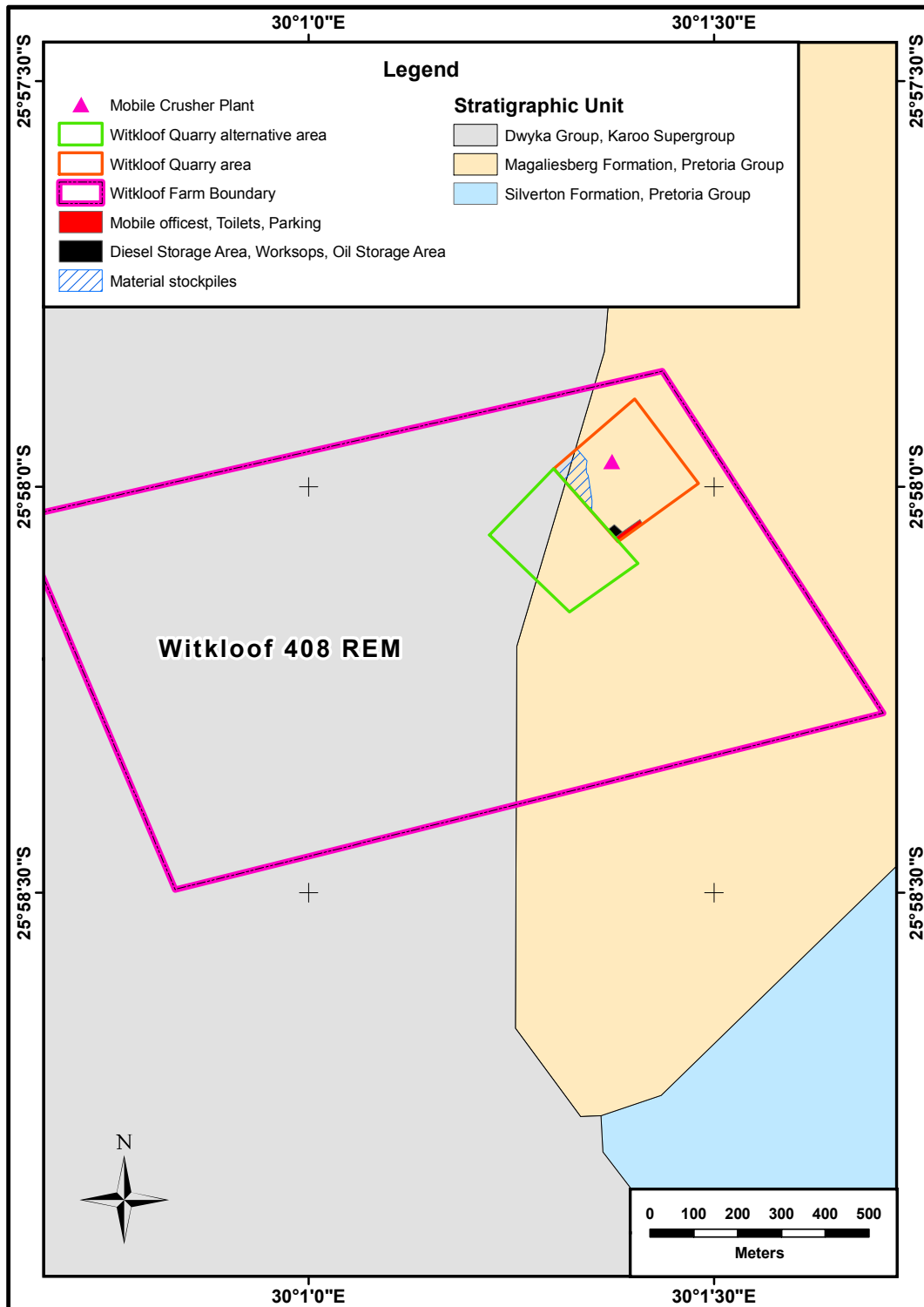


Figure 3: Geological map showing the aerial extent of the geological units that underlie the preferred project area (red polygon) and the preferred alternative project (green polygon), their surrounding environs and the infrastructure elements required for the project.

6.1 Transvaal Supergroup

6.1.1 Magaliesberg Formation

6.1.1.1 Geology

The Archaean Magaliesberg Formation forms part of the upper Pretoria Group (a heterogeneous assemblage of up to 7 km of siliciclastics together with subordinate volcanics and iron-formation). The Magaliesberg Formation is the best-developed and topographically most imposing formation of the Pretoria Group, maintaining the same uniform characters throughout the Transvaal basin. Deposition of the units 160-720 m of pale, medium- to coarse-grained quartzarenite with occasional argillaceous interbeds was in a shallow shelf environment with sediments reworked under littoral conditions. Palaeocurrent indicators point to a northerly provenance (Eriksson *et al.*, 2006).

6.1.1.2 Palaeontological Potential

The rocks of the Magaliesberg Formation are not known to be fossiliferous anywhere throughout their extent.

6.2 Karoo Supergroup

6.2.1 Dwyka Group (Mbizane Formation)

6.2.1.1 Geology

The Late Carboniferous/Early Permian Dwyka Group lies unconformably upon glacially scoured and striated Precambrian basement along the northern Main Karoo basin margin. In the south it overlies the Cape Supergroup unconformably or paraconformably, while in the east it unconformably overlies the Natal Supergroup (Johnson *et al.*, 2006).

Lithologically the unit consists of diamictites, varved shales and mudstones with abundant dropstones, fluvio-glacial gravel and conglomerates of glacial origin. The group comprises of two formations (representing major facies associations):

- The Elandsvlei Formation – the southern marine platform facies
- The Mbizane Formation – the northern valley/inlet facies

It is the rocks of the Mbizane Formation (identified as Dwyka Group) that underlie the two potential project areas. The terrestrially deposited Mbizane Formation is characterised by rapid thickness changes (up to a 200 m) variation within short distances. It is a highly variable lithology with a low massive diamictite (ca. 20 %) and

high mudrock (ca. 40 %) content. The argillites tend to be pale colored and kaolin-rich. The warming associated with the end of the Permo-Carboniferous glaciation led to melting of the ice sheets, with the northern facies representing valley-fill deposits left by retreating glaciers (Johnson *et al.*, 2006).

6.2.1.2 Palaeontological Potential

The presence of spores and pollens has been noted previously elsewhere within the sediments of the unit by the author as well as other workers. Rare plant remains of (belonging to the *Glossopteris* Flora) and arthropod trackways have also been noted within the unit (Anderson and Mclauchlan, 1976; Bamford, 2004).

7 ENVIRONMENT OF THE PROPOSED PROJECT SITE

The site proposed for the mining activities (for both the preferred area and the preferred alternative area) is small measuring approximately 4.9 ha in aerial extent. Figure 4 shows that the land surface underlying the entire extent of the project area is flat and featureless. The R33 is located approximately 500 m west of the preferred alternative area and 700 m west of the preferred project area. An unsealed road lies approximately 150-200 m south of both potential project areas. It is apparent from Figure 5 that a short, unsealed road connects the previous road to the project area. No significant fluvial drainage lines crosscut either the preferred or the preferred alternative project areas. However, an ephemeral northeasterly flowing drainage line is located immediately proximal to the northern borders of both prospective mining areas. The drainage line flows into the Nooitgedacht Dam (Figure 5). Figure 6 shows that the central portion of the preferred project area consists of a historical quarry void. Extensive portions of the land surface lying to the immediate west and south of the quarry void has been disturbed by the mining activity.

The majority of the surface area underlying the preferred project area and the preferred alternative area is vegetated with the Eastern Highveld Grassland veld type. The northern third of the preferred project area and the northern-most corner of the preferred alternative location is vegetated with the KaNgwane Montane Grassland veld type (Figure 7). Mucina and Rutherford (2006) indicate that the conservation status of the Eastern Highveld Grassland veld type is categorised as vulnerable and the KaNgwane Montane Grassland veld type is categorised as endangered.

It is evident from Figure 5 that the entire region is utilised for agriculture. The area underlying both the preferred location and the preferred alternative location appear not to have been cultivated and are probably utilised for grazing. Numerous white, straight

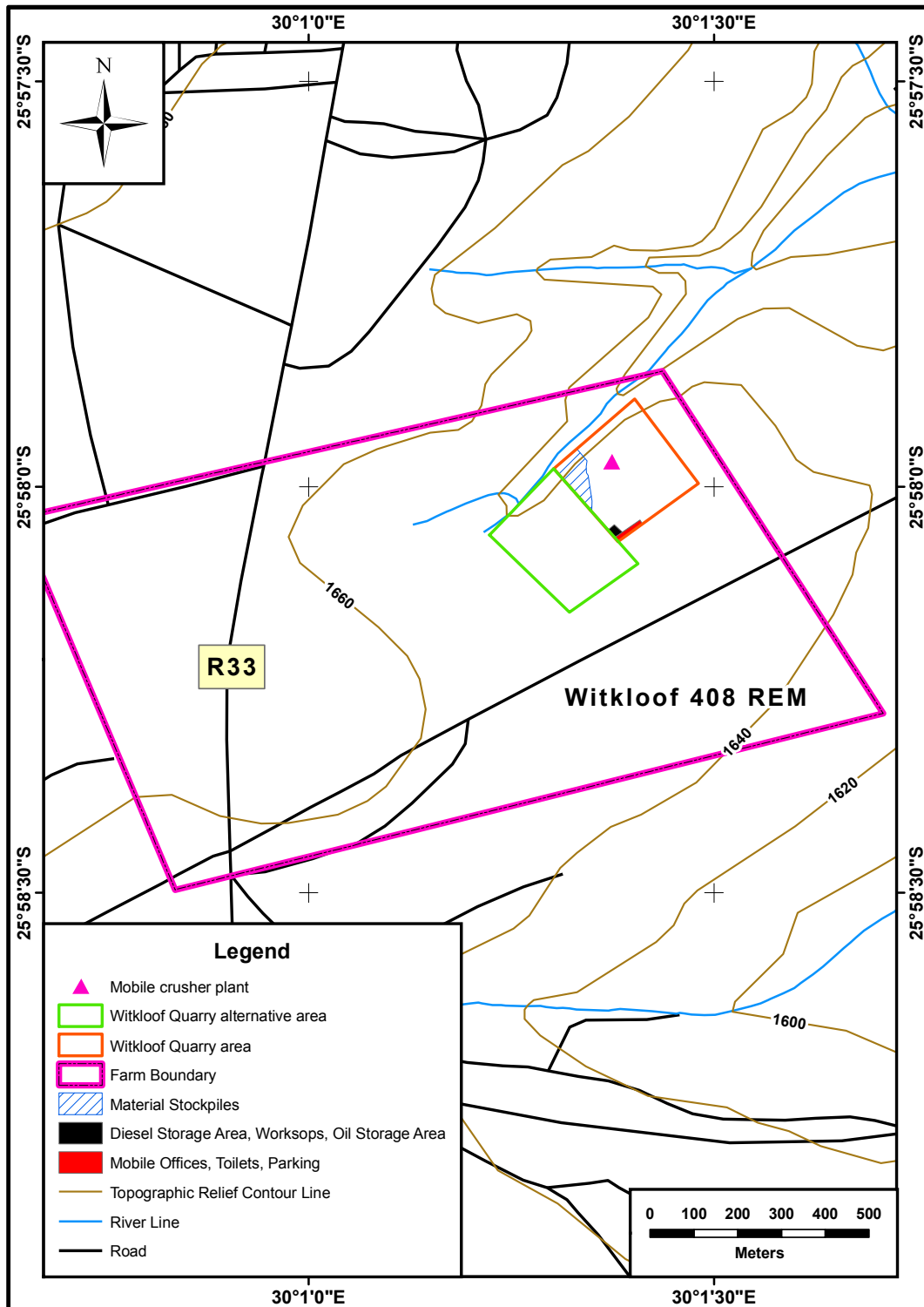


Figure 4: Map of the environment of the two potential project areas and their immediate environs. The topographic relief contour interval is 20 m.

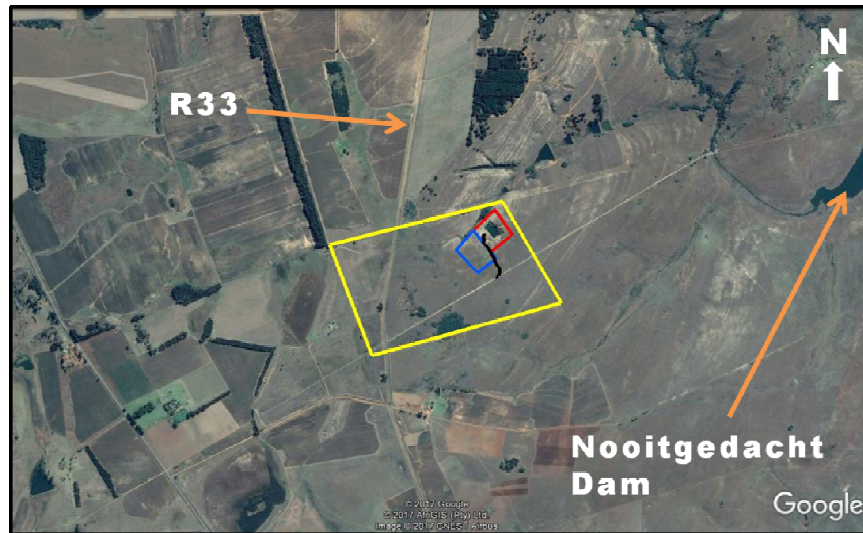


Figure 5: Google earth image of the farm Witkloof 408 JT REM containing the preferred project area (red polygon) and the preferred alternative project area (blue polygon). A short, unsealed road is also shown (black line) connecting the project areas with a larger road to the south. The location of the Nooitgedacht Dam relative to the project areas is also indicated.

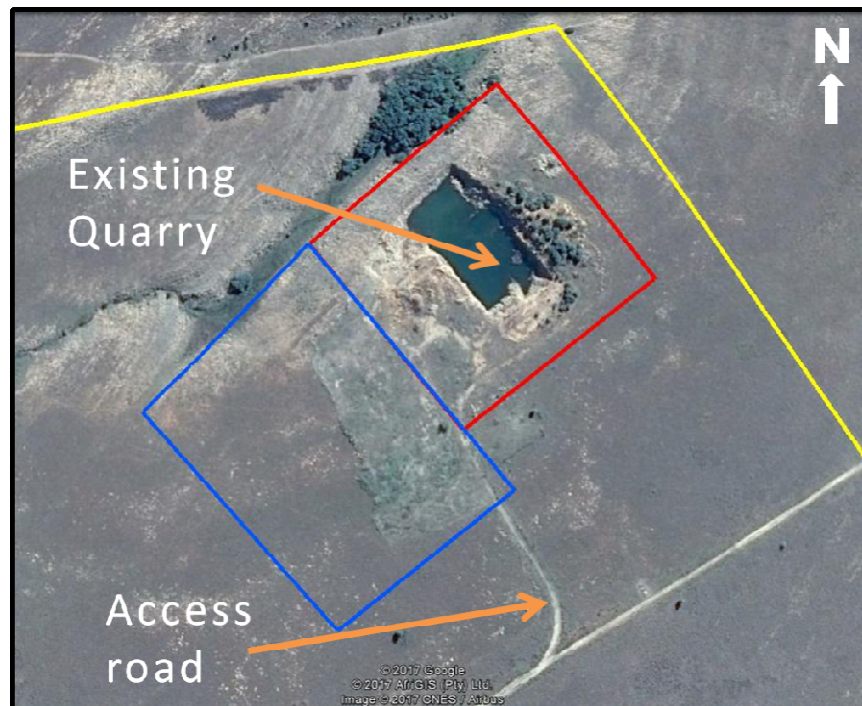


Figure 6: Google earth image of northeastern portion of the farm Witkloof 408 JT REM (boundary shown as yellow line) containing the preferred project area (red polygon) and the preferred alternative project area (blue polygon). The location of the existing quarry void and the unsealed access road depicted in Figure 5 are also shown.

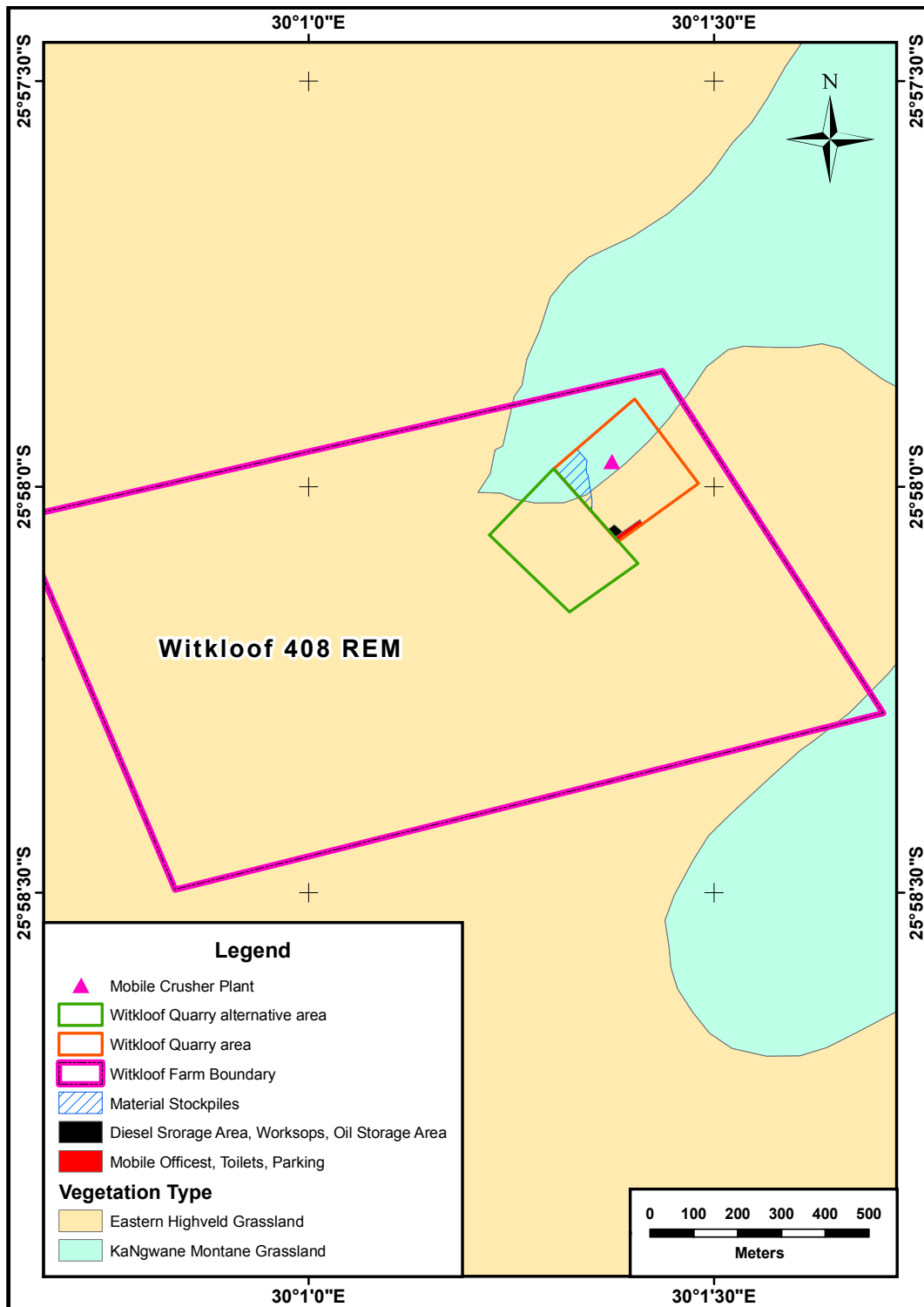


Figure 7: The distribution of the various vegetation veld types occurring beneath the proposed preferred project area and the preferred alternative project area and their immediate environs (after Mucina and Rutherford, 2006).

to curved, northeast oriented lineations are evident within the preferred project location and areas to the north and east of it (Figure 6); these lineations are interpreted, herein, as outcrops of beds of the Magaliesberg Formation. The area underlain by the Dwyka group sediments appears to be extensively vegetated with grassland. This would suggest that the land surface nears an extensive regolith cover.

8 OVERVIEW OF SCOPE OF THE PROJECT

The proposed mining site will be an extension of the existing open cast quarry pit previously distributed by stone aggregate mining activities (Figures 6). The proposed mining area is approximately 4.9 ha in extent with an intended life-of-mine of at least 2 years with a possible extension of another 3 years being possible. The extracted aggregate / stone gravel to be removed from the quarry will be used for road construction in the vicinity. The proposed quarry will contribute to the upgrading / maintenance of road infrastructure in and around the Carolina area.

8.1 Mining method

The open cast mining methods will make use of blasting means of explosives in order to loosen the hard rock, the material is then loaded and hauled out of the excavation to the mobile crushing and screening plants. Aggregate will be stockpiled and transported to the clients using trucks and trailers. All activities will be contained within the boundaries of the site. The proposed depth of mining is unknown to the author at the time of preparation of this report. It is assumed from examination of Figure 6 that the depth of the existing quarry void appears to be relatively shallow (on the scale of meters rather than tens of meters).

8.2 Mining activity

The mining activities will consist out of the following:

- Stripping and stockpiling of topsoil;
- Blasting;
- Excavating;
- Crushing;
- Stockpiling and transporting;
- Sloping and landscaping upon closure of the site;
- Replacing the topsoil and vegetation the disturbed area.

The mining site will contain the following plant and equipment:

- Drilling equipment;
- Excavating equipment;
- Earth moving equipment;
- Mobile crushing and screening plants.

8.3 Infrastructure

The surface infrastructure elements required to support the proposed mining activities include the following (Figure 4):

- Material stockpile;
- Workshops;
- Diesel storage area;
- Oil storage area;
- Mobile offices;
- Toilets;
- Parking area.

8.4 Vehicular access

Informal roads already exist on site and no new roads will be constructed. Vehicular movement will be restricted to existing access routes to prevent crisscrossing of tracks through undisturbed areas. Should any other access roads to the mining area be required existing roads will be used as far as practicable.

8.5 Effect upon the bedrock geology

The rock strata targeted for exploitation (quarrying) will be blasted and extracted. Accordingly, these rock strata will be completely destroyed to the eventual depth of the mine pit. It is evident from Sections 8.1 to 8.4 that the required infrastructure elements are superficial in extent and will only result in the disturbance or destruction of the land surface to a maximum extent of approximately 1-2 m.

The anticipated life of the project is planned to be 2-5 years, but the effects of the project upon those rock strata directly impacted will be permanent.

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).

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 any new infrastructural elements, but which are not uncovered during the necessary excavations, will be unavailable for scientific study for the life of the existence of those features (i.e., 2-5 years).

9.4 Probability of impact

The rocks of the Dwyka Group (Karoo Supergroup) underlie the northwestern third of the preferred alternative project area and the western-most tip of the preferred project area. It is known that this unit and its stratigraphic equivalents are fossiliferous elsewhere in South Africa where it contains rare plant macrofossils and uncommon arthropod

trackways. As such, there is a **low** probability of macrofossil materials occurring within either preferred project location or the preferred alternative location.

The author's experience shows that the fossil spore and pollen (palynomorphs) content of the Dwyka Group rocks is often abundant. However, the construction of the project infrastructure will only affect the upper-most 1-2 m of the land surface. As such, only the oxidized superficial regolith and upper-most weathered bedrock will be impacted. Palynomorphs are extremely sensitive to oxidation and are usually completely destroyed by surface oxidation processes. As a result of the anticipate oxidation the probability of the construction of the new project infrastructure elements causing a negative impact upon the palynomorph content heritage of the project area's bedrock is **low**. The rocks of the Dwyka Group that will be impacted by the mining excavation is relatively small (4.9 ha) and the palynomorph content of the aerially extensive Dwyka Group rocks is ubiquitous and uniform, so the probability of any significant negative impact being caused to the palynoflora of the stratigraphic unit as a whole will also be **low**.

The rocks of the Magaliesberg Formation are not known to be fossiliferous anywhere in their extent. Accordingly, the probability of any negative impact upon the palaeontological heritage of the stratigraphic unit being caused by the mining activities is **nil**.

9.5 Significance of the impact

Should plant macrofossils of the *Glossopteris* Flora be present within the rocks underlying the project area their presence would be scientifically important as they provide a window of understanding into the evolution and composition of the earliest Permian floras of Gondwana. Similarly, any trace fossil materials present would provide very significant data concerning the environments of deposition of the sediments that contain them.

Palynomorph assemblages that may be present within the Dwyka Group sediments are usually biostratigraphically important. However, where palynomorphs occur they are widely distributed within the geological unit. Their destruction within in a restricted portion of an aerially extensive Dwyka Group will not result in significant loss of palaeontological heritage.

The scientific and cultural significance of fossil materials is underscored by the fact that 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 materials are present and will be directly affected by the building

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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, the probability of a negative impact on the palaeontological heritage contained within the Dwyka Group sediments underlying the project area is categorised as low. However, the significance of any negative impact posed by the project on the plant macrofossil and trace fossil elements of the palaeontological heritage is categorised as potentially high if appropriate mitigation procedures are not put into place.

The rocks of the Magaliesberg Formation are unfossiliferous. The significance of any impact upon the palaeontological heritage of the unit resulting from the proposed project is **nil**.

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

Two separate areas have been identified for the project, a preferred location and a preferred alternative location. Damage mitigation protocols required for the two areas are discussed separately below.

10.1.1 Preferred Project Location

Should the mining project precede within the preferred project location no damage mitigation procedures are required.

10.1.2 Preferred alternative Location

Should the mining project proceed within the preferred project alternative location no damage mitigation procedures are required in the area underlain by rocks of the Magaliesberg Formation.

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It is evident from the discussion above (Section 7) that the rocks of the Dwyka Group within the preferred alternative area appear to be covered by a vegetated regolith layer without outcrop. As such, little value would accrue from the conduct of a Phase 1 Palaeontological Impact Assessment Study being conducted prior to the initiation of mining.

Should the preferred alternative project area be selected for mining there is a low possibility of fossils occurring within the Dwyka Group sediments. The following damage mitigation protocols should be put into place:

- Biannual (six monthly) inspections of the mine void should be conducted by a qualified palaeontologist and a palaeontological audit report submitted to SAHRA;
- That palaeontological audit report should make necessary recommendations to mitigate any negative impact on the palaeontological heritage of the region.
- A suitable member of staff of the mining operation (e.g., the environmental officer) should be trained to recognise the types of fossils that may reasonably be expected to occur within the Dwyka Group sediments.
- Should macrofossil materials be unearthed during the excavations associated with the project the excavations in that area should be halted in that location and SAHRA informed of the discovery (see Section 3.3 above) and a palaeontologist contracted to evaluate their importance.
- Should scientifically or culturally significant fossil material exist within the project area any negative impact upon it could be mitigated by its excavation (under permit from SAHRA) by a palaeontologist and the resultant material being lodged with an appropriately permitted institution. In the event that an excavation is impossible or inappropriate, the fossil or fossil locality should be protected and the fossil site excluded from any further construction activities.

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 and that potentially significant fossil material may be made 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**.

Fossils are usually scarce and sporadic in their occurrence and the chances of negatively impacting on a fossil in any particular area are low. However, any fossil material that may be contained within the strata underlying the project area is potentially of the greatest scientific and cultural importance. Thus, the potential always exists during the conduct of the construction of the project 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, the available scientific literature and the author's knowledge based on previous studies within nearby region. In order to assess the potential impacts of the project upon the palaeontological heritage of the area assumptions were made concerning both the scope of impact that will result from the construction of the identified infrastructure elements. The geological occurrence of fossils within fossiliferous geological units is sporadic and cannot be interpreted with precision or certainty.

12 ENVIRONMENTAL IMPACT STATEMENT

B&E International (Pty) Ltd intends to apply for a Mining Permit to mine for aggregate on 4.9 ha of the remaining extent of Portion 2 of the farm Witkloof 408 JT, which falls in the Albert Luthuli Local Municipality in the Gert Sibande administrative district, Mpumalanga Province. The proposed life-of-mine for the project is two years, with a possibility to extend for an additional three years.

The proposed mining operation is situated approximately 14.55 km north-west of Carolina and 0.7 km east of the R33. The area earmarked for the proposed mining falls on a section of the farm that was previously used as an existing quarry and the intention of this application is to increase the existing quarry. An alternative site has also been proposed for mining, but is not preferred by the company for a number of reasons, including the fact that the natural area will need to be disturbed for the quarry to be established.

The site of the preferred project location is almost completely underlain by strata of the Magaliesberg Formation. The site of the preferred alternative project location is

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underlain by rocks belonging to both the Magaliesberg Formation and the Late Carboniferous/Early Permian glaciogene sediments of the Dwyka Group.

Any negative impacts to the palaeontological heritage of the region will result from the infrastructure construction activities and to the extraction of the rocks material targeted for utilisation as aggregate. It is assumed, herein, that the construction of the infrastructure elements that will comprise the project will only impact upon the uppermost 1-2 m of the land surface. The depth of the quarry void is not known at the time of compilation of this report, but the depth of the historical mine void that exists in the area but it appears (from inspection of Google earth imagery) to be in the order of meters rather than from tens of meters.

Dwyka Group sediments are known to contain rare plant macrofossil assemblages belonging to the *Glossopteris* Flora, equally uncommon arthropod and palynomorph assemblages. Should plant macrofossils of the *Glossopteris* Flora or trace fossil assemblages be present they would be scientifically significant. The rocks of the Magaliesberg Formation are unfossiliferous; any impacts upon those rocks resulting from the proposed quarrying activities will have nil impact upon the palaeontological heritage of South Africa.

Damage mitigation protocols recommended for the preferred project location and the preferred alternative project location are as follow:

Preferred Project Location

Should the mining project precede within the preferred project location no damage mitigation procedures are required

Preferred alternative Location

Should the mining project proceed within the preferred project alternative area no damage mitigation procedures are required on the area underlain by rocks of the Magaliesberg Formation.

In the area underlain by Dwyka Group, sediments the following damage mitigation protocols should be put into place:

- Biannual (six monthly) inspections of the mine void should be conducted by a qualified palaeontologist and a palaeontological audit report submitted to SAHRA;
- That palaeontological audit report should make necessary recommendations to mitigate any negative impact on the palaeontological heritage of the region.

- A suitable member of staff of the mining operation (e.g., the environmental officer) should be trained to recognise the types of fossils that may reasonably be expected to occur within the Dwyka Group sediments.
- Should macrofossil materials be unearthed during the excavations associated with the project the excavations in that area should be halted in that location and SAHRA informed of the discovery (see Section 3.3 above) and a palaeontologist contracted to evaluate their importance.
- Should scientifically or culturally significant fossil material exist within the project area any negative impact upon it could be mitigated by its excavation (under permit from SAHRA) by a palaeontologist and the resultant material being lodged with an appropriately permitted institution. In the event that an excavation is impossible or inappropriate, the fossil or fossil locality should be protected and the fossil site excluded from any further construction activities.

This study has not identified any palaeontological reason to prejudice the redevelopment of the Witkloof Quarry Project subject the proposed damage mitigation protocols being enacted.

13 REFERENCES

Anderson, A.M. and Mclauchlan, I.R. (1976). The plant record in the Dwyka and Ecca Series (Permian) of the south-western half of the Great Karoo Basin, South Africa. *Palaeontologia Africana*, 19: 31-42.

Bamford, M.K. (2004). Diversity of woody vegetation of Gondwanan southern Africa. *Gondwana Research*, 7: 153-164.

Eriksson, P.G., Altermann, W. and Hartzler, F.J., (2006). *The Transvaal Supergroup and its precursors*. in Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J. (eds) *The Geology of South Africa*, Johannesburg: Council for Geoscience, Pretoria: Geological Society of South Africa: 237–260.

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., de V. Wickens, H., Christie, A.D.M., Roberts, D.I., and Brandl, G. (2006). Sedimentary Rocks of the Karoo Supergroup, In Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J. (eds) *The Geology of South Africa*, Johannesburg: Council for Geoscience, Pretoria: Geological Society of South Africa, pp. 461–499.

Mucina, L. and Rutherford, M.C. (Eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelizia* 19. South African National Biodiversity Institute, Pretoria.

Republic of South Africa (1998). National Environmental Management Act (No 107 of 1998). Pretoria: The Government Printer.

Desktop Palaeontological Impact Assessment Report – Mining Right application on the farm Witkloof 408 JT, near Carolina, Mpumalanga Province

Republic of South Africa (1999). National Heritage Resources Act (No 25 of 1999). Pretoria: the Government Printer.

A handwritten signature in black ink, appearing to read 'B.D. Millstead', with a horizontal line extending to the right.

Dr B.D. Millstead

12th July 2017