PALAEONTOLOGICAL IMPACT ASSESSMENT FOR THE DEVELOPMENT OF THE PROPOSED VENTERSBURG PROJECT-AN UNDERGROUND MINING OPERATION NEAR VENTERSBURG AND HENNENMAN, FREE STATE PROVINCE

Prepared for:

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EXECUTIVE SUMMARY

Prime Resources has been appointed as the independent Environmental Assessment Practitioners (EAP) by Gold One Africa Limited for the undertaking of the Environmental Impact Assessment process for the development of the Ventersburg Project. According to the National Heritage Resources Act (Act No 25 of 1999, section 38), a palaeontological impact assessment is required to detect the presence of fossil material within the proposed development footprint.

The surface geology of the proposed underground mining operation and pipeline, near the towns of Ventersburg and Hennenman, Free State Province is completely underlain by the Adelaide Subgroup, Beaufort Group and Cenozoic superficial sediments. The Adelaide Subgroup includes a rich and diverse vertebrate fauna of exceptionally high scientific significance due to the diversity of the tetrapod fauna from Pangea/Gondwana and their part in recording the evolutionary transition from reptiles to mammals. Various types of superficial deposits of Late Caenozoic (Miocene / Pliocene to Recent) occur widely throughout the Great Karoo Basin and thus also on the development site. On the South African Heritage Research Agency (SAHRA) PalaeoMap the Adelaide Subgroup has a very high Palaeontological Sensitivity, but the scarcity of fossil heritage, low relief and absence of steep river gullies or sharp outcrops on the proposed development footprint indicate that the impact on the development site will be of a low significance in palaeontological terms. It is therefore considered that the construction and operation of the Ventersburg Project is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

Should fossil remains be discovered during any phase of construction, either on the surface or exposed by fresh excavations, the ECO responsible for these developments should be alerted immediately. Such discoveries ought to be protected (preferably *in situ*) and the ECO should alert SAHRA so that appropriate mitigation (*e.g.* recording, sampling or collection) can be taken by a professional paleontologist.

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1 INTRODUCTION

Prime Resources has been appointed as the independent Environmental Assessment Practitioners (EAP) by Gold One Africa Limited for the undertaking of the Environmental Impact Assessment process for the development of the Ventersburg Project. Gold One Africa Limited holds five adjacent prospecting rights (DMR Reference: FS 10140 PR, FS 10228 PR, FS 10229 PR, FS 10087 PR and FS 10080 PR) over several farm portions (between the towns of Hennenman and Ventersburg in the Free State) and proposes to develop an underground mining operation and construction of a water pipeline (Fig.1&2).

1.1 BACKGROUND (INFORMATION PROVIDED BY PRIME RESOURCES)

The lifespan of the proposed Ventersburg Project mine is expected to be 17 years (this includes four years for construction). Planned commencement of construction is expected to be in 2021 with mining operations commencing in 2025, continuing for 13 years until 2038.

Mining

The proposed Ventersburg Project will consist of a main and ventilation shaft. The Run of Mine (RoM) ore and the waste rock will be lifted separately at the Main Shaft. Full production will be achieved in year 9 at 80,000 tonnes of RoM ore per month and will be maintained for seven years. A steady amount of approximately 30,000 tonnes of waste rock will be generated per month.

The ore and/or waste rock will be fed from the shaft headgear bin, and conveyed to the processing plant, while waste rock will be conveyed to the waste rock dump. Waste rock hoisted through the ventilation shaft will be trucked to the waste rock dump.

Preceding the commissioning of the processing plant, RoM ore will be trucked from the shaft headgear bin to the ore emergency/commissioning stockpile. Once the processing plant has been commissioned, ore will be retrieved from the ore commissioning stockpile with a front end loader and loaded onto the conveyor to be transported to the processing plant.

Groundwater in the underground workings will be dewatered and pumped to the surface and treated at a water treatment facility. The treated excess water will be discharged to the Rietspruit via a pipeline. Treated water discharged will be treated according to discharge standards (stipulated by the Department of Water and Sanitation) and will consequently be considered as clean water. The maximum volume of treated water to

be discharged is 6 Mℓ per day at a steady state for 13 years, with a ramp up of between 1 and 3 Mℓ per day for the first four years during construction.

Processing

The processing plant will operate constantly and involve the crushing of ore, the removal of the gold from the crushed ore through a chemical extraction process producing concentrate, the refining of the concentrate through electrolysis and the smelting of the gold in a furnace for the casting of gold bullions. Tailings from the processing plant will be disposed of on a tailings storage facility.

Surface Infrastructure

The extent of the proposed surface infrastructure associated with the proposed Ventersburg Project is approximately 250 ha and comprises of:

- Main shaft, conveyor transfer houses and conveyor systems, ventilation shaft, workshops, stores, salvage yard, waste transfer area, power lines and substations, topsoil stockpile, pipeline network, office and administrative buildings, processing plant, bulk fuel storage facility, emulsion storage silos and on site access and haul roads.
- Mining material and waste infrastructure to be constructed includes an emergency/commissioning ore stockpile, waste rock dump and tailings storage facility (which will be lined as per legislative requirements and equipped with pollution control infrastructure).
- Water management infrastructure includes various dams, pollution control infrastructure, water treatment facility and pipeline to discharge treated water to the Rietspruit.

After operations cease, decommissioning will commence. A period of 1 year has been allocated for decommissioning and rehabilitation, during which all the surface infrastructure components aside from the tailings storage facility and waste rock dump will be removed and the disturbed areas rehabilitated.

Figure 1. Google Earth Image of the proposed Ventersburg Project near the towns of Ventersburg and Hennenman, Free State Province. The development footprint is indicated in green while the pipeline is indicated in blue.

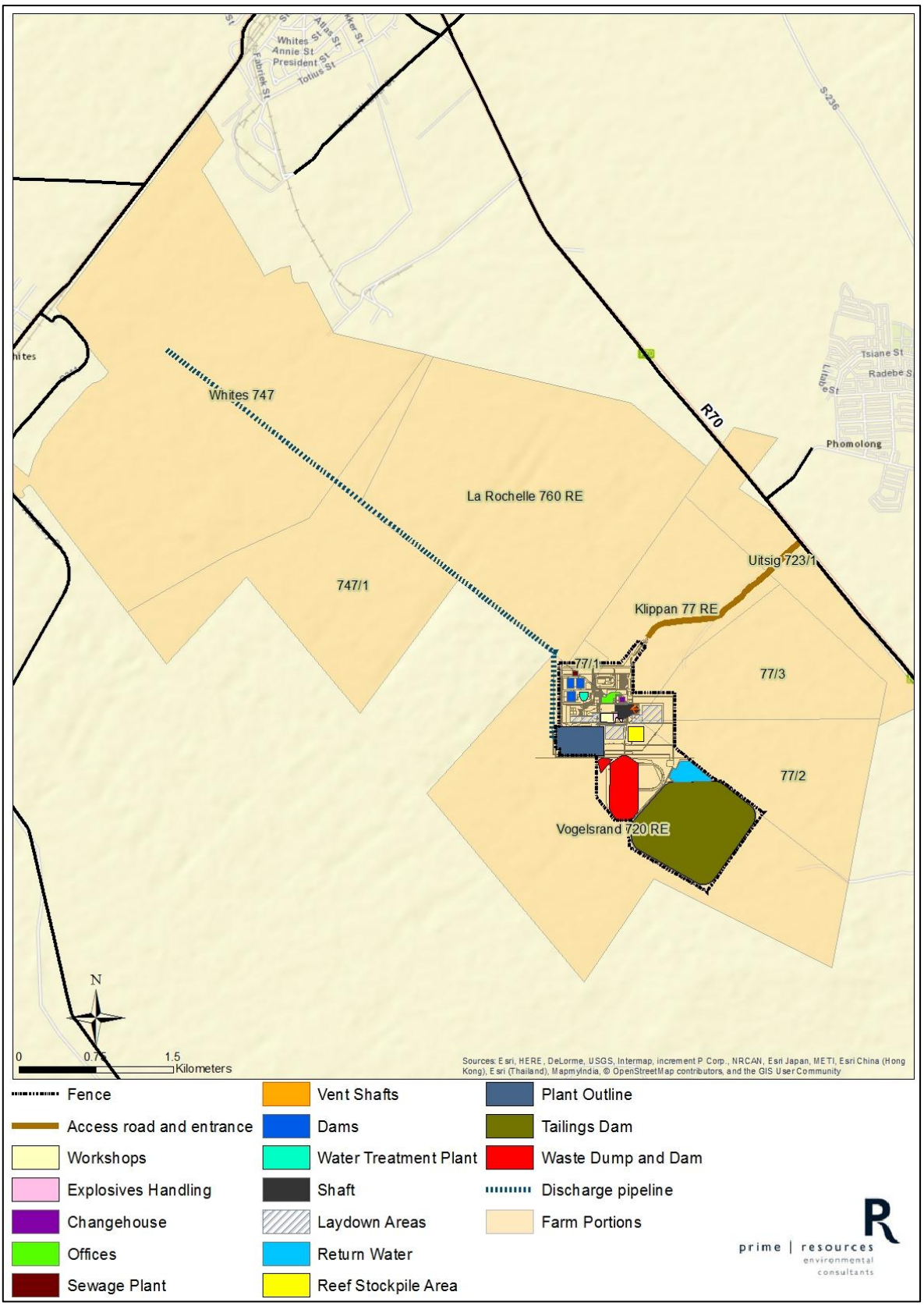

Figure 2. Location of the proposed underground mining operation, near the towns of Ventersburg and Hennenman, Free State Province. (Map provided by Prime Resources).

2 LEGISLATION

2.1 GENERAL MANAGEMENT GUIDELINES

The National Heritage Resources Act (Act 25 of 1999) states that, any person who intends to undertake a development categorised as-

(a) the construction of a road, wall, transmission line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;

(b) the construction of a bridge or similar structure exceeding 50m in length;

(c) any development or other activity which will change the character of a site-

  (i) exceeding 5 000 m^2 in extent; or

  (ii) involving three or more existing erven or subdivisions thereof; or

  (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or

  (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA.SAHRA;

(d) the re-zoning of a site exceeding 10 000 m^2 in extent; or

(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources 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.

Cultural Heritage in South Africa is governed by the National Heritage Resources Act (Act 25 of 1999). In accordance with the above mentioned general management guidelines three listed activities were triggered namely A; C and D. This Palaeontological Scoping Study forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the above mentioned Act. In accordance with Section 38, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

SECTION 35 OF THE NATIONAL HERITAGE RESOURCES ACT 25 OF 1999

The various categories of heritage resources are recognised as part of the National Estate in Section 35 of The National Heritage Resources Act. This include among others:

- geological sites of scientific or cultural importance
- palaeontological sites
- palaeontological objects and material, meteorites and rare geological specimens

According to Section 35 of the National Heritage Resources Act 1999, dealing with archaeology, palaeontology and meteorites:

- The protection of archaeological and palaeontological sites and material and meteorites are the responsibility of a provincial heritage resources authority.

- All archaeological objects, palaeontological material and meteorites are the property of the State.
- 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.
- No person may, without a permit issued by the responsible heritage resources authority—
    - 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 which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
- When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of Section 38 has been followed, it may—
    - serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order; and/or
    - carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary.

3 OBJECTIVE

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports' the aims of the palaeontological impact assessment are:

- to identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assess the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.

The objective is thus to conduct a Palaeontological Impact Assessment to determine the impact of the development on potential palaeontological material at the site.

When a palaeontological desktop/scoping study is conducted, the potentially fossiliferous rocks (i.e. groups, formations, members, etc.) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is collected from published scientific literature; Fossil sensitivity map; consultations with professional colleagues, previous palaeontological impact studies in the same region and the databases of various institutions may be consulted. This data is then used to assess the palaeontological sensitivity of each rock unit of the study area on a desktop level. The likely impact of the proposed development on local fossil heritage is subsequently established on the basis of

- the palaeontological sensitivity of the rocks and
- the nature and scale of the development itself (extent of new bedrock excavated).

When rocks of moderate to high palaeontological sensitivity are present within the study area, a field-based assessment by a professional palaeontologist is necessary. Based on this desktop data as well as a field examination of representative exposures of all major sedimentary rock present, the impact significance of the planned development is considered with recommendations for any further studies or mitigation.

4 BACKGROUND TO THE GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The Karoo Supergroup strata are between 310 and 182 million years old and span the Upper Carboniferous to Middle Jurassic Periods. During this period the basin developed from an inland sea flooded by a melting ice cap, to a giant lake (Ecca Lake) fed by seasonal meandering (and periodically braided) rivers. The lake progressively shrank as it filled with sediment and the basin's rate of subsidence stabilised.

The Beaufort group consists of largely fluvial sediments which were deposited on the floodplains of these rivers. In time the land became progressively more arid and was covered with windblown sand just before the end of the basin's cycle. Finally the subcontinent was inundated with basaltic lava to form the capping basalts of the Jurassic aged Drakensberg Group. During the Jurassic, the volcanic Drakensberg were formed and cracks in the earth's crust were filled with molten lava that cooled to form dolerite dykes. Magma injected horizontally between sediments, cooled down and formed horizontal sills of dolerite.

The flood plains of the Beaufort Group (Karoo Supergroup) are internationally renowned for the early diversification of land vertebrates and provide the worlds' most complete transition from early "reptiles" to mammals.

4.1 PALAEONTOLOGICAL AND GEOLOGICAL HERITAGE

The surface geology of the proposed underground mining operation and pipeline, near the towns of Ventersburg and Hennenman, Free State Province is completely underlain by the Adelaide Subgroup, Beaufort Group and Cenozoic superficial sediments.

The geology of the study area between Ventersburg and Hennenman is outlined on the 1: 250 000 geology sheets of 2826 Winburg (Nolte 1995). This region is underlain by shallow marine/or lacustrine to continental sediments of the Karoo Supergroup of Late Permian age. According to the 1: 250 000 geological map, these Karoo sediments belong to the predominantly fluvial Lower Beaufort Group (Adelaide Subgroup) that is of latest Permian age (Fig 3).

The Beaufort Group is subdivided into a series of biostratigraphic units on the basis of its faunal content. Based on available biostratigraphic mapping it is evident that only the upper, Late Permian is present in the Hennenman-Ventersburg district, most probably corresponding to the *Daptocephalus* Assemblage Zones (Kitching 1995, Rubidge 2005, Van der Walt et al. 2010) (Fig. 4).

The *Daptocephalus* Assemblage Zone (AZ) of the Balfour Formation, is characterized by the occurrence of the two therapsids namely *Dicynodon* and *Theriognathus*. The *Daptocephalus* AZ of the Beaufort Group shows the greatest vertebrate diversity and includes numerous well preserved genera and species of dicynodonts, biarmosuchians, gorgonopsian, therocephalian and cynodont therapsid Synapsida as well as captorhinid Reptilia and less well represented eosuchian Reptilia, Amphibia and Pisces (Groenewald & Kitching 1995, Rubidge 2005). Fossil plants of the Balfour Formation are relatively rare compared to the vertebrate fossil assemblages. The presence of the wood genera, *Agathoxylon* and *Australoxylon,* was described by Bamford (2004).

Cenozoic superficial sediments

Various types of superficial deposits of Late Caenozoic (Miocene to Pliocene to Recent) age occur throughout the Karoo Basin (Partridge *et al*. 2006). They include pedocretes (*e.g*..calcretes), colluvial slope deposits, down wasted surface gravels, river alluvium, wind-blown sands as well as spring and pan sediments. Hill slopes are usually mantled with a thin to thick layer of colluvium or slope deposits (*e.g.* sandstone and dolerite scree or talus deposits, sheetwash).

The Cenozoic superficial deposits have been relatively neglected in palaeontological terms. They may occasionally contain important fossil biotas, e.g. bones, teeth and horn cores of mammals as well as remains of reptiles like tortoises. Non-marine molluscs (bivalves, gastropods), ostrich egg shells, trace fossils (*e.g.* calcretised termitaria, coprolites), and plant remains such as peats or palynomorphs (pollens, spores) in organic-rich alluvial horizons and siliceous diatoms in pan sediments have also been found. However, these fossil assemblages are generally sparse, low in diversity, and occur over a wide geographic area, so the palaeontological sensitivity of the calcretes within the study region is rated as low. This also applies to the thin veneer of other surface deposits (rocky scree, stream alluvium etc.) within the region.

The Adelaide Subgroup consists of greenish or blue grey and greyish-red mudstones and sandstones (South African Committee for Stratigraphy, 1980; pp. 538-539).

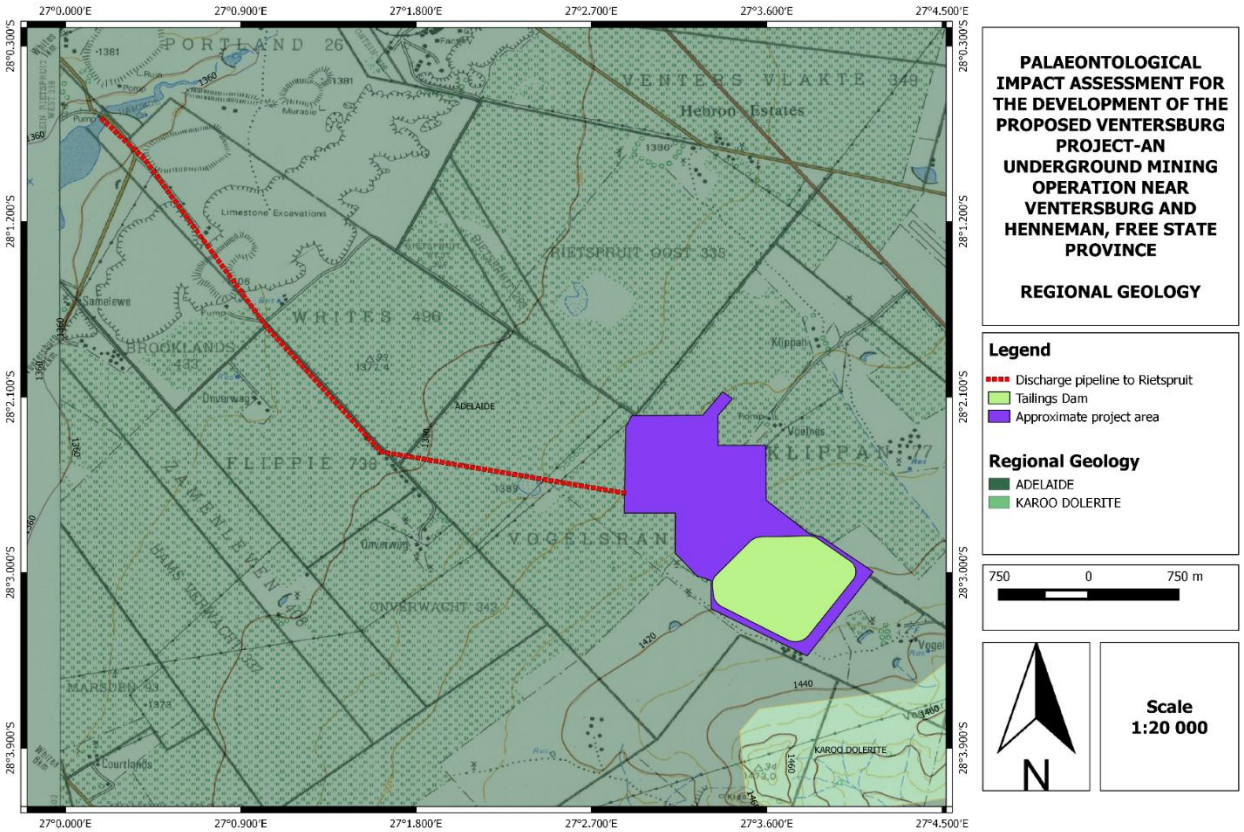

Figure 3. The surface geology of the proposed underground mining operation and pipeline, near the towns of Ventersburg and Hennenman, Free State Province. The development site is completely underlain by the Adelaide Subgroup, Beaufort Group as well as Cenozoic superficial sediments.

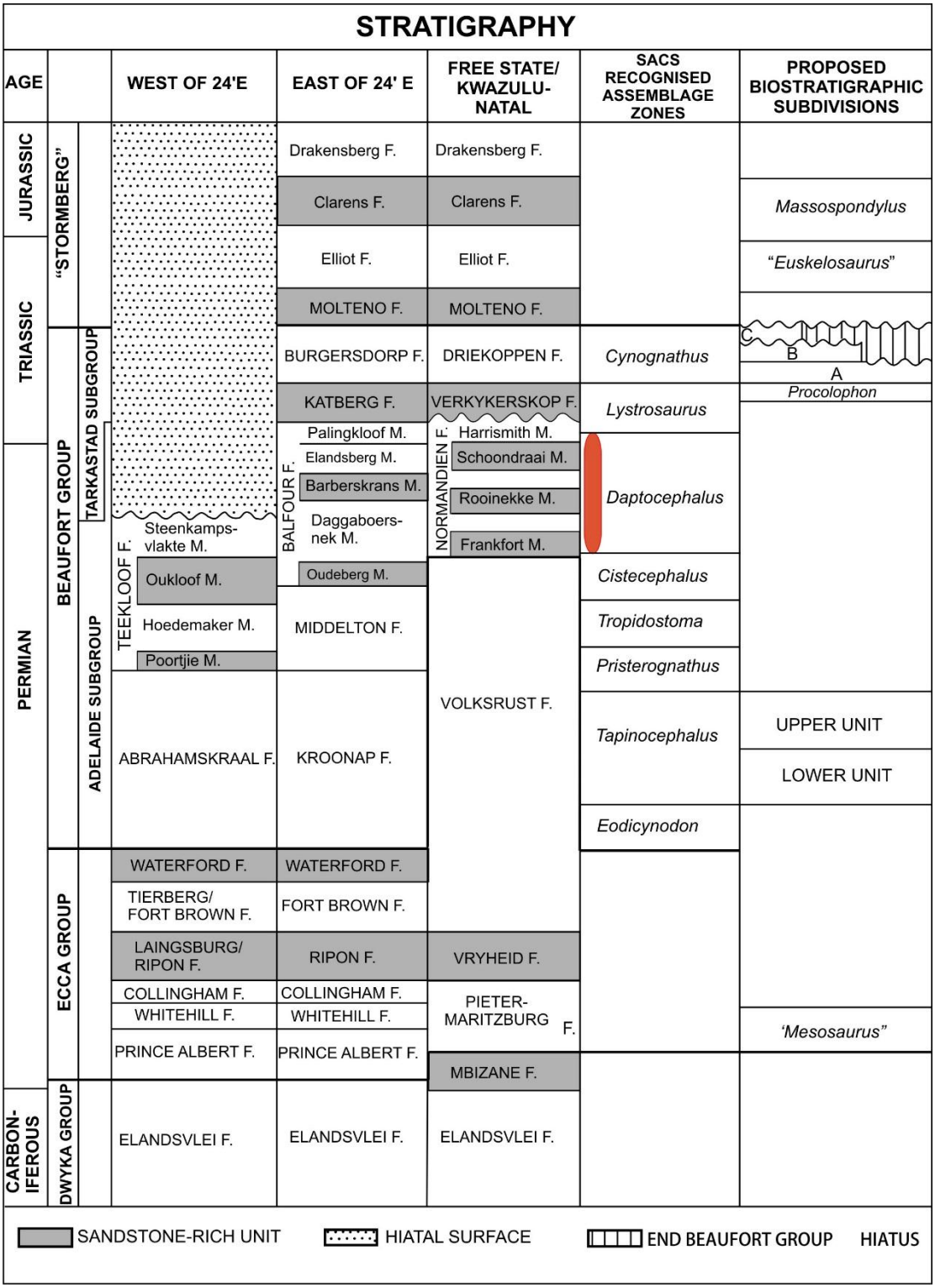

Figure 4: Karoo stratigraphy and biostratigraphy (after Smith *et al.*, 2012).Red line indicates the stratigraphic interval impacted by the proposed development

5 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development area is located in an area of low relief without any sharp outcrops. Most of the original vegetation has been replaced by agricultural activities.

6 METHODS

As part of the Palaeontological Impact Assessment, a field-survey of the development footprint was conducted to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed footprint of the development. A physical field-survey was conducted on foot within the proposed development footprint as well as the route of the water pipeline. The results of the field-survey, the author's experience, aerial photos (using Google Earth, 2015), topographical and geological maps and other reports from the same area were used to assess the proposed development footprint. No consultations were undertaken for this Impact Assessment.

6.1 ASSUMPTIONS AND LIMITATIONS

The accuracy and reliability of desktop Palaeontological Impact Assessments as components of heritage impact assessments are normally limited by the following restrictions:

- Old fossil databases that have not been kept up-to-date or are not computerised. These databases do not always include relevant locality or geological information. South Africa has a limited number of professional palaeontologists that carry out fieldwork and most development study areas have never been surveyed by a palaeontologist.
- The accuracy of geological maps where information may be based solely on aerial photographs and small areas of significant geology have been ignored. The sheet explanations for geological maps are inadequate and little to no attention is paid to palaeontological material.
- Impact studies and other reports (*e.g*. of commercial mining companies) - is not readily available for desktop studies.

Large areas of South Africa have not been studied palaeontologically. Fossil data collected from different areas but in similar Assemblage Zones might however provide insight on the possible occurrence of fossils in an unexplored area. Desktop studies of

this nature therefore usually assume the presence of unexposed fossil heritage within study areas of similar geological formations. Where considerable exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a Palaeontological Impact Assessment may be significantly improved through field-survey by a professional palaeontologist.

In order to ensure that an accurate description of the area proposed for the development is considered a field survey was undertaken to ground truth any potential impacts that development may have on the palaeontological resources of the site. The field-survey was undertaken on 18 February 2017, as indicated in Section 5 above.

7 FIELD OBSERVATIONS

The following photographs were taken on a site visit to the proposed Ventersburg Project development site on 18 February 2017. The proposed development footprint is currently used as agricultural land. Good exposures on the development site are rare and none were encountered during the present field study.

Figure 4. Location of the beginning of the proposed pipeline for the Ventersburg Project. Lush vegetation and agricultural activities is present on the proposed site

Figure 5. Agricultural activities on the proposed development site of the Ventersburg Project. The low relief and absence of sharp outcrops and steep river gullies on the proposed development footprint indicate that the impact on the development site will be of a low significance in palaeontological terms.

8 FINDINGS AND RECOMMENDATIONS

The development footprint is primarily represented by sedimentary rocks of the late Permian Adelaide Subgroup, Beaufort group, Karoo Supergroup.

The Balfour Formation underlying the development footprint form part of the *Daptocephalus AZ*. This biostratigraphic zone include a rich and diverse vertebrate fauna of exceptionally high scientific significance due to their part in recording the evolutionary transition from reptiles to mammals.

However, the scarcity of fossil heritage and a lack of appropriate exposure at the proposed development footprint indicate that the impact is of low significance in palaeontological terms. Considering impacts, it can be concluded that the construction and operation of the Ventersburg Project and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. It can also be concluded that the proposed route for the water supply pipeline is considered to be acceptable.

It is thus recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required for the commencement of this development, pending the discovery or exposure of any fossil remains during the construction phase.

Should fossil remains be discovered during any phase of construction, either on the surface or exposed by fresh excavations, the ECO responsible for these developments should be alerted. Such discoveries ought to be protected (preferably *in situ*) and the ECO should alert SAHRA (South African Heritage Research Agency) so that appropriate mitigation (*e.g.* recording, sampling or collection) can be taken by a professional palaeontologist.

The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved collection (*e.g.* museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

9 REFERENCES

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10 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Elize Butler has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty years and has been conducting Palaeontological Impact Assessments since 2014. She has extensive experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa for 10 years.

11 DECLARATION OF INDEPENDENCE

I, Elize Butler, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise my objectivity in this work.

Sincerely