PALAEONTOLOGICAL IMPACT ASSESSMENT

IKHEPHU FEEDLOT DEVELOPMENT NEAR KHOWA (ELLIOT) IN THE EASTERN CAPE

2022

COMPILED FOR:

GIBB Environmental (Pty) Ltd

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favorable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting palaeontological impact assessments, including knowledge of the NEMA, EIA Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the NEMA, EIA Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Section 38 of the NHRA when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing – any decision to be taken with respect to the application by the competent authority; and – the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not;
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected from a palaeontological specialist in terms of the NEMA and the constitutions of my affiliated professional bodies; and

- I realize that a false declaration is an offense in terms of Regulation 71 of the EIA Regulations and is punishable in terms of Section 24F of the NEMA.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the EIA Regulations.

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

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Email: elizebutler002@gmail.com

SIGNATURE: 

The palaeontological impact assessment report has been compiled considering the ,Act 107 of 1998), as amendedNEMA and ,EIA (Regulations,) requirements for specialist reports, Appendix 6, as indicated in the table below.

Table 1: NEMA Table

Requirements of Appendix 6 – GN No. 326 (EIA Regulations)	**The relevant section in the report**	**Comment where not applicable**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 3 – refer to **Appendix A**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 5 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 6 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 9	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1;10 & 12	-

Requirements of Appendix 6 – GN No. 326 (EIA Regulations)	**The relevant section in the report**	**Comment where not applicable**
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 8 Approach and Methodology	-
(f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Section 1;10 & 11	-
(g) An identification of any areas to be avoided, including buffers	Section 1 & 12	-
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 6 – Geological and Palaeontological history	-
(i) A description of any assumptions made and any uncertainties or gaps in knowledge	Section 8.1 – Assumptions and Limitations	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 12	-
(k) Any mitigation measures for inclusion in the EMPr	Section 13	-
(l) Any conditions for inclusion in the environmental authorisation	Section 13	-
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 13	-

Requirements of Appendix 6 – GN No. 326 (EIA Regulations)	The relevant section in the report	Comment where not applicable
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised; and	Section 1 & 12	-
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities		-
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 12	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	N/A. A public consultation process was handled as part of the IEA process
(p) A summary and copies of any comments that were received during any consultation process	N/A	N/A. To date, no comments regarding heritage resources that require input from the specialist have been raised

Requirements of Appendix 6 – GN No. 326 (EIA Regulations)	**The relevant section in the report**	**Comment where not applicable**
(q) Any other information requested by the competent authority	N/A	N/A
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply	Section 3 compliance with SAHRA guidelines	-

EXECUTIVE SUMMARY

Banzai Environmental was appointed by GIBB Environmental (Pty) Ltd to conduct the Site Sensitivity Verification (SSV) for Palaeontology Resources, the findings of the SSV confirmed the "Very High Sensitivity" for the palaeontology theme indicated in the Screening Report as such a Palaeontological Impact Assessment (PIA) to assess the site for the Proposed Ikhephu Co-Operative (Ikhephu) near Khowa (Elliot), under the jurisdiction of Sakhisizwe Local Municipality (SLM) and Chris Hani District Municipality (CHDM) was recommended by the palaeontologist. In accordance with the Environmental Impact Assessment Regulations, 2014 as amended (EIA Regulations), enacted under the National Environmental Management Act, 1998 (Act 107 of 1998) as amended (NEMA), and to comply with Section 38 of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) as amended (NHRA), this PIA is necessary to confirm if fossil material could potentially be present in the planned development area, to evaluate the potential impact of the proposed development on the Palaeontological Heritage and to mitigate possible damage to fossil resources.

The western margin of the alternative site is mostly underlain by Jurassic dolerite while the eastern margin of the development is underlain by the Late Triassic Molteno Formation (Stormberg Group, Karoo Supergroup) as well as a very small portion of Quaternary alluvium. The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of Quaternary alluvium is Moderate, that of Jurassic dolerite is Zero as it is igneous in origin, while the Palaeontological Sensitivity of the Molteno Formation is Very High (Almond and Pether, 2009; Almond *et al*., 2013). Recent updated geology indicates that the proposed Ikhephu Feedlot Development is underlain by sediments of the Late Triassic Molteno Formation (Stormberg Group, Karoo Supergroup).

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 10 September 2022. The study area has an undulating topography, mostly mantled by grassy vegetation and trees in the northern and north-western portion of the preferred alternative site. No fossiliferous outcrop was detected in the proposed development area. The apparent rarity of fossil heritage in the proposed development footprint suggests that the impact of the development will be of a Low significance in palaeontological terms. It is therefore considered that the proposed development will not lead to damaging impacts on the palaeontological resources of the area. The construction of the development may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.

However, if fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the Chance Find Protocol must be implemented by the Environmental Control Officer (ECO)/site manager in charge of the proposed development. These discoveries

ought to be protected (if possible, *in situ*) and the ECO/site manager must report to the South African Heritage Resources Agency (SAHRA). The contact details of the Eastern Cape Provincial Heritage Resources Authority (ECPHRA) are: 16 Commissioner Street, East London, 5201, South Africa. Tel: 043 745 0888. Fax: 043 745 0889., email: info@ecphra.org.za; Web: https://www.ecphra.org.za/). Web: www.sahra.org.za) so that mitigation (recording and collection) can be carry out by a paleontologist.

Preceding any collection of fossil material, a specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.

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1 INTRODUCTION

Ikhephu proposes to develop a cattle feedlot in Khowa (Elliot), under the jurisdiction of SLM and CHDM. The development will fall on Erf 1 of Elliot owned by SLM. The Ikhephu Feedlot has an existing footprint developed by CHDM and is accessed through a gravel road with a boundary fence intact on all sides, however, the site cannot be utilized to full capacity due to design issues.

The current facility infrastructure includes:

- 3 camp feedlot meant to house 450 animals
- A steel storage structure (to be retained and utilised)
- Some water infrastructure (borehole)
- Incomplete offices (to be completed and utilised

The proposed design will include:

- 2.3 hectare (ha) feedlot to house 1 500 head of cattle in camps not exceeding 150 head of cattle (15m^2 / animal) with feeding troughs and water reticulation
- Load and off-load facility (existing)
- Vehicle weigh bridge
- Animal handling facility
- Receiving pen and isolation pen
- Water supply infrastructure (existing)
- Feed storage shed (Existing)
- Grain storage silo (2 x 30 ton) and hammer mill
- Vehicle storage / workshop facility (18 x 40 m steel structure)
- Office facilities (existing incomplete offices to be completed)
- The design makes provision for the control of run-off water, waste lagoons, disposal of solid waste, toilets and facilities for labour force and internal roads

Provision will be made for future expansion to 2 000 head of cattle in camps not exceeding 200 head of cattle (20 m^2 / animal).

Surrounding land uses are a mix of agricultural, open land and a regional road, R58 leading to Barkly East (Figure 1-2, below).

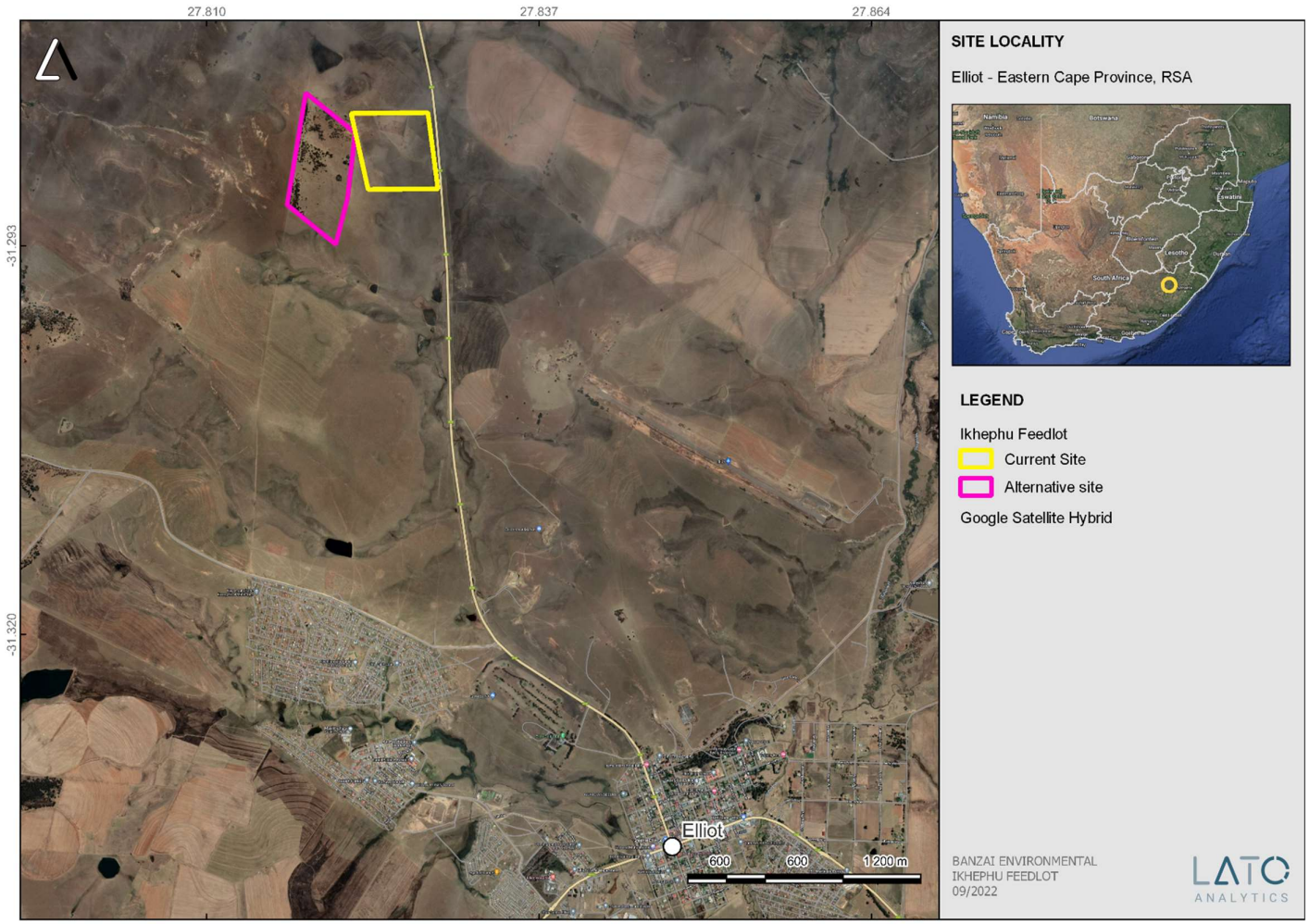


Figure 1:*Regional Locality of the proposed Ikhephu Feedlot Development in the Eastern Cape.*

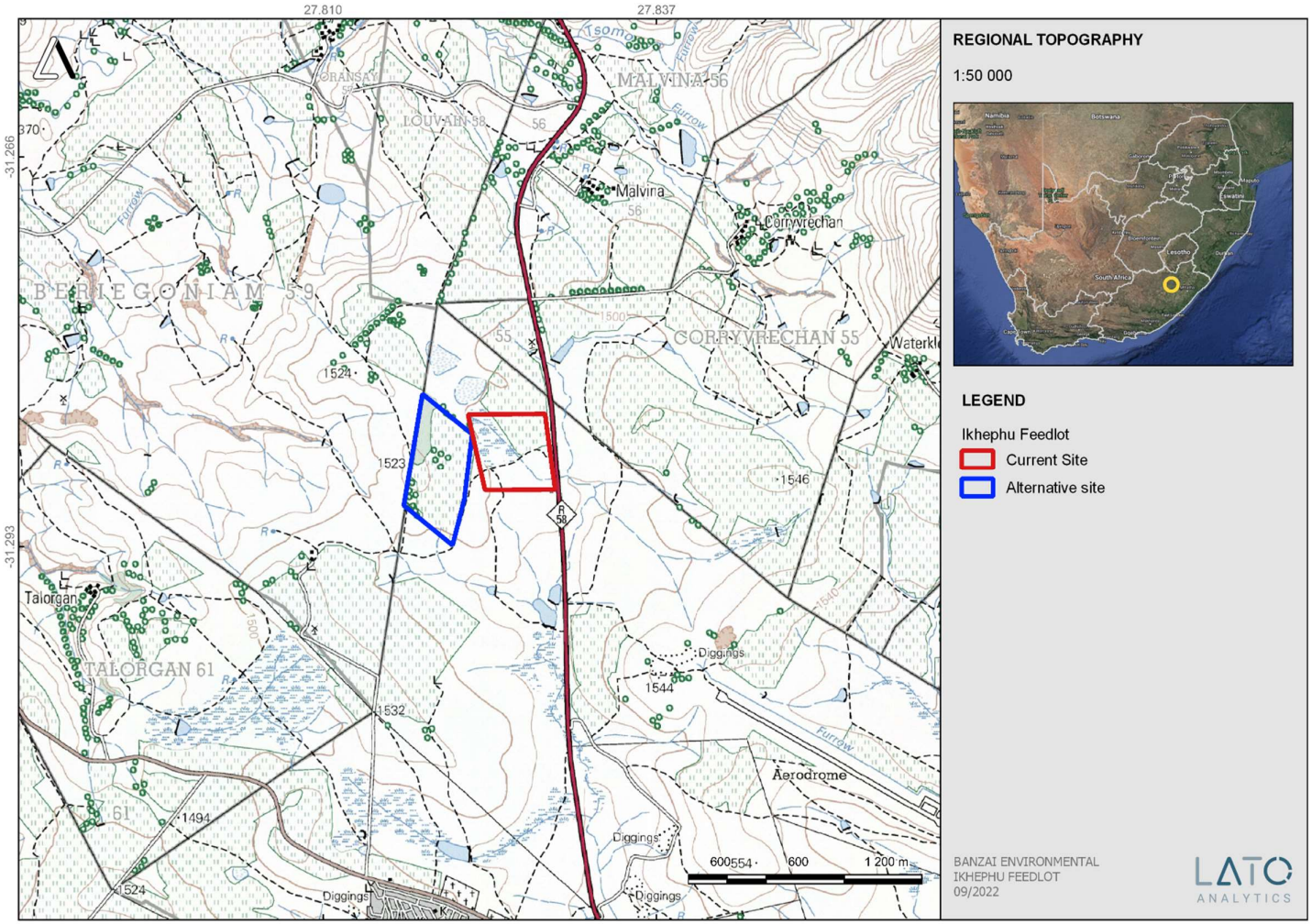


***Figure 2**:Locality of the proposed Ikhephu Feedlot Development in the Eastern Cape.*

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This study has been conducted by Mrs Elize Butler. She has conducted approximately 300 PIAs for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-eight years. She has 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 (PSSA) since 2006 and has been conducting PIAs since 2014.

3 LEGISLATION

National Heritage Resources Act, 1999 (Act 25 of 1999)

Cultural Heritage in South Africa, including all heritage resources, is protected by the NHRA. Heritage resources as defined in Section 3 of the Act include "all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens".

The identification, evaluation and assessment of any cultural heritage site, artefact or finds in the South African context is required and governed by the following legislation:

- NEMA
- NHRA
- Government Notice (GN) No. 648 of the Government Gazette 45421 - general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified

The next section, as prescribed in each Act, is directly applicable to the identification, assessment, and evaluation of cultural heritage resources.

GN No. 326 (Government Gazette 40772, 07 April 2017) promulgated under the NEMA:

- Basic Assessment Report (BAR) – Regulations 19
- Environmental Impacts Assessment (EIA) – Regulation 23
- Environmental Scoping Report (ESR) – Regulation 21
- Environmental Management Programme (EMPr) – Regulations 19 and 23

NHRA:

- Protection of Heritage Resources – Sections 34 to 36
- Heritage Resources Management – Section 38

The NEMA states that an integrated EMP should (23:2 (b)) "*…identify, predict and evaluate the actual*

and potential impact on the environment, socio-economic conditions and cultural heritage".

In agreement with legislative requirements, EIA rating standards as well as SAHRA policies the following comprehensive and legally compatible PIA report have been compiled.

Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources may not be unearthed, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per Section 35 of the NHRA.

This PIA forms part of the Heritage Impact Assessment (HIA) and adheres to the conditions of the Act. According to Section 38 (1), an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length.
- the construction of a bridge or similar structure exceeding 50 m in length.
- any development or other activity which will change the character of a site—
    - (Exceeding 5 000 m^2 in extent; or
    - involving three or more existing erven or subdivisions thereof; or
    - involving three or more erven or divisions thereof which have been consolidated within the past five years; or
    - the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority.
- the re-zoning of a site exceeding 10 000 m^2 in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

The objective of a PIA is to determine the impact of the development on potential palaeontological material at the site.

According to the "SAHRA Palaeontological, Archaeological and Meteorite (APM) Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports", the aims of the PIA are: 1) to identify the palaeontological status of the exposed as well as rock formations just below the surface in the development footprint; 2) to estimate the palaeontological importance of the formations; 3) to determine the impact on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.

The terms of reference of this PIA are as follows:

4.1 General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations;
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements;
- Submit a comprehensive overview of all appropriate legislation, guidelines;
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study;
- Description and location of the proposed development and provide geological and topographical maps;
- Provide palaeontological and geological history of the affected area;
- Identification of sensitive areas to be avoided (providing shapefiles/kml files) in the proposed development;
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
    - Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
    - Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity.
    - Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses, etc).

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed Ikhephu Feedlot Development in the Eastern Cape is depicted on the 1: 250 000 Aliwal North 3026 Geological map (1983) (Council of Geoscience, Pretoria). The western margin of the project is mostly underlain by Jurassic dolerite (Jd, red) while the eastern margin of the development is underlain by the Late Triassic Molteno Formation ($T_{Rm,}$- orange) of the Stormberg Group (Karoo Supergroup) with a very small portion underlain by Quaternary alluvium (yellow, single bird figure) in the east(Figure 3). The PalaeoMap of the SAHRIS indicates that the Palaeontological Sensitivity of Quaternary alluvium is Moderate, that of Jurassic dolerite is Zero as it is igneous in origin, while the

Palaeontological Sensitivity of the Molteno Formation is Very High (Almond and Pether, 2009; Almond *et al*., 2013; Figure 4).

The geology has recently been updated (Council of Geosciences, Pretoria; Figure 5). This map indicates that the proposed Ikhephu Feedlot Development is underlain by sediments of the Late Triassic Molteno Formation (Stormberg Group, Karoo Supergroup).

The Quaternary superficial deposits are the youngest geological deposits formed during the most recent geological period (approximately 2.6 million years ago to present). Most of the superficial deposits are unconsolidated sediments and consist of clay, gravel, sand, silt, that form relatively thin, discontinuous patches of sediments. These sediments comprise of channel, floodplain and stream deposits. Quaternary deposits are very important because palaeoclimatic changes are reflected in the different geological formations (Hunter et al., 2006). During the climate fluctuations in the Cenozoic Era most geomorphologic features in southern Africa where formed (Maud, 2012). Barnosky (2005) indicated that various warming and cooling events occurred in the Cenozoic but states that climatic changes during the Quaternary Period, specifically the last 1.8 Ma, were the most drastic climate changes relative to all climate variations in the past. Climate variations that occurred in the Quaternary Period were both drier and wetter than the present and resulted in changes in river flow patterns, sedimentation processes and vegetation variation (Tooth et al., 2004).

Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. These fossil assemblages may in some cases occur in extensive alluvial and colluvial deposits cut by dongas. In the past palaeontologists did not focus on Caenozoic superficial deposits although they sometimes comprise of significant fossil deposits. These fossil assemblages resemble modern animals and may comprise of mammalian teeth, bones and horn corns, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known from Quaternary deposits. Plant material such as foliage, wood, pollens and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts).

The development area is extensively intruded by dolerite dikes and sills of the Karoo Dolerite (Jd, red) of the Karoo Igneous Province. This Province in southern Africa is a classic continental flood basalt province that was formed during the Early Jurassic Period. This province occurs over a comprehensive area in southern Africa and comprises a widespread system well developed igneous bodies (dykes, sills) that invaded the sediments of the Main Karoo Basin. Flood basalts do not typically form any visible volcanic structures, but with a series of outbursts form a suite of fissures of sub-horizontal lava flows that may vary in thickness. The Karoo is an old flood basalt province and is preserved today as erosional remnants of a more extensive lava cap that covered much of southern Africa in the geological past. This Suite is entirely unfossiliferous.

The Molteno Formation of the Stormberg Group is Late Triassic in age. In its most southern outcrop this formation is about 600m thick and can be divided into five members (Turner, 1975; Christie, 1981) namely [oldest (bottom) to youngest (top)] Bamboesberg, Indwe, Mayaputi, Qiba and Tsomo Members. This Formation becomes thinner and reaches 10m in the far north. The Molteno Formation consists of alternating coarse to medium grained sandstones and grey mudrocks. The characteristic "glittering" look of this Formation is caused by secondary quartz overgrowths. This Formation is known for well-preserved insect and plant fossils with coal seams in places. The Bamboesberg Member is the basal member in the south while the Indwe Sandstone Member, is the only representative in the north. These Members overlies the Beaufort Group unconformably (Turner, 1975). The Bamboesberg Member is about 130m thick and is a complex succession that becomes finer upwards in the succession and more erosively based. Medium to fine grained sandstone beds is present with thin, lenticular mudrock intercalations. The Indwe Sandstone Member is about 60m thick and consists of course (pebbly) to medium grained sandstones with an erosively based cobble and pebble bed at its base. The Mayaputi Member is thicker than 50 m and is mostly an argillaceous unit while the more than 60m thick Qiba Member consists of fine- to medium-grained sandstone beds associated with thin mudrock partings. The Tsomo Member is about 300m thick and comprise of a recurring pattern of erosively based, coarse-grained to pebbly sandstones (up to 25m thick) grading upwards into mudrock units (up to 60 m thick). The Molteno Formation is known from two sporadically developed coal seams present in the Tsomo Member comprising of thin, lenticular coal seams.

The Dicroidium Flora of Gondwana preserved in the Molteno Formation is known for the richest plant fossils in the world comprising of diverse vascular plant fossils (horsetails, ferns, gymnosperms include ginkgophytes, cycads, conifers, and seed ferns, silicified woods and palynomorphs) insect's groups as well as dinosaur trackways. Other fossils include bivalves, conchostracans, fish as well as invertebrate trace fossils. This Formation is not known to contain vertebrate fossils (Hancox et al 2020).

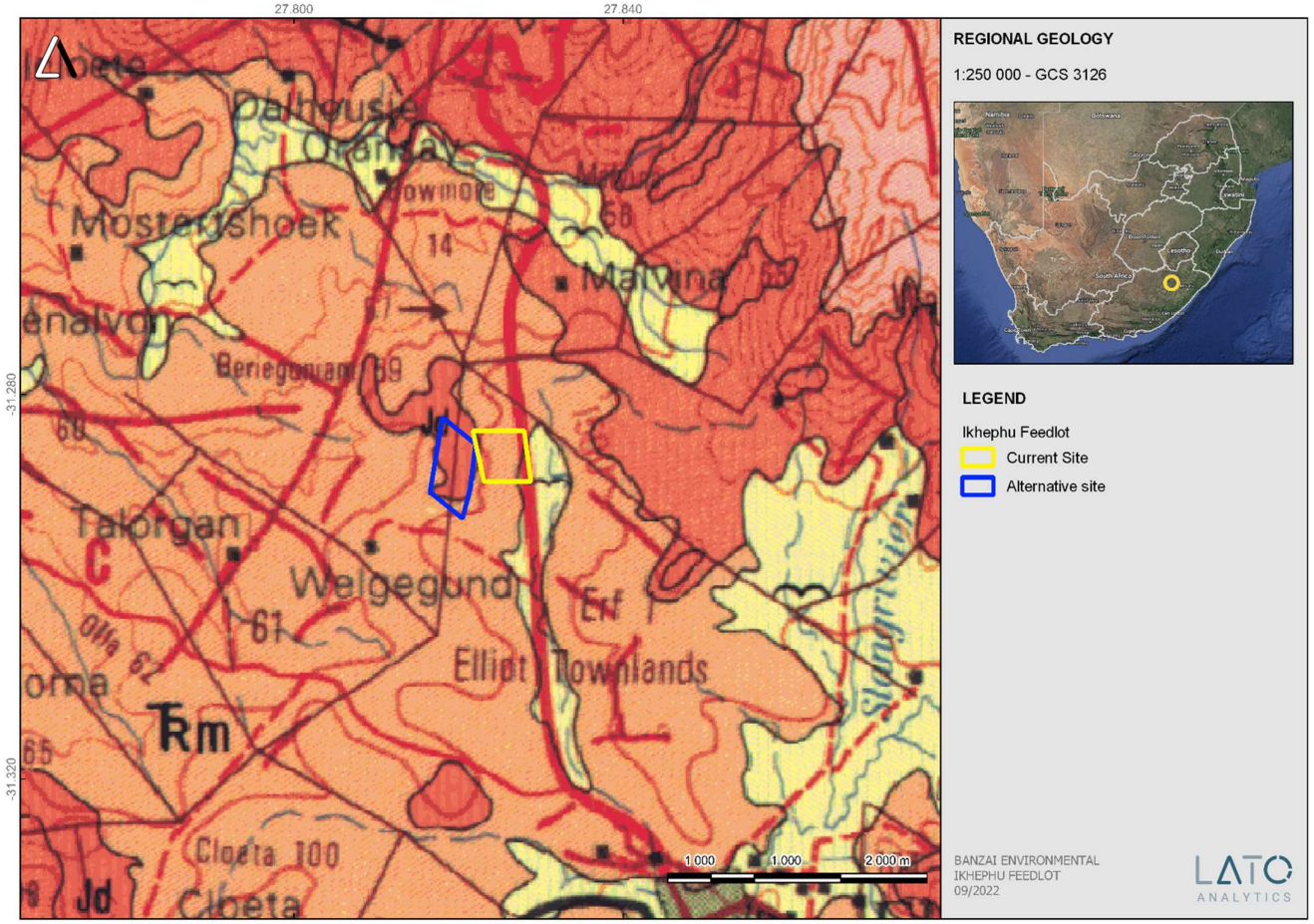
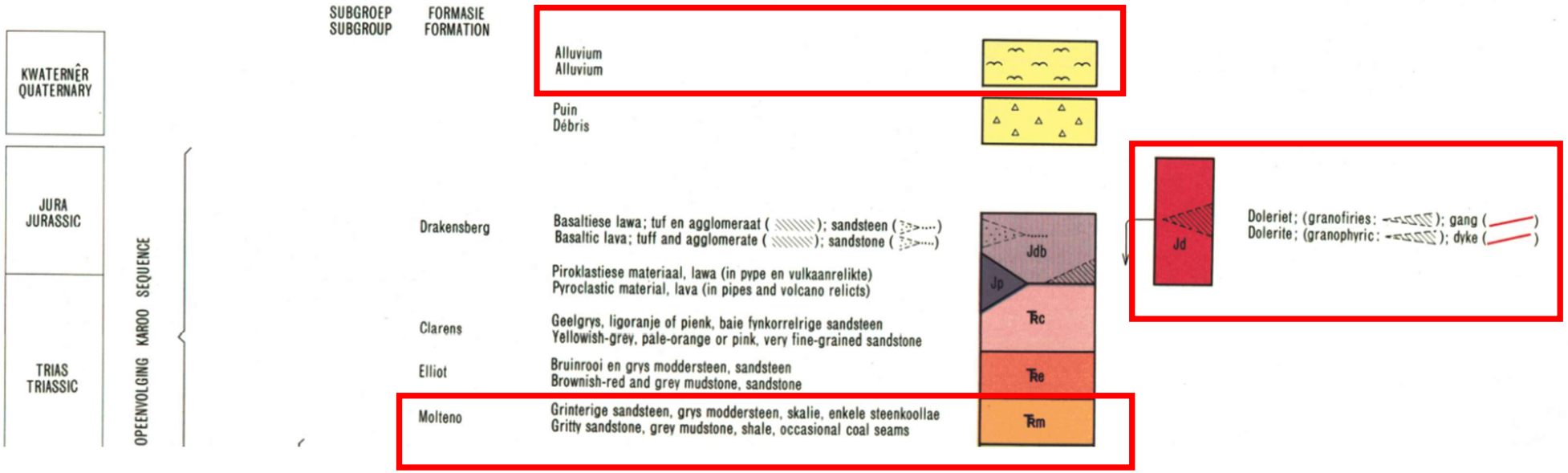


***Figure 3**: Extract of the 1: 250 000 Aliwal North 3026 Geological map (1983) (Council of Geoscience, Pretoria) indicating the proposed Ikhephu Feedlot Development in the Eastern Cape.*

Table 2: Legend to the Aliwal North 3026 Geological map (1983) (Council for Geoscience, Pretoria).

Relevant sediments are indicated in a red block



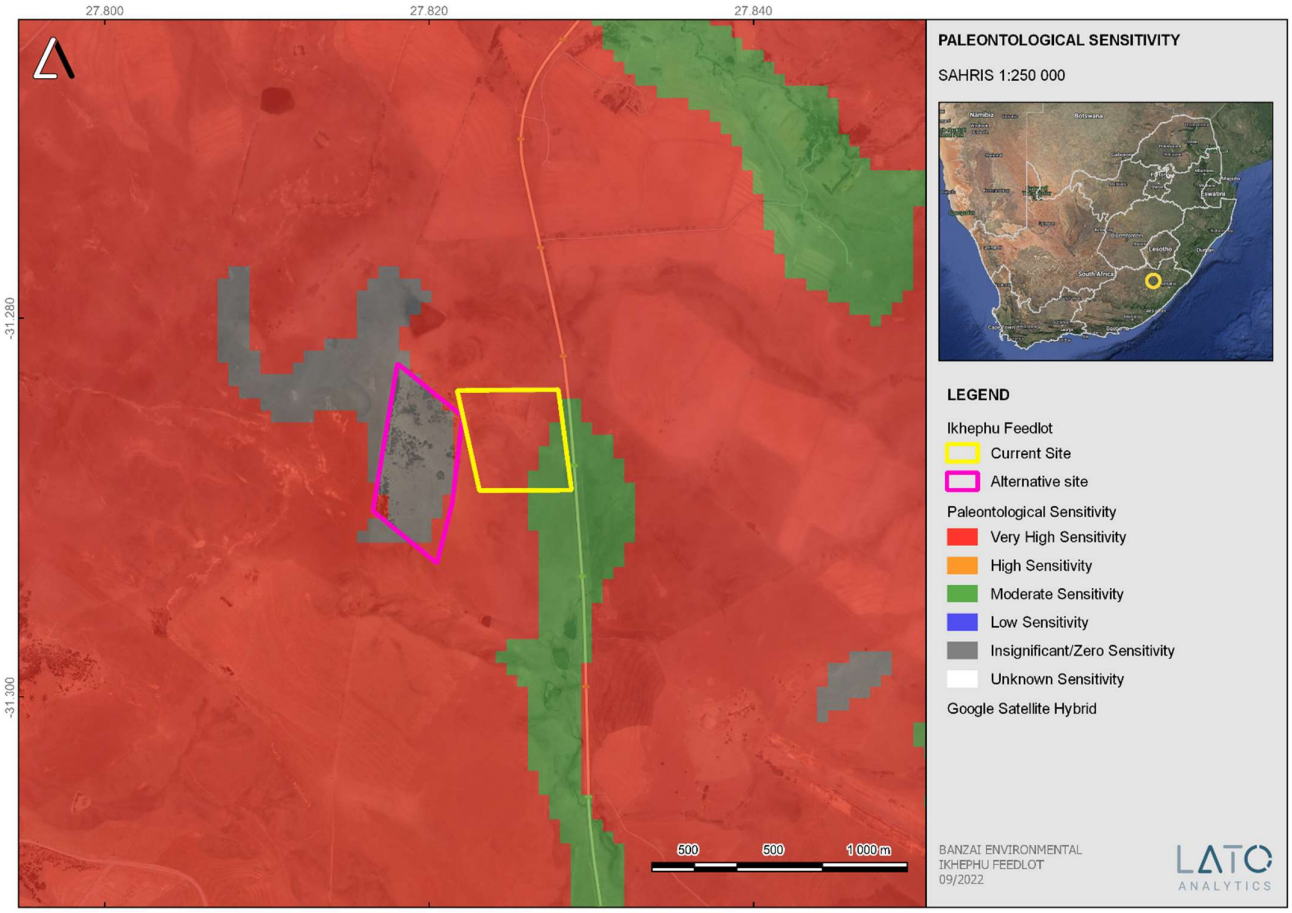


***Figure 4**: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed Ikhephu Feedlot Development in the Eastern Cape.*

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Table 3:Palaeontological Sensitivity according to the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website

Colour	Sensitivity	Required Action
RED	**VERY HIGH**	**Field assessment and protocol for finds is required**
ORANGE/YELLOW	HIGH	Desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	**MODERATE**	**Desktop study is required**
BLUE	LOW	No palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	No palaeontological studies are required
WHITE/CLEAR	UNKNOWN	These areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

According to the SAHRIS Palaeosensitivity map (Figure 4) the proposed development is underlain by sediments with a Very High (red), Moderate (green) and Zero (grey) Palaeontological Significance.

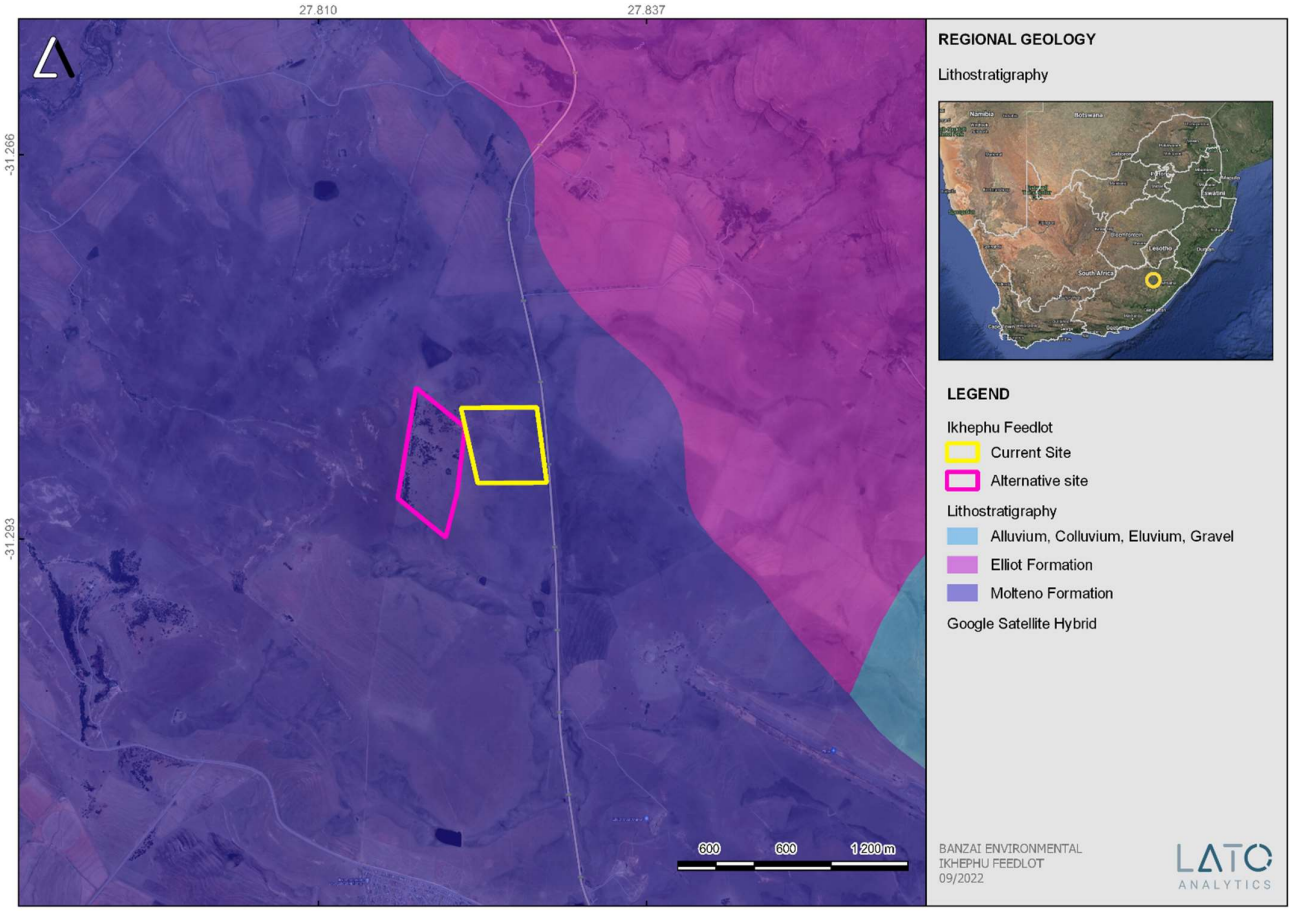

Figure 5: *Updated Geology (Council of Geosciences, Pretoria) indicates that the proposed Ikhephu Feedlot Development in the Eastern Cape is underlain by the Late Triassic Molteno Formation of the Stormberg Group (Karoo Supergroup)*

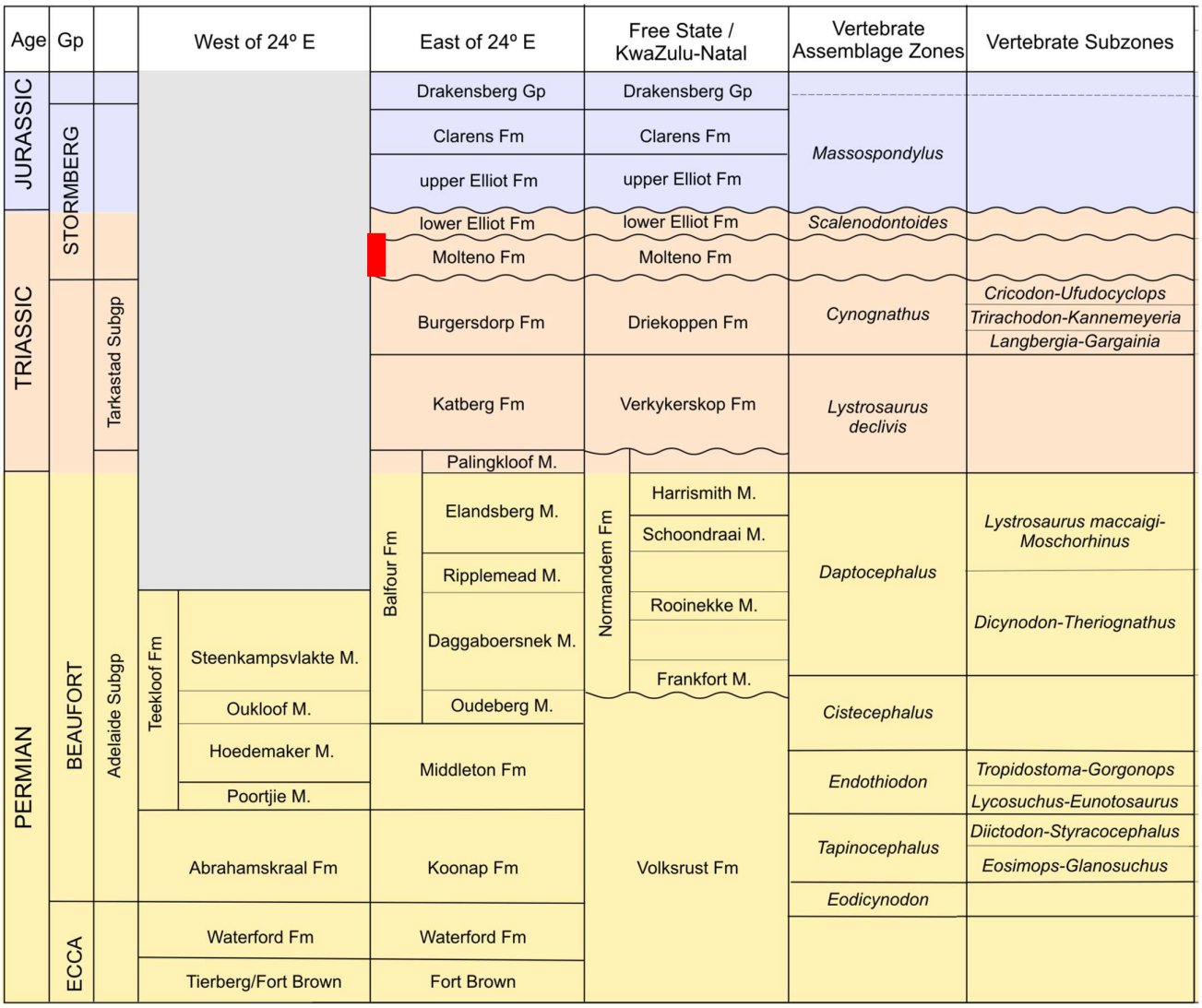

***Figure 6**: Vertebrate biozonation range chart for the Main Karoo Basin of South Africa.*

Solid lines indicate known ranges, dotted lines indicate suspected but not confirmed ranges, single dot represents the stratigraphy is position of the taxa that have only been recovered from a single bed. Wavy lines indicate unconformities. (PLYCSR=Pelycosauria and MAMMFMES Mammaliaformes. Gp=group, Subgp-Supbroup, Fm=Formation, M=Member. Molteno Formation is indicated in red.

6 GEOGRAPHICAL LOCATION OF THE SITE

Elliot is located approximately 4 km south-east of the proposed development. (Figure 1-2).

Table 4:GPS coordinates

		Latitude	Longitude
Current feedlot	North eastern border	31°17'1.57"S	27°49'40.61"E
	North western border	31°17'1.74"S	27°49'18.28"E
	South eastern border	31°17'20.51"S	27°49'43.70"E
	South western border	31°17'20.63"S	27°49'23.21"E
Alternative feedlot	North western Border	31°16'56.73"S	27°49'4.94"E
	North eastern border	31°17'6.78"S	27°49'19.34"E
	Southern border	31°17'34.58"S	27°49'13.75"E
	Western Border	31°17'24.47"S	27°48'59.52"E

7 METHODS

The aim of a desktop study is to evaluate the possible risk to palaeontological heritage in the proposed development. This includes all trace fossils as well as all fossils in the proposed footprint. All possible information is consulted to compile a desktop study, and this includes the following: all Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

7.1 Assumptions and Limitations

The focal point of geological maps is the geology of the area and the sheet explanations of the Geological Maps were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have never been reviewed by palaeontologists and data is generally based on aerial photographs alone. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is also used to provide information on the existence of fossils in an area which has not documented in the past. When using similar Assemblage Zones and geological formations for Desktop studies it is generally assumed that exposed fossil heritage is present within the footprint. A field-assessment will thus improve the accuracy of the desktop assessment.

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- A Google Earth map with polygons of the proposed development was obtained from Gibb.

- 1:250 000 **Aliwal North 3026** Geological Map (Council for Geosciences, Pretoria)

9 SITE VISIT

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 10 September 2022. Outcrops are very rare in the development and no fossiliferous outcrops were identified during the site visit.

Figure 7*:View from the east overlooking the sites indicates an undulating topography with dense but low vegetation*

Figure 8*: Quaternary outcrops exposed in the eastern portion of the current feedlot site.*

Figure 9: Surface sandstones present in the alternative feedlot site

***Figure 10**: Thick quaternary sediments in the eastern portion of the alternative feedlot site.*

Figure 11: Mudrock exposures present in donga in the alternative feedlot site

10 IMPACT ASSESSMENT METHODOLOGY

The environmental assessment aims to identify the various possible environmental impacts that could results from the proposed activity. Different impacts need to be evaluated in terms of its significance and in doing so highlight the most critical issues to be addressed.

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e., site, local, national or global whereas intensity is defined by the severity of the impact e.g., the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 5 below.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

10.1 Impact Rating System

Impact assessment must take account of the nature, scale and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the project phases:

- planning
- construction
- operation

- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact, the following criteria is used:

Table 5:The rating system

NATURE		
Loss of fossil heritage.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter

		than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation

		and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.

4	High cumulative impact	The impact would result in significant cumulative effects

SIGNIFICANCE

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive effects.

Table 6:Summary of Impacts

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

	Extent	Duration	Magnitude	Reversibility	Irreplicable loss	Cumulative effect	Impact
Pre-Mitigation	1	4	4	4	4	3	64
Post-Mitigation	1	4	1	4	4	3	16

11 FINDINGS AND RECOMMENDATIONS

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 10 September 2022. The study area has an undulating topography, mostly mantled by grassy vegetation, while trees are present in the northern and north-western portion of the alternative site. No fossiliferous outcrop was detected in the study area. The apparent rarity of fossil heritage in the proposed development footprint suggests that the impact of the development will be of a Low significance in palaeontological terms. It is therefore considered that the proposed development will not lead to damaging impacts on the palaeontological resources of the area. The construction of the development may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.

However, if fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the Chance Find Protocol must be implemented by the ECO/site manager in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO/site manager must report to SAHRA (Contact details: Eastern Cape Provincial Heritage Resources Authority (ECPHRA), 16 Commissioner Street, East London, 5201, South Africa. Tel: 043 745 0888. Fax: 043 745 0889., email: info@ecphra.org.za; Web: https://www.ecphra.org.za/). Web: www.sahra.org.za) so that mitigation (recording and collection) can be carry out by a paleontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.

12 CHANCE FINDS PROTOCOL

The following procedure will only be followed if fossils are uncovered during the excavation phase of the development.

12.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the National Heritage Resources Act (Act No 25 of 1999) (NHRA). According to Section 3 of the Act, all Heritage resources include "all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens".

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens of South Africa. Palaeontological resources may not be excavated, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

A fossil is the naturally preserved remains (or traces thereof) of plants or animals embedded in rock. These organisms lived millions of years ago. Fossils are extremely rare and irreplaceable. By studying fossils, it is possible to determine the environmental conditions that existed in a specific geographical area millions of years ago.

This informational document is intended for workmen and foremen on construction sites. It describes the actions to be taken when mining or construction activities accidentally uncovers fossil material.

It is the responsibility of the Environmental Site Officer (ESO) or site manager of the project to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. In the absence of the ESO, a member of the staff must be appointed to be responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

12.2 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately stop working and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately report the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa.

Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.

- A preliminary report must be submitted to the Heritage Agency within 24 hours of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.
- Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.
- The site must be secured to protect it from any further damage. No attempt should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- If the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO. Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once the Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

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Appendix A – Elize Butler CV

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	29 years in Palaeontology
EDUCATION:	B.Sc Botany and Zoology, 1988
	University of the Orange Free State
	B.Sc (Hons) Zoology, 1991
	University of the Orange Free State
	Management Course, 1991
	University of the Orange Free State
	M. Sc. *Cum laude* (Zoology), 2009
	University of the Free State

Dissertation title: The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

PROFESSIONAL MEMBERSHIP

Palaeontological Society of South Africa, 2006 - current

EMPLOYMENT HISTORY

Part-time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part-time laboratory assistant	Department of Virology
	University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant	National Museum, Bloemfontein
and Collection Manager	1998–currently

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