APPENDIX E15 – Desktop Palaeontology Impact Assessment

BANZAI ENVIRONMENTAL

PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED 750MW COMBINED CYCLE GAS TURBINE POWER PLANT IN RICHARDS BAY, CITY OF UMHLATHUZE LOCAL MUNICIPALITY, KING CETSHWAYO DISTRICT MUNICIPALITY, KWAZULU-NATAL

March 2026

COMPILED FOR: Nemai Consulting (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 favourable 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 Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, 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 favourable 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 a palaeontological specialist in terms of the Act 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 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 Regulations.

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

Tel: +27 844478759

Email: info@banzai-group.com

SIGNATURE: 

This Palaeontological impact assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

Table 1: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended)

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in 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 1	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 2 – refer to Appendix 1	-
(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 1	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – 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 6	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment		Desktop Assessment
(e) a description of the methodology adopted in preparing the report or	Section 4 Approach and Methodology	-

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
carrying out the specialised process inclusive of equipment and modelling used		
(f) details of an assessment of the specific 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 and 8	
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified
(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 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.5 – 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 1and 8	
(k) Any mitigation measures for inclusion in the EMPr	Section 1, 7 and 8	
(l) Any conditions for inclusion in the environmental authorisation	Section 1and 8	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 1and 8	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1and 8	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(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 1and 8	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	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	

EXECUTIVE SUMMARY

Banzai Environmental (Pty) Ltd was appointed by Nemai Consulting (Pty) Ltd to conduct the Palaeontological Desktop Assessment (PDA) to assess the Proposed 750MW Combined Cycle Gas Turbine Power Plant in Richards Bay, City of uMhlathuze Local Municipality, King Cetshwayo District Municipality, Kwazulu-Natal. In accordance with the National Environmental Management Act 107 of 1998 (NEMA) and to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PDA 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 proposed study area is underlain by unconsolidated Quaternary dune sands derived from the reworking of the Kosi Bay Formation on the Northern Natal coastal plain that resulted from marine regression and dry periods when dune formation was wide spread. These are characterised as yellowish-red, grey, and white dune sands with local pockets of calcareous clays. The SAHRIS Palaeontological Sensitivity Map classifies the area as having Low Palaeontological Sensitivity (Almond & Pether, 2009; Almond et al., 2013), which is supported by the Department of Forestry, Fisheries and the Environment (DFFE) National Web-Based Environmental; Screening Tool Report. Based on the desktop assessment, which identified the surface geology as low-sensitivity unconsolidated dune sand, a site-specific field investigation was not deemed necessary. This determination is supported by the low Palaeontological Sensitivity ratings assigned to the area by both the SAHRIS PalaeoMap and the DFFE National Screening Tool.

It is therefore considered that the development may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources. It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required, pending the discovery of newly discovered fossils.

Recommendations:

However, if significant fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Environmental Control Officer (ECO) in charge of these developments must be informed. Any fossil discoveries must be protected *in situ* (if possible), and the ECO or site manager must report the find to AMAFA (KwaZulu-Natal AMAFA and Research Institute) for further guidance. Contact details: 195 Langalibalele Street, Pietermaritzburg, KwaZulu-Natal, South Africa, 9301; Tel: 0333946543 ; Website: https://amafainstitute.org.za/; email: info@amafainstitute.org.za). This will allow the necessary mitigation measures (recording and collection) to be undertaken by a qualified Palaeontologist.

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.

It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils. `These recommendations should be incorporated into the Environmental Management Programme (EMPr) for the proposed 750MW Combined Cycle Gas Turbine Power Plant in Richards Bay, City of uMhlathuze Local Municipality, King Cetshwayo District Municipality, Kwazulu-Natal.

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ABBREVIATIONS AND TERMINOLOGY

BA	Basic Assessment
BOP	Balance of plant
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
CA	National Competent Authority
CBD	Central Business District
CCPP	Combined Cycle Power Plant
ECO	Environmental Control Officer
EMPr	Environmental Management Programme
ESO	Environmental Site Officer
GE	General Electric
Ha	Hectares
HRSGs	Heat Recovery Steam Generators
HIA	Heritage Impact Assessment
LM	Local Municipality
Ma	Millions of years ago
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PIA	Palaeontological Impact Assessment
PGRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
PoRB	Port of Richards Bay
PWD	Process Water Dams
RBIDZ	Richards Bay Industrial Development Zone
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SEZ	Special Economic Zone
SO	Secunda Operations
S&EIA	Scoping & Environmental Impact Assessment
STG	Steam Turbine Generator
ToR	Terms of Reference
WR	Water Recovery

FOSSIL

A fossil is the preserved remnants or vestiges of a long-dead organism, generally from millions of years ago. Fossils can be mineralised skeletons, shells, or other hard pieces of ancient animals and plants, as well as impressions, moulds, and casts left in sedimentary rock when the organism's remains decomposed and left an impression. Fossils provide valuable insights into the evolution and biodiversity of ancient species, allowing scientists to study and understand their evolution and biodiversity.

HERITAGE

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act No 25 of 1999).

HERITAGE RESOURCES

This means any place or object of cultural significance and can include (but is not limited to) as stated under Section 3 of the NHRA,

- 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 natural features of cultural significance.
- geological sites of scientific or cultural importance.
- archaeological and palaeontological sites.
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa.

PALAEONTOLOGY

Palaeontology is the scientific study of ancient life through time and entails the examination of fossils—remains, traces, or impressions of organisms preserved in rocks. It seeks to understand the evolution, diversity, and interactions of past life forms, as well as the environmental conditions in which they lived. By integrating geology and biology, palaeontology provides crucial insights into the history of life on Earth over geological time.

The term palaeontology derives from the Latin palaeontologia, which in turn originates from the Greek words palaios (παλαιός), meaning “ancient,” and ontos (ὄντος), meaning “being” or “creature,” combined

with the suffix -logia, meaning "study of." The literal translation is therefore "the study of ancient beings." In English usage, the classical Latin, British and South African spelling is palaeontology, while the American spelling omits the a after the p, rendering palaeontology. In this report the Latin, English and South African spelling of Palaeontology will be used.

1 INTRODUCTION

Nemai Consulting (Pty) Ltd has been appointed by Mabasa Energy and Fuels (Pty) Ltd as the independent Environmental Assessment Practitioner (EAP) to undertake an Environmental Impact Assessment for the proposed 750MW Combined Cycle Gas Turbine (CCGT) Power Plant (the "Plant") in Richards Bay, which falls within the City of uMhlathuze Local Municipality, King Cetshwayo District Municipality, Kwazulu-Natal (the Project) (Figure 1–2). Banzai Environmental (Pty) Ltd has, in turn, been commissioned to undertake the Palaeontological Desktop Assessment for the Project.

1.1 Scope of the Study

The aim of the study is to identify palaeontological sites/sensitivity that may occur in the proposed project area. The PDA aims to inform the Environmental Impact Assessment (EIA) to assist the developer in managing the discovered heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act (Act 25 of 1999) as amended (NHRA).

1.2 Project Locality

The earmarked site is located on Erf 16673 in Phase 1F of the RBIDZ, which is approximately 12.7 Ha in extent. The access point to the industrial complex is via Alumina Allee Road, which runs along the eastern boundary of the site. The Project is located within Phase 1F of the Richards Bay Industrial Development Zone (RBIDZ) under a long-term lease agreement. The RBIDZ, which is a Special Economic Zone (SEZ), is a purpose-built and secured industrial estate linked to the Port of Richards Bay (PoRB) which aims to attract local and foreign direct investment.

1.3 Project description

The Combined Cycle Power Plant (CCPP) Module will consist of 750 MW Power block. A Module consists of two (2) Gas Turbines each having capacity of 250 MW along with Electrical Generators, two (2) Heat Recovery Steam Generators (HRSGs) and one (1) Steam Turbine Generator (STG) having capacity of 250 MW. The CCPP is based on the latest state of art heavy duty industrial type Gas Turbines GE 9FA, which is suitable for base load and cyclic load operation in both simple (open) cycle and combined cycle mode.

The Combustion Turbines are capable of firing on a variety of fuels however most commonly natural gas or light distillate oil. The combustion system installed on the units will be configured for natural gas fuel.

The proposed Plant will comprise of the following key equipment:

- Two (2) General Electric (GE) Frame 9 (model 9F.03) combustion turbines and generators;
- Two (2) triple pressure, 3 drum, natural circulation HRSGs;
- One (1) condensing steam turbine and generator;
- One (1) de-aerating surface condenser;
- One (1) induced draft cooling tower;
- Balance of plant (BOP) equipment consisting of Pumps, Heat Exchangers, Transformers, Power Electrics, etc.;
- One (1) integrated plant distribution control system; and
- 275 kV Switchyard comprising of three (3) x 15kV to 275kV step-up transformers and one (1) station auxiliary transformer (the rating to be defined during detailed design).

The Plant will be designed for base load operations at 500MW in Simple Cycle and 750MW in Combined Cycle on twenty-four hours a day, seven days a week basis. The scope of supply for the Plant will be based on a "2+2+1 combination" comprising of two GE Frame gas turbines (the "Combustion Turbine") each with a dedicated HRSG to generate and supply steam to a shared steam turbine (the Combustion Turbine, HRSG and steam turbine together known as the "Power Plant"). Generators attached to each of the Combustion Turbines and steam turbines will supply electrical power to the grid.

The application excludes the natural gas pipeline and grid connection associated with the proposed development. The Applicant will source the supply and delivery of natural gas from the planned terminal development at the PoRB. The natural gas is expected to be supplied through a pipeline from the Transnet natural gas terminal to the Plant. The PoRB lies approximately 5 km to the south of the site.

1.4 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 Nemai.
- 1.5 Assumptions AMAFA Palaeotechnical Report for Kwa-Zulu Natal (Groenewald *et al*., 2012).
- 1: 250 000 St Lucia 2732 Geological Map (Council for Geosciences, Pretoria)
- Published geological and palaeontological literature

Limitations

The geology of the area is the focal point of geological maps, and the sheet explanations of the Geological Maps were not intended to focus on palaeontological heritage. Many inaccessible areas of South Africa have never been examined by palaeontologists, and data are typically dependent solely on aerial pictures.

Locality and geological information in museums and university databases is out of date, and data acquired in the past is not always adequately documented.

To address these gaps, comparable Assemblage Zones and geological formations from better-studied regions are often referenced to infer the potential for fossil presence in previously undocumented areas. In desktop studies, it is typically assumed that fossil heritage may be present where similar stratigraphy is exposed. However, a field-based assessment is essential to validate and refine these assumptions, thereby enhancing the accuracy of the palaeontological sensitivity rating.

Figure 1: Regional locality of the proposed 750MW Combined Cycle Gas Turbine Power Plant in Richards Bay, City of uMhlathuze Local Municipality, King Cetshwayo District Municipality, Kwazulu-Natal.

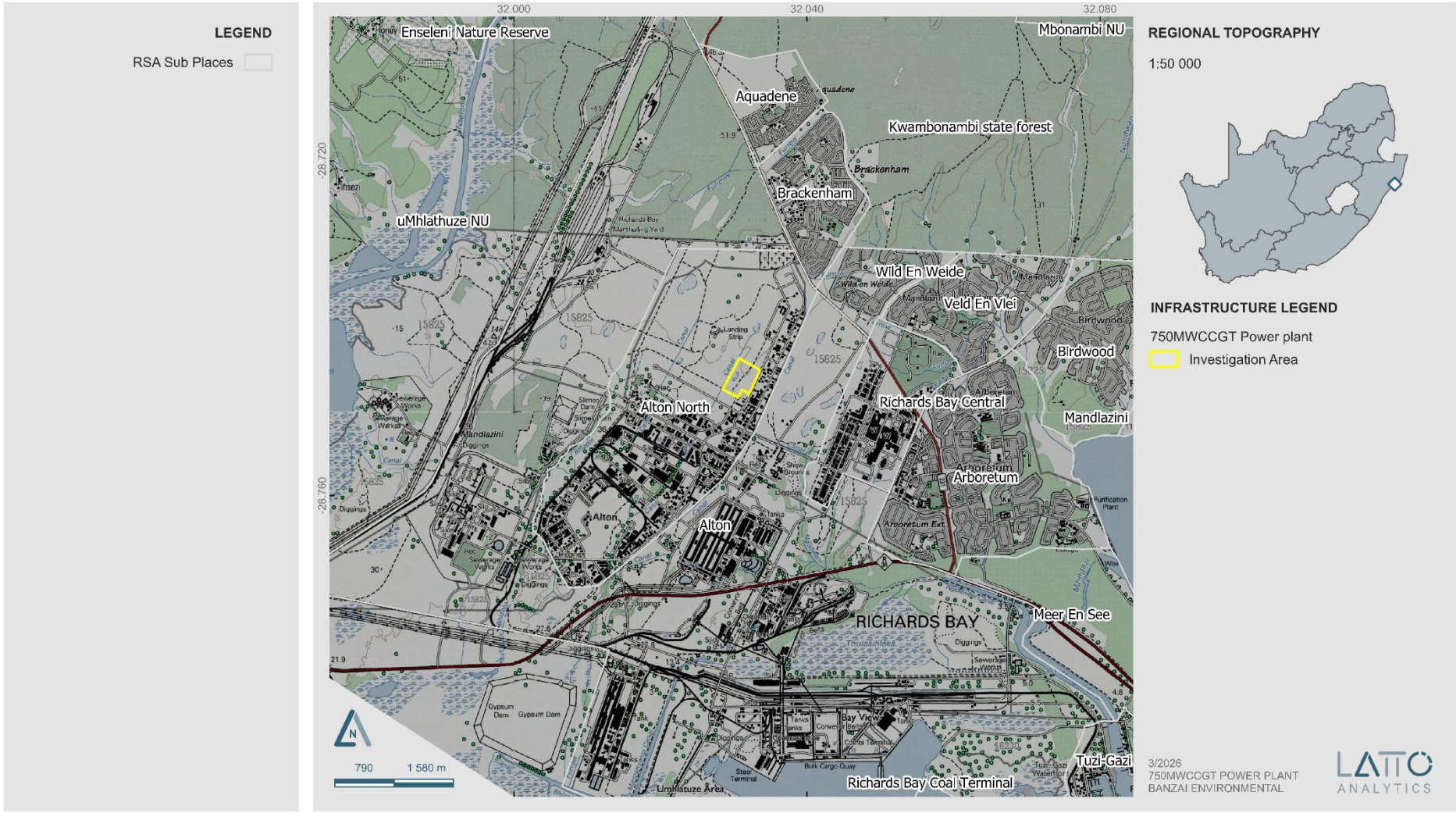

Figure 2: Site locality.

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Please refer to Appendix 1 (Specialist CV).

This study has been conducted by Mrs. Elize Butler of Banzai Environmental (Pty) Ltd. She has conducted approximately 900 palaeontological impact assessments (PIA) for developments in the Free State, KwaZulu-Natal, Eastern and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specialising in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than thirty 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

The cultural and palaeontological heritage in South Africa is safeguarded by an extensive legal framework that facilitates the identification, assessment, and management of heritage resources. The National Heritage Resources Act (NHRA, Act 25 of 1999) serves as the foundation of this framework, delineating heritage resources as components of the national estate, which include cultural, historical, archaeological, palaeontological, and geological elements of importance. Section 3 of the NHRA explicitly encompasses "all items retrieved from the soil or waters of South Africa, including archaeological and palaeontological artefacts, meteorites, and rare geological specimens." Palaeontological heritage is non-renewable and safeguarded by Section 35, which prohibits the disturbance, destruction, or removal of fossils without a valid permit from SAHRA or the pertinent Provincial Heritage Resources Authority (PHRA). Fossil specimens must be gathered and preserved in a recognised institution in accordance with SAHRA's minimal standards.

The NHRA is governed nationally by SAHRA and provincially by PHRAs, establishing a three-tier system that reflects South Africa's cooperative governance framework. This method facilitates the identification, safeguarding, and preservation of heritage treasures for the advantage of current and future generations.

3.1 Supporting Legislation and Regulations

Heritage and palaeontological management are incorporated into the comprehensive environmental framework, specifically via the National Environmental Management Act (NEMA, Act 107 of 1998) and the Environmental Impact Assessment (EIA) Regulations (GN 982, 2014, updated by GN 326, 2017).

Section 23(2)(b) of NEMA mandates integrated environmental management to "identify, predict, and assess the actual and potential impacts on the environment, socio-economic conditions, and cultural heritage."

Government Notice 320 (GN 320, Government Gazette 43110, 20 March 2020) delineates broad prerequisites for executing initial site sensitivity verification in the absence of a specific assessment process. GN 320 necessitates desktop analysis, first site inspections, verification of land usage, and the submission of corroborative documentation (e.g., photographs). Table 1 encapsulates these standards and their alignment within this report.

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Table 1: GN 320 Reporting Requirements

GN 320	Relevant section in report	Where not applicable in this report
2.2(a) Desktop analysis using satellite imagery	Section 1	–
2.2(b) Preliminary on-site inspection	Executive Summary and Section 8	–
2.3(a) Confirm or dispute environmental sensitivity	Executive Summary and Section 8	–
2.3(b) Motivation and evidence	Executive Summary and Section8	–

3.2 Heritage Screening – DFFE National Web-based Environmental Screening Tool

A heritage screening was undertaken using the DFFE National Web-based Environmental Screening Tool, as mandated by GN 982. The April 2025 protocol notes that the mapped layers for cultural, archaeological and palaeontological resources represent only a limited number of recorded sites, which may be widely dispersed and could potentially occur at any proposed development site. The protocol further specifies the following:

A Heritage Impact Assessment is required for all developments, irrespective of the sensitivity indicated on the archaeological and cultural heritage theme layers. A Palaeontological Impact Assessment is required for all developments according to the SAHRIS PalaeoSensitivity Map, regardless of the indicated sensitivity.

Both HIA and PIA are required to adhere to Section 38(3) of the NHRA for developments in the Northern Cape Province. These assessments must be undertaken by a suitably qualified specialist, adhere to the

requirements of GN 326 Appendix 6, and meet the applicable South African Heritage Resources Agency (SAHRA) minimum standards (2007 for HIA; 2012 for PIA).

According to the heritage screening report, the palaeontological sensitivity of the proposed development area is Low (green), indicating that a detailed palaeontological desktop assessment is required.

3.3 Section 38: Heritage Impact Assessments

Section 38 of the NHRA regulates the administration of heritage resources concerning development. Specific forms of development necessitate a Heritage Impact Assessment (HIA), including: Linear constructions including roads, pipelines, canals, or electricity lines that surpass 300 meters; Bridges or other constructions surpassing 50 meters; Changes that modify site characteristics, including those beyond 5,000 m², involving three or more properties, or rezoning exceeding 10,000 m².

Upon activation, SAHRA or the pertinent PHRA must be informed, and the HIA is required to: Identify and delineate heritage resources within the impacted region; Evaluate importance and possible effects; Evaluate viable alternatives; Propose suitable mitigation and management strategies.

3.4 Integration with Environmental Assessment

Section 38(8) of the NHRA permits the amalgamation of historic evaluations with NEMA EIA processes, thereby eliminating redundancy. Palaeontological Impact Assessments (PIAs) can be executed as a component of the Heritage Impact Assessment (HIA) under the overarching Environmental Impact Assessment (EIA) framework. This guarantees the prompt identification, safeguarding, and administration of fossil heritage throughout development planning.

If no environmental process is necessary, but the development activates Section 38(1) of the NHRA, SAHRA or the pertinent PHRA assumes the role of the authorising authority and may mandate a comprehensive HIA, encompassing public participation and stakeholder interaction.

4 ASSESSMENT METHODOLOGY

This PDA assesses the development's potential impact on the fossil heritage. This Palaeontological Assessment is part of the HIA Report. The PIA's goals are to: 1) identify the palaeontological significance of the rock formations in the footprint; 2) evaluate the palaeontological magnitude of the formations; 3) clarify the impact on fossil heritage; and 4) make recommendations for how the developer might protect

and minimize potential harm to fossil heritage, according to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports".

Calculations of the palaeontological state of each rock segment and the potential impact of development on fossil history take into account the palaeontological status of the rocks, the type of development, and the amount of bedrock removed.

The Provisional DFFE Screening Tool, the SAHRIS Palaeosensitivity map, all Palaeontological Impact Assessment reports for the same area, Google Earth images, topographical and geological maps, as well as academic articles about specimens from the development area and Assemblage Zones, are all used to create scoping reports.

When the development footprint has a Very High Palaeontological Sensitivity, a field-based assessment is necessary. A desktop or field assessment of the exposed rock is used to evaluate the significance of the proposed development's impact, and recommendations for more research or mitigation are made. Excavations for the project often only take place during the building phase, changing the terrain and destroying or permanently encasing fossils at or below the ground surface. Then, access to Fossil Heritage will no longer be available for academic study.

When doing a site investigation, a palaeontologist examines the local development as well as the quantity and variety of fossils found there. This can be demonstrated by looking at representative fossiliferous rock exposures (most igneous and metamorphic rocks are not fossiliferous, whereas sedimentary rocks contain fossil heritage). Examined rock exposures frequently contain a sizeable portion of the stratigraphic unit, which is primarily made up of recently exposed (unweathered) rock. These exposures may be man-made (such as quarries, open building excavations, even railway and road cuttings) or natural (such as cliffs, and dongas as well as rocky outcrops along stream or river banks). It is usual practice for palaeontologists to record well-preserved fossils (GPS, and stratigraphic data) during field assessment examinations.

Although mitigation is often done prior to construction, it may take place if potentially fossiliferous bedrock is revealed. Fossil collection and documentation are examples of mitigation. A permit from SAHRA must be obtained before beginning any fossil excavation, and the material must be stored at an authorized facility. When mitigation is properly used, it is possible to have a positive impact by raising awareness of the palaeontological past of the area.

By physically evaluating bedrock outcrops to determine their lithology and fossil richness and crisscrossing the development footprint, one can assess an area's fossil potential. Because the presence of fossils at the surface is so unexpected, an average sample size of the region is investigated. To be

clear, however, the lack of fossils in a development footprint does not automatically suggest that there is no palaeontologically important material present on the site (on or below the ground surface).

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements;
- Submit a comprehensive overview of all appropriate legislation, guidelines;
- Describe the proposed project and provide information regarding the developer and consultant who commissioned the study;
- Describe location of the proposed development and provide geological and topographical maps
- Provide palaeontological and geological history of the affected area;
- Identify sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluate 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.
- Fair assessment of alternatives (infrastructure alternatives have been provided);
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Detail the implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed 750MW CCGT Power Plant is located in the Richards Bay area of KwaZulu-Natal. The topography is characterised by a low-lying, flat to gently undulating coastal plain, a direct manifestation of its geological history dominated by Late Cenozoic marine and aeolian processes. The landscape is primarily defined by a series of relict, stabilised parabolic and longitudinal dune cordons, oriented parallel to the contemporary shoreline, which represent successive phases of Pleistocene and Holocene sea-level change and arid climatic periods (Botha & Porat, 2007). These dunes, formed from the reworking of

the Kosi Bay Formation, create a subtle ridge-and-swale topography. Elevations generally does not exceed 30 metres above mean sea level, with the land sloping gently eastwards towards the Indian Ocean and the large, estuarine lagoon system of Richards Bay Harbour (Cooper & Flores, 1991). The Mhlatuze River floodplain forms a distinct, low-lying topographic feature dissecting the region, contributing to the overall subdued relief and poorly developed drainage characteristic of this sandy coastal plain.

The vegetation of the Richards Bay coastal plain falls within the Maputaland Coastal Belt of the Indian Ocean Coastal Belt Biome, a region recognised for its high biodiversity and unique mosaic of forest, woodland, and grassland types (Mucina & Rutherford, 2006). The dominant vegetation on the stabilised sandy soils is Maputaland Coastal Forest, a species-rich, low-canopy forest interspersed with areas of Maputaland Woodland and Northern Coastal Forest (Moll & White, 1978). On the older, inland dune ridges, Tongaland-Pondoland Sourveld grasslands occur, while the freshwater wetlands and riparian zones associated with the Mhlatuze River support Northern Afrotemperate Forest and swamp forest patches. The vegetation patterns are linked to the subtle topographic and soil moisture gradients, with the dune forests being an important feature of this coastal landscape. Significant portions of the natural vegetation have been transformed for forestry (commercial *Eucalyptus* and *Pinus* plantations), sugarcane cultivation, and urban-industrial development associated with the port (van Wyk & Smith, 2001)

The geology of the proposed Project is depicted on the 1:250 000 St Lucia 2732 Geological Map (Council for Geoscience, Pretoria). The proposed study area is underlain by unconsolidated Quaternary dune sands (Qs) derived from the reworking of the Kosi Bay Formation on the Northern Natal coastal plain. These deposits resulted from marine regression and dry periods when dune formation was wide spread. These are characterised as yellowish-red, grey, and white dune sands with local pockets of calcareous clays (Qs) (Figure 3). The SAHRIS Palaeontological Sensitivity Map (Figure 4, Table 2) classifies the area as having Low (blue) Palaeontological Sensitivity (Almond & Pether, 2009; Almond et al., 2013), which is supported by the Department of Forestry, Fisheries and the Environment (DFFE) National Web-Based Environmental; Screening Tool Report (screening tool; Figure 5). Based on the desktop assessment, identifying the surface geology as low-sensitivity unconsolidated dune sand, a site-specific site investigation was not deemed necessary. This is supported by the low Palaeontological Sensitivity ratings assigned to the area by both the SAHRIS PalaeoMap and the DFFE National Screening Tool.

The extensive dune sands on the Northern Natal coastal plain, including the Richards Bay area, are primarily derived from the reworking of the Kosi Bay Formation. This geological process occurred during periods of marine regression in the Late Pleistocene to Holocene, when falling sea levels exposed vast areas of unconsolidated, sandy coastal sediments (McCarthy & Rubidge, 2005). During subsequent arid climatic phases, these exposed sediments were mobilised by prevailing onshore winds, leading to the widespread formation of extensive, unconsolidated aeolian dune systems (Botha & Porat, 2007). These

dunes are typically characterised by well-sorted, fine to medium-grained quartz sands, often exhibiting large-scale cross-bedding structures. Their formation represents a significant geomorphological response to the interplay between eustatic sea-level change and regional climatic shifts, creating a dominant surficial geology that masks older underlying formations across much of the coastal plain (Cooper & Flores, 1991).

Palaeontologically, these unconsolidated dune sands are generally considered to have very low sensitivity for in-situ fossil preservation (Almond et al., 2013). The high-energy aeolian environment of dune formation is not favourable to the burial and preservation of organic remains. Consequently, the dune sands themselves are typically barren of primary fossil assemblages (Smith, 1990). However, they can be of indirect palaeontological significance as they may seal and protect older, potentially fossiliferous underlying strata, such as the Kosi Bay Formation or other Pleistocene coastal deposits, from erosion (Avery, 1987). Furthermore, during erosional episodes, these dunes can act as a source for derived or reworked fossil material, where older fossils from the original parent sediment are redeposited within the dune matrix without stratigraphic context (Klein, 1976). Any palaeontological assessment in such areas must therefore consider the potential for sealed deposits beneath the dune cordon and the possibility of encountering reworked fossil fragments, though the dune sands per se do not constitute a primary fossil resource.

A discrepancy exists between the sensitivity ratings: the SAHRIS PalaeoMap and DFFE tool indicate Low sensitivity, while the KZN technical report (Groenewald, 2012) notes a High sensitivity for these sediments. This is reconciled through site-specific assessment. The 'High' rating likely refers to the potential of the underlying Kosi Bay Formation or other sealed Pleistocene deposits. The dune sands themselves, as unconsolidated aeolian deposits, have a low potential for containing in-situ fossils. Therefore, the site-specific sensitivity for surface and near-surface disturbances within the dune sand is assessed as Low. However, the 'High' rating is acknowledged as a precaution for deeper excavations that might penetrate the dune base and encounter older strata.

Figure 3: Extract of the 1:250 000 St Lucia 2732 Geological Map (Council for Geosciences, Pretoria) indicates that the study area is underlain by unconsolidated Quaternary dune sands (Qs) derived from the reworking of the Kosi Bay Formation on the Northern Natal coastal plain.

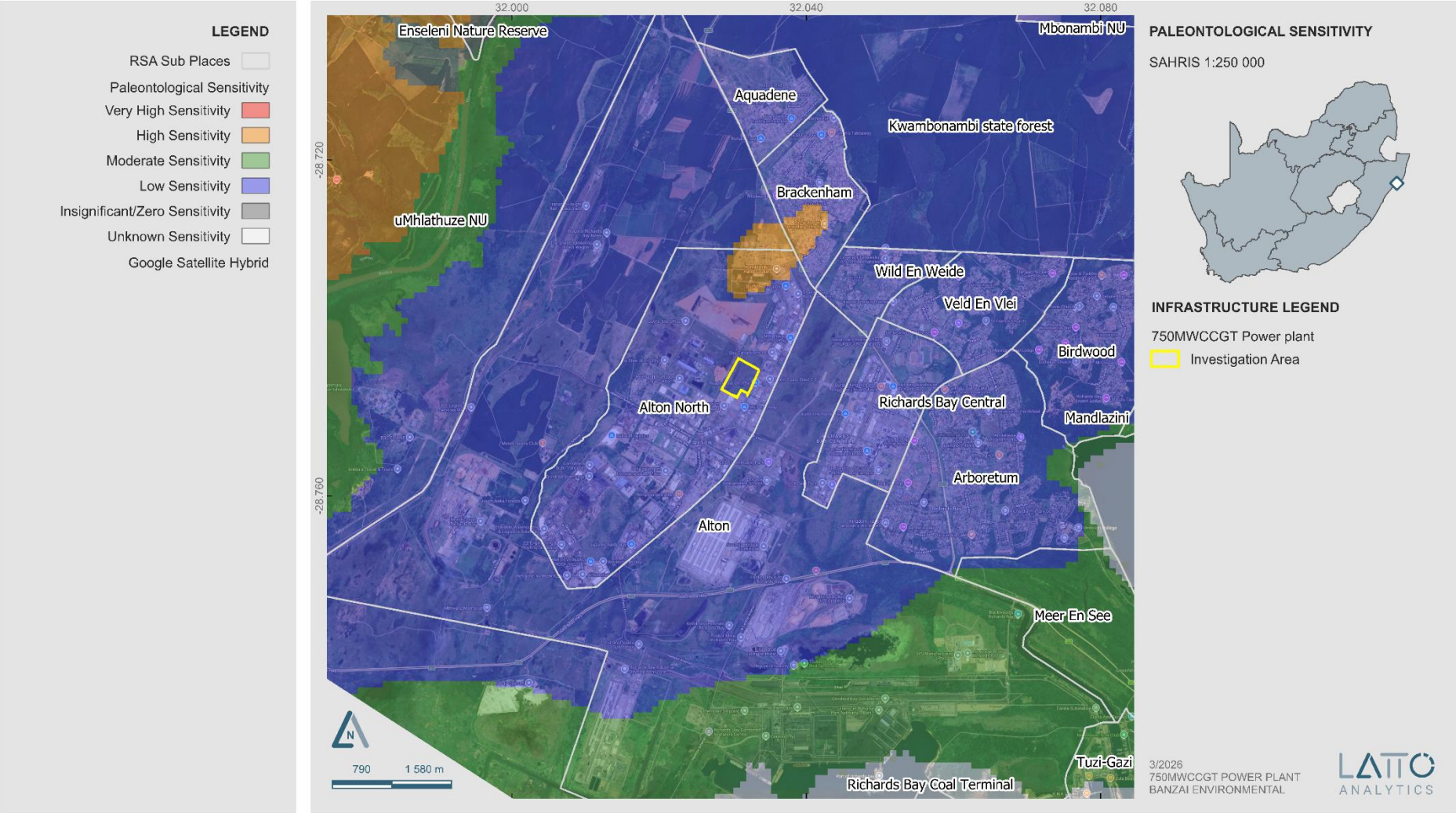

Figure 4: Extract of the SAHRIS PalaeoMap (Council for Geosciences, Pretoria) indicating that the study area is entirely underlain with sediments with Low (blue) Palaeontological Sensitivity.

Table 2: Paleontological 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.

The PalaeoMap (Council for Geosciences, Pretoria) indicates that the proposed study area has a Low (blue) Palaeontological Sensitivity.

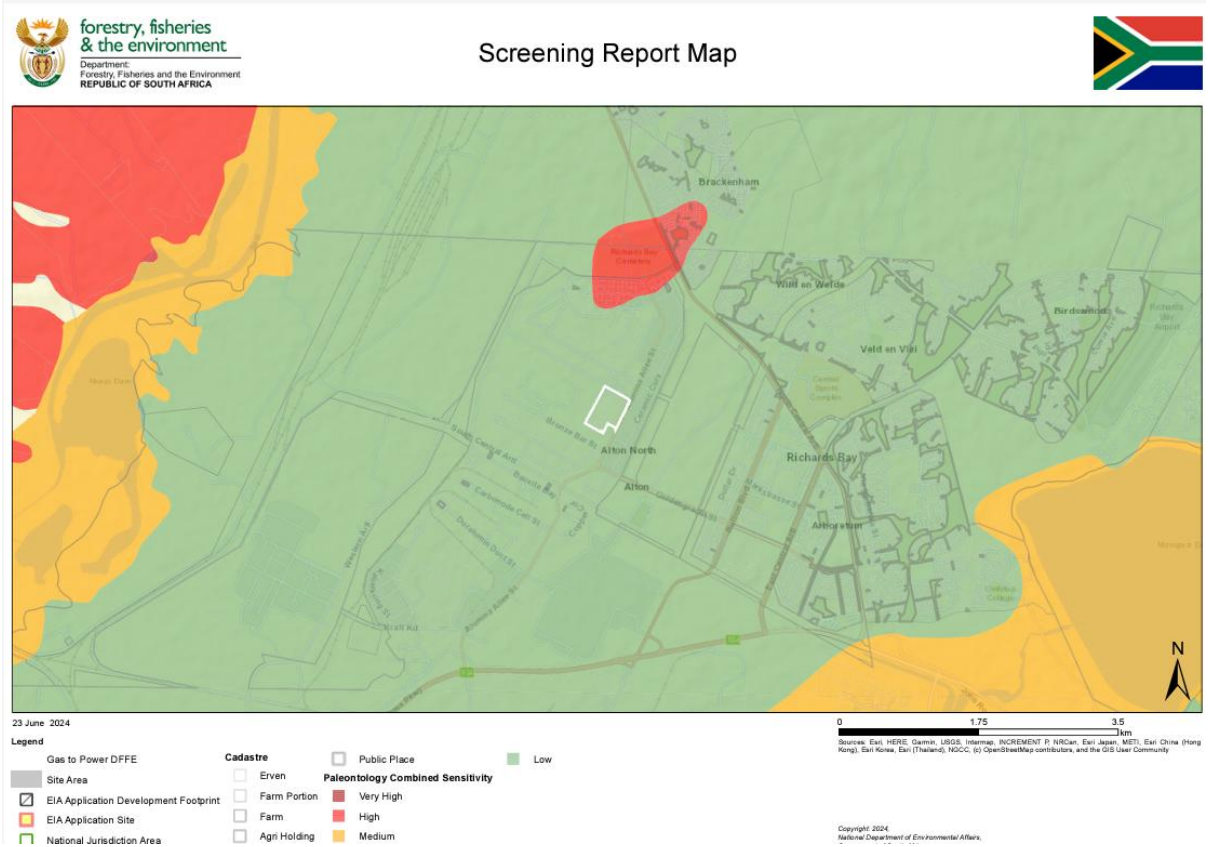

Figure 5: Paleontological Sensitivity of the proposed study area by the National Environmental Web-based Screening Tool indicates a Low (green) Palaeontological Sensitivity.

The SAHRIS Palaeosensitivity map (Figure 4, Table 2) indicates that the proposed development is underlain by sediments with a Low (blue) Palaeontological Sensitivity, which is supported by the DFFE Screening Tool (green, Figure 5). No site investigation was conducted due to the Low sensitivity shown by the desktop investigation for Paleo resources, and therefore, the actual Palaeontological Sensitivity of the development was not verified through ground truthing.

6 IMPACT ASSESSMENT METHODOLOGY

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 are used:

Table 3: The rating system

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
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.

6.1 Impact Summary

Table 4: Summary of Impacts

PALAEONTOLOGICAL								
NATURE	LOSS OF FOSSIL HERITAGE BY DESTRUCTION, MOVEMENT OR SEALING IN OF FOSSIL HERITAGE IN OR BELOW THE EARTH'S SURFACE							
	SITE(S):							
DEVELOPMENT PHASE	DEVELOPMENT IMPACT			IMPACT RATING		RECOMMENDED MITIGATION	IS IMPACT ACCEPTABLE?	
	CRITERIA	*BM	**AM	BEFORE MITIGATION	AFTER MITIGATION		*BM	**AM
PLANNING PHASE	Extent			No Impact	No Impact		None	None
	Probability							
	Reversibility							
	Irreplaceability							
	Duration							

	Cumulative Effect					NONE		
	Magnitude							
	Impact Significance							
CONSTRUCTION PHASE	Extent	1	1	Negative Low impact	Negative low impact	NONE	NO	YES
	Probability	2	2					
	Reversibility	4	4					
	Irreplaceability	2	2					
	Duration	4	4					
	Cumulative Effect	1	1					
	Magnitude	1	1					
	Impact Significance	14	16					
OPERATIONAL PHASE	Extent			No Impact	No Impact	NONE	None	None
	Probability							
	Reversibility							
	Irreplaceability							
	Duration							
	Cumulative Effect							
	Magnitude							
	Impact Significance							
DECOMMISSIONING PHASE	Extent			No Impact	No Impact	NONE	None	None
	Probability							
	Reversibility							
	Irreplaceability							
	Duration							
	Cumulative Effect							
	Magnitude							
	Impact Significance							

7 MANAGEMENT RECOMMENDATIONS AND GUIDELINES

7.1 Construction phase

The initial construction phase of the proposed plantl will include activities such as site clearance. During these activities, cultural material may be exposed and could be recoverable.

While construction delays can be costly, mitigation measures should aim to minimise disruptions while ensuring compliance with heritage requirements. Excavations for the development, and other ground disturbances, may provide opportunities to document and rescue fossil heritage material. The construction require consideration within the heritage management framework.

During the construction phase, it is important to recognize any significant material being unearthed, making the correct judgment on which actions should be taken. It is recommended that the following Chance Finds Procedure (CFP) should be implemented:

7.2 Chance Finds Procedures

The procedure outlined below is only triggered if fossil material is exposed during site clearance and construction activities.

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 uncover fossil material.

It is the responsibility of the Environmental Control Officer (ECO), Environmental Site Officer (ESO) or site manager (whatever the case may be) 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 ECO / ESO / Site Manager, 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.

7.3 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 ECO / 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 ECO / 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 ECO / 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.

8 CONCLUSION AND SUMMARY

8.1 Summary of findings

T The proposed study area is underlain by unconsolidated Quaternary dune sands derived from the reworking of the Kosi Bay Formation on the Northern Natal coastal plain that resulted from marine regression and dry periods when dune formation was wide spread. These are characterised as yellowish-red, grey, and white dune sands with local pockets of calcareous clays. The SAHRIS Palaeontological Sensitivity Map classifies the area as having Low Palaeontological Sensitivity (Almond & Pether, 2009; Almond et al., 2013), which is supported by the Department of Forestry, Fisheries and the Environment (DFFE) National Web-Based Environmental; Screening Tool Report. Based on the desktop assessment, which identified the surface geology as low-sensitivity unconsolidated dune sand, a site-specific field investigation was not deemed necessary. This determination is supported by the low Palaeontological

Sensitivity ratings assigned to the area by both the SAHRIS PalaeoMap and the DFFE National Screening Tool.

It is therefore considered that the development may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources. It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required, pending the discovery of newly discovered fossils.

Recommendations:

However, if significant fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Environmental Control Officer (ECO) in charge of these developments must be informed. Any fossil discoveries must be protected *in situ* (if possible), and the ECO or site manager must report the find to AMAFA (KwaZulu-Natal AMAFA and Research Institute) for further guidance. Contact details: 195 Langalibalele Street, Pietermaritzburg, KwaZulu-Natal, South Africa, 9301; Tel: 0333946543 ; Website: https://amafainstitute.org.za/; email: info@amafainstitute.org.za). This will allow the necessary mitigation measures (recording and collection) to be undertaken by a qualified Palaeontologist.

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.

It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils. `These recommendations should be incorporated into the Environmental Management Programme (EMPr) for the proposed 750MW Combined Cycle Gas Turbine Power Plant in Richards Bay, City of uMhlathuze Local Municipality, King Cetshwayo District Municipality, Kwazulu-Natal.

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APPENDIX 1

CURRICULUM VITAE: E. Butler

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	30 years in Palaeontology
EDUCATION:	University of the Orange Free State
	B.Sc Botany and Zoology, 1988
	University of the Orange Free State
	B. Sc (Hons) Zoology, 1991
	University of the Free State
	M. Sc. *Cum laude* (Zoology), 2009

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

EMPLOYMENT HISTORY

Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant	National Museum, Bloemfontein
and Collection Manager	1998–2022
Banzai Environmental	2016 to present

Elize Butler has conducted approximately 900 Paleontological Impact Assessments for developments in the Free State, KwaZulu-Natal, Eastern, Northern and Western 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. She has experience in locating, collecting, and curating fossils. She has been a member of the Paleontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

MEMBERSHIP

Paleontological Society of South Africa (PSSA) 2006-currently.

A full CV is available on request.