

**Phase 1 Palaeontological Impact Assessment of a
proposed new residential development on the
farm Brandkop 702 near Bloemfontein, FS
Province.**

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Executive Summary

A Phase 1 Palaeontological Impact Assessment was carried out on a portion of land marked for the proposed development of a new residential area on the farm Brandkop 702 outside Bloemfontein, Free State Province. The development footprint is situated within the Beaufort Group (Karoo Supergroup), and is underlain by palaeontologically significant, late Permian, Adelaide Subgroup sedimentary rocks, that have been widely intruded by Jurassic-age dolerites. The dolerite component (*Jd*) is not palaeontologically vulnerable and the likelihood of impact on palaeontological remains in the vicinity of igneous outcrop is considered unlikely. The koppies, koppie slopes and zones immediately adjacent are assigned a field rating of Generally Protected C (GP.C). The likelihood of impact on palaeontological material from fresh sedimentary bedrock strata, which may occur further away from the koppies is considered low, but if *in situ* fossil material is exposed as a result of excavations into fresh sedimentary bedrock, it should be reported to SAHRA and a professional palaeontologist as soon as possible. The capped sedimentary bedrock component that is potentially unaffected by dolerite intrusions is assigned a field rating of Generally Protected B (GP.B). It is unlikely that the proposed development will affect palaeontological heritage resources within the superficial component (Quaternary overburden) due to the disturbed condition of the substrate and the absence of suitable Quaternary-aged alluvial contexts within the boundaries of the footprint. The palaeontological significance of the Quaternary overburden along the proposed footprint is therefore considered to be very minor. The proposed pipeline footprint is assigned a field rating of Generally Protected C (GP.C).

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Introduction

A Phase 1 Palaeontological Impact Assessment was carried out on a portion of land marked for the proposed development of a new residential area on the farm Brandkop 702 outside Bloemfontein, Free State Province (**Fig.1**). The assessment is required as a prerequisite for new development in terms of the National Environmental Management Act and is also called for in terms of the National Heritage Resources Act (NHRA) 25 of 1999. The region's unique and non-renewable archaeological and palaeontological heritage sites are 'Generally' protected in terms of the National Heritage Resources Act (Act No 25 of 1999, section 35) and may not be disturbed at all without a permit from the relevant heritage resources authority. As many such heritage sites are threatened daily by development, both the environmental and heritage legislation require impact assessment reports that identify all heritage resources including archaeological and palaeontological sites in the area to be developed, and that make recommendations for protection or mitigation of the impact of the sites.

The NHRA identifies what is defined as a heritage resource, the criteria for establishing its significance and lists specific activities for which a heritage specialist study may be required. In this regard, categories of development listed in Section 38 (1) of the NHR Act are:

- The construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
- The construction of a bridge or similar structure exceeding 50m in length;
- Any development or other activity which will change the character of the site
 - a) exceeding 5000 m² in extent; or
 - b) involving three or more existing erven or subdivisions thereof; or
 - c) involving three or more subdivisions thereof which have been consolidated within the past five years;
- The rezoning of a site exceeding 10 000 m²; or
- Any other category of development provided for in regulations by the South African Heritage Resources Agency (SAHRA).

A site visit and subsequent assessment took place during November 2014. The task involved identification of possible paleontological sites or occurrences in the proposed zone, an assessment of their significance, possible impact by the proposed development and recommendations for mitigation where relevant.

Terms of Reference

- Identify and map possible heritage sites and occurrences using available resources.
- Determine and assess the potential impacts of the proposed development on potential heritage resources;
- Recommend mitigation measures to minimize potential impacts associated with the proposed development.

Methodology

The heritage significance of the affected area was evaluated through a desktop study and carried out on the basis of existing field data, database information and published literature. This was followed by a field assessment by means of a pedestrian survey. A Garmin Etrex Vista GPS hand model (set to the WGS 84 map datum) and a digital camera were used for recording purposes. Relevant publications, aerial photographs (incl. Google Earth) and site records were consulted and integrated with data acquired during the on-site inspection.

Field Rating

Site significance classification standards prescribed by SAHRA (2005) were used for the purpose of this report (**Table 1**).

Locality data

1 : 50 000 scale topographic map: 2926 AA Bloemfontein

1: 250 000 scale geological map 2926 Bloemfontein

The proposed development is located on a portion of the farm Brandkop 702, which is situated north of the R706 going to Jagersfontein and about one kilometre west of the N1 national road going through Bloemfontein (**Fig. 2 & 3**).

Site coordinates:

A) 29°10'4.75"S 26°10'17.80"E

B) 29°10'26.99"S 26°10'29.79"E

C) 29°10'52.54"S 26° 9'52.46"E

D) 29°10'22.43"S 26° 8'53.61"E

The study area consists of very flat terrain interspersed by two large koppies that make up the northern (Platkop) and eastern (Tafelkop) boundary of the footprint (**Fig. 3**).

Geology

The geology of the region has been described by Theron (1963) and Johnson (2006). It is situated within the Beaufort Group (Karoo Supergroup), and is primarily represented by late Permian, Adelaide Subgroup sedimentary rocks, which are made up of alternating sandstone and mudstone layers (*Pa*) (**Fig. 4**). Dykes and sills of resistant Jurassic dolerites (*Jd*) determine the relief in the region as witnessed by the Platkop and Tafelkop koppies. The site is capped by younger, superficial deposits of Quaternary age. Superficial deposits in the region consist mainly of and shallow to well-developed, windblown sand and residual soils of varying depth.

Background

The local palaeontological footprint is primarily represented by Late Permian Karoo vertebrate fauna and Late Cenozoic (Quaternary) macrofossils (Broom 1909 a; Broom 1909 b; Goodwin & van Riet Lowe 1929; Kitching 1977; Churchill *et al* 2000; Rossouw 1999, 2000, 2006). The succession of Beaufort Group sedimentary rocks is subdivided into eight biostratigraphic units, called assemblage zones (Rubidge 1995) and the sedimentary strata underlying the affected area are assigned to the *Dicynodon* Assemblage Zone (AZ) (Kitching 1995) (**Fig. 4 & 5**). This assemblage zone is characterized by the presence of a distinctive and fairly common dicynodont genus. Therapsids and other vertebrate fossils from this biozone are usually found as dispersed and isolated specimens in mudrock horizons, associated with an abundance of calcareous nodules. Plant fossils (*Dadoxylon*, *Glossopteris*) and trace fossils (arthropod trails, worm burrows) are also present. The sediments assigned to the *Dicynodon* AZ are associated with stream deposits consisting of floodplain mudstones and subordinate, lenticular channel sandstones. In more recent times the central interior and what is now the Free State Province, was once a vast and highly

productive grassland ecosystem. Quaternary palaeontological sites, often associated with Stone Age artefacts, are found eroding out of Pleistocene alluvial terraces and dongas along the Modder River and its tributaries north and east of Bloemfontein (**Fig. 5**). Some of these alluvial deposits contain numerous occurrences of *in situ* Middle and Later Stone Age material eroding out of the overbank sediments where they are often found in association large mammal fossil remains (Churchill *et al.* 2000; Rossouw 1999, 2000, 2006).

Field Assessment

Results from the field assessment are summarized in **Table 2** (see **Fig. 9**).

The affected area is situated within the Beaufort Group, Adelaide Subgroup (Karoo Supergroup), but is primarily underlain by intrusive, Jurassic-age dolerites, which also determines the relief of the surrounding area. A pedestrian survey indicates that bedrock is capped by unconsolidated Quaternary-age sediments (*Qs*) with moderate profile development, consisting of brown to red calcareous sand and residual soils ranging in depth between 250mm and 750mm (**Fig. 6**). The superficial overburden is largely degraded by previous farming activities. It thins out towards Platkop and Tafelkop, exposing dolerite and associated metasediments made up of fine to coarse-grained sandstones. The koppies are almost exclusively doleritic and not palaeontologically significant, being part of an interconnected network of igneous dolerite intrusions (**Fig. 7 & Fig. 9, Area A**). These dykes intruded the local environment during the Jurassic and “cooked” the adjacent sedimentary rocks (metasediments) (**Fig. 8**). This had the effect of hardening the rocks and destroying any fossil plant material or physically destroying the vertebrate fossils. As a result, intact sedimentary bedrock exposures are mostly lacking or are covered by superficial sediments along the areas of low relief (**Fig. 9, Area B**). A foot survey of the terrain revealed no evidence for the accumulation and preservation of intact fossil material within the superficial Quaternary sediments.

Impact Statement and Recommendation

The proposed development footprint is situated away from major alluvial water courses. It is unlikely that the proposed development will affect palaeontological heritage resources within the superficial component (Quaternary overburden) due to

the disturbed condition of the substrate and the absence of suitable Quaternary-aged alluvial contexts within the boundaries of the footprint. The palaeontological significance of the Quaternary overburden within the boundaries of the proposed footprint is therefore considered to be very minor. This component is assigned a field rating of Generally Protected C (GP.C). The dolerite component (*Jd*) is not palaeontologically vulnerable and the likelihood of impact on palaeontological remains in the vicinity of igneous outcrop is considered unlikely. The koppies, koppie slopes and zones immediately adjacent are assigned a field rating of Generally Protected C (GP.C) (**Fig. 9**, Area A). It is assumed, for the sake of prudence, that fossil remains are always uniformly distributed in fossil-bearing rock units indicated on the relevant geological map of the region, although in reality their distribution may vary significantly. Even so, the proposed footprint is largely located on and adjacent to dolerite bedrock and thermally derived metasediments. The likelihood of impact on palaeontological material from fresh sedimentary bedrock strata, which may occur further away from the koppies (**Fig. 9**, Area B), is considered low, but if *in situ* fossil material is exposed as a result of excavations into fresh sedimentary bedrock, it should be reported to SAHRA and a professional palaeontologist as soon as possible. The capped sedimentary bedrock component possibly unaffected by dolerite intrusions in Area B is assigned a field rating of Generally Protected B (GP.B).

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Tables and Figures

Table 1. Field rating categories for heritage sites as prescribed by SAHRA.

Field Rating	Grade	Significance	Mitigation
National Significance (NS)	Grade 1	-	Conservation; national site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; provincial site nomination
Local Significance (LS)	Grade 3A	High significance	Conservation; mitigation not advised
Local Significance (LS)	Grade 3B	High significance	Mitigation (part of site should be retained)
Generally Protected A (GP.A)	-	High/medium significance	Mitigation before destruction
Generally Protected B (GP.B)	-	Medium significance	Recording before destruction
Generally Protected C (GP.C)	-	Low significance	Destruction

Table 2. Summary of impacts within the proposed footprint.

Zone	Rock types and Age	Potential heritage / Biostratigraphy	Palaeontological Significance before site visit	Potential Impact (after site visit)
Area A	<p>Superficial deposits, soils Quaternary to Recent</p> <p>Dolerite (<i>Jd</i>) Intrusive igneous bedrock. Jurassic</p> <p>Adelaide Subgroup (<i>Pa</i>) Metasediments Late Permian</p>	<p>Stone Age material culture mammal fossil remains and microfossils in alluvial deposits</p> <p>No fossils</p> <p><i>Dicynodon</i> Assemblage Zone</p>	<p>High</p> <p>Low</p> <p>Low</p>	<p>Low</p> <p>Low</p> <p>Low</p>
Area B	<p>Superficial deposits, soils Quaternary to Recent</p> <p>Dolerite (<i>Jd</i>) Intrusive igneous bedrock. Jurassic</p> <p>Adelaide Subgroup (<i>Pa</i>) Fluvial and lacustrine mudstones and sandstones. Late Permian</p>	<p>Stone Age material culture mammal fossil remains and microfossils in alluvial deposits</p> <p>No Fossils</p> <p><i>Dicynodon</i> Assemblage Zone Therapsids, amphibians, fish, amniotes, invertebrates, plant fossils, trace fossils</p>	<p>High</p> <p>Low</p> <p>High</p>	<p>Low</p> <p>Low</p> <p>Low to Moderate</p>

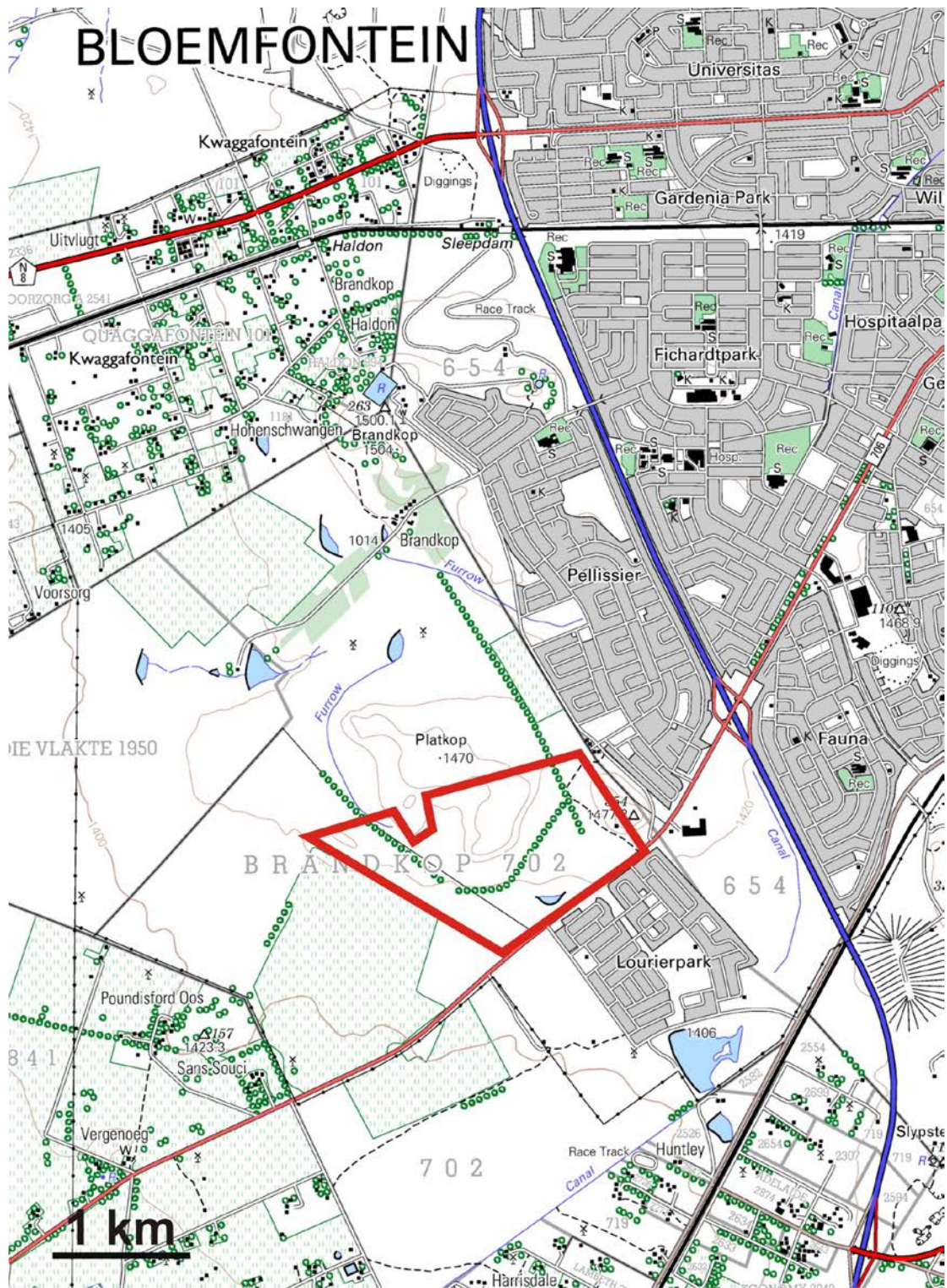


Figure 1. Map of the study area at Brandkop 702. (portion of 1:50 000 scale topographic map 2926 Bloemfontein).



Aerial view of the study area.



Figure 3. Panoramic view of the site, looking north. The study area consists of very flat terrain interspersed by two large koppies that make up the northern (Platkop) and eastern (Tafelkop) boundary of the footprint .

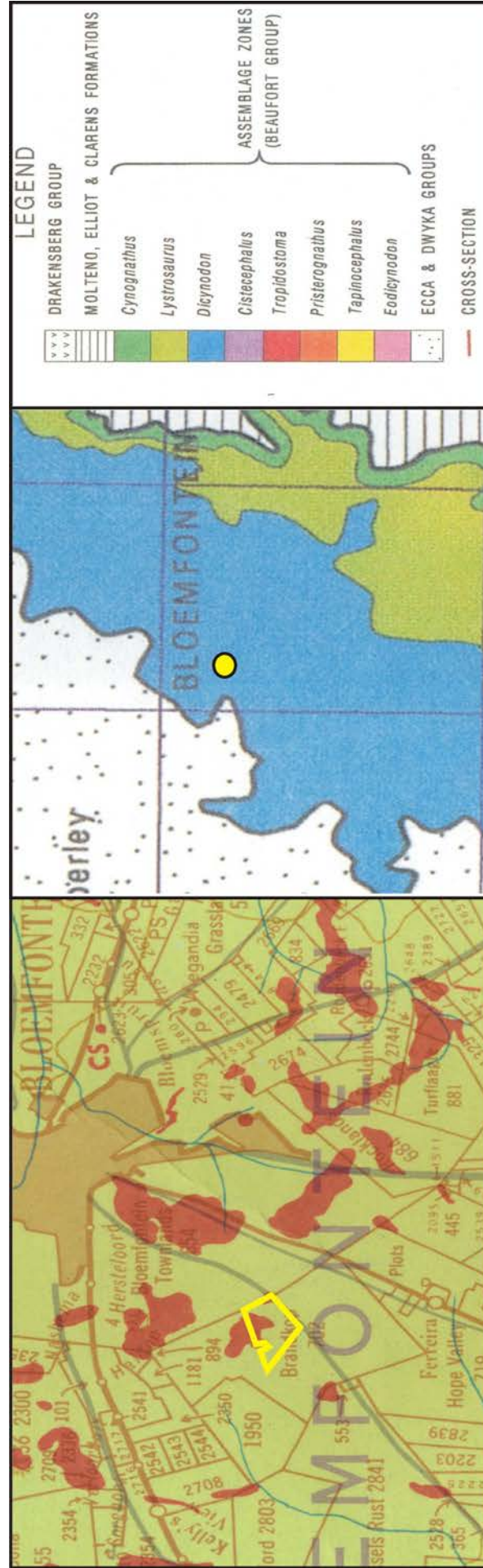


Figure 4. The study area is underlain by late Permian, Adelaide Subgroup sedimentary rocks (*Pa*) and weather-resistant Jurassic dolerites (*Jd*) (portion of 1:250 000 scale geological map 2926 Bloemfontein, left map). According to the SAHRIS palaeo-sensitivity map (2015), the site is located within an area considered to be of high palaeontological sensitivity, with sedimentary strata underlying the affected area assigned to the Dicynodon Assemblage Zone (right map; distribution of vertebrate biozones of the Beaufort Group around Bloemfontein after Rubidge 1995).

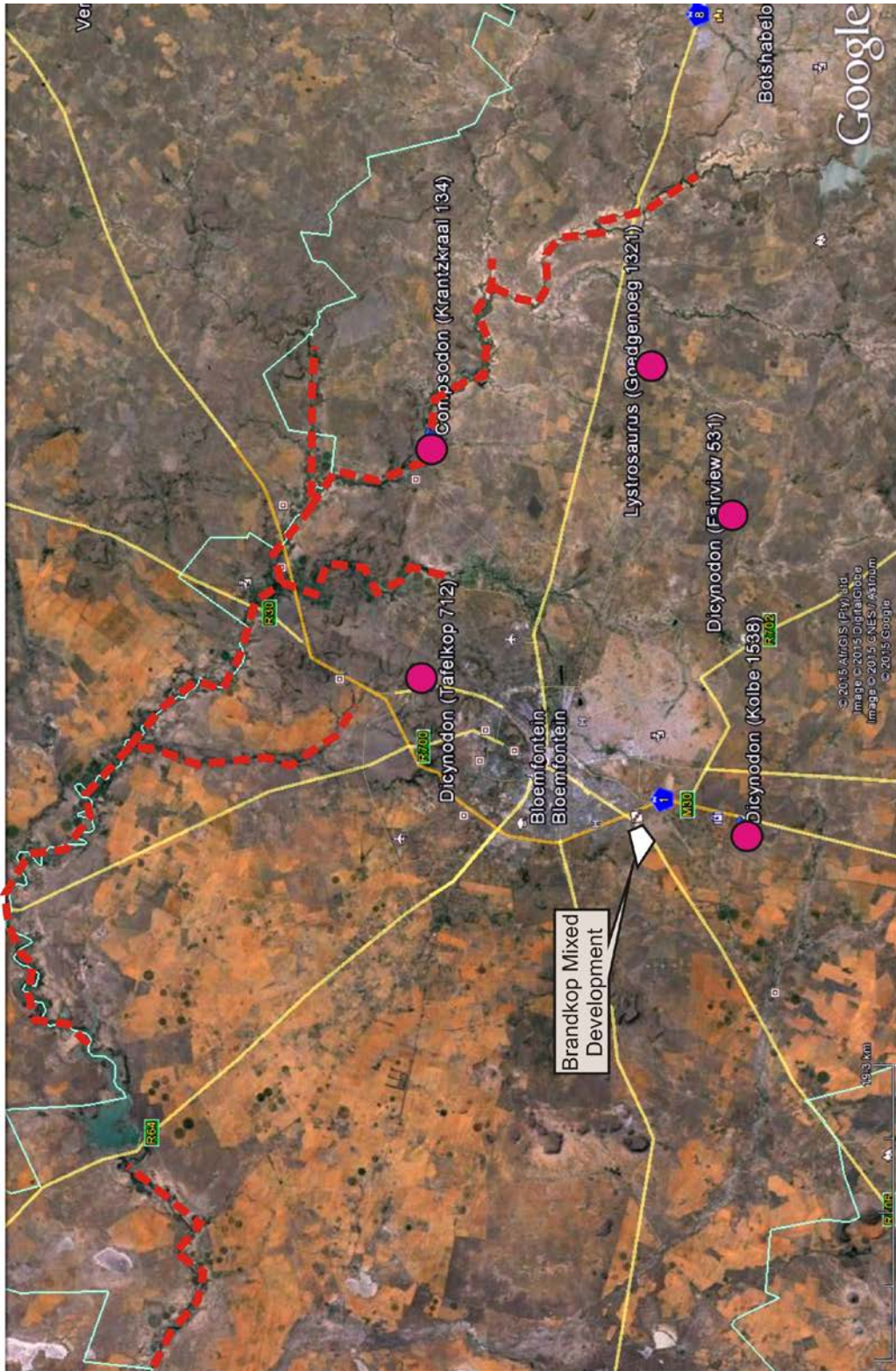


Figure 5. Position of fossil-bearing and archaeologically significant overbank sediments of the Modder River and its tributaries (red line) and recorded Karoo vertebrate fossil localities (circles) in relation to the location of the proposed development footprint.



Figure 6. The study area is primarily underlain by intrusive, Jurassic-age dolerites (left & bottom) capped by unconsolidated Quaternary-age sediments that is made up of brown to red calcareous sand and residual soils of varying depth (top centre & right &, looking east and north, respectively).
Scale 1 = 10 cm.

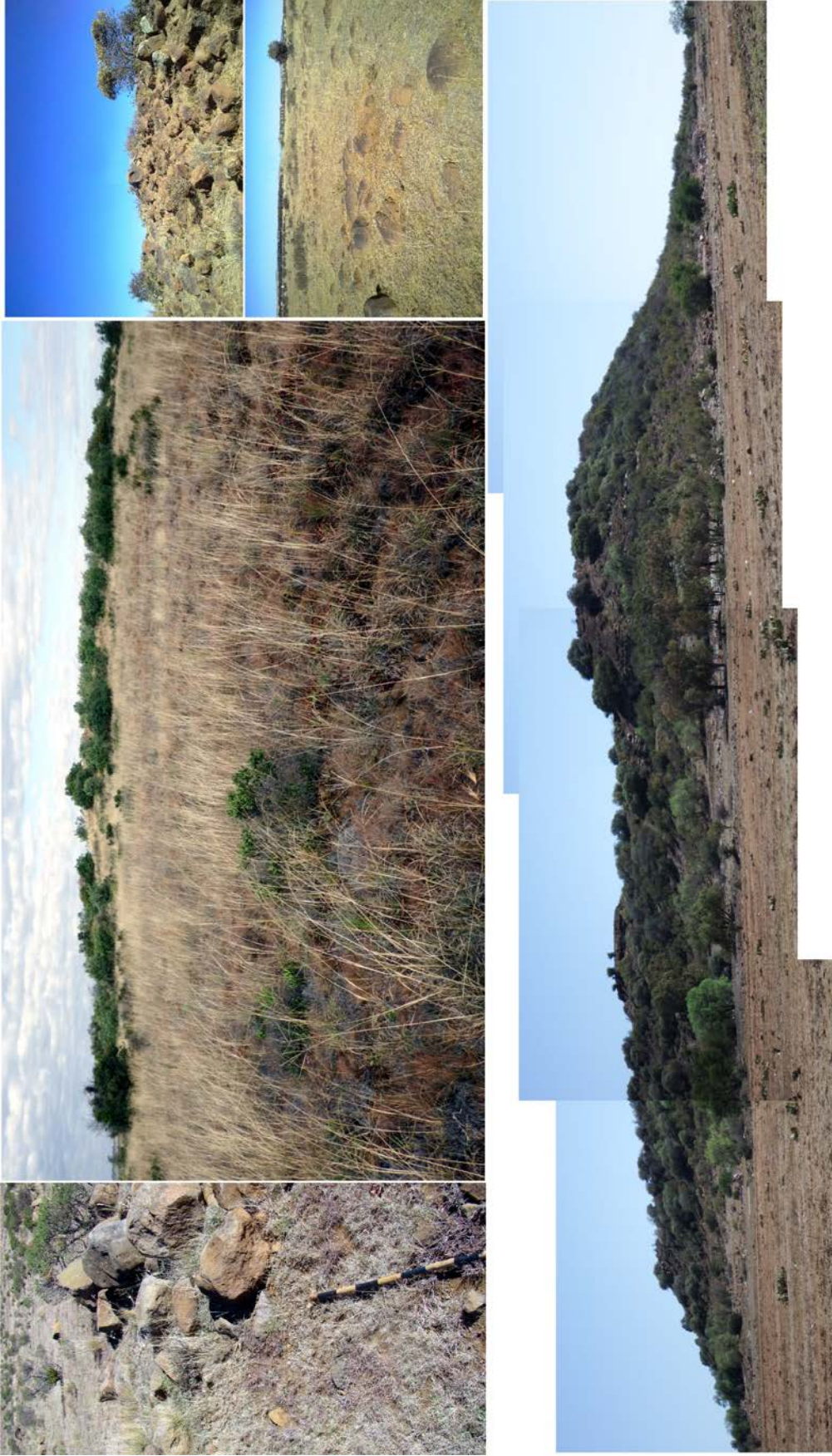


Figure 7. Waether-resistant Platkop (top) and Tafelkop (bottom, looking north) form part of an interconnected network of igneous dolerite intrusions.



Figure 8. Dolerite outcrop and associated metasediments at Platkop and Tafelkop. Scale 1 = 10 cm.



Figure 9. Tentative layout of areas representing low (Area A) to moderate (Area B) palaeontological potential within the boundaries of the proposed development footprint.